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Evaluation Study

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Case Study Report

Lane Council of Governments

Comprehensive Community Infrastructure

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Executive Summary

About BTOP

The American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated \$4.4 billion in federal funding to the National Telecommunications and Information Administration (NTIA) to implement the Broadband Technology Opportunities Program (BTOP) in order to spur job creation, stimulate economic growth, and increase access to broadband services.¹ BTOP projects are intended to support increased broadband access and adoption, provide broadband training and support through community organizations, and stimulate the demand for broadband. NTIA distributed grant funding to 233 projects, benefiting all 50 states, 5 territories, and the District of Columbia. The types of projects BTOP funded include Public Computer Centers (PCC), Sustainable Broadband Adoption (SBA), and Comprehensive Community Infrastructure (CCI). CCI projects deploy new or improved broadband Internet facilities to connect households, businesses, and community anchor institutions (CAI) such as schools, libraries, hospitals, and public safety facilities.² CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded.³

Comprehensive Community Infrastructure projects deploy new or improved broadband Internet facilities to connect households, businesses, and community anchor institutions such as schools, libraries, hospitals, and public safety facilities.

About the Evaluation Study

This case study report is one of twelve case studies performed by ASR Analytics, LLC (ASR) on CCI projects. It is part of a larger mixed-methods evaluation of the social and economic impacts of the BTOP program.

The purpose of this case study is to:⁴

- Identify how the grantee maximized the impact of the BTOP investment.
- Identify successful techniques, tools, materials, and strategies used to implement the project.
- Identify any best practices, and gather evidence from third parties, such as consumers and anchor institutions, as to the impact of the project in the community.

The information presented in this report intends to capture the social and economic impacts of the grant, and is not an evaluation of Lane Council of Governments, its partners, or its subgrantees.

This case study is primarily qualitative. Social and economic impacts are categorized by the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.⁵ Section 2 includes the presentation of these impacts by focus area.

The evaluation study team collected information to evaluate the social and economic impact of the Lane Council of Governments' (LCOG) Oregon South Central Regional Fiber Consortium Lighting the Fiber Middle Mile Project during field visits. From November 12 to November 15, 2013, the evaluation study team met with representatives of LCOG, network operators, service providers, and CAIs connected by the project. In total, the evaluation study team performed ten interviews. ASR transcribed these discussions and used this information, along with other information and reports provided by the grantee, to supplement Quarterly Performance Progress Reports (PPR),

Annual Performance Progress Reports (APR), and other publicly available information. The information presented here is intended to capture the social and economic impacts of the grant, and is not an evaluation of LCOG, its partners, or its subgrantees.

About the Grantee



Lane Council of Governments (LCOG) is an association of local governments with headquarters in Lane County, Oregon. It provides member governments with services that include regional planning, coordination, program-development, and service-delivery. Established in 1945, LCOG serves twenty-nine members including Lane County, all twelve cities located within the county, in addition to education, public utilities, and other special districts. LCOG also collaborates with organizations from neighboring counties on regional initiatives.⁶ As part of its technology services, LCOG assists members with telecommunications management and operation.⁷ LCOG also has experience in the implementation of broadband infrastructure projects through the development of a Public Area Network (PAN).

The LCOG – Lighting the Fiber project proposed to invest a total of \$10,439,035 in western Oregon, including \$8,325,530 in federal funds.

On February 1, 2010, NTIA awarded LCOG a BTOP CCI grant for \$8,325,530 to implement the Oregon South Central Regional Fiber Consortium Lighting the Fiber Middle Mile Project. Matching funds totaled \$2,113,505, or 20 percent of the project's total budget. Altogether, the project proposed to invest a total of \$10,439,035 in western Oregon. As of June 30, 2013 LCOG spent \$9,737,490 with the expectation that all \$10,439,035 would be spent by the conclusion of the third quarter of 2013. LCOG estimated that the construction of the network would create approximately fifty jobs over the two years of construction, with a maximum employment at any one time of thirty people.⁸

Project Proposal and Status

LCOG planned to enhance a high-speed, fiber-optic backbone and deploy new fiber-optic network across Lane County, Douglas County, Klamath County, and the Klamath Tribal regions in western Oregon to improve broadband access for CAIs in rural and underserved communities.⁹ LCOG proposed the following, with results shown:

- Construct 124 miles of new fiber and directly connect more than 100 CAIs.¹⁰ By the end of June 2013, LCOG had installed 102 miles of new fiber and leased an additional 353 network miles. LCOG also reported connecting 131 CAIs.¹¹
- Expand the Internet connectivity options for the Klamath Tribe.¹² At the time of the site visit, the Klamath Tribal Headquarters in Chiloquin, Oregon had been connected to the BTOP-funded network. The tribe plans to upgrade service from a 1.5 Mbps T1 line to a 100 Mbps connection.
- Complete negotiations with six last mile providers to use the network to provide broadband in the service area.¹³ By the end of June 2013, LCOG had signed agreements with Douglas Fast Net (DFN), CoastCom, and Hunter Communications. Each of these service providers was selected to operate a portion of the network. Three additional agreements are being negotiated with broadband wholesalers or last mile providers.¹⁴

LCOG accomplished the following from their proposed goals:

- Installed 102 miles of fiber and leased an additional 353 network miles
- Connected 131 CAIs to the network
- Connected the Klamath Tribal Headquarters to network
- Signed agreements with 3 Internet Service Providers

- Facilitate new or improved high-speed Internet access for an estimated 104,000 households and 6,000 businesses by enabling local Internet Service Providers (ISP) to use the project's open access network.¹⁵ LCOG received grant funding to build a middle mile network. ISPs interconnect to this network to provide last mile connections to residents and businesses. The number of businesses and residents connected by local ISPs is not publicly available. Section 3.2 of this report describes LCOG's approach to open access in more detail.

As shown in Table 1, 28 percent of the CAIs connected by LCOG are community support institutions. One-quarter of the CAIs connected are classified as educational institutions including K-12 schools and universities, colleges and postsecondary institutions. Medical/healthcare facilities and public safety institutions are the next most frequent CAI types (19 percent and 21 percent respectively).¹⁶ The project directly connected 131 CAIs, including 29 K-12 public schools, 25 medical/healthcare institutions, 27 public safety entities, 9 libraries, 4 postsecondary institutions, and 37 other community support institutions.¹⁷ The grantee reported that most of the CAIs in the service area that were not served by the BTOP-funded project had access to broadband already.

Table 1. Community Anchor Institutions Located in Oregon

Type	Served by Grantee		Service Area
School (K-12)	29	22%	264
Library	9	7%	13
Medical/Healthcare	25	19%	400
Public Safety	27	21%	37
University, College, or Other Postsecondary	4	3%	13
Other Community Support	37	28%	37
All	131		764

There is a substantial opportunity to use the LCOG infrastructure in western Oregon beyond the scope of the original set of CAIs proposed in the grant application. The fixed cost of laying the middle mile fiber network has already been incurred. The incremental cost of connecting additional CAIs and bringing fiber into residential areas is the remaining cost driver. At the time of the site visit, one of the network operators reported that it had signed agreements with wireless providers to connect to the network and had interest from several additional local ISPs. While there is sufficient bandwidth available to serve the 131 connected CAIs with the equipment that is currently on the network, future investments in improved equipment could provide substantial increases in bandwidth to meet growing usage.

Outcomes and Impacts

Through interviews and data collection from a number of sources, the evaluation study team observed qualitative and quantitative outcomes and impacts of the project. The list below highlights these outcomes and impacts, with additional detail provided in Section 2.

- As of June 30, 2013, LCOG had connected 29 of 264 public primary and secondary K-12 schools, and 4 of the 13 public higher education institutions in the service area.¹⁸ Teachers in the recently connected schools are using streaming online media that was not available due to earlier bandwidth limitations. Teachers now use digital tools such as SMART Boards and iPads to increase students' hands-on engagement with lessons. Increased bandwidth enables the use of open educational resources (OER), which are freely available materials without traditional

copyright limitations. College students are able to use OERs in place of textbooks, saving them money and making college more affordable.

- LCOG connected twelve of twenty-nine police stations in the project's service area as of June 30, 2013.¹⁹ Police stations are able to use broadband to transmit video from traffic stops to secure databases. Broadband allows the transition from paper documents to digital files that are easier to manage and share across government agencies. Public safety and government offices in remote towns are using broadband to support teleconferencing and video conferencing for meetings and arraignments, reducing transportation costs.
- LCOG connected 25 of the 420 healthcare institutions in the three-county service area.²⁰ The LCOG network provided the necessary speeds to support telehealth programs for time-sensitive medical conditions such as strokes. Network redundancy increases the reliability of healthcare institutions and improves the level of service they are able to provide to patients. The increased bandwidth enables rapid transmission of patient and administrative data between healthcare facilities.
- Call centers, home-based entrepreneurs, and other Internet-based businesses are actively seeking to connect to the LCOG network in remote towns such as Florence and Veneta, which previously lacked sufficient broadband infrastructure.

Through BTOP, the project achieved the following community impacts:

- Increased educational opportunities for K-12 institutions
- Operations improvements for public safety and government services
- Increased telemedicine and patient data sharing opportunities for healthcare providers
- Increased interest from Internet-based businesses

Conclusions

Without the BTOP grant, LCOG would not have been able to connect 131 CAIs to fiber-optic service with the speeds and prices available on the new network. According to the project application, none of the proposed CAIs could access or subscribe to adequate broadband service before the project. Broadband was not available to some CAIs, and for others it was not affordable. LCOG worked with the service providers to ensure low prices for CAIs in order to incentivize them to subscribe to higher speeds. The BTOP grant also provided equipment and support to CAIs as part of the upgrades to broadband access. For example, the LCOG grant provided CAIs with modems and other equipment that would allow them to access the network through any ISP.

