



www.magellan-advisors.com



Final

A photograph of a large, illuminated archway at night. The archway is made of light-colored stone or concrete and is lit from below. The words "DOWNTOWN" and "SAN LEANDRO" are carved into the top of the arch. Two palm trees are visible on either side of the archway. In the background, there are streetlights and buildings.

CITY OF SAN LEANDRO FIBER OPTIC MASTER PLAN



Acknowledgements

Magellan Advisors wishes to thank the City of San Leandro for the opportunity to assist with this important work. We would like to thank City leadership and staff for the vision, time, and thoughtful input they invested in providing the development of this feasibility study.

Magellan Advisors would like to acknowledge the work of City staff for their role in coordinating and bringing together the representative voices of broadband consumers in San Leandro. The valuable input for this study would not have been possible without local business leaders and residents discussing their internet connectivity challenges and ambitions.

We would like to thank the people of San Leandro who took the time to share their experiences and opinions through the surveys and group discussions. The insights derived through public meetings, interviews and surveys were central to the development of this study.

Municipal and Community Anchors

City of San Leandro | City of San Leandro City Manager’s Office & Division of Information Technology | San Leandro Chamber of Commerce | City of San Leandro Community Development Department | City of San Leandro Department of Public Works | City of San Leandro Finance Department | City of San Leandro Department of Engineering and Transportation | City of San Leandro Recreation and Human Services Department | City of San Leandro Police Department | Alameda County Fire Department | San Leandro Unified School District | San Leandro Public Library |

Special thanks to the following City Staff for their contributions:

Tony Batalla, Debbie Acosta, Michael Hamer, Scott Gilliland, Tamika Greenwood, Norite Vong, Captain Jamie Knox, Denise Joseph, Chief Jeff Tudor, Scott Koll, Jennifer Auletta, Liz Jimenez, Mariana Garcia, Katie Bowman, Tom Liao, Reh-Lin Chen, Dean Hsiao, Keith Cooke, Theresa Mallon, Jeanette Dong, Heidi DeRespini, Acting City Manager Jeff Kay, Debbie Pollart, Eric Engelbart, Nick Thom, Lars Halle, and Diane Era

Retail Provider Community

Lit San Leandro | Crosslink

All participants in the City’s Broadband Survey and External Stakeholder Focus Group Sessions



Table of Contents

Executive Summary..... 5

 Broadband Planning Guiding Principles..... 6

 A Broadband and Smart City Vision for the City of San Leandro 7

 Meeting the Needs of San Leandro 8

 Broadband Implementation Alternatives & Strategy 9

 Summary of Business and financial models..... 10

 Funding Summary 14

 Recommendations/Next Steps 16

 Roadmap and Action Plan..... 16

 Conclusions 17

Background 18

 Overview of Broadband Technology..... 18

Smart City Strategy 26

 National League of Cities “Smart Cities” Report..... 27

 Smart Cities Readiness Guide 30

 Smart City Model 31

 San Leandro As a Smart City 32

 San Leandro’s Smart City Initiatives..... 34

 Buildings & Facilities 37

 Smart Streetlights 37

 “Small Cells” and Wireless Cellular Connectivity 40

 Internet of Things..... 41

 Mobility..... 41

 Intelligent Traffic Signaling & Intersections..... 43

 Public Safety..... 47

 Public Wi-Fi 51

 Advisory Board 52

 Complete Fiber Map & Conclusion 54

Broadband Market Assessment..... 55

 Internet Service Offerings to Enterprise / Large Businesses 55

 Internet Service Offerings to Small Businesses..... 57

 Internet Service Offerings for Residents..... 58

 Access, Competition and Costs in San Leandro, Ca 60



Creation of a Municipally-Owned Fiber Network 61

The City of San Leandro Needs Assessment 63

 The State of Broadband in the City of San Leandro 64

 Municipal Needs Assessment 67

 City Departments – Description & Interviews 70

 San Leandro Unified School District 78

 San Leandro Public Library 79

 San Leandro Healthcare 80

 Anchor Institution – Stakeholder Interviews 82

 Residential & Business Survey – Community Broadband Assessment 83

 Digital Inclusion 89

Business Models 106

City of San Leandro Future Broadband Network 110

 San Leandro City Fiber Network Design 110

 Capitalizing on San Leandros Existing Network 113

 Opportunistic Builds 114

 Funding San Leandro’s Network 114

Five-Year Broadband Implementation Strategy Overview 119

 Recommendations 119

 Fiber Management 123

 Roadmap and Action Plan 124

 San Leandro Implementation Plan – Next Steps 131

 Conclusions 134

Appendices 135

Appendix A. Smart Street Light Options 135

Appendix B. Municipal Wireless Implementation Strategies 151

Appendix C. City of San Leandro Needs Assessment SURVEY 157

Appendix D. Residential and Business Survey Result Details 164

Appendix E. Cost Assumptions 175

Appendix F. Municipal Broadband Business Models 200



EXECUTIVE SUMMARY

In planning for the future, cities have begun to envision novel ways to achieve sustainability, innovation, and versatility. Technology, in all its diversity, is an increasingly vital asset in the realization of these goals. Digital technology has become essential to effectively managing and using traditional systems even as it has opened new possibilities for business, commerce, education, healthcare, governance, public safety, and recreation. These innovations depend on infrastructure, bandwidth and connectivity—the ability to move information quickly and flexibly from and to most anywhere. Therefore, cities around the globe are realizing the emergence of high-speed broadband internet as an essential utility among businesses, residents, and municipal operations.

The City of San Leandro (“the City”) has taken immense strides in realizing the importance of broadband and Smart City solutions. San Leandro’s position as an ambitious city in close proximity to Silicon Valley puts a spotlight on the City’s innovation and vision for an efficient, affordable and reliable broadband network, along with technological solutions and implementations. As such, San Leandro has already made significant progress in planning for the future through a partnership with Lit San Leandro (LSL), Smart City projects, such as Public Wi-Fi, connected facilities and traffic signals and, more recently, Smart Street Lights.. These steps have enabled San Leandro to get ahead of the curve in planning for the best interests of the community, its businesses, residents, stakeholders, and for the continued growth of the City.

To further these goals, San Leandro’s leadership selected Magellan Advisors as its partner in commissioning this Fiber Optic Master Plan & Smart City Strategy. Throughout the process of its development, Magellan’s team worked with the City and community to assess the current and future needs of San Leandro and to develop a blueprint for San Leandro to ensure the availability of affordable, reliable high-speed internet access. City staff, the local business community, community anchor institutions, and the broadband provider community provided key input for the development of this Fiber Optic Master Plan. The experience and best-known practices of other pioneers have been incorporated into this Master Plan, and include:

- Managing the public right-of-way and assets therein;
- Using advanced networks to deliver government services;
- Leveraging public works projects to support the cost-effective installation of telecommunications infrastructure;
- Partnering with local and regional utilities and transportation agencies for joint trench and other cost sharing opportunities;



- Facilitating competition to encourage universal access and address digital divide; and
- Establishing incremental plans for the growth and evolution of telecommunications services in San Leandro.

San Leandro’s commitment to its broadband future has already had far reaching impacts on area schools, non-profits and municipal services. This Fiber Optic Master Plan is designed to allow the City to take this commitment further, leading the way for enhanced services that will benefit San Leandro for years to come.

BROADBAND PLANNING GUIDING PRINCIPLES

Cities implementing a strategy for the deployment of broadband and smart city solutions should consider a few simple guidelines that cannot be overstated if the plan is to be successful. These guiding principles include:

- **Long-term Perspective.** The City shall have a long-term view for the deployment of their broadband network and smart city strategy. It often takes many years to see the vision deployed. A 10-12-year scope is not unusual for these projects. The City of San Leandro does have a head-start in this process with its existing network assets.
- **Leadership Commitment.** Support from the City Council and City Mayor are necessary to champion the plan. To deploy day-to-day strategies, a Broadband Infrastructure Program (BIP) managed by City staff will ensure successful implementation. Under the leadership of the City’s management team, the ability to mitigate challenges and risks over time will help ensure the successful implementation of the Plan throughout the City. The City should continue collaborations with region partners to further these efforts.
- **Shared and Collaborative Vision.** The City shall have an engaged group of interested shareholders that support and share the vision of the project both in terms of political influence as well as with financial means. The plan will require perseverance and foresight. Key stakeholders to engage should include: departments within the City, local businesses, anchor institutions, hospitals and healthcare providers, current telecommunications providers, schools and libraries, public safety organizations and community organizations.
- **Utility-oriented Cultural Shift.** The City shall develop a new cultural shift within all divisions of the City and throughout the community that demonstrates broadband is another important utility, just like sewer, water and electricity, and that as such, broadband and the deployment of broadband should be visible in all aspects of budgeting, planning, construction processes and operations, not just an afterthought.
- **Incremental Approach.** The Plan shall be implemented in an incremental, but not ad hoc fashion; identifying opportunities to build in conjunction with other capital projects such as road construction, connecting traffic signals or when replacing water mains. This is a practice that has been successfully implemented by cities



throughout the country, however to do so each opportunity must be evaluated on a case-by-case basis. The City’s Fiber Master Plan provides a network design that allows the City to capitalize on these opportunities when they arise.

- **Premier Business Location.** The City Council’s goals include to “advance projects and programs promoting sustainable economic development, including transforming San Leandro into a center for innovation.” This involves establishing San Leandro as a premier business location. A business survey conducted by the City and Magellan indicated that 30% of respondents stated they would “definitely” relocate their business if they were unable to find internet services that meet their business’ needs. A fiber infrastructure is a vital asset needed to achieve this vision.

A BROADBAND AND SMART CITY VISION FOR THE CITY OF SAN LEANDRO

The City of San Leandro (incorporated in 1872) is located in California’s Alameda County along the eastern shoreline of San Francisco Bay, between the city of Oakland to the north and unincorporated Alameda County and the city of Hayward to the south. With a population of approximately 88,000 and a rich tapestry of historical heritage neatly packaged into distinctive neighborhoods, the City is a residential haven.

San Leandro has already distinguished itself as a progressively tech-enabled City through a variety of initiatives, including its relationship with the Lit San Leandro (LSL) network. This partnership has created a number of benefits for the City, including connecting its schools, non-profits and many businesses. Additionally, the City of San Leandro has been developing long-term plans for Smart City deployment and public Wi-Fi initiatives.

Driven by its location in the heart of the San Francisco Bay area, the city’s 2035 General Plan calls for a continued transformation as a community focused on technology, research and innovation. While many of the traditional manufacturers are gone today, the City continues to support a robust industrial and manufacturing base, and attracts investment in new operations and companies that are driving economic growth in the City.

Investment in fiber-optics systems helps fuel the growth of traditional industries such as food processing and manufacturing, with the added benefits

Figure 1: The City of San Leandro¹



¹ Full-sized images of all maps available in Appendix A.



and productivity of new technologies. With the emergence of Smart City² applications and a digitally-focused lifestyle, the City of San Leandro will play a key role in maintaining a high quality of life by providing municipal services that are streamlined and customized to the needs of its community.

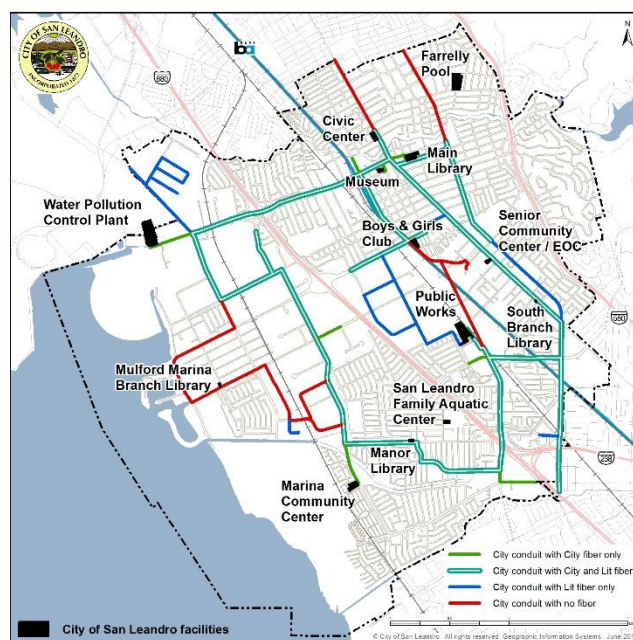
MEETING THE NEEDS OF SAN LEANDRO

To understand the broadband needs of the City of San Leandro, Magellan Advisors and the City’s team hosted online business and residential surveys throughout the fall of 2017. These surveys asked a variety of questions to assess the local broadband market, satisfaction, cost and speeds. Additionally, Magellan’s team conducted face to face interviews with key members of each department of San Leandro’s city government and anchor institutions to grasp some of the capabilities and needs of municipal operations.

Our findings indicate that although satisfaction with internet services in San Leandro is neither overwhelmingly positive nor negative, **businesses, residents, and municipal entities all expressed strong support for a municipally owned network that could offer high speeds at reasonable costs.** Many residents indicated frustration with cost and service among current providers, while many businesses (approximately 27%) expressed dissatisfaction with overall service (accounting for speed, cost, and availability)⁴.

While the LSL network has connected up to 300 businesses in the area, only around 19% of the businesses that completed the survey stated that they were connected to LSL. Many of them were unaware of the network’s offerings or stated that the service was too expensive. Among residents, the City has also identified a “digital divide,” in which a large number (22.4%) of households do not have access to residential internet service in their home. Although some of these residents may have chosen to opt out of home internet service and many others may rely solely on smartphones with data plans, it is likely that for many of them, broadband internet service is simply not affordable.

Figure 2. San Leandro’s Current Fiber Network³



² [Smart City](#) refers to the secure use of communication and information technology to manage City assets, and enable connection of growing array of smart devices in the “Internet of Things”.

³ Full sized network maps can be found in Appendix A.

⁴ See Section 4, Needs Assessment, for detailed findings of these surveys.



A SMART CITY VISION FOR THE CITY OF SAN LEANDRO

This Master Plan introduces a Smart City Strategy that identifies several, significant areas where San Leandro can develop or further expand initiatives and projects for its vision as a Smart City. These areas were identified throughout the planning process, in conjunction with resident and business outreach as well as departmental interviews with City Staff and elected officials. Initiatives in these areas align with San Leandro's existing infrastructure strengths, current and future needs, as well as address challenges facing the City and region in the future.

These areas include:

- Digital Transformation, the process of creating a digital City government experience, often called “e-Government,” which includes digital services and open data;
- Smart Buildings & Facilities, connecting facilities and using integrated management systems for climate control, HVAC, energy;
- Smart Streetlights, Small Cells, and preparing for the deployment of 5G;
- Intelligent Traffic Signal Systems that adaptive to real-time traffic conditions, making San Leandro streets more efficient;
- Public Safety, and using intelligence and data to help improve quality of life;
- Digital Inclusion, which entails connecting the unconnected and helping community members engage in the digital economy;
- Public Wi-Fi and infrastructure to drive economic development and bridge the digital divide.

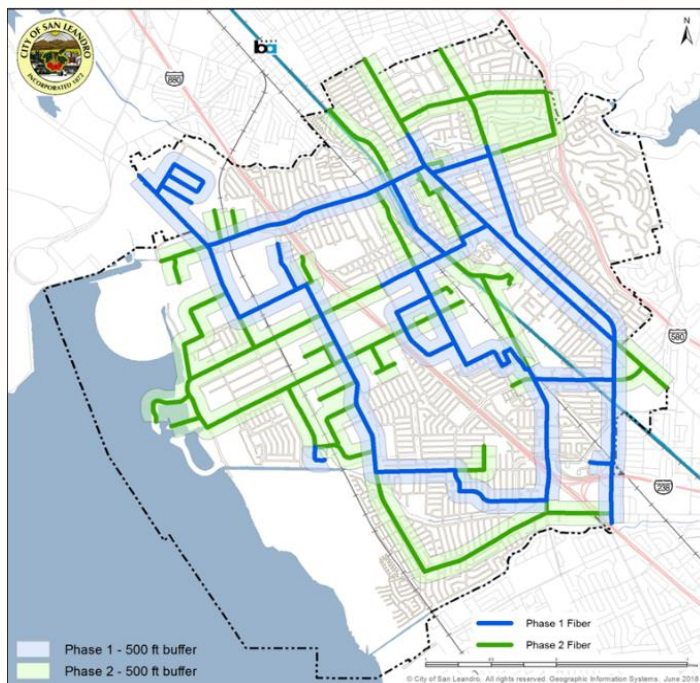
Emerging needs have also been considered in these areas, ranging from smart metering to drones to autonomous vehicles. All of these technologies and initiatives share a common infrastructure and unifying factor: the fiber optic network, which must be reliable, secure, and highly available.

BROADBAND IMPLEMENTATION ALTERNATIVES & STRATEGY

This Fiber Optics Master Plan and Smart City Strategy provides an incremental approach for the City, focusing on meeting the needs of the City, other public agency partners, and the greater business community. This document outlines an overall strategy for the implementation of Smart City solutions, broadband throughout the City, potential business models for deployment, and overall costs for development over time.



Figure 3. Proposed Citywide Network Design



Business and Anchor Focus

As in any capital-intensive project, there are advantages and risks that vary depending on the broadband deployment scenario chosen. The City of San Leandro Fiber Optics Master Plan analyzes these scenarios and provides a strategy for deploying broadband throughout the City.

Each implementation phase offers opportunities for the City to connect government facilities and assets such as traffic signals, cameras, and wireless devices. Connected devices establish the means to measure, monitor and improve traffic, the resident and visitor experience, public

safety and many other municipal services and operations. Additionally, the design includes the ability to expand competitive internet services to the business community within the buffer zones of the network design. As a result, the City of San Leandro's network becomes a network able to expand broadband to the business community enabling revenue that helps to pay for the cost of building and maintaining the network.⁵ A redundant network architecture that will serve as the backbone for the core of the City, main traffic routes, and commercial zones is illustrated in Figure 3. The network will also be the backbone and gateway for provisioning broadband for municipal, commercial, and anchor institutions.

The proposed implementation strategy includes two primary phases:

1. Enhance Existing Core Network with Lit San Leandro;
2. Populate existing empty network conduit with new fiber and expand network to reach additional businesses, anchor institutions and commercial zones.

SUMMARY OF BUSINESS AND FINANCIAL MODELS

Several options exist when planning for the design of a municipal network. Magellan's analysts and San Leandro's team have examined several of these and determined that a

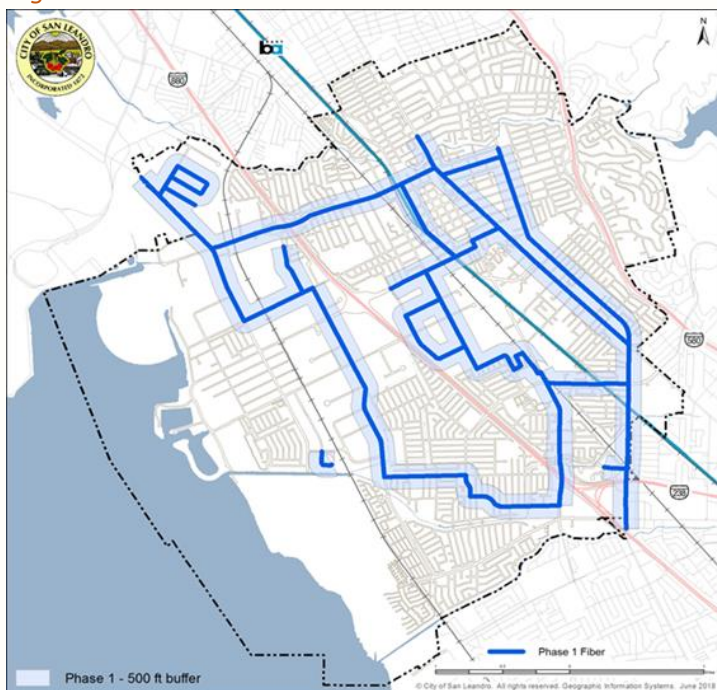
⁵ During community outreach sessions, residents and community members also expressed a need to ensure residential access to high-speed internet. A fiber-to-the-home (FTTH) analysis that explores residential access is not included in the scope of this study, but should be considered to ensure the economic development, workforce development and bridging the digital divide within the City.



phased approach to expanding and building the network is the best method for meeting the needs expressed above. The City should first capitalize on the need to enhance the City’s current shared Lit San Leandro network and assets.

Phase 1 of the proposed business model includes continuing to capitalize on the existing network assets currently managed by Lit San Leandro, and to further develop the City’s own fiber strands in enabling Smart City solutions. Lit San Leandro has a core network (see Figure 4 - Phase 1 map below) that covers a large part of the City. The City offered Lit San Leandro their exiting conduit for Lit San Leandro to populate with their own fiber thereby enabling them to offer broadband services to the business community. When the existing conduit was populated, 10% of strands of fiber were reserved for the City to use for their own purposes. (Given Lit San Leandro pulled a 288-count fiber strand bundle, this translates into 28.8 strands, which was rounded up to 30. The City in turn dedicated 10 strands for public benefit and has donated those to the San Leandro Unified School District to connect all of its facilities, which was completed in 2015). The remaining strands could be used by the City to continue the implementation of government innovation and Smart City solutions.

Figure 4. Lit San Leandro – Phase I

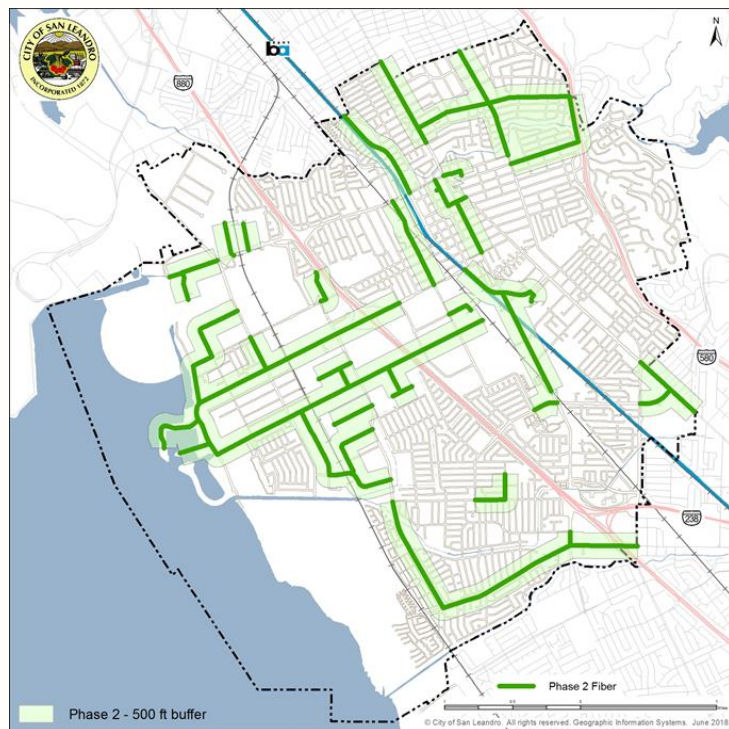


Three fourths of the cost of building a network in a community such as San Leandro would be in putting the fiber assets in the ground, namely the conduit. Once the conduit is in place, the cost to populate it with fiber is reduced by about one fourth. Lit San Leandro should continue to be encouraged to look for additional products and services to offer the business community and anchor institutions that will further fulfill the initial vision of being an economic engine within the City. Both the City and Lit San Leandro need to capitalize on the past efforts of the City (putting in conduit) to help drive affordable broadband adoption.

Phase 2 of the network consists of populating fiber in current empty conduit and extending the network through construction of new conduit and fiber. The current fiber network would be supplemented by populating unused conduit with fiber and expanding upon the network’s current footprint. The resultant network is shown in Figure 5.



Figure 5. Proposed Fiber Network and 500-Foot Buffer Zones – Phase 2



The proposed expansion takes into account the location of municipal facilities, community anchor institutions, traffic infrastructure, and concentration of businesses likely to subscribe to a municipally offered service. While Phase 2 does require more funding to complete the build out, our projections indicate positive returns on investment from leasing the fiber to businesses and anchor institutions when combined with leasing vertical assets and fiber to wireless carriers deploying small cells for 5G.

Magellan Advisors has seen many different network deployment models from other Cities and providers. It is our recommendation that the City offer, through outsourced network management partners, wholesale broadband services to all businesses and anchor institutions within 500 feet of the core network. The City should offer not just dark fiber, but “lit” services. Using Wave Division Multiplexing (WDM) technology, the City can offer lit services, such as those outlined below, to all businesses within their foot print, thus better utilizing the strands that are available or could become available with Phase 2 of the network.

If the City were to use only their own funds to build the entire network, the City could spend up to \$31M over a 6-year period. However, some of this investment has already been done via the Lit San Leandro build. Capitalizing on other grant funds, dig once and joint trench opportunities will be a smart practice that allows the City to reduce the overall capital outlay. Grant funds have not been captured in the financial analysis. The analysis assumes the City will supply all the build funds directly.



The primary assumptions used to estimate the two phases include:

Revenue, Take Rates & Price Assumptions
City facilities – 100%
Commercial Businesses – 30% with a 3-year ramp per phase
<ul style="list-style-type: none"> Includes commercial businesses that are within 500’ of core network assets
<ul style="list-style-type: none"> \$720 per month for 1Gbps/1Gbps dedicated transport services
<ul style="list-style-type: none"> \$360 per month for 100Mbps/100Mbps dedicated transport service
<ul style="list-style-type: none"> \$90 per month for 1Gbps Best Effort internet access
<ul style="list-style-type: none"> \$70 per month 100Mbps Best Effort internet access
Vertical Asset Leases– 7% of all available poles with a 5-year ramp per phase at a rate of \$400 per month with backhaul, \$180 per month for lease only

To help build and fund the ongoing operations of the network, the City needs to generate reoccurring revenue through the lease of services on its network to others. The leasing of services at competitive rates will help provide ongoing capital to affordably maintain and operate the network over time. The City should provide services to existing and new ISP’s at a wholesale rate, who in turn will provide broadband to the business community. Due to the construction costs of the lateral connections from the network into the properties, we do not anticipate this network to reach all businesses within the City of San Leandro; typically, those that are within 500 feet of the core network are able to be connected. Expanding the network to those outside of the 500-foot buffer can be considered on a case-by-case basis.

The model also assumes the leasing of vertical assets such as streetlight poles for 5G-enabling small cell attachments to wireless carriers on an annual basis. Some carriers will need only to lease vertical assets, while others will also ask for fiber backhaul services from those streetlights, which this Phase of the network is designed to provide.



FUNDING SUMMARY

Funding for these broadband networks can come from many sources.

These sources include:

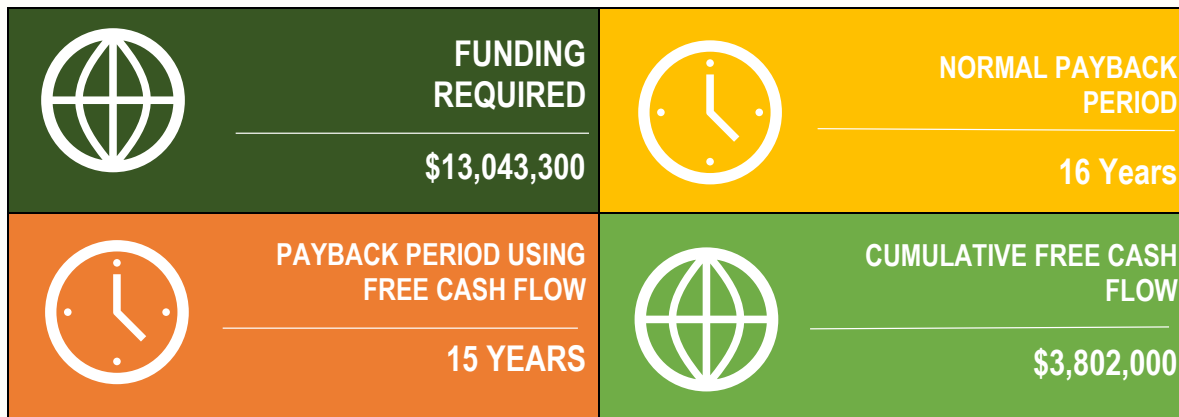
- Dig Once Opportunities
- Opportunistic Options
- Grants such as traffic signaling funding
- Like/kind exchanges with other carriers or providers (BART, CalTrans, utilities, fiber and wireless carriers seeking small cell streetlight pole attachments)
- Grants from public safety, transportation and economic development sources
- Existing funds including Plan of Record (POR) allowances

Ongoing maintenance funds will be offset by offering wholesale broadband access/services to businesses and anchor institutions.

None of these funding sources has been reflected in the financial model. Magellan Advisors has created three models for the City to consider.

Model A – Building Out/Enhancing Existing Core Network: assumes revenue and cost projects for Phase 1 but using Magellan’s recommended business model.





Figure 6. Model A Financial Snapshot









Model B – Upgrading Existing Conduit and Network Expansion with Fiber: assumes the City builds and maintains Phase 2 of the network and sells wholesale services to ISP’s.

Figure 7. Model B Financial Snapshot

 <p>FUNDING REQUIRED</p> <p>\$19,852,669</p>	 <p>NORMAL PAYBACK PERIOD</p> <p>20 Years</p>
 <p>PAYBACK PERIOD USING FREE CASH FLOW</p> <p>17 YEARS</p>	 <p>CUMULATIVE FREE CASH FLOW</p> <p>\$4,976,000</p>

Model C - Combined Network Models: assumes a combined Phase 1 and Phase 2 costs and deployment assuming one entity (City, Lit San Leandro or other) were to build and maintain the network.

Figure 8. Model C Financial Snapshot

 <p>FUNDING REQUIRED</p> <p>\$30,785,000</p>	 <p>NORMAL PAYBACK PERIOD</p> <p>20 Years</p>
 <p>PAYBACK PERIOD USING FREE CASH FLOW</p> <p>14 YEARS</p>	 <p>CUMULATIVE FREE CASH FLOW</p> <p>\$20,926,000</p>

The financial models presented here demonstrate potential cost models for building and maintaining a broadband network for the City of San Leandro. These models should be viewed as only three of many available options to the City and assume more of a total finance scenario rather than incorporating cost savings from opportunistic builds or grant funding options. The City of San Leandro should assume that much of this network will be paid for by grant funds, or that the cost of building the network can be greatly reduced by joint trenching, use of existing assets or opportunistic builds as they present themselves.



SUMMARY OF RECOMMENDATIONS TO ENHANCE BROADBAND SERVICES

Recommendation #1: Develop Fiber-Friendly Public Policies

Recommendation #2: Enhance Data Center and Network Interconnects

Recommendation #3: Work with Community Anchor Institutions on meeting their broadband needs

Recommendation #4: Identify Additional Community Uses (Smart City)

Recommendation #5: Formalize an internal Broadband Infrastructure Program (BIP) – Led by City Staff To Oversee the Business Plan and Program to Make Use of Broadband Assets

Recommendation #6: Release RFPs for Construction and Operations

Recommendation #7: Incorporate broadband governance strategies into the daily operations of all City departments and work with local and regional public agencies and private investors, especially for dig once and joint trench, leveraging streetlight poles for in-kind fiber swaps during small cell lease negotiations, during development review committee meetings, capital project budget considerations and during development agreement negotiations

ROADMAP AND ACTION PLAN

Implementation of the Broadband Infrastructure Program through completion of the following tasks: Primarily for Phase 2

- Task 1. Document and maintain an inventory of available assets
- Task 2. Implement a fiber management system
- Task 3. Develop and standardize agreements for fiber and conduit leasing
- Task 4. Develop pricing policies for fiber and conduit leasing
- Task 5. Publish rates and terms
- Task 6. Create a city enterprise fund to maintain proper budgets, cost accounting, and track revenues generated by the program
- Task 7. Develop an RFP and competitively bid for a design/build contractor for outside-plant (OSP) O&M
- Task 8. Decide on management structure
- Task 9. Develop an RFP for contractual services or a public-private partnership for marketing and managing the network and services
- Task 10. Expand fiber segments in business districts and corridors
- Task 11. Deploy and implement Smart City equipment and services that can be supported by each phase of network expansion



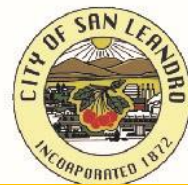
The recommended steps to implementing the Broadband Master Plan within the City are provided below.

1. Review and Adopt the Broadband Master Plan
2. Finalize Strategy, Budgets and Timelines
3. Inventory Existing Assets
4. Develop and Issue RFP for Design Engineering of the Outside Plant (Phase 2)
5. Develop and Issue an RFP for Construction and Project Management (Phase 2)
6. Engineer Operational Support Systems (Phase 2)
7. Develop and Issue an RFP for O&M Contract (Phase 2)

CONCLUSIONS

There are many options available to the City and its stakeholders and partners to achieve their goals of providing robust broadband throughout the City. The City has already entered into this business with their arrangement with Lit San Leandro. This report has recommendations based on Magellan Advisors' experience, that can help Lit San Leandro enhance its product offering and make more broadband available and affordable throughout the City. These recommendations need to be further evaluated by Lit San Leandro and the City to ensure the needs of the City are being met and that it will continue to support the City's goals now and into the future. Many options are discussed, and this report includes risks associated with each model. The City's risk tolerance, in terms of financial obligations and disruptions to current operating paradigms, will need to be considered in determining the City's role in advancing broadband services to the San Leandro community.

In general, in order to mitigate the aforementioned risks, it is recommended that the City of San Leandro take an incremental and collaborative approach to the implementation and upgrade of broadband infrastructure throughout the City. An incremental and opportunistic deployment of broadband within the region will be supported through consistent wireless and dig once policies and best governance practices that emphasize incorporating broadband into the daily activities of every City department and local and regional public agencies for economic development, bridging the digital divide, Smart City and enhancing public safety.



BACKGROUND

In creating this Plan for the City of San Leandro, or indeed for any city, current trends, best practices, and comparative business models must be considered. This background information provides the context by which to examine options and to evaluate what is most important and most feasible for San Leandro’s leadership, residents, business community, and anchor institutions. As the landscape of technological advances is constantly changing, it is imperative that the most current information be thoroughly assessed to allow for a comprehensive understanding of the current and future state of technology within the City.

OVERVIEW OF BROADBAND TECHNOLOGY

The term “broadband” refers to high-speed internet services that provide users access to online content including websites, television shows, videoconferencing, cloud services, or voice conversations. These applications can be accessed and shared through a variety of technologies including personal computers, smartphones, tablets, and other connected devices. Although demands for this high-speed data are rapidly increasing, the Federal Communications Commission (FCC) defines broadband speeds as at least 25 Mbps downstream and 3 Mbps upstream. Cable, DSL, fiber, and wireless are the prime broadband delivery systems used to meet these demands by connecting users to the internet.

Fiber-optic cables (or just “fiber”) are strands of glass the diameter of a human hair that carry waves of light. Unlike other connections that carry electrons across copper wire, fiber supports fast, reliable connections by using photons across glass, giving it the capacity to carry nearly unlimited amounts of data across long distances at spectacularly fast speeds. Because of this speed and reliability, fiber is considered the gold standard for supporting broadband across the full spectrum of devices and applications. Its usability and resiliency has brought fiber to the forefront, making it a highly desired asset for all entities, public and private, that own or control it. The availability of a reliable, cost-effective fiber connection creates opportunities for the communities it serves.

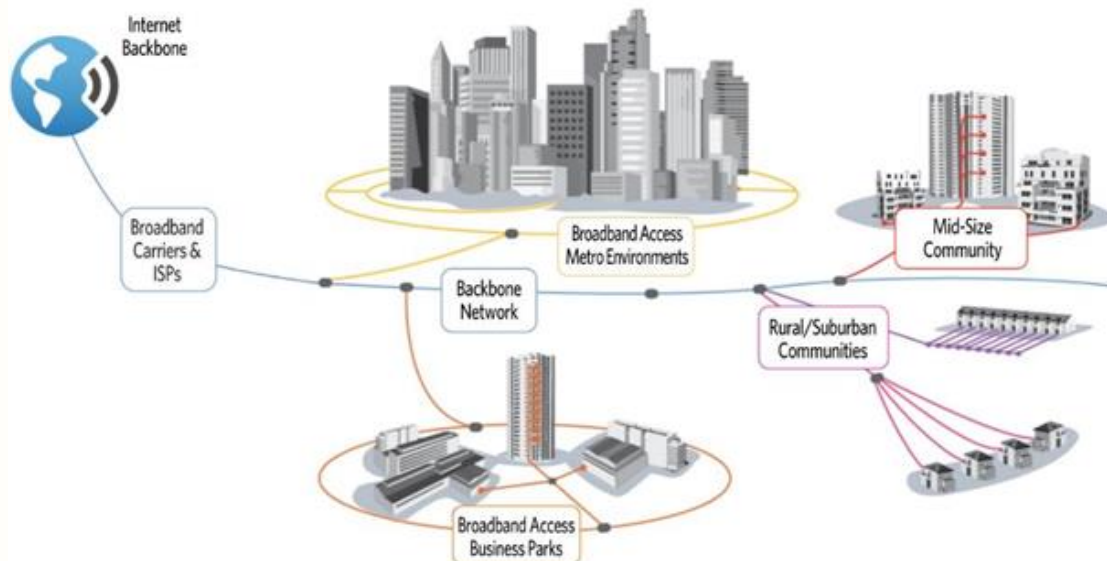
Generally, broadband is one of many services offered by telecommunications companies on multiple tiers of performance and cost. These services are divided into business and consumer users and are then offered at a subscription fee. The variety of services and technologies are increasing—exemplified by the explosion in smartphone apps—but the networks themselves are converging, so that any device operated by any user can potentially connect with vast amounts of information either inside or outside of the same network.

Broadband is deployed throughout communities as wired cables or wireless technologies that carry digital signals to and from users. The content comes into the local community from around the world via global, national and regional networks. The local infrastructure is built, connected and operated by internet and telecommunications companies that own



the physical wires to each household. This started with telephone companies, which deployed twisted-pair copper telephone lines. The second wire came from television companies in the form of coaxial cable. Later satellite and wireless phone companies provided video and voice, with more flexibility to mobile and remote devices using radio waves. Beginning in the mid-1990s these companies repurposed their infrastructures to connect to the internet and carry digital content.

Figure 9. How Broadband Connects Us



Infrastructure built on the older technologies described above is aging and results in slower, less reliable access to content. Capacity limits of this infrastructure limit service providers' ability to reliably provide high speeds, and in turn, the amount of data consumers can use is also limited. Fiber provides the robust infrastructure that connects telephone, cable and internet infrastructure between communities and around the world. It was originally used by telecommunications for their core infrastructure, to connect their major switching centers, and was only available to their biggest corporate and institutional customers.

Today, fiber-optic networks serve homes and businesses throughout the world providing telephone and television as well as internet access services. The next section describes internet access technologies in more detail.

Dial-Up Access

Though not defined as a broadband technology due to speed and bandwidth limitations, dial-up access still exists. Dial-up internet access uses the public switched telephone network (PSTN) to establish an analog connection from a computer to an internet service provider (ISP). The computer connects via a modem by dialing a telephone number on a conventional telephone line and translating digital data into an analog signal.



Digital Subscriber Line (DSL)

DSL is a wireline technology that uses high frequencies, which are not used by analog voice calls, to transmit digital data over traditional copper telephone lines faster than modems. DSL-based broadband provides transmission speeds ranging from several thousand bits per second (Kbps) to millions of bits per second (Mbps), generally ranging from 1.5 Kbps to 10 Mbps. DSL operates over the phone line—in parallel with voice traffic so calls are not affected—which plugs directly into a computer or router at the customer’s site. The other end of the phone line connects to a DSL line card in the telephone company’s central office or remote cabinet. Each user’s data is multiplexed with their neighbors’ over high-capacity fiber, transported to internet interconnection points, then routed over internet backbones to their online destinations.

There are different types of DSL:

- Asymmetrical Digital Subscriber Line (ADSL/ADSL2/ADSL2+) provides faster speed in the downstream direction than the upstream direction. This is fine for most customers who receive a lot of data but do not send much.
- Symmetrical Digital Subscriber Line (SDSL) – SDSL has the same speeds as ADSL and is used typically by businesses that generate online content or for services such as video conferencing, which need significant bandwidth both to and from the internet.
- Very-high-bit-rate Digital Subscriber Line (VDSL) – is a new generation of technology that provides up to 52/16 Mbps. It is more sensitive to line quality and requires a more expensive line card.

The availability and speed of DSL service depends on the distance from the customer to the closest telephone facility known as a central office. Telephone lines were optimized for voice communications and conditioned to eliminate high frequency noise. Consequently, some telephone lines cannot handle DSL, and others must be modified to support the service. Multiple DSL lines can be bonded to provide higher speeds, but the cost multiplies, too.

Digital Carrier Systems

Most commonly known as T-1s, this is the digital telephone standard in the US and has been the mainstay of corporate telecom for years. This service uses a four-wire interface to deliver 1.5 Mbps, which can be subdivided into 24 channels when bonded together. While not falling within today's federal definition of broadband, this is the way many companies get internet access and connect their various facilities. T-1s are almost universally available from local service providers, although they may charge for mileage and other things that make the service rather expensive. The digital services hierarchy extends to multi-megabit services and fits with the even higher bandwidth optical carrier services.



Cable Modem

Cable operators provide broadband to subscribers using the same coaxial cable that has historically delivered content to televisions through a cable modem across the same “tree and branch” network used to distribute channelized broadcast television. Technically termed DOCSIS (Data Over Cable Service Interface Specification), cable broadband literally allocates channels for carrying data to and from customers instead of television. Most cable modems are external devices that have two connections: one to the cable wall outlet via coaxial cable that goes out to the internet, the other to a computer or router via Ethernet cable.

On the cable network, where the coaxial physically ends, a DOCSIS interface strips out the data and routes them all to their destinations via fiber optic cable. DOCSIS uses a “multiple access” approach to network in which every user’s data is intermingled with others on the wire from the house to the router. Transmission speeds vary depending on the type of cable modem, cable network, and traffic load.

In response to growing consumer demand for bandwidth, DSL and cable network operators upgrade outdated or underperforming equipment following their revenue models and capital budget limitations to attempt to make the infrastructure faster and more reliable. However, several fundamental issues exist that pose long-term challenges to meeting the growing bandwidth demand through copper infrastructure:

- Broadband signals degrade significantly over copper as distances increase.
- Broadband signals over copper are susceptible to electrical interference and signal degradation, particularly as they age.
- The amount of bandwidth available on portions of broadband networks is often shared among multiple users, which can result in an uneven distribution of speed to users, and slower speeds to all as facilities become congested.

Fiber-Optics

As previously stated, fiber-optic network technology converts electrical signals carrying data into light and sends the light through transparent glass fibers about the diameter of a human hair. Fiber transmits data at speeds far exceeding copper, typically by hundreds of megabits per second. With fiber-optic broadband networks, speeds in the billions of bits per second range are possible. The fiber-optic network today operates at nearly 300 Terabits per second, which is so fast that a single fiber could carry all the traffic on the internet.

More commonly, fiber-optic networks provide between 100 Mbps and 10 Gbps to users. Fiber-optic networks can be designed to be highly reliable as well as fast. Fiber-optics are used extensively by major corporations and institutions and are beginning to be at the core of every telecom company’s network. There are numerous standards for fiber optic



networks. The two most common for broadband applications are Active Ethernet (AE) and Gigabit Passive Optical Network (GPON).

The actual speeds the customer experiences will vary depending on a variety of factors, such as how the network is structured, the hardware attached to the fiber-optics, and how the service provider configures the service. The same fiber that provides broadband internet can also simultaneously deliver voice (VoIP) and video services, including video on demand. Fiber operates synchronously, meaning the service is just as fast to download as to upload, which is increasingly important for households and businesses.

Dark fiber is a fiber-optic strand with no hardware attached to generate laser light signals across the fibers. From the business perspective, dark fibers are facilities—real estate—that are leased to customers. As with any real estate, the value of dark fiber depends on location, location, location: its end points and route. Dark fiber customers are large enterprises, including ISPs, that need to interconnect local area networks or “last mile” access network infrastructure.

The fiber must be “lit” to carry data between network nodes and provide network services. That equipment must be powered and connected to other network infrastructure and must be housed in a building or cabinet. And, of course, all this infrastructure must be secured and maintained. Dark fiber lessors and lessees need to be thorough, clear, and in agreement about who is responsible for each portion of the infrastructure.

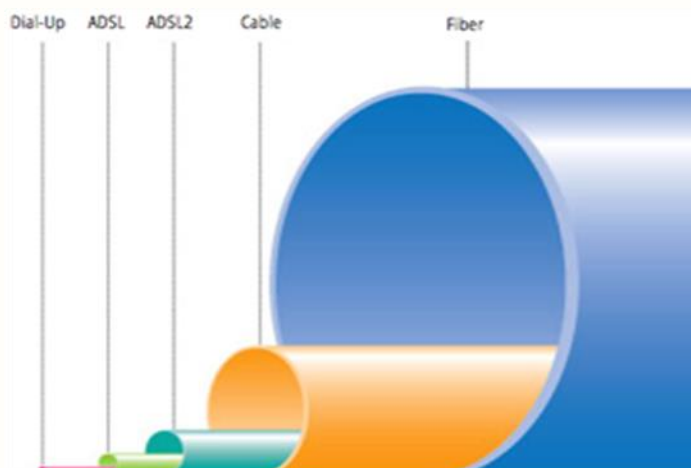
- **Fiber to the Node (FTTN)** brings high-capacity fiber-optic cables to communities and then connects to existing DSL and coaxial equipment. This is not an “all fiber” approach. Rather than bringing fiber-optic cables to every home or business, the fiber is connected to the existing copper network to increase its capacity. The copper-based “last mile” network that connects homes and businesses to the local nodes is still a bottleneck and results in subscribers not accessing the true speeds of fiber-optic connections.
- **Fiber to the Premise (FTTP)** provides internet access by running fiber-optic cable directly from an ISP to a customer’s home or business. This approach is “all fiber” all the way to the customer. Fiber facilitates much faster speeds than copper wire, generally needs to be serviced less, and is “future proof” because technology can increase the bandwidth of fiber-optic cables. AE and GPON are both FTTP technologies.

Figure 10 illustrates the relative difference between common internet connection methods, comparing access technologies from basic dial-up service through DSL, cable, and fiber. Whereas traditional broadband technologies have an upper limit of 300 Mbps, next-generation broadband that utilizes fiber-optic connections surpasses these limitations and can provide data throughputs of 1 Gbps and greater.



Figure 10. Physical Bandwidth Capacity Comparisons

- Dial-Up – 56Kbps**
 - Legacy Technology
 - Shared Technology
- ADSL – 10Mbps**
 - First Generation of DSL
 - Shared Technology
- ADSL2 – 24Mbps**
 - Second Generation DSL
 - Shared Technology
- Cable – 150Mbps**
 - Data Over Cable (DOCSIS 3.0)
 - Shared Technology
- Next Generation Fiber – 1Gbps**
 - Passive Optical, Active Ethernet
 - Shared and Dedicated Technology



Wireless

Wireless broadband can operate as mobile, hotspot, or fixed. Wireless can also be used as “backhaul” to connect remote locations or sparsely populated areas, where DSL or cable service would not be economically feasible, via long-range directional antenna. Fixed wireless services allow consumers to access the internet from a fixed point while stationary, and often require an external antenna with direct line-of-sight between the wireless transmitter and receiver. Speeds are generally comparable to DSL and cable modem. These services have been offered using both licensed spectrum and unlicensed devices.

Hotspot wireless uses the Wi-Fi standard to provide connectivity for digital devices in an area via physical access points and a router, which interconnects wireless devices to the internet. Hotspots typically operate at 54 Mbps, but the actual bandwidth depends on the quality of the wireless signal and speed of backhaul to the internet. Wi-Fi is a multiple access technology, so bandwidth is shared with other users. While users can move around in the hotspot, they can’t drive away: Wi-Fi does not provide a mobile connection. Wi-Fi is fast and robust, if limited in distance and susceptible to interference because it operates in open, unlicensed spectrum. Wi-Fi hotspots are common at hotels, restaurants, and public buildings for public access. It is used in many homes and businesses for private access. Many WISPs use Wi-Fi, and it is increasingly available from traditional telecoms (AT&T and Comcast have many branded hotspots). Wi-Fi complements cellular data via mobile wireless (users often use it to avoid cellular data caps and slow speeds), and is used in conjunction with wired broadband services—most hotspots connect to the internet via broadband.

Wireless cellular data services, which borders on broadband speeds, are widely available from mobile phone companies. Typically referred to as either 3G or 4G (G for “generation”), mobile connections operate within cells that hand off signals from antenna



to antenna as the device moves. 4G can move data at 12/5 Mbps, but speeds in the Kbps range are more common. Cellular data connections are most commonly used with smartphones, or with computers via cellular network interface card. Many smartphones can act as Wi-Fi hotspots or tether to computers via Bluetooth.

The next generation of wireless networks, 5G, are being designed and developed, with forecasted commercial availability in 2020 and an increased maturity of the network in approximately 2035. 5G networks operate multiple frequencies (i.e., 5-GHz, 60-GHz, 0.47-0.71 GHz) and will utilize millimeter wavelengths. 5G networks will operate on the IEEE 802.11ac, 802.11ad, and 802.11af standards, also known as Gigabit Wi-Fi and are expected to provide download/upload speeds up to 1 Gbps, which depends on the number of connections. The networks are designed to provide increased efficiencies while decreasing latency, and are designed for improving the performance of connected devices that define the IoT. In particular, network architectures with an emphasis on massive multiple input multiple output technologies (MIMO) and device-to-device (D2D) communications. For example, autonomous vehicles, healthcare technologies (such as blood glucose monitoring), ultra-high-definition video, virtual reality with many more network designs architectures and other applications. With 5G networks being heterogeneous, it must include macrocells, microcells, small cells and relays.

Satellite

Satellite internet uses licensed radio spectrum to send data from and to anywhere on Earth. The signals go on a 46,000-mile roundtrip from earth-bound devices through the atmosphere via the satellite and back to earth to another computing device. These radio signals have limited capacity and thus the connections tend to be slow. Because of the distance the signal must travel, satellite transmissions are susceptible to weather. Satellite should be considered a last resort for all but the most rural and remote areas. Areas with a high adoption of satellite generally indicates a need for better service. Today, the federal government finds that no satellite broadband service meets the 25/3 Mbps threshold of broadband.

Modern 21st Century Networks

Modern 21st century networks are comprised of a combination of technologies, not just one. Fiber is used in nearly all modern networks as it carries the most “data” and bandwidth when compared to other access technologies. Fiber is used not only for last mile access, but also as a middle-mile technology that carries data from cell towers, Wi-Fi hotspots, and other networks. Fiber is the backbone of the internet.

Wireless also plays a role in a modern network. Wireless access takes many forms including cellular, fixed wireless, Wi-Fi, Bluetooth, Zigbee, ZWave, and many others. Wireless offers a mobile or untethered experience that fiber cannot. However, the trade-



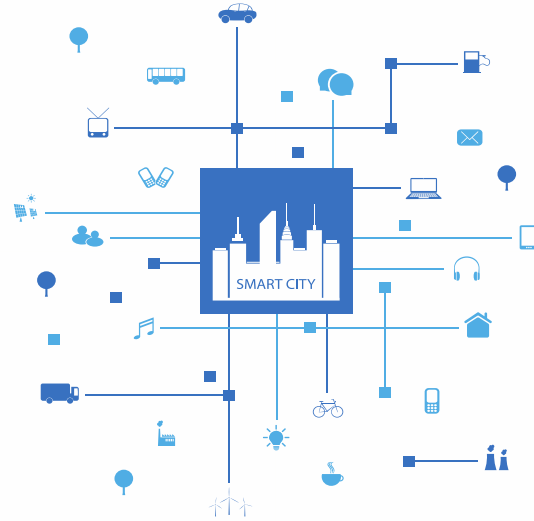
off is less bandwidth when compared to fiber, but still may be appropriate for the desired mobile applications.

Wireless networks will nearly always need fiber for backhaul. So, having a robust fiber network is the anchor to any modern broadband network design. The combination of these network access technologies is what provides the foundation for the Internet-of-Things (IoT), especially in respect to Smart City applications and technology.



SMART CITY STRATEGY

Cities are on the cusp of rapid change precipitated by technology – technology that is being integrated into municipal operations for a variety of functions and applications. A “Smart City” is one that “has developed some technological infrastructure that enables it to collect, aggregate, and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents.”⁶ Advancing technologies place cities at the center of innovation: autonomous vehicles revising the concept of traffic and traffic signals; Wi-Fi transforming the way information is used and accessed; shared vehicles allowing a move away from parking costs and land use; integration of renewable energy sources and smart metering technology for water, electric and gas; smart street lighting poles providing a vertical asset for wireless data via 4G/5G and Wi-Fi, applications enabled via wireless data, smart lighting and embedded sensors enabling numerous applications including embedded sensors providing for faster responses for public safety; and integration of systems with customer feedback loops to enhance and improve customer service for residents and visitors.



Smart Cities are enabled generally by the “Internet of Things” (IOT), which is being driven by the increased sophistication and reduced costs associated with wireless, Bluetooth and sensor technologies, coupled with the advent of cloud computing, which places storage and computing power in remotely hosted data centers, collectively called “the Cloud.” Devices around us are undergoing technological re-imagination to make them “smart.” Increasingly simpler and cheaper devices can be deployed by cities to connect municipal assets and functions to generate data – enabling more efficient and effective

⁶ “Trends in Smart City Development: Case Studies and Recommendations”, National League of Cities, 2016. <http://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20Development.pdf> (“NLC Smart City Report”)



management of services and programs. “Smart City” also refers to the secure use of communication and information technology to manage City assets.

However, Smart City initiatives require both high and low bandwidth network connectivity for transmission of large (and constantly growing) amounts of data as well as small amounts of sensor data. Municipal broadband networks provide affordable means for implementing Smart City initiatives for public safety, mobility, quality of life and economic growth. Therefore, as communities invest in fiber infrastructure, they are constructing foundational communications networking useful in supporting a multitude of technology-based initiatives that require connectivity. By building out fiber networking, cities become Smart City ready, but ultimately a Smart City depends on installing applications using the fiber network.

Smart Cities are not exclusively technological; organizational and human factors must be provided for to foster the necessary collaborations and investment in human capital. Cities serve communities and Smart Cities must be designed with public benefits in mind. Additionally, cybersecurity and data privacy are ever more important in maintaining a healthy Smart City strategy. Ultimately Smart Cities initiatives are layered, involving network facilities infrastructure, with connected devices (cameras, sensors, Wi-Fi, etc.), and the data from these devices which allows capabilities to be embedded in daily practices based on collaboration among organizations and departments.

This Strategy is intended to guide the City of San Leandro in leveraging the assets it has in and above the ground in the strategic deployment of Smart City technologies and applications to improve services, communication, and enhance the quality of life for its residents.

NATIONAL LEAGUE OF CITIES “SMART CITIES” REPORT



There is a vast and growing body of studies, information, products and research on the “Smart City.” The National League of Cities has produced a report on trends in Smart City development, which serves as a guideline.⁷ According to the NLC, Smart City applications require three

components working together for effectiveness: computing and telecommunications infrastructure to collect data, software applications and tools to analyze and interpret the data, and a collaborative environment in the organizations that innovate, create and use Smart City applications.

The Report contains many examples of interconnection of devices in a Smart City, while noting that:

⁷ “Trends in Smart City Development: Case Studies and Recommendations”, National League of Cities, 2016. <http://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20Development.pdf> (“NLC Smart City Report”)



“A reliable Internet ecosystem is the glue that holds the Internet of Things together.”

These examples include:

- Transportation Congestion Sensors
- Water and Wastewater Monitoring
- Parking Apps and Kiosks to Coordinate with Smart Metering
- Bridge Inspection Systems
- Self-driving cars shuttling people in or out of the city or making deliveries
- Waste Management Sensors
- Lighting
- Fire Detection
- Energy Monitoring
- Solar Panels
- Smart Logistics/Freight
- Vehicle Fleet Communications
- Drones for Public Safety and Infrastructure
- Monitoring Cameras
- Body Cameras
- Wearable Detection

Municipal Smart City Trends

The Report also contains case studies for Chicago, Philadelphia, Charlotte, NC, San Francisco and New Delhi, India, along with comparisons and recommendations.

- **Chicago, IL** has created an administrative structure including its Department of Innovation and Technology which provides for “an open data platform and mandated cross- functional collaboration.”⁸ This structure positioned Chicago to partner with Argonne National Laboratory on the Array of Things.
- **Philadelphia, PA** created an Office of Innovation and Technology to support movement toward smart city concepts, including programs and measures designed to lower the crime rate.
- **Charlotte, NC** established a PPP to help the City support its accelerating population growth, including an initiative to reduce wasted energy consumption.
- **San Francisco, CA** has focused on environmental and transportation improvement measures, including programs designed to reduce traffic congestion and improve reliability of municipal transportation services.

Although not from the NLC report, it is worth noting that other cities have taken similar measures to develop innovation. Las Vegas created a Department of Innovation and Technology, as did Albuquerque, NM, Long Beach, Riverside, Rancho Cucamonga, and Boston, MA. This model is not solely for larger cities. In the Bay Area, the city of Cupertino

⁸ NLSC Smart Cities Report



recently created a Department of Innovation and Technology. Similarly, Alameda, CA created a Director level position to oversee Innovation and IT.

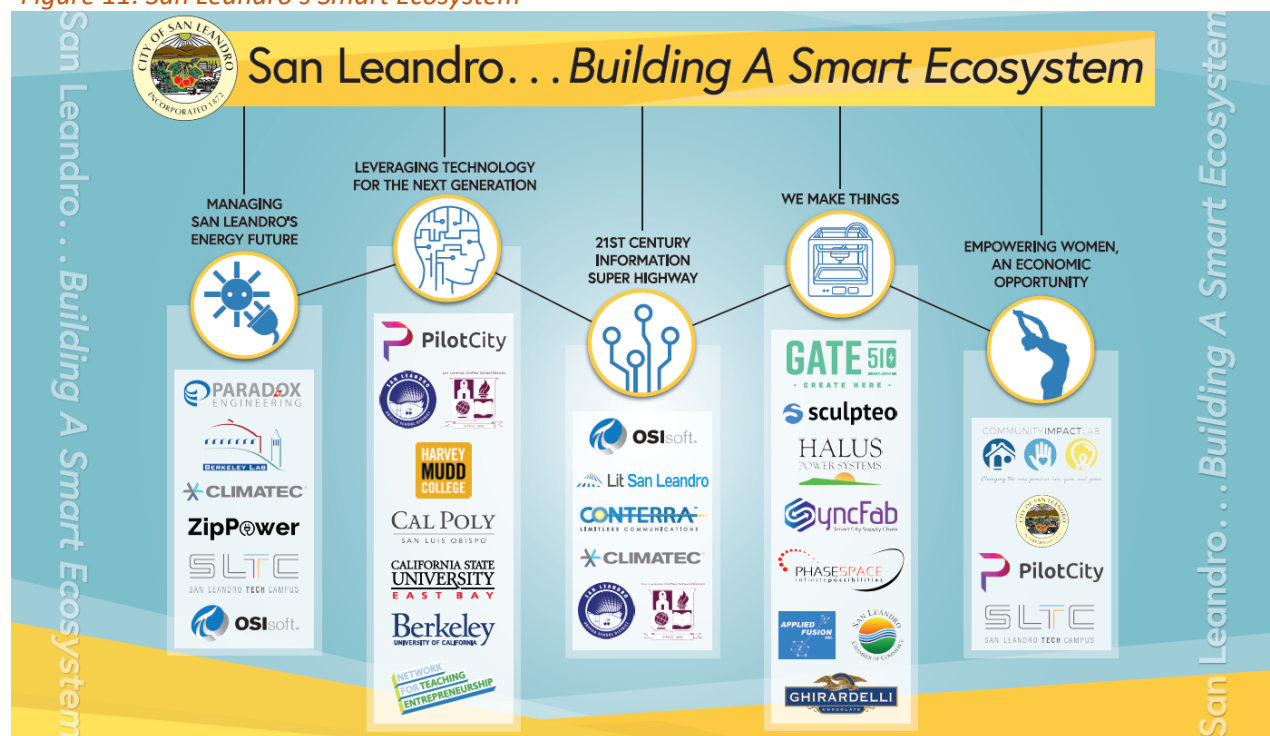
The National League of Cities Smart City recommendations, listed below, are very valuable as a framework for considering Smart City Initiatives:

Cities should consider the outcomes that want to achieve. “Data collection is not an end in itself.” Initiatives need to be clearly defined. Consider what the need is, not just what other cities are doing.

Cities should look for ways to partner with universities, non-profits and the private sector. Cities can even partner with other cities. There are many benefits to partnering and collaboration, including access to experience, shared risks of development, and providing project continuity. Downsides to collaboration also need to be considered in structuring any partnership.

Cities should continue to look for Smart City best practices. Technologies are new and at present there is significant variability and a lack of agreed standards. The National Institute of Standards and Technology is working on this matter. In addition, municipalities need not reinvent the wheel; when one city figures out a solution, it can be shared openly for other cities to adopt and learn from. This open sharing and collaboration can be a powerful resource for city planners, IT professionals, and administrators.

Figure 11. San Leandro’s Smart Ecosystem





SMART CITIES READINESS GUIDE

The Smart Cities Council is a network of leading companies advised by top universities, laboratories and standards bodies that develops and advocates for Smart City policies.⁹ They have published a “Smart Cities Readiness Guide” that includes detailed information on Smart City drivers and barriers, benefits, beyond “silos,” and City responsibilities.

