Covid-19 Response
Telecommunications Recovery Plan

DRAFT

Prepared for the State of Vermont
November 2020

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1 Executive Summary

Covid-19 has laid bare the challenges of lack of universal broadband in Vermont. In the midst of a pandemic, inequities in availability and affordability of broadband create further inequities in areas such as education, telehealth, and ability to work from home.

To understand and address those challenges on an emergency basis, this Covid-19 Emergency Telecommunication Plan (Report) was commissioned by the Vermont Department of Public Service in October 2020. The Report is intended to meet the requirements of Section 15 of H.966, an act relating to COVID-19 funding and assistance for broadband connectivity, housing, and economic relief, and 30 V.S.A. § 202d. The Report was funded by Vermont's federal CARES Act funds to provide research and recommendations regarding how to address, in the near term, the immediate connectivity crisis created by Covid-19.[1] The Report was prepared in October and November 2020 by a project team led by CTC Technology & Energy and Rural Innovation Strategies, Inc.

1.1 The Scope of This Report

The research undertaken for this Report illuminates and illustrates the short-term connectivity challenges that require immediate effort to minimize the harm to Vermonters during the pandemic. Despite the best efforts of stakeholders, many students are not receiving instruction, workers are not able to work remotely from home, patients who want telehealth services are struggling to connect, and doctors participating in prudent quarantine practices are unable to connect to hospitals and patients. Even citizens hoping to stay connected to their municipal government's activities are struggling to attend public meetings. With surging cases and cold weather approaching, these challenges are likely only to further exacerbate inequitable access to education, work, healthcare and the democratic process.

The research for this Report also reinforces the importance of accelerating progress toward the State's 100/100 Mbps broadband goal. For example, surveys conducted as part of this effort found that, even among Vermonters who do have access to broadband, satisfaction with current internet service has decreased during the pandemic; approximately one-third of respondents to an online survey express dissatisfaction with connection speed and reliability during the pandemic.

At the same time, given the immediacy and urgency of this effort, it's important to note what this Report was not intended to accomplish: It does not represent a long-term strategy to meet the State of Vermont's important residential 100/100 goal.

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[1] H.966, https://legislature.vermont.gov/Documents/2020/Docs/BILLS/H-0966/H-0966%20As%20Passed%20by%20Both%20House%20and%20Senate%20Unofficial.p

The consulting team heard from many stakeholders the hope that this Report would offer the Vermont broadband "Marshall Plan" to accelerate the State's path to 100/100 service by 2024. However, given the scope established for this effort and the source of funding for the work, this Report is focused on short-term efforts, not long-term strategy. Indeed, given the short time horizon for executing any strategy recommended by this Report, it does not incorporate recommendations regarding medium- or long-term strategies or technologies, such as construction of fiber-to-the-premises or use of neutral host infrastructure, however important those strategies are likely to be for Vermont's long-term broadband future.

Stated simply: *This Report should be understood as a complement rather than an alternative to long-term planning* that would address the State's broader internet goals. We strongly recommend that Vermont continue with that longer-term planning once the immediate emergency has been addressed.

In light of the scope of this Report, this analysis follows three key principles:

1. Recommendations in this plan are intended to address immediate, urgent needs during the pandemic.
2. Recommendations in this plan should not make achieving the State's long-term goals (universal 100/100 service before 2024) more difficult.
3. Wherever possible, recommendations for short-term connectivity strategies in this plan should be constructed to accelerate the State's path toward long-term goals.

The Report builds on the State's considerable efforts and achievements to date. The Vermont Department of Public Service has developed more granular and up-to-date data on broadband availability than perhaps any other State. The electric utilities in the State share crucial data regarding utility poles and fiber assets. Public, Education and Governmental Television (PEG TV) stations and libraries have taken on new and critical roles during the pandemic, as educational content, Covid safety guidelines, and municipal events need to be disseminated to the public in new ways. The State also moved very quickly to deploy centrally located public hotspots and invested in programs to identify people with distinct needs and bring Vermonters online quickly.

1.2 Summary of Tasks

Over the course of October and early November 2020, the project team conducted quantitative and qualitative research to understand the use of telecommunications services during the Covid-19 pandemic and the gaps that still exist in Vermont.[2] At the same time, attorneys from Keller &

[2] The Report is based on data developed in October and November 2020, and there exist some pending processes that may impact the recommendations made here. For example, the status of federal Coronavirus financial support is unclear, and there exists potential for additional funding should another federal stimulus be made available or

Heckman, a national firm, and Montroll, Backus & Oettinger, a Vermont-based firm, provided regulatory and legal consultation regarding these issues.[3]

Specifically, the project team undertook the following activities:

1. **Assessed the current state of commercial and residential telecommunications infrastructure and services and surveyed Vermont residents and businesses:**[4] The effort was intended to understand how Vermont's telecommunications infrastructure has performed during the pandemic to lay the groundwork for near-term changes that should be considered in light of the emergency. The team undertook multiple surveys of Vermont residents and businesses, in cooperation and consultation with the Agency of Commerce and Community Development (ACCD) and the relevant departments of State government, to determine what telecommunications services are needed during the pandemic with respect to the education, healthcare, public safety, and workforce training sectors. Specifically, the team conducted online surveys of Vermont residents and businesses and currently has underway a telephone survey of unserved residences.[5]

2. **Evaluated State-owned and managed telecommunications systems and related infrastructure:**[6] In this task, the project team analyzed public sector telecommunications systems and related infrastructure and evaluated the need to provide the best available and affordable technology for use by State and local government, public safety, educational institutions, community media, nonprofit organizations performing governmental functions, and other community anchor institutions. In particular, we analyzed how publicly-owned infrastructure has performed during the pandemic and what needs have emerged as a result of this emergency. To this end, the team conducted more than 50 interviews of Communications Union Districts (CUDs), ISPs, health care

should the deadline for spending the current CRF money be extended. In addition, the ongoing Rural Digital Opportunities Fund (RDOF) reverse auction and VTel's pending USDA Reconnect grant application could impact connectivity in Vermont in the coming year or two.

[3] Given the urgency of the Covid-19 pandemic and the short timeline for writing this plan, as well as the plan for public comment, this Report will be further refined in the final submission. Two elements to note that will be included in the final Report are the full legal review of these recommendations, and results from an ongoing phone survey of Vermont residents.

[4] This effort is responsive to Tasks 1 and 2 of the scope of work assigned by the Vermont Department of Public Service.

[5] The project team's initial plan was to conduct a statistically valid mail survey of thousands of Vermont households, but the urgent and accelerated nature of the engagement made infeasible a methodology that would require several months of effort. As of the date of this writing, a polling firm is conducting a phone survey of Vermont residents in areas without internet of at least 25/3. The results of the phone survey will be incorporated into the final version of the Report. The phone survey is focused only on Vermont residents thought to have little to no broadband connection, to correct for the obvious limitations of a residential survey conducted online.

[6] This effort is responsive to Task 3 of the scope of work.

providers, electric utilities, superintendents, librarians, community media experts, public safety entities, anchor institutions, and local government leaders.

3. **Assessed status, coverage, and capacity of telecommunications networks and services:**[7] The project team assessed the status, coverage, and capacity of telecommunications networks and services available throughout Vermont in light of how the pandemic has affected the capacity of current networks, with particular focus on telehealth and distance learning requirements. To this end, the team conducted dozens of interviews and surveys of health care professionals and school superintendents, among other critical stakeholders. In addition, robust geospatial and mapping analysis was performed to understand the options for reaching as many Vermonters as possible in response to the pandemic. The team utilized data including, but not limited to, Vermont's data on served and unserved premises, cable and fiber systems, 248a permit applications, NRB data, various cellular service data from drive tests, and data from the census.

4. **Assessed opportunities for shared infrastructure:**[8] The project team completed an assessment of opportunities for shared infrastructure, open access, and neutral host wireless facilities to guide deployment of new technology that can assist the State in responding to, and recovering from, the pandemic. We concluded that strategies related to neutral host infrastructure are long-term in nature and advise against policy changes in the short-term to deal with the pandemic; we recommend instead that these long-term strategies be considered in the context of a long-term, comprehensive broadband plan.

5. **Analyzed PEG TV responses to the pandemic:**[9] PEG access media organizations were assessed with particular attention to changes brought on by the pandemic and how PEG Access has been leveraged to address the crisis in the context of the State's overall communications needs. To this end, we interviewed key PEG stakeholders and experts.

6. **Analyzed strategies to use public ownership and control of rights-of-way to expand broadband and increase network resiliency during the pandemic:**[10] The project team was tasked to develop short-term measures that the State can undertake to leverage its ownership and management of the public rights-of-way to create opportunities for accelerating the buildout of fiber-optic broadband and for increasing network resiliency capacity. We concluded that strategies related to ownership and management of rights-of-way are long-term in nature and advise against policy changes in the short-term to deal

[7] This effort is responsive to Task 4 of the scope of work.
[8] This effort is responsive to Task 5 of the scope of work.
[9] This effort is responsive to Task 6 of the scope of work.
[10] This effort is responsive to Task 7 of the scope of work.

with the pandemic; we recommend instead that these long-term strategies be considered in the context of a long-term, comprehensive broadband plan.

7. **Assessed emergency communications initiatives and requirements:** [11] Public safety specialists on the project team analyzed federal initiatives and requirements, including the Department of Commerce FirstNet initiative and the Department of Homeland Security Statewide Communication Interoperability Plan, and how these activities can best be integrated with strategies to advance the State's short-term responses to the pandemic. The analysis includes an assessment of how these systems have performed during the pandemic and what is needed to respond to the crisis. As part of this analysis, the project team interviewed key stakeholders within Vermont and drew on best practices nationally.

8. **Analyzed regulatory and legal barriers facing State action:**[12] As of the date the first draft of this Report is delivered to the State, the project team is still preparing a discussion of relevant federal and State laws and regulations affecting State action in the telecommunications area, including relevant preemption issues raised by any proposed policy initiatives.

9. **Developed recommendations designed to advance State telecommunication policies and goals:**[13] The recommendations are intended, per the scope of this effort established by the State of Vermont, to address short-term needs and to ensure that short-term strategies for addressing the pandemic not interfere with longer-term efforts to address larger broadband needs as defined by 30 V.S.A. § 202c.

1.3 Summary of Findings

Based on the Tasks described above, this Report finds the following:

- Institutional and governmental telecommunications systems have been resilient during the pandemic, and emergency plans and adaptations have successfully minimized gaps in operations of government services. Most commercial business locations are generally served by adequate broadband.

- Broadband use has increased dramatically since the start of the pandemic, as would be expected. For example, respondents to an online poll report increased use of the internet for telemedicine (an increase from 19 percent to 75 percent) and for civic engagement (an increase from 33 percent to 74 percent). Additionally, 62 percent of respondents use

[11] This effort is responsive to Task 8 of the scope of work.
[12] This effort is responsive to Task 9 of the scope of work.
[13] This effort is responsive to Task 10 of the scope of work.

the internet for teleworking on a daily basis, compared with 21 percent of respondents before the pandemic.

- There exist considerable challenges with respect to insufficient residential telecommunications infrastructure. Many Vermonters are struggling with connectivity for remote work, online education, and telehealth (including doctors in quarantine who cannot connect to hospitals and patients from home with video conferencing). For example, four in 10 respondents to a residential survey reported that they have experienced connectivity issues during telehealth appointments. Overall, satisfaction with internet service aspects has decreased during the pandemic, particularly for speed and reliability of service. More than one-half of respondents are not at all satisfied (approximately one-third) or are only slightly satisfied (approximately one-fifth) with connection speed and reliability during the pandemic.

- Low-income Vermonters in particular are facing challenges accessing broadband and getting assistance. For example, a survey of families connected to the internet suggests that more low-income respondents to the survey who currently have service had applications to ISP low-income programs denied than those who were able to enroll.

- Small businesses, remote workers, parents, patients, and civically engaged Vermonters are learning digital skills quickly, but are still struggling to understand how to use connectivity tools during the pandemic.

- Many municipalities have struggled to engage citizens and elected officials via online tools, and few have made plans for larger engagement challenges like Town Meeting Day. In some cases, PEG TV is filling the gap. Sixteen percent of all respondents to a survey report viewing PEG TV content during the Covid-19 pandemic. Among those who viewed PEG programming, the most commonly accessed content was broadcasts of municipal functions, cited by 72 percent of respondents. One-half of PEG viewers accessed information about Covid-19.

1.4 Summary of Recommendations

Given that, for the most part, the immediate challenge for connectivity during the pandemic appears to be on the residential rather than business or institutional fronts, this Report focuses its recommendations on the needs of the following categories of Vermonters:

1. **Served but low-income**: This category is of those Vermonters who have available broadband service of 25/3 or more, but may not be able to afford service

2. **Unserved but able to pay**: This category is of those Vermonters without access to broadband—who could and would pay for service, if the infrastructure was made available

3. **Unserved *and* low-income**: Vermonters without access to broadband who also need assistance paying for monthly service

Addressing the needs of these Vermonters requires work and programming in three categories that are responsive to the needs: First, we recommend infrastructure deployments to enable short-term solutions to address the needs of the unserved. Second, we recommend service subsidies for low-income Vermonters who may struggle to afford broadband service in the current economic crisis. Finally, we recommend execution capacity to reach everyone across the State. The recommendations are based on the assumption that the State can mobilize financial and staff/contract resources to act quickly.

1.4.1 Recommendation: Provide a Broadband Service Subsidy to Low-Income Vermonters During the Pandemic

The Vermont Department of Public Service has already developed a successful effort to reimburse broadband costs to families that are adversely impacted by the pandemic's economic crisis. We recommend that the State complement that effort, and expand it, by also focusing resources on providing free broadband to low-income families that may not already have service to their homes because of the barrier of cost.

Specifically, the State could purchase services in bulk from providers that currently serve communities throughout Vermont, then provide codes for qualified residents to redeem for free service from any participating provider—thus completely eliminating cost as a barrier to adoption.

This approach would enable the State to use its large-scale purchasing power to realize efficiencies and ensure competitive pricing—reducing its costs both in total and on a per-subscriber basis. This is especially true to the extent that the State can leverage carriers' underutilized low-cost programs such as Comcast internet Essentials and Spectrum Internet Assist. The State could use a quick-turnaround procurement process to engage internet service providers willing to offer low pricing, flexibility, and high-quality customer service.

Given the reality of service availability in Vermont, the program would offer codes for service over fixed networks wherever possible and mobile hotspots everywhere else.

To maximize participation and the overall impact of this approach, the State would need to make the process as simple as possible for residents and would need to commit to providing support and guidance to families as they navigate the program. Ideally, eligible residents would receive communications through multiple channels—both analog and digital—that clearly describe the program's benefits, include a personalized code, and provide instructions for subscribing to service from the participating provider of their choice.

For purpose of equity and ease of program deployment, eligibility should be based on income level and should build on existing mechanisms like a Vermonter's eligibility for Medicaid or the National School Lunch Program. This will require collaboration and data sharing by public school systems or other institutions.

Assuming an average cost per household of $350 for 12 months, representing service, equipment, and installation, and approximately 20,000 eligible households, we estimate the potential cost of a program like this could be $7 million in the first year.

1.4.2 Recommendation: Fund Modest Infrastructure Enhancements Where Feasible in the Short-Run and in Areas Where These Investments Will Not Compromise Long-Term Efforts

After consideration of the Emergency Connectivity Initiative, 60,511 homes, or approximately 20 percent of Vermont households, are not served by wireline service that meets the federal definition of broadband (25 Mbps download and 3 Mbps upload) and thus face difficulty working remotely, learning remotely, or obtaining telemedicine services over broadband.

This Report considers possible approaches for addressing these broadband gaps. While the optimal long-term approach is to connect unserved premises with fiber or other high-speed wireline services, we recommend an emergency approach that accomplishes the following:

1. **Use of Mobile**. Leverages the commercial mobile broadband networks that serve most of Vermont, including areas unserved by wired 25/3 broadband services. Households without fixed broadband service can use a mobile hotspot device to access service. We have identified 44,420 households (73 percent of the 60,511 unserved households) in this category through use of State drive test data, State tower data, and AT&T data regarding planned 2020 FirstNet expansion.

2. **Line Extensions.** Pays to extend cable or fiber service to small unserved pockets within or adjacent to otherwise-served areas. These can be built quickly and will be difficult to serve by a new fiber provider such as a Community Utility District. We identified 2,023 homes in this category using a mapping algorithm that identifies small unserved areas in mostly-served towns—and we estimate this will cost $5.6 million.

3. **Rooftop Boosters.** Identifies where the use of rooftop booster antennas could help households with marginal mobile broadband service attain service at acceptable speeds and provide equipment and installation services, along with the hotspot device. We

identify 3,700 additional households in this category by selecting areas with lower signal level thresholds for mobile broadband, but at levels that can be boosted to provide acceptable service.

1.4.3 Recommendation: Develop a Broadband Corps

To support Vermonters in their adoption and use of broadband, we recommend development of a Broadband Corps. The Corps would be a statewide team dedicated to supporting CUDs and mobilizing the people power necessary to confirm mobile hotspot options, assist with nontechnical installations, and provide technical support for low income and technology challenged Vermonters. The Corps would launch before December 30 and would continue over the next 8 to 10 months, transitioning to longer term data collection (such as pole assessments) in the late spring once emergency connections are completed.

Consistently, during the research for this Report, stakeholders demonstrated need for more hands-on resources to assist with the technical issues that inevitably arise as more Vermonters move online. A Broadband Corps could address these gaps through organizing volunteers through the CUDs and providing direct service to Vermonters to make sure as many as possible are connected quickly.

We recommend the creation of a Broadband Corps in order to: (1) Assist with infrastructure and service deployment; (2) Perform outreach, and direct technical support to Vermonters becoming familiar with their broadband connections and devices; and (3) Provide high touch support to ensure low-income Vermonters take advantage of broadband support programs. If the Corps is successful in connecting Vermonters rapidly, we recommend in the Spring that Corps members spend available time on pole surveys of towns on behalf of CUDs and thereby advance their work toward deploying fiber.

As an illustration of what is possible, this Report describes a Broadband Corps structure that combines regionally assigned Corps members with a statewide installation team. Corps members could be assigned to Regional Planning Commission regions and could work closely with RPCs and/or CUDs if desired, with centralized, statewide management. We recommend at least 22 regional corps members (two for each RPC region), and at least 20 statewide Corps members.

While a Corps could be put together quickly to get started as early as December, it is likely such a team would be focused on executing for a six-month period, for a budget of approximately $1.3 million, including staffing and equipment.

2 Survey of Vermont Residences and Businesses

The project team—in consultation with key State stakeholders—conducted an online business survey and online residential survey over the course of three weeks, and commissioned a residential phone survey (which is ongoing, as of the writing of this report).

The online residential survey illuminated important aspects of changing customer behavior due to the pandemic in terms of use of the internet and demand for access—and, importantly, a severe lack of usage of low-cost broadband programs available to low-income residents.

2.1 Residential Survey Methodology

The online residential survey ultimately secured more than 4,000 responses from Vermonters, 3,046 were deemed "valid" by the statistician analyzing the data. The survey was promoted through organic and paid promotions, including a press release from Vermont's Department of Public Service (PSD); requests made to town administrators, librarians, State legislators and other stakeholders to post the survey on town listservs; social media promotion from a range of entities; paid Front Porch Forum advertisements; outreach via Communications Union Districts (CUD), and more.

The survey responses (presented in full in Appendix A) were weighted based on the age of the respondent and region. Since older persons are more likely to respond to surveys than younger persons, the age-weighting corrects for the potential bias based on the age of the respondent. In this manner, the results more closely reflect the opinions of each county's adult population. The figures below summarize the sample distribution by county and by age.

Figure 1: Residential Survey Response Distribution by County

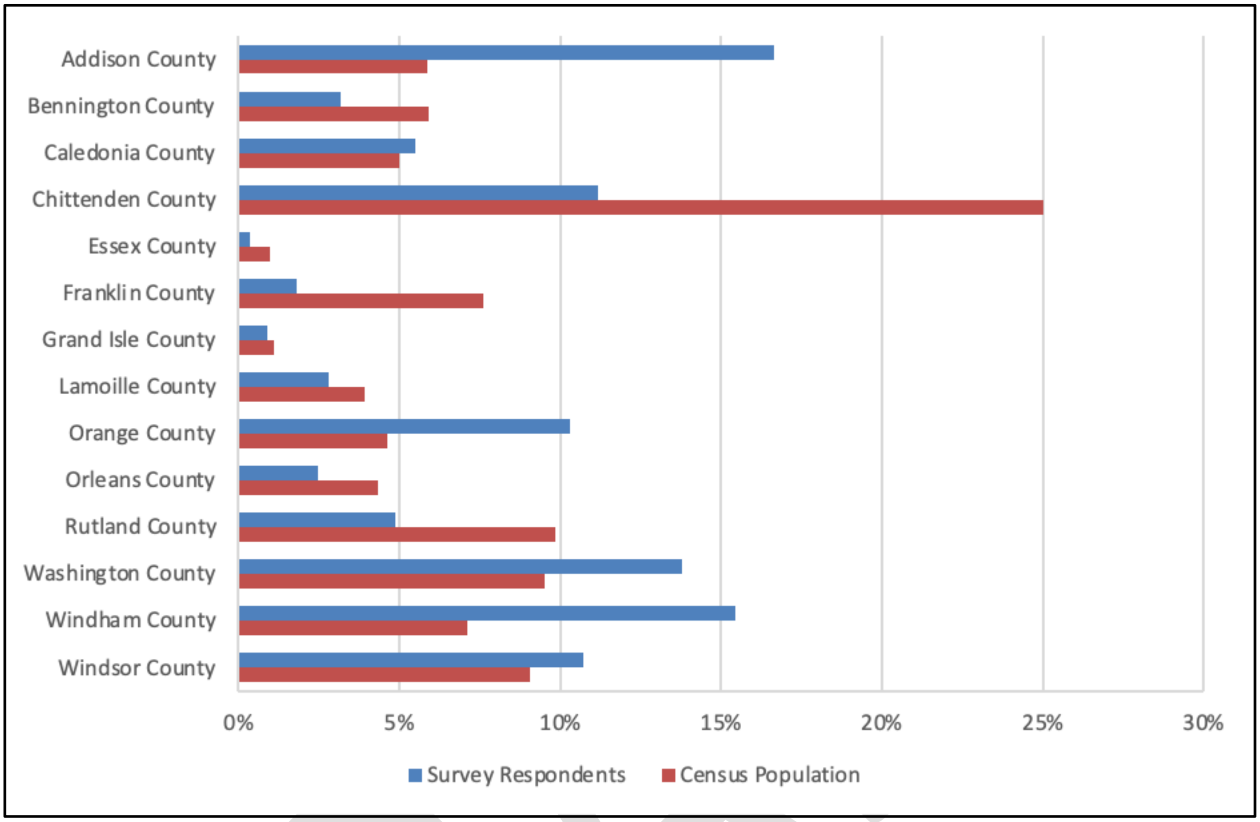
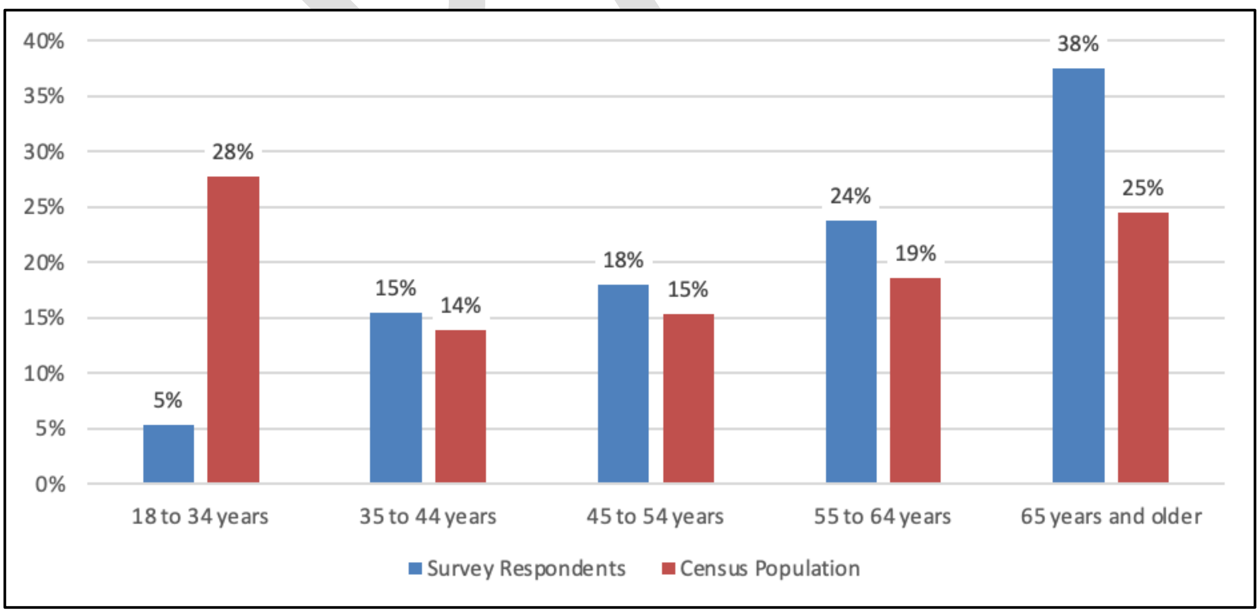


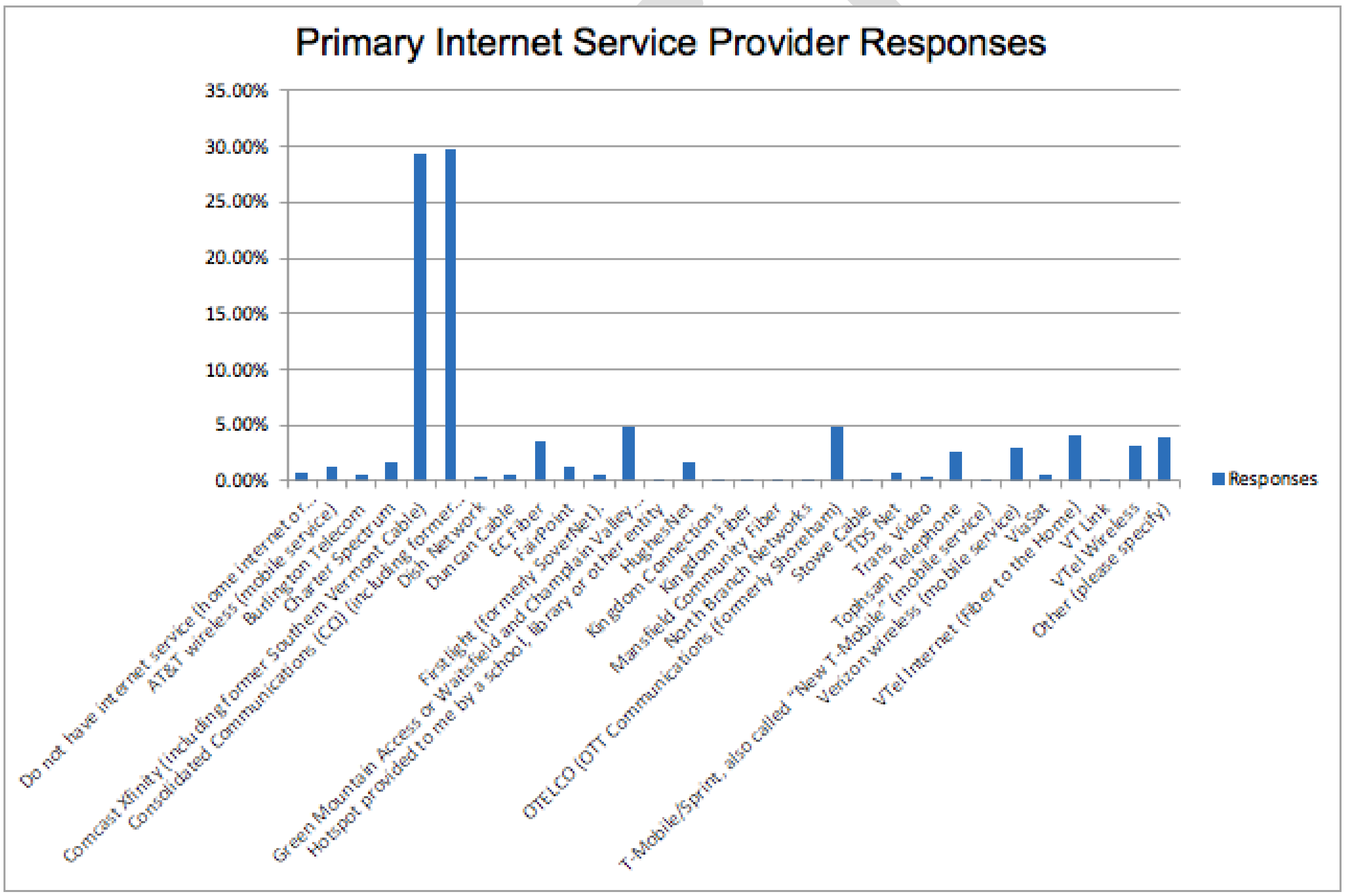
Figure 2: Residential Survey Response Distribution by Age



Most respondents (96 percent) reported having internet access, including 79 percent who have both home internet service and a cellular/mobile telephone service with internet (smartphone). The high saturation of internet access would be expected in an online survey.

Comcast Xfinity and Consolidated Communications (CCI) are the leading internet service providers (ISP) used according to our surveys responses. Three in 10 respondents subscribe to Comcast Xfinity, and three in 10 subscribe to CCI. Other ISPs comprise much smaller shares of the market statewide but may represent larger shares in some individual counties. Further detail on companies used by respondents are provided in the body of the report. The figure below shows the sample size distribution by primary internet service provider.

Figure 3: Internet Service Providers Used by Survey Respondents



2.2 Key Residential Survey Findings

2.2.1 Broadband Access Gaps

The online residential survey found very few gaps in acquisition of residential internet access services. This was to be expected from a survey conducted online. However, the survey illuminated important aspects of changing customer behavior due to the pandemic in terms of use of the internet and access points to the internet, and importantly, a severe lack of usage of low-cost broadband programs available to low-income residents. The following are key findings:

- **5 percent of all respondents and 9 percent of low-income households (earning less than $25,000 per year) only use a smartphone for home internet access.** This may limit their ability to fully utilize online services at home.

- **Residents may be significantly underutilizing existing broadband subsidy programs.** Only one percent of all Comcast subscribers, and 10 percent of low-income subscribers, participate in the Comcast Internet Essentials program. Another 59 percent of low-income subscribers were unaware of the program, and 15 percent attempted to enroll but were declined.

- **Most (99 percent) respondents access the internet from any location, including a range of locations outside the home.** However, use of the internet outside of the home has declined significantly during the Covid-19 pandemic.

- **Most respondents are unaware of the State's emphasis on Communications Union Districts.** Three in 10 respondents said they are aware of CUDs as a way to improve broadband access in unserved areas, while 59 percent are unaware and 11 percent are unsure.

- **Public Wi-Fi access may not be adequate.** Nearly one-half of respondents (45 percent) are aware of public Wi-Fi hotspot locations near their home, but just eight percent said that hotspot access is adequate in the area. Another 43 percent were unsure.

- **Most respondents use search engines to learn about availability of internet service.** Two-thirds named search engines as the leading source of information to learn about available service options, and seven in 10 named search engines as the top source for learning how to use the internet more effectively.

2.2.2 Covid-19 Impacts on Broadband Use

Respondents reported increased use of and demand for broadband services during the Covid-19 pandemic. They are utilizing the internet more at home and less often outside the home, as may be expected, and they are engaged in more online activities for work, school, and entertainment. The following are key findings:

- **Daily use of home internet services at various times has increased during the pandemic**. Prior to the Covid-19 pandemic, just over one-half of respondents made daily use of the internet mid-morning or early afternoon, compared with approximately nine in 10 respondents during the pandemic. Four in 10 households have at least three members online during peak usage times during the Covid-19 pandemic.

- **Use of internet services outside of the home has declined significantly during the Covid-19 pandemic.** Use of the internet in key areas decreased significantly when comparing figures pre-Covid and during-Covid, including in work settings (79 percent vs. 56 percent), private businesses (65 percent vs. 27 percent), schools or colleges (38 percent vs. 20 percent), and public buildings (37 percent vs. 18 percent).

- **Engagement in online activities has increased significantly during the Covid-19 pandemic.** Use of the internet for telemedicine or medical appointments (19 percent vs. 75 percent) and for civic engagement (33 percent vs. 74 percent) increased substantially from pre-pandemic to during-pandemic, although some of the use is at a monthly or less than monthly basis. Additionally, 62 percent of respondents use the internet for teleworking on a daily basis, compared with 21 percent of respondents before the pandemic.

- **Satisfaction with internet service aspects has decreased during the pandemic, particularly for speed and reliability of service.** More than one-half of respondents are not at all satisfied (approximately one-third) or are only slightly satisfied (approximately one-fifth) with connection speed and reliability during the pandemic.

- **Many respondents have experienced some challenge with accessing telehealth or an online medical appointment during the pandemic.** Specifically, four in 10 respondents experienced an issue (e.g. having to switch from video to audio only), while three in 10 have not had a medical appointment and another three in 10 did not respond or had no issue.

- **Most households with children have internet access, but it may not be sufficient for some families.** Most respondents disagreed that their children have to do homework or distance learn at various locations outside the home (although 13 percent agreed or strongly agreed that their children cannot complete their homework or cannot distance learn because they do not have access to the internet at home.) However, four in 10 respondents strongly disagreed that their home internet connection is adequate for their or their children's needs for doing homework or attending classes online.

Sixteen percent of all respondents consumed public, educational, or governmental (PEG) TV content during the Covid-19 pandemic. Among those who viewed PEG programming, the most commonly accessed content was broadcasts of municipal functions, cited by 72 percent of respondents. One-half of PEG viewers accessed information about Covid-19.

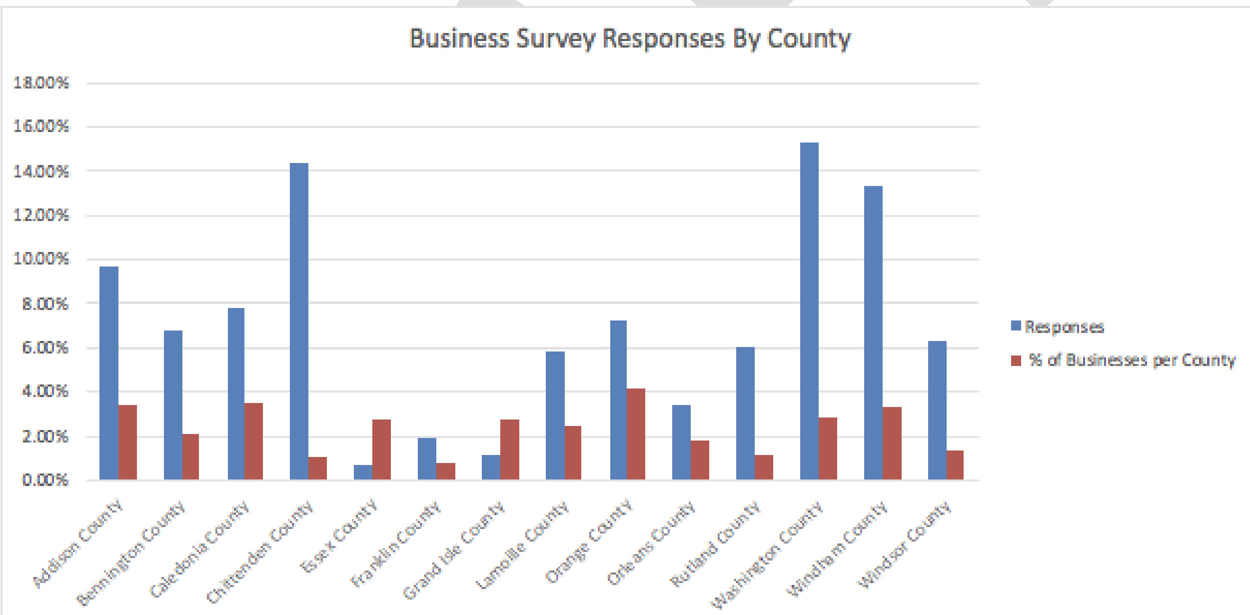
2.3 Business Survey Methodology

The online business survey was promoted through organic and paid promotions, including a press release from the PSD, requests made from town administrators and managers, social media promotion from a range of entities, paid Vermont Business Magazine advertisements, outreach via Regional Planning Commissions and Regional Development Corporations, and other efforts.

The survey received responses from 422 respondents. The survey results are presented in full in Appendix B.

More than two-thirds (70 percent) of respondents owned a business that employed one to four employees; more than 84 percent of the respondents stated they only operated out of one location.

Figure 4: Business Survey Responses by County



2.4 Key Business Survey Findings

Key findings are here presented thematically in two subsections: broadband internet usage and Covid-19 impacts on broadband use.

2.4.1 Broadband Internet Usage

The survey found that communication services are widely used and that there are very few gaps in acquisition of business internet. The following are key findings:

- **Almost all businesses have internet access.** Leading types of primary internet service include cable modem (35 percent), DSL (27 percent), and fiber (15 percent). One-half (50 percent) of businesses do not have a backup or secondary internet connection, and 32 percent have a cellular/mobile connection as their backup or secondary internet connection.

- **The most utilized connectivity services were internet and telephone.** Most (99 percent) reported having internet access at their primary business location, while 75 percent have telephone service, 61 percent have cellular data service, and 54 percent have videoconferencing service.

- **Almost all (99 percent) businesses have personal computers.** Specifically, 65 percent of businesses have 1-4 computers, 21 percent have five to nine computers, and 13 percent have ten or more computers.

- **Price may be a barrier to purchasing carrier-grade internet service.** Nearly two-thirds of respondents (65 percent) are extremely willing to purchase 1 Gbps internet for $75 per month, but willingness drops considerably at higher price points. Just eight percent of businesses would be extremely willing to pay $250 per month for very fast internet service, but 22 percent would be extremely willing to purchase carrier-grade Ethernet transport and internet access service at this price point. Businesses would be not at all likely to slightly likely to pay more than $250 per month for carrier-grade service.

2.4.2 Covid-19 Impacts on Broadband Use

Businesses are relying more on remote work during the pandemic and at the same time are reporting some inadequacies in their broadband internet service, particularly with speed and reliability of service. The following are key findings:

- **Businesses report their internet service being slower during the pandemic**. Before the Covid-19 pandemic, more than four in 10 respondents (42 percent) thought their internet connection speed was fast enough for their needs, dropping to 35 percent during the Covid-19 pandemic. Only 15 percent thought their internet connection speed was very slow and would like to be connected at much higher speeds before the pandemic, while during the pandemic this number increased to 26 percent.

- **Satisfaction with internet connection speed and reliability has dropped somewhat during the pandemic.** Nearly one-half of businesses (47 percent) were very or extremely satisfied with their internet's speed of connection prior to the pandemic, dropping to 38 percent during the pandemic. Similarly, 47 percent of businesses were very or extremely satisfied with their internet's reliability of connection, dropping to 35 percent during the pandemic.

- **Businesses are making more use of online platforms to sell goods or services or to engage in online marketing and promotions during the pandemic.** The percentage of businesses that exclusively use online platforms to sell goods or services or to engage in online marketing and promotions has increased from six percent before the Covid-19 pandemic to 15 percent during the pandemic.

- **The percent of time that employees work remotely has increased during the pandemic.** Specifically, one-third of employees now telework 75-100 percent of the time, compared with 11 percent of employees before the pandemic.

- **The percentage of employees working remotely is expected to increase after the Covid-19 pandemic.** More than four in 10 (42 percent) businesses said they did not have a work remote option prior to the pandemic, while 29 percent said they do not plan to have one after the pandemic and seven percent are undecided. One-fifth of business plan to have a fully remote work option for some or all employees after the pandemic, compared with 13 percent during the pandemic.

- **Many businesses said that most or all of their employees (75-100 percent) experienced issues due to inadequate broadband service during the pandemic**. For example, one-third of businesses said that all or most of their employees experienced delays in uploading or downloading content. More than one-half of businesses said inadequate broadband service is a very significant or extremely significant issue.

- **Many businesses plan to take some action in the next 12 months related to broadband internet service and computers.** Most businesses expect to obtain higher-quality broadband service (57 percent) and to enhance an existing website or online sales effort (56 percent) in the next 12 months. Fewer respondents expect to take other actions; however, 15 percent plan to help employees obtain internet access at home and 11 percent plan to move to an area with better broadband service.

3 Pre-Covid Use and Expected Future Requirements for Telecommunications Services in Vermont

In every major use category we analyzed—including telehealth, telework, remote learning, and civic participation—we found that Covid-19 led to an increased demand for and reliance on telecommunications services in the State. Looking ahead, we anticipate those trendlines to continue; while remote learning and telework levels, in particular, will likely decline in a post-Covid-19 world, our analysis indicates broadband requirements in Vermont will be higher after the pandemic than they were before.

3.1 Healthcare and Telehealth in Vermont

Telehealth usage has dramatically increased in the State of Vermont due to the Covid-19 pandemic, and with that, more Vermonters are reporting challenges with connectivity related to healthcare appointments. According to our online residential survey, 75 percent of respondents have used telehealth services during the pandemic, and four in 10 experienced technical difficulties or challenges related to connectivity.

The growth in telehealth usage is a direct result of the pandemic and the desire to avoid in-person hospital visits; however, it could not have happened were it not for a range of State and federal regulatory waivers and changes, including the waiver of platforms from being HIPAA compliant;[14] the expansion of telehealth by the U.S. Centers for Medicare & Medicaid Services (CMS) through section 1135 waivers that allow a range of medical visits to be reimbursed by Medicare;[15] and the temporary allowance of audio-only telehealth appointments to be reimbursed by Medicaid at the State level.[16][17]

Though it is unclear whether these regulatory changes will be made permanent (thus enabling continued heightened use of telehealth) or allowed to expire, the use of telehealth has provided a range of benefits, including the reduction of travel burdens and miles driven, the elimination of wait times (especially in indoor, shared spaces), and a reduction in missed appointments, especially for certain specialties.

3.1.1 Telehealth Appointment Trends

UVM Health Network saw eConsult appointments increase from an average of 300 appointments weekly to an average of 3,400 appointments as a result of the pandemic. UVM Health Network

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14 https://www.hhs.gov/about/news/2020/03/17/ocr-announces-notification-of-enforcement-discretion-for-telehealth-remote-communications-during-the-covid-19.html

15 https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet

16 https://dvha.vermont.gov/sites/dvha/files/documents/News/DVHA%20Telemedicine%20%26%20Emergency%20Telephonic%20Coverage_Dental%20Providers%2004.10.2020.pdf

17 https://dfr.vermont.gov/sites/finreg/files/doc_library/dfr-memo-covid19-telehealth-guidance.pdf

reached a peak in April, estimating around 7,000 eConsults in a single week. Pre-pandemic, their annual goal had been to conduct 3,000 eConsults within the year.

Community-based Federally Qualified Health Centers (FQHC) serve about a third of the Vermont population and saw a spike in telehealth visits in April. As patients have been able to return for in-person care, the number of telehealth appointments has declined to about 10 percent of weekly appointments. However, the percentage of telehealth delivered as video visits as compared to telephone visits has increased—implying that more residents are relying on their home broadband connections or smartphones for telehealth.

Dartmouth-Hitchcock Medical Center reported that pre-Covid, offices were delivering about 10 outpatient video visits per day, split about 50/50 between patients at home and patients at another clinical facility closer to their home. In mid-April, DHMC hit a high of 2,600 telehealth appointments per day, including both video and telephone appointments.

After an initial spike in telehealth usage in March and April, healthcare providers saw a slow decline of telehealth appointments, especially as patients returned to in-office appointments for in-person needs like flu shots, immunizations, and testing that was delayed from earlier in the year. Nationally, the trend is similar, with telemedicine visits averaging around 6 percent of the total weekly visits.[18] However, rising case numbers in Vermont may cause telehealth usage to rise again—as residents who have sufficient telecommunications connectivity request telehealth visits, and as healthcare providers require virtual appointments whenever feasible as a way to limit exposure.

As telehealth appointments have increased in the last six months, providers have seen significant variability in telehealth usage by specialty. Nationally, behavioral health telehealth usage remains high as the pandemic continues, whereas surgical specialties have little to no usage of telemedicine. Additionally, telehealth has been adopted more widely in specific areas of care management, particularly in chronic care management and mental health services. OneCare Vermont reported that in a survey it conducted, Vermont healthcare providers responded that the top four telehealth services they plan to continue post-pandemic are chronic management, mental health services, medication management, and non-urgent acute visits.

Though advocates do not anticipate telehealth increasing the number of patients that can be served in a given amount of time because practices' implementation is still at the stage where it

[18] "The percentage of all visits via telemedicine visits is slowly declining from its April peak. But it continues to be well above the pre pandemic baseline of very few telemedicine visits." Ateev Mehrotra et al., ((Commonwealth Fund, Oct. 2020)

is taking providers as long or longer to see each patient with the new workflows, practices are seeing a reduction of the number of no-shows, particularly in mental health.

Lastly, it is important to note that FQHCs found that there is not a correlation between telehealth usage with a patient's broadband coverage or type (though clearly a patient requires reliable and sufficient broadband access to be able to consider a telehealth visit). Telehealth usage is influenced by many factors related to the provider, including:

- Practice culture – incorporating telehealth workflows requires investment in new trainings
- Grants and funding – practices that have received funding for telehealth equipment are more likely to see higher usage of telehealth appointments
- Buildings and facilities – providers that have access to buildings large enough to continue seeing patients in person while taking Covid-19 precautions may be less reliant on telehealth options
- Reimbursement – practices are reluctant to use telehealth until long-term reimbursement decisions are made

3.1.2 Barriers to More Effective Telehealth Engagement

Though audio-only telehealth visits are widely used, lack of broadband access is cited as a major barrier to effective telehealth appointments in the State. According to a OneCare Vermont survey, over 75 percent of providers reported insufficient broadband access as a barrier for patients to participate in telehealth services. Providers routinely experience appointments where they are required to switch to audio-only to complete providing care. Though audio-only appointments may make telehealth services available to more people, some providers, like DHMC, believe that video-enabled telehealth appointments provide for better outcomes.

UVM Health Network provided mobile hotspots to senior living centers to allow for telehealth appointments where broadband connectivity was unable to meet remote care needs. By providing mobile hotspots to boost connectivity, UVM also eliminated unnecessary exposure for both patients and providers. Another pilot to provide short-term connectivity for telehealth needs was facilitated by the Vermont Legislature through the Department of Health for the Covid-Response Telehealth Connectivity Program. The program was administered by the Vermont Program for Quality in Health Care, Inc. and ran a pilot to provide 1000 tablets and 350 Wi-Fi boosters for patients prioritizing high risks and medically underserved areas across the State. The pilot was not able to meet the demand of all requested devices due to financial constraints and a limited timeline. Further, VPQHC identified some applicants as ineligible for the pilot because of the practices' limited access to broadband infrastructure.

In addition to a lack of broadband access, technical support and digital literacy were also a large barrier to effective telehealth. In March 2020, OneCare Vermont and Vermont Medical Society each completed a survey of Vermont providers to assess the transition to telehealth where both surveys received responses indicating that appointments take longer due to technical issues from patient/provider knowledge and broadband issues.[19] 55.7 percent of providers who took their survey state "Lack of staff time/ability to coach patients" as a barrier for providing telehealth service.[20] Nearly half of the respondents in the OneCare Vermont survey stated that they had appointed a dedicated employee in their office to educate and assist patients in telemedicine. Relatedly, we heard from several interviewees that clinical teams are spending too much time on technical issues with the patients, shortening appointment time for health related discussion and limiting the amount of patients providers are able to serve.

In some cases, Covid-19 has also created the need for practices to bring on additional staff. For example, UVM Health Network increased staff who participated in telehealth delivery from 50 providers to 1,600 since March. This increase in staffing clearly indicates the impact of the pandemic on demand for telehealth, and implies a likely future baseline of telehealth demand that exceeds the pre-Covid levels.

A lack of widespread residential broadband also impacts medical staff and healthcare providers. A key concern of providers in the State is that when providers are exposed or test positive for Covid-19, they are required to quarantine for 10 days, which can leave offices short-staffed. The potential for a Covid surge in the winter has heightened the fear that hospital resiliency is thus limited to some degree by lack of universal residential broadband access. By the same token, if hospitals themselves do not have systems in place to perform telehealth appointments, they are at a disadvantage during the pandemic, and potentially afterwards as telehealth takes on new prominence in our healthcare system.

The field of telehealth is evolving quickly. Data and metrics about effectiveness are still being studied, and the techniques needed to make appointments as efficient as possible are still being developed. Given the short transition timeline due to the urgency of the pandemic, telehealth services have worked considerably well for Vermonters who have strong-enough broadband service to access it and available devices to use. The health, safety, and environmental benefits to the State have been demonstrated, and more Vermonters are using telehealth than ever before—but, the benefits of telehealth (now and in the future) can only truly be captured by a connected, digitally trained population.

[19] Vermont Medical Society Survey. OneCare Vermont Survey summary, March 2020

[20] OneCare Vermont survey summary, 325 responses, over 55% from the Burlington Health Service Area, March 2020.

3.2 Telework

The shift to telework is one of the most pronounced impacts of the pandemic, and will have a lasting impact on how large segments of the population work even after the recovery. Reliable and sufficient broadband access has been critical to Vermonters' ability to telework during the pandemic and will continue to be required post-Covid for those whose jobs can be performed remotely.

LinkedIn members shifted from self reporting 10 percent worked remotely in February of 2020 to 60 percent working remotely in May.[21] Many large companies (e.g., Zillow, Twitter) have declared that distributed work will be made permanent and the applications market has exploded with tools to facilitate distributed collaboration.

However, the ability to move one's job online is not universal. Most jobs in tourism, manufacturing, agriculture, and construction need to be done in person. As in most rural parts of the country, Vermont's employment mix makes it particularly susceptible to the impacts of pandemic-related shutdowns. Vermont's unemployment soared in the spring of 2020 (though there has been a rebound over the past six months).

Part of the reason the unemployment rate is not currently higher is that Vermont appears to have also benefited from the move to remote work, with evidence of an influx of people seeking refuge from cities (on a temporary or part-time basis) who brought their jobs with them. This trend is dependent on the availability of residential broadband services. The Agency of Commerce and Community Development cited research from UVM that anticipates that of the new arrivals in Vermont, many of whom are currently working remotely, one-third will stay permanently (and will presumably continue to require broadband service), one-third will leave after the pandemic is over, and another third are undecided.[22]

Vermonters also saw a significant shift to online work. Our online survey showed that 62 percent of respondents use the internet for teleworking on a daily basis, compared with 21 percent of respondents stating they teleworked on a daily basis before the pandemic. This shows a huge spike in demand for broadband as a result of Covid—a spike that will continue to the extent that residents continue to telework post-Covid. Respondents to the business survey also saw significant shifts in their employees working from home and the phone survey found that a large number of people who are not deemed served are attempting to work from home with deeply inadequate connection speeds or needing to find publicly available connectivity.

[21] Interview with Allen Blue, co-founder of LinkedIn.

[22] Interview, Ken Jones, Agency of Commerce and Community Development, conducted October 16, 2020.

Figure 5: How Often Used the Internet for Various Activities Before Covid-19 Pandemic

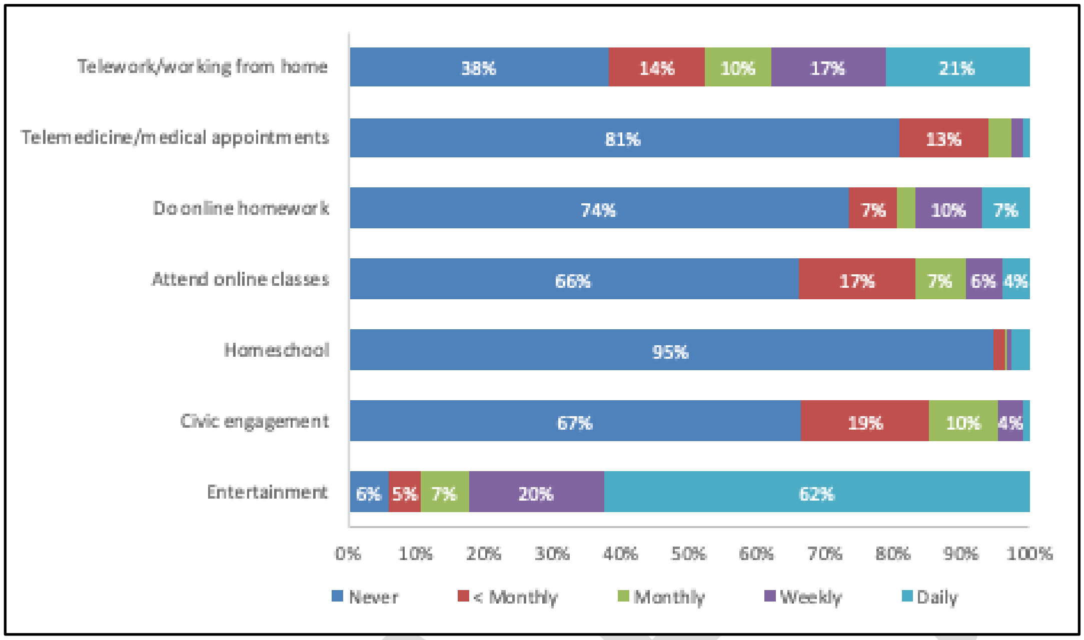
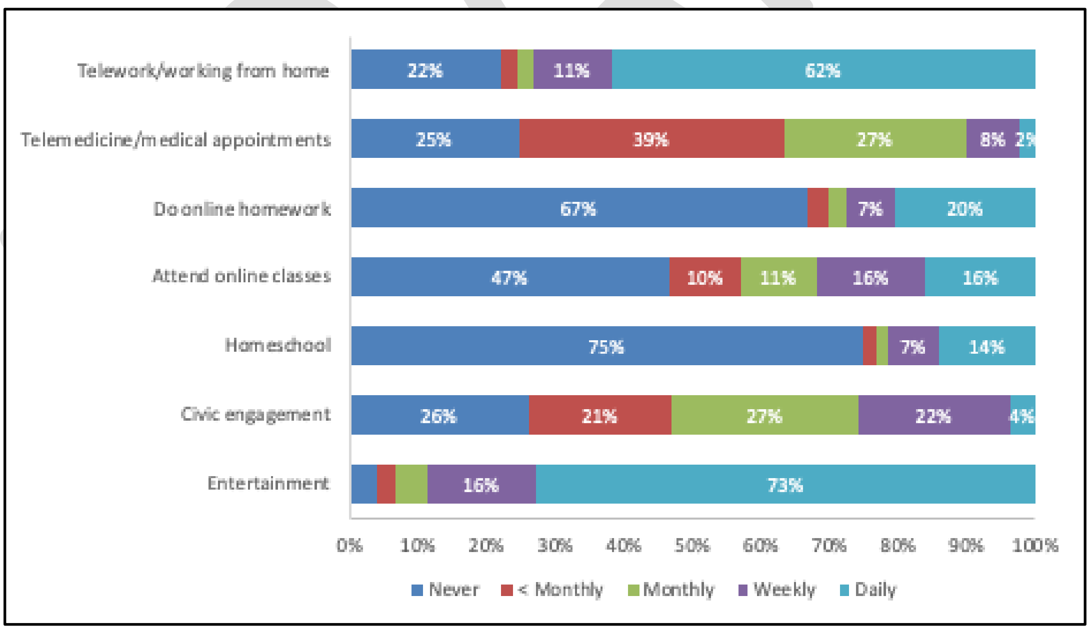


Figure 6: How Often Used the Internet for Various Activities During Covid-19 Pandemic



Understandably, this movement to remote work has put unprecedented value on access to residential broadband—and on the quality of that service. The online residential survey results suggest deepening dissatisfaction with broadband speeds as more people attempt to work from home. Not only does this reinforce the need for remote workers who are struggling to have passable connectivity as soon as possible, it reinforces the need for Vermont to move to a 100/100 statewide solution.

Vermonters have responded to the remote work mandates as directed by the governor—and employers have been working hard to develop new mechanisms for continuing operations in a remote work environment. Clearly these efforts have been thwarted by inadequate residential broadband speeds in some areas, even from those who are considered served. The move to remote work has the opportunity to benefit Vermont as more people from out of state seek a rural lifestyle and Vermont's other benefits, yet regions with poor broadband connectivity will be left out of this potential migration.

3.3 Remote Learning

Clearly, connectivity challenges are continuing to present challenges for educators despite best efforts to adjust to the realities of the pandemic. Disadvantaged students whose parents are less likely to be able to afford broadband connections and those without broadband infrastructure are now at an even greater risk of falling behind. Some school districts have clearly made attempts at accommodating many of their students, but unlike other states, Vermont has not taken a comprehensive statewide approach to address the problem.

Superintendents who responded to a survey (described in detail below) overwhelmingly expressed that expanded residential high-speed internet is needed to facilitate online learning. As one superintendent explained, "Connectivity is the biggest challenge for us as a district; we are one to one with devices, but connectivity is the challenge."

Because of the pandemic, children across the State spent the fall 2020 semester—and most of the earlier spring semester, after about mid-March—in a learning environment unlike any other. The operations of Vermont schools are decided on a school-by-school basis, and the majority have taken "hybrid" approaches with some in-person teaching and some remote learning, to minimize the Covid-19 transmission risks to children, teachers, and families. This environment is challenging, and though schools and teachers are adapting curricula and teaching strategies to provide the best learning environment they can, many students are struggling with remote learning due to inadequate residential broadband internet, especially because online learning often uses broadband-intensive applications like Zoom.

When interviewed, representatives of the Vermont Agency of Education (AOE) emphasized that it is clear that many families are struggling with broadband, but it is not always apparent whether the underlying issue is affordability or access to infrastructure. Nearly every town has some areas that are served and some unserved with broadband, and there are low-income families in all Vermont communities.

The AOE also reported that the shift to online learning has caused a large increase in workload for school district employees. Technology directors are spending time helping students navigate computer and other technical issues, teachers are having to create multiple lesson plans to be taught online and in-person, and administrators have been preparing for a potential "second wave" that would force schools to operate entirely online. The AOE also reported that the Vermont Virtual Learning Cooperative, which allows students to take online classes from other schools, now supports a record 11,000 students—all of whom depend on broadband connections.[23]

Though some ISPs with close relationships to the community—like Waitsfield Champlain Valley Telecom—have worked with schools to connect all students who need broadband, other school districts have been cautious about any sharing of student data, and the AOE has echoed concerns surrounding privacy of student data given the quick transition to online learning. An additional privacy concern is that public Wi-Fi networks, by their nature, are less secure; a number of students without broadband at home are using these networks to access classes and homework.

The project team sent a survey to 52 superintendents whose email addresses were available online to determine how school districts are adjusting to the Covid-19 pandemic and what gaps still remain; 32 superintendents from 11 counties completed the survey, representing over half of superintendents (there are 54 supervisory unions in the State). Complete results are presented in Appendix C.

Importantly, it was clear that schools were working hard to ensure students had access to broadband by expanding Wi-Fi coverage in school parking lots, distributing laptops and hotspots, and working with the Department of Public Service to identify households that cannot access broadband infrastructure. Among the survey findings are the following:

- 94 percent of superintendents said their school districts surveyed their students to determine which students have access to broadband at home.
- 78 percent of superintendents said their school district assisted the State of Vermont in identifying households with K-12 students without access to broadband for the Emergency Connectivity Initiative and Get Vermonters Connected Now Initiative; the remaining superintendents were "not sure" if their district participated.
- Access to internet-connected devices is less of a concern than broadband access; 94 percent of school districts are providing equipment, such as Chromebooks to students;

[23] https://www.vtvlc.org/

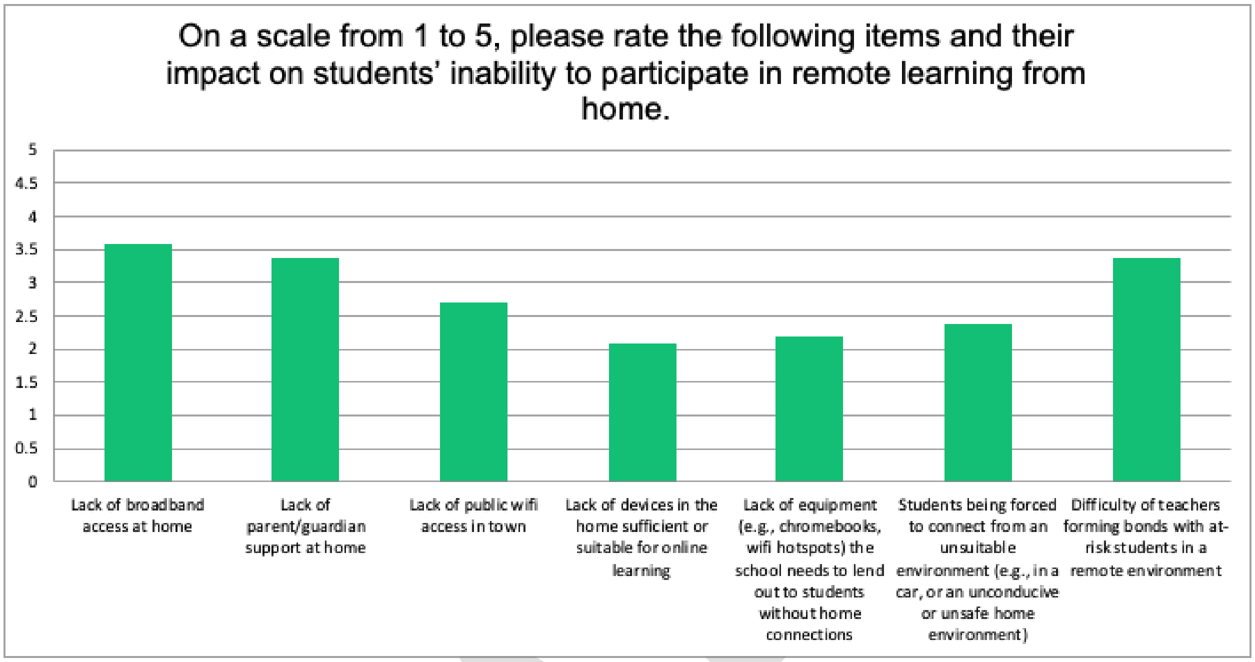
the remaining superintendents were "not sure" if their school district provided equipment.

- It is less common for schools to provide students equipment to connect to the internet, such as portable Wi-Fi hotspots, with 53 percent of superintendents reporting their district did so. Portable hotspots rely on cellular service, which is poor in much of the State.
- 75 percent of superintendents said their district added equipment to strengthen Wi-Fi signal in school parking lots.
- 50 percent of superintendents said that their district either participated in a subsidy program or promoted a program with an Internet Service Provider to bring low-cost internet to low-income families.

That being said, connectivity issues were far from solved by what schools were able to do, and lack of broadband access among some students had a major impact on school operations throughout the year:

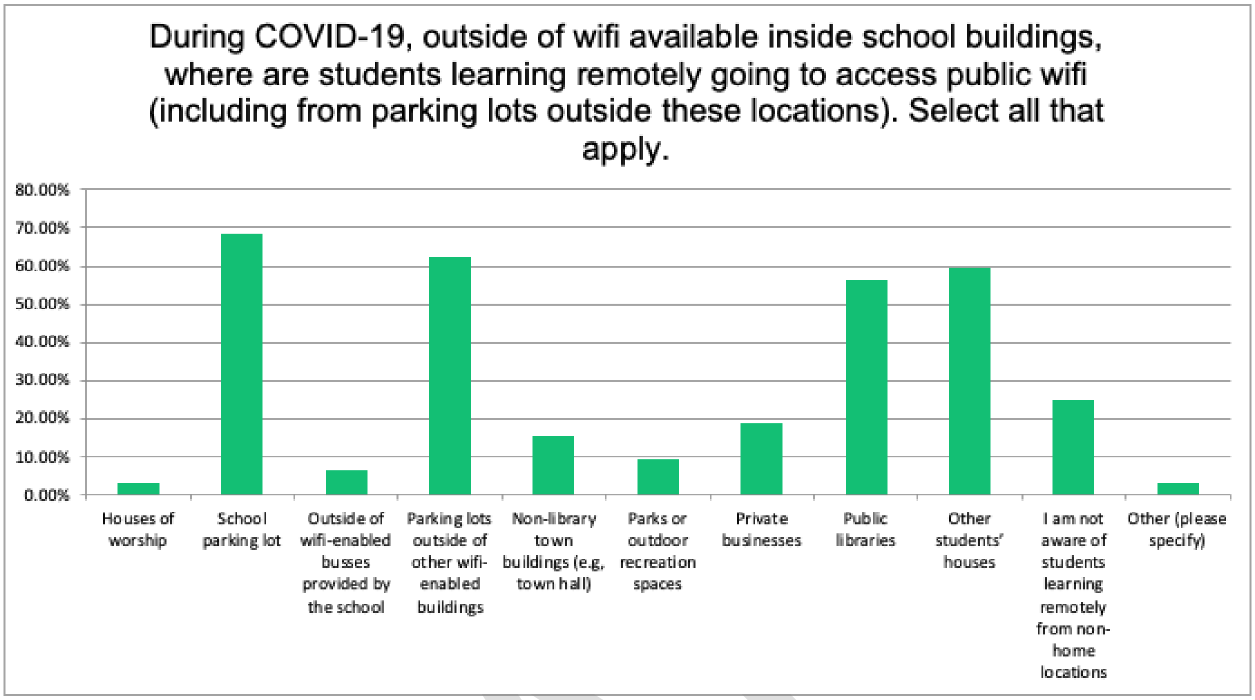
- 71 percent of superintendents said broadband access for students and teachers was a "very important" factor when making plans for this school year.
- The biggest barriers to online learning were a lack of broadband access at home, a lack of parent/guardian support at home, and difficulty of teachers forming bonds with at-risk students in a remote environment.

Figure 7: Importance of Broadband for Remote Learning



- 56 percent of superintendents said 75 percent of students or fewer had access to broadband at home
- 75 percent of superintendents said students were completing online work at locations other than home. In particular, students were connecting to the internet in school parking lots, other parking lots with Wi-Fi access, and at other students' homes.

Figure 8: Public Wi-Fi Has Been Critical for Remote Learning During Covid-19



- Teachers also struggle with access to adequate broadband: 81 percent of superintendents said teachers had difficulties with low video quality due to poor internet connections and 68 percent said that teachers had difficulty accessing online tools due to a lack of broadband.

- Absenteeism is a concern for many schools; 44 percent of superintendents said absenteeism for online students had slightly or significantly increased compared to a normal semester. 40 percent said absenteeism stayed about the same, and 16 percent said it decreased.

- Teachers are using applications that require faster upload and download speeds. Before the Covid-19 pandemic, the use of video conferencing software was not widespread: No superintendents reported that 75 percent or more teachers were using video conferencing software (Zoom, Microsoft Teams, etc.) for teaching. In stark contrast, during the Covid-19 pandemic, 84 percent of superintendents reported 75 percent of teachers or more using video conferencing software.

- 75 percent of superintendents reported increased challenges addressing health and mental health needs of students. Of superintendents who answered yes, 75 percent said lack of sufficient broadband has exacerbated difficulties addressing health issues.

- Superintendents are reasonably confident that they could pivot to online-only learning. On a scale of 1 – 5, where 5 is extremely confident, 71 percent of superintendents rated their readiness to pivot as a 4 or 5.

- Superintendents noted some groups are particularly at risk of falling behind: rural students, students of color, students at risk of dropping out of school, students living in poverty, students who need access to reduced-price lunches, students with disabilities, young children, students without adult support at home, English language learners, and students without internet access.

Inadequate cellular service is also an issue, as mobile hotspots rely on cellular service; one superintendent reported that families in remote areas "can all reach enough Wi-Fi to operate a cell phone, [but] they do not all have sufficient connection to run Zoom for multiple hours a day." Sentiments like this reinforce the need for something more than just mobile hotspots—like signal-boosting equipment—for students with poor cell service.

3.4 Civic Participation

During the Covid-19 pandemic, access to broadband internet has become necessary for Vermonters to fully engage with local governance, and equally so for local leaders to engage with constituents as selectboard, school board, and other public meetings transitioned to being held online. Telecommunications services—for both residents and their local leaders—has been essential during the pandemic.

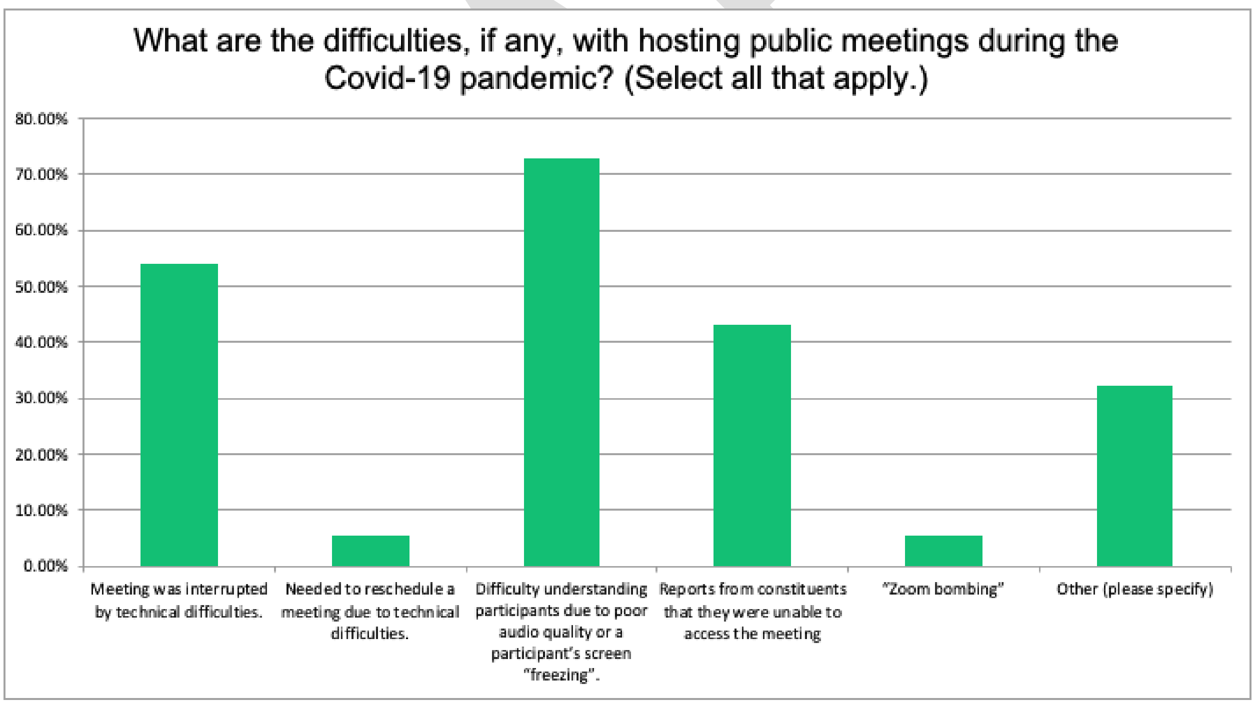
The project team sent a town administrator survey to 205 town managers, mayors, administrators, selectboard chairs, and other local officials across the State; email addresses were provided by the Vermont League of City and Towns. A total of 41 municipal leaders located in 13 counties completed the survey. (As of the writing of this report, the project team has decided to keep the survey open to gather additional responses; the Vermont League of Cities and Towns has also sent a second email asking local leaders to complete the survey. Results to date are presented in Appendix E.)

Vermont is a very civically engaged state, and widespread participatory democracy has served the State well for years, ensuring good faith and cooperative and collaborative governance of our cities, towns, and state. Indeed, broadband availability during the pandemic seems to have enabled even more civic participation than before. Whereas 33 percent of survey respondents reported participating in civic engagement at least monthly before the pandemic, over 50 percent report participating now. With the fast approach of Town Meeting Day next year, it is important to note that just as a lack of connection is a barrier to equity for schoolchildren participating in distance learning, it also can present an equity issue for Vermonters participating in local government.

The survey's initial findings include the following:

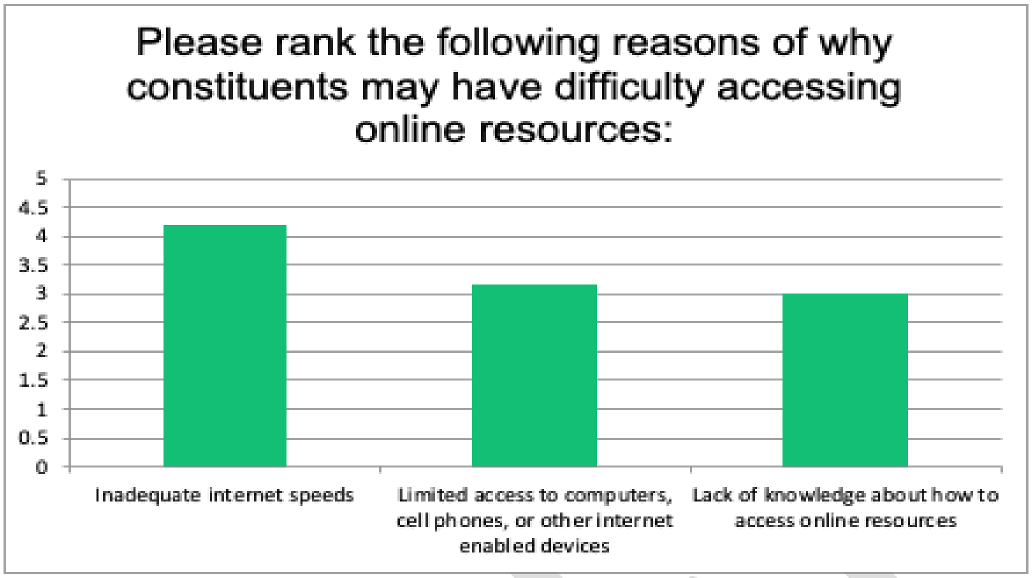
- While no towns utilized video conferencing software for public meetings before the pandemic, 84 percent of towns are doing so during the pandemic. The percentage of towns utilizing telephone conferencing for public meetings increased from 20 percent to 73 percent.
- 36 percent of towns have held in-person meetings during the pandemic.
- Both before and during the pandemic, 34 percent of towns broadcast public meetings on Public, Educational and Government Access Television.
- Hosting public meetings online was challenging, with 73 percent of respondents reporting difficulty understanding participants due to poor audio quality or a participant's screen "freezing." 43 percent reported that some constituents have had trouble accessing online meetings.

Figure 9: Challenges with Hosting Virtual Public Meetings



- 27 percent of respondents reported that attendance at public meetings increased during the Covid-19 pandemic, 15 percent reported decreased attendance, and the remaining respondents said attendance stayed about the same.
- Inadequate internet speeds was listed as the biggest reason constituents were not able to access online resources.

Figure 10: Importance of Broadband for Accessing Resources



- 37 percent of respondents said their towns have started planning for an online town meeting this spring. When asked to rate their confidence in hosting an online spring meeting on a scale of 1 to 5, where 5 is "extremely confident," only 15 percent of respondents rated themselves a 4 or a 5.

- To ensure residents can participate in public meetings, the vast majority of respondents stated that increased high-speed internet access would be most helpful. Other respondents also asked the State to provide guidance as to what the best practices would be for online municipal meetings, and how-to videos and technical assistance were also requested.

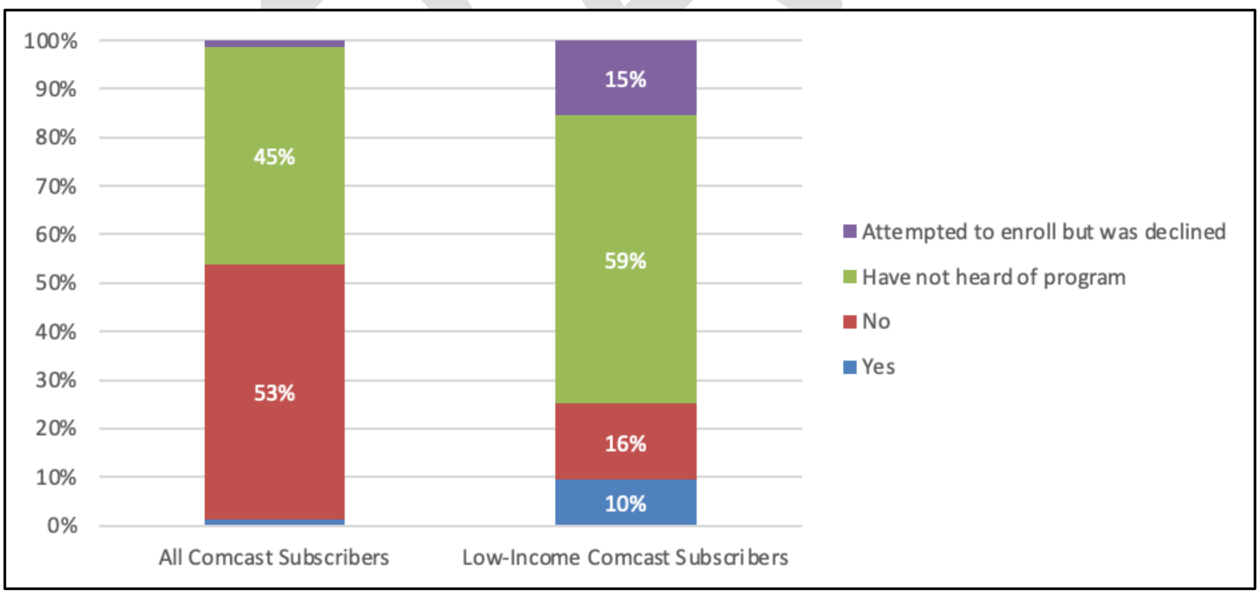
4 Status, Coverage, and Capacity of Telecommunications Networks and Services

4.1 Status Reported by Residents

Online residential survey respondents were only moderately satisfied with aspects of their internet service prior to the Covid-19 pandemic, and satisfaction has dropped somewhat during the pandemic. Specifically, more than one-half of respondents are not at all satisfied or only slightly satisfied with their connection speeds and service reliability during the pandemic. Just 29 percent are very or extremely satisfied with these service aspects, compared with four in 10 before the pandemic. Respondents are also less satisfied with price compared with other service aspects (which is typical in satisfaction surveys).