The LCOG network made it possible for last mile providers to expand the availability of broadband service in western Oregon. LCOG had agreements with three third-party last mile providers and was in negotiations with three additional providers as of June 30, 2013.²¹ LCOG deployed an interconnection point in Eugene to give all last mile providers and network subscribers access to the middle mile network. The interconnection facility also enables service providers to colocate and work with one another. The network brings at least 100 Mbps connections to each CAI and is able to accommodate faster speeds through additional hardware. While this BTOP project is not designed to bring broadband to businesses or households, open access policies enable third-party service providers to reach them by connecting to the middle mile infrastructure.

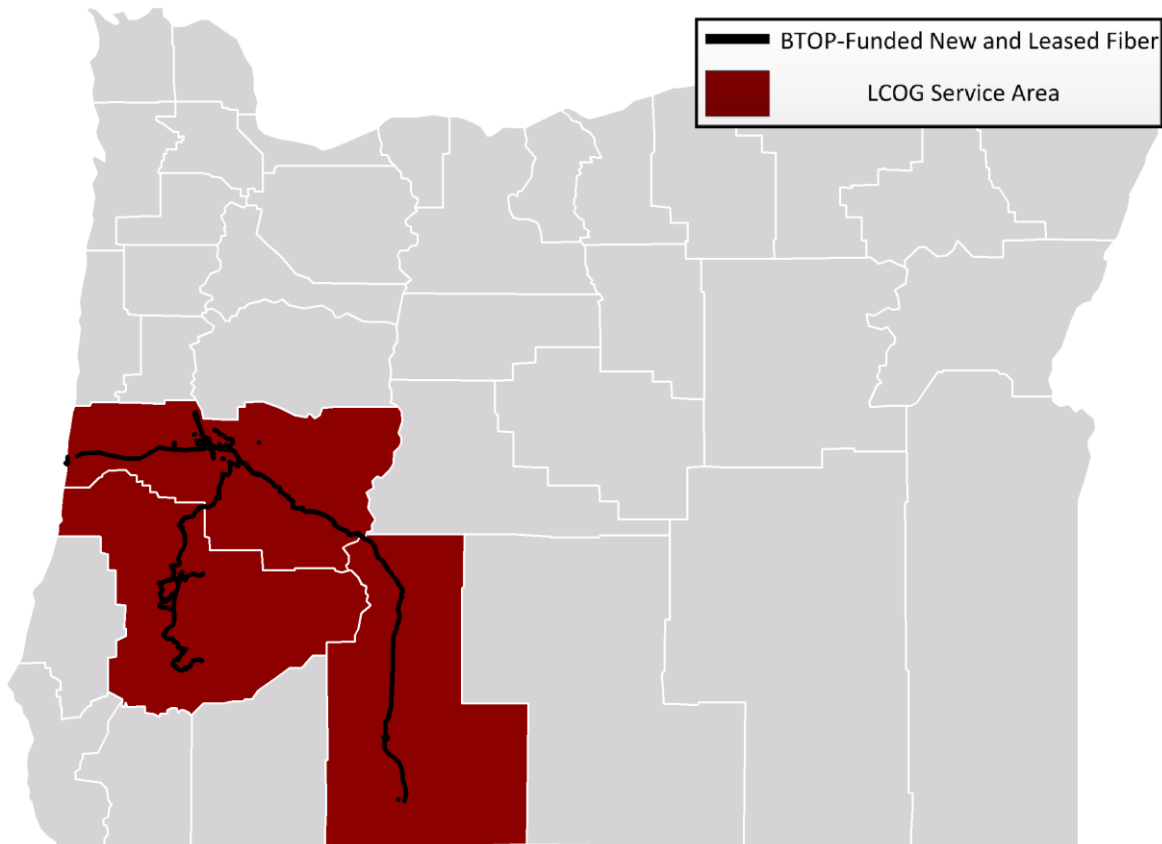
Community anchor institutions interviewed by the evaluation study reported that the average price of broadband per megabit per month dropped from \$343 to \$7, while speed increased by an average of more than 27 times their original speeds.

Price and capacity data from six CAIs interviewed by the evaluation study team show that the average price of broadband per megabit per month was reduced from \$343 to \$7, while the average speed increased by more than 27 times the original connection speeds.

Section 1. Introduction

LCOG's goal was to connect more than 100 CAIs and to provide middle mile broadband connectivity in a three-county area. As shown in Figure 1, the area served by LCOG includes the following counties: Lane, Klamath, and Douglas. The fiber route, shown in black, captures both the newly built, BTOP-funded fiber and the fiber miles leased as of December 31, 2012.²²

Figure 1. LCOG Service Area Map



The service area is predominantly rural, with the exception of Eugene and Springfield. Lane County has the highest population per square mile with 77.2 compared to 21.4 and 11.2 per square mile in Douglas and Klamath Counties respectively.²³ Outside of Eugene and Springfield, all communities served by the grant have fewer than 20,000 residents, and 9 of the communities have fewer than 5,000 residents.²⁴ The project used existing backbone branching out from Eugene to provide middle mile fiber connectivity that was absent before the grant. Most CAIs previously relied on copper telephone circuits for T1 or DSL service.²⁵

The American Community Survey (ACS) Five Year Summary for 2007 to 2011 shows that slightly less than 14 percent of the state's population resides in these three counties. Ninety percent of the residents of the service area are White, compared to 85 percent of the population in the rest of the state.²⁶ Nearly 58 percent of the service area residents have a household income of less than \$50,000 per year, compared to 49 percent of the population in the rest of Oregon.²⁷ Using publicly available data, the evaluation study team identified 764 CAIs in the service area, including 264 K-

12 schools, 400 healthcare institutions, 37 public safety institutions, 13 libraries, 13 institutions of higher education, and 37 other community support facilities.

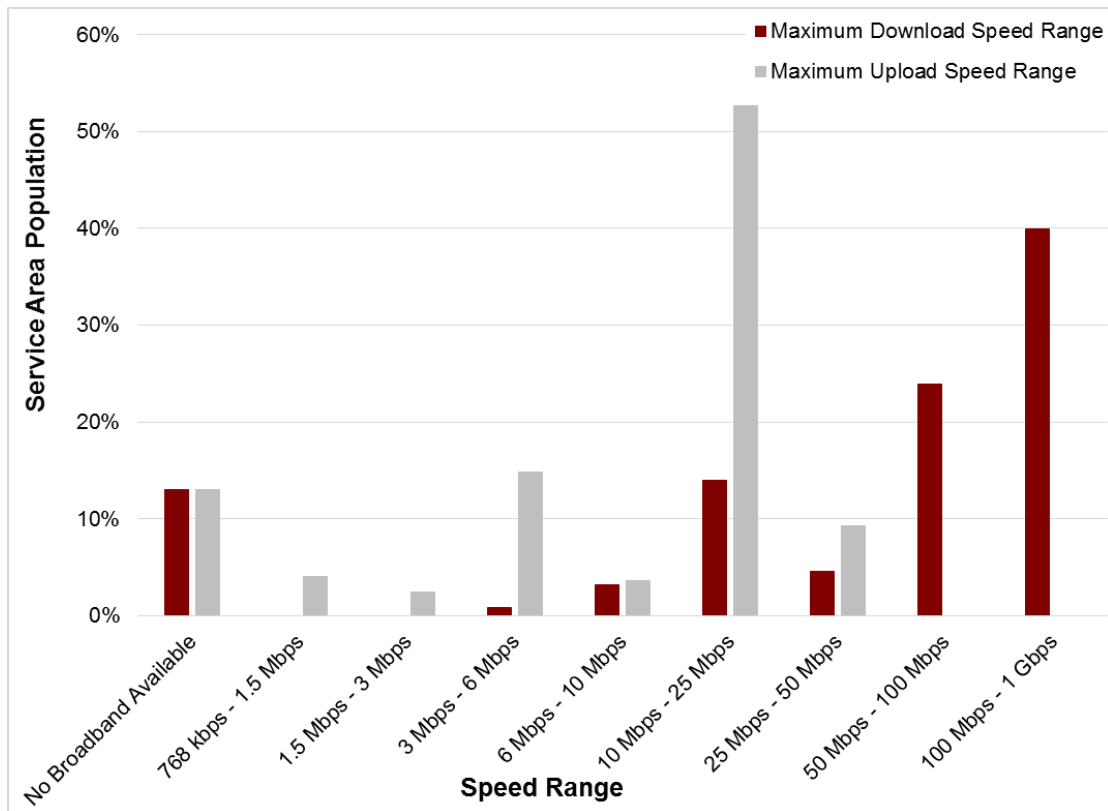
Table 2 shows the percentages of the populations in the service area and the rest of Oregon by the number of broadband providers available according to data and speed thresholds defined by the National Broadband Map (NBM).²⁸ Thirteen percent of the service area population does not have broadband available to them, compared to nearly seven percent of the rest of Oregon. The same is true of the relative populations of the service area and the rest of Oregon with only one broadband provider available: more than 25 percent of service area residents have access to only one provider, compared to nearly 10 percent of residents in the rest of Oregon. Less than 3 percent of the service area population has five or more broadband service providers available compared to 38 percent of the population in the rest of Oregon. All provider statistics use the June 2011 release of the NBM and 2010 population data from GeoLytics.