City responsibilities and opportunities are outlined as follows:

- **Built Environment:** Leading and planning for “smart buildings” powered by ICT, using sensors, meters, systems and software to monitor and control a wide range of building functions including lighting, energy, water, HVAC, communications, video monitoring, intrusion detection, elevator monitoring, and fire safety.
- **Digital City Services:** Switching to digital delivery of city services to increase citizen engagement, increase employee productivity, increase competitiveness, increase citizen satisfaction, and reduce cost. Services are delivered via the web, smartphones and kiosks, which can require implementation of new technologies, and attitudes or approaches.
- **Energy:** Smart energy is a priority for Smart Cities, which start with smart energy systems.
- **Health and Human Services:** Smart Cities ride the transformation wave provided by advances in ICT to transform the delivery of essential health and education services since “an educated and healthy city is a wealthy and successful city.”
- **Ideas to Action:** A “roadmap” linked to a City’s vision document and comprehensive plan is necessary to turn ideas to action, and make technology serve the City’s larger goals. The path to a Smart City is not quick, and targets are needed for clear goals to motivate citizens and permit any required course corrections.
- **Mobility and Logistics:** Population growth and wasteful congestion make this a critical area for the Smart City. Traffic congestion is wasteful and costly to the economy – both directly and indirectly. There are a variety of action steps and targets that can provide for safer, more efficient transportation, including accommodating electric and autonomous vehicles and smart parking among others.
- **Public Safety:** Public safety relies on a lengthy list of infrastructure, agencies and people to keep the public safe. ICT in the smart city fosters quicker and smarter responses without wasteful duplicated effort to save lives, property and resources.
- **Smart Payments and Finance:** Digitalizing both disbursements and collections generates significant savings and increases operational efficiency.
- **Smart People:** A new city hall mindset that is more open, transparent and inclusive to build two-way communications and create stronger initiatives.

⁹ <https://smartcitiescouncil.com/article/about-us-global>



- **Telecommunications:** An adequate telecommunications infrastructure is vital for business and community development and underlies the Smart City.
- **Waste Management:** Population growth and accelerating consumption have created a rising tide of waste, outpacing the rate of urbanization. Smart cities can collect and process waste more efficiently and recover materials which have value, with a beneficial impact on public health, the environment and sustainability/zero waste, and cost control.
- **Water and Wastewater:** Like energy, water is critical to everyday life. There is also an energy – water nexus, where it takes water to produce electricity, and electricity to pump water. The Smart City provides intelligence for both energy and water systems and provide the platform for economical and sustainable production of both energy and water.

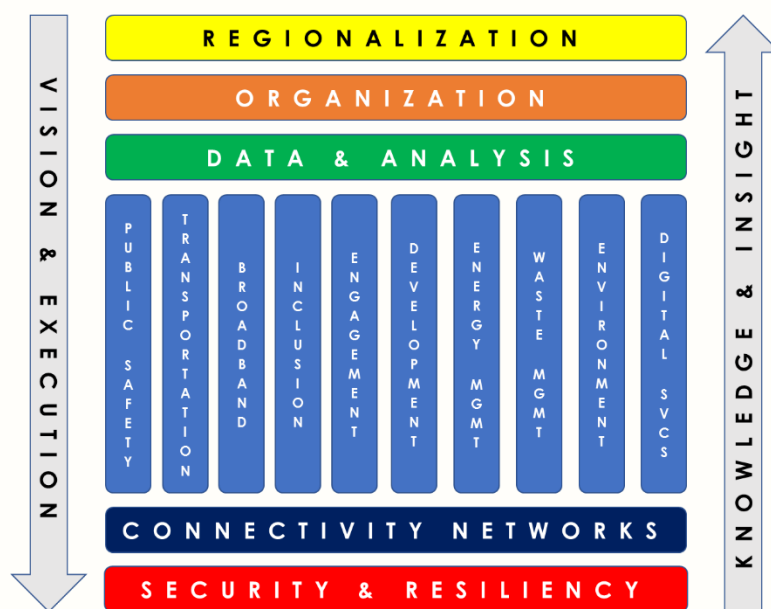
The City of San Leandro has made progress in many Smart City areas. The following sections will discuss San Leandro in depth, specifically how it can continue along the path to becoming a leading Smart City.

SMART CITY MODEL

Certain trends have emerged on which a Smart City model can be developed. One includes the concept of “regionalization” – meaning that tech-enabled services should be designed and deployed with regional connectivity and interoperability between systems and municipalities in mind. For example, traffic congestion affects the entire region, not just a single municipality. And for that matter, a single city may have several municipal organizations operating within it, including the City, water and utility districts, transit agencies, and services provided by a county. All of these agencies may operate disparate systems, yet a service such as one intended to decrease traffic congestion, in order to be fully effective, must work across these systems. **The concept of regionalization rests on the principles of inter and intra agency information sharing, interoperability and connectivity.**

Building on this, a **Smart City must also have an organization structure and culture that supports it.** This rests on supporting innovation, creativity, and big-picture thinking. It also requires a willingness to try new things and develop ways to innovate

Figure 12. Smart City Model





safely, while minimizing structural and financial risks.

Following this, a Smart City requires **Data and Analysis**, which are collected across many disparate systems and processes and drive smart decision making. Data can be shared openly, through an Open Data Policy, and used to create new services and products, such as weather apps that use governmental weather data.

Under these broad areas, **Smart City initiatives** can be launched in every domain a city manages. These include: Public Safety; Transportation; Broadband; Inclusion; Engagement; Development; Energy Management; Waste Management; Environment; and Digital Services. Individually, these initiatives can have positive benefits such as increased efficiency, cost-savings, increased public safety and community engagement. Collectively, they constitute a grouping of initiatives that, added up over time, multiply and build upon each other.

Undergirding these initiatives are **common infrastructure, such as telecommunication networks, datacenter servers, and data architecture**. This includes the data generated by these systems and the analysis of that data, which can lead to new insights, knowledge, and innovation. This all requires ubiquity connectivity over fiber optics, wireless, and sensor networks.

Finally, these **common infrastructures must be made resilient and secure, both against cyber-attack and disasters**. Cities must increasingly design cybersecurity into their solutions and this challenge becomes even more important with the movement towards Smart Cities.

For a built-out City like San Leandro, this entire process happens incrementally, over a period of one or more decades. Funding is a major constraint and opportunities can be capitalized as they arise. In addition, technology changes rapidly and some promising solutions may fizzle out. This Smart City Strategy will act as a roadmap for guiding the awareness, evaluation, and potential future deployment of these systems and services, which collectively will transform San Leandro into a Smart City.

SAN LEANDRO AS A SMART CITY

Over the past several years San Leandro has garnered a well-deserved reputation as a leading Smart City, being named a Top 10 Digital City by the Center for Digital Government three years in a row¹⁰, a Top 31 Smart Communities to Watch by State Scoop¹¹, and recently winning a Smart 50 award from Smart Cities Connect¹². This rise is due to the San Leandro City Council's leadership and vision to advance projects and programs promoting sustainable economic development, including transforming San

¹⁰ <http://www.govtech.com/dc/digital-cities/digital-cities-survey-2017-winners-announced.html>

¹¹ <https://statescoop.com/monthly/top-31-smart-communities-to-watch-5>

¹² <https://spring.smartcitiesconnect.org/Smart50Awards/>



Leandro into a center for innovation. As recently as January 2018, the City Council identified Smart Cities and the Broadband Strategy as its top action area to drive achievements toward this goal.

Department interviews conducted during Magellan’s site visit make clear that City of San Leandro management and staff have significant interest in Smart City initiatives. San Leandro, in fact, has made laudable strides in deploying technology-enabled services such as adaptive traffic signaling, public Wi-Fi and broadband service, backend IT infrastructure modernization, smart street lights, energy and waste management solutions, a mobile 311 smartphone app for residents, data analytics platform, and a digital literacy program for community members offered in public facilities, such as the Library System and Senior Community Center. Smart parking, public safety cameras are being discussed, pedestrian and vehicle traffic monitoring, and other projects are in the pipeline.

San Leandro has made such strides because of its planning and development of fiber optics facilities, which are the fundamental building blocks for Smart Cities and high-speed broadband connectivity networks. San Leandro, through its municipal network and its unique, public-private partnership with San Leandro Dark Fiber (Lit San Leandro) is “fiber rich” and this has created an incredible opportunity for San Leandro to continue its global leadership role as a leading Smart City.

San Leandro Smart City Vision

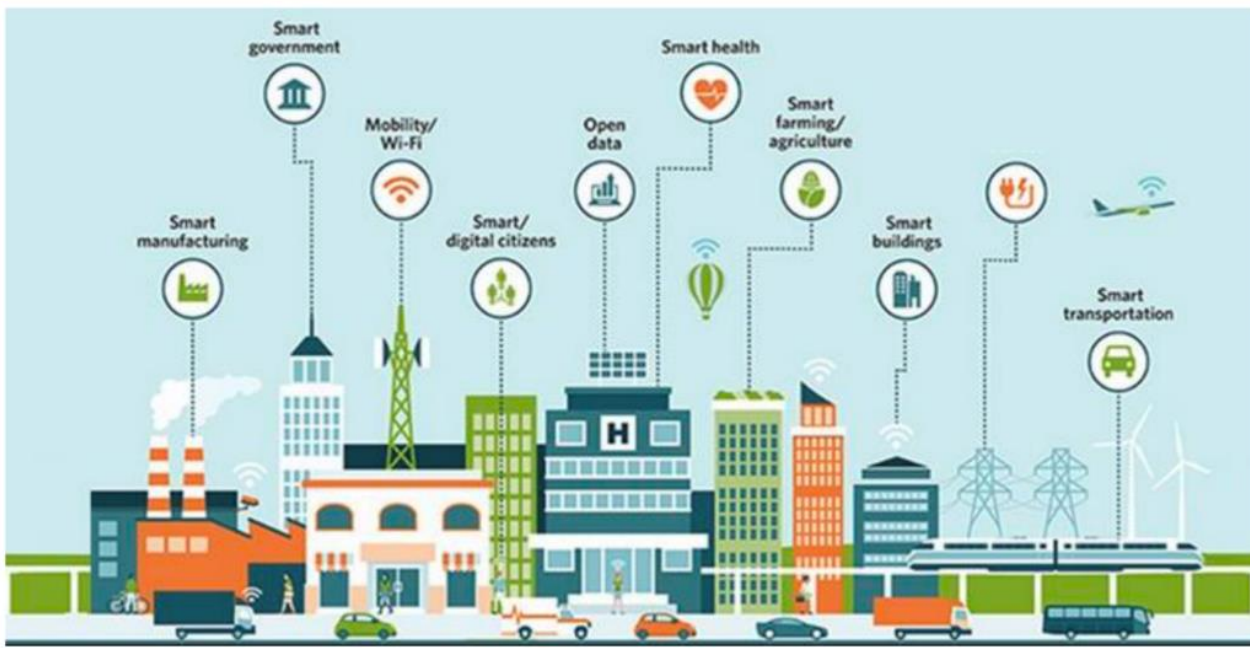
While many definitions can be found for a Smart City, there is no single definition that can be applied that perfectly suits every city. This is because cities vary greatly. They can be big, small, urban, rural, modern, quaint, and everything in between. As such, a one-size-fits-all approach to defining Smart Cities doesn’t work. To be effective, each local government needs to understand its population, its values, its constraints, goals and objectives, and then be able to translate these into solutions that support them.

In speaking with San Leandro community members, City Staff, and Elected Officials in several interviews and community meetings, and soliciting input and feedback from City Staff, a collective vision statement was developed that represents a vision for San Leandro as a Smart City:

San Leandro as a Smart City will be easy to use and navigate, friendly and kind, inclusive, sustainable, and promote innovation and the arts to enhance economic development and quality of life for its residents.



Figure 13. The Smart City



SAN LEANDRO'S SMART CITY INITIATIVES

Digital Transformation

The hallmark of the information age is the transition from the analog and physical world to the digital world. Examples are everywhere: compact discs were replaced by MP3s; movies are now streamed online; Amazon has changed how we purchase goods. The share of e-commerce as a percentage of total retail sales continues to grow year-over-year¹³ and businesses addressed this by shifting to deliver many of their services online, through the internet and mobile apps. Collectively, this is often called *Digital Transformation*¹⁴.

Government services are part of this transformation. In a 2015 survey of government leaders around the world, “three-fourths of the respondents said that digital technologies are disrupting the public sector [and] nearly all (96 percent) characterized the impact on their domain as significant”¹⁵.

What does digital transformation look like for San Leandro?

¹³ <https://www.statista.com/statistics/379112/e-commerce-share-of-retail-sales-in-us/>

¹⁴ <https://www.techopedia.com/definition/30119/digital-transformation>

¹⁵ <https://www2.deloitte.com/insights/us/en/topics/digital-transformation/digital-transformation-in-government.html?id=gx:2el:3dc:dup1081:eng:fed>



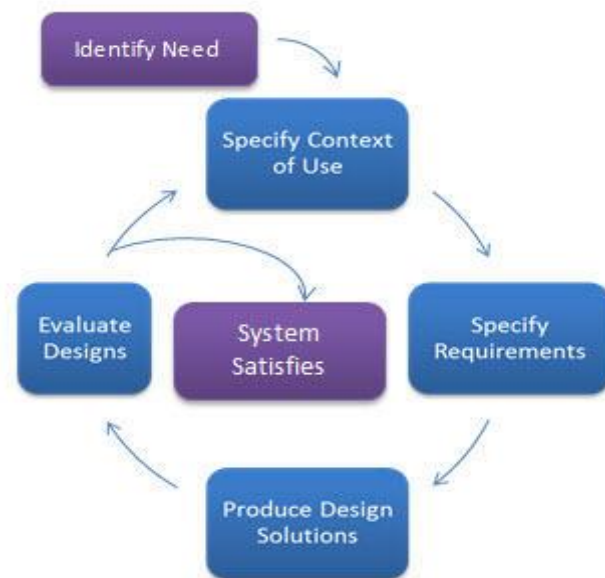
Digital Services

First and foremost, the delivery of services online and through mobile apps, collectively referred to as Digital Services, is the primary and most visible element of digital transformation. San Leandro has made strides in this area in recent years, including:

- Deploying a mobile 311 app called “My-SL”
- A mobile app for its flagship Cherry Festival
- Introducing Nextdoor and social media as communications channels
- Utilizing online applications and backend systems for permits and business licenses
- Utilizing Peak Democracy for online polling of residents
- Introducing a parking app with its Parking Plan
- Rolling out digital Boards and Commissions applications

However, many more public-facing forms and applications remain paper-based and/or rely on PDF forms. These services should be built on an ethos of “user-centered design,” which means that the services should be based on the user experience. Usability.gov has produced a framework to help organizations produce and support services that address the user experience¹⁶.

Figure 14. Smart Planning Process



In addition to these public-facing forms, the City conducts much of its internal business with forms and paperwork. For example, staff must fill out forms to perform financial requests, such as budget adjustments and expenditure corrections and to update their direct deposit allocations. The City deployed SharePoint Online as part of Office 365 and developed an online request system for Time Off and Overtime. This can be built upon to deploy more services in the future.

The Smart City Strategy portion of this Plan recommends San Leandro develop a cohesive Digital Services roadmap and incrementally replace all paper-based and PDF forms with digital versions. These services should be trackable and staff should be able to report on volume, time to complete, and other key performance metrics.

¹⁶ <https://www.usability.gov/what-and-why/user-centered-design.html>



Financial Transactions

Currently, the City’s Accounts Payable, Accounting, and Accounts Receivable divisions are paper-based. Automated clearinghouse (ACH) electronic payment and processing systems can replace check-based systems, increasing efficiency and saving on printing costs and staff time. These features and functionality can be explored in future Enterprise Resource Planning (ERP) systems upgrades and conversions.

Archival Documents

While its current records are scanned into Laserfiche and accessible online, the majority of City records are in paper form. These historical and vital records are costly to maintain because of the numerous fees associated with storage, retrieval and destruction.

A digital conversion will improve efficiency and effectiveness by increasing access to information, improved customer service, minimizing duplication and improved compliance with records laws and retention schedules. Additionally, a digital conversion could save time, money and reduce waste. The Plan recommends that the City look for ways to fund such an effort as the long-term benefits are numerous.

Security & Resiliency

Smart Cities must have a focus on cybersecurity. While San Leandro has implemented a strong traditional cyber defense system - composed of firewalls that are programmed to allow and block incoming and outgoing traffic based on a ruleset, paired with antivirus and antimalware software on end-user devices - these systems must evolve. The Smart City Strategy recommends a thorough review and analysis of cyber security and privacy systems and policies related to the City’s firewalls and network infrastructure, including wireless technologies such as Wi-Fi and the Internet of Things (IoT); data architecture and information; business applications and cloud-hosted systems; email and collaboration applications, such as Office 365; and end-user training.

Meanwhile, City telecommunications infrastructure and services should be protected against disaster (natural, manmade or otherwise) in such a way that critical digital functions can continue to operate even in a disaster scenario. Disaster recovery services can provide secondary, off-site data center resources where IT infrastructure can be used and connected to the internet providing continuity of service. In addition, cloud-based hosting can provide data replication and offsite storage that can be accessed to restore critical data during an emergency. The Strategy recommends that the City develop a complete IT Disaster Recovery Plan, aligned with the City’s Local Hazard Mitigation Plan, which should include offsite data center and storage resources, that can be activated during a disaster to operate IT systems remotely.



The Fiber Optics network will also need to have additional resiliency built into it to provide network redundancy during fiber cuts and outages. This includes having a diverse route to the internet and key City facilities, which can come by connecting to data centers in the South Bay Area. These redundancies have been included in the conceptual network design described later in this document and shown in recommended network expansion routes.

BUILDINGS & FACILITIES

The City has made tremendous progress connecting its facilities to the fiber network and only a few sites remain unconnected. Those include the Marina Harbor, Mulford Branch Library, Farrelly Pool, and SL Family Aquatic Center. The Marina Harbor will be demolished during the upcoming marina development, and the Mulford Branch will be rebuilt and connected on City fiber. As a result, the only facilities not connected will be Farrelly Pool and SL Family Aquatic Center. Each is having their respective pools reconstructed, which provides an opportunity for additional construction. Utilizing millimeter wave wireless technology, it is possible to service these facilities with 100 megabits or greater bandwidth; enough to provide desktop, phone, and Wi-Fi service for both Staff and residents.

HVAC upgrades have already been done, while projects with OSISoft have demonstrated the benefits of a centralized energy management data collection system. San Leandro is also slated to join the Alameda County Community Choice Aggregation program and is working on installing solar panels at the Water Pollution Control Plant. These upgrades, along with smart irrigation clocks at City Parks, are already yielding energy savings.

In the future, “smart” buildings may include additional functions, such as fire protection, climate control, lighting, and even video surveillance integrated into one master automation system that connect to microgrids that dynamically store and distribute power based on real-time supply and demand. The Strategy recommends that City leaders continue to connect their facilities and implement energy savings and building automation programs.

SMART STREETLIGHTS

One of the of the most commonly underutilized assets in municipalities is the street light pole. Their sheer numbers and locations deployed throughout municipalities make them well suited for the delivery Smart City services and devices, such as broadband and narrowband wireless connectivity technologies.

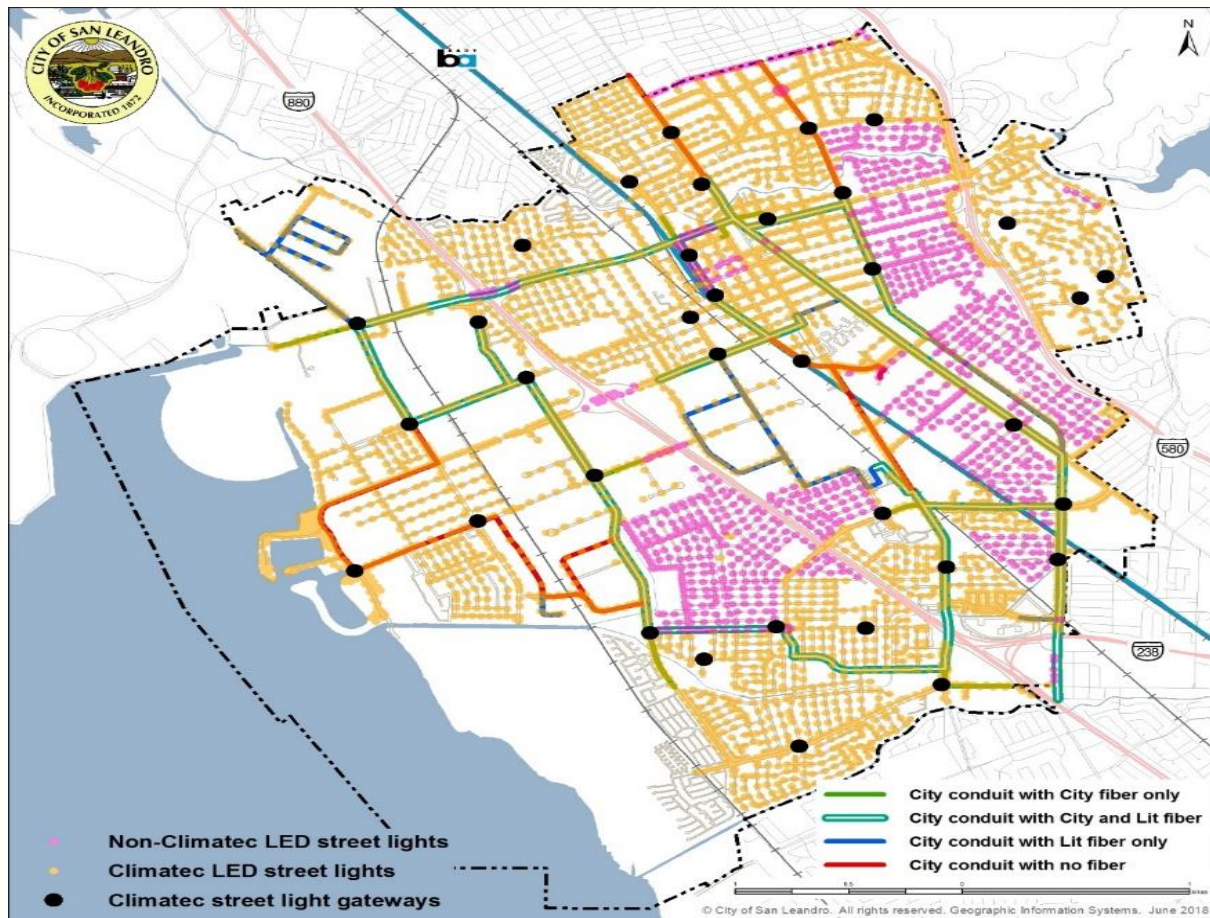
There are 5,243 street lights in total in the City of San Leandro, 2,186 – nearly 42% - of which are owned and operated by the City. See Street Light table data for details.



Figure 15. San Leandro Street Light Data Table.

	Total	Concrete	Décor	Metal	Wood	NULL
City of San Leandro	2186	6	395	1763	5	17
PGE	2949	0	0	50	2888	11
Caltrans	87	0	0	86	0	1
City of Oakland	17	2	3	12	0	0
Null	4	0	0	0	1	3
Total	5243	8	398	1911	2894	32

Figure 16. Fiber Expansion with Street Light Poles





Street light poles can be retrofitted with smart LED-based lighting and can be leased out to service providers for deployment of small cell technology. As a result, Smart City initiatives allow for municipalities to take light poles in the rights-of-way and utilize them for many different functionalities beyond lighting.

Smart City initiatives allow for municipalities utilize light poles in the rights-of-way for many different functionalities from light monitoring and management to deployment of sensor technologies that can monitor environmental factors including crime activity, trends in traffic congestion and pollution. Community standards regarding aesthetics, design and style solutions require that high functionality be coupled with pleasing design characteristics.

Current trends in smart street lighting range from cost saving LED lighting to powerful engineered solutions including sensor placement, distributed antenna systems (DAS) and Wi-Fi deployment, and municipal communications functionality (i.e. security cameras, traffic monitoring). Municipalities vary in their implementation of these devices and technologies; however, determining an appropriate street pole can assist a city or town in scaling technology for the future, enabling additional technologies to be added as they come to market.

San Leandro is well ahead of this curve, thanks to an innovative project lead by its Public Works Department. In 2014, the City issued a Request for Proposals (RFP) for an LED retrofit project. This eventually lead to a citywide deployment of Smart LED Street Lights. These lights are mesh-connected in a Low-Power Wireless Personal Area Network (6LoWPAN) operating in the 900 MHz ISM Band. These nodes backhaul on approximately 35 strategically placed Wi-Fi access points which, in turn, connect to the City's fiber-optic network at designated traffic signal intersections. The data transports along the fiber network to City Hall, where it reaches a virtual Control Management System (CMS). Using a web interface to access the CMS, City staff can individually control every light, set policies for when the lights turn off and on, monitor functionality and even get text messages and email alerts to do proactive maintenance when a light bulb fails.

This citywide IoT network effectively transforms the City into a technology platform. To show its commitment to this concept, the San Leandro City Council formally signed the TM Forum's "City as a Platform Manifesto," which outlines steps for exactly how a technology platform like this can benefit a city and its residents¹⁷.

City Staff have already begun exploring what the City as a Platform concept can look like. In summer 2017, students from Harvey Mudd College (including a San Leandro High School graduate) interned with Pilot City, a San Leandro education incubator, to develop a Smart Waste Monitoring pilot solution for street trash cans that connected to the City's

¹⁷ <https://www.tmforum.org/smart-city-forum/city-platform-manifesto/>



platform. In the future, additional services can be developed that utilize this connectivity network. San Leandro should continue to explore these opportunities.

The Strategy recommends that the City continue to explore ways to utilize the City platform and develop new services that can use the communication network. It should focus on trials, pilots, and proof of concept projects with low financial risk to evaluate potential technologies.

“SMALL CELLS” AND WIRELESS CELLULAR CONNECTIVITY

Currently, 4G transfer speeds top out at about one gigabit per second in perfect conditions. However, we rarely experience 4G’s maximum download speed since the signal can be disrupted by buildings, microwaves, Wi-Fi signals, trees etc. 5G on the other hand, will have much higher speeds (up to 10 gigabits per second), capacity, and significantly lower latency. It will also support the thousands of connected devices being introduced into our lives. The high reliability and low latency of 5G creates opportunities for City Management and Public Safety to control critical services and infrastructure. Cities can now connect to millions of networked devices, making real-time, intelligent, and autonomous decisions. This real-time data will reduce maintenance and create greater operational efficiency. 5G will bring broadband and media everywhere allowing users and devices to communicate in crowded or remote areas with lightning fast broadband speeds.

The 5G standard is officially expected to be ratified in the year 2020; however, deployments are already happening¹⁸. At the same time, mobile providers are supplementing their current 4G networks with small cellular base stations (“small cells”) to increase bandwidth and capacity on existing networks. A small cell is generally considered any device that is not a macro site and acts similarly to a hot spot in that covers a small area with high density usage.¹⁹

4G small cells and the evolution to 5G mobile phone technology depends on closely spaced antennas – for which street lights and other vertical assets can be very useful. By planning strategically for 4G small cells and possible 5G devices in the future, a city or town could potentially future proof for these developments and ensure that undesirable devices and structures do not enter their rights-of-way and add blight or clutter to the city. In addition, cities can benefit from leasing city assets to providers.

The City, with help from Magellan Advisors, has drafted a Master License Agreement to govern Wireless Devices on Street Poles. In addition, the City is planning to update its municipal and/or administrative and zoning codes with language appropriate for this shift to small cell devices.

¹⁸ <https://www.gsma.com/futurenetworks/technology/understanding-5g/>

¹⁹ <https://www.commscope.com/Blog/What-Exactly-Is-a-Small-Cell/>



INTERNET OF THINGS

In addition to LED lighting and small cell devices, street lights can also be used to install addition devices for Smart City technology. These devices, or “things,” constitute a concept called the Internet of Things (IoT) and can include:

Sensors: Sensors are an area of many current and potential applications. The light pole is ideal for accommodating sensors, as the poles already have electricity, and provide sensors an aerial advantage. Additionally, light poles are great for transmitting wireless signals due to their height. Sensors are used to monitor air quality, weather conditions, and motion. Law enforcement can employ them for parking enforcement, contacting emergency services in the event of an accident, and security cameras. Motion sensors could be configured to dynamically light up a section of road when vehicular or pedestrian movement is detected and switch off or reduce the illumination in the absence of any movement, aiding in public safety. Additionally, the sensors and networks can be sensitive to sunrise and sunset for LED operating hours, or the dimming of the lighting can be set to a schedule to accommodate City needs. Besides the cost savings, there are many other benefits from smart lights. The system can be used to control stop lights from a central location. One example of a public safety application enabled is for a fire truck to remotely activate the system to have street lights flash red ahead of the truck’s route. Drivers are thus warned that an emergency vehicle is approaching, and it reduces travel times for the emergency vehicle.

Solar Panels: Solar panels are now being deployed onto street lights, enabling cities to realize a net zero energy cost in relation to the energy consumed by the lamps. However, the majority of the products currently on the market require another “head” on the lamp with the solar equipment built into it. The market is evolving and allowing for smaller, more efficient use of the light pole for solar powered energy. In these newer designs, the solar panels are on the physical poles.

This Plan recommends that the City continue to evaluate opportunities to deploy sensors and technology on its street lights and poles that advance its Smart City goals. The map below shows the very substantial array of “smart grid” light poles within San Leandro and their proximity to fiber that, combined with “Smart Technology,” can provide the necessary backhaul for wireless services as well as other “Smart City” applications.

MOBILITY

The term “mobility” can be applied to several things, many of which relate to core missions and functions of municipalities. Mobility in a society – “social mobility” – refers to the movement of individuals, families, or groups through a system of social hierarchy or



stratification²⁰. In medical terms, “mobility” relates to the physical ability to move and control one’s body²¹. Mobility is also often used in telecommunications to convey movement on a network, such as a cellular network with a wireless device²².

While all of these are valid usages of the word, for the purposes of this Plan, mobility will refer to the concept of “urban mobility” which is concerned with the movement of people and freight in urban spaces.²³ Trends in urban mobility are towards multimodal transportation: cars, bikes, pedestrians, public transit, delivery services and more, all of which are sharing the public right-of-way. Right-of-way owners must strike a balance between the most efficient and effective methods of managing transit, while enforcing laws and rules and striving for maintain a high quality of life for the denizens of their places.

San Leandro’s General Plan and Bicycle & Pedestrian Master Plan articulate a leading vision for the future of mobility, which the Smart City Strategy must align to. To support these objectives, there are technological solutions and associated policies, which can be pursued.

²⁰ <https://www.britannica.com/topic/social-mobility>

²¹ <https://www.disabled-world.com/disability/types/mobility/>

²² <https://www.techopedia.com/definition/24983/mobility-management>

²³ https://transportgeography.org/?page_id=4617



INTELLIGENT TRAFFIC SIGNALING & INTERSECTIONS

The City of San Leandro owns and operates 62 traffic signals within the City limits. An important component of San Leandro's technology infrastructure is connected traffic signals on its fiber-optic network. This allows for these lights to be controlled with an Advanced Traffic Management System (ATMS), which is located in the Traffic Operations Center (TOC) in the Department of Engineering & Transportation. Currently, 45 traffic lights are connected by fiber, some 17 – nearly 27% - not connected (see data table below).

Figure 17. Benefits of Adaptive Traffic Control

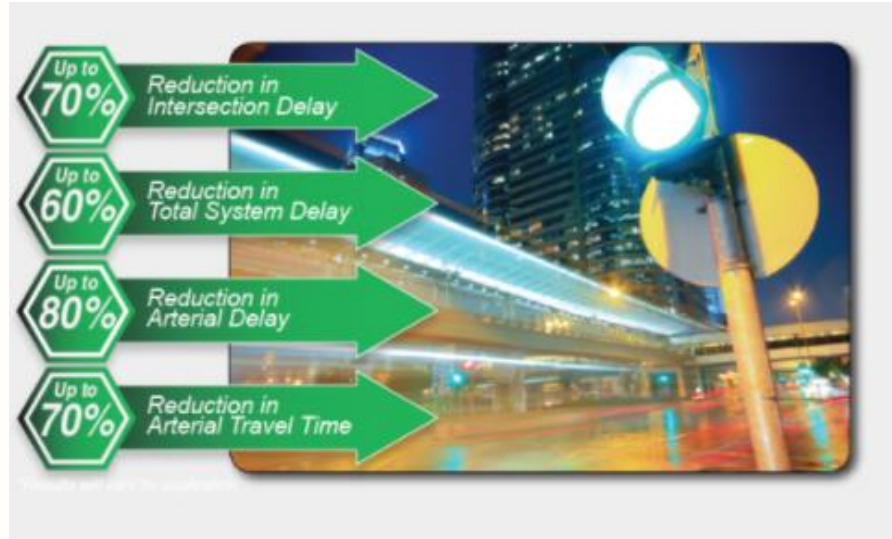


Figure 18. San Leandro Traffic Signals

City of San Leandro - on fiber	45
City of San Leandro - no fiber	17
Caltrans	40
Alameda County	3
Total	105

A recent evolution of ATMS technology is called “Adaptive Traffic Control,” which is defined as a system where traffic signal timing is dynamic and changes in real-time, based on actual traffic conditions. These systems have the potential to reduce intersection, arterial, and total system delay, thereby improving traffic flows for the entire community. According to the U.S. Department of Transportation, “real-time management of traffic systems is proven to work, yet these systems have been deployed on less than 1 percent of existing traffic signals.”²⁴

²⁴ <https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/asct.cfm>

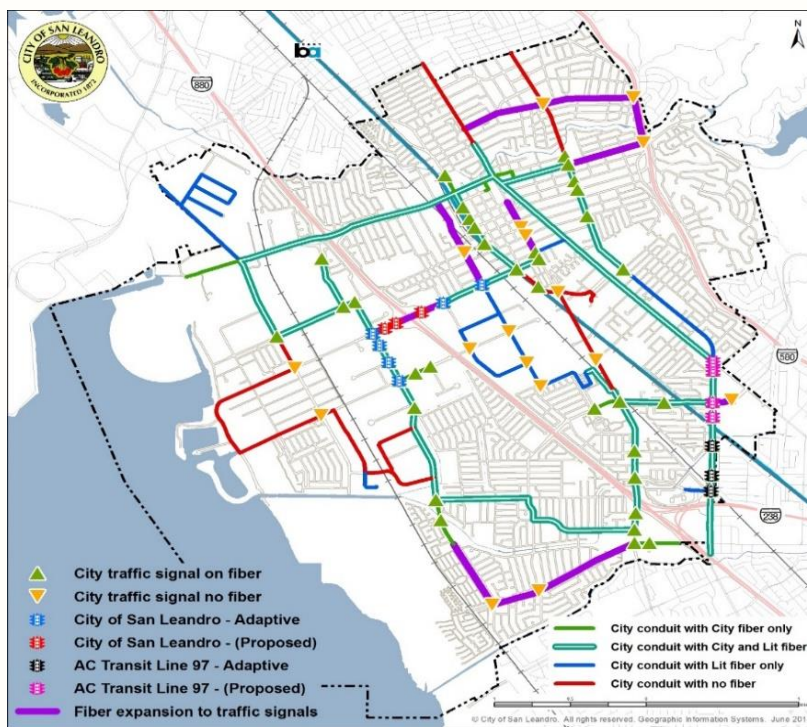


In addition to the benefit of improved traffic, adaptive systems can support public transportation as well as public safety, such as fire trucks and police vehicles responding to an incident by prioritizing these traffic flows at any given moment.

San Leandro has already deployed this technology throughout its traffic network. In 2014 as part of the Kaiser Permanente project, six intersections near the new hospital were converted to adaptive signaling; in addition, the City is in discussions to convert three more in the same area along Marina Blvd. Beginning in 2018, construction on a “smart corridor” began with AC Transit along Hesperian Blvd, which will include adaptive signaling. As part of its Smart City roadmap, the City envisions eventually converting all traffic signal intersections to use adaptive technology.

However, to implement an adaptive system throughout the entire city, San Leandro would need to expand its fiber loop to connect the traffic signal intersections that are currently not on the network. This is shown in the diagram below; these expansion sections are considered part of the overall Fiber Optic Master Plan.

Figure 19. Traffic Data Map



The data generated and collected by the ATMS is increasingly of value to the private sector, particularly those companies working on autonomous vehicles. The City recently signed an agreement with Technology Traffic Solutions to share such information. In addition to ATMS data, the City should explore traffic data collection systems on its busiest and most important intersections. These data collection systems can provide precise information on traffic counts, speeds, flow rate, number of turns, etc. Such systems can be installed into the existing traffic network.

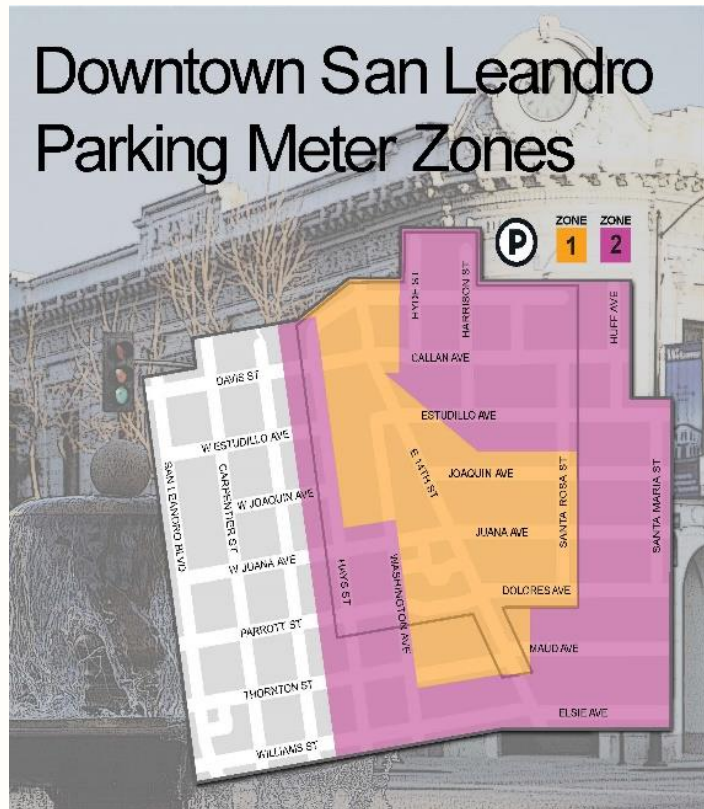
Looking forward, technology upgrades like this will pave the way for autonomous vehicles, as the cars themselves may one day transmit data directly to traffic signals, without the need for human interaction. Continuing to invest in its traffic infrastructure will enable San Leandro to reap these benefits in the future.



Parking Management

Figure 20. Downtown San Leandro Parking Meter Zones

In 2017, the City Council adopted a wide-ranging Downtown Parking Management Plan to address parking availability, enforcement, usage of its downtown parking garage and lots and on-street parking, along with identifying technology solutions to support the plan²⁵. While the parking systems in San Leandro are outdated (meters are coin-operated, etc.) and there is no centralized management system, a lot of progress has been made toward improving the situation, shifting parking behavior among residents to utilize space more effectively, while offering cost-effective services, such as mobile payment on existing meter heads.



One of the primary goals of the parking plan is to encourage drivers to park in the garage if they require stays of longer than three hours. To enable this, new technology systems are slated to manage the City garage. Telecommunications infrastructure is being installed that will allow the new systems to connect to the municipal telecommunications network, thereby reducing monthly cellular costs and connectivity issues.

In the future, smart meters may one day be installed along with real-time parking and directional signage. A real-time parking system can push space availability to drivers for on-street parking, lots, and the garage via mobile apps. These smart parking technologies can reduce the time it takes to find a space and, in turn, reduce traffic congestion and lower the carbon footprint from vehicles looking for a place to park.

This Plan recommends that all City fiber optics, telecommunications, and IT infrastructure continue to be deployed in a manner that aligns with the goals and strategies of the Parking Plan and supports the technology solutions required for it to be successful.

²⁵ <https://www.sanleandro.org/civicax/filebank/blobdload.aspx?BlobID=28250>



Autonomous Vehicles

The National League of Cities has released a policy preparation guide for cities concerning autonomous vehicles²⁶. It includes four specific recommendations:

1. AVs are on our roads today, so start planning now
2. Policy development with the right people at the table.
3. Track and monitor federal and state developments and make your voices heard.
4. Begin planning infrastructure needs and building data and computing capacity to position your city to take advantage of an automated mobility future.

The Strategy recommends designing future transportation planning infrastructure and systems with an eye toward autonomous vehicles, as well as preparing for a possible ordinance in the future, which governs their usage.

Bikes, Ride-Sharing, and More

Uber, the ride-sharing pioneer, recently acquired JUMP Bikes, an electric dockless bike-sharing service, and now calls itself a champion of “smart technology for smart cities²⁷.” From a policy perspective, these early days of the “sharing economy” can create headaches. However, they are also creating opportunities. The city of Alameda was the first to launch a bikesharing program with LimeBike and is analyzing the results²⁸. Meanwhile, the City & County of San Francisco have passed a law required motorized scooters to have a permit to park their vehicles.²⁹

While there have been challenges with each of these modes of transit, the likely reality is that the startups and companies in the marketplace are here to stay. The Strategy recommends that San Leandro continue monitoring this space at the local, regional, and state levels and implement policies that promote healthy multimodal transportation in the City while maintaining the balance of efficient transit, enforcement of laws, and quality of life.

²⁶ <http://www.nlc.org/sites/default/files/2017-04/NLC%20AV%20Policy%20Prep%20Guide%20web.pdf>

²⁷ <https://www.uber.com/newsroom/welcomejump/>

²⁸ <https://alamedaca.gov/bikeshare>

²⁹ <https://www.sfchronicle.com/bayarea/article/SF-supervisors-pass-law-to-regulate-scooters-that-12842796.php>



PUBLIC SAFETY

One of the primary obligations of local government is to protect the public and provide safety through law enforcement and emergency response. The San Leandro Police Department prides itself on partnering with the community to provide professional police services and public safety and has done an exemplary job of maintaining a high quality of life for its residents.

However, San Leandro receives a higher amount of calls for service per capita compared to several other municipalities in Alameda County. Based on FBI Uniform Crime Reporting (UCR) data, San Leandro’s crime rates are also higher than the regional average.

Figure 21. Public Safety UCR Data³⁰

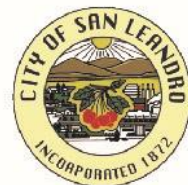
Agency	Population	Violent Crime Rate	Property Crime Rate	Calls for Service Rate
Alameda	78,906	30.06	3.21	1,128
Berkeley	121,240	50.26	5.53	
Hayward	158,937	31.84	3.54	828
Livermore	89,115	22.45	1.83	441
Oakland	420,005	60.34	13.54	
Pleasanton	82,270	20.43	1.23	880
San Leandro	90,465	41.31	5.80	1,080
Union City	75,322	20.46	3.16	
Averages	139,533	34.64	4.73	871

This reality makes effective use of technology even more important in San Leandro. Technology is often described as a “force multiplier,” which is defined as a capability that significantly enhances the probability of successful mission accomplishment.³¹ Smart City technologies provide a number of ways to enhance public safety operations in such a manner.

Police Departments tend to be technologically advanced and SLPD has maintained a leadership position as a technology innovator by deploying body-worn cameras in 2014, modernizing the Police Department’s IT Infrastructure and core information systems in 2015 and 2016, and hiring a full-time crime analyst to use data to help in strategic and

³⁰ Based on 2017 UCR Data and 2016 Census Data

³¹ https://www.militaryfactory.com/dictionary/military-terms-defined.asp?term_id=2165

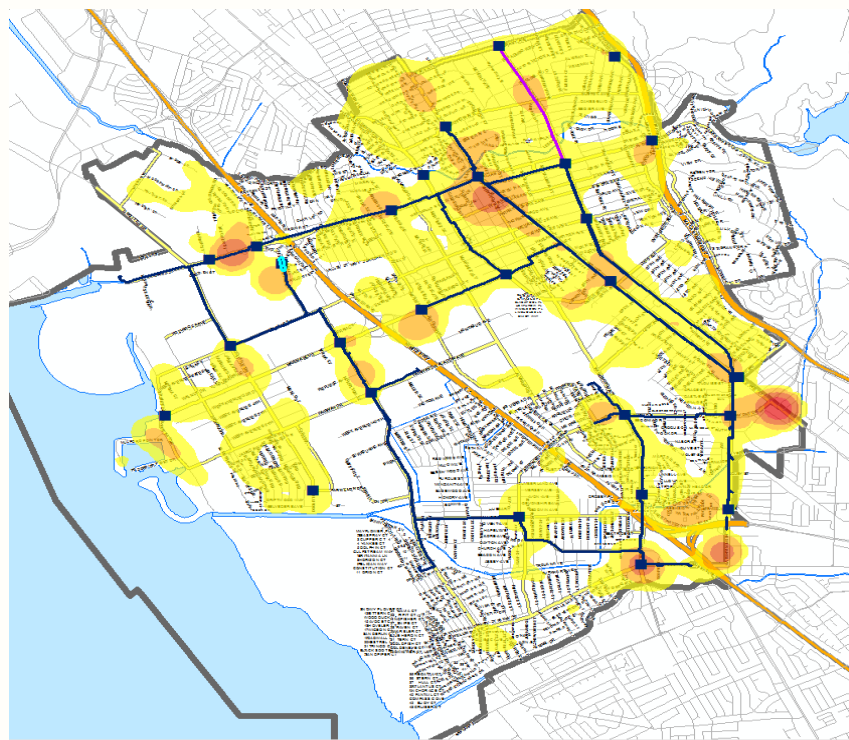


tactical decision-making. SLPD also utilizes social media and communication apps and services to further community engagement, such as Nixle and Weibo, a Chinese-language social media site.

Security Cameras

On February 26, 2018 the San Leandro Police Department presented a data-driven discussion regarding potential camera locations within the community at a City Council Work Session. Given the City’s access to municipal high-speed fiber optics and wireless communication systems, security cameras can be deployed cost-effectively to achieve the force-multiplier effect. The map below was developed by the Police Department and shows 27 potential camera locations that line up with the City’s fiber optics network. The additional sites can be reached wirelessly and connect to the same master system.

Figure 22. Proposed Camera Network Map



Evidenced-Based Policing

Evidence-based policing is an approach to law enforcement that emphasizes research, evaluation, analysis, and scientific processes in decision making³². It applies to public safety a philosophy found in public health that strives to provide prescriptions that are rigorously tested and proven to be beneficial, while minimizing and rejecting those which are shown to do harm.

The potential benefits to police agencies adopting this approach are many and include:

- Reduced crime
- Increased legitimacy
- Reduced internal problems
- Addressing community concerns

³² Lum, C. and Koper, C.S. (2015). Evidence-Based Policing. In R. Dunham and G. Alpert (Eds.), (2015) Critical Issues in Policing. Seventh Edition. Longrove, IL: Waveland Press.



- Reduced fear

In addition, time and money can be saved, while staffing resources are utilized in the most production and beneficial manner to both the police department and the community.

However, while the San Leandro Police Department is receptive and supportive of the concept, there are significant hurdles to implementing such a program. It requires partnerships with the academic and research community and a paradigm shift toward applying research in practice. To address these challenges, a variety of factors are recommended by experts, including new methods of officer training³³.

In addition to partnerships with the academic community and a willingness to implement a paradigm-shift, evidenced-based policing will require large amounts of data and the infrastructure to layer sophisticated analytics on top of those data to uncover the research on which evidenced-based policing policies will be designed and applied.

To apply the philosophy of evidence-based policing, the San Leandro Police Department will need the ability to compare disparate data sets to look for possible correlations. The intended goal of an evidence-based policing philosophy is to reduce and/or prevent crime and disorder, but a common mistake in this endeavor is to limit analysis to data related to crime. This may reveal crime trends and aid in predicting what future numbers will be, but it does little to understand the causalities associated with crime and disorder. To unlock the full potential of an evidence-based philosophy, the data must be very broad and include data collected by other city departments and outside organizations.

Public Policy meets Data Analytics

SLPD is making strides in using data to inform public policy decisions. Currently, the department manually aggregates multiple data sources to provide crucial insights around a number of subjects, like its service delivery model, workforce recruitment, and crime-fighting efforts. The next step in the evolution for this data-driven policymaking (i.e. a “public policy hub”) concept will be deploying business intelligence (“BI”) software. Integrating BI software removes time-consuming manual aggregation of disparate data sets while minimizing the demands of visualizing any insights through manually crafted dashboards or infographics. Deploying new business intelligence software technology will streamline the processes of data collection, aggregation, and visualization. By streamlining these processes, key operational insights can be delivered at a fraction of the current cost. Ultimately, these insights deliver policymakers with better information—a more comprehensive look—and a list of policy alternatives for making decisions that could have far-reaching impacts. The department intends to use this policy hub platform

³³ Huey, Laura and Mitchell, Renee J. (2016). Unearthing Hidden Keys: Why Pracademics Are an Invaluable (If Underutilized) Resource in Policing Research. *Policing*, Volume 10, Number 3, pp. 300–307. 28 July 2016. Oxford University Press



to deliver performance metrics as well. These performance metrics connect taxpayer money to service delivery outcomes—an organizational report card of performance each year.

The department continues to foster working relationships with research institutions to ensure adherence to best practices. Relationships with both UC Berkeley’s Goldman School of Public Policy and California Polytechnic State University help to expand upon concepts of evidence-based policy-making that also reach across departments where common ground exists—Finance, Community Development, as well as Recreation and Human Services (RHS).

Lastly, the Department’s crime analyst is working on geographic information systems (GIS) to build crime dashboards to disseminate complex information quickly and easily. In addition, data sources need to be integrated through data warehousing solutions that allow analysis to not only look across municipal operations, but also across the region, to correlate the factors surrounding crime and the effectiveness of any particular strategy deployed to address it. The Plan recommends continuing to focus on analytics as a future force multiplier.

Emerging Trends

Looking several years into the future, technology may continue to redefine how public safety services are deployed by cities. Some of these are listed below:

- **Robotics.** Although it may be too early for Robocop, robotics technology is influencing police work. Security guards, bomb sniffing machines and emergency responders are becoming commercially available and have the potential to save lives and protect officers.
- **Next Gen 911.** NG911 is a term for public safety answering points (PSAPs) (i.e., dispatch stations) that will enable multimedia to be sent to dispatchers over Internet Protocol (IP) based digital technology. This means that residents can send voice, photos, videos, images, and text messages directly into 911 dispatch centers from their mobile devices. The technology is well on its way to becoming standardized and implemented into leading dispatch control systems³⁴.
- **Machine-learning/artificial intelligence.** Machine learning and artificial intelligence refer to software technology that can “learn” by analyzing data. Future crime analysis may utilize ML/AI to find trends, insights, and make recommendations to ensure service levels through computer analysis. Predictive analytics are already being used by police forces today³⁵. However, technology has

³⁴ https://www.911.gov/issue_nextgeneration911.html

³⁵ <http://www.govtech.com/data/Role-of-Data-Analytics-in-Predictive-Policing.html>



been shown to have the same inherent biases that humans do and this is an ongoing dialogue within the data science, law enforcement, and public policy community³⁶.

- **Drones.** Drone technology is used in search and rescue, traffic collision analysis, active shooter situations, crime scene analysis, and more. This usage is predicted to increase over the coming years as drones become more widespread³⁷. However, drone surveillance can be an issue of contention for the public. This requires open discussion with the community as well as adherence to existing federal and state laws.

The Smart City Strategy section of this Plan recommends continuing to explore the usage of these powerful new technologies. SLPD, in its community-based partnership approach, is well positioned to continue its leadership and advancement of smart city technology to improve public safety outcomes and overall quality of life for its residents.

PUBLIC WI-FI

There are many use-cases for modern Public Wi-Fi systems and municipalities have become proficient at using Wi-Fi at City facilities to support municipal operations. In addition, City governments have increasingly looked at Wi-Fi as a means to provide social and public benefits, such as digital inclusion, economic development, and providing service to students who do not have connectivity at home. An emerging use-case includes backhaul connectivity for IoT networks³⁸.

San Leandro is known nationally for being a leader in supporting Public Wi-Fi projects. When it launched a free service in its downtown core in 2015, it was highlighted in media publications for its innovative Wi-Fi designs³⁹. Throughout 2016, Wi-Fi was expanded to all City facilities, including the Senior Community Center, Main Library, City Hall, Police Department, Public Works Service Center, and Water Pollution Control Plant. Public, outdoor Wi-Fi was expanded in 2016 to the San Leandro History Museum and surrounding open space at the Casa Peralta and Cherry Festival area.

³⁶ <http://theconversation.com/why-big-data-analysis-of-police-activity-is-inherently-biased-72640>

³⁷ <http://www.thedrive.com/aerial/15092/drones-in-law-enforcement-how-where-and-when-theyre-used>

³⁸ <https://pages.nist.gov/GCTC/uploads/blueprints/20170823-GCTC-PWSC-Public-WIFI-Blueprint-FINAL-v2.pdf>

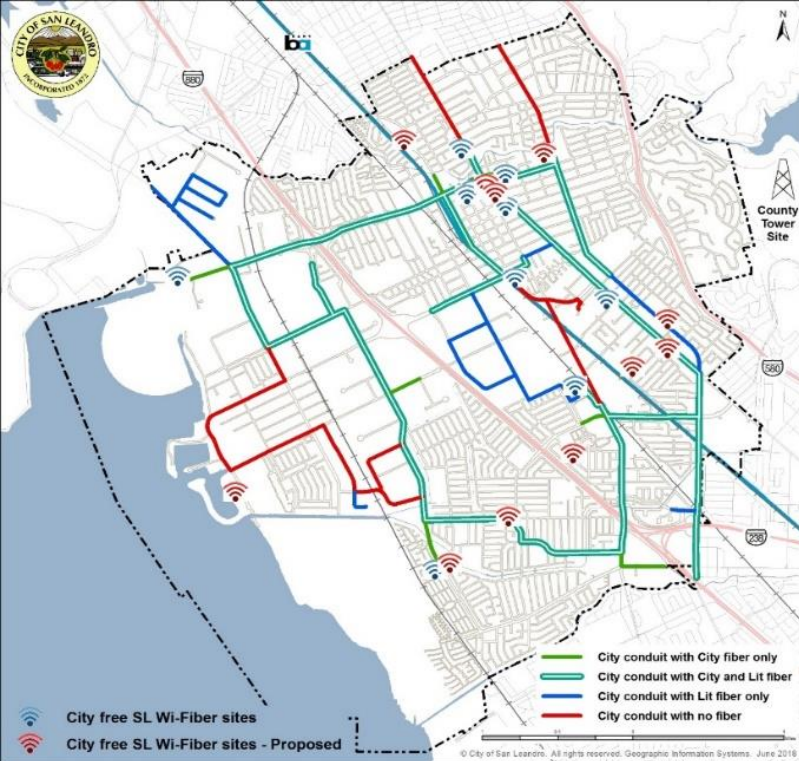
³⁹ <http://www.governing.com/topics/transportation-infrastructure/san-leandro-calif-launches-free-wi-fi.html>



Figure 23. Public Wi-Fi Network Map

In the Fiscal Year 2017-2018 Capital Improvements Program, the City Council authorized funding to greatly expand public Wi-Fi at City Parks and other outdoor venues. City Staff has been working to secure mounting locations throughout the community to best deploy this service through a combination of fiber and wireless backhaul technologies.

In addition, City Staff is experimenting with deploying a secure Wi-Fi service that would allow residents and visitors to have an encrypted internet connection equivalent to a password protected network.



The Plan recommends that the City continue to support free, public Wi-Fi and looks for ways to deploy it in the highest areas of need, as part of the Digital Inclusion efforts. In addition, public Wi-Fi and infrastructure should be considered as part of new development projects whenever possible. The City should also make a concerted effort to promote its networks and inform the public of their existence. Examples can be physical signs, similar to “Free Parking Signs,” indoor stickers and placards, and continued online promotion. The map in Figure 20 depicts the City’s existing and planned Public Wi-Fi network.

ADVISORY BOARD

Smart Cities ultimately require the voice of the public in order to best serve them. Thus, the Plan recommends that the City formalize its Smart City considerations via the formation of a **Smart Cities Advisory Board**. This Advisory Board should include senior management from relevant departments, members of City Council, and members of the community and local technology business leaders. The Advisory Board should review and investigate Smart City applications that have been under consideration by the various City departments and “vet” those applications with a view toward determining feasibility and requirements.

Review and investigation of particular Smart City applications would include:



- Determining the organization(s) or department(s) that would “own” the application and its implementation;
- Organizational adaptations that must be made within the City;
- Department ranking of importance of implementing the application versus other potential Smart City applications;
- City management and council ranking of the priority of the application versus other potential Smart City applications;
- Community views on the importance and utility of the Smart City application;
- Legal or policy requirements that must be addressed (if any);
- Costs of the application and its associated equipment;
- Network implications of supporting the application, including network proximity;
- Timeline for installation of the application, including activation of the application;
- Resources needed for installing and testing the application;
- Savings and benefits for the City generated by use of the application;
- Funding and budget sources (including potential grant funding) and what budget actions are necessary

Figure 23 below shows a graph of phases and locations that San Leandro could deploy Smart City applications over the next several years.

Figure 24 : Smart City Application Roadmap for City of San Leandro

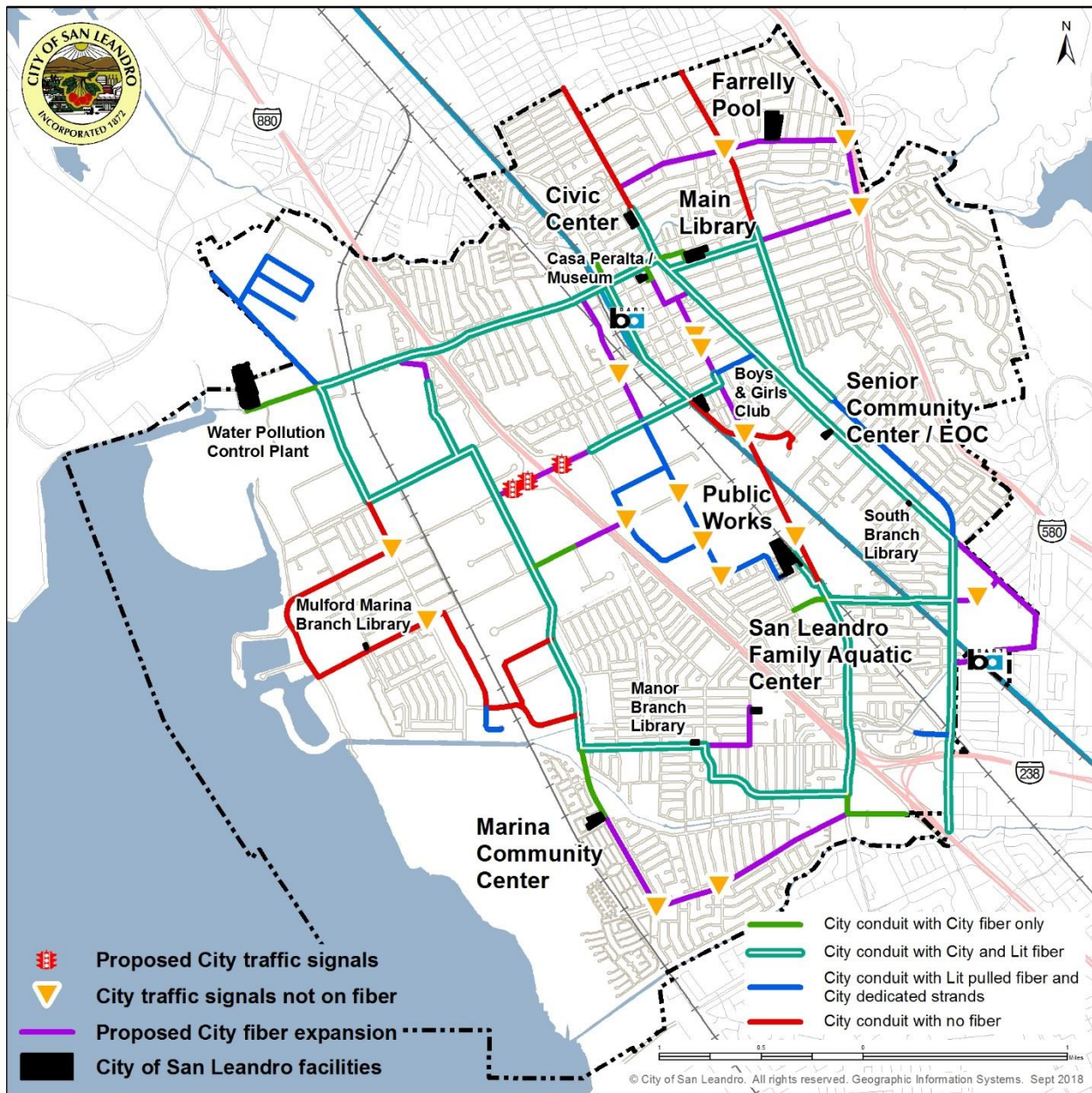
Department	Wi-Fi / Broadband	Digital Records / Forms	Parking	Smart Lights / IoT	Intelligent Traffic	Cyber Resilience	Digital Inclusion	Smart Grid / EV Charging	CCTV	Shared Fiber/Dig Once	Digital Payments
Information Technology / Innovation	X	X	X	X	X	X	X	X	X	X	X
Public Works				X				X	X		
Recreation & Human Svcs											
Community Development	X		X								
Library Services							X				
Police Dept									X		
Emergency Svcs						X					
Human Resources											
Finance											X
Engineering & Transportation					X				X		
City Clerk		X									
Regional Partnerships										X	

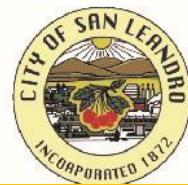


COMPLETE FIBER MAP & CONCLUSION

The Smart City Strategy should be regarded as a comprehensive roadmap for the City to implement over time, incrementally, to achieve its technology and innovation goals. It requires collaboration and partnership across the entire organization, as well as with external agencies and the private sector. The map below shows the entire fiber expansion map and denotes the benefits that will come from these future enhancements. San Leandro has made great strides and is well positioned to continue to do in the future.