Although most ISPs are offering low-cost services for low-income residents, the survey found there is a major gap in participation between those who are eligible and those who actually use the services. Comcast's Internet Essentials, for example, was used by only 2 percent of Comcast customers in Vermont who took our online survey, and used by only 10 percent of the low-income Comcast customers. More low-income Comcast customers were denied access to this program than are currently enrolled; a full 15 percent of low-income Comcast customers who tried to sign up for Internet Essentials were denied.

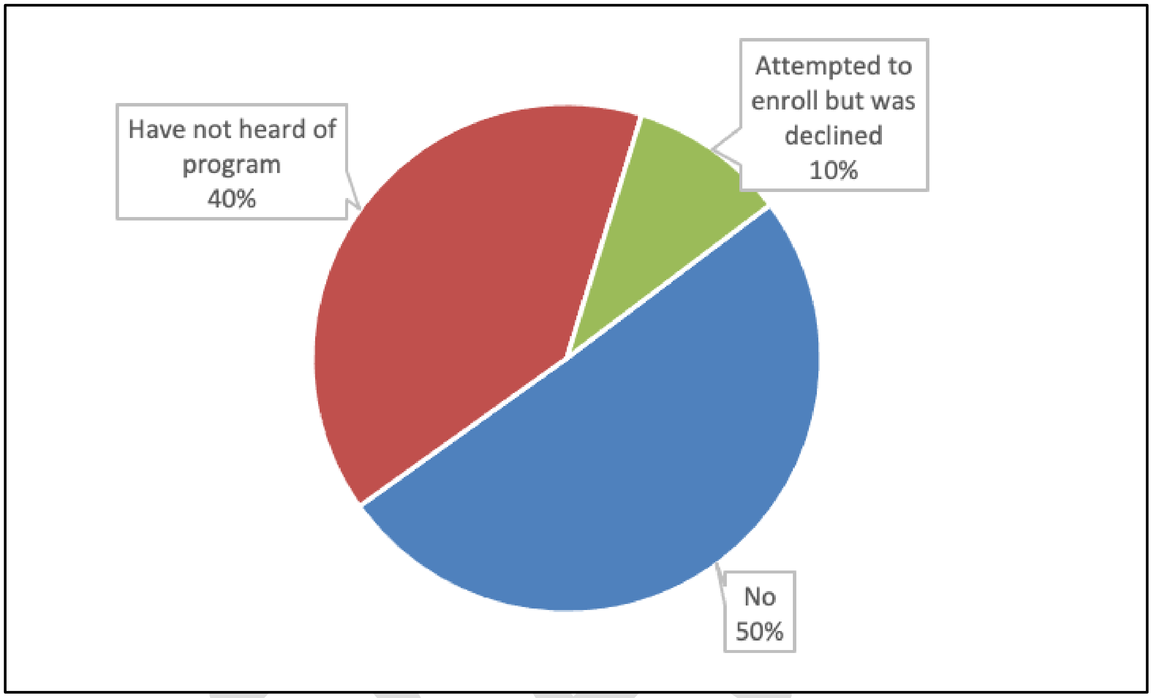
Figure 11: Vermonters' Use of Comcast's Low-Cost Internet Essentials Service



The online survey suggests that usage of Charter Spectrum's program is even lower. Compared to Comcast, Charter Spectrum's program is barely promoted and difficult to find on their website;

likely impacting usage and familiarity with the program. The following chart shows online survey responses from low-income Charter Spectrum customers, when asked if they enroll in Spectrum Internet Assist.

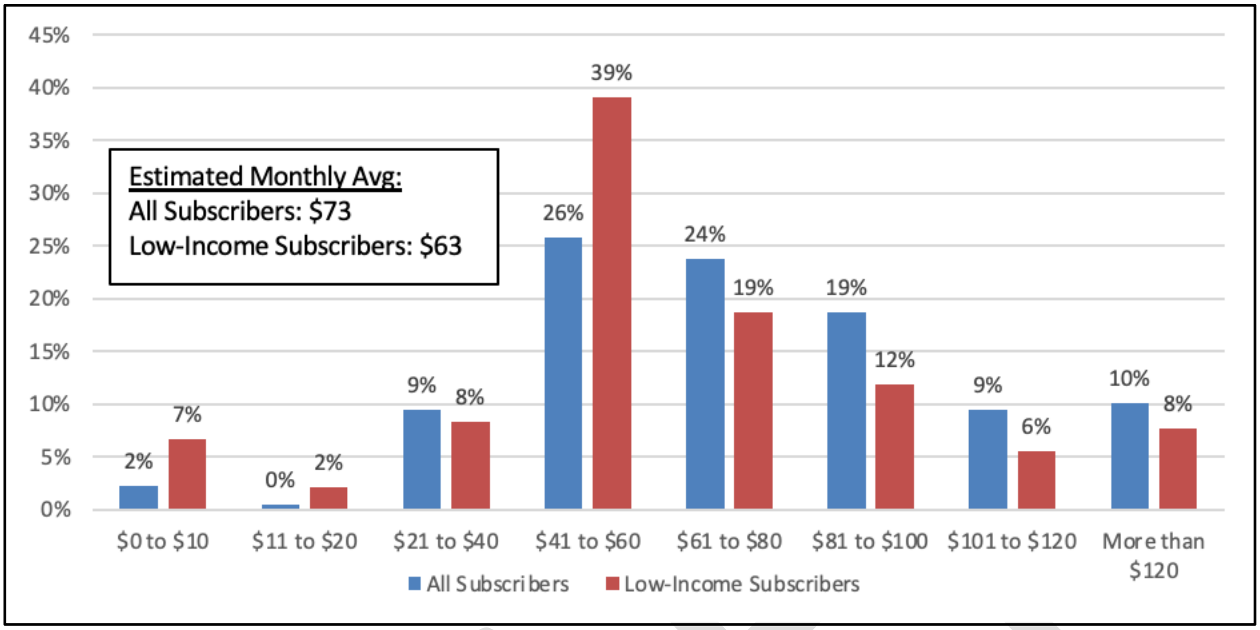
Figure 12: Vermonter's Use of Charter Spectrum's Low-Cost Service



Charter Spectrum also reported that their Stay Connected program, which allows schools to bulk-purchase internet access for educators and students' homes, was not utilized in the State.

Survey responses indicate that low-income internet subscribers are paying only $10 less per month, on average, than non-low-income subscribers.

Figure 13: Monthly Fees for Low-Income Subscribers Compared to All Subscribers



These survey results also clearly indicate a lack of usage of existing low-income programs. Providers' prices for service in Vermont, as well as a comparison to prices in other states, are in Appendix F.

4.1.1 Overview of Service Based on State Broadband Mapping and Testing

The State Department of Public Service has compiled a rich set of broadband maps providing the level of wired broadband service available at each address in the State, as well as wireless service areas based on drive tests on major State roads. The map and the accompanying drive tests and resources are among the most comprehensive sets of information compiled by any state and provide a starting point to assessing and addressing the State's broadband challenges. Unlike databases produced by the Federal Communications Commission and others that work on the Census Block level, and erroneously describe entire areas as "served," when only one or a few addresses are claimed to be served by a service provider, the State's Interactive Broadband Map and accompanying materials provide the wired broadband service at each address from the State's E-911 database. The map fits the existing service into categories of 100/100 Mbps service, 25/3 Mbps service, 10/1 Mbps, 4/1 Mbps and underserved. The broadband map also provides the opportunity to comment on the service at each address, to correct information and to provide more background about other aspects of the broadband service or needs at the address.

Because the wireless drive test data was taken in 2018 and was measured only on major roads, the information from those tests is more impressionistic. Yet it is still a useful complement to the wired data and, accompanied by further information from subsequent drive tests in various parts of the State as well as further analysis based on tower locations, provides a starting point for understanding both wired and wireless coverage.

Based on the interactive broadband map, approximately 61,000 premises, or about 20 percent of the total, do not receive at least 25 Mbps download and 3 Mbps upload speeds—the current definition of broadband by the FCC.

Households and businesses not receiving 25/3 service will likely have challenges with stable and consistent access to the following applications, especially when a home's broadband connection is used by more than one person at a time:

- Interactive video as part of Zoom, Teams, or other tools commonly used for distance learning
- Access to data resources such as maps and stored videos (YouTube, etc.)
- Access to resources in a work or learning environment based in the cloud
- Sharing and backup of files in a storage and application environment such as Google Docs, Dropbox or OneDrive
- Medical appointments including video, medical charts, and rudimentary testing

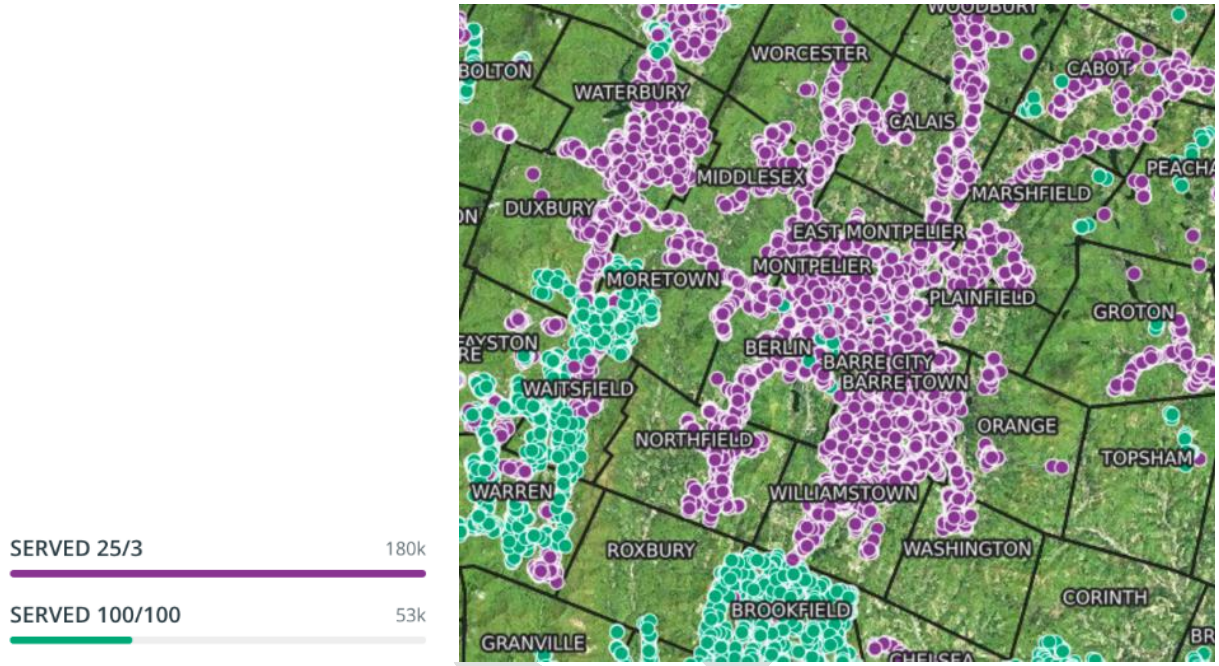
Moreover, households and businesses who have bandwidth-limited or metered services (e.g. "up to 20 GB per month"), even if their service is adequate for these applications, will need to be extremely sparing in their use, needing to ration bandwidth between work needs, classroom learning by children, and entertainment. Even wireless and satellite services which claim to be unlimited often have fine print terms enabling the provider to "deprioritize" users who hit their bandwidth caps, resulting in inability to effectively use video resources until the following month billing period, and/or may pay significant overage charges.

Therefore we identify the 61,000 premises without access to wireline broadband over 25/3 to be at immediate connectivity risk during the pandemic, and we identify strategies targeted at these homes and businesses.

The 61,000 premises that do not receive 25/3, not including premises set to be served by the Emergency Connectivity Initiative, are distributed throughout the State, which poses significant and varied challenges for both short-term and long-term connectivity goals.

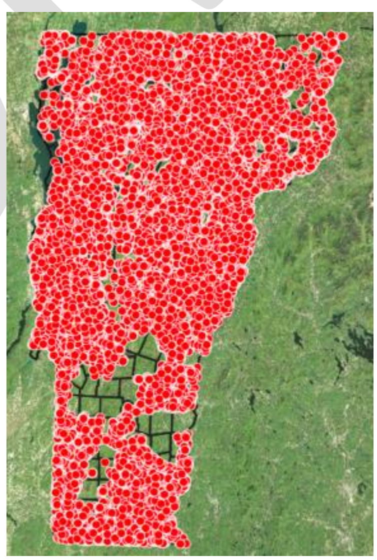
However, there are some clear trends. Those served by 25/3 or 100/100 tend to be in the cities and towns. Those without the service are often in a perimeter area around a town or in an outlying area. The following figure provides a typical example.

Figure 14: Sample Coverage Map



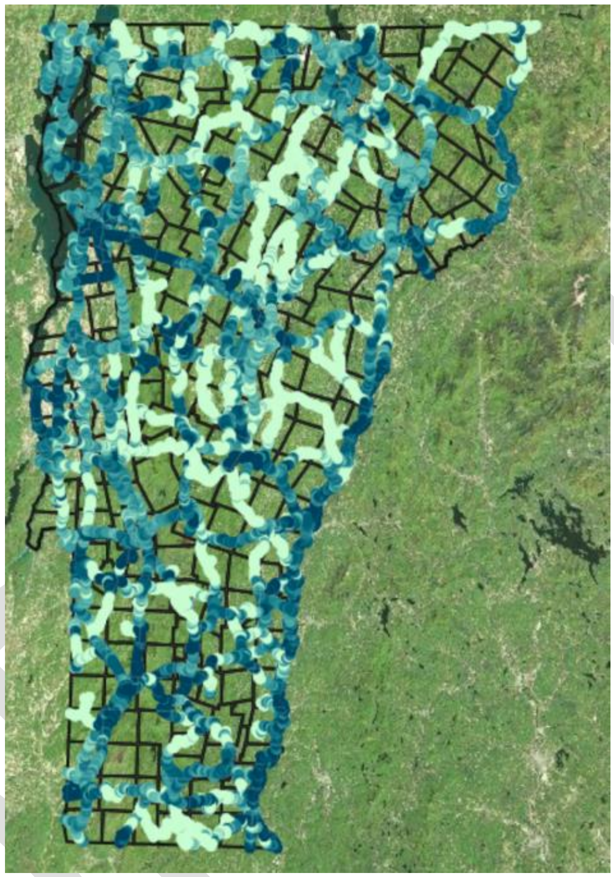
Because most of the 25/3 service is provided by cable broadband companies (Comcast, Charter) the distribution is mostly historical, due to the fact that cable operators were only required to build to areas up to a particular density in their franchise agreements. The following is a map of unserved premises in Vermont. This data was collected by the State in 2019 and is current as of that date, however, premises funded by the Emergency Connectivity Initiative have been removed.

Figure 15: Unserved Premises (State Data)



Vermont's mobile broadband coverage is strongly influenced by the topography and geography of the State; due to the hills, mountains, and trees, almost no town is completely covered by service, though very few towns are also wholly unserved. The following is a map of drive-test data performed on major roads in 2018, with additional data collected by volunteers in 2020.

Figure 16: Drive Test Routes



In addition to the drive-test data, we have mapped locations of cell provider antenna sites in Vermont used by one or more providers. The infrastructure ranges from latticed towers to monopoles or "stealth trees" to radios on siloes, steeples, or water towers. Naturally, the height of the infrastructure and surrounding topography will dictate how far service reaches; however due to time constraints, we have estimated that good service can be provided to premises up to three miles away from the radios. This is a crude estimate that is an average; with good height and lines of sight, service could potentially extend for five or more miles. Installed low and in a valley or obstructed by trees, service might be limited to a mile.

Even advanced RF propagation estimates may not be able to predict how strong a signal is at a particular premise. Any first responder who knows the back roads of the State would tell you that propagation maps published by providers themselves largely overstate the range of their signal.

However, our high-level analysis based on the drive test maps and the tower sites, indicates that there may sufficient coverage over many parts not served by 25/3 with wired services, to provide broadband using mobile service to many underserved Vermonters—and that because provide them with mobile service does not require new construction or new towers, they can receive service in time to address their needs during the pandemic.

An even larger number of the remaining unserved and underserved premises in the State could be served if the signal were augmented by a rooftop signal booster. We note again the difficulty in precisely predicting the signal levels and capacity of wireless networks, and emphasize that it will need to examine individual cases more closely, which may be the responsibility of the proposed Broadband Corps discussed in more detail below.

4.1.2 Status Reported by Providers

In interviews, internet service providers across the State reported increases in bandwidth usage over the course of the epidemic, with a larger increase in upstream utilization. For example, Waitsfield and Champlain Valley Telecom reported a 30 percent increase in bandwidth usage; AT&T reported that core network traffic increased 22 percent and that video conferencing increased 400 percent. ISPs also reported changes in peak utilization times: Peak internet usage used to be around 8pm; providers are finding now that peak usage occurs throughout the day as well as in the evening, as people are working and learning from home.

Internet service providers reported that their networks were able to handle increased utilization, although in practice, certain types of networks become much more constrained with more usage. In particular, wireless technology and DSL based technology, have greater capacity constraints and are more likely to provide slow performance with many users on the network. In contrast to wireless and DSL, operators of fiber networks and cable networks reported no bandwidth constraints during the pandemic, despite increased bandwidth needs.[24]

Wireless providers face similar constraints due to limitations of their technology and the spectrum. VTel reports that they manage capacity by limiting service to customers with adequate line of sight from the antenna to their home or business. They report that they do not like to hook up customers on their wireless 4G LTE network unless they are confident the customer can

[24] Sutich, John, and Matthews, Alicia, "Comcast Covid Response Interview," October 22, 2020; Gruendling, Kurt, "Waitsfield Champlain Valley Telecom Covid Response Interview," October 30, 2020.

get at least 10 Mbps download, because customer satisfaction drops significantly at lower speeds.

Several internet service providers interviewed said they saw an increase in requests for customer installations, and in some cases did not have enough technicians to meet the demand; for example, ECFiber, FirstLight, and Waitsfield and Champlain Valley Telecom all expressed the need for more trained technicians.

Prices for service in Vermont range by provider, but are not out of step with service costs in other areas (see Appendix F for comparison to other states). Providers have also launched a range of programs to assist Vermonters who may be struggling financially due to the Covid-19 pandemic, many focused on ensuring children in school have access to the internet. The Department of Public Service has aggregated a list of ISP programs on their website:[25]

- CenturyLink, Comcast, Consolidated Communications, FirstLight, Sprint, AT&T, Burlington Telecom/Schurz Communications, TDS Telecom, US Cellular, Verizon, Waitsfield and Champlain Valley Telecom signed the FCC Keep America Connected Pledge,[26] which was in effect through June 30th
- AT&T, Burlington Telecom, Charter, Comcast, Franklin Telephone, Stowe, T-Mobile, VTel, and Waitsfield and Champlain Valley Telecom, opened up public Wi-Fi hotspots.
- Comcast, Charter, and others introduced programs to assist customers with overdue bills.
- Waitsfield Champlain Telecom and Burlington Telecom have not been disconnecting customers during the Covid-19 pandemic, and ECFiber has announced they are not disconnecting any customers until further notice. Duncan Cable has extended all disconnections for non-pay from the normal 30 days past due to 60.
- Charter and Comcast have existing low-cost options for qualifying low-income customers. Comcast has given 60 days free to new Internet Essentials customers. Comcast expressed that while about 14-15,000 Vermonters are currently enrolled in Internet Essentials, there are many eligible Vermonters who have not enrolled. Charter offers Spectrum Internet Assist as an option for low income customers.

[25] https://publicservice.vermont.gov/content/new-connectivity-resources-support-you-during-covid-19-state-emergency-vermont

[26] The pledge is "to not terminate internet/data service to any residential or small business customers because of their inability to pay their bills due to the disruptions caused by the coronavirus pandemic; waive any late fees that any residential or small business customers incur because of their economic circumstances related to the coronavirus pandemic; and open its Wi-Fi hotspots to any American who needs them."

- Burlington Telecom, Charter, Consolidated Communications, ECFiber, Otelco, TDS, Waitsfield and Champlain Telecom have introduced programs to connect K-12 students. These programs vary, but the most common program is providing 60 days of free service.
  - Some programs are for low-income students, while others are designed for all students.
  - Some have been funded by private philanthropists, and some by providers themselves.
- Charter instituted a program that provided one month of free service for new small business customers.
- Comcast and CenturyLink suspended data caps; AT&T suspended data caps for fixed internet service. T-Mobile and Sprint gave their customers 60 days of unlimited data, and Verizon added 15GB of free data for residential and small business customers free of charge. Charter continues to impose no data caps or hidden fees.

Our study did not determine whether the quality of infrastructure provided to low-income Vermonters is significantly worse than that available to wealthier Vermonters. It has been documented in other states that some providers charge similar amounts in wealthier and lower-income areas, but only upgrade infrastructure in higher income areas. This investigation was not able to be done within the confines of this work; however, it is important to understand whether low-income Vermonters are paying similar rates for similar quality infrastructure, or if they are more likely to have only less capable infrastructure available to them.

4.2 State-Owned and Operated Systems

Operators of State telecommunications systems report their networks have functioned well during the Covid-19 pandemic, and alterations to operations or resiliency measures put in place have not impacted delivery of services.

Many State agencies successfully changed telecommunications protocols or operational protocols due to the pandemic—increasing the IT and network load to State agencies. The Agency of Natural Resources switched to a contact-free payment system as a Covid-19 safety precaution, which requires an internet connection to use. The Agency of Natural Resources now allows game harvest reporting online. During the height of the pandemic, when thousands of Vermonters were filing new unemployment claims, and the department successfully replaced their aging Unemployment Insurance system.

The Agency of Digital Services reported that the State moved to the cloud-based Microsoft Office 365 system before the start of the pandemic, which eased the challenge in migrating State employees to remote work. ADS has also helped State agencies transition to remote work by purchasing preconfigured laptops and facilitating the participation in Consolidated Communications' Enterprise@Home program, which allows business customers to extend their LAN to their worker's remote sites, and which was used here to extend the State's enterprise network to state-employees' homes.[27] Because most remote work is now done on employee's home networks the State's WAN network has experienced lower traffic during the Covid-19 pandemic. However, this has put the strain on the connection to employee home networks, and many State employees working from home struggle with the same residential connectivity challenges as other employers in the State.

In interviews, employees at a range of State agencies reported that co-workers were struggling with reliable broadband at home. For example, one State employee reported that a co-worker had trouble using CAD software at home, as CAD requires significant bandwidth. It is common for employees with poorer home connectivity to need to come into the office more often to do work, use office equipment, or communicate.

Some State telecommunication systems need upgrades or expanded capacity, although many of these needs predate the pandemic. First, the Agency of Transportation and Agency of Natural Resources have buildings in remote locations, which still struggle with connectivity. Cellular service is also an issue at many of these locations. In addition, libraries on the FiberConnect network are responsible for maintaining the network electronics on location. Because of the age of the network but the need to use compatible systems, libraries buy electronics that are eight or nine years old, and report that it is becoming difficult to find equipment of that age. Upgrading the network to use newer equipment will cost about $250,000 but will be key to ensuring resiliency.

In addition to the needs of State employees, as government services are increasingly offered online, many State agencies are most concerned about making sure that constituents who are not connected to the internet are not left out. Thirty-five percent of town managers, town administrators, and selectboard chairs surveyed said that their constituents were having trouble accessing State and federal resources, such as Unemployment Insurance applications and DMV services.

Workforce development and training and other programming, offered by agencies like the Department of Labor and Department of Libraries, has also shifted online. The Department of

27 https://www.consolidated.com/about-us/news/article-detail/id/750/consolidated-communications-enterprisehome-connects-remote-home-office-locations-with-reliable-secure-technology

Labor noted the need to make training materials compatible with smartphones, as some people they worked with had access to a smartphone but not a computer.

In addition, the Unemployment Insurance system is operated online, with reminders to file claims and other information sent by email. As backup, there is an automated phone system that the Department of Labor uses to reach people without emails though. In general, most people filing for unemployment had access to a computer and the internet, and the Department of Labor addressed connectivity on a case-by-case basis (for example, filing by fax or in person).

Based on our discussions with agencies, the State has been able to serve its internal needs adequately. For example, the 911 system upgrade this year is slated to save the State $1 million over the course of the next five years, and ADS's migration of many government services to the cloud is a desirable approach, as it will allow for more resiliency, security, alignment with industry standards, and—in the pandemic—help State workers to more easily access work when outside of the States' LAN. The State should keep in mind that the suite of technology solutions employed across agencies may become more complicated and network-intensive as functions migrate to the cloud, and maintaining secure and resilient connections that employees can access from residences is extremely important, as is maintaining top-tier cybersecurity protocols.

Though 40 libraries are on the FiberConnect network, some libraries are being served by fiber networks outside of the State's FiberConnect system. Some schools, by the same token, have fiber access through the e-rate program, and some do not. These unserved institutions, as well as many unserved Agency of Transportation and Agency of Natural Resources sites, will potentially only be served when the State achieves its goal of 100/100 Mbps service across the State. By supporting the Communication Union Districts and their deployment, the State will also quickly be able to bring sufficiently fast and reliable service to these unserved institutions, whose subscription to services as anchor customers can potentially provide modest revenue to the emerging networks.

We recommend that connectivity on a building-by-building basis be expanded upon in the 10-year plan.

4.3 Opportunities for Shared Infrastructure, Open Access, and Neutral Host Wireless

The project team completed an assessment of opportunities for shared infrastructure, open access, and neutral host wireless facilities to guide deployment of new technology that can assist the State in responding to, and recovering from, the pandemic. We concluded that strategies related to neutral host infrastructure are long-term in nature and advise against policy changes in the short-term to deal with the pandemic; we recommend instead that these long-term strategies be considered in the context of a long-term, comprehensive broadband plan. At the same time, we offer these high-level observations.

4.3.1 Shared Infrastructure

One opportunity to increase the options for broadband to underserved and unserved Vermonters in time to assist during the pandemic is to continue and expand the placement of wireless broadband in and around government and community anchor locations. All stakeholders with infrastructure of this nature—from librarians to the Agency of Transportation, Agency of Natural Resources, and others—expressed interest in making their facilities available if needed. Should the pandemic worsen in winter months, we recommend that entities with fiber or cable connections to large buildings consider if there is a safe way to allow individuals to work and learn inside, physically distanced, to alleviate the number of people currently connecting from parking lots. This could be considered for underused town halls, heated Agency of Transportation garages, or other similar buildings.

Because of the needed Covid-19 precautions, however, this must be done with great caution; and to not burden existing employees, the operation of facilities like this could be done by the proposed Broadband Corps, who could be responsible for opening and closing facilities, monitoring usage, setting up Covid-19 barriers, and sanitizing surfaces.

4.3.2 Open Access and Neutral Host Wireless

Open access networking is a model where the physical infrastructure is built and operated for the benefit of multiple service providers who can access the network on a non-discriminatory basis and provide competitive services. A neutral host model is where the entity that builds and operates the open access physical network is it itself not a service provider.

For purposes of long-term planning, with the understanding that neutral host infrastructure will not materially impact immediate pandemic-era needs, we recommend the State examine the suitability of both approaches for areas which are unserved or underserved by wireless providers. These are potential models in particular for areas where the cost to build and operate is sufficiently high that an individual wireless provider will not take the risk to build, or where construction is particularly challenging. One example is the US-6 corridor in the Colorado Front Range, where CDOT planned and built a DAS with Crown Castle acting as a neutral host provider

Further, as CUDs around the State launch plans for new fiber networks, many have been asking if they can build "open-access" networks that a range of providers can use, to encourage competition and hopefully drive down prices. Utopia Networks, in Utah, has been cited as a potential model.

Advocates of open-access fiber seek to provide the best quality and most affordable service to people passed by the network by having competing service providers on a single fiber network.

The main challenges with building and operating an open-access model in areas as rural as Vermont are in attracting partners to fund and build the network, and in finding service providers interested in setting up operations if they had only a portion of an already limited number of customers.

With regards to neutral-host wireless facilities, an illustrative experiment in Vermont was the small cell deployment done by CoverageCo to fix cell service gaps in 2016 and 2017. The project did not ultimately succeed for three primary reasons:

1. The first radios deployed were along driving corridors, and usage was 5x less than anticipated due to Vermonters talking less while driving than the national average, and a moratorium on talking while driving enacted shortly after deployment.

2. Many initial radios were deployed using DSL as backhaul, which proved to be unreliable and insufficient, leading to poor customer experiences.

3. Refusal by a telephone company to allow its subscribers to roam on the network decreased usage.

The problems listed above resulted in the majority of deployments losing money every month; clearly, an unsustainable operation.

The company pivoted their deployment strategy to focus on locations with cable or fiber backhaul, and in locations where the radios could serve residential clusters. This strategy relied on field organizing to find households, businesses, churches, and other entities willing to place a receiver on their structures; however, many were happy to do so to bring service to their neighborhood. Highly reliable and functional sites were put up, for example, at Coburn's General Store in Strafford, Kedron Valley Inn in South Woodstock, and on the steeple of the Hartland UU Church. These sites became profitable; however, CoverageCo was not able to pivot fast enough to install enough profitable sites to overcome the number of sites losing money month to month.

4.4 Short-Term Strategies to Leverage Ownership of Rights-of-Way

The State's ownership and management of rights-of-way does have an impact on broadband deployment; however, the project team did not find and service providers did not report major impediments to broadband deployment regarding the use of rights-of-way. As was concluded in a previous study, opening up State rights-of-way by itself is not by itself going to catalyze significant broadband deployment. Right-of-way concerns were not expressed by ISPs, CUDs, or other stakeholders in the State as being significant roadblocks.

Across Vermont, town owned roads and state-owned roads have different Right of Way permitting requirements, which adds complexity, time, and cost to deployments; however, any recommendations for changes to this system must be given careful consideration and are beyond the scope of this plan, especially considering the time needed to design and adopt changes.

The project team recommends two models be investigated in the next 10-year plan; the "Utah model" and the "New York City" model.

In the former, the State built and traded communications conduit, fiber, and communications circuits statewide. The state built an initial allotment of 600 fiber-miles as part of an initial infrastructure deployment centered around intelligent transportation systems on UDOT corridors. The state publicized its existing routes and a wish list of future routes for future needs. It established a master lease agreement with each entity seeking to build in UDOT right of way and engaged in mile-for-mile trades of its excess infrastructure to expand its own use to new areas built by other providers, as well as making it possible for new providers to get a head start in their builds using the excess UDOT infrastructure in already-constructed routes. Trades are not required, however, and providers may also simply pay a fee for access to UDOT rights-of-way.

New York City has identified three different zones, A, B, and C, based on broadband need. Fees for Right of Way access—in the case of New York, rent for access to City streetlights for small wireless facilities, can operate on a sliding scale. The fee is 3.5 times higher per month to operate a small cell in Midtown Manhattan than in an area with less service.

Lastly, the Agency of Transportation notes that the State does not have "dig once" or provisions. The establishment of these provisions should be considered in the next 10-year plan. While these are not concerns raised by providers, we note that the vast majority of deployments being aerial, pole space will likely become scarce, with providers needing to choose between expensive pole replacement and make ready, and underground construction. Considering the high cost of underground construction in rocky soils, it will make sense for the State and municipalities to make potential excavators and broadband deployers aware of road expansion and improvement projects, and for the State to be aware of projects considered by other utilities, in order to build communications infrastructure or to notify excavators who may want to take the opportunity to build—especially in expensive routes in urban areas, rocky soils and alongside limited access roads.

4.5 Emergency Communications Initiatives and Requirements

Through interviews with a range of emergency personnel and State emergency management leadership, and review of the 2020 Statewide Communications Interoperability Plan (SCIP), the project team found that though emergency services were forced to react, adapt, and in some cases make contingency plans due to the pandemic, emergency communications and operations in Vermont have not been adversely impacted by the pandemic.

The e911 Board has six Public Safety Answering Points (PSAPs), which provides redundancy to the system. All six have continued to operate during the pandemic, and the e911 Board also created a back-up PSAP location in case one needed to be closed down due to a Covid-19 outbreak; the e911 Board plans to keep the back-up location after pandemic has subsided for additional redundancy. While the 911 system is operating well, there are ongoing concerns regarding customer education with regards to 911 communication, and interoperability with certain calling and texting mechanisms. For example, not all messaging apps and/or over-the-top Wi-Fi calling apps work with the State's 911 system.

Further, the State delayed the transition to a next generation 911 system by several months due to travel restrictions and other Covid-related challenges; however, they had a fully functioning system in place they could continue to rely on, and when the transition ultimately happened in October, it went smoothly.

The primary concerns of the e911 Board include spotty cell coverage in the State—a problem that clearly pre-dated the pandemic—and concerns regarding customer education. For example, not all text messaging apps work with the State's text to 911 system, and it is incumbent upon all involved parties (not the least of which the apps themselves) to communicate their constraints to the public.

Land Mobile Radio (LMR) is the primary means of communication for first responders in Vermont; this system is resilient and robust in all parts of the State.[28] The LMR system has continued to function well during the Covid-19 pandemic.

The Vermont Communications System (VCOMM) is an alternate interoperable radio system that operates on the Very High Frequency (VHF) and Ultra High Frequency (UHF) bandwidths.[29] This system provides frequencies that can be used across service areas, regions and states; first responders that receive grant money through the Department of Homeland Security are required to put VHF and UHF channels on their radios, which ensures interoperability across state lines. Vermont's Statewide Communication Interoperability Plan (SCIP) includes plans to promote the VCOMM system. There were no reported issues with the VCOMM system during the pandemic.

Cellular broadband is also often used by first responders when available. Verizon is the cellular provider with the most coverage in the State, followed by AT&T, though coverage by the latter is increasing due to FirstNet deployments and roaming agreements AT&T has recently enacted with VTel. Still, locations with unreliable cell service remain a public safety concern for first responders, Agency of Transportation employees in the field, and drivers on Vermont's roads;

[28] https://rts.vermont.gov/interoperability-planning
[29] https://rts.vermont.gov/interoperability-planning

however, first responders know their communities well and have always accounted for known gaps in service and planned ahead accordingly.

The FirstNet network, currently being deployed, should improve cellular coverage for all Vermonters, but will prioritize traffic from first responders. FirstNet originated as the National Public Safety Broadband Network created in response to the 9/11 Report's call for nationwide public safety communications interoperability and was assigned spectrum for broadband wireless communications for first responders. FirstNet issued a national request for proposals and selected AT&T to build and operate the network.

AT&T has use of the FirstNet public safety spectrum nationwide and is required to increase its coverage according to FirstNet specifications. As a result, AT&T is expanding its service nationally and in Vermont, using the FirstNet spectrum and its other spectrum. AT&T may use the spectrum to serve its customers, but must provide priority and, if necessary, preemption to support first responders in an emergency.

The project team interviewed AT&T to understand their deployment in Vermont. AT&T has committed to deploying 36 FirstNet sites in Vermont by the end of the first quarter of 2022 (including six sites to be built for FirstNet by Great North Woods Wireless (GNWW)). So far, AT&T has deployed radios at 4 new sites in Vermont, as well as upgrades to 2 existing sites. By the end of the year, AT&T projects they will deploy 8 additional sites and upgrade one more site, bringing AT&T's total number of FirstNet sites in the State to 15.

FirstNet deployment has not been proceeding as quickly as some had hoped, although AT&T is still within the timeline allotted for deployment and will accelerate deployments in the next 2 years to meet their deadline. One challenge identified is that many FirstNet deployments are in areas where there is no cellular coverage; deploying in these areas requires extending utilities backhaul to a new cell tower, which takes more time and planning. AT&T said that in these situations, delays are increased by the fact that ISPs providing backhaul often do not want to begin planning backhaul deployment until the cell tower is "room ready," which can add another six months to the deployment process. Permitting for new towers can also be a challenge; additionally, AT&T cited deployment in certain areas such as the Green Mountain National Forest or the State-owned Green Mountain Reservoir. However, this tension is to be expected in a state with robust environmental concern and attention paid to environmental impacts, and the project team does not feel that assessing permitting processes was appropriate to do on an extremely accelerated project timeline.

The decision to enroll in FirstNet will remain the jurisdiction of local public safety departments, as they understand their own territory best, however there are cost, redundancy, and interoperability benefits to the prioritization of a single system. AT&T allows first responders to try out FirstNet enabled devices to determine if there is service free of charge, which will allow public safety departments to make an informed decision.

The nature of Vermont's geography means that the FirstNet network will likely still have gaps after being fully deployed. The State has hired a company to verify FirstNet's claimed coverage, and the State should ensure that the next 10-year plan includes an assessment of how the State can fill remaining gaps in service.

The State should expect everything that supports public safety communication ecosystems will expand, become more complicated, and more dependent on broadband. For example, an application that allows 911 callers to send photos of an injury to a 911 dispatcher, or even video call a 911 dispatcher, would have the potential to improve public safety — but only where adequate coverage is available. While the appetite for adopting cutting edge applications varies by agency and department, these applications will not even be possible without better cellular coverage. With the State's recent migration to a new, improved e911 call system, the State has remained up to date and even ahead of the majority of other states in terms of sophistication of its system.

It will also be necessary to bridge the LMR system with new cellular-based communications. The Vermont State police are starting to implement "Project 25" design standards, which will bridge legacy LMR radios and digital radios that use 4G LTE; under P25, first responders can download an application that allows them to use their cell phone like two-way radio. While the State police force is starting to implement this system, municipalities have not yet done so. Because the State police work closely with local police departments, state police will wait until all or a majority of local departments are on board to begin using the P25 system. This is a prudent approach.

Vermont's Statewide Communication Interoperability Plan (SCIP) provides a future vision which includes the FirstNet mobile broadband network assuming a more critical role in emergency communications. The need to migrate public safety to broadband and FirstNet in particular means that public safety is now tethered to mobile broadband coverage and capacity. Underserved areas for broadband are also underserved from the point of view of public safety communications, even if the traditional land-mobile radios systems serve the area—because LMR is no longer the sole infrastructure needed for emergency response.

Accelerating AT&T expansion will thus have the dual purpose of furthering broadband for the public as needed for Covid and providing the emergency communications that responders need in the same area

One notable success described in the SCIP that has paid dividends during the pandemic is that Vermont is significantly ahead of most states in implementation of next-generation NG-911 statewide. Among other many other functional benefits, this means that the State has interconnected PSAPs that can handle each other's calls and thus manage surges in needs due to Covid, the system creates more options for the State to have PSAPs handling each other's loads if staff are reduced due to Covid, or locations need to be closed or scaled back due to infection or needs for distancing, and that the State having a GIS based database of all homes and businesses in VT that can be used for 9-1-1 and also leveraged for broadband planning.

Noting the priority in the SCIP for FirstNet rollout, there should be increased emphasis on addressing any issues that may be delaying the FirstNet rollout. One step could be to address the claim by AT&T that fiber providers will not begin planning and design of backhaul until site is complete—and address any technical and business issues with the fiber providers that are creating the delay.

5 Local Institution Pandemic Responses

The project team would like to recognize the efforts many local institutions have done in response to the pandemic and resulting telecommunications challenges. Not only have their responses to date helped alleviate the challenges of the pandemic for many people; their willingness to continue to work hard and collaborate to drive toward a solution will be key to successfully implementing a state-wide, comprehensive emergency response plan.

5.1 Municipalities

The project team is hoping to augment the town administrator survey results below with more responses before publishing the final draft. However, based on initial responses, it is clear that towns are doing what they can to assist with connectivity issues. We found that

- Of surveyed town managers, town administrators, and select board chairs, 73 percent said their town is using public Wi-Fi hotspots to connect residents,
- 13 percent of respondents said their town was either participating in or promoting a program with an ISP to bring low-cost internet to low-income constituents (e.g., Comcast's Internet Essentials)
- 10 percent of respondents said their town was providing opportunities for residents to improve their digital literacy and technical skills
- Towns expanded public Wi-Fi access: Before the Covid-19 pandemic, across the towns represented by respondents, constituents could connect to public Wi-Fi at 46 town buildings or parks; during the Covid-19 pandemic, that number increased to 57 locations (including parking lots).
- 15 percent of respondents said their town added equipment to strengthen Wi-Fi signal in parking lots.
- That being said, many town buildings and parks do not have public Wi-Fi availability: Between all respondents, there were about 200 town owned or leased buildings and 120 parks of at least one acre.
- Across the survey respondents, there were at least 25 town buildings with a fiber connection that do not currently offer public Wi-Fi.

The Public Service Department, in collaboration with town administrators and municipalities, is continuing to deploy free Wi-Fi locations, which are crucial to providing options for low-income and underserved residents alike.

5.2 Public, Educational and Government Access Television

The Covid-19 pandemic has increased the difficulty of delivering PEG services, while also increasing the importance and urgency of those services.

PEG stations have been tasked with providing crucial communications resources for Vermonters, including information on the pandemic, support for remote education, access to governmental affairs, and connections with other community events. Overall, viewership has been steady or increasing, and in many cases, the Vermont community's engagement with PEG resources has increased significantly, with many stations reporting spikes in Facebook views, YouTube views, and Google website traffic during the pandemic months. For example, GNAT saw a 71.6 percent year over year increase in Facebook video views from July-September 2019 to July-September 2020;

BCTV saw a 197 percent increase in YouTube subscribers added in January-March 2020 compared to January-March 2019; and CAT-TV saw a 75 percent increase in quarterly web traffic from April-June 2020 compared to April-June 2019.

At the same time, PEG stations face declining revenues in part due to decreases in cable franchise fees. They also face greater pressure on their existing technical capacities, as the growth in demand for coverage of an increasingly wide array of events is stretching staffs thin. Stations report spending increased time on digital management and training of local community members on digital technology. They also have had to adapt to health protocols in the actual filming and production of events.

Importantly, PEG stations have responded to the Covid-19 pandemic by providing critical content to meet community needs. PEG stations have provided:

- Ongoing emergency management updates, including access to government press conferences, related to the Covid-19 pandemic.

- Production and technical support to stream and archive public meetings and events. This involves working with community members and institutions to facilitate best use of virtual meeting tools.

- Delivery of education programs for students and adults, including live-streamed distance learning opportunities, graduations and school ceremonies, and school sports coverage.

- Election coverage, including candidate forums, information on absentee ballot casting, and town meeting feeds.

- Production of community-meeting events and open forums, including anti-racism demonstrations, theater performances, and local fundraising events.

PEG stations reported responding to the effects of the pandemic by continuing to expand their virtual offerings and design hybrid public meetings and events. They are working to increase security, success, and transparency of these events, as the pandemic continues to change the way that video production can operate, and to change the way that video consumption is done.

Lastly, as they continue to respond to this increased demand and shifting environment, PEG stations are concerned with the barrier of inadequate broadband speeds, which many member stations have already documented as impeding the ability to broadcast certain local events, including those in public buildings.

5.3 Regional Development Corporations

Regional Development Corporations are running a technical assistance program to help businesses during the Covid-19 pandemic; 40 to 60 percent of the funded projects are “internet based,” such as helping businesses build e-commerce capabilities. Moving to e-commerce has become a necessity for businesses; even main street stores have discovered that they need an e-commerce platform; businesses also need assistance in social media and building an online brand. As a whole, this is a healthy evolution for businesses to make; however, doing so during a pandemic when traditional revenue sources are constrained is not ideal. What is clear is that the businesses that survive will likely make digital elements a long-term part of their operations. An increase in digital literacy across the State, and residential broadband, will allow the employees and employers of newly digital businesses better ability to continue operations and grow.

The RDCs are providing valuable technical assistance to many businesses in Vermont, but they need additional resources in order to meet all the needs of Vermont businesses. RDCs have not been able to keep up with the demand for this program; they are currently assisting a cohort of 300 businesses, with 80 to 100 more businesses on waiting lists; the RDCs stopped advertising their program when they realized they would not be able to serve all the businesses that had signed up, so the true demand for this program is likely even higher.

Furthermore, while the current program will help businesses set up e-commerce programs, the RDC does not have capacity to then support businesses in maintaining those platforms, and importantly, the RDCs have not had the funding to provide technical assistance regarding cybersecurity, which will become increasingly important as more functions migrate online.

Finally, as many other stakeholders have reported, digital literacy is a big issue, and businesses could benefit from additional assistance training their employees on how to use video conferencing, online platforms, and digital work technologies.

5.4 Libraries

Vermont's libraries are working hard to support residents during the Covid-19 pandemic with online resources and programming, laptop and tablet lending programs, and access to Wi-Fi where possible. The project team surveyed librarians in a survey distributed by the Vermont Department of Libraries; 81 librarians representing libraries in all 14 counties completed the survey. Complete results are presented in Appendix D. Findings include:

- 50 percent of libraries are open for patrons, 30 percent are appointment-only, and about 20 percent are closed.
- 66 percent of libraries are providing programming for the general public, both online and in person. Programming includes virtual book clubs, support for remote learners, virtual or outdoor storytime, take-home craft kits, and digital literacy training.
- 67 percent of librarians reported their library increased access to electronic materials, 87 percent are offering online or by-telephone reference services, and 97 percent have implemented minimal-contact pickup
- 80 of the 82 libraries surveyed are allowing patrons to connect to their library's Wi-Fi in the parking lot.
- Most librarians say 5 to 10 people use their Wi-Fi in the parking lot on a given day, but some librarians reported 30, 50 and 65 patrons using the parking lot Wi-Fi.
- 24 percent of librarians say they have added equipment to strengthen the Wi-Fi signal, 38 percent have added tents or seating outside, and 8 percent are allowing patrons to use library computers outside.
- Before the Covid-19 pandemic, only 8.6 percent of librarians say their library lets patrons check out laptops or tablets; during the pandemic, 25 percent of libraries offer this service.
- 70 percent of librarians say their library has never run out of laptops to lend; only 4 libraries reported a lack of laptops weekly or daily
- During the Covid-19 pandemic, two libraries are lending out MiFi portable hotspots
- Libraries have published "how to" videos, resources, and have hosted workshops to help Vermonter's access online resources. Several libraries are also offering IT support over the phone.
- Libraries have partnered with local schools as well as recreation centers, food banks, and other local organizations.

5.5 Communications Union Districts

In addition to their work planning fiber-to-the-premises networks, CUDs and their all-volunteer boards have taken on an active role in responding to the Covid-19 pandemic.

Although expansion of a competitor's service in their territories encroaches into CUDs ultimate business plans, CUDs recognized the need for short-term connectivity and have worked to connect their constituents in whatever way possible. Several pursued plans for temporary wireless networks as long as possible, until it was evident the time constraints of the CARES act funding became too restrictive to meet.

At least one CUD worked to aggregate neighbors to apply for line extension grants under LECAP, although one CUD chair we interviewed expressed their efforts had largely not been rewarded, as few constituents ultimately received LECAP grants.

The CUDs also had an important role to play in the Emergency Connectivity Initiative and Get Vermonters Connected Now Initiative (GVCNI). CUDs assisted the Department of Public Service in collecting priority locations for the Emergency Connectivity Initiative and GVCNI. Additionally, CUDs have interpreted their ability to participate in the approval of Emergency Connectivity Initiative grant recipients as a mandate to thoroughly vet grant applicants. While CUDs the project team interviewed ultimately accepted most applications, the CUDs spent significant time researching applicant entities. In some cases, the CUDs balanced the need to bring short-term relief to disconnected constituents with information on the providers, their service levels, and reputations.

Ensuring CUD buy-in to further short-term emergency planning is essential to maintain a clear, efficient path toward universal 100/100 service in Vermont. The pandemic has made CUDs realize the importance of broadband, and providing service to low-income and struggling Vermonters, like never before, and the work they have done during the pandemic to continue on the path to fiber networks, while also exploring short-term options, has only increased their sophistication and understanding of the challenges that lie ahead.

6 Evaluation of State's Responses to Expand Broadband

In response to the Covid-19 pandemic, Vermont's Department of Public Service (PSD) quickly launched several programs to support Vermonters' telecommunications needs—working to connect Vermonters as fast as possible and assist those struggling financially. In general, programs were beneficial and accomplished their stated goals—though, as with most programs executed so quickly, they would have been even more effective if PSD had additional resources and time.

6.1 Line Extension Customer Assistance Program

The Line Extension Customer Assistance Program (LECAP) awarded $3,000 grants to subsidize the customer contribution, or contribution-in-aid-of-construction (CIAC), of a line extension.[30] Up to $500 of that amount may be applied to subsidize the cost of a customer drop beyond 300 feet. The consumer is responsible for any costs exceeding $3,000.

LECAP is a unique program, as it is driven by the consumer rather than ISPs. In the project team's experience, most line extension programs rely on the ISP applying for funding for specific projects, meaning line extension funding is driven by where ISPs desire to expand. In contrast, consumers apply for LECAP grants, meaning funding is allocated based on consumer demand.

That being said, the LECAP model does put some burden on consumers, as they must apply with their ISP for a LECAP grant. Additionally, because a single line extension to serve multiple premises would decrease the cost for each individual applicant, residents would benefit from coordinating with their neighbors—which could be challenging.

Under Vermont Public Utility Commission Rule 8.313(B), cable companies must extend service to customers within their franchise territory, but the cost of construction is split between the customer and the cable company, with the cable company paying a larger share in more densely populated areas. The CIAC is shared between all residents who commit to subscribing to cable television. The PSD provides an online calculator (https://jscalc.io/calc/Z9n1nal1nku3VNP4) to estimate the CIAC per subscriber. The calculator estimates that the cost per subscriber for a 1-mile line extension, with a construction cost of $30,000 is:

- $0 with 16 subscribers
- $625 with 12 subscribers
- $1,875 with 8 subscribers
- $3,125 with 6 subscribers
- $5,625 with 4 subscribers
- $13,125 with 2 subscribers

[30] https://publicservice.vermont.gov/content/vermont-covid-19-line-extension-customer-assistance-program

LECAP is available to Vermonters who can demonstrate a Covid-19 related need, such as remote learning, telehealth, or telework, lack 25/3 broadband internet service, and are near an existing cable video provider or other ISP. If a service provider did not project that they could complete a requested line extension by the end of the year, the consumer making the request would not be eligible for a LECAP grant.

Consumers had to apply for a line extension with the service provider *and* apply for the LECAP grant from the PSD. Applications were due September 15.

Some ISPs, consumers, and community institutions express frustration with LECAP. For example, the NEK CUD partnered with school districts to hold an educational seminar explaining how their constituents could apply for LECAP, and also attempted to help organize neighbors to apply together, but ultimately felt that these efforts were in vain as few constituents were connected through the program. The roll-out of the program may have also created high expectations among consumers, some of whom were eventually told they were not eligible or their line extension would cost significantly more than $3,000. ISPs felt they had to manage consumer expectations; for example, Comcast expressed that it wished there was better communication about who was eligible and how they could apply.

Overall, LECAP is a successful program, well designed and implemented quickly. The Department of Public Service stood up an innovative program driven by consumer demands in an incredibly short timeframe. Particularly impressive is how customer demand drove deployments, to ensure that line extensions were targeted to people who were going to use them.

6.2 Emergency Connectivity Initiative and Get Vermonters Connected Now Initiative

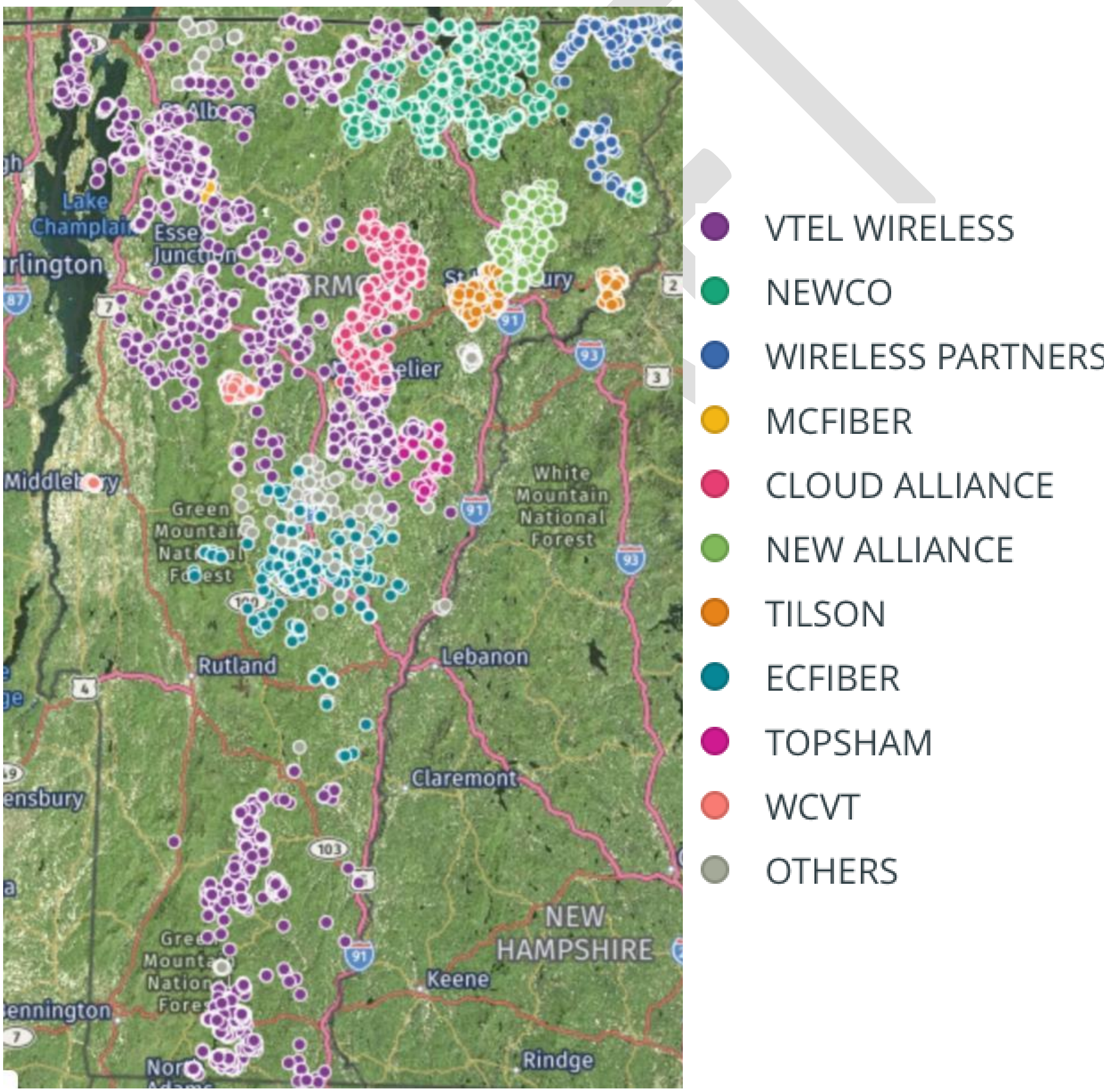
The Emergency Connectivity Initiative and Get Vermonters Connected Now Initiative (GVCNI) awarded $12 million in three rounds to fund broadband deployment to locations without access to the internet with speeds of at least 25/3 Mbps. This program prioritizes "underserved locations with K-12 students, teleworkers, and those with identified telehealth needs," as well as locations lacking 4/1 service. While the Connectivity Initiative is an existing program in Vermont, typically funded through the Vermont Universal Service Fund, the most recent awards were funded through the Coronavirus Relief Fund. This round of funding was made up of two programs: the GVCNI, which was created by H. 966 and funds fiber-to-the-premises customer installations and service drops, especially when underground conduit or lengthy drops have made deployment cost prohibitive, and the Emergency Connectivity Initiative, which funds broadband deployment delivering speeds of at least 25/3 Mbps.

The PSD administered these two programs together, using one RFP and one list of priority and eligible locations. Providers must provide at least 500 MB of un-throttled service. Wireless and

DSL providers must conduct a speed test at funded locations demonstrating that their service provides internet at speeds of 25/3, and providers will forfeit funding for any locations that do not meet this requirement; if 15 percent or more locations cannot provide 25/3 service, the provider will forfeit the entire grant. All funded projects must be completed by the end of the year.

The Emergency Connectivity Initiative and GVCNI have funded deployments that will connect 9,771 locations: about 2,200 with fiber to the home, 271 with cable, and about 7,300 with wireless.

Figure 17: Emergency Connectivity Initiative and GVCNI-Funded Deployments



Collecting data to determine locations with remote learning, telework and telehealth needs was challenging. The Department of Public Service relied on school districts, CUDs, town governments, and other community institutions, many of which worked diligently to help their constituents connected. The data used to inform the program's priority locations did vary by region. For example, not all school districts provided data on which students had connectivity needs because of privacy concerns. Healthcare providers similarly had to be cautious of privacy laws.

In addition to assisting the Department of Public Service in identifying priority locations, CUDs also had the right to object to any Emergency Connectivity Initiative and GVCNI grants within their footprints. Many ISPs did not appreciate this aspect of the initiative. The project team also interviewed several CUDs, and found that while they recognized that grants might hurt their future business case, CUDs understood the importance of improved connectivity in the short term and approved most projects, especially projects that did not offer wired services. The CUDs the project team interviewed only rejected funding for projects that the CUDs felt would not appropriately serve their community, or would be clearly detrimental to reaching the long-term goal of 100/100 service.

The Emergency Connectivity Initiative and GVCNI will connect nearly 10,000 previously unserved premises by the end of the year for a price of $1,200 per premises. Importantly, if CUDs are going to continue to play a role in shaping the connectivity landscape of their regions, the State and CUDs should collaboratively provide guidance, with public input from that region, as to what infrastructure and deployments should be prioritized. For example, cable line extensions in unserved pockets within already cabled towns are less likely to affect CUD plans, and yet are equally as helpful at connecting difficult-to-serve areas.

Lastly, additional assessment of the effectiveness of this program should be undertaken after speed tests confirm that promised speeds have been delivered.

6.3 Public Wi-Fi Hotspot Programs

The Department of Public Service took several steps to expand access to public Wi-Fi hotspots at buildings like schools, libraries, town offices, and more, which allow residents to park nearby and access free Wi-Fi. These hotspots are an important resource Vermonters without access to broadband infrastructure and Vermonters who cannot afford a broadband subscription.

First, the Department of Public Service identified existing public Wi-Fi hotspots through an email survey of schools, libraries, and town offices in March 2020; the Department of Public Service then published an online interactive map of existing public Wi-Fi.

In April, Governor Phil Scott announced a new program, where RTO Wireless installed 35 new commercial-grade outdoor Wireless Access Points, which were funded by Microsoft. Seeing the success of these hotspots, and with a waitlist of 30 sites, the Department of Public Service approved emergency funding for 65 additional hotspots; in October, the PSD approved funding for a third round of 50 RTO hotspots. The PSD has prioritized funding hotspots in locations without adequate broadband infrastructure or cell service. While there are many public Wi-Fi hotspots, public Wi-Fi access may not be adequate: only 8 percent of respondents to the online residential survey said public Wi-Fi was adequate, while another 43 percent were unsure, which may be indicative of more promotion and publicization of their locations and availability. Further, counties with the highest awareness of public Wi-Fi hotspots—like Caledonia and Orleans—were also the most likely to say that their availability and access was inadequate.

The Department of Public Service effectively leveraged existing public Wi-Fi, philanthropic dollars and emergency funding to help Vermonters connect to public Wi-Fi hotspots. There is no doubt that these are critical to allowing people easy access to Wi-Fi. These hotspots will continue to be important, as an estimated 4,000 premises will still be unserved after implementing the proposed infrastructure investments. As is described below in the recommendations section, Public Wi-Fi hotspots also provide great central, non-home locations where "Broadband Corps" members can show people how to use internet tools.

Despite the need to provide public Wi-Fi hotspots, the State of Vermont should still work to ensure as many Vermonters can connect to the internet from home as soon as possible. Completing work or school from a car can be difficult, especially during the winter, and attending a telehealth appointment in a parking lot is not ideal due to privacy and network security concerns.

6.4 Programs for Vermonters Struggling Financially

The Department of Public Service also started programs to assist Vermonters who are struggling financially due to the Covid-19 pandemic. First, the Vermont Covid-19 Arrearage Assistance Program provides eligible Vermont households and businesses with a grant to pay for past-due balances for regulated utility bills; this program covers electric, landline telephone, Vermont Gas and private water companies, but not broadband internet.

The Department of Public Service also hosted a page on its website of all the programs ISPs have created to support Vermonters during this time.

Finally, the Department of Public Service created the Temporary Broadband Subsidy (TBS), which provides eligible households with a credit of up to $40 to assist with broadband internet costs; payments can be applied retroactively to March 1. While the TBS is a generous program, its reach was unfortunately limited, perhaps by the effort required to receive the subsidy. The Department of Public Service estimates that about 2,000 Vermonters took advantage of the program, while the program had funding to assist up to 8,600 Vermonters.

The Temporary Broadband Subsidy could be improved by reducing friction for end-users (i.e., making the program easier to take advantage of), wider promotion via community institutions, nd potentially promotion in coordination with other programs targeted to similar users.

7 Broadband Technology Sufficiency Standards in a Pandemic

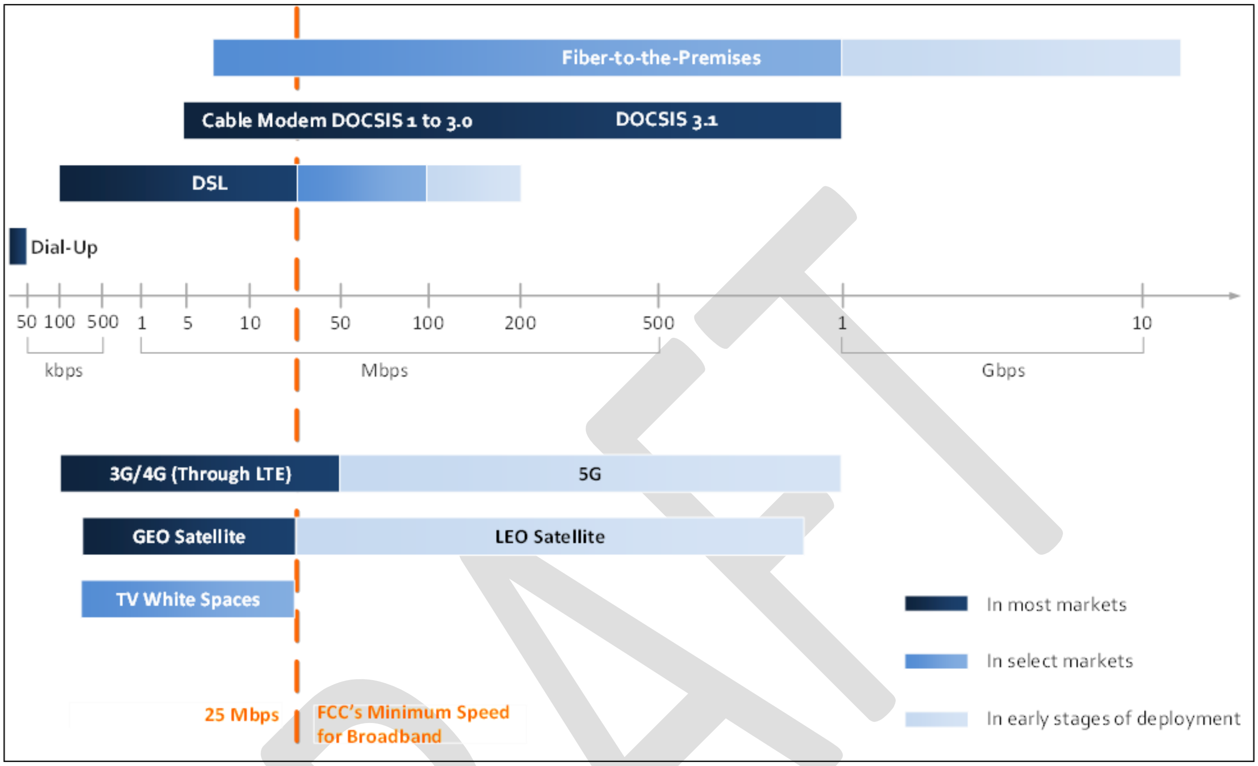
To meet the challenge of connecting thousands of new users to broadband in a short period of time, it will be important to understand the strengths and weaknesses of each technology to determine the best type of technology in a situation. It is also important to understand which types of technologies can support very heavy use (that is, those that are most scalable).

Where wireline networks are available, their technical characteristics mean that they will be able to support significant numbers of new connected households. This is especially true of fiber optic, cable broadband, and high-speed DSL connections (rated at 25/3 Mbps). The majority of students in Vermont are in homes passed by a high-speed wireline technology, though many are not.

Where wireline networks are not available, adding many new users all at once could tax the wireless networks. This is the case for both fixed wireless service and mobile broadband (4G) service. Wireless providers can provide maps and estimates of signal quality, which can provide an estimate. However, even with this type of estimate, there will need to be flexibility in the program to change to a different technology (satellite or wireline) if the broadband service at a given location cannot perform adequately. Ideally, the broadband provider should also be responsive and potentially modify its network—in areas with many students having poor signal, the provider may be able to improve the situation with a deployable Cell on Wheels (CoW) antenna. Providers may also offer outdoor antennas to boost the signal.

Where no other option is available, satellite technology can connect students who cannot be effectively connected with a wireline or mobile broadband connection. A satellite internet connection is far better than none at all but will be less robust than terrestrial networks for two-way video use in distance learning.

Figure 18: Internet Speed by Delivery Type



In a pandemic environment, a scenario in which two students are attending school classes using Zoom and two adults are using their broadband connections to attend occasional meetings, send e-mail, and do research, the combined required bandwidth could easily exceed the Federal Communications Commission's 25/3 Mbps minimum.[31] A 25/3 Mbps connection might be workable if internet usage were mainly in the form of internet browsing, email, and even streaming movies (i.e., primarily downloads). But essential applications in the context of a pandemic, video conferencing and tele-medicine, demand high bandwidth in the upload direction as well. For example, while there is no specific set minimum for healthcare broadband speeds, many telehealth programs require a minimum of 1.5 Mbps for both upload and download speeds to successfully display audio and video data.

In this scenario, even the FCC's next tier of service (50/5) would strain to supply the needed bandwidth.[32]

[31] Federal Communications Commission, "Broadband Speed Guide," https://www.fcc.gov/consumers/guides/broadband-speed-guide?contrast=

[32] A rule by the Federal Communications Commission regarding the Rural Digital Opportunity Fund and Connect America Fund, https://www.federalregister.gov/documents/2020/03/10/2020-03135/rural-digital-opportunity-fund-connect-america-fund

Peak Bandwidth Utilization for a Family of Four

	PEAK BANDWIDTH UTILIZATION TYPICAL FAMILY OF FOUR (DAYTIME)	DOWNLOAD / UPLOAD
x1	Tele-Work / Tele-Health Video Conferencing	1.5 Mbps / 1.5 Mbps
x2	Tele-Learning Remote Classroom	3.0 Mbps / 3.0 Mbps
x1	Streaming Music / Video	2.0 Mbps / 0.1 Mbps
x10	Home Security (Ring, etc.) and other household smart devices (Alexa, Cortona, etc.)	0.3 Mbps / 2.0 Mbps
	TOTAL BANDWIDTH USE (rounded)	7 Mbps / 7 Mbps

	PEAK BANDWIDTH UTILIZATION TYPICAL FAMILY OF FOUR (EVENING)	DOWNLOAD / UPLOAD
x1	Online Video Gaming	2.0 Mbps / 1.0 Mbps
x2	Streaming Video Applications (Netflix, Prime, etc.)	10 Mbps / 0.2 Mbps
x3	Surfing Internet	3 Mbps / 1.0 Mbps
x10	Home Security (Ring, etc.) and other household smart devices (Alexa, Cortona, etc.)	0.3 Mbps / 2.0 Mbps
	TOTAL BANDWIDTH USE (rounded)	15 Mbps / 4 Mbps

In another example, in which a Vermonter works from home during the pandemic, an internet connection would need to support process financial transactions through e-commerce applications, occasional video meetings with customers, the transfer of files via online cloud storage providers, and sending e-mail. During peak times, other family members may be using the internet to stream videos, attend tele-health appointments, or send e-mail as well. This scenario would require at least 20 Mbps downstream and 17 Mbps upstream.

Figure 19:Peak Bandwidth Utilization for a Home Business and Large Family

	PEAK BANDWIDTH UTILIZATION HOME BUISNESS (DAYTIME)	DOWNLOAD / UPLOAD
x1	Home Business Operations	10.0 Mbps / 10.0 Mbps
x1	Tele-Work / Tele-Health Video Conferencing	1.5 Mbps / 1.5 Mbps
x1	Streaming Video Applications (Netflix, Prime, etc.)	5.0 Mbps / 0.2 Mbps
x2	Tele-Learning Remote Classroom	3.0 Mbps / 3.0 Mbps
x10	Home Security (Ring, etc.) and other household smart devices (Alexa, Cortona, etc.)	0.3 Mbps / 2.0 Mbps
	TOTAL BANDWIDTH USE (rounded)	20 Mbps / 17 Mbps

	PEAK BANDWIDTH UTILIZATION MULTI-GENERATIONAL FAMILY OF ELEVEN (EVENING)	DOWNLOAD / UPLOAD
x2	Online Video Gaming	4.0 Mbps / 2.0 Mbps
x3	Streaming Video Applications (Netflix, Prime, etc.)	15.0 Mbps / 0.3 Mbps
x3	Surfing Internet	3.0 Mbps / 1.0 Mbps
x1	Video Chat (Zoom, etc.)	1.5 Mbps / 1.5 Mbps
x10	Home Security (Ring, etc.) and other household smart devices (Alexa, Cortona, etc.)	0.3 Mbps / 2.0 Mbps
	TOTAL BANDWIDTH USE (rounded)	24 Mbps / 7 Mbps

The following is a more detailed summary of the four most critical types of internet broadband and a summary of advantages and disadvantages and the key factors for each.

1) **High-speed wireline technology (fiber optic and cable)**

   a. Advantages

      i. High top speed—able to simultaneously connect many individuals in a household to video services and two-way distance learning.

      ii. Scalability—underlying network can simultaneously connect all homes in a service area without losing speed or reliability.

   b. Disadvantages

      i. Not present in all areas, especially outside of metropolitan areas and towns.

ii. If a student is not in a connected home, requires an installer to come to the house to install, or may require a change of equipment.

2) Lower-speed wireline technology (telephone lines, DSL)

a. Advantages

i. May have high speed, depending on age and maintenance of system—if so it can connect many individuals in a household to video services and two-way distance learning.

ii. Might be scalable, depending on age and maintenance of system; underlying network might be able to connect all homes in a service area.

iii. Serves many parts of the State outside of towns and metropolitan areas.

b. Disadvantages

i. Older, less well-maintained systems might not be able to support distance learning.

ii. If customer is not already connected, requires an installer to come to the house to install, or may require a change of equipment.

3) Wireless

a. Advantages

i. Available within range of wireless towers across State.

ii. May be able to support distance learning, depending on location of antennas and student, the type of technology (mobile must be 4G or better), the connection to the tower (fiber), and the level of congestion.

iii. Scalability—depending on service area, available spectrum, type of technology and number of users, a tower may be able to connect dozens of students to distance learning.

iv. Ease of installation—mobile providers can provide a device to a student that works “out-of-the-box” and doesn’t require an installer to come to the house.

b. Disadvantages

i. Not all parts of State have wireless coverage, particularly indoors, in rural areas, in treed or hilly areas, or away from main roads and towns.

ii. Not always scalable—sharp increases in use (like adding thousands of distance learners) may use up all the bandwidth, especially in rural areas where towers already tend to have slower connections.

iii. Difficult to predict where and when speed and service exist—while providers know where towers are and how they are connected, the actual service depends on dozens of factors that vary from place to place and change unpredictably (terrain, indoor/outdoors, number of users, material in a building)—this is why wireless providers tend not to advertise or promise speeds.

iv. Service runs significantly slower in "upstream" direction from student to network—because of the technical challenge of wireless, it is harder to get speed in the upstream direction than with wired technologies, which can result in poor quality of signal from the student to the network, and fuzzy or broken images and poor sound quality.

v. Fixed wireless providers typically need to perform installation at the home.

4) Satellite

a. Advantages

i. Available anywhere there is an unobstructed view from the house to the south and an antenna can be mounted on the roof or the house.

ii. Can provide high speed for distance learning in downstream signal (network to student).

iii. Scalability—depending on service area, congestion on network and number of users, a satellite may be able to connect thousands of students to distance learning.

b. Disadvantages

i. Signal has to travel a long distance through space, so there is a significant delay, making distance learning and videoconferencing confusing and difficult at times.

ii. Upstream (student to network) connection is limited, it is harder to get speed in the upstream direction than with wired technologies, which can result in poor quality of signal from the student to the network, and fuzzy or broken images and poor sound quality.

iii. Very large numbers of distance learners may use up the capacity in an area.

iv. Typically requires professional installation.

8 Strategic Recommendations

The Covid-19 pandemic has laid bare the challenges faced by Vermonters who do not have quality, residential broadband internet. This analysis, narrowly defined, focuses on creating actionable steps to ensure significantly increased broadband access during the pandemic. While many of these recommendations may not contribute to long-term solutions, they can deliver broadband swiftly to those who need it most as an immediate solution in the pandemic.

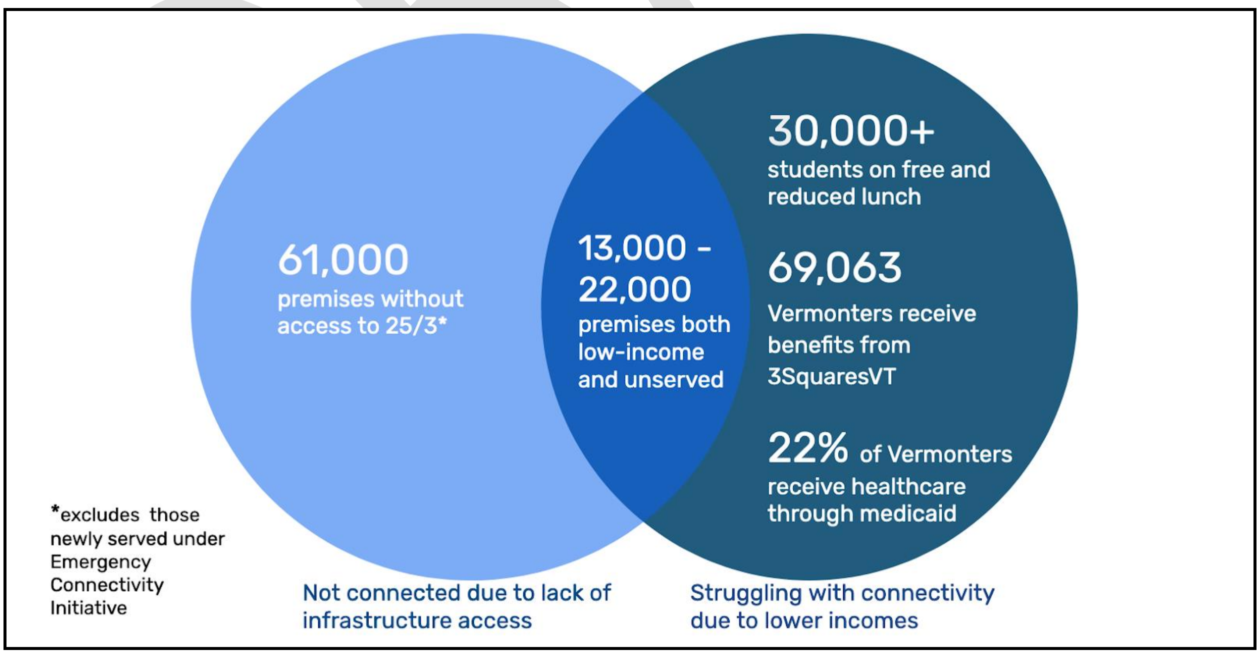
As discussed, Vermonters without home broadband internet fall into three categories:

- Low-income Vermonters who are potentially served with available infrastructure for 25/3 broadband, but unable to afford it
- Unserved Vermonters without access to broadband who could and would pay for service, if the infrastructure was made available
- Unserved, low-income Vermonters without access to broadband who also need assistance paying for monthly service

These three categories are addressed in our recommendations, where we provide estimated numbers of people in each group and the likely costs needed to provide a solution to them.

Below are an approximate number of Vermonters who fit into each category outlined above. The State may wish to use other thresholds to determine eligibility.

Figure 20: Numbers of Unserved Vermonters



These numbers are meant to provide benchmarks to lawmakers and stakeholders in understanding the scope of the challenges. It should be noted that the data used has two main sources of variability. First, the data on which premises are served vs unserved is largely from 2019, and though we have removed premises served by the Emergency Connectivity Initiative, many ISPs reported doing some additional deployment this year.

Second, tracking accurate data on who is low-income during a pandemic when spikes in cases continue to affect businesses, employment, and income levels. The State should choose an income threshold they feel is clear and appropriate, so eligibility is easily understood.

To estimate the number of people each of our strategic recommendations can reach and estimate costs to do so, we used various forms of geospatial analysis, cost estimates based on what the project team has seen in other states, and data from state and federal sources. To the extent we can, we will refine our estimations if updated data becomes available to us, for the final report.