Table 2. Number of Broadband Providers Available in Oregon

Number of Providers	Service Area	Rest of Oregon
0	13.06%	6.88%
1	25.34%	9.71%
2	30.94%	17.36%
3	18.31%	14.81%
4	9.46%	13.51%
5	2.40%	12.46%
6	0.49%	15.15%
7	0%	8.89%
8	0%	1.21%

Figure 2 shows the percentages of the service area population with respect to the fastest download and upload speed range available to them.²⁹ According to the NBM, there are fifteen broadband providers in the service area. Two of the service area providers deliver service in the fastest download speed range of 100 Mbps to 1 Gbps. Maximum available download speeds range from 3 Mbps to 1 Gbps, while maximum upload speeds range from 768 kbps to 50 Mbps.

Figure 2. Maximum Speed Ranges Available for the Service Area Population



Broadband subscribership rates are also lower in the service area than across the state. Federal Communications Commission (FCC) data from June 2012 show that 62 percent of households in the service area subscribe to an Internet service that has at least 768 kbps download speeds and 200 kbps upload speeds.³⁰ More than 68 percent of the state’s population subscribe to an Internet service with the same minimum thresholds.³¹

Figure 3 presents a summary of CAI subscriptions since the LCOG network first served an institution in the first quarter of 2012.³² CAIs subscribe to service through third party service providers. For this reason, LCOG does not have details on the subscription speeds for each end user. Speed tiers are available from 1 Mbps to 1 Gbps, but most subscribers have service in the 10 Mbps range.

Figure 3. Total CAI Subscribers

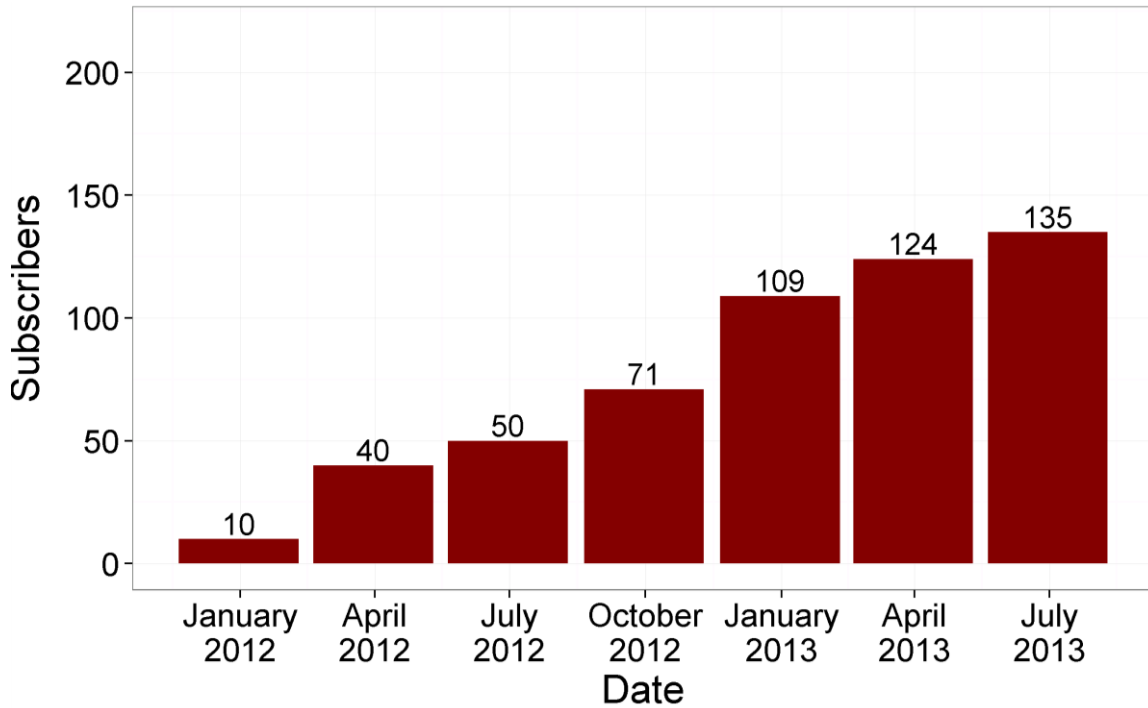
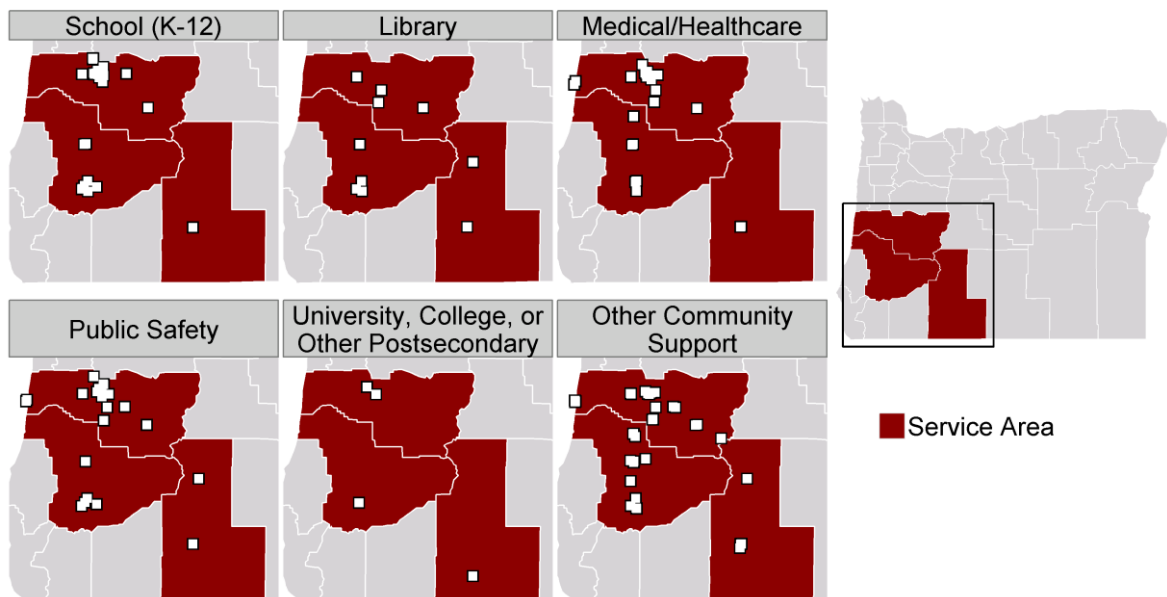


Figure 4 displays maps of LCOG’s service area and the locations of the CAIs served as of June 30, 2013.³³ Excluding libraries, several CAIs of each type were connected in the Eugene, Springfield, and Roseburg areas. Public safety institutions, healthcare providers, and other community support organizations were the most widely distributed types of CAIs.

Figure 4. Map of CAIs in the Service Area



The evaluation study team met with LCOG staff, project partners, and government leaders. These interviews helped the team understand the grantee’s approach to project implementation and the

strategies used to create demand for the broadband service. Additional interviews with CAIs focused on describing the impact of improved broadband for these organizations. Benefits were discussed in relation to several factors, including the quality of service of the upgraded network, speed, reliability, flexibility, and cost. The analysis in this report focuses on outcomes and impacts to CAIs. Interviews conducted include the following:

- K12 Schools
 - **Days Creek School District 15** is a small, rural district in Douglas County with an elementary school in Tiller and a middle and high school in Days Creek. The district serves about 250 students.³⁴ Before BTOP, the district connected all three schools with a single 1.5 Mbps T1 line. Now, they share a 100 Mbps fiber connection from Douglas Fast Net.³⁵ With the T1 circuit, the Internet functioned too slowly for either administrators or teachers to use it effectively, and students often could not complete online tests. Now, teachers use streaming media in the classrooms, and staff have a reliable connection to the student data system, which can now be hosted at the Douglas Educational Service District (ESD). The school has begun a program for struggling students to use online content outside of the normal class schedule, and has seen an improvement in student performance and test scores.³⁶
 - **Bethel School District**, serving northwestern Eugene, is the third largest school district in Lane County. There are approximately 5,700 students in the district's 11 schools.³⁷ Lane ESD is the ISP for Bethel School District and thirteen other districts in the county. The ESD provisions bandwidth to each district based on average daily student population. Bethel School District shares a 100 Mbps Internet connection among all of its schools. Five of the schools in the district received fiber connections through the project in the summer and fall of 2012, replacing the T1 circuits each had used previously to connect to the district office. Each school now has a 1 Gbps connection to the district office. The district is planning to upgrade these connections to 10 Gbps. The total price of the connections between each of the five schools and the district office decreased from \$25,000 per year to \$5,000 per year after connecting to the LCOG network.³⁸ One of the schools that received a fiber connection was Prairie Mountain School. This school is using the increased bandwidth to support administration and to increase the use of technology resources in the classroom. Teachers now use iPads to keep students more engaged, and staff use Google Docs to communicate about students' academic progress. The school is now able to host open computer lab hours in the morning for students and parents.³⁹
- Community College
 - **Lane Community College (LCC)** is a two-year college system in Lane County. The LCC system consists of four campuses: the main campus in central Lane County between Eugene and Springfield, and satellite campuses located in downtown Eugene, Florence, and Cottage Grove. LCC also has a location at the Eugene airport for its Aviation Academy. Students can choose from several associate degree programs, certificate programs, and a GED program.⁴⁰ LCC had a student enrollment of about 36,000 in the 2013-2014 school year. Staff members estimate that 3,500 students are on campus at any time.⁴¹ LCC's downtown campus and Aviation Academy were connected by the LCOG project. At the time of the site visit, these connections had just recently been made with service expected to begin shortly thereafter. Both locations will transition from 10 Mbps commercial cable broadband to 1 Gbps point-to-point through the fiber. Staff members expect the price of approximately \$750 per month to remain the same. The increased connections will allow administrators at the satellite locations to have the same connectivity to the LCC system as the main campus. It will also allow instructors to use technology in the classroom more frequently in order to serve students better.⁴²
- Local Government
 - **The Klamath Tribal Headquarters** house the council chambers and the administrative offices of the Klamath Tribes, which include the Klamath, Modoc, and Yahooskin people of southern Oregon. Before BTOP, the headquarters paid \$700 per month for a 1.5 Mbps T1 connection, which was used by all 15 departments and approximately 100 staff members in

the building. The tribe was unable to implement several desired initiatives including video conferencing, Voice over Internet Protocol (VoIP), and remote monitoring of tribal buses. At the time of the site visit, the Tribes were connected to the BTOP-funded network and were planning to subscribe to service over the network. They expected to subscribe to 100 Mbps, and were quoted a price under \$500 per month for this service. The tribe is considering providing Wi-Fi to the public in the main building. The Tribal Headquarters also hosts a fiber hut for the LCOG fiber route.⁴³

