

Stimulating Broadband Adoption in Delaware: A Planning Tool

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Preface

As Director of the Institute for Public Administration (IPA) at the University of Delaware, I am pleased to provide this report, *Stimulating Broadband Adoption in Delaware: A Planning Tool*. This research is part of a multi-phase effort undertaken by IPA under contract with the Delaware Department of Technology and Information (DTI) through a grant from the National Telecommunications and Information Administration (NTIA). NTIA is an executive branch organization that focuses on advancing the adoption of Internet broadband access nationwide, with particular attention to disparities in access, in order to foster growth and innovation.

While Delaware has enjoyed very high connectivity and broadband speeds compared to other states nationwide, this access is not uniform across the state. This disparity, known as the “digital divide,” is particularly pronounced between the northern portion of the state—the urbanized corridor north of the C&D Canal—and the southern portions, particularly in Kent and Sussex Counties. In this latter region provision and adoption of broadband has been limited, and some areas completely lack adequate options for high-speed Internet access. In addition to geographic factors affecting the adoption of broadband, there are demographic factors that also can have a negative effect on adoption.

Increasingly, the world will be divided into the technological “haves and have-nots,” a situation that will place those without access to the power and resources offered by robust Internet access at a competitive disadvantage. In many aspects of peoples’ lives, including business, medicine, education, and government, the negative effects of this disadvantage will be increasingly pronounced. The research here attempts to frame the issues associated with differentials in broadband adoption rates, and pinpoint the areas of the state where problems exist.

Part of IPA’s service mission in the state of Delaware is to assist local governments to better meet the needs of constituents, businesses to grow, and communities to prosper. Broadband access is increasingly becoming a critical factor toward this end. We have sought to frame this issue for Delawareans by providing models and case studies, identifying physical and demographic barriers, and developing specific strategies that can be applied in differing circumstances. I hope that we can make a real difference in Delaware and play a part in expanding provision of fast, reliable, and universal broadband access to position our state for current and future challenges.

Jerome R. Lewis, Ph.D.
Director, Institute for Public Administration

Institute for Public Administration

The Institute for Public Administration (IPA) prepared this report. A unit within the College of Arts & Sciences' School of Public Policy & Administration at the University of Delaware, IPA links the research and resources of the University with the management and information needs of local, state, and regional governments in the Delaware Valley. IPA provides assistance to agencies and local governments through direct staff support and research projects as well as training programs and policy forums. IPA's Andrew Homsey, Todd O'Boyle, and Ted Patterson were involved with the research and writing of this report, with assistance from Maggie Coleman.

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Introduction and Overview: IPA's Role in Increasing Broadband Capacity in Delaware

In mid-December 2009, the state of Delaware was awarded funds to research and publish broadband options for its citizens. Governor Jack Markell designated the Department of Technology and Information (DTI) as the agency to receive, apply, and implement the funds, according to the guidelines and mandates of the National Telecommunications and Information Administration (NTIA).

In 2010 the broadband-mapping portion of this program was initiated by DTI, consisting of data collection, the development of a statewide broadband-availability map, transmission of those data to NTIA for the development of its national broadband map, and the long-term maintenance of these data by the state. The University of Delaware's Institute for Public Administration (IPA) is assisting DTI with project-data collection, public outreach, and public policy development that includes the following:

- **Delaware Broadband Map**—The mapping website was launched by DTI in spring 2011. Go to *broadband.delaware.gov* to locate places in Delaware that offer public Internet access and learn about Internet access in Delaware.
- **Community Anchor Institution (CAI) Inventory**—CAIs are potential public Internet-access locations such as libraries, senior centers, schools, and hospitals. IPA conducts a CAI inventory twice a year to find new CAIs, gain more information about CAIs, and provide the public with information about where to go to access a higher-quality Internet connection.
- **Broadband Planning Tool**—The broadband planning tool will seek to quantify, and make spatially explicit, the factors that encourage or inhibit wider adoption of high-speed Internet access. The tool will consist of spatially explicit information that serves to identify the viability of high-speed Internet connectivity across the state of Delaware based on physical, demographic, and economic factors. Measures are grouped into three separate and independent categories:
 - Physical Connectedness (how physically connected a location is to existing infrastructure, population centers, or projected growth areas)

- Demographic Risk Factors (how at risk an area is to not adopting broadband technologies based on characteristics such as age, education level, income, etc.)
- Level of Service (the degree to which broadband is available, affordable, and of sufficient speed to enable a population to take full advantage of Internet-based resources)

Together these measures will form a picture of the degree to which broadband adoption is facilitated or deterred by these factors. Depending on the scores within each category, the preferred strategy to address the problem of bridging the digital divide will vary.

- **Technology Planning Teams**—The Broadband Data Improvement Act authorizes grants to create and facilitate local technology planning teams. The State of Delaware has identified three broadband user groups to be targeted—local governments, small businesses, and agriculture.

IPA is engaging representatives of each of these three groups, who, as members of “technology planning teams,” will help to identify:

- Issues affecting the deployment and full use of broadband.
- Broadband best practices for their community of interest.
- Potential projects for expanding the use and deployment of broadband in these communities.

Anyone interested in participating in this broadband technology–planning endeavor is encouraged to contact IPA Broadband Project team leader Doug Tuttle (dougt@udel.edu).

- **Technical Assistance**—This component, starting in fall 2011, involves the provision of technical assistance to municipalities, nonprofit community-service organizations, and the small business community and is essential to expanding the awareness of and engagement with issues related to broadband availability and use. IPA will leverage its established relationships with Delaware’s local governments, grant-in-aid recipients, and economic-development agents to build a higher understanding of broadband capabilities and needs. Currently available digital-literacy initiatives will be identified, catalogued, and evaluated. Enhanced broadband education programs will be developed through established partnerships with organizations (e.g., the Delaware Municipal Web

Developers Group) and will be made available to community-support entities through an ongoing program of train-the-trainer sessions. Broadband literacy will be explicitly incorporated into the established programs of certificate training and professional development that IPA provides for local elected and appointed officials and their staff. Field deployment of a graduate-level broadband research assistant will result in expanded direct-assistance capabilities through economies that are similar to those associated with the Americorps VISTA program.

Structure of the Broadband Planning Tool Document

The Broadband Planning Tool, which the current document represents, includes the following components.

Chapter 1. Getting the Most Out of Broadband frames the issues related to broadband in Delaware by exploring the benefits of broadband, comparing available technologies, and examining the challenges to improving connection. **Chapter 2. Geospatial Analysis of the Factors Affecting the Adoption of Broadband in Delaware** describes and quantifies the factors that contribute to broadband connectivity or digital isolation.

Appendix 1 provides maps of the latest data available to visualize community “hotspots” and “coolspots” of connectivity across Delaware. **Appendix 2** outlines how to use the Broadband Mapping Tool. The tool enables planners and local government officials to evaluate their own broadband challenges and opportunities. It includes three Delaware broadband case studies from across the state to demonstrate how to improve connectivity. **Appendix 3** lists federal grant and loan programs available to communities and agencies across the state. Each entry in the resource list includes a description of the purpose of funding, and qualifications for each program, along with contact information.

Chapter 1: Getting the Most Out of Broadband

Broadband is critical to Delaware's future in the 21st century. Much like the state's other crucial physical infrastructure—the Port of Wilmington, Interstate 95, and its rail lines—a high-quality and affordable connection facilitates economic development. Yet, connecting households and businesses has been a challenge nationally and globally. A minimal connection is no longer enough. Bandwidth is key.

Why does broadband matter?

- **Business**—Firms increasingly consider the level of broadband when citing operations.
- **Workforce Development**—Libraries and schools make use of quality connections to educate the workforce.
- **Helping the unemployed**—Many employers only accept online job applications.
- **Quality of Life**—For end-users, today's web applications require broadband connections to function properly. A fast connection allows users to connect with distant relatives via videoconferencing (e.g., Skype) or upload home movies to share with grandparents. Additionally, more and more applications are moving into "the Cloud," which will require ever more bandwidth to stay regionally and internationally competitive in the near future. Choosing the wrong broadband strategy means that communities will not reap all the benefits of broadband investments.

What is the Cloud?

The Cloud is a new paradigm for computing, which allows commodity computers with fast connections to perform high-end tasks. In the Cloud, high-capacity servers handle the data-intensive tasks and then communicate back with the end-user's computer. Examples of Cloud-based web applications include Dropbox, which keeps documents in sync across every computer you use. Google uses the Cloud to keep your contacts and calendars synchronized between your phone and computer. Microsoft is currently testing a Cloud version of Office to allow teams to collaborate on documents.

In rural Delaware or low-income areas, broadband often is not available at all. Where broadband is available, consumers usually have a choice of, at most, two providers: the local Digital Subscriber Line (DSL) or cable Internet provider. Cable tends to out-perform DSL, so the typical consumer has only one true high-speed option. Clearly, these are not optimal market conditions, and, as such, the public and nonprofit sectors have a role to play in improving the delivery of telecommunications.

“The Last Mile” is Actually 4 Problems—2 Technical, 1 Educational, 1 Economic

Physically wiring households and businesses is referred to as “last-mile service.” This process is capital-intensive, so “the last-mile problem” is usually thought of as an economic issue. In reality, the last-mile problem represents four related issues: level of service, technical competency, physical availability of infrastructure, and affordability. Figure 1.1 illustrates.



Figure 1-1. Four Factors in the last-mile problem

Level of Service (LoS)—Is the connection fast enough? The Federal Communications Commission (FCC) targets a minimum of 4/1 Mbps bandwidth for functional Internet usage in 2010 (FCC, 2010b). Data needs are only likely to grow in the future, so this figure is probably a moving target. Communities should plan for bringing in the highest bandwidth feasibly possible, as discussed below.

Why does upstream bandwidth matter?

Most subscribers pay attention to downstream bandwidth, which measures how quickly users can download data from servers. Users often forget about upstream bandwidth, which measures the speed at which data go back out to the network. Tasks like real-time video conferencing, distance learning, and telemedicine require quality upstream bandwidth. Upstream needs will grow as more tasks move to the Cloud.

Technical Competency—Does the end-user know enough about using a computer to make the most of broadband? Seniors are often not technologically sophisticated, and other target community members might wish to use computers but lack training. Fortunately, there a variety of resources for both issues.

Affordability—Research by the Pew Foundation shows that the number one hurdle to broadband adoption by consumers who have access to it is cost (Horrigan, 2009, p7). For the poor, the upfront price of a computer is a frequent deterrent. Many other households cannot justify the monthly expense.

Physical Availability—This is the traditional definition of the last-mile problem. Can a potential user get a connection that offers reasonable speed at an affordable price? However, the mere presence of a good connection does not mean that the community will get the most out of broadband.

How Much Can Broadband Actually Do for Your Community?

In the past 20 years, politicians, technology enthusiasts, and investors have weighed in on the power of the Internet. The rosier and gloomiest scenarios of how the Internet would change life have thus far proven inaccurate. However, broadband does play an important role in shaping the way people interact, conduct business, and become informed.

The Internet can play an instrumental role in community development. Teachers can use the Internet to improve classroom instruction. Senior-center employees have stories of helping seniors discover videos of their favorite oldies on YouTube or immigrants using Skype to connect with relatives back home.

However, in terms of economic development, broadband on its own creates relatively few jobs. Though there are anecdotal cases of cities transformed by broadband, the research so far shows that broadband impacts economic development as part of a broader development strategy that addresses the traditional issues of quality schools, reliable roads, and so on (see, for example, Atasoy, 2011; Brogan, 2009; Van Gaasbeck et al., 2007; and Gillett et al., 2006).

Different Technologies, Different Needs

Delivering service to the last mile is a complex problem. There are no easy solutions. Different sectors and populations of users have different technology needs, and so policymakers should consider what technology the public sector should promote.

Doesn't Wireless Internet Solve the Last-Mile Problem?

Next-generation wireless Internet, known as "4G," offers one solution. The advantage of wireless is that a subscriber could purchase a connection for the home and on the go, and have access to the Internet via a USB modem attached to his/her laptop. The service marketed as 4G is typically one of several competing wireless technologies, such as "LTE," "HSPA+," or "WiMAX." However, no matter the wireless technology used, there are a number of caveats, and wireless Internet should not be considered a panacea.

Currently, CLEAR, the largest retailer of 4G services, offers home and mobile Internet in the Wilmington area but nowhere else in Delaware. CLEAR speeds are roughly comparable to Comcast Cable Internet in the same area. Open Range, another wireless operator, had a similar service footprint, but was much less competitive. Table 1.2 compares the offerings.

Provider	Low Tier	Higher Tier
Comcast	1.5/.384 Mbps @ \$40.95	6/1 Mbps @ \$49.95
CLEAR	1.5/.5 Mbps @ \$35.00	6/1 Mbps @ \$45.00
Open Range	1/.5 Mbps @ \$30.00	1.5-3/1 Mbps @ \$38.95

Table 1-2. Comparison of CLEAR and Open Range to Comcast

Of note, CLEAR's lower tier is only for in-home usage. To fully realize the advantages of wireless Internet (specifically, access anywhere on the go), the user has to purchase the higher tier. Moreover, these prices are for advertised speeds. Outside of CLEAR's 4G service area, the user has to contend with much slower 3G speeds. Under optimal conditions, CLEAR offers users sufficient bandwidth to accomplish basic Internet tasks like sharing photos or watching short video clips online. Additionally, Open Range has recently filed for bankruptcy, rendering its future uncertain (Schrader, 2011).

Satellite Broadband

Satellite broadband is the only option in a few areas of rural Delaware. Satellite providers like Hughes offer low speeds at high prices. For these reasons, planners around the state should not prioritize satellite service.

However, wireless Internet should not be viewed as a major driver of economic development. Data-intensive firms will not relocate to a community that only has wireless Internet available. Moreover, wireless Internet is not a guaranteed fix for the last-mile problem. As with other technologies, providers may not be interested in building out infrastructure in areas with low population density. Currently, CLEAR has not stated publicly when it might expand its 4G network outside of the Wilmington area. Additionally, and perhaps most critically, many wireless-Internet companies have considered creating monthly usage caps. As more routine computer activities move to the Cloud, usage caps create a significant barrier to getting the most out of broadband. Finally, any wireless broadband tower requires high-capacity fiber-optic wiring to connect users to the wider Internet.

To summarize the strengths and weaknesses of wireless broadband:

PRO	CON
Offers users connectivity on the go	Speeds not sufficient to drive economic development.
Higher tier comparable in price and speed to cable	Price may be out of reach for many lower-income households.
May arrive sooner than high-speed cable or fiber	No sign from private providers when they will offer high-speed wireless outside of Wilmington area.

Table 1-3. Strengths and weaknesses of wireless broadband

Digital Subscriber Line (DSL)

From a development standpoint, DSL technologies are the least attractive because they are the slowest and most difficult to upgrade to next-generation speeds. An example is AT&T’s U-Verse, which the company markets as fiber optics but is actually a hybrid fiber-and-DSL network. U-Verse delivers high throughput, but the transition from traditional DSL to hybrid fiber has been expensive and fraught with delays. AT&T has indicated some ambivalence towards expanding U-Verse deployments to areas not already served (Godinez, 2010). Therefore, planners and local administrators across Delaware should not count on high-speed DSL becoming available in the near term. Nevertheless, DSL can meet basic data needs, and Delaware’s seniors, for example, may find DSL sufficient for the exchange photos of grandchildren via email. However, even though DSL allows for basic websurfing today, that may change quickly, as complex websites demand ever more bandwidth.

Cable Internet

Cable Internet offers sufficient capacity to many local nonprofits, smaller businesses, and consumers. Unlike DSL, cable can be upgraded quickly and affordably through the transition to a new technology known as DOCSIS 3. Most major cable vendors already have

plans to upgrade to DOCSIS 3, in which case public-private partnerships and incentives may be useful to accelerate those deployments to end-users. A weakness with cable, however, is that it typically lags in upstream capacity, making it a poor fit for real-time interaction.