8.1 Recommendation for Broadband Subsidy Plan

We recommend that the State of Vermont bulk purchase internet service to connect low-income households with K-12 students so that they can participate in distance learning for the coming year, on the assumption that the pandemic may last that long. Given available funding, it may also be possible to extend the program to other low-income households for purposes of telehealth service, post-secondary education, employment searches, and job training.

The following offers a recommended strategy to implement such a program, with the following key priorities in mind:

1. Service must be able to support meaningful remote work and learning activities
2. Quality service must be equally accessible to all eligible students
3. The plan should be efficient, non-burdensome, and capable of enabling service to eligible households as soon as possible

Because the quality of service and the timeline on which it must be delivered is paramount, our recommendations seek to leverage existing mechanisms whenever possible, and to allocate responsibilities among entities in a manner that maximizes strengths to ensure effective and efficient program implementation.

While there will be challenges inherent in this program related to the unequal distribution of broadband infrastructure across Vermont, it's important to note that the State of Vermont has been working to address the rural digital divide for a number of years and that Vermont currently manages a successful, well-regarded broadband subsidy program for households adversely impacted by the pandemic. The rural digital divide is a problem in every state, without exception, and it reflects challenges that are not within Vermont's control. Some of these challenges will present themselves in execution of this strategy, but the State deserves credit for having narrowed that gap substantially through Vermont's broadband efforts in recent years.

This recommendation is based on best practices in jurisdictions around the country.

8.1.1 Current State of Home Broadband Affordability

While Vermont-specific data about home broadband adoption based on income is not available, national data consistently shows that adoption is drastically lower in low-income households than in households with higher income. Data from the Pew Research Center shows that in 2019, 92 percent of Americans with an annual income of $75,000 or more had home broadband, while only 56 percent of those with an annual income of less than $30,000 had home broadband.[33] Cost of service is the primary reason for choosing not to subscribe.[34]

The fact that high cost so often keeps broadband service out of reach even when it is physically available is critical, because it means that the need for assistance extends throughout the entire State of Vermont (and, indeed, the entirety of the United States), as opposed to solely in rural communities.

At the current time, there does not exist reliable data regarding which low-income Vermont households are not connected to broadband. In the absence of such data, we recommend development of a program that would apply broadly based on income level rather than based on current levels of connectivity.

8.1.2 Technology Assessment and Recommended Service Requirements

Bringing service to hundreds of thousands of Vermont homes on an expedited basis is a significant logistical and technical challenge. Given that the need is urgent and immediate, it will not be feasible to significantly expand core networks.

For example, it will not be possible for wireline providers to construct any significant amount of new cables on utility poles or place cable underground in rights-of-way. Wireline providers will either serve customers who already have connections, or who are already passed by a cable on the street. Wireless providers—mobile as well as fixed—will not be able to construct new towers or new antennas, nor place new fiber optic cables to those towers. Wireless providers will only be able to provide new user devices (such as Wi-Fi hotspots) and perform smaller-scale upgrades,

[33] https://www.pewresearch.org/internet/fact-sheet/internet-broadband/
[34] https://www.pewresearch.org/internet/2015/12/21/3-barriers-to-broadband-adoption-cost-is-now-a-substantial-challenge-for-many-non-users/

such as changing the speeds or configurations of equipment using software or placing temporary antennas.

As a result, to meet the State's goals, it will be necessary to make the best use of existing resources. Rather than prioritizing new construction and engineering, service providers will need to dedicate staff to acquire, configure, and ship equipment. They will need to enter new customers into their billing and support systems and provide customer support. They will need to install service at customer homes. In addition, in order to alleviate strains on existing networks that will result from the sudden addition of a large number of new customers, including a broad array of locally available providers is preferable to contracting with only a few large providers.

8.1.2.1 Recommended Performance Characteristics for Services

Based on discussions with educators in the State, this report recommends technical specifications for service that can support meaningful distance learning, telehealth, and job retraining (Table 1). These specifications can be provided by different types of service providers, and, given the scale of the challenge, will require the full participation of multiple service providers to fulfill across the State.

Table 1: Technical Specifications

Capacity	25/3 Mbps or capable of operating at least two simultaneous Zoom or Google Classroom sessions
Latency	< 150 ms for terrestrial networks
Data caps and restrictions	No limitations on time of day. Data unlimited, with at least 25 GB data per month at full speed
Wi-Fi	Capable of supporting at least five simultaneously connected devices
Equipment	Must include necessary equipment to enable service, including Wi-Fi distribution within the home
Installation	All necessary installation at the home to be included, or capability to work out-of-the-box with written instructions. If devices work out-of-the-box, delivery to be provided at home
Customer service	Available 8 am to 5 pm seven days a week
Coverage Data	Respondent to provide map indicating ZIP codes (or census blocks) where service is available and where there may be limitations (e.g., chance of lower speed, or poor performance indoors)

8.1.2.2 Particular Challenges in the Unserved Parts of the State

The challenge remains that broadband infrastructure is distributed unevenly throughout the State—a pattern that is consistent with that of the rest of the country. There has been an exemplary ongoing effort on the part of Vermont to incentivize construction of new infrastructure, and while progress is being made, gaps still remain.

To address the challenges with connectivity, this program will need to maximize use of existing networks across all platforms. The scale of the effort to connect all eligible schoolchildren to home broadband far out-scales the capacity of any single network, both in terms of footprint and capacity. To that end, the success of this program depends on the strategic maximization of all available broadband networks, utilizing a layered approach.

Because wireline networks often have more capacity than their wireless and cellular counterparts, wireline broadband connections should be prioritized wherever they are available. In areas where wireline broadband is not available, mobile cellular service can be used where the signal is strong enough. Finally, satellite service can be used to fill in remaining gaps where neither wireline nor cellular 25/3 Mbps service is possible.

8.1.3 Potential Program Scale and Budget

The likely budget for the full program is summarized below and is based on a number of assumptions regarding the potential cost per household for service over 12 months, bundled with the necessary equipment and installation to make service possible.

8.1.3.1 Program Eligibility and Budget Considerations

We recommend that the State leverage existing eligibility parameters for the National School Lunch Program, which offers free and reduced-price school meals to low-income students, to determine initial eligibility for this program.[35] In creating parallel eligibility, the State would be able to significantly reduce the complexity of implementing a new program, resulting in fast execution and efficient distribution of resources to families identified as being in need.

Based on data provided by the Vermont Department of Education, we understand that approximately 32,000 students in Vermont schools are eligible for the National School Lunch Program. Based on average household sizes, this equates to approximately 20,000 eligible households. Should the State choose to expand eligibility, additional households could be added, including those eligible for Medicaid (enabling telehealth services) and unemployment insurance payments (enabling online job searches and worker retraining). This analysis assumes eligibility of 20,000 households, but the numbers can be increased in a linear fashion if eligibility is expanded.

[35] Based on eligibility parameters for free and reduced-cost school meals, the following students would be eligible: (1) Those in households with incomes at or below 185 percent of the federal poverty level; and (2) those in households participating in the Supplemental Nutrition Assistance Program and Temporary Assistance for Needy Families, as well as foster youth, migrant, homeless, or runaway youth, and Head Start participants.

In brief, we estimate that approximately $7 million could be used for a one-year term, based on average costs per household of $350 and assuming utilization by 20,000 low-income Vermont households.[36] The potential budget is thus based on an estimated cost per household of $350 for 12 months of service, including installation and equipment, as follows:

Fixed service: $150 for service $200 for home equipment and installation
Mobile service: $250 for service $100 for mobile hotspot device

Given the uncertainties regarding how many eligible households might participate in the program, it is prudent to develop a contingency plan for surplus funds. A determination of whether to repurpose unused funds could be made after several months of program execution. If the data show that fewer households than expected utilize the benefit, the surplus funds can be repurposed to support other low-income users, including low-income post-secondary students and telehealth users.

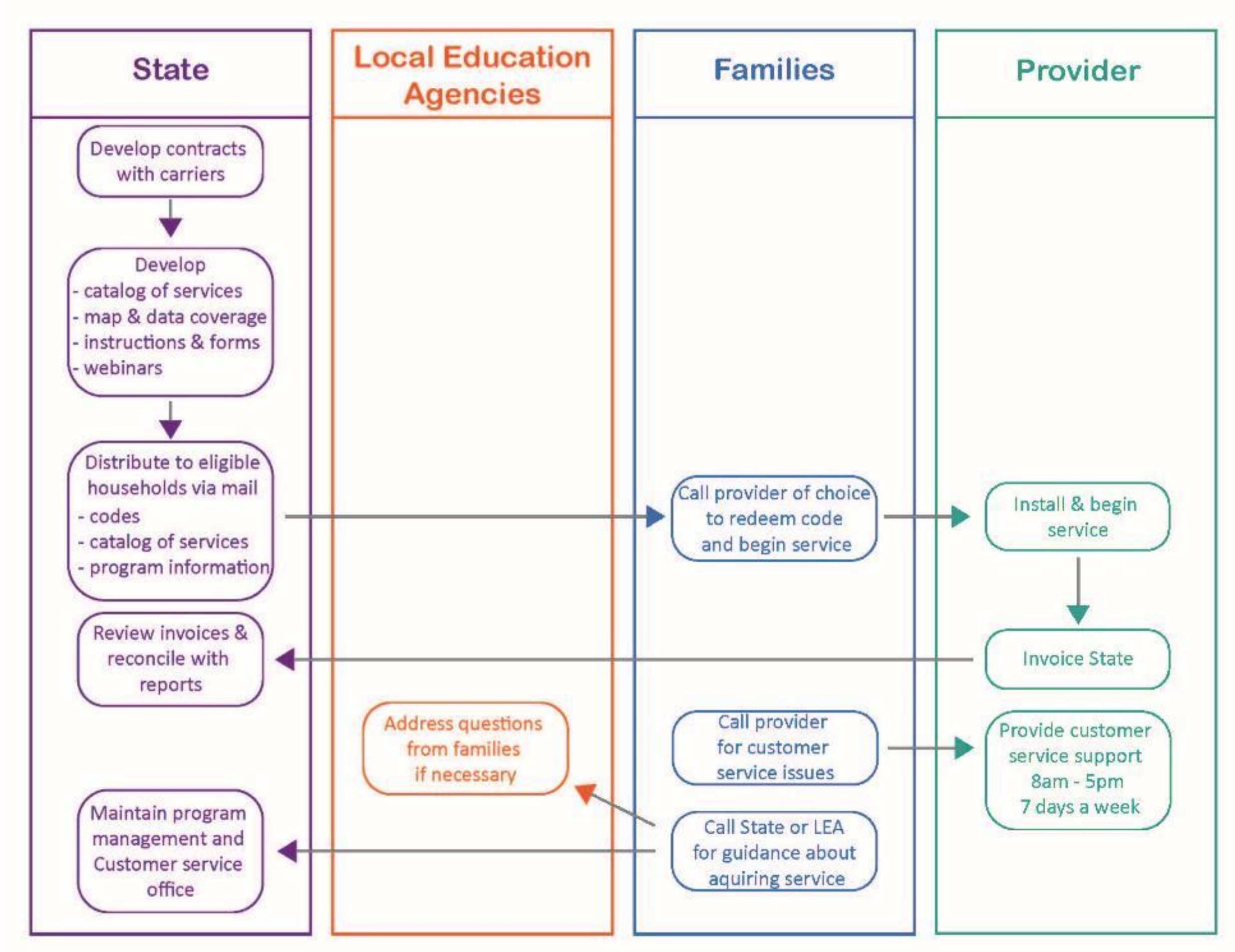
8.1.4 Recommended Process

This report recommends the following process to quickly and efficiently procure bulk internet service to provide eligible students home broadband connectivity. The recommendations seek to leverage existing mechanisms whenever possible, and to allocate responsibilities among entities in a manner that maximizes strengths to ensure effective and efficient program implementation.

Given the urgency of this effort, it will be critical to keep the process as simple and efficient as possible and to allocate roles and responsibility efficiently, without duplication of effort or need for extensive preparation time. The process recommended below seeks to create that level of efficiency. The following graphic illustrates the process recommended, which is described in greater detail below.

[36] The great uncertainty in the projected budget concerns the level of participation by eligible households. There is no precedent for this program, which makes challenging projections regarding how many households will choose to take advantage of the program. As a result, there is a certain level of uncertainty about how much funding will be utilized.

Figure 21: Recommended Program Structure



8.1.4.1 Procurement Mechanism

We recommend that the State utilize existing contracts with providers wherever possible and also issue a simple solicitation document, appropriate to State procurement rules, that seeks to identify additional providers that are able to meet requirements related to broadband service, customer service, equipment and installation, and reporting.

This proposed process seeks to leverage existing State contracts wherever possible and utilizes an emergency declaration in order to rapidly procure new services that meet the RFP requirements.

Due to the scale of this effort, a multi-provider solution is necessary in order to reach all eligible students and to avoid overloading any one network to the point of severe service degradation. The recommended procurement structure is intended to capture all respondents that would be capable of providing services that meet the technical specifications outlined in Table 1, above.

8.1.4.1.1 Procurement Structure

Based on best practices, the following components should be included in a comprehensive yet efficient procurement:

1. **Geographic coverage.** Respondents should be asked to provide a map of the State of Vermont indicating ZIP codes or census blocks where service is available that meets the capacity and data requirements outlined in the item below. The map should indicate where there may be service limitations, such as a chance of lower speeds or poor performance indoors.

2. **Service requirements.** Respondents should be asked to indicate their ability to meet the following requirements.

   a) **Minimum required capacity**. Eligible service will perform indoors at minimum speeds of 25 Mbps download and 3 Mbps upload, with no limitations on speed dependent on the time of day. Terrestrial networks will have latency less than 150 ms.

   b) **Minimum required data.** Eligible service will provide unlimited data, with a minimum of 25 GB of data available at an unthrottled capacity, per household served per month. There will be no limits on data use dependent on time of day.

   c) **Equipment and installation requirements.** Respondents must provide the equipment necessary to enable in-building Wi-Fi within the home, including but not limited to modems, routers, or hotspot devices. Such equipment must be capable of connecting at least five devices simultaneously through Wi-Fi.

Respondents must be able to provide installation services as necessary and when customer self-installation is not possible. Any necessary in-home installations must follow appropriate social distancing guidelines and use of masks or other personal protective equipment (PPE), as determined appropriate by the State. If devices are to work directly out of the box, they should be delivered to the home and with included instructions.

d) **Customer service obligations.** Respondents must indicate their ability to make customer service available between 8am and 5pm Central time, seven days a week, for the extent of the service period.

3. **Timeline.** Respondents must indicate their ability to offer service beginning as soon as possible and continuing for one year.
4. **Proposed pricing.** Respondents should indicate proposed pricing for such services, on a per-household basis, for service, equipment, and installation (if any) for one year.
5. **Reporting requirements.** Reporting requirements will be included as deemed necessary by the State.
6. **Invoice format.** A standardized invoice format will be developed and included in the RFP so that submissions by providers are consistent and aligned with State requirements.

8.1.5 Service Enrollment and Installation

Based on best practices in other states, we recommend that the State directly mail each eligible household a package that contains the following:

- **A code that is unique to that household** and can be used to redeem service directly with a participating service provider
- Information about the program, including a phone number for the customer service office within the State, and a step-by-step explanation of how the code can be used to redeem service
- District-specific information about participating providers and a phone number to contact each provider for service enrollment

Families may then choose the service they wish to receive and use their unique code to enroll directly with the service provider.

8.1.5.1 Invoicing and Payment

We recommend that participating service providers be required to track and collocate households served at least once per month, and submit to the State a single monthly invoice based on the number of service connections made that month, as well as a list of the individual voucher codes that have been used to redeem service.

Service providers would invoice the State directly and submit one invoice on a monthly basis based on the number of connections set up during the preceding month. This strategy vastly simplifies the invoicing process for both the provider and the State, enabling a streamlined transaction and efficient compensation.

8.1.5.2 Program Support and Service Validation

CTC recommends that the State create a small office in order to provide program support and service validation to ensure the integrity of the program. The office's responsibilities would include:

- Develop and distribute promotional and informational materials to families and school districts, including:
    - Catalog of services
    - Explanatory information regarding each provider and their service offering
    - Map of provider coverage areas
    - Explanatory information regarding accessing and using vouchers, including how to sign up for service with providers
    - Instructions for accessing customer service
    - Draft materials for communications with families
- Develop and maintain a dedicated website with all written and webinar materials, to be updated frequently
- Develop and deliver a series of webinars to communicate this information to the school districts
- Provide customer service support to eligible families as they navigate the program. We recommend that a customer service telephone line be made available and staffed between 8 am to 5 pm from project initiation. Customer service representatives should be able to answer questions from families and intervene with providers in the event of customer challenges (such as service not working or significant delays associated with installation). Escalation to technical support, made available during the same hours, should also be available

- Review invoices from service providers and reconcile with reports of participating households
- Conduct random quality control and spot checks of service to ensure service level requirements are being met

8.1.6 Timeline for Implementation

Assuming a fast procurement, we believe the following timeline is feasible:

Figure 22: Potential Timeline for Implementation

Milestone	Month 1	Month 2	Month 3	Month 4	Month 5	Month 5
State launches program & develops procurement						
State develops program materials & webinars						
State finalizes contracts with providers						
State distributes materials to families & school districts						
Families contact providers for service						
State maintains program management & customer service office to support families & districts						
Providers deliver service						

In addition, in the event that the federal government extends the timeline for use of CARES Act funds, the period for delivery of service could be extended by the State through the end of the school year.

8.2 Improving Broadband Access for Unserved Vermonters

In many areas of the State, Vermonters cannot access broadband internet at any price due to a lack of infrastructure. These places are often rural, low-density areas where it is not profitable for private Internet Service Providers to extend service.

The State of Vermont has long recognized the need for more robust broadband infrastructure and has set a statutory goal of serving every E911 address with 100/100 Mbps service by 2024. The State has taken many steps to improve broadband access over the last decade, including creating the Vermont Universal Service Fund, allowing the creation of Communication Union Districts (CUDs), and using loans from the Vermont Economic Development Authority to facilitate broadband expansion.

Still, many gaps remain, and the Covid-19 pandemic has introduced new challenges to those without access to broadband. According to Public Service Department data, there are 60,511 premises in Vermont without access to broadband infrastructure that could deliver speeds of at least 25/3 Mbps, excluding those that will soon receive service under the Emergency Connectivity Initiative and GVCNI. (For the purposes of this report, locations that will soon be served by the Emergency Connectivity Initiative and GVCNI are considered served.)

8.2.1 Types of Unserved Premises

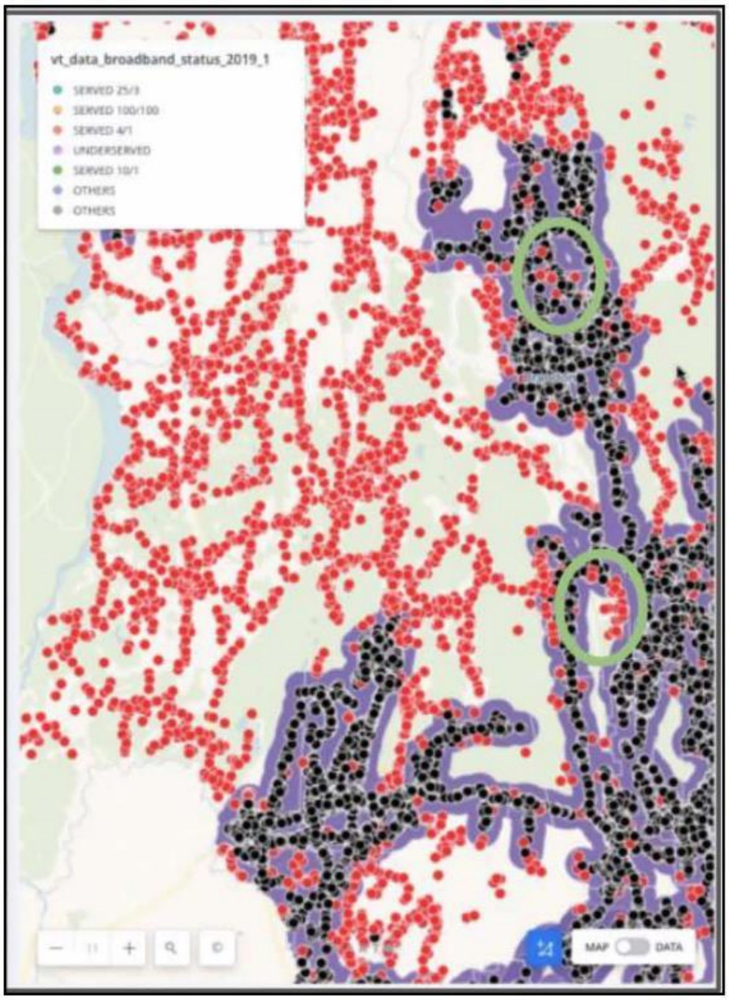
We have identified three primary "categories" of unserved premises. We note that the category numbers do not indicate prioritization or emphasis in terms of the State's approach to filling its broadband gaps; the numbers are merely a convenient way to refer to the categories. All three of these categories of unserved premises are prevalent and distributed throughout the State.

- **Category 1: Large, contiguous unserved areas where there is no wired provider available for miles.** These areas are typically rural and have a low density of premises per mile. CUDs in particular are eager to serve these areas as it is significantly cheaper for a new provider to build out in areas with no existing cable or fiber presence, and being the only provider offering 25/3 much less 100/100 in those areas provides for healthy penetration rates. However, these areas cannot be connected with wired service quickly enough to address the Covid-19 pandemic, as the infrastructure does not exist in close proximity; however, wireless infrastructure, including 4G LTE service, does reach the majority of these locations.

- **Category 2: Discrete clusters of unserved addresses in an otherwise largely served area.** These can also be referred to as "pockets" or "islands" of unserved houses. The isolated unserved premises are typically on roads that are particularly long relative to the number of potential broadband customers on the road; in other words, they have a lower density of potential customers than the surrounding areas. The incumbent ISP has not built infrastructure on those roads because their potential return on investment is not great enough to prompt an investment in reaching the potential customers who live there. Given the low density of houses, too, a cable provider is not obligated to build infrastructure on those roads under the terms of their cable franchise agreements with the local jurisdiction.

  For the residents on roads like these, which exist in locations in many parts of the State, this situation is particularly challenging; the cost of an ISP's line extension down their road—which the residents would be required to pay in order to get service from those companies—can be high. Furthermore, these locations are unlikely to be served by a CUD or another competitor in the near future because of similar investment costs and lack of return needed to keep CUDs sustainable. Reaching these locations would require overbuilding significant amounts of cable or fiber, which increases construction costs, and due to the low-density in these areas, means expected revenue is low. Based on our analysis, an estimated 16,000 unserved premises are within a half-mile on either side of existing cable or fiber infrastructure, and 27,000 unserved premises are within a mile of existing infrastructure. (Note, this calculation includes premises with lengthy drops, mentioned below.)

Figure 23: Unserved Premises Close to Existing Infrastructure



However, we advise that the Public Service Department identify the pockets to be prioritized by line extensions, rather than large, contiguous sections that extend out into category 1 areas. The map (above) of portions of the western side of the State illustrates the difference between Category 1 unserved contiguous areas, and Category 2: unserved pockets. The Purple "buffer" demonstrates a half-mile distance from existing cable and fiber plant (Category 1); green circles identify unserved pockets surrounded by, and a short distance away from, existing wired service (Category 2).

- **Category 3: Premises with long driveways or requiring underground conduit.** Here, homeowners struggle to get service, despite the presence of broadband infrastructure passing the entrance to their driveway, due to being set so far back from the road that the ISP has no obligation to build the service drop from the road to the user's premises at no cost to the customer. This generally refers to locations where the home or business is more than 300 feet away from the road—that distance being the typical limit for cable franchisees' obligations to install a service drop at no cost to the customer.

  Additionally, ISPs may charge customers for installations that must be connected via underground conduit; manufactured housing parks in particular often must be connected by underground conduit. Although these homes are effectively unserved because many homeowners find the drop construction cost unaffordable, the homes do not always fit into the category of unserved for purposes of federal or Emergency Connectivity Initiative funding. The State has taken some actions to solve this problem, though: GVCNI funds fiber-to-the-premise customer drops and installations, and up to $500 of a LECAP grant can be applied to the cost of customer drops beyond 300 feet.

8.2.2 Strategic Recommendations for Connecting Unserved Premises

This strategic plan is designed to quickly and efficiently bring internet service capable of performing work from home, telehealth, and remote learning tasks, to unconnected Vermonters in the pandemic, without harming the State's progress toward a long-term 100/100 solution. Therefore, recommendations focus on leveraging existing infrastructure whenever possible.

For unserved areas, we are using the following "triage" of service mechanisms. The fastest, most economical solutions are tried first; more challenging, slower, and/or more expensive solutions are implemented in areas where the optimal solutions are not viable. The triage is as follows:

1. Cellular service has expanded in the State, due to AT&T's FirstNet deployments, and roaming agreements between carriers and VTel. Where good cell service is available, **provide mobile hotspots to low-income families**.

2. **Fund Line Extensions in a targeted way to reach "pockets" of unserved premises surrounded by existing wired service.** Mobile hotspots can be provided to low-income residents in these locations to bridge the gap until line extensions are built.

3. **Provide signal boosting equipment** to premises with poor cell signal via rooftop antennas.

This triage also enables the State to serve the low-income households that are also unserved with the subsidy program outlined in recommendation #1—because a mobile broadband solution is very likely to be technically attainable for low income households, whether or not they are passed by 25/3 wireline service

Lastly, this section will also discuss considerations around other technology solutions that were vetted and deprioritized.

8.2.2.1 Cellular Service Expanded by Hotspots

As noted, there are 60,511 unserved premises according to the Department of Public Service, after Emergency Connectivity Initiative grants were awarded. These premises are distributed throughout the entire state.

Using cellular coverage data compiled by 2018 drive tests on major roads, 2020 volunteer drive-tests, 248a tower applications that list at least one mobile data provider, and a list of AT&T's FirstNet deployments projected through the end of 2020, we identify areas where we estimate there will be acceptable mobile broadband service. With the drive test results, we identify areas that had a minimum download speed of 10 Mbps or higher in 2018 and any point within a half-mile as likely mobile broadband service areas; 21,500 premises can be reached according to drive-tests.

Figure 24: Drive Test Routes

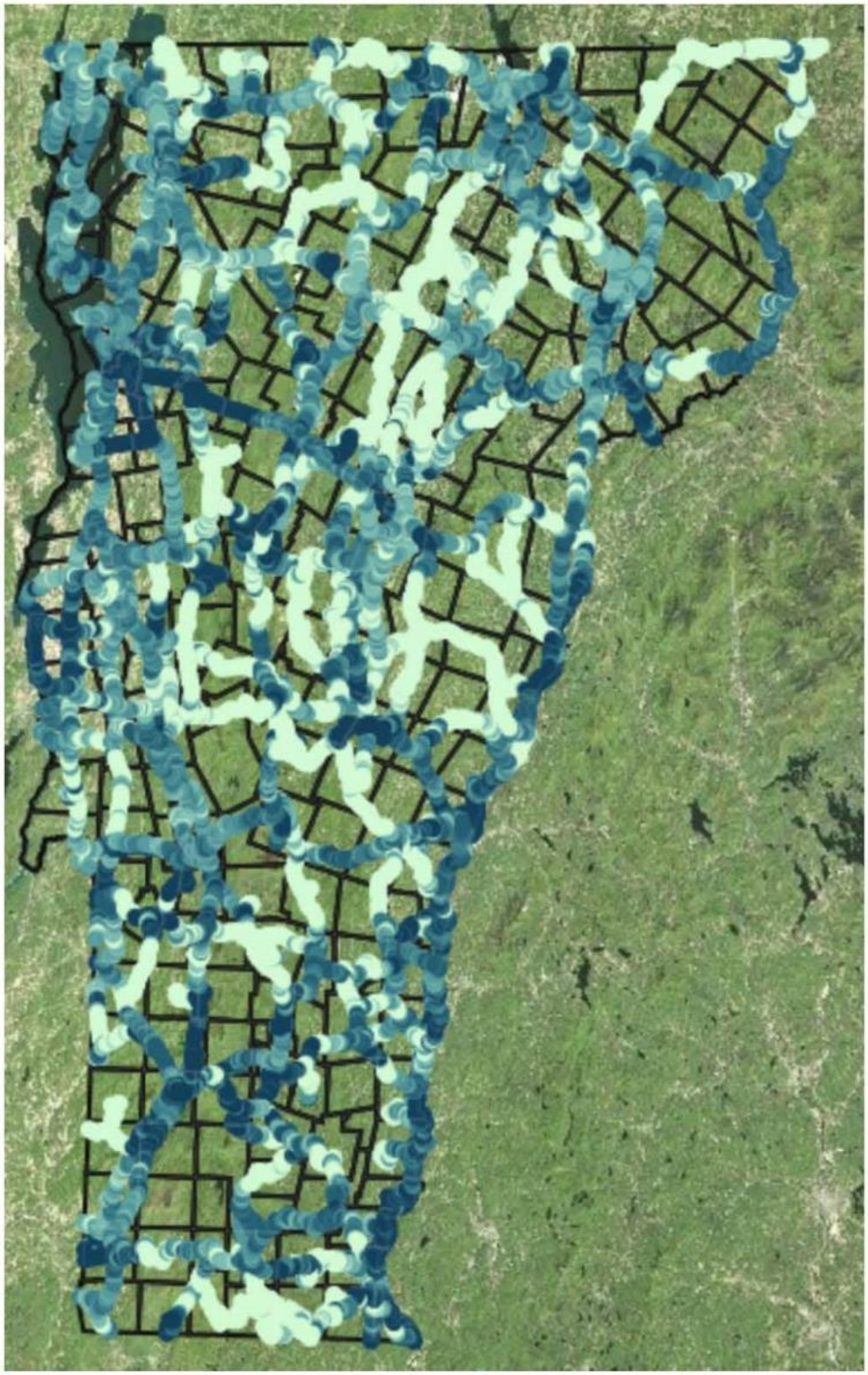
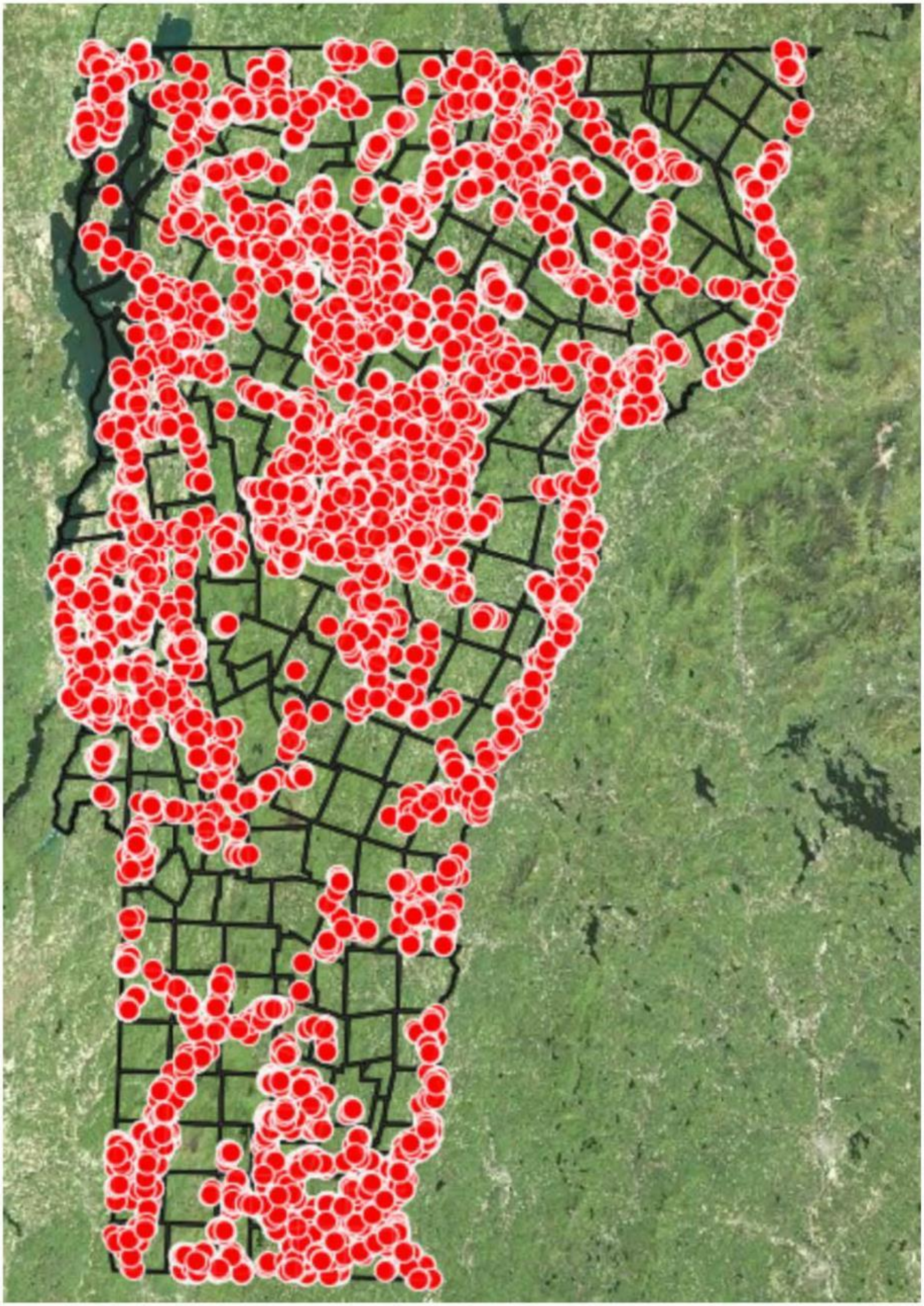
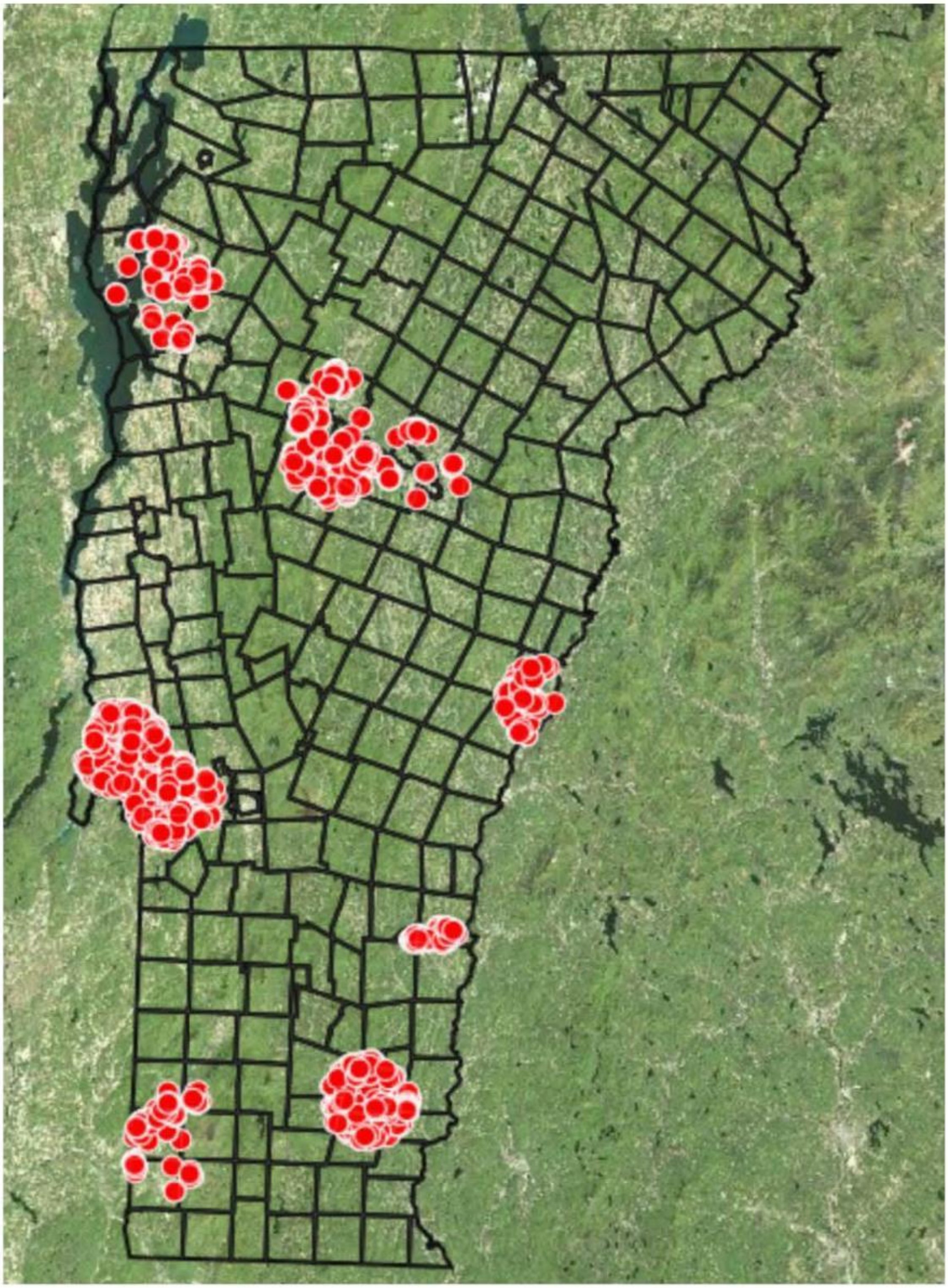


Figure 25: Drive Test Results – AT&T Signal Strength



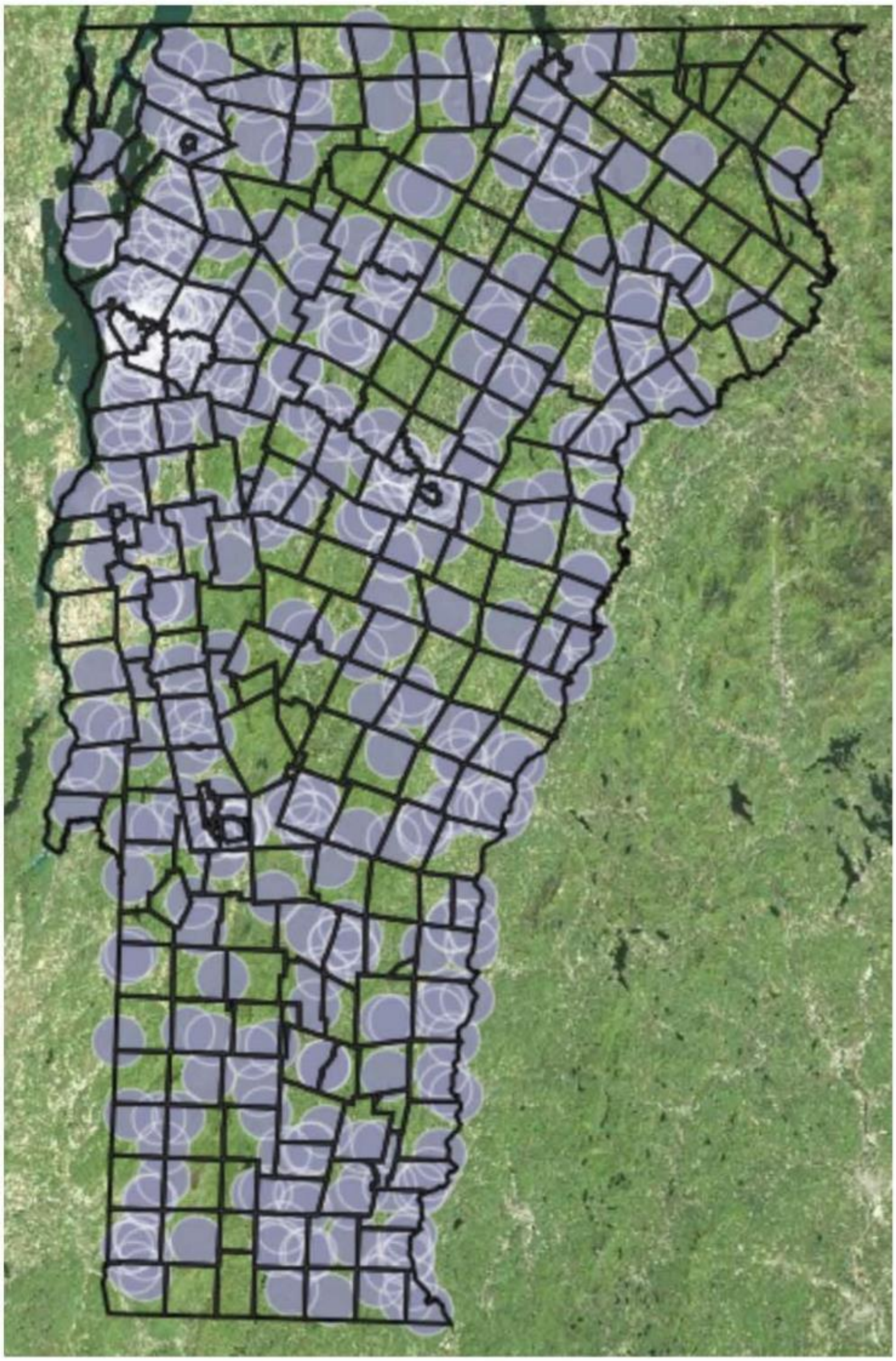
An additional 2,801 premises can be reached via AT&T FirstNet deployments that are required to be completed in 2020.

Figure 26: Premises That Can Be Reached by AT&T FirstNet



Lastly, adding in an analysis of 248a Tower Permit data outside the other mobile broadband service areas, we believe an additional 20,000 premises not captured in the drive-test data or by new AT&T deployments, that are within 3 miles of the additional towers, can be served by cellular data.

Figure 27: 248a Installations With at Least One Cellular Data Provider



In addition, recent roaming agreements between VTel and cell carriers, and the fact that not all roads were surveyed likely make this number significantly higher.

Using the threshold of 22 percent of Vermonters as qualifying as low income, we project that 9,750 of these households may qualify for the recommended subsidy program, and should the State anticipate subsidizing mobile hotspots for all of these low-income premises for 1 year, the cost would be approximately $2.4 million.

8.2.2.2 Targeted Cable and Fiber Line Extensions

Many Vermonters live in proximity to areas served by cable networks but their homes are not passed by cable service. These pockets of unserved locations are unlikely to be served by entities other than the providers that are already close by, as that would require costly and extensive construction by the new provider solely to reach them.

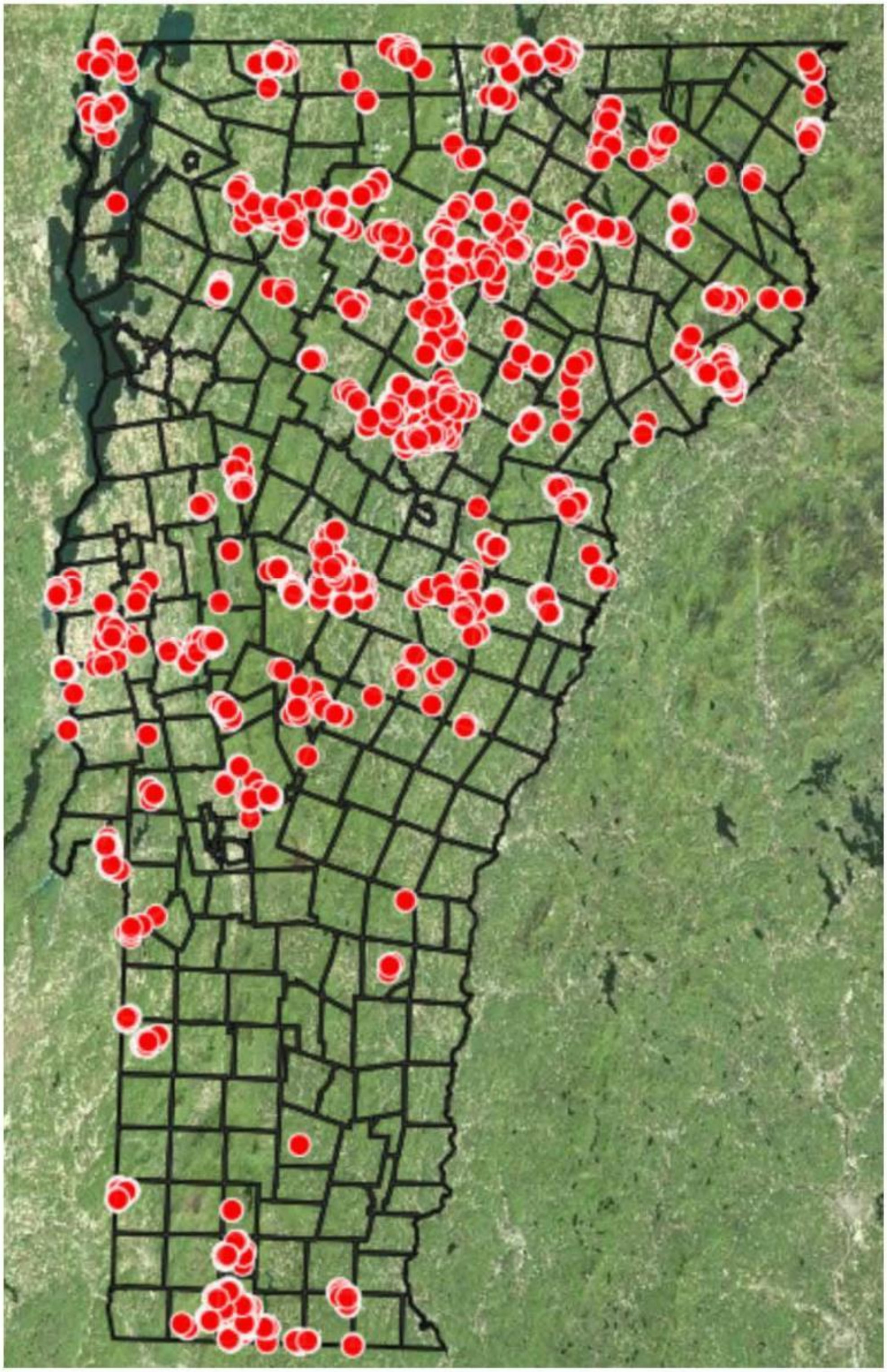
An estimated 16,000 unserved premises are within a half a mile of a cable or fiber line, and 27,000 unserved premises are within a mile buffer, although some of these premises are located on the outskirts of existing wired infrastructure (Category 1) and are therefore not considered in an "unserved island" (Category 2). The project team identified 39 towns where at least 85 percent of the existing road miles are already served by cable or fiber; these towns are most likely to have islands of unserved premises. In these towns, there are 1,762 premises in islands within 0.5 miles of existing cable or fiber, and 2023 premises within 1 mile of fiber. There are approximately 186.6 road miles without infrastructure, not including interstates and two-lane highways. Assuming the cost of cable and fiber deployment remains at $30,000 per mile (the number the State of Vermont has used as a benchmark for cable line extensions), the project team estimates that building out the unserved islands in the 39 priority towns would cost $5.6 million. This results in a cost per premises of $2,768.

An explanation of our methodology and details on each of these towns are in Appendix G. Because these deployments are extending existing infrastructure, the project team believes that with sufficient resources and cooperation by the cable and fiber providers, this deployment could be completed by the end of the year and if possible, funded using CARES Act dollars.

8.2.2.3 Cellular Service Signal Boosters

Some Vermonters have weak cellular service and would not be able to get consistent broadband but would be able to get significantly better service by installing cell service repeaters, also known as signal boosters, typically on a premise's roof. Installing signal boosters will allow a greater number of Vermonters to receive adequate internet speeds on existing cellular networks. Using data from The Department of Public Service's drive test (expanding to areas with any measured speed, and any area within one-half mile of those areas), we estimate that about 3,700 additional unserved locations likely have weak cell service and could benefit from repeaters. (If VTel receives ReConnect funding and expands its network as discussed below, a further 3,500 locations would receive enough signal to likely benefit from repeaters.)

Figure 28: Premises Where Cell Boosters Could Benefit Connectivity



The project team recommends the State of Vermont notify residents who may benefit from signal boosters and provide a list of options. The project team recommends that the State bulk purchase signal boosters for an estimated 820 low-income households that would benefit; another 775 low-income households would likely benefit from a cell service repeater if VTel expands its network. The State should also consider the bulk purchase of signal boosters for additional Vermonters who are not below the low-income threshold, which would allow them to access better service without needing to pay as much for the installation of new equipment.

As described below, the proposed Broadband Corps could install these signal boosters for Vermonters. Corps members will receive a simple training on installation, as well as Covid-19 safety precautions.

Cell signal boosters typically cost about $400, with installation costs of about $350. Assuming the Broadband Corps is able to complete installations and the State can negotiate a lower price when purchasing in bulk, the project team estimates that the State of Vermont can install signal boosters for 1,575 low-income households for about $535,000.

8.2.2.4 Potential New Wireless Deployments

VTel has applied for ReConnect funding from the USDA to extend its wireless network. While this application is still pending, VTel has already begun to expand its network with new wireless deployments, like their recent deployment in Whitingham. Our estimates indicate that VTel's proposed network expansion will cover about 2,500 that are currently without access to mobile data service; and would not be well covered by the mechanisms described above. In addition, another 3,500 premises could be served be VTel's proposed network with the installation of cellular signal boosters. It is not known whether VTel would build part or all of the proposed networks should USDA funding not be available.

We do not recommend at this point that Vermont step in to subsidize VTel's proposed deployment should the USDA decline to fund it. First, this wireless infrastructure would not provide speeds of 100/100, and therefore does not advance the State's long-term goals. Second, funding this project may keep many parts of the State of Vermont ineligible for future USDA ReConnect funding for a longer period of time, which would inhibit the State's ability to meet its long-term goals. Because the State has set 100/100 as a goal, any investment in long-term, permanent investment should be directed toward meeting that goal.

8.2.2.5 Wireless from Other Non-Residential Fiber

We evaluated whether it was possible to expand broadband access by deploying wireless equipment on buildings or other vertical assets where there is existing non-residential fiber; for example, a wireless provider could attach equipment to a building connected by FirstLight or a fiber splice located outside a VELCO substation on VELCO's fiber network. However, the project team does not recommend that the State of Vermont fund the deployment of this type of wireless network at this time.

Nearly all locations within a 0.5 mile radius of a building served by FirstLight or a VELCO substation could be more rapidly served by mobile data (including those households that could benefit from signal boosters) or line extensions. Identifying and deploying small-scale wireless solutions would require time from PSD employees or employees from other agencies that could best be used implementing other programs.

Individuals across the State have been working on these types of hyper local solutions — from Addison County to the Northeast Kingdom. Individuals with experience could be supported by the CUDs may be able to set up and manage these micro-networks. These deployments are not to be discouraged; however, if is not in the State's best interest to fund them to address an immediate Covid-19 emergency.

8.3 Using Broadband Corps to Mobilize Solutions

Consistent through interviews and survey feedback, stakeholders have illustrated a need for more hands-on resources to assist with the technical issues that inevitably arise as the State moves online. Schools tech directors that were busy serving an in-person school enterprise now need to also assist educators, students and parents for both online and in person instruction. Healthcare providers report that appointments take longer due to technology barriers and state that they often are using appointment time to walk patients through use of their online systems. And the rapid distribution of wireless devices and boosters to connect many unserved locations will require relatively low skill but intensive work on the ground.

8.3.1 Overview of Broadband Corps Tasks

A quickly organized Broadband Corps could address these gaps through organizing volunteers through the CUDs and providing direct service to Vermonters to make sure as many as possible are connected quickly and able to use this new connectivity.

We recommend the creation of a Broadband Corps to perform the following tasks:

1) **Assist with infrastructure and service deployment**. Corps members will assist Vermonters to measure what type of hot spot would work best, and whether a signal booster is needed. Corps members would also be responsible for installations, updating coverage maps, and other duties related to infrastructure deployment. Installation of signal boosters are very simple efforts that require few specialized skills and could be ideal for volunteer efforts.

2) **Perform outreach, and direct technical support to Vermonters becoming familiar with their broadband connections and devices.** Corps members will work with schools,

libraries, town administrators, CUDs, to increase effective utilization of devices and online tools. Structured as a digital literacy help desk that used telephone service to engage participants, Corps members would deliver support to those unfamiliar with core video conferencing tools, as well as specific applications related to remote education and telehealth.

3) **Provide "high touch" support to ensure low-income Vermonters take advantage of broadband support programs.** Enrollment in programs for low-income Vermonters – from State subsidies to ISP specific programs – is very low. In collaboration with regional organizations who work with low income populations, Broadband Corps members can undertake proactive outreach to eligible Vermonters and provide phone based support to ensure applications get processed and submitted.

If the Corps is successful in connecting Vermonters rapidly, we recommend in the Spring that Corps members spend available time on pole surveys of towns on behalf of CUDs and thereby advance their work toward deploying fiber.

8.3.2 Possible Broadband Corps Structure and Scale

We have created a sample Broadband Corps structure that combines regionally assigned Corps members with a statewide installation team. Corps members could be assigned to Regional Planning Commission regions, and could work closely with RPCs and/or CUDs if desired, with statewide management based in a central location. We recommend at least 22 regional corps members (two for each RPC region), and at least 20 statewide corps members.

Regional corps members would be focused on evaluating the viability of hotspot or booster for unserved households. Statewide corps members would comprise the trained installation teams. Though this may seem like extra driving for the central corps members, central storage of equipment provides great efficiencies, and this is how installation teams in the renewable energy space and other similar ventures operate.

A recommended management structure for the Broadband Corps would include a statewide director, two to three regional managers, one data manager, and one operations manager. The initiative could be assigned to a nonprofit with experience in this arena or potentially managed under the SerVermont office with the understanding that traditionally the Vermont National Service Commission has been largely focused on distributing AmeriCorps resources, not managing direct service activities. Though this structure would also work well as an AmeriCorps program with the benefits that kind of structure provides (e.g., insurance, recruiting support, education awards), incorporating it into this national structure would likely delay the project by many months or longer. There would remain opportunities to leverage other national service programs like the National Community Conservation Corps (NCCC), which has the ability to quickly deploy teams of trained AmeriCorps members to a state for six-week labor-intensive projects like this one, although preparations would need to be made to maximize the value of this deployment. Once this program is underway, SerVermont could evaluate whether the initiative could be transitioned to a statewide AmeriCorps program.

While a Corps could be put together quickly to get started as early as December, it is likely such a team would be focused on executing for a six-month period. Below is a draft budget for a six month effort:

Table 2: Sample Broadband Corps Budget

Personnel	Cost	Number	Total
Regional Corps Member	$18,000.00	22	$396,000
Statewide Corps Member	$18,000.00	20	$360,000
Full Team Director	$50,000.00	1	$50,000
Regional Director	$40,000.00	3	$120,000
Data Manager	$40,000.00	1	$40,000
Operations Manager	$40,000.00	1	$40,000
Fringe	15%		$150,900
Total Personnel Cost	$1,156,900		
Work Equipment	**Cost**	**Number**	**Total**
Monthly Truck Lease	$500	10	$50,000
Gas, oil, tires, maintenance	$500	10	$50,000
Construction equipment	~$350	10	$3,500
Pole Collection software	$50	10	$5,000
Total Equipment Cost			$108,500

Note: This is a sample budget to provide scale to this proposal. Room for contingencies should be built into this budget, as well as administration costs and overhead for the managing entity, and estimates should be further vetted for equipment and personnel costs.

9 Legal Analysis

This section is in progress.

Appendix A: Residential Survey Results

Executive Summary

As part of its efforts to perform a comprehensive evaluation of broadband gaps during the Covid-19 pandemic, the State of Vermont commissioned an online survey of households. The survey was intended to gather basic data about the types of services to which residents subscribe and their use of these services (including subsidized programs such as Comcast Internet Essentials). Moreover, the survey was designed to provide insights about how the pandemic has impacted residents' use of the internet at various times and locations inside and outside the home and whether internet service is sufficient to meet the needs of households across the State.

Almost all respondents have access to the internet, which is to be expected of online survey participants. At the same time, households' internet service may be inadequate to meet their needs during the pandemic. Usage in the home at various times and for various activities has increased significantly during the pandemic, at the same time that satisfaction with connection speed and reliability has decreased. Many respondents disagreed that their home internet connection is adequate to meet their needs, particularly for attending online classes and doing homework. Additionally, very few respondents (8 percent) feel that public Wi-Fi access in their area is adequate.

This appendix documents the survey process, discusses methodologies, and presents results intended to assist the State in developing strategies to close the identified gaps.

Key Findings

Key findings are here presented thematically in two subsections: broadband access gaps and Covid-19 impacts on broadband use. These and other findings are presented in greater detail in the body of the report.

Broadband Access Gaps

The survey found very few gaps in acquisition of residential internet access services, but also that relatively few residents are taking advantage of available subsidized programs. The following are key findings:

- **Most residents do have home internet access.** Most (96%) reported having internet access, including 79 percent who have both home internet service and a cellular/mobile telephone service with internet (smartphone). The high saturation of internet access would be expected in an online survey.

- **Five percent of all respondents and nine percent of low-income households (earning less than $25,000 per year) only use a smartphone for home internet access.** This may limit their ability to fully utilize online services at home.

- **Comcast Xfinity and Consolidated Communications (CCI) are the leading internet service providers used.** Three in 10 respondents subscribe to Comcast Xfinity, and three in 10 subscribe to CCI. Other ISPs comprise much smaller shares of the market statewide but may represent larger shares in some individual counties. Further detail on companies used by respondents are provided in the body of the report.

- **Residents may be significantly underutilizing existing broadband subsidy programs.** Only one percent of all Comcast subscribers, and 10 percent of low-income subscribers, participate in the Comcast Internet Essentials program. Another 59 percent of low-income subscribers were unaware of the program, and 15 percent attempted to enroll but were declined.

- **Most (99 percent) respondents access the internet from any location, including a range of locations outside the home.** However, use of the internet outside of the home has declined significantly during the Covid-19 pandemic.

- **Most respondents are unaware of the State's emphasis on Communication Union Districts.** Three in 10 respondents said they are aware of CUDs as a way to improve broadband access in unserved areas, while 59 percent are unaware and 11 percent are unsure.

- **Public Wi-Fi access may not be adequate.** Nearly one-half of respondents (45%) are aware of public Wi-Fi hotspot locations near their home, but just eight percent said that hotspot access is adequate in the area. Another 43 percent were unsure.

- **Most respondents use search engines to learn about availability of internet service.** Two-thirds named search engines as the leading source of information to learn about available service options, and seven in 10 named search engines as the top source for learning how to use the internet more effectively.

Covid-19 Impacts on Broadband Use

Respondents reported increased use of and demand for broadband services during the Covid-19 pandemic. They are utilizing the internet more at home and less often outside the home, as may be expected, and they are engaged in more online activities for work, school, and entertainment. The following are key findings:

- **Daily use of home internet services at various times has increased during the pandemic**. Prior to the Covid-19 pandemic, just over one-half of respondents made daily use of the internet mid-morning or early afternoon, compared with approximately nine in 10 respondents during the pandemic. Four in 10 households have at least three members online during peak usage times during the Covid-19 pandemic.

- **Use of internet services outside of the home has declined significantly during the Covid-19 pandemic.** Use of the internet in key areas decreased significantly when comparing figures pre-Covid and during-Covid, including in work settings (79% vs. 56%), private businesses (65% vs. 27%), schools or colleges (38% vs. 20%), and public buildings (37% vs. 18%).

- **Engagement in online activities has increased significantly during the Covid-19 pandemic.** Use of the internet for telemedicine or medical appointments (19% vs. 75%) and for civic engagement (33% vs. 74%) increased substantially from pre-pandemic to during-pandemic, although some of the use is at a monthly or less than monthly basis. Additionally, 62 percent of respondents use the internet for teleworking on a daily basis, compared with 21 percent of respondents before the pandemic.

- **Satisfaction with internet service aspects has decreased during the pandemic, particularly for speed and reliability of service.** More than one-half of respondents are not at all satisfied (approximately one-third) or are only slightly satisfied (approximately one-fifth) with connection speed and reliability during the pandemic.

- **Many respondents have experienced some challenge with accessing telehealth or an online medical appointment during the pandemic.** Specifically, four in 10 respondents experienced an issue (e.g. having to switch from video to audio only), while three in 10 have not had a medical appointment and another three in 10 did not respond or had no issue.

- **Most households with children have internet access, but it may not be sufficient for some families.** Most respondents disagreed that their children have to do homework or distance learn at various locations outside the home (although 13 percent agreed or strongly agreed that their children cannot complete their homework or cannot distance learn because they do not have access to the internet at home.) However, four in 10 respondents strongly disagreed that their home internet connection is adequate for their or their children's needs for doing homework or attending classes online.

- **Sixteen percent of all respondents consumed public, educational, or governmental (PEG) TV content during the Covid-19 pandemic.** Among those who viewed PEG programming, the most commonly accessed content was broadcasts of municipal functions, cited by 72 percent of respondents. One-half of PEG viewers accessed information about Covid-19.

Survey Process and Data Analysis

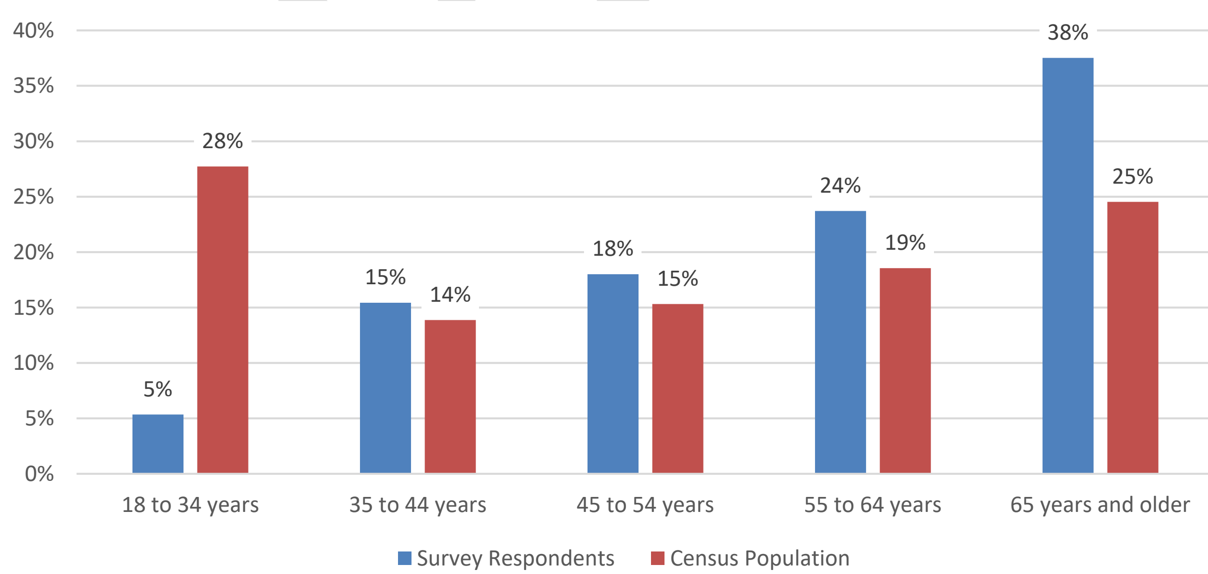
CTC, in close coordination with the State of Vermont, managed the survey project, including development of the questionnaire, programming and hosting the online survey, survey data analysis, and reporting of results. CTC developed the draft survey instrument and the State provided revisions and approved the final questionnaire. A total of 3,046 useable surveys were completed by the date of analysis.

The survey responses were entered into SPSS[37] software and the entries were coded and labeled. SPSS databases were formatted, cleaned, and verified prior to the data analysis. The survey data was evaluated using techniques in SPSS including frequency tables, cross-tabulations, and means functions. Statistically significant differences between subgroups of response categories are highlighted and discussed where relevant.

The survey responses were weighted based on the age of the respondent and region. Since older persons are more likely to respond to surveys than younger persons, the age-weighting corrects for the potential bias based on the age of the respondent. In this manner, the results more closely reflect the opinions of the County's adult population.

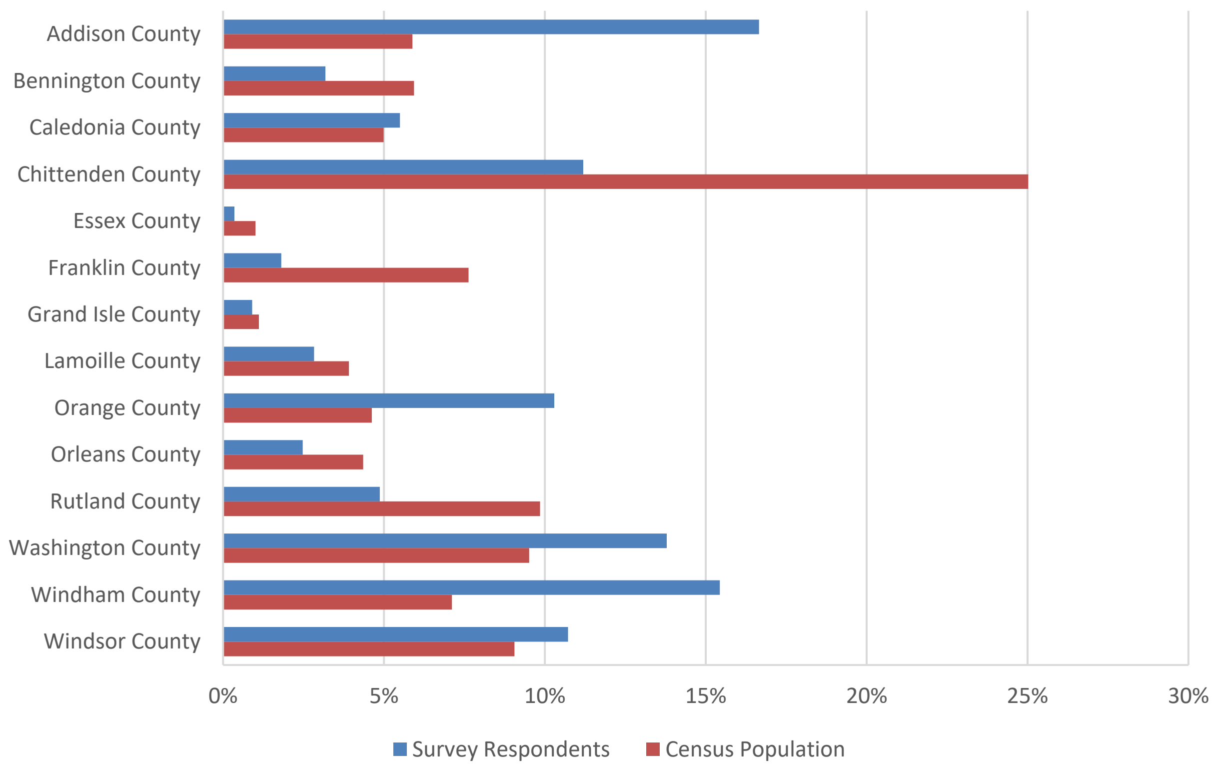
Figure 29 and Figure 30 summarize the sample and population distributions by region and age.

Figure 29: Age of Respondents and Adult Population



[37] Statistical Package for the Social Sciences (http://www-01.ibm.com/software/analytics/spss/)

Figure 30: County of Respondents and Population



The following sections summarize the survey findings.

Survey Results

The results presented in this report are based on analysis of information provided by 3,046 State of Vermont residents. Unless otherwise indicated, the percentages reported are based on the "valid" responses from those who provided a definite answer and do not reflect individuals who said "don't know" or otherwise did not supply an answer because the question did not apply to them. Key statistically significant results ($p \leq 0.05$) are noted where appropriate.

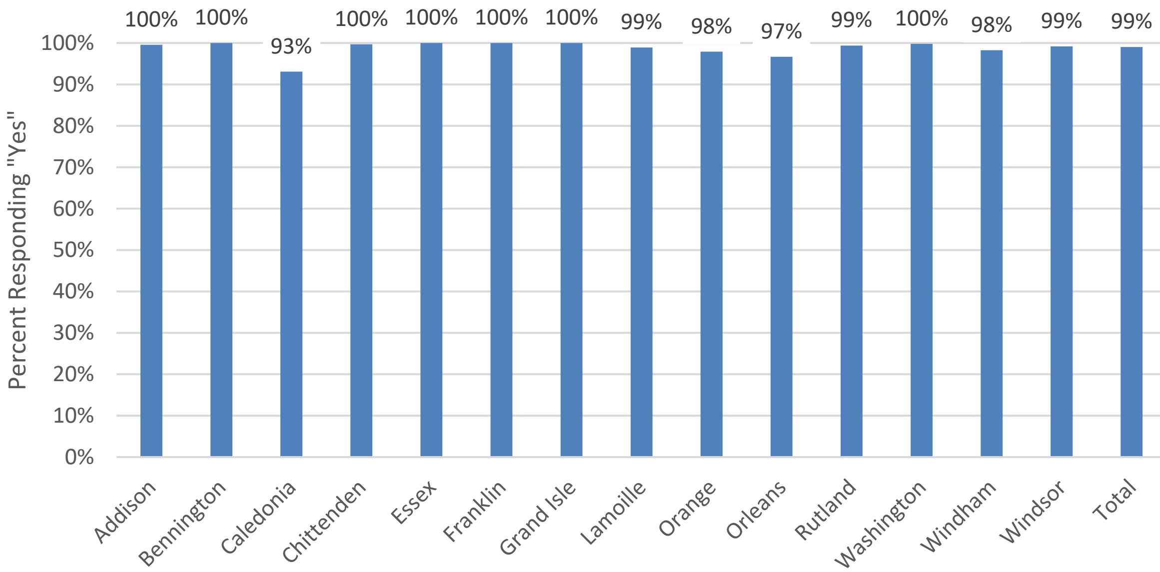
Internet Connection and Use

Respondents were asked about their use of the internet, including home internet connection types and providers, internet costs and enrollment in programs for low-income subscribers, and Wi-Fi availability. This information provides valuable insight into residents' need for various internet and related communications services.

Internet Usage

Almost all (99%) respondents make some use of the internet, on any device from any location, as shown in Figure 31. Usage is high across all demographic groups, including low-income households (99%).

Figure 31: Internet Usage by County



Agreement with reasons for not accessing the internet are highlighted in Figure 32 and Figure 33. Availability of internet service is the leading barrier to internet access, with 17 of 27 (64%) of those who do not access the internet strongly agreeing that internet is not available. The next tier of factors include the ability to get internet at another location and service is too expensive.

Figure 32: Reasons for Not Using the Internet (Mean Ratings)

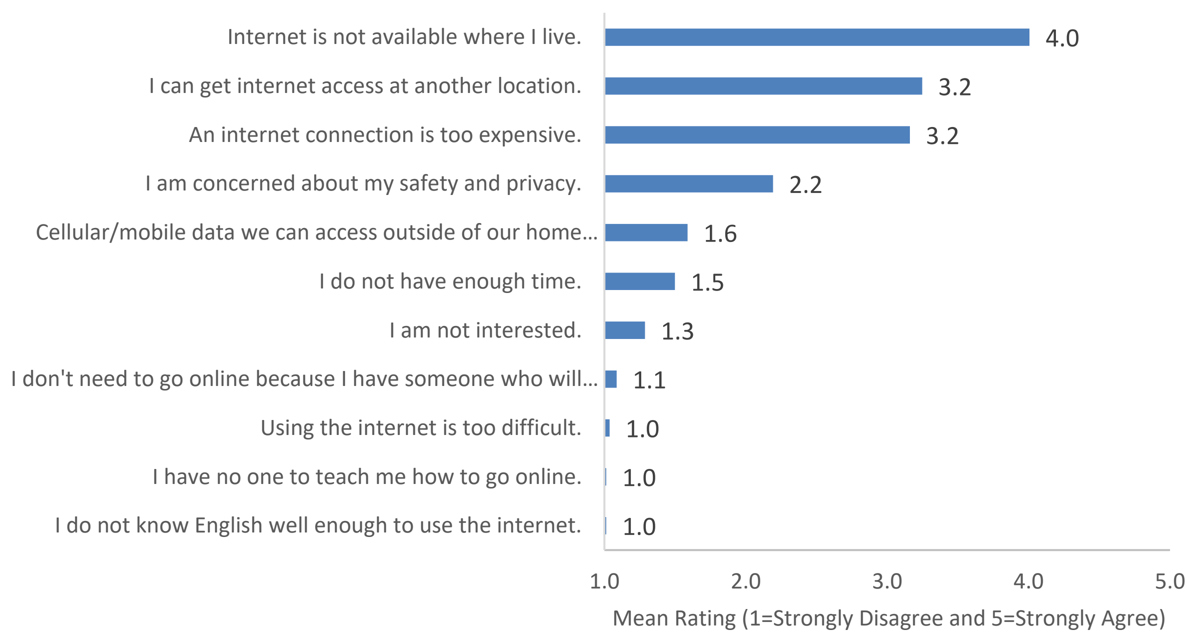
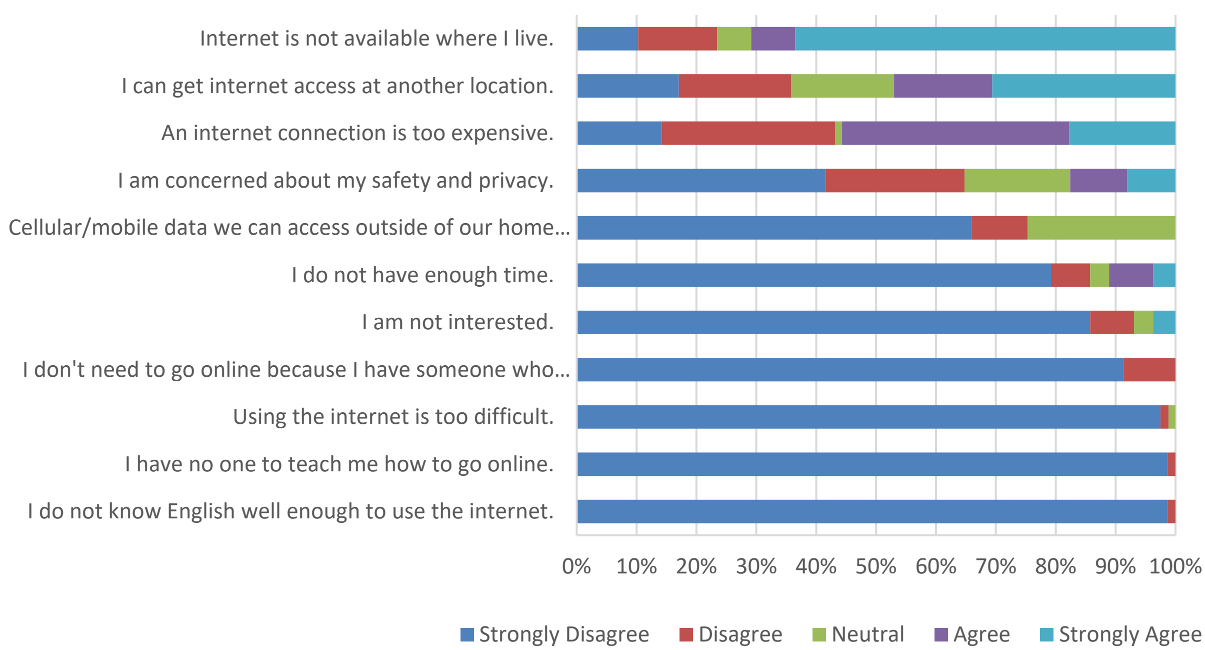


Figure 33: Reasons for Not Using the Internet



Communications Services

Saturation of communications services currently purchased for the household is illustrated in Figure 34 and Figure 35. Overall, 96 percent of respondents indicated having some internet access—either a home connection or via smartphone. Specifically, 91 percent have internet service in the home and 83 percent have cellular/mobile telephone service with internet. Fewer households have landline telephone service, cable/satellite television service, cellular/mobile telephone service without internet, and free Wi-Fi service.