- **The City of Florence** is a community on the Pacific coast. Before BTOP, the city government did not have broadband connections between most of its facilities, and shared a 1.5 Mbps T1 connection between City Hall and the Justice Center. Now, the City has 1 Gbps fiber connectivity that connects City Hall, the public works department, the police department, the Justice Center, and the Florence Events Center in a wide area network (WAN). The new fiber infrastructure inspired a five-year IT plan, and the City has transitioned to VoIP telephone service, new accounting software, and updated hardware to take advantage of the broadband. The fiber also has a secondary impact of promoting economic development in the area. The city's economy is largely dependent on tourism, but the fiber opens opportunities for local entrepreneurs and businesses as well as attracting broadband-dependent companies to a business park.⁴⁴
- The **Cow Creek Band of Umpqua Tribe of Indians** has lived in southern Oregon for hundreds of years. The Tribe has about 1,600 members and is governed by an elected eleven-member board of directors. The Tribal government is responsible for economic development, healthcare, resource management, and emergency management.⁴⁵ Douglas Fast Net (DFN) is the ISP for most of the Tribal buildings. Although none of these facilities were connected directly by the LCOG project, the Tribe benefited from the increased middle mile infrastructure in Douglas County. Because of this new infrastructure, DFN extended fiber services to the Cow Creek Health and Wellness Center (CCH&WC) South. CCH&WC's 100 Mbps connection now gives them a diverse path to offices and other buildings in Roseburg, and saves them about \$2,000 per month. It allows them to connect to Oregon Health Services to interface with other health institutions in the state to share data. The new connection also allows them to use VoIP telephone services, which improves operations.⁴⁶
- **Healthcare**
 - **PeaceHealth** is a nonprofit healthcare system that operates hospitals and clinics in Eugene, Springfield, Florence, and Cutters Grove, Oregon.⁴⁷ PeaceHealth also has facilities in Vancouver, four cities in Washington, and Ketchikan, Alaska. They own fiber between some facilities and lease circuits to connect all locations to the main and backup datacenters in Springfield and Eugene. PeaceHealth's Electronic Health Innovation Works (EHI Works) Department also works to provide virtual private network (VPN) connections to independent physicians' offices and partners that are not part of the PeaceHealth network.⁴⁸ PeaceHealth leases dark fiber on the BTOP-funded network, and manages the fiber as part of its private network among all PeaceHealth facilities. The BTOP grant connected five PeaceHealth facilities and an outreach clinic that provides service to low income and uninsured adults. The five connected hospitals and clinics were previously using T1 circuits, with connections ranging from 1.5 Mbps to 6 Mbps. They are all now connected with 1 or 2 Gbps fiber service. PeaceHealth staff members reported that they are saving about \$50,000 per month versus what they would have had to pay a commercial carrier to provide adequate broadband services to the clinics and hospitals without the BTOP grant. The fiber connections allow the clinics and doctor's offices to access patient data, transfer radiological images, communicate via e-mail with other PeaceHealth doctors behind the network's secure firewall, adopt telemedicine applications, and use VoIP services.⁴⁹
- **ISP**
 - **Douglas Fast Net (DFN)** is a wholly owned subsidiary of Douglas Electric Cooperative. Its mission is to ensure that advanced telecommunications do not bypass Douglas County.⁵⁰ LCOG chose DFN through a competitive bid process to operate the network and build connections to CAIs in Douglas County. The BTOP grant helped DFN reach new service

areas, including the southern part of Douglas County. It also allowed DFN to increase capacity in areas where it had existing middle mile infrastructure. This helped DFN support more customers and provide better redundancy in its existing service area. DFN has increased its staff from about eighteen at the beginning of the project to about twenty-five. DFN also leverages the BTOP-funded network to connect cellular towers and directly serve about 300 residential customers.⁵¹

- The following partner helped build and design the network for CAIs that were part of its existing network:
 - **Network for Educational Research Oregon (NERO)** is a high-speed network with hubs in Portland, Corvallis, and Eugene. It began in the 1990s as a research project to develop WANs to further the interests of education and research in the state.⁵² By aggregating traffic among educational institutions, NERO saves customers money and advocates for more robust broadband connections.⁵³ Its partners include the Oregon University System, the Oregon Department of Administrative Services, and the Oregon Association of Education Service Districts.⁵⁴ These partners aggregate demand, and NERO provides Internet connectivity to them through its hubs.⁵⁵ NERO has a long-standing relationship with LCOG that informed the development of the BTOP grant. LCOG and NERO worked together on the grant proposal and NERO helped to engineer, build, and operate the network. Many of the CAIs connected through the project were NERO partners and customers. Staff members reported that the new BTOP-funded network had a significant impact on its customers, particularly for rural K-12 schools and libraries that only had access to T1 connectivity prior to the BTOP grant.⁵⁶

Section 2 provides a summary of the outcomes and impacts the evaluation study team observed.

Section 2. Impacts

This section describes the impacts of the LCOG project in terms of the five focus areas described in *Interim Report 1*, with the addition of the Government Services focus area.⁵⁷ These outcomes and impacts focus on understanding the effect on CAIs. Digital Literacy is not a focus of CCI grants and the evaluation study team did not note significant Digital Literacy impacts outside of the outcomes and impacts related to the other focus areas.

LCOG's project allowed it to expand middle mile fiber infrastructure through much of Lane, Douglas, and Klamath counties to reach CAIs that had limited access to broadband service. Before BTOP, the majority of CAIs interviewed by the evaluation study team subscribed to service using T1 lines. Due to budgetary or infrastructure constraints, they had to limit broadband use. Now, they are subscribing to faster speeds at lower costs, and are expanding their use of broadband-based technologies.

2.1 Education and Training

Impacts within the Education and Training focus area are measured as changes to elements of educational content distribution and instruction. These impacts occur at K-12 institutions, community colleges, four-year institutions, universities, and other education providers. This focus area includes how the broadband Internet connections help the educational CAIs to perform activities that lead to helping students earn a certificate or diploma or receive training that is recognized as valuable for career advancement. Examples of certificates or diplomas include community college degrees, four-year college degrees, advanced degrees, general equivalency degrees, certifications in advanced software technologies such as network engineering, and other licenses or certifications that reflect knowledge of a particular subject at a level that would typically be taught at an educational institution.

When assessing impacts it is important to understand the characteristics and composition of education providers within the service area. Table 3 identifies the school level of all schools in the service area.⁵⁸ LCOG connected more primary schools than any other level. Nearly 14 percent of the K-12 institutions in the service area connected to the new network. No match could be found to the National Center for Education Statistics (NCES) dataset for five connected schools. The grantee reported that most schools in the three-county service area that were not served by the project had access to broadband before BTOP. LCOG reported connecting every school building within practical reach of the middle mile fiber build.

Table 3. Oregon Schools (K-12) by School Level

School Level	Served by Grantee	Others in Service Area
Primary	13	96
Middle	5	28
High	5	48
Other	1	7
Unmatched	5	N/A
All	29	179

The 24 connected schools that could be matched to the NCES dataset serve nearly 7,900 students, 11 percent of the primary and secondary school students in the service area. More than 1,800 of these students are minorities and 4,600 qualify for free or reduced lunch. Approximately 385 full-time equivalent (FTE) teachers are employed by schools connected to the network, representing 12 percent of the FTE teachers employed in the service area. LCOG connected four of the thirteen higher education institutions located in the service area. All of the higher education institutions connected by LCOG are public schools, three are two-year colleges, and one is a four-year university. Six of the thirteen higher education institutions in the service area are public.⁵⁹

This section summarizes the activities observed by the evaluation study team during site visits. The literature review presented in *Interim Report 1* provides evidence that these activities and situations lead to economic and social impacts. This report lists these impacts from the literature along with the evaluation study team's observational evidence supporting either the realization of impacts or their potential to occur.

In Oregon, county education service districts (ESD) often serve as ISPs to school districts. Lane ESD has been working for several years to build high-speed broadband connectivity for all schools, but before BTOP they were limited by a lack of middle mile infrastructure in the county. The LCOG grant allowed Lane ESD to provide expanded service to K-12 schools. The previous project coordinator for the ESD reported it consistently takes about eighteen months after connecting for a school to embrace new technologies fully. After that point, teachers and administrators are more likely to feel comfortable experimenting with methods of instruction that broadband-based technologies make possible.