Fiber Optics

Businesses, schools, hospitals, and other community anchor institutions (CAIs) stand to benefit most from fiber-optic connections that provide the highest-bandwidth upstream and downstream speeds.

Simply put, quality fiber optics offer the greatest economic and community development opportunity to local governments throughout Delaware. Furthermore, since fiber optics use light to transmit data and nothing travels faster than the speed of light, fiber optics will not soon be displaced by another technology. However, fiber is the most capital-intensive. Verizon offers its FiOS service in Delaware, mostly in New Castle County and in the beach towns.

To get the most out of broadband, local governments should look for any opportunity to promote fiber optics in their communities. Table 4 compares fiber to other technology options and demonstrates the relative strengths and weaknesses of each. Other benefits of fiber and strategies to improve fiber-optic penetration are outlined below.

Technology	Downstream	Upstream	Ideal Fit	Strengths	Weaknesses
Wireless	Low to Med	Low	Home users who do not use upstream bandwidth	Good choice for rural Delaware	Suffers from interference; unknown deployment timeframe
Satellite	Low	Low	Geographically remote locales where no other options exist	Ubiquitous availability	Very uncompetitive prices, low speeds
DSL	Low to Med	Low	Cost-conscious consumers with minimal data needs	Low price, good for non-data-intensive applications	Low speeds; difficult to upgrade
Cable	Med to High	Med	Nonprofits, small businesses, consumers	Good speeds, easily upgraded	Low upstream; price may be out of reach for some
Fiber Optics	High	High	Cities	Best Speeds	High capital cost

Table 1-4. Comparison of broadband technologies.

Public-Sector Involvement in Broadband: Federal, State, and Local

Federal Policy

Compared to most other Western economies, the telecommunications industry in the United States has developed uniquely. In several continental European nations, for example, the government laid the wiring for Internet connections. The public sector, in turn, allows any private providers to buy access wholesale and offer retail service to local customers. Such enhanced competition has lowered price and improved level of service. This arrangement, known as “open access,” allows multiple providers and ensures pro-consumer competition. In contrast, the United States has taken a much more hands-off approach to the diffusion of Internet connections. Research at the Berkman Center for Internet & Society at Harvard University has linked open-access provisions with the high level of service in other developed nations to America’s slide as a broadband leader (Benkler, 2010). As an example, Americans pay more than Swedes and British citizens, whether they are buying high-speed or low-speed service (Losey & Li, 2010). Even at these relatively uncompetitive prices, FCC research notes that the typical American broadband consumer purchases service marketed as 7-8 Mbps download, but typically only realizes 3-4 Mbps in throughput (FCC, 2010a). The Organization for Economic Cooperation and Development (OECD) now ranks the United States, once a global leader in connectedness, the 14th most connected nation (OECD, 2010).

The Obama administration appears dissatisfied with the status quo and, as a part of the American Recovery and Reinvestment Act of 2009 (ARRA or “stimulus”), appropriated \$7.2 billion for broadband. In addition to the various broadband-mapping projects and Broadband Technology Opportunity Program (BTOP) grants, the stimulus called for a National Broadband Plan (NBP).

In March 2010, the FCC released its NBP, with a detailed list of policy objectives to improve broadband penetration and speeds in the United States. The FCC proposed a two-pronged approach, with one set of solutions for areas that will be easier to connect due to existing infrastructure, and one set for areas that are more difficult to connect because of geographic isolation or low income. The twin proposals are, respectively, the “100² initiative” and the “Connect America Fund” (CAF). The 100² initiative aims to connect 100 million households to a 100/50 mbps connection by 2020 (FCC, 2010b). The CAF suggests reforming the Universal Service Fund (USF) that is added to phone bills. The USF money is currently used to connect schools and libraries through the e-Rate program, which supports the Lifeline and Linkup programs that make telephony available to the

impoverished. With legislative authorization, that money could be used to provide computers and Internet connections to those in financial need.

While the NBP has important aims, it includes a number of provisions that depend upon Congressional action. At this time, it is unclear whether the current Congress will find time on the legislative calendar to consider NBP recommendations and, if so, how they would fare. The NBP was met with criticism by several conservative Republicans, who took control of the U.S. House following the 2010 elections. A year after its introduction, the National Broadband Plan has not achieved many of its goals. News headlines have derided the plan as moving “at dial-up speed” (Romm & Krigman, 2011). The FCC itself has stated publicly on two occasions that it is dissatisfied with the speed of the plan’s implementation (Engebretson, 2011). Given the questions surrounding the National Broadband Plan, the best examples to follow may come from the states.

State and Interurban Policy Initiatives

The story of American broadband, however, has not been one of uninterrupted loss of global position. States, municipalities, and nonprofits across the nation have developed innovative solutions to deliver high-speed and reasonably priced telecommunications to underserved markets. In fact, an array of policy tools relevant to Delaware’s situation is available to policy makers and planners, a few of which are discussed below.

Maryland Broadband Cooperative

Just across the border in Maryland, outlying communities across the state from Frederick in Western Maryland to Salisbury at the southern end of the Delmarva Peninsula worked together to create a public-private partnership. The Maryland Broadband Cooperative (MdBC) is a public-private partnership, in that the public sector utilizes local and federal money to install Internet backhaul capacity and private providers to foster economic development. “Backhaul” refers to the connections that link backbone of the network to its periphery.

The MdBC’s emphasis has been on solving the last-mile problem. Public money lays the fiber-optic backbone between communities and main trunk lines, while private providers offer the last-mile service. Twenty-six of the 60 member agencies are Internet service providers that connect individual homes and businesses. The venture has been an effective means of connecting rural locations in Maryland. As a sign of the project’s promise, the federal government awarded the MdBC \$115 million in stimulus funds for broadband (Maryland Broadband Cooperative, 2010).

UTOPIA

In Utah, 16 municipalities around Salt Lake City pooled their resources to install a large fiber-optic loop connecting the cities, forming the Utah Telecommunication Open Infrastructure Agency (UTOPIA). The system is open-access, and more than a dozen providers compete to resell the service to homes and businesses. The competitive marketplace has contained prices, even as consumers purchase some of the highest speed service in the country. UTOPIA succinctly makes this point on their webpage, advertising itself to residents with the pitch that...

Since your community owns the network, you're not dependent on a single service provider — you can choose from UTOPIA's wide variety of service providers to best meet your needs. And since they're competing for your business, you get the best quality and the best services (UTOPIA, n.d.).

Municipal Case Studies

Public, nonprofit provision is another avenue for policymakers to consider. Under this model, the local government, or one of its subsidiaries such as a utility authority, uses public money to provide high-quality service on a not-for-profit basis. Typically, the money is in the form of General Obligation Bonds (GOBs) or Certificates of Participation (COPs). Public provision is appealing for a number of reasons. For one, public networks often serve all neighborhoods within the city and can be a vector for simultaneously promoting economic and community development. Second, as nonprofits, they are motivated by public service, rather than shareholder value. As such, they are either cheaper for end-users or else offer higher level of service at comparable prices. Finally, local networks keep local money in the community.

Nevertheless, public provision is not without risk and in some cases has resulted in financial problems for the municipality if subscribership does not meet projections, as in Burlington, Vt. (Briggs, 2011). Moreover, municipal networks usually face opposition from incumbent for-profit providers, as the administrators of the Philadelphia, Pa., and Lafayette Parish, La., networks found out. In Pennsylvania, lobbyists for the telecommunications industry quickly shepherded a *de facto* ban on any further community networks following Philadelphia's wireless initiative (Blevins, 2009). In Louisiana, despite residents voting in 2005 to create a fiber network, incumbent provider BellSouth (now AT&T) took the parish government to court to have the vote overturned on technical grounds. After several rounds of legal challenges and re-votes, service became operational in early 2009 (Perlman, 2009).

Bristol Optinet

An example of a municipal broadband success story comes from rural southwestern Virginia. Bristol, a city that had watched its coal-mining economy decline in recent years, had been operating a fiber-optic network for internal data-management purposes. Administrators began to hear from residents who wanted access to high-speed and reliable data, so the network was made available to businesses and households. Optinet has been central to the city's economic-development strategy and has helped lure major defense contractors to the area (The Economist, 2009). It now occupies a 62 percent market share and has been such a success that the National Broadband Plan even makes explicit mention of it and suggests that federal policymakers consider local municipally operated networks as a viable policy tool (FCC, 2010b, p. 153).

Neighboring communities have also benefited. In addition to the aerospace jobs that quality information infrastructure recruited, Bristol and surrounding counties won \$28 million in state and federal funding to expand Optinet's fiber-optic backbone across the region (BVU, 2010).

An unforeseen benefit to the city from Optinet has been in consulting with other local governments on managing their own municipal networks. The towns of Davidson and Mooresville, N.C., contracted until recently with Bristol for the management of their own network—MI-Connection (Marusak, 2010).

Wilson Greenlight

Wilson is a community of 50,000 an hour east of the bustling Triangle region of North Carolina. Like Bristol, Wilson has seen its bedrock industries of tobacco and textiles falter and, in an effort to reinvigorate the city, created a municipal fiber-optic network in 2008. City elders modeled their Greenlight network on Optinet. As in other cases, it has proven controversial, and the telecommunications industry has sought legislation restricting municipal broadband on four occasions since the city first contemplated Greenlight.

Speeds start at 10/10Mbps symmetric (City of Wilson, n.d.). This bandwidth is much higher than either of the incumbent providers, and the upstream capacity is notable. Upstream bandwidth is crucial for real-time teleconferencing, distance learning, telecommuting, and other next-generation Web applications. The competition has also increased its speeds to retain customers, and has been much slower to raise prices in Wilson than in surrounding areas with less competition. Presently, Greenlight's 150/150 Mbps service tier offers the highest speed in the state (Moore, 2011). Already, Wilson has reports of families moving to the city just to have access to higher broadband speeds (Bowman, 2011).

Despite legislative challenges, Greenlight has been a tremendous success. Around 5,700 members have signed up, beating their three-year, 30 percent market-penetration goals, and the service is making an operating at a profit years ahead of schedule (Moore, 2010a, 2010b, 2011). Reflecting on Greenlight, Wilson city manager Grant Goings stated, “Well, you can’t talk about jobs without talking about the infrastructure that brings them and keeps them. Short and simple—advanced broadband is critical infrastructure” (Moore, 2011).

Chattanooga EPB

In another high-profile municipal network, the Chattanooga Electric Power Board (Chattanooga EPB) in Chattanooga, Tenn., operates a network that currently delivers the fastest available speeds in the country. The municipal utility offers packages of service up to 1 Gbps for residents and businesses. Chattanooga EPB, as a wing of the local electric utility, also allows customers to use smart-grid technologies, which hold significant environmental and economic advantages.

A network that fast has allowed the city to position itself as an enclave for biomedical research (Bregel, 2011). The EPB is an information infrastructure so powerful that it allows Chattanooga to compete directly with North Carolina’s Research Triangle Park and Cambridge, Mass., for high-quality biotech jobs.

Picking the Right Approach

Policy must meet local needs, and a single approach would not work in Delaware statewide. Specifically, in lower-income urban areas, broadband may be available, but unaffordable. In these areas, the Lifeline and Linkup programs may provide a useful model for improving broadband uptake in poorer areas of Delaware by offering low-income citizens vouchers with which to purchase computer equipment and a broadband Internet connection. Planners should not overlook cost; it is one of the most common reasons why consumers choose not to purchase broadband even when it is available (Smith, 2010).

To reiterate, different users have different needs, and a community may have sufficient wireless coverage for its home consumers but insufficient cable for its small businesses. In these cases, local administrators should look for creative ways to match policy tools with technology needs. The best technology to pursue depends on the policy goals. This section includes an overview of broadband strategy considerations. An in-depth discussion of broadband planning is available in Appendix 1, complete with broadband case studies drawn from across the state.

Aligning Goals, Technology, and Policy

A critical decision for local planners is goal-setting. This section outlines some strategies for improving broadband, depending on the planner’s goal.

Livability

If the aim is to enhance livability by offering a functional broadband connection for home users, then a public-private partnership with a wireless company may work well. The following table outlines the major issues involved in creating a wireless public-private partnership, from the perspective of consumers and providers.

Stakeholder	Potential Issue	Action Item
Consumers	Price	Offer broadband vouchers.
	Reliability	Incentivize reliable service with provider.
Provider	Unsure about ROI in a small or low-income community	Lure providers with financial incentives.

Table 1-5. A public-private partnership for wireless broadband

Job Creation

Research and design and logistics firms process large amounts of data. Data centers have proven to be a crucial generator of high-paying jobs in rural areas across the Southeast, but managers will not move to a location with low data capacity. Even agricultural operations constantly process weather and price information, which require a reliable Internet connection. To tap into the economic-development potential of the Internet, planners must focus on improving fiber-optic connections in their community. Again, even if the community focuses on wireless technology in their broadband plan, wireless towers require fiber-optic connections, so fiber cannot be ignored in any case.

As previously stated, fiber is capital-intensive, and the private sector has been slow to provide it. There are three major strategies for improving fiber optics: incentives, public-private cooperative, and public provision.

Incentives

The state should consider tax credits for capital investment to spur the expansion of quality connections. Local governments can waive the property taxes on rights-of-way dedicated to broadband infrastructure.

Public-Private Cooperative

Closely situated small- and medium-sized towns may consider a cooperative fiber installation in the model of UTOPIA. The municipalities would undertake the installation of a fiber ring among the communities that would link CAIs, major employers, and (ideally) households. Private providers could then compete to provide the service and support to subscribers. This model would be ideal for places such as Middletown, Odessa, and Townsend. In municipalities situated along the Maryland border, finding innovative ways to partner with the Maryland Broadband Cooperative should be a priority. The cooperative ensures competition and spreads the risk of the capital expenditure while avoiding many of the political complications associated with public provision.

Public Provision

Public provision is a “high-risk, high-reward” option. The communities involved must borrow substantial funds and then take on the day-to-day operation of a fiber-optic network. Typically, private providers object vociferously and mount legal challenges. Nevertheless, in many smaller towns the private sector may not be inclined, even with incentives, to offer state-of-the-art connections.

Public provision has its own advantages. Research shows that public provision is a substantial driver of economic growth (Ford & Koutsky, 2005; Kelley, 2004). The community captures more of that prosperity—and revenue—when it owns the network. Finally, local governments are already paying for data, and operating their own networks may be more cost-efficient.

Blending Jobs and Community Development

A hybrid option is also available. Planners can work with a wireless provider to bring basic service to households while simultaneously building a cooperative fiber ring for businesses and CAIs.

Concluding Thoughts

Finding the right balance of public-, private-, and nonprofit-sector involvement is no simple task. Yet it is a crucial task, as the state of Delaware’s economic competitiveness rests on the quality of its informational infrastructure. From the classrooms that are training our next generation of entrepreneurs to the farmers who need weather and price information, reliable and quality access to data is a necessary component of any economic-development strategy. In a global age, the state’s competition comes not just from its neighbors but from around the world. Several developed nations already have national broadband plans,

many of which set much more ambitious goals. Australia also has plans for a nationwide fiber-optic network. South Korea plans to achieve 2Gbps nationwide by 2012 (Falch & Henten, 2010). Delaware communities do not have the luxury of time to deliberate over whether the public sector has a role to play in information services provision. Yet, with adequate planning and public investment, Delaware can assure its success in the technologically driven economies of the future.

Chapter 2: Factors Affecting the Adoption of Broadband in Delaware

Introduction

It is beyond question that access to the resources and information available through the Internet plays a major role in the degree to which people are empowered both economically and politically. The “digital divide” between those who are highly connected through this world-wide network and those who are not mirrors that between the wealthy, educated, upwardly mobile sectors of society and those who are disadvantaged and isolated from the mainstream economy.