Figure 34: Communication Services Purchased

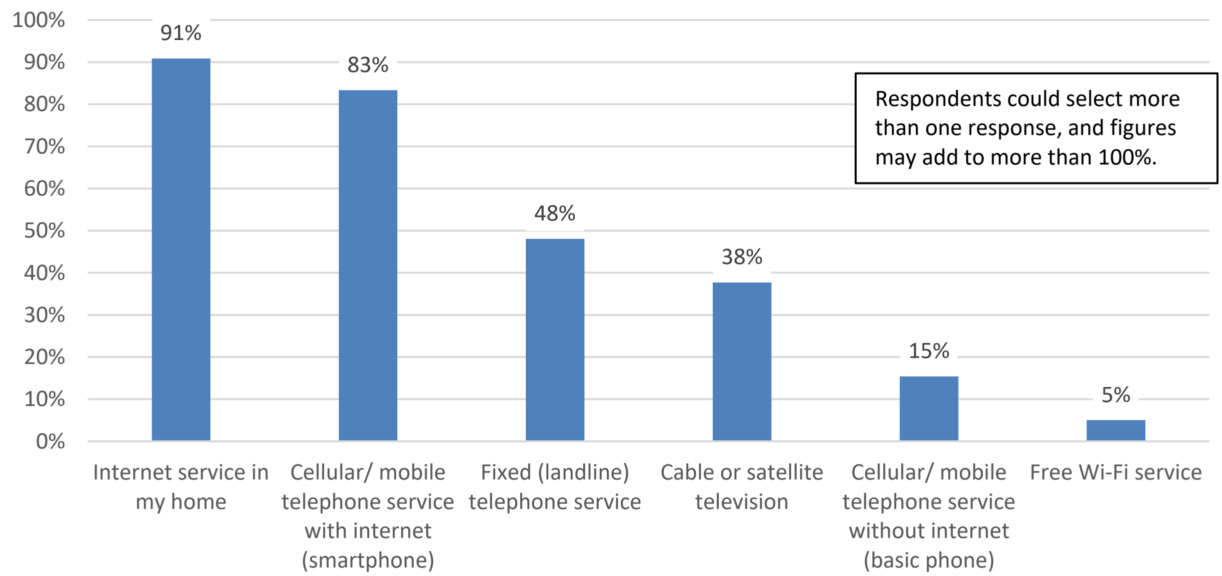
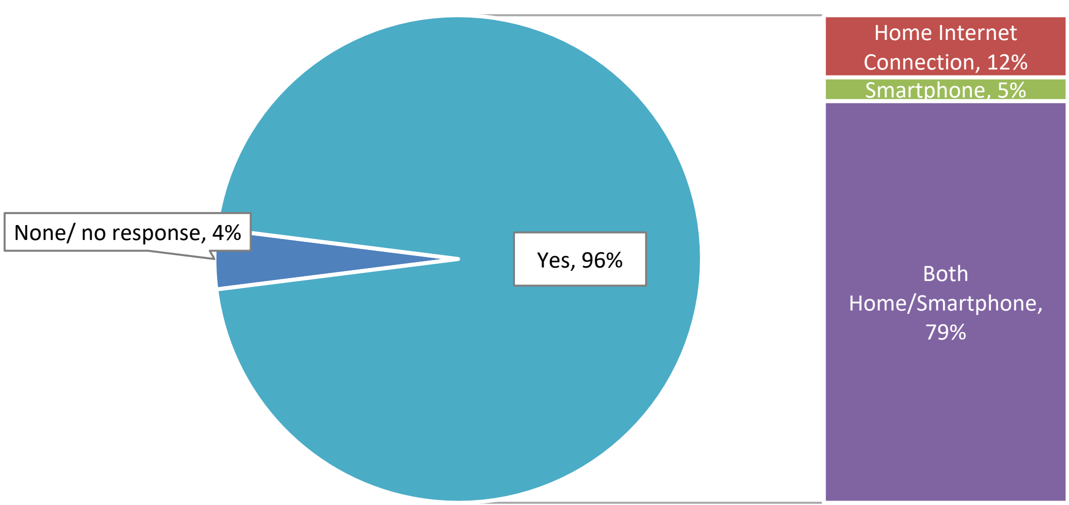


Figure 35: Internet Services Purchased



As discussed previously, most respondents have some internet access, including 79 percent who have both home internet service and a cellular/mobile telephone service with internet (smartphone). Total internet access is high across all demographic groups, as shown in Table 3. Older respondents and those in lower income households are more likely to have a home internet connection only, and they are less likely to have both a home internet connection and a smartphone.

Table 3: Internet Access by Key Demographics

TOTAL	**4%**	**12%**	**5%**	**79%**	**96%**	***3046***
County						
Addison County	0%	8%	3%	89%	**100%**	*151*
Bennington County	0%	9%	3%	88%	**100%**	*151*
Caledonia County	4%	7%	17%	72%	**96%**	*127*
Chittenden County	1%	6%	2%	91%	**99%**	*636*
Essex County	7%	13%	6%	74%	**93%**	*25*
Franklin County	0%	19%	5%	76%	**100%**	*193*
Grand Isle County	0%	5%	0%	95%	**100%**	*28*
Lamoille County	2%	19%	5%	74%	**98%**	*99*
Orange County	1%	24%	7%	68%	**99%**	*120*
Orleans County	3%	19%	0%	78%	**97%**	*110*
Rutland County	2%	11%	4%	83%	**98%**	*250*
Washington County	1%	17%	4%	79%	**99%**	*243*
Windham County	2%	13%	6%	78%	**98%**	*181*
Respondent Age						
18 to 34 years	1%	8%	4%	88%	**99%**	*702*
35 to 44 years	0%	7%	3%	90%	**100%**	*356*
45 to 54 years	1%	7%	5%	88%	**99%**	*390*
55 to 64 years	1%	14%	6%	79%	**99%**	*474*

65 years and older	2%	21%	5%	72%	**98%**	*639*
Education						
HS education or less	2%	14%	6%	77%	**98%**	*304*
Two-year/technical degree	1%	15%	10%	73%	**99%**	*286*
Four-year college degree	1%	11%	3%	85%	**99%**	*998*
Grad, prof, doctorate	1%	11%	3%	84%	**99%**	*975*
Income						
Less than $25,000	1%	22%	9%	68%	**99%**	*140*
$25,000 to $49,999	2%	15%	8%	75%	**98%**	*351*
$50,000 to $74,999	1%	8%	6%	85%	**99%**	*423*
$75,000 to $99,999	2%	10%	3%	85%	**98%**	*424*
$100,000 to $149,999	1%	14%	3%	83%	**99%**	*485*
$150,000 to $199,999	1%	6%	2%	91%	**99%**	*165*
$200,000 or more	0%	7%	3%	89%	**100%**	*130*
Race/Ethnicity						
Other race/ethnicity	0%	11%	6%	83%	**100%**	*88*
White/European American	1%	11%	4%	83%	**99%**	*2171*
Gender Identity						
Woman	2%	12%	5%	82%	**98%**	*1463*
Man	0%	11%	3%	86%	**100%**	*909*

Internet Service Provider

As illustrated in Figure 36, Comcast Xfinity and Consolidated Communications are the leading ISPs overall in the Vermont market area. This varies significantly by county of residence, with saturation of Comcast Xfinity customers highest in Chittenden County and saturation of CCI customers highest in Lamoille and Franklin Counties (see Figure 37).

Figure 36: Primary Internet Service Provider

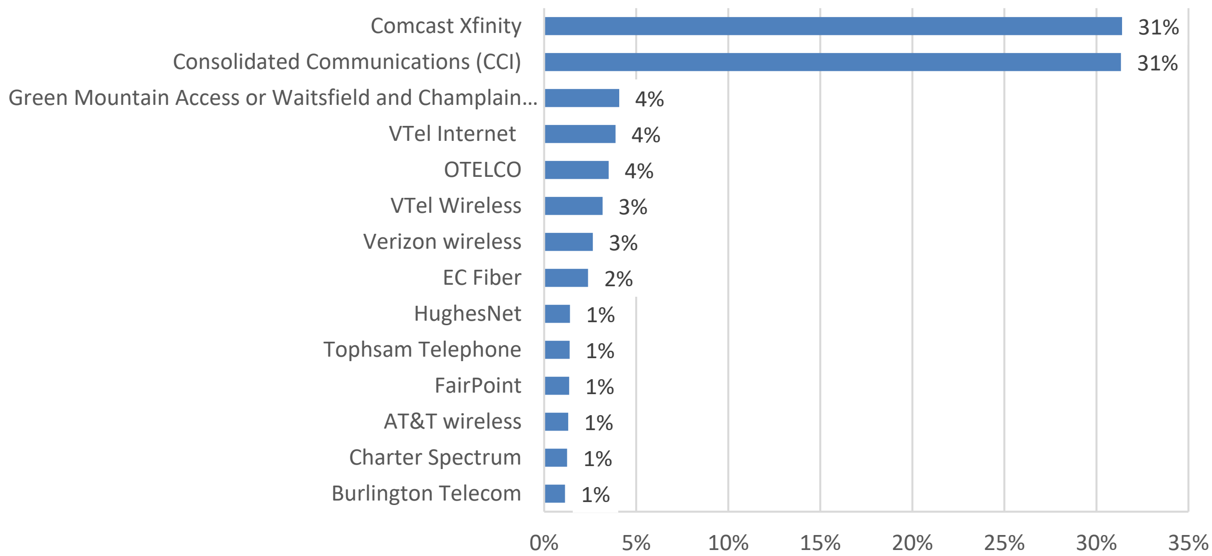
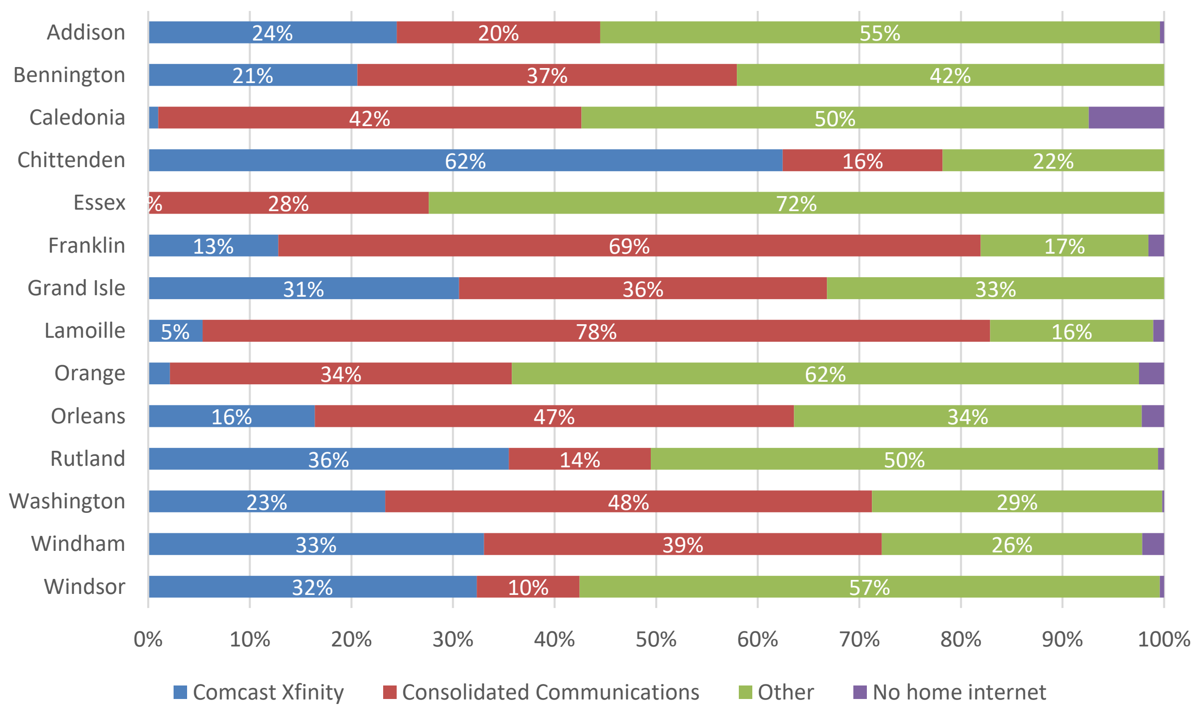


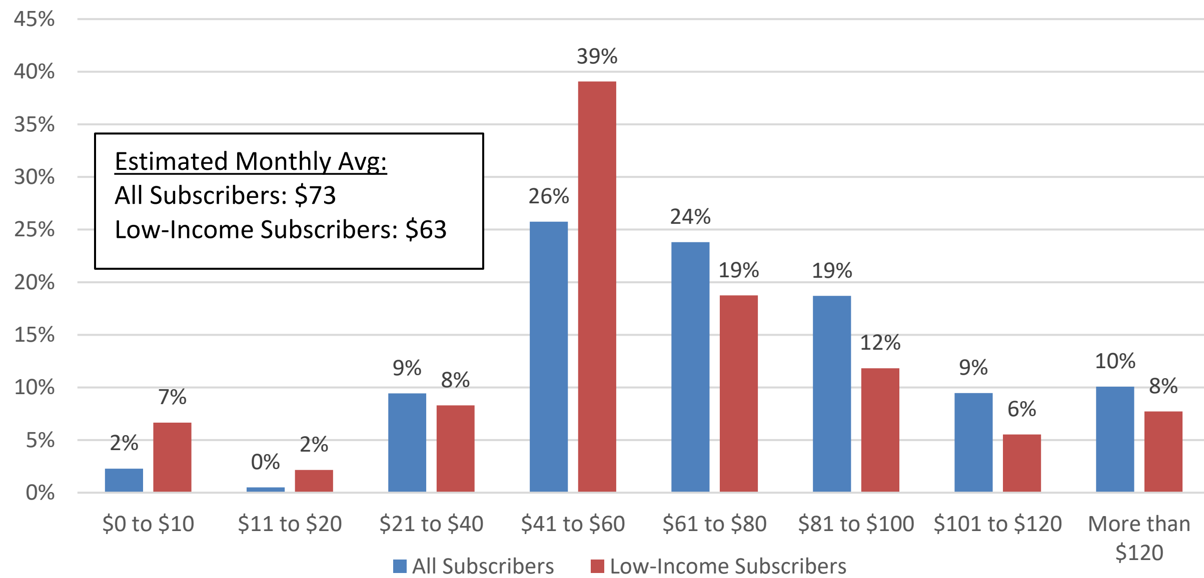
Figure 37: Primary Internet Service Provider by County



Internet Service Cost and Programs for Low-Income Subscribers

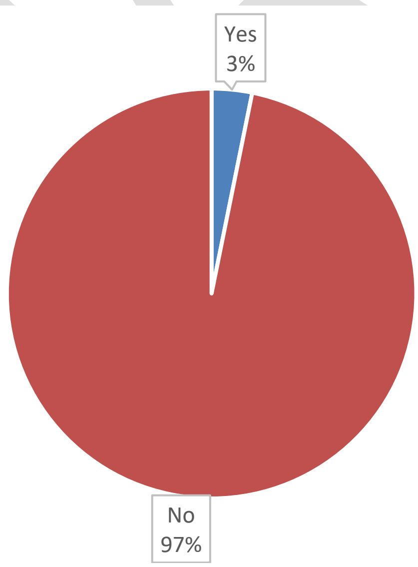
The estimated monthly average cost for internet service is $73, as shown in Figure 38. One-fifth of respondents pay over $100 per month. Low-income subscribers (earning less than $25,000 per year) pay a slightly lower monthly fee for internet service (not controlling for type of service).

Figure 38: Monthly Price for Internet Service



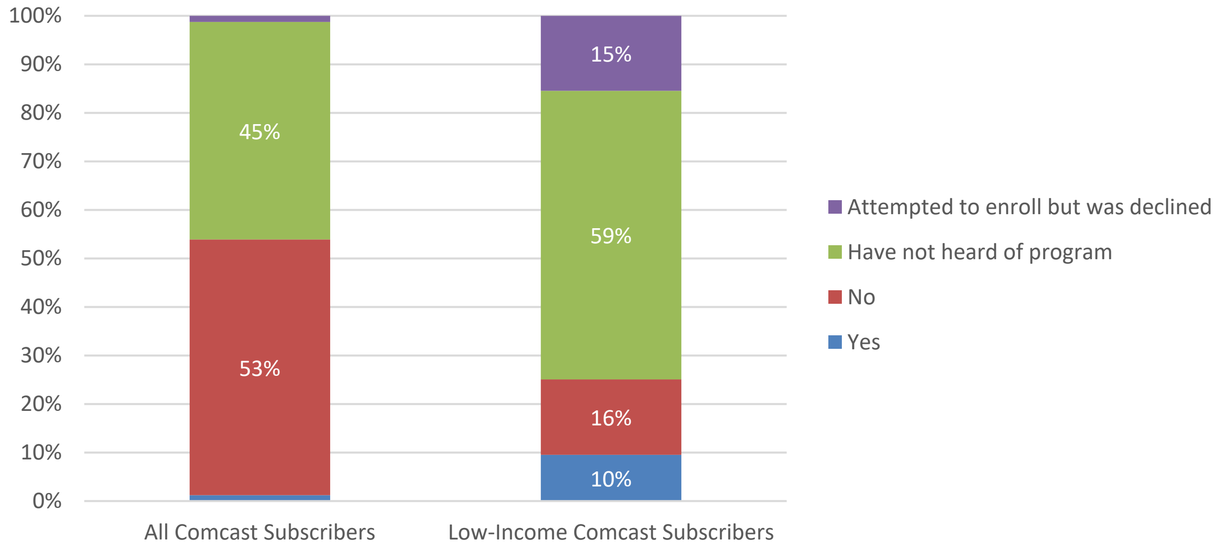
Three percent of all internet subscribers (and 10 percent of low-income subscribers) have missed an internet service payment but found their service remained connected due to the State's or the provider's policy on halting disconnections during the Covid-19 pandemic (see Figure 39).

Figure 39: Missed Payments But Service Remained Connected



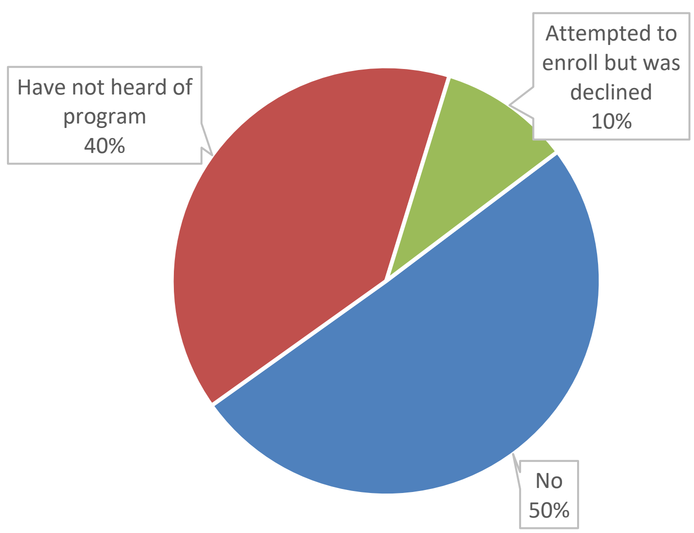
As illustrated in Figure 40, just one percent of all Comcast customers, and 10 percent of low-income customers, are enrolled in the ISP's Internet Essentials program for low-income households. Another 15 percent of Comcast customers earning under $25,000 per year said they attempted to enroll but were declined. Keep in mind that figures among low-income households are based on a relatively small number of respondents.

Figure 40: Participate in Comcast's Internet Essentials Program



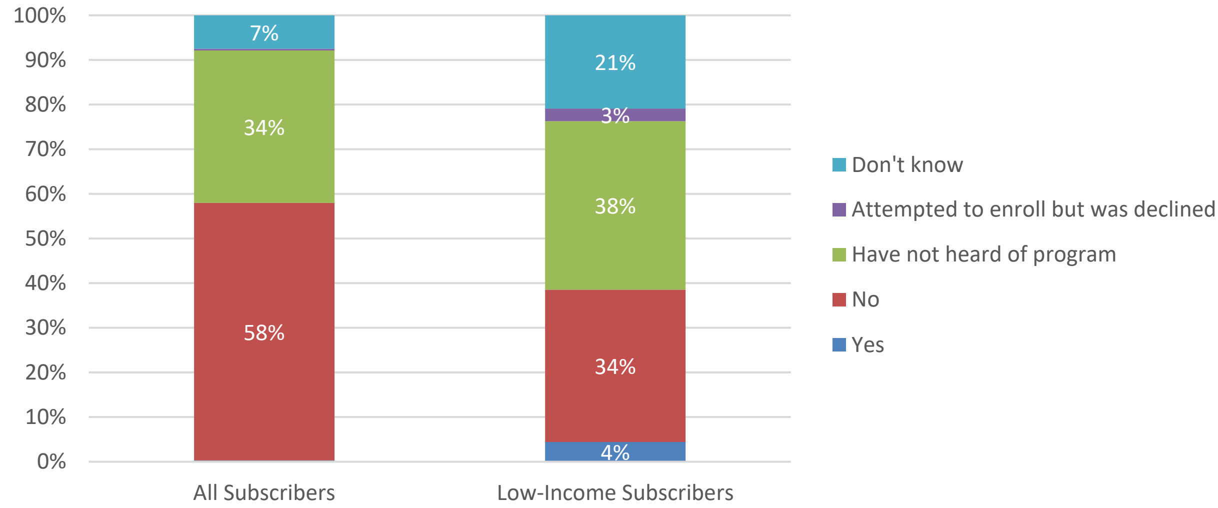
No Spectrum customers are enrolled in the ISP's Internet Assist program for low-income subscribers, while four in 10 said they have not heard of the program (see Figure 41). Seven of 10 low-income customers said they have not heard of the program.

Figure 41: Participate in Spectrum's Internet Assist Program



Just four percent of low-income subscribers (earning under $25,000 per year) receive the $9.25 subsidy under the FCC's Lifeline program, and 21 percent are unsure if they receive the subsidy. Most households are not receiving the subsidy (see Figure 42).

Figure 42: Receive $9.25 Subsidy Under FCC's Lifeline Program



Internet Service and Wi-Fi Availability

Nearly two-thirds (65%) of respondents use a search engine to find out more about internet service options, and seven in 10 use a search engine to learn how to use the internet more effectively. Other sources used include friends/family members and broadband providers. Just two percent of respondents use CUDs to learn about internet service options (see Figure 43 and Figure 44).

Figure 43: Sources Used to Learn About Internet Service Options

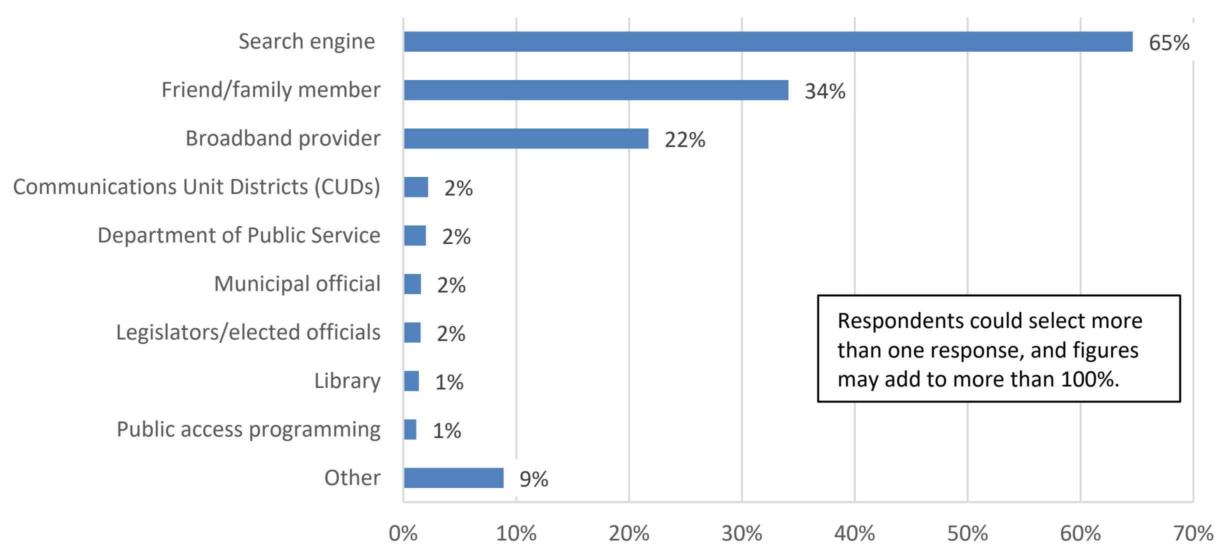
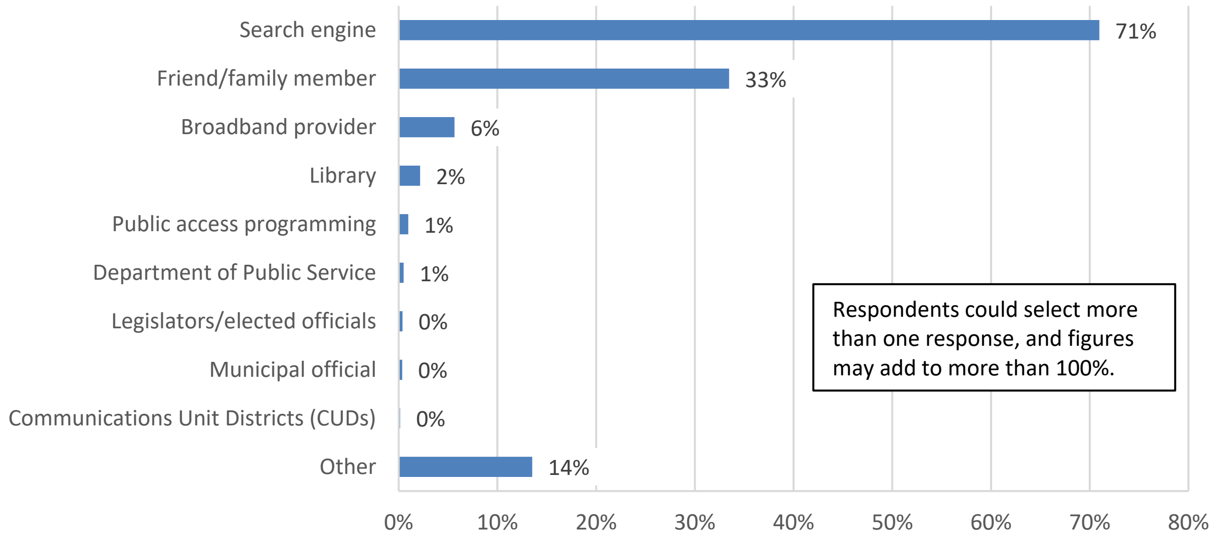


Figure 44: Sources Used to Learn How to Use the Internet More Effectively



Search engine is the top source used across age groups; however, the proportion of respondents using it declines as age increases (see Figure 45 and Figure 46). Nearly nine in 10 respondents ages 18 to 34 years old use a search engine to learn about internet service options, compared with 50 percent of those ages 65 years and older. Conversely, younger adults are less likely than older adults to contact their broadband provider for information.

Figure 45: Top Sources Used to Learn About Internet Service Options by Respondent Age

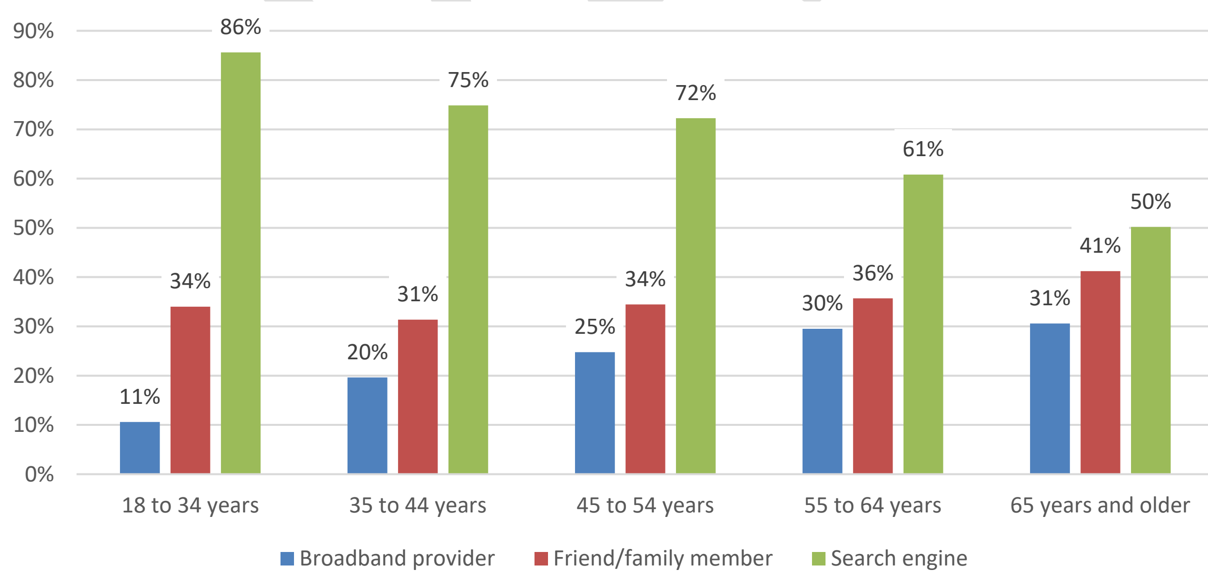
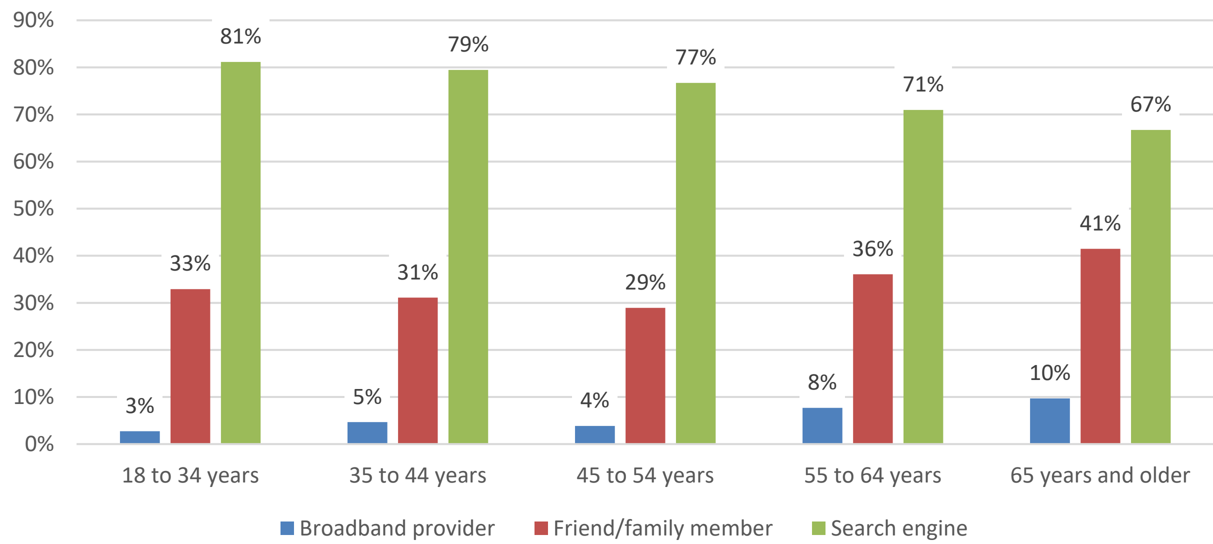


Figure 46: Top Sources Used to Learn How to Use the Internet More Effectively by Respondent Age



Respondents were also asked if they are aware of public Wi-Fi hotspot locations near their home and if they believe public Wi-Fi hotspot access is adequate in their area. Nearly one-half of respondents (45%) are aware of public Wi-Fi hotspot locations near their home, but just eight percent said that hotspot access is adequate in the area, as shown in Figure 47 and Figure 48. Another 43 percent were unsure.

Figure 47: Aware of Public Wi-Fi Hotspot Locations Near Home

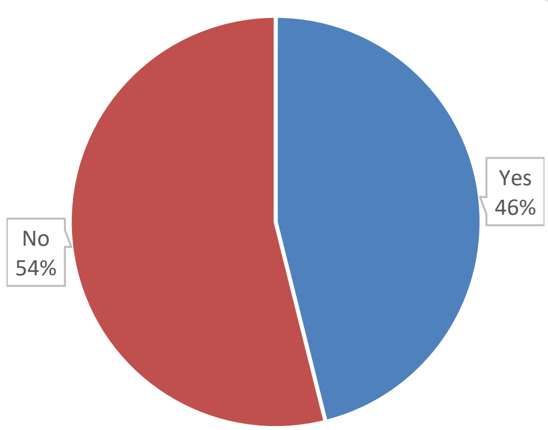
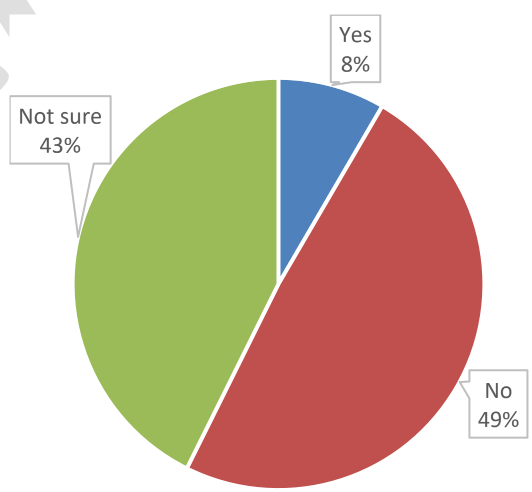


Figure 48: Public Wi-Fi Hotspot Access Is Adequate in Area



Awareness of public Wi-Fi hotspot locations varies significantly by county of residence. Specifically, awareness is highest among Caledonia County and Orleans County residents, although just a small percentage of residents said that access is adequate (see Figure 49 and Figure 50).

Figure 49: Aware of Public Wi-Fi Hotspot Locations Near Home by County

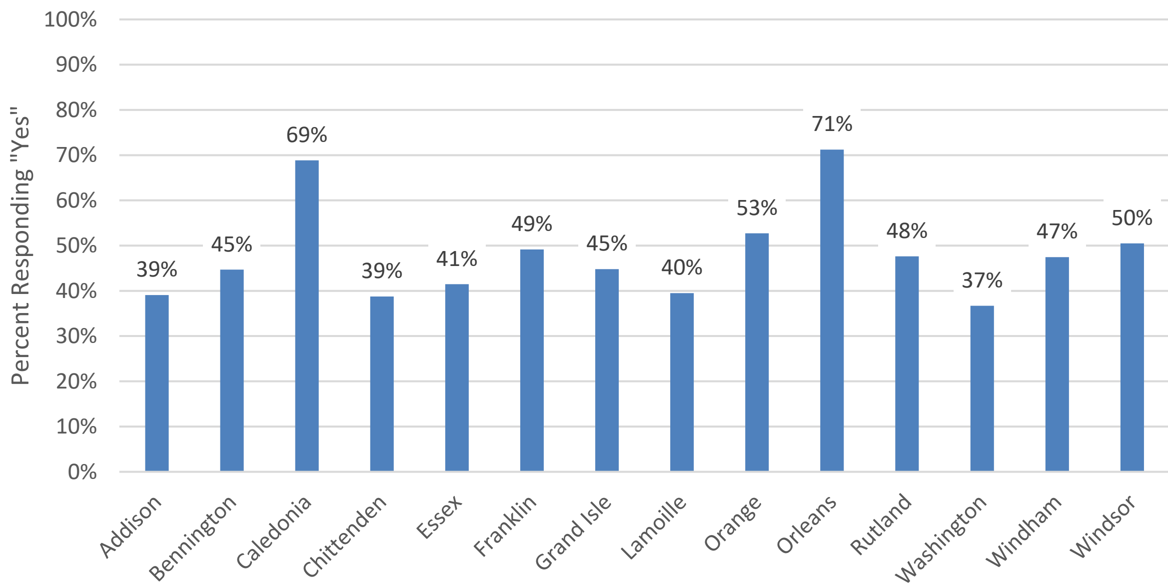
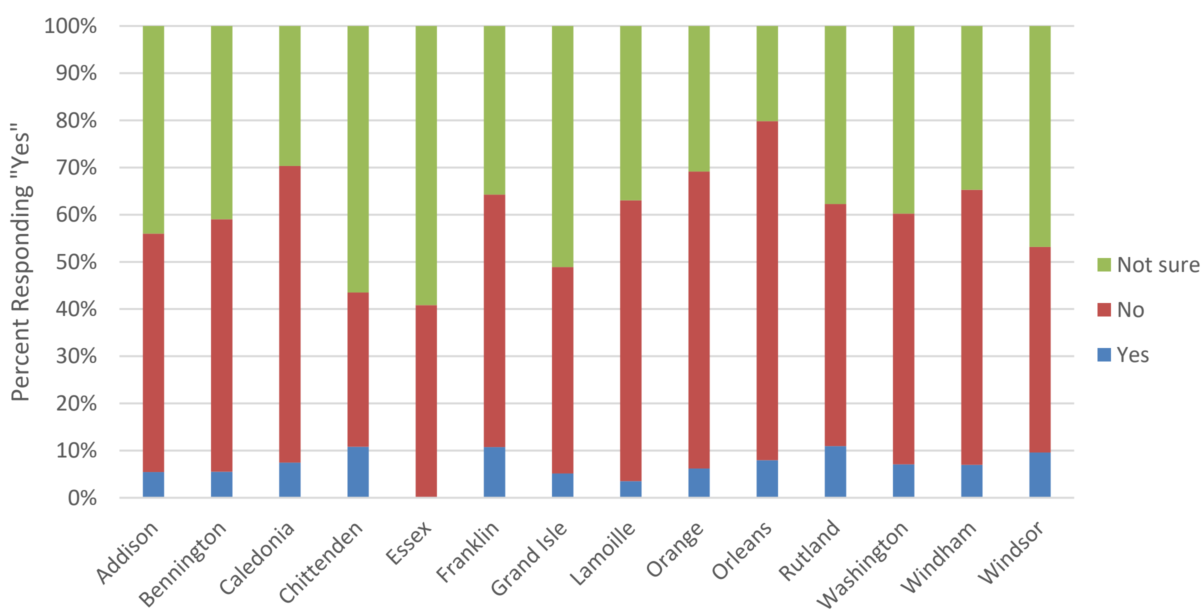


Figure 50: Public Wi-Fi Hotspot Access Is Adequate by County



Overall, three in 10 respondents were aware of the State's emphasis on Communication Union Districts as a way to improve broadband access to unserved areas around the State. Another 59 percent of respondents were unaware, and 11 percent were unsure. As illustrated in Figure 51, awareness was highest among Bennington County, Caledonia County, and Orleans County residents. Also, awareness is correlated with respondent age, with just 23 percent of respondents under age 45 aware of CUDs compared with 37 percent of those ages 65 and older (see Figure 52).

Figure 51: Aware of State's Emphasis on Communication Union Districts by County

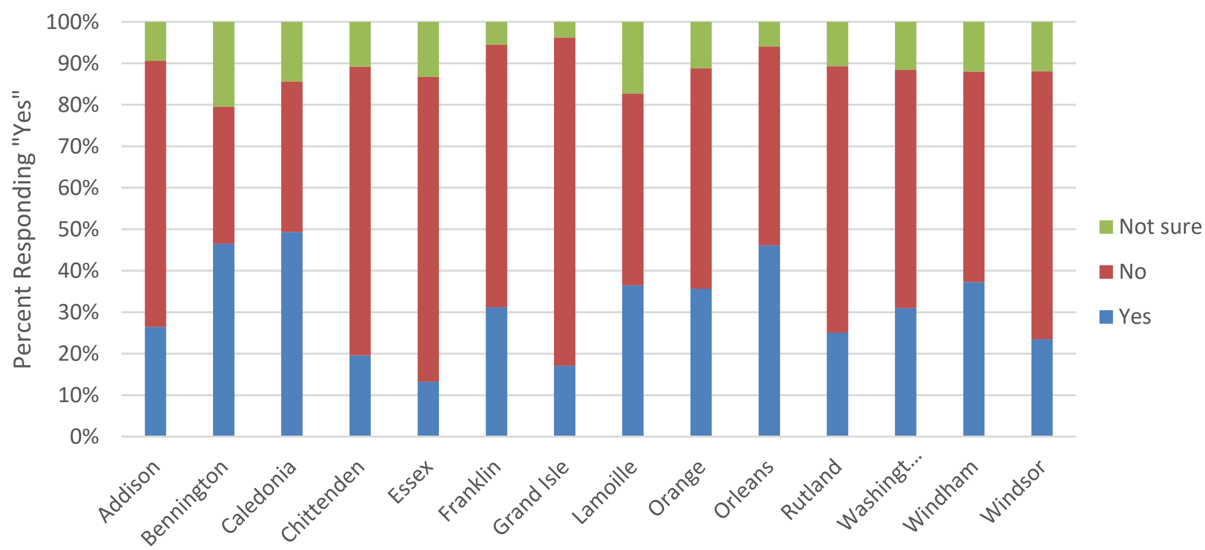
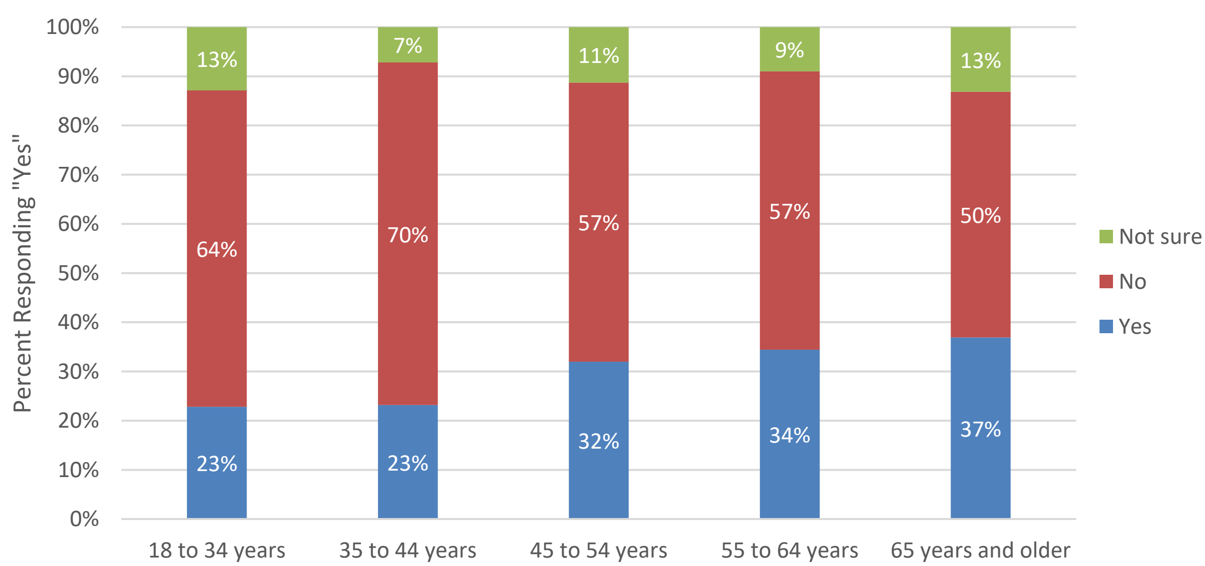


Figure 52: Aware of State's Emphasis on Communication Union Districts by Respondent Age



Covid-19 Impacts on Home Broadband

Respondents were asked a series of questions on how their broadband use has changed during the Covid-19 pandemic, including impacts on time and location of internet use, engagement in various internet activities, satisfaction with internet service, distance learning, and consumption of PEG programming. This information provides valuable insight into demand for broadband service during the pandemic.

Internet Use at Various Times

Respondents were asked to indicate how often they use the internet at various times before and during the Covid-19 pandemic. As shown in Figure 53, daily use of internet services at various times has increased during the pandemic. Most respondents are making use of the internet throughout the day, whereas prior to the pandemic usage was lower during daytime hours and peaked in the evening.

Figure 53: Daily Use of the Internet at Various Times Before and During Covid-19 Pandemic

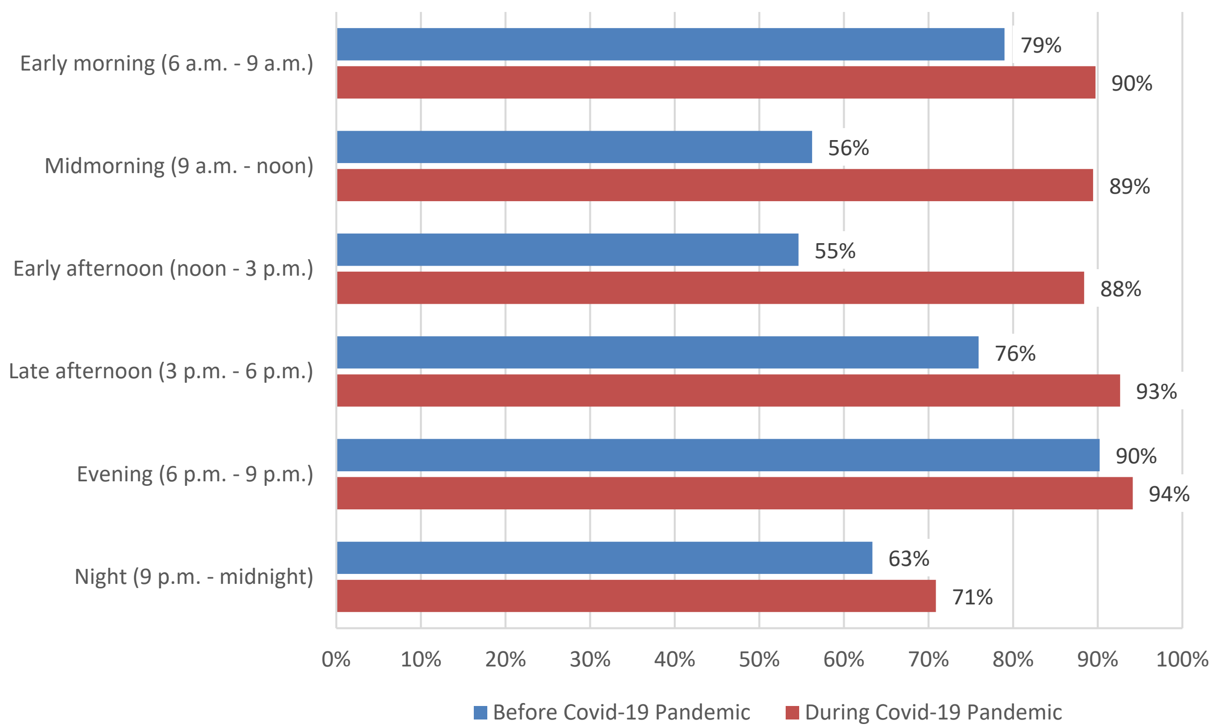


Figure 54 and Figure 55 show detailed usage of the internet at various times, before and during the pandemic. Most respondents made/make daily use of the internet in the evening, before and during the pandemic. Prior to the Covid-19 pandemic, just over one-half of respondents made daily use of the internet mid-morning or early afternoon, compared with approximately nine in 10 respondents during the pandemic.

Figure 54: How Often Use the Internet at Various Times Before Covid-19 Pandemic

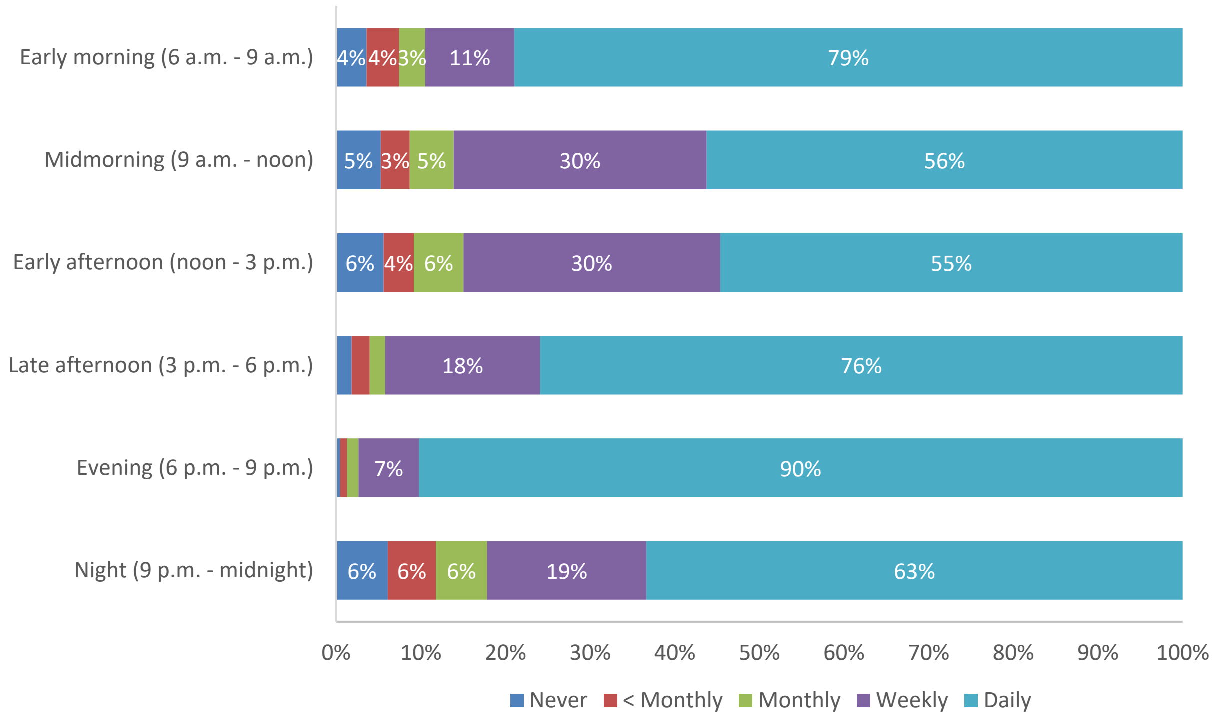
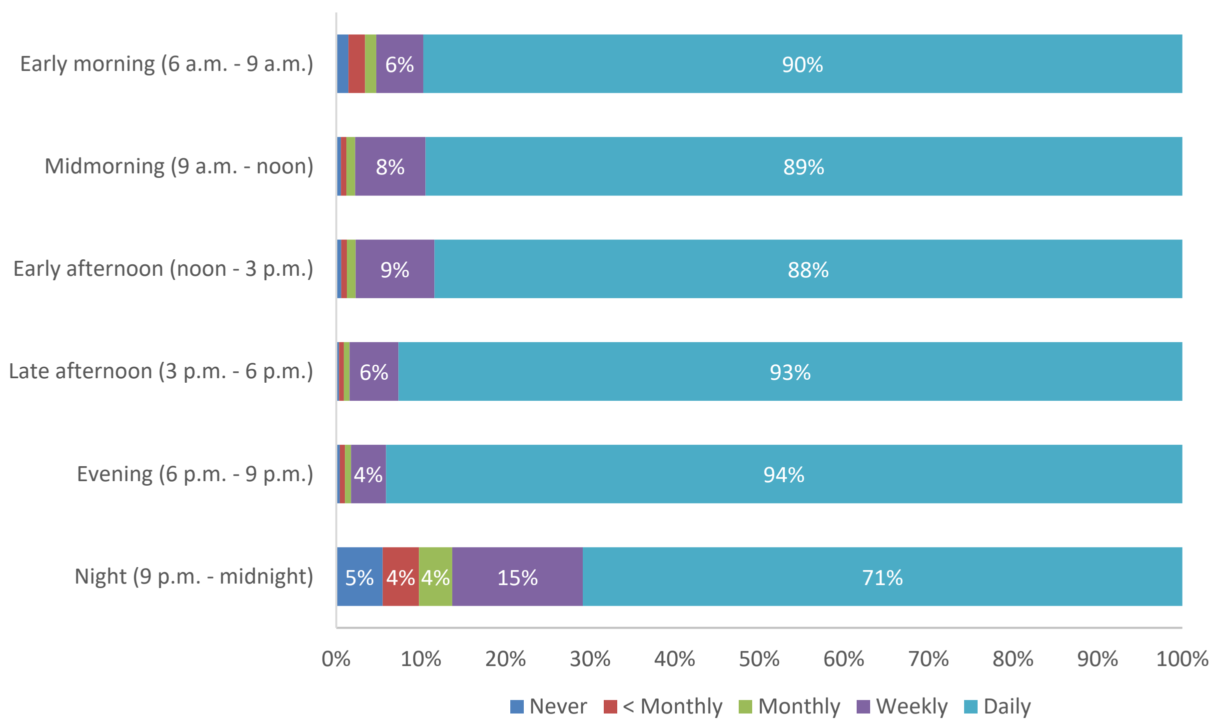


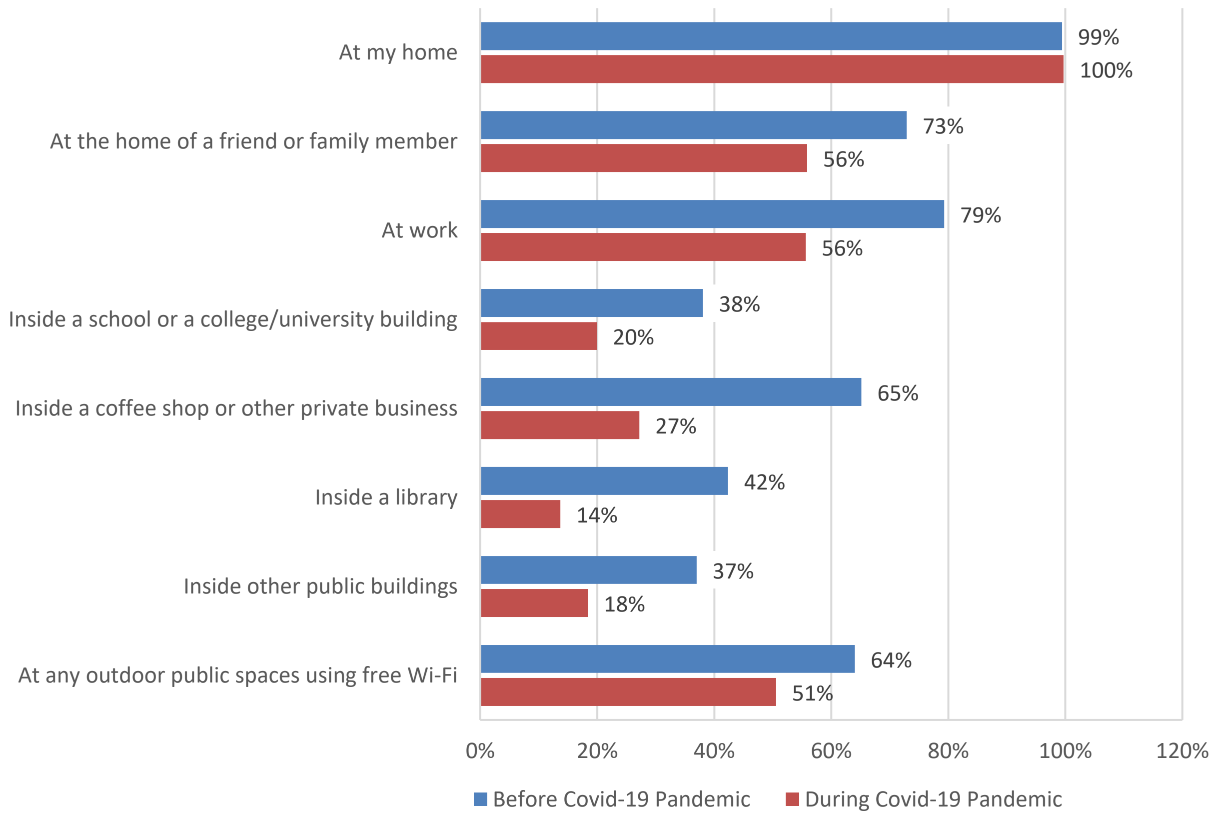
Figure 55: How Often Use the Internet at Various Times During Covid-19 Pandemic



Internet Use by Location

Respondents were also asked to indicate how often they use the internet in various locations before and during the Covid-19 pandemic. As shown in Figure 56, use of internet services outside of the home has declined significantly during the pandemic, which makes sense as many public areas and work settings have not been accessible.

Figure 56: Ever Use the Internet in Various Locations Before and During Covid-19 Pandemic



Significantly, use of the internet declined in work settings (79% vs. 56%) and private businesses (65% vs. 27%) when comparing pre-Covid and during-Covid figures. Use of the internet at schools or colleges declined from 38 percent of respondents pre-Covid to 20 percent currently. Use in libraries (42% vs. 14%), public buildings (37% vs. 18%), and outdoor public spaces (64% vs. 51%) also declined. Use of the internet at the home of a friend or family member declined from 73% of respondents pre-pandemic to 56% of respondents during the pandemic. Usage inside the home remained flat.

Figure 57 and Figure 58 show detailed usage of the internet at various locations, before and during the pandemic.

Figure 57: How Often Use the Internet in Various Locations Before Covid-19 Pandemic

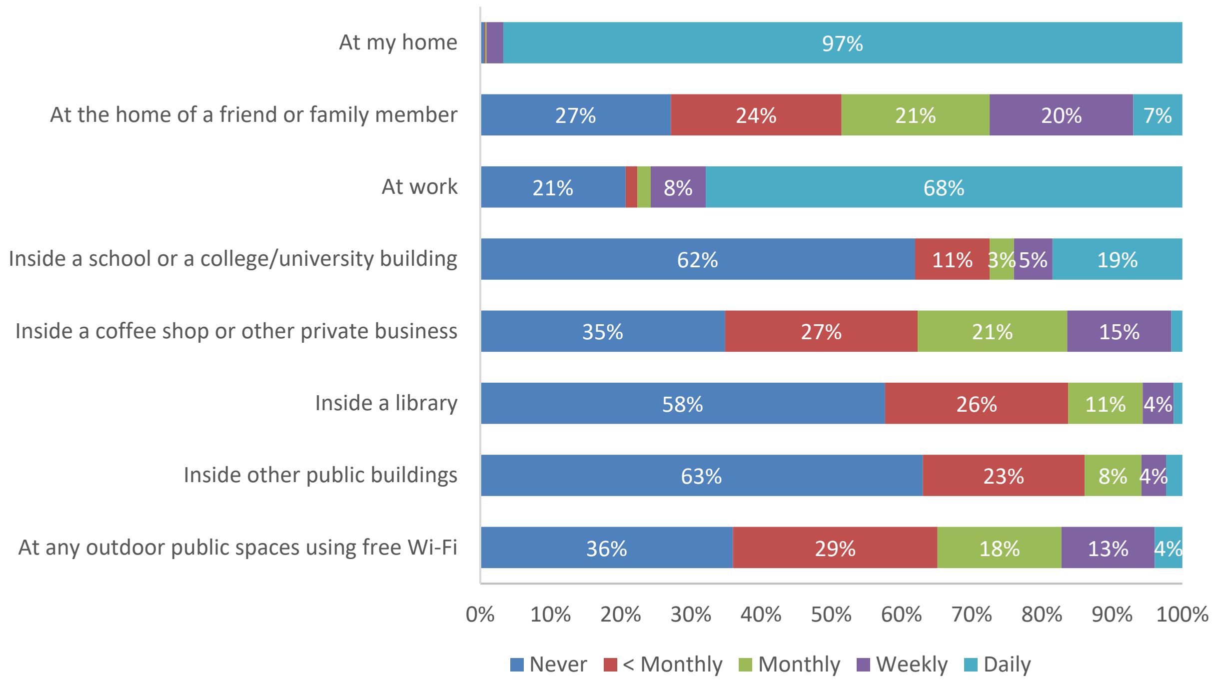
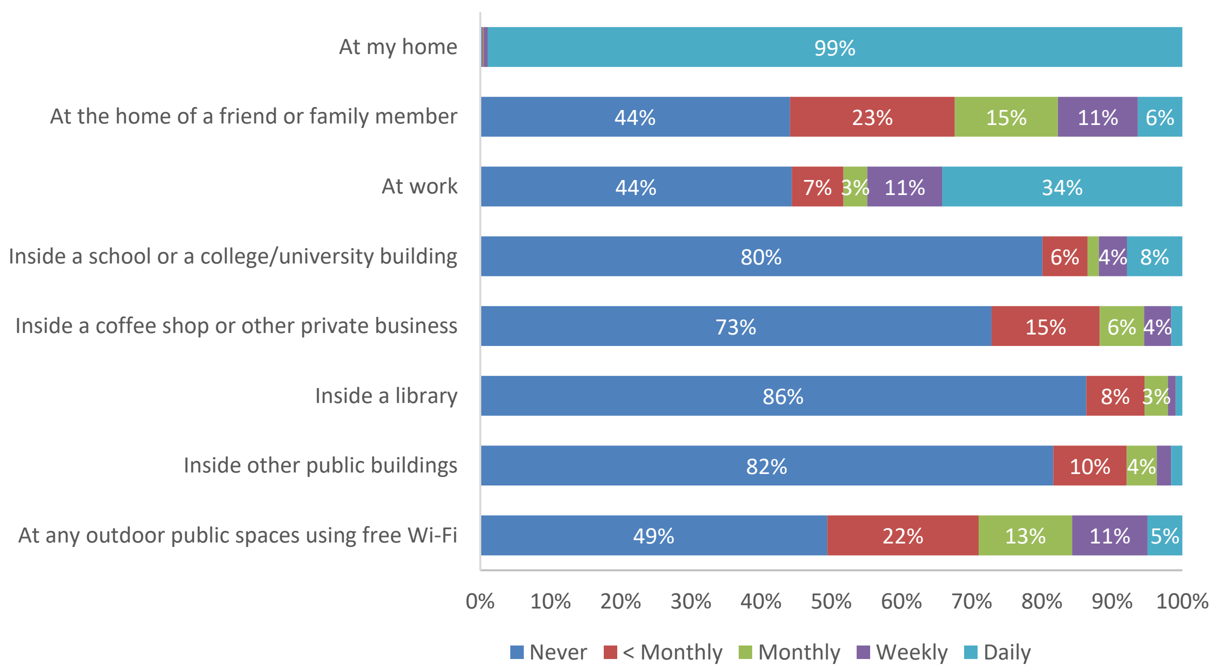


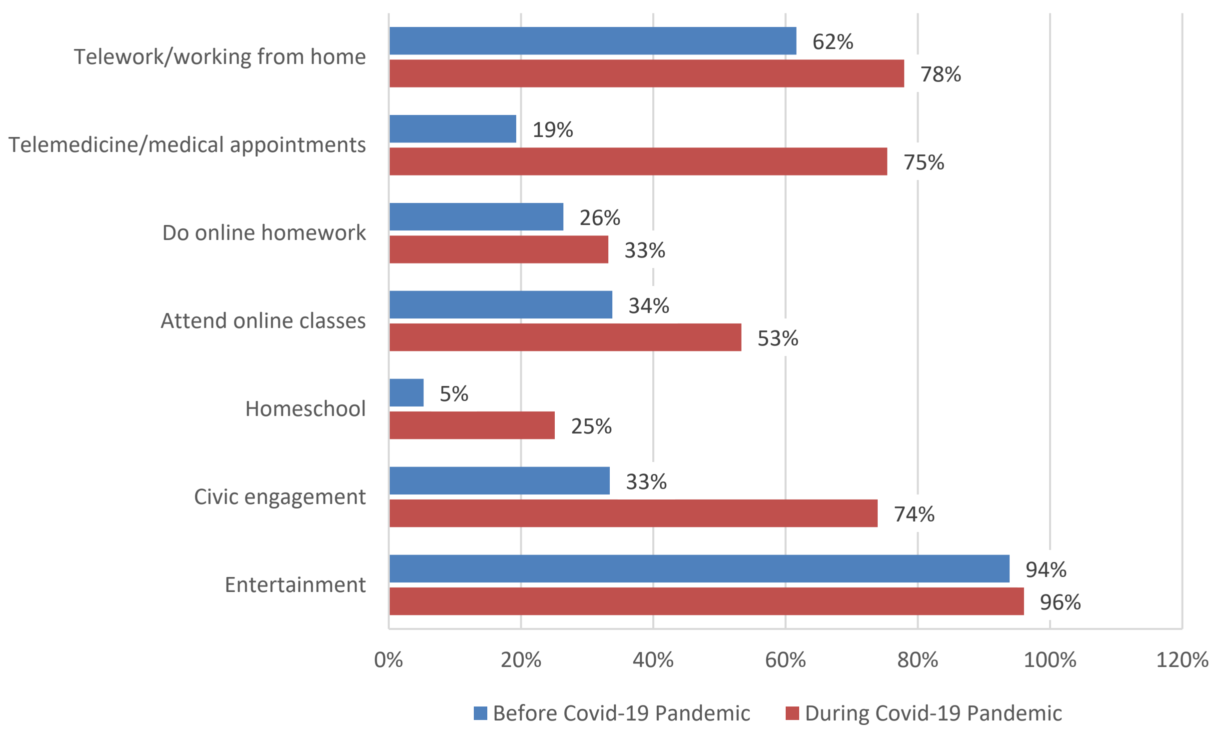
Figure 58: How Often Use the Internet in Various Locations During Covid-19 Pandemic



Engaged in Internet Activities

Respondents were asked about how they engaged in various internet activities before and during the Covid-19 pandemic. As shown in Figure 59, engagement in online activities has increased significantly during the Covid-19 pandemic, with the exception of using the internet for entertainment which already had a very high usage rate.

Figure 59: Ever Used the Internet for Various Activities Before and During Covid-19 Pandemic



Three-fourths of respondents have used the internet for telemedicine or medical appointments during the Covid-19 pandemic (most on a monthly or less than monthly basis), compared with just 19 percent before the pandemic. Use of the internet has also increased substantially for civic engagement, going from 33 percent of respondents pre-pandemic to 74 percent of respondents during the pandemic. Specifically, weekly use of the internet for civil engagement jumped from four percent to 22 percent of respondents during the pandemic. Additionally, 62 percent of respondents use the internet for teleworking on a daily basis, compared with 21 percent of respondents before the pandemic.

Figure 60 and Figure 61 show detailed usage of the internet for various activities, before and during the pandemic.

Figure 60: How Often Used the Internet for Various Activities Before Covid-19 Pandemic

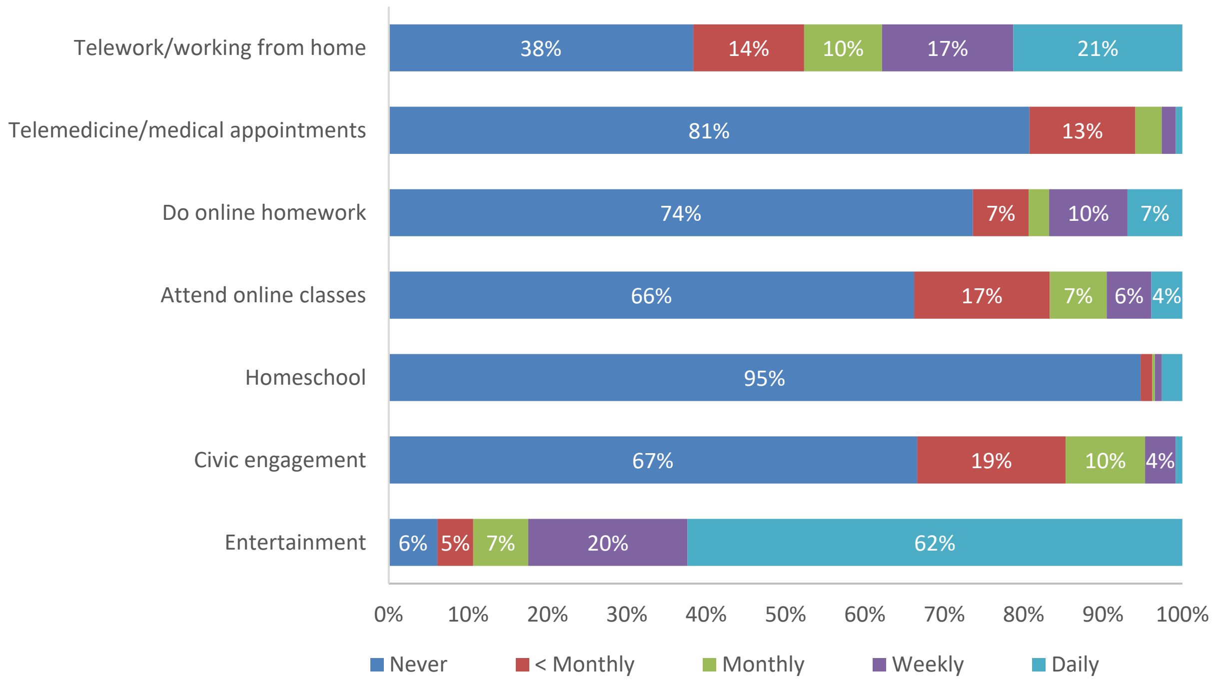
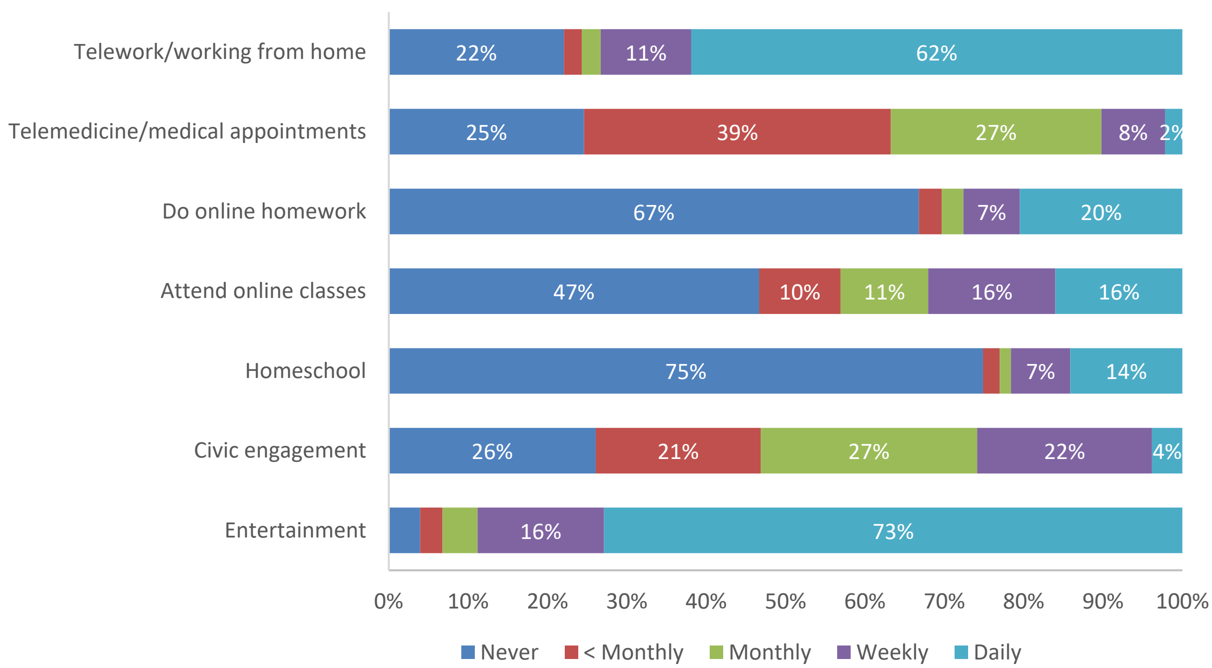


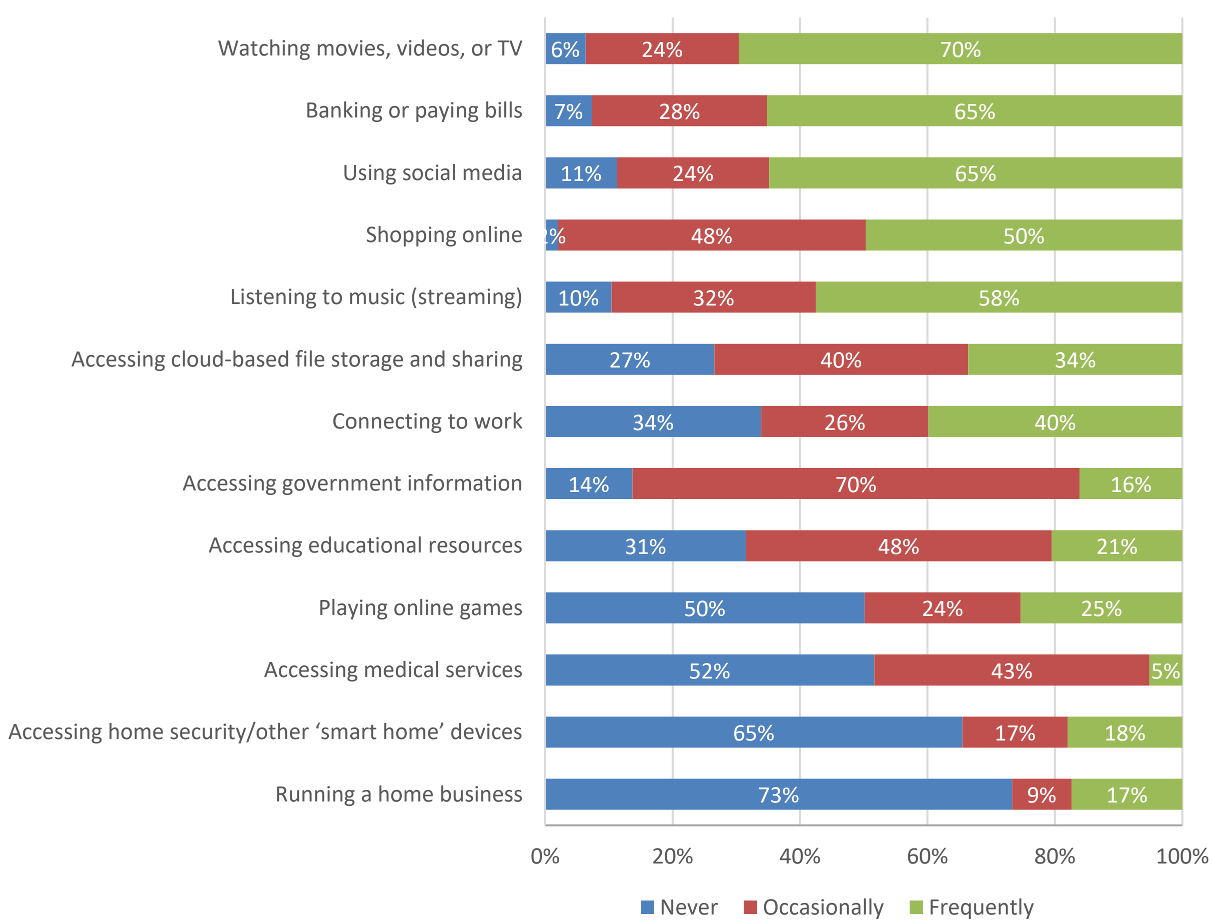
Figure 61: How Often Used the Internet for Various Activities During Covid-19 Pandemic



Respondents were also asked if they never, occasionally, or frequently engage in other internet activities. Among those items listed, the internet was most frequently used before the Covid-19 pandemic for watching movies, videos, or TV, followed by banking or paying bills, using social media, shopping online, and streaming music (see Figure 62). A home internet connection was less frequently used for other activities.

Some respondents used a home internet connection to access other key information and services. Seven in 10 respondents accessed government information occasionally, and 43 percent accessed medical services occasionally. Another 48 percent accessed educational resources occasionally, and 21 percent accessed them frequently, while another 31 percent never used it for this purpose. Four in 10 respondents frequently used the internet to connect to work, and 26 percent occasionally used the internet for this purpose. Another 26 percent of respondents occasionally or frequently used the internet to run a home business.

Figure 62: Internet Use for Various Activities Before the Covid-19 Pandemic



Among the items listed, the most frequently conducted internet activities during the pandemic remain watching videos, banking or paying bills, shopping online, using social media, and listening to music, although frequency of use has increased somewhat (see Figure 63). During the pandemic, two-thirds of respondents frequently use the internet to connect to work, up from 40 percent before the pandemic. Many respondents frequently use the internet for accessing government information (38%), accessing educational resources (40%), accessing medical services (20%), and running a home business (21%).