Figure 25. Smart City Fiber Expansion Map





BROADBAND MARKET ASSESSMENT

Twenty-five (25) service providers in San Leandro offer business broadband service. The average download speed in is 30.68 Mbps, which is 11.7% slower than the average in California and 6.0% slower than the national average. San Leandro has a total of 23 provider networks, with 7 providers catering to residential broadband services:

- 1 cable provider,
- 8 copper providers,
- 5 DSL providers,
- 2 fixed wireless providers,
- 5 mobile broadband providers,
- 2 satellite providers,
- 2 fiber providers.

SAN LEANDRO, CA BROADBAND STATISTICS:

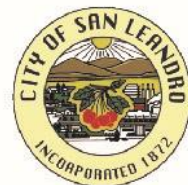
- San Leandro is the 23rd most connected city in California ahead of Alameda, Oakland, San Lorenzo, and Castro Valley.
- There are 289 internet providers in all of California.
- Approximately 14,000 people in Alameda County don't have access to any wired internet.
- California is the 9th most connected state in the U.S.
- Approximately 99% of San Leandro residents are serviced by multiple wired providers.
- Almost 95% of consumers in California have access to a wired connection with true broadband speeds faster than 25mbps⁴⁰ (although it is important to note that access and affordability are two distinct factors in broadband adoption).

INTERNET SERVICE OFFERINGS TO ENTERPRISE / LARGE BUSINESSES

For enterprise and large business entities in San Leandro, internet services are available in all areas. However, service tends to be expensive, coverage offerings are dependent on technology offered by providers, and true broadband as defined by the Federal Communications Commission (FCC)⁴¹ is not always available.

⁴⁰ Source: Broadband Now

⁴¹ The Federal Communications Commission (FCC) defines broadband speeds as at least 25 Mbps downstream and 3 Mbps upstream



Broadest Coverage Offeror: The broadest coverage available to enterprise business is offered by Comcast Cable with downloads speed at around 250 Megabits per second (Mbps). Etheric Wireless offers 100% of fixed wireless, but only up to 35Mbps download at a very high price.

Broadband Coverage: Broadband services are available to more than 95% of San Leandro businesses, using cable and DSL technologies. Crosslink Networks and Paxio, partners of Lit San Leandro (LSL), offer fiber-based service, while AT&T has started launching fiber-based business service in some locations within the City.

Cable Service: Comcast Business covers about 97.6% of the city, also provides high speed data services to Enterprise/Large businesses, offering asymmetric 250 Mbps service.

DSL Services: XO Communications only offers to 4.3% of businesses, at around 50 Mbps download speed. Verizon Copper offers DSL copper at up to 45Mbps down asymmetric, covering around 23.7% of the city. Megapath, TPX Communication, Gtt cover 30% of San Leandro ZIP coverage, and only offer up to 12Mbps download service. Fixed wireless is offered to 100% of the businesses by Etheric networks at around 35 Mbps download; Crosslink Networks also offers wireless service in some locations.

Figure 26. Enterprise Providers in San Leandro

ENTERPRISE PROVIDERS				
Provider	Customer Rating	Business Coverage	Fastest speed	
CABLE 	CUSTOMER RATING ★★☆☆☆	ZIP COVERAGE 97.6%	FASTEST SPEED 250 mbps	CONTACT INFO (833) 377-4748 Website
COPPER 	CUSTOMER RATING ★★☆☆☆	ZIP COVERAGE 4.3%	FASTEST SPEED 50 mbps	CONTACT INFO (855) 211-5696 Website
COPPER 	CUSTOMER RATING ★★☆☆☆	ZIP COVERAGE 23.7%	FASTEST SPEED 45 mbps	CONTACT INFO (888) 573-0683 Website
COPPER 	CUSTOMER RATING ★★☆☆☆	ZIP COVERAGE 14.3%	FASTEST SPEED 45 mbps	CONTACT INFO (855) 211-1492 Website
FIXED WIRELESS 	CUSTOMER RATING ★★★★★	ZIP COVERAGE 100.0%	FASTEST SPEED 35 mbps	CONTACT INFO (650) 772-6459 Website



INTERNET SERVICE OFFERINGS TO SMALL BUSINESSES

For small business entities in San Leandro, broadband services are available in all areas. However, like enterprise and large business offerings, the service can be expensive, coverage area is dependent on technology offered, and broadband meeting the speed definitions of the FCC is not universally available. Based on Magellan's primary research, customer satisfaction ratings are average, at best, for all providers. Comcast Business offers up to 250 Mbps download speeds, and covers about 97% of the small businesses. AT&T offers DSL to 100% of the City which could reach up to 75 Mbps download speed, while average from other providers is measured at 35-12 Mbps. However, it is important to note that these speeds are not the norm. Most of the respondents we spoke to are experiencing speeds that average around 1.5 Mbps and state that the connections are slow.

Broadest Coverage Offeror: 100% coverage available to small businesses is offered by ATT DSL, at advertised download speeds that could reach up to 75Mbps; again, this is not reflective of the speeds typically experienced by small businesses interviewed for this study, who reported slower connections. Etheric Networks, a fixed wireless, offers speeds up to 35Mbps, and covers 100% of the city, though it appears to have very low adoption within the City. While the fastest offering from AT&T is classified as broadband (download speeds of up to 250 Mbps are available), and coverage exists to all points in the San Leandro area, service is extremely expensive at around \$450 per month with a 3-year contract.

Broadband Coverage: Broadband services as defined by the FCC are available in more than 90% of San Leandro, using cable and DSL technologies. Pricing is much more favorable than fixed wireless in these cases.

Cable Services: Almost complete coverage of the area is serviced by Comcast, with reported over 95% availability. Higher speed service is available, with 350 down/20 up for \$450 Monthly Recurring Cost (MRC), or 150Mbps down / 20Mbps for \$249 MRC. Rates are based on a promotional 2-year agreement for extra free services, based on subscription commitment and a free install.

DSL Services: AT&T advertises DSL services to 100% of San Leandro's small businesses. DSL services are around \$50.00 MRC which could include speeds up to 50 Mbps down / 10 (Mbps); however, as stated above, this is not the typical speed experienced by most small businesses. This promotional rate is conditional on a two-year subscription commitment, with an additional \$99 Non-Recurring Cost (NRC) for installation. A Wi-Fi enabled modem is included.



Figure 27. Small Business Providers in San Leandro

**** Note - All Service providers claim the data speeds to be best effort in fine print.**

Provider	Customer Rating	Zip Coverage	Fastest speed	Lowest pricing
DSL 	CUSTOMER RATING ★ ★ ★ ☆ ☆	ZIP COVERAGE 100.0%	FASTEST SPEED 75 mbps	PRICING FOR 50 MBPS \$50.00
FIXED WIRELESS 	CUSTOMER RATING ★ ★ ★ ★ ☆	ZIP COVERAGE 100.0%	FASTEST SPEED 35 mbps	PRICING FOR 10 MBPS \$339.00
CABLE 	CUSTOMER RATING ★ ★ ★ ☆ ☆	ZIP COVERAGE 97.6%	FASTEST SPEED 250 mbps	PRICING FOR 75 MBPS \$149.95
COPPER 	CUSTOMER RATING ★ ★ ☆ ☆ ☆	ZIP COVERAGE 29.0%	FASTEST SPEED 12 mbps	PRICING FOR 20 MBPS \$120.00

INTERNET SERVICE OFFERINGS FOR RESIDENTS

For residents of San Leandro, internet services are available in all areas. Service is not unreasonably priced, and coverage offerings are dependent on technology offered by providers.

Broadest Coverage Offerors

Broadband Coverage: Broadband services are available to all 100% of San Leandro residents, using cable and DSL technologies.

Cable Services: Xfinity offers up to 250 Mbps down service for around \$99 MRC with no data cap, modem included, rising to \$120 MRC after one year. A modem with Wi-Fi is offered at an additional \$10 per month. There is a professional setup charge of \$89.99 as well.

DSL Services: AT&T covers over 99% of the city and offers DSL service at \$40 per month for 50 Mbps. 10 to 75 Mbps plans are also available, depending on location, and come with a 1000 GB per month data cap. This is a 1-year promo rate; the regular rate is \$70.00. A one year contract applies with up to \$180 Early Termination Fee (ETF). There is also a \$99.00 one-time installation fee, and a Wi-Fi enabled modem is included.



Fixed Wireless: Etheric Networks offers fixed wireless (requiring line-of-sight to the business) to 100% of San Leandro area. While the fastest offering is classified as broadband (download speeds of up to 25 Mbps are available), and coverage exists to all points in the San Leandro area, cost of this service is extremely high, and cheaper base service offerings fail to meet the FCC broadband definition. The internet plan for Etheric Network is \$349.00 per month for 25 Mbps and includes Symmetrical speeds of 25 Mbps guaranteed and 100 Mbps maximum with a 2400 GB per month data cap. A 2-year contract is required, and setup fees include a \$99 labor cost for the first two hours of installation and a \$338 one-time purchase fee for a modem. Residents can save \$239 on equipment by using a promo code⁴². Etheric's adoption rate is low and throughout the course of the study, we were unable to identify anyone who subscribed to their service. This leads us to believe their footprint within San Leandro is relatively small.

Satellite Providers: HughesNet and Viasat offer satellite internet service with 100% coverage. Pricing is approximately \$50 for around 12Mbps of download service. Plans offer 12 Mbps down and 2 Mbps up with no data cap on a three-month promo rate; the regular rate is \$70.00. After 40 GB of data usage, users' data may be prioritized behind other customers during network congestion. A contract term of 2 years applies, along with a \$9.99 monthly modem fee. Installation is free.

To illustrate how data services will require next generation networks, Netflix cites the following typical usage on its support page:

One hour of standard definition (SD) video viewing uses approximately 700MB of data hourly; one hour of high-definition (HD) video consumes 3GB hourly; one hour of ultra-high-definition (UHD), on one's 4K flat-screen monitor, consumes 7GB hourly. Binge-watching is clearly not feasible. Similarly, YouTube estimates data usage as follows: at standard 30 frames-per-second (FPS), video content consumes about 264MB hourly; HD video consumes 870MB hourly; and full HD uses about 1.65GB hourly. Streaming YouTube videos of cats or family can consume an entire month's worth of data in the first few days.⁴³

⁴² Promo code NEWYEAR18

⁴³ Netflix Support Page, December 2017



Figure 28. Residential Providers in San Leandro

Provider	Customer Rating	Zip Coverage	Fastest speed	Lowest pricing
CABLE 	CUSTOMER RATING ★★★★☆	ZIP COVERAGE 99.5%	FASTEST SPEED 250 mbps	PRICING FOR 15 MBPS \$29.99
DSL 	CUSTOMER RATING ★★★★☆	ZIP COVERAGE 8.0%	FASTEST SPEED 100 mbps	PRICING --
DSL 	CUSTOMER RATING ★★★★☆	ZIP COVERAGE 99.4%	FASTEST SPEED 75 mbps	PRICING FOR 50 MBPS \$40.00
FIXED WIRELESS PROVIDERS				
Provider	Customer Rating	Zip Coverage	Fastest speed	Lowest pricing
FIXED WIRELESS 	CUSTOMER RATING ★★★★☆	ZIP COVERAGE 100.0%	FASTEST SPEED 35 mbps	PRICING FOR 10 MBPS \$179.00
FIXED WIRELESS 	CUSTOMER RATING ★★★★☆	ZIP COVERAGE 8.9%	FASTEST SPEED 30 mbps	PRICING FOR 100 MBPS \$99.95

ACCESS, COMPETITION AND COSTS IN SAN LEANDRO, CA

Access to broadband internet in San Leandro is nearly universal, with almost the entire area having a choice of two or more providers for service. As is typical, businesses have more choices than residences. Most area businesses and residents can subscribe to cable broadband or DSL broadband, but fiber broadband is not offered. Almost every entity, business or residential, can get minimum 50 Mbps download, but less than 80% of entities can get 10 Mbps upload.

Mobile wireless, which is a source of broadband connectivity, is also ubiquitous; residential cellular service options are plentiful in San Leandro. However, data plans can be limited, and costs can be exorbitant. (Mobile wireless data unit costs are most expensive, and caps are quickly reached.)

Competition for residential fiber-optic based high-speed broadband services is non-existent, although AT&T has begun rolling out its AT&T Fiber solution within the City. Consequently, recurring costs are high. One-time connection and installation costs may be waived, or otherwise seemingly low, but those provider costs are included in the monthly recurring costs. In addition, promotional pricing packages can artificially reduce upfront costs, leaving customers to deal with significant rate hikes in the future.



Access to Commercial Internet Exchanges and Data Centers

Businesses in San Leandro have some choice of commercial fiber providers, most prominently Lit San Leandro, that can provide access to commercial internet hubs and major regional data centers. Routes and commercial terms would have to be negotiated with any of the several commercial providers, of course, but many can provide fiber access to primary regional internet exchanges, such as Digital Realty Trust in Oakland and numerous data centers in Fremont, San Jose, and Santa Clara, among others⁴⁴.

CREATION OF A MUNICIPALLY-OWNED FIBER NETWORK

Businesses and residents would benefit from the City of San Leandro deciding to expand availability of fiber-optic based high-speed broadband by extending its municipally-owned fiber network.. Having expanded its fiber network, San Leandro could create agreements with one, or several, private internet service providers for faster, less expensive service. Increased fiber availability would result in downward pricing pressures, benefiting the City's residents and businesses.

Once a plan for extending the fiber network is submitted and approved and funding for construction is secured, San Leandro should issue a request for proposal (RFP) to private entities to become ISPs for the City.

As a separate decision San Leandro could choose to become an ISP itself. That decision, however, comes with significant strategic and operational effects. If the City desires this further, Magellan Advisors recommends a separate study be undertaken to evaluate whether this direction should be taken or not.

Other Benefits of a Municipally-Owned Fiber Network

In addition to increased availability of high-speed fiber-optic broadband services via a fiber network constructed and owned by the City of San Leandro, other activities and services may be offered or improved such as:

1. Future-proof technology platform for Economic Development Activity – Encouraging businesses to relocate to, or expand within, San Leandro. Competitive broadband is a magnet for attracting and retaining businesses.
2. Other New Revenue Streams – With a municipally-owned fiber network, San Leandro may choose to lease some unused fiber assets for revenue streams, rather than allowing unused fiber to lie fallow.
3. Supporting Smart City initiatives as referenced in the Smart City Strategy section of this document

⁴⁴ See "Proposed Interconnections Document for San Leandro, CA."



This Market Assessment indicates that there is room for growth and improvement in the internet and broadband service offerings in San Leandro. Thus, Magellan Advisors' recommendation to complete planning of extension of the City's municipally-owned fiber network is supported by this research. The extensions to the fiber network will increase availability of high-speed fiber-optic based broadband, having favorable effects on choice and value for services. The new fiber network will also provide a set of opportunities to provide new and improved government services, new partnership opportunities, and new revenue streams.



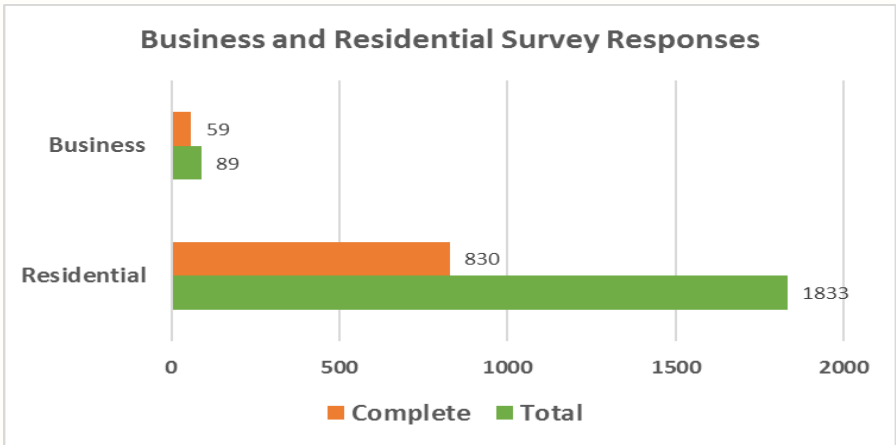
THE CITY OF SAN LEANDRO NEEDS ASSESSMENT

The surge of popularity of the internet in recent years has led to a monumental increase in its capabilities and has tightly integrated it into the everyday lives of both individuals and businesses. As residents and businesses discover more beneficial applications, each of which requiring an increasing amount of bandwidth capacity, communities are finding that their broadband service needs are not being met.

As part of the needs assessment process, Magellan Advisors’ conducted candid and open discussions with key city staff, community organizations, business and community leaders, and technology service providers. The goal of the meetings was to better understand San Leandro’s broadband market conditions and to learn about the challenges of the people who live, work, and operate businesses in San Leandro today.

The needs assessment for the City of San Leandro includes the results from interviews with the City Manager and Assistant City Manager, as well as other City departments and stakeholder institutions conducted in October 2017; feedback from four broadband workshops over a three-day period (February 2018) including one for businesses, another for anchor partners such as regional utilities and transportation, and one for residents; and a Broadband Business Survey distributed in January 2018⁴⁵. In addition, a residential survey was also distributed during the same timeframe with 1,833 responding⁴⁶.

Figure 29. Survey Responses



The results of the data collected through this process are provided in the following sections and comprise the City of San Leandro’s Broadband Needs Assessment.

⁴⁵ The survey obtained 89 responses, 59 of which were complete, from San Leandro’s business community
⁴⁶ 830 of these 1,833 responses were complete.

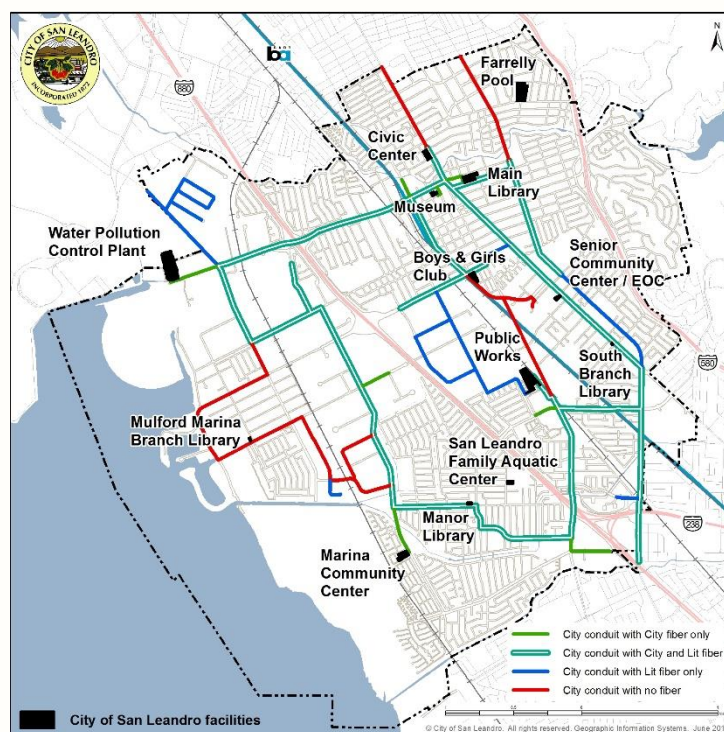


THE STATE OF BROADBAND IN THE CITY OF SAN LEANDRO

In 2011, the City of San Leandro entered into an agreement with San Leandro Dark Fiber to install a city-wide fiber-optic loop utilizing existing City conduit. The resultant offering, known as “Lit San Leandro” (LSL), was created to bring high-speed voice, video and data services to businesses and the technology industry in the community. Lit San Leandro leases fiber lines from BART’s Telecommunications Division to connect from San Leandro Bart to Digital Realty Trust regional data center in Oakland, CA. It offers broadband speeds of up to 10 Gbps/sec and has approximately 20 miles of fiber through existing conduit throughout the City. As of 2013, the City estimated that almost 2 million square feet of building space is connected in San Leandro, totaling over 300 businesses. The Lit San Leandro system was subsequently expanded to the San Leandro Unified School District to connect their facilities and school buildings, and to connect many non-profits, such as St. Leanders Church, Assumption Church, and the Boys & Girls Club, among others.

The map below shows the current fiber optic network in the City of San Leandro.

Figure 30: Current San Leandro Fiber Optic Network



Planning and Economic Development

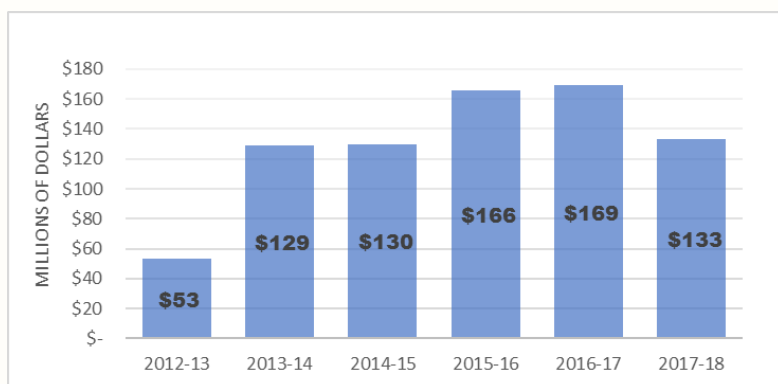
San Leandro understands the importance of being a business-friendly city and is committed to become a leading innovative economy in the Bay Area with a goal to capture



a greater share of the Bay Area’s professional and tech-focused growth industries. Most recently, this has included the development of the San Leandro Tech Campus and the Gate, both of which connect to the Lit San Leandro fiber-optic network.

During the last 15 years, San Leandro has gained momentum as a regional and corporate office market, with considerable potential for this sector to expand in the future. Health care has been the fastest growing industry in San Leandro during the past decade⁴⁷.

Figure 31: Construction Investment in San Leandro



San Leandro has benefited from robust economic development over the last several years. Since 2014, construction spending has exceeded \$720 million, with over \$300 million of investment in the past two years alone.

Recent residential development included the approval of Westlake Urban to build 197 multi-family housing units as part of the San Leandro Tech Campus, and Bridge Housing is underway on construction of 85 senior affordable housing units to match 100 affordable units at the Marea Alta. Other residential housing projects include:

- 60 units at Washington Ave & Thorton /Street (Gordon Galvan)
- 60 units at San Leandro Blvd. & Parrott Street (Eden Housing)
- 140+ units at former CVS Site at E. 14th & Callan Street (Sansome Pacific Properties - 28 for-sale units and ground floor retail/restaurant space at Parrott & Washington Streets)

There are approximately 800 developed commercial parcels and 650 developed industrial parcels in the City. Many of these sites are developed at much lower intensities than is permitted by zoning. On an aggregate basis, the city has 22.1 million square feet of industrial floor space on 56.6 million square feet of land area.

Prior plans for the Downtown TOD area and East 14th Street have included estimates of development capacity. The Downtown TOD Strategy identified potential sites for 120,800 square feet of retail space, 718,200 square feet of office space, and over 3,400 residential units. More recently, the Shoreline Development Plan identified sites for a 200-225 room hotel, up to 500 residential units, two restaurants, a new library, a new public park, and the redesign of the 9-hole executive golf course. The Kaiser Permanente Development EIR identified the potential for 387,000 square feet of retail space and a hotel or 250

⁴⁷2035 City of San Leandro General Plan.



residential units on the 25-acre “North” parcel,. In 2017, the Bay Fair TOD plan estimated potential for over 2,500 new residential units and over 300,000 square feet of new office space in the area around the Bayfair BART station.

Community Development

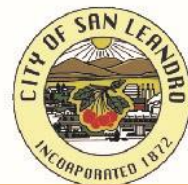
The Community Development Department has five divisions: Building and Safety, Economic Development, Housing Services, Planning Services, and Code Enforcement. The Building and Safety Division regulates and inspects private development and construction throughout the City. Economic Development guides economic and business assistance strategies to maintain and improve the City’s fiscal vitality. The Housing Services Division administers the City’s federal Community Development Block Grant (CDBG) and HOME funds to implement the City’s Consolidated Plan and Housing Element. The Planning Services Division coordinates development review and land use policy activities. The Code Enforcement Division works to improve the quality of life and aesthetics of our community through education, cooperation, and responsive enforcement of the City’s Municipal Code.

Interview with Community Development

Planning – Community Development (Cynthia Battenberg) – October 18, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • City engineering/planning responsible for planning/permitting for macro cell towers. • No condition of approval requiring broadband. • Current (busy) workload resulting in limited time to strategize about projects. • The City has dedicated staff that focuses on outreach to community, brokers, business owners, builders and attending conferences to develop best practices in dealing with building practices. 	<ul style="list-style-type: none"> • City (not LSL) should consider a fiber ordinance that any developer would be required to build a broadband amenity and add to the City's fiber network, one that provides for wireless communications, public safety, virtual education, autonomous vehicles, real time parking, etc. • Opportunity for all of the buildings to be connected to a fiber backbone, owned by the City, operated by others. Needs to be a balanced approach by existing impact fees & infrastructure requirements the City already assesses. • Opportunity to incorporate planning tools, rules and policy to have flexibility in pushing and molding projects.

Interview with Community Development

Community Development (Katie Bowman, Andy Mogensen, Tom Liao) – October 23, 2017	
Key Findings	Opportunities & Needs



- City Municipal Code does have a chapter for wireless zoning/code, but it is out of date and does not include provisions for small cells in that code.
- No City standards or design guidelines regarding telecom requests on pole construction/additions. This is handled by Traffic & Engineering. There are no City licensing agreements for micro sites in place.
- Planning Department and Traffic & Engineering do work together on planning when there is a crossover between public right-of-way and private development, but not regarding aesthetics.
- There is no CUP process for broadband. If it is in the public right-of-way, there is no administrative oversight. Anything in public right-of-way is managed by Municipal Code. City Attorney would craft new telecom CUP language.
- Trend is to move from large macro sites to smaller micro sites (on electric or light poles) to accommodate 5G service/applications.
- Magellan to provide “best practices and examples” of what other cities have done for ordinances.
- Opportunity to form a committee for pre-application planning including Planning, Fire, T&E, Environmental and IT.
- Need a plan on the roles of the City departments to provide direction on how they work together on broadband and technology across departmental lines.
- Program needed to educate broadband stakeholders to identify benefits of getting buildings connected to buildings.

MUNICIPAL NEEDS ASSESSMENT

Fiber-optic networks can provide a public infrastructure that can be used for an assortment of public benefits, including enhanced municipal utilities, new e-government applications, public safety, collaboration, and infrastructure sharing programs. In addition, the fiber provides a platform for long-term adoption and smart community innovation, ranging from Smart Home and Smart City applications for energy management to enabling a community-scale platform for the IoT.



Interview with Internal Leadership Team

Internal Leadership Team (Debbie Pollart – Director Public Works, Nick Thom – Engineering, Keith Cooke – Director Traffic & Engineering) – October 23, 2017

Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • Focus for project will be on infrastructure, but also for the City to become “smart” by leveraging vertical assets in a way that are not currently used. • There is no policy that addresses light pole attachments, but City does own and the poles are “free of clutter”. PG&E owns the power poles (City owns light poles). • There is a JPA that governs use of PG&E poles (AT&T, Comcast, PG&E). • There are underground initiatives, such as on E14. Magellan can provide possible lease rates/incremental savings from open trench policies. • Right-of-way permits go through Traffic & Engineering; attachment to City property permits is handled by Public Works. • City has not established any rental fees for poles, including fee for maintenance. 	<ul style="list-style-type: none"> • Magellan recommends City retain ownership of light poles and cabinets in the rights-of-way. The public right-of-way is where the City’s smart assets will reside. • When telecom permit is requested – this should signal potential revenue opportunities. This also applies to wireless (lease fee). • Should address changes to existing permit process or establish new ordinance where there is an absence. • Developing a sound, “good governance” policy framework is key to establishing sustainable change. The City should maintain control over their own assets (do not sub contract to another entity to manage). • 5G offers a huge opportunity – more dense wave lengths, so more microcells will be needed. City should leverage their poles and create revenue opportunities for carriers in 5G rather than allowing incumbent to dig for more fiber trenching to micro cell sites.



Interview with City Manager’s Office

CMO (Tamika Greenwood, Rich Pio Roda, Sbeydeh Walton) – October 24, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> Public Information Office (PIO) Discussion: Magellan to work with Sbeydeh on community outreach for project, including business and residential segments. Language divided (English as 2nd language) and low-income people to be addressed. Service groups (like Kiwanis) and long-time advocates will be approached. City Attorney Discussion: Policies like Open Trench done informally, but Engineering has expressed that they would like these codified. Each proposed microcell pole attachment agreement must be approved by the City Council on consent calendar. Microcell applications were on hold (due to SB649), but not that it is dead, City moving forward with Master Plan. Applications to remain on hold until standards and MLA in place. 	<ul style="list-style-type: none"> Codification of open trench policies needed. Codified policies will enable staff to make decisions without need of Council approval. Magellan recommends industry meeting with Traffic & Engineering, Community Development & PIO regarding Dig Once and Wireless Ordinance. Magellan to draft Dig Once and Wireless Ordinance – send to Michael Stella. City Clerk requested additional tools to assist the community to engage in public meetings (i.e. online public speaker cards).

Interview with City Manager and Assistant City Manager

City of San Leandro (Chris Zapata and Jeff Kay) – October 19, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> The City and business community is no longer underserved as it has fiber - broadband provided by Lit San Leandro (LSL). Comcast & AT&T have also installed fiber recently. LSL has connected a number of new businesses and the new Tech Campus. City has its own fiber optic asset, but have not utilized to serve business community. Original intention was to use LSL as an economic development asset (connecting businesses). 	<ul style="list-style-type: none"> LSL has been focused on wholesale (not retail/end user customer). City’s own fiber optic asset is underutilized. Identifying and implementing viable Smart City applications (i.e. parking) that would be utilized is needed, as well as exploring whether FTTH (fiber-to-the-home) make sense. 5G industry standard has not yet been defined, but is on the radar with carriers coming out with trials. Partnership opportunities exist with incumbents particularly with City-pole attachments (wireless or wireline) and focusing on monetization strategies. With SB 649 off the table, other opportunities will be available. Should continue to look into connecting non-profits (i.e. City’s benefit fiber program that connected City fiber to schools) and help bridge the ‘digital divide’. Need to develop map of current assets and a plan that identifies best places to lay fiber for ROI.



CITY DEPARTMENTS – DESCRIPTION & INTERVIEWS

Finance

The Finance Department provides quantitative fiscal analyses that assist the City Council and City departments with decisions about allocating City resources. The department accounts for these resources and discloses the financial condition of the City in the Comprehensive Annual Financial Report (CAFR). They also prepare the Biennial Budget document - a blueprint of the City's priorities and spending plan. The Finance Department is responsible for a number of other tasks including management of Accounts Payable, the City Treasury, Payroll, Purchasing, the City Cashier, and Risk Management.

Interview with Finance Department

Finance Department (MaryAnn Perini) – October 23, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> The City's CIP budgets are on a 2-year cycle (with mid-cycle updates). Both are reviewed annually. 2017-2018 CIP Budget: \$30.9M 2018-2019 CIP Budget: \$44.4M The plan is to go for a \$20M bond to support CIP budget in 2018-2019. This is not available funding, but money that has already been spoken for in terms of projects on the CIP list. General Fund contributes to CIP \$10M and \$7M respectively. Once a project is on a CIP list, funds are appropriated for a maximum of 5 years. If not used by 5th year through auto carryovers, then project needs to be reapproved (i.e. street, roads, sidewalks are most common carryovers). Enterprise Funds: Wastewater Treatment Plant, Stormwater, Marina Golf Course Operations, the Marina. Golf course is managed by American Golf Corp. Internal Service Funds (Enterprise Fund): Self Insurance Fund, IT, Vehicle Equipment & Replacement, Building & Facilities Fund. 	<ul style="list-style-type: none"> No Wi-fi at Marina Golf Course. There has not been a fund specifically for broadband. Possibilities include as a CIP budget item, or savings / revenues from broadband could go into a special revenue fund that is consolidated (revenues & expenses) and rolled up. IT has an internal service account and the ability to transfer funds within divisions and has reserve for projects (IT makes the decision and prioritizes, along with an internal committee called IMSC). Could also go to Council for anything over \$50K to make budget changes.

Engineering & Transportation

The department is made up of three divisions and is responsible for all engineering and transportation related services for the City.



The Administrative Services Division provides acquisition and management services for City-owned properties, financial management of the City's Capital Improvement Plan, oversight of federally funded transportation projects and support to the other two divisions within the department.

The Land Use Division provides engineering services to private development projects in the City of San Leandro. This includes a review of all subdivisions and other private developments, as well as permits for construction within public rights-of-way and grading permits. Land Development staff administers the City Sidewalk Program, Undergrounding Districts, Assessment Districts and implementation of the Urban Runoff Clean Water Program. The Land Use / Transportation Section also provides traffic engineering and transportation planning services for the City.

The Project Development Division provides engineering services in support of various public improvements and provides engineering related services to staff in all City departments. This division implements the City's Capital Improvement Program, which includes contract development, project oversight, and design services for capital projects within San Leandro. Examples of capital improvement projects include street improvements, sewer replacements, street tree planting, municipal building enhancements, and Marina area and park improvements. This division is also responsible for inspection of public improvement projects during construction.

Current projects include sanitary sewer replacement and repair (2017-2018) including routine & specific CCTV inspections, with locations where critical defects and distresses are found listed for repair and/or replacement. Annual Street Overlay/Rehabilitation is also continuing for select streets throughout the City, as well as annual street sealing.

Fiber Conduit Networking Extension Project

San Leandro's original fiber optic loop spanned 11.8 miles throughout the core of the City. In an effort to promote business growth, the City applied for and was awarded a matching \$2 million grant from the United States Economic Development Agency (EDA) for installation of communications conduits into under-served industrial areas. This included an expansion of approximately 8.1 miles, including the Adams Tract (Doolittle and Davis to the north), Marina Blvd Loop (Marina, Farrallon Dr and Monarch Bay Dr), and the Teagarden/Alvarado loop. Lit San Leandro has populated the Adams Tract and Teagarden routes with hundreds of strands of fiber optic cabling and is serving businesses with those areas, while the Marina area conduit will be utilized for the upcoming Marina shoreline redevelopment and to connect the new, state of the art Mulford Branch Library with gigabit speed Internet service.

With favorable construction results, the City ended up with a surplus grant balance, which it utilized to add an additional 1.3 miles of additional conduit. These expansion routes included Washington Avenue, completing a network loop between the City's



Public Works Service Center and conduit in San Leandro Boulevard at Polar Way, as well as conduit to two traffic signals for future signal interconnects and conduit to the San Leandro Hospital and the Ghirardelli Chocolate properties. In addition, a critical route was added between the Main Library and City Hall running up to eight feet below the San Leandro Creek, providing a superior and resilient connection between those facilities. Construction was completed in fall 2017.

Interview with Engineering & Transportation

Engineering and Transportation Department (Keith Cooke, Kurry Foley, Dean Hsiao, Reh Lin Chen, John O’Driscoll, Nick Thom) – October 23, 2017

Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • Department projects are partially funded by Alameda County Transportation Division each year and is usually underfunded. • 5 Year grant from Alameda CTC will apply \$15M toward roads (still \$100M behind) to reduce backlog. However, rising costs have both increased the backlog and reduced the amount of work that can be done with the grant. • Alleyways are maintained by Public Works. • Work done in the public right-of-way. Encroachment permit polices fall under municipal code. • Engineering & Transportation meets with all utilities once per year to review projects underway and to determine challenges and opportunities. • LSL and BART share the same fiber cable back to Oakland. • Wireless and pole attachments are handled through encroachment permit process. • Underground Utility Fund (used to underground basic utilities) is tapped out in order to support E. 14th St. Undergrounding. 	<ul style="list-style-type: none"> • Meetings with utilities don’t address join trench opportunities. Need to develop a policy on “moratorium on new pavement.” • Department has interest in dig once policy, especially in conjunction with electrical undergrounding. Need to first develop a clear map of where they want fiber to go (network design). • Fiber assets are tracked via GIS in SLAM to determine where conduit goes and then referring to PDF copies of maps; department would love to have fiber tracking capacity. • Opportunity for planning staff to handle policy writing and adoption – addressing aesthetic and design issues, with Engineering responsible for public right-of-way issues. Public property – Engineering. Private property – Planning. • Need to establish a colocation⁴⁸ mandate. • Need policy on pole leasing (cash, trading a City asset for Carrier asset, trading pole assets for fiber assets, etc.). • The Department currently has an informal approach to assure quality development (including new conduit for new development), and would like to codify the process. • Needs the strategic plan in order to develop fiber roadmap to help them identify appropriate fiber requirements for new development.

⁴⁸ Colocation refers to the practice by which multiple carriers attach devices to the same poles or other locations, limiting the space required for multiple networks to operate in one area.



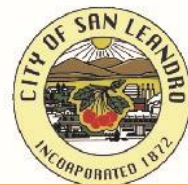
Public Works

The Public Works Department is responsible for the operation and maintenance of the City’s infrastructure including public facilities, parks, streets and other public rights-of-way, street trees, storm inlets, sanitary sewers, recycling program, environmental services, as well as overseeing the San Leandro Recreational Shoreline (including the Marina, Monarch Bay Golf Club, the Bay Trail and marshlands). The Department also maintains and manages three golf courses⁴⁹ and the water pollution control plant. San Leandro’s Public Works Department recently completed a Climatec/Paradox Smart Lighting system whereby over 4,000 new LED street lights are now managed in a centralized control system.

Interview with Public Works

Public Works Department (Debbie Pollart, Dean Wilson, Steve Lomardi) – October 24, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • PW maintains light poles and Climatec completed the LED light installation. GIS has maps of all light poles and manholes. • Public Works maintains all parks and sports fields. • Internal communication among PW Staff is primarily with cell phones, although radios used occasionally (as in Oakland Hills fire). • Public Works has one large radio antennae, but usage is undetermined. • Plant and Public Works are both connected to City Fiber; both have Wi-fi. • Maintenance is a shared responsibility with Engineering. Engineering and sub-contractors take care of sidewalk replacements. Public Works does the ‘street grinds’ (prep sealing, potholes, grinds). • Caltrans maintenance (weed abatement on State property) is complaint driven only – no routine maintenance. They do an adequate job of maintaining signals. • There is no joint maintenance agreements or projects with BART. • There are homeless encampments in the City/area and Public Works is responsible for clean-up/maintenance of camps. • Alameda County is responsible for maintaining flood control basins. 	<ul style="list-style-type: none"> • Improve communications with PG&E to be aware of PG&E projects. • Harvey Mudd college students collaborated with Paradox Engineering to build a new smart garbage can app for San Leandro. Would be nice to have smart garbage cans at parks and sports fields. • Cameras needed at parks and sports fields to deter graffiti and vandalism. • A camera is present at the Plant (entrance). • Cloud based system at plant tracks maintenance & scheduling, but Wi-fi is not always available in field and employees reluctant to use their own cell data. Wi-fi is available at the plant. • No smart meters in public parking spaces. City’s parking garage payment system is under a new Downtown Parking Master Plan, currently in implementation. • A good fiber strand product needed to help monitor/coordinate activity.. • Need to assess condition of underground assets.

⁴⁹ Monarch Bay Golf Club, Tony Lema golf course and the Marina 9-hole golf course



- IT provides support for employee cell devices to make sure employee has access to City apps on their device.
- Street lights are a mix of metered and unmetered.

- CIP projects need to identify maintenance and replacement funding sources (Smart City technology can help).

Recreation and Human Services

The City Recreation and Human Services Department consists of two community centers⁵⁰, and three community pools⁵¹. In addition, there are 23 parks and recreation facilities including community and neighborhood parks, swimming pools, an aquatic center⁵², dog park, tennis courts, ball park and sports fields. The parks range in size from the smaller 1-acre neighborhood parks to the 30-acre Marina Park.

Additional services offered under the Recreation and Human Services Department include Human Services, which provides social service resource information and support for nonprofit organizations; the Kids Club, an afterschool program for transitional kindergartners through 5th grade; Senior Services; Volunteer Services; and a variety of other programs for children, teens, adults and seniors.

Interview with the Recreation and Human Services Department

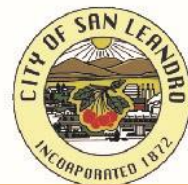
Recreation and Human Services Department (Jeanette Dong) – October 24, 2017

Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • The Cherry Festival is the only major City-run event. They have a new app for the festival, which had 100 Gb of data downloaded via public Wifi (5,000 connections over 8 hours). • Department manages fields for various sports leagues and Recreation manages scheduling for all Rec facilities. • The Department offers and manages various activities in the community including events for teens, at senior center, outdoor movie nights, and it is experimenting with outdoor music at the shoreline. • Rec has about 15 computers at the Senior Center. 	<ul style="list-style-type: none"> • Presently none of the parks have Wifi, although CIP has a \$200k budget to install in the most heavily used parks. • Possibility is to backhaul fiber that is already going into schools (many parks are adjacent to schools). The City IT and SLUSD have begun discussions. • Some City pools still need Wifi. Boys & Girls Club/pool is connected. • Updating of cameras at community centers is needed (currently managed by PW). Need for cameras at high-incident parks (Marina, Aquatic Center at Washington Manor, Halcyon). • Aquatic center pools are quite dated, but would be nice to have equipment/sensors connected to fiber if possible. Having infra-red (movement) detectors is desired.

⁵⁰ Marina Community Center and the Senior Community Center

⁵¹ Farrelly, San Leandro Boys & Girls Club and the San Leandro Family Aquatic Center

⁵² Washington Manor Park



- There are 5 commission and 2 advisory groups that meet at various locations. If meeting is not an AV-enabled facility (City Hall, Senior Community Center), then meetings are typically recorded by cell phone.
- ActiveNet has had a problematic implementation due to lack of training, but a budget has been established to train staff over next 2 years.
- Regarding Human Services – there are no HUD vouchers in San Leandro. Most of the homeless are in about 10-15 encampments, with many living in cars and RVs at the Marina.
- Looking to film some events and would like to view in real time. For example, the new competitive pool might require fiber so that competitive swimming events can be televised in real time.
- New shoreline park may require Bay programming to support activities.
- Shoreline development as a Smart Community is still undetermined as staff project manager or developer have not indicated their intentions regarding the tech infrastructure.
- Human Services is capturing new data (LotaData dashboard obtained through STIR program) to reframe the mindset of staff and to make programming decisions. Previously there was no historic data.

Information Technology

The Information Technology Division provides technology solutions, guidance, training and support for the growing technological needs within community. This includes its SL Wi-Fiber and an Open Data Hub (providing various GIS information and public records).

In July 2015 the City of San Leandro launched SL Wi-Fiber, free public wireless internet service in the downtown core. The gigabit Internet system utilizes fiber in Lit San Leandro. The system has since been expanded to the Senior Community Center, the Casa Peralta and Cherry Festival area on West Estudillo, the Marina Community Center and Civic Center and Boys & Girls Club, City Hall, the Police Department and exterior Civic Center plaza, Main Library, Public Works Service Center, and Water Pollution Control Plant. In 2017, City Council authorized a capital improvement project to expand public Wi-Fi into parks and other City facilities.

The needs of the Information Technology Division have been addressed throughout this Plan. IT’s personnel were contributors to many sections and worked alongside Magellan in its development. In its role as the City’s provider of technology solutions, the Information Technology Division needs are comprehensive of all other departments described herein.

Police Department

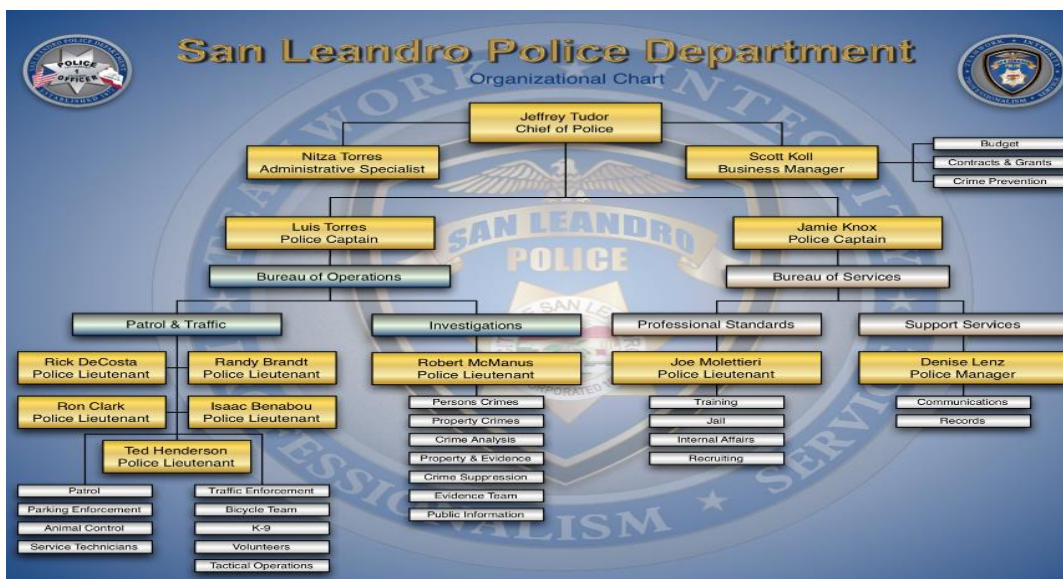
The City of San Leandro Police Department (SLPD) is comprised of four divisions and units including the command staff, management staff, crime prevention unit and traffic division. SLPD offers a variety of programs including alarm system registration, child car seat safety, citizens police academy, citizen ride-along, crime free business program, crime free multi-housing program, National Night Out, neighborhood watch, police



explorers, teen policy academy, video surveillance camera registration, volunteers in police service and a free telephone reassurance program.



Figure 32. San Leandro Police Department



Presently, and even more so moving into the future, public safety demands high-speed, reliable connectivity to ensure for effective management of their mobile information technology systems. Additionally, the use of closed circuit television, traffic cameras, and pedestrian and bicycle safety initiatives linked to Smart City Applications will continue to underscore the importance of technology to the Police Department. These applications and initiatives are further outlined in Section 2, the Smart City Strategy section of this Plan.

Fire Department

The Alameda County Fire Department (ACFD), through a contract, provides services to the City of San Leandro. ACFD services include fire suppression, hazardous materials migration, paramedic services, urban search & rescue, fire prevention and public education. In addition, ACFD offers various community education programs including safety presentations, CPR and AED training, fire extinguisher training, ride along program, station tours and Vial of Life.

There are 5 stations, 1 administration office and 1 training facility located within the city.

- A) Administration Office (835 East 14th Street)
- D) Training Facility (890 Lola Street)
- 9) ACFD Station 9 (450 Estudillo Ave.)
- 10) ACFD Station 10 (2194 Williams Street)
- 11) ACFD Station 11 (14903 Catalina Street)
- 12) ACFD Station 12 (1065 143rd Ave.)
- 13) ACFD Station 13 (637 Fargo Ave.)



Figure 33. Alameda County Fire Department Locations in San Leandro



SAN LEANDRO UNIFIED SCHOOL DISTRICT

The San Leandro Unified School District (SLUSD), a special district that is not part of the City, is comprised of 8 elementary schools, 2 middle schools, 3 high schools and 1 adult school. There are also 5 administrative offices. In the 2016-2017 school year, the district had 8,638 students enrolled and 422 teachers employed, representing a 21.2 pupil to teacher ratio.

Figure 34. San Leandro Unified School District Schools

Elementary Schools	Middle Schools	High Schools	Adult Schools
Garfield	Bancroft	Lincoln High	San Leandro Adult
Jefferson	John Muir	San Leandro High	
James Madison		San Leandro High – Korematus Campus	
McKinley			
James Monroe			
Roosevelt			
Washington			
Woodrow Wilson			

E-Rate Spending in San Leandro



E-Rate is the commonly used name for the Schools and Libraries Program of the Universal Service Fund, which is administered by the Universal Service Administrative Company (USAC) under the direction of the Federal Communications Commission (FCC). The program provides federally-subsidized discounts to help schools and libraries obtain affordable telecommunications and Internet access.

The E-Rate program is one of four federal programs funded through the Universal Service Fund fees that are charged to telecommunications companies that provide interstate and/or international services. This fee is passed on to consumers on their telecommunications bills. Since all households that subscribe to video and/or telephone services are required to pay into the Universal Service Fund, it is important that communities maximize their participation in the E-Rate program to help recoup the investment made by their residents that pay into the fund.

San Leandro Unified School District subsidy rate is 80%. This means that 80% of the school district's total telecommunications and Internet access costs are funded by the federal government and that the school district must pay the remaining 20% through its own internal cost allocation.

SAN LEANDRO PUBLIC LIBRARY

The San Leandro Library System consists of a Main Library, three branch locations (Manor Branch, Mulford-Marina Branch, South Branch), Casa Peralta (an “historic house museum”), and the San Leandro History Museum & Art Gallery. Services include computer tutors, Discover & Go Museum Passes, an Electronic Learning Center, meeting rooms, Project Literacy, public computers and a Veteran’s Resource Center. In addition, the library system offers a variety of programs for adults, children and teens including tutoring, book clubs, reading programs, homework help, downloadable e-books and online learning.

Interview with Public Library

Public Libraries (Theresa Mallon, Bill Sherwood) - October 24, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • Wifi available at Main (Cisco 1100 – 11 access points). CIP project to upgrade Wi-Fi at South and Manor. Mulford will be entirely rebuilt with the Shoreline project. • There are 70 computers at the main library and most are always occupied. Wireless printers are available at Main and Manor. 	<ul style="list-style-type: none"> • Business training & services (although a challenge as many homeless people use library). • New library planned at the Marina (to replace Mulford). Could become a tech showcase • More collaboration with schools, but library offers classes and opens library to students as needed for off-days. • Meeting rooms seldom used – opportunity to become a small-business incubator. Challenge is that community groups use the meeting rooms throughout the year.



<ul style="list-style-type: none"> • Meeting rooms are free for non-profits and there is a fee for general public use. • Mulford Branch has no fiber (but T1). • IT manages all computers and electronic devices. • Local San Leandro access channel is managed by IT. • There are 3 cameras in Main, 12 at Manor, and approximately 50 throughout library system. • RFID program is in IMSC Budget (auto book check in) is yet to be scheduled. Very important service for non-tech library users. 	<ul style="list-style-type: none"> • No AV hookups available in Carnegie Auditorium. Additional AV equipment needed in meeting rooms • Meeting room space could be re-envisioned for small business activities, child computer commons, hackathons, etc. • Planned CIP upgrades to bring AV improvements to library – allowing for live broadcasts of Council meetings. • Nobody is actively managing/programming content on public access channel due to lack of content. City’s Public Info Officer should get involved. • South Branch could be moved to Bayfair and turn into a tech library/hub.
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

SAN LEANDRO HEALTHCARE

Broadband is expected to transform healthcare, simultaneously enabling better outcomes and lowering costs. The National Broadband Plan says that Electronic Health Records and Remote Monitoring technology could alone save over \$700 billion over 15-25 years⁵³. Beyond the cost aspects, using telehealth is a viable way to revolutionize patient care. The American Medical Association (AMA) believes that the appropriate use of telehealth applications to deliver care to patients could greatly improve access and quality of care while maintaining patient safety. In 2014, the American Medical Association created guiding principles for ensuring the appropriate coverage of telehealth services.

The AMA believes:

- Telehealth provided over robust broadband networks can facilitate immediate diagnoses and care to prevent lasting damage to stroke victims, prevent premature births, and deliver psychiatric treatment for patients in underserved rural areas.
- Telehealth is viewed as a cost-effective alternative to the more traditional face-to-face consultations or examinations between provider and patient.
- Similar to regular small businesses, rural clinics and small physician offices have the same price sensitivity to broadband, which is often priced beyond their means or altogether insufficient to support their health IT needs.

⁵³ The Federal Communications Commission. National Broadband Plan-Connecting America. Accessed May 12, 2016 from <http://www.broadband.gov/issues/healthcare.html>.



For patients, getting remote access to healthcare providers offers major advantages over traditional methods of delivery. At the top of this list is making certain types of care more accessible for those who struggle to get to distant medical facilities or hospitals.

- Patient-provider communications
- Patient self-management and provider feedback
- Health literacy and lifestyle behavior modification
- Medication management
- Patient-provider consultations

Although telehealth is not a substitute for in-person visits, it can still provide face-to-face care and improve practices of patient education. Broadband is crucial for San Leandro's healthcare providers as they begin to leverage electronic medical records and other important capabilities of telehealth and the electronic exchange of health care information. These and other healthcare applications used today require high performance broadband capabilities.

There are 8 primary hospitals and/or medical facilities that serve the residents of the City of San Leandro including:

Kaiser Permanente – San Leandro Medical Center (2500 Merced Street). The facility includes a 275,000-square-foot medical office (with space for 116 primary-care and specialty-care providers), as well as a 437,000-square-foot hospital with 216 licensed beds, a 24-hour Emergency Department with 40 emergency treatment bays, 10 operating rooms, a labor and delivery department and a neonatal intensive care unit.

San Leandro Hospital (13855 E. 14th Street) – This is an Alameda County facility providing inpatient and outpatient services, including basic emergency services. It is currently undergoing a \$26.8 million renovation to meet current state seismic requirements, as well as add 28 acute rehab beds, administrative offices, and occupational/physical therapy treatment areas. Renovations are expected to be complete in April 2019.

Fairmont Hospital / Alameda County Medical Center (15400 Foothill Blvd.) - Fairmont Hospital is an Acute Rehabilitation Center treating severe injuries such as stroke, brain and multiple-trauma. They provide inpatient and outpatient services. Fairmont also provides a hospital-based Skilled Nursing Facility for long-term care services. This is in unincorporated Alameda County.

Kindred Hospital (2800 Benedict Drive) – Kindred Hospital is a 99-bed transitional care hospital, and also offers a 24-hour clinical care, and a 10-bed ICU. This is in unincorporated Alameda County.



San Leandro Surgery Center (15035 E. 14th Street) – The San Leandro Surgery Center is part of the Sutter Health Network of Care. The facility offers most out-patient surgery services, but also has limited overnight beds.

Epic Care (13851 E. 14th Street) – Epic Care San Leandro is part of the Epic Care network (Bay Area) and offers surgery, endocrinology, infectious disease, internal medicine, primary care and urology services.

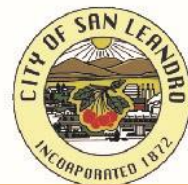
St Lukes Subacute Hospital / Seaton Rehabilitation Hospital (1652 Mono Ave) - St Luke's Sub Acute Care Hospital provides extended-stay nursing care to seniors with varying levels of disabilities in San Leandro, CA. This is in unincorporated Alameda County.

City Health Urgent Care (13690 E. 14th Street) – This clinic provides urgent care and out-patient services.

ANCHOR INSTITUTION – STAKEHOLDER INTERVIEWS

Crosslink (Clark Smith) – October 25, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • Crosslink has worked with Lit San Leandro (LSL) since 2011, but lately the relationship has been challenging in light of Comcast and AT&T installing fiber and offering incentives. As a result, LSL has focused on 10 Gb wireless. • Crosslink has limited success targeting larger buildings with competitive/price pressure and lack of marketing/price support from LSL. • Crosslink will market and pitch customer, but if LSL construction costs are not competitive, Crosslink will deploy wireless solution. • Crosslink has approximately 30 hard-wire connected properties and about 30 wireless connections. The # of customers is more. 	<ul style="list-style-type: none"> • Collaboration is needed with LSL on marketing, pricing (construction costs) and pitching large building groups for fiber deployment. • Competition with Comcast and AT&T is fierce and there are other providers that have entered the market. Prior to LSL, there was little competition. As an established (first to market) provider, LSL has an opportunity to revitalize its brand and partner to offer competitive plans/pricing and service to multi-tenant properties. • Biggest challenge is connecting property to fiber. As a smaller company, the cost is a big hurdle. A more creative approach is needed. • It would help if City would let developers know that they can build for fiber while digging during construction (i.e. new development on Williams).

Lit San Leandro (Kathy Otterson, Rene Campos) – October 24, 2017	
Key Findings	Opportunities & Needs
<ul style="list-style-type: none"> • Focusing on growth by leasing dark fiber and sell to ISPs and customers in San Leandro that want to connect buildings to fiber network. 	<ul style="list-style-type: none"> • Building out WDM equipment in anticipation of customer expansion. • Nine San Leandro cell towers have connected fiber.



- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • LSL partners with other entities to reach customers outside of San Leandro. • It is expensive to build underground laterals. City is expensive and slow to permit. Customer connection is almost always subsidized by LSL or City. Leasing to ISP via a wireless solution to extend to adjacent customers is usually the best solution. | <ul style="list-style-type: none"> • LSL interested and open to recommendations to move more aggressively in terms of market expansion and working with City to offer services supplied on the network; recognizing opportunities to manage fiber more creatively (in-kind services provided by ISPs). • Introduce a virtual marketplace – a service that provides small business backup. • Enterprise based services – similar to Digital Reality Trust (DRT). • Identifying mutual expansions plans between City and LSL will help to focus resources for expansion. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

RESIDENTIAL & BUSINESS SURVEY – COMMUNITY BROADBAND ASSESSMENT

To assess the broadband experiences across the community, an online survey of San Leandro households and businesses was conducted. The surveys were promoted in large part with the help of San Leandro project staff. In sum, 1,883 (830 complete) San Leandro households⁵⁴ and 89 (59 complete) businesses⁵⁵ responded to the survey.

The responses were entered into the survey platform and evaluated using Magellan's established data analysis techniques. No answer weighting or bias tools were applied to the data, and statistically significant differences between response categories are highlighted and discussed where relevant in the needs assessment narrative.

The survey was designed to understand the current broadband environment, existing residential & business needs and future opportunities. Responses are summarized in this section, which provide insight into opportunities for fiber infrastructure to better serve the City's business community.

Residential Survey and Needs Assessment

Responses to the residential survey were evenly distributed among the three San Leandro zip code areas, with between 33 and 34 percent coming from each⁵⁶. The average family size of respondents was 2.8 per household. This is slightly less than the 2.95 per household in California.⁵⁷

⁵⁴ The high household response rate lends to a high statistical relevancy of data. With approximately 32,000 households in San Leandro, the 830 completed residential survey responses yield a 95% confidence level with a ±3.36% margin of error, exceeding industry research standards of 95% confidence level and a ±5% margin of error.

⁵⁵ With approximately 8,600 businesses in the City the total responses yield a statistically relevant 95% confidence level with a ±12.72% margin of error.

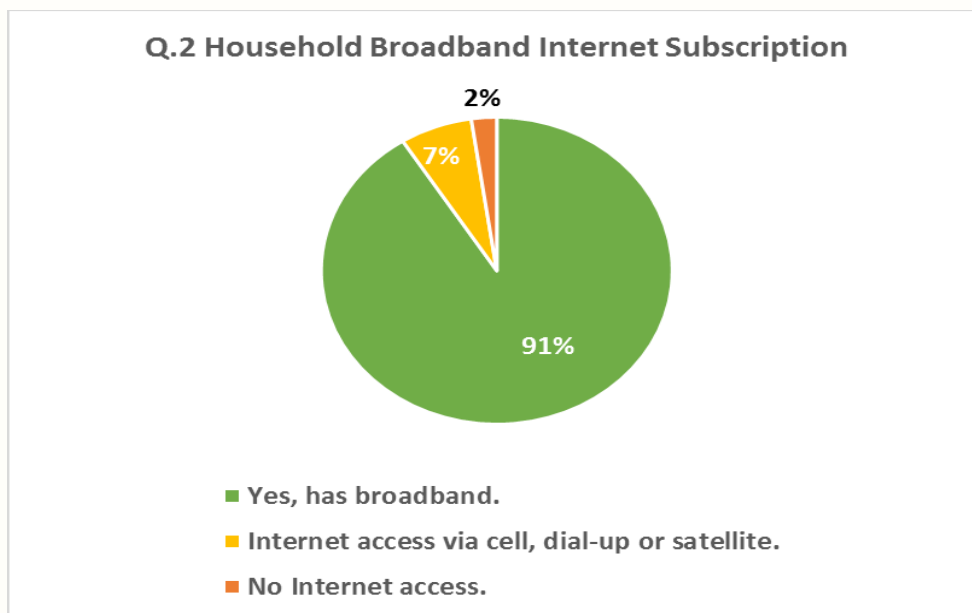
⁵⁶ Appendix D contains detailed graphs and maps from the residential survey results.

⁵⁷ 2012-2016, U.S. Census data



The percentage of households with broadband in San Leandro is high, with 91% subscribing to broadband service. Where access is available for San Leandro households, the adoption of the internet and use of internet-enabled devices is strong. In comparison, approximately 80% to 84% of all households in California have broadband service⁵⁸. This and other survey responses to follow indicate that internet has become heavily relied upon in the lives of San Leandro residents, suggesting strong demand for residential broadband services into the future.