Overall, Delaware has one of the highest Internet connection speeds (Akamai, 2011); however, the provision of broadband service varies greatly by geographic location within the state. In particular, more rural and economically disadvantaged areas often only have access to much slower and less robust connectivity. Barriers in some cases exist due to economic or cultural conditions, in others due to physical isolation or business strategy decisions on the part of providers. Some areas, especially in the more rural southern part of the state do not have access to the levels of service enjoyed in the more highly connected urban locations. This urban-rural Internet gap has been noted in the literature (LaRose et al., 2007), as has the “digital divide” based on economic or other demographic factors (see, for example, FCC, 2009).

The question of the use, availability, and viability of Internet usage is multi-layered, related not only to the technical aspects of physical connectedness (for instance, whether through cable, telephone lines, fiber-optic cable, or wireless signals), but also to socio-economic, demographic, and geographic factors. Making the distribution and adoption of broadband access more universal, across a larger cross-section of the population will go far in helping to bridge the “digital divide.”

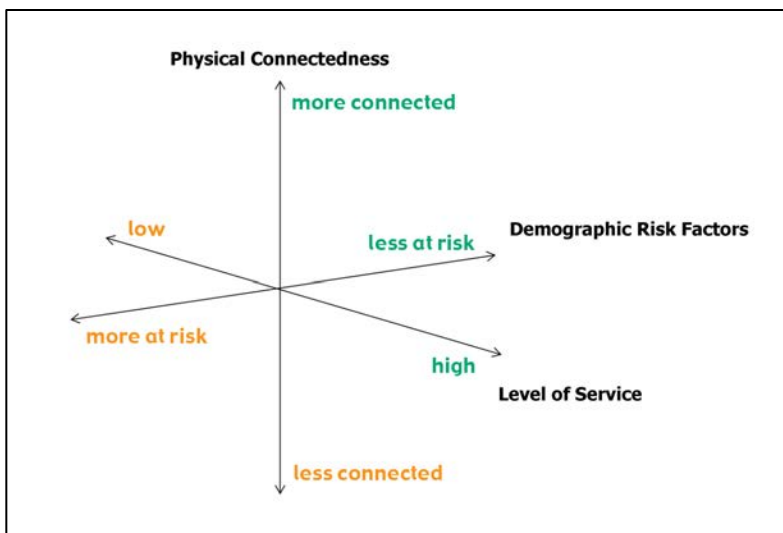


Figure 2-1. Schematic representation of the factors used to determine barriers to broadband adoption in Delaware

The spatial analysis developed in this document seeks to quantify and make spatially explicit the factors that encourage or work against wider adoption of high-speed Internet access. The analysis combines a wide variety of spatial information to identify the expected viability of broadband adoption in Delaware based on three factors—physical, demographic, and economic. The three separate and independent categories are:

- **Physical Connectedness**—how physically connected a location is to existing infrastructure, population centers, or projected growth areas
- **Demographic Risk Factors**—how at-risk an area is to lack of adoption of broadband technologies, based on characteristics such as age, education level, income, etc.
- **Level of Service**—the degree to which broadband is available, affordable, and of sufficient speed to enable a population to take full advantage of Internet-based resources

See Figure 2.1 on the previous page for a schematic representation of the factors affecting broadband adoption as defined in the *Planning Tool*. Each measure is largely independent of the others, and together they form a picture of the degree to which broadband adoption is facilitated or deterred. Areas in the state are ranked on a relative scale into one of eight levels based on the combination of factors within each set. The rankings do not seek to quantify a precise prediction of broadband adoption rates in a particular area but to

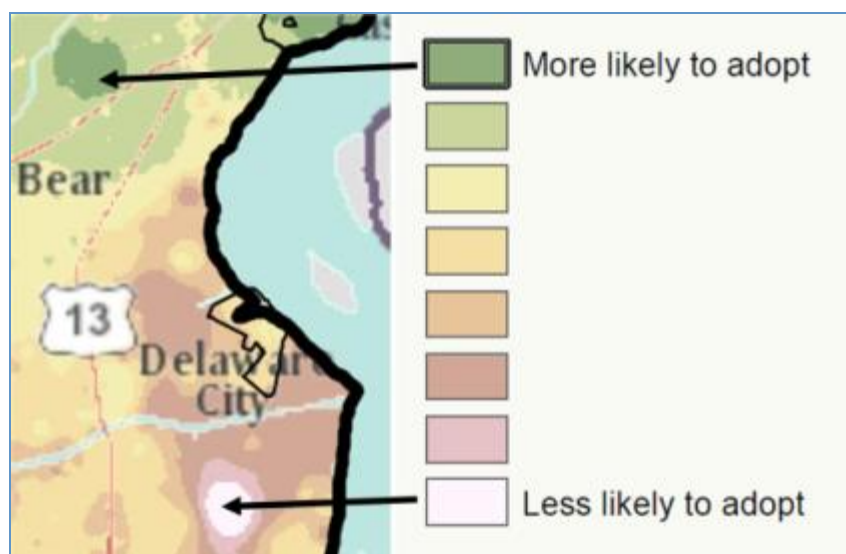


Figure 2-2. Representative map detail showing the relative scale of the likelihood of broadband adoption based on factors related to level of service provision

broadly indicate where, based on independent factors, there is a greater or lesser likelihood. Figure 2.2 indicates the relative scale showing representative areas on the map where both high and low levels of Internet service exist.

Depending on the scores within each category, the preferred strategy to address the problem of the digital divide will vary. For

instance, subsidized access or investment in CAIs providing high-speed Web access might be most appropriate in areas where there is a great deal of provision of service, but low adoption rates due to demographic factors.

Factors Relating to the Adoption of Broadband

Physical Connectedness

The degree of physical connectedness is expressed as an impedance, or resistance to overcoming a barrier of distance to a given feature representing a certain level of connectedness. Examples of connectedness relate to physical infrastructure, utilities, and planned growth areas; the farther one is from such features or regions, the more difficult or unlikely interaction will be. For instance, CAIs, which offer public access to high-speed Internet, are most likely to be used by those closest to them. The likelihood of someone using the facility is assumed to decrease with increased travel distance to that facility. The notion of a “distance decay” in the interaction between actors correlates with the physical model of gravity. William J. Reilly (1931) extended the idea of gravity to interactions between trade centers and potential customers. Modified for this project, the distance-decay function can be stated as:

$$I = \frac{1}{1 + (\frac{1}{d})^p}$$

Where:

I = impedance, with zero indicating no impedance, and 1 indicating infinite impedance

d = distance (e.g., in kilometers), from the feature or facility

p = power term, indicating the degree of resistance for each unit distance from the feature or facility

With the power term, *p*, set to 1, this equation simplifies to:

$$I = \frac{d}{d+1}$$

Figure 2.3 illustrates the relationship between the distance (in kilometers) and the impedance to broadband adoption, according to this model. All of the inputs related to Physical Connectedness use this general equation to determine resistance or impedance based on distance, except the measure of road density, which is based on the size of traffic analysis–zone units.

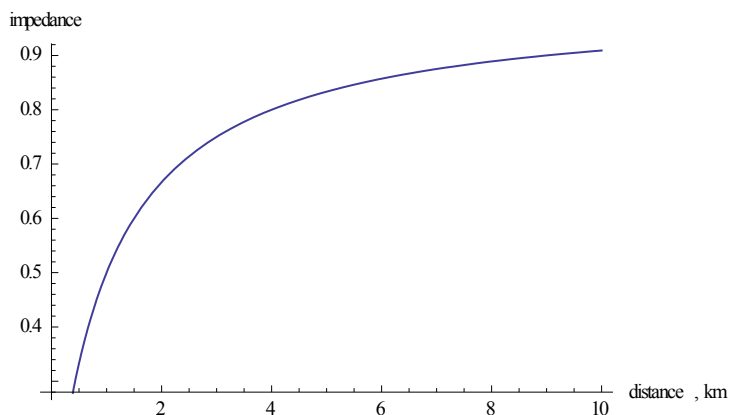


Figure 2-3. Relationship between distance and resistance to broadband adoption

To derive this measure, a spatial-data layer representing the physical distance (in kilometers) of each location in the state to the input facility or feature is generated and then used to calculate the impedance figure. Impedance, or resistance due to separation by distance, is considered to be zero at or within the feature (or a designated buffer around the feature). For instance, in the case of CAIs, impedance is zero at the site of the institution, increasing as a function of distance to it. For areal features (such as municipal boundaries), impedance is considered to be zero within the boundaries, increasing as a function of distance away from those boundaries.

To determine an overall score for impedance, a summation of all input impedances, divided by the total possible impedance, is used. Based on the final score, each location is categorized based on threshold values into several discrete levels. Map A1 in Appendix 1 illustrates the level of connectedness summarized for the nine input factors, symbolized by different colors for each of the eight levels. The levels shown on the map were established using the Jenks Natural Breaks Classification method.

Connectedness Data Layers

Municipal Boundaries

Based on the current municipal boundaries, impedance is calculated as a function of the square of the distance to any given municipality, with areas within the municipality having zero impedance (i.e., a high level of connectedness).

Growth and Annexation Area

Areas of future growth are identified in each town's comprehensive plan. Within these areas, impedance is calculated to be identical to the impedance from the nearest municipal boundary. Outside each growth area, the impedance is the lesser of either the impedance calculated for municipal boundaries or the impedance calculated as function of distance to the annexation zone.

County Growth Zones

Each county has determined areas in which growth is to be encouraged. Impedance will increase with distance outside these zones, as noted above.

Access to DART Routes

Using a buffer of $\frac{3}{4}$ miles around a DART bus route, which correlates to the distance people can comfortably walk in 15 minutes, the barrier to access to public transportation is calculated based on distance beyond this limit.

Sewer and Water Districts

Public sewer and water districts are powerful factors in focusing where people settle and, therefore, correlate to overall connectedness. Water and sewer areas are based on current Certificates of Public Convenience and Necessity (CPCNs) and other service-area boundaries. Impedance is based on proximity to these existing areas of sewer provision and public water availability.

Community Anchor Institution (CAI)

Distance from existing, identified CAIs has a direct impact on the ability of people without broadband service at home to access the Internet. Impedance increases based on distance from the CAI.

Road Density

Road density is used to characterize locations based on their overall level of road infrastructure. The more physically connected within a road network, the more likely that a location will have access to other infrastructure such as broadband. Instead of using the gravity model, a scoring system based on the measured area of Modified Grid polygons is used as a proxy for road density. Modified Grid geographic units (similar to Traffic Analysis Zones) are ranked based on size and placed into one of four density categories.

Distance to Major Road Arteries

Based on DelDOT's layer of major arteries in Delaware, which include interstates, federal routes, and numbered state routes, a $\frac{1}{4}$ mile buffer will be established. Impedance will be determined based on distance from this buffer.

Urban Areas

The U.S. Census (2000) identifies areas of urbanization (defined as "Urban Areas" or "Urban Clusters"), which include census blocks with a density of 1,000 people per square mile or more, plus adjacent blocks with a density of 500 people per square mile

or more. Impedance is calculated based on distance from these defined urbanized areas.

Demographics

Many demographic factors of a population correlate with the adoption of broadband, independent of the level of infrastructure or its provision in an area. While research on the topic is still fairly young—broadband adoption in the home has only become widespread in the last 10 to 15 years—several studies indicate that demographic factors including age, income, educational level, and ethnicity have an effect on the rates of broadband adoption (Aron and Burnstein, 2003; LaRose et al., 2007; FCC, 2009).

The approach here uses demographic data from the U.S. Census Bureau and other sources to rank certain factors based on the degree to which it is expected that they will constitute a systemic barrier to broadband adoption. Geographic and demographic data were compiled at the smallest physical area available. Centroids (points corresponding to the center of gravity) for each geographic unit (Census tract or Census block) were generated, and rankings assigned to each point. The impedance (i.e., degree to which the demographic factor is a barrier to adoption of broadband) was calculated on a scale of 0 (no impedance) to 1 (highest impedance), for each point, based on the demographic parameter (e.g., median household income of the population). A raster surface, representing impedance values for areas across the state, was then calculated by interpolating values from the centroids. In general the function to determine impedance was:

$I = (1 - f^p)$, for characteristics where impedance decreases with rank value (Figure 2.4a) and

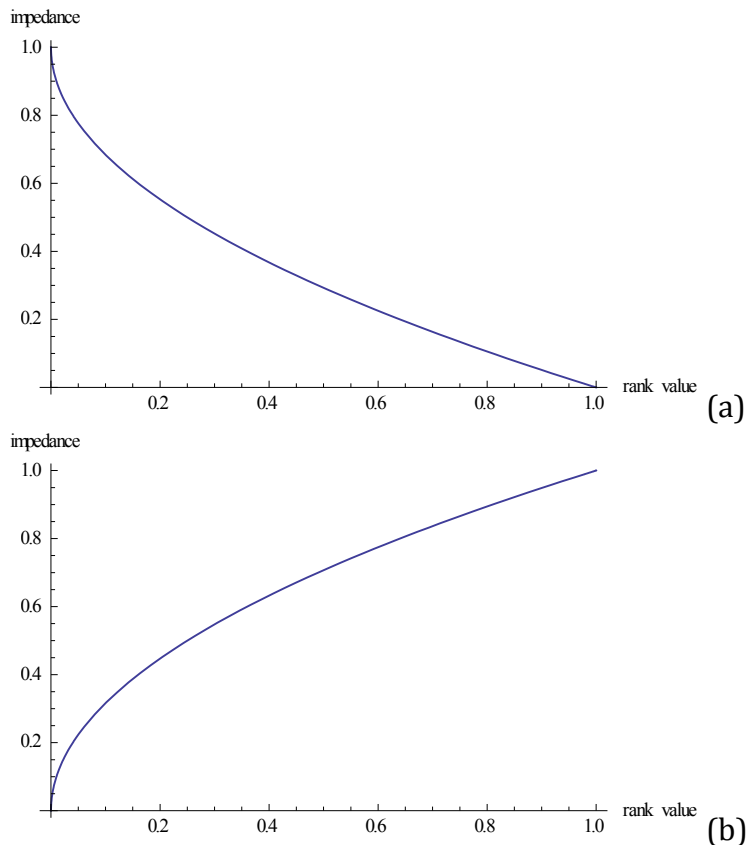
$I = (f^p)$, for characteristics where impedance increases with rank value (Figure 2.4b)

Where:

I = impedance, with zero indicating no impedance and 1 indicating infinite impedance

f = demographic factor, on a scale of 0 to 1; based on highest and lowest values of the population value

p = power term; determines the relationship between the factor and impedance to adoption (set to 0.5).



Figures 2-4a and 2-4b. Relationship of scaled demographic factor (x-axis) to impedance to broadband adoption (y-axis)

To derive a final value for overall demographic factors, impedances were summed and divided by the total potential impedance. Map A2 in Appendix A depicts a map of the level of resistance to broadband adoption based on demographic factors.

Demographic Data Layers

Median Household Income

Using U.S. Census American Community Service (ACS) data for 2005-2009, at the Census tract level, an index value scaled between 0 and 1 based on the range of median household income in Delaware is calculated. The higher the income in a tract, the lower the impedance to adoption of broadband.

Age 65 and Older

Since research shows that rates of broadband adoption peak with those in early adulthood and falls off considerably with age, the percentage of the population of age 65 and above Census tracts is determined using ACS data for 2005-2009.

College Degree

Census tracts are categorized based on percentage of the population age 25 and older with a college degree (based on the ACS). Based on the ranked value of educational attainment, the impedance for each tract is determined, with impedance decreasing with higher percentages of college graduates.

Vehicle Ownership

Access to a vehicle is considered a determinant in an individual's ability to use broadband at CAIs or other providers of access. Based on the percentage of households in a Census tract owning at least one personal vehicle (based on the ACS), impedance is determined, with higher impedance ascribed to areas with lower rates of vehicle ownership.