Figure 63: Internet Use for Various Activities During the Covid-19 Pandemic

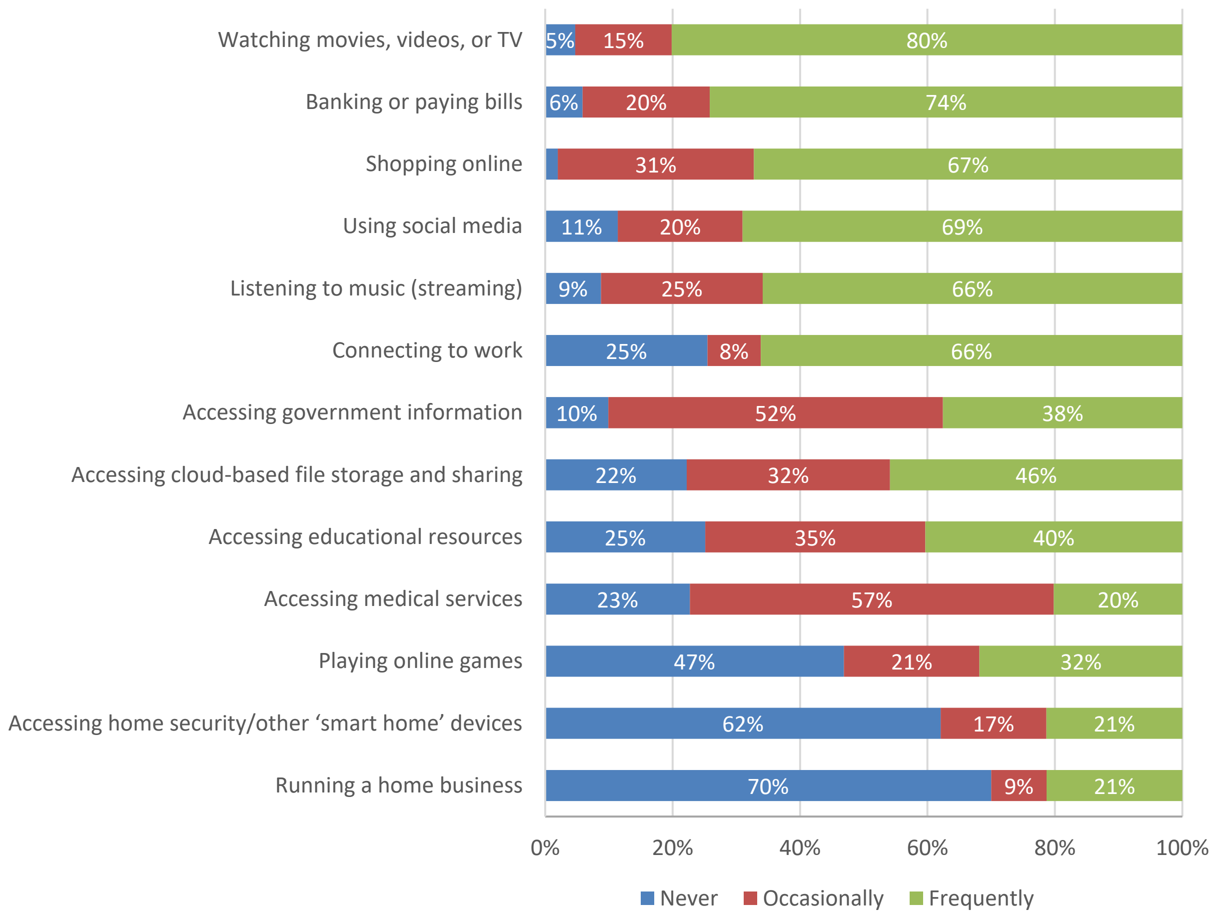
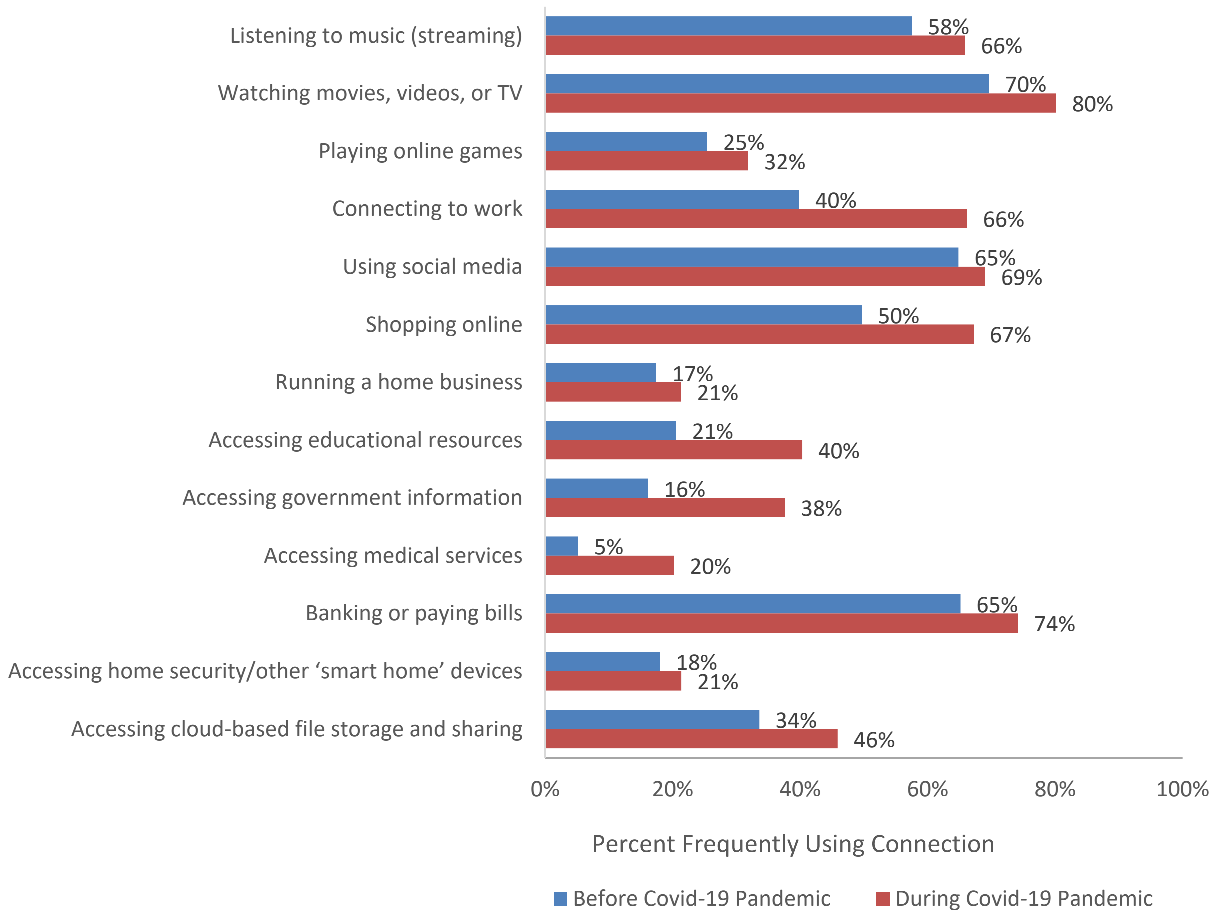


Figure 64 compares the percentage of respondents who frequently used their connection for various activities before and during the Covid-19 pandemic. Across many categories, usage is higher during the pandemic as many respondents shifted from occasional use to frequent use of the internet.

Specifically, respondents are much more likely to frequently use the internet during the pandemic than before the pandemic for: connecting to work, shopping online, accessing educational resources, accessing government information, and accessing medical services.

Figure 64: Frequently Used the Internet for Various Activities Before and During Covid-19 Pandemic



9.1.1.1.1 Internet Uses by Respondent Age

Younger respondents were more likely than older respondent to use the internet for key activities before and during the pandemic, in particular streaming music, watching videos, using social media, and banking or paying bills. Respondents under age 65 saw larger increases in frequency of use during the pandemic for some key activities, such as connecting to work and accessing educational resources and government information, compared with those ages 65 and older.

Table 4: Frequently Used Internet Activities Before Covid-19 Pandemic by Respondent Age

	18-34 years	35-44 years	45-54 years	55-64 years	65 + years
Listening to music (streaming)	77%	71%	66%	47%	32%
Watching movies, videos, or TV	85%	82%	76%	61%	51%
Playing online games	28%	23%	27%	26%	23%
Connecting to work	31%	52%	53%	49%	28%
Using social media	75%	72%	67%	62%	50%
Shopping online	49%	60%	54%	49%	43%
Running a home business	11%	21%	22%	23%	16%
Accessing educational resources	24%	23%	21%	20%	15%
Accessing government information	14%	16%	17%	18%	16%
Accessing medical services	4%	4%	3%	5%	8%
Banking or paying bills	69%	74%	72%	57%	59%
Accessing home security/other 'smart home' devices	24%	23%	19%	16%	10%
Accessing cloud-based file storage and sharing	39%	44%	36%	30%	24%

Table 5: Frequently Used Internet Activities During Covid-19 Pandemic by Respondent Age

	18-34 years	35-44 years	45-54 years	55-64 years	65 + years
Listening to music (streaming)	82%	81%	77%	58%	40%
Watching movies, videos, or TV	94%	91%	87%	75%	62%
Playing online games	36%	32%	37%	31%	25%
Connecting to work	76%	89%	83%	68%	32%
Using social media	78%	79%	76%	65%	52%
Shopping online	66%	80%	74%	68%	58%
Running a home business	15%	29%	27%	27%	17%
Accessing educational resources	44%	58%	54%	35%	22%
Accessing government information	42%	39%	45%	37%	28%
Accessing medical services	22%	24%	22%	18%	17%
Banking or paying bills	78%	80%	81%	71%	65%
Accessing home security/other 'smart home' devices	25%	29%	25%	21%	12%
Accessing cloud-based file storage and sharing	56%	59%	53%	43%	29%

9.1.1.1.2 Internet Uses by Household Income

Lower income respondents were less likely than higher income households to engage in some key activities particularly connecting to work and online shopping. Respondents earning over $25,000 per year connect to work more frequently during the Covid-19 pandemic compared with before the pandemic. Those in low income households did not show an increase in usage for work purposes; 29 percent of low-income households frequently used the internet to connect to work before the pandemic, and 30 percent frequently use it to connect to work during the pandemic.

Table 6: Frequently Used Internet Activities Before Covid-19 Pandemic by Household Income

	<$25k	$25-49k	$50-74k	$75-99k	$100k +
Listening to music (streaming)	53%	58%	56%	61%	62%
Watching movies, videos, or TV	69%	59%	73%	71%	73%
Playing online games	37%	30%	25%	28%	20%
Connecting to work	29%	24%	33%	42%	49%
Using social media	68%	64%	72%	66%	66%
Shopping online	36%	41%	52%	55%	53%
Running a home business	17%	16%	16%	18%	16%
Accessing educational resources	31%	18%	22%	23%	19%
Accessing government information	18%	12%	20%	20%	13%
Accessing medical services	6%	4%	3%	11%	3%
Banking or paying bills	63%	60%	59%	62%	75%
Accessing home security/other 'smart home' devices	11%	9%	15%	21%	23%
Accessing cloud-based file storage and sharing	19%	27%	30%	29%	45%

Table 7: Frequently Used Internet Activities During Covid-19 Pandemic by Household Income

	<$25k	$25-49k	$50-74k	$75-99k	$100k +
Listening to music (streaming)	65%	68%	63%	66%	71%
Watching movies, videos, or TV	78%	74%	81%	81%	85%
Playing online games	37%	38%	35%	33%	27%
Connecting to work	30%	50%	62%	66%	85%
Using social media	63%	72%	76%	66%	70%
Shopping online	48%	62%	67%	69%	72%
Running a home business	15%	24%	20%	22%	19%
Accessing educational resources	46%	38%	40%	42%	41%
Accessing government information	40%	38%	36%	42%	39%
Accessing medical services	26%	23%	19%	27%	17%
Banking or paying bills	71%	74%	71%	68%	81%
Accessing home security/other 'smart home' devices	14%	14%	16%	24%	26%
Accessing cloud-based file storage and sharing	31%	38%	44%	40%	60%

Satisfaction with Internet Service

Respondents were asked to evaluate their satisfaction, before and during the Covid-19 pandemic, with various internet service aspects. Average rating scores are highlighted in Figure 65, while Figure 66 shows detailed responses.

Figure 65: Satisfaction with Internet Service Aspects (Mean Ratings)

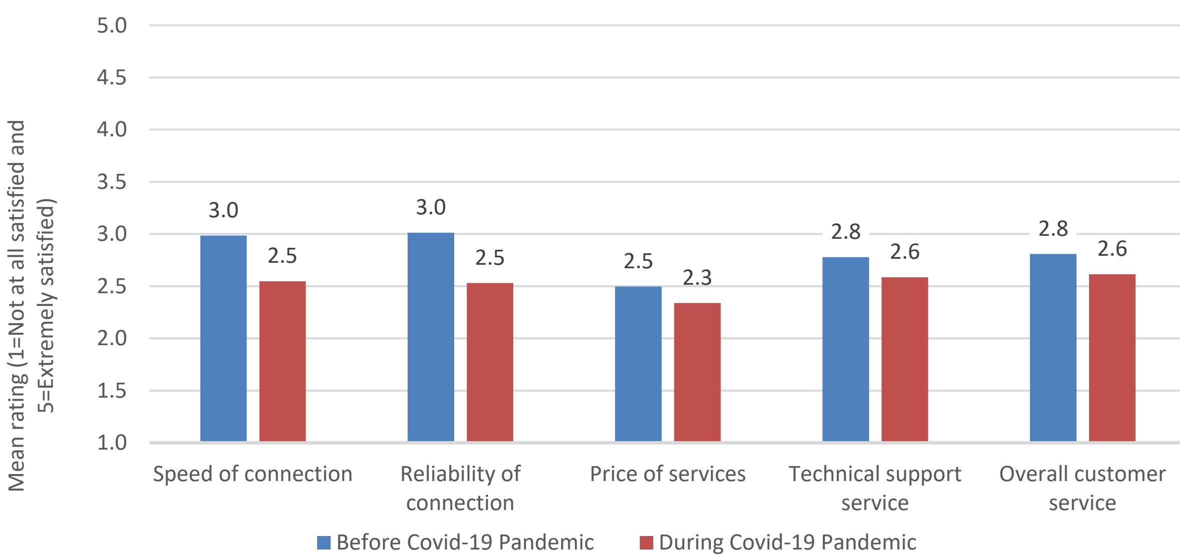
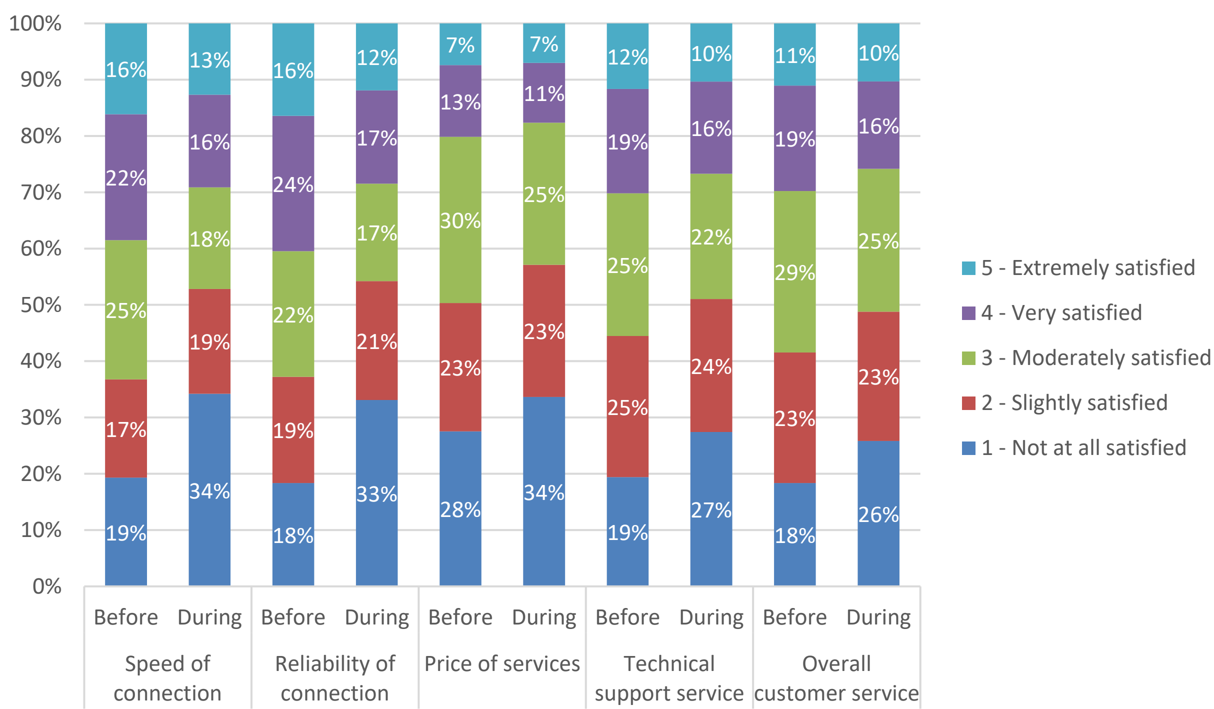


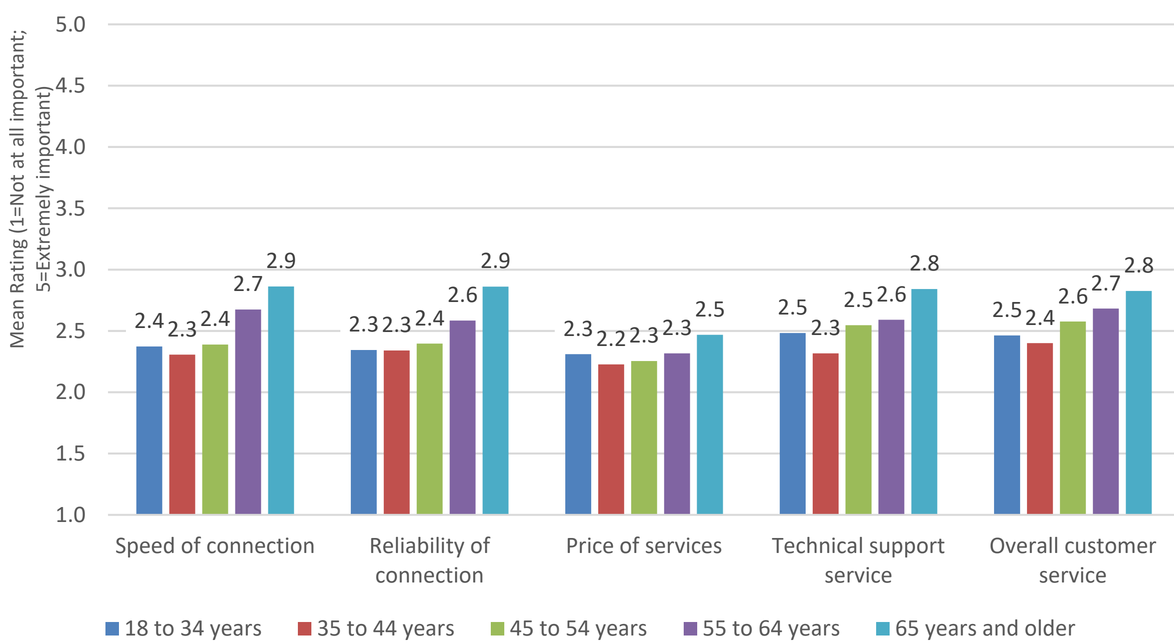
Figure 66: Satisfaction with Internet Service Aspects



Overall, respondents were only moderately satisfied with aspects of their internet service prior to the Covid-19 pandemic, and satisfaction has dropped somewhat during the pandemic. Specifically, more than one-half of respondents are not at all satisfied or only slightly satisfied with connection speed and reliability during the pandemic. Just 29 percent are very or extremely satisfied with these service aspects, compared with four in 10 before the pandemic. Respondents are less satisfied with price compared with other service aspects, which is typical in satisfaction surveys.

Both prior to and during the Covid-19 pandemic, respondents ages 65 and older expressed a higher level of satisfaction with internet service aspects compared with younger respondents (see Figure 67).

Figure 67: Satisfaction with Internet Service Aspects During Covid-19 Pandemic by Respondent Age



Adequacy of Primary Home Broadband Connection

Respondents were asked to evaluate the adequacy of their home internet connection during the Covid-19 pandemic. Average rating scores are highlighted in Figure 68, while Figure 69 shows detailed responses.

Overall, respondents were neutral on whether their home internet connection is adequate for their needs for having online medical appointments. More than one-half of respondents disagreed or strongly disagreed that their internet service is adequate for working from home. More than four in 10 respondents strongly disagreed that their home internet connection is adequate for their or their children's need for doing homework or attending classes online; six in 10 respondents disagreed or strongly disagreed.

Figure 68: Agreement with Statements About Adequacy of Primary Home Broadband Connection During Covid-19 Pandemic (Mean Ratings)

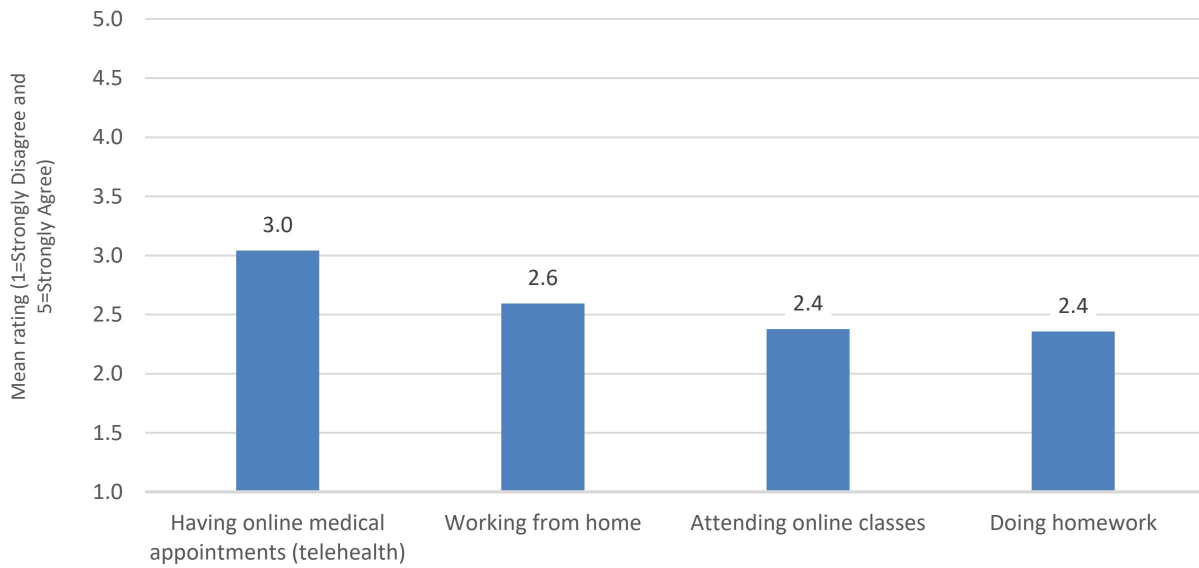
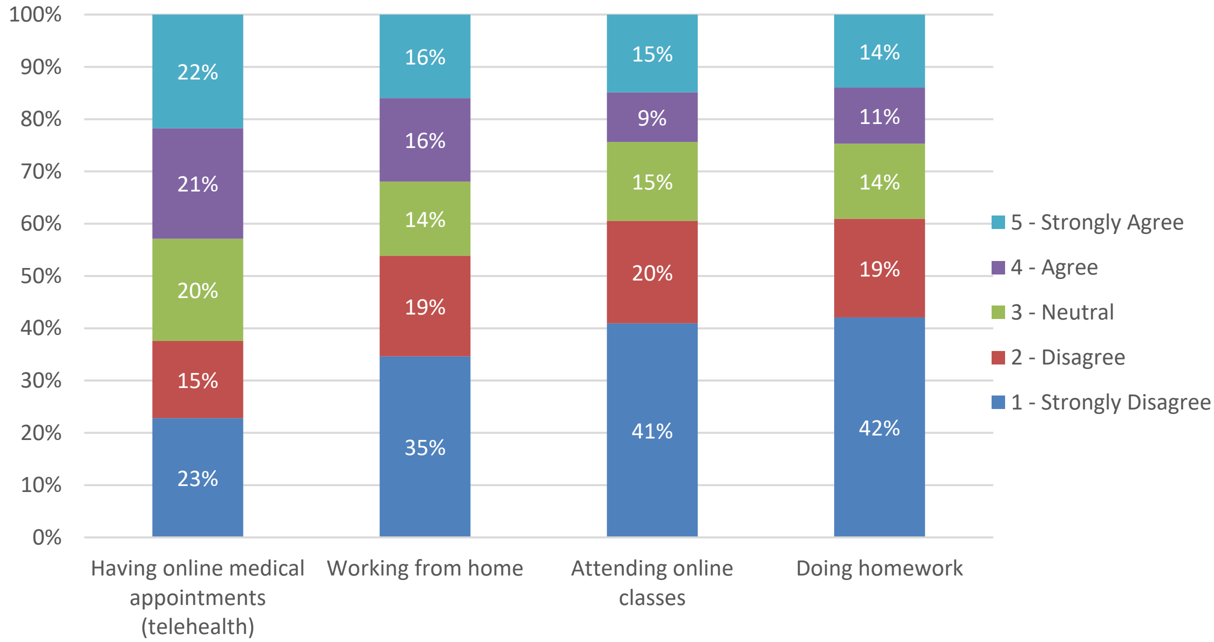
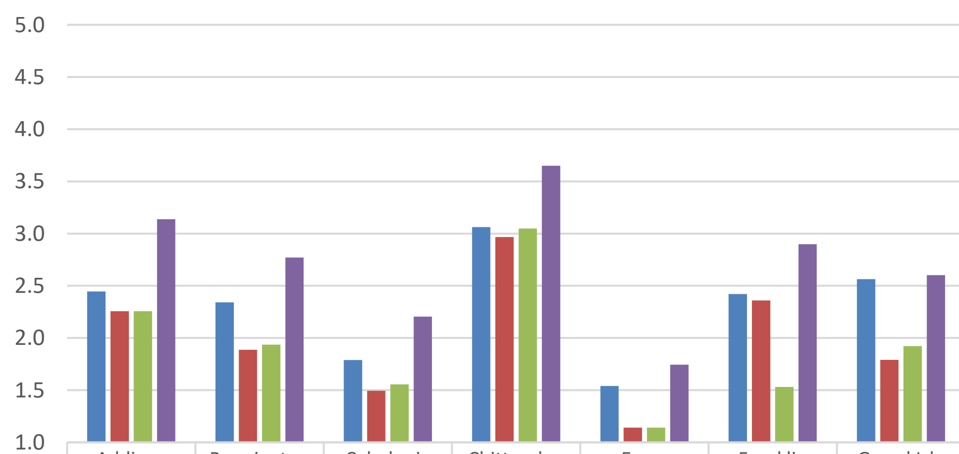


Figure 69: Agreement with Statements About Adequacy of Primary Home Broadband Connection During Covid-19 Pandemic



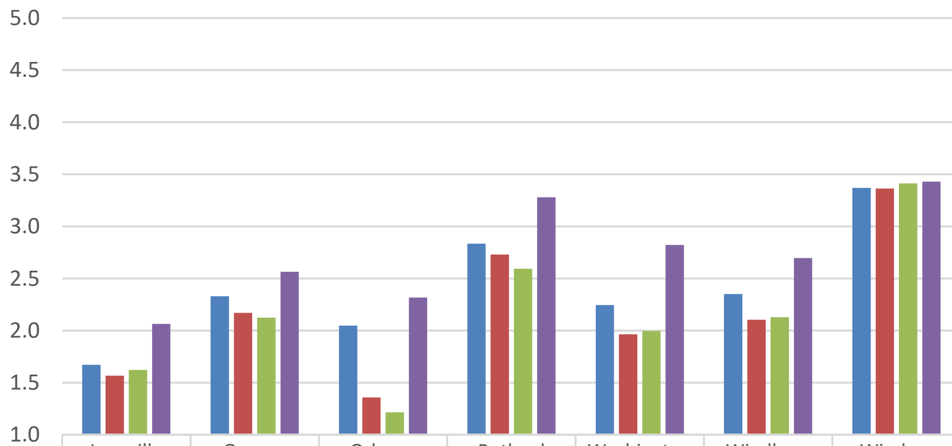
Chittenden, Rutland, and Windsor County residents expressed a higher level of agreement with adequacy of their home internet connection, compared with residents of other counties (see Figure 70 and Figure 71).

Figure 70: Agreement with Statements About Adequacy of Primary Home Broadband Connection During Covid-19 Pandemic by County (Part A)



	Addison	Bennington	Caledonia	Chittenden	Essex	Franklin	Grand Isle
Working from home	2.4	2.3	1.8	3.1	1.5	2.4	2.6
Attending online classes	2.3	1.9	1.5	3.0	1.1	2.4	1.8
Doing homework	2.3	1.9	1.6	3.0	1.1	1.5	1.9
Having online medical appts	3.1	2.8	2.2	3.6	1.7	2.9	2.6

Figure 71: Agreement with Statements About Adequacy of Primary Home Broadband Connection During Covid-19 Pandemic by County (Part B)



	Lamoille	Orange	Orleans	Rutland	Washington	Windham	Windsor
Working from home	1.7	2.3	2.0	2.8	2.2	2.4	3.4
Attending online classes	1.6	2.2	1.4	2.7	2.0	2.1	3.4
Doing homework	1.6	2.1	1.2	2.6	2.0	2.1	3.4
Having online medical appts	2.1	2.6	2.3	3.3	2.8	2.7	3.4

Cell Phone Bill

Overall, 22 percent of respondents said their cell phone bill increased during the pandemic due to increased data usage, while 71 percent said it has not increased (see Figure 72). Another seven percent of respondents said they do not have a cell phone plan; this saturation is higher for lower-income households earning under $50,000 per year (15%).

Figure 72: Cell Phone Bill Increased During Pandemic Due to Increased Data Usage

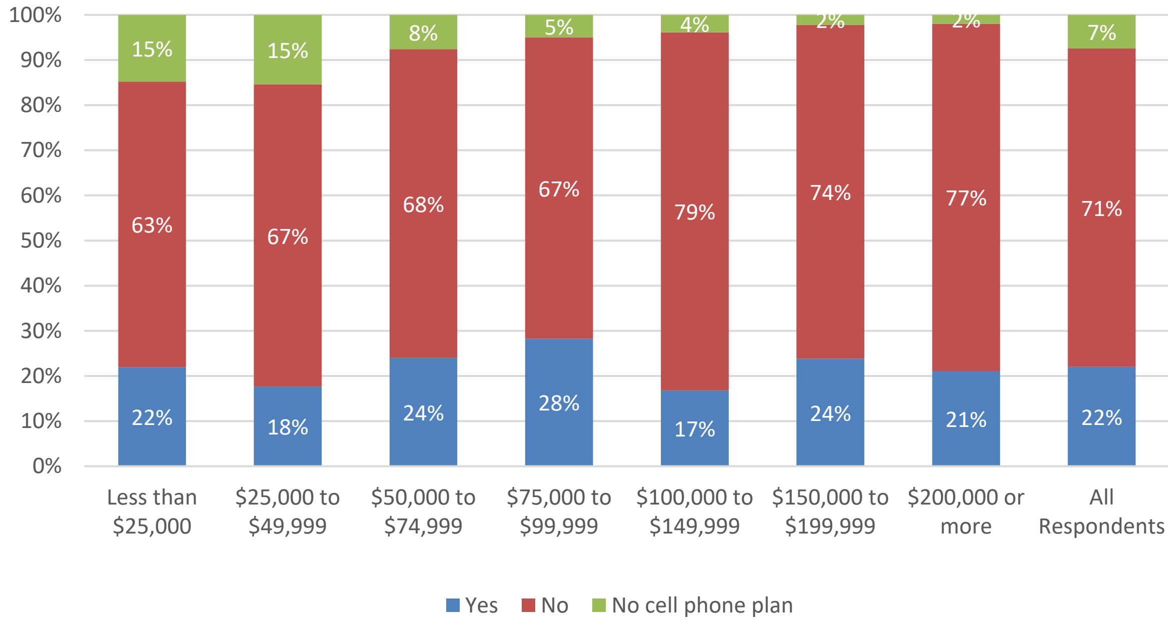
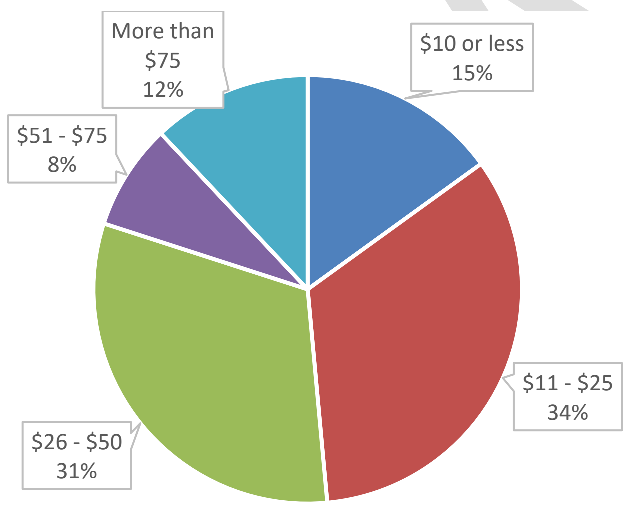


Figure 73: How Much Monthly Cell Phone Bill Increased During Covid-19 Pandemic



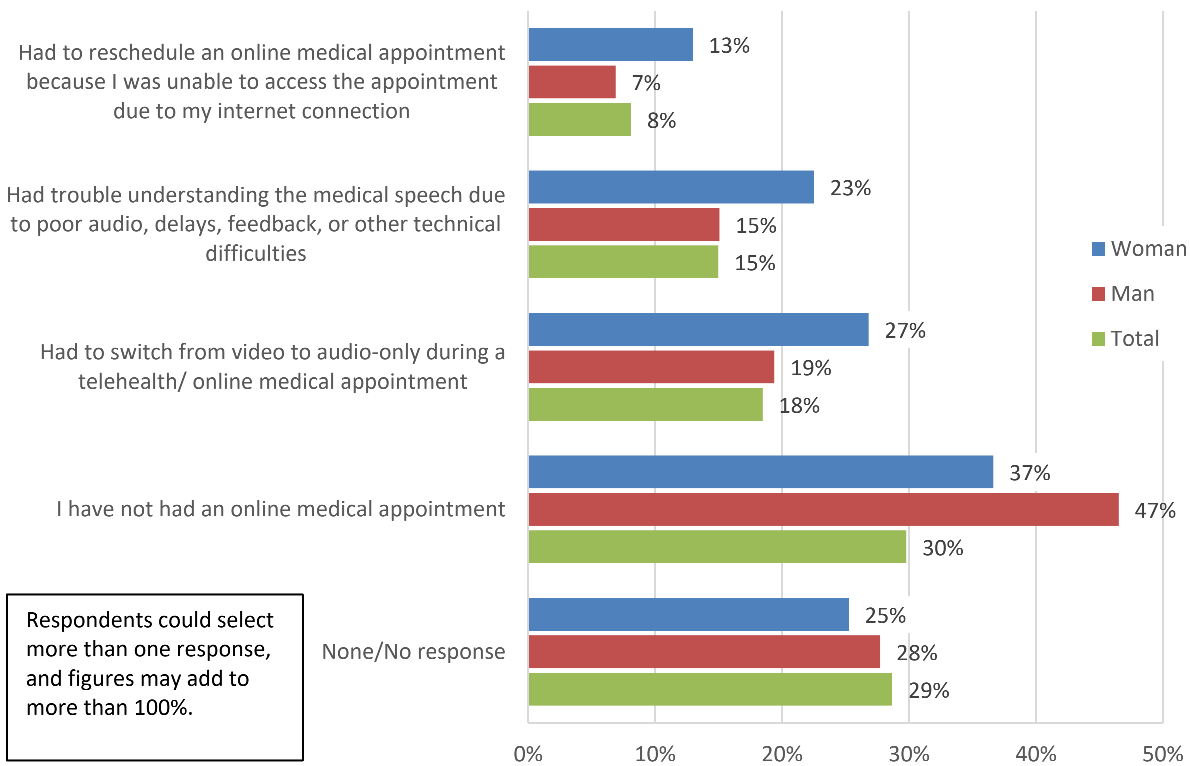
Those whose monthly cell phone bill increased during the pandemic saw significant changes in the amount they pay. As illustrated in Figure 73, one-fifth of those whose monthly cell phone bill increased during the pandemic saw an increase of over $50. One-third saw an increase of $11 to $25, and three in 10 saw an increase of $26 to $50. Another 15 percent had their monthly bill increase by $10 or less.

Challenges Accessing Online Medical Appointments

Four in 10 respondents experienced some challenge while accessing telehealth or an online medical appointment, including having to switch from video to audio only (18%), having trouble understanding speech due to technical issues (15%), and having to reschedule because they were unable to access an appointment due to internet connection issues (8%). Three in 10 respondents have not had an online medical appointment, and another three in 10 did not respond or had no issue (see Figure 74).

Women are more likely than men to have experienced challenges while accessing telehealth or an online medical appointment, but men were more likely to have not had an online medical appointment.

Figure 74: Challenges Experienced While Accessing Online Medical Appointments



Number of Household Members Online During Peak Usage Times

Four in 10 households have at least three members online during peak usage times during the Covid-19 pandemic, and another 43 percent have two members online (see Figure 75). Respondents ages 35 to 54 years have the most members online during peak usage, with six in 10 reporting they have three or more members online at the same time. Respondents ages 65 and older have fewer members online during peak usage; however, the majority have at least two members using the internet.

Figure 75: Number of Households Members Online During Peak Usage Times

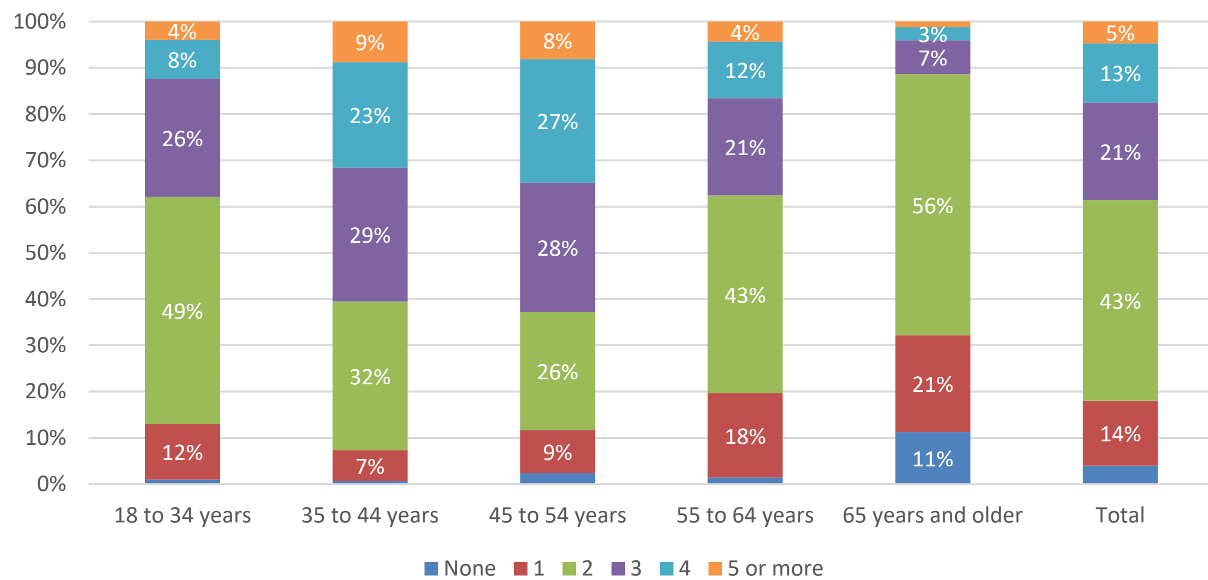
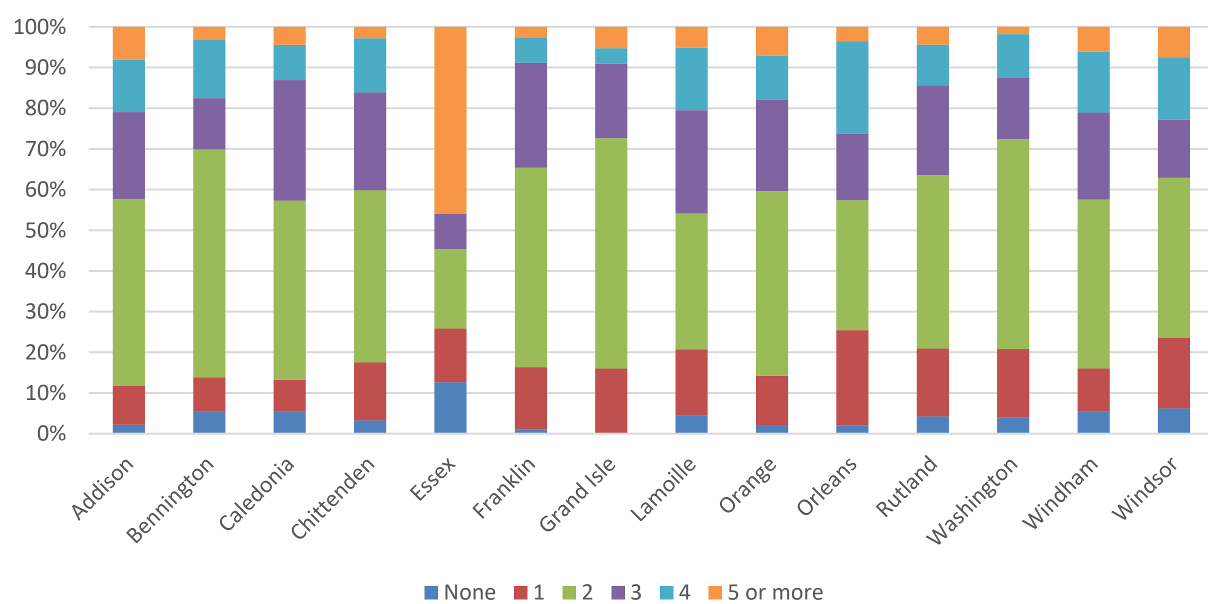


Figure 76: Number of Households Members Online During Peak Usage Times by County



As illustrated in Figure 76, the majority of all counties have at least two household members using the internet during peak usage times, and a sizeable percentage have three or more members online at the same time. Although Essex County households appear to have more members online during peak usage times, this is based on a small number of responses (weighted count of 25).

Technology for Children and Students

Four in 10 respondents have a child or student in the household across a range of education levels, including seven percent in preschool, 15 percent in primary school, and 10 percent in secondary school (see Figure 77). Respondents ages 35 to 54 are more likely than others to have a child or student in the household (see Figure 78).

Figure 77: Education Level of Children or Students in the Household

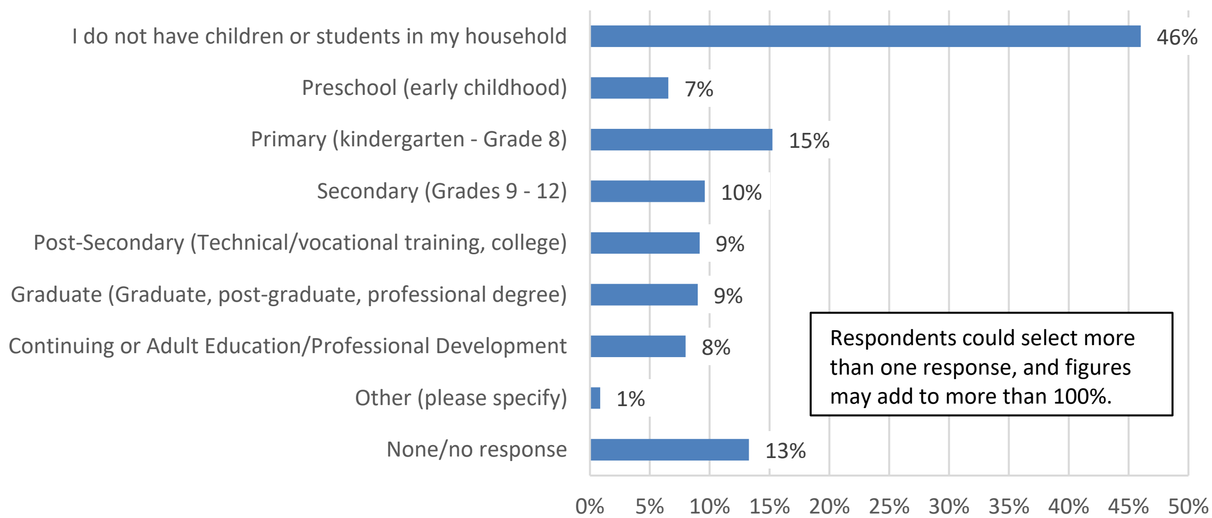
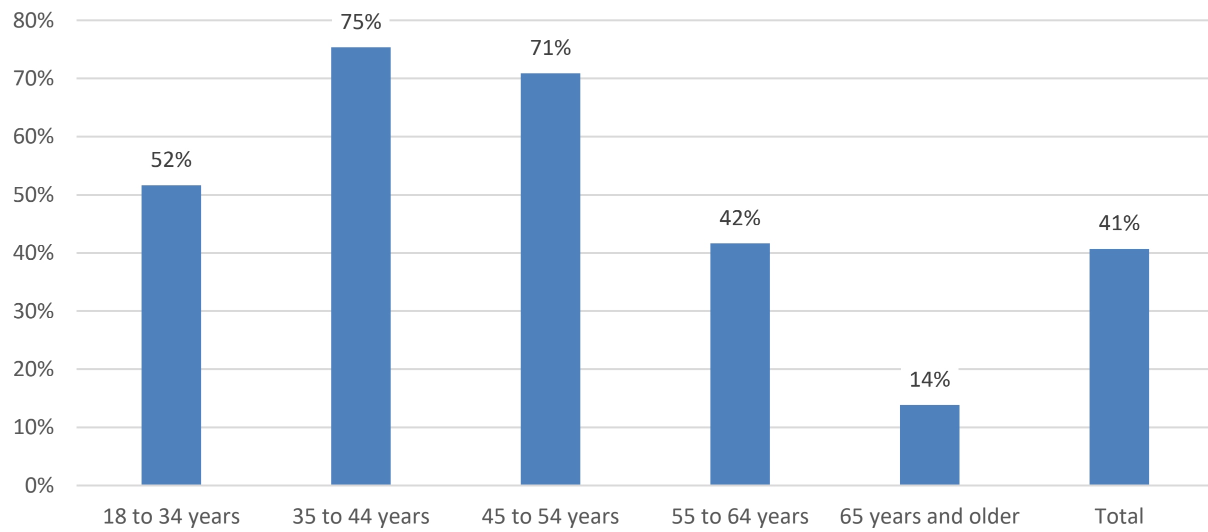


Figure 78: Education Level of Children or Students in the Household by Respondent Age



Respondents who have a child or student in the household were asked their level of agreement with statements about how their child is able to distance learn or do homework. Average rating scores are highlighted in Figure 79, while Figure 80 shows detailed responses.

A majority of respondents indicated that the children in their care have sufficient internet access. Most respondents strongly disagreed with the various statements, particularly that children do not have access to a computer or device to complete distance learning and/or homework (85%), that children have to distance learn or do homework using free internet services provided by restaurants, town government, or other entities (76%), and that students have to distance learn or do home at the home of family or friends in order to have access to the internet (11%).

Still, accessibility may be an issue for a small segment of households. Particularly, 13 percent agreed or strongly agreed that their children cannot complete their homework because they do not have access to the internet at home, and 13 percent agreed or strongly agreed that their children cannot distance learn because they do not have access to the internet at home. Furthermore, the percentage of children who access the internet at a public or school library has decreased somewhat during the pandemic.

Figure 79: Agreement with Statements About Children's Use of Technology During the Covid-19 Pandemic (Mean Ratings)

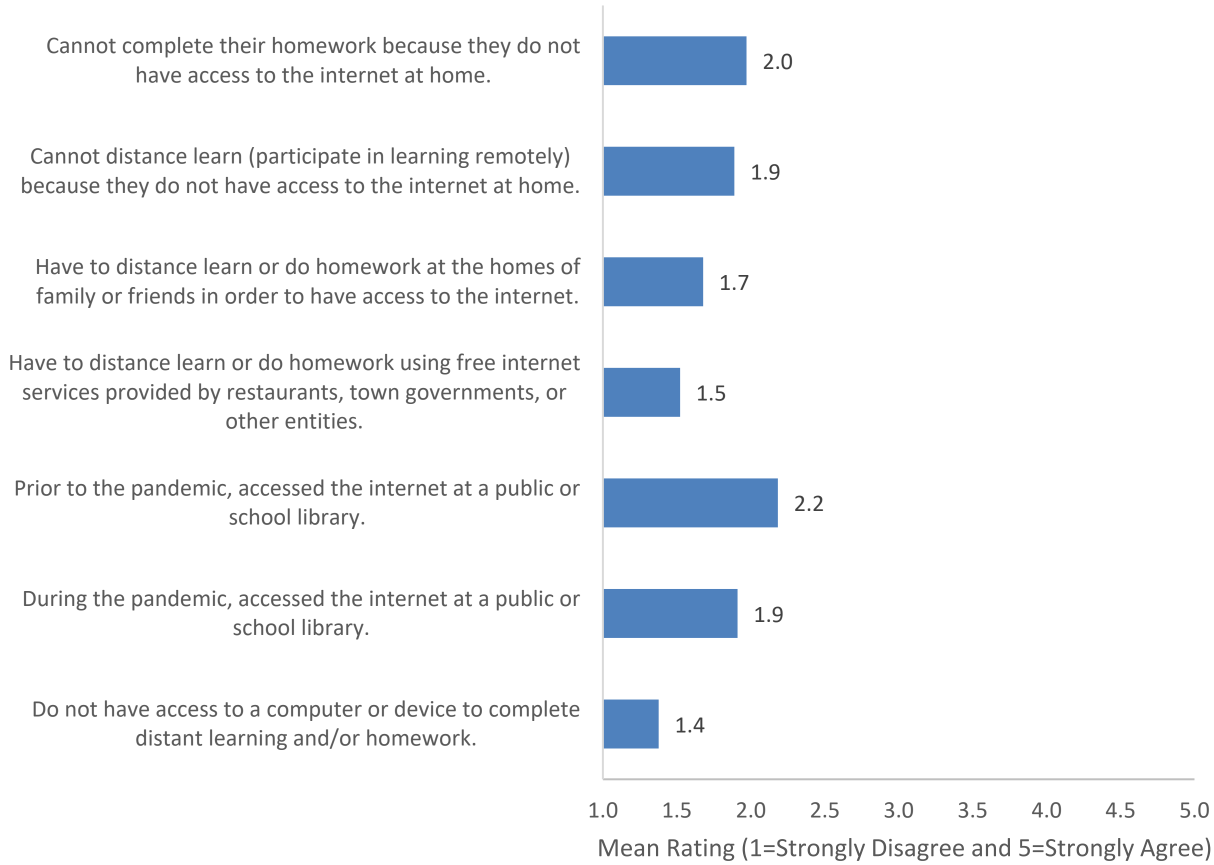
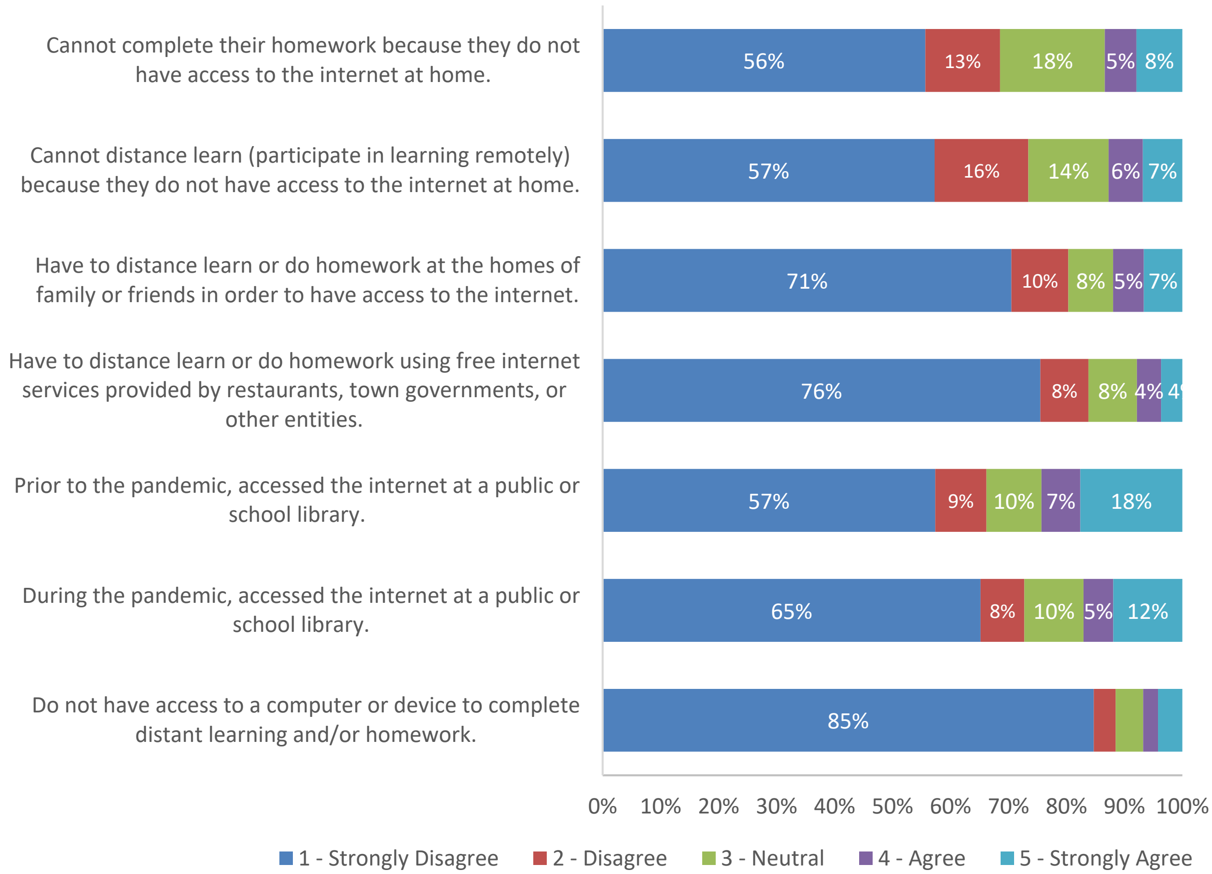


Figure 80: Agreement with Statements About Children's Use of Technology During the Covid-19 Pandemic



Caledonia County residents were more likely than residents of other counties to agree that their children cannot complete homework or distance learn because they do not have access to the internet at home (see Figure 81 and Figure 82).

Additionally, respondents earning under $25,000 per year were more likely than those with a higher household income to agree that their children cannot complete homework or distance learn because they do not have access to the internet at home, although this is based on a small number of responses (weighted count of 22; see Figure 83 and Figure 84).

Figure 81: Agreement That Children Cannot Complete Their Homework Because They Do Not Have Access to the Internet at Home by County (Mean Ratings)

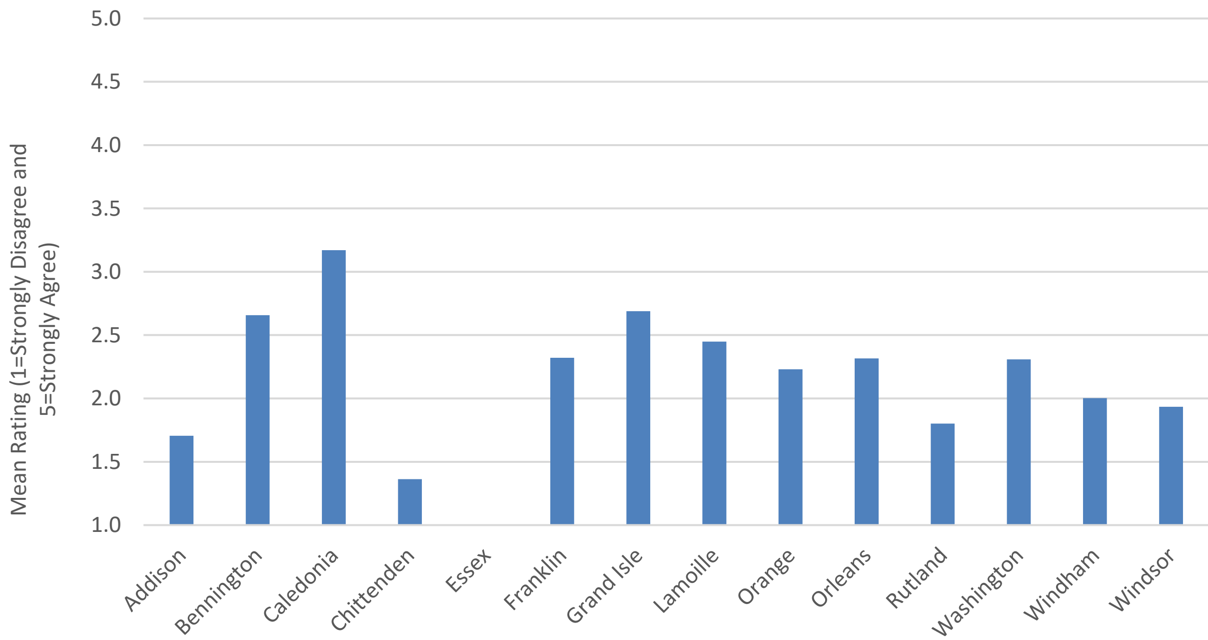


Figure 82: Agreement That Children Cannot Distance Learn Because They Do Not Have Access to the Internet at Home by County (Mean Ratings)

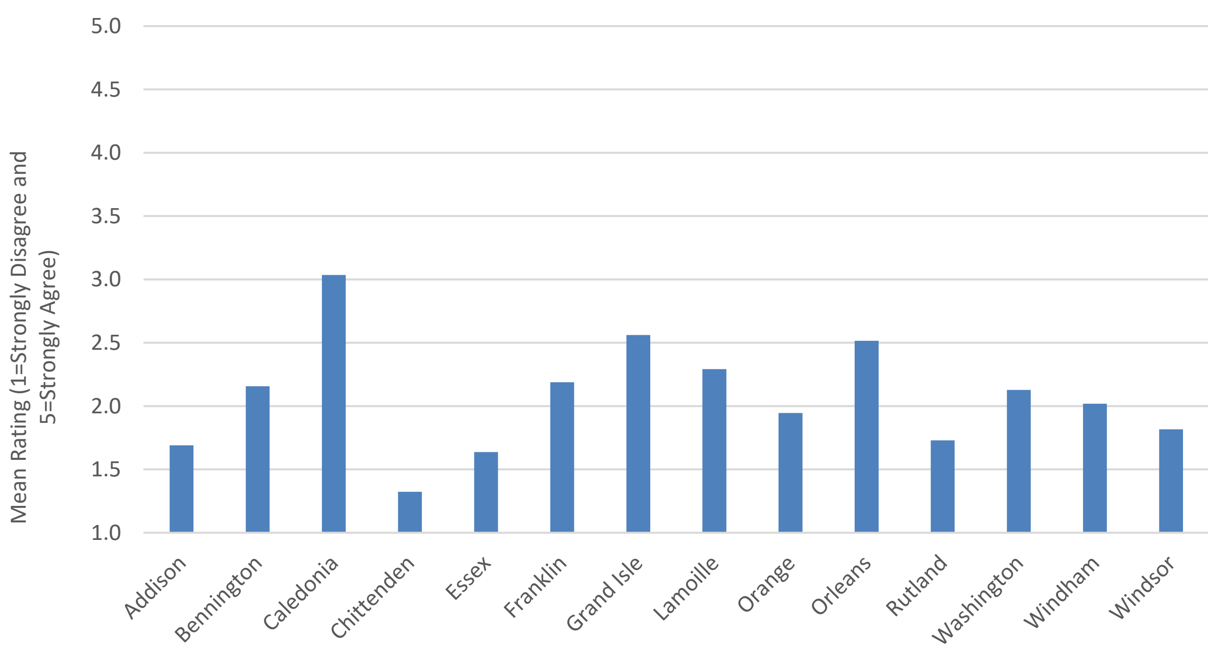


Figure 83: Agreement That Children Cannot Complete Their Homework Because They Do Not Have Access to the Internet at Home by Household Income (Mean Ratings)

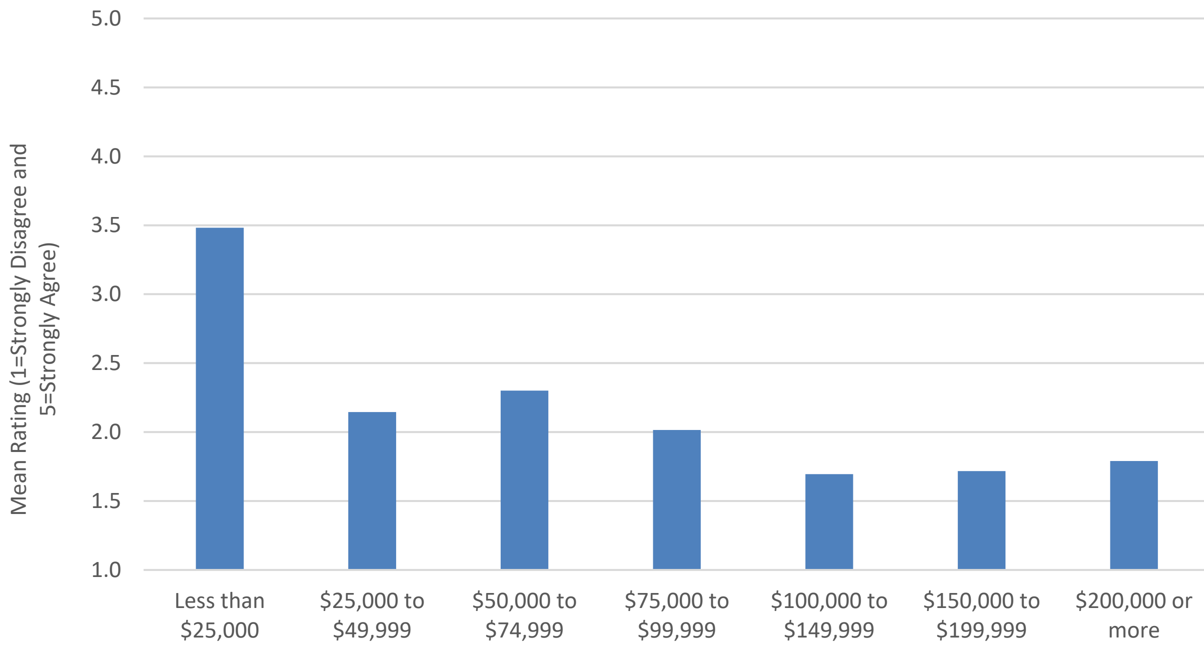


Figure 84: Agreement That Children Cannot Distance Learn Because They Do Not Have Access to the Internet at Home by County (Mean Ratings)

PEG TV Content

Sixteen percent of all respondents consumed public, educational, or governmental (PEG) TV content during the Covid-19 pandemic. Respondents ages 18 to 34 years (21%) were more likely than older respondents to consume PEG content (see Figure 85). Also, men were more likely than women to have watched PEG programming (23% vs. 13%). As illustrated in Figure 86, PEG viewership was highest in Franklin County.

Figure 85: Consumed Public, Educational, Governmental (PEG) TV Content During the Covid-19 Pandemic

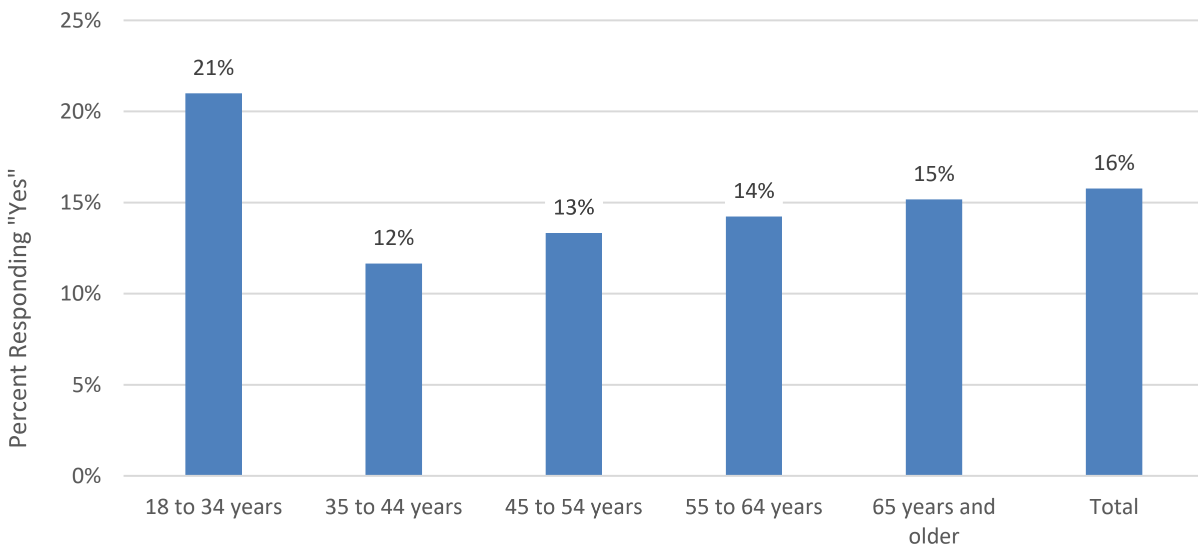
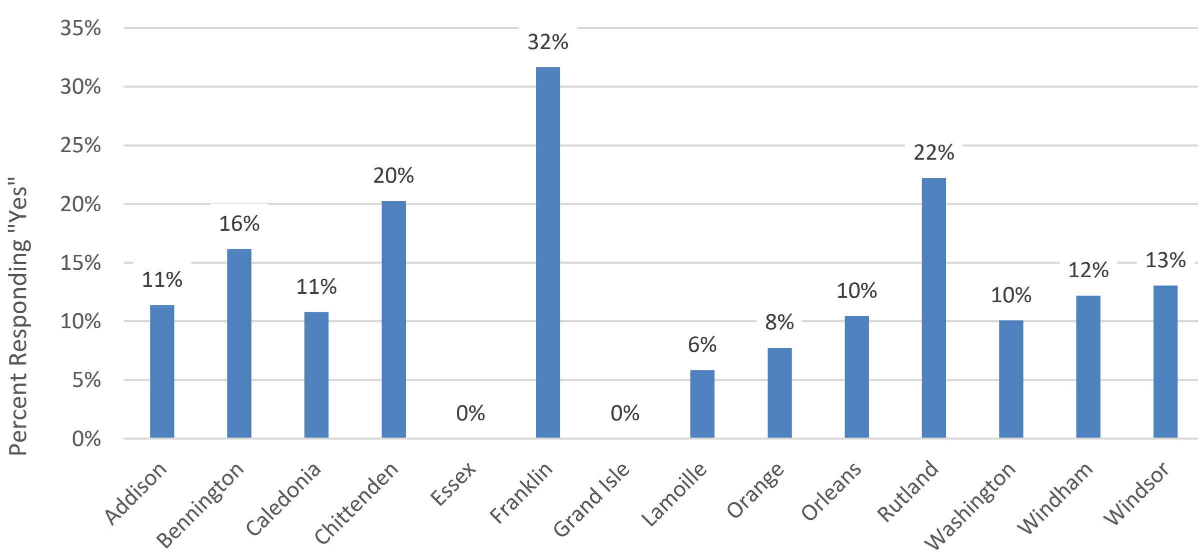
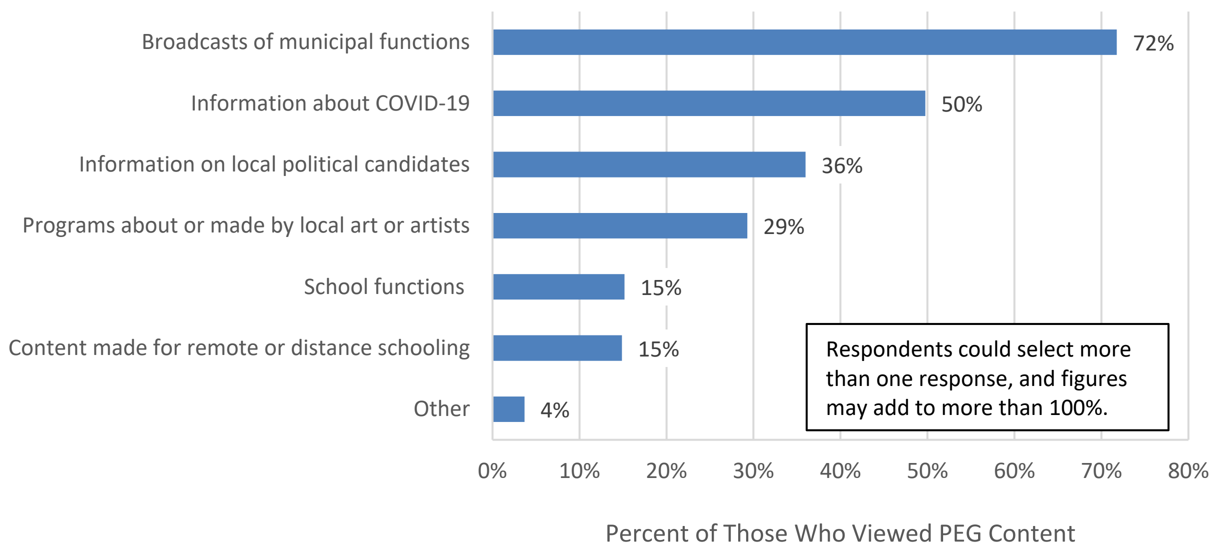


Figure 86: Consumed Public, Educational, Governmental (PEG) TV Content During the Covid-19 Pandemic by County



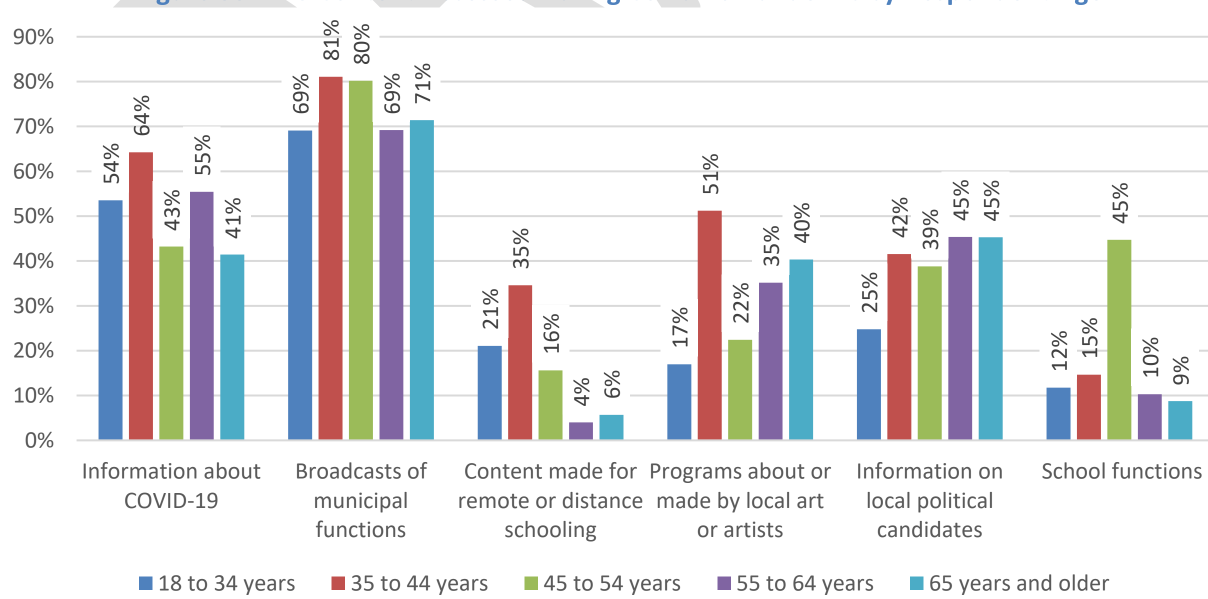
Among those who viewed PEG programming, the most commonly accessed content was broadcasts of municipal functions, cited by 72 percent of respondents. One-half of PEG viewers accessed information about Covid-19 (see Figure 87).

Figure 87: PEG Content Accessed During Covid-19 Pandemic



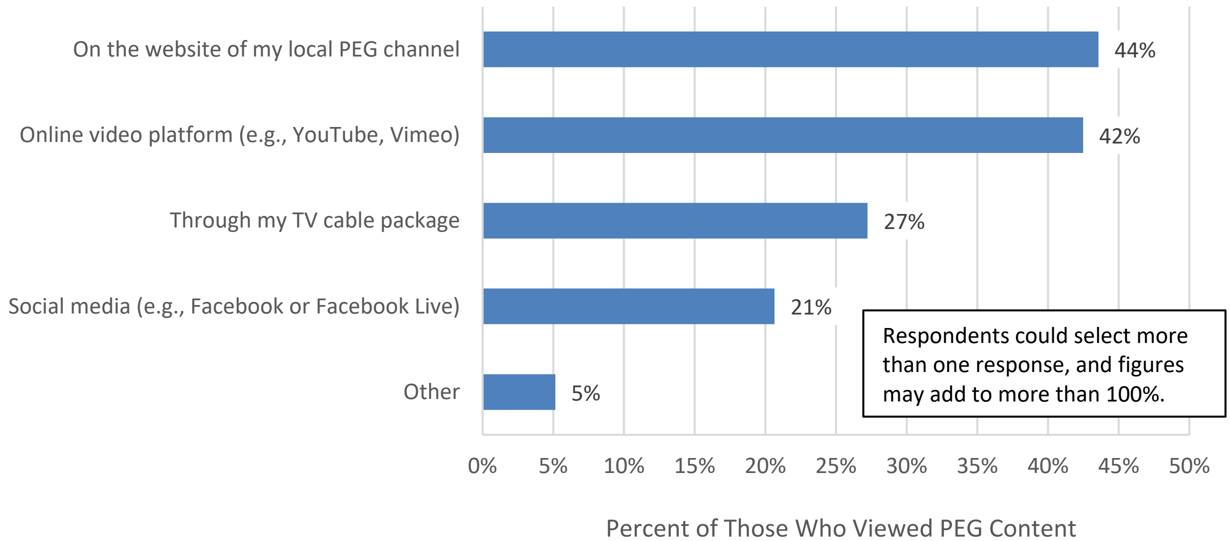
Respondents under age 35 were somewhat less likely than older respondents to view some types of content, such as program about/by local artists and information on local political candidates. PEG viewers ages 45 to 54 were much more likely than older and younger viewers to access content about school functions (see Figure 88).

Figure 88: PEG Content Accessed During Covid-19 Pandemic by Respondent Age



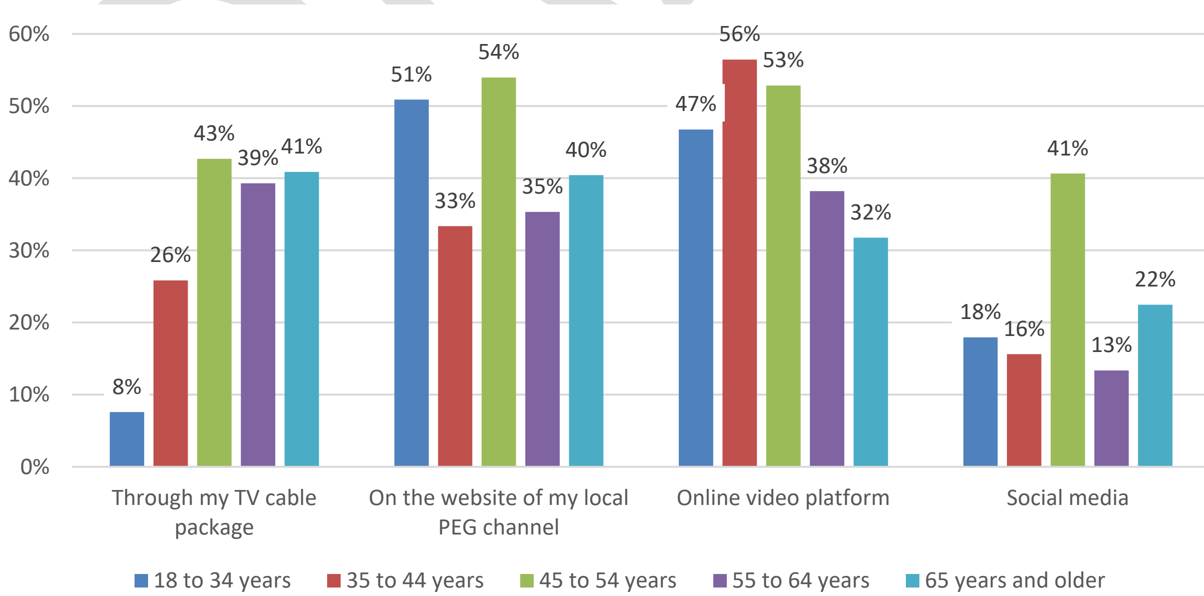
The most widely used media for watching PEG TV content include the website of the local PEG channel (44%) and online video platforms (42%). Fewer viewers said they watched through their TV cable package (27%) or via social media (21%), as shown in Figure 89.

Figure 89: Medium Used to Watch PEG TV Content



Respondents under age 35 were less likely than older respondents to watch PEG TV Content through a TV cable package, as illustrated in Figure 90. Viewership through an online video platform was lower for those ages 55+ compared with younger respondents, and viewership through social media was highest among respondents ages 45 to 54 years.

Figure 90: Medium Used to Watch PEG TV Content by Respondent Age



Respondent Information

Basic demographic information was gathered from survey respondents and is summarized in this section. Several comparisons of respondent demographic information and other survey questions were provided previously in this report.

As indicated previously in Figure 1 regarding age-weighting, disproportionate shares of survey respondents were in the older age cohorts relative to the State's adult population as a whole (see Figure 91). Similarly, the data were weighted to account for differences in response by County. The weighted survey results presented in this report are adjusted to account for these differences and to provide results that are more representative of the State's population, as discussed previously.