Figure 35. Residential Survey Results – Household Broadband Internet Subscription



At 65% and 30% of all residential subscribers respectively, Comcast and AT&T are the dominate providers of internet service in San Leandro. Over 1,300 respondents (91%) indicated that broadband was their primary subscribed technology of connecting to the internet. Of those, almost 60% currently subscribe to the internet via coaxial cable, with 15% accessing via DSL and 15% unsure. In comparison, only 6% indicated using fiber optics. Having internet access was deemed to be critical or very important by 93% of the respondents, with 96% indicating reliability as being critical or very important. A high percentage also considered performance (90%) and price (84%) to be critical/very important.

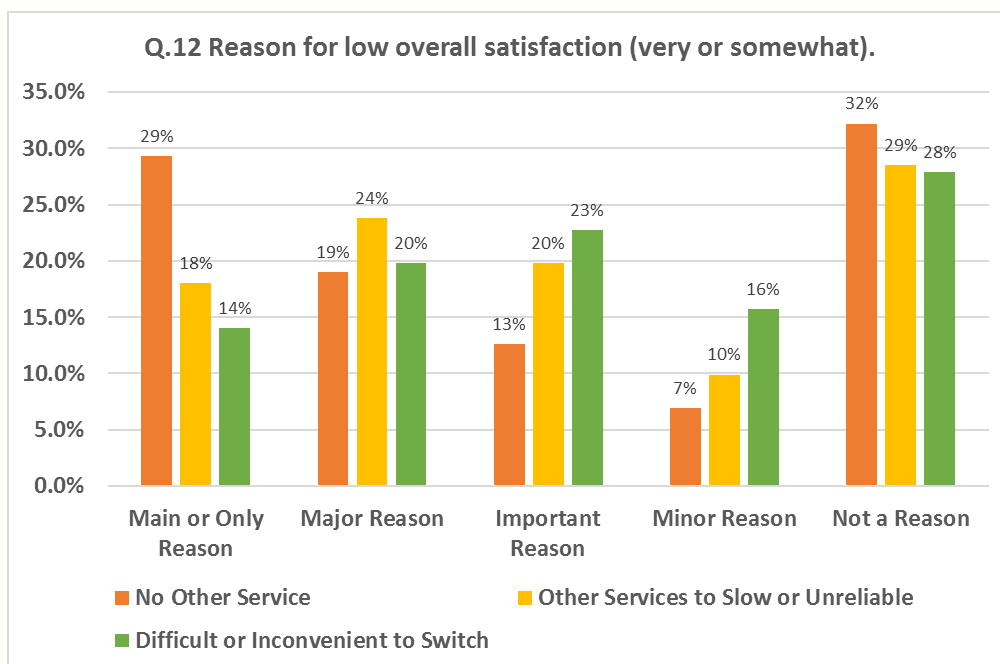
In regards to customer satisfaction, only a small percentage of the respondents reported being very satisfied with any of the five variables. This ranged from just 13% being very satisfied with tech support and customer service to 21% being very satisfied with internet access. Overall, the level of satisfaction is on the low side with all five variables. Price is where customers are most dissatisfied, with over 50% indicating they were either “somewhat dissatisfied” or “very dissatisfied.”

⁵⁸ (U.S. Census / Digital Divide)



Of those expressing low overall satisfaction, 61% indicated that there were no other (internet) service options in their area and 62% were dissatisfied because the connection was slow or unreliable. These results suggest an opportunity for a provider with high-speed, reliable broadband to capture significant market share with the residential sector.

Figure 36. Residential Survey Results – Reasons for Low Overall Satisfaction



Magellan conducted a speed test among respondents⁵⁹, which revealed that both the actual download and actual upload speeds are less than what was contracted or advertised by the provider. It should be noted that the actual speed tested may not be entirely accurate as some may have measured their speed with a Wi-Fi connection.

In general, most respondents are receiving other services from their broadband provider. In addition to traditional internet services, more and more households are turning to ISPs for complementary phone and TV services. In many cases, these are the result of “bundles” offered by service providers. These bundles typically include telephone and television services, alongside internet service.

Increasingly, television is being consumed on-demand, streamed, and accessed away from traditional scheduled broadcast programming. Services such as Netflix, Sling, Hulu, Roku, YouTube TV, Amazon, and others increasingly deliver their content via the internet for a small monthly access fee. Even traditional broadcasters, such as CBS or ABC, or

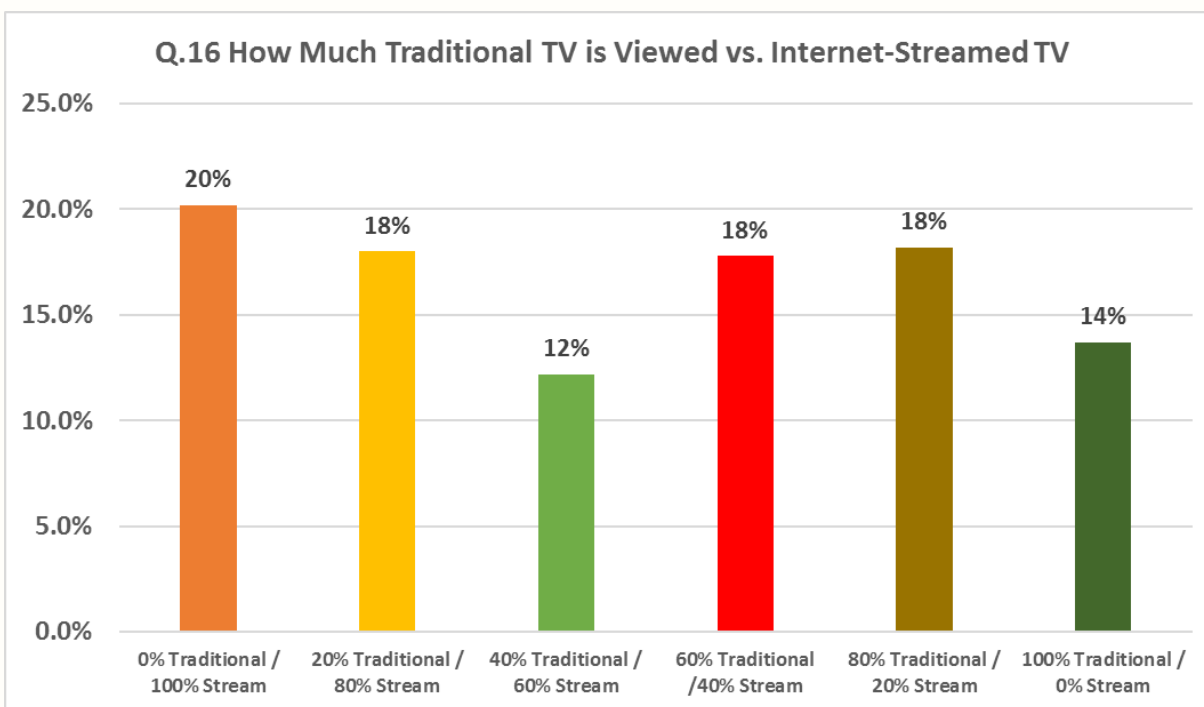
⁵⁹ Ookla, a global leader in internet testing, data and analysis, provides a speed test that measures internet performance and network diagnostics. Using this test, bandwidth speeds were tested among survey respondents to identify true broadband speeds.



sports networks, such as ESPN, have introduced subscription services, where content can be accessed directly. All of these services deliver their content via broadband internet, where they can be consumed on smart TVs, smart phones, or any internet-connected device.

Survey responses indicated that these trends are also present among the residents of San Leandro. Of the households responding, only 14% indicated they did not stream video and 40% indicated they streamed at least 60% of the time. The internet subscription model can be expected to increase in the coming years, increasing demand for unlimited, high-speed broadband.

Figure 37. Residential Survey Results – Traditional vs. Streamed Television



The survey also indicates the high degree to which San Leandro residents have integrated broadband access into their daily lives, for personal, health, education, business and work needs, with many respondents indicating that they access the internet for learning, business, or work on a daily basis.

Demand is strong in San Leandro, with numbers of connected devices set to climb as more services and 5G devices come to market. While the survey did not ask for specific devices inside the home that connect to the internet, the most current U.S. research⁶⁰ finds that devices related to security lead the way as the most used among households, followed by devices that help manage utilities and energy consumption, smart appliances, health monitoring, and entertainment/gaming systems.

⁶⁰ Delivering on the Promise of Connected Homes: www.mckinsey.com/spContent/connected_home





Gartner Research says there were 174 million smart homes in 2015, and that number almost doubled in 2016 to 339 million. Consumer applications fueling the growth of smart homes are smart TVs, smart lighting and various automation tools, such as smart thermostats, home security systems and kitchen appliances. Overall, the total number of connected devices is expected to hit 1.6 billion, up from 1.2 billion in 2016.⁶¹

Further evidence of these trends is that, for the first time ever, 53% of U.S. households have smart TVs that connect to the internet.⁶² Many multimedia entertainment systems, thermostats, irrigation systems, food storage and preparation areas, and security and monitoring systems are now connected to the internet, consuming even more home broadband bandwidth. In the coming years, the explosion of internet-connected devices in and around the “smart home” will lead to increased use of always-on residential broadband connections.

Enabling smart homes is the ability to wirelessly connect all the various devices around the house quickly and conveniently. This wireless connection is most commonly made through Wi-Fi technology, which is often done through the use of a router with wireless functionality. With the ease of Wi-Fi connectivity, homes are consuming more video and streaming applications, which require significant bandwidth and reliability from their broadband connections.

Today, average monthly broadband usage in U.S. homes is 190 gigabytes per month.⁶³ More than 95% of this traffic is video, as TV watching has moved from a group activity where the whole family might watch the same show, to now being a personal activity. This means that not only are homes watching video over the internet, but also that if four people live in a household, four times the data is being consumed.

A majority⁶⁴ of the households indicated they would subscribe to a community broadband network offering download speeds of at least 100 Mbps. Responses also indicate that most of the households are interested in higher bandwidth/speed with price acceptance points varying by speed.

With at least 34% of responders using the City’s free public Wi-Fi (SL-WiFiber), it is likely that more would use the service if it was promoted and/or additional hot spots were added.

⁶¹ <http://www.gartner.com/newsroom/id/3175418>

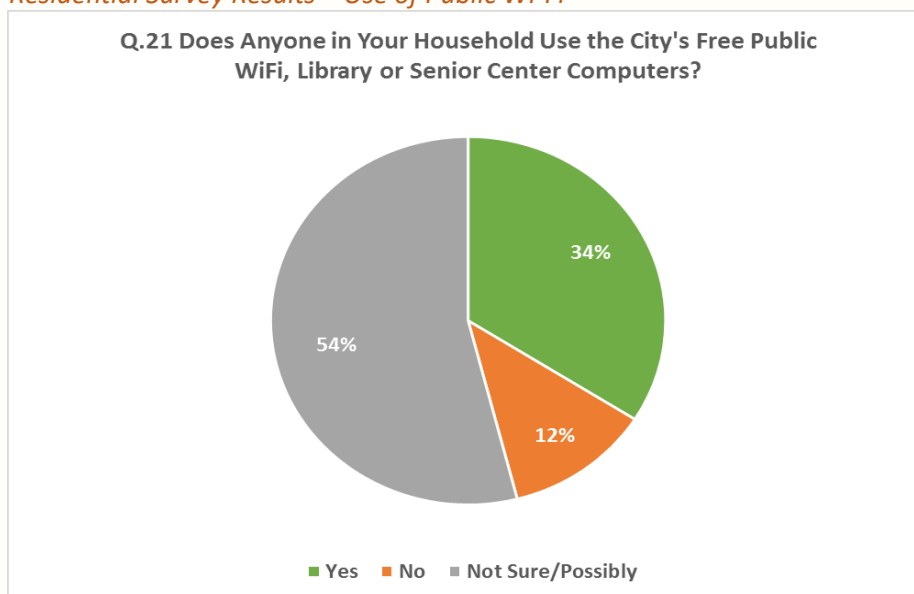
⁶² <http://www.broadcastingcable.com/sites/default/files/public/pdf/MagidTubeMogulPressReleaseFINAL.pdf>

⁶³ <http://igr-inc.com/advisory-subscription-services/wireless-mobile-landscape>

⁶⁴ 67% of survey respondents



Figure 38. Residential Survey Results – Use of Public Wi-Fi



In general, the City’s internet service at the various locations is marginal with the residential segment.

- **Library Wi-Fi:** 56% rate as good or excellent and 44% rate as average to poor.
- **Library Computer:** 51% rate as good or excellent, and 49% rate as average to poor.
- **Senior Center:** 45% rate as good or excellent, and 55% rate as average to poor.
- **Community Center:** 45% rate as good or excellent, and 55% rate as average to poor.
- **Public Wi-Fi:** 38% rate as good or excellent, and 62% rate as average to poor.

Although the focus of this Report is on connecting businesses and anchor institutions in an incremental fashion, these results provide strong evidence that eventual expansion of San Leandro’s network to include residential services throughout the City is supported. For the purposes of the current needs and capabilities of the City, this report focuses on addressing issues of digital inclusion at this point in time; further evaluation is required to better understand how a residential offering might function in San Leandro.

DIGITAL INCLUSION

Through discussions with San Leandro Management Staff and City Councilmembers, it was clear that there is a strong desire to support underserved community members through programs and services that help close the digital divide, homework gap, and remove the language barrier to communications. Collectively, such programs address a concept called “Digital Inclusion.”

Digital Inclusion is defined as the “ability of individuals and groups to access and use information and communication technologies (ICTs). Digital inclusion encompasses not



only access to the Internet but also the availability of hardware and software; relevant content and services; and training for the digital literacy skills required for effective use of information and communication technologies.”⁶⁵

The Digital Divide, meanwhile, is understood to be the gap between those members of society with access to modern information and communication technologies (ICT) and those without it.⁶⁶ For practical reasons, the San Leandro Smart City Strategy will consider lack of residential broadband internet access, whether because it is unavailable or, just as likely, it is unaffordable, to be the defining characteristic of the Digital Divide in San Leandro. While some may suggest that smartphones can be a substitute for home broadband, Pew Research found that cellular and smartphone service doesn’t bridge the Digital Divide for these individuals and families still face constraints in doing things such as online research, filling out job applications, accessing and reading content that is not mobile-friendly, and more.⁶⁷ For students, whether in K-12 or higher education, this lack of home internet can manifest itself as the “Homework Gap.” The Benton Foundation has called the Digital Divide the “number-one threat to community and economic development in the 21st century.”⁶⁸

Regarding computer ownership, 88.8% of San Leandro residents have a computer or handheld device, which is just below the 89.7% at the state level.⁶⁹

Figure 39. San Leandro Computer Ownership

Subject	San Leandro city, California			
	Total		Percent	
	Estimate	Margin of Error	Estimate	Margin of Error
Total households	32,325	+/-2,030	(X)	(X)
TYPES OF COMPUTER				
Has a computer	28,708	+/-1,681	88.8%	+/-2.9
Desktop or laptop	26,354	+/-1,594	81.5%	+/-3.5
Desktop or laptop alone	3,840	+/-881	11.9%	+/-2.6
Handheld computer	24,379	+/-1,529	75.4%	+/-3.5
Handheld computer alone	1,791	+/-716	5.5%	+/-2.1
Other computer	3,555	+/-1,094	11.0%	+/-3.6
Other computer alone	319	+/-404	1.0%	+/-1.2
No computer	3,617	+/-1,046	11.2%	+/-2.9

However, only 77.6% of households have a broadband internet subscription, which is less than the 81.3% at the state level.⁷⁰ To put that another way, 22.4% of San Leandrans do not have a home broadband subscription. While some fraction of this subset may be

⁶⁵ https://www.imls.gov/assets/1/AssetManager/BuildingDigitalCommunities_Framework.pdf

⁶⁶ <https://whatis.techtarget.com/definition/digital-divide>

⁶⁷ <http://www.pewresearch.org/fact-tank/2016/10/03/smartphones-help-those-without-broadband-get-online-but-dont-necessarily-bridge-the-digital-divide/>

⁶⁸ <https://www.benton.org/headlines/2015-digital-divide-index>

⁶⁹ <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

⁷⁰ <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>



choosing to opt out of home broadband, for many it may be likely that residential broadband internet is either not available or is not affordable.

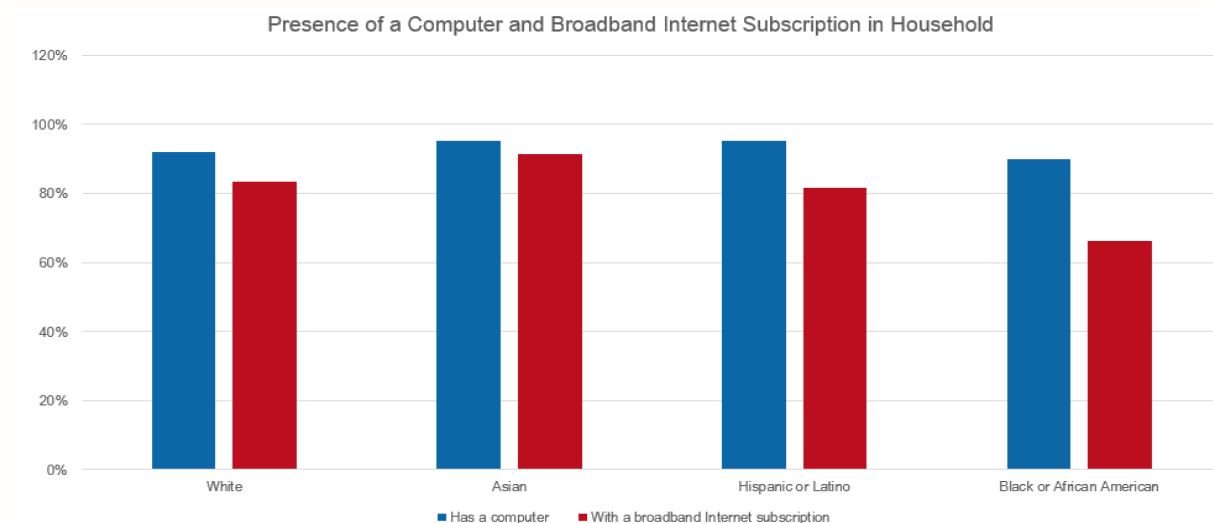
Figure 40. Presence and Types of Internet Subscriptions in Household

Presence and Types of Internet Subscriptions in Household

Subject	San Leandro city, California			
	Total	Margin of Error	Percent	Margin of Error
	Estimate		Estimate	
Total households	32,325	+/-2,030	(X)	(X)
TYPE OF INTERNET SUBSCRIPTIONS				
With an Internet subscription:	25,441	+/-1,606	78.7%	+/-3.8
Dial-up alone (no broadband subscription)	367	+/-246	1.1%	+/-0.8
With broadband subscription:	25,074	+/-1,588	77.6%	+/-3.8
DSL	4,757	+/-935	14.7%	+/-2.8
Mobile broadband	13,690	+/-1,606	42.4%	+/-4.6
Mobile broadband alone or with dialup	2,390	+/-778	7.4%	+/-2.4
Cable modem	12,350	+/-1,456	38.2%	+/-4.4
Fiber-optic	1,142	+/-462	3.5%	+/-1.5
Satellite Internet service	851	+/-398	2.6%	+/-1.2
Without an Internet subscription	6,884	+/-1,440	21.3%	+/-3.8

Demographically, computer ownership and internet subscription rates are high, and particularly encouraging in San Leandro for the Hispanic/Latino community. However, African Americans lag behind Whites, Asians, and Hispanics on both measures.⁷¹

Figure 41. Presence of a Computer Broadband Internet Subscription in Household

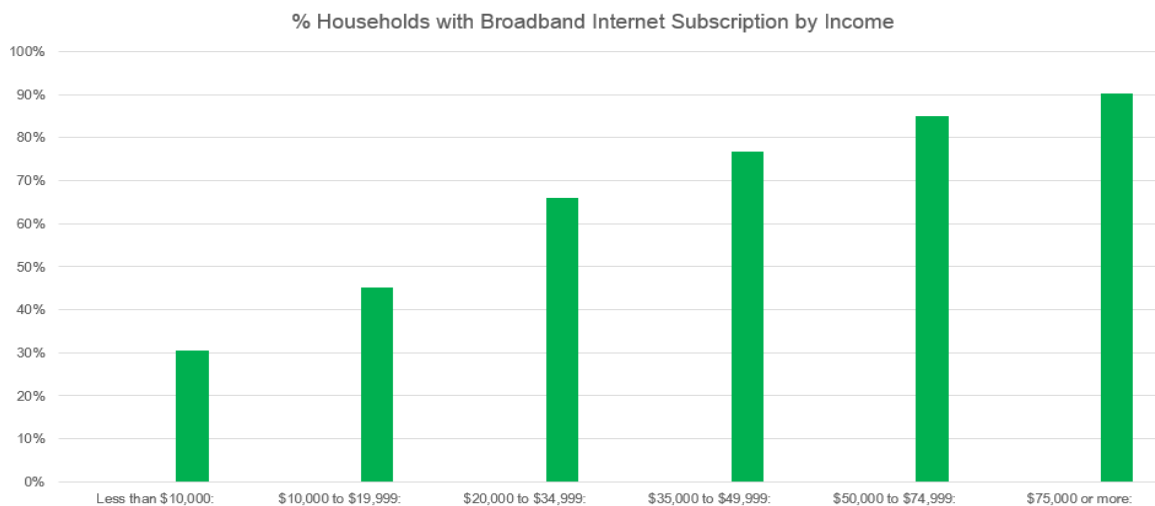


⁷¹ <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>



Income distribution is where the Digital Divide can be most clearly seen. While 80% of households in San Leandro with annual incomes of \$75,000 or higher have broadband internet subscriptions, the number falls sharply to just 30% for households with less than \$10,000.⁷²

Figure 42. Percent of Households with Internet by Income



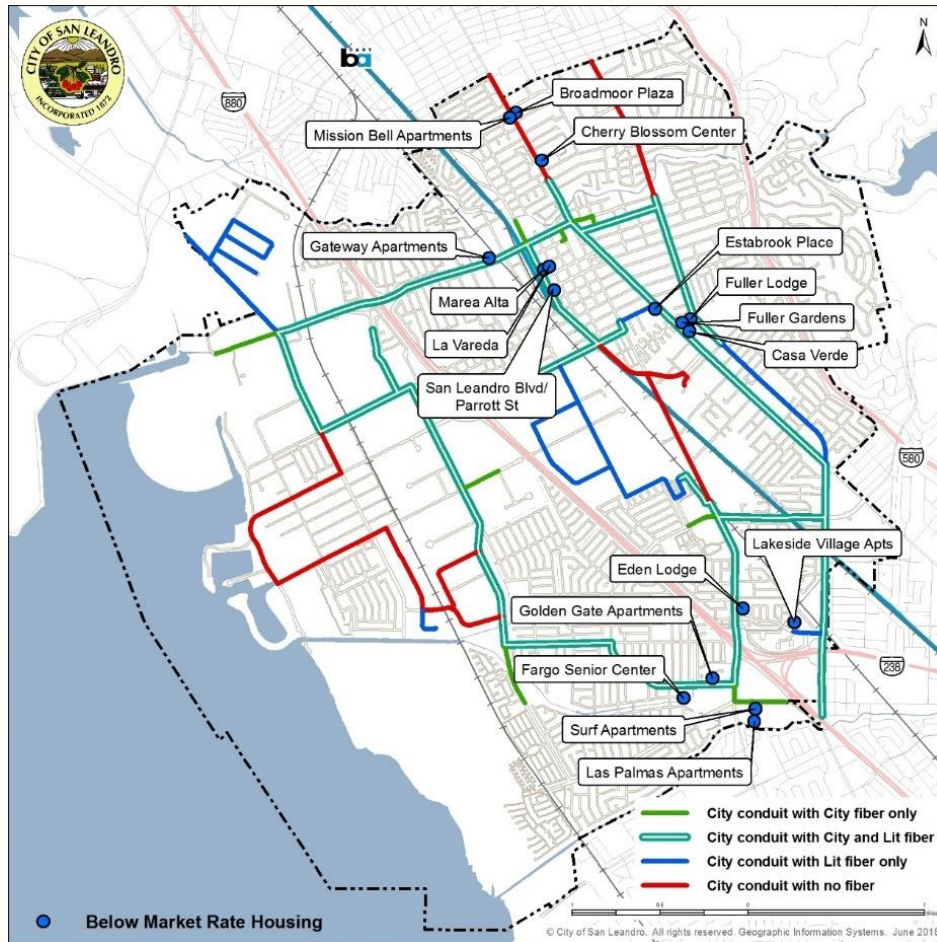
San Leandro can utilize its fiber optics network to develop models to address these needs. Public Wi-Fi can be very effective tool in delivering free, high speed internet to residents of the City. As the City itself has a surplus of internet bandwidth (the City, through its fiber optic network, has a one gigabit internet connection and only uses 20-30% every month), it makes sense to devise methods to deliver that excess internet bandwidth to pockets of the community where it is needed most. Wi-Fi and the fiber network are the medium with which this can be done.

To make effective investments, San Leandro should focus on affordable housing projects that likely have the highest need. The map below shows all the existing and upcoming affordable housing within the City. By leveraging its existing fiber and Wi-Fi infrastructure, the City can potentially help encourage low income housing developers to invest in broadband infrastructure in their projects, such as wiring for in-unit Wi-Fi and procuring Wi-Fi hardware. This Plan recommends that City Staff make this process easy to understand by articulating simple guidelines, partnering with developers, and utilizing its service providers to manage technical details and design challenges.

⁷² <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>



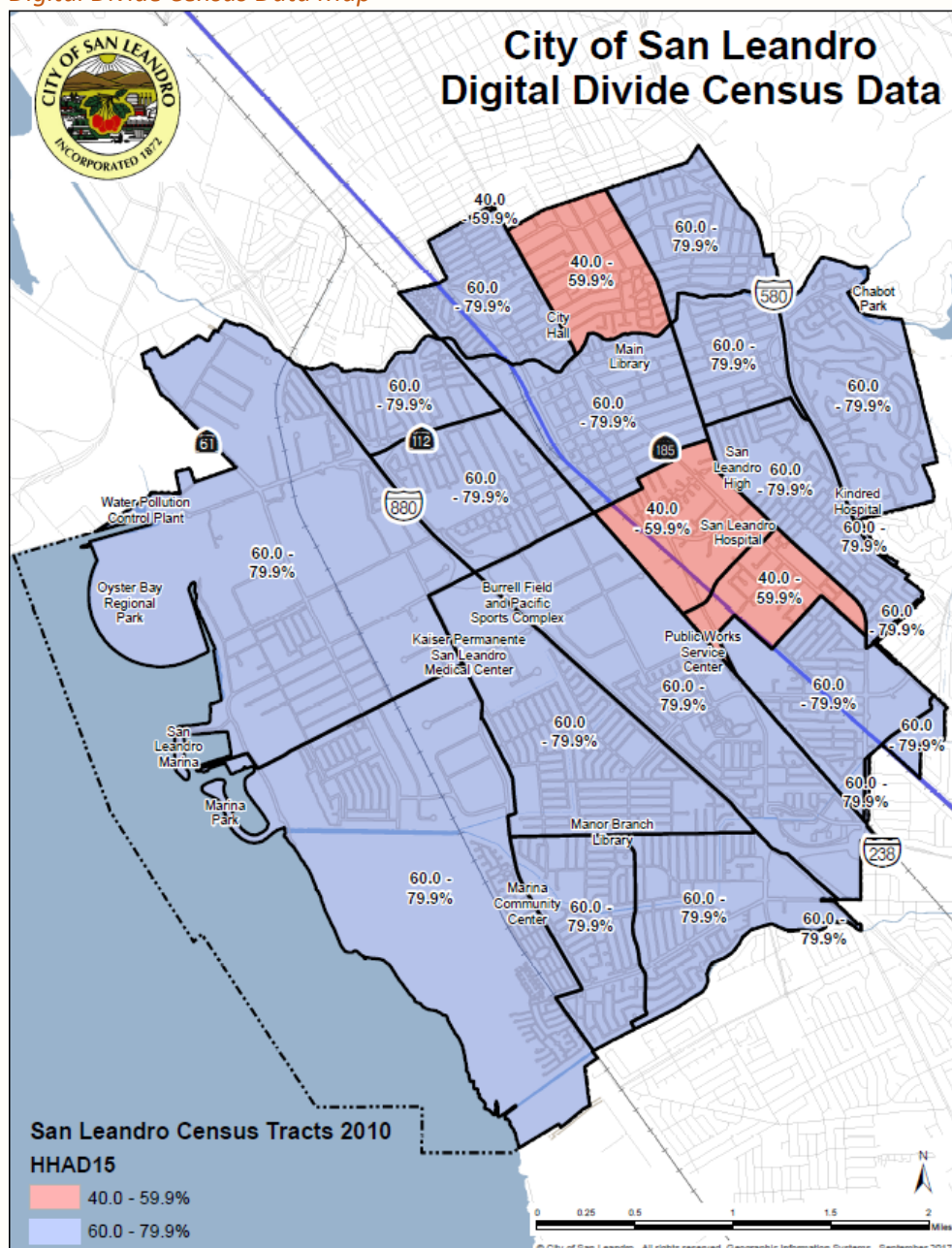
Figure 43. Affordable Housing Map



In addition, research done by the FCC identifies the census tracts with the lowest home broadband adoption. Future projects to provide free or low-cost internet service can target these areas as pilots, based on their being the areas of the biggest need.



Figure 44. Digital Divide Census Data Map



Finally, Digital Inclusion includes creating content and programs that help develop digital literacy. The City of San Leandro is very proficient at outreach in multiple languages and creating programs that support its very diverse community base. In addition, computer labs in the Library System and Senior Community Center offer residents free internet access and support. The City can continue to build on these successes by doing the following:



- Offer computer training in languages other than English at community centers and/or public libraries.
- Consider partnering with local nonprofit(s) to offer the computer training and/or train or place volunteers onsite. The nonprofits can place trainers and/or run events onsite.
- Consider purchasing a mobile computer lab for the community centers and/or libraries. Since the centers have Wi-Fi, they would be able to offer training in different rooms, or other sites / events.
- Consider purchasing a license for online language training for the library and/or school, and offer help sessions on how to use it.
- Offer information about discount broadband and training opportunities at community events. ISPs and/or nonprofits could set up booths.
- Partner with the San Leandro and San Lorenzo Unified School District's to develop outreach materials for students to bring home for parents and other family members that promote the City's services and Digital Inclusion training programs.
- The City can also develop an annual hackathon at its public library that brings together the civic technology community from throughout the greater Bay Area and beyond. A virtual hackathon could include participants from all over the world to develop smart city solutions that are aligned with this vision and recommendations of this Strategy.
- The City can research lendable internet hotspots programs, that allow residents to borrow Wi-Fi and cellular hotspots from the Library, just as they would books and other media. These programs have been successful throughout the country, including in Alameda County.
- Lastly, the City can look to partner with organizations that repurpose old desktop and laptop computers and give them away to members of the public. Such a program would replace the City's current e-waste policy for legacy PCs.

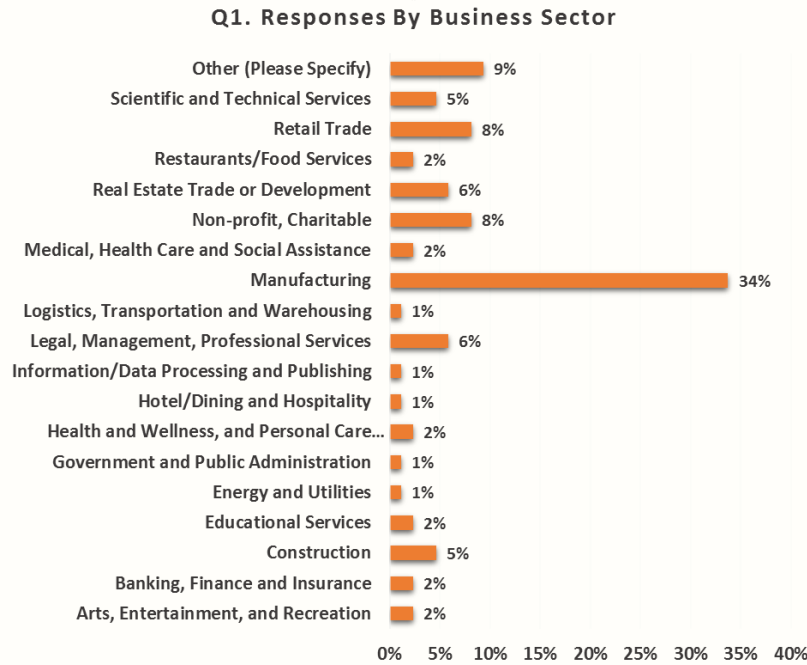
Business Survey and Needs Assessment

As noted, there were a total of 86 responses to the business survey, of which 59 completed the survey⁷³. Of these, 34% of the responding businesses were in manufacturing, the most of any sector. Those that indicated "other" included claims processing services, printing, design, packaging/supply, marketing and software services.

⁷³ Refer to Appendix D for maps of business survey results.



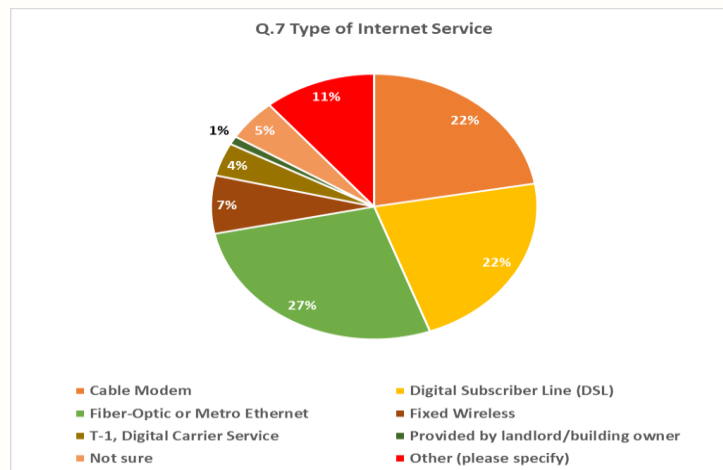
Figure 45. Business Survey Results – Responses by Business Sector



On average, the businesses responding to the survey had 1 location in San Leandro (maximum of 4 San Leandro locations), 3 total locations in other geographic locations (maximum of 34), 38 employees in San Leandro (maximum of 500 in San Leandro), and an average of 148 total employees (maximum of 3,000).

All of the businesses responding indicated they had internet service. The top three types of internet service the businesses used were Fiber (27%), DSL (22%) and Cable Modem (22%). The other category (11%) included CrossLink Networks, Fiber-to-node (Sonic), Microwave, MPLS, The Gate High Speed and U-Verse.

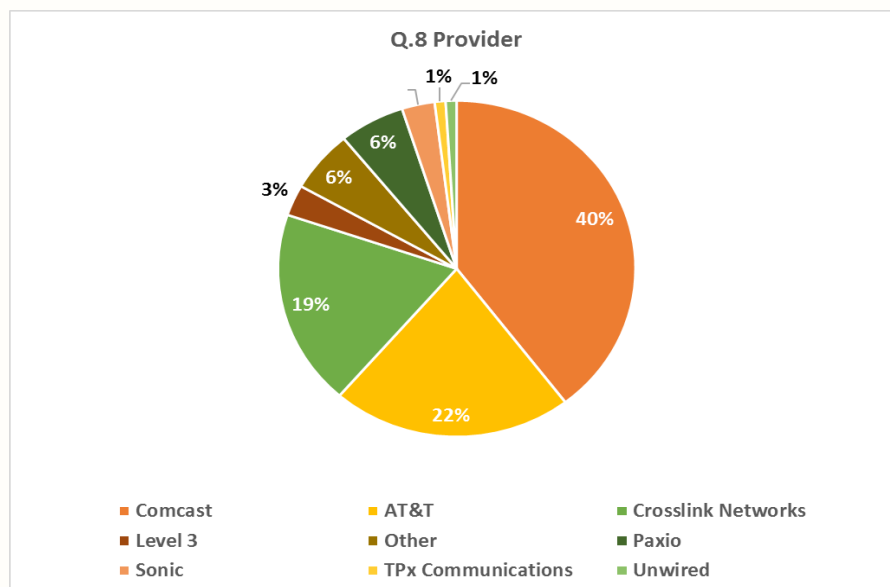
Figure 46. Business Survey Results – Type of Internet Service





Comcast (40%), AT&T (22%) and Crosslink Networks (19%) were the primary providers of internet service to the businesses. A handful of businesses subscribed to Level 3, Sonic, TPx and Paxio.

Figure 47. Business Survey Results – Internet Service Providers



The following table indicates average download/upload speed (contracted/advertised), as well as the average monthly cost by provider.

Figure 48. Business Survey Results – Contracted Vs. Actual Provider Speeds

Provider	Avg. Download Mbps (Contracted)	Avg. Upload Mbps (Contracted)	Avg. Monthly Cost
Comcast	64	22	\$184.15
AT&T	29	10	\$66.09
Crosslink	309	311	\$435.69
Level 3	26	26	\$756
Paxio	549	549	\$356
Sonic	16	6	\$173
TPx Comm	20	20	\$180
Other	25	25	\$280
Unwired	12	3	\$160

When measuring the actual download and upload speeds (using respondent-reported Ookla results), the results were much less than advertised for the 3 primary providers.



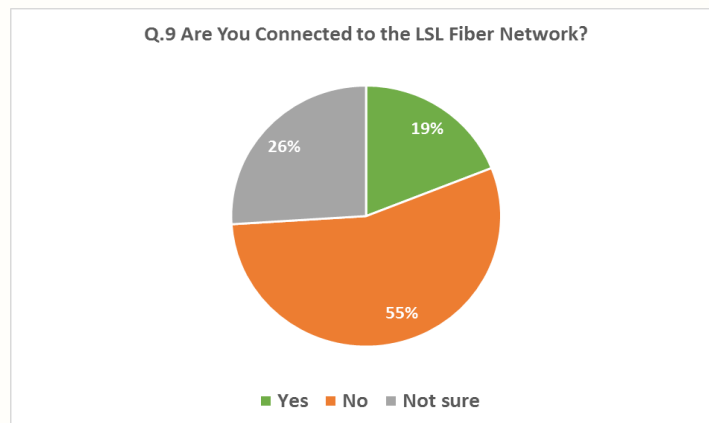
Comcast: 43 Mbps Down / 23 Mbps Up

AT&T: 12 Mbps Down / 2 Mbps Up

Crosslink Networks: 67 Mbps Down / 47 Mbps up

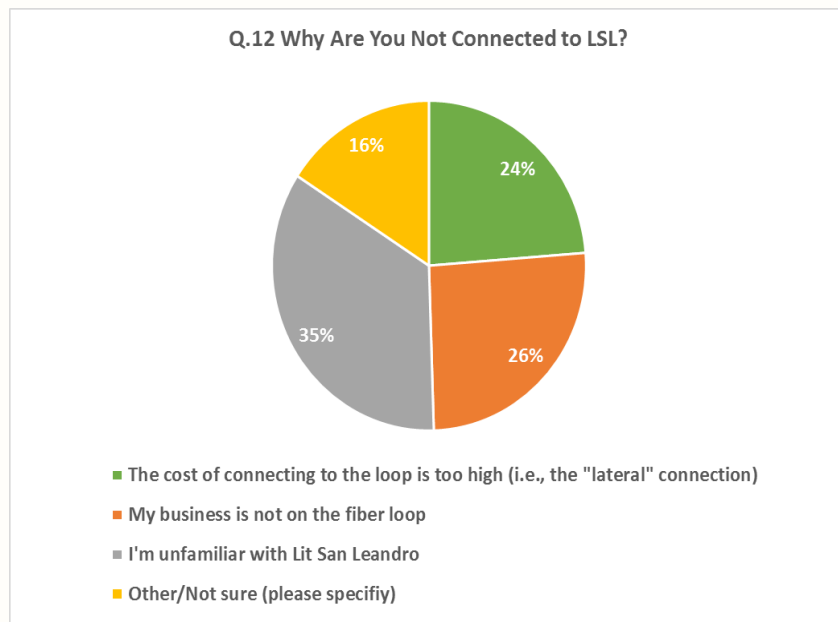
Among respondents, 19% indicated they were connected to the Lit San Leandro Fiber network. Of those, 71% had Crosslink Networks as their internet provider, 14% used Paxio, 7% were unwired and 7% did not know their ISP.

Figure 49. Business Survey Results – Connection to LSL Fiber Network



Of those businesses responding that were on the fiber loop route, 24% indicated they were not on LSL because the price was too high. Moreover, 35% were not familiar with LSL but it was unclear if they were on the fiber loop.

Figure 50. Business Survey Results – Reasons for No Connection to LSL Network





Additional comments from businesses not on LSL included:

“Got a good deal from AT&T; but ready to look at changing”

“Is it available or in use at Marina / Verna Court?”

“My business model does not benefit from the faster speeds”

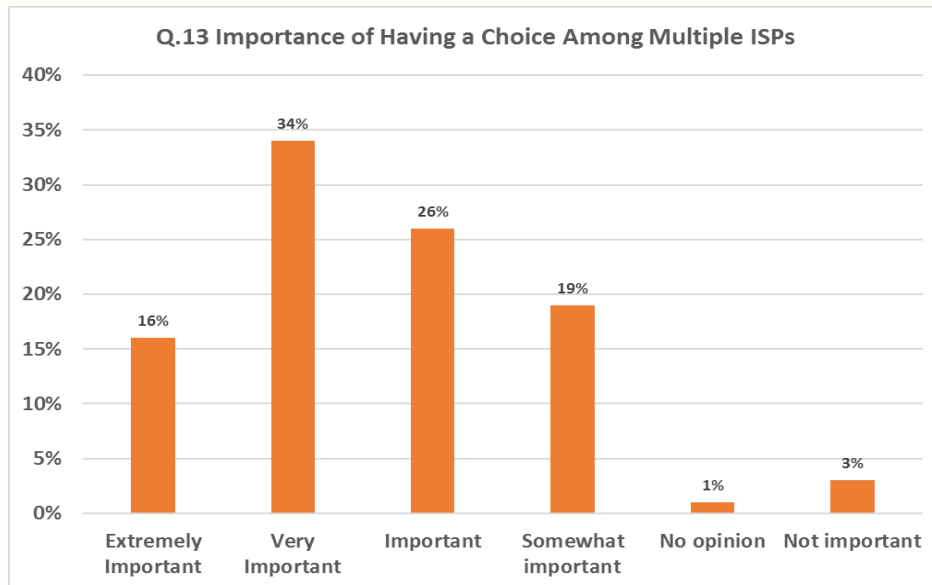
“Dedicated network with all facilities”

“Was not available when we were looking”

“Have not been made aware of the details of that service”

In general, most businesses responding to the survey indicated that having a choice of multiple ISPs was important to extremely important (76%).

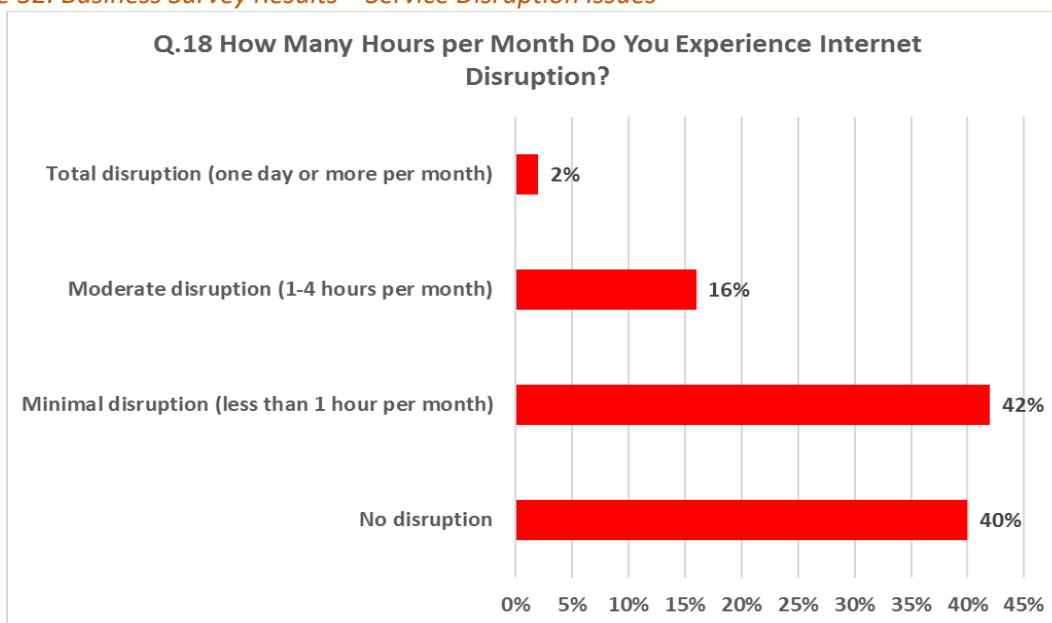
Figure 51. Business Survey Results – Importance of Choice of Provider



Most businesses indicated having little disruption with their internet service, yet 18% indicated having some issues.

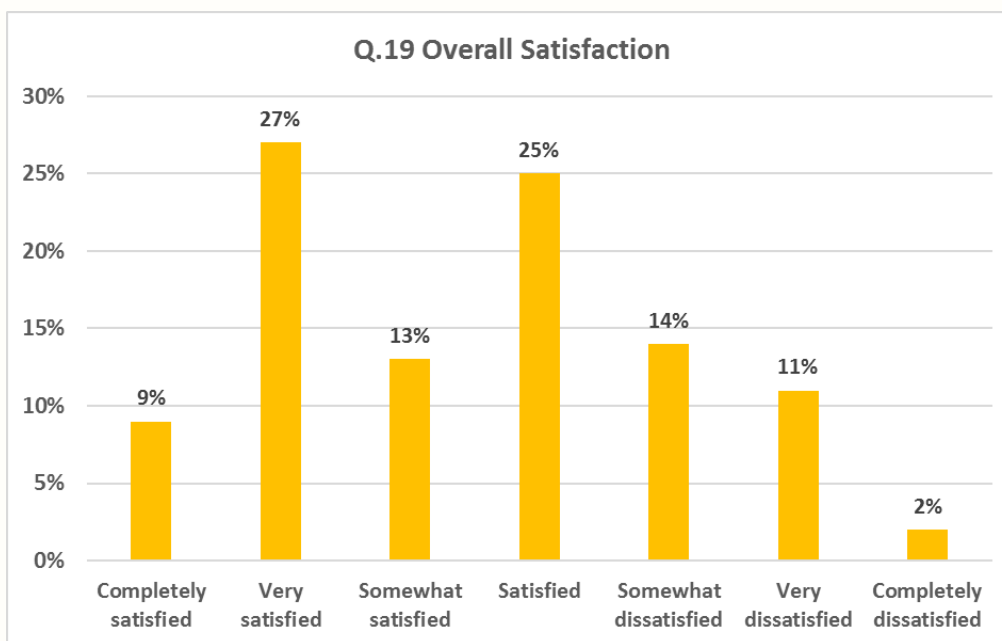


Figure 52. Business Survey Results – Service Disruption Issues



Of the businesses responding, 74% indicated some level of satisfaction with their overall internet service, with 36% indicating they were very to completely satisfied.

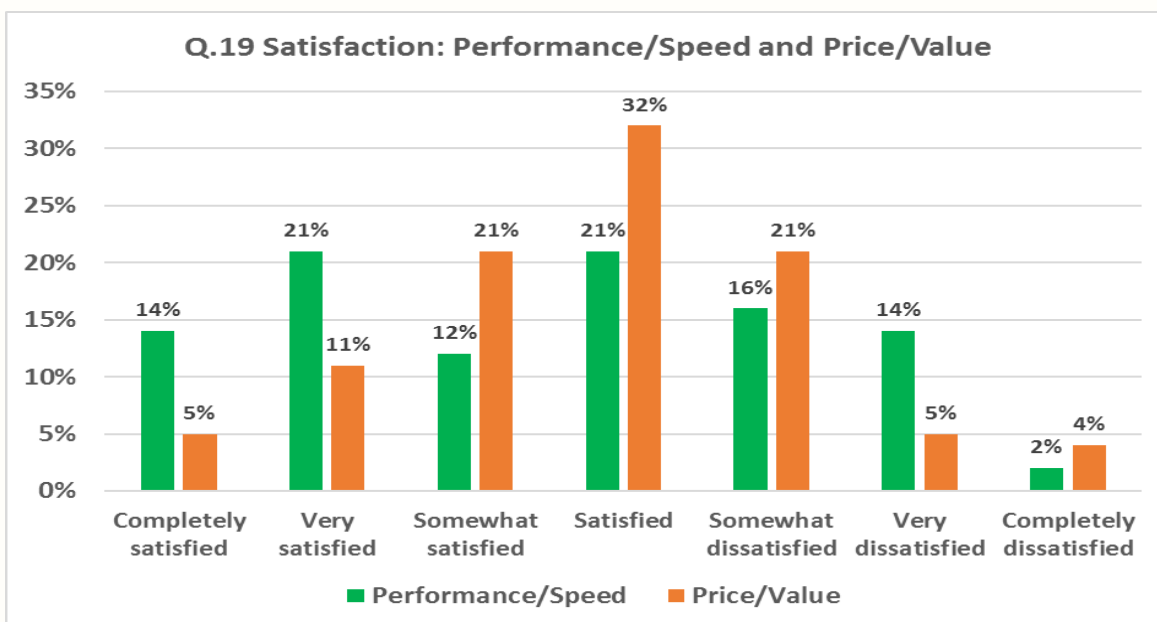
Figure 53. Business Survey Results – Overall Satisfaction with Service



Performance/speed and price/value received slightly less favorable ratings, with 68% and 69% respectively – indicating some level of satisfaction.

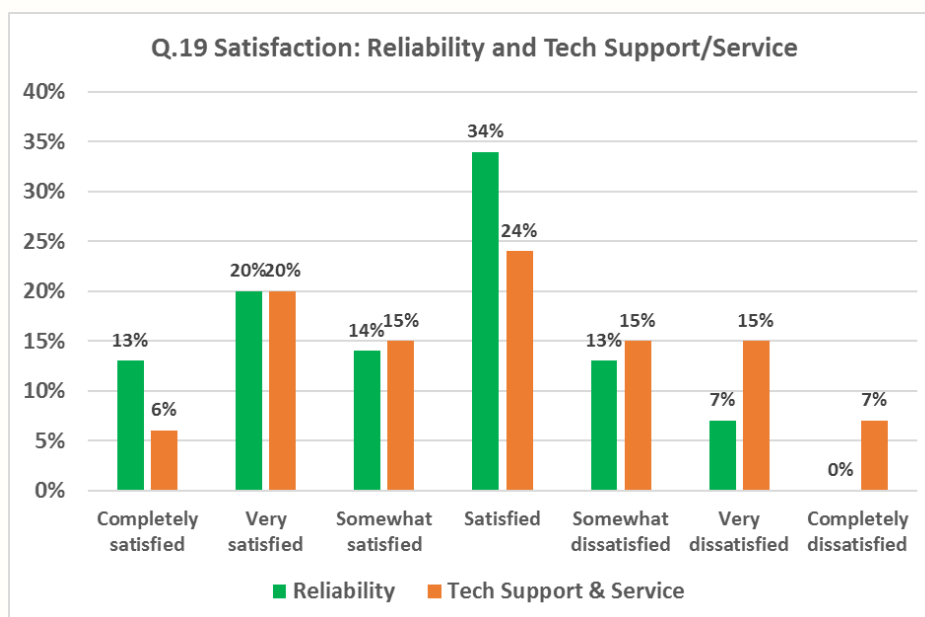


Figure 54. Business Survey Results – Satisfaction Factors



Approximately 81% of business had some level of satisfaction with the reliability of internet services, and 65% had some level of satisfaction with technical support and customer service.

Figure 55. Business Survey Results – Satisfaction with Reliability and Tech Support



Other comments related to the significant impacts of internet service disruption to businesses or organizations over the past year included:



“AT&T disrupted internet service; switched providers to Comcast 3 months ago”

“Had to work in a coffee shop when connection was down”

“Had to have Comcast come in 18-20 times over the course of 2 years due to major interruption issues and their prices continue to rise; I need a secure network”

“Router issue – problem with IP address, replaced and new one provided”

“Slow speeds”

“Someone hacked IP addresses and we had to get a new set; it said we were located in Iran and caused a lot of issues”

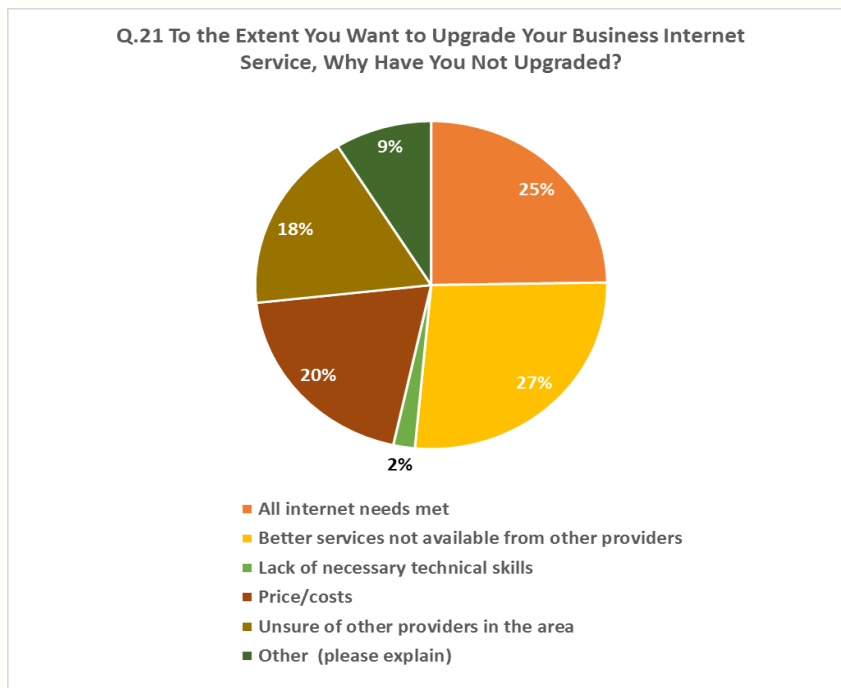
“Was a couple days without internet because the building is old and a new neighbor moved in; when their internet was connected a couple of our lines went down.”

“We had 2 outages last year – one of which lasted several hours, perhaps even a day; PAXIO was very proactive in resolving it and promised to upgrade infrastructure to prevent such events in the future”

“We run entirely on internet for our payments, etc.; if it goes out, it’s a big deal”

With just 25% of responding businesses indicating all internet needs have been met, there appears to be a high potential for businesses upgrading their internet service in the future. Reasons for not yet pursuing these upgrades were given as follows in Figure 54.

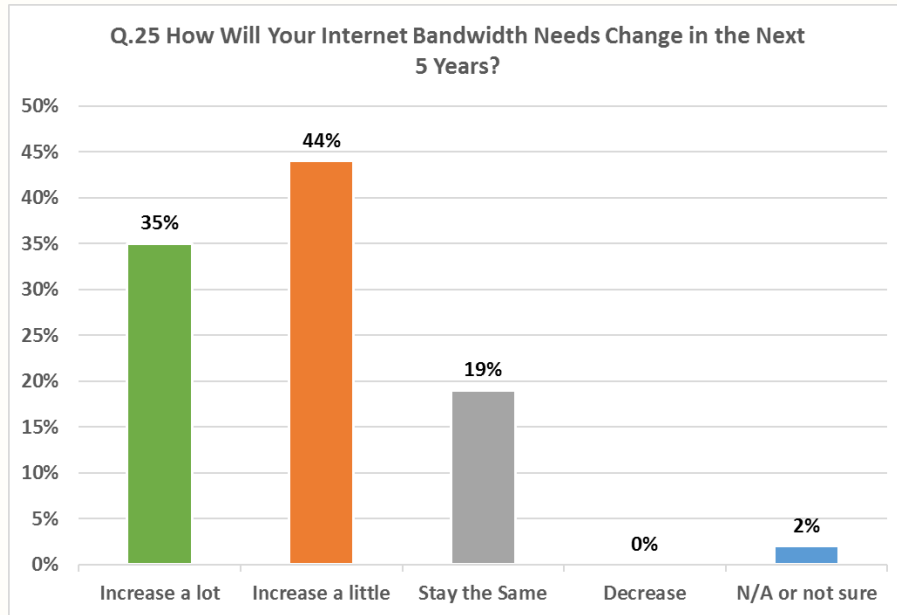
Figure 56. Business Survey Results – Reasons for Not Upgrading Service





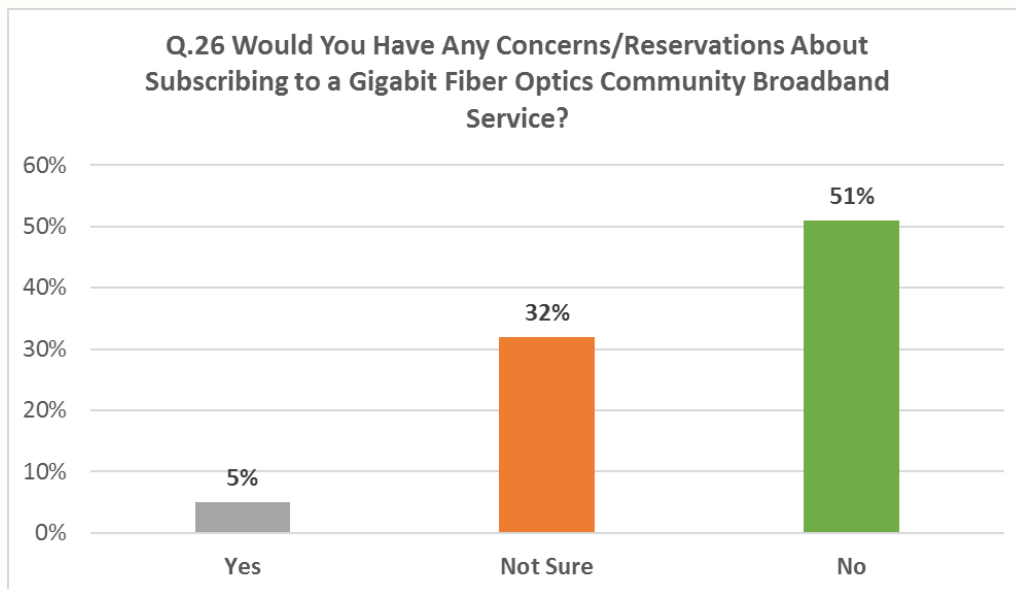
Almost 80% of businesses expect their internet and broadband needs to grow over the next 5 years, with 35% anticipating significant growth in usage.

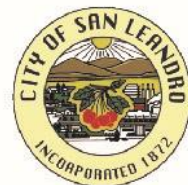
Figure 57. Business Survey Results – Changing Needs in the Next 5 Years



Just over half of the businesses indicated they would be open to subscribing to a community (fiber-optic) broadband service.

Figure 58. Business Survey Results – Openness to Community Broadband Service





The survey asked businesses to imagine having a fiber-optic internet connection with unlimited speed and data and how this might enable them to enhance overall performance and improve their bottom line. Some of these benefits included:

“Being able to offer Wifi to my customers and speeding up daily operations”

“Better customer service”

“Decrease wait times for employees doing work online”

“Definitely will improve my international TV and phone line calls, as well as emails”

“Ease of transferring large print files for printing/proofing purposes”

“I do a lot of my business virtually via webinars and uploading/downloading to secure sites; I use a lot of sensitive data, must have a 100% secure system”

“Improved VoIP and video call quality would be great, having to use a cell phone due to slow internet does not make my business look professional; I sometimes need to download client videos – current connection speeds make that problematic”

“It could enable us to provide streaming ART culture, education, training and entertainment to a global audience; I have suggested for years for the city to monetize the fiber loop with internet services, email services and anything else that can be offered to the community at a discounted rate while providing superior reliability, services and experience; glad to see it is manifesting”

“It could improve our deliverables to our clients”

“It may save us time throughout the day working with large files that we transmit online including via email; email service would speed up”

“It would give us a unique value proposition as we work with technology companies whom are our signed-up employers to impact our schools; all our technologies use internet for the most part – so modeling great use and connectivity would be important to our customers”

“Many of our programs are cloud based and time is money”

“No outages causing slow-down of classes or lack of payment; could also offer co-work space”

“Purchase newer manufacturing equipment that can tie to the internet; better communication with staff and monitoring devices”

“That will help our company download and upload files faster; saving time and keeping our business growing and more reliable with our customers”

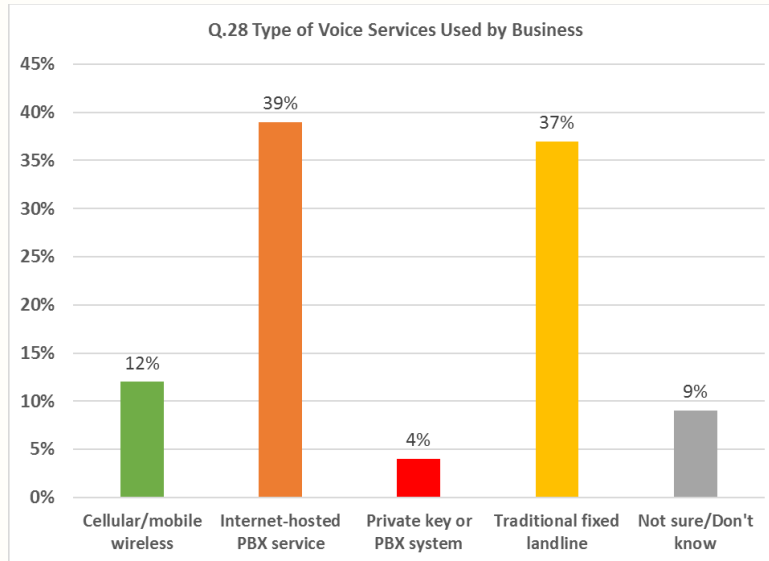
“We could add business management and customer entertainment to future retail locations that would enhance customer experience and business functionality – potentially in highly impactful ways”

“We could install crucial monitoring systems such as security cameras”



Almost 40% of businesses indicated they were using an internet-hosted/cloud PBX / VoIP solution for their voice services.