Percentage Minority

Since broadband adoption tends to be lower in areas with higher proportions of minorities, the percentage of non-white minorities are used as a risk factor for low broadband adoption rates. U.S. Census data for the 2010 Decennial Census is used to summarize information at the Census Block level, and impedance is calculated based on the ranking of minority percentage.

Population Density

Population density indicates areas of higher levels of urbanization and thus connectedness to existing infrastructure. Broadband providers are more likely to develop broadband infrastructure in areas with a large potential customer base, as well as areas close to existing connectivity. Impedance is determined based on calculated population density, with higher values associated with less densely populated Census blocks.

Level of Service

Based on research conducted by DTI and its subcontractors, existing provision of broadband was assessed, and a series of parameters was developed indicating the level of service. By quantifying the degree of broadband connectivity in an area, gaps in the level of service provision can be identified. Considerations to determine level of service include geographic extent of broadband by commercial or other providers, classification based on the highest advertised speed of service, number of available technologies, number of competing providers within an area, and cost of service based on a download rate per unit price. Statistics on actual rates of adoption within a Census unit would be an informative metric, which could indicate with a high degree of certainty the actual level of adoption; however, such data from the provider community have not been reported at a sufficient

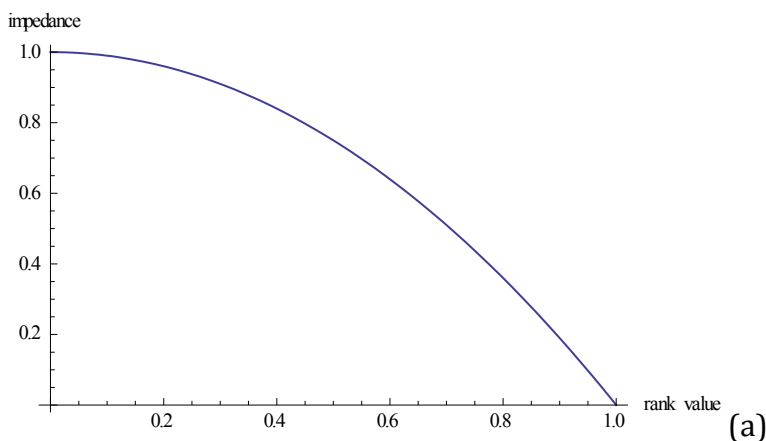
level of detail to be useful. It should be recognized that the Planning Tool’s ability to accurately evaluate the level of broadband service across the state is affected by data-collection methods as well as data gaps due to contractual limitations such as non-disclosure agreements.

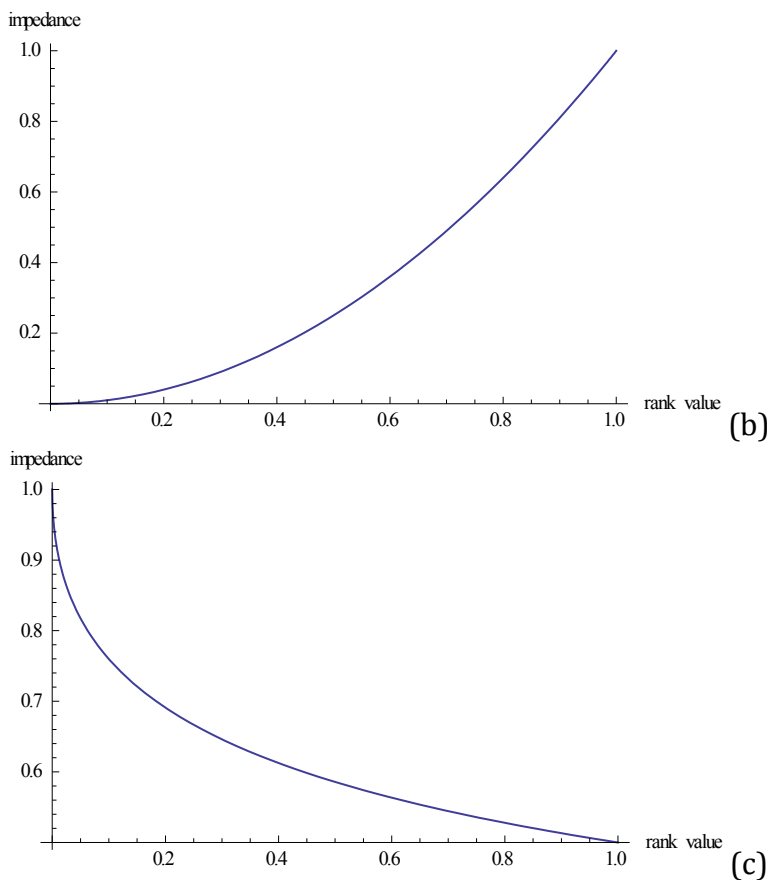
As with the demographic factors, level-of-service factors are first ranked on a scale of 0 to 1, and impedance to broadband adoption is calculated from this. Centroids for Census blocks are used as the basis for interpolating a surface representing the impedance. The functions for determining impedance are given by (subsequent references to these functions will be referenced by the letter in parentheses):

- $I = (1 - f^2)$, for characteristics where impedance decreases with rank value (Figure 2.5a) (a)
- $I = (f^2)$, for characteristics where impedance increases with rank value (Figure 2.5b). (b)
- $I = (1/(1 + f^{0.5}))$, for characteristics where impedance decreases with rank value (Figure 2.5c). (c)

Where:

- I = impedance, with zero indicating no impedance and 1 indicating infinite impedance
- f = level of service factor, on a scale of 0 to 1; based on highest and lowest values of the range of values





Figures 2-5a, 2-5b, and 2-5c. Functions employed to determine impedance. Impedance is calculated for each Census block centroid, and a statewide data layer is generated by interpolating these points.

Block-level data analysis included GIS processing to calculate the metric from fields in the tabular data. Areas in which service was not available were given a metric value of 0. A final layer of impedance to broadband adoption was generated, using the same methods as described in the sections above. Map A3 in Appendix A depicts a map of the level of resistance to broadband adoption based on level-of-service factors.

Level-of-Service Data Layers

Maximum Download Speed Available

Based on provider-reported maximum download speed within a Census block. Missing blocks were not included in the analysis. Impedance was calculated based on function (a), previous page.

Cost per Unit Download Speed

Based on provider-reported maximum download speed and representative cost of service type as reported by DTI documentation, the lowest available cost per megabit per second (Mbps) download speed is determined for each Census block. Generally,

this measure is lowest for the fastest and most costly service. This speed is ranked on a scale of 0 to 1, and impedance calculated according to formula (b), page 26. See Table 1 for a list of technologies with representative speeds and costs of service.

Numbers of Broadband Providers

The list of unique providers for each block were totaled and used to generate the interpolated surface based on function (c), page 26.

Number of Technologies Available

The list of unique technologies for each block were totaled and used to generate the interpolated surface based on function (c). Technologies were divided into four types: DSL (asymmetric and symmetric DSL were considered as a single technology for this analysis), copper wire, cable, and fiber optic.

Distance to Middle-Mile Point

Middle-mile points are facilities that link a provider's core network to the local loops that connect to local service areas. Distance to these locations was used as a proxy to determine how removed a location is from the core Internet "backbone" (see impedance calculation function from the section on Physical Connectedness, page 20).

Technology	Speed	Cost Per Mo.	Cost Per Mbps*
aDSL	768 kbs - 1.5 mbs	20	13.33
aDSL	1.5 mbs - 3 mbs	30	10.00
aDSL	3 mbs - 6 mbs	40	6.66
aDSL	6 mbs - 10 mbs	40	4.00
aDSL	10 mbs - 25 mbs	40	1.60
sDSL	768 kbs - 1.5 mbs	20	13.33
sDSL	1.5 mbs - 3 mbs	30	10.00
sDSL	3 mbs - 6 mbs	40	6.66
copper wire	768kbs - 1.5mbs	41	27.33
copper wire	1.5 mbs - 3 mbs	30	10.00
copper wire	3 mbs - 6 mbs	45	7.50
copper wire	6 mbs - 10 mbs	60	6.00
copper wire	10 mbs - 25 mbs	70	2.80
cable	10 mbs - 25 mbs	70	2.80
cable	50 mbs - 100 mbs	115	1.15
cable	50 mbs - 100 mbs	115	1.15
fiber	> 1 gbs	200	0.20
fiber	50 mbs - 100 mbs	150	1.50

Table 2-6. Technologies used and representative speed and cost of service, per month and per megabit per second *approximate

Validation

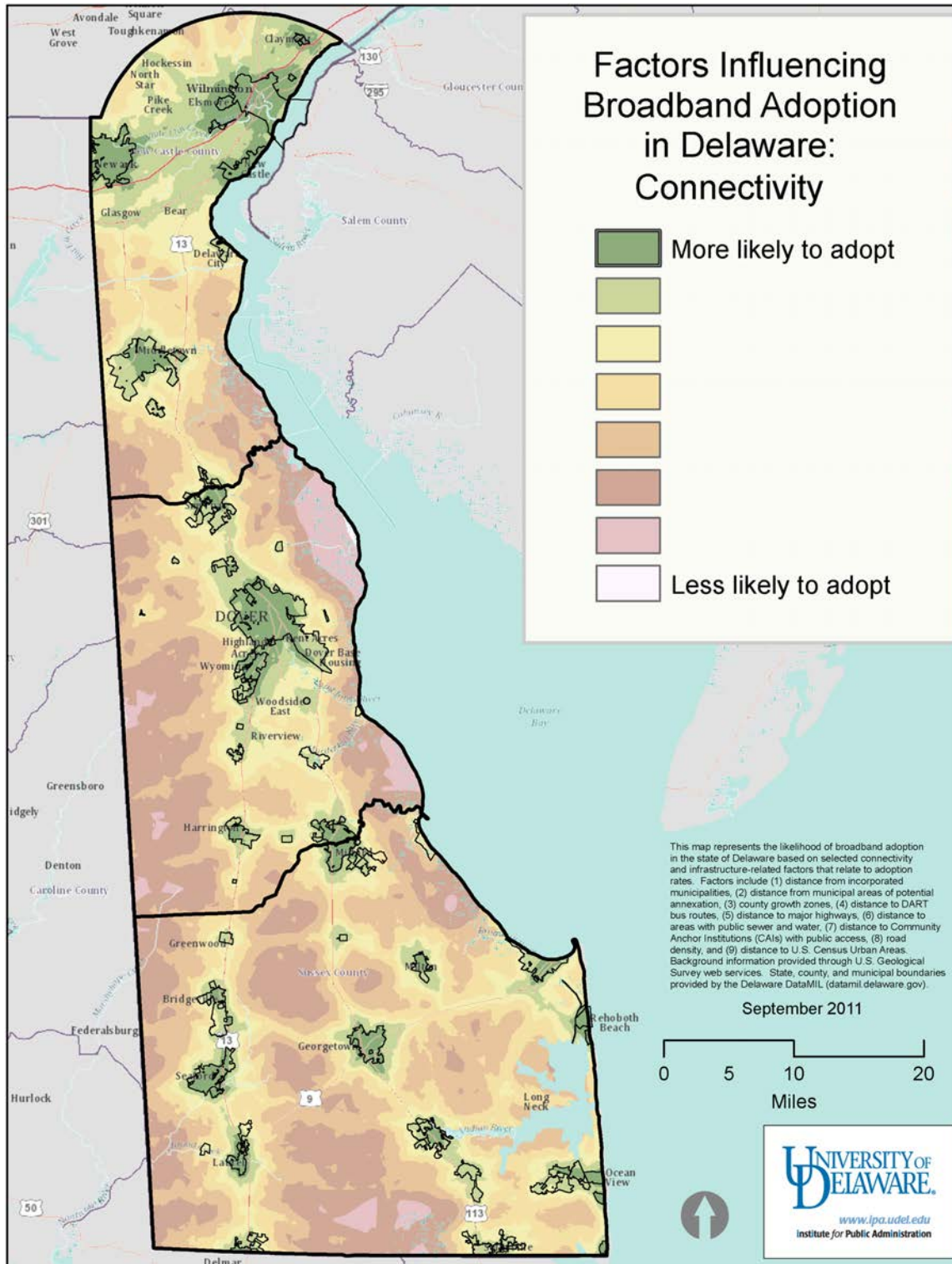
It is intended that this analysis be presented to broadband planning groups organized by the Institute for Public Administration (IPA) for feedback and to determine whether the factors affecting broadband paint a realistic picture of the situation on the ground. IPA has convened three working groups, including members from the agricultural community, the private business sector, and the governmental and public service sector. Feedback will also be sought from interested members of the broadband planning and provision community beyond the three working groups. In particular, it is anticipated that more refined estimates of the various factors affecting broadband adoption might be developed by refining the threshold values and developing specific definitions for each of the discrete levels.

Appendices

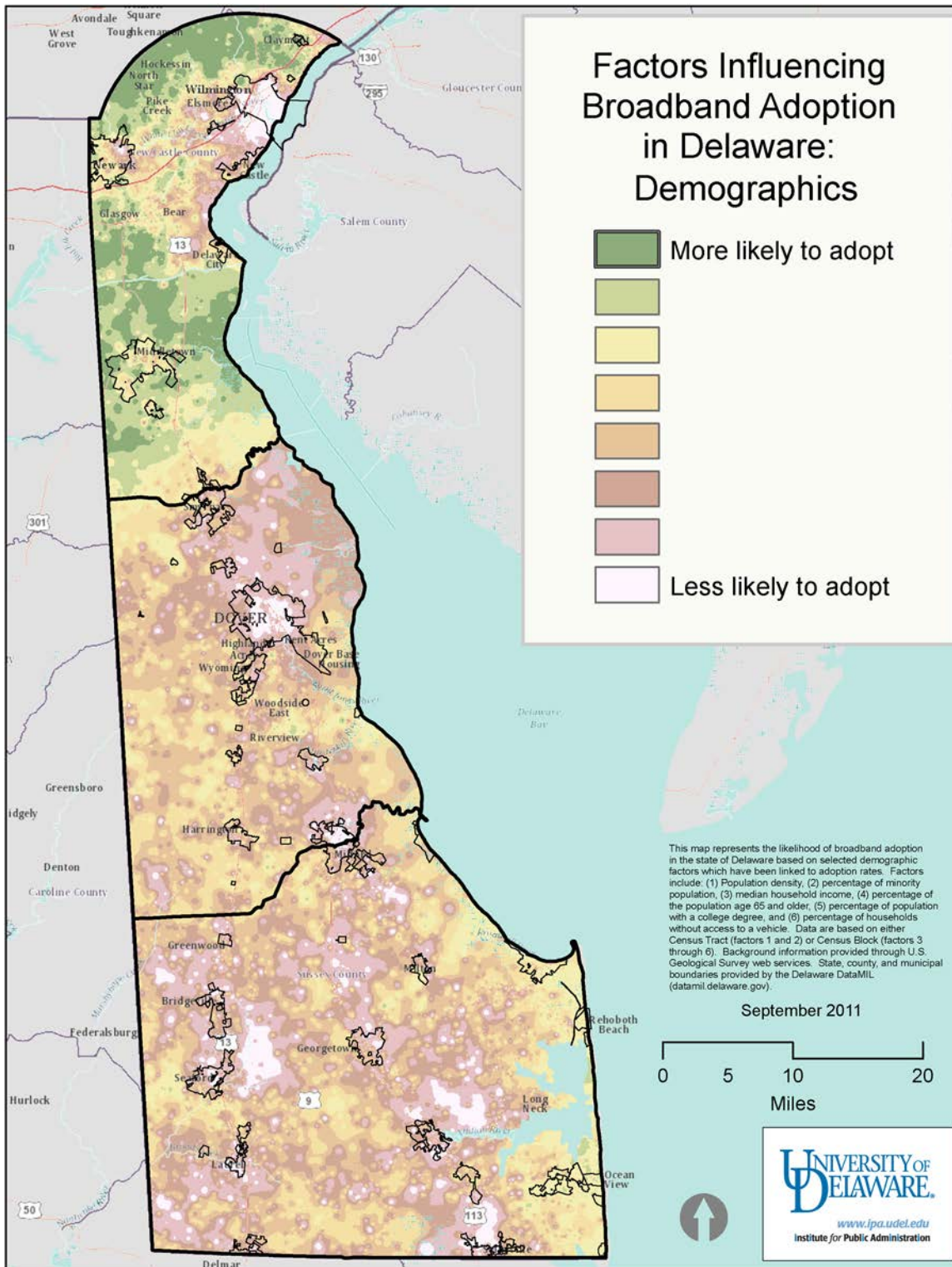
Appendices follow on the next several pages.