- **Broadband gives teachers a wide range of media through which to facilitate lessons. The integration of technology into classroom activities creates the opportunity for interactive and personalized educational experiences for students.**⁶⁰
 - Technology use in the classroom at Days Creek has changed substantially after connecting to the BTOP-funded network. Before the upgrade, teachers could not integrate interactive technology in the classroom using the T1 connection that they shared with an alternative high school. Now, teachers can stream media in class, and multiple classes can do so at the same time. This is particularly important for elementary classrooms that use an ESD-provided resource called Learn 360 to present multimedia lessons that complement instruction. Most teachers also use SMART Boards, and the Internet connection gives them access to downloadable lessons. The school is also starting to use iPads for instruction, which would not have been possible without the increased broadband speeds.
 - The network upgrade allowed Prairie Mountain School to support increased Wi-Fi access in its classrooms. The school is beginning to use technologies such as iPads to support interactive teaching programs for students with autism. Without the LCOG project, the school would not have had sufficient bandwidth to use the iPads.
- **Research has shown that computer use among students leads to improved academic performance, greater levels of educational attainment, improved school enrollment and graduation rates, and increased earning potential for students.**⁶¹
 - LCC has an Academic Technology Department that researches new applications and provides training to instructors on using technology to enhance educational experiences for students. Before the LCOG project, the use of technology in classrooms was limited by a lack of broadband availability. Now that the new broadband infrastructure is in place, the college is exploring new classroom applications. For example, the Academic Technology Department is providing incentives for classrooms to use open educational resources (OER), or freely available materials without traditional copyright limitations, in place of textbooks. This saves students money and makes attending college more accessible for low-income students.
 - Since connecting to the network, Days Creek has been able to offer additional support for struggling middle school students. The school has a four-day school week, and only students who need extra help with schoolwork attend school on Fridays. This supplemental

program is largely dependent on web content, including Achieve 3,000, which provides individualized instruction online for struggling students. The high school uses Assessment and Learning in Knowledge Spaces (ALEKS), a math tool that helps students track progress and assessment. Days Creek staff members reported that test scores have greatly improved because of this expanded educational opportunity, which is particularly significant in the middle school.

- The increased broadband connectivity at Days Creek helps the school to implement standardized testing. Before BTOP, only a handful of students could complete the online tests at the same time, so school-wide testing took several days to complete. Even with this rotation, the Internet connection would often stall during tests, frustrating students and sometimes preventing them from finishing the tests. Days Creek staff members estimated that test scores have increased because of the new connection. Quantitative measures of improvement were not available during the site visit.
- **School administrations use broadband infrastructure to carry out internal operations. Broadband represents a rapid, reliable channel of communication to improve interactions among administrators, teachers, parents, and students.**⁶²
 - Before BTOP, Days Creek shared one T1 circuit between the high school, middle school, and elementary school. All schools were limited in what they could do administratively. Now, with the increased broadband connection, Days Creek is able to shift IT services to the Douglas ESD in Roseburg. The district is saving approximately \$1,200 to \$1,500 per year with free access to ESD-hosted e-mail. This shift has also allowed teachers, students, and parents to use the e-mail system anywhere that has Internet access. Similarly, before BTOP, Days Creek School District had to host its own servers for its student information system (SIS), Schoolmaster. Now, Days Creek has shifted this hosting to the ESD, saving approximately \$500 per year. Finally, Days Creek saves about \$700 per year by hosting its financial server at the ESD.
 - After the upgrade, Prairie Mountain School began to hold open computer lab hours in the morning before school. Advisors are present to help students who are struggling, and the lab is open to parents who might not have broadband at home. Parents use the lab to check grades and to read teacher blogs. Teachers and the principal use blogs on the school's website to communicate with parents about school activities.
 - Bethel School District operates security cameras at each school to prevent crime and vandalism. At the time of the site visit, the IP cameras were hosted locally at each school. This made monitoring them more difficult, and the principal of Prairie Mountain School reported that she would prefer to be able to monitor them remotely. The district is planning to install a centralized server to connect all of the school cameras at the district office, which would allow for remote monitoring of all schools. This would not have been possible for the district without the BTOP grant.
 - The State of Oregon Department of Education has a Google Apps license that is available to all districts. With the increased connectivity that schools have received as a part of the LCOG project, they are beginning to take advantage of this license to shift classroom and administrative documents to the cloud. Some schools are also looking at remote desktop and other cloud applications in order to reduce costs for licensing and hosting.

2.2 Government Services

One of the five core purposes established by the Recovery Act was to “improve access to, and use of, broadband service by public safety agencies.”⁶³ The Government Services focus area identifies how broadband improves services provided by government organizations to the public and includes both the provision and administration of public safety activities. Examples of public safety agencies include law enforcement agencies, fire departments, and emergency medical services (EMS). Some potential government service impacts include enhanced government efficiency,

improved ability to save lives and reduce injuries, prevention of criminal activity, and improved information sharing between citizens and public safety entities.

When assessing impacts it is important to understand the characteristics and composition of government service providers within the service area. Table 4 identifies the agency type of all police departments in the service area.⁶⁴ LCOG connected six police stations in the service area. Four of the six connected police buildings are local police departments, representing nearly one-third of all the local police departments in the service area.

Table 4. Oregon Police Stations by Agency Type

Agency Type	Served by Grantee	Others in Service Area
Local police department	4	11
Sheriff's office	1	2
Primary state law enforcement agency	0	0
Special jurisdiction	1	1
All	6	18

This section summarizes the activities observed by the evaluation study team during site visits. This report lists these impacts from the literature along with the evaluation study team's observational evidence supporting either the realization of impacts or their potential to occur.

- **The use of broadband at all levels of government allows government entities to deliver services more efficiently. Intranet systems enable the secure and rapid exchange of information among government agencies. Governments are also able to store and safeguard massive quantities of data. By streamlining in-house operations with the use of broadband-supported tools, governments realize greater internal efficiency and productivity.**⁶⁵
 - The City of Florence is upgrading its accounting software to take advantage of the increased connectivity it received from the LCOG project. The upgrade includes installing a server at City Hall to host its accounting database. Before BTOP, the City would not have been able to make this change due to limited connectivity between City Hall and other city offices. The upgrade will allow each department to see real-time budget data. It will also ensure that accounting data from different departments is entered and stored in the same format, which is expected to reduce time spent manually cleaning data. The upgrade will also allow the City to transition to an online bill payment system, which is expected to increase accounting efficiencies. The city manager also expects that the new accounting software will increase transparency and help prevent fraud and embezzlement within the government by keeping all transactional data in a single digital system.
 - The Justice Center hosts servers for data backups for all city data in Florence. Before BTOP, the slow broadband connection at many departments prevented them from efficiently using the centralized servers for regular backups. Now, all departments can back up their data more reliably after connecting directly to the Justice Center through the BTOP-funded fiber.
 - Tribal IT staff members expect to spend less time managing the Klamath Tribal Headquarters internal network after connecting to the LCOG fiber. For example, the IT director has to work with the GIS analyst to schedule times to download large data sets. After connecting to the fiber, the IT director expects that staff members will be able to download data sets without delay.
 - In Florence, city agencies used increased bandwidth to transition to VoIP telephone service. This saves the City money on its monthly telephone bill. It also allows city employees to

teleconference with colleagues in other locations, including Eugene, which saves time and cost of traveling for meetings.

- **Broadband also improves the relationship between governments and their constituents. Diffusion of online information engages citizens and enhances transparency of government agencies.**⁶⁶
 - The City of Florence reported that the WAN it established using the BTOP-funded fiber has allowed it to streamline the digitization of paperwork, which helps make the government more transparent and accessible. Citizens can more easily access electronic government documents, and e-mails provide a time-stamped and reliable form of accountability for elected officials.
 - The Klamath Tribes plan to use the fiber to make their website more accessible for Tribal Members. For example, with faster upload speeds, the IT director expects that departments will be able to move documentation and information online so that members with Internet access can fill out paperwork without traveling to the offices.
 - Council members of the Klamath Tribes would like to use streaming and video conferencing to broadcast events and allow members to join meetings remotely. Tribe members who have moved away from the area and those who are not able to leave their homes would be able to view events and participate in Tribal meetings. The IT director is confident that the improved service they will have over the fiber, in particular the symmetrical upload and download speeds, will allow them to provide these video services to members.
- **Broadband contributes to public safety indirectly, by reducing energy use and emissions, and directly, by improving services provided by public safety entities.**⁶⁷
 - Because of the fiber upgrade to the police station, the Florence Police Department can videotape its traffic stops and easily transfer the video from its office to the court building. The videos are stored in a secure database, and can be accessed when needed by the police or the courts. The police department is also transitioning to using more digital files in place of paper files, which can easily be backed up and are quickly accessible by other departments when needed.
- **Broadband connectivity helps to preserve continuity of government operations in the wake of disasters or epidemics.**⁶⁸
 - The Klamath Tribal Headquarters is in the process of a large infrastructure change in preparation for the increased broadband service. The IT department is building a new server room, and has upgraded its servers. The department is planning to use the new connection for remote backup services that will ensure data is not lost in the event of a disaster.

2.3 Healthcare

This focus area includes activities intended to increase elements of the provision and administration of healthcare services, including health information technology, e-Care, electronic health records (EHR), telehealth, and mobile health. Impacts in the Healthcare focus area include broadband-enabled activities aimed at improving personal health or that of someone else. This definition includes not only sophisticated tasks, such as viewing medical records online, but also more common activities that might not involve a medical provider at all. Healthcare impacts might be observed at primary care physicians' offices, hospitals, or in areas served by nurse practitioners.