Figure 59. Business Survey Results – Type of Voice Services Used



Respondents indicated that the average monthly price paid for services is as follows:

Internet:	\$237
Phone (include VoIP and virtual PBX):	\$476
Video (including conferencing, TV, etc.):	\$42
Cloud Services:	\$722
WAN:	\$91
Web Hosting:	\$123
Security/Surveillance:	\$100



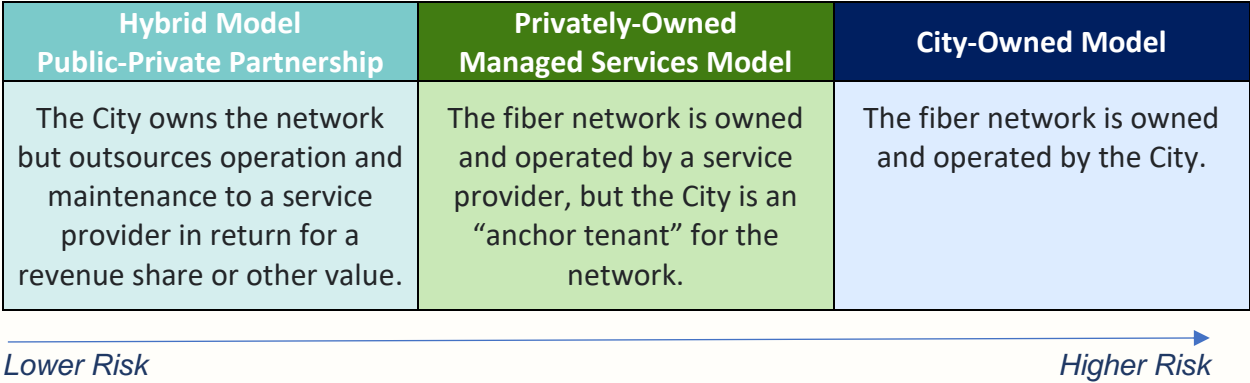
BUSINESS MODELS

In determining whether and how to provide community fiber network services, the City needs to consider the different business models that municipalities and regions use to provide broadband access capabilities. The factors that define what business model fits well within the current environment, organizational and operational capabilities of the City include competitive and market factors as well as financial and risk factors that determine what risks, rewards, and funding commitments San Leandro is willing to accept for a broadband initiative. The commonly implemented business models fall on a continuum that ranges from low risk, low investment options to higher risk, high investment options.

As the City evaluates the various business model options along the continuum, it will encounter greater degrees of risk and reward; risk, in terms of financial, operational, and regulatory risk; reward, in terms of community benefits, revenue generation, and overall potential for profit. In addition, moving “up” the continuum also implies greater local government participation in the delivery of broadband services.

These business models fall into three general types⁷⁴ as show in Figure 60 below.

Figure 60. Business Model Options



Lit San Leandro’s business model falls into the far left side of this diagram.

Also, there are variations on the City-owned, or Public model around the extent of the operation, as follows:

- Infrastructure Provider:** Municipalities lease and/or sell physical infrastructure, such as conduit, dark fiber, poles, tower space, and property to broadband service providers that need access within the community. These providers are often

⁷⁴ Further information and examples of successful municipal broadband implementations is provided in Appendix F: Municipal Broadband Business Models.



challenged with the capital costs required to construct this infrastructure, particularly in high-cost urbanized environments. The utility infrastructure provides a cost-effective alternative to providers constructing the infrastructure themselves. In these cases, municipalities generally use a utility model or enterprise fund model to develop programs to manage these infrastructure systems and offer them to broadband service providers using standardized rate structures.

- **Government Services Provider:** Municipalities that become a government service provider will utilize a fiber-optic network to interconnect multiple public organizations with fiber-optic or wireless connectivity. These organizations are generally limited to the community anchors that fall within their jurisdiction, including local governments, school districts, higher educational organizations, public safety organizations, utilities, and occasionally healthcare providers. The majority of these anchors require connectivity and often, the municipal network provides higher capacity at lower costs than these organizations are able to obtain commercially. Municipal and utility networks across the country have been built to interconnect cities, counties, school districts, and utilities to one another at lower costs and with long-term growth capabilities that support these organizations' future needs and protect them from rising costs. In these cases, government service providers may be cities, counties, or consortia that build and maintain the network. The providers utilize inter-local agreements between public agencies to establish connectivity, rates, and the terms and conditions of service.
- **Open Access Provider:** ([Recommended Option for San Leandro – Phase 2](#)) Municipalities that adopt open-access generally own a substantial fiber-optic network in their communities. Open-access allows these municipalities to “light” the fiber and equip the network with the electronics necessary to establish a “transport service” or “circuit” to service providers interconnecting with the local network. The City will provide last mile/lateral infrastructure and fiber to the building and then service providers are connected to that fiber to provide end user services. This is often referred to as a wholesale model. Open-access refers to a network that is available for any qualified service providers to utilize in order to connect their customers. It allows municipalities to provide an aggregation of local customers on a single network that are able to compete for and provide services. The concept of open-access is designed to enable competition among service providers across an open network that is owned by the municipality. The municipality retains neutrality and non-discriminatory practices with the providers who operate on the network. The municipality establishes a standard rate structure and terms of service for use by all participating service providers.
- **Retail Provider:** This involves provision of business and residential services at retail rates to customers.



Figure 61. Variations of Business Models

	PUBLIC/PRIVATE PARTNERSHIP	PRIVATE OWNERSHIP/ MANAGEMENT, CITY AS ANCHOR TENANT	CITY-OWNED/ PUBLIC OWNERSHIP & MANAGEMENT
Fiber Network Ownership	City	Private Owner	City
Construction Costs	City/Private Partner	Private Owner	City
Wireless Equipment Ownership	City/Private Partner	Private Owner	City
System Operations & Maintenance	City/Private Partner	Private Owner	City
Customer Service	City/Private Partner	Shared	City
Technology Replacement Cost	City/Private Partner	Private Owner	City
Marketing	City/Private Partner	Private Owner & City	City
Digital Inclusion Initiatives	Shared	City	City

Risk/reward profiles may be illustrated as follows in Figure 60.

Figure 62. Business Model Risks and Rewards

	PUBLIC/PRIVATE PARTNERSHIP	PRIVATE OWNERSHIP/ MANAGEMENT, CITY AS ANCHOR TENANT	CITY-OWNED / PUBLIC OWNERSHIP & MANAGEMENT
Public Financial Risk	Moderate, depending on structure	Minimal to none	Higher
Private Financial Risk	Moderate, depending on structure	Moderated by Anchor Tenancy	None
City Revenue Sources	Fiber Network & Revenue Sharing	Fees from Provider, funding for initiatives	Wholesale & Retail ISP Services
Private Revenue Sources	Wholesale & Retail ISP Services	Wholesale & Retail ISP Services	None



Factors that guides the City of San Leandro in selecting and managing the best business model for its own successful network deployment included:

- Considered other successful implementations, and drew applicable lessons;
- Considered unique needs and challenges of the community, and addressed them in planning;
- Drove to clarity of purpose among stakeholders regarding the purpose and goals for the network;
- Assessed the marketplace for current providers and services;
- Used existing City infrastructure wherever possible in network design and planning;
- Build opportunistically;
- Identified backhaul options to ensure adequate capacity;
- Planned to leverage the network for additional uses once initial deployment objectives have been satisfied;
- Maintained a long-term view of investing in and operating the network;
- Ensured clear financial expectations and sound financial projections; and,
- Opened collaboration with partners, and maintain the relationship (i.e. Lit San Leandro)



CITY OF SAN LEANDRO FUTURE BROADBAND NETWORK

This section explores the design of the City’s fiber network, an implementation strategy, an analysis of the potential business model with which the City can implement the network, and the associated costs of each alternative.

SAN LEANDRO CITY FIBER NETWORK DESIGN

Developing a city network through a two-phased implementation strategy allows the City to prioritize broadband needs, take advantage of “quick wins,” address immediate opportunities, leverage costs savings, provide for reinvestment opportunities, and to build a high-speed network that achieves the goals of the City and the greater community needs.

Figure 63. City of San Leandro Proposed Fiber Network and Buffer Zones

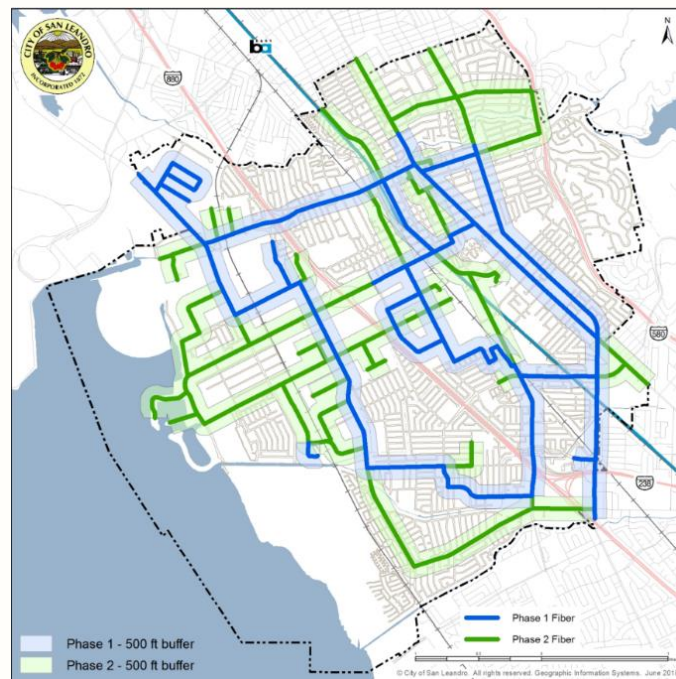


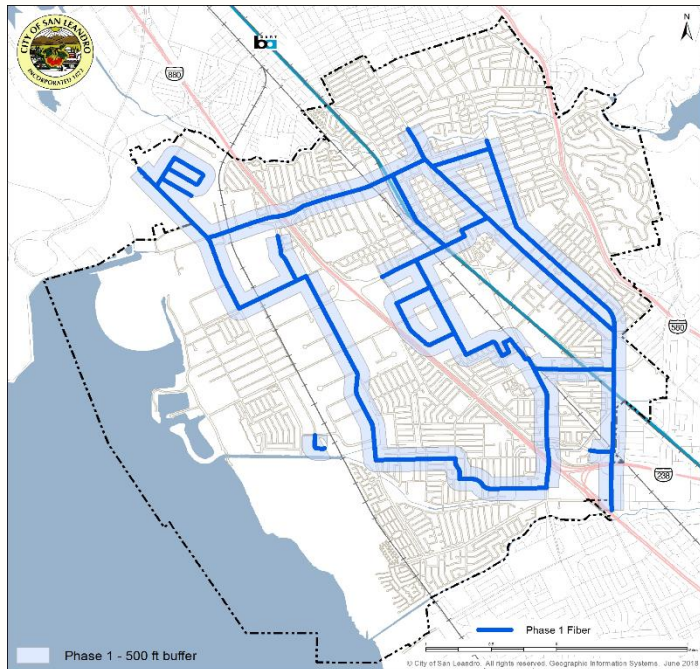
Figure 63 illustrates the completion of a two-phased approach. The buffer zone illustrates the potential of extending fiber to the business community within the areas of the network. Laterals to businesses within the buffer zones are estimated based on take rate assumptions and the costs associated with extending fiber transport services to the San Leandro business community.

This network design is based on a three-phased implementation strategy that includes:

- Phase 1- Blue Lines – Existing Fiber
- Phase 2 - Populating Existing Conduit and Planned Fiber Ext Network to support fiber for vertical assets and fiber to all businesses within 500’ of network



Figure 64. Phase 1 – Existing Fiber Network



Phase 1 is mostly finished today and is the network that the City shares with Lit San Leandro. Funds have already been expended to build this network either through direct investment by LSL, and/or through other provided grant funding.

Phase 1 covers a large portion of the City and passes within 500 feet of roughly 3,000 businesses or potential subscribers. Lit San Leandro owns a 288 strand bundle through this portion, of which the City owns 30 strands of fiber with unrestricted use (while in the EDA expansion areas the City owns an additional 48 strands of fiber with restricted/noncompetitive use). . In addition, the City maintains and operates a separate 72 strand

bundle along the original route that connects the majority of its buildings, community centers, and libraries, as well as traffic signals and other City owned facilities.

The City currently does not lease any fiber or bandwidth to any for-profit companies but has left that to LSL. LSL’s current business model is to sell dark fiber to businesses through ISPs such as Crosslink and Paxio, who then in turn sell broadband services to the end customer.

It should be noted that the Lit San Leandro fiber assets are within conduit provided by the City. This arrangement allowed the local provider (LSL) the ability to greatly reduce their infrastructure costs when compared to a “traditional” type of build. LSL was able to capitalize on existing City assets to reduce costs and thereby offer affordable broadband services to the community.

If an outside vendor constructed a network a similar fiber-optic network without the benefit of existing conduit, it may have cost as much as \$12 million. Given the availability of existing conduit, we estimate that the cost for the fiber was reduced to around \$3.0-\$3.5 million. This network build also provided the City with 30 strands of fiber in the original area and 72 within the expanded area under the first amendment to the agreement.

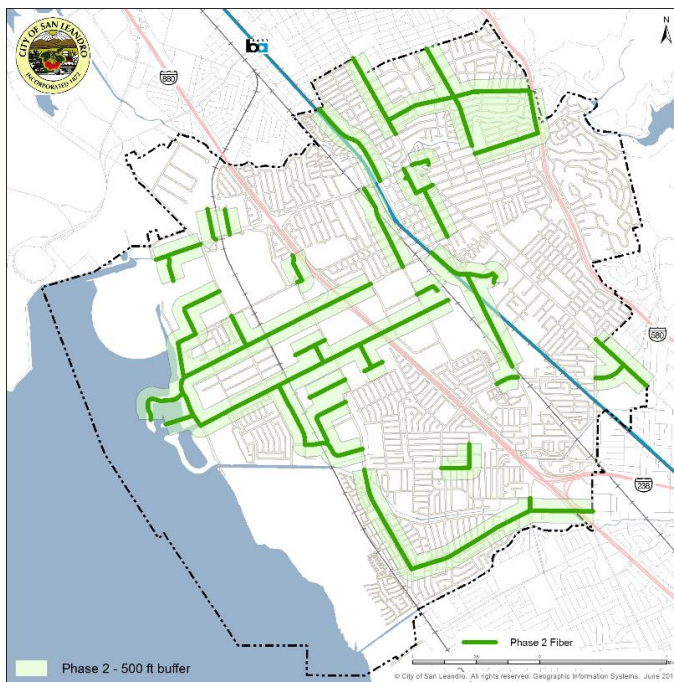
The costs shown below do not show the value of the Phase 1 asset, but the potential out-of-pocket expenses to build the network.



Phase 1

- Network Costs = \$3.0M - \$3.5M (estimate to establish fiber in existing conduit)
- Network Electronics = \$250,000 (existing model, no lit fiber)
- Average cost per lateral = \$6,000
- Total footage – 108,904 feet
- Total number of businesses within 500 ft – 3024
- City owns 30 fiber strands
- Current LSL business model – Opportunistically lease dark fiber to ISP's or businesses
- Limited opportunity to offer 5G backhaul services given network layout/design

Figure 65. Phase 2 - Proposed Network Expansion



Phase 2 involves the expansion of San Leandro's existing fiber network to serve more area businesses, anchor institutions, and municipal facilities. The proposed additions include 72,500 feet of additional fiber to be placed in existing conduit and through the construction of new conduit laterals.

Phase 2 will allow for additional connections of nearly 2,800 businesses within a five hundred (500) foot "buffer zone" of the network, allowing San Leandro to provide additional fiber and "lit" services to service providers, who will in turn provide connectivity to businesses.

Phase 2

- Network Costs = \$9.0M - \$9.5M (estimate to establish fiber in existing conduit and build new conduit)
- Network Electronics = \$1,000,000 (recommended model)
- Average cost per lateral = \$6,000
- Total footage – 72,500 feet
- Total number of businesses within 500 ft – 2782
- Vertical Assets (light poles) – 1,765
- City owns all fiber strands
- Recommended business model – City provides laterals and "lit" services to ISP's
- Opportunity to offer 5G backhaul services given network layout/design



- City owns/operates (via outsource vendor) network
- Take advantage of existing empty conduit in addition to new fiber builds.

CAPITALIZING ON SAN LEANDROS EXISTING NETWORK

To help reduce the cost of building the network, the City should work to capitalize on the use of existing infrastructure, including traffic signal conduit and existing conduit, to enable cost savings during Phase 1 and to reduce the overall cost of Phase 2.

Figure 66. Map of All Businesses in City Limits

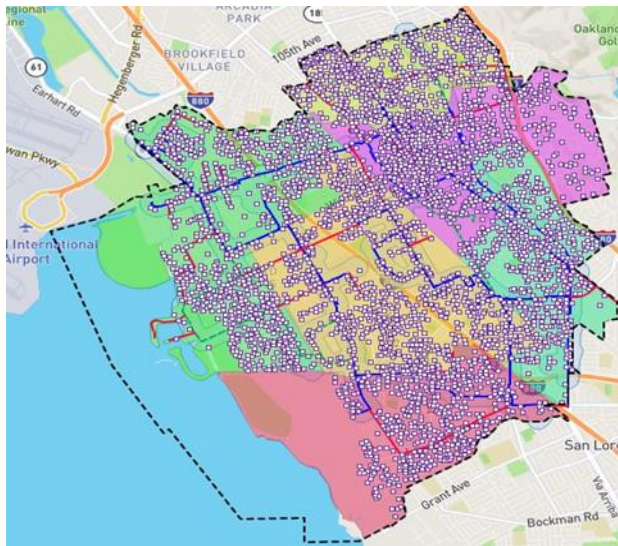
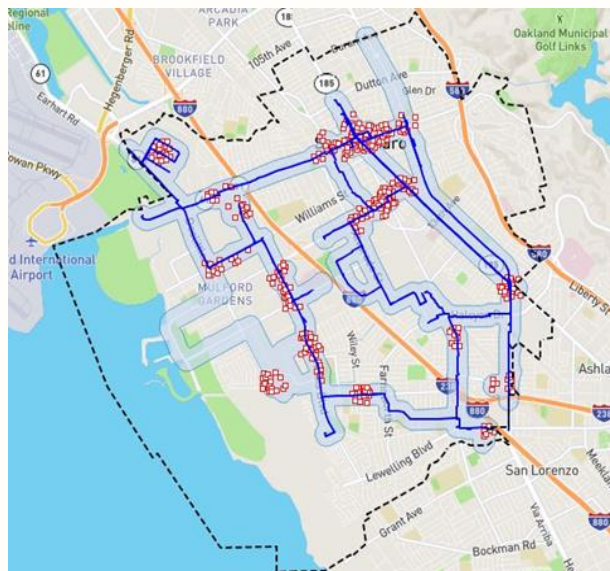


Figure 67. Businesses on the 500 ft. Fiber Ext



Figure 68. Lit SL with 500 Foot Buffer Zone



Figures 66, 67, and 68 show businesses within San Leandro, businesses that lie within the 500 foot fiber extension, and the current LSL network with a 500 foot buffer zone. The businesses in Figure 68 represent potential (not current) LSL customers.



OPPORTUNISTIC BUILDS

Magellan Advisors has provided a series of network diagrams demonstrating potential network build “phases” that are designed to become the fiber core of San Leandro’s network over time. From this core, all other access technologies can be incorporated including Wi-Fi, cellular access and Smart City applications of the future. We call this opportunistic network building. All cities incorporate opportunistic building options into the broadband network, but the City does need to be prepared, both financially and internally, to respond when these opportunities present themselves.

Opportunistic builds can be a great savings facilitator for the City. However, opportunistic does not mean ad hoc. The City will need to have a detailed network plan/design that demonstrates the long-term view of the desired network. Potential opportunities will only be considered when they fall on the proposed network routes. Fiber need not be built or installed if it does not connect to any strategic location.

These builds also require some capital. A fund should be created and maintained in anticipation of capitalizing on opportunistic builds. A balance of \$250,000 in a capital project account is recommended for a city the size and scope of San Leandro. If these funds are not available at the time of joint trench opportunities, a loan from other public works projects in the public right-of-way should be used and paid back at the next capital improvement project budgeting cycle.

FUNDING SAN LEANDRO’S NETWORK

Funding of a network is generally bucketed into two parts: first, initial construction, and then, ongoing maintenance.

Many cities realize revenue in the form of broadband services offered to end users (business or residential, retail or wholesale) and from savings by not having to lease commercial services for their work internal needs. This revenue varies from city to city and from network to network.

Magellan Advisors’ financial model demonstrates a potential cost model for building and maintaining a broadband network. This model, we suggest, should be viewed as only one option available to the City and assumes a total finance scenario (i.e., the City takes out a loan covering the full cost of construction) rather than incorporating cost savings from opportunistic builds or grant funding options. However, the City of San Leandro can assume that, in actuality, some of this network could be paid for by grant funds and/or the cost of building the network very well may be reduced by joint trenching, use of existing assets, and opportunistic builds as they present themselves.

When reviewing the financials, one should not conclude Magellan Advisors is recommending issuing a bond or securing all loans to build this network. Similar networks have been built and subsidized or financed through alternative means using incremental



and on-demand strategies. However, careful planning and vision is still required to facilitate an appropriate network over time.

Funding Summary

Building the broadband network can happen in many ways, including:

- Dig Once Opportunities
- Opportunistic Options
- Grants such as traffic signaling funding, E-Rate for schools and libraries
- Like/kind exchanges with other carriers or providers (BART, CalTrans, fiber and wireless carriers)
- Existing funds including Plan of Record (POR) allowances

While ongoing maintenance funds are expected to be offset by offering wholesale broadband access/services to businesses and anchor institutions, such maintenance costs have not been reflected in the financial model.

Financial Model

The included financial model (found in Appendix E) makes assumptions about network costs, network maintenance costs, revenue and funding sources. This model uses conservative estimates for end user take rate and revenue opportunities and was built to reflect the most challenging scenario for network costs and associated funding requirements. The model does not take into consideration any of the potential funding or grant sources available to help augment the cost of the network, nor does it include any potential network lease savings by using the City’s own network assets instead of leasing services from outside providers.

Many of the benefits of having a broadband network owned and operated by the City are difficult to capture in monetary terms, such as having broadband available for the disadvantaged population, Smart City initiatives, aging in place, or increased security and services from the EMS groups. Monetary economic development advantages that come from having a robust broadband network should also be considered.

Magellan Advisors does not recommend rushing out and issuing a bond or financing the project in total; however, as the model indicates, such a paradigm would be financially viable if all the assumptions are met.

These models demonstrate the two phases of the City network: Lit San Leandro and the proposed expansion to the City network. In general, each phase calls for building a core



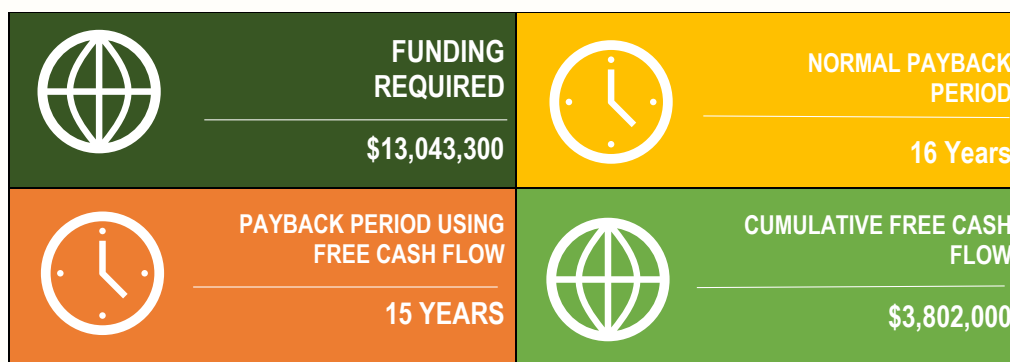
network, then providing businesses within five hundred (500) feet⁷⁵ of the core with revenue-generating services that help offset the cost and maintenance of the network. The take rate shown is 30% of those within the 500-foot buffer zone. In this scenario, the City would be responsible for providing the fiber lateral to the building for businesses, and then an ISP would be responsible for providing all the premise equipment to the end user.

Model C shows a combination of Phase 1 and 2 scenarios, demonstrating that the City could be profitable if it were to own and operate both phases as one network. In this scenario, there are some economies of scale that can be recognized including having one network team and management vs two separate models.

We also model each Phase as if a standalone network with Lit San Leandro following Magellan Advisors business model recommendations in Phase 1, and with the City managing Phase 2, also using Magellan Advisors recommended business assumptions. Modeling for each phase demonstrates that both can become financially viable.

Model A assumes revenue and cost projects for Phase 1, using Magellan’s recommended business model.

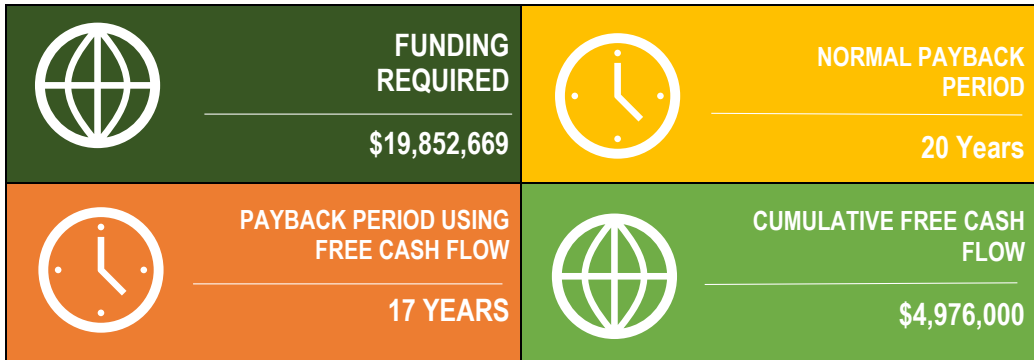
Figure 69. Model A Financial Snapshot



Model B assumes the City builds and maintains Phase 2 of the network and sells wholesale services to ISP’s.

Figure 70. Model B Financial Snapshot

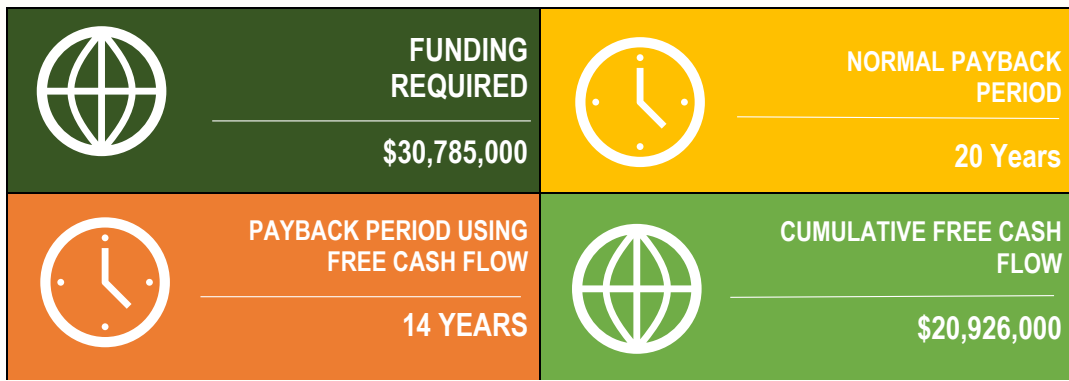
⁷⁵ Five hundred feet was chosen as an average distance that is within the generally accepted cost to have an acceptable return-on-investment. At distances further than 500, the cost to construct the “drop” from the core to the business increases and makes it more difficult to get a return-on-investment (ROI). However, the City should take each request on a case-by-case basis as each drop cost may differ slightly depending on how many potential subscribers are being connected



Model C assumes a combined Phase 1 and Phase 2 costs and deployment assuming one entity (City, Lit San Leandro or other) were to build and maintain the network.

Model C – Combined Network Models

Figure 71. Model C Financial Snapshot



Financial Model Conclusions

The included pro formas (found in Appendix E) demonstrate that even with these conservative assumptions, the City could be cash flow positive in a few years if it elects to provide businesses with broadband services while enjoying the off-balance sheet benefits of a city owned network, which are more difficult to quantify.

Summary:

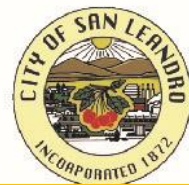
- Each phase can be profitable, including Lit San Leandro (Phase 1);
- The model does not consider any savings from opportunistic builds;
- The model is only one potential model for the City; other forms of partnerships and arrangements could be possible to deliver broadband service;
- The model does not show any cost savings the City might realize by connecting facilities not currently on its fiber network (e.g., SL Family Aquatic Center and



Farrelly Pool), thereby eliminating annual costs associated with leasing private lines from regional ISPs, such as AT&T and Comcast;

- Revenue will be from businesses within 500 feet of the fiber run and from leasing of vertical assets and fiber to wireless providers; and
- No Smart City costs were included in the model

The City of San Leandro can build and maintain a profitable broadband network throughout the City through careful planning and execution. The City will have to assess its own risk tolerance and tactical abilities to make this network successful. Magellan Advisors has provided guidance on possible options.



FIVE-YEAR BROADBAND IMPLEMENTATION STRATEGY OVERVIEW

The implementation of the City’s fiber network should be progressive in nature and with the intent of building a redundant, business-class network offering gigabit fiber services throughout the City. Each phase expands the availability of municipal services throughout the City, with the potential to extend fiber to the San Leandro business community. The costs incurred by the City and potential revenue generated vary depending on the business model that will be implemented.

RECOMMENDATIONS

The City has many opportunities available to expand its network and can capitalize on low cost/no cost options, such as joint trenching, that are typically available for most municipalities – at least those that maintain other utilities, rights-of-way, and capital improvement programs. In other cases, the City will have to design and construct in new areas of the City where these opportunities are not present.

It should be noted that these recommendations, roadmap and action plan should be viewed as only one option available to the City and assumes more of a total finance scenario rather than incorporating cost savings from opportunistic builds or grant funding options. The City of San Leandro should continue to look for ways to build on demand and incrementally, meeting demands as they arise, and using a “crawl, walk, run” approach.

Recommendation #1: Develop Fiber-Friendly Public Policies

Magellan believes that San Leandro’s most immediate strategy to encourage next-generation broadband infrastructure growth is to formalize broadband-friendly public policies. In meetings with the City of San Leandro departments, it was discovered that many progressive considerations are already in place, and informal policies were being formalized that are generally accepted as best practice. The City of San Leandro needs to ensure that it employs conditions for development that include telecommunications assets as a part of the necessary development infrastructure.

In support of this strategy, San Leandro should continue to implement broadband-friendly public policy tools. These policy tools influence how broadband services develop throughout the City and show the community and prospective newcomers that San Leandro is serious about promoting broadband growth and accessibility. In addition, it will allow the City to expand its underground conduit and fiber system with savings over more traditional fiber construction methods, allowing the City to take a master planning approach versus deploying in an ad-hoc, unplanned way.



What are Broadband-Friendly Public Policies?

Broadband-friendly public policies are tools that San Leandro is formalizing that will encourage broadband infrastructure growth. These include many items that are already informally performed by the City, such as practices that reduce the duplication of effort and minimize the cost associated with installing utility and broadband infrastructure within its jurisdiction. Below is a list of ways that the City can encourage broadband development through the adoption or continuation of broadband-friendly policies:

Evaluate fees levied on broadband providers for constructing broadband infrastructure to ensure they do not discourage broadband investment.

Develop methods to streamline the broadband permitting processes within public rights-of-way to ensure broadband providers do not face unnecessary obstacles to building infrastructure.

Develop a process so that municipal Planning, Engineering, Public Works, and IT departments coordinate with each other to identify projects in which infrastructure can be installed at reduced costs.

Identify opportunities to install broadband infrastructure in conjunction with public and private construction projects.

Maintain broadband infrastructure specifications in a City-owned GIS-based fiber management system, requiring updates as built, and implement processes for accurate documentation.

Adopt policies that incorporate broadband as a public utility and create a policy framework to promote its deployment in public and private projects as appropriate.

Draft policies specific to San Leandro's needs and adopt them into local policy, codes, and standards (including Dig Once, joint trenching, engineering standards, etc).

Incorporate broadband concepts into San Leandro's Capital Improvement Plans (CIP) as appropriate and make a commitment to funding broadband infrastructure.

The City should adopt a Dig Once ordinance and effectively manage its new wireless communications ordinance for placement and method of 5G small-cell deployments.

The City should adopt in-kind negotiation strategies when licensing small-cell pole attachment agreements.

Comprehensive Broadband Standards and Joint Trenching policies that incorporate broadband infrastructure requirements into San Leandro's land development statutes or General Plan will allow and encourage broadband construction in conjunction with other capital projects. For example, installation of fiber-optic conduit during all projects involving roads, sidewalks, trails, or lighting projects where the ground is to be opened for other purposes would be less costly than installing conduit through standalone broadband projects. Since the majority of costs to build broadband infrastructure are incurred through trenching, boring, and restoration, this strategy can alleviate significant costs by opening the ground once instead of multiple times. In many states and municipalities, this formalized policy is referred to as a "Dig Once" policy.



Recommendation #2: Data Center and Network Interconnects

The City should establish a new data center facility or room in its existing facility specifically for use by the fiber-optic network and should deploy fiber patch panels and lit transport equipment (WDM). This facility would act as San Leandro's Point-of-Presence, or PoP, and would include direct fiber interconnects with service and content providers. The City's success as a wholesale provider of fiber and lit transport services will be dictated by the level of "connectedness" of the City data center and fiber network. Connections into major data center facilities in Oakland, San Francisco and/or San Jose, Santa Clara, and Palo Alto, will provide numerous points of interconnect to hundreds of potential providers and content partners. A second local data center should be considered when funding permits.

Recommendation #3: Work with Community Anchors Institutions

Many municipalities are finding ways to partner with their community anchors, working in a collaborative effort to maximize taxpayer dollars, and prioritizing local investment into local community owned infrastructure. These networks are allowing community anchors, which again, are funded primarily through tax dollars, the ability to offset and manage long-term operating costs.

Community anchors, such as schools, libraries, hospitals, and county or city facilities, all have a common need and contract for the exact same types of telecom services; services that can be provided over a common telecommunications platform. Point-to-point connectivity (i.e., connecting a school to an administrative facility) is the most common service required at the local government level and is a relatively simple service to provide, in either a dark fiber configuration or using lit network services.

The City of San Leandro should also begin to identify public and private partnerships, outside grant opportunities, and/or revenue sources from working with their community partners. Broadband infrastructure grants come in many forms and having other anchor partners can open new windows to help fund the project.

Recommendation #4: Implement Smart City Initiatives and Identify Additional Community Uses

As each phase of the network plan is built and the City's network is operational, the City will be able to implement many of the Smart City initiatives outlined in the Smart City Strategy section of this document. In addition, the network will enable San Leandro to continue to build on these Smart City initiatives well into the future as new opportunities arise.



Recommendation #5: Formalize a BIP to Make Use of Broadband Assets

The City of San Leandro should begin to formalize a Broadband Infrastructure Program (BIP), focused on continuing to meet the needs and demands of the City operation, while bringing value to the greater community, and monetizing any assets that are available. Cities across the United States, and in California specifically, are developing these types of infrastructure programs to drive new revenues to the city and to support the long-term sustainability of their communities. The City's IT Division is already leading efforts that can, with some further planning and development, be formalized as a BIP. This can include the City's plans to deploy Smart City initiatives. Revenues can be generated off conduit and dark fiber assets, lit network services, and through the lease of vertical assets such as street lights and towers. And in many cases, municipal broadband networks can provide residential fiber-to-the-home (FTTH) or business fiber-optic telecommunications services both in retail and wholesale offerings.

There are several tasks required in order for San Leandro to formalize such a program, including:

- Document and maintain an inventory of available assets;
- Implement a fiber management system;
- Develop and standardize agreements for fiber and conduit leasing;
- Develop pricing policies for fiber and conduit leasing;
- Publish rates and terms;
- Create a City enterprise fund to maintain proper budgets, cost accounting, and to track revenues of the program; and,
- Create a capital fund to cover costs of building infrastructure.

The City should plan to incrementally grow its program as outlined in this analysis, layering additional services onto the network as the City moves through the various phases of the plan. This series of progressions will allow San Leandro to take measured steps to deploy broadband throughout the community, enabling the City to incrementally expand its network as opportunities and community needs present themselves. This City should work closely with Lit San Leandro on any network opportunities that become available within their footprint.

Recommendation #6: Release RFP for the Solicitation for Partners

The City of San Leandro must identify how it will utilize the fiber-optic network to bring next-generation broadband services to the greater community. The City will also have to select the most appropriate business model that aligns with the vision of the community and its leadership, and one that fits organizationally into the City's municipal operation. While many communities strive to be a fully functioning provider of retail services, this comes with significant challenges. The most common approach is for the City to contract many of its municipal operations to other organizations; this should be considered when



selecting a business model as it is likely this endeavor would follow suit. The City would be best served in partnering with a private service provider to deliver services to business customers. Under this type of partnership, otherwise known as a Public-Private Partnership (PPP), San Leandro would own, oversee and pay for the construction of the physical broadband infrastructure, while the private provider delivers retail service offerings. **This arrangement is similar to the current relationship with Lit San Leandro for Phase 1.**

This arrangement would provide the greatest positive impact to the City, while leaving substantial fiber capacity that could be used to support the municipal operations of San Leandro well into the future. The additional capacity will help “future proof” San Leandro, allowing the City to take advantage of future technologies that require robust connectivity, at little incremental cost.

Recommendation #7: Incorporate Broadband Strategies

San Leandro should work to incorporate broadband governance strategies into the daily operations of all City departments and work with local and regional public agencies and private investors, especially for dig once and joint trench, leveraging streetlight poles for in-kind fiber swaps during small cell lease negotiations, during development review committee meetings, capital project budget considerations and during development agreement negotiations.

FIBER MANAGEMENT

The Plan also identified specific challenges the City currently faces in managing its fiber network. For instance, fiber tracking has historically been done on computer-aided drawing (CAD) files, spreadsheets and similar database files. However, these can become outdated over time. In addition, fiber strands are not tracked in GIS; only conduit is. This presents difficulty when fiber is spliced or changes need to be made as previous modifications may not be known to all parties involved resulting in fiber strands not connecting where they are supposed to or not being available when they should be.

Specific steps can be taken in order to improve this situation:

- Conduct a fiber audit to ascertain usage throughout the entire fiber optic network. This should include cataloging connectivity of each strand and bundle.
- Denote the number of strands in each section of the network. For example, some areas have 48 strands whereas others have 72 or more.
- Mark all City strands within Lit San Leandro bundles.
- Identify quality of fiber strands throughout the network by measuring throughput and performance.
- Procure a fiber strand management software that can integrate with the City GIS system for tracking and planning purposes
- Develop an in-house process with the IT Division, GIS, Public Works, and Engineering Departments for reporting all fiber installations, changes, updates,



and improvements. This information should be maintained by IT in the GIS systems.

- Develop in-house competency to perform complete fiber optics testing and maintenance. This could be done through training programs and coordination between various City departments.

ROADMAP AND ACTION PLAN

The City of San Leandro has deemed fiber-optic infrastructure to be critical infrastructure for the community. Through development of this Plan, we have evaluated a number of options and opportunities for the City to expand its fiber-optic footprint. In the previous section, there are specific recommendations the City should consider for building its fiber infrastructure. From the recommendations, this Plan’s Roadmap and Action Plan provides a step-by-step process the City could adopt to implement its network. Through analysis of these opportunities, Magellan, in cooperation with the City of San Leandro, have developed a recommended roadmap that the City can consider as they continue making key investments in broadband infrastructure.

The broadband roadmap that has been developed outlines a step-by-step approach to building San Leandro’s fiber services throughout the City. This roadmap will focus on leveraging some of the existing assets and will build a plan to enable San Leandro to expand its operations to connect more organizations, which may include businesses, community anchors, broadband providers, and other public organizations.

The City must also evaluate the opportunities to leverage the light poles it owns. These poles will likely provide a prime opportunity for increased wireless carrier expansion, and the City must determine how to participate in this planning, and provide the necessary infrastructure to support deployment, likely creating a significant revenue stream.

The City should look for every option available to drive down the costs of constructing this network. As it has in the past, the City must use smart public policy to deploy network infrastructure where possible. Alignment with the City’s capital project plans will also provide additional relief to the overall project cost.

Through expansion of the City’s fiber network, the City will make available all additional excess capacity to the market. It will accomplish this through the development of a Broadband Infrastructure Program, focused on commercial utilization of the City’s fiber assets.

Implementation of the Broadband Infrastructure Program

The City of San Leandro should first focus its efforts on the development of the City’s Broadband Infrastructure Program. The City’s IT Division can continue efforts it has begun to facilitate such a program. A BIP is intended to formalize the development of a new Enterprise Fund and a new brand and marketing campaign, as well as the incorporation of new policies and procedures to support the operation. BIPs are



structured as multi-phased programs to which additional services and infrastructure can be added as new opportunities are presented. This provides a “crawl, walk, run” approach to implementing broadband, where each additional phase becomes more complex, connects more of the community, and provides more value. The City should consider formalizing this program immediately.

The BIP phasing is explained further below:

Phase 1 – Develop, Brand, and Market a Broadband Infrastructure Program. San Leandro will need to formalize the BIP, as previously outlined, and will need to brand and market the program and services. San Leandro should build on its “Digital City” concept, driving home the City’s position in ensuring high-speed connectivity for all.

The City should take on the following tasks:

Task 1. Document and maintain an inventory of available assets

San Leandro will need to maintain an inventory of all available assets that could be included in the program. The City will need to identify the fiber capacity that will be required internally to support the City’s operation and ultimately the capacity that will be made available for potential third-party use. The capacity for available third-party use will be deemed excess capacity and can be made available for lease.

The City currently maintains a reasonable amount of conduit and fiber strand that could form as the basis for this inventory, and some of it is already in the City’s GIS system. Over time, the City will continue to add to the assets inventory as it continues to invest and build additional infrastructure. As detailed earlier in this report, carriers are beginning to lease vertical right-of-way assets from communities to provide more cellular coverage.

Task 2. Implement a fiber management system

As San Leandro considers utilizing its broadband infrastructure to enhance municipal operations and for potential commercial broadband purposes, the importance of documentation and record keeping for the network becomes more critical. San Leandro will need to maintain accurate documentation of its existing network and document new network construction as it occurs throughout the City. The system should document how new network facilities are integrated into the program. Magellan recommends the City establish a fiber management system to accurately document, track, and report on the fiber designated for broadband applications.

Several vendors offer fiber management systems particularly well suited for municipal fiber networks. Costs for these software packages will depend on the features San Leandro requires and the professional services the City selects for implementation and integration. San Leandro should begin this process as early as possible to minimize the amount of data that needs to be migrated to the system. As the City builds more infrastructure, the costs to migrate existing infrastructure into the system can drive the overall implementation costs higher.



Task 3. Develop and standardize agreements for fiber

San Leandro will have to develop fiber leasing policies to formalize the commercial use of its dark fiber, lit services and possible conduit. This includes standard agreements for dark fiber and conduit leasing for the City's existing infrastructure. San Leandro should develop the core agreements necessary to formalize its broadband infrastructure program, including:

- Develop a standard Master Services Agreement for leasing infrastructure to private organizations, including an industry standard service level agreement and acceptable use policy;
- Develop a standard inter-local agreement for leasing infrastructure to public organizations, including an industry standard service level agreement and acceptable use policy.
- Develop wholesale pricing structure and associated Service Level Agreements

Task 4. Develop pricing policies for fiber and conduit leasing

San Leandro needs a standard rate schedule for leasing its fiber to ensure the City is providing these services at competitive, non-discriminatory rates and covering all of its costs. The schedule should provide normalized rates across its program to ensure pricing consistency to the market. San Leandro should assign costs proportionally to the allocation of its network that is used for commercial broadband purposes. The City should also maintain flexibility in its rate schedule to offer promotions and incentives in conjunction with economic development programs in San Leandro.

Key pricing tasks include:

- Document San Leandro's cost structure for fiber, accounting for one-time and ongoing costs;
- Build a rate schedule using a per foot/per strand model for dark or a cost for point-to-point fiber segments anywhere on the network;
- Develop leasing terms for 1, 3, 5 and 10 years with discounts applied to longer lease terms; and,
- If rates will be formally adopted by the City Council, build in provisions to adjust rates in special cases to accommodate the competitive marketplace.

Task 5. Publish rates and terms

The City should have its standardized rates available to the market in San Leandro, focused on broadband providers, businesses, and public organizations. The rate schedule should contain the relevant rates for fiber, one-time charges, monthly charges, and terms. San Leandro should also set a disclaimer on its rate schedule that any "special construction" of new fiber beyond its existing network will be subject to individual case basis, otherwise known as "ICB" pricing.

Key sub-tasks include:



- Establish and approve the standardized rate schedule;
- Approve terms and conditions for fiber and,
- Consider what information to publish, where, and to whom.

Task 6. Create a city enterprise fund to maintain proper budgets, cost accounting, and track revenues generated by the program

San Leandro will be best served developing its broadband infrastructure program as a City enterprise fund. An enterprise fund would allow the City to accurately track all capital and operating expenses and revenues from the program, while keeping strict separation between general fund accounts and the broadband program.

The City should determine if internal departments will be charged for services to “pay” for the necessary infrastructure required to provide connectivity. In addition, as more infrastructure is deployed, departments and devices that access the network should contribute to the operation as many of these initiatives will depend highly on this program.

San Leandro will have many opportunities to include conduit and fiber into capital projects taking place across the City. The departments managing these projects are not prepared or adequately funded to include additional infrastructure that may be above and beyond the basic project requirements. The City should develop a capital fund to accrue money to pay for these additional “add ins” whenever a project lends itself to including conduit and fiber infrastructure in the Plan.

The City should work to identify potential funding options for buildout of the network. San Leandro would likely qualify for some state or federal programs, due to its demographics, income levels, and urban nature. There are many programs for which the City could qualify if it focused its efforts on serving public housing or other community-based programs and facilities. In addition, as a municipality, the City has the ability to use special districts to finance infrastructure programs and projects.

Task 7. Develop an RFP for a design/build contractor for outside-plant (OSP) O&M

The City will require an Operations and Maintenance (O&M) contract to install and manage the fiber, conduit, and other outside plant components. This would be a unit cost contract for material and labor, allowing the City to incrementally build infrastructure as needed while providing maintenance to vital infrastructure during emergency outages. The City will have to respond to outages and fiber cuts as quickly as possible, as most services the City will provide will have stringent industry accepted service level agreements tied to them.

Task 8. Decide on management structure

The City will need to make a decision regarding the appropriate management and governance structure for the program. Internal resources could manage the network assets, contracts, and service levels, or the City could contract with a firm to manage and



operate the program. A network operator would manage day-to-day operations and hold responsibility for growing the enterprise and managing all facets of the business on behalf of the City, working to leverage the infrastructure wherever possible. Many firms and operators exist that would be interested in managing this program for a fee or revenue share.

Task 9. Expand fiber segments in business districts and corridors

The City would expand fiber segments when the need arises, or more specifically when requested. San Leandro will have to identify when and where it expands the fiber service, and under which business case metrics. The City should be well poised to take a longer-term approach on developing business cases, as its requirements for return are much different than private providers.

Lit Transport, IP, and Data Center Services should be included once the City has developed the Broadband Infrastructure Program and begun to realize the demand for services in the community. Then the City should consider adding additional services to the program.

Lit transport services can be provided through different platforms including wave division multiplexing (DWDM, CWDM), or Carrier Ethernet services. In addition, these services can be delivered in varying architectures such as point-to-point (PTP), and point-to-multipoint (PTMP). The City would utilize the newly constructed data center to house any network components and supporting systems, and to terminate potential customers who may require access to this type of data center facility. These types of services would be provided by the ISP directly to the end user.

This could be considered a form of open-access network offering, where the City would own and operate the physical fiber-optic network and transport services through which retail service providers deliver services to end users. Instead of providing dark fiber, an open-access network provides wholesale transport connections or bandwidth to service providers and/or end users. Retail service providers purchase services from the provider to reach end users using fiber-optic lit connections. This model alleviates the open-access provider from managing any end user services or customers. It allows retail providers to use the open-access network to reach more customers without the need to build costly fiber infrastructure to subscribers; the open-access provider is responsible for this function. Cities find the open-access business model compelling because it allows them to focus on the operating infrastructure, a low level of active electronics, and attracting multiple service providers to their networks, which helps stimulate competition and keeps prices low for subscribers.

In an open-access network, the City of San Leandro would not provide any retail services directly but would provide a new wholesale fiber solution to service providers that would utilize the network to serve businesses, community anchors, and potentially residents within San Leandro. In doing so, the City could provide a new source of broadband access to service providers while maintaining neutrality and nondiscrimination, alleviating competitive risks with San Leandro’s existing service providers. In an open-access



network, the City's customers are service providers rather than retail customers, allowing San Leandro to maintain transparency and avoid any direct "customer service" issues with customers using the network.

The City should identify prime target commercial buildings that could be connected to the fiber network. Commercial buildings with a direct fiber connection to a major data center facility could be quite attractive for companies looking to locate within the City of San Leandro. These buildings would be considered "on-net," meaning they are serviced by City fiber and have a connection to a major computing center or an internet point-of-presence (POP).

While taking on this form of endeavor may seem daunting, it is being done daily by municipalities and new competitive service providers. These additional services could have a major impact to the community, while building next-generation foundational community owned infrastructure.

In addition, this platform would be utilized to connect City facilities and sites, utility components, sensor networks, 5G and small cell deployments, while functioning as the infrastructure of San Leandro's digital eco-system and powering Smart City initiatives.

The City would contract for capacity or bandwidth from a provider that could interconnect the San Leandro network to a regional data center or colocation facility. Many providers in San Leandro have dark fiber and provide dark or lit transport services.

The City's network would have the ability to provide access to businesses located within the fiber network's footprint. While the City wouldn't service these businesses directly, there may be opportunities to align with a retail business provider to deliver the required services. San Leandro should identify multi-unit commercial buildings to connect to the network, as these buildings will normally include many potential users, but will require a single premise drop. These opportunities should reduce the overall cost to connect business users, lowering the average capital cost of each connection.

Under a wholesale lit transport business model, San Leandro would identify the potential market for both business and community anchor connections, as well as connections and pole attachments for the light poles. Through buffer analysis, San Leandro can target businesses and light poles at specific distance from the fiber-optic network – this becomes the potential market for the City. San Leandro would likely not be able to make the business case to run a fiber lateral one mile to a business – however, 500ft could be a manageable build. In some cases, the City may ask potential users to contribute capital toward the fiber buildout. In Santa Monica, the City required "capital contribution" for business transport connections, which served as a way to reduce the overall capital burden on the City. While this practice is advisable, San Leandro will encounter local businesses that simply cannot afford this. Capital contributions can become an obstacle to gaining market share; however, the City has the ability to set these policies as it develops its rate schedule in the future.



San Leandro should develop an appropriate rate structure for both best-effort and dedicated transport connections. The best-effort services will be geared toward the SMB (Small Medium Business) market, while dedicated offerings will be targeted toward providers, enterprise customers (Large Business), and community anchor institutions.

The City's fiber network as proposed will pass thousands of businesses across the City. These routes have been specifically routed to pass through major business corridors to maximize the number of businesses that can make use of these assets for the purpose of potential future connectivity; the location of existing City assets also impacted the route development. Although direct last-mile retail services are not a part of the recommended roadmap, potential wholesale capacity can be made available for any retail provider that would like to access a potential customer. In addition, businesses can contract for transport connectivity to any On-Net data center facility. These routes will advance the City's economic development initiatives by providing a high-speed carrier neutral fiber backbone to area businesses.



SAN LEANDRO IMPLEMENTATION PLAN – NEXT STEPS

The recommended steps to implementing the Broadband Master Plan within the City are provided below.

1. Review and Adopt the Broadband Master Plan
2. Finalize Strategy, Budgets and Timelines
3. Inventory Existing Assets
4. Design Engineering of the Outside Plant
5. Develop and Issue an RFP for Construction and Project Management
6. Engineer Operational Support Systems
7. Develop and Issue an RFP for O&M Contract

As the City continues to make progress in bringing this project to fruition, there are a number of key tasks to consider that will validate the project's cost structures and will assist the City in planning for how these assets will be constructed and utilized.

The City should take the following next steps outlined below.

Review and Adopt the City of San Leandro's Broadband Master Plan

City Management and elected leaders must have the opportunity to review, comment, and provide direction on this Broadband Master Plan. The roadmap outlined in this document requires funding and resources and should be vetted in this manner.

Construction and ownership of broadband infrastructure at this proposed scale will include a major expansion of the existing conduit and fiber as outlined herein. The City should designate this broadband effort as a City program, and it should be funded and structured just like any other City enterprise.

Finalize Staging, Budgets, Timelines, and Develop Implementation Plan

City leadership will have to determine when funding can be committed to begin construction of the network as outlined in this Plan. Before actual timelines are identified, City leadership must provide details as to how and when this program will be incorporated into the City's overall plan and budget.

- Review funding requirements
- Develop budget and funding requests for project funding
- Develop implementation plan with project timelines, including all procurement timelines and tasks

Inventory Existing Broadband Assets

The City must audit existing conduit. There are some existing conduits that are suitable for new fiber. These assets should be viewed as City communications assets and utilized where possible.



Design Engineering of Outside Plant

Once existing assets have been identified and inventoried, the City should move forward with design/engineering of the existing assets, conduits, and Phase 2 deployment, including all backbone routes and facilities. During the design/engineering process, actual routes will be solidified, engineers' estimates will be developed, and project costs can be refined.

Conceptual route design as conducted in this Plan are meant to provide capital cost ranges or estimates based on potential routes. An actual design will provide a construction ready design document with supporting levels of detail to move the project directly into Year 1 construction. With these new estimates, the City will be able to update the financial model that has been developed through this Plan, and continually refine the strategic goals and direction of the project.

A full design engineering package of the proposed outside plant will allow the City to prepare to release an RFP for construction of the initial network routes. A design engineering timeline for the initial project should be completed within a three to four-month time period.

The City's Broadband Master Plan (this document) and its accompanying financials should be updated and revised regularly as major project events take place allowing the City to continue to capture true costs.

Issue RFP and Select Construction Firm to Begin Construction

Upon completion of OSP design-engineering, the City would issue an RFP for the multi-year construction schedule of the proposed network infrastructure. The RFP would include all specifications and requirements of the OSP design-engineering deliverable; maps including all fiber routes and other network facilities; compliance and bonding requirements of the selected contractor; previous experience and references for similar OSP construction projects; and detailed requirements on the OSP documentation and modeling in the City's GIS or selected fiber management system.

The RFP should be released per California Procurement guidelines, with a 30-day response window to allow for scheduled site visits and thorough responses. A respondent should be selected based on predetermined weighting criteria, and a contract negotiated to follow the City's 10-year construction schedule. A project manager should be assigned to oversee the project and report status updates to the City. The project manager would be responsible for coordinating with the selected contractor on the project schedule, lateral facility managers for building access, and with relevant City departments for traffic control and right-of-way access.



Establish Operating Support Systems

The City should consider investing in a telecom-centric facility management system that provides documentation, inventory, work orders, and other relevant information about the network’s physical plant assets. These assets include outside plant, equipment, contracts, and other relevant assets. This system will provide documentation, inventory, tracking, processes, and management of network assets throughout the system. The system is particularly important in management of the outside plant fiber-optic network to ensure the City has valid documentation and control of as-built documents, assignments, splice plans, work orders, changes, and other information pertaining to the outside plant network. Availability of this information is crucial for both managing the existing network and future system expansion. These systems are also important for tracking and depreciating assets with a long economic life, such as conduit, fiber, towers, and facilities. The cost for such a system has been included in the proposed capital budget.

Establish Fiber Outside Plant (OSP) O&M Contract

The City of San Leandro would issue an RFP for a multi-year O&M (Operations & Maintenance) contract, for a construction firm that would provide emergency restoration of the fiber infrastructure and would be available to expand the network as needed. Through this contract, all incremental construction, splicing, and other tasks would be performed ensuring the fiber and supporting passive components are functioning at optimal levels at all times. Any CAI or wholesale carrier will require the City to offer industry standard Service Level Agreements (SLA) on the fiber infrastructure and transport network ensuring their ability to guarantee its services to its downstream retail customers.

The City’s contractor would have the necessary expertise and equipment available to maintain the City’s fiber-optic infrastructure. The contractor would be required to respond to emergency fiber cuts and service outages within an agreed upon service level (i.e., response within one hour, onsite within three hours). Once carrier Ethernet electronics are incorporated, given the redundant nature of the design, fiber cuts along core routes and between potential network nodes will recover immediately using ring protection services. However, fiber cuts in the route or laterals to customers are subject to extended periods of outages affecting service, unless additional redundancy is built to specific customers who may be requesting this service. It will be important for the partner to be local to the region and with adequate staff and equipment to deploy at any time.

The OSP contractor would likely be responsible for all aspects of OSP operations and maintenance. The responsibility would include adds, moves, and changes associated with the network as well as standard fiber maintenance. These tasks could include:

- Adding or changing fiber routes and patching requirements



- Extending service drops to customers
- Extending backbone and lateral segments, as required
- Relocating fiber routes due to roadway construction activity
- Tree trimming, as necessary
- Maintaining accurate documentation on network and all modifications (adds/changes) Maintaining splicing diagrams
- Emergency repair services (24x7x365)
- Design-engineering, as necessary
- Fiber locating

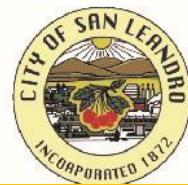
CONCLUSIONS

Leaders of the City of San Leandro recognize fiber-optic infrastructure as an important part of the community. They understand that in today's world, connectivity affects every aspect of and part of a community – whether in municipal operations, education, healthcare, or public safety. Today, this infrastructure also plays a crucial role in economic development and will be pivotal in the future as an enabler of long-term sustainability.

Over the past years, San Leandro has taken several steps to ensure the availability of affordable high-speed broadband. The City has distinguished itself as a leader through its Smart City and public Wi-Fi initiatives, provided internet to organizations in need by connecting schools and non-profits through Lit San Leandro, and demonstrated its commitment to further endeavors by commissioning this Plan. All of these actions have enabled San Leandro to be ahead of the curve in planning for the best interests of the community, its residents, its stakeholders, and the continued growth of the City.

The model presented here provides the City with a plan to enhance its 21st century fiber-optic network, and a framework to begin utilizing these assets for the benefit of the greater community, providing new dark fiber and perhaps lit services to community anchors, businesses, and partnering providers. Ultimately, it will be up to San Leandro's leaders, innovators, and its community to bring this vision to fruition.

The time, efforts, resources, and investments necessary to execute these plans are not small; they require a long-term dedication, a shared purpose, and perseverance through any roadblocks and challenges that may come along. Ultimately, however, this dedication will be met with the many benefits that such prudent investments bring across San Leandro's community. When these are considered, the way ahead is clear: an investment in this infrastructure is a smart investment in the future of San Leandro.