Appendix 1: Final Maps Showing Predicted Likelihood of Broadband Adoption

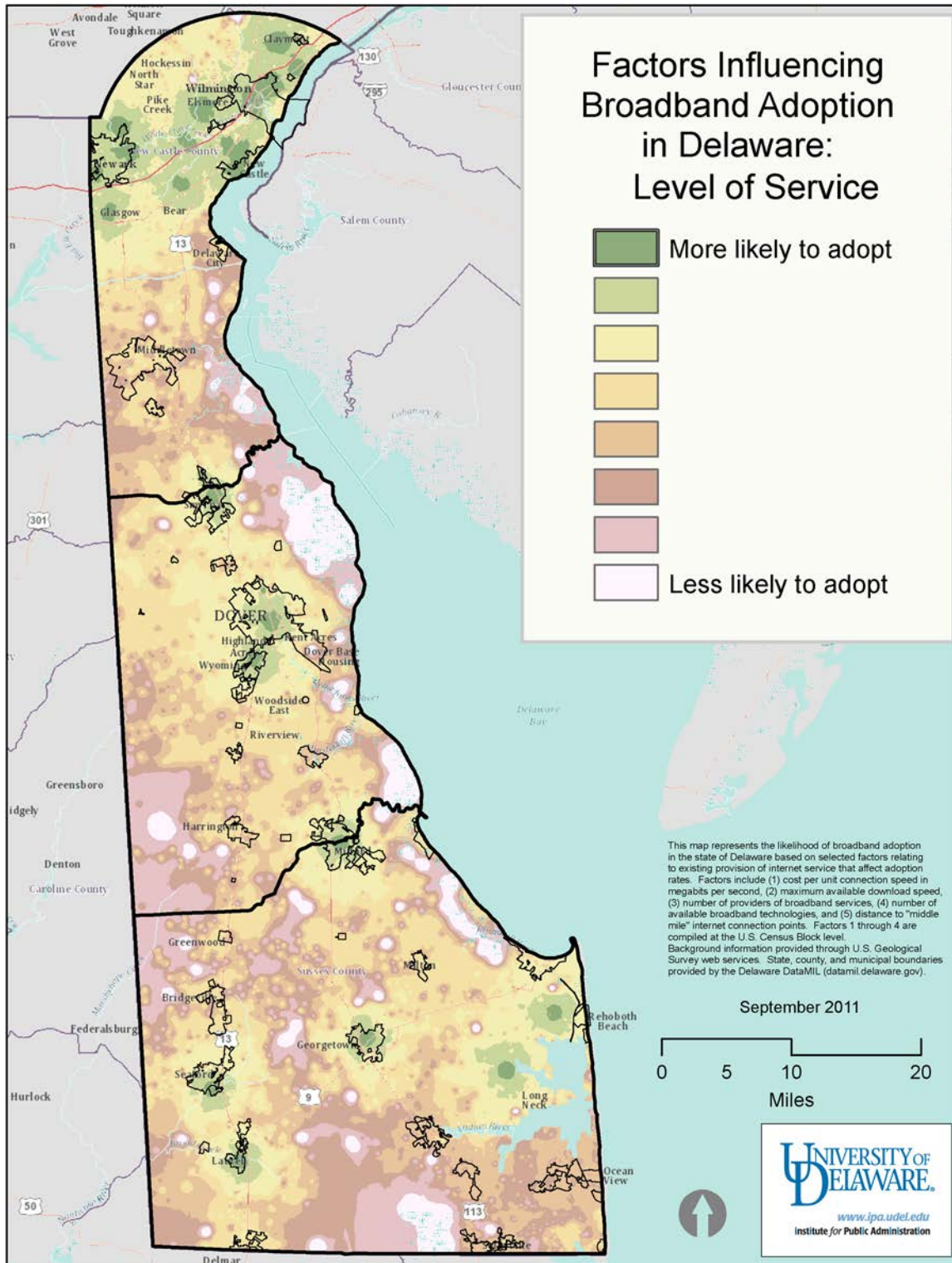
Map A1 - Physical Connectedness



Map A2 - Demographic Factors



Map A3 - Level of Service



Appendix 2: Using the Planning Tool—Case Studies

Introduction

Typically, it has been difficult to directly quantify the precise level of broadband adoption due to the cost of conducting surveys and the reluctance of private providers to furnish detailed business data. The present method of quantifying the likelihood of broadband adoption in an area of Delaware uses indirect factors such as connectedness, demographics, and the level of service available to infer the barriers to this adoption. Such inferred adoption barriers are supported by studies nationwide. Since the American Recovery and Reinvestment Act of 2009 (ARRA), there has also been an increased level of funding for, and awareness of, the needs of underserved sectors of the population and geographic areas. The first issue to address is to find out where broadband access and/or adoption is lacking and to then address the causes of this deficiency.

The spatial analysis developed in this *Planning Tool* is an attempt to identify geographic areas where physical and social barriers are most likely affecting adoption rates. This section presents some scenarios for addressing these needs in areas across the state, in which various challenges and solutions might apply. Three distinct user groups have been identified—the business community (particularly small businesses), the governmental sector, and the agricultural community. Each of these has a distinct geographic location, constituency, and needs or issues of concern. Likewise, based on the mapping conducted for the *Planning Tool*, it is evident that different areas of the state have widely differing challenges to adoption of broadband. By understanding the needs of the constituent population in an area, based on physical and social factors affecting adoption rates, a series of broad recommendations have been developed to meet each area's unique set of needs.

Nationwide, the percentage of households *without* access to high-speed Internet is relatively low, depending on what measurements are used. For example, in 2009 the percentage of households with access to high speed (>4Mbps download speed) was between 85 and 90 percent (Elliot, 2010). Adoption rates, however, differ widely, depending on the sector of the population is considered and where those people live. Minorities, the elderly, less-educated populations, and those in rural areas have lower adoption rates, even where there is availability (Horrigan, 2009). The issue of differential access and barriers to access typically becomes an issue for Delaware, in areas outside the metropolitan corridor (the northern portion of New Castle County in Delaware), and in areas whose population is less prone to make use of available technology due to economic, social, or demographic factors. The following section lays out some broad strategies that have been used to bridge these gaps in areas across the country. Next, several scenarios

are presented for various areas within the state of Delaware that face distinct challenges based on imputed factors highlighted by the *Planning Tool* maps (see Appendix A). Then, potential strategies to address the shortcomings at each location are discussed.

Strategies

The following present some broad strategies employed in areas around the country, as identified by Mix et al. (2009). There is some overlap among these approaches, and it is unlikely that a single solution will be applicable in all areas and at all geographic scales. Some combination of these approaches is likely to be appropriate in Delaware.

Status Quo

The *status quo* entails no further expenditure or planning efforts to boost implementation and adoption of broadband. This approach relies on existing and future private provision of both the infrastructure required to implement broadband connectivity, as well as the provision of the service itself. This has traditionally been the model for most areas of the country (and in Delaware), and has resulted in a fairly complete level of coverage at reasonably high speeds and reliability. The main drawback is a resulting divide in the coverage into areas of “haves” and “have-nots.” In areas of high demand, this is an efficient method for quickly building broadband penetration. If, however, the business case is not favorable for provision at a given location, infrastructure will not be extended there. Likewise if there is not demand in an area due to economic, social, or demographic factors, providers will not be likely to provide service without further incentives.

Aggregation of Demand

Aggregation of demand is a strategy that seeks to establish a process by which the level of demand in an area can be brought to a level that will be considered profitable by the providers. This process begins by developing an education and outreach effort to inform the population of the potential in and benefits of access to broadband. Organizations such as chambers of commerce, governments, and citizen-action groups could help providers see the business case for extending service. The next step is assuring that technical assistance is available, both to advise on technologies appropriate for provision of service and to coordinate efforts among private, nonprofit, and governmental sectors. Ongoing coordination and building of a community of stakeholders is essential to ensure that implementation is carried out successfully.

Broadband Cooperatives

A strategy that has seen great success in bringing provision of utilities such as electric power and water to rural and underserved areas is the idea of a cooperative, or not-for-profit organization with providers as members. While the cooperative might own some infrastructure (cables and switches) itself, its primary role is as a broker between

end-users and private providers. The provider gains access to a large group of customers and can leverage existing infrastructure and service agreements. The end-user gets access to a wider range of provision options at competitive prices. Since the cooperative is quasi-public, providers also often realize benefits in terms of streamlined permitting and access to public rights-of-way. A prominent and successful example of this model is the Maryland Broadband Cooperative, referenced in Chapter 1, which serves all of Maryland and some portions of neighboring states.

Local Network and Infrastructure Provision

The previous strategies have the advantage of relying primarily on private-sector investment, and, therefore, require less public input. Providing public support for network and infrastructure provision is a strategy that has seen some success nationally, though, in general, success tends to be localized and dependent on proper planning, technical expertise, and political will. Depending on the nature of public-private partnerships, this option can be more or less costly to a locality. With proper planning (including identification of stakeholders, assessment of needs, implementation of appropriate technical solutions, and realization of material benefits to the community) this can be a viable approach in Delaware. Implementation of this strategy can run the gamut from installation of a WiMAX or WiFi hotspots to tax incentives for companies that provide high-quality access to targeted areas or groups to direct subsidies for organizations (e.g., CAIs such as libraries and community centers) to extend public services (e.g., by providing more computers, expanding access, or increasing connection speeds).

Scenarios

Each of the following sections describes an area of the state in which there are particular challenges to the adoption of broadband. Where one or more of the factors affecting broadband adoption (physical connectedness, demographic factors, and level of service) ranks low relative to other areas, certain strategies may be employed to overcome those barriers. In the areas presented, relying on pure market forces (i.e., the *status quo* strategy) to adequately fulfill the provision of broadband is not likely to be fruitful. Various approaches for each scenario presented are discussed. These approaches are termed “tactics,” to distinguish them from the broader strategies outlined above; they are concrete actions that might be considered to address each unique need.

Downtown Wilmington – Urban Access Desert

Downtown Wilmington (roughly between the Brandywine and Christina Rivers, and east of Interstate 95) is characterized by a Central Business District of mostly high- and mid-rise office buildings, surrounded by a fairly dense population of mostly lower-income, largely minority residents. As the state’s largest city and center of many multi-national businesses, this area is among the most highly connected, with the highest level of broadband service

in the state. The demographic profile, however, indicates that there are potentially other significant barriers to broadband adoption. See Figures A1-A3 on the following pages (38-40) for maps of the relative likelihood of adoption based on the three factors. Figure A4 on page 41 illustrates this scenario graphically.