When assessing impacts it is important to understand the characteristics and composition of healthcare service providers within the service area. LCOG connected twenty-five healthcare institutions by June 30, 2013.⁶⁹ Table 5 identifies the taxonomy groups of these connected institutions and the taxonomy groups of all healthcare institutions in the service area according to the National Plan and Provider Enumeration System (NPPES).⁷⁰ Eleven of the twenty-five healthcare institutions connected by LCOG (41 percent) are Ambulatory Health Care Facilities. Ten agencies are connected by LCOG, representing 10 percent of all Healthcare Agencies located in

the service area. The grantee reported that the majority of the healthcare institutions in the service area that did not receive service as part of the grant were connected to broadband before BTOP.

Table 5. Oregon Healthcare Institutions by Taxonomy Group

Taxonomy Group	Served by Grantee	Others in Service Area
Agency	10	101
Ambulatory Health Care Facilities	11	190
Hospital Units	0	8
Hospitals	3	18
Managed Care Organizations	1	9
Nursing & Custodial Care Facilities	0	52
Residential Treatment Facilities	0	15
All	25	393

This section summarizes the activities observed by the evaluation study team during site visits. The literature review presented in *Interim Report 1* provides evidence that these activities and situations lead to economic and social impacts. This report lists these impacts from the literature along with the evaluation study team’s observational evidence supporting either the realization of impacts or their potential to occur.

- **Patients obtain improved ongoing care.**⁷¹
 - Some PeaceHealth clinics that have connected through the grant-funded fiber use the improved connection to support more telehealth initiatives using mobile video conferencing carts at remote locations. These include interpretive services for non-English speakers and people with disabilities, and tele-stroke applications. For example, the PeaceHealth medical center in Florence is piloting a tele-stroke program to provide on-call support and e-consults between doctors at the clinic and neurology specialists. These consultations can decrease the diagnosis time and provide faster access to treatments, which can save lives.
 - Although the BTOP-funded network focused on connecting CAIs, some providers, such as Douglas Fast Net, are already providing service to residential customers using the middle mile infrastructure. PeaceHealth reported that as high bandwidth broadband becomes available it expects to transition to telehealth applications that will allow on-call doctors to communicate with patients from their own homes. This would not only provide a convenience for doctors, but also decrease wait times for patients.
- **Broadband connectivity enables providers to adopt new technologies and practices that enhance productivity, achieving outcomes such as improved appointment and treatment scheduling and more complete medical records at lower costs.**⁷²
 - Before BTOP, several PeaceHealth clinics connected to the medical system using T1 circuits. These connections were not adequate to transfer patient data and conduct research over the Internet. PeaceHealth reported that before the project, its largest clinic connected over four bonded T1 lines. The clinic was required to house extra servers on site due to the limited amount of data that could be transferred over its 6 Mbps connection. Now, the hospital system provides the clinic a 1 Gbps connection, allowing it to have full access to the hospital’s network and quickly transfer patient and administrative data. The clinic was able to decommission three local servers, reducing IT costs and preventing file duplication.
 - PeaceHealth IT staff no longer has to route and shape traffic, which saves time. For example, prior to the BTOP grant, the Women’s Care facility had difficulty synchronizing with the PeaceHealth server for mammography applications. Staff had to delay data transfer until

there was less demand on the network, which often took several hours. Now, the data transfers are immediate, allowing the clinic to operate more efficiently.

- The redundant data connections provided by the BTOP network are important to healthcare providers because a network interruption of just a few minutes could be life threatening. Before BTOP, most of the PeaceHealth facilities connected by the LCOG project did not have redundant connections. Now, all are connected to a fiber ring, which provides 1 Gbps speeds and full redundancy. For example, the Cottage Grove Hospital previously had only one 300 Mbps Ethernet connection with no redundancy. Now, it uses the 1 Gbps connection through the BTOP-funded fiber as its primary connection, and keeps the Ethernet connection as a backup.
- **Broadband access enables providers to rapidly share patient information with other healthcare providers.**⁷³
 - As part of the BTOP grant, PeaceHealth's EHI connected independent physician offices to the PeaceHealth system. The fiber connections allow the doctor's offices to access shared patient data, transfer radiological images, and communicate via e-mail with PeaceHealth doctors behind the network's secure firewall. If the doctors were not able to connect to the PeaceHealth system, they would have to print films or share CDs of patients' images with other doctors.

2.4 Workforce and Economic Development

Impacts within the Workforce and Economic Development focus area can occur through activities intended to increase overall employment of the target population, or to assist employed members of that population in finding jobs that offer increased salaries, better benefits, or a more attractive career path, including self-employment. This focus area also includes activities to attract new businesses to locate along the fiber path or to expand the economic activity of existing businesses connected to the network. While this focus area primarily describes jobs, it also includes other economic impacts such as wages, property values, and the number of firms in a region.

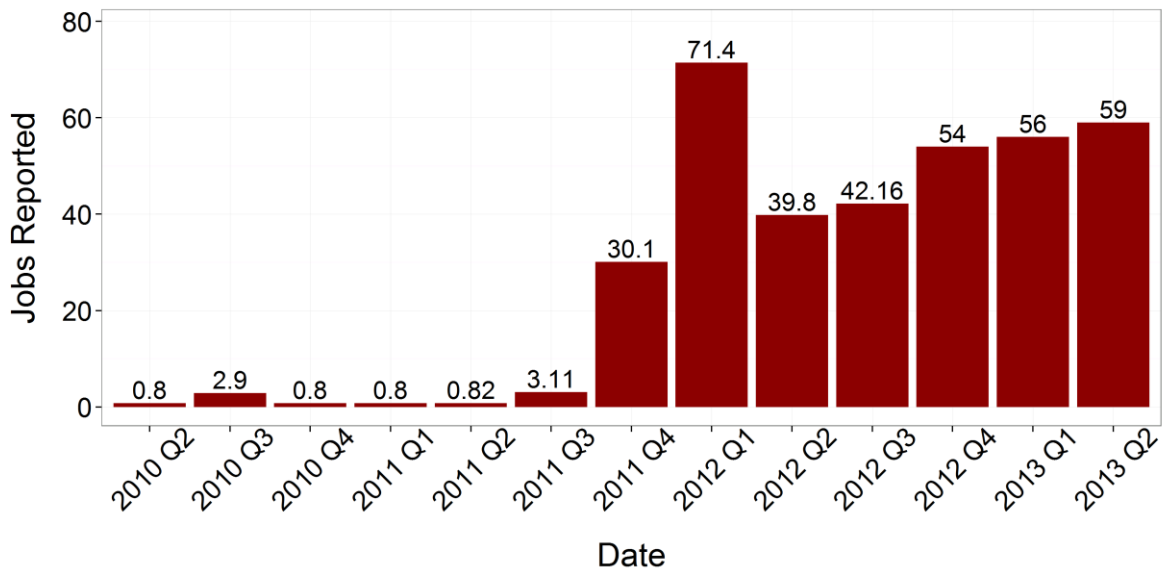
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- **Workforce and Economic Development activities supported by broadband infrastructure strengthen job and population growth.**⁷⁴
 - Before BTOP, Florence did not have adequate broadband infrastructure to attract Internet-based businesses. The city had a fiber link through Alaska Cable Systems to the north, but the LCOG grant provided a key redundant connection to Eugene. The City of Florence has designated a special e-commerce zone in the Pacific View Business Park to attract new businesses. The city manager reported that they are in discussions with a company that is considering building a call center in Florence. This company would not have considered Florence without the redundant broadband connection provided by BTOP.
- **The availability of infrastructure in a community enables firms reliant on broadband services to relocate or open additional locations. Local businesses are able to obtain improved access to inputs and markets.**⁷⁵
 - The BTOP-funded project is already spurring economic development in its service area. For example, a call center decided to relocate to Veneta partly because of the availability of fiber in that town. LCOG worked with the City of Veneta to extend fiber from the BTOP-funded network to a new location for the call center using a grant from the state's Business Development Department.

- o DFN was able to expand its footprint to the southern part of Douglas County, reaching more CAIs and towns. It is building off the network to reach other CAIs, such as the Cow Creek Tribal government. It was also able to use the network to connect cell towers, through a partnership with Light Speed Networks. DFN has grown from eighteen to twenty-five employees since the beginning of the grant.

As required by the Recovery Act, LCOG reported the number of jobs created quarterly as a direct result of the project. As shown in Figure 5, LCOG funded more than fifty full-time equivalent positions in four different quarters from the second quarter of 2010 through the second quarter of 2013.⁷⁶ These were largely jobs related to construction of the fiber network. It is important to note that this includes only direct jobs created, and does not include indirect or induced job creation.⁷⁷

Figure 5. Direct Jobs Created by LCOG



Section 3. Grant Implementation

This section presents LCOG's strategy to maximize the social and economic impacts of the BTOP grant. The following subsections describe LCOG's implementation strategies; LCOG's approach to open access; major results of LCOG's implementation strategy; an overview of sustainability efforts; and successful tools, techniques, and strategies identified during interviews with the grantee.

3.1 Implementation

LCOG is an association of regional governments in Lane County, Oregon that provides regional planning, coordination, program development, and service-delivery. LCOG provides regional technology services to participating agencies by assisting with telecommunications management and operation, coordinating regional technology systems, and providing GIS and data services.⁷⁸ As part of these technology services, LCOG partnered with the Regional Fiber Consortium (RFC) to extend telecommunications services throughout Lane County and the surrounding counties.⁷⁹

Before the project, LCOG had experience in the development, design, and implementation of broadband infrastructure projects. In the Eugene and Springfield area, LCOG was responsible for developing a Public Area Network (PAN). The PAN is a multi-agency network involving both state and local entities that uses dense wave division multiplexing (DWDM) equipment to support a fiber network approximately 100 miles in length. LCOG also had preexisting partnerships with the University of Oregon and the Department of Transportation supporting a fiber route that covers the hundred-mile stretch from Portland to Eugene. Similar to its role with the PAN, LCOG provides the organizational management that helps to keep the BTOP-funded network operating.