APPENDICES

APPENDIX A. FULL SIZED NETWORK MAPS

Figure 72. San Leandro's Current Fiber Network: Full Size

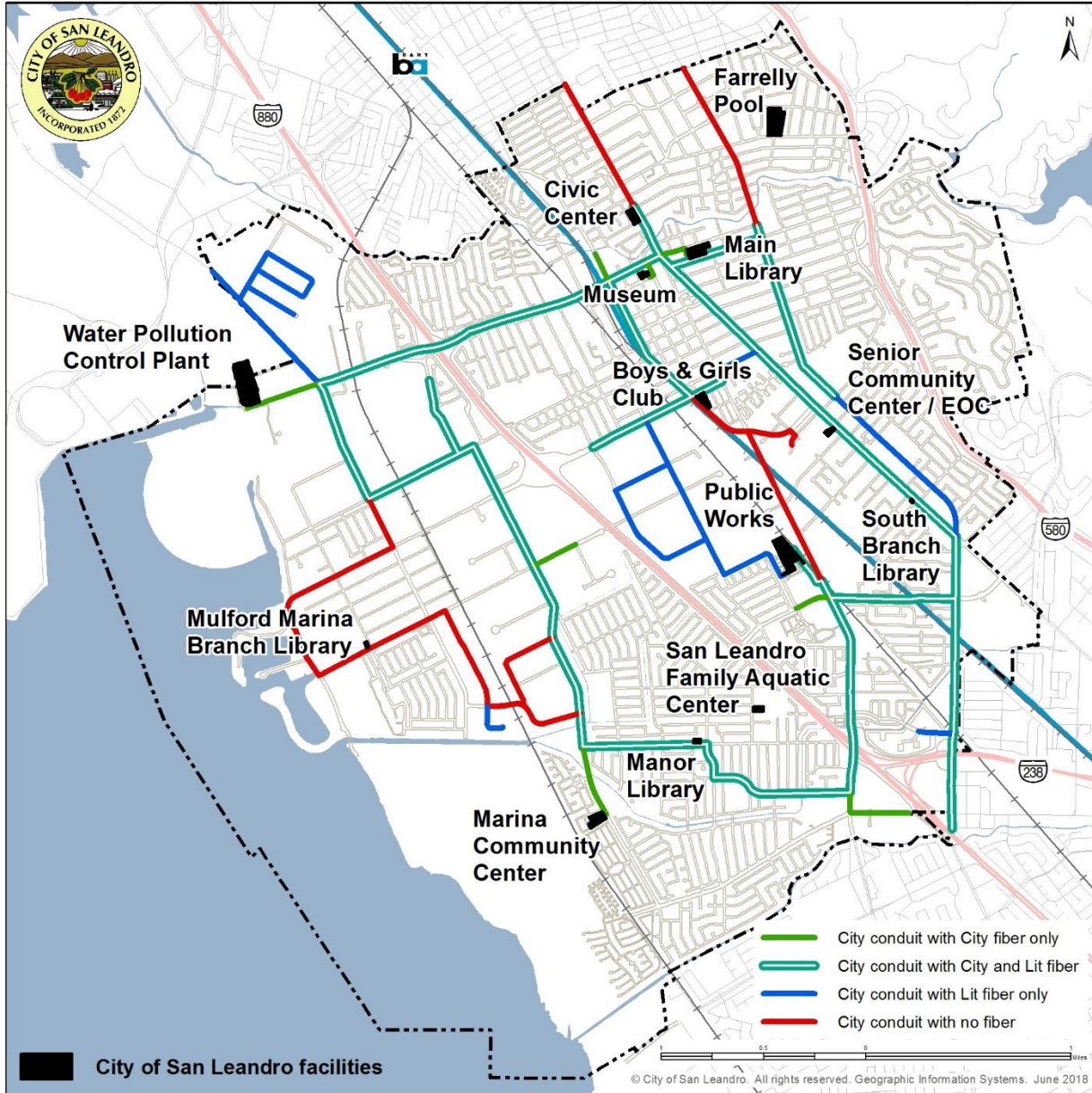




Figure 73. Proposed Fiber Network – Phase 1 and 2: Full Size





Figure 74. Lit San Leandro – Phase 1: Full Size

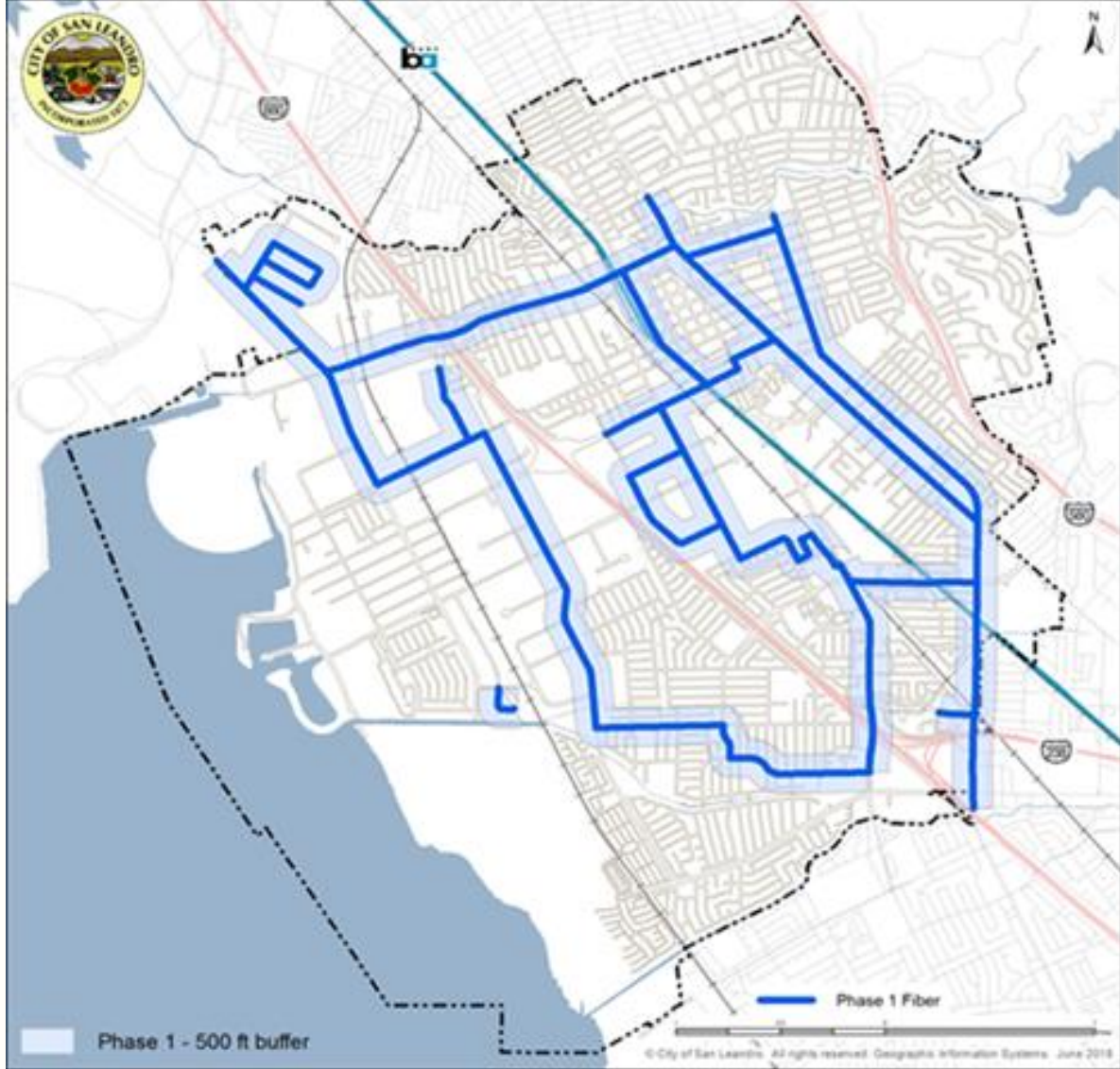




Figure 75. Proposed Network Expansion – Phase 2: Full Size





Figure 76. Traffic Data Map: Full Size

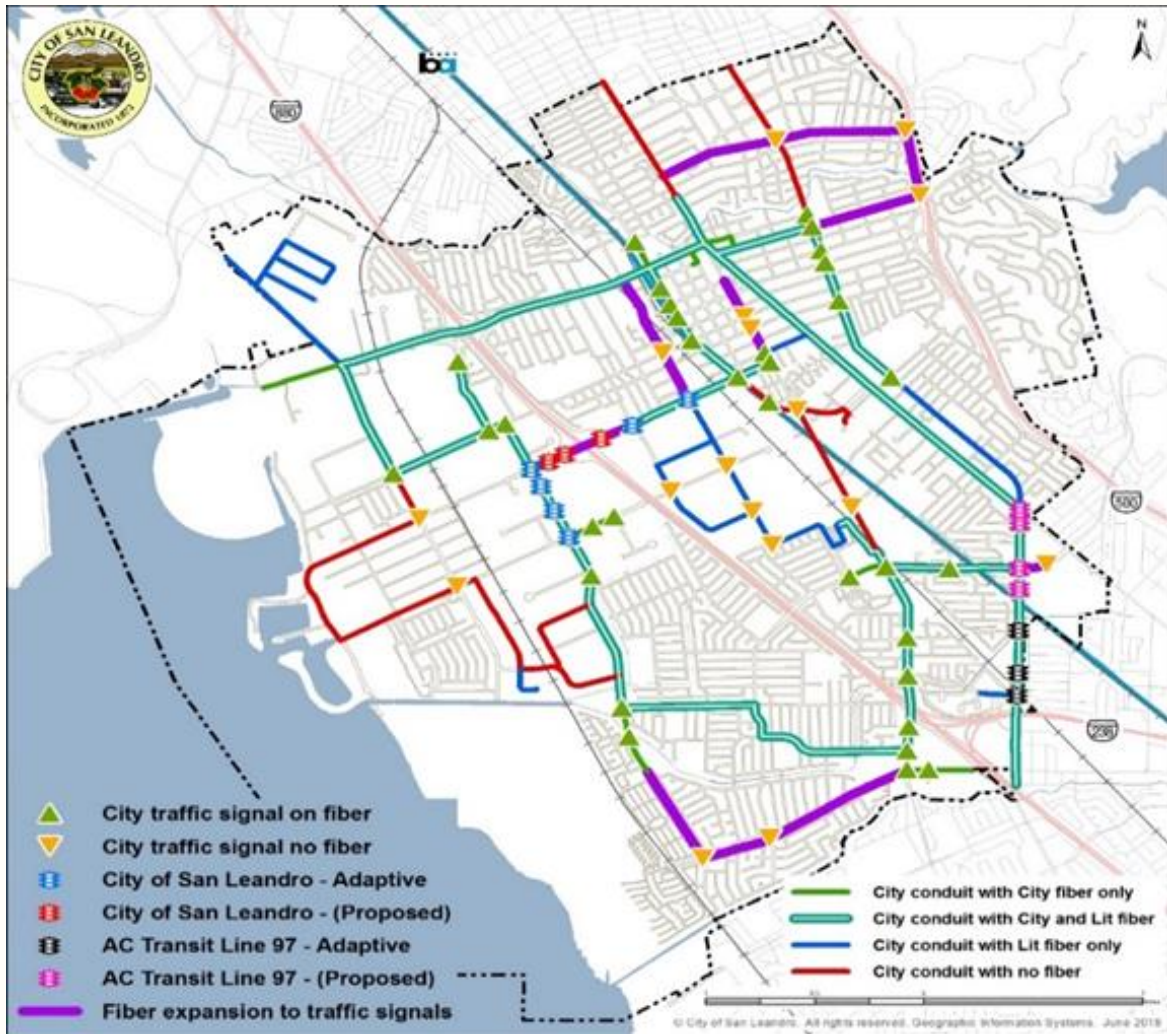




Figure 77. Proposed Camera Network Map: Full Size

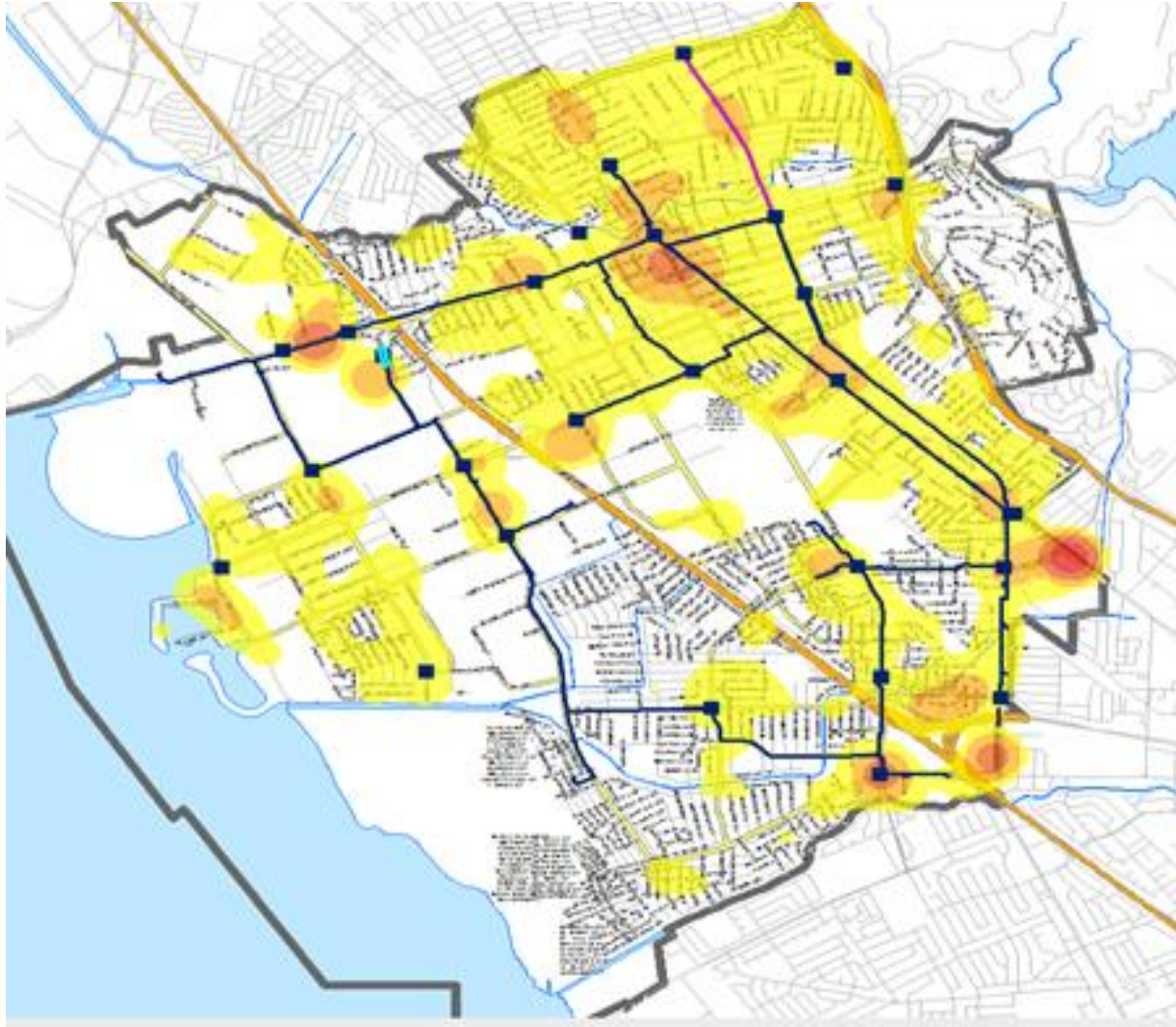




Figure 78. Public Wi-Fi Network Map: Full Size

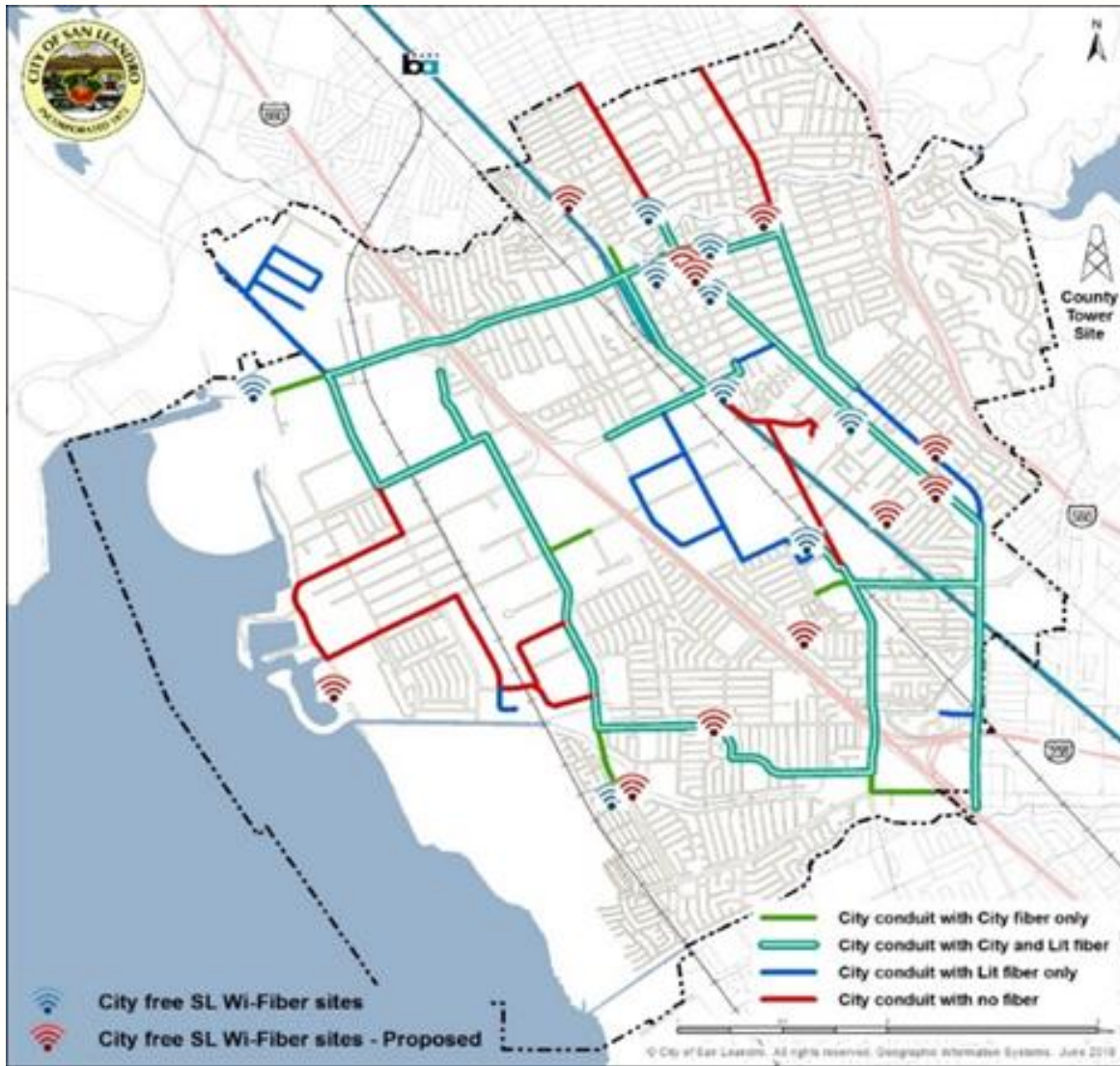




Figure 79. Smart City Expansion Map: Full Size

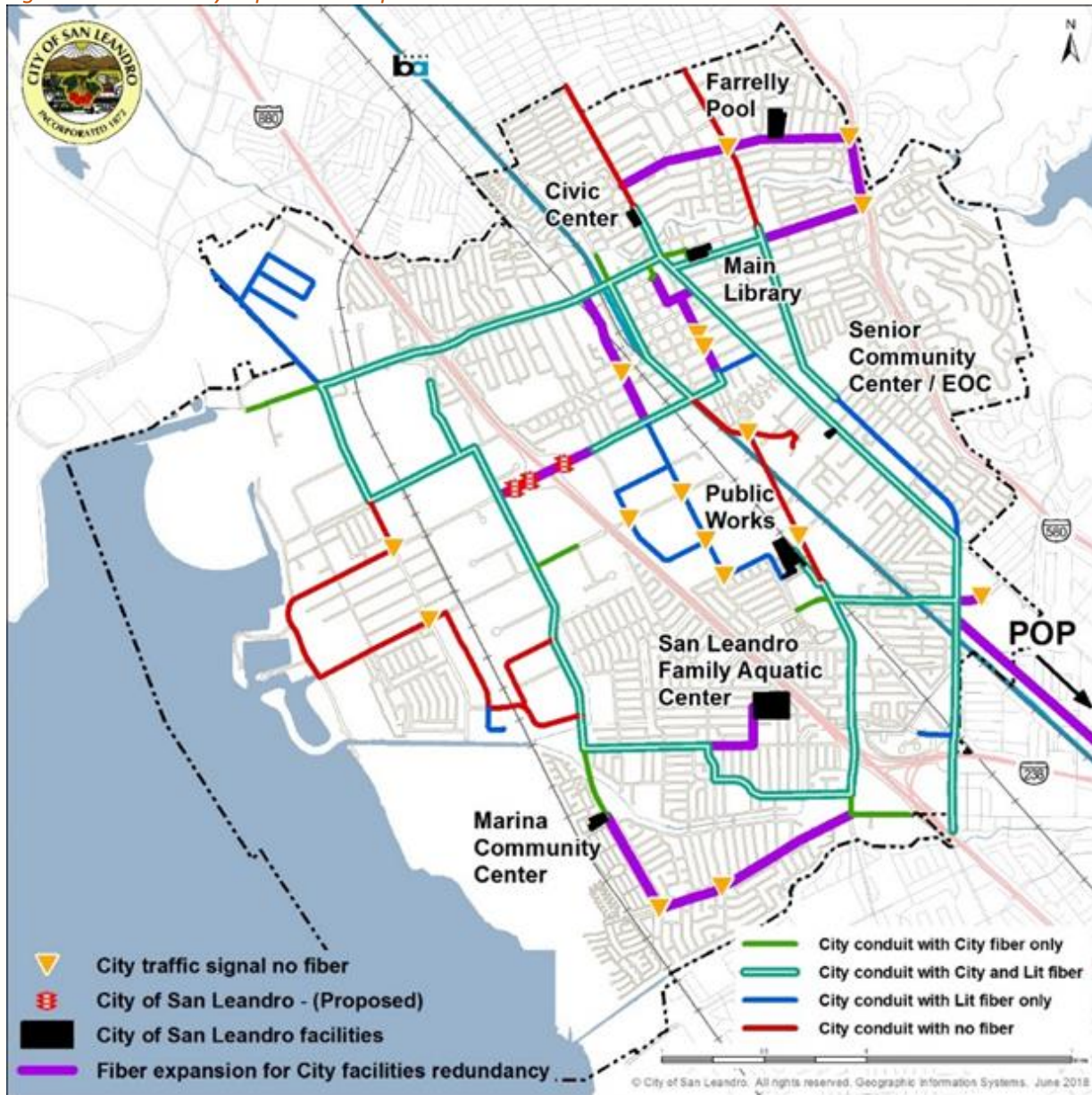




Figure 80. Fiber Expansion with Streetlight Poles: Full Size

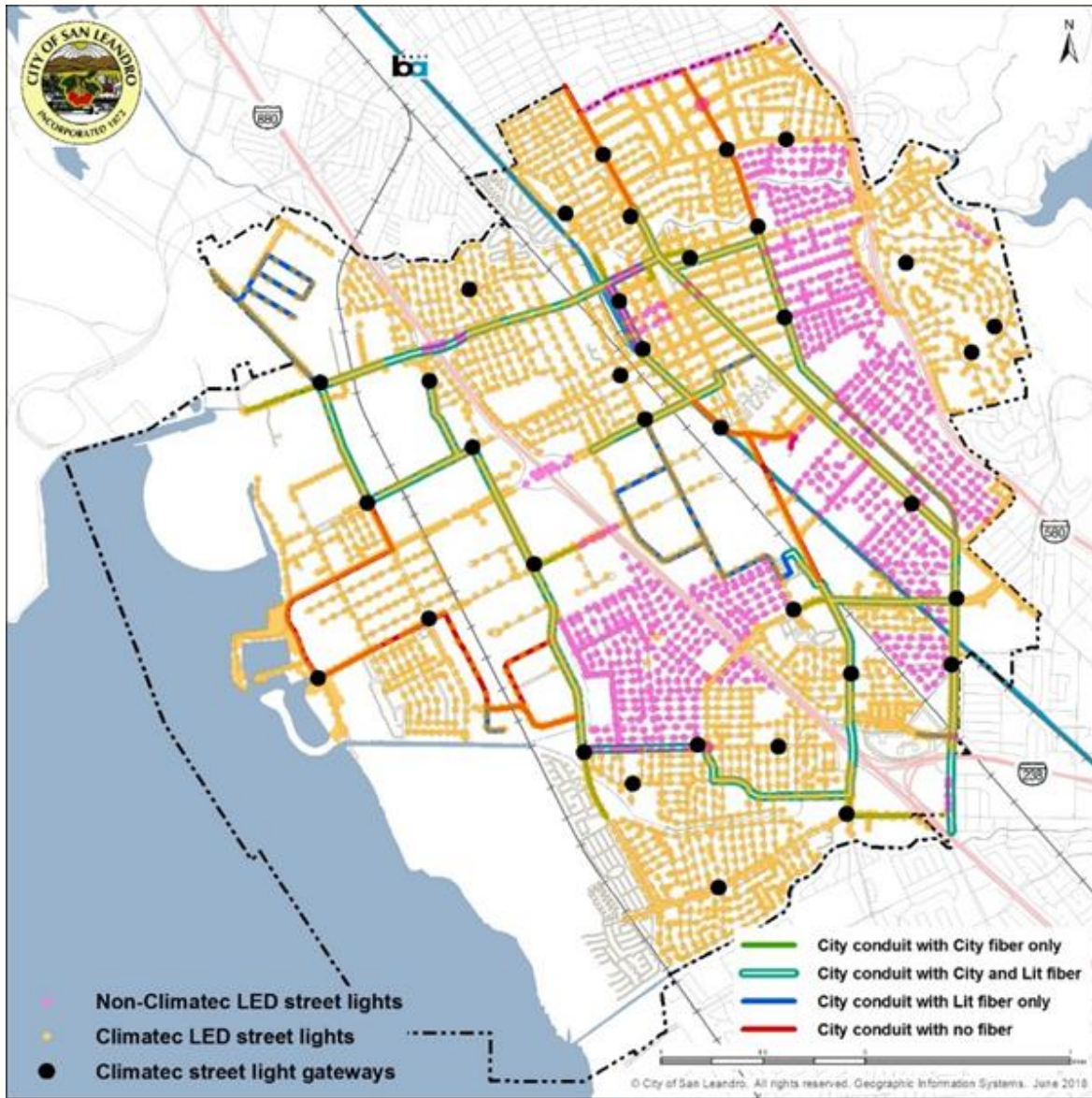
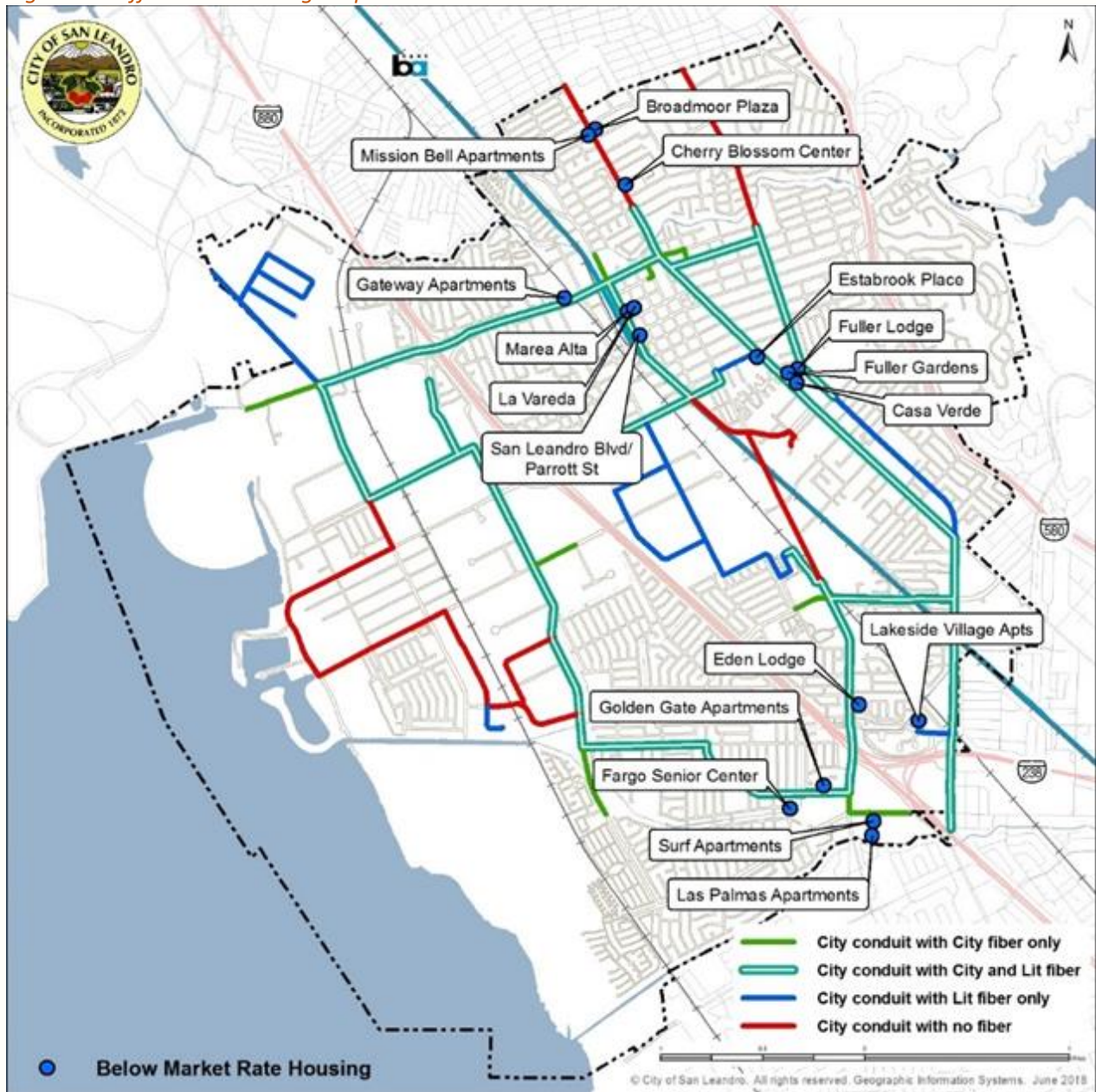




Figure 81. Affordable Housing Map: Full Size





APPENDIX B. SMART STREET LIGHT OPTIONS

The smart pole industry continues to grow and evolve and the innovations aren't slowing anytime soon. It will be important for cities and municipalities to choose a light pole partner that is prepared for the evolution of the market, with products that are easily scalable for future needs. A selection of products currently on the market are summarized below.

Phillips

Phillips, a multi-national, conglomerate organization, is the largest, most well-known organization implementing smart street lighting across the globe. Phillips touts the only “wrap and go” solution for smart street lighting delivering all equipment and technology bound within the confines of the shaft of the pole.

At the time of this report, Phillips offers the only completely self-contained solution, with the equipment and technology being housed within the pole. Other structures typically utilize a “can” antennae on the top of their pole structures. Phillips offers one variation of their light pole, with alterations possible on the external, bottom base of the pole. Fluting of the light poles are also possible as a customization option. The solution would be through a public-private-partnership, where the municipality would receive the poles for free and Phillips would receive a share of revenue generated from the potential leasing of access by wireless carriers.

For more information please visit:

<http://www.lighting.philips.com/main/systems/connected-lighting/connected-lighting-for-smart-cities.html>

Figure 82. Phillips Sample Pole





Valmont

Magellan Advisors was referred to Valmont Structures by Silver Spring and Ameresco, manufacturers of remote monitoring equipment and LED lighting organizations. Valmont has had great success in the street light pole market, although they have recently entered the DAS/small cell market within the past two years. All equipment, technology, and radios would need to be purchased from other organizations, such as Silver Spring, Ameresco and/or GE Current.

Valmont is able to produce a highly customizable street light pole and the sales team stated that the municipality would coordinate with their engineers regarding whether the radio equipment would be enclosed within the light pole, engineered with a vault in the ground, box at the base, or separate pole external to the street light pole. The sales team stated that the engineers could be consulted with regarding development of a light pole that would enclose the equipment and be larger in size to enable the pole to withstand hurricane force winds.

Figure 83. Valmont Sample Pole



For more information please visit:

<http://www.valmontstructures.com/valmont-structures/lighting/small-cell-and-das-structures>

Silver Spring Networks

Silver Springs is an international organization providing smart city technologies to cities and municipalities throughout the world, with customers such as Miami, Copenhagen, Paris, and Glasgow. While each city has different needs, Silver Spring works with municipalities to implement platforms that suit the clients' needs. The company presents an "app" store on the website providing applications from smart grid management, lighting maintenance, and environmental sensor technology. Silver Spring Networks provides the technology, not the pole. Therefore, the municipality would need to seek out a pole manufacturer such as Valmont or HAPCO to engineer the light poles.

For more information please visit: www.silverspringnet.com

Ameresco

Ameresco is leading the green energy movement by providing energy saving LED lighting along with solar powered lighting to cities, municipalities, and organizations internationally. Some of the Ameresco local government clients include: Lowell, MA; San Antonio, TX; Englewood, CA; and Emmock, AK. Organizations can save 50-60% on energy consumption and expenses through implementation of LED lighting and even more when solar technologies are used. Ameresco could be considered a partner for LED and solar lighting in the event that the municipality would decide to purchase technology, poles, and luminaires separately. Upon Magellan making



contact with the Ameresco sales team, the manager referred Magellan to Valmont for pole structures capable of supporting DAS/small cell technology.

For more information please visit: www.ameresco.com

GE Current

GE Current provides smart city technology applied to smart light poles. Typically, the organization partners with Valmont or HAPCO for the physical light pole. The trademarked technologies GE Current utilizes include:

- Evolve LEDs – delivering 50 - 65% energy savings for municipalities.
- LightGrid – providing remotely controlled lighting, by letting city staff control metering, maintenance, and light output.
- Evolve IQ LEDs – built-in data-collecting sensors that can access real-time reactive and predictive information.

Typically, the intelligent nodes are attached to the door in the case of standard roadway LED cobra head type fixtures. Depending on the fixture style, GE Current could explore options of inserting the intelligence into the fixture slip fitter, base of the fixture that mounts to the

pole, or via an external node which would be external to both the pole or fixture. At this time, GE Current does not offer DAS or 5G compatibility, but the organization is researching these capabilities.

For more information please visit: <http://www.currentbyge.com/cities>

Metro Smart

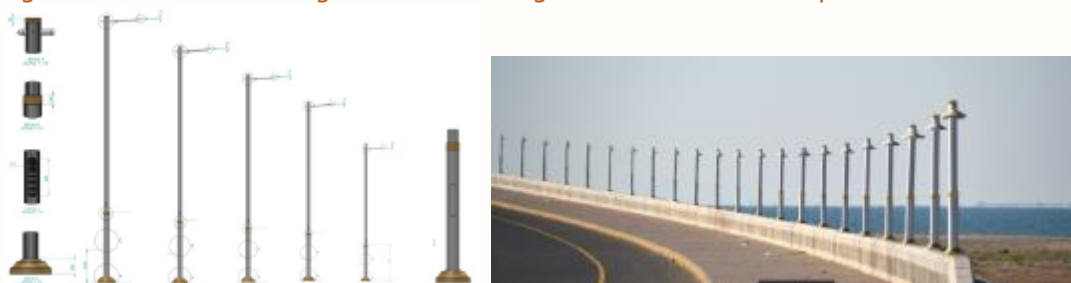
Metro-Smart International is an organization located in Dubai, United Arab Emirates. They participate in conferences such as the Middle East Smart Lighting and Energy Summits, forging the way for energy saving street lighting as well as smart city initiatives. Metro-Smart partners with Sapa Pole Products, located in the Netherlands for environmentally sustainable poles constructed from aluminum. Metro-Smart is truly international, with projects in Australia, the United States, the Middle East, China, Singapore, and Europe.

Through email communications with the company's group chairman, Magellan has learned that Metro-Smart can provide the following capabilities– LED dimming, control, and maintenance; security cameras; Wi-Fi deployment with the potential for 5G; sensor technologies; and solar capabilities. However, the chairman would need more information from the client to provide significantly more information. Their engineers created generic renderings for review, although through further discussion with the client, other models could be developed.

Magellan has included the renderings and an image of another lighting project for additional depictions.



Figure 84. Metro-Smart Engineered Rendering and Metro-Smart Sample Pole



For more information, and a gallery of photos, please visit: www.metro-smart.com

Lumca

Lumca is a light pole manufacturer based in Quebec, Canada. Within the past two years they have made significant advances in developing smart street lighting poles for cities and organizations across the world. Lumca incorporates the various technologies within a “can” antennae attached to the top of the pole. 95% of the light poles sold by Lumca are LED based. Although LED lighting typically comes in a white hue, the company could offer hue options to suit the city or town needs. For instance, the LED utilized could be in the amber hue or the LED could possibly be half amber and half white to enable the municipality in selecting which hue to use during various seasons. Also important to the municipality would be the suitability of the pole for nautical conditions. Lumca is conscious of nautical environments and has placed poles in Vancouver and other seaside areas in Canada. They use a plethora coat, which is a high-quality, non-toxic coating which endures a 5,000-hour salt spray test and is treated with a special primer to enable the pole to withstand extreme weather conditions, including hurricanes.

The company is focused on manufacturing and producing the highest quality pole possible and does not produce the technology housed inside the remote node. Partnerships have been formed through which the company works to incorporate the monitoring and Wi-Fi mesh technologies, sensors, security cameras, and hotspots. Lumca desires to get the full operating parameters of what their clients’ functionality requires, however, some of the partners they have worked with in the past include: DASBOX for environmental sensors, Imposa for variable messaging board, Digital Watchdog for digital cameras, Wicatr for Wi-Fi, Leviton for electronic vehicle charging stations, and ROAM for lighting control systems. The design of the structural pole in part will determine how and where the various technologies and nodes will be placed. The Lumca engineers would work with the client to assist in developing the product in a manner that would suit the client’s needs, along with establishing the appropriate functionality requirements.

Lumca offers multiple designs for their smart poles, providing options for the municipality. Part of the design of the smart poles includes four bands on the outside of the shaft of the pole. This eliminates the need for banding items onto the pole (i.e. signage, wreaths) that could potentially damage the pole. These bands also allow for the pole to be upgraded in the future.



The organization realizes that this is a quickly changing market and they are attempting to create a product that is scalable into the future. The manufacturer also offers various add-ons to their poles such as: USB charging stations, electric vehicle charging stations, banners, and more are expected to come to the market.

Figure 85. Sample Lumca Poles



For more information please visit: <http://www.lumca.com/en/series/smart-cities>

Lumizone

Lumizone is a smart street pole manufacturer that integrates technologies from premier manufacturers from all over the world. The CEO of Lumizone founded Valmont and successfully ran one of the largest street pole manufacturers for approximately 20 years prior to retirement. She came out of retirement to open Lumizone and work with talented engineers and designers to become an innovator in the smart city movement. While the street poles are their main focus of their business, Lumizone encompasses the technology side of the organization.

The Lumizone product is made from steel or aluminum poles and their engineers believe there is no limit as to what they can design. The engineers can work hand in hand with the client to deliver a pole that suits their aesthetic and functionality requirements. The poles are integrated with various modules that can be customized, changed, and added to over time. Members of the organization state that their organization partners with other companies for technology, in order to integrate the best features on the market onto their product – high-definition cameras, thermal cameras and face recognition; LED luminaries with photo cells and dimming capabilities; 2 way communication; card readers; Wi-Fi; motion sensors; public announcements;



LCD touchscreen; radio-frequency identification (RFI) for entrance into a neighborhood; and electric vehicle charging stations. Solar panels are also available on the poles in different forms. Some clients need the poles to be completely off the grid, or solar can be added to simply further decrease energy costs. The poles are extremely scalable and flexible, according to the members of their team. Adding to and updating the modules is seamless, as technology changes and evolves. The city or municipality could potentially contact Lumizone and have the poles updated with new technology or add more modules to their systems. Clients can choose varying numbers of modules, or they can start with a certain number and add to their poles over time. Lumizone engineers would work with the client to determine the maximum number of modules available per pole based on the voltage of each module.

Some clients might require a pole made of aluminum or steel to stand up to extreme climate and the possibility of hurricane force winds. The engineers would work with the client to ensure that the correct metal is used to ensure that the pole would not rust or fail during a storm. The company has installed poles in areas of Canada that require strong structures to withstand extreme weather conditions and winds up to 200 mph. The client would have a choice of polished or brushed aluminum.

Lumizone has worked with communities in Florida and understand the climate and region. In one such project, they placed their product in a gated community with card readers for entry and Wi-Fi enabled life-saving buttons for the older population. These buttons were placed on key rings or necklaces and were enabled through the 100% wireless coverage of the community. If pushed, the notification would immediately go to a response team with the location of the device. These devices are assisting the older population in aging in place through use of a functional Wi-Fi network.

The Lumizone product would be tailored to the specific needs of the client. The company also has branch offices moving to Nevada and Minnesota which would save the municipality in freight costs, as the main office is located in British Columbia, Canada.

Figure 86: Lumizone Sample Poles



For more information please visit: <http://www.lumizoneglobal.com/smart-poles>



APPENDIX C. MUNICIPAL WIRELESS IMPLEMENTATION STRATEGIES

California Cities – Wireless Implementations⁷⁶

Richmond, California

Population (2014 Estimate): 108,565

Area: 52.48 sq mi

Population Density: 2,000/sq mi

The city joined a Community Partnership, “roof2roof,” to support antenna-based Internet access to the community. The venture is supported by Internet Archive, a non-profit entity with the main objective to address the digital divide. Internet Archive installed a 70-foot antenna on its building, which provides internet access to anyone with line-of-sight and who purchases a directional antenna. In addition, there are two repeating locations as well as booster antennas. City-owned fiber provides the backhaul. In addition, the city provides access to other infrastructure as well as city staff. Other non-profit partners support the project with custom software and provide refurbished computers to low-income families. Access is relatively high-speed (16 Mbps).

San Francisco, California

Population (2016 Estimate): 870,887

Area: 46.87 sq mi

Population Density: 18,581/sq mi

San Francisco’s #SFWi-Fi was developed in stages, beginning with an abandoned EarthLink deployment. The focus then turned to deployments for low income communities, which created a strong but bare bones network. The city is working to upgrade the network through its current public Wi-Fi initiative that expands service along Market Street, in public parks, and in other areas throughout the city and county. The network uses city-owned fiber, traffic cabinets, and traffic poles to mount wireless access points. The city received significant contributions from Google, Cisco, and donated connections to the internet. Speeds average 10 Mbps down and 5 Mbps up. The network is managed by the city and county’s Department of Technology. A total of \$1.4 million was invested to serve public areas, and operating expenses are approximately \$120,000 funded from the city budget.

San Jose, California

Population (2014): 1,026,908

Area: 179.97 sq mi

Population Density: 5,700/sq mi

The City of San Jose deployed Wickedly Fast Wi-Fi in the downtown area as a free service. The network has been expanded on a targeted basis to the airport and convention center, as well as the new MLS stadium. The city manages and operates the network and has two partners cooperating for the deployment and operational support. A total amount of \$94,000 was spent for deployment, and operating expenses are minimal. Much of the network usage is from streaming online content. The network is intended to be supplemental or niche in nature, as there are numerous providers in the area including good coverage from wireless providers.

⁷⁶ Insert source document.



Santa Clara, California

Population (2014): 116,468

Area: 18.407 sq mi

Population Density: 6,300/sq mi

The network originated in a desire of the city’s municipal electric utility to support Advanced Metering Infrastructure (AMI). Santa Clara Free Wi-Fi is a joint venture between the city and the city-owned utility. While the AMI implementation totaled \$11 million, the Wi-Fi implementation cost \$2 million, which included \$800,000 in fiber-optic extension with operating costs of approximately \$200,000. The utility’s fiber network provides the backhaul for approximately 600 access points placed on city light poles and facilities. The network is divided between utility/city use, and public use. Customer speeds are capped at 3 Mbps.

Santa Monica, California

Population (2010): 89,736

Area: 8.415 sq mi

Population Density: 11,000/sq mi

The City Wi-Fi network was preceded by the implementation of the city-owned fiber network for business connections. Earnings from the fiber network provided funding for implementation of the wireless network. The fiber network is also used for backhauling data. The network currently consists of over 550 access points and is deployed to cover transit and commercial corridors as well as other popular areas including the beach, boardwalk, business improvement districts and parks. Most access points are linked directly to the fiber network which provides higher quality of service, and speeds of up to 8 Mbps symmetrical. The city’s initial goals have been achieved in that there have been benefits for business districts, public safety, and city needs and functions. The network supports development and deployment of mobile apps which provide information relevant to citizens and visitors such as real-time parking availability, and a sense of place with a different internet launch page depending on where the person is on the network. Capital cost for network implementation was approximately \$500,000, and annual operating costs are approximately \$100,000.

Additional Cities – Wireless Implementations

Boston, Massachusetts

Population (2016 Estimate): 673,184

Area: 89.63 sq mi

Population Density: 14,024/sq mi

The “Wicked Free Wi-Fi” network implementation followed several years of discussion and planning to address the digital divide. Partial funding for the network came from a grant from the Department of Housing and Urban Development (HUD) in 2011, for redevelopment. The project began in 2014 with installation of 70 access points in a low-income neighborhood. The network relies upon the city’s existing fiber network (“BoNet”) for backhaul. Public Wi-Fi has also been installed in many of Boston’s downtown locations and business districts for economic development purposes. The city carefully plans access point locations to be able to rely upon the city’s fiber network in an economical fashion. The Wicked Free Wi-Fi network can be expanded as the city’s fiber network expands to obtain economical backhaul capability. Beyond that, the network also uses and leverages other existing city infrastructure to the extent possible.



The network cost approximately \$6 million to install, \$300,000 of which was provided by the HUD grant. Annual operating costs are approximately \$100,000. Near term plans include expansion to approximately 300 access points in total. It is an outdoor network, with bandwidth limitations, supporting speeds up to 1 Mbps. The network is managed and operated by the City’s Department of Innovation and Technology, who contracts out some functions to private companies. The Wi-Fi service has been presented as an “as-is” service, in part to avoid creating user demands on administrative capacity.

Corpus Christi, Texas

Population (2016 Estimate): 305,215 Area: 503.6 sq mi Population Density: 610/sq mi

The origin of the city-funded project was to enable Automated Meter Reading (AMR), in 2002, for the city’s gas and water meters. The network spans the city through 1,700 access points, supporting speeds of up to 54 Mbps, although typical usage is 3 Mbps symmetrical. Costs at the time were \$7.1 million, and specification and deployment of the system was supported with outside resources. City infrastructure (e.g., traffic signal poles) and 200-mile city fiber network is used to support the outdoor network. Annual maintenance costs are approximately \$500,000, under management of the City’s CIO. The network was purchased by EarthLink in 2007 for subscription-based use, but abandoned by EarthLink and reclaimed by the city the following year.

The system has provided the expected efficiencies of AMR, including safety, convenience, precision, cost economies, and the ability to monitor and manage resource usage. Following implementation of AMR, it became clear that bandwidth was also available for public Wi-Fi use, which was enabled in 2005. Beyond use by the public, this has fostered efficiencies and collaborations among government departments and city workers.

Minneapolis, Minnesota

Population (2016 Estimate): 382,578 Area: 58.4 sq mi Population Density: 7,485/sq mi

The city met with key stakeholders in the early days of wireless to explore options for the city. It was concluded that the best approach was through a Public-Private Partnership, using an RFP process for selection. The network was fully complete by 2009. Requirements and objectives included that the entire city must be covered, pricing must be reasonable to assist in addressing the digital divide, and city uses must be supported, such as enabling remote data collection by field staff, and more. In addition, the operator provides ongoing funding for efforts to increase digital literacy. Support for public safety applications is also viewed as crucial. The operator pays the city a fee for use of city assets including light poles and traffic signal standards. The city pays \$1.25 million per year for use of the network as an anchor tenant.

Network speeds range from 1 – 6 Mbps, and higher speeds (25 – 40 Mbps) are being tested in pilot projects, which would also require higher subscription prices. There are approximately 120 free public Wi-Fi areas in parks and business districts. Three thousand wireless devices



support the network across the City of Minneapolis. Network costs are estimated at \$20 million.

Oklahoma City, Oklahoma

Population (2015 Estimate): 638,367

Area: 620.34 sq mi

Population Density: 930/sq mi

The city-wide network was developed for public safety purposes, funded by a new sales tax. The network was expanded to support connectivity to city facilities, and for city field staff. Oklahoma City encompasses a very large geographic area. The initial cost of the network was \$5.2 million, and annual operating costs are \$245,000 from the city’s budget, as managed by the city’s IT Department.

Some consideration has been given to enabling public access, but so far that has not happened. The network supports average speeds of 4 Mbps and consists of approximately 1,500 nodes. The network has improved city services and enhanced efficiencies. The network incorporates extensive security, given the public safety use of the network.

Ponca City, Oklahoma

Population (2010): 25,389

Area: 19.3 sq mi

Population Density: 1,382/sq mi

Originally installed and tested for field communications among city personnel, the network was later opened for public access. The network uses city-owned fiber. City funds provided the initial \$3.2 million to build the network, and subscription revenues for business fiber connections and residential modems support annual operating costs. The network currently consists of approximately 500 nodes. User speeds are 3 – 12 Mbps, with potential for up to 25 Mbps.

The network is viewed as successful since it provides efficiencies for city operations and services and provides economical access to the public thereby expanding internet utilization. The network also supports educational technology. Public use has exceeded expectations from the beginning.

Port Angeles, Washington

Population (2015): 19,448

Area: 14.52 sq mi

Population Density: 1,779/sq mi

The primary purposes of the network are to support public safety, including security cameras, and to provide public access in a city with a high percentage of the population below the poverty line. Original capital investment was \$3.7 million, current operating expenses are approximately \$90,000, and the network is now managed and operated by an ISP with a revenue share to the city. Speeds range up to 6 Mbps down and 1.2 Mbps up. While the public subscription is lower than anticipated, the network provides the anticipated public safety benefits for the city.



Comparative Wireless Strategies Summary

Each network was implemented for specific original purposes, supported by a specific business model. The table below provides a comparison of the purpose, business model, funding mechanisms, and resultant network speeds of the cities' wireless implementations.

Figure 87: Comparison of City Wireless Implementation Strategies

City	Purpose		Business Model			Funding			Speed	
	Address Digital Divide & Public Access	Support City Functions	Public**	Public-Private	Public Partnership	City Budget	Grant or Partnership	Subscriber Fees	Relatively Low	Higher
Boston, MA	●					●	●\$\$		●+	
Corpus Christi, TX		●*	●			●				●
Minneapolis, MN		●*		●				●		●
Oklahoma City, OK		●*	●			●		●\$\$		●
Ponca City, OK	●	●*	●			●				●
Port Angeles, WA	●	●*		●			●\$\$	●		●
Richmond, CA	●				●		●\$\$			●+
San Francisco, CA	●			●		●				●
San Jose, CA	●			●		●				●
Santa Clara, CA	●		●			●				●
Santa Monica, CA	●		●			●				●

*Network Purposes: Corpus Christi, Texas (AMR); Minneapolis, Minnesota (Anchor Tenant, City field staff); Oklahoma City, Oklahoma (Public Safety); Ponca City, Oklahoma (City Departments); Port Angeles, Washington (Public Safety)

**Run by city department.

\$\$Boston, Massachusetts—HUD; Oklahoma City, OK—fiber capacity for business, in-home residential modems; Port Angeles, Washington—ARRA; Richmond, CA—Partner

*Boston, Massachusetts—1Mbps; Richmond, CA—16Mbps

Regardless of the scale and scope of the wireless broadband network deployment chosen by the City of San Leandro, there are successful best practice implementations to guide the City for its own successful network deployment. As the City moves forward with its wireless deployment strategy it is important to:

- Examine successful implementations and draw applicable lessons;
- Consider unique needs and challenges of the community and address them in planning;
- Strive for clarity of purpose among stakeholders regarding the purpose and goals for the network;



- Assess the marketplace for current providers and services;
- Use existing City infrastructure wherever possible in network design and planning;
- Start small before rolling out a network covering broader geography;
- Build opportunistically;
- Identify backhaul options and ensure adequate capacity;
- Plan to leverage the network for additional uses once initial deployment objectives have been satisfied;
- Maintain a long-term view of investing in and operating the network;
- Ensure clear financial expectations and sound financial projections; and,
- Promote open collaboration with partners and maintain the relationships.



APPENDIX D. CITY OF SAN LEANDRO NEEDS ASSESSMENT SURVEY

City of San Leandro Business Broadband Survey

Survey Start

1.1 THANK YOU FOR TAKING THE TIME TO SHARE YOUR EXPERIENCES REGARDING INTERNET AVAILABILITY AND QUALITY OF SERVICE FOR YOUR BUSINESS.

Please take this survey from a computer located in your business that uses your business Internet service. The majority of questions are multiple choice or have yes-no responses. Depending on your answers, this brief survey should take 5-10 minutes to complete.

1. Please provide the physical street address of your business. (Your information will be used solely to help determine Internet availability in Concord.)

Business Name

Street Address

Suite/Room

City

Zip Code

Phone

Email



* 2. Which industry category would you classify your business?(Check all that apply)

- Accommodation and Food Services
- Agricultural and Farming
- Arts, Entertainment, and Recreation
- Construction
- Educational Services
- Finance and Insurance
- Government and Public Service
- Other (please specify)
- Healthcare and Social Assistance
- Hospitality
- Manufacturing
- Professional, Scientific, and Technical Services
- Real Estate, Rental and Leasing
- Retail Trade
- Transportation and Warehousing

* 3.How many people are employed locally by your business?

	1-10	11-20	21-49	50-99	100-149	150-299	300+
Employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If more than 300 employees, please indicate how many:

* 4. Does your business currently subscribe to Internetservices?

- Yes
- No



* 5. What type of Internet service do you subscribe to at your business? (Choose all that apply)

- Digital Subscriber Line (DSL)
- Cable
- Fiber-Optic
- Fixed Wireless
- Mobile Wireless (cellular)
- Satellite
- Dial-up
- Not sure
- Other (please specify)

* 6. How much does your business pay each month for Internet service?

Less than \$49	\$50-\$99	\$100-\$199	\$200-\$499	\$500-\$749	\$750-\$999	More than \$1,000
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

If more than \$1,000 per month, please specify:

* 7. On a scale from 1 to 10, how important is the Internet for your business? Please respond in terms of functionality, availability, and responsive times.

Not important	2	3	4	5	6	7	8	9	Critically important
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





* 8. Please click the [Speedtest](#) link below from a computer that uses the Internet connection from your business.

[Speedtest Link - Click Here](#)

(Then click "Begin Test" and when the speed test is complete fill in the results below.)

Download Speed (Mbps):

Upload Speed (Mbps):

Internet Provider:



* 9. To what degree do Internet problems (including speed, connectivity, and reliability issues) disrupt your business?

- No disruption
- Minimal disruption (less than 1 hour per month)
- Moderate disruption (1-4 hours per month)
- Severe disruption (up to 1 day per month)
- Total disruption (1 day or more per month)

Other (please explain)

*

* 10. Is your current Internet provider fulfilling all of your business needs?

- Yes
- No
- Not Sure

Other (please specify)



* 11. To what degree does your current level of Internet services impact the future growth of your company?

Absolutely no impact on growth										Growth depends entirely on Internet
	2	3	4	5	6	7	8	9		
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 12. In what ways is your Internet insufficient for your business needs? (Check all that apply)

- Not fast enough
- Unreliable
- Availability of options (e.g. services, bandwidth, speed)
- Price too high for received services
- Access to customer/technical support
- Other (please explain)

* 13. If your business was unable to obtain Internet services that meet your needs, how likely would you move out of Concord?

Would definitely not move									Would definitely move
	2	3	4	5	6	7			
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 14. Why hasn't your business upgraded Internetservices?

- I don't know of another provider that services in my area
- Better services are not available in my area
- I don't have the technical skills necessary
- The price is too high
- Other (please explain)





* 15. Please rate your level of satisfaction with your current Internet services

	Not Satisfied				Completely Satisfied	
Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reliability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Speed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer Service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 16. Do you view high-speed Internet access as an essential service, like water and electric utility service is today?

- Yes
- No
- Not Sure

Other (please specify)

* 17. How important is it for your business to have a choice more than one Internet service provider?

- Not important
- Somewhat important
- Moderately important
- Very important
- Extremely important

* 18. Rank the following factors in order of importance when selecting an internet provider (1 = Least Important to 4 = Most Important)

⋮	<input type="text"/>	Customer Support
⋮	<input type="text"/>	Price
⋮	<input type="text"/>	Reliability
⋮	<input type="text"/>	Service level options (e.g. speed, bandwidth, products)



* 19. If the City of Concord were to offer Internet access, how likely would you be to subscribe if comparable services were offered at [a similar price as other local Internet providers](#)?

Not likely Maybe Definitely

20. Please share any additional comments regarding your Internet service that you feel is relevant.

21. Would you be willing to participate in a focus group session on Broadband in the City of Concord? If so, please complete the contact information in Question 2.