Figure 91: Age of Respondents and State of Vermont Adult Population

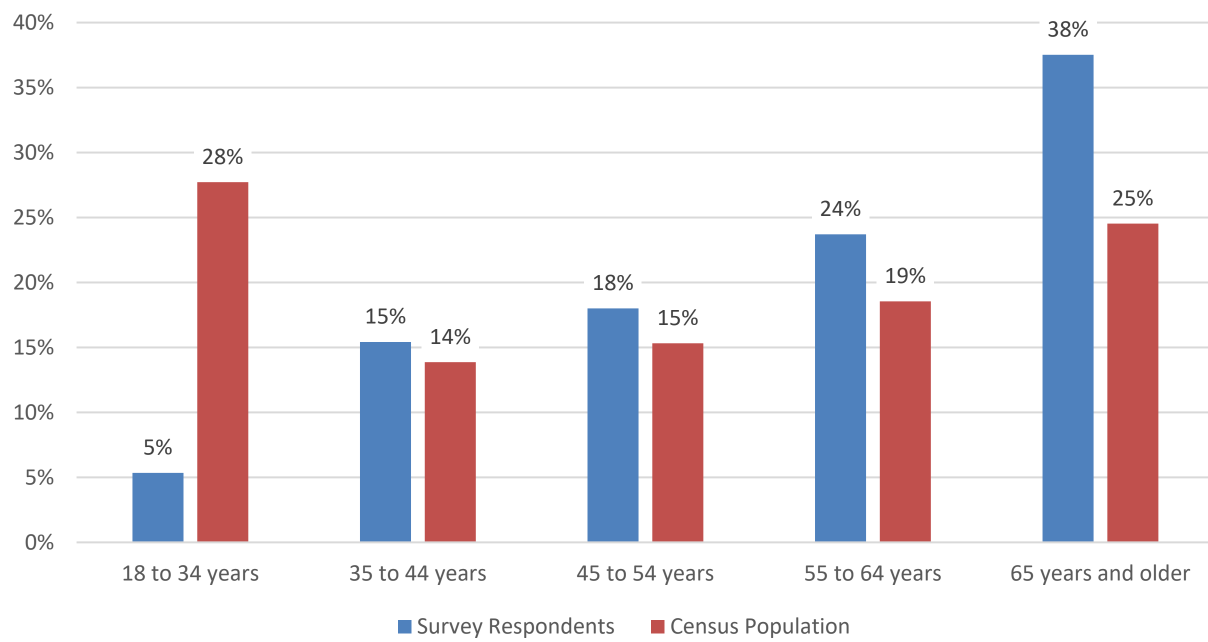
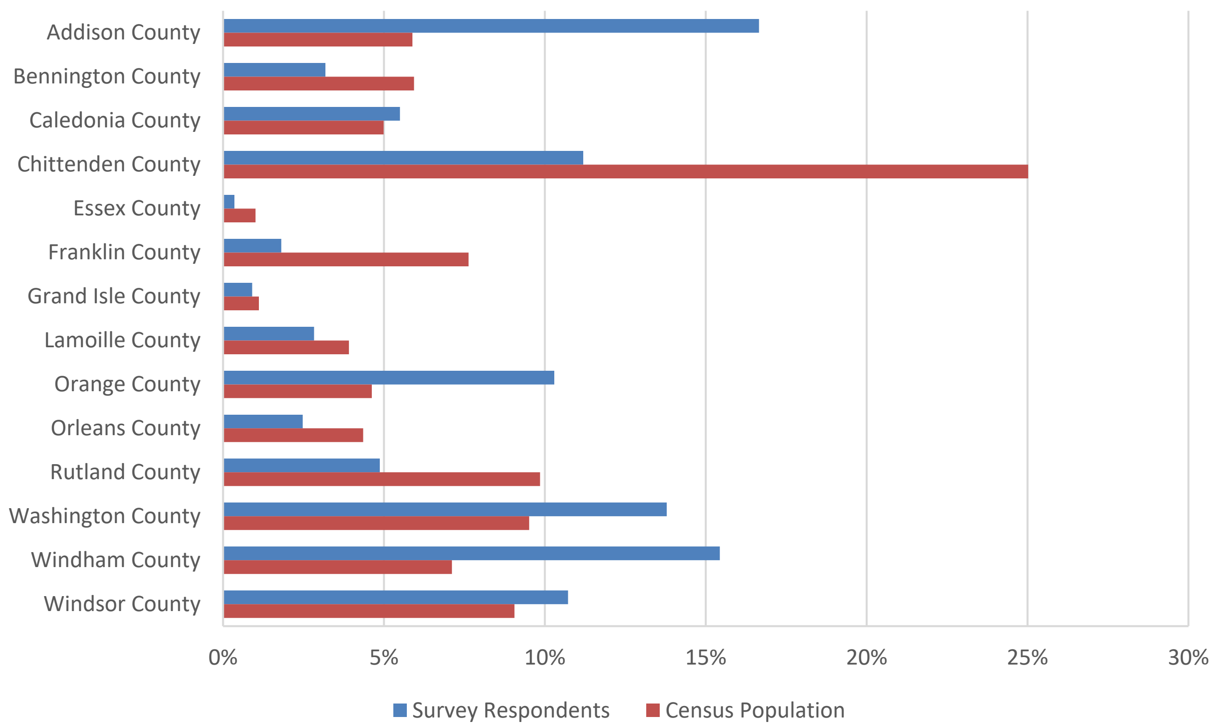
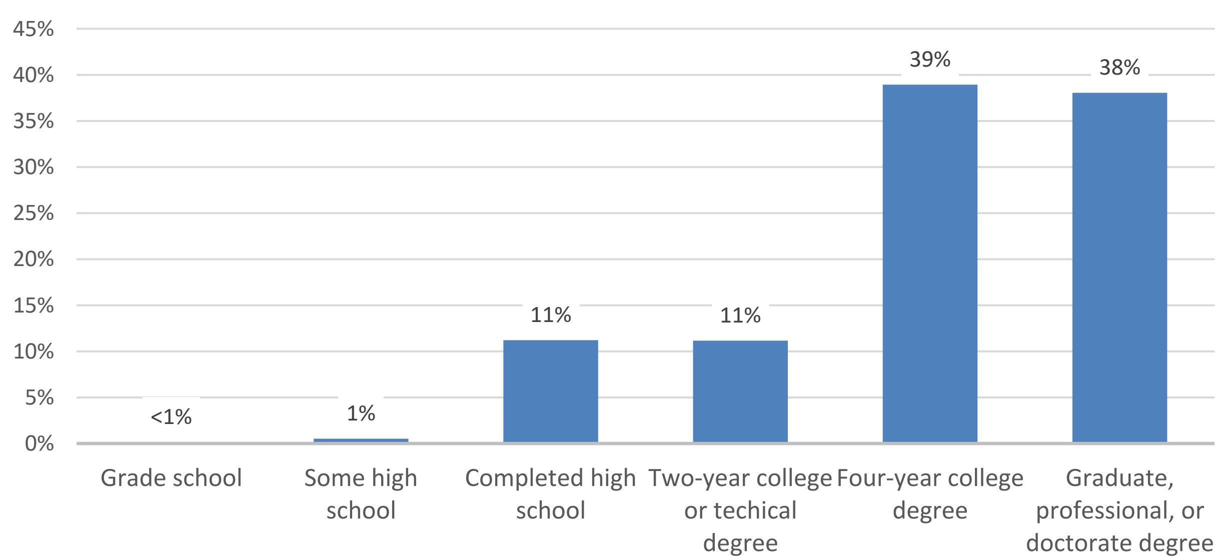


Figure 92: County of Residence



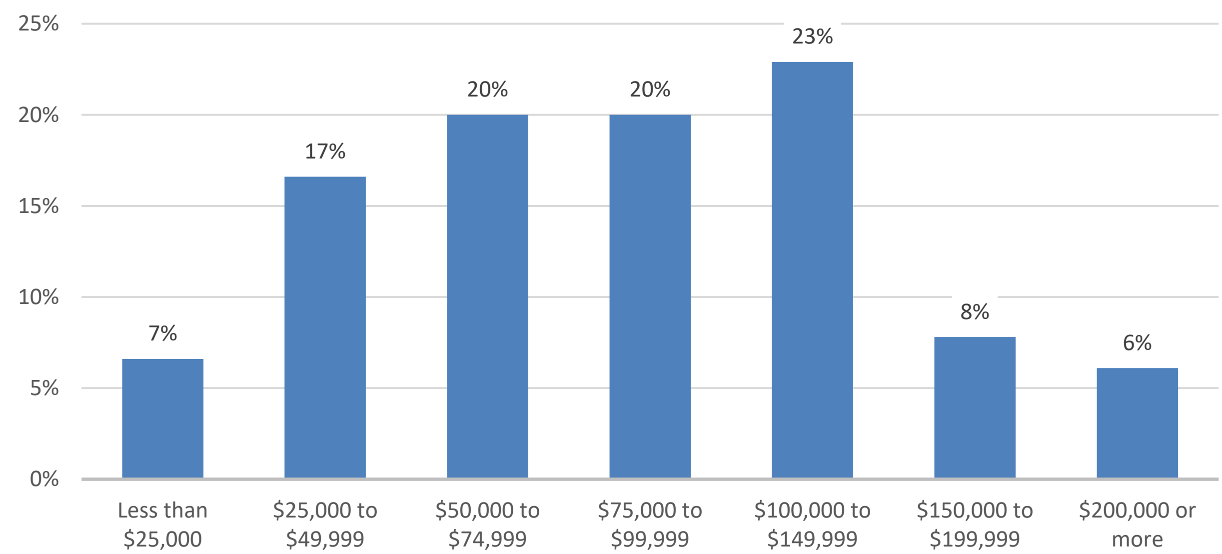
The respondents' highest level of education attained is summarized in Figure 93. Most respondents have a four-year college degree (39%) or a graduate, professional, or doctorate degree (38%).

Figure 93: Education of Respondent



One-fourth of respondents earn less than $50,000 per year, including seven percent who earn under $25,000. Four in 10 earn $50,000 but less than $100,000, while 37 percent earn $100,000 or more per year (see Figure 94).

Figure 94: Annual Household Income



As illustrated in Figure 95 and Figure 96, the majority of respondents are White/European American and identify most strongly with that race/ethnicity.

Figure 95: Race/Ethnicity

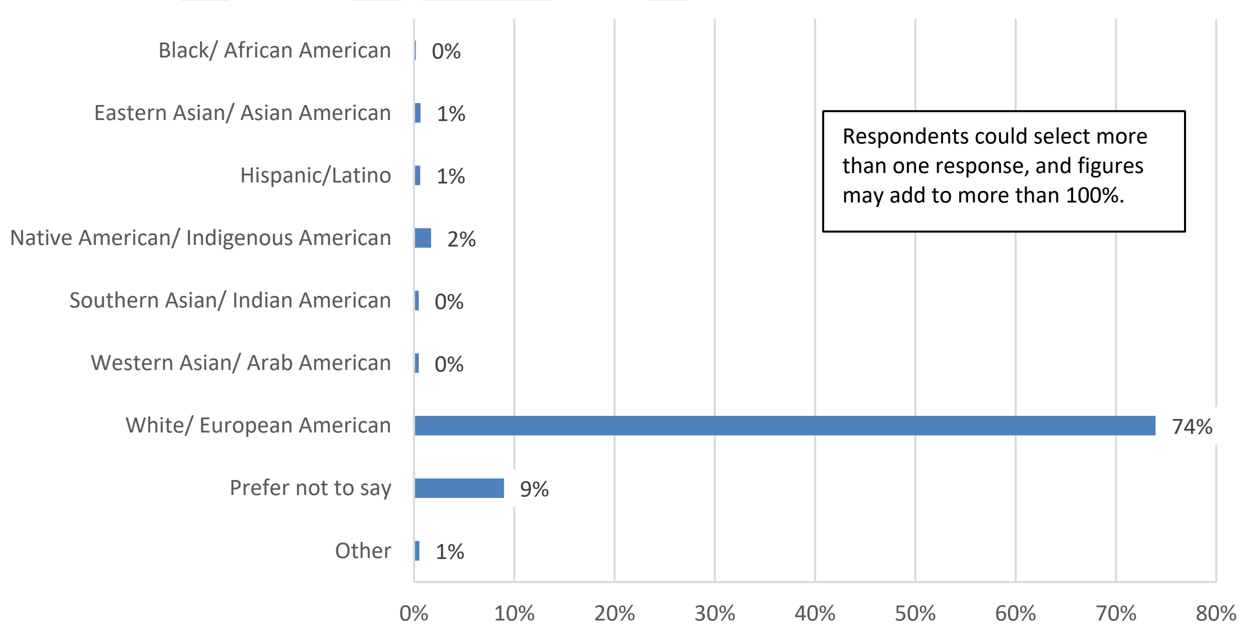
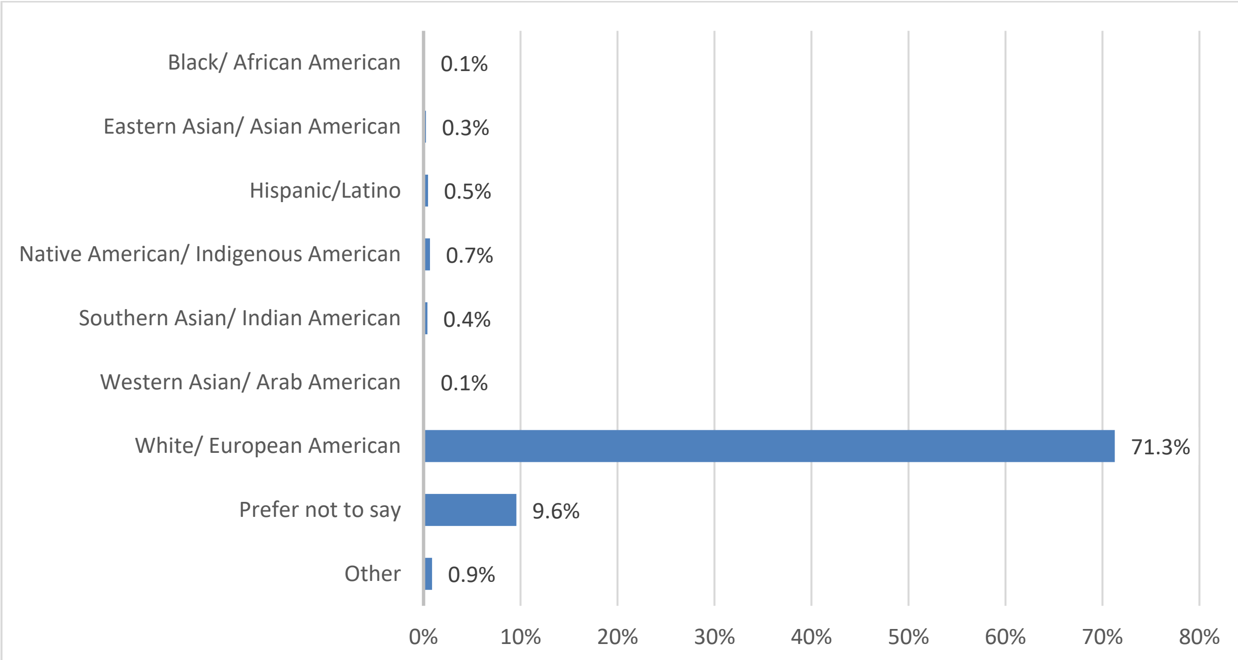
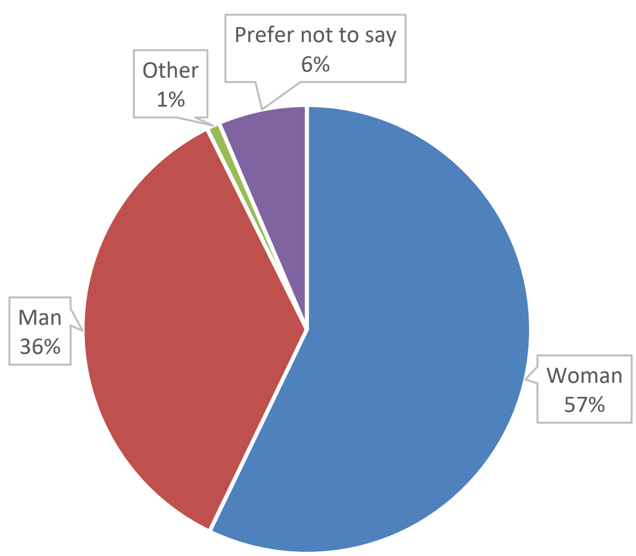


Figure 96: Race/Ethnicity Most Strongly Identify With



More than one-half of respondents (57%) identify as female, and 36 percent identify as male (see Figure 97).

Figure 97: Gender Identity



Appendix B: Business Survey Results

Executive Summary

As part of its efforts to perform a comprehensive evaluation of broadband gaps during the Covid-19 pandemic, the State of Vermont commissioned an online survey of businesses. The survey was intended to gather basic data about the types of communication services that businesses use and their willingness to purchase high-speed internet. Moreover, the survey was designed to provide insights about how the pandemic has impacted businesses' and employees' use of the internet and whether internet service is sufficient to meet the needs of businesses across the state.

Almost all businesses have access to the internet, which is to be expected of online survey participants. At the same time, businesses' internet service may be inadequate to meet their needs during the pandemic. As more employees are working remotely, some businesses are reporting internet issues faced by employees such as delays in uploading or downloading content and inability to use interactive video conferencing due to insufficient internet bandwidth. Reported internet speeds have declined, and satisfaction with internet reliability and speed has decreased during the pandemic.

This report documents the survey process, discusses methodologies, and presents results intended to assist the State in developing strategies to close the identified gaps.

Key Findings

Key findings are here presented thematically in two subsections: broadband internet usage and Covid-19 impacts on broadband use. These and other findings are presented in greater detail in the body of the report.

Broadband Internet Usage

The survey found that communication services are widely used and that there are very few gaps in acquisition of business internet. The following are key findings:

- **Almost all businesses have internet access.** Leading types of primary internet service include cable modem (35%), DSL (27%), and fiber (15%). One-half (50%) of businesses do not have a backup or secondary internet connection, and 32% have a cellular/mobile connection as their backup or secondary internet connection.

- **The most utilized connectivity services were internet and telephone.** Most (99%) reported having internet access at their primary business location, while 75 percent have telephone service, 61 percent have cellular data service, and 54 percent have videoconferencing service.

- **Almost all (99%) businesses have personal computers.** Specifically, 65 percent of businesses have 1-4 computers, 21 percent have five to nine computers, and 13 percent have ten or more computers.

- **Price may be a barrier to purchasing carrier-grade internet service.** Nearly two-thirds of respondents (65%) are extremely willing to purchase 1 Gbps internet for $75 per month, but willingness drops considerably at higher price points. Just eight percent of businesses would be extremely willing to pay $250 per month for very fast internet service, but 22 percent would be extremely willing to purchase carrier-grade Ethernet transport and internet access service at this price point. Businesses would be not at all likely to slightly likely to pay more than $250 per month for carrier-grade service.

Covid-19 Impacts on Broadband Use

Businesses are relying more on remote work during the pandemic and at the same time are reporting some inadequacies in their broadband internet service, particularly with speed and reliability of service. The following are key findings:

- **Businesses report their internet service being slower during the pandemic**. Before the Covid-19 pandemic, more than four in 10 respondents (42%) thought their internet connection speed was fast enough for their needs, dropping to 35 percent during the Covid-19 pandemic. Only 15% thought their internet connection speed was very slow and would like to be connected at much higher speeds before the pandemic, while during the pandemic this number increased to 26%.

- **Satisfaction with internet connection speed and reliability has dropped somewhat during the pandemic.** Nearly one-half of businesses (47%) were very or extremely satisfied with their internet's speed of connection prior to the pandemic, dropping to 38 percent during the pandemic. Similarly, 47 percent of businesses were very or extremely satisfied with their internet's reliability of connection, dropping to 35% during the pandemic.

- **Businesses are making more use of online platforms to sell goods or services or to engage in online marketing and promotions during the pandemic.** The percentage of businesses that exclusively use online platforms to sell goods or services or to engage in online marketing and promotions has increased from six percent before the Covid-19 pandemic to 15 percent during the pandemic.

- **The percent of time that employees work remotely has increased during the pandemic.** Specifically, one-third of employees now telework 75-100 percent of the time, compared with 11 percent of employees before the pandemic.

- **The percentage of employees working remotely is expected to increase after the Covid-19 pandemic.** More than four in 10 (42%) businesses said they did not have a work remote option prior to the pandemic, while 29 percent said they do not plan to have one after the pandemic and seven percent are undecided. One-fifth of business plan to have a fully remote work option for some or all employees after the pandemic, compared with 13 percent during the pandemic.

- **Many businesses said that most or all of their employees (75-100%) experienced issues due to inadequate broadband service during the pandemic**. For example, one-third of businesses said that all or most of their employees experienced delays in uploading or downloading content.

More than one-half of businesses said inadequate broadband service is a very significant or extremely significant issue.

- **Many businesses plan to take some action in the next 12 months related to broadband internet service and computers.** Most businesses expect to obtain higher-quality broadband service (57%) and to enhance an existing website or online sales effort (56%) in the next 12 months. Fewer respondents expect to take other actions; however, 15 percent plan to help employees obtain internet access at home and 11 percent plan to move to an area with better broadband service.

Survey Process and Data Analysis

CTC, in close coordination with the State of Vermont, managed the survey project, including development of the questionnaire, programming and hosting the online survey, survey data analysis, and reporting of results. CTC developed the draft survey instrument and the State provided revisions and approved the final questionnaire. A total of 422 completed surveys were received by the date of analysis.

The survey responses were exported into SPSS[38] software and the entries were coded and labeled. SPSS databases were formatted, cleaned, and verified prior to the data analysis. Address information was merged with the survey results using the unique identifiers included in each survey invitation. The survey data was evaluated using techniques in SPSS including frequency tables and means functions.

The following sections summarize the survey findings.

[38] Statistical Package for the Social Sciences (http://www-01.ibm.com/software/analytics/spss/)

Survey Results

The results presented in this report are based on analysis of information provided by 422 businesses in the State of Vermont. Unless otherwise indicated, the percentages reported are based on the "valid" responses from those who provided a definite answer and do not reflect individuals who said "don't know" or otherwise did not supply an answer because the question did not apply to them. Key differences by business types are noted where appropriate.

Business Information and Services Used

Basic information was gathered from survey respondents to profile businesses in the survey. The following charts in this section highlight characteristics of businesses in the survey sample, services used, and willingness to purchase internet services (see Figure 98 through Figure 112).

Eighty-four percent of businesses are the sole location, and seven in 10 businesses have fewer than five full-time employees. Six in 10 businesses own their office location, and one-fourth share their space with other, unrelated businesses. Three-fourths of respondents completed the survey from their typical place of business.

All Vermont counties are represented in the sample, including 15 percent of businesses with a main office location in Washington County, 14 percent in Chittenden County, 13 percent in Windham County, and 10 percent in Addison County.

Thirteen percent of businesses spend less than $1,000 per year on their telecommunications expenses, while 39 percent spend $1,000 to $2,499 per year and 21 percent spend $2,500 to $4,999 per year. Another 16 percent of respondent spend $5,000 or more per year on telecommunications expenses.

Almost all (99%) businesses have personal computers. Specifically, 65 percent of businesses have 1-4 computers, 21 percent have five to nine computers, and 13 percent have ten or more computers.

The most utilized connectivity services at the businesses' primary business location were internet (99%) and telephone (75%). Six in 10 use cellular data, 54 percent use video conferencing, and four percent wrote-in other connectivity services.

Almost all (99%) businesses reported having internet service. Over one-third (35%) of businesses use a cable modem as their primary internet connection, 27 percent use DSL primarily, and 15 percent have fiber service as their primary internet connection. One-half (50%) of businesses do not have a backup or secondary internet connection, and 32% have a cellular wireless connection as their backup or secondary internet service.

One in 10 businesses pay less than $50 per month for internet service at their primary location, while 31 percent pay $50 to $99, 22 percent pay $100 to $149, 23 percent pay $250 to $299, and 15 percent pay $300 or more per month for internet service.

Figure 98: Number of Employees in Vermont

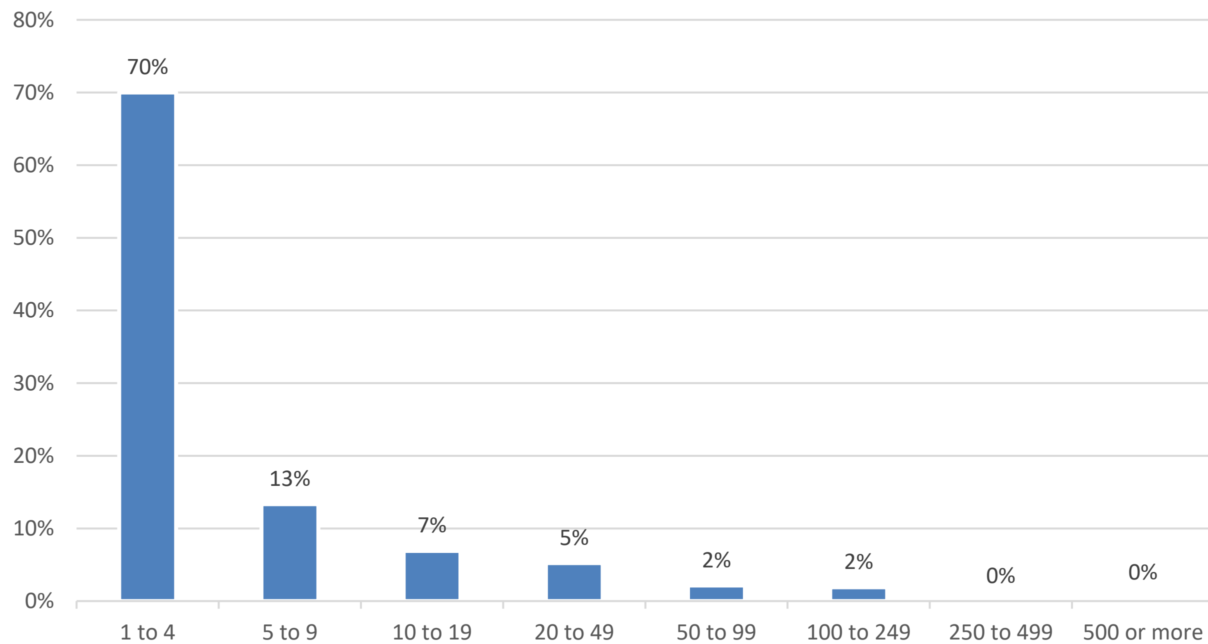


Figure 99: Number of Business Locations in Vermont

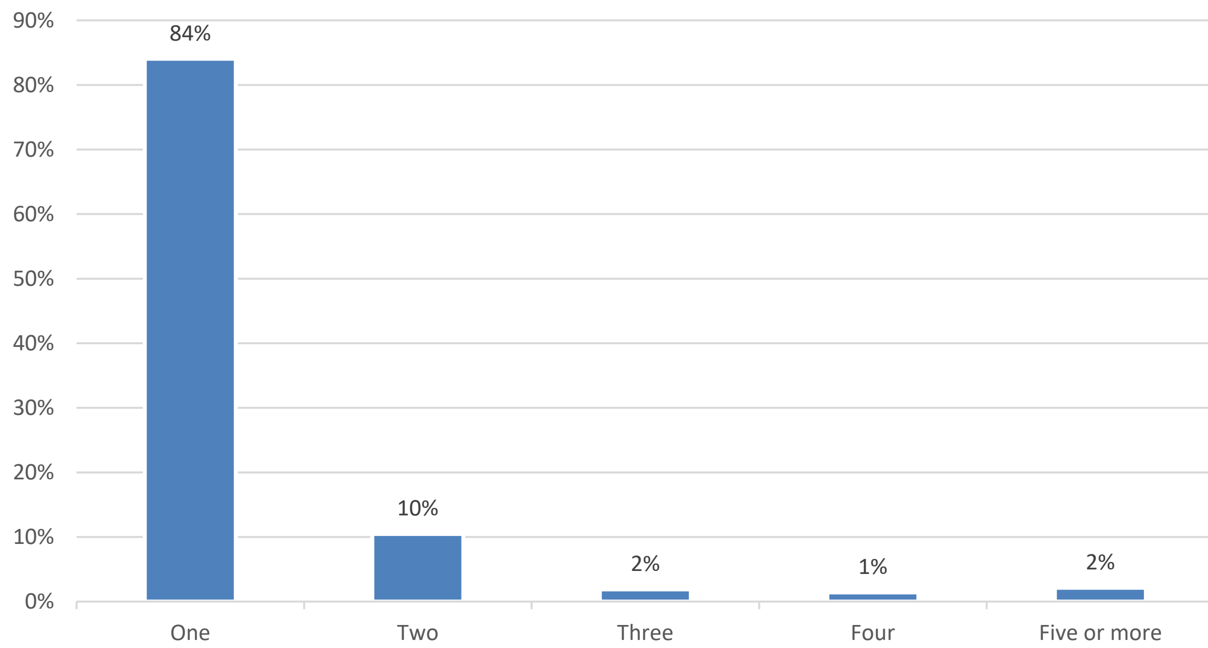

90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
84%
10%
2%
1%
2%
One
Two
Three
Four
Five or more

Figure 100: Own or Lease Vermont Locations

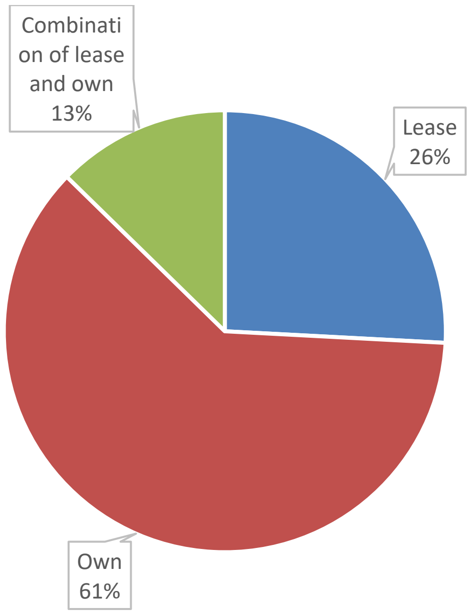


Figure 101: Share Space with Other Businesses

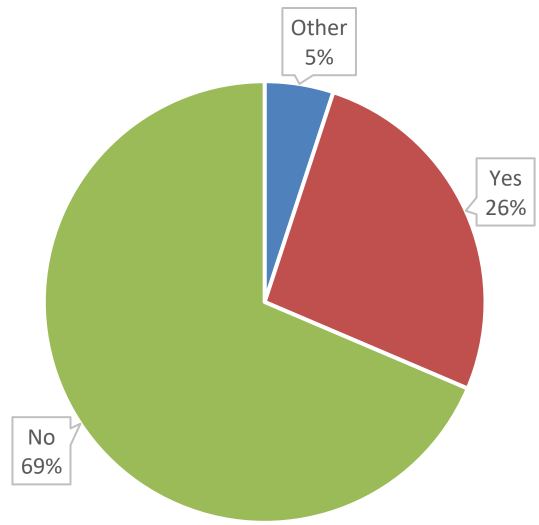


Figure 102: County of Main Business Location

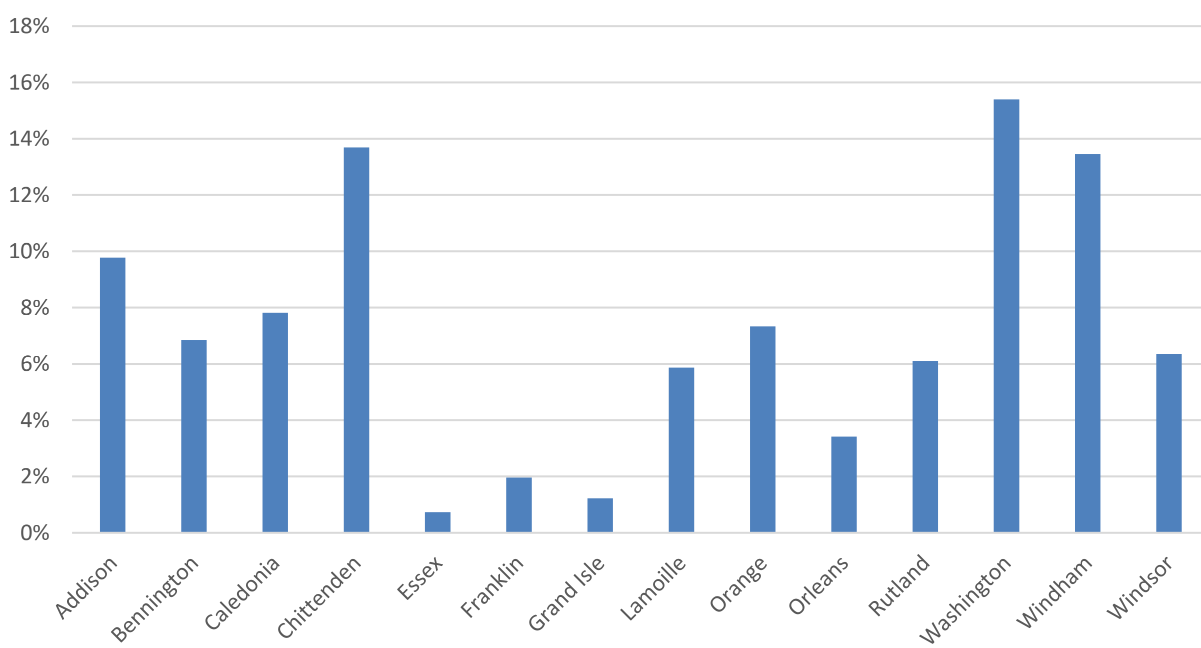


Figure 103: Annual Telecommunications Expense

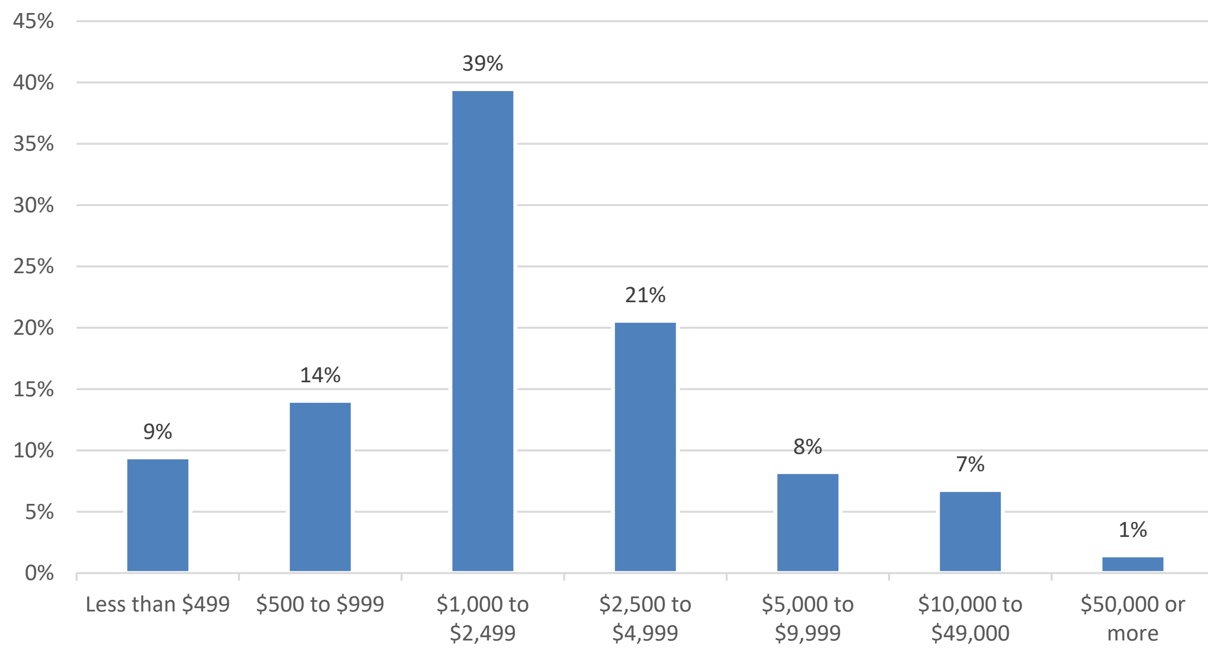


Figure 104: Number of Personal Computers or Terminals at Vermont Location(s)

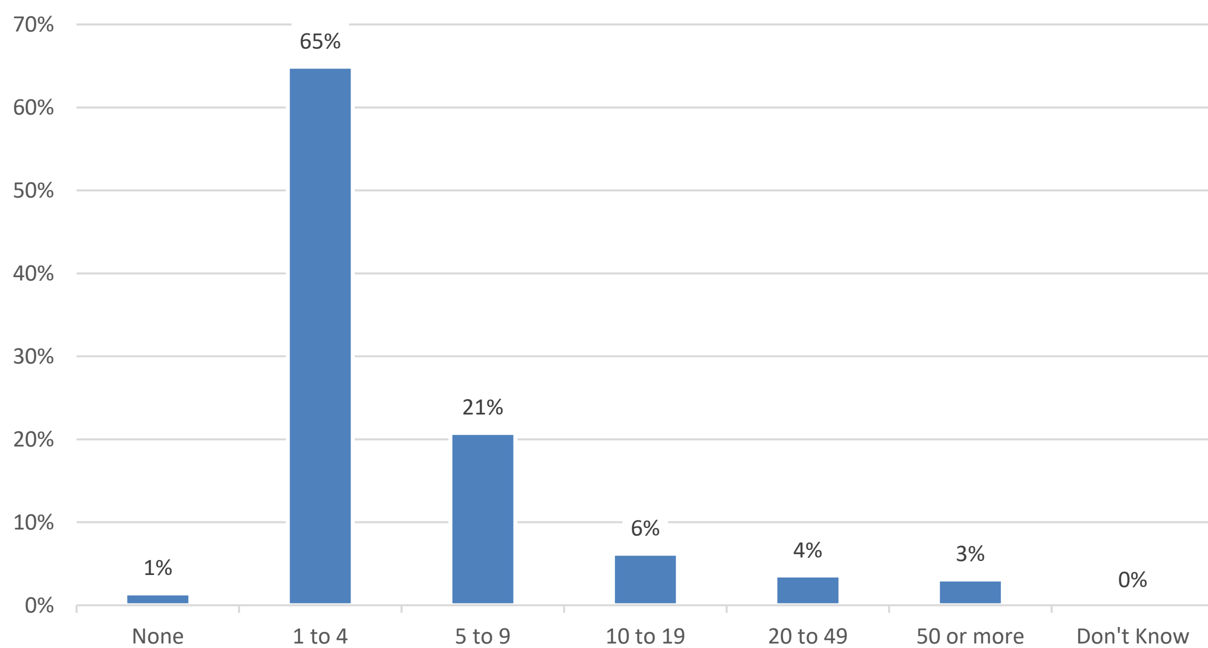


Figure 105: Primary Connectivity Services

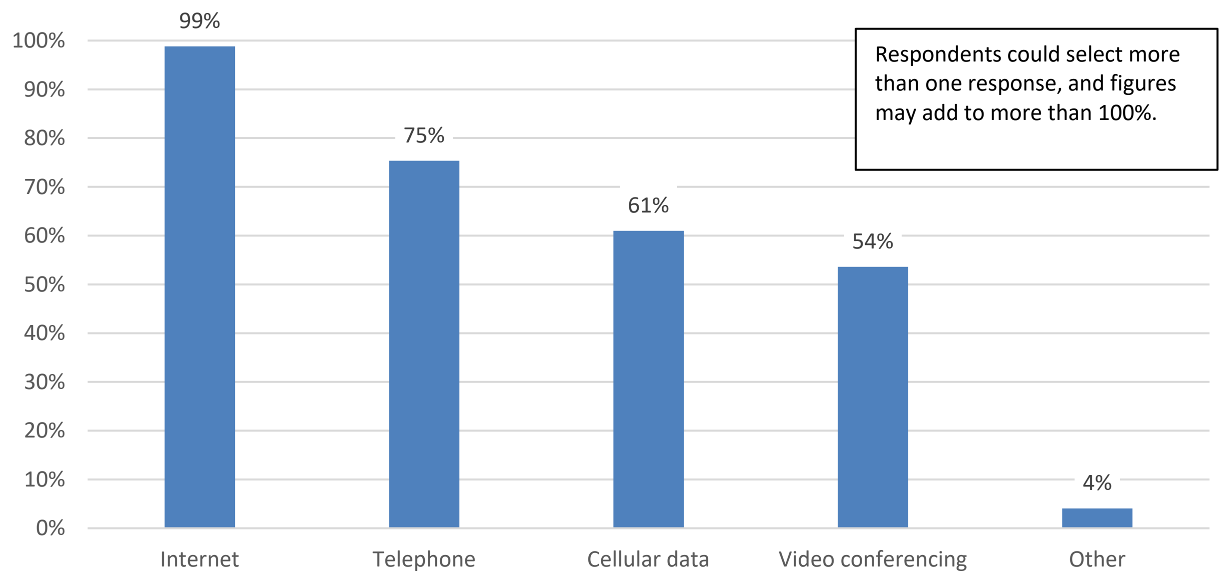


Figure 106: Primary Internet Connection

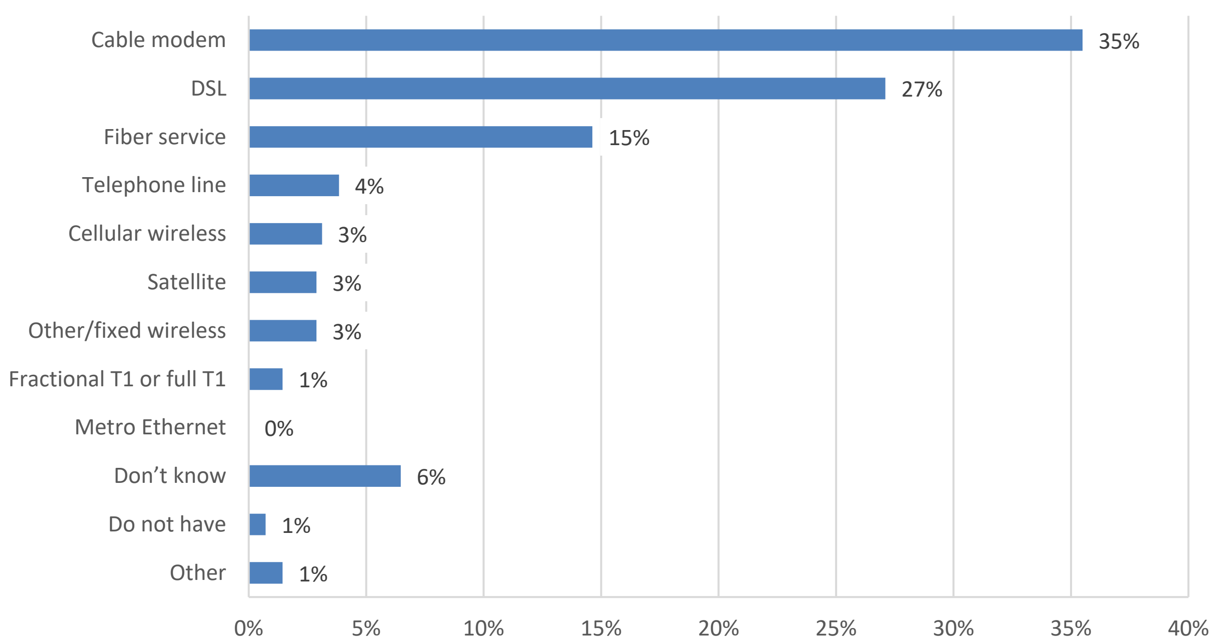


Figure 107: Backup or Secondary Internet Connection

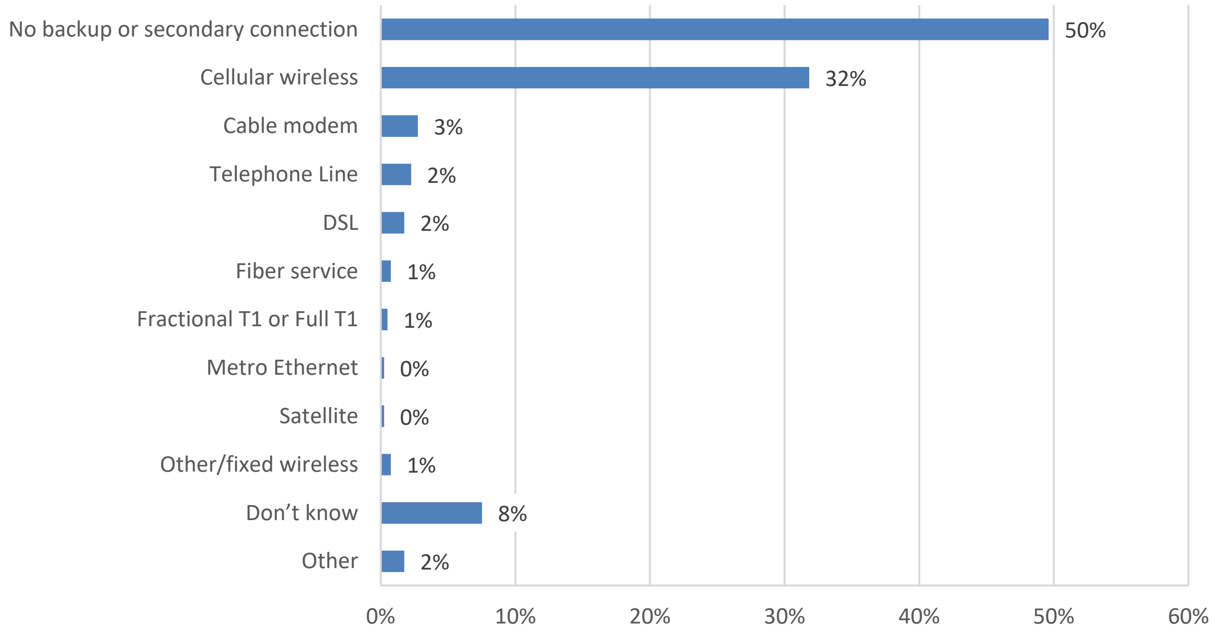
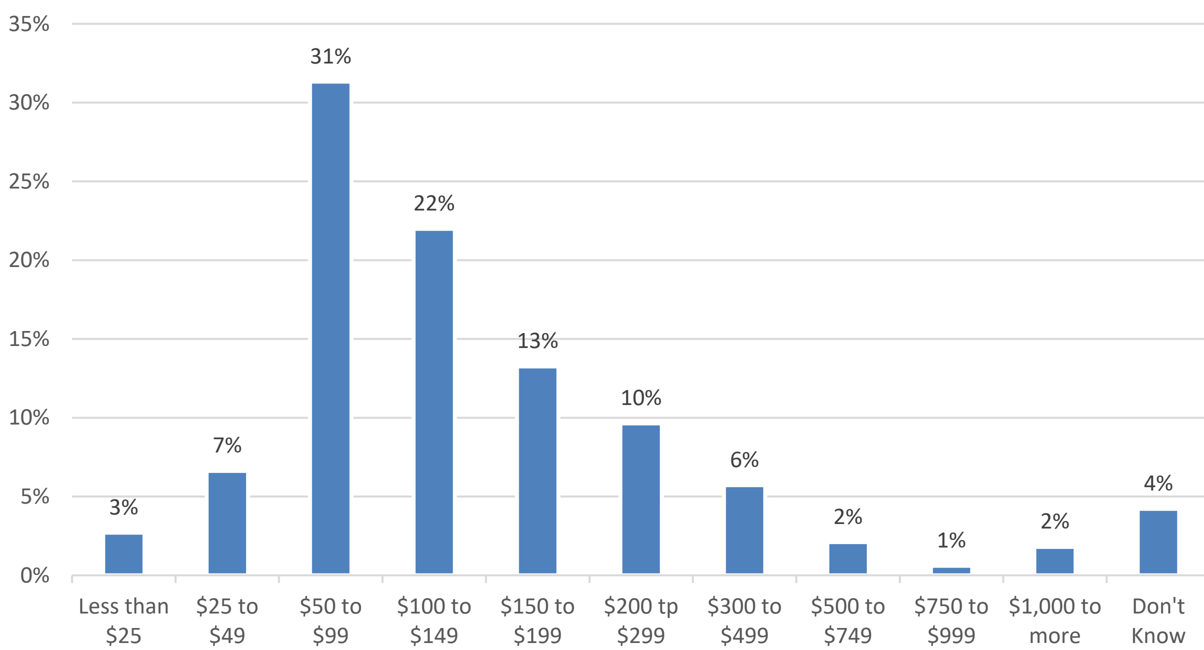


Figure 108: Monthly Cost of Internet Service at Primary Location



Respondents were asked if they would be willing to purchase 1 Gbps internet service for various price levels. The mean willingness to purchase across this array of questions is illustrated in Figure 109, while detailed responses are illustrated in Figure 110.

Figure 109: Willingness to Pay for Access to 1 Gbps Internet Service (Mean Ratings)

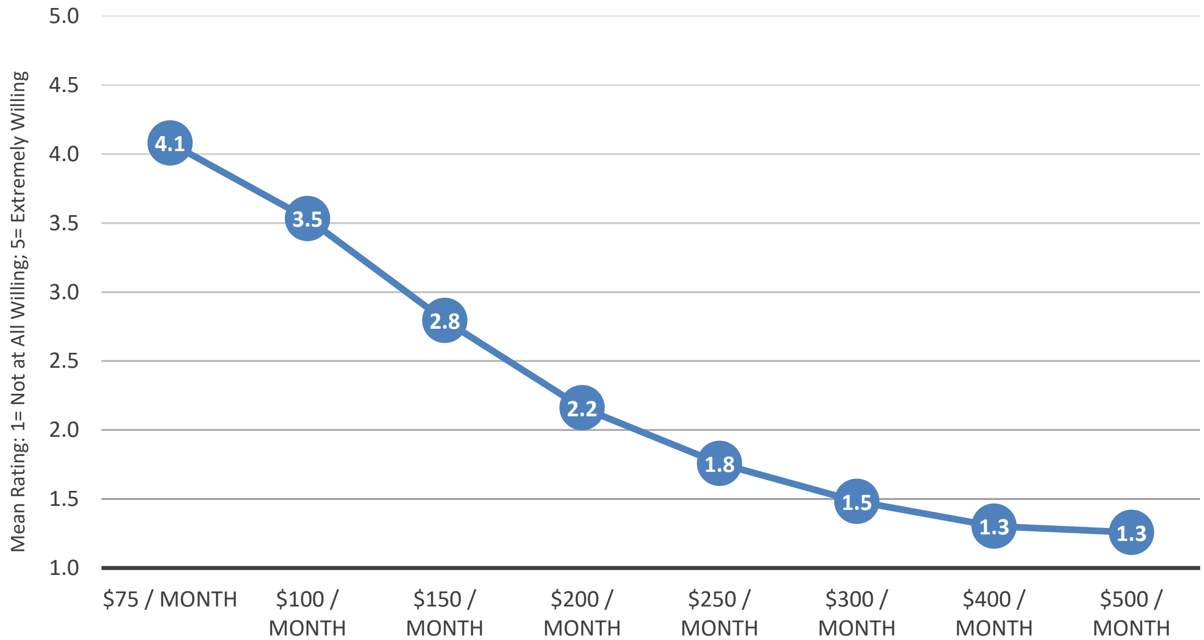
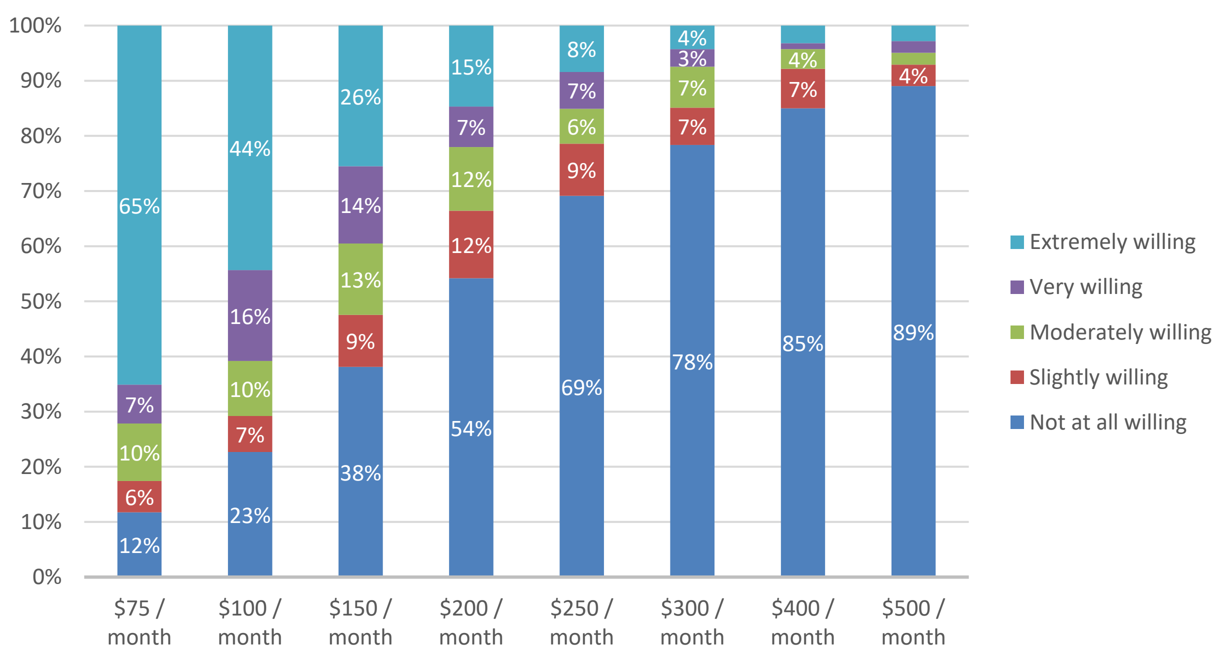


Figure 110: Willingness to Pay for Access to 1 Gbps Internet Service



Respondents' willingness to purchase 1 Gbps internet service is high at $75 per month (4.1 mean), but it decreases as the price increases. The mean rating falls to 3.5 at a price point of $100 per month and 2.8 at a price point of $150 per month (slightly to moderately willing). From another perspective, 65 percent of respondents are extremely willing to purchase 1 Gbps internet for $75 per month, dropping to 44 percent at $100 per month and 26 percent at $150 per month. Very few businesses would pay $400 or $500 per month for very fast internet service.

Businesses were also asked to indicate how willing they would be to pay for access to 1 Gbps carrier-grade Ethernet transport and internet access service. The mean willingness to purchase across this array of questions is illustrated in Figure 111, while detailed responses are illustrated in Figure 112.

Respondents' willingness to purchase 1 Gbps carrier-grade Ethernet transport and internet service is slight to moderate at $250 per month (2.5 mean), and it drops considerably as the price increases. The mean rating falls to 1.6 at a price point of $500 per month and 1.3 at a price point of $750 per month (not at all to slightly willing). From another perspective, 22 percent of respondents are extremely willing to purchase 1 Gbps carrier-grade internet for $250 per month, dropping to five percent at $500 per month and three percent at $750 per month. Very few businesses would pay $400 or $500 per month for very fast internet service.

Figure 111: Willingness to Pay for Access to 1 Gbps Carrier-Grade Ethernet Transport and Internet Service (Mean Ratings)

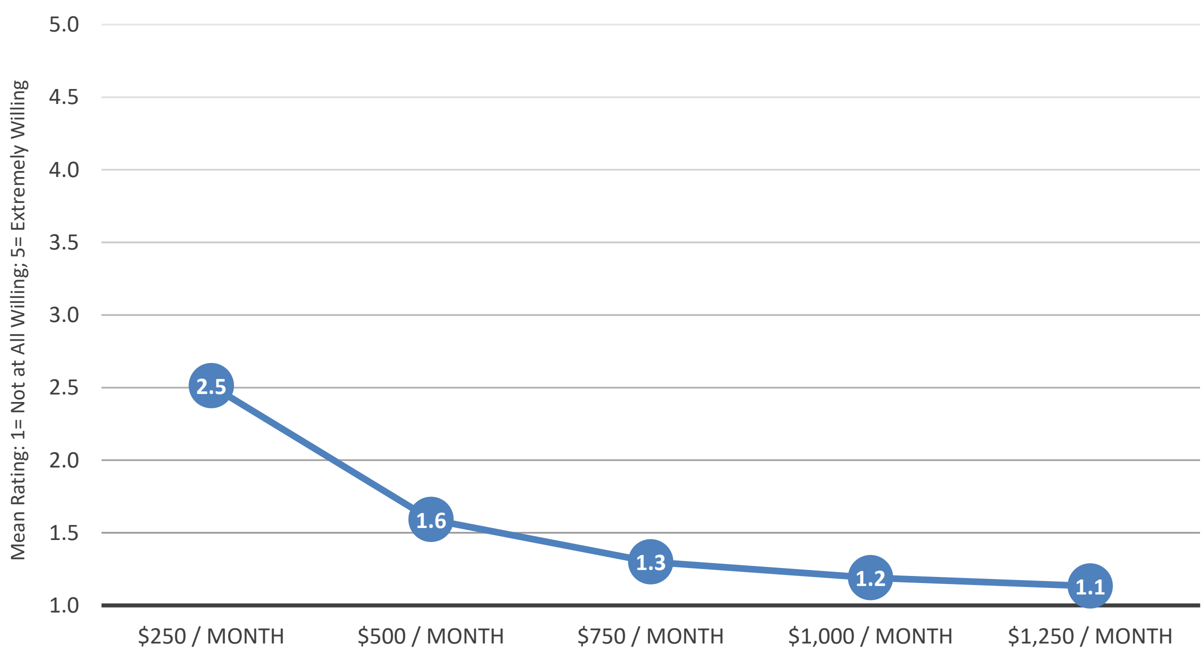
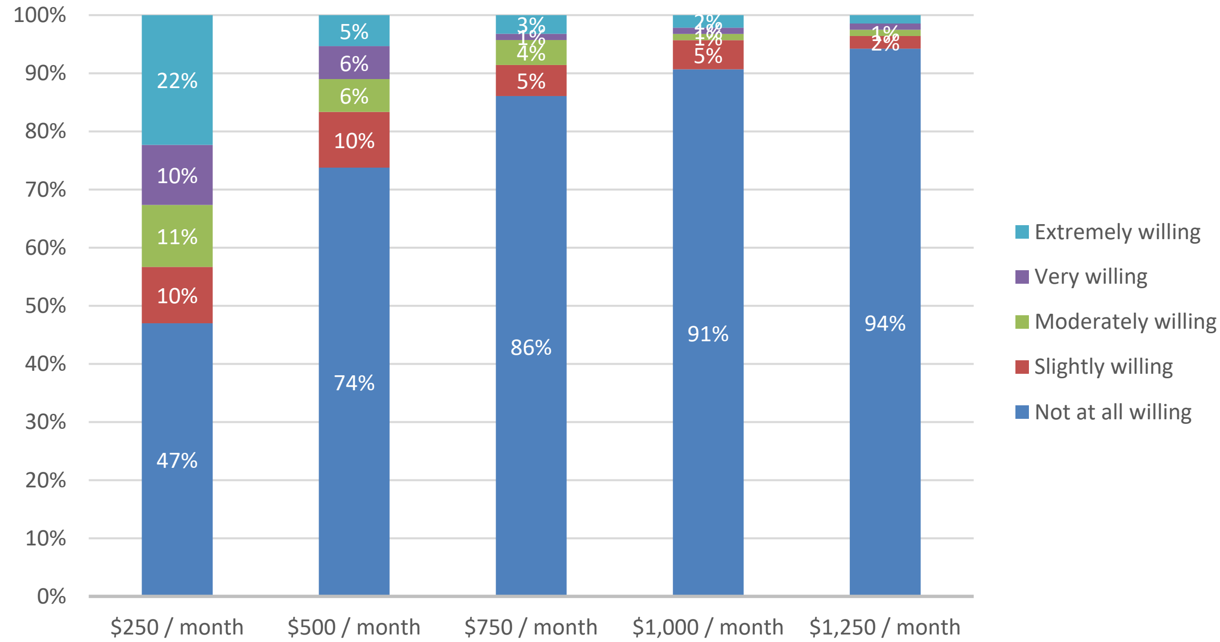


Figure 112: Willingness to Pay for Access to 1 Gbps Carrier-Grade Ethernet Transport and Internet Service



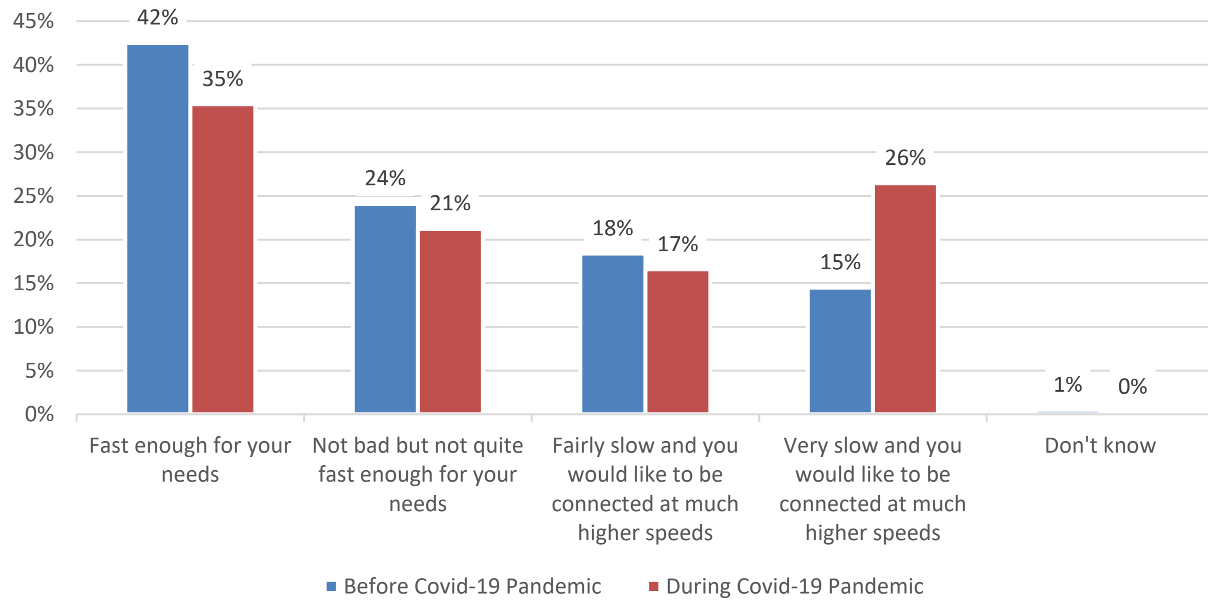
Covid-19 Impacts on Business

Businesses were asked a series of questions on how their broadband use has changed during the Covid-19 pandemic, including impacts on connection speed, satisfaction with internet service, use of online platforms for selling goods or services, amount of time employees worked remotely, and issues experienced due to broadband service during the pandemic. This section also evaluated expected changes in broadband ad computer use over the next 12 months. This information provides valuable insight into demand for broadband service during the pandemic.

Internet Connection Speed

Before the Covid-19 pandemic, more than four in 10 respondents (42%) thought their internet connection speed was fast enough for their needs, dropping to 35 percent during the Covid-19 pandemic. Only 15% thought their internet connection speed was very slow and would like to be connected at much higher speeds before the pandemic, while during the pandemic this number increased to 26% (see Figure 113).

Figure 113: Internet Connection Speed Before and During Covid-19 Pandemic



Satisfaction with Business Internet Service

Respondents were asked to evaluate their satisfaction with aspects of their current business internet service before and during the Covid-19 pandemic. Average rating scores are highlighted in Figure 114, while Figure 115 shows detailed responses. Overall, respondents were only moderately satisfied with aspects of their internet service prior to the Covid-19 pandemic, and satisfaction has dropped somewhat during the pandemic particularly for connection speed and reliability.

Figure 114: Satisfaction with Internet Business Service Aspects (Mean Ratings)

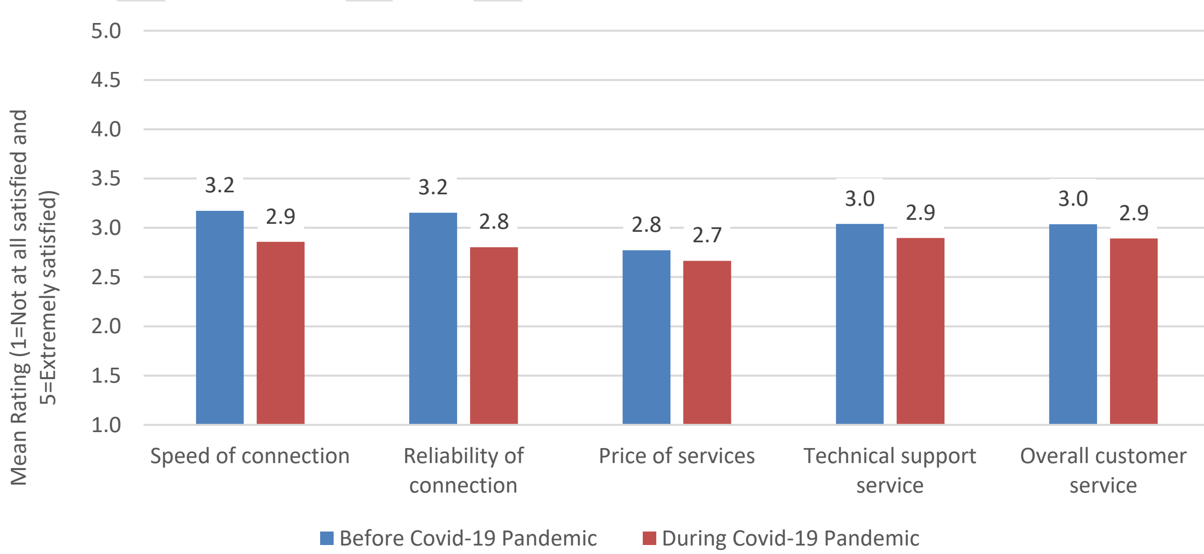
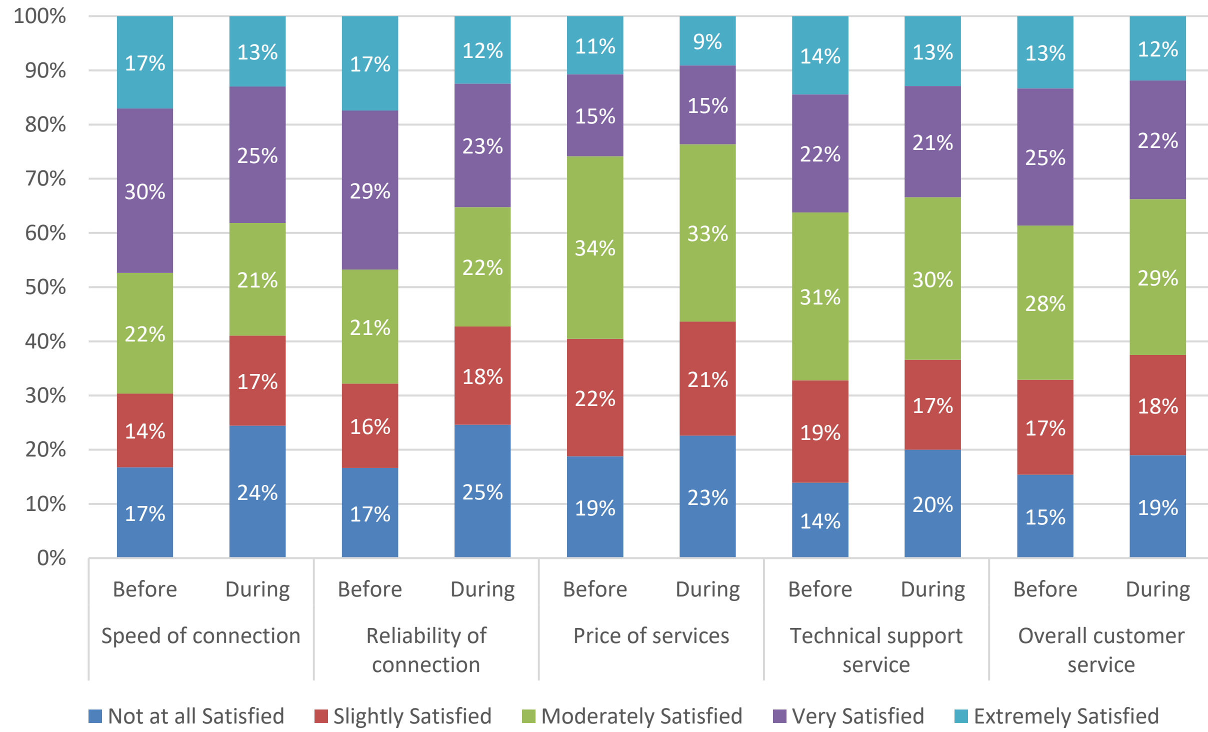


Figure 115: Satisfaction with Internet Business Service Aspects



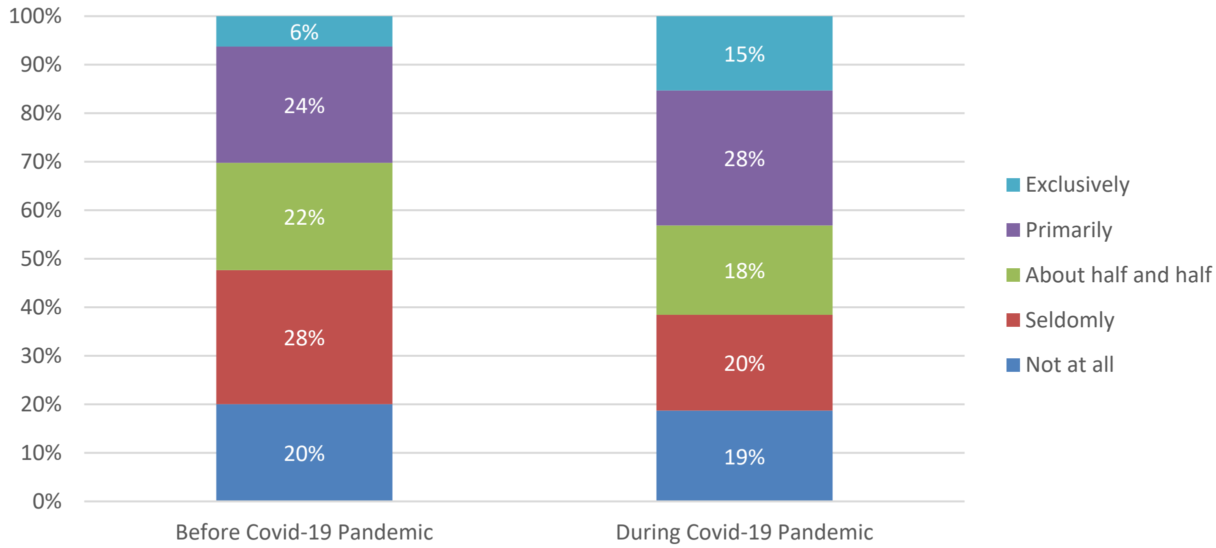
Specifically, nearly one-half of respondents (47%) were very or extremely satisfied with their internet's speed of connection prior to the pandemic, while 17 percent were not at all satisfied. During the pandemic, 38 percent of respondants were very or extremely satisfied with their internet's speed of connection, and 24 percent of businesses were not at all satisfied with their internet's speed of connection.

Satisfaction with business internet's reliability of connection decreased during the Covid-19 pandemic as well. Prior to the pandemic, nearly one-half (47%) of respondants were very or extremely satisfied with their internet's reliability of connection, while 17% being not at all satisfied. During the pandemic, 35% of respondants were very or extremely satisfied with their internet's reliability of connection, and 25% of businesses were not at all satisfied with their internet's reliability of connection.

Use of Online Platforms

The percentage of businesses that exclusively use online platforms to sell goods or services or to engage in online marketing and promotions has increased from six percent before the Covid-19 pandemic to 15 percent during the pandemic (see Figure 116).

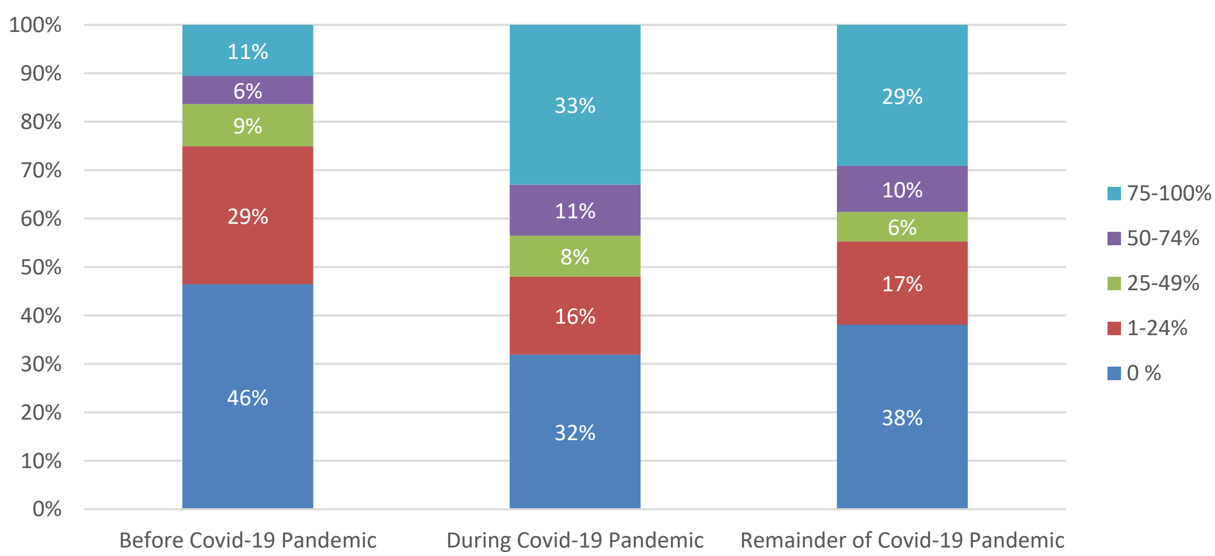
Figure 116: Use of Online Platforms to Sell Goods or Services Online



Remote Work

Businesses were asked a series of questions to help evaluate how remote-work has changed during the Covid-19 pandemic. As illustrated in Figure 117, the percent of time that employees work remotely has increased during the pandemic. Specifically, one-third of employees now telework 75-100 percent of the time, compared with 11 percent of employees before the pandemic.

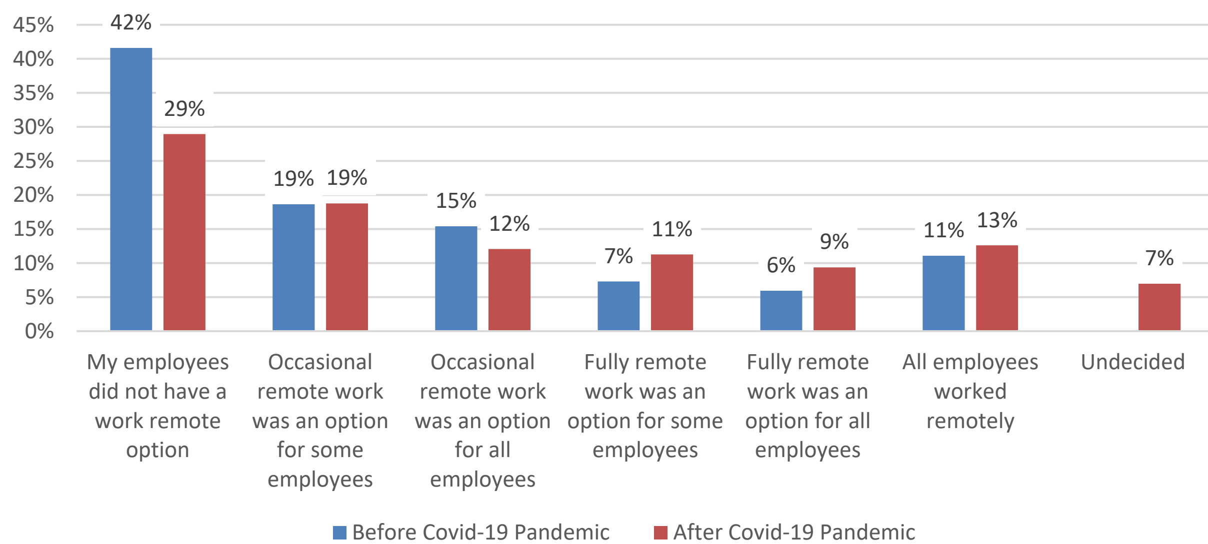
Figure 117: Percent of Time Employees Work Remotely



The percentage of time that employees telework is expected to remain at a similar level for the remainder of the Covid-19 pandemic but may decrease slightly. Prior to the pandemic, 46 percent of businesses said no employees telecommuted, compared with 32 percent during the pandemic and 38 percent for the rest of the pandemic.

The percentage of employees working remotely is expected to increase after the Covid-19 pandemic, as shown in Figure 118. More than four in 10 (42%) businesses said they did not have a work remote option prior to the pandemic, while 29 percent said they do not plan to have one after the pandemic and seven percent are undecided. One-fifth of businesses plan to have a fully remote work option for some or all employees after the pandemic, compared with 13 percent during the pandemic.

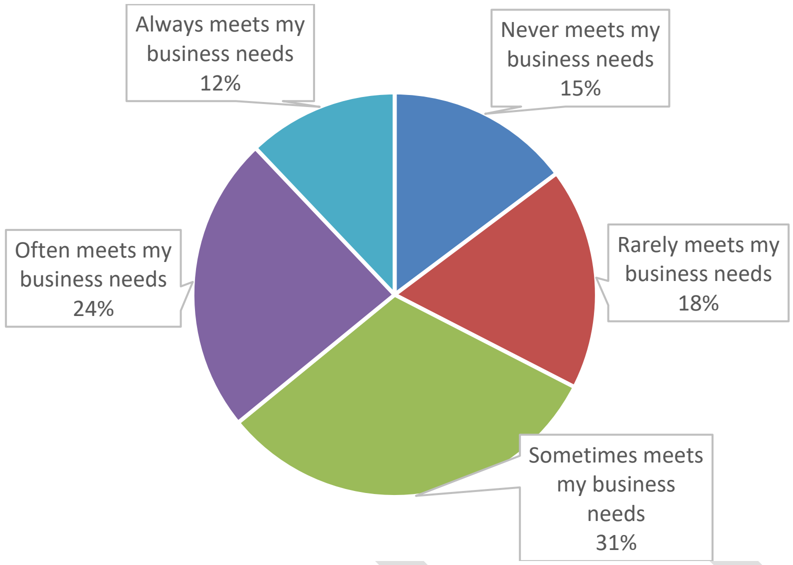
Figure 118: Remote-Work Policy Before and After Covid-19 Policy



Internet Issues During Pandemic

Businesses were asked how well their employees' internet connections meets their company's needs during the pandemic, along with the percentage of employees who have dealt with various issues due to inadequate broadband service.