LCOG designed the project to enhance the existing fiber-optic backbone in the area. The project built an additional 102 miles of fiber throughout Lane County, Douglas County, Klamath County, and the Klamath Tribal regions. The CAIs connected by LCOG are concentrated along Interstate 5, running north to south through Lane and Douglas counties. Additional CAIs are located along the coastline in Florence and further east within Klamath County and the Klamath Tribal regions. Most of the network was built as aerial fiber-optic cable because of the mountainous and densely forested geography of the service area.

LCOG established partnerships with experienced providers in the service area to support the implementation of this project. LCOG planned to have third party providers operate the network and contracted with these providers for portions of the design and construction of the network. This helped to align the incentives of both LCOG and its subcontractors. The network operators include:

- CoastCom, a private competitive local exchange carrier (CLEC) in the coastal regions of Lane County, owns and operates a small network in Florence. The LCOG project leveraged CoastCom's existing infrastructure and knowledge of the area. LCOG partnered with CoastCom to design the portion of the network extending to Florence. CoastCom is using one-half of the BTOP-funded fiber installed in Florence.
- Douglas Fast Net (DFN) is an ISP that serves customers throughout Douglas County. LCOG contracted with DFN, which already had a fiber presence in Douglas County, to act as a design advisor on the LCOG network in the Douglas County area. DFN was able to help LCOG reduce the cost of the initial build out due to its familiarity with the service area. DFN was also able to help LCOG locate and connect additional CAIs in the service area. DFN uses one-half of the constructed fiber in Sutherlin, Myrtle Creek, Canyonville, Winston, and Riddle, Oregon.

- Hunter Communications was contracted by LCOG to operate a portion of the network in Chemult and Chiloquin. Additionally, Hunter Communication provides service over half of the fiber located in Chemult and Chilquin.
- In the Eugene and Springfield areas, LCOG partnered with Eugene Water and Electric Board (EWEB) and Springfield Utility Board (SUB) to help design portions of the network. Both EWEB and SUB had existing networks that were expanded with BTOP funding to reach additional CAIs in underserved areas.
- LCOG contracted with the University of Oregon to operate the network equipment between Eugene and Klamath Falls.

The BTOP network connects several broadband networks that were previously unconnected, extending their reach into mostly rural, underserved areas. The BTOP network hardware varies to match the equipment used on these pre-existing networks. Most commonly, LCOG used gigabit Ethernet switches with passive optics using Coarse Wave Division Multiplexing (CWDM).⁸⁰ These sections of the network provide 100 Mbps connections to CAIs. In an effort to match the electronics of the PAN, LCOG built laterals in other areas using Dense Wave Division Multiplexing (DWDM). These laterals provide 1 Gbps service for directly connected institutions.

By connecting to other networks in the area, the LCOG network provides route redundancy for many of the CAIs connected. This is particularly important for healthcare institutions, such as PeaceHealth, that have gained complete redundancy from the LCOG network. LCOG chose this system because it is compatible with the existing Internet connections in Florence, Veneta, Junction City, and in the Douglas County segment.

A key aspect of the LCOG network is the interconnection point in Eugene that has rack space for multiple users. This enables vendors to colocate in one place, allowing possibilities for cross connection and peering. LCOG expects that this interconnection facility will facilitate the use of broadband by allowing opportunities for direct connections and expediting the transmission of Internet data and messages between vendors.

3.2 Open Access Policies

CCI projects funded by BTOP are predominantly middle mile projects, although a small number of last mile projects were awarded. These grants are intended to improve available broadband capabilities for CAIs, to facilitate the development of last mile services in unserved and underserved areas, and to promote economic growth. This investment through the BTOP grant is intended to “lay the foundation for the ultimate provision of reasonably priced end-user broadband services” through open and nondiscriminatory interconnection strategies to enable last mile providers to have open access to the network.⁸¹

There is considerable debate on the impact of open access policies on the competitiveness of the broadband market.⁸² Open access is implemented through a wide variety of strategies. “These can range from commercial or voluntary arrangements, between communication operators and third-parties, through to regulatory intervention aimed at promoting certain policy objectives, such as expanding broadband availability, increasing competition, or promoting investment that may otherwise not be economic, such as in the case of enabling the establishment and treatment of shared facilities.”⁸³ The impact of open access will be dependent upon how well the practices and policies help to reduce the time, cost, and difficulty for last mile providers to interconnect to the network.⁸⁴ The impact also depends on how well the policy mechanisms ensure competitive pricing for wholesale services in the event of the presence of a middle mile provider that may also be a last mile provider.⁸⁵

Prior to the BTOP project, LCOG advocated for open access policies when working with the Regional Fiber Consortium (RFC). All contracts written by LCOG for the project have both open access and open network policies included. LCOG and the RFC promote open access and the

development of competitive broadband services by leasing dark fiber to CLECs at below market rates and providing technical assistance to entities seeking to improve broadband services.⁸⁶ The availability of lower priced middle mile bandwidth also encourages the entry of new providers of broadband-based services. As of June 30, 2013, LCOG had three signed agreements with broadband wholesalers or last mile providers and was in negotiations with three additional providers.⁸⁷ Open network policies ensure that the operators of the LCOG network cannot raise service prices or use other criteria to impede another provider from operating on the network. Additionally, the open network policies ensure that network operators cannot selectively screen any kind of content carried over the network.

The LCOG project is building laterals to CAIs even when those CAIs might already have existing service agreements in place with other ISPs. Through the new fiber, CAIs are often able to obtain better rates for bandwidth or more redundancy.

3.3 Results

There were three major results of the LCOG project observed by the evaluation study team:

- The LCOG BTOP project implemented technologies that provided increased bandwidth to CAIs. Prior to the BTOP grant, the CAIs in the service area typically used T1 or bonded T1 lines for their broadband connections. In some cases, several CAIs shared a single T1 line. Where CAIs had T1 connections prior to the grant, the LCOG connection enabled an increase of nearly sixty-seven times their original capacity, to 100 Mbps. Increased bandwidth opens the door for new uses of broadband technology by CAIs. These new uses of broadband and their impacts are detailed in Section 2, above.
- The LCOG network is more reliable than the network it replaced. The increased route redundancy provided by the new network has enabled CAIs to implement more bandwidth-intensive applications. For example, healthcare providers can implement tele-stroke applications that are sensitive to interruptions in service, and schools can use online standardized testing.
- The LCOG network provides middle mile connectivity at lower prices than before the construction of the network. Price and capacity data from six CAIs interviewed by the evaluation study team show that the average price of broadband per megabit per month was reduced from \$343 to \$7, while the average speed increased by more than 27 times the original speeds.

The longer-term impact of the LCOG network will depend on several factors:

- The service providers must maintain the reliability of the network over time. The LCOG business plan is to contract with service providers to maintain and operate the BTOP-funded network. At present, DFN, CoastCom, and Hunter Communications are responsible for the maintenance of the fiber they purchased on the network. LCOG's past success with this approach for the PAN suggests that this is a viable business model.
- The impact of this network also depends on how well the open access policies are able to attract future private investment.⁸⁸ The LCOG project made the initial investment in fiber infrastructure. Open access policies ensure competitive pricing for wholesale services, attracting providers to leverage the BTOP network to expand their facilities and footprint across the service area. The network has already seen investments from wireless providers to connect cellular towers to the network. If the operators of the LCOG network continue to provide attractive wholesale services, increased use of the network will generate additional social and economic benefits.
- One concern for attracting additional competition on the network is the management structure established by LCOG. The partners that operate the network are responsible for providing wholesale fiber at attractive rates in order to spur competition, even when this competition may drive their own service prices down. LCOG reported that it will continue to work with additional

service providers as necessary to increase competition and ensure prices for service remain low.

3.4 Sustainability

The sustainability of the LCOG project will largely depend on the third-party providers that operate the network and their ability to recruit additional customers. LCOG designed the network with the intention of running as little of the network as possible and went through a request for proposal (RFP) process to select these initial providers. LCOG has continued its service provider outreach program to attract additional providers to offer service on the network. Through this outreach, several additional providers have approached LCOG about serving particular portions of the network service area. LCOG has entered into three agreements and is in discussions with three providers.⁸⁹

3.5 Successful Tools, Techniques, and Strategies

This subsection describes successful techniques, tools, and strategies identified by the grantee and interviewees. Successes and challenges described in earlier sections are not repeated here.

- LCOG maximized the reach of the new network by connecting to existing fiber networks in the three county service area. Local providers and utility companies such as DFN, CoastCom, EWEB, and SUB owned and operated fiber networks prior to BTOP. LCOG leveraged these networks to extend the reach of the BTOP grant and to reach new CAIs.
- LCOG designed the network with the help of existing broadband providers. Leveraging the experience and knowledge of local providers, LCOG was able to anticipate potential construction challenges and quickly identify areas that were in need of broadband infrastructure.
- LCOG aligned the incentives of its partners towards the long-term success of the network by designing and building a network that was useful to these partners and involving them as much as possible in the design and build of the network. Using the RFP process, LCOG ensured that companies were qualified and engaged in a contractual partnership, as opposed to a subrecipient relationship, to maintain control as well as avoid the burden of reporting these partners would otherwise bear.