- Yes
- No



APPENDIX E. RESIDENTIAL AND BUSINESS SURVEY RESULT DETAILS

Figure 88. Residential Survey Result Map: Expected Increase in Internet Needs

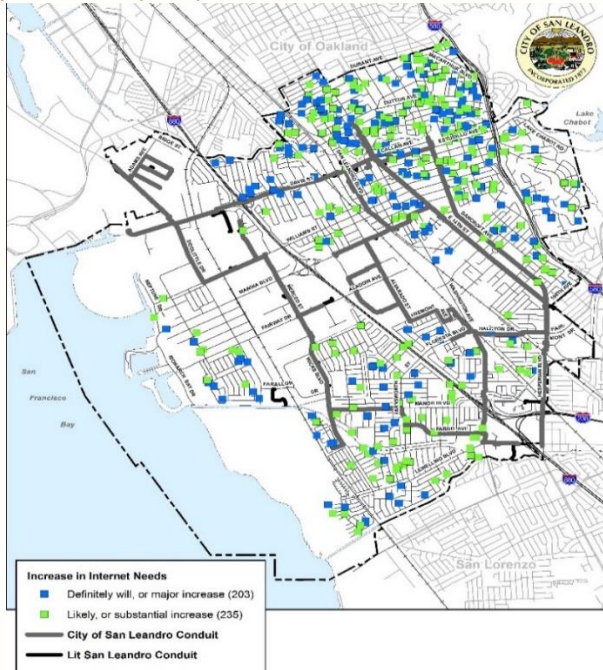


Figure 89. Residential Survey Result Map: Overall Satisfaction

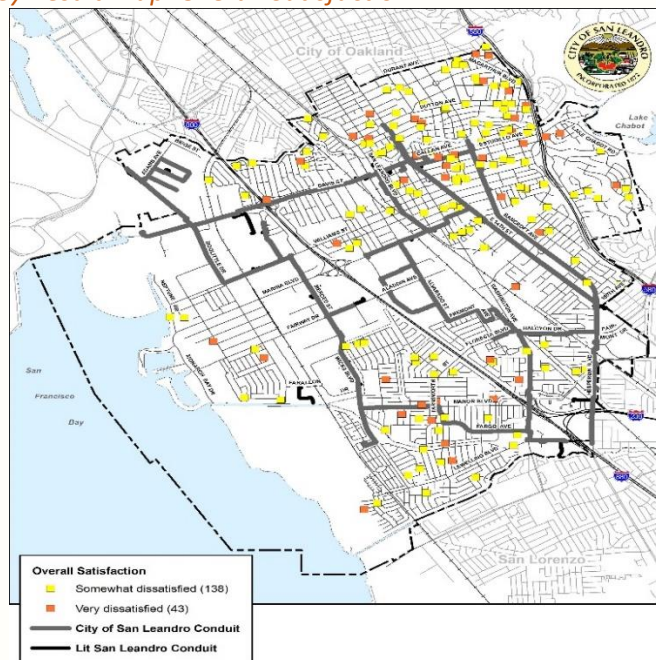




Figure 90. Residential Survey Result Map: Total Responses

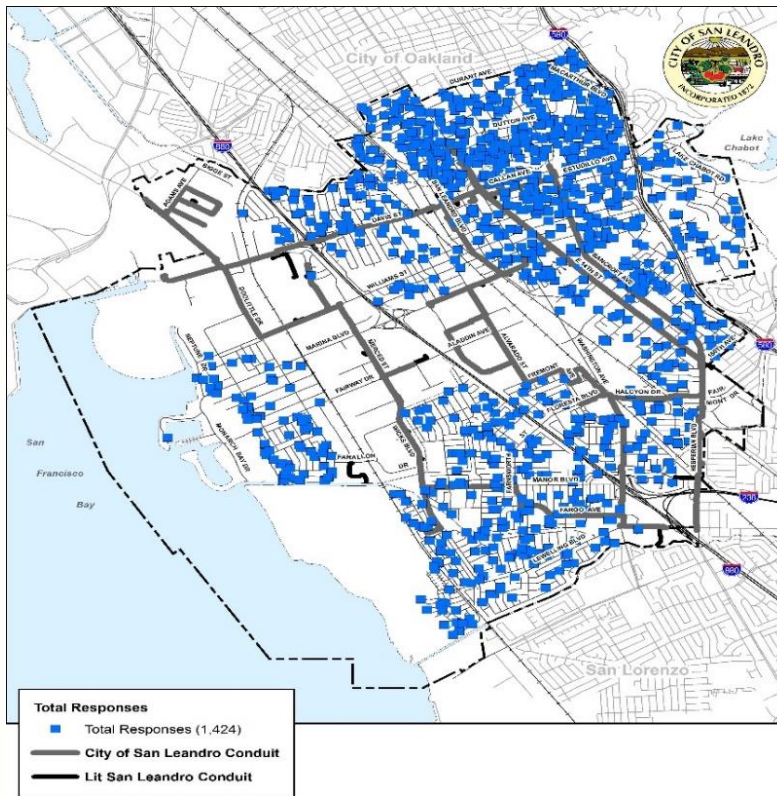


Figure 91. Business Survey Results Map: Total Responses

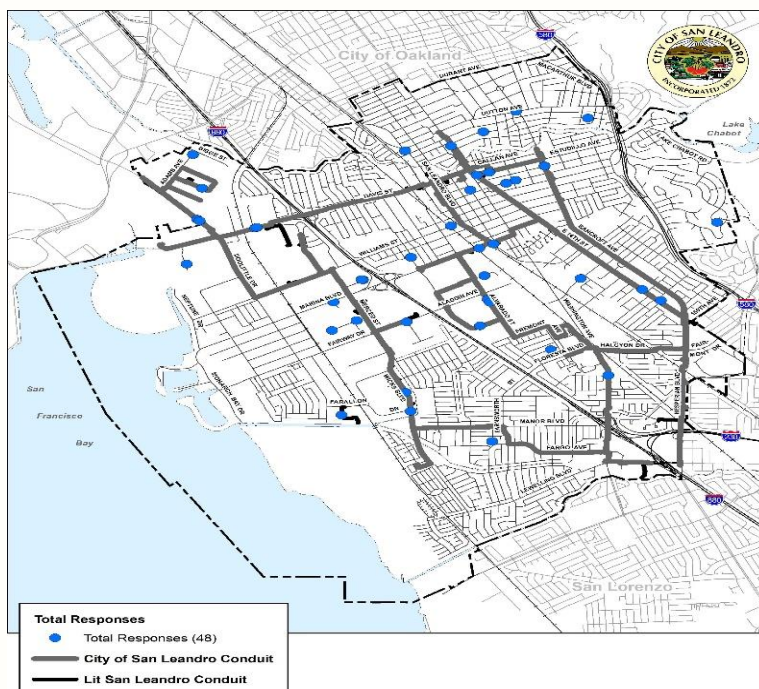




Figure 92. Business Survey Results Map: Overall Satisfaction

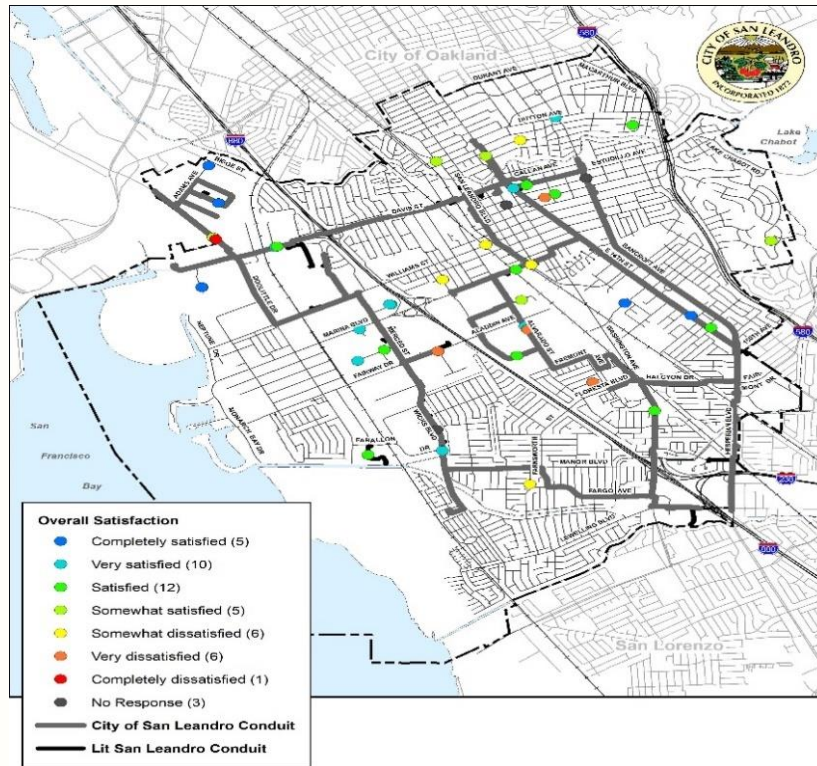




Figure 93. Business Survey Results Map: Businesses Connected to LSL

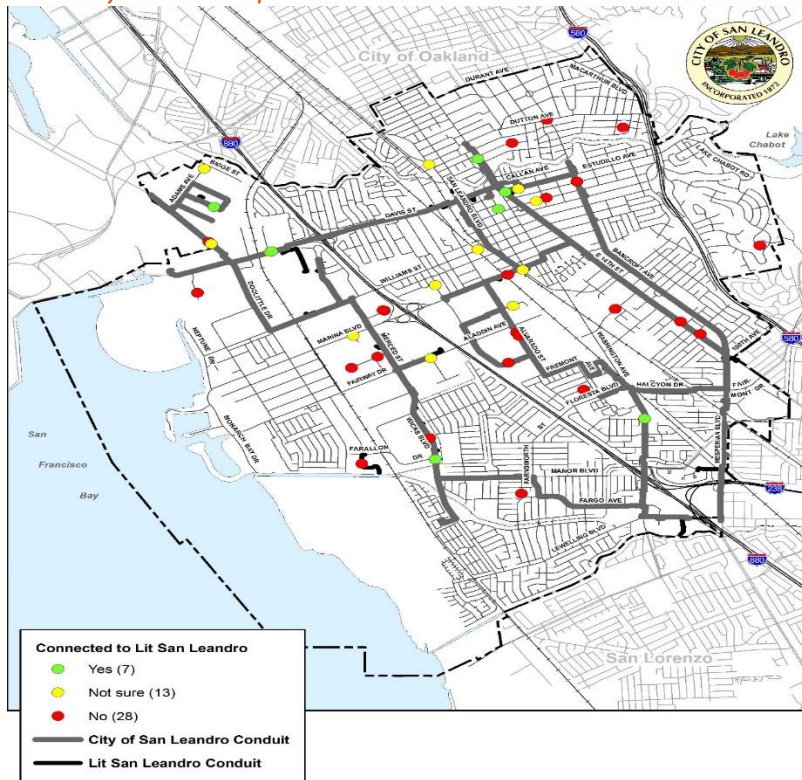
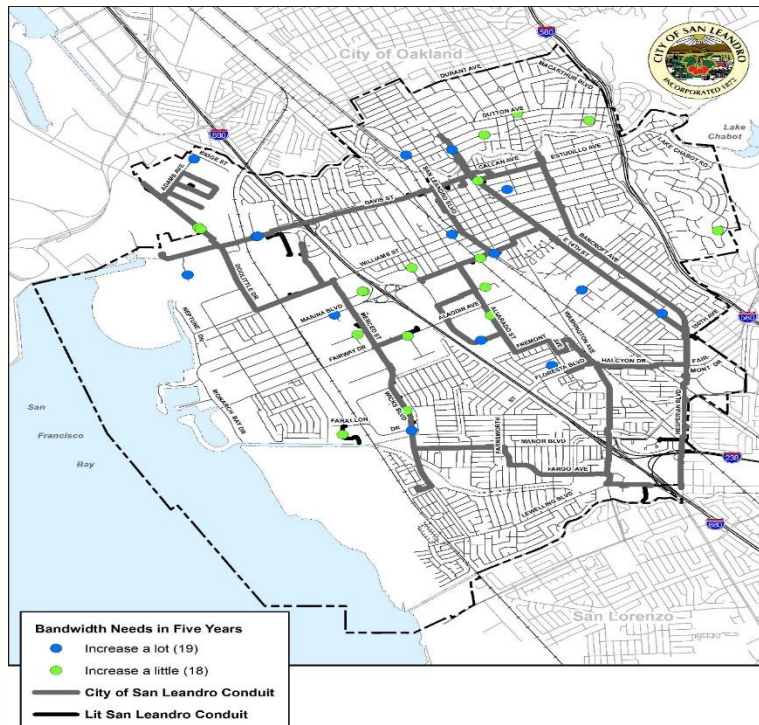


Figure 94. Business Survey Results: Bandwidth Needs





Residential Survey Result Graphs

Figure 95. Residential Survey Responses by Zip Code

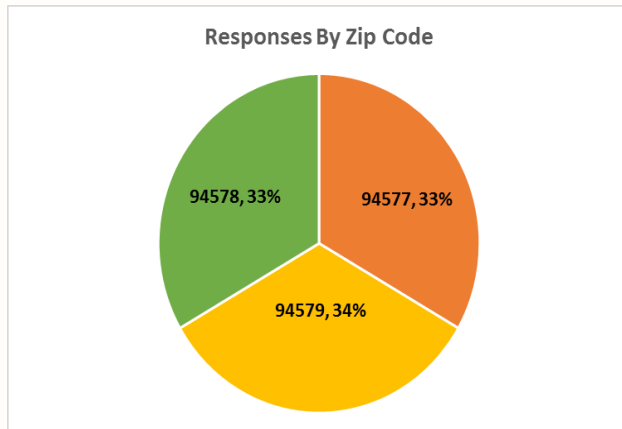


Figure 96. Residential Survey Responses

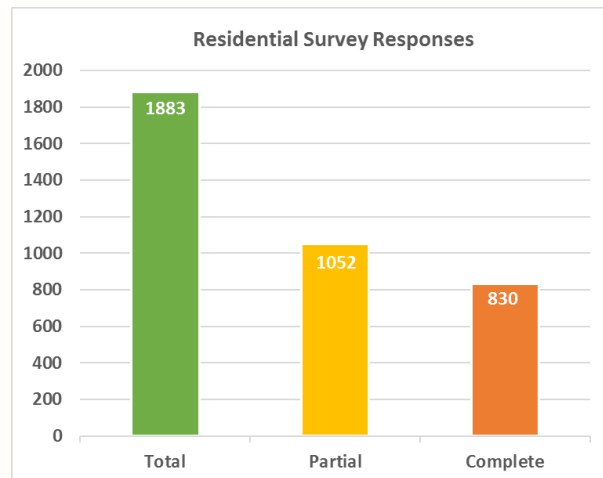


Figure 97. Residential Survey Results - Area of Work

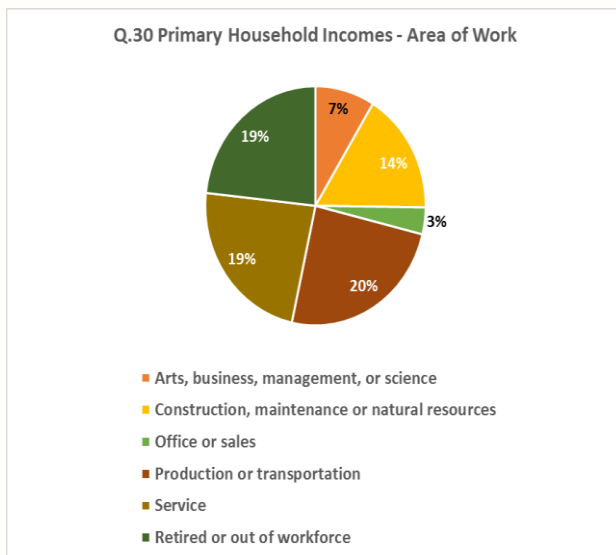


Figure 98. Residential Survey Results – Family Income

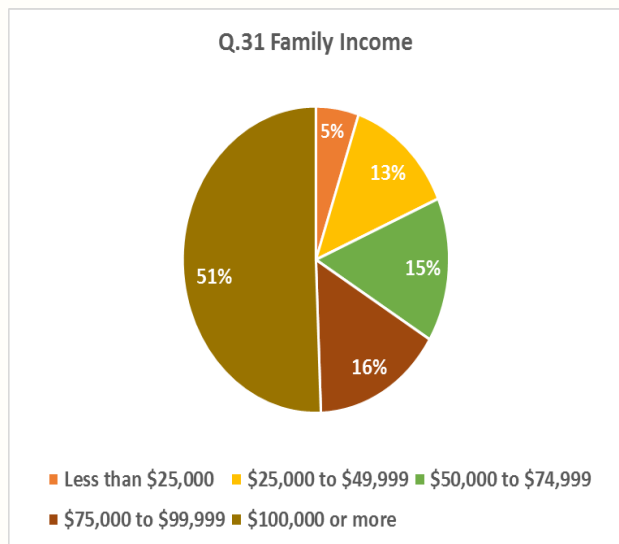




Figure 99. Residential Survey Results – Highest Level of Education

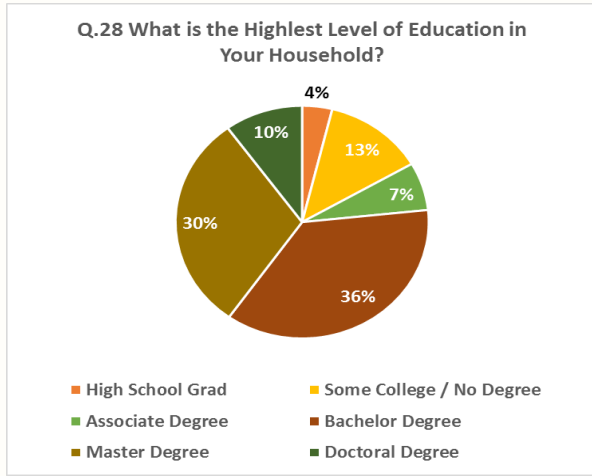


Figure 100. Residential Survey Results – Providers of Service

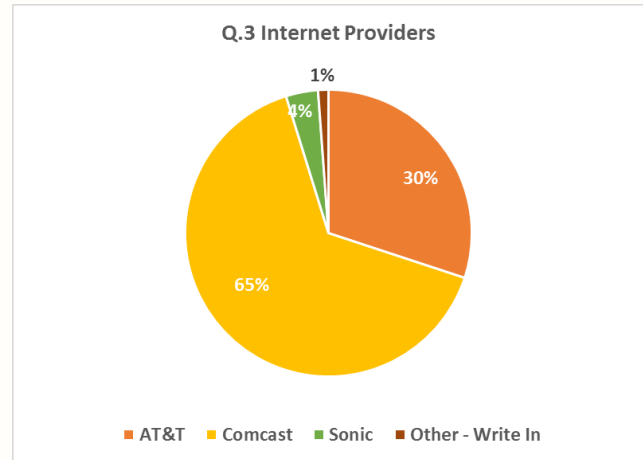


Figure 101. Residential Survey Results – Technologies

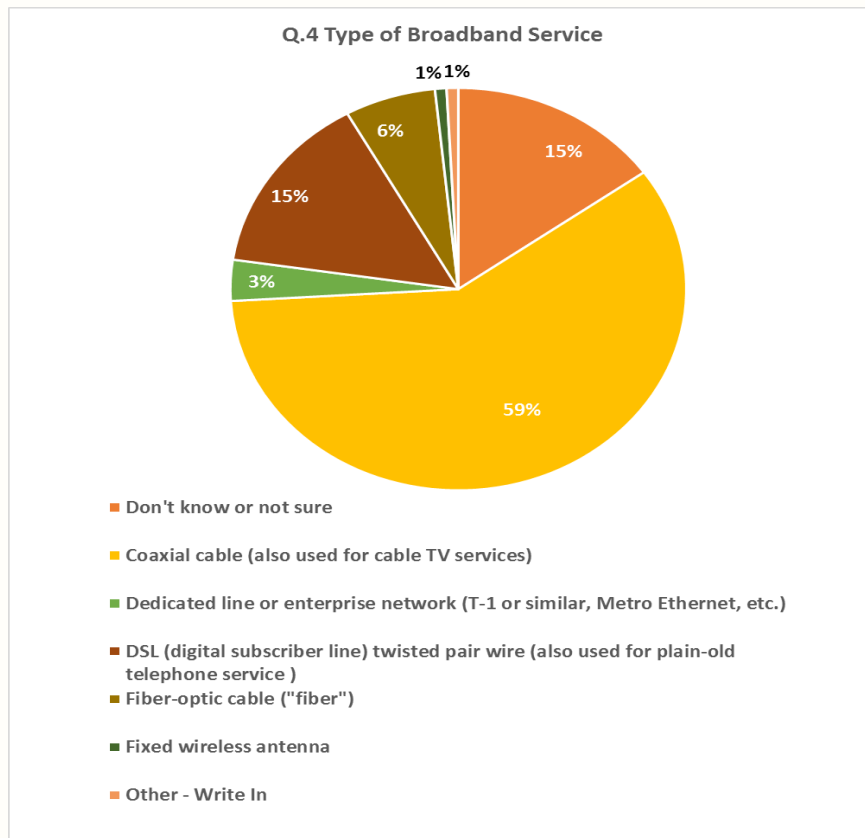




Figure 102. Residential Survey Results – Satisfaction with Service

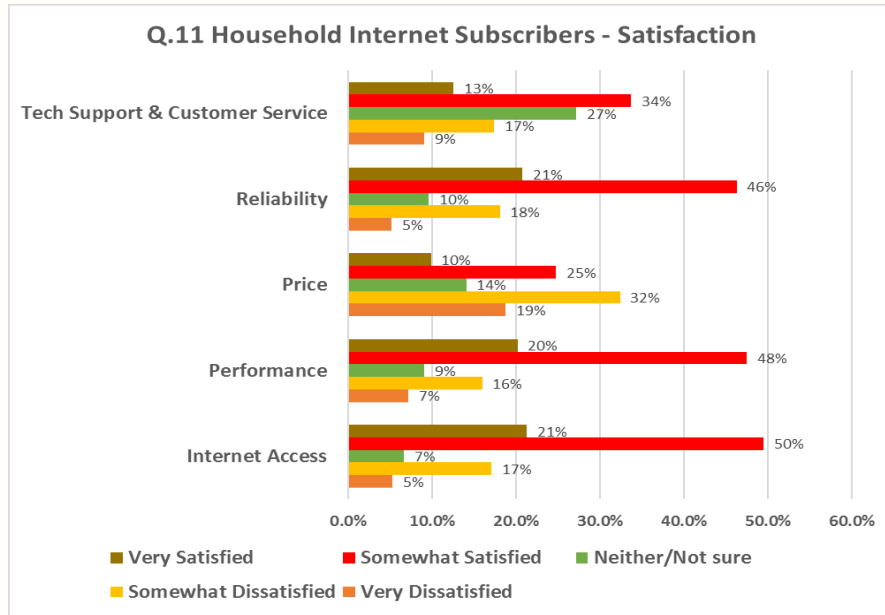


Figure 103. Residential Survey Results – Importance of Broadband Aspects

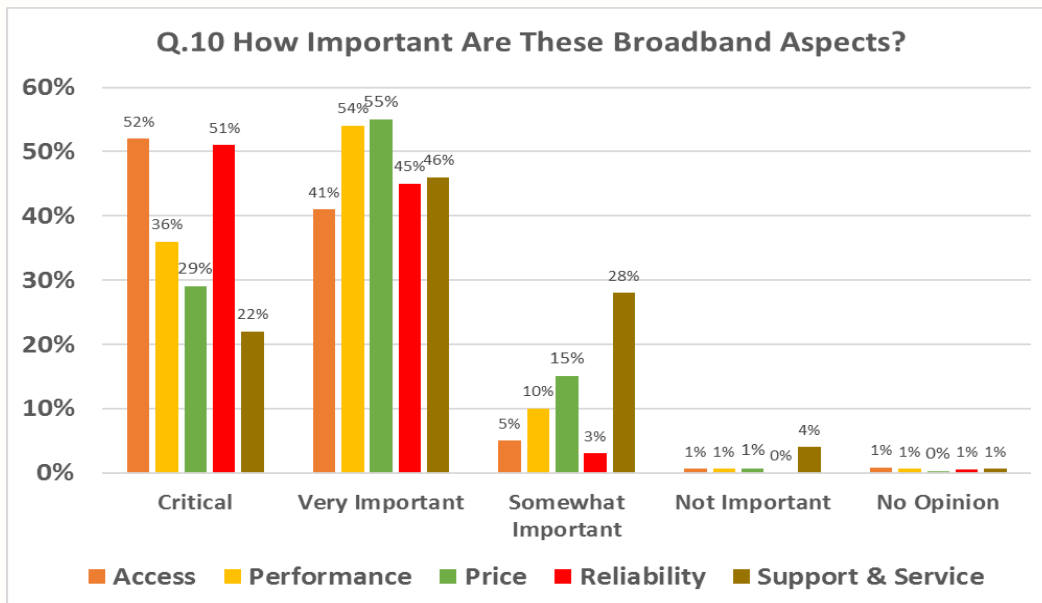




Figure 104. Residential Survey Results – Broadband Provider Bundles

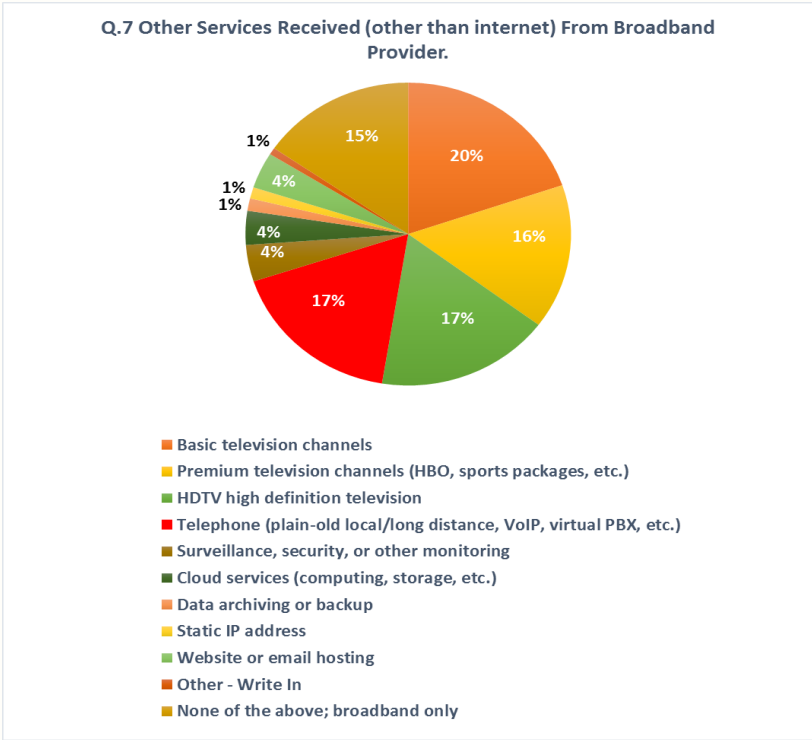


Figure 105. Residential Survey Results – Uses of Internet

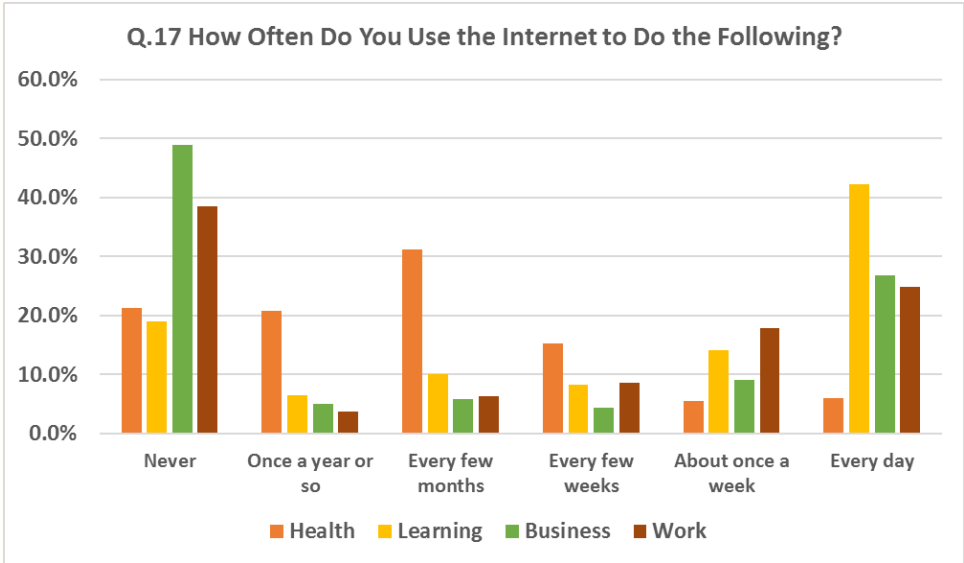




Figure 106. Residential Survey Results – Expectations of How Needs Will Change

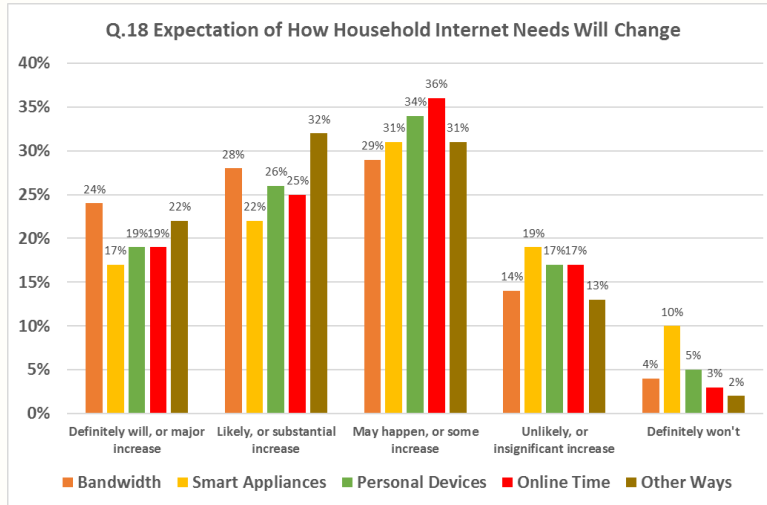


Figure 107. Residential Survey Results – Willingness to Pay for Speeds

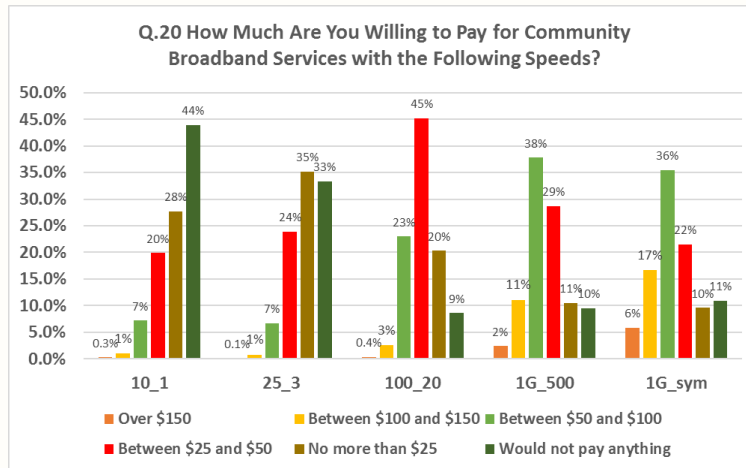




Figure 108. Residential Survey Results – Ranking the Current Public Wi-Fi

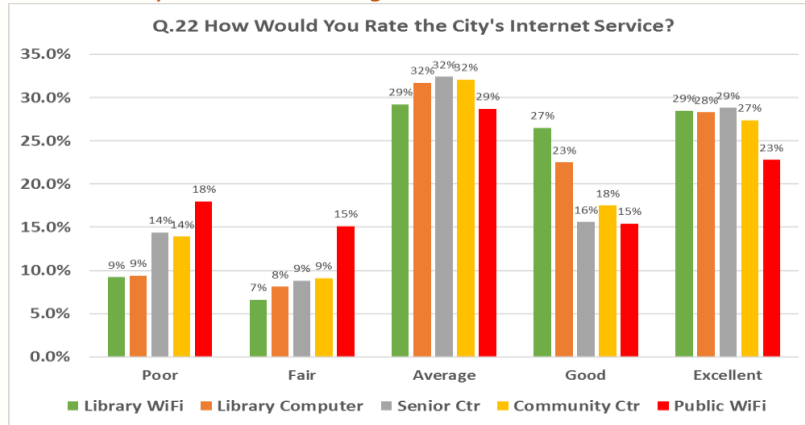


Figure 109. Residential Survey Results – How the City Can Improve Public Wi-Fi

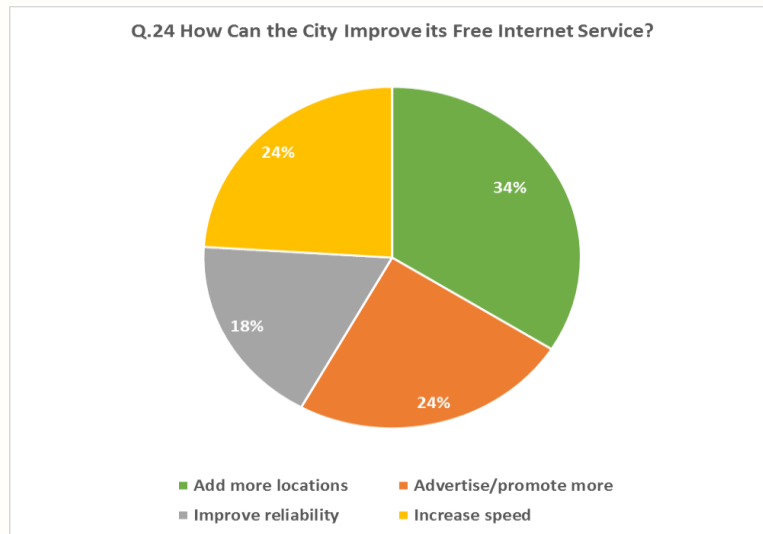
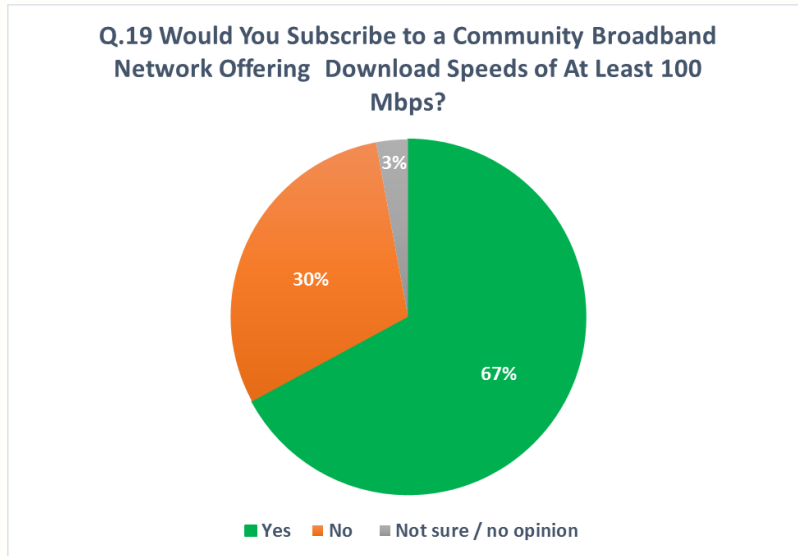




Figure 110. Residential Survey Results – Likelihood to Subscribe to a Community Network





APPENDIX F. COST ASSUMPTIONS

The following financial models are based on conservative estimates to reflect a “worst case scenario” in which user take rates and revenue opportunities are low. It also does not consider potential grant and assistance programs that may supplement the cost of the project nor lease savings made possible by using City assets instead of leasing from outside providers.

The model assumes that Phase 1 will continue as is, but with a change in business model. Currently, Lit San Leandro is only offering dark fiber services and is missing a large part of the market. Dark fiber is not for all businesses as it requires a large capital expense in terms of equipment, and resources that have knowledge and expertise in managing the appropriate electronics to make the dark fiber useful. Dark fiber dedicates a strand of fiber for each end user, that will in turn do what they want with that fiber. Eventually, many dark fiber suppliers run out of strands to lease. An alternative approach is to offer “lit” services on a wholesale basis to an ISP, that in turn offers services to the end user. Lit services, for purposes of this model, will offer the following solutions:

- 1Gbps Dedicated (not oversubscribed, higher priced) \$1,250 monthly (\$720 wholesale)
- 100Mbps Dedicated \$500 monthly (\$360 wholesale)
- 1Gbps Best Effort (oversubscribed, less expensive) \$130 monthly (\$90 wholesale)
- 100Mbps Best Effort \$100 monthly (\$70 wholesale)

Offering these lit services opens the market from just large enterprise customers, to all small medium and enterprise customers.

As of this writing, 1Gbps (1,000 Mbps) and 100 Mbps are products and speeds end users are asking for today. However, it should be noted that the proposed network can deliver much higher speeds than those advertised above, and consideration should be given to higher offerings if it encourages a better take rate. Once the fiber is in the ground, the incremental cost to provide 1Gbps service vs 100Mbps service is negligible. If offering a 500Mbps service instead of a 100Mbps service will help in the marketing efforts, than it should be considered.

Dedicated vs Best Effort

Dedicated bandwidth essentially guarantees a certain level of performance between the customer site and the internet connection point. Generally, no other users “share” the fiber, but it is dedicated to that customer.



Best Effort services use a method of “sharing” the fiber with other users (encrypted and not viewable by the other users), but still get burstable speeds as outlined above. There are better economies of scale in a best effort scenario, hence the lower price.

Many businesses in San Leandro cannot afford, and do not need, dedicated services. By offering the tiered services, the City creates a larger available market.

Our recommendation is that Lit San Leandro move from a dark fiber leasing only business, to a “lit” services provider to better enhance the goals of the City for economic development.

The primary assumptions used to estimate the Phase 1 and 2 include:

- 100% City Facility Take Rate
- 30% Commercial Business Take Rate for businesses within 500’ of core network assets with 3-year ramp per phase
 - *20% of businesses within 500 ft of the core network*
 - *\$720 per month for 1Gbps/1Gbps transport services*
 - *\$360 per month for 100Mbps/100Mbps transport services*
 - **All rates are wholesale to an ISP; the ISP would charge full retail prices for services**
- 7% Vertical Assets Leases with 5-year ramp starting in 2023 (not available in Phase 1)
 - *\$400 per month with backhaul, or \$180 per month for lease only*

Other off-balance sheet benefits to consider:

- Each phase can be profitable, but most profitable if managed as a single network
- Model does not consider any savings from opportunistic builds
- Model is only one potential model for the City
- Model does not show any cost savings the City would have by not leasing from existing carriers
- Revenue will be from businesses within 500 feet of the fiber run and from leasing of vertical assets and fiber to wireless providers
- No Smart City costs were included in the model



Phase 1 – 2 Combined Using Magellan Advisors Business Recommendations

Summary:

Total funding required is \$30,785,000 which includes:

- All existing costs for Phase 1 - \$3,500,000
- Network costs for new construction for Phase 2 - \$9,678,000
- Lateral costs (\$6,000 per sub X 30% take rate) - \$12,720,000
- DWDM and Inside Plant Costs - \$1,010,000

Total Businesses for Phase 1 – 2

- Phase 1 – 3,028
- Phase 2 – 2,782
- Total 5,836
- 30% over 4-year ramp - 1,750 subs

Total Vertical Assets for Phase 2

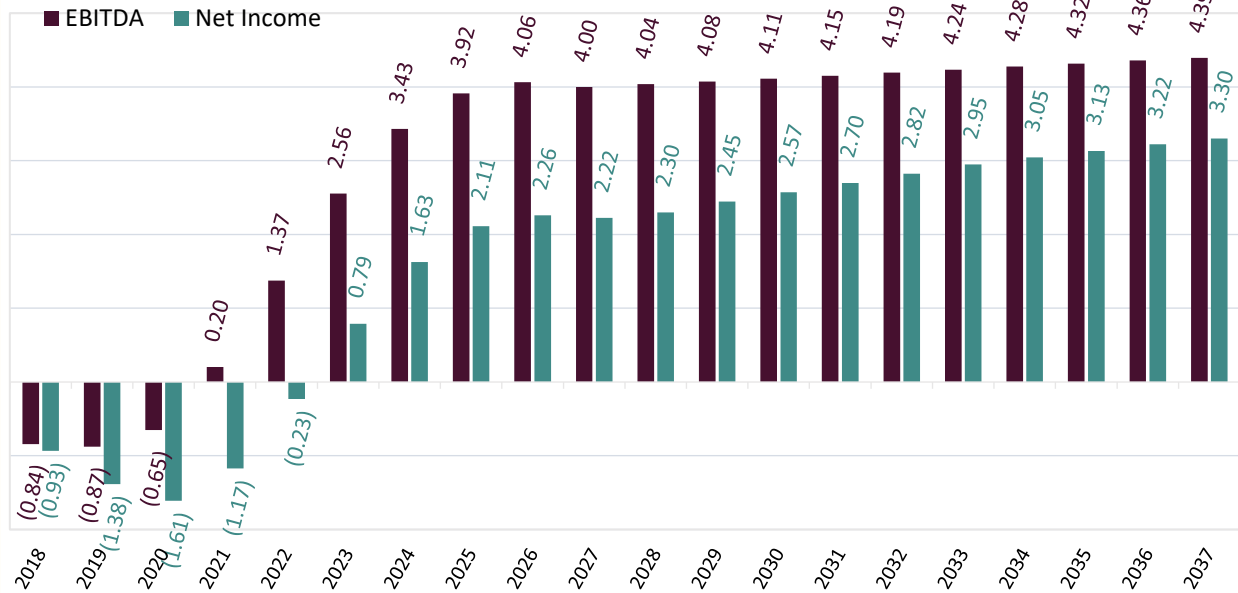
- Phase 2 Vertical Assets – 1,765
- 7% Take Rate – 123

	LIT San Leandro	San Leandro City
Total Businesses (inside the city limits)	1134	7931
Business w/LT 15 employees		7458
Business w/GE 15employees		473
Business w/GE 15 and LE45		327
Business w/ GT 45 employees		146
Business in New Development		0
Businesses in 500 ft ext		3962



Figure 111. Phase 1 & 2 EBITDA & Net Income

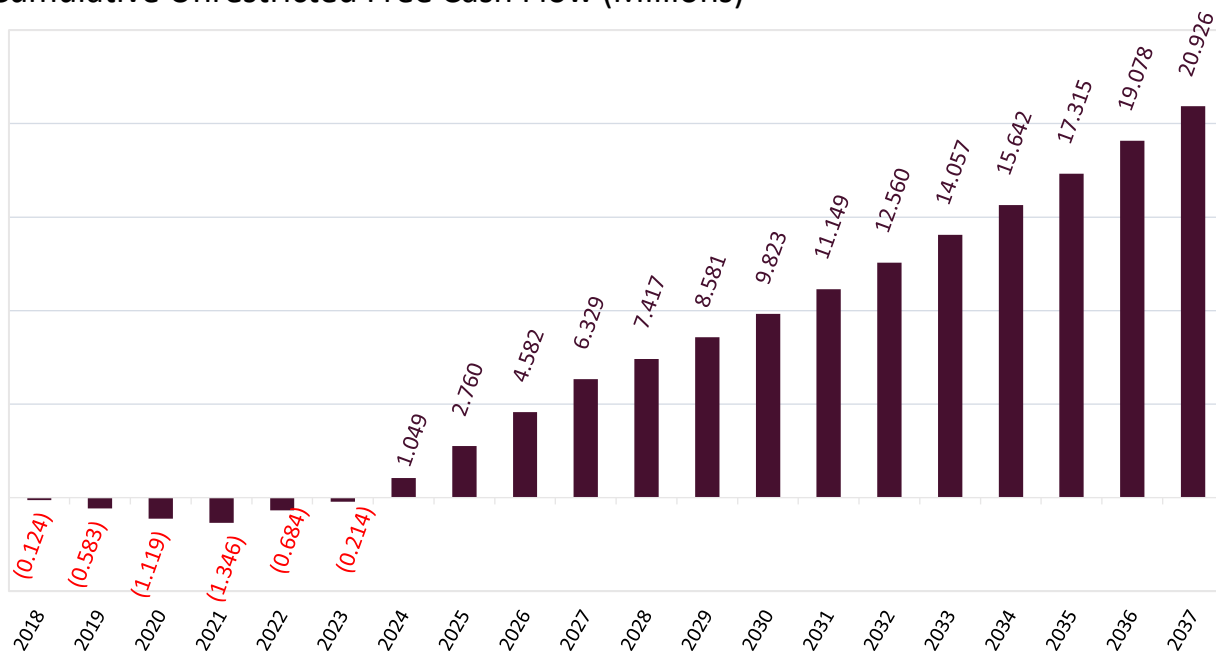
EBITDA & Net Income (Millions)



Over a 20 year period, the model could generate a \$21,000,000 positive cash flow, or about \$1,000,000 per year

Figure 112. Phase 1 & 2 Cumulative Unrestricted Free Cash Flow

Cumulative Unrestricted Free Cash Flow (Millions)





Model assumes a loan of 20 years at 2.5% interest rate. City does not have to finance the network but can look for opportunistic builds over time to help construct the network. This model does demonstrate the scenario of financing and show it can still be profitable even with the debt load.

Figure 113. Phase 1 & 2 Debt Balance

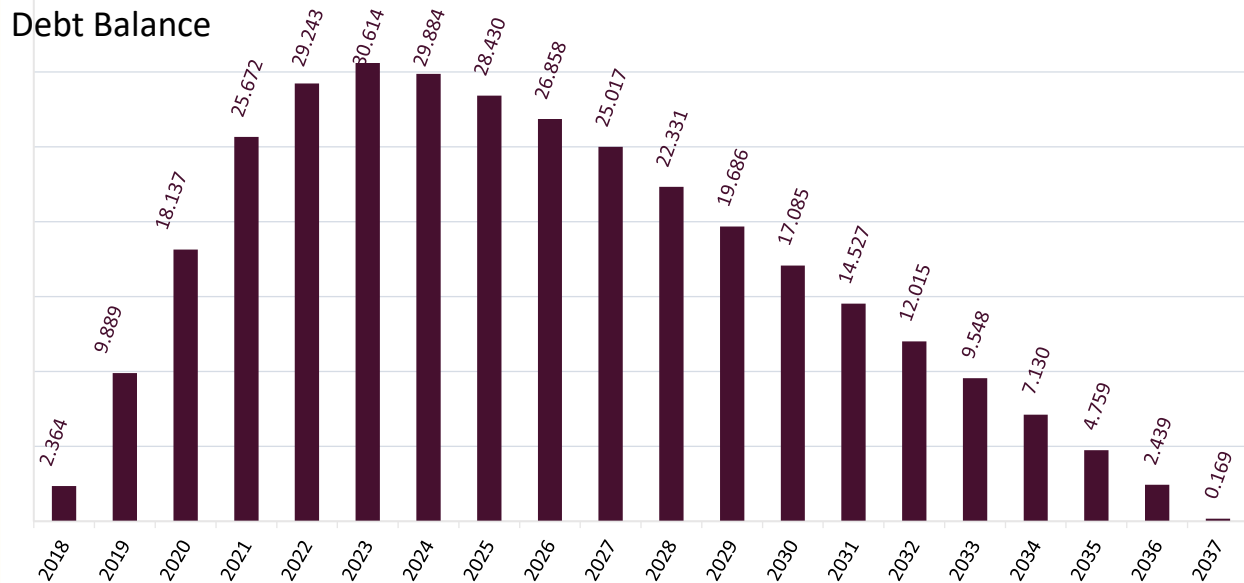
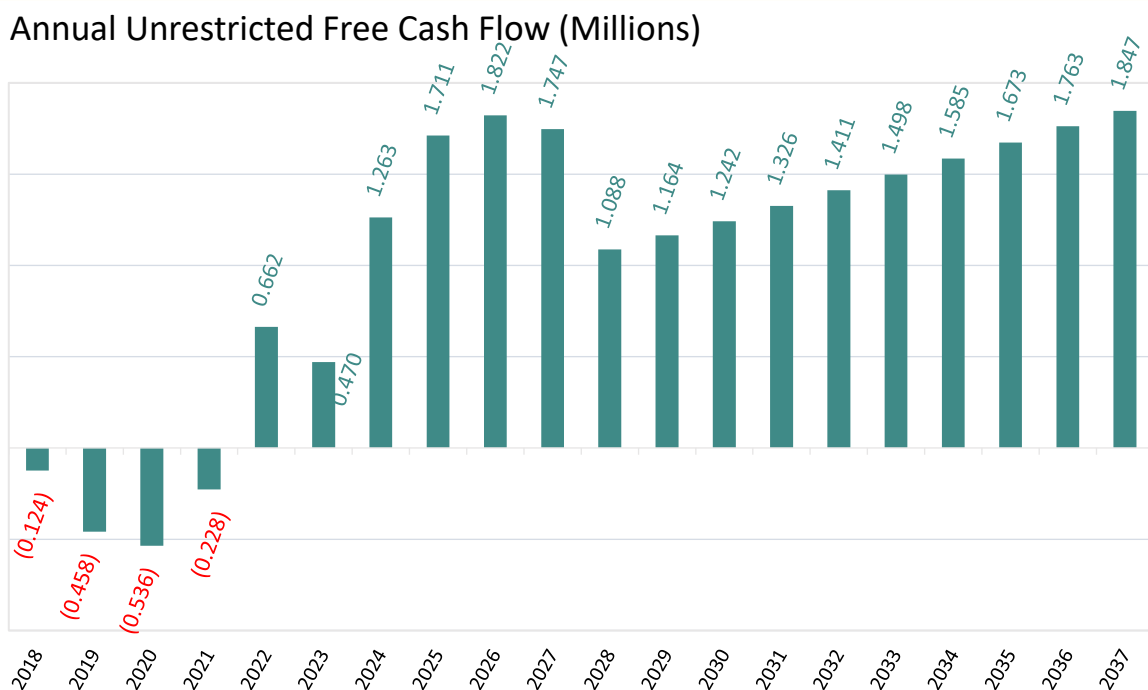


Figure 114. Phase 1 & 2 Annual Unrestricted Free Cash Flow





The model assigns a percentage of revenue set aside for Reserve Balance. This fund is used to upgrade the network over time.

Figure 115. Phase 1 & 2 Total Reserve Balances

Total Reserve Balances (Millions)

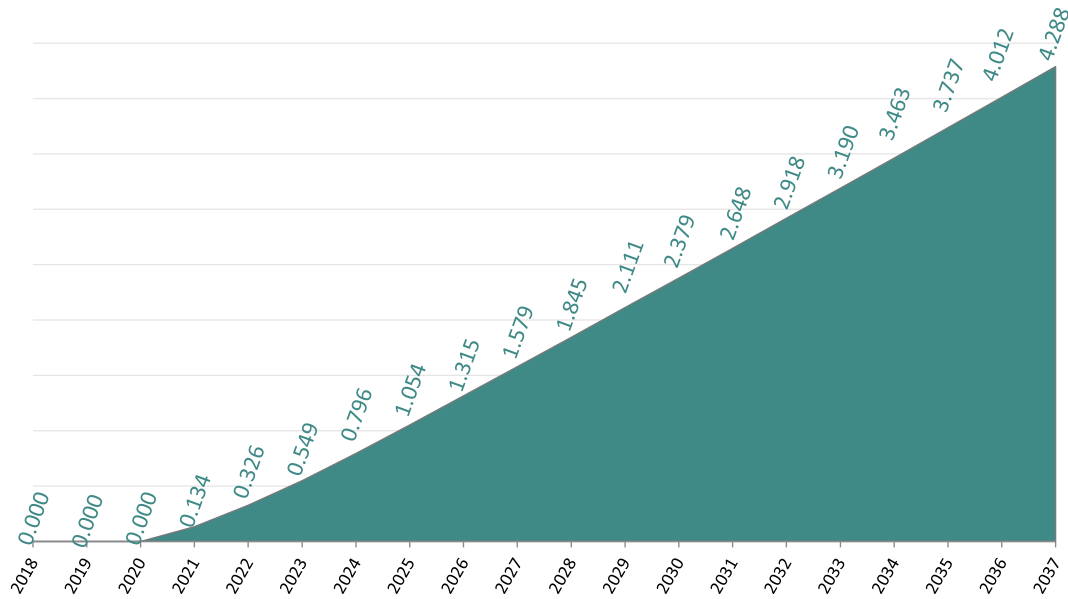


Figure 116. Phase 1 & 2 Annual Capital Spending

Annual capital spending (Millions)

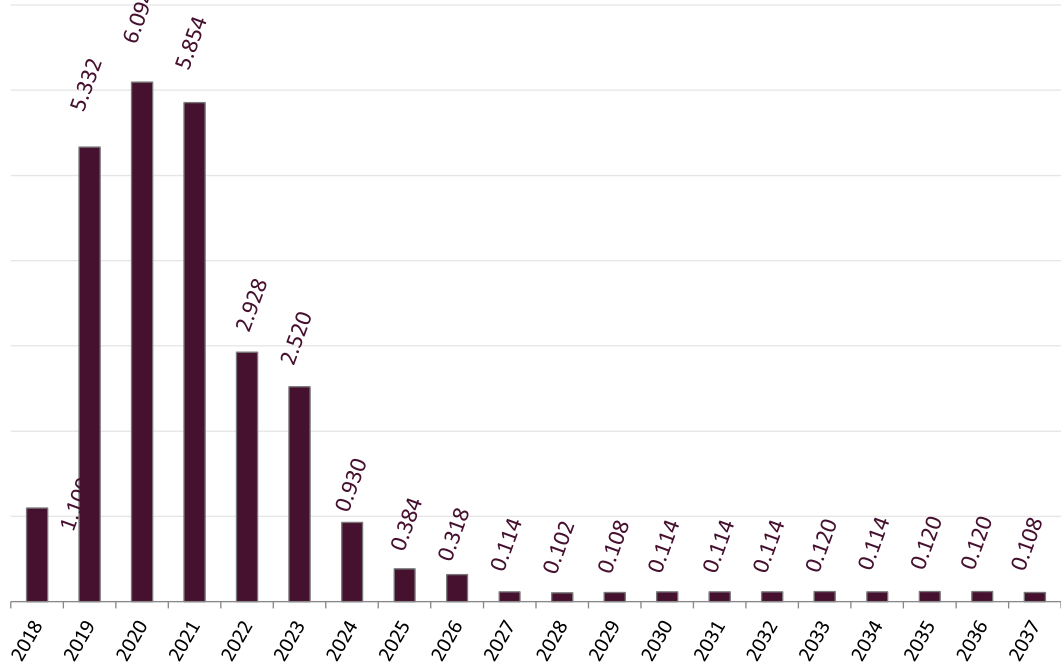




Figure 117. Phase 1 Profit Margins

Profit Margins

- Gross Profit Margin
- Net Profit Margin

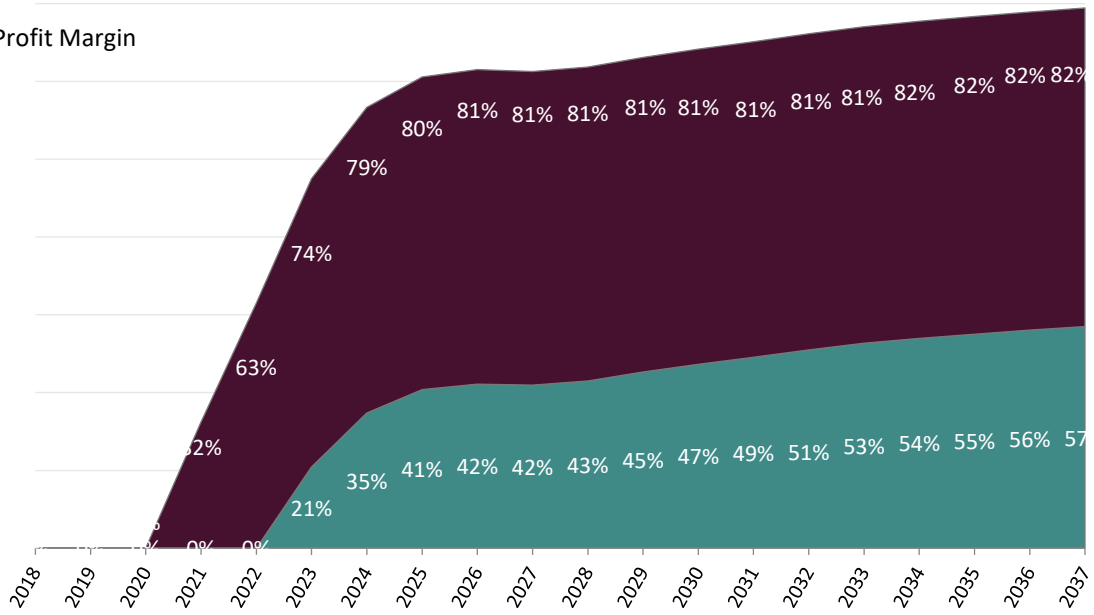




Figure 118. Phase 1& 2 Capital Plan

Capital Plan

Proprietary and Confidential Information

		Year #		1	2	3	4
			Totals	2018	2019	2020	2021
Feeder & Distribution Fiber Design & Construction							
Total Costs							
Phase 1 Core Network Buildout	Labor	\$ 3,000,000	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000		
Phase 1 Core Network Buildout	Materials						
Phase 1 Core Network Buildout (5% Labor and Material)	Materials	\$ 300,000	\$ 100,000	\$ 100,000	\$ 100,000		
Phase 1 Core Network Buildout TOTAL		\$ 3,300,000					
Phase 1 Populate Conduit	Labor	\$ 750,000		\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000
Phase 1 Populate Conduit	Materials	\$ 150,000		\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000
Phase 1 Populate Conduit (5% Labor and Material)	Materials	\$ 18,000		\$ 6,000	\$ 6,000	\$ 6,000	\$ 6,000
Phase 1 Populate Conduit TOTAL		\$ 918,000					
Phase 2 Conduit Enhancements	Labor	\$ 6,999,000		\$ 2,333,000	\$ 2,333,000	\$ 2,333,000	\$ 2,333,000
Phase 2 Conduit Enhancements	Materials	\$ 965,250		\$ 321,750	\$ 321,750	\$ 321,750	\$ 321,750
Phase 2 Conduit Enhancements (5% Labor and Material)	Materials	\$ 796,425		\$ 265,475	\$ 265,475	\$ 265,475	\$ 265,475
Phase 2 Conduit Enhancements TOTAL		\$ 8,760,675					
Premises Connected							
Materials Cost							
Connectorized Drop Fiber Cost Per Passing	Materials	\$ 9,540,000		\$ 229,500	\$ 1,093,500	\$ 1,971,000	
Premise Inside Wiring Per Passing	Equipment						
Other Materials	Equipment						
Equipment Cost							
Optical Network Terminal + Power Supply	Equipment	\$ 2,120,000		\$ 51,000	\$ 243,000	\$ 438,000	
Residential Gateway	Equipment						
Settop Boxes - 2.5 Per Subscriber @ 245 ea.	Equipment						
Labor Cost							
Drop Fiber Installation, Splicing and Termination Per Pa	Materials	\$ 1,060,000		\$ 25,500	\$ 121,500	\$ 219,000	
Premise Equipment Installation Per Passing (2 Hours)	Materials						
Premise Inside Wiring Per Passing	Equipment						



Headend Equipment / PM			2018	2019	2020
Core switch routers	Equipment	\$ 320,000		\$ 160,000	\$ 160,000
Encoders/Transcoders	Equipment				
Fiber termination panels	Equipment	\$ 25,000		\$ 25,000	
Firewalls	Equipment	\$ 40,000		\$ 40,000	
Internet routers	Equipment	\$ 300,000		\$ 150,000	\$ 150,000
Intra-facility cabling	Equipment	\$ 20,000		\$ 20,000	
Ladder/raceway	Equipment	\$ 10,000		\$ 10,000	
OLTs	Equipment	\$ 150,000		\$ 150,000	
Racks/cabinets	Equipment	\$ 10,000		\$ 10,000	
Switches, servers, storage	Equipment	\$ 100,000		\$ 100,000	
IP TV Middleware	Equipment				
Video On Demand	Equipment				
Network Management Systems	Equipment	\$ 35,000		\$ 35,000	
Provisioning Systems	Equipment				
Billing Systems	Equipment				
Installation & Project Management	Labor				

Subtotal Categories Annual		Totals	2018	2019	2020
Feeder & Distribution Fiber Design & Construction		\$ 1,596,675	\$ 1,100,000	\$ 4,326,225	\$ 4,326,225
Premises Connected		\$ 12,720,000		\$ 306,000	\$ 1,458,000
Headend Equipment / PM		\$ 1,010,000		\$ 700,000	\$ 310,000
Building Improvements		\$ -			
General Equipment		\$ -			
Wireless Equipment		\$ -			
Cumulative by Year Categories		Totals	2018	2019	2020
Feeder & Distribution Fiber Design & Construction		\$ 1,596,675	\$ 1,100,000	\$ 5,426,225	\$ 9,752,450
Premises Connected		\$ 12,720,000		\$ 306,000	\$ 1,764,000
Headend Equipment / PM		\$ 1,010,000		\$ 700,000	\$ 1,010,000
Building Improvements		\$ -			
General Equipment		\$ -			
Wireless Equipment		\$ -			



Subtotal Type Annual		Totals	2018	2019	2020	2021
20 Year Lifetime (Materials / Labor)		\$ 23,578,675	\$ 1,100,000	\$ 4,581,225	\$ 5,541,225	\$ 5,416,225
10 Year Lifetime (Equipment)		\$ 3,130,000		\$ 751,000	\$ 553,000	\$ 438,000
Subtotal Type Cumulative			2018	2019	2020	2021
20 Year Lifetime (Materials / Labor)		\$ 23,578,675	\$ 1,100,000	\$ 5,681,225	\$ 11,222,450	\$ 16,638,675
10 Year Lifetime (Equipment)		\$ 3,130,000		\$ 751,000	\$ 1,304,000	\$ 1,742,000
Total Annual Capital		\$ 26,708,675	\$ 1,100,000	\$ 5,332,225	\$ 6,094,225	\$ 5,854,225
Total Cumulative Capital		\$ 26,708,675	\$ 1,100,000	\$ 6,432,225	\$ 12,526,450	\$ 18,380,675
Depreciation			2018	2019	2020	2021
20 Year Lifetime (Materials / Labor)						
2018		\$ 880,000	\$ 44,000	\$ 44,000	\$ 44,000	\$ 44,000
2019		\$ 3,664,980		\$ 183,249	\$ 183,249	\$ 183,249
2020		\$ 4,432,980			\$ 221,649	\$ 221,649
2021		\$ 4,332,980				\$ 216,649
2022		\$ 1,952,000				
2023		\$ 1,680,000				
2024		\$ 620,000				
2025		\$ 256,000				
2026		\$ 212,000				
	Total:	\$ 18,030,940				
10 Year Lifetime (Equipment)			2018	2019	2020	2021
2018		\$ -				
2019		\$ 751,000		\$ 75,100	\$ 75,100	\$ 75,100
2020		\$ 553,000			\$ 55,300	\$ 55,300
2021		\$ 438,000				\$ 43,800
2022		\$ 488,000				
2023		\$ 420,000				
2024		\$ 155,000				
2025		\$ 64,000				
2026		\$ 53,000				
	Total:	\$ 2,922,000				
Total Depreciation		\$ 21,028,822	\$ 46,018	\$ 304,368	\$ 581,318	\$ 841,768

Cost Summary



There are certain annual or monthly recurring costs with this type network and associated business plan/model.

Outsource Operations. Outsource Operations is for outsourcing the network maintenance and management of the network as opposed to having a Full Time Employee(s) do the work. - \$800,000 per year, but actual amount will need to be negotiated with a potential vendor.

Model has assigned one FTE equivalent to be the outsource vendor liaison.



Figure 119. Phase 1 & 2 Cost Summary

Cost Summary

Proprietary and Confidential In

	Year #				
	1	2	3	4	5
	2018	2019	2020	2021	2022
Cost of Services					
Direct Staffing	\$ -	\$ -	\$ -	\$ -	\$ -
Data Center Rack and Power (UM)	\$ 10,000	\$ 10,100	\$ 10,200	\$ 10,300	\$ 10,400
Broadband Transport & Internet Costs	\$ -	\$ -	\$ -	\$ -	\$ -
Outsource Operations	\$ 800,000	\$ 800,000	\$ 800,000	\$ 800,000	\$ 800,000
Vehicle Maintenance	\$ -	\$ -	\$ -	\$ -	\$ -
Facilities Maintenance, Power, Environmental	\$ -	\$ 20,200	\$ 20,402	\$ 20,606	\$ 20,812
Miscellaneous	\$ -	\$ 2,061	\$ 13,588	\$ 40,305	\$ 76,686
Network & Headend Maintenance	\$ -	\$ 20,000	\$ 20,200	\$ 20,402	\$ 20,606
Pole attachments	\$ -	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ -	\$ -	\$ 5,250	\$ 5,303	\$ 5,355
Utilities	\$ 10,000	\$ 10,025	\$ 10,050	\$ 10,075	\$ 10,100
Network Operations Outsource Contract	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal: Cost of Services	\$ 820,000	\$ 862,386	\$ 879,690	\$ 906,991	\$ 943,959
Sales, General & Administrative Expenses					
Administrative Staffing	\$ -	\$ -	\$ 143,222	\$ 147,518	\$ 151,944
Professional & Legal Fees	\$ 20,000	\$ 20,400	\$ 20,808	\$ 21,224	\$ 21,649
Sales Commissions & Marketing Expense	\$ -	\$ -	\$ -	\$ -	\$ -
Reporting & Compliance	\$ -	\$ 20,000	\$ 20,400	\$ 20,808	\$ 21,224
Travel & Entertainment Expense	\$ -	\$ 10,200	\$ 10,404	\$ 10,612	\$ 10,824
Office Expense	\$ -	\$ 10,200	\$ 10,404	\$ 10,612	\$ 10,824
General Overhead	\$ -	\$ 20,400	\$ 20,808	\$ 21,224	\$ 21,649
Cost Allocation for City Services	\$ -	\$ -	\$ -	\$ -	\$ -
Bad Debt Expense	\$ -	\$ -	\$ -	\$ -	\$ -
Subtotal: Sales, General & Administrative Expenses	\$ 20,000	\$ 81,200	\$ 226,046	\$ 231,999	\$ 238,114
Total:	\$ 840,000	\$ 943,586	\$ 1,105,736	\$ 1,138,990	\$ 1,182,073

Conclusion – Phase 1 -2 Combined

Phase 1 is currently being run and managed by Lit San Leandro. Phase 2 would be managed (via outsource vendor) directly by the City.