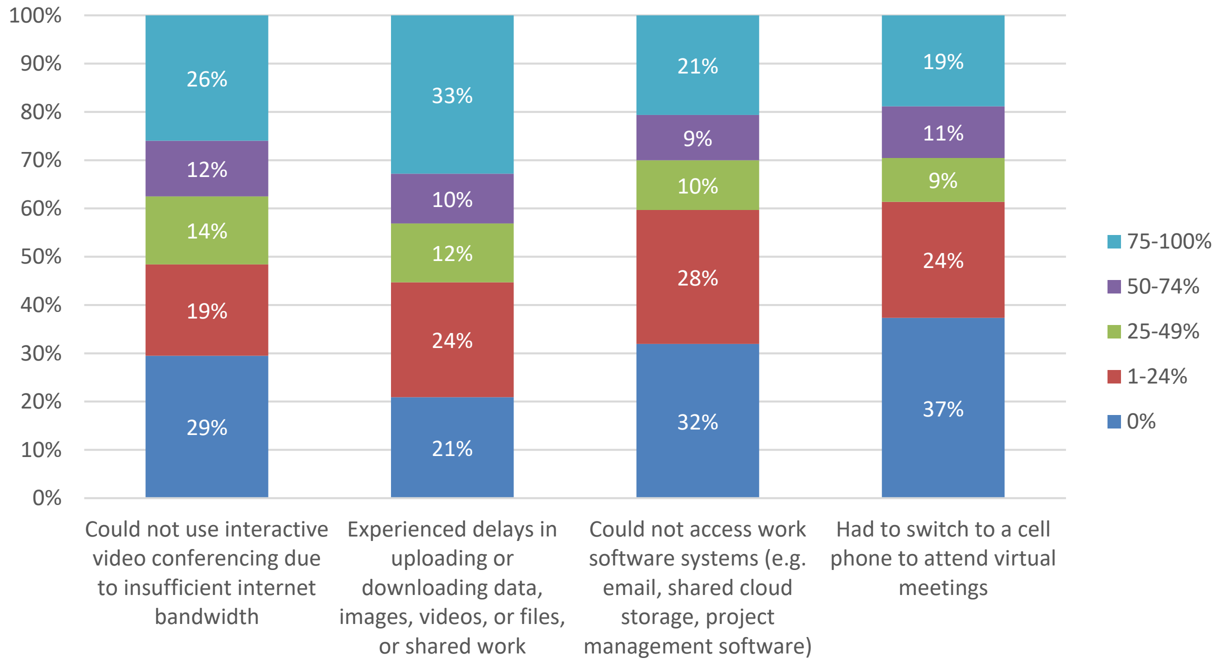
Figure 119: How Employees' Internet Connection Meets Company's Needs



More than one-third of businesses said their employees' internet connection always (12%) or often (24%) meets their needs (see Figure 119). Another 31 percent said it sometimes meets their needs. Another one-third of businesses said their employees' internet connection rarely (18%) or never (15%) meets their needs (see Figure 119).

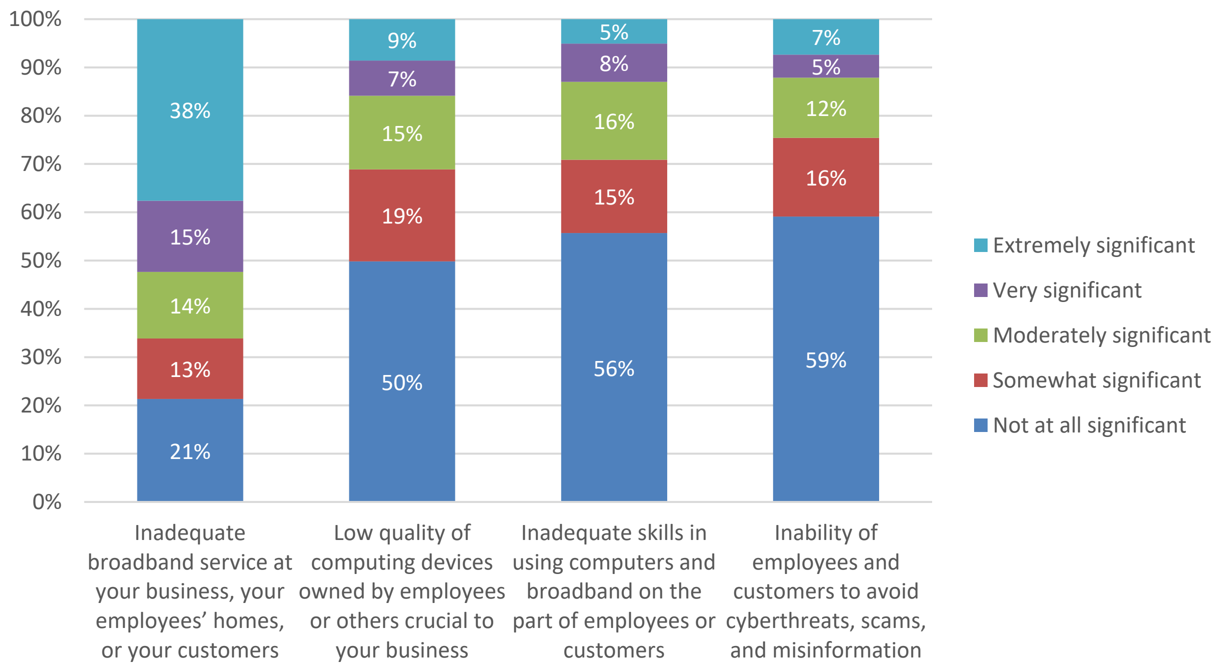
Additionally, a sizeable segment of businesses said that most or all of their employees (75-100%) experienced issues due to inadequate broadband service during the pandemic (see Figure 120). Specifically, one-third of businesses said that all or most of their employees experienced delays in uploading or downloading content. One-fourth of businesses said all or most employees could not use interactive video conferencing due to insufficient internet bandwidth. Also, one-fifth of businesses said all or most employees could not access work software systems or had to switch to a cell phone to attend virtual meetings.

Figure 120: Broadband Issues Experienced During the Pandemic



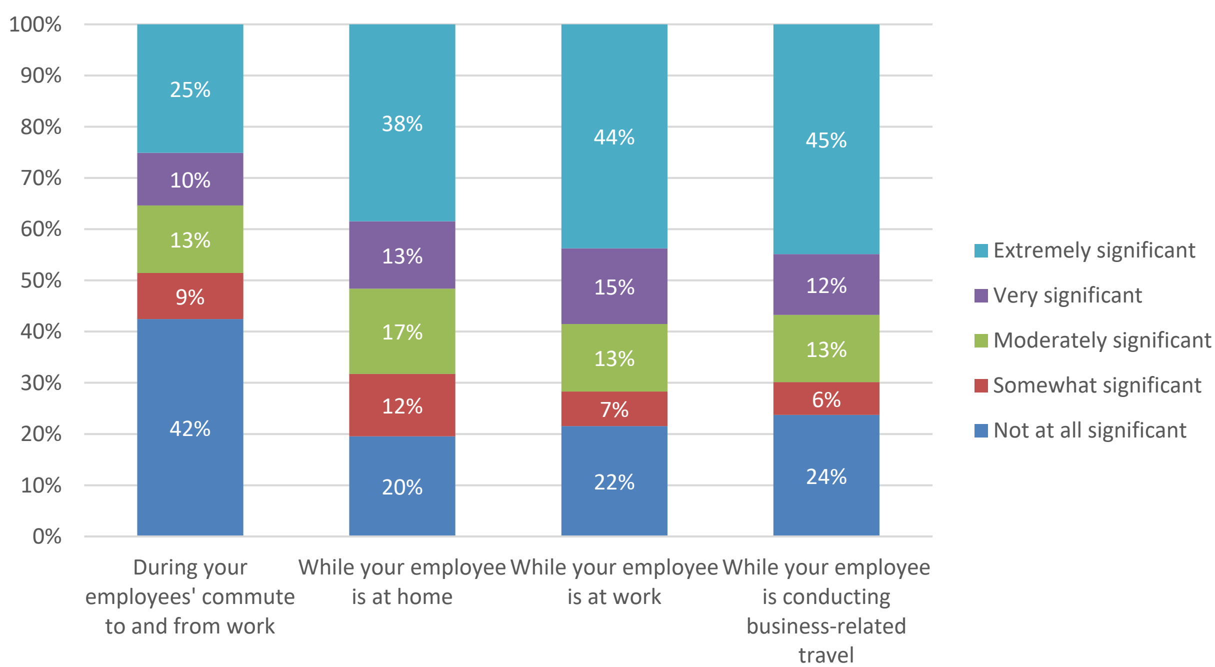
Respondents were also asked to evaluate the significance of problems employees experience with their use of broadband and computers (see Figure 121). Overall, more than one-half of businesses said inadequate broadband service is a very significant or extremely significant issue. Just one-fifth said this issue is not at all significant. At the same time, more than one-half of businesses said that other issues are not at all significant.

Figure 121: Significance of Broadband and Computer Issues



As illustrated in Figure 122, more than one-half of respondents said that cell phone issues with their employees at home (51%), at work (59%), or while conducting business-related travel (57%) are very to extremely significant situations. More than four in 10 (42%) said that cell phone issues during their employees' commute is not at all significant.

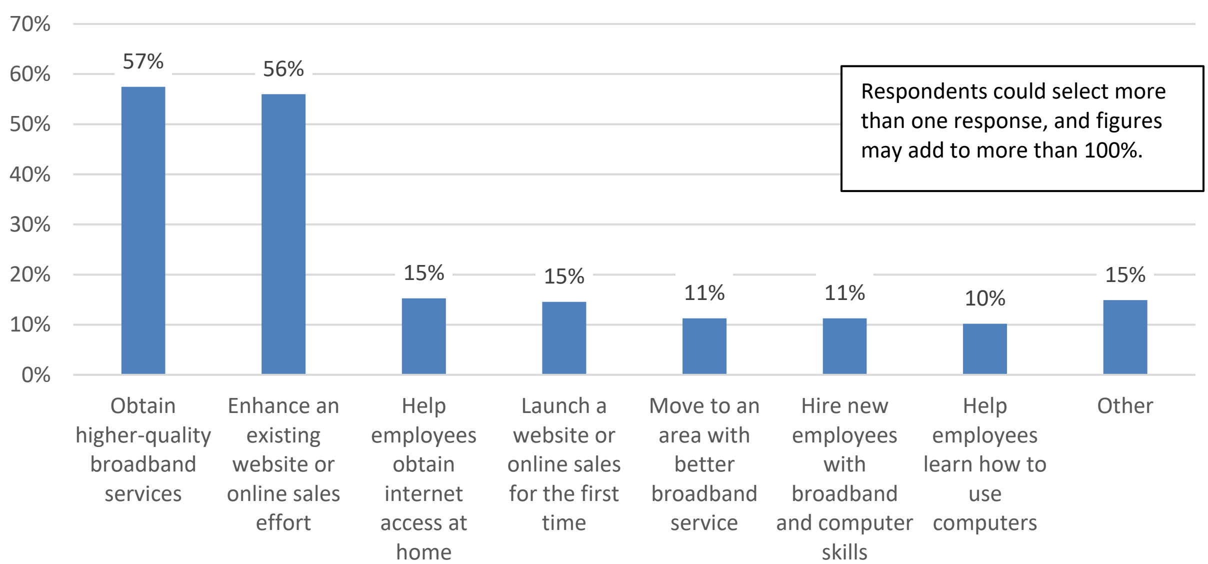
Figure 122: Significance of Cell Phone Issues



Future Actions Related to Computer and Internet Service

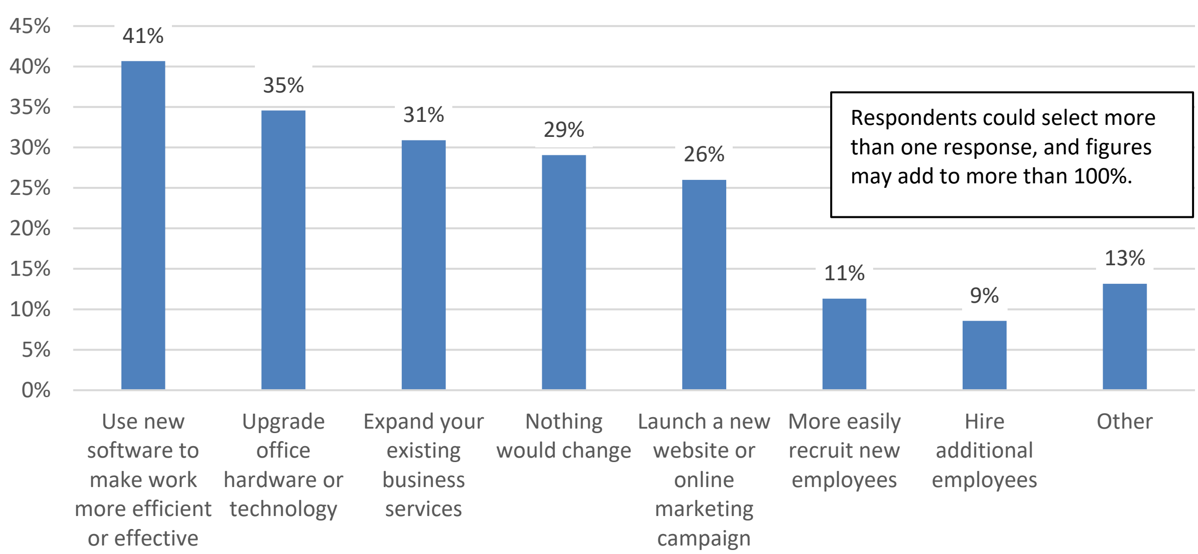
Most businesses expect to obtain higher-quality broadband service (57%) and to enhance an existing website or online sales effort (56%) in the next 12 months. Fewer respondents expect to take other actions; however, 15 percent plan to help employees obtain internet access at home and 11 percent plan to move to an area with better broadband service (see Figure 123).

Figure 123: Actions Will Take in Next 12 Months Regarding Broadband and Computers



Most businesses would make some changes in the next 12 months if they were able to get faster internet service; just 29 percent said they would make no changes (see Figure 124).

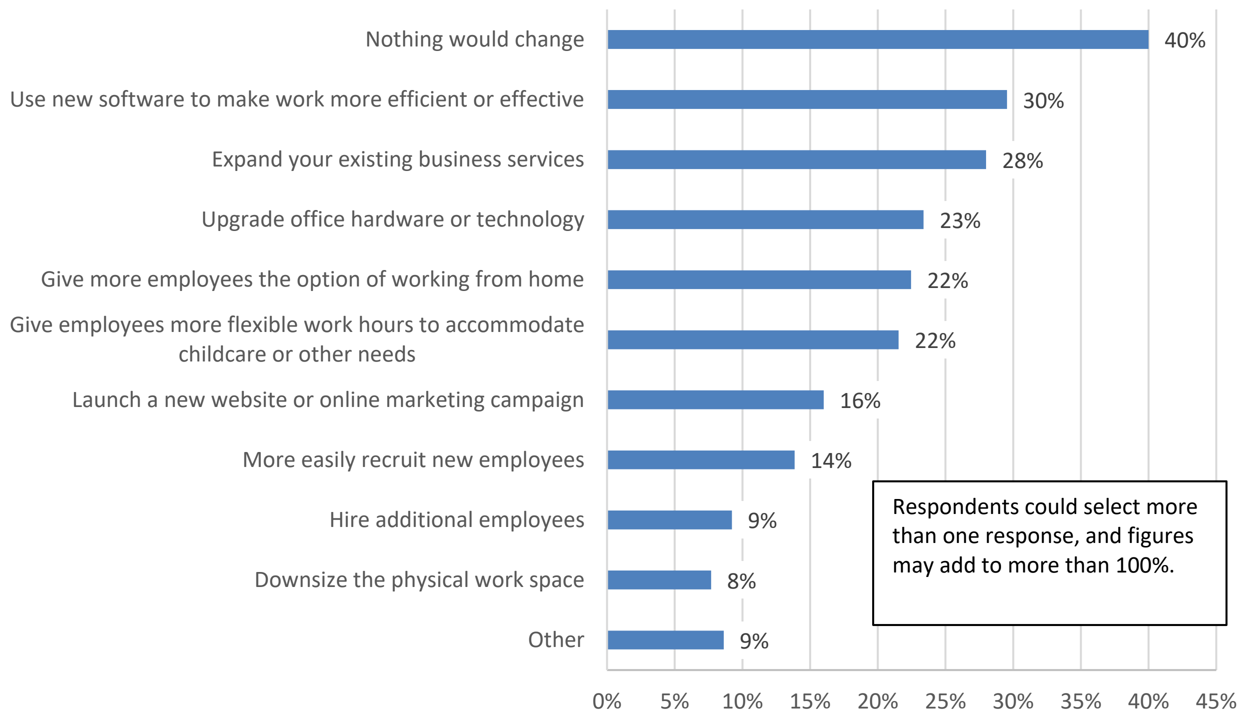
Figure 124: Actions Would Take in Next 12 Months If Able to Get Faster Internet



Four in 10 businesses would use new software to make work more efficient and effective, 35 percent would upgrade office hardware or technology, 31 percent would expand their existing businesses services, and 26 percent would launch a new website or online market campaign.

However, four in 10 businesses said nothing would change if their employees got faster internet service in their home (see Figure 125). Three in 10 would use new software to make work more efficient and effective, 28 percent would expand their existing business services, and 23 percent would upgrade office hardware or technology. More than one-fifth would give more employees the option of working from home (22%) or give employees more flexible work hours to accommodate childcare or other needs (22%).

Figure 125: Actions Would Take in Next 12 Months If Employees Got Faster Internet at Home

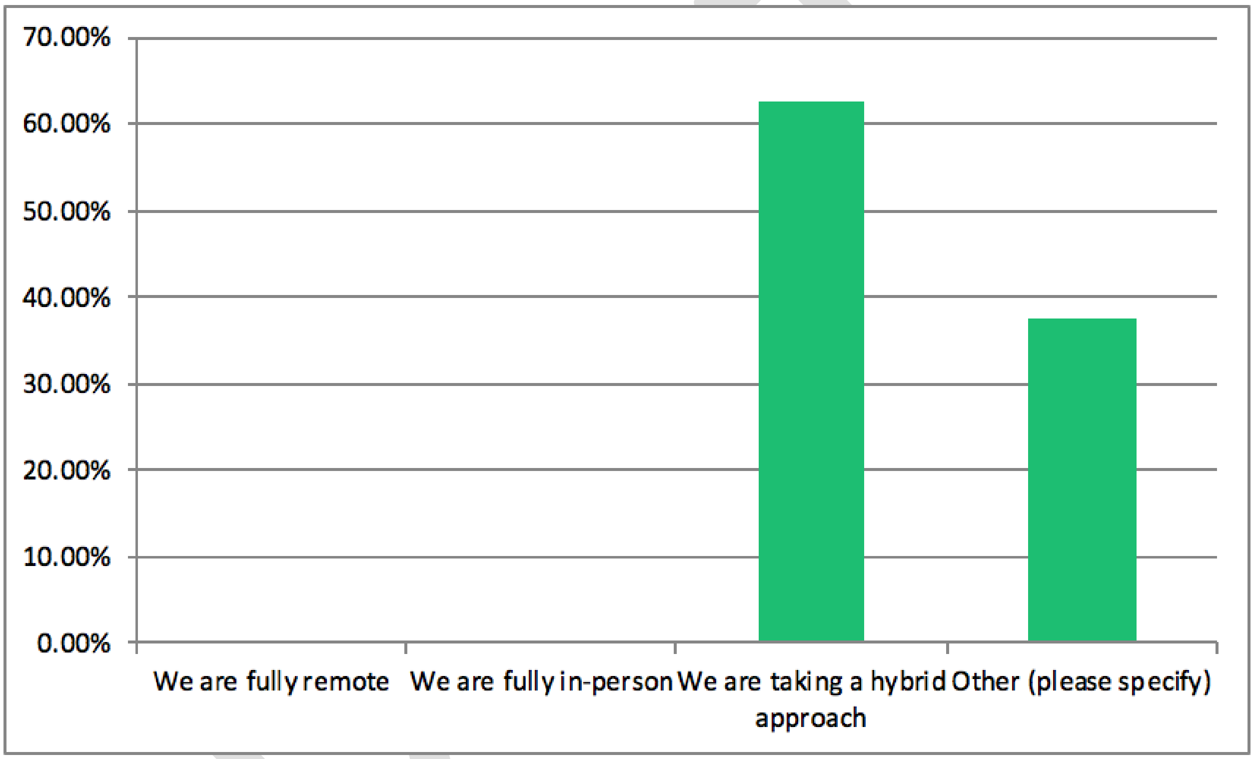


Appendix C: Superintendent Survey Results

This survey was sent to superintendents of school districts across the State of Vermont. Thirty-two superintendents responded.

4. What is your current back-to-school approach that your school district has taken as a result of the Covid-19 pandemic?

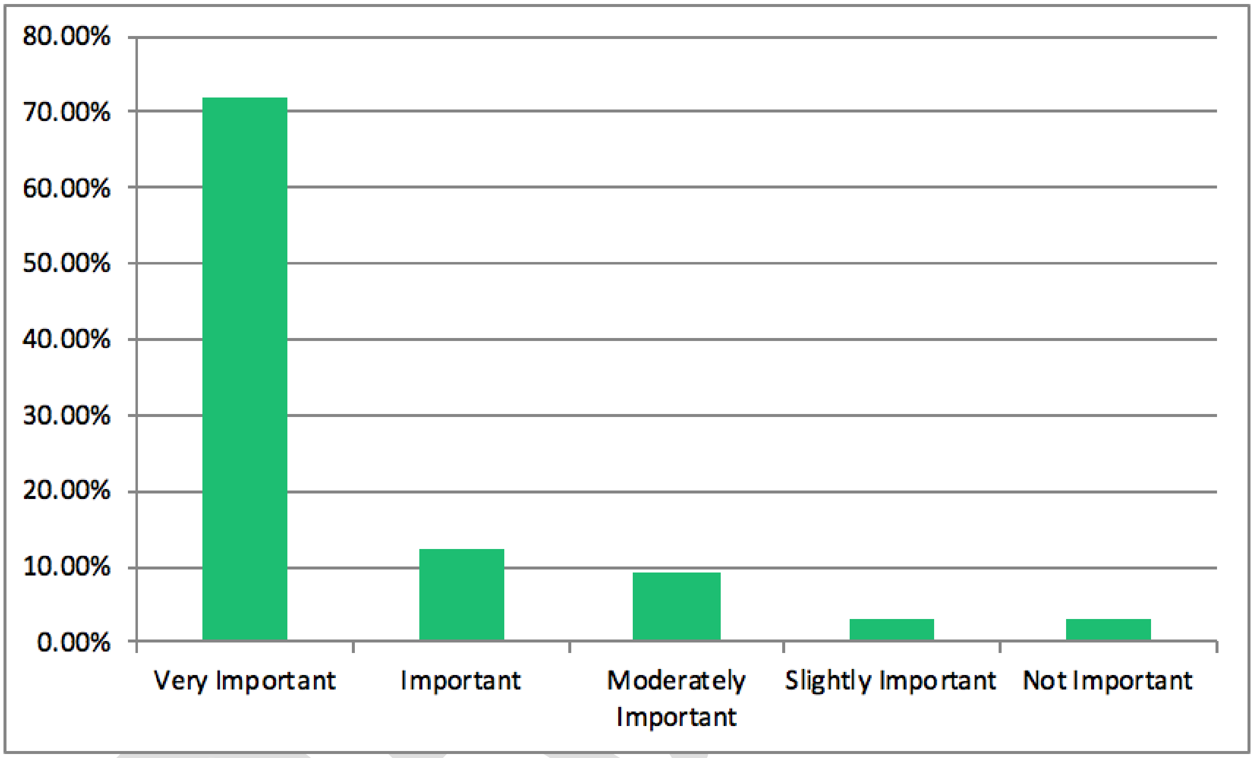
Answered: 32 Skipped: 4



Most respondents who selected "other" stated that their high schools were taking a hybrid approach, and their K-8 students were attending school fully in-person.

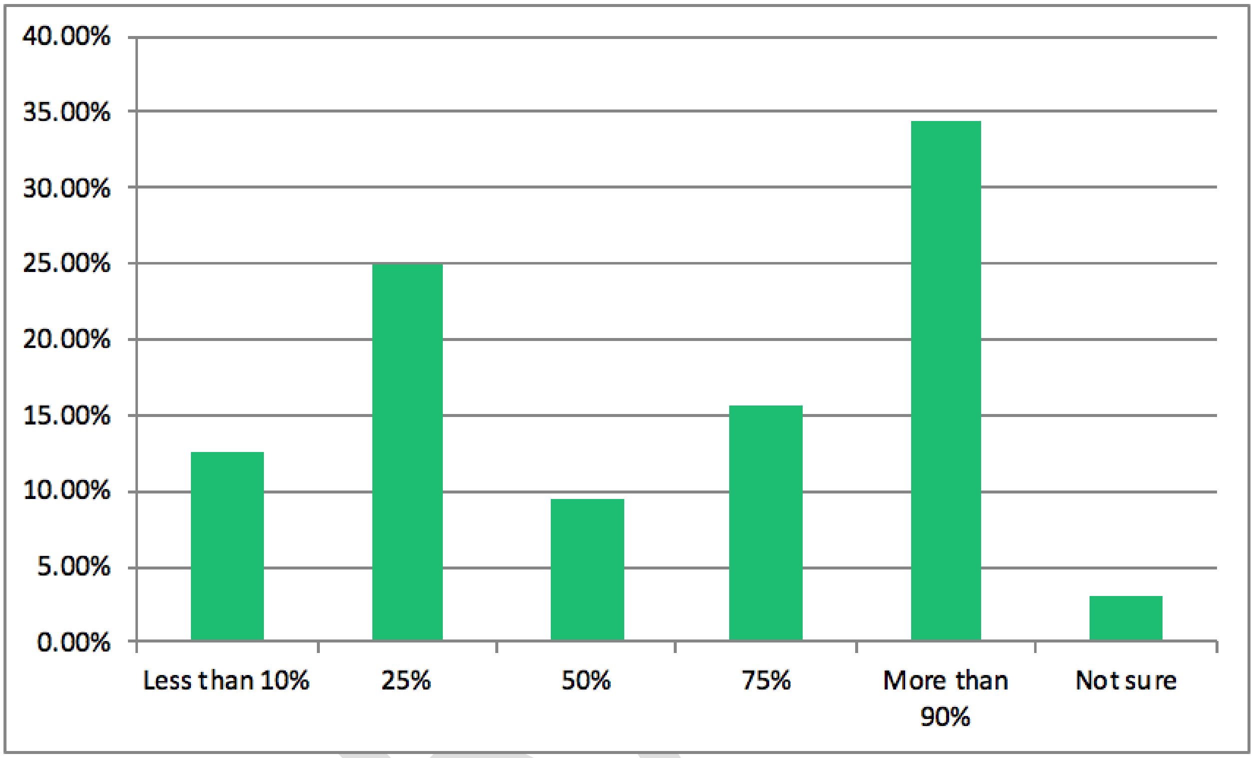
6. How important was your students' and teachers' ability to connect to the internet at home in determining your back-to-school approach to the 2020-2021 school year?

Answered: 32 Skipped: 4



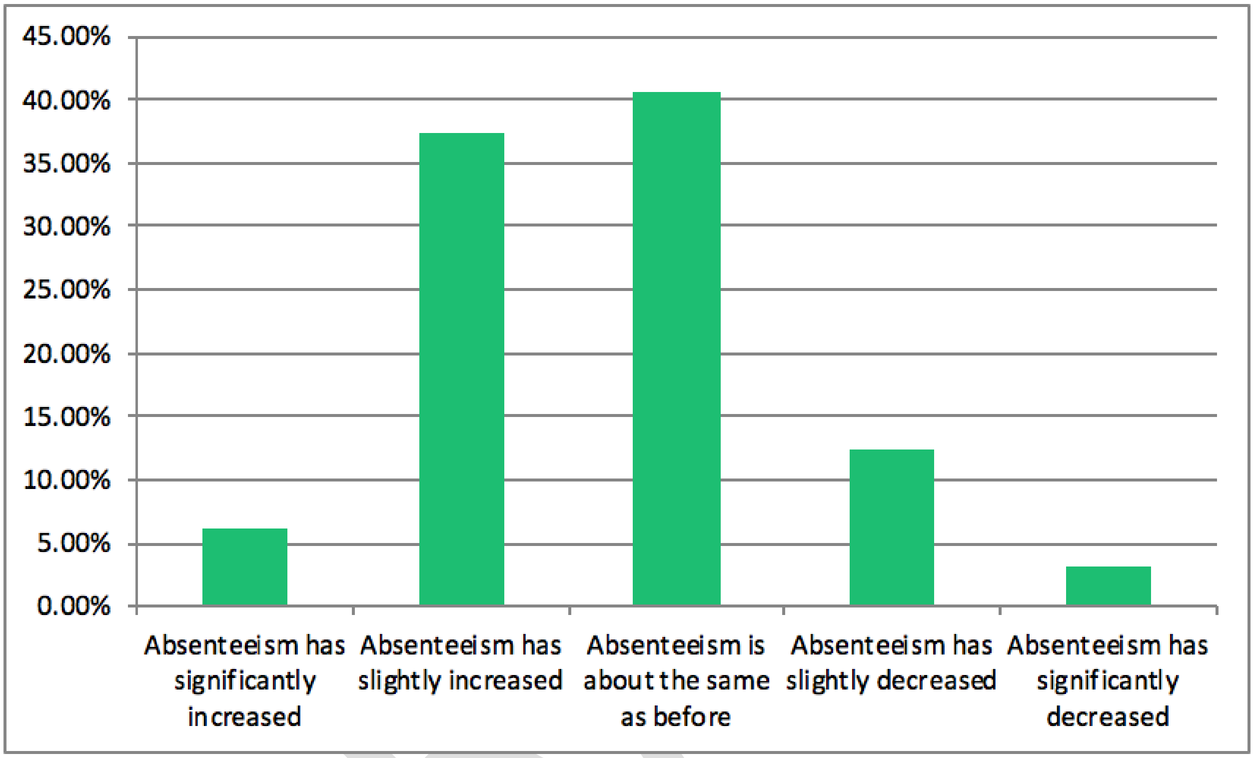
7. What percentage of students are receiving some amount of online instruction within your school district?

Answered: 32 Skipped: 4



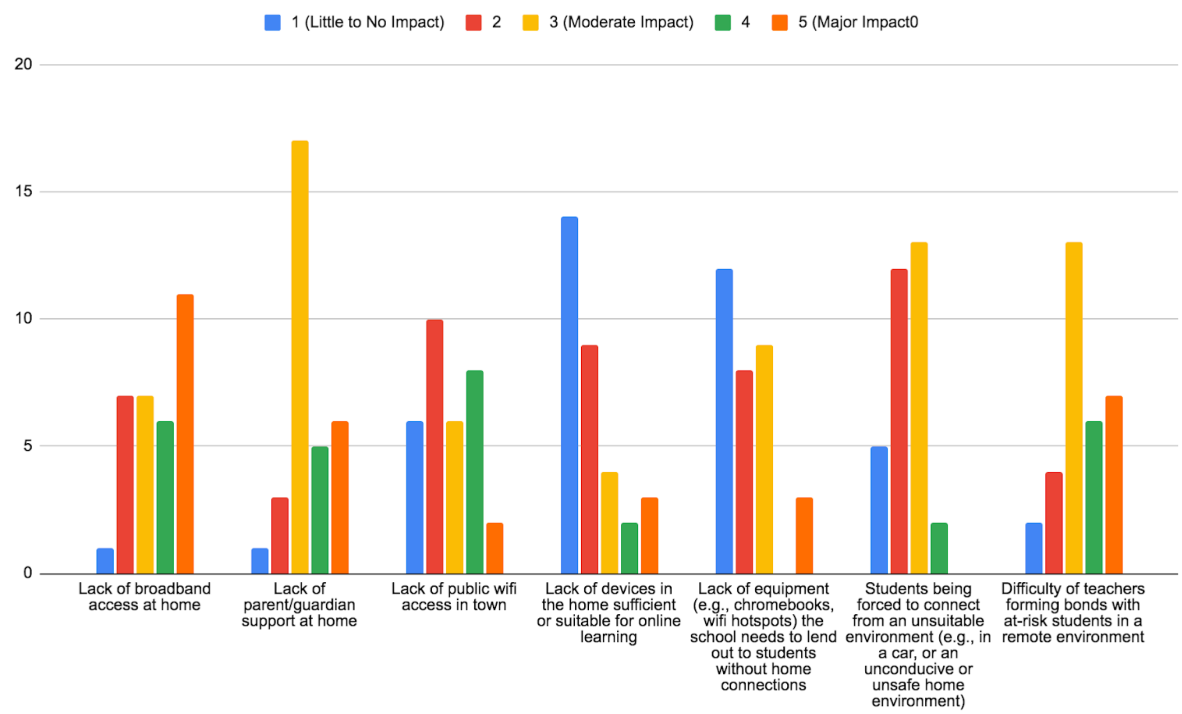
8. For students attending school remotely during the Covid-19 pandemic, has there been an increase or decrease in absenteeism (compared to a typical semester)?

Answered: 32 Skipped: 4



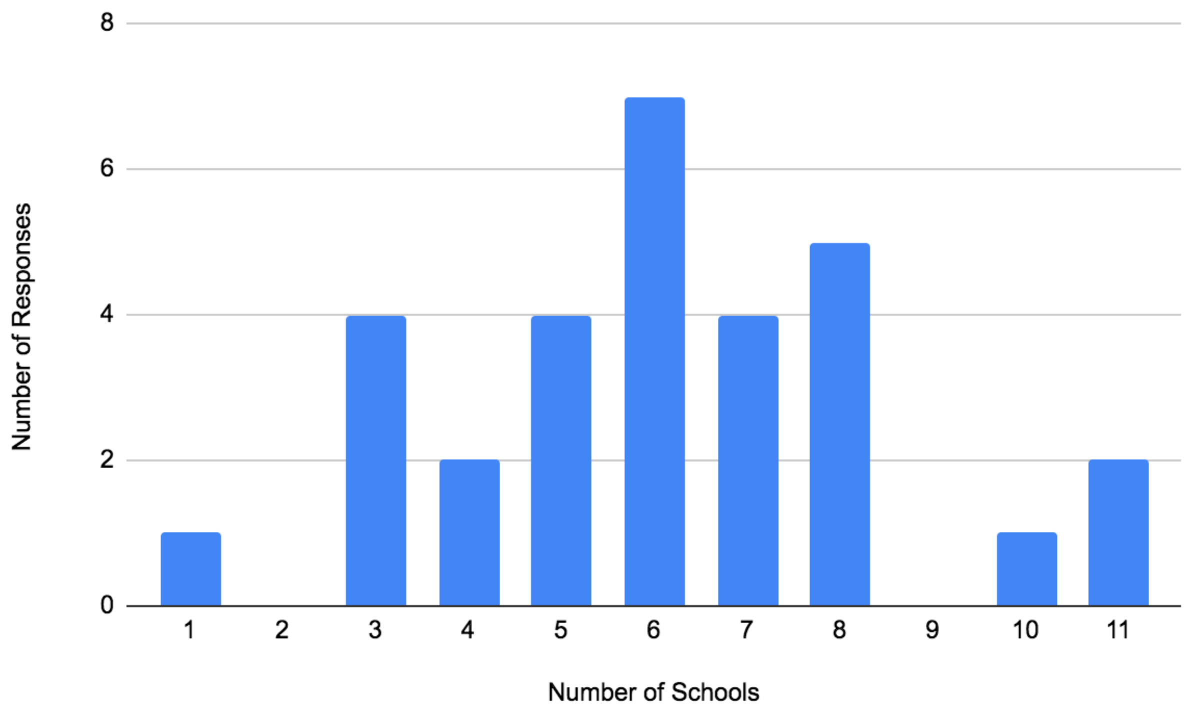
9. On a scale from 1 to 5, please rate the following items and their impact on students' inability to participate in remote learning from home.

Answered: 32 Skipped: 4



10. How many individual schools are there in your district?

Answered: 32 Skipped: 4



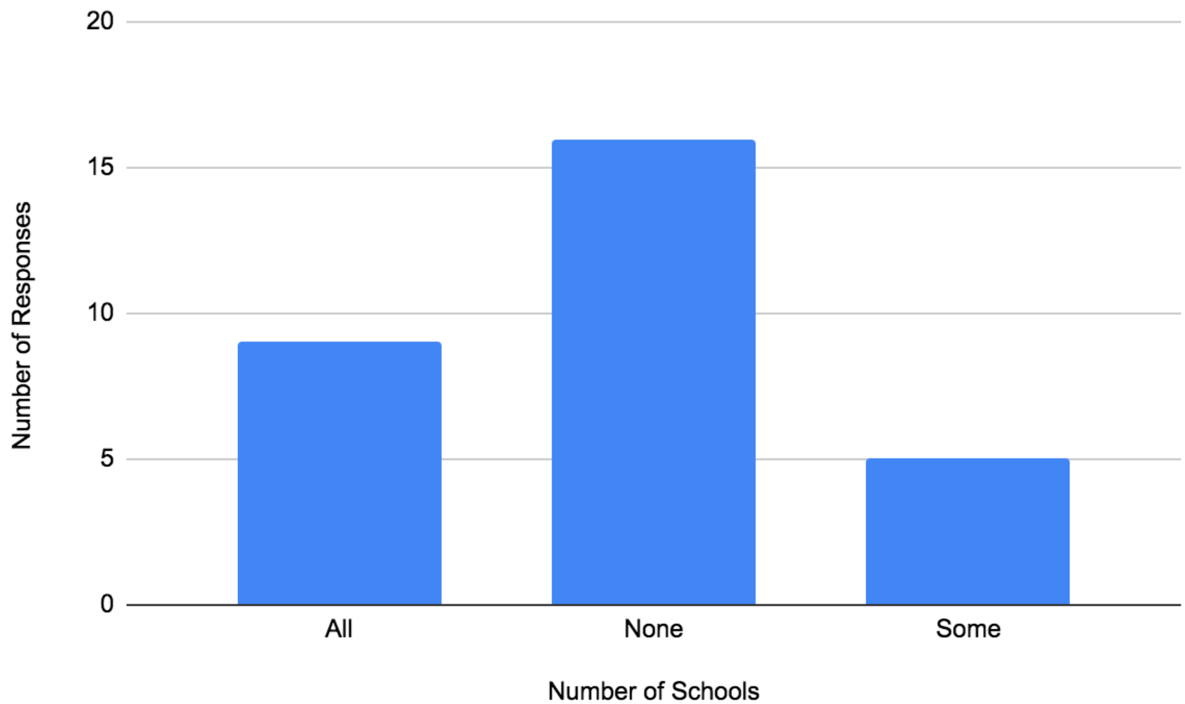
11. DURING the Covid-19 pandemic, how many of the schools in your school district offer wifi in the building to students?

Answered: 32 Skipped: 4

Every respondent answered this question stating that 100% of their schools offer wifi in the building to their students.

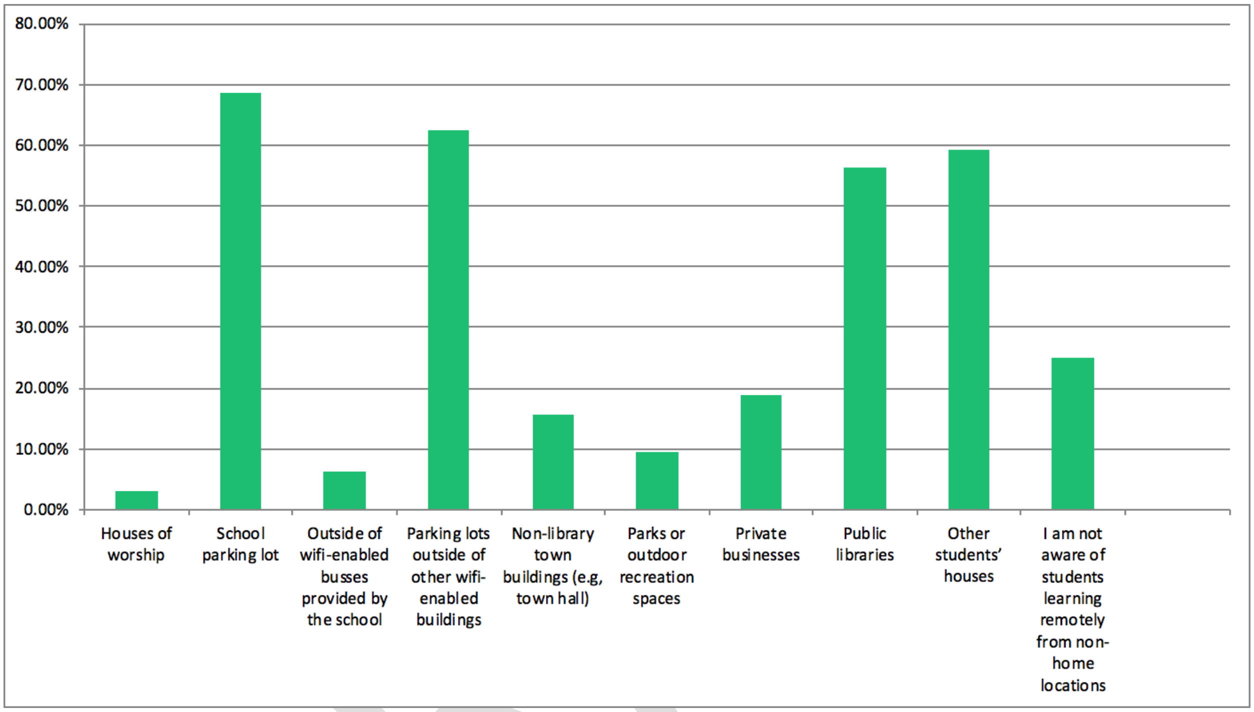
12. How many schools offer expanded hours before and after school to provide students a location with good internet access to do homework?

Answered: 32 Skipped: 4



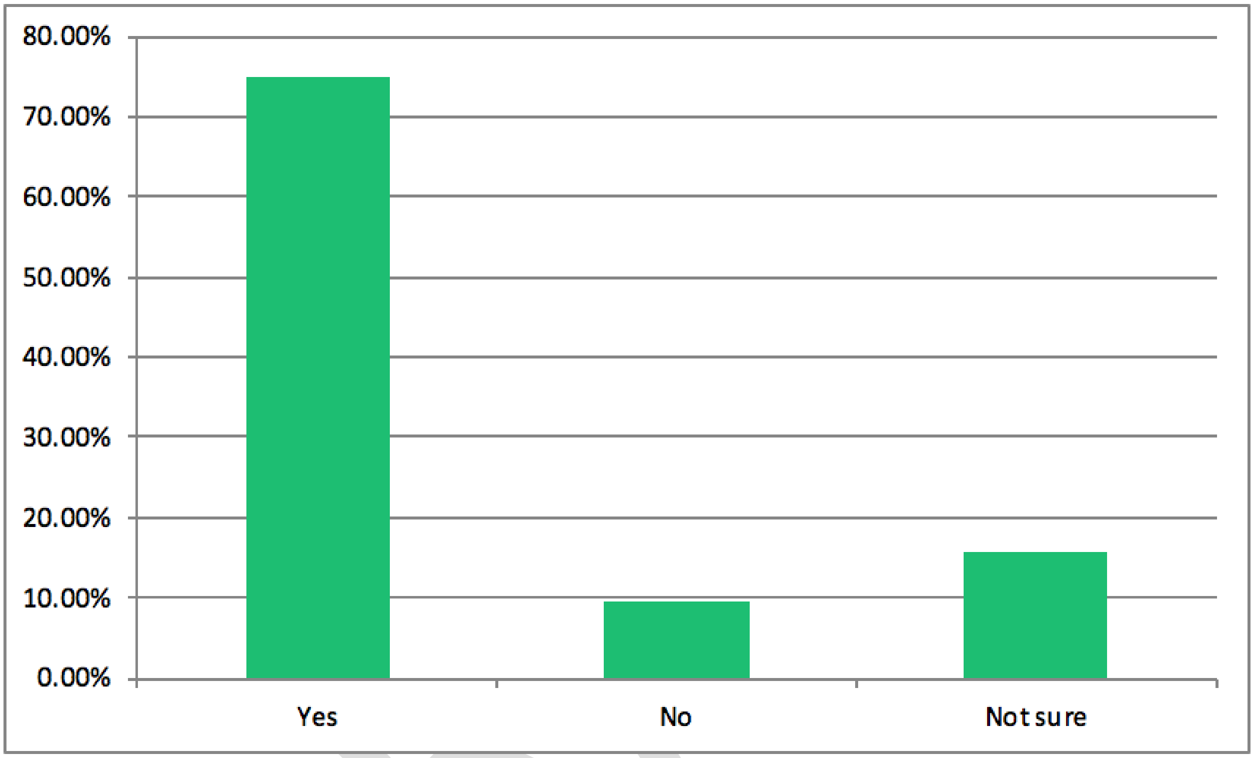
13. During Covid-19, outside of wifi available inside school buildings, where are students learning remotely going to access public wifi (including from parking lots outside these locations). Select all that apply.

Answered: 32 Skipped: 4



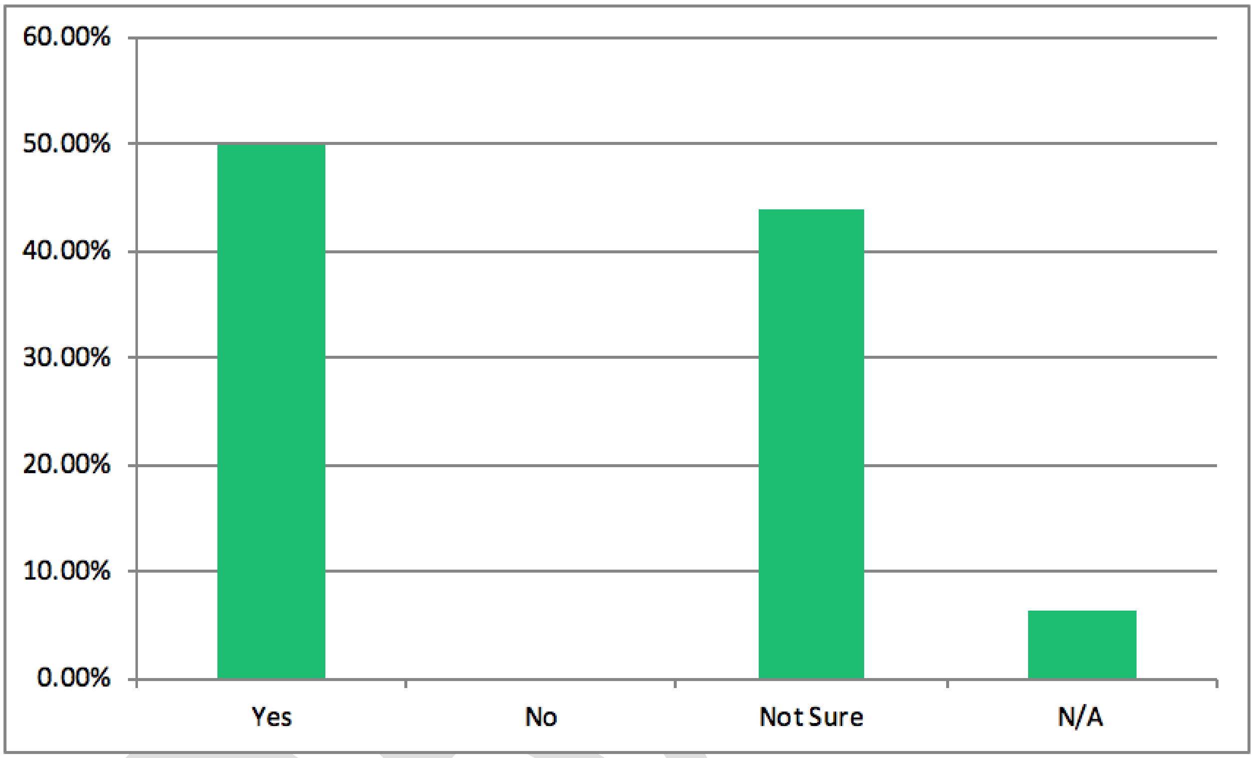
14. Since the start of the Covid-19 pandemic, has your district added equipment to extend or strengthen Wi-Fi signals at school facilities?

Answered: 32 Skipped: 4



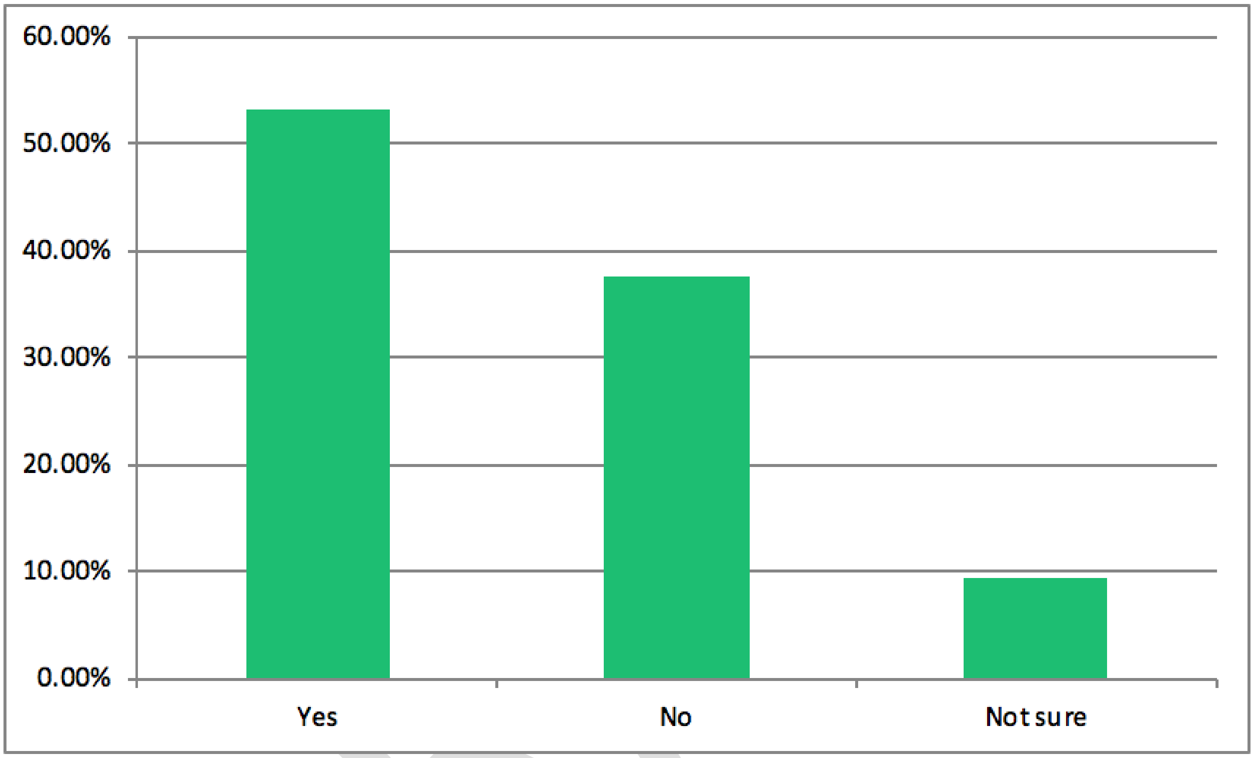
15. If the area around your schools has limited broadband or cell service access, would you be willing to participate in a program to install equipment at the library to provide better cell service or broadband to surrounding homes?

Answered: 32 Skipped: 4



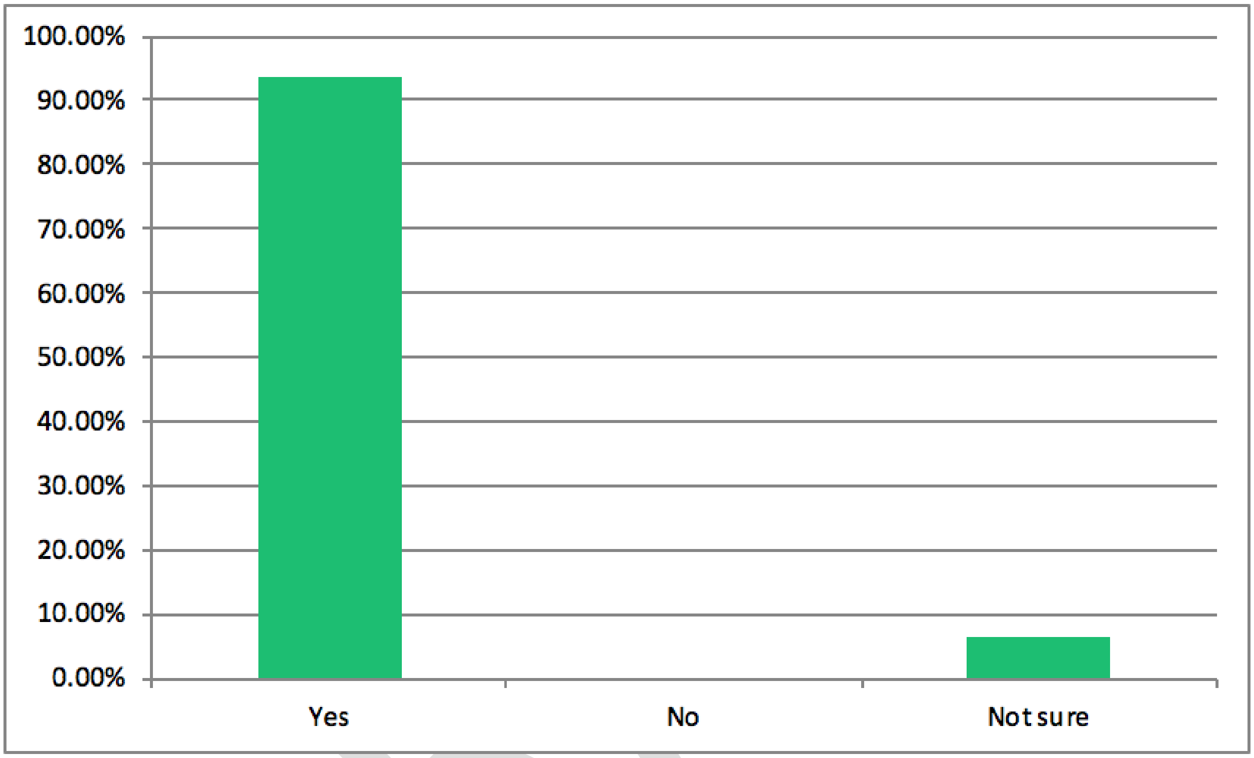
16. Does your school district provide equipment for students to connect to the internet for remote learning? (e.g., portable wifi hotspots)

Answered: 32 Skipped: 4



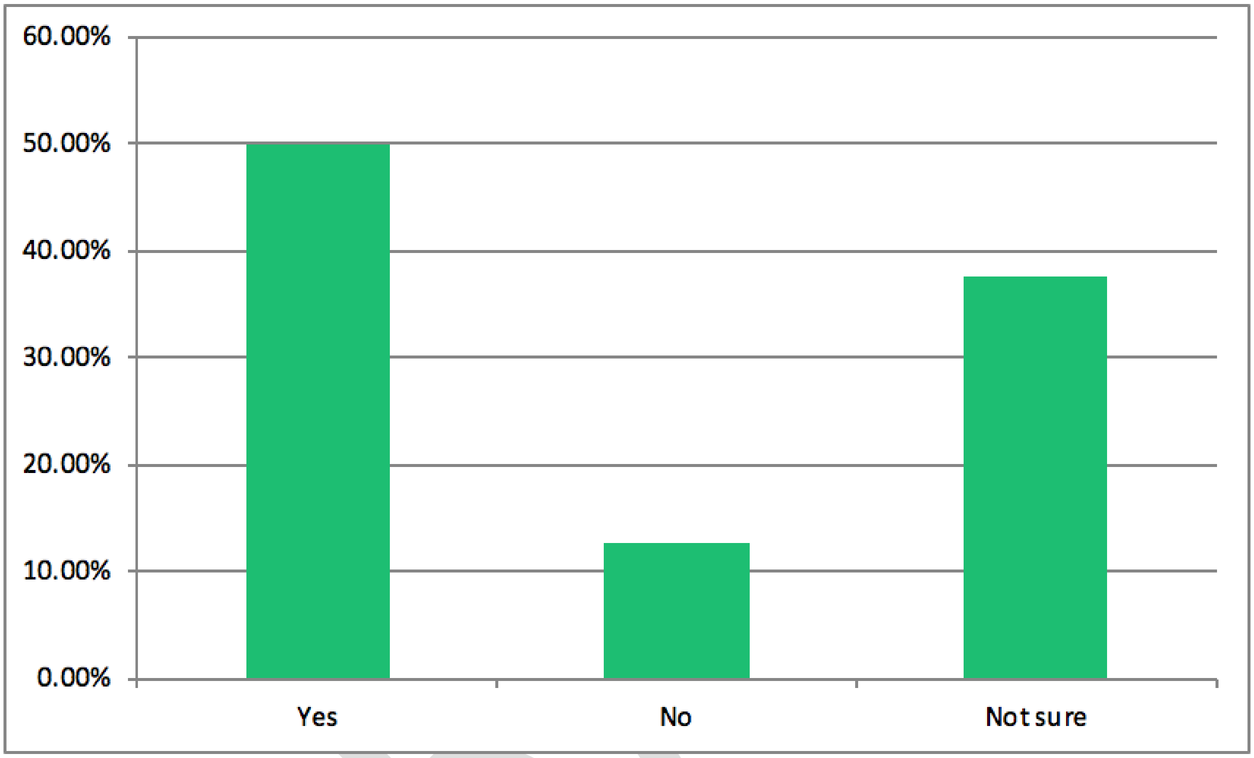
17. Does your school district provide other equipment for students to use for remote learning? (e.g., Chromebooks, earphones, etc.)

Answered: 32 Skipped: 4



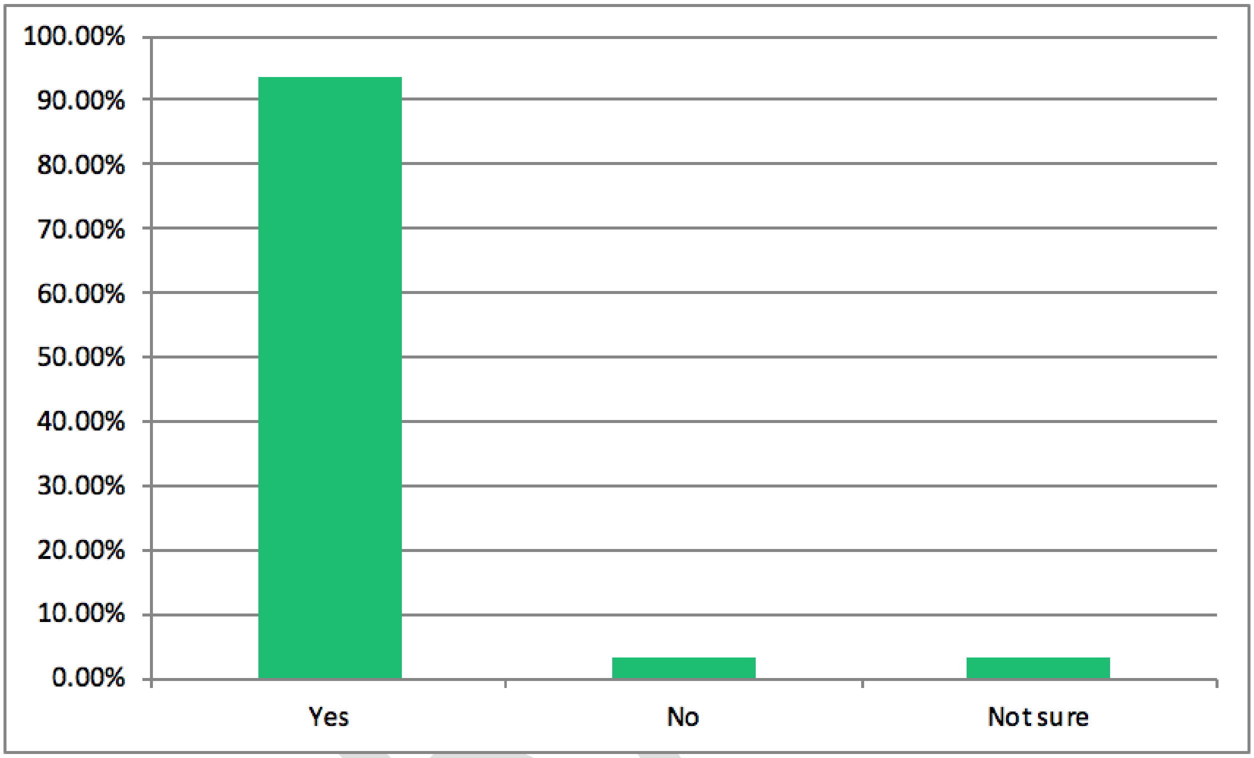
18. Does your school district participate in a subsidy program or promote a program with an Internet Service Provider to bring low-cost internet to low-income families (e.g., Comcast Essentials)?

Answered: 32 Skipped: 4



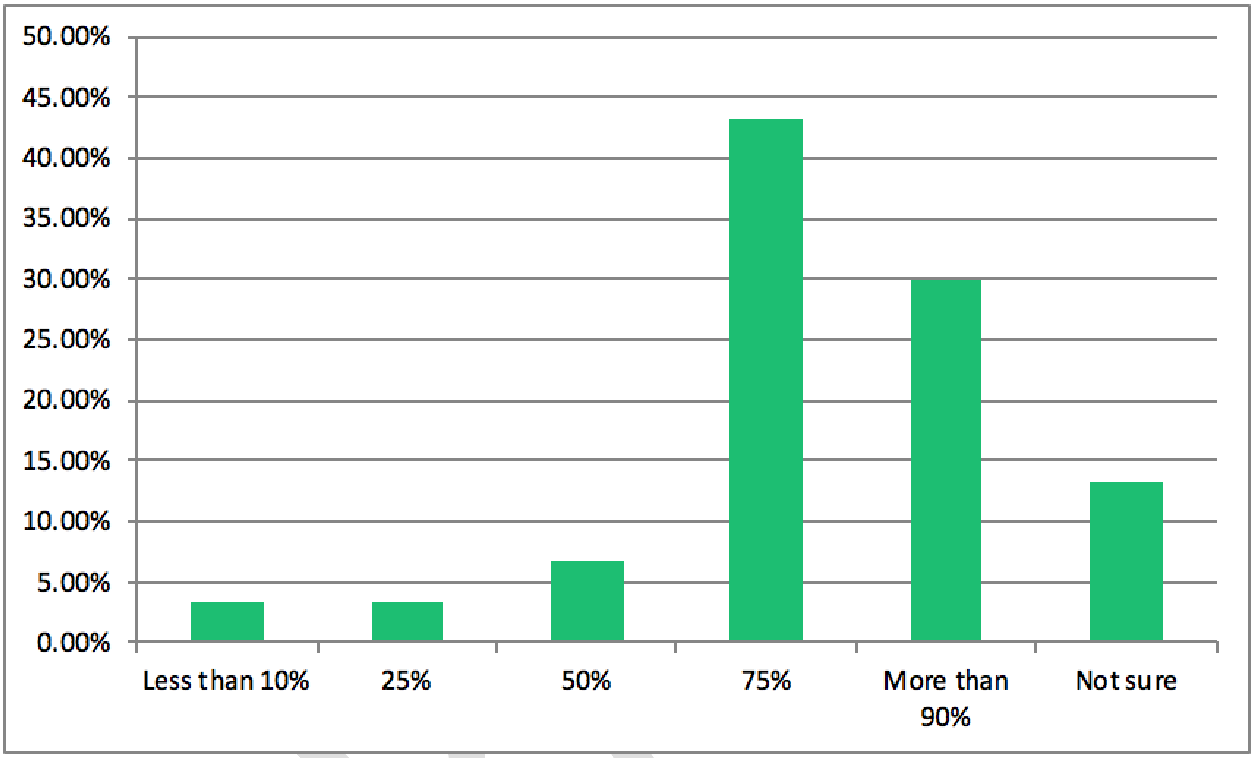
19. Have you surveyed your students to understand who has broadband access at home for remote learning and who doesn't?

Answered: 32 Skipped: 4



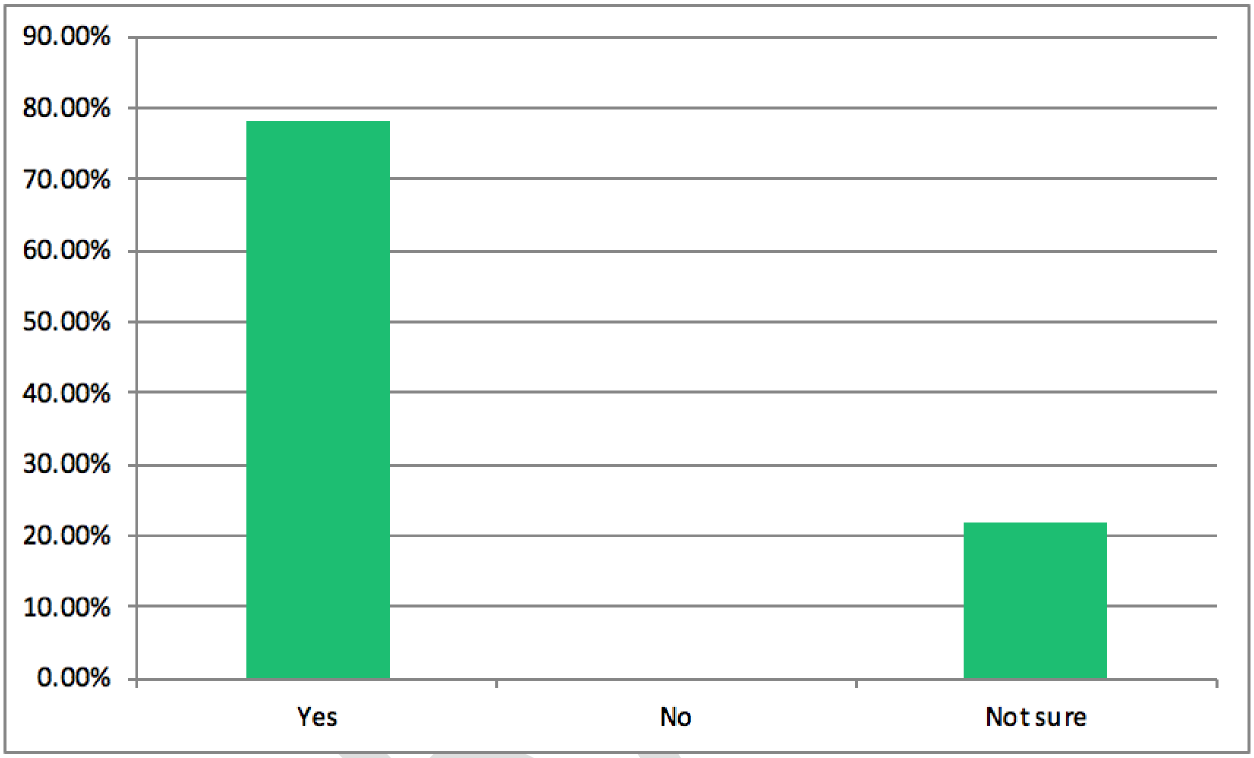
20. If you know, what percent of students have broadband access at home?

Answered: 30 Skipped: 6



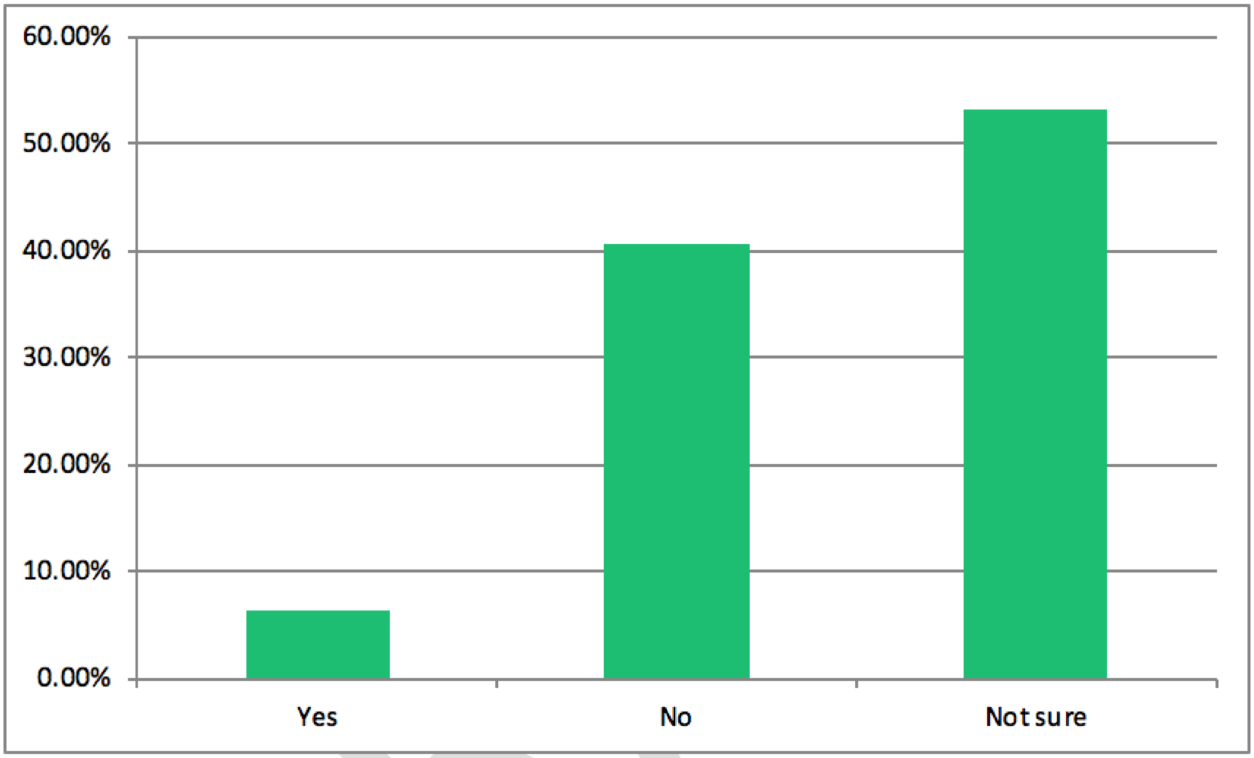
21. Did your school district assist the State of Vermont in finding households with K-12 students without access to broadband as part of a Connectivity Initiative program?

Answered: 32 Skipped: 4



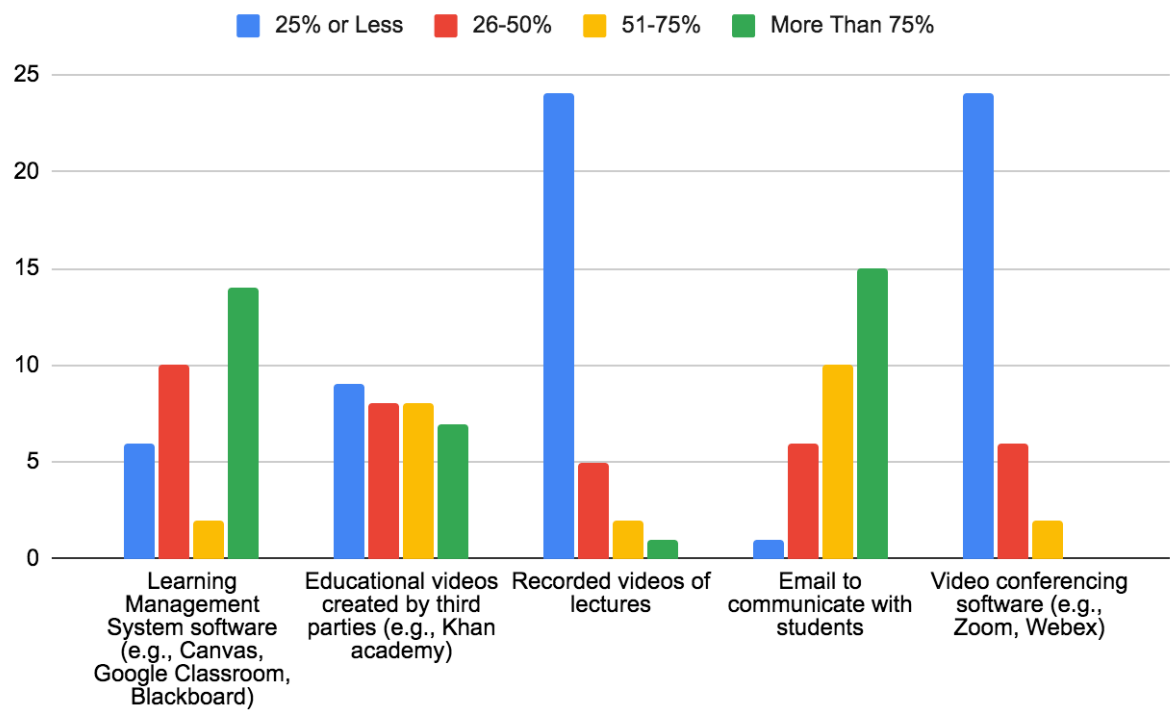
22. To-date, has Vermont's Connectivity Initiative and/or Get Vermonters Connected Now Initiative made a measurable impact in expanding broadband access for students in your district?

Answered: 32 Skipped: 4



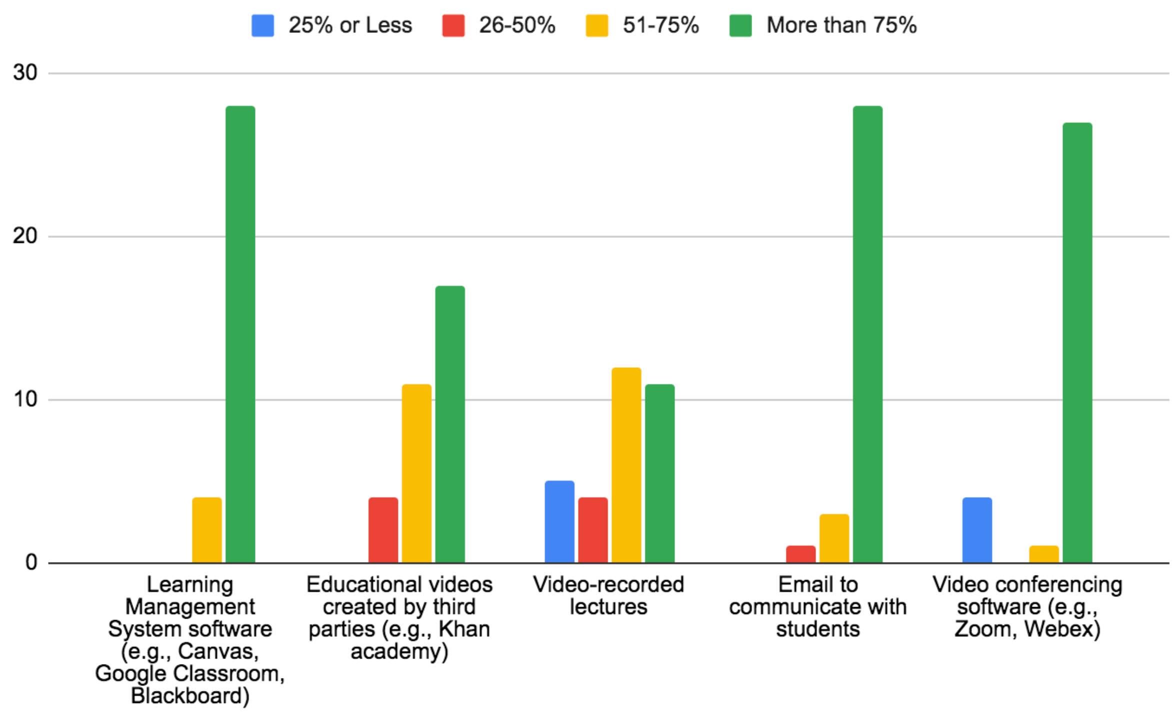
23. BEFORE Covid-19 pandemic, approximately what percent of teachers in your school district used the following tools for teaching?

Answered: 32 Skipped: 4



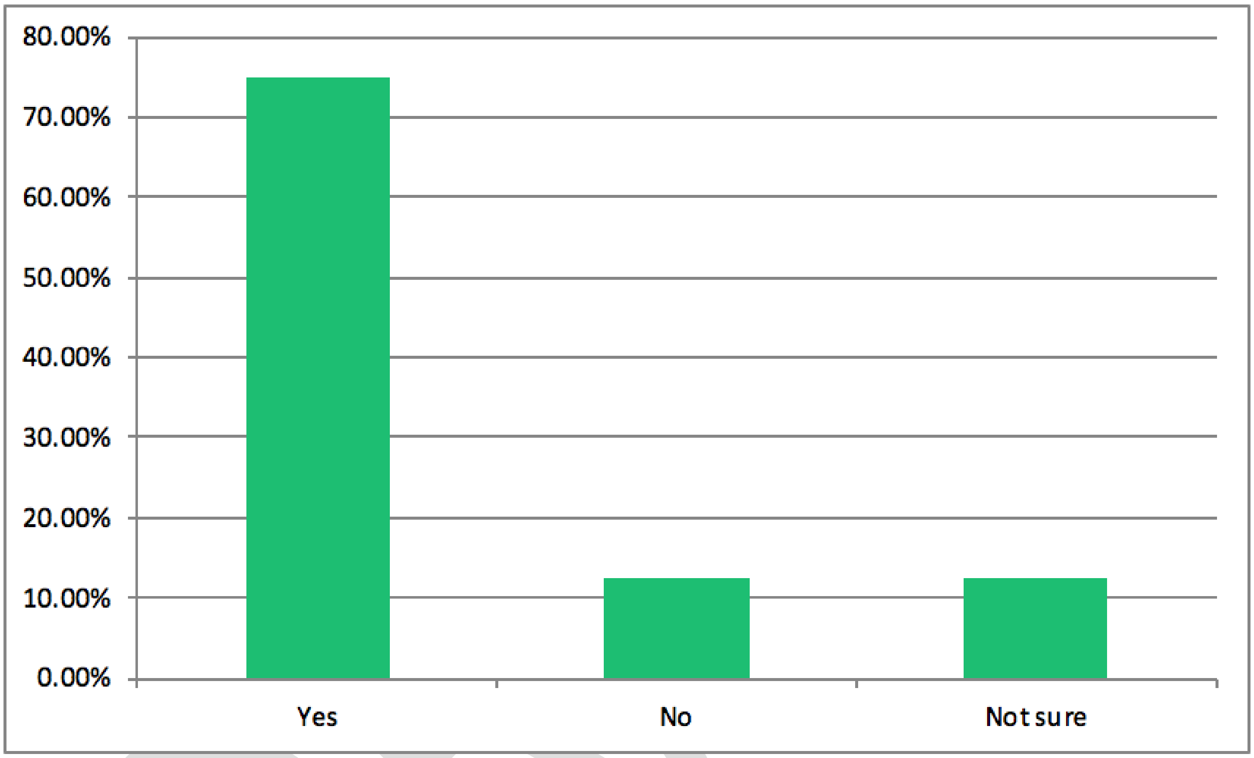
24. DURING the Covid-19 pandemic, approximately what percent of how often did teachers in your school district used the following tools for teaching?