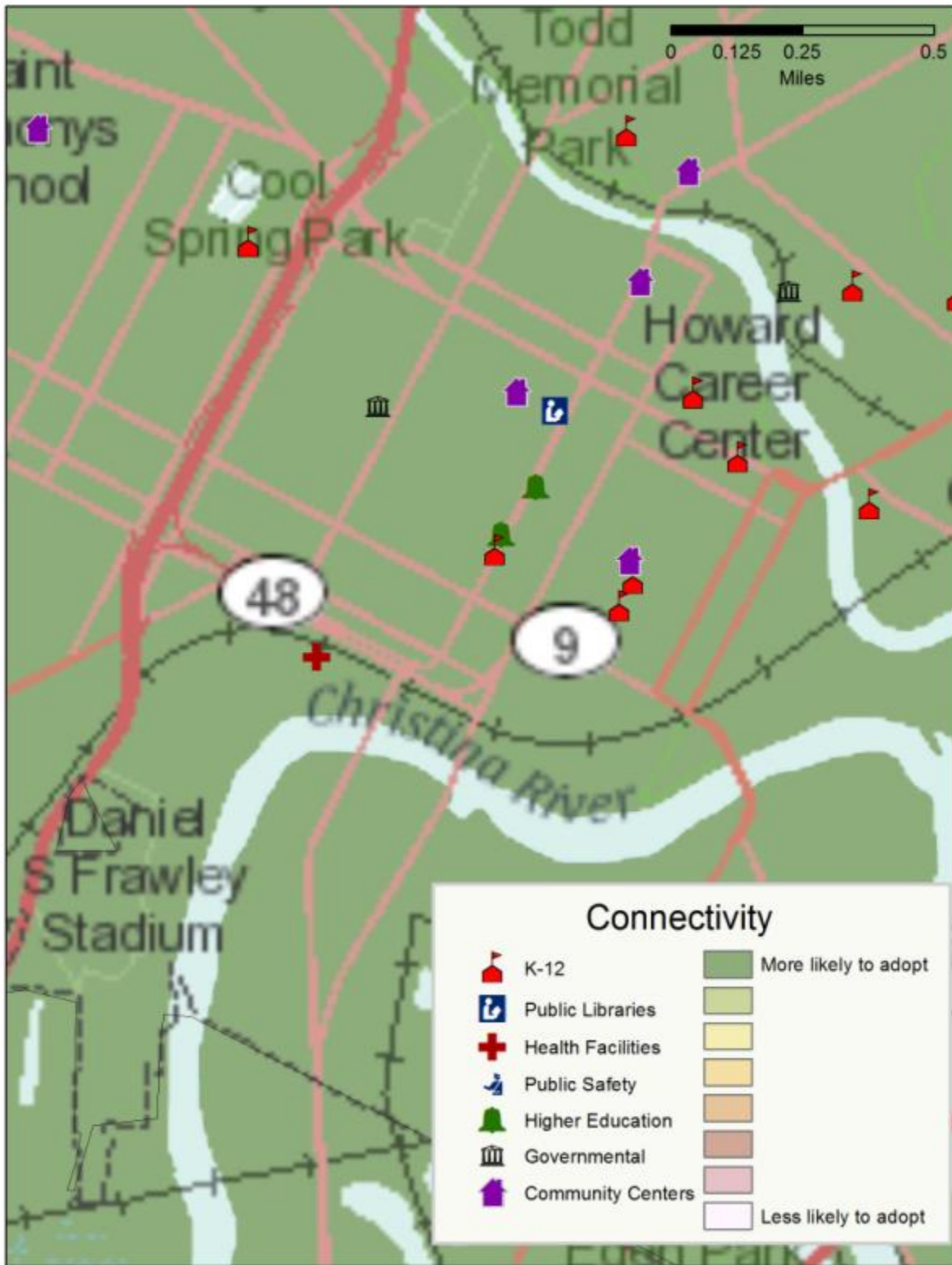


Figure A1. Wilmington predicted adoption based on connectivity factors

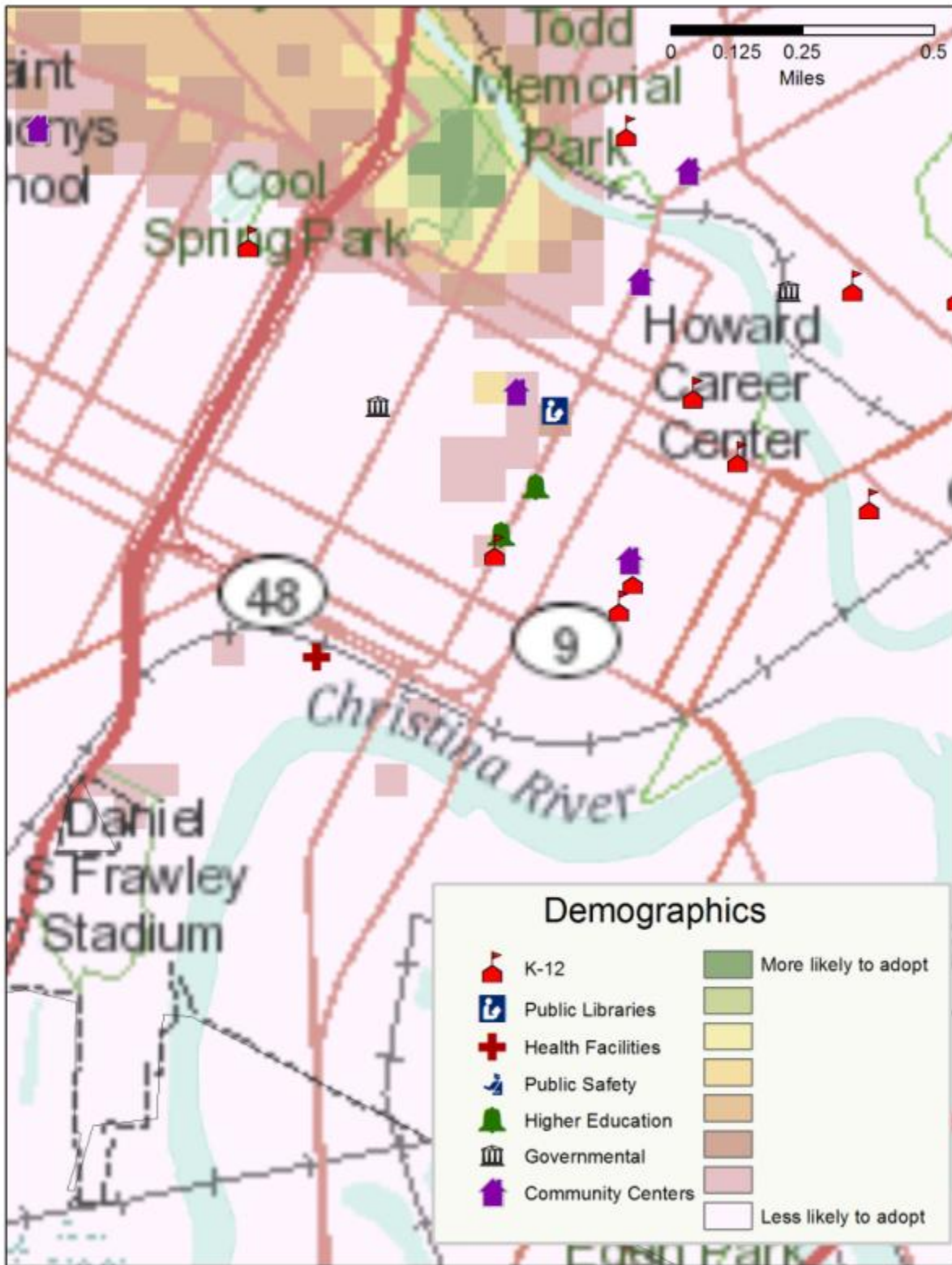


Figure A2. Wilmington predicted adoption based on demographic factors

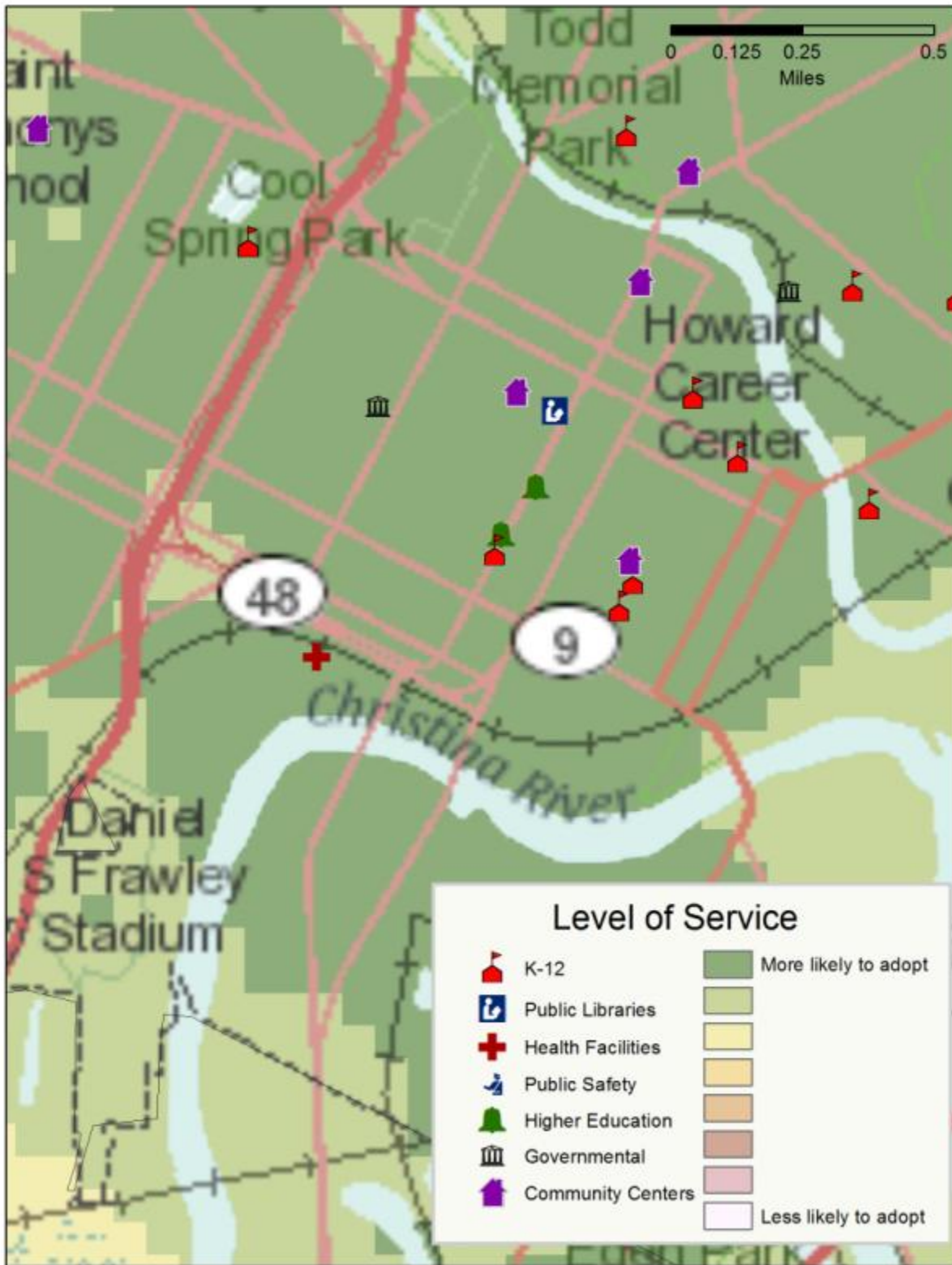


Figure A3. Wilmington predicted adoption based on level-of-service factors

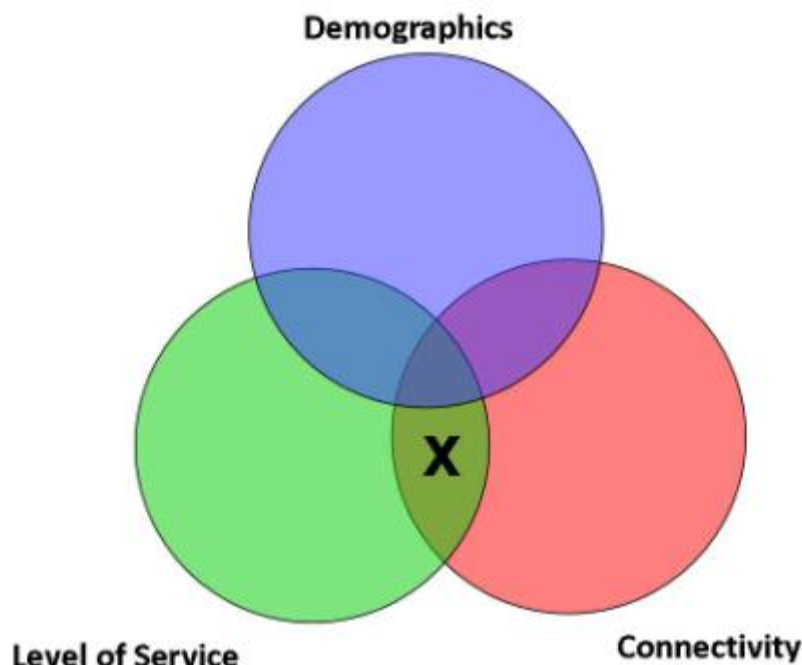


Figure A4. Diagram showing Wilmington connectivity strengths and challenges

Outreach and Education/Stakeholder Cultivation

Often, one of the greatest challenges in cultivating demand for broadband is educating the target population about the advantages for individuals and the community as a whole that high-speed Internet access affords. A core group of local groups should be identified and information on the possibilities of and opportunities for broadband presented. In particular the benefits in terms of job access, job training, distance learning, access to social programs, and technical skills development could be of critical importance to many residents of the area. The influence that existing neighborhood and civic groups already have with local residents could be leveraged to both educate and provide the aggregated demand to attract competition among service providers. A connected neighborhood can then become more of a magnet for residents who successfully advance in their education or employment horizons; if those people choose to stay in the neighborhood to take advantage of the amenities and connectedness afforded by proximity to the downtown, they can serve as models for future growth.

Technical Assistance

There is a need for ongoing technical support at all levels of government, as well as coordination among governmental and non-governmental agencies. Organizations such as the Delaware Economic Development Office (DEDO), the Wilmington Department of Economic Development, and the University of Delaware's Institute for Public Administration can provide these services. Close coordination with key stakeholder groups will ensure that steps taken are effective and long-term.

Direct Assistance

City, county, or state governments can assist local neighborhood groups or other nonprofit organizations through direct grants for computer workstations, building space, or extension of hours and/or access to facilities. Wilmington already has a rich network of CAIs, which can form the backbone of a connected city. Assessment of each of these facilities is key to determine whether the capacity is sufficient for the demand, both current and future, and if there are any issues or shortcomings that need to be addressed. Examples of low-cost options for extending the efficacy of CAIs at addressing disparities in broadband access include extending hours of operation of certain facilities, providing more workspace or computers, augmenting security at sites, assuring high-quality data connections, and encouraging more open public access to locations such as senior centers and fire stations.

Incentives for Providers

To stimulate investment by private service providers regulators may offer incentives, often in exchange for expedited approvals of business plans or other considerations. The recent offer by Comcast to provide lower-cost service to new customers who meet a needs-based test as part of a deal to acquire NBC Universal is an example of this.

Western Kent County – Rural Isolation

Western Kent County is a primarily agricultural area with some large tracts of forest and a relatively sparse network of roads. Though not physically far from the state's capital, the area is relatively isolated, with the lowest levels of existing broadband service in the state (see Figures A5 and A7). With some exceptions, the barrier to broadband adoption based on demographic profile is not significant (Figure A6). Since the area is quite sparsely populated, there is a very low availability of CAIs to fulfill the demands for Internet access for those without connectivity.