3.6 Challenges

- LCOG spent approximately one year performing the Environmental Assessment, causing delays in construction of the network. The grantee reported that the prolonged Environmental Assessment was a result of many small changes that had to be made to the original design. Revisions required the grantee submit change orders to NTIA and revise the Environmental Assessment, both of which were time consuming.

Section 4. Conclusions

The American Recovery and Reinvestment Act of 2009 (Recovery Act) instructed NTIA to implement BTOP to promote five core purposes:⁹⁰

1. Provide access to broadband service to consumers residing in unserved areas of the country.
2. Provide improved access to broadband service to consumers residing in underserved areas of the country.
3. Provide broadband education, awareness, training, access, equipment, and support to:
 - a. Schools, libraries, medical and healthcare providers, community colleges and other institutions of higher learning, and other community support organizations.
 - b. Organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband services by vulnerable populations (e.g., low-income, unemployed, seniors).
 - c. Job-creating strategic facilities located in state- or federally designated economic development zones.
4. Improve access to, and use of, broadband service by public safety agencies.
5. Stimulate the demand for broadband, economic growth, and job creation.

This section summarizes how LCOG's implementation of BTOP has encouraged the fulfillment of the Recovery Act's goals. LCOG supported Recovery Act goals to improve access in unserved and underserved areas. With these connections, CAIs are beginning to transform their services for healthcare and education and provide higher quality public safety services in the service area. The LCOG network has enabled small, rural school districts to aggregate demand for services such as student administrative software and host these applications off-site, saving them both time and money.

4.1 Improve Access to Unserved and Underserved Areas of the Country

The first two goals of the Recovery Act encourage improved access for unserved and underserved areas:

- Provide access to broadband service to consumers residing in unserved areas of the country.
- Provide improved access to broadband service to consumers residing in underserved areas of the country.

According to the June 2011 release of the NBM, more than 13 percent of the LCOG service area residents do not have a broadband provider available to them. This is a larger proportion of residents without broadband service available than in the rest of Oregon, where almost 7 percent of the population has no access to a broadband provider.

The LCOG network improved access to broadband. The greatest impact made by the LCOG grant was directly connecting 131 CAIs throughout western Oregon.⁹¹ The benefits of connecting these institutions are widespread as the grant connected medical centers, public safety entities, schools, community colleges, and libraries that are now experiencing cost savings, increases in broadband speed, and improved network reliability. Additionally, LCOG's fiber network route establishes a fiber presence in western Oregon, allowing ISPs to provide service to residents and businesses.⁹²

LCOG placed interconnection points strategically along the route to facilitate the future expansion of this network, particularly in underserved areas such as the towns of Chemult and Chiloquin. Open access policies for the network dictate that last mile providers that are interested in using the network are able to connect at these interconnection points.

4.2 Broadband Education, Awareness, Training, Access, Equipment, and Support

Most closely aligned with PCC and SBA grants, the next Recovery Act goal is for grantees to provide broadband education, awareness, training, access, equipment, and support to:

1. Schools, libraries, medical and healthcare providers, community colleges and other institutions of higher learning, and other community support organizations.
2. Organizations and agencies that provide outreach, access, equipment, and support services to facilitate greater use of broadband services by vulnerable populations (e.g., low-income, unemployed, seniors).
3. Job-creating strategic facilities located in state- or federally designated economic development zones.

The LCOG grant focused on constructing both a middle mile broadband network and last mile connections to CAIs so that third party providers could serve connected institutions using the network. LCOG has continued an outreach program that educates providers on the network to increase interest. This outreach has been successful in attracting additional providers. As of June 30, 2013, LCOG signed three agreements with broadband wholesalers or last mile providers and was in negotiations with three additional providers.⁹³ Because LCOG is not the service provider, subscription speed information for all CAIs is not known, but the network is capable of service at speeds from 1 Mbps to 1 Gbps. Most subscribers are choosing services in the 10 Mbps range.⁹⁴

4.3 Public Safety Agencies

The fourth goal of the Recovery Act is to improve access to, and use of, broadband service by public safety agencies. LCOG connected sheriff substations and fire stations. The increased bandwidth has enabled firefighters, particularly those located in remote areas, to access online training opportunities from their fire station. Section 2.2 includes a discussion of the initial outcomes and impacts these organizations experienced.

4.4 Demand for Broadband, Economic Growth, and Job Creation

The final Recovery Act goal is to stimulate the demand for broadband, economic growth, and job creation. The LCOG network leveraged existing networks in the service area to extend broadband service to mostly rural, underserved areas. In doing so, the network improved broadband access to CAIs and their surrounding communities, facilitating the increased use of broadband and stimulating local economies.

All CAIs connected by LCOG through the BTOP grant were already Internet users, often using T1 lines, but faced bandwidth and price limitations. The LCOG project stimulated the demand for broadband by providing increased speeds at lower prices to meet the bandwidth needs of these users. Police departments are using the broadband network to capture streaming video of key traffic intersections. Schools are using the increased speeds to use streaming interactive media and digital tools, such as iPads, in the classroom. Healthcare organizations are able to rapidly share patient information among one another and are piloting innovative telehealth services.

LCOG believes that it takes approximately eighteen months from when CAIs receive improved service for them to change the culture surrounding their use of technology, embrace new capabilities, and begin leveraging them. Because of this, LCOG expects that CAIs will continue to increase their demand for broadband in that timeframe. As connected CAIs continue to learn how they can utilize the enhanced broadband services made possible through the BTOP grant, it is expected larger impacts will emerge.

While there are no studies that discuss the effect of the LCOG project on job growth in the service area, the evaluation study team observed success stories. A call center relocated to Veneta partly because of the availability of BTOP-funded fiber. Another call center is interested in using the BTOP-funded infrastructure to open a location in Florence.

LCOG was able to expand the footprint of the PAN because of the BTOP grant. The grantee reported that LCOG and its partners in the PAN had been trying to build a similar network for the past decade. Without BTOP funding, LCOG would not have been able to extend fiber to previously unserved and underserved members of the PAN nor would it have been able to connect 131 CAIs across the three county service area.

Section 5. Next Steps for the Evaluation Study

In early 2014, ASR will deliver *Interim Report 2* to NTIA. This report will include a summary of the site visits to twelve CCI projects. It will also include a summary of the second round of site visits to the fifteen PCC and SBA grants.

For the CCI projects, *Interim Report 2* will summarize the activities underway by twelve CCI grantees and the social and economic impacts of these projects. For the PCC and SBA projects, *Interim Report 2* will provide an update to and refinement of the analysis presented in *Interim Report 1*.

In September 2014, ASR will deliver a *Final Report* that quantitatively and qualitatively assesses the economic and social impact of BTOP grants (including CCI, PCC, and SBA grants). The centerpiece of the *Final Report* will be an assessment of how and to what extent BTOP grant awards have achieved economic and social benefits in areas served by the grantees. To the extent that such information is available, ASR will use results from studies performed by the grantees to round out the conclusions presented.

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- Last mile project – any infrastructure project the predominant purpose of which is to provide broadband service to end users or end user devices (including households, businesses, community anchor institutions, public safety entities, and critical community facilities).
- Middle mile project – a broadband infrastructure project that does not predominantly provide broadband service to end users or to end-user devices, and may include interoffice transport, backhaul, Internet connectivity, or special access.

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- Primary: lowest grade offered is in pre-kindergarten through third grade and highest grade offered is in pre-kindergarten through eighth grade
 - Middle: lowest grade offered is in fourth through seventh grades and highest grade offered is in fourth through ninth grades
 - High: lowest graded offered is in seventh through twelfth grades and highest grade offered is twelfth grade
 - Other: grades offered do not follow the primary, middle, or high school level configurations, or the school does not have a grade system
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2. Divide 2,080 Total Hours by 4 to equal 520 regular quarterly hours.
3. If two full-time employees each worked 520 hours (1,040 hours) for the quarter and another half-time employee worked 260 hours, the Total Hours for the three employees is 1300 (520 + 520 + 260 = 1300).
4. Divide 1300 by 520 to equal 2.5 Recovery funded jobs during that quarter.

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Glossary

Acronym	Definition
ACS	American Community Survey
ALEKS	Assessment and Learning in Knowledge Spaces
APR	Annual Performance Progress Report
BTOP	Broadband Technology Opportunities Program
CAI	Community Anchor Institution
CCH&WC	Cow Creek Health and Wellness Center
CCI	Comprehensive Community Infrastructure
CLEC	Competitive Local Exchange Carrier
CWDM	Coarse Wave Division Multiplexing
DFN	Douglas Fast Net
DSL	Digital Subscriber Line
DWDM	Dense Wave Division Multiplexing
EHI Works	Electronic Health Innovation Works
EHR	Electronic Health Record
ESD	Educational Service District
EWEB	Eugene Water and Electric Board
FCC	Federal Communications Commission
FTE	Full-Time Equivalent
GIS	Geographic Information System
IMLS	Institute of Museum and Library Sciences
ISP	Internet Service Provider
LCC	Lane Community College
LCOG	Lane Council of Governments
NBM	National Broadband Map
NCES	National Center for Education Statistics
NPPES	National Plan and Provider Enumeration System
NTIA	National Telecommunications and Information Administration
PAN	Public Area Network
PCC	Public Computer Centers
PPR	Quarterly Performance Progress Report
RFC	Regional Fiber Consortium

Acronym	Definition
RFP	Request for Proposal
SBA	Sustainable Broadband Adoption
SIS	Student Information System
SUB	Springfield Utility Board
VPN	Virtual Private Network
WAN	Wide Area Network

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