However, for purposes of illustration, we have demonstrated what a single combined network financial picture could look like for whoever takes on this endeavor using Magellan Advisors business plan recommendations.

The combined network, managed by one entity, can be profitable in just a few years. It will take a rather large investment of over \$30M, but that can be paid back and profit of over \$1,000,000 can be realized.

Phase 1 - Using Magellan Advisors Business Recommendations

Summary:

Total funding required is \$13,049,000 which includes:

All existing costs for Phase 1 - \$3,500,000

Lateral costs (\$6,000 per sub X 30% take rate) - \$6,348,000

DWDM and Inside Plant Costs - \$1,010,000

Total Businesses for Phase 1

- Phase 1 – 3,028 increasing 2% per year
- 30% over 4-year ramp ~ 980 subs

Total Vertical Assets for Phase 1

- Phase 1 Vertical Assets – 0

Figure 120. Phase 1 EBITDA & Net Income

EBITDA & Net Income (Millions)

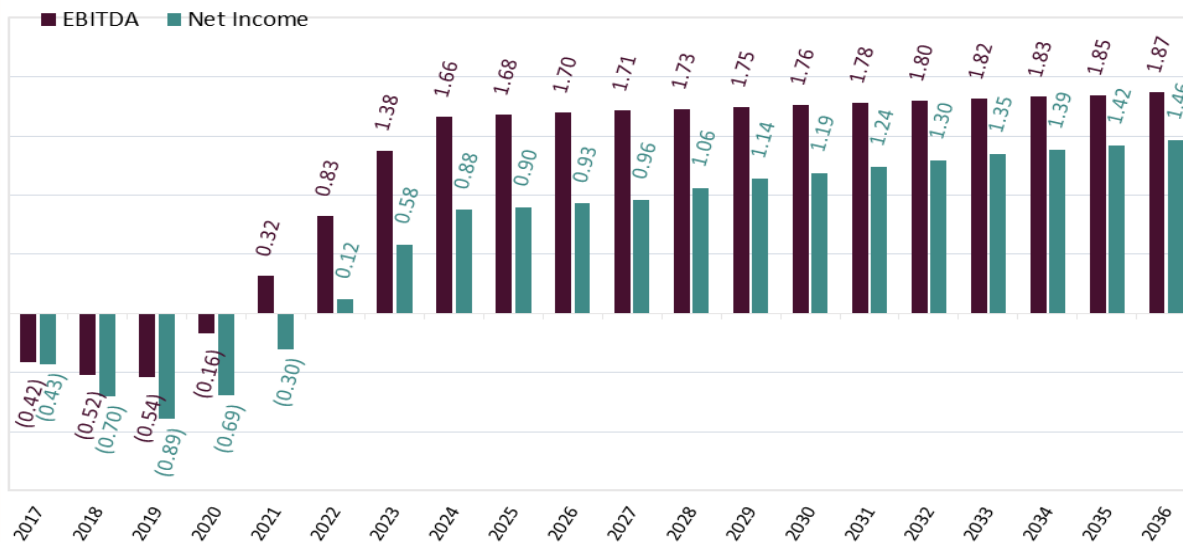




Figure 121. Phase 1 Cumulative Unrestricted Free Cash Flow

Cumulative Unrestricted Free Cash Flow (Millions)

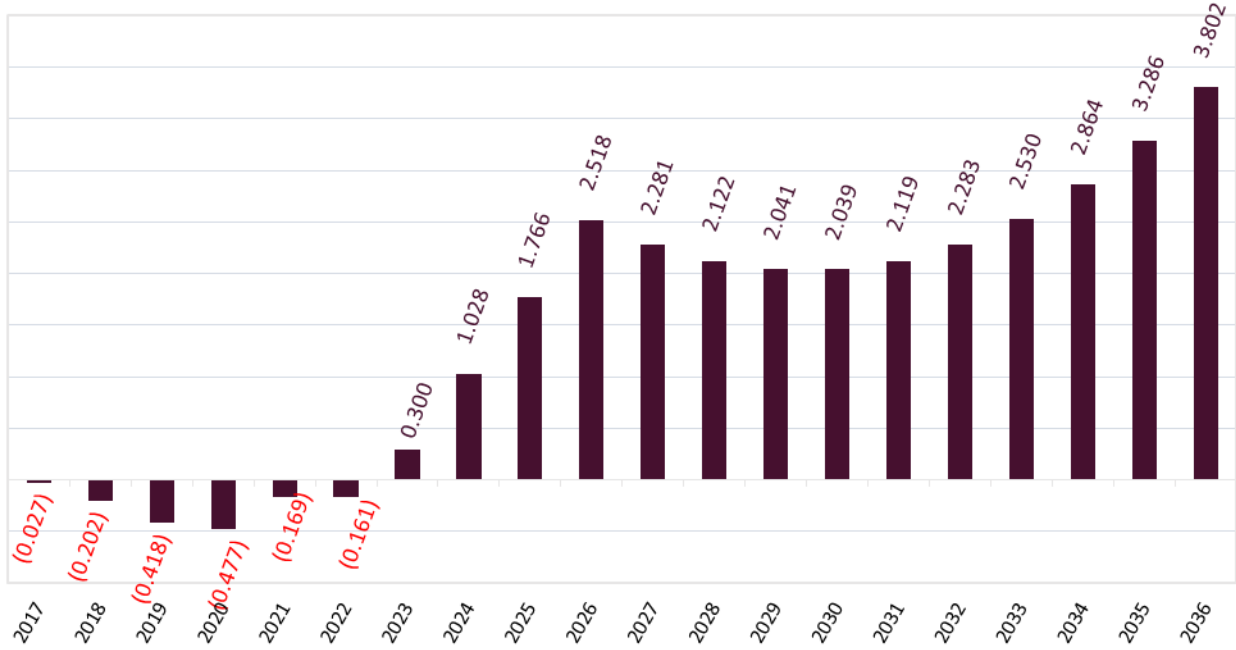


Figure 122. Phase 1 Debt Balance

Debt Balance

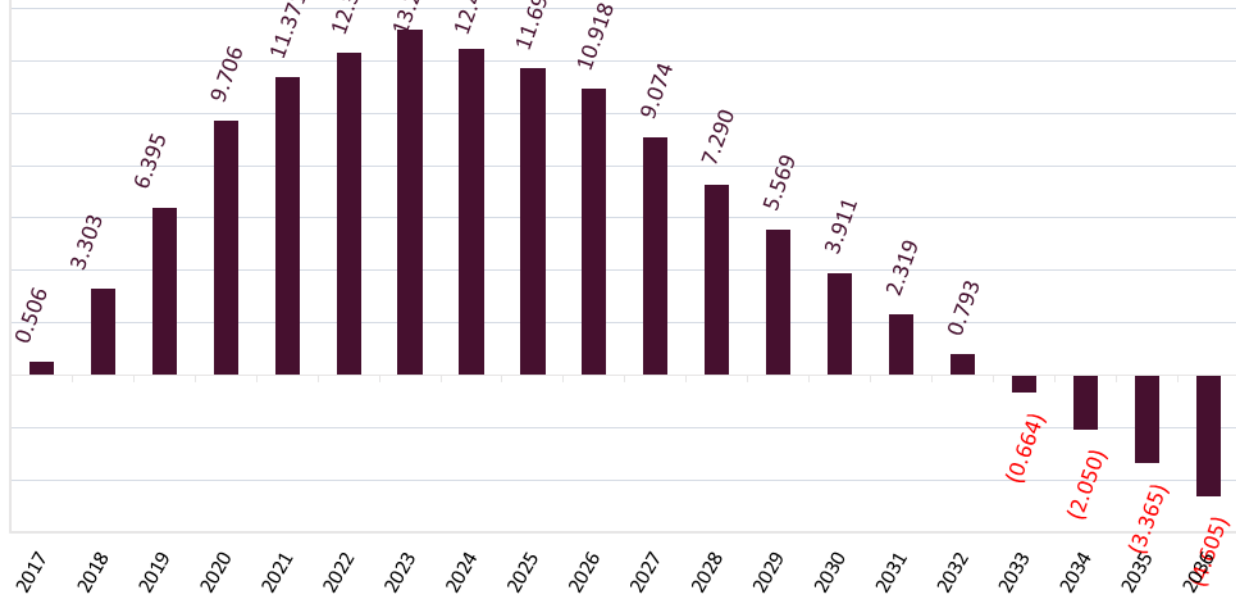




Figure 123. Phase 1 Annual Unrestricted Free Cash Flow

Annual Unrestricted Free Cash Flow (Millions)

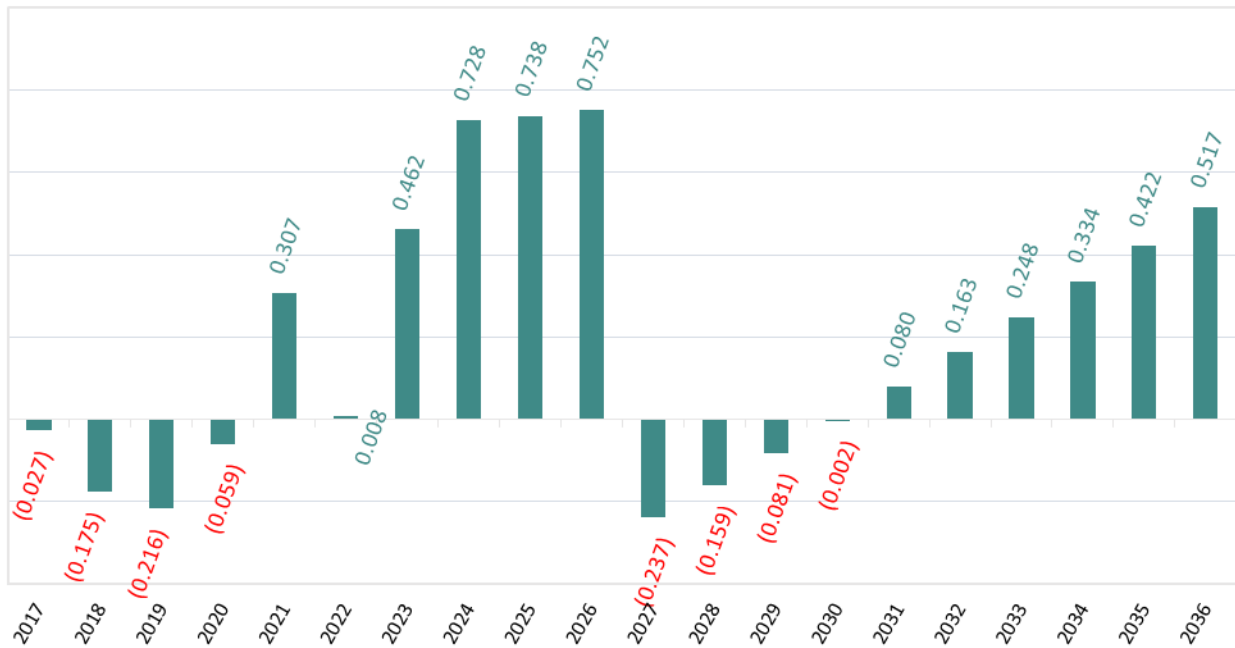


Figure 124. Phase 1 Total Reserve Balances

Total Reserve Balances (Millions)

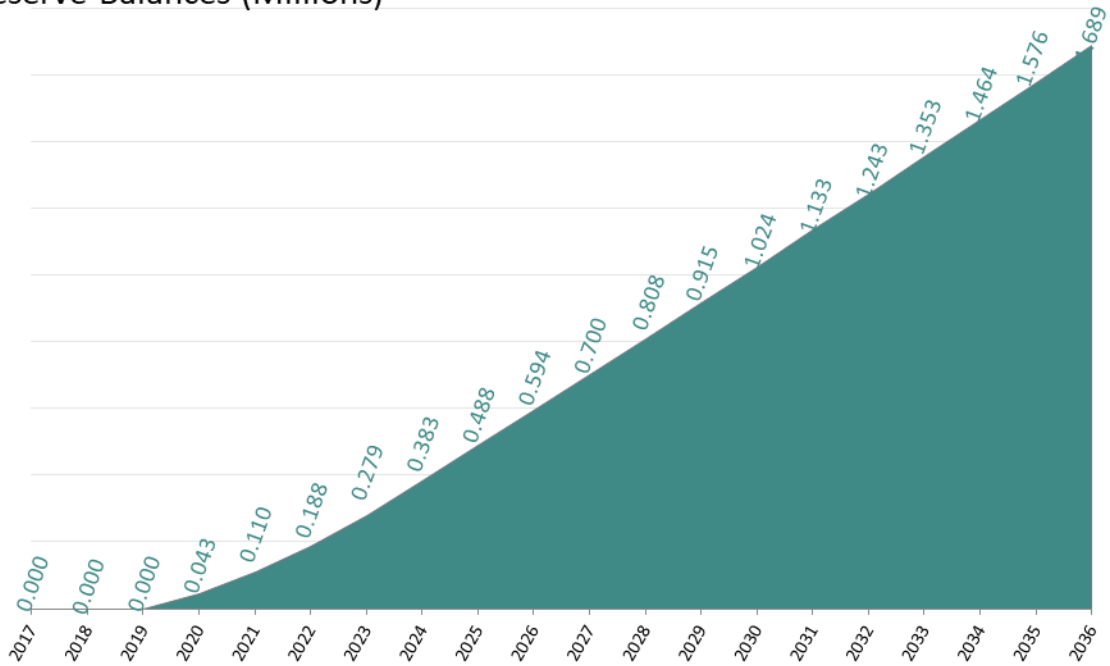




Figure 125. Phase 1 Annual Capital Spending

Annual capital spending (Millions)

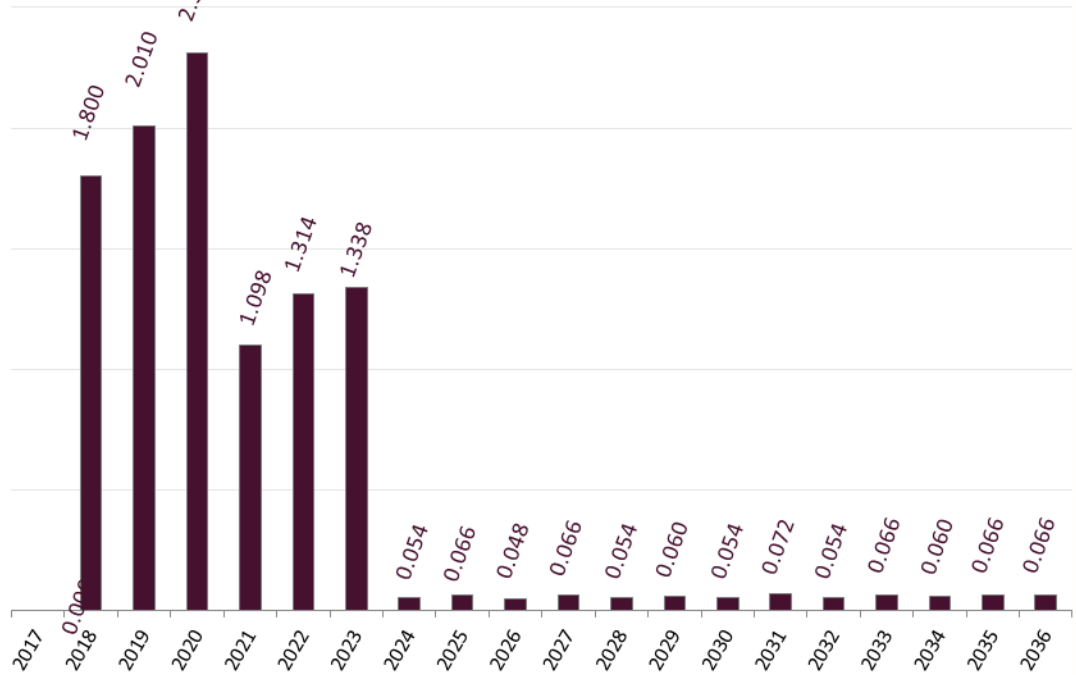


Figure 126. Phase 1 Profit Margins

Profit Margins

- Gross Profit Margin
- Net Profit Margin

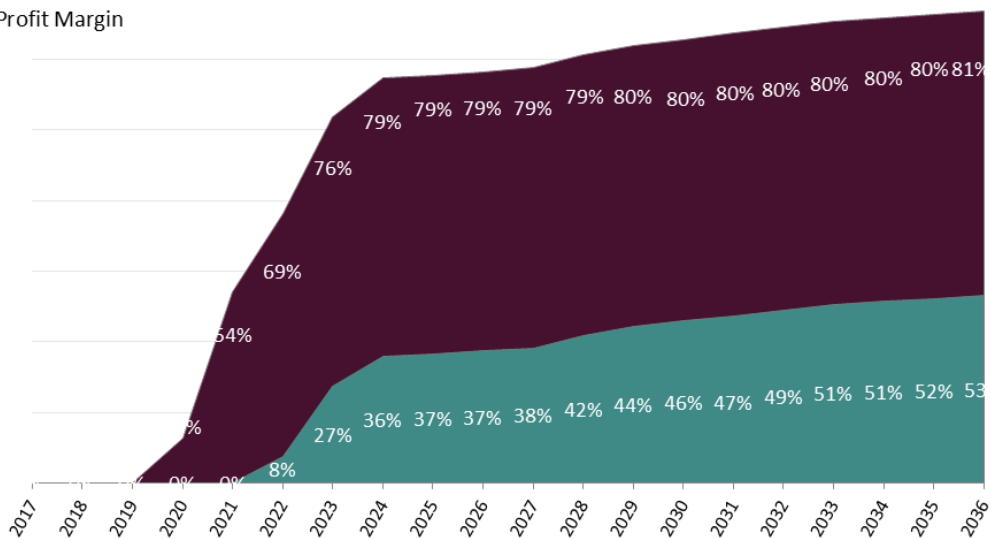




Figure 127. Phase 1 Business Customers

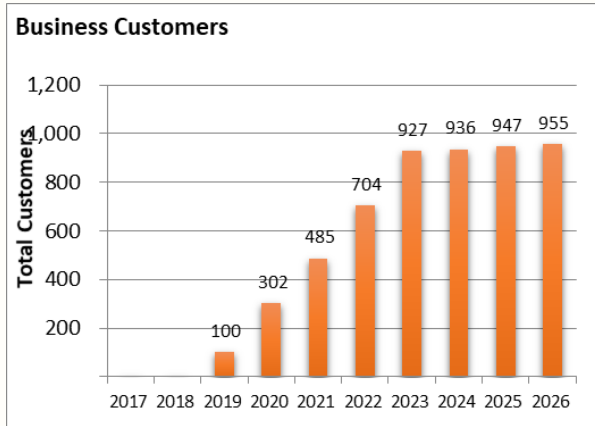


Figure 128. Phase 1 Percent of Available Market

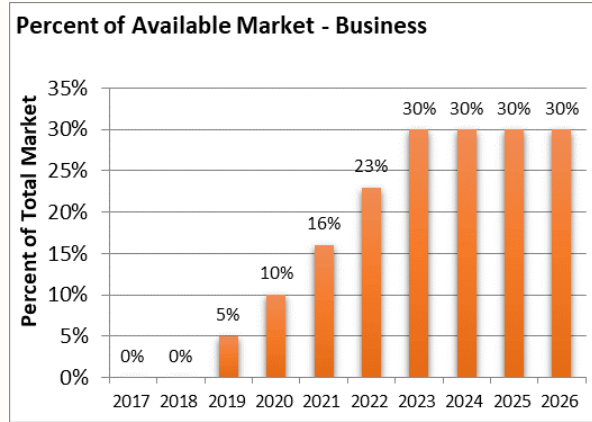
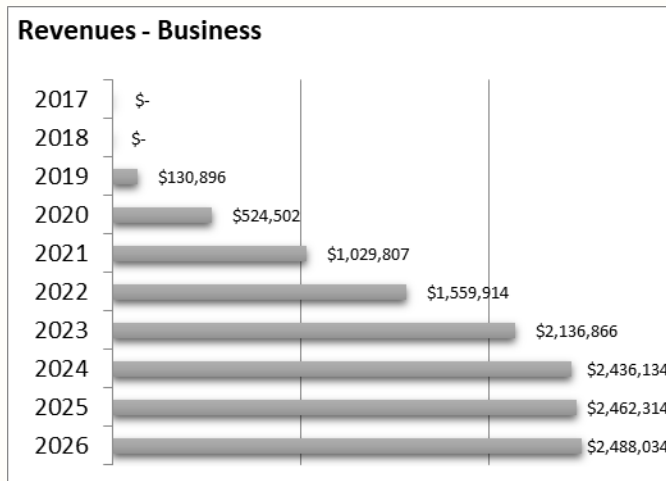


Figure 129. Phase 1 Business Revenues





Phase 2 Only - Using Magellan Advisors Business Recommendations

Summary:

Total funding required is \$19,852,669 which includes:

All existing costs for Phase 1 - \$9,678,000

Lateral costs (\$6,000 per sub X 30% take rate) - \$6,570,000

DWDM and Inside Plant Costs - \$1,010,000

Figure 130. Phase 2 EBITDA & Net Income

EBITDA & Net Income (Millions)

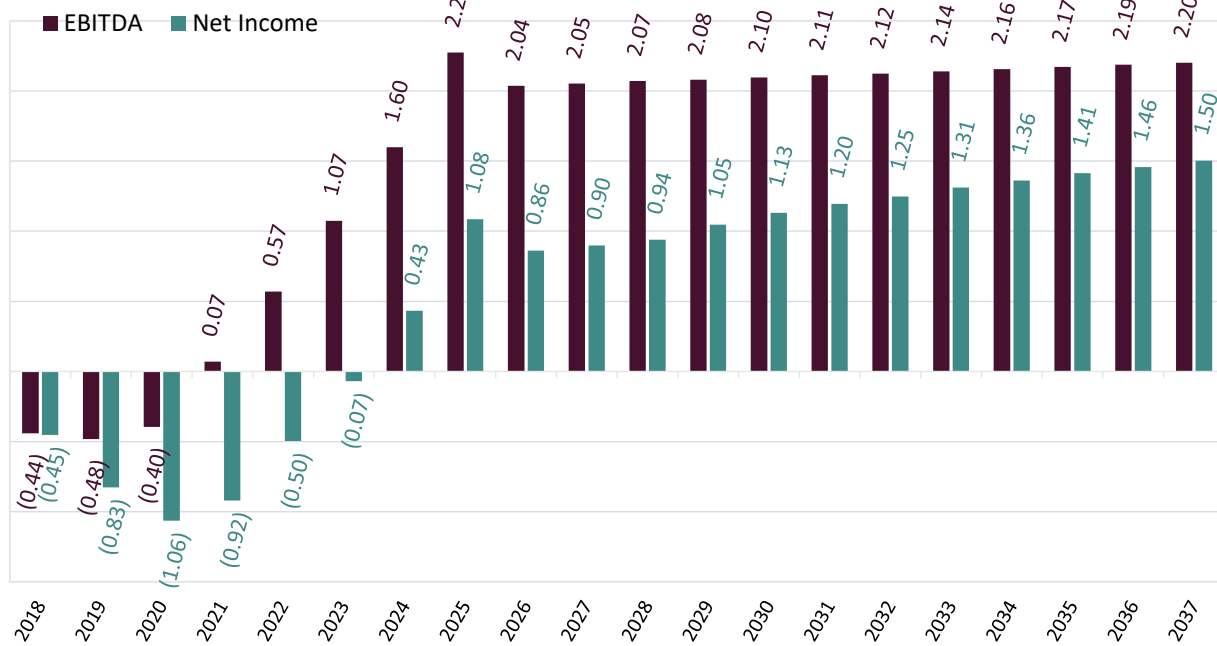




Figure 131. Phase 2 Cumulative Unrestricted Free Cash Flow

Cumulative Unrestricted Free Cash Flow (Millions)

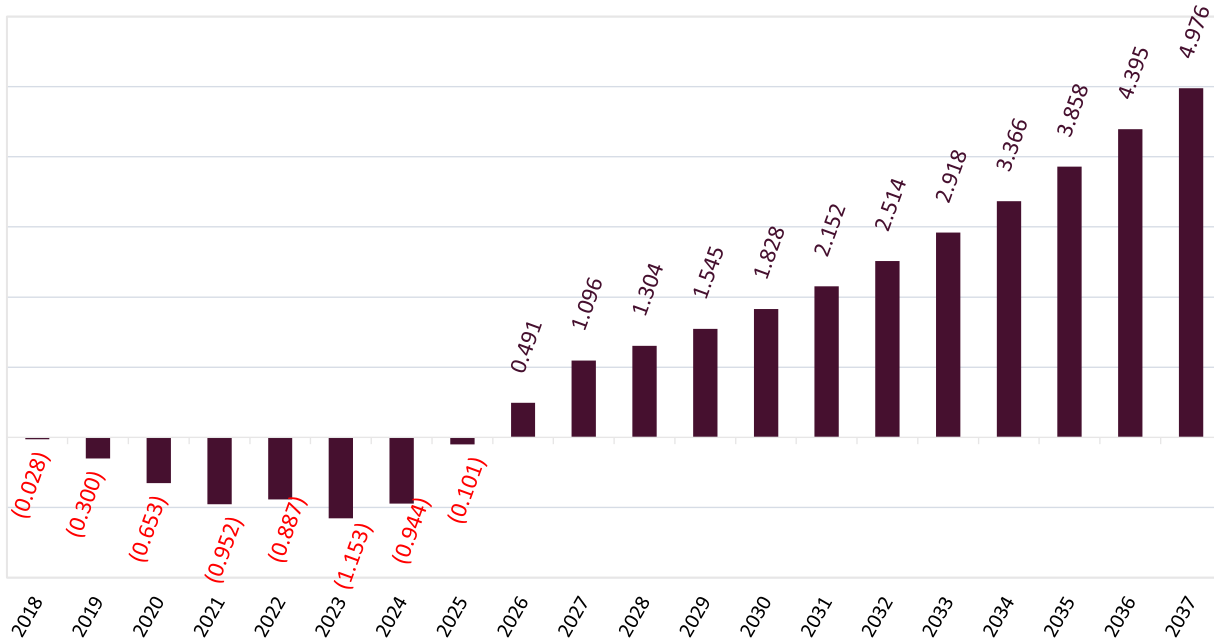


Figure 132. Phase 2 Debt Balance

Debt Balance

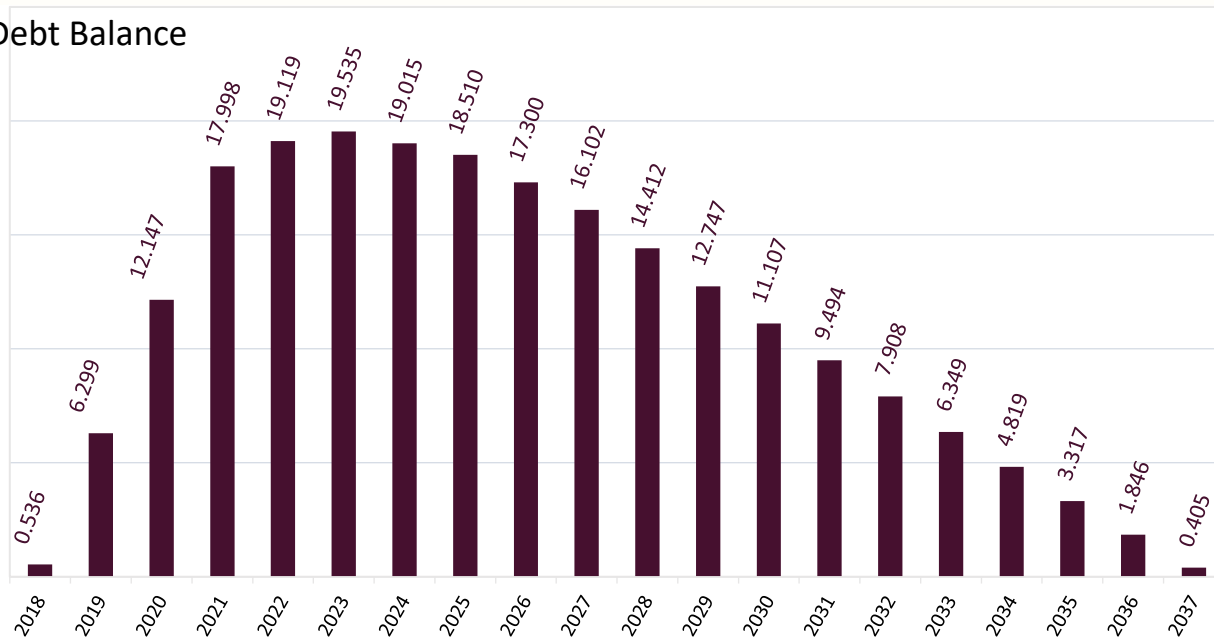




Figure 133. Phase 2 Debt Annual Unrestricted Free Cash Flow

Annual Unrestricted Free Cash Flow (Millions)

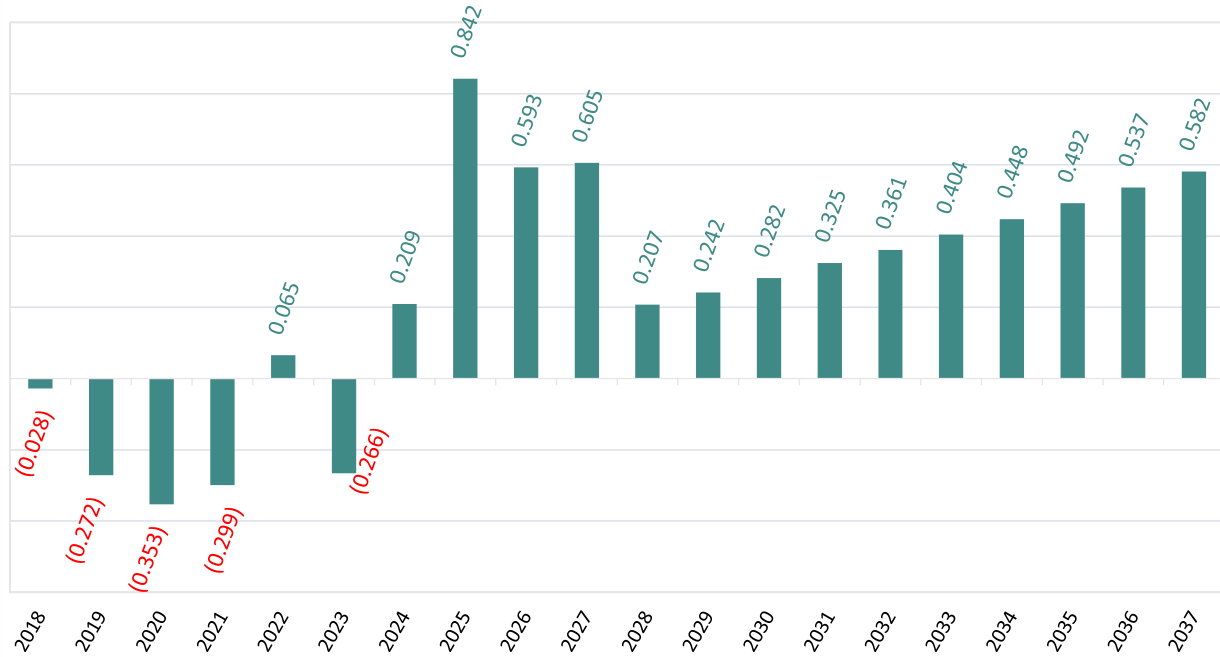


Figure 134. Phase 2 Total Reserve Balances

Total Reserve Balances (Millions)

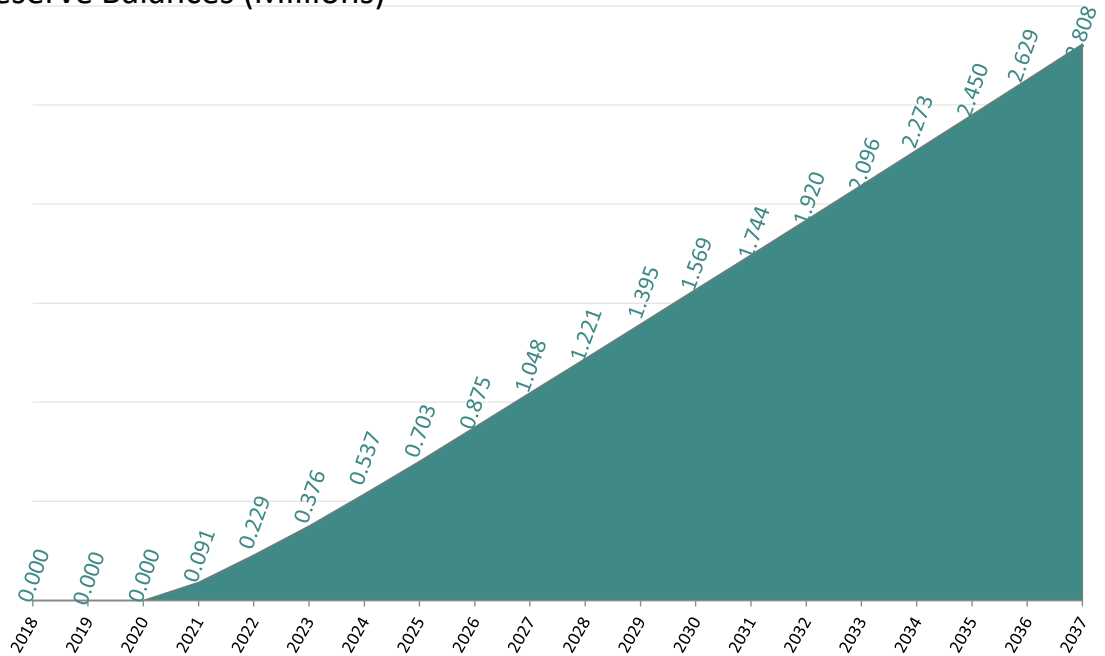




Figure 135. Phase 2 Annual Capital Spending

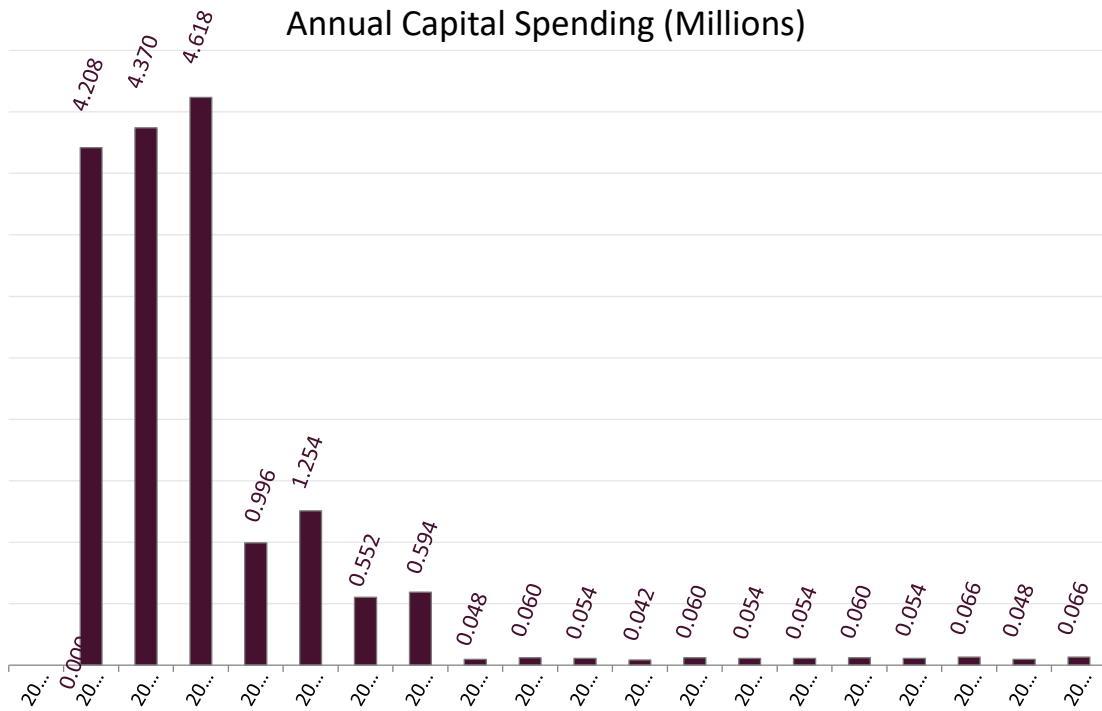


Figure 136. Phase 2 Total Profit Margins

Profit Margins

- Gross Profit Margin
- Net Profit Margin

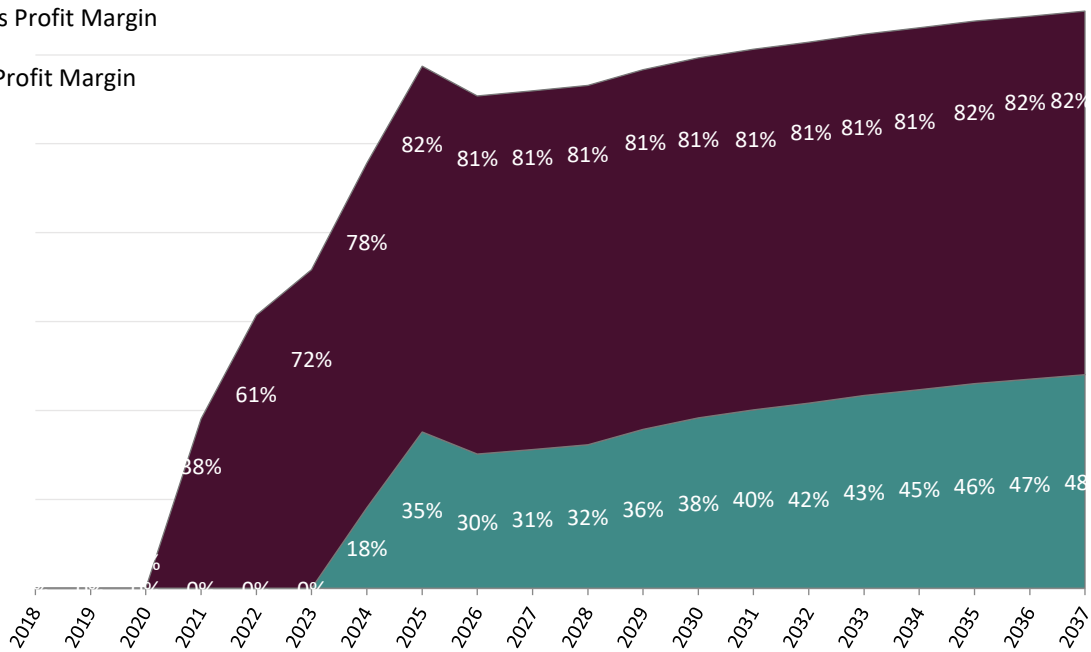




Figure 137. Phase 2 Business Customers

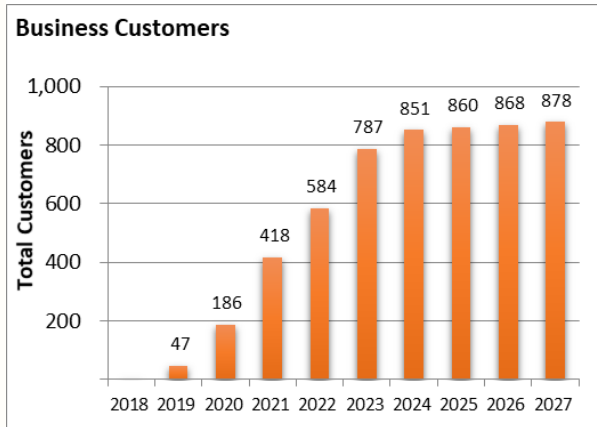


Figure 138. Phase 2 Percent of Available Market

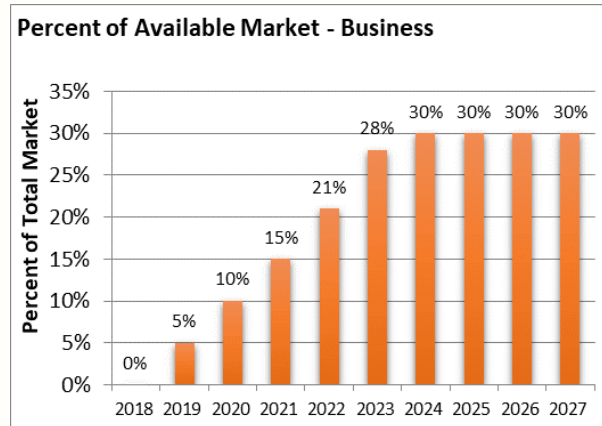


Figure 139. Phase 2 Business Revenues

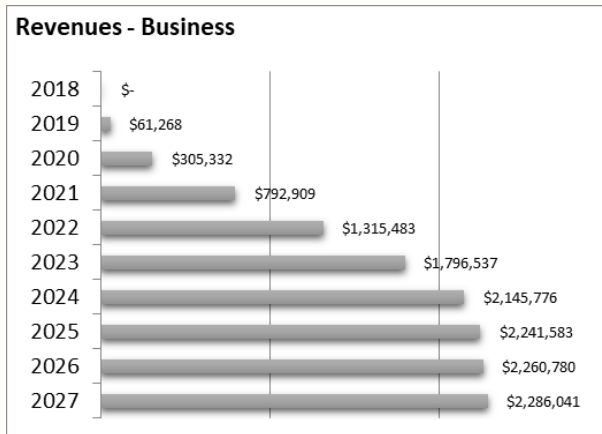


Figure 140. Vertical Asset Customers

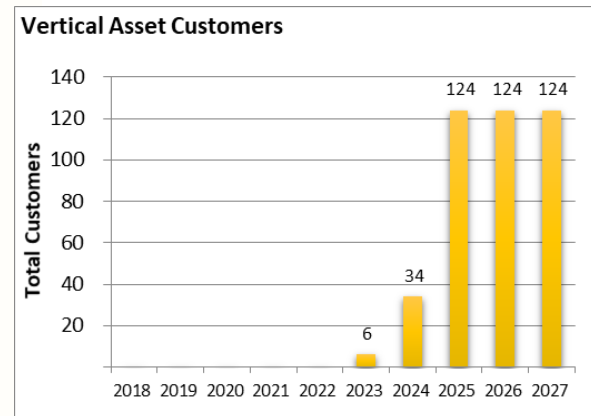


Figure 141. Percent Total Market - Vertical

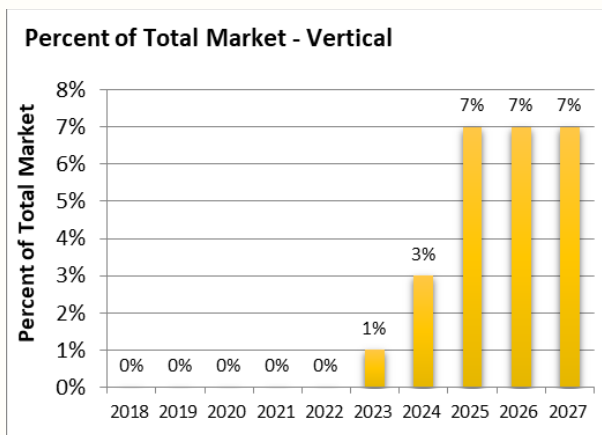


Figure 142. Vertical Asset Revenues

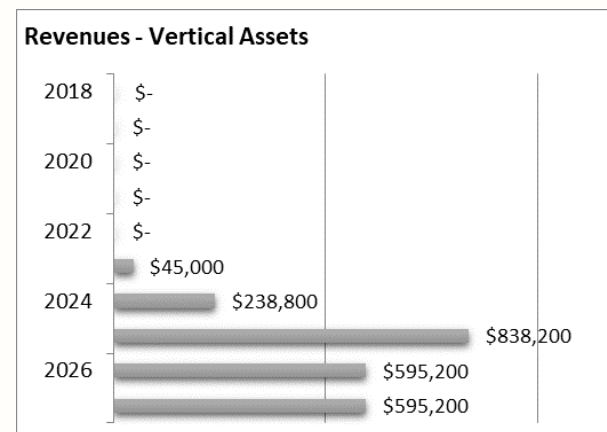




Figure 143. Phase 2 Capital Plan

Phase 2 Populate Conduit	Labor	\$ 750,000	\$ 250,000	\$ 250,000	\$ 250,000	
Phase 2 Populate Conduit	Materials	\$ 150,000	\$ 50,000	\$ 50,000	\$ 50,000	
Phase 21 Populate Conduit (5% Labor and Material)	Materials	\$ 18,000	\$ 6,000	\$ 6,000	\$ 6,000	
Phase 1 Populate Conduit TOTAL		\$ 918,000				
Phase 2 Conduit Enhancements	Labor	\$ 6,999,000	\$ 2,333,000	\$ 2,333,000	\$ 2,333,000	
Phase 2 Conduit Enhancements	Materials	\$ 965,250	\$ 321,750	\$ 321,750	\$ 321,750	
Phase 2 Conduit Enhancements (5% Labor and Material)	Materials	\$ 796,425	\$ 265,475	\$ 265,475	\$ 265,475	
Phase 2 Conduit Enhancements TOTAL		\$ 8,760,675				
Premises Connected			2018	2019	2020	2021
Materials Cost						
Connectorized Drop Fiber Cost Per Passing	Materials	\$ 4,927,500	\$ 211,500	\$ 625,500	\$ 1,044,000	
Premise Inside Wiring Per Passing	Equipment					
Other Materials	Equipment					
Equipment Cost						
Optical Network Terminal + Power Supply	Equipment	\$ 1,095,000	\$ 47,000	\$ 139,000	\$ 232,000	
Residential Gateway	Equipment					
Settop Boxes - 2.5 Per Subscriber @ 245 ea.	Equipment					
Labor Cost						
Drop Fiber Installation, Splicing and Termination Per Pa	Materials	\$ 547,500	\$ 23,500	\$ 69,500	\$ 116,000	
Premise Equipment Installation Per Passing (2 Hours)	Materials					
Premise Inside Wiring Per Passing	Equipment					



Figure 144. Phase 2 Cost Summary

Headend Equipment / PM			2018	2019	2020
Core switch routers	Equipment	\$ 320,000		\$ 160,000	\$ 160,000
Encoders/Transcoders	Equipment				
Fiber termination panels	Equipment	\$ 25,000		\$ 25,000	
Firewalls	Equipment	\$ 40,000		\$ 40,000	
Internet routers	Equipment	\$ 300,000		\$ 150,000	\$ 150,000
Intra-facility cabling	Equipment	\$ 20,000		\$ 20,000	
Ladder/raceway	Equipment	\$ 10,000		\$ 10,000	
OLTs	Equipment	\$ 150,000		\$ 150,000	
Racks/cabinets	Equipment	\$ 10,000		\$ 10,000	
Switches, servers, storage	Equipment	\$ 100,000		\$ 100,000	
IP TV Middleware	Equipment				
Video On Demand	Equipment				
Network Management Systems	Equipment	\$ 35,000		\$ 35,000	
Provisioning Systems	Equipment				
Billing Systems	Equipment				
Installation & Project Management	Labor				

Subtotal Categories Annual	Totals	2018	2019	2020	2021
Feeder & Distribution Fiber Design & Construction	\$ 3,894,675	\$ 3,226,225	\$ 3,226,225	\$ 3,226,225	\$ 3,226,225
Premises Connected	\$ 6,570,000	\$ 282,000	\$ 834,000	\$ 1,392,000	\$ 1,392,000
Headend Equipment / PM	\$ 1,010,000	\$ 700,000	\$ 310,000		
Building Improvements	\$ -				
General Equipment	\$ -				
Wireless Equipment	\$ -				

Cumulative by Year Categories	Totals	2018	2019	2020	2021
Feeder & Distribution Fiber Design & Construction	\$ 3,894,675	\$ 3,226,225	\$ 6,452,450	\$ 9,678,675	\$ 9,678,675
Premises Connected	\$ 6,570,000	\$ 282,000	\$ 1,116,000	\$ 2,508,000	\$ 2,508,000
Headend Equipment / PM	\$ 1,010,000	\$ 700,000	\$ 1,010,000	\$ 1,010,000	\$ 1,010,000
Building Improvements	\$ -				
General Equipment	\$ -				
Wireless Equipment	\$ -				



<u>Cost of Services</u>	2018	2019	2020	2021
Direct Staffing	\$ -	\$ -	\$ -	\$ -
Data Center Rack and Power (UM)	\$ 10,000	\$ 10,100	\$ 10,200	\$ 10,300
Broadband Transport & Internet Costs		\$ -	\$ -	\$ -
Outsource Operations	\$ 400,000	\$ 400,000	\$ 400,000	\$ 400,000
Vehicle Maintenance	\$ -	\$ -	\$ -	\$ -
Facilities Maintenance, Power, Environmental		\$ 20,200	\$ 20,402	\$ 20,606
Miscellaneous	\$ -	\$ 1,838	\$ 9,160	\$ 23,787
Network & Headend Maintenance	\$ -	\$ 20,000	\$ 20,200	\$ 20,402
Pole attachments	\$ -	\$ -	\$ -	\$ -
Software Maintenance	\$ -	\$ -	\$ 5,250	\$ 5,303
Utilities	\$ 10,000	\$ 10,025	\$ 10,050	\$ 10,075
Network Operations Outsource Contract	\$ -	\$ -	\$ -	\$ -
Subtotal: Cost of Services	\$ 420,000	\$ 462,163	\$ 475,262	\$ 490,473
<u>Sales, General & Administrative Expenses</u>				
Administrative Staffing	\$ -	\$ -	\$ 143,222	\$ 147,518
Professional & Legal Fees	\$ 20,000	\$ 20,400	\$ 20,808	\$ 21,224
Sales Commissions & Marketing Expense	\$ -	\$ -	\$ -	\$ -
Reporting & Compliance		\$ 20,000	\$ 20,400	\$ 20,808
Travel & Entertainment Expense	\$ -	\$ 10,200	\$ 10,404	\$ 10,612
Office Expense	\$ -	\$ 10,200	\$ 10,404	\$ 10,612
General Overhead	\$ -	\$ 20,400	\$ 20,808	\$ 21,224
Cost Allocation for City Services	\$ -	\$ -	\$ -	\$ -
Bad Debt Expense	\$ -	\$ -	\$ -	\$ -
Subtotal: Sales, General & Administrative Expenses	\$ 20,000	\$ 81,200	\$ 226,046	\$ 231,999
Total:	\$ 440,000	\$ 543,363	\$ 701,307	\$ 722,472



APPENDIX G. MUNICIPAL BROADBAND BUSINESS MODELS

POLICY PARTICIPATION ONLY

Public policy tools influence how broadband services are likely to develop in the community. This includes permitting, right of way access, construction, fees, and franchises that regulate the cost of constructing and maintaining broadband infrastructure within its jurisdiction. This option is not considered a true business model but does significantly affect the local broadband environment and is therefore included as one option. Municipalities that do not wish to take a more active role in broadband development often utilize policy participation to positively impact the local broadband environment.

Example: Santa Cruz County, CA

The Santa Cruz County board of supervisors in November 2013 approved an eight-month timeline to overhaul its broadband infrastructure plans and regulations. Specific areas of focus include permitting fee reductions and a proposed “dig once” ordinance that would make it easier to install new fiber-optic cables during other work on area roads or utilities lanes. “The County will continue a focus on broadband infrastructure throughout the county to enable businesses to function in the digital era, and students and households to have high quality access to information and communication. The County will work with industry providers to develop a Broadband Master Plan in order to identify focus areas within the county that will be most suitable for gigabyte services, particularly as the Sunesys backbone line is constructed during 2014 and 2015. The County will work with service (last mile) providers to ensure that these focus areas are deemed a priority, in order to support streaming requirements, product development, job creation, and online selling capability.”

INFRASTRUCTURE PROVIDER

Municipalities lease and/or sell physical infrastructure, such as conduit, dark fiber, poles, tower space, and property to broadband service providers that need access within the community. These providers are often challenged with the capital costs required to construct this infrastructure, particularly in high cost urbanized environments. The utility infrastructure provides a cost-effective alternative to providers constructing the infrastructure themselves. In these cases, municipalities generally use a utility model or enterprise fund model to develop programs to manage these infrastructure systems and offer them to broadband service providers using standardized rate structures.



Example: City of Palo Alto, CA

In 1996, Palo Alto built a 33-mile optical fiber ring routed within the city to enable better Internet connections. Since then, the City has been licensing use of this fiber to businesses. For the past decade, this activity has shown substantial positive cash flow and is currently making in excess of \$2 million a year for the city. Palo Alto now has that money in the bank earmarked for more fiber investments.

GOVERNMENT SERVICES PROVIDER

Municipalities that become a government service provider will utilize a fiber-optic network to interconnect multiple public organizations with fiber-optic or wireless connectivity. These organizations are generally limited to the community anchors that fall within their jurisdiction, including local governments, school districts, higher educational organizations, public safety organizations, utilities, and occasionally healthcare providers. The majority of these anchors require connectivity and often, the municipal network provides higher capacity at lower costs than these organizations are able to obtain commercially. Municipal and utility networks across the country have been built to interconnect cities, counties, school districts, and utilities to one another at lower costs and with long-term growth capabilities that support these organizations' future needs and protect them from rising costs. In these cases, government service providers may be cities, counties, or consortia that build and maintain the network. The providers utilize inter-local agreements between public agencies to establish connectivity, rates, and the terms and conditions of service.

Example: Seminole County, FL

Seminole County owns and operated a 450-mile fiber-optic network that was installed over the past 20 years by the County's Public Works department primarily to serve the needs of transportation. Since that time, the network has grown to connect the majority of the county's facilities, five cities within Seminole County, Seminole Community College, Seminole County Schools, and other public network to a common fiber-optic backbone. The network has saved millions of dollars in taxpayer dollars across the county and has become a long-term asset that enables the county and the other connected organizations to meet their growing connectivity needs.

OPEN-ACCESS PROVIDER

Municipalities that adopt open-access generally own a substantial fiber-optic network in their communities. Open-access allows these municipalities to "light" the fiber and equip the network with the electronics necessary to establish a "transport service" or "circuit" to service providers interconnecting with the local network. Service providers are connected from a common interconnection point with the open-access network and have access to all customers connected to that network. Open-access refers to a network that is available for any qualified



service providers to utilize in order to connect their customers. It allows municipalities to provide an aggregation of local customers on a single network that they are able to compete for and provide services. The concept of open-access is designed to enable competition among service providers across an open network that is owned by the municipality. The municipality retains neutrality and non-discriminatory practices with the providers who operate on the network. The municipality establishes a standard rate structure and terms of service for use by all participating service providers.

Example: City of Palm Coast, FL

In 2006, the Palm Coast City Council approved a 5-Year fiber-optic deployment project funded at \$500,000 annually for a total investment of \$2.5 million. The network was developed to support growing municipal technology needs across all public organizations in the area, including city, county, public safety, and education. It was also planned to support key initiatives such as emergency operations, traffic signalization, collaboration, and video monitoring. The city utilized a phased approach to build its network using cost-reducing opportunities to invest in new fiber-optic infrastructure. As each phase was constructed, the city connected its own facilities and coordinated with other public organizations to connect them; incrementally reducing costs for all organizations connected to the broadband network. Showing a reasonable payback from each stage of investment allowed the city to continue to fund future expansion of the network. Through deployment of this network, the city has realized a savings of nearly \$2 million since 2007 and projects further annual operating savings of \$350,000 annually. In addition to these savings, the city's network provides valuable new capabilities that enhance its mission of serving the residents and businesses of the community, while generating over \$500,000 annually in new outside revenue generated from use of the network.

RETAIL SERVICE PROVIDER – BUSINESS ONLY

Municipalities that provide end users services to business customers are considered retail service providers. Most commonly, municipalities provide voice and Internet services to local businesses. In many cases, a municipality may have built a fiber network for the purposes of connecting the city's primary sites that has been expanded to connect local businesses, in effort to support local economic development needs for recruitment and retention of businesses in the city. Municipalities that provide these services are responsible for managing customers at a retail level. They manage all operational functions necessary to connect customers to the network and providing Internet and voice services. Municipalities compete directly with service providers in the local business market, which requires the municipality to manage an effective sales and marketing function in order to gain sufficient market share to operate at a break-even or better.

Example: Fort Pierce Utilities Authority



Primary FPUAnet services are Dedicated Internet Access, Fiber Bandwidth Connections, E-Rate IP Links, and Dark Fiber Links. FPUAnet services also include Wireless Broadband Internet and Wireless Bandwidth Connections, which extend FPUA's fiber through wireless communications. The FPUAnet Communications mission statement is "To help promote economic development and meet the needs of our community with enhanced, reasonably priced communications alternatives." It all began around 1994, when FPUA began to build a fiber-optic network to replace leased data links between its buildings in Fort Pierce. The new optical fiber system proved more reliable and cost effective and was built with sufficient capacity for external customers. In 2000, FPUA allocated separate fibers through which it began to offer Dark Fiber Links to other institutions. This soon expanded to include businesses and more service types.

RETAIL SERVICE PROVIDER – BUSINESS & RESIDENTIAL

Municipalities that provide end user services to businesses and residential customers are considered retail service providers. Most commonly, municipalities provide voice, television, and Internet services to their businesses and residents through a municipally owned public utility or enterprise fund of the city. As a retail service provider that serves businesses and residents, the municipality is responsible for a significant number of operational functions, including management of its retail voice, television and Internet offerings, network operations, billing, provisioning, network construction, installation, general operations, and maintenance. The municipality competes with service providers in the business and residential markets and must be effective in its sales and marketing program to gain sufficient market share to support the operation. Many municipalities that have implemented these services are electric utilities that serve small to midsize markets. Many of these markets are rural or underserved in areas that have not received significant investments by broadband service providers. Retail service providers must comply with state and federal statutes for any regulated telecommunications services. These organizations must also comply with state statutes concerning municipal and public utility broadband providers; a set of rules has been developed in most states that govern the financing, provision, and deployment of these enterprises.

Example: Bristol Virginia Utilities (BVU OptiNet)

BVU OptiNet is a nonprofit division of BVU, launched in 2001, that provides telecommunication services to approximately 11,500 customers in areas around Southwest Virginia. OptiNet is known for its pioneering work in the area of municipal broadband throughout the area. BVU is acknowledged as the first municipal utility in the United States to deploy an all-fiber network offering the triple play of video, voice, and data services. Offering digital cable, telephone service, and high-speed Internet from a remote-area utility provider makes BVU exceptional, even on a global level.



PUBLIC PRIVATE PARTNERSHIP

A broadband public-private partnership is a negotiated contract between a public and private entity to fulfill certain obligations to expand broadband services in a given area. In recent years, PPPs have been increasingly implemented as more municipalities employ public broadband and utility infrastructure in conjunction with private broadband providers. PPPs leverage public broadband assets, such as fiber, conduit, poles, facilities with private broadband provider assets, and expertise to increase the availability and access to broadband services.

Municipalities forgo the “getting into the business” of providing retail services and instead, make targeted investments in their broadband infrastructure, and make it available to private broadband providers with the goal of enhancing their communities. In this type of model, the Town would be considered an Infrastructure Provider who maintains permanent ownership interest in the broadband infrastructure (e.g., conduit and perhaps dark fiber) that is funded by the Town for a “piece of the action”, generally a negotiated revenue share paid by the provider.

Example: The Town of Jupiter, FL

In 2013, the Town of Jupiter completed construction of its initial fiber ring, which was planned to interconnect city facilities at 1 Gbps and 10 Gbps speeds. Previous to this, AT&T provided 50 Mbps connections between the town's facilities at \$75 thousand annually. The town constructed its ring for \$400 thousand and expects a nearly 5-year payback on this investment. Since completion of the town's ring, the town has been working with a national service provider to form a Public Private Partnership to deploy fiber to the business and fiber to the home services throughout the Jupiter town limits. Fiber end user services are currently unavailable in Jupiter; this agreement would introduce them for the first time.

Under the initial agreement, the town would build out the broadband infrastructure and would connect the commercial and residential structures to the network at its cost. The network would remain under ownership of the town, and the partner provider would use the network to deliver fiber-based telecommunications services to the town's constituents. For its investment, the town would receive a revenue share of gross profits generated off the network. Under this agreement, the town would receive a revenue stream from its investment and would bring a faster, competitively priced service to its constituents.

Example: The Covenant of Rancho Santa Fe, CA

The Covenant of Rancho Santa Fe (RSF) was established in 1928 as a country residential community located in San Diego County, CA. Today it is one of the most exclusive, beautiful, and desired rural communities in the country. The community includes a world class golf course and over 1,800 homes with an average home price of approximately \$3 million. Rancho Santa Fe is home to many famous people including movie stars, politicians, sports figures, and corporate executives/CEOs. Several years ago, RSF requested an upgrade



to its telecommunications facilities, specifically asking for a FTTH build. Its incumbent providers agreed, however requested that RSF pay the capital required to build out the network which was estimated at \$20 million at the time. The RSF Board declined their offer, and instead undertook a FTTH Feasibility Study that outlined the options available to bring fiber-based service offerings to its community. Since the study was completed, RSF has decided to self-fund the buildout, maintaining long-term ownership of this very important community asset, and has embarked on the process to develop a Public Private Partnership. RSF has identified numerous potential partners that would operate the network while providing its residents, businesses, and anchors with state of the art fiber-based telecommunications services. RSF is currently negotiating the partnership with the selected partner and the network is due to be operational in 2017/2018.