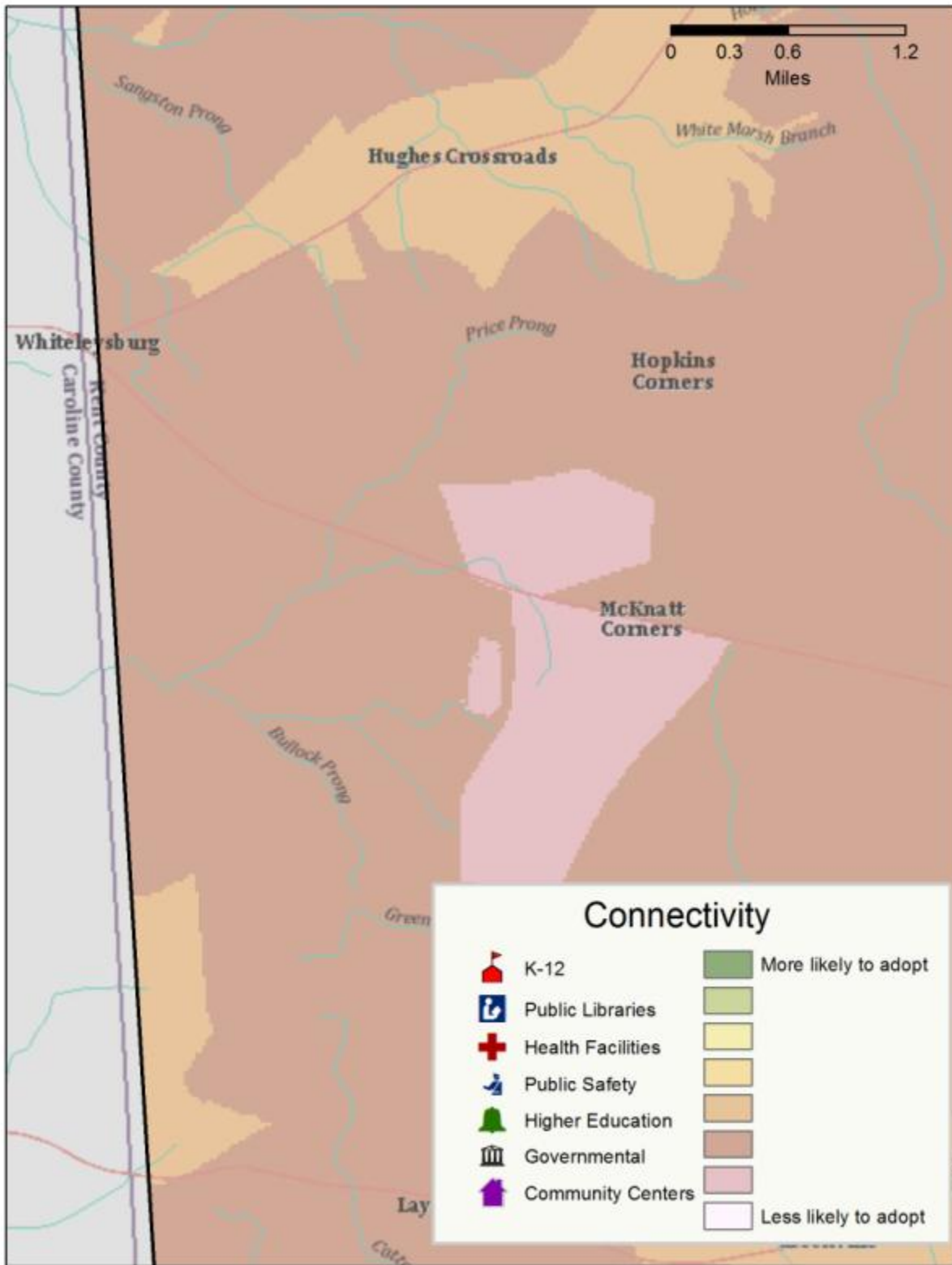


Figure A5. Western Kent County predicted adoption based on connectivity factors

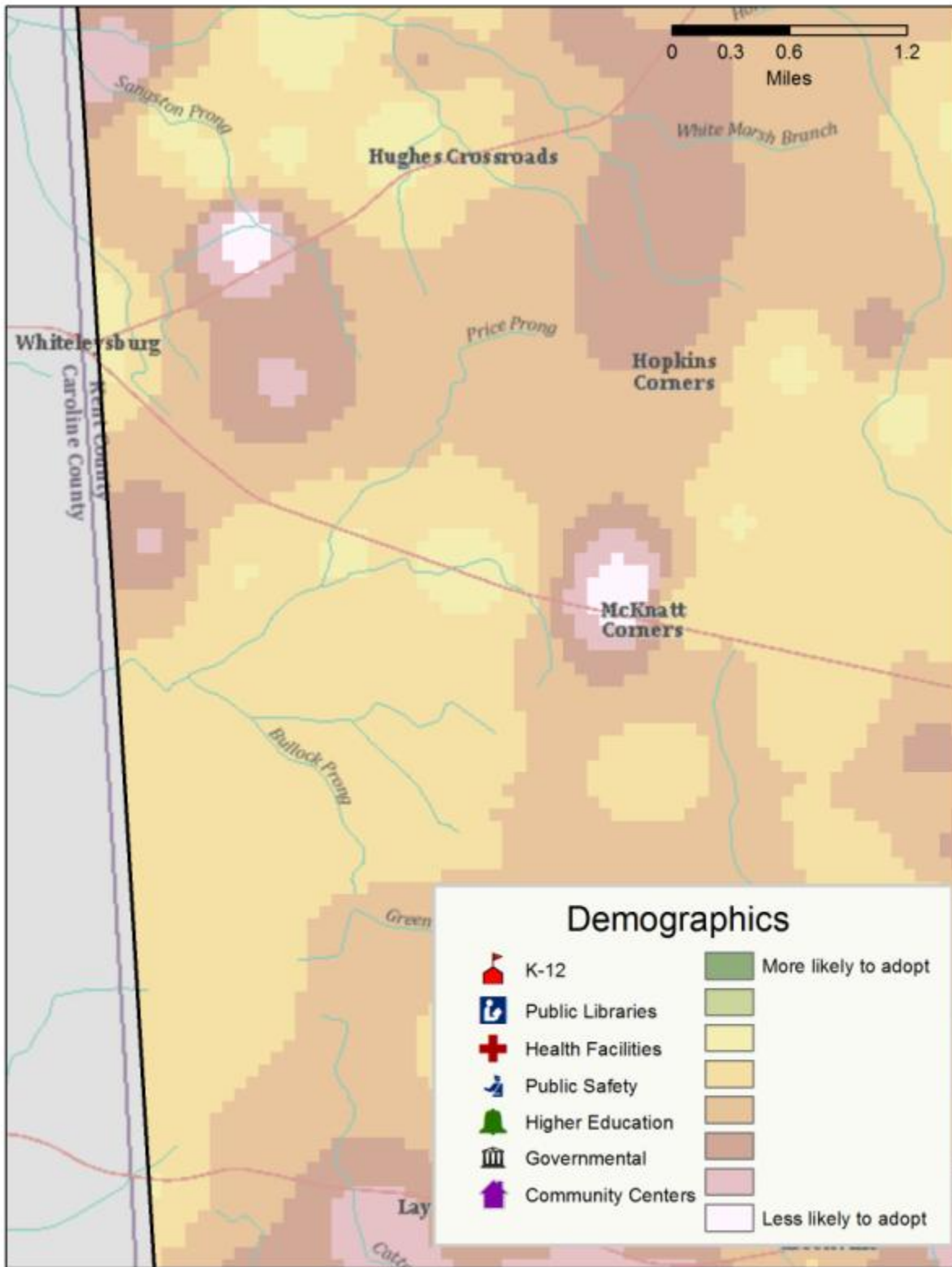


Figure A6. Western Kent County predicted adoption based on demographic factors

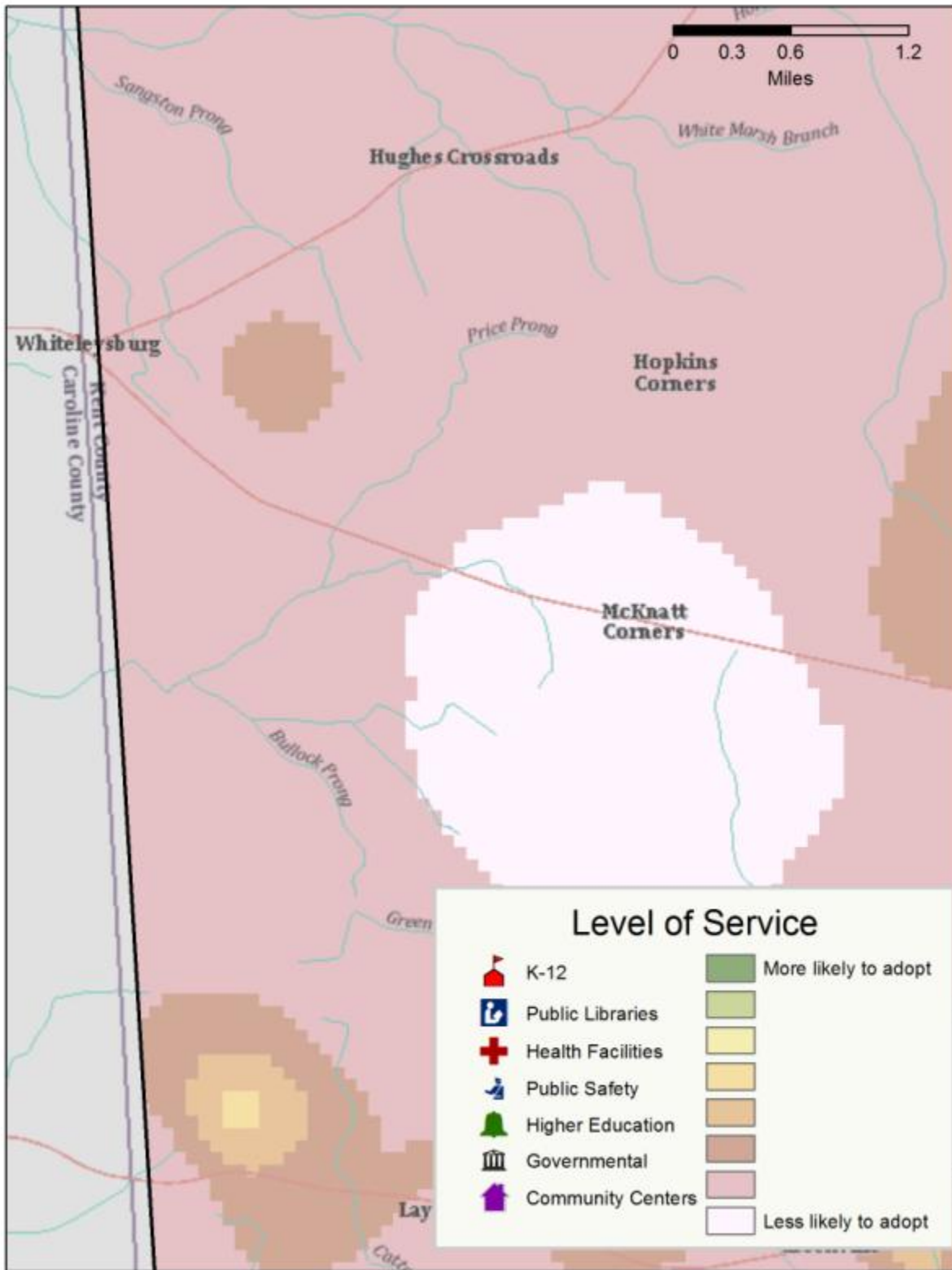


Figure A7. Western Kent County predicted adoption based on level-of-service factors

Outreach and Education/Stakeholder Cultivation

Since there is a low population density, developing a broad base of aggregated demand and stakeholder groups would be a challenge. Outreach efforts, therefore, should be coordinated by existing channels, such as the Delaware Department of Agriculture and the University of Delaware's Cooperative Extension. Depending on the agricultural sector (e.g., poultry operations, grain crops, fruit and vegetable farming, etc.) there may be varying levels of awareness of and adoption of Internet technologies to aid business ventures and meet personal needs. Therefore, educating each sector of the potential and opportunities for leveraging communication and technologies is a priority. Since aggregating demand would likely not result in robust provision of connectivity on the part of private companies, and since the current needs of the community might be adequately served by the level of service afforded through wireless technologies (e.g., 3G and 4G mobile service), use of "smart phone" devices should be considered a viable approach to augmenting broadband penetration. As these technologies mature, coverage is increasingly becoming universal, and speeds approaching or exceeding thresholds set by the FCC for classification as broadband connectivity are being realized. Therefore, the utility of these devices and the potential applications, particularly for agricultural applications, should be stressed in any education and outreach efforts. Connectivity challenges and opportunities in western Kent County are visually depicted in Figure A8.

Technical Assistance

Groups such as extension services at universities and through the Department of Agriculture will be critical in both coordinating this outreach to reach the widest audience possible in western Kent County and similar areas around the state. Continued contact will need to be maintained to ensure changes and improvements in technologies and in access to critical information and applications that will afford residents the advantages that broadband connectivity brings.

Direct Assistance

There is potential to leverage existing assistance programs to provide material assistance, particularly to more disadvantaged farmers and other residents of the area. Small grants would encourage purchase and use of smart phones. While it is unlikely that new CAIs would be easily established, it is possible that certain institutions (public, private, or not-for-profit) could be targeted as potential sites to install computer hardware and networking capability to serve the needs of the broader community.

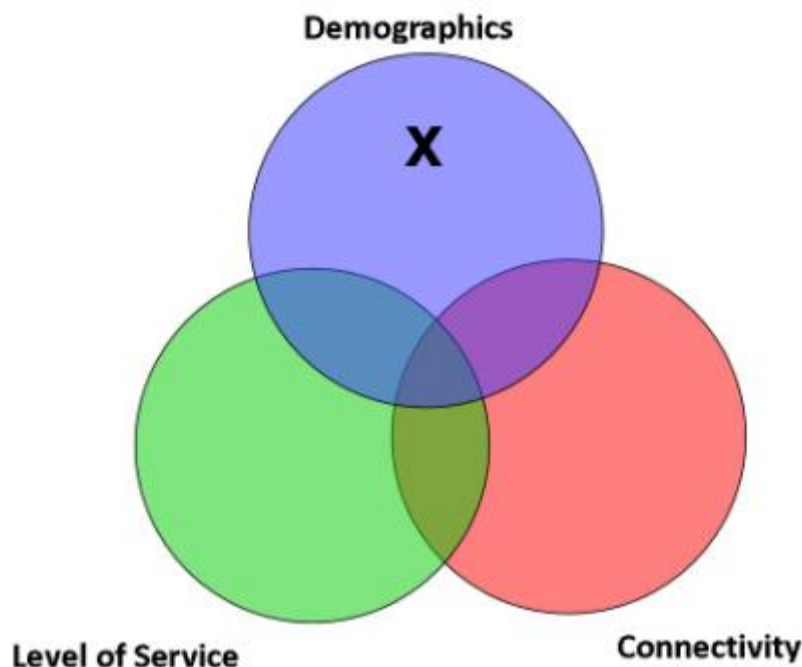


Figure A8. Diagram showing western Kent County connectivity strengths and challenges

Seaford, Delaware – Small-Town Potential

The City of Seaford lies in the western portion of Sussex County and is characterized by a small-town atmosphere, a strong central core, and agricultural and natural areas in the surrounding countryside. The town lies along U.S. Route 13, a major road and rail corridor running north-south through the state. There is significant regional commercial development along this corridor, which lies slightly east of the city's downtown. In recent decades, the greater Seaford area has seen considerable suburban growth, as lower land values have drawn families from eastern portions of the county and from elsewhere in the region. Seaford boasts a high level of connectedness based on its location along major travel corridors, with comparably high level of service only in the city's central core (see Figures A9 and A11). There is a precipitous fall-off in the level of service with distance from the city, and there is a high barrier to adoption based on demographic profile (Figure A10). As a major population center in the western portion of the county, situated on a corridor with a fiber-optic backbone running along the rail line (this is "dark-fiber," meaning that the infrastructure is laid but not currently being used), and with a fiber-optic loop within the city linking governmental offices and medical facilities, Seaford is well placed to develop robust and universal broadband.

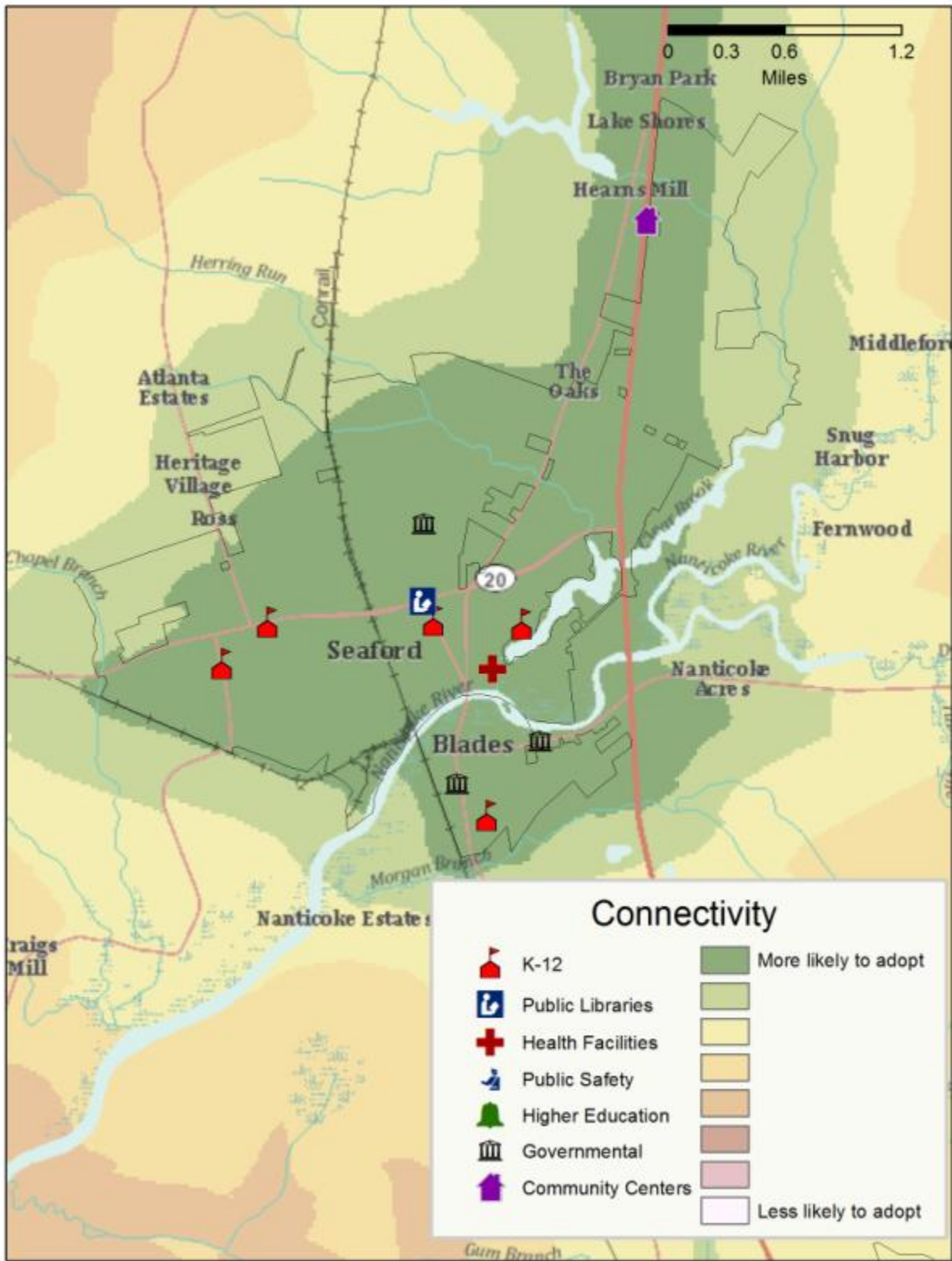


Figure A9. Seaford predicted adoption based on connectivity factors

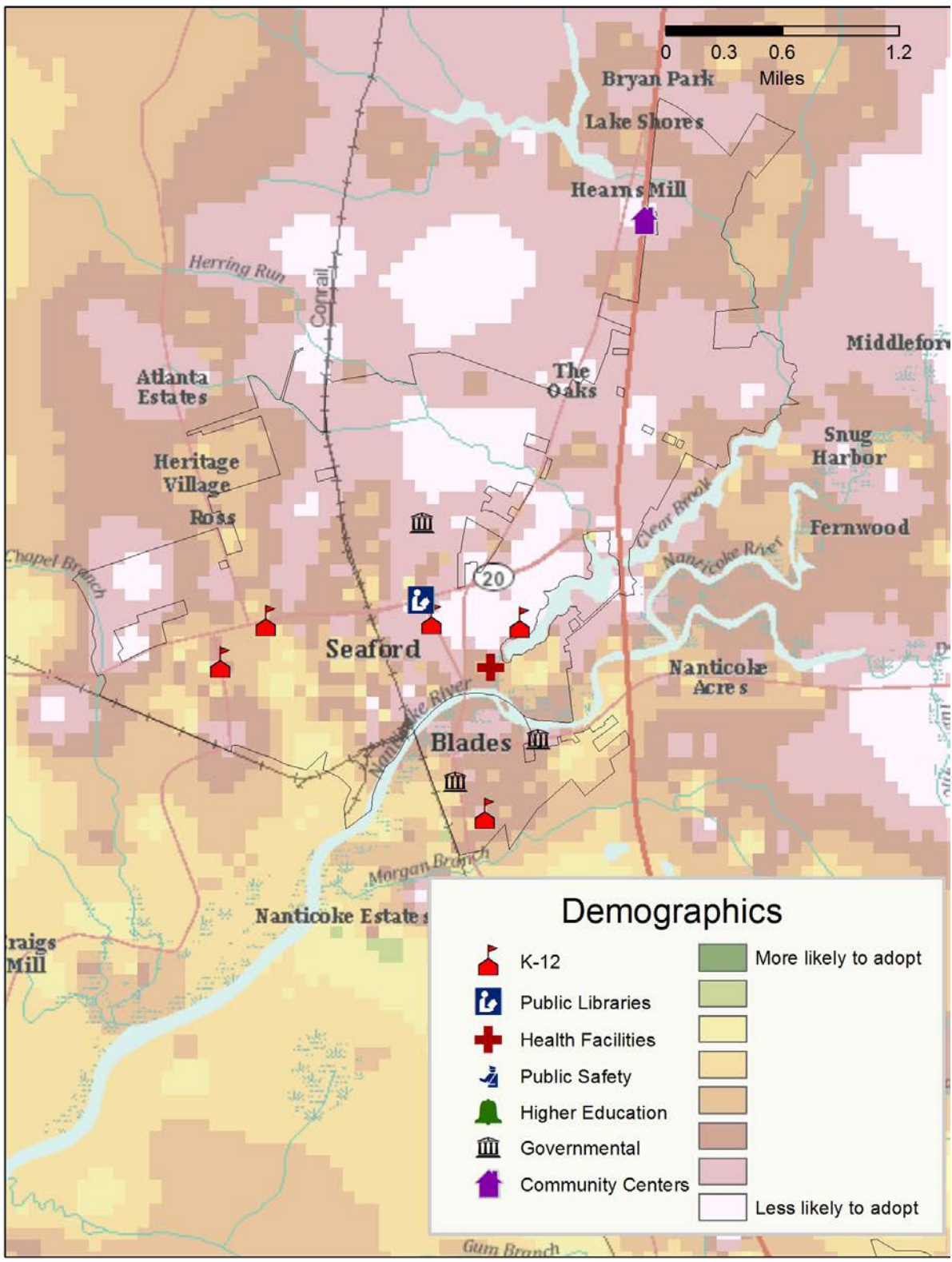


Figure A10. Seaford predicted adoption based on demographic factors

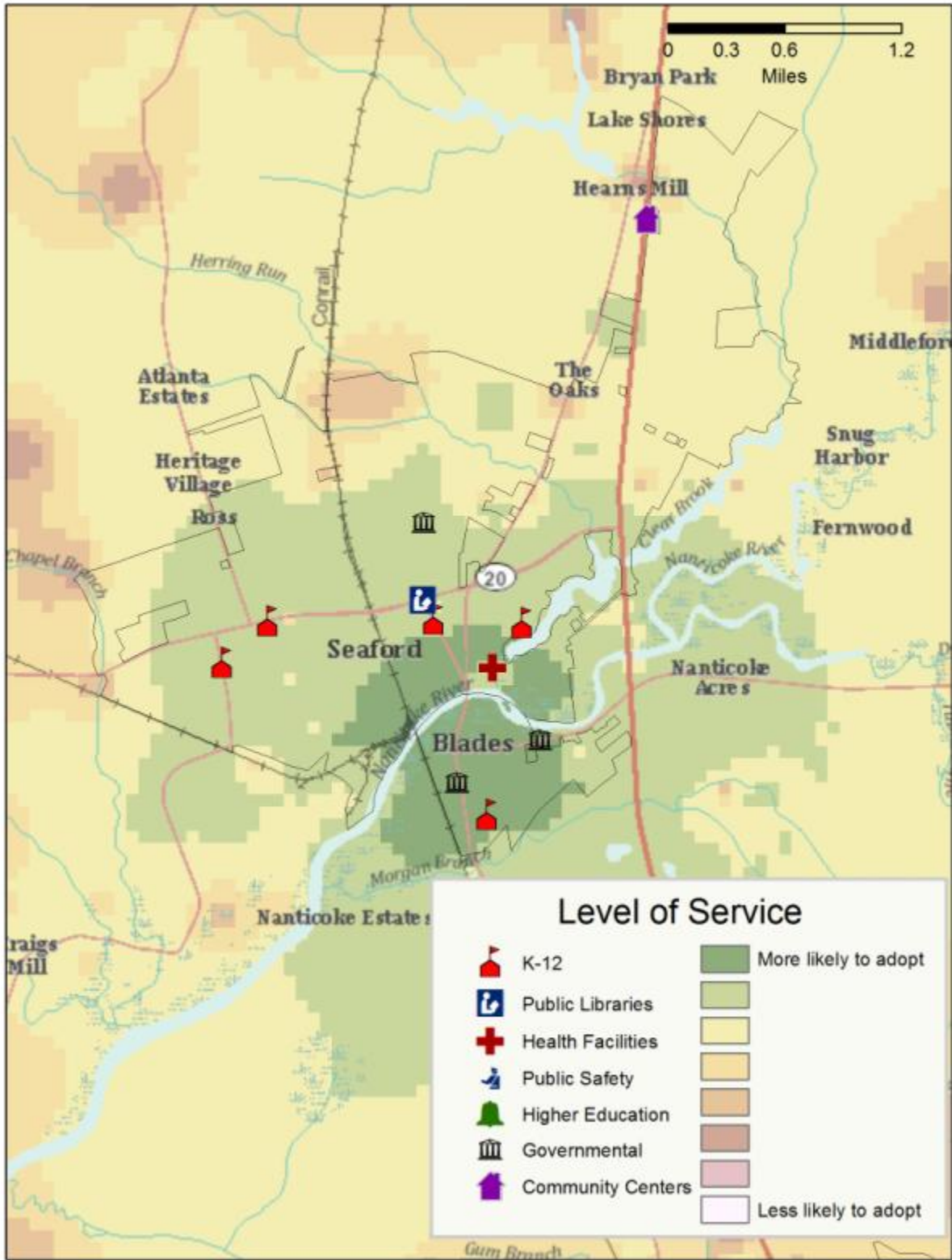


Figure A11. Seaford predicted adoption based on level-of-service factors

Outreach and Education/Stakeholder Cultivation

Seaford has a broad base of users whose demand could be aggregated to drive broadband development. An active business community, a diverse population base, and proficient municipal governance are factors that could help foster such development. The University of Delaware Institute for Public Administration has convened working groups with representatives from business, agriculture, and municipal governments; in each of these groups Seaford and environs is well represented. By recognizing the importance of broadband connectivity in many aspects of the town's functioning, Seaford has taken important steps in becoming a leader in regional connectivity and in bridging the digital divide.

Technical Assistance

Since Seaford has existing infrastructure and technical expertise in the development of broadband and its applications, it is important that organizations at the state level, such as the Delaware Economic Development Office (DEDO), Delaware Department of Technology and Information (DTI), DelDOT, plus institutes of higher education and advocacy groups such as local and state chambers of commerce, be included in coordination efforts to provide the widest and highest level of broadband access possible. Then, Seaford can partner with governments, service providers, cooperatives, and owners of infrastructure to become a center of excellence and a model for other communities in the state to emulate.

Direct Assistance

Once the partnerships required to establish Seaford as a model of a wired community are established, it will be possible to leverage funding and assistance from partner organizations and other sources to augment the physical infrastructure and identify local populations that may require financial assistance in order to become part of a connected population. Funding for computer hardware and software to schools, community centers, libraries, and other CAIs could be pursued, and subsidies for disadvantaged citizens could be given, either as direct assistance, or through agreements with service providers themselves. Universal fast and robust access could be provided, for instance, through free WiFi access to all within the city limits.

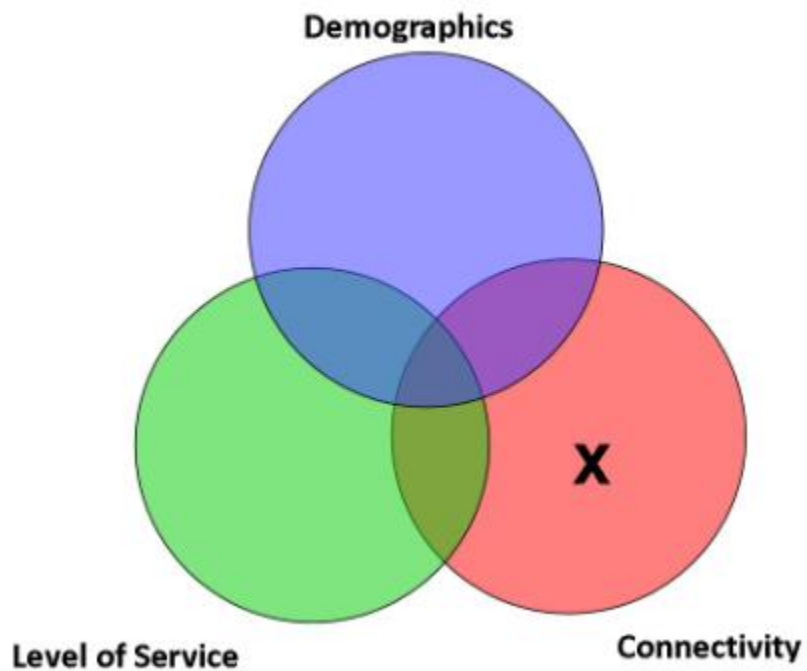


Figure A12. Diagram showing Seaford connectivity strengths and challenges

Appendix 3: Potential Funding Sources

Improving broadband in Delaware communities will require substantial funds. Appendix 3 includes information on what funding is available to local governments and CAIs. A variety of federal loans and grants can ease the task of upgrading local broadband.

Community Connect Rural Broadband Grant Program

Awarding Entity—United States Department of Agriculture (USDA)

Summary—The USDA Rural Utilities Service (RUS) has an annual program called Community Connect, specifically for small rural communities with no broadband access.

Qualifications—The following entities are eligible for funding: Incorporated Organizations, Indian Tribes or Tribal Organizations, as defined in 25 U.S.C. 450b(b) and (c), state or local units of government, or cooperative, private corporations or limited liability companies, organized on a for-profit or not-for-profit basis. Eligible areas include: a single community with a population less than 20,000 that does not have Broadband Transmission Service

Money Available—Varies

Deadline—Offered annually, last deadline May 3, 2011.

Contact Information/Person(s)—Kenneth Kuchno, Director, Broadband Division, Telecommunications Program 202-690-4673 or Email: community.connect@wdc.usda.gov.

Website/Application Link—www.rurdev.usda.gov/utp_commconnect.html

Distance Learning and Telemedicine Program (DLT)

Awarding Entity—USDA

Summary—DLT is designed specifically to meet the educational and healthcare needs of rural America. Through loans, grants, and loan/grant combinations, advanced telecommunications technologies provide enhanced learning and healthcare opportunities for rural residents.

Qualifications—Organizations that deliver or propose to deliver distance-learning or telemedicine services for the term of the grant, be legally organized as an incorporated organization or partnership, a state or local unit of government, or other legal entity.

Money Available—Appropriations for this year are unknown. Last year, the program received an appropriation of approximately \$30 million. With respect to the size of awards, the maximum is \$500,000 and the minimum is \$50,000.

Contact Information/Person(s)—For questions: *dltinfo@wdc.usda.gov*. Sam Morgan - *sam.morgan@wdc.usda.gov*, 202-205-3733. Gary Allan - *gary.allan@wdc.usda.gov*, 202-720-0665

Website/Application Link—

www.rurdev.usda.gov/supportdocuments/2011-dlt-app-guide-Final-Feb-23-2011.pdf

Farm Bill Loan Program

Awarding Entity—USDA

Summary—The Farm Bill Loan Program provides loans, grants and loan/grant combinations, to enhance learning and healthcare opportunities for rural residents.

Qualifications—Eligible entities may be either a nonprofit or for-profit organization and must take one of the following forms: corporation; limited liability company (LLC); cooperative or mutual organization; Indian tribe or tribal organization as defined in 25 U.S.C. 450b; or state or local government, including any agency, subdivision or instrumentality thereof. Individuals or partnerships are not eligible entities.

Money Available—Varies annually.

Contact Information/Person(s)—Ken Kuchno - 202-690-4673,
kenneth.kuchno@wdc.usda.gov

Website/Application Link—
www.rurdev.usda.gov/supportdocuments/Broadband%20Application%20Guide%203.14.11.pdf

Telecommunications Infrastructure Loan Program

Awarding Entity—USDA

Summary—Long-term direct and guarantee loans to qualified organizations for the purpose of financing the improvement, expansion, construction, acquisition, and operation of telephone lines, facilities, or systems to furnish and improve telecommunications service in rural areas.

Qualifications—Entities providing, or who may hereafter provide, telephone service in rural areas, public bodies providing telephone service in rural areas as of October 28, 1949, and cooperative, nonprofit, limited dividend or mutual associations.

Money Available—Varies

Contact Information/Person(s)—Northern Division at 202-720-1025; Southern Division at 202-720-0800

Website/Application Link—www.rurdev.usda.gov/utp_infrastructure.html

Universal Service Rural Health Care Pilot Program

Awarding Entity—Universal Service Administrative Company (USAC)

Summary—Makes discounts available to eligible rural healthcare providers for telecommunication services and monthly Internet service charges. The program is intended to ensure that rural healthcare providers pay no more for telecommunications in the provision of healthcare services than their urban counterparts.

Qualifications—Post-secondary educational institutions offering healthcare instruction, teaching hospitals, or medical schools; community health centers or health centers providing care to immigrants, local health departments or agencies, community mental-health centers, not-for-profit hospitals, rural health clinics including mobile clinics.

Money Available—Varies

Contact Information/Person(s)—1-800-229-5476

Website/Application Link—www.universalservice.org/rhc

Universal Service Schools and Libraries Program

Awarding Entity—USAC

Summary—Provides discounts for affordable telecommunications and Internet access services to ensure that schools and libraries have access to affordable telecommunications and information services.

Qualifications—Schools: may be public or private, must operate as nonprofit, must provide elementary or secondary education as determined by state law. Libraries: must be eligible for assistance from a state library administrative agency under the Act, must have budgets completely separate from any schools.

Money Available—Varies

Contact Information/Person(s)—1-800-229-5476

Website/Application Link—www.universalservice.org/sl

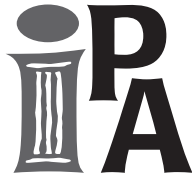
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