Answered: 32 Skipped: 4



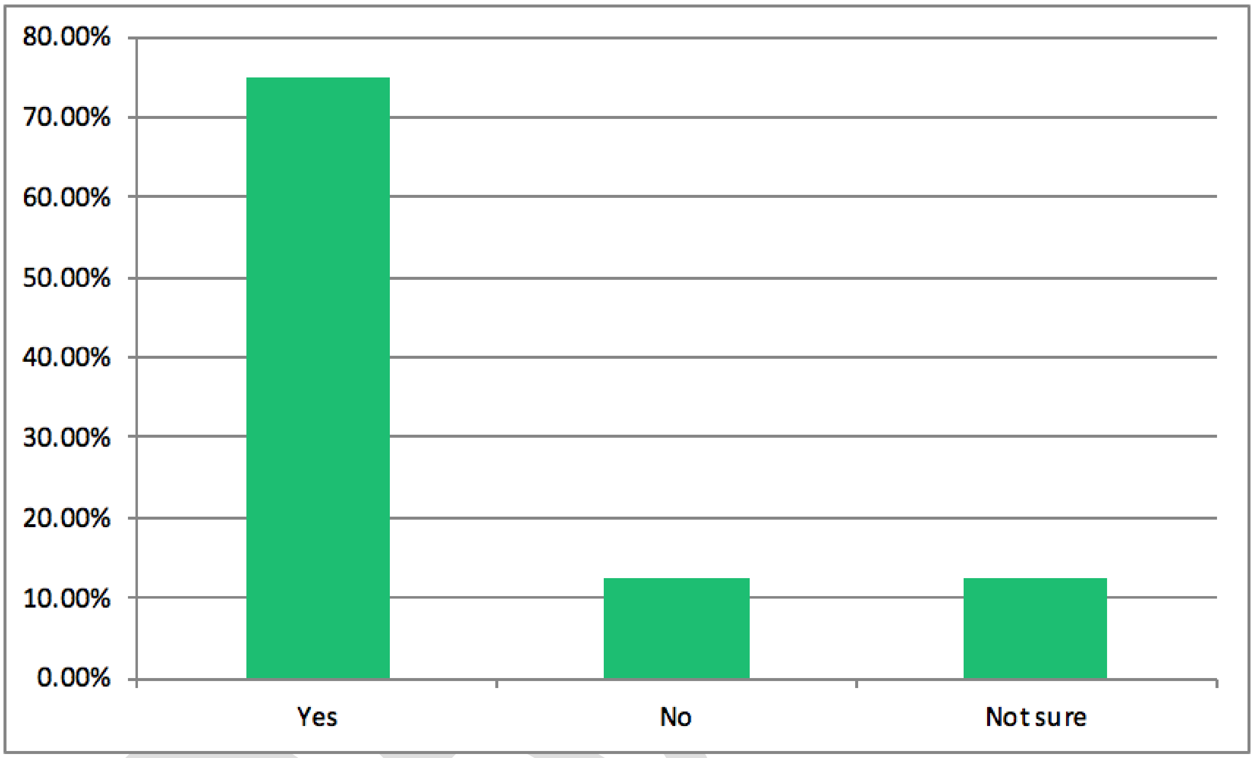
25. DURING the Covid-19 pandemic, have you had increased challenges addressing health or mental health issues faced by students (usually handled in person by a school nurse, counselor, or faculty) through video conferencing?

Answered: 32 Skipped: 4



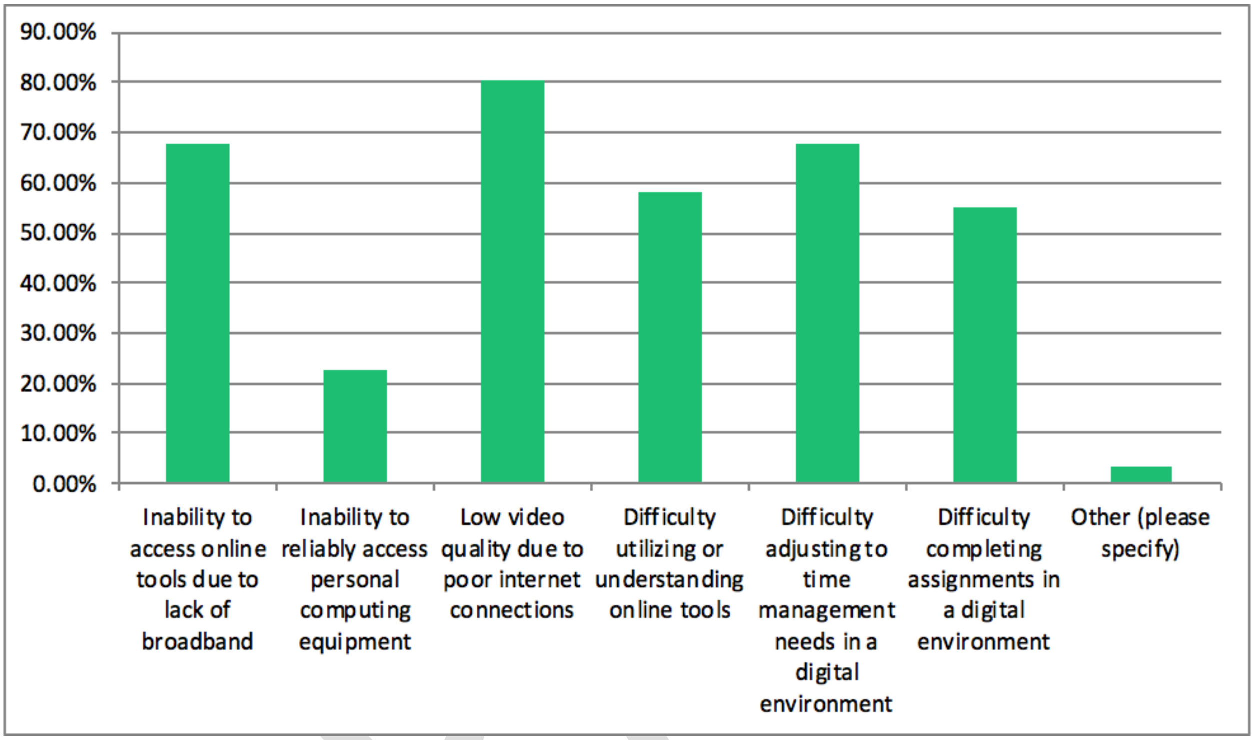
26. If yes, has the increased difficulty in addressing health or mental health challenges been exacerbated by insufficient broadband access leading to difficulty communicating with, empathizing with, or establishing connections with students?

Answered: 24 Skipped: 12



27. DURING the Covid-19 pandemic, which of the following challenges have teachers in your school district faced with regards to online learning? Select all that apply.

Answered: 31 Skipped: 5



28. Are there any groups of students that have faced particular challenges with remote learning during the Covid-19 pandemic?

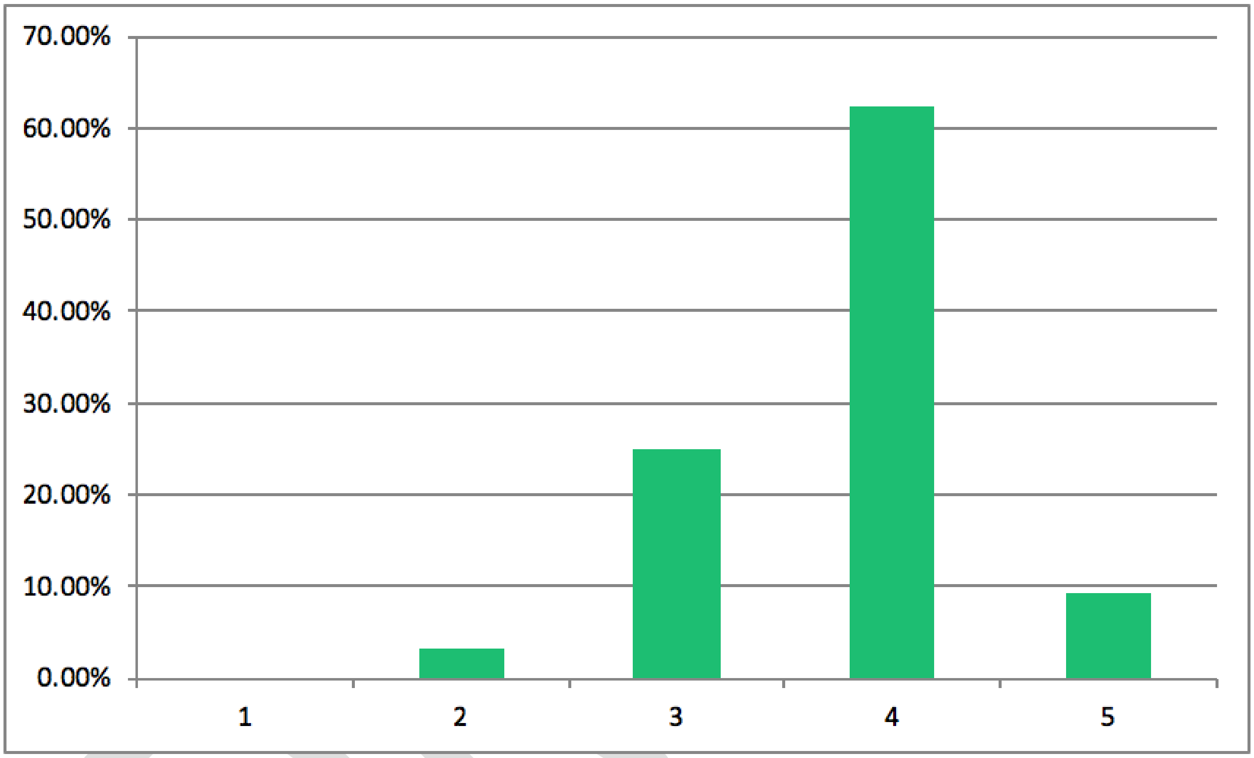
Answered: 30 Skipped: 6

Responses fell into these general categories:

- Rural students
- Students of color
- Students at risk of dropping out of school
- Students living in poverty
- Students who need access to reduced-price lunches
- Students with disabilities
- Young children
- Students without adult support at home
- ELL students
- Students without internet access

29. If an outbreak of Covid-19 forced your school district to immediately switch to fully remote learning for a period of time, do you feel like you have access to all possible short-term telecommunications resources, tools, programs, or equipment you would need in order to make this switch as effectively as possible? Answer on a scale of 1-5, where 5 is extremely prepared and 1 is not prepared at all

Answered: 32 Skipped: 4



30. What additional telecommunications-related resources would be useful to your school district to facilitate online learning and/or make an immediate shift to fully remote learning during the Covid-19 pandemic?

Answered: 26 Skipped: 10

Most respondents shared the following answers:

- High-speed internet access for 100% of students
- Additional hotspots

31. Is there anything else we should know about how the State can assist school districts with regards to telecommunications policies, programs, equipment, or resources, during the pandemic?

Answered: 21 Skipped: 15

All the respondents who answered stated that ensuring all students have access to high-speed internet would be the most helpful.

32. What were some of the learnings you applied during the 2020-2021 that you learned from having to switch to remote learning in Spring 2020?

Answered: 21 Skipped: 15

Respondents had a wide range of answers, including the following:

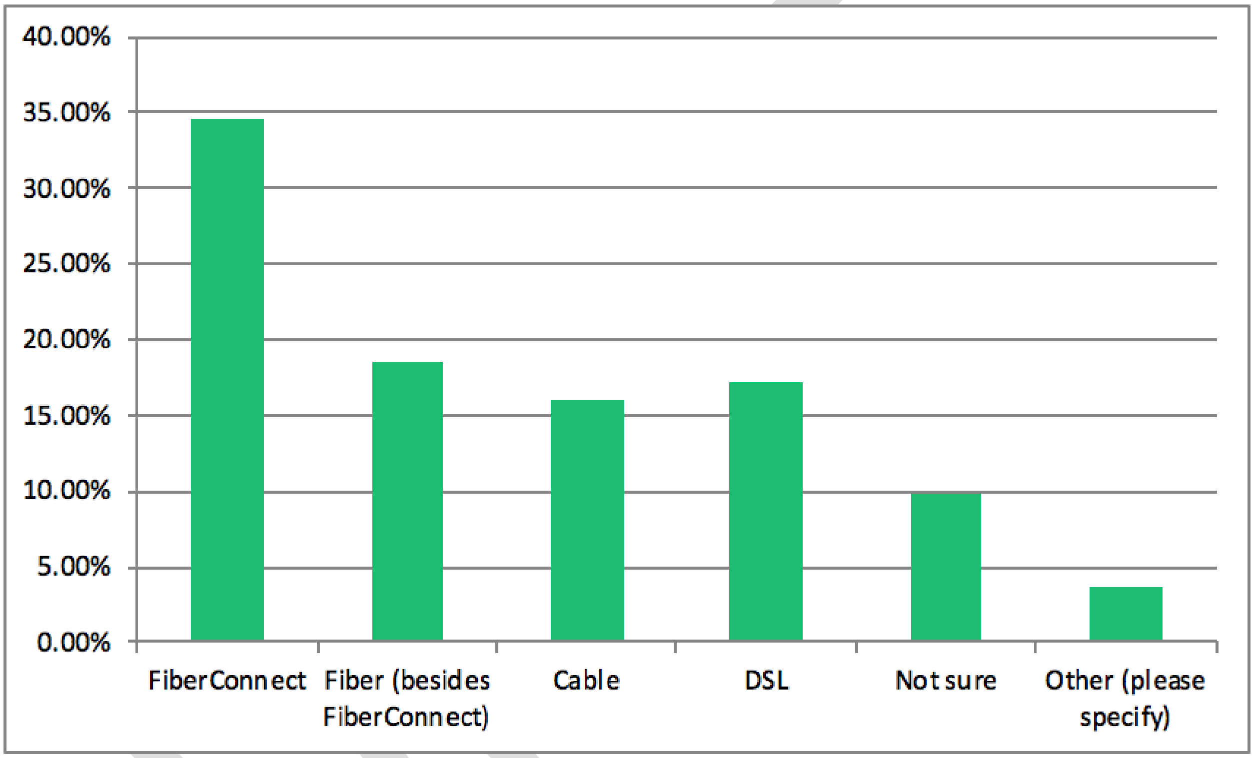
- “Not to recreate everything that was being done in in-person instruction remotely”
- “Greater knowledge of online resources.”
- “We have shifted our hybrid model to sending students home with learning application materials because we could not guarantee access to zoom for all our families.”
- “Breaks from screens need to be explicitly build into the day”
- “Increased use of zoom and more appropriate assignments”

Appendix D: Librarian Survey Results

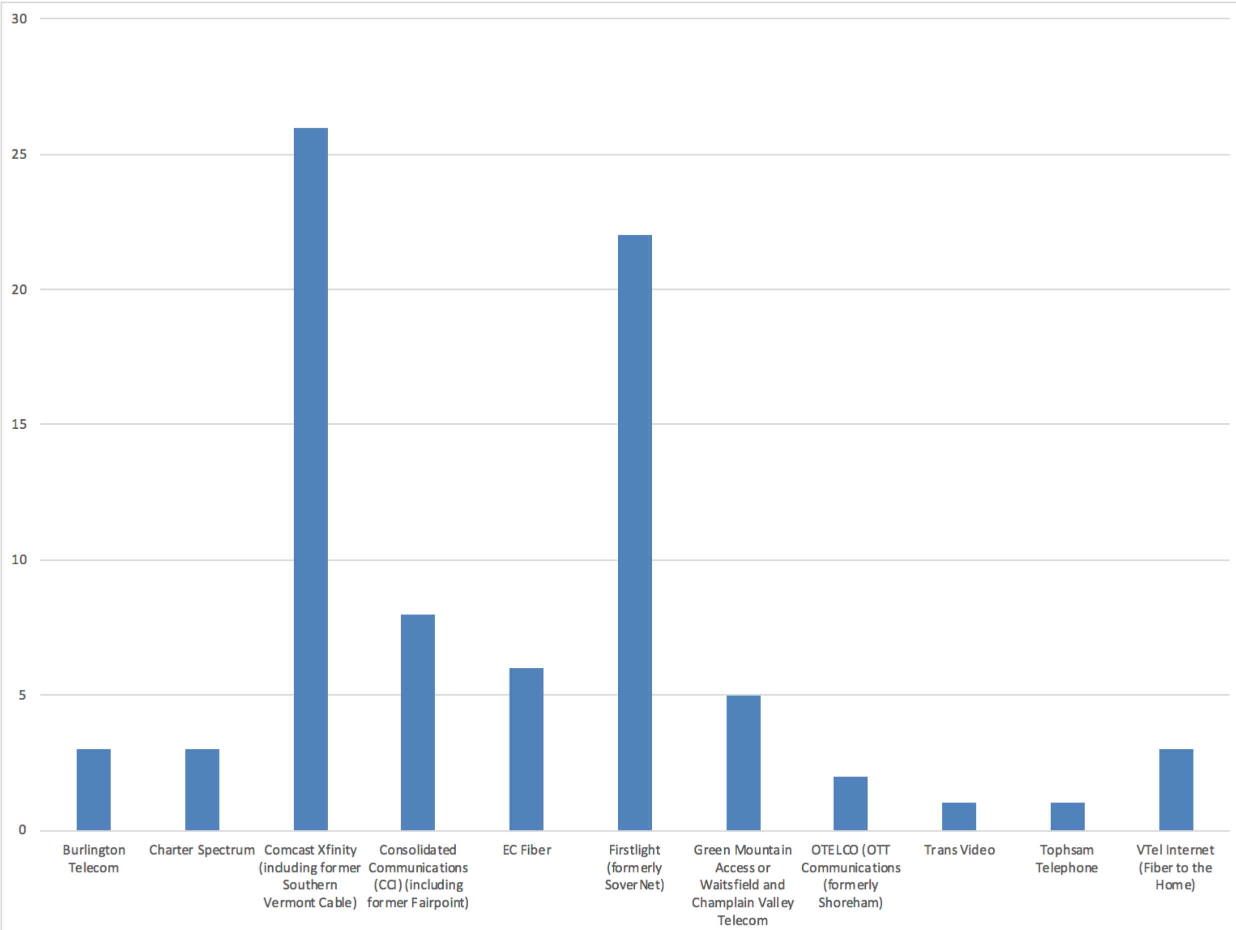
This survey was sent to librarians across the State of Vermont. Eighty-two librarians responded.

1. **Which library do you represent?**
   Answered: 82 Skipped: 0

2. **What kind of internet connection does your library have?**
   Answered: 81 Skipped: 1

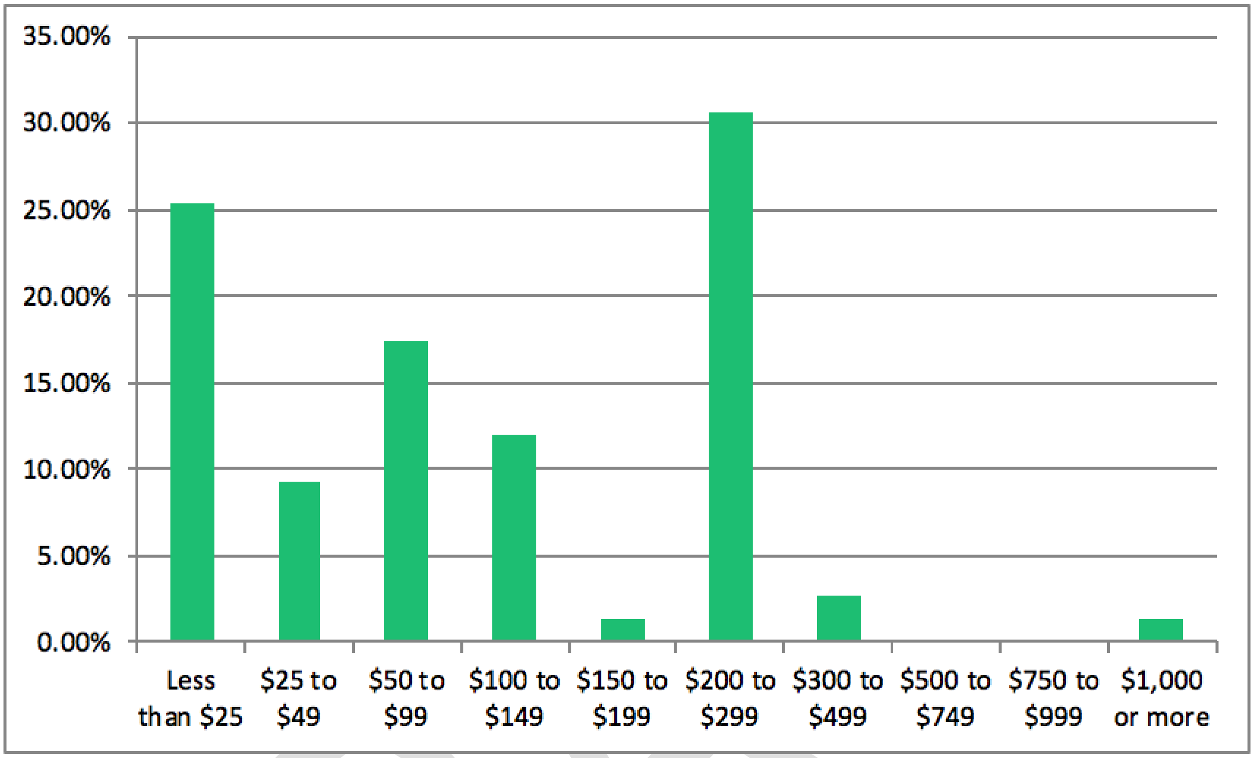


3. Which company is your library's internet service provider?
Answered: 80 Skipped: 2



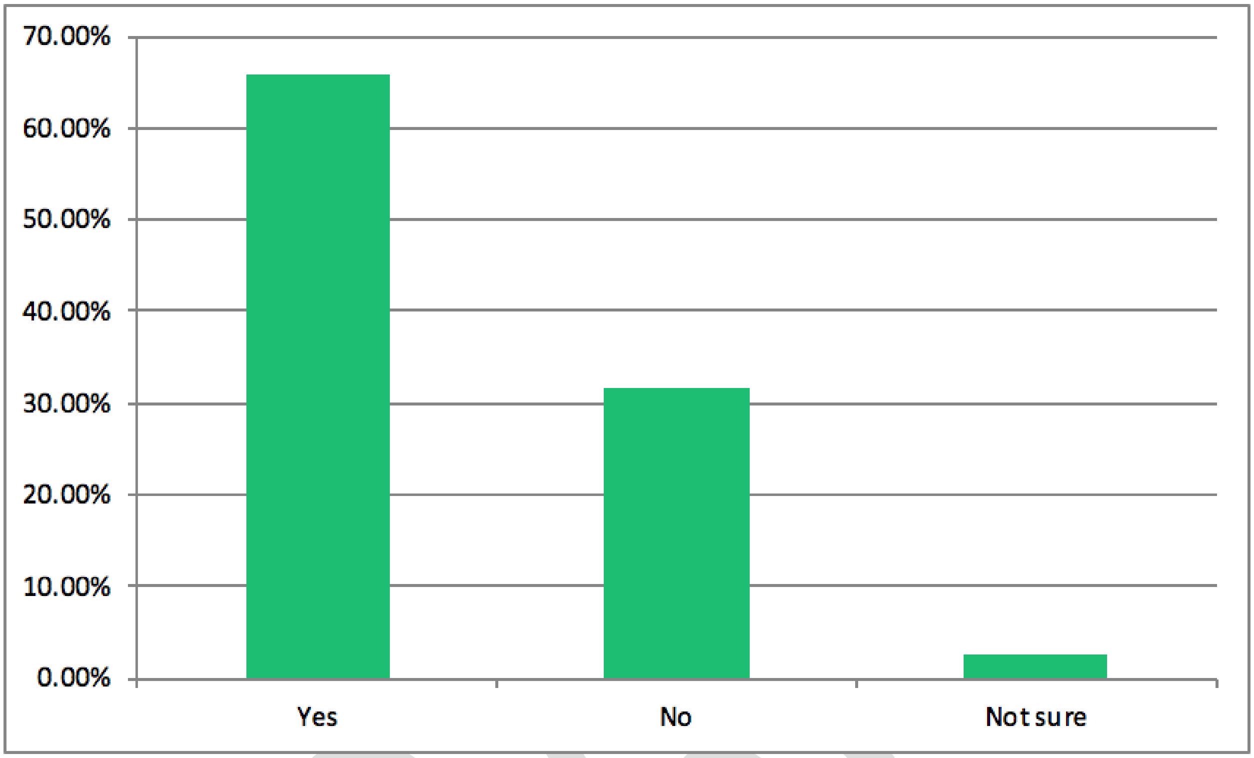
4. Approximately how much do you pay PER MONTH for internet service at your primary location?

Answered: 75 Skipped: 7

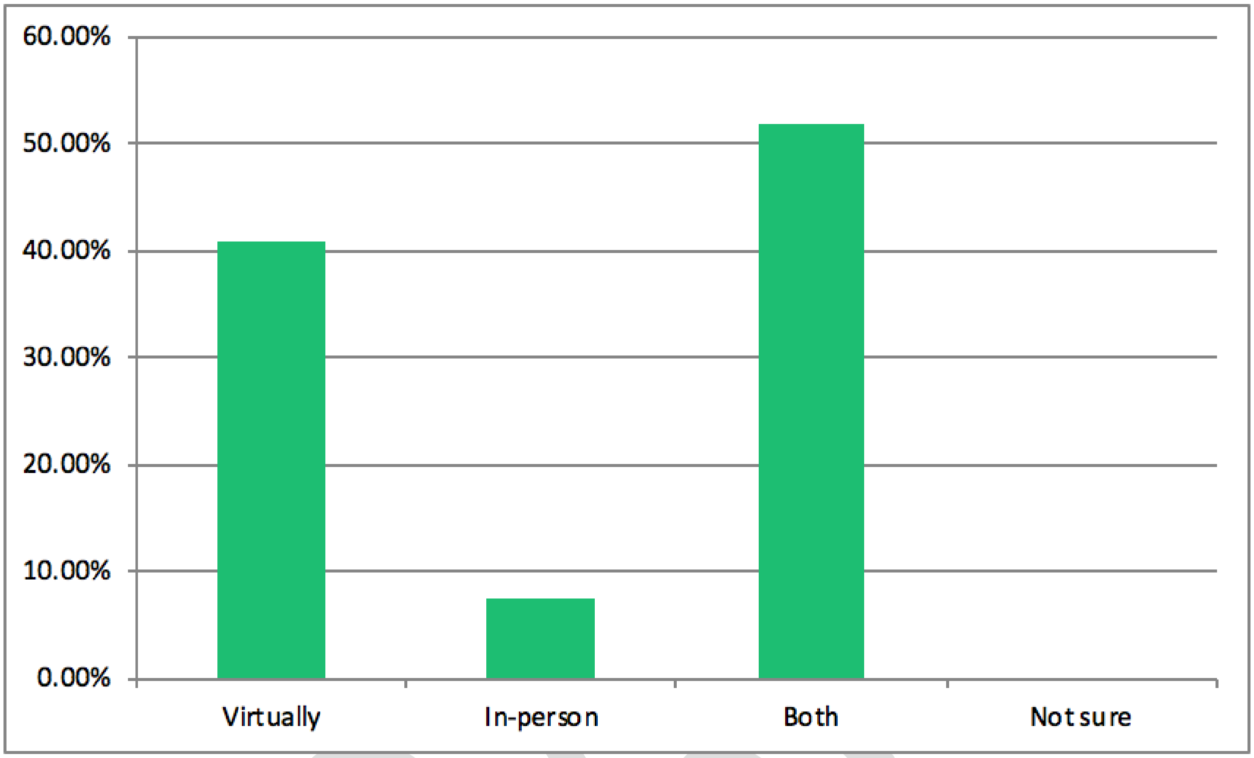


5. What is the current status of your library building?
Answered: 82 Skipped: 0

6. Is your library providing programming/training for the general public at this time?
Answered: 82 Skipped: 0

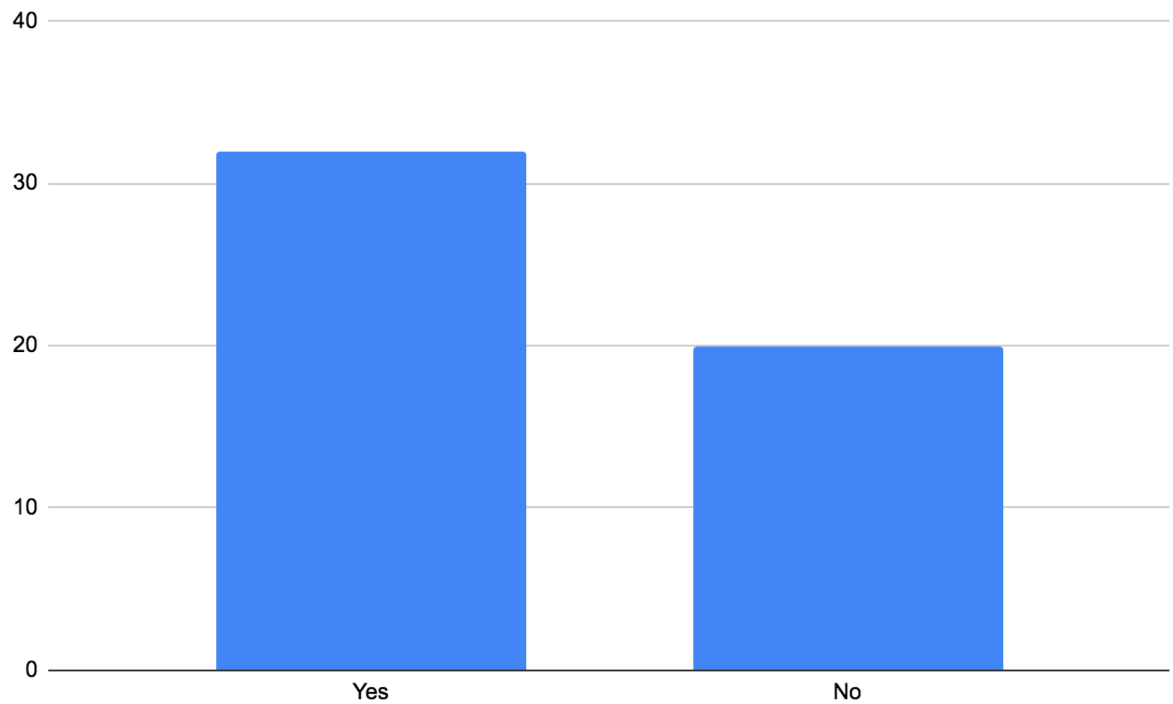


7. Is that programming available virtually, in-person, or both?
Answered: 54 Skipped: 28



8. Has your library created or provided programming as a direct response to community needs or community demand during the pandemic?

Answered: 52 Skipped: 30



9. If so, please briefly describe the programs here

Answered: 37 Skipped: 45

Respondents highlighted a variety of programs serving children, families, and seniors including:

- Virtual book clubs
- Virtual or outdoor storytimes
- Trainings for digital services
- Homeschooling supports
- Zoom classes/clubs for activities such as knitting, mushroom foraging, cooking, etc.
- Take-home craft kits and book

10. What other programming (in-person or virtual) is your library offering?

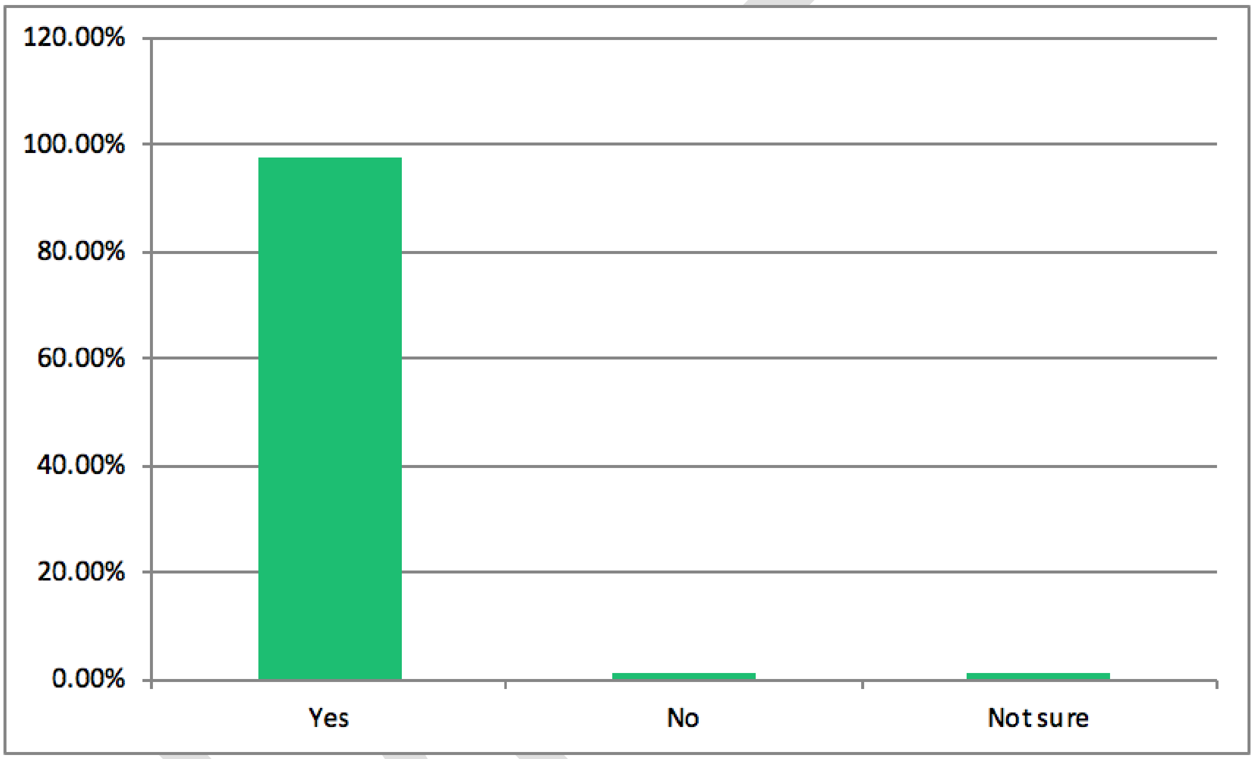
Answered: 45 Skipped: 37

Respondents highlighted a variety of programs serving children, families, and seniors including:

- Storytimes
- Lecture series

- Book groups
- Classes in yoga, cooking, etc.
- Naturalist programs
- Craft kits
- Socially-distant Halloween parties
- D&D
- Trivia

11. Do you offer Wi-Fi outside the building?
Answered: 82 Skipped: 0



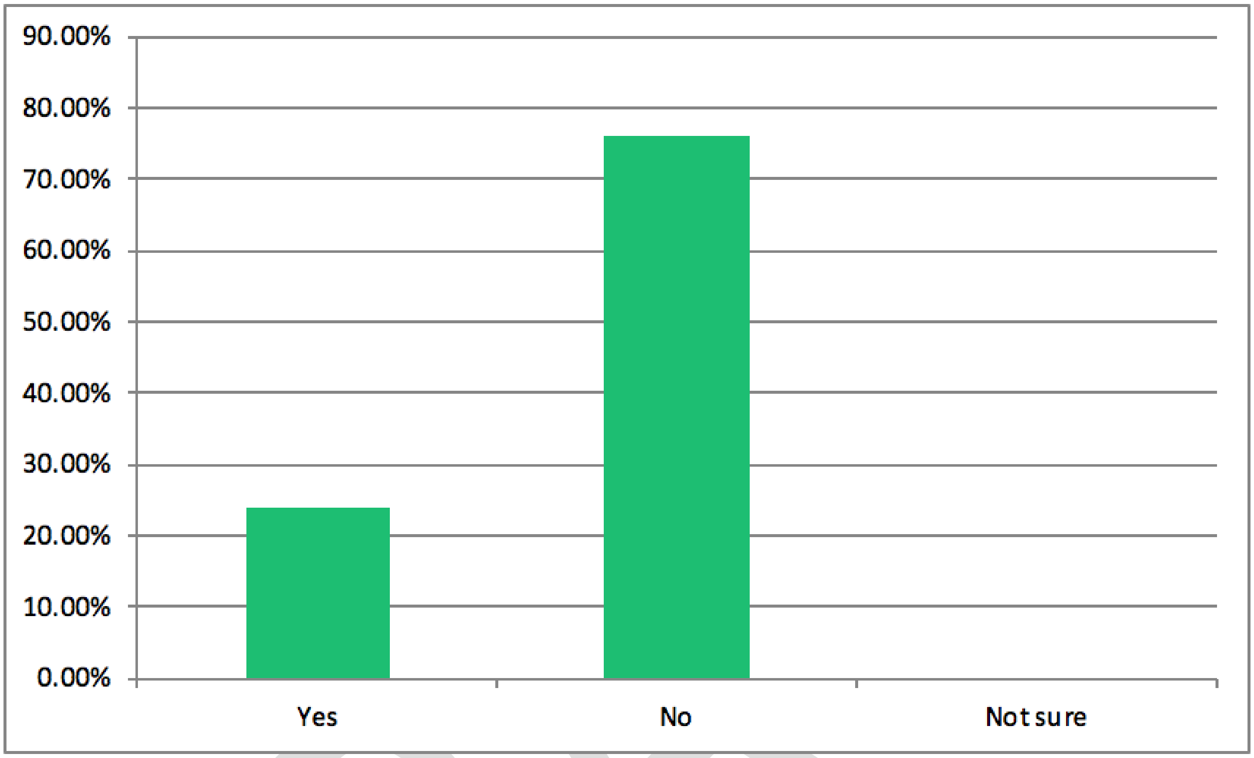
12. Since the start of the Covid-19 pandemic, how many people would you estimate use the Wi-Fi outside of your library on an average day?
Answered: 80 Skipped: 2

Respondents provided the following range of answers:

- 44 stated that 10 or fewer people use the Wi-Fi
- 20 stated the number was between 10-40
- 2 stated that the number was 65

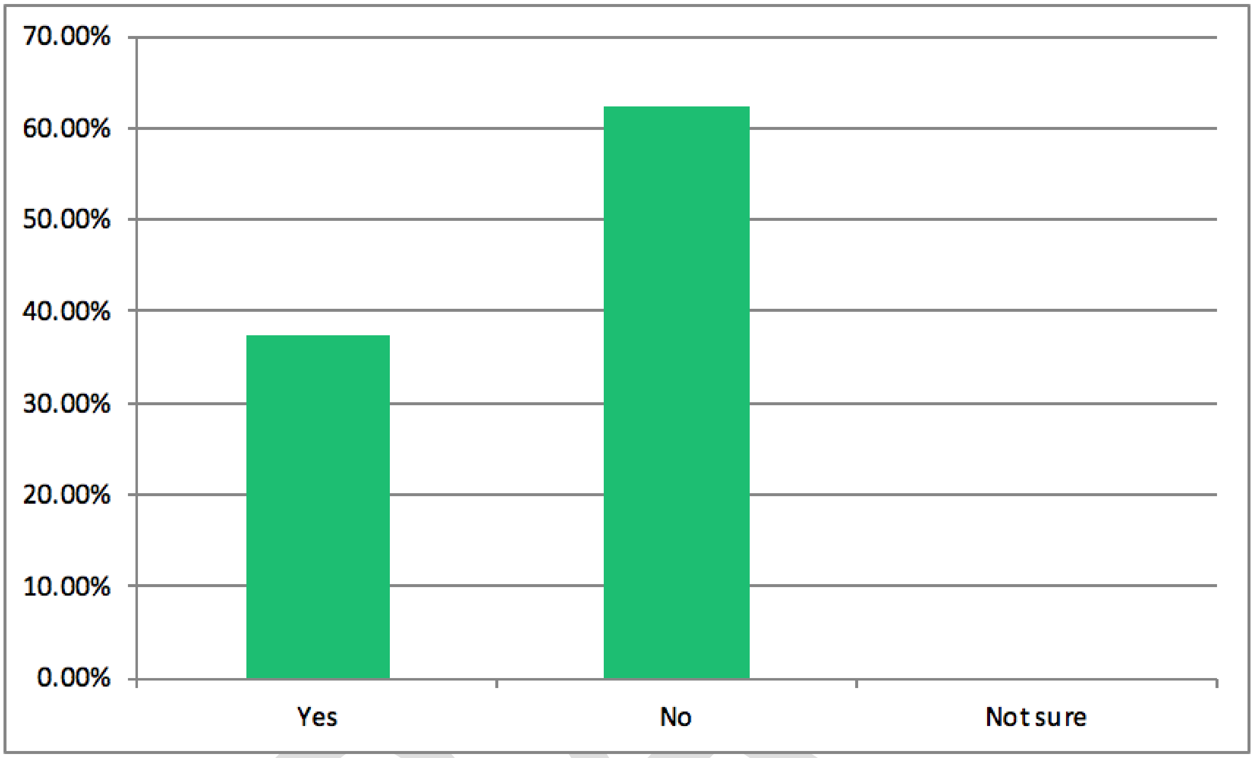
13. Since the start of the Covid-19 pandemic, has your library added equipment to extend or strengthen Wi-Fi signals outside of the building?

Answered: 80 Skipped: 2

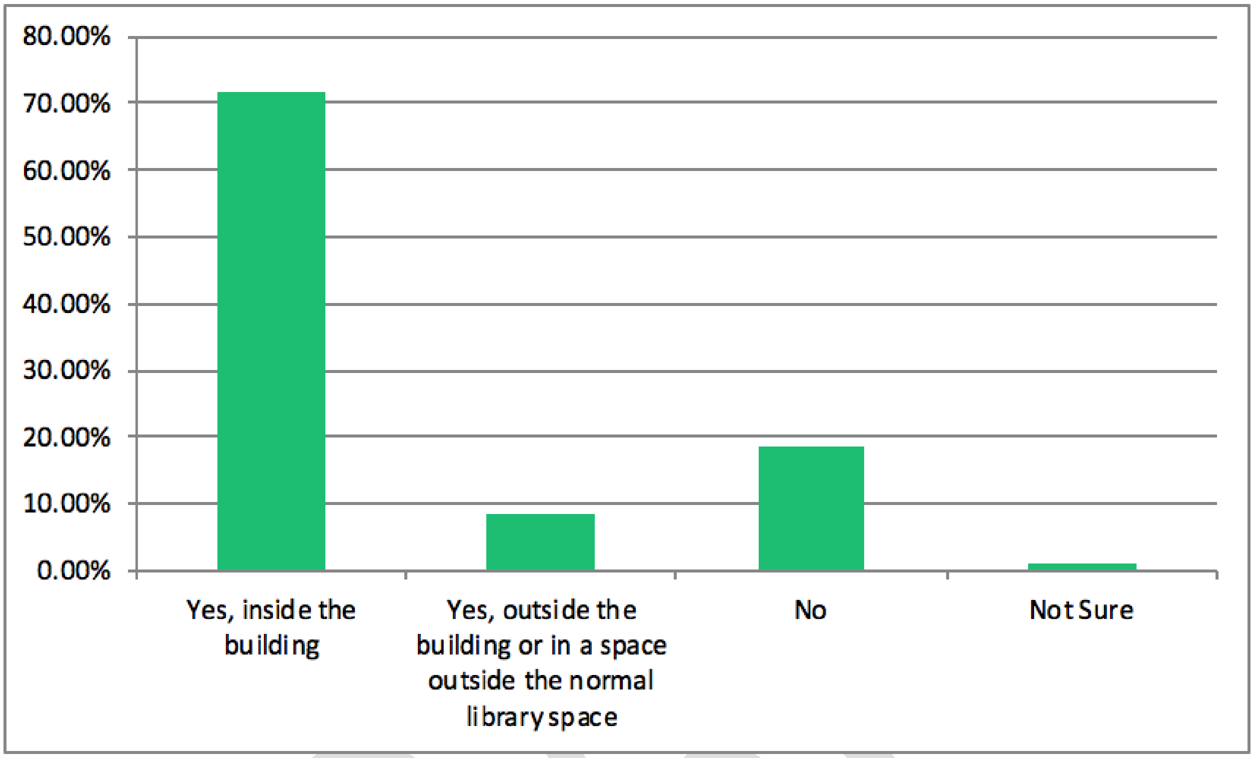


14. Since the start of the Covid-19 pandemic, have you made any accommodations to make Wi-Fi outside the building more comfortable to use (tents, tables, etc.)?

Answered: 80 Skipped: 2



15. Are you allowing patrons to use public computers at present?
Answered: 81 Skipped: 1



16. Have you made any changes/accommodations to public computer use during the Covid-19 pandemic?
Answered: 81 Skipped: 1

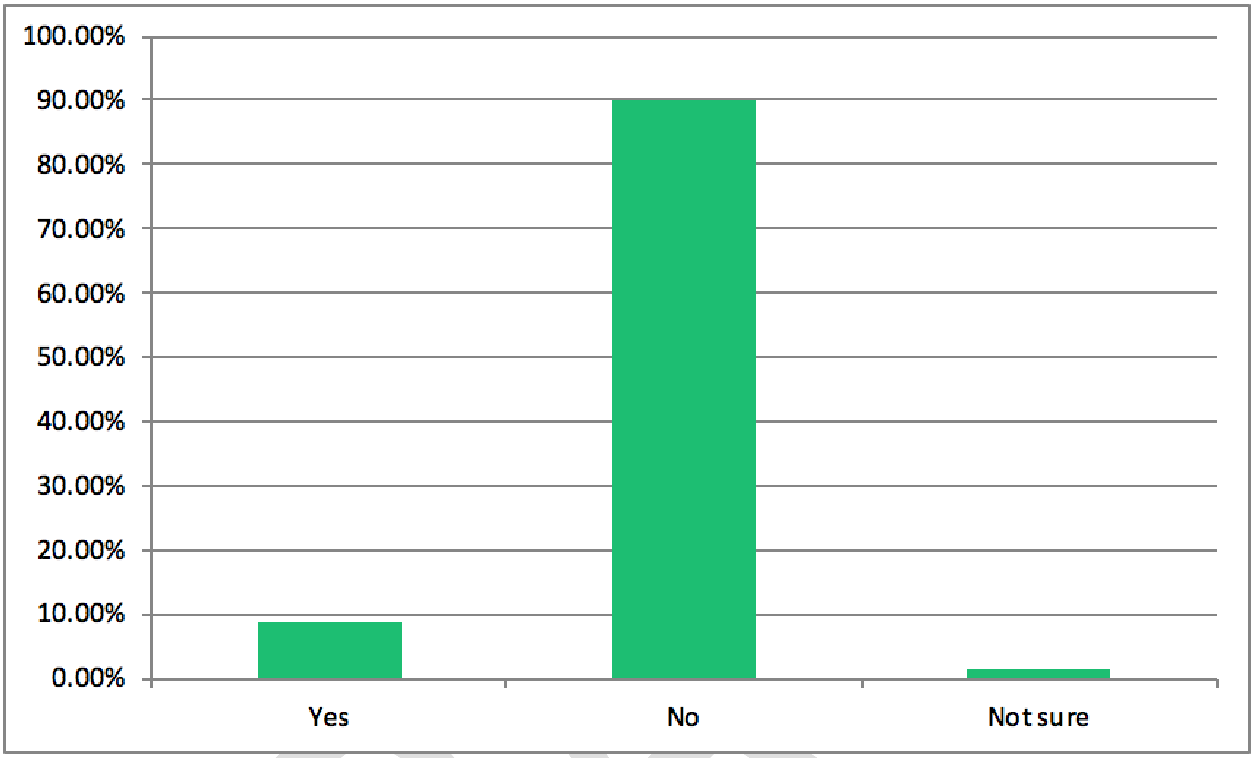
Accommodations listed by respondents included:

- Limiting the number of computers used at a time
- Placing computer 6 feet apart
- Sanitizing computers
- Limiting the amount of time an individual could use the computer
- Requiring patrons to reserve computers ahead of time
- Checking out laptops and iPads for home use
- Reducing the number of computer stations in order to maintain social distancing
- Purchase washable keyboard covers

Several respondents indicated that they made no changes.

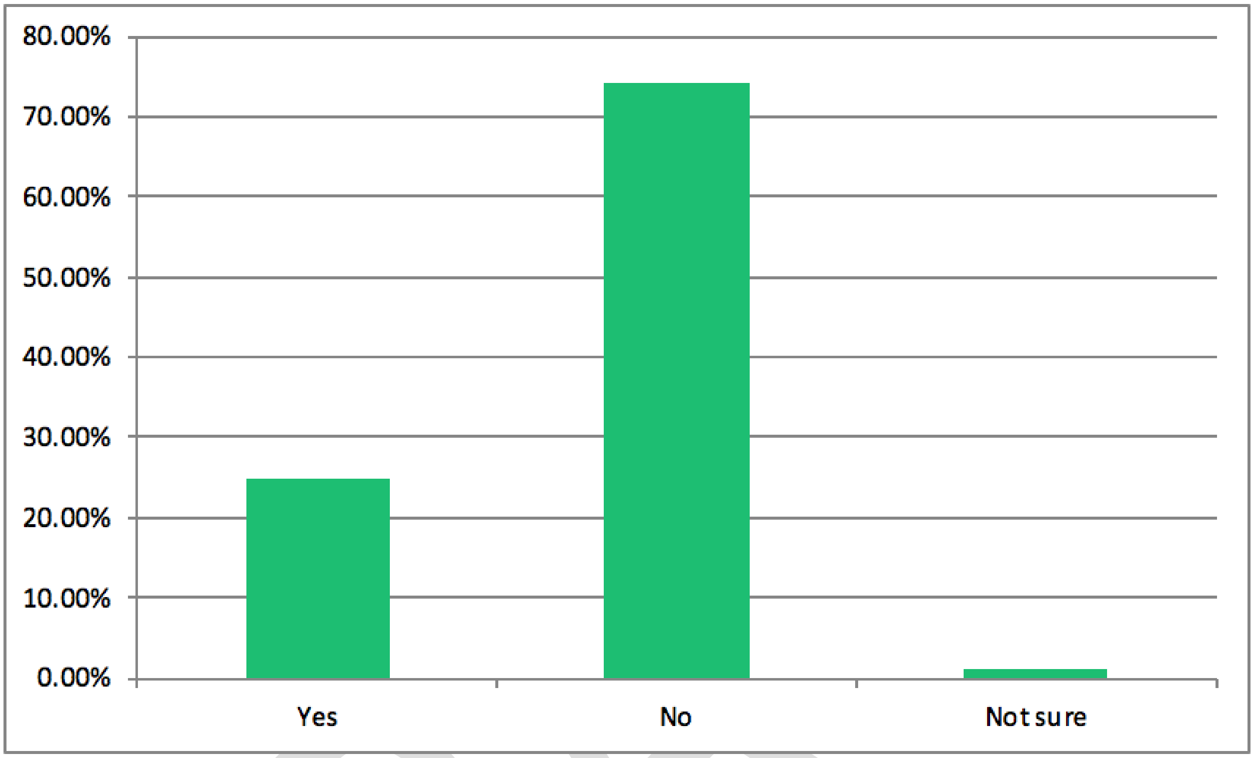
17. BEFORE the Covid-19 pandemic, were patrons able to check out laptop computers or tablets to use at home?

Answered: 81 Skipped: 1



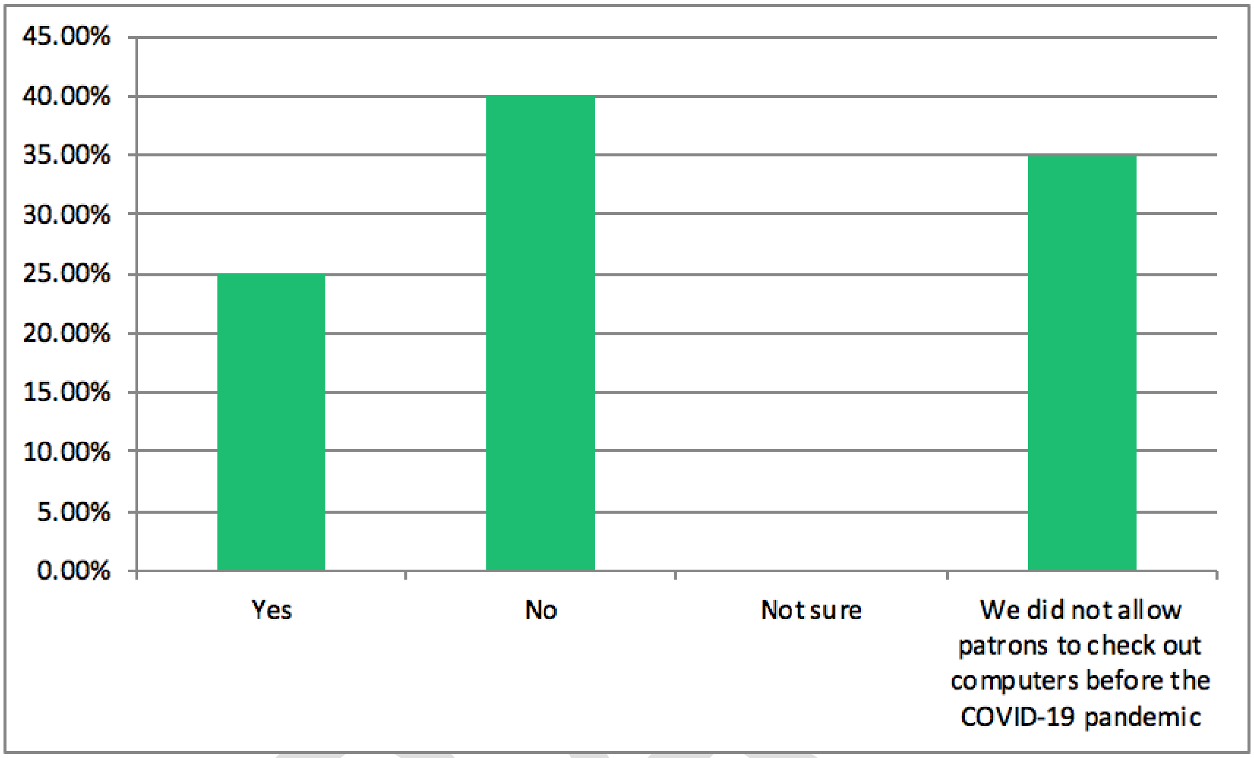
18. DURING the Covid-19 pandemic, are patrons able to check out laptop computers or tablets to use at home?

Answered: 81 Skipped: 1



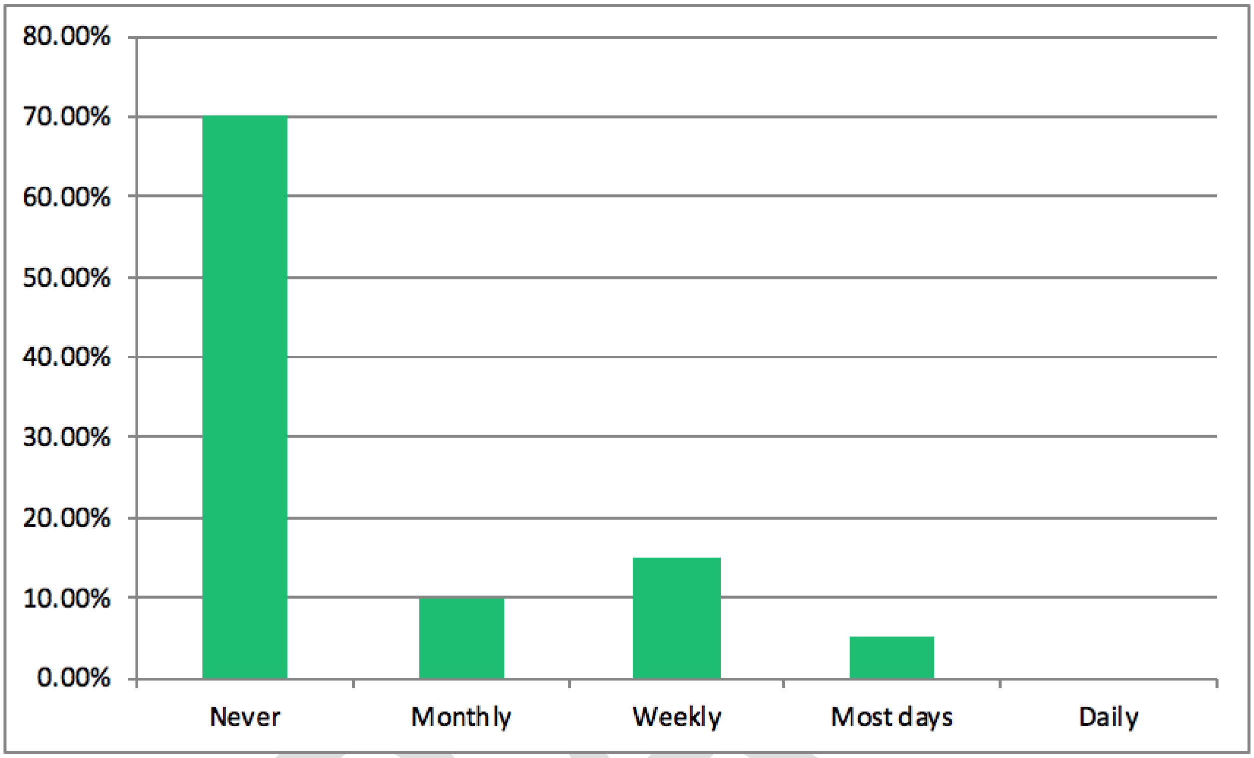
19. Since the start of the Covid-19 pandemic, have you seen an increase of patrons checking out library laptops or tablets for use at home?

Answered: 20 Skipped: 62



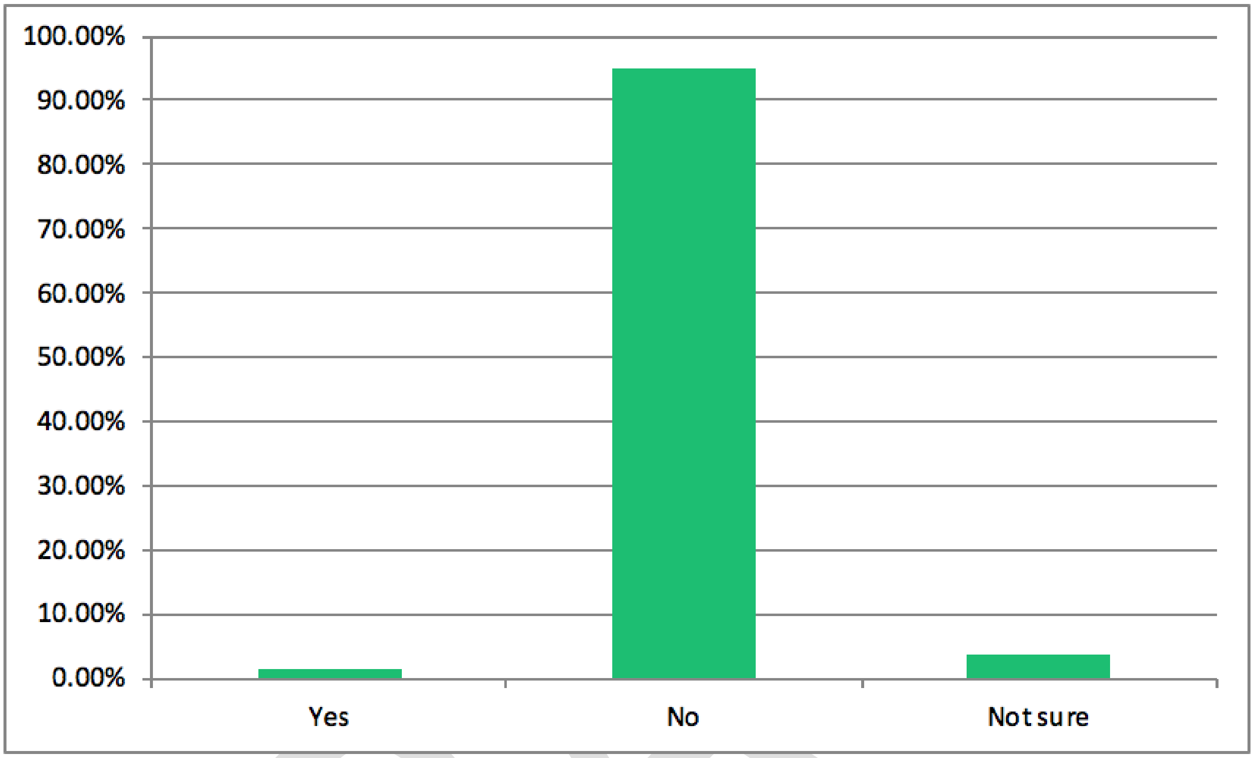
20. How often do you have more demand for laptops or tablets than you have equipment available?

Answered: 20 Skipped: 62



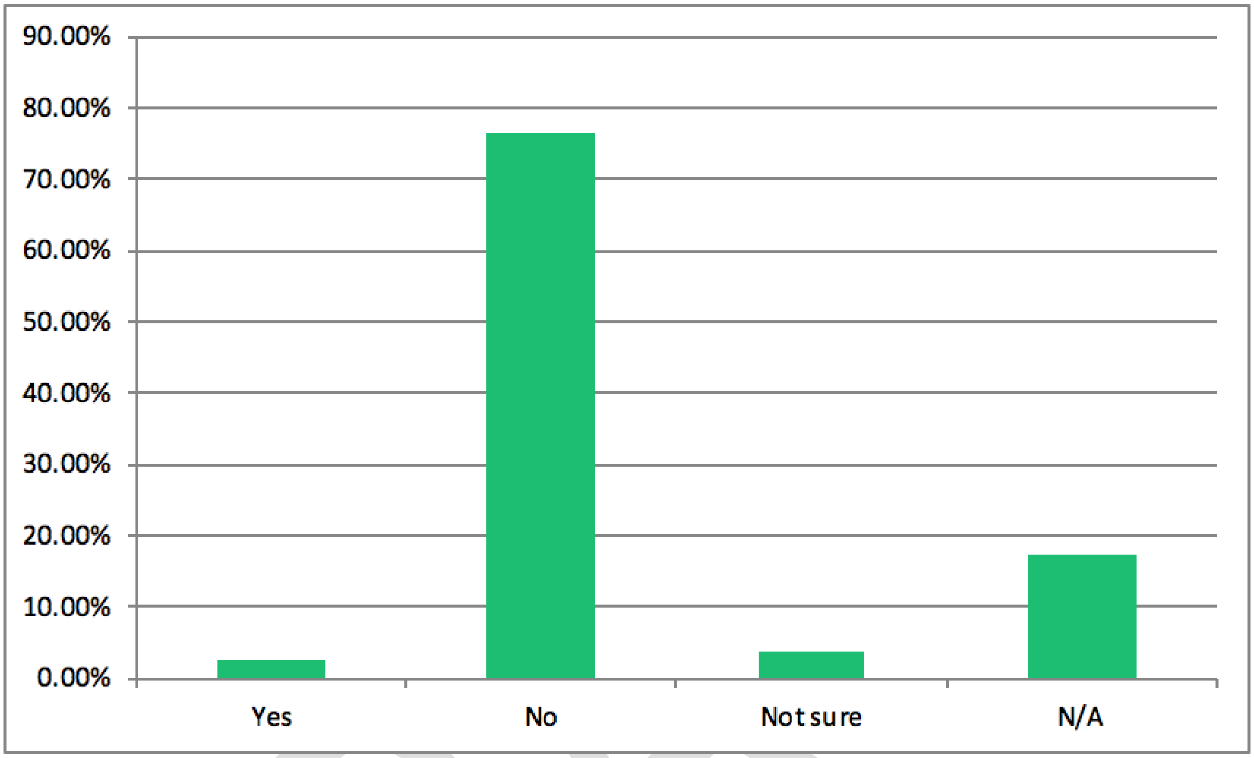
21. BEFORE the Covid-19 pandemic, was your library allowing patrons to check out hotspots (e.g., MyFi Connect) or other equipment to expand broadband access?

Answered: 81 Skipped: 1



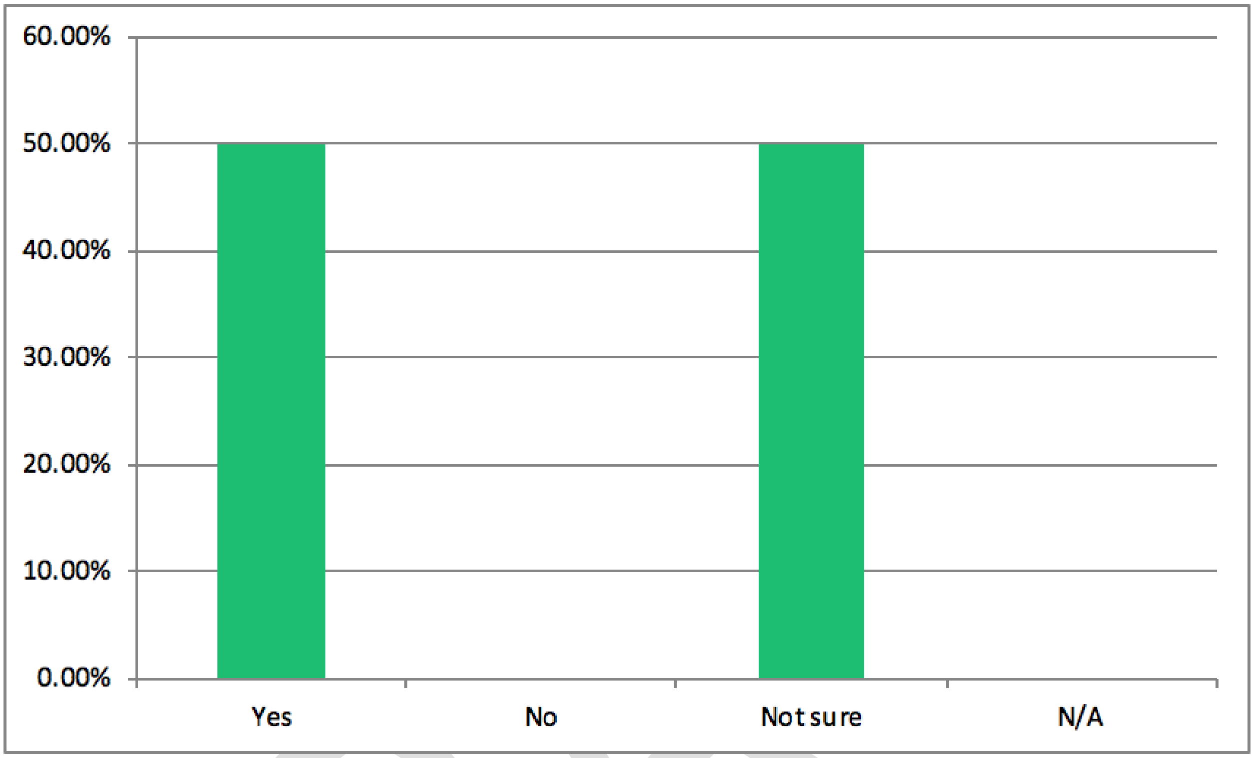
22. DURING the Covid-19 pandemic, is your library allowing patrons to check out hotspots or other equipment to expand broadband access?

Answered: 81 Skipped: 1



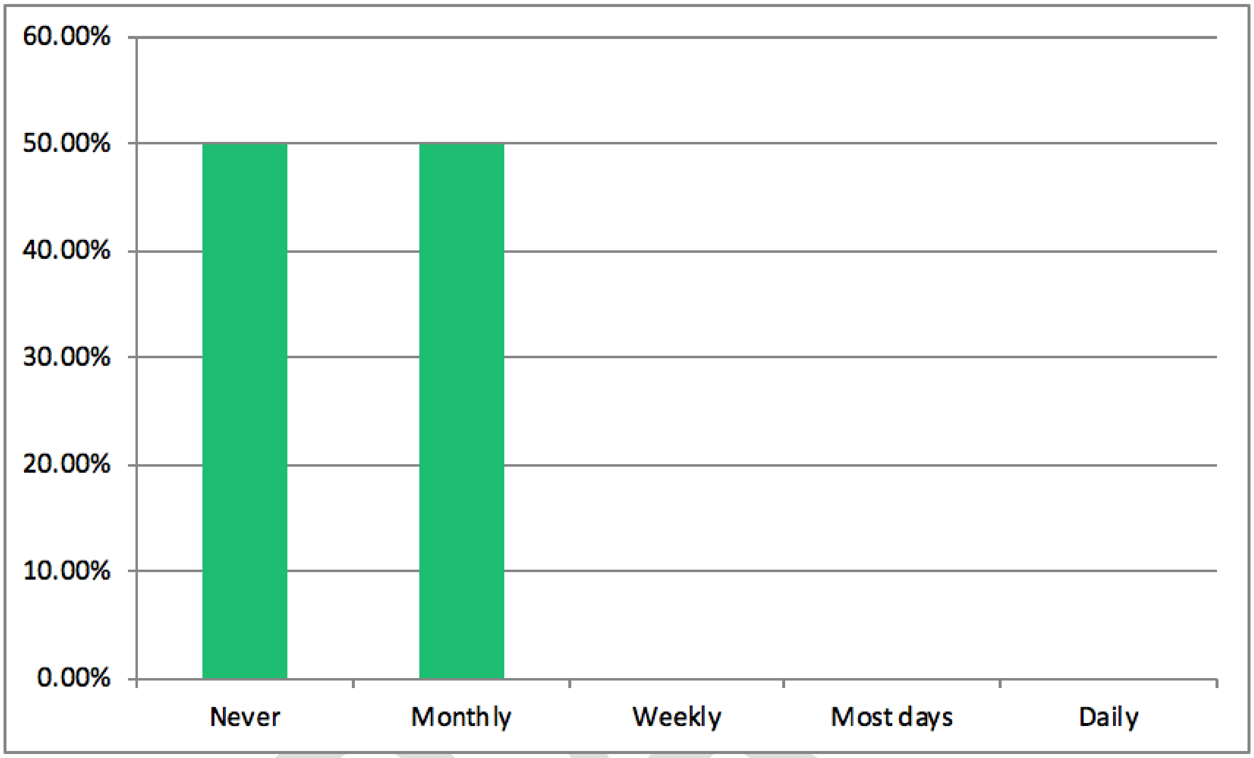
23. Since the start of the Covid-19 pandemic, have you seen an increase of patrons checking out hotspots or other equipment to expand broadband access?

Answered: 2 Skipped: 80



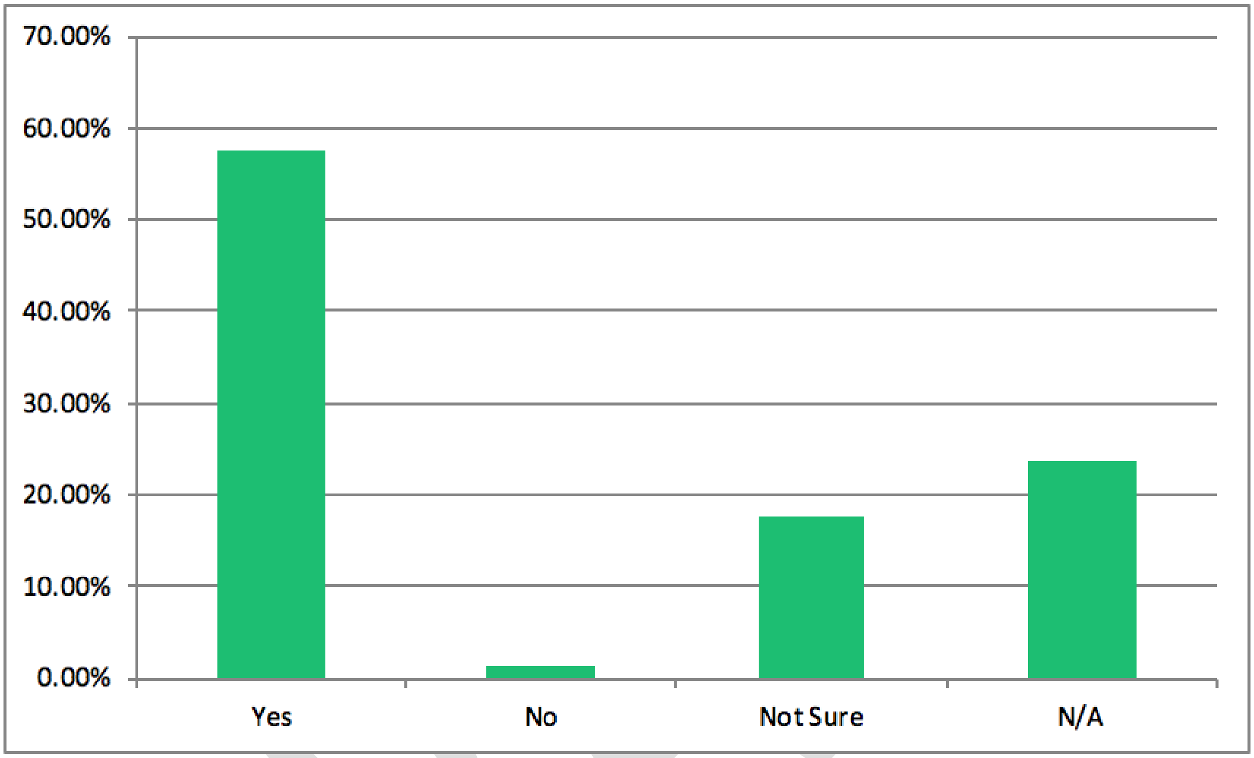
24. How often do you have more demand for portable hotspots than you have equipment available?

Answered: 2 Skipped: 80



25. If the area around your library has limited broadband or cell service access, would you be willing to participate in a program to install equipment at the library to provide better cell service or broadband to surrounding homes?

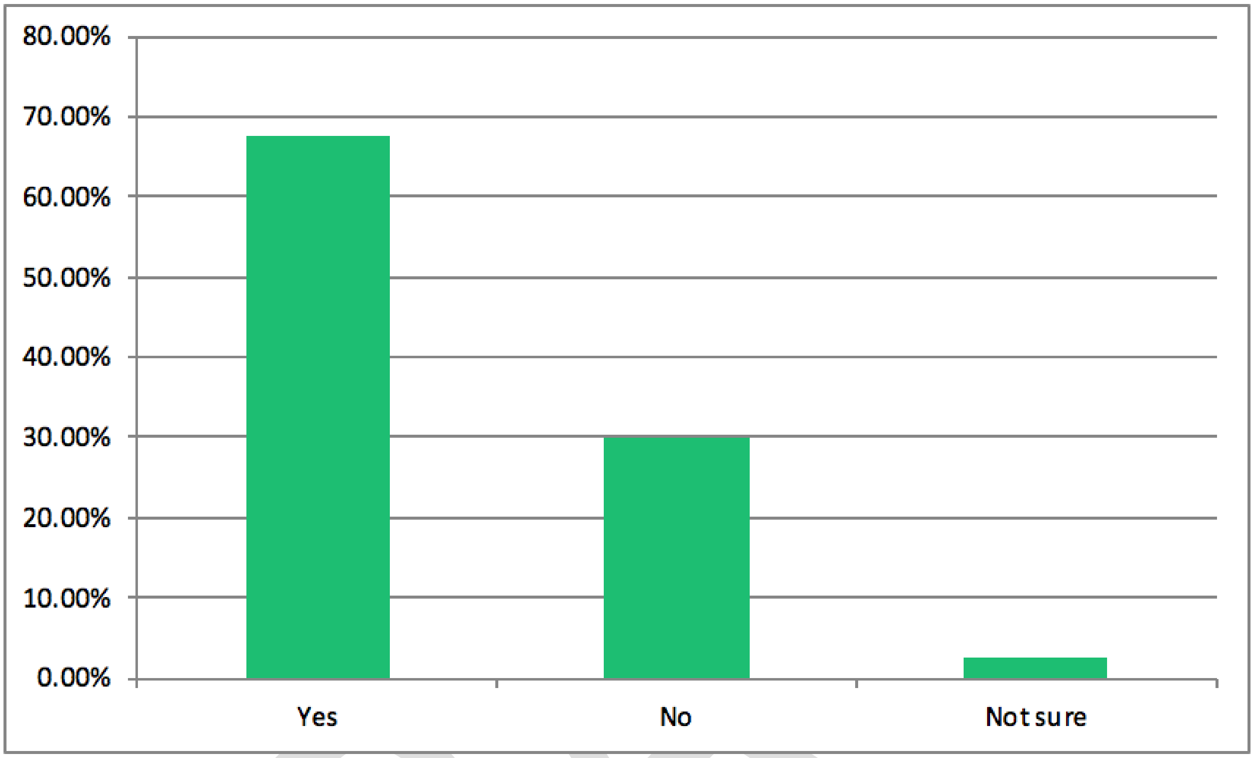
Answered: 80 Skipped: 2



26. Did your library add or increase access to electronic collections (downloadable items, databases, and the like) due to the Coronavirus (Covid-19) pandemic? This includes adding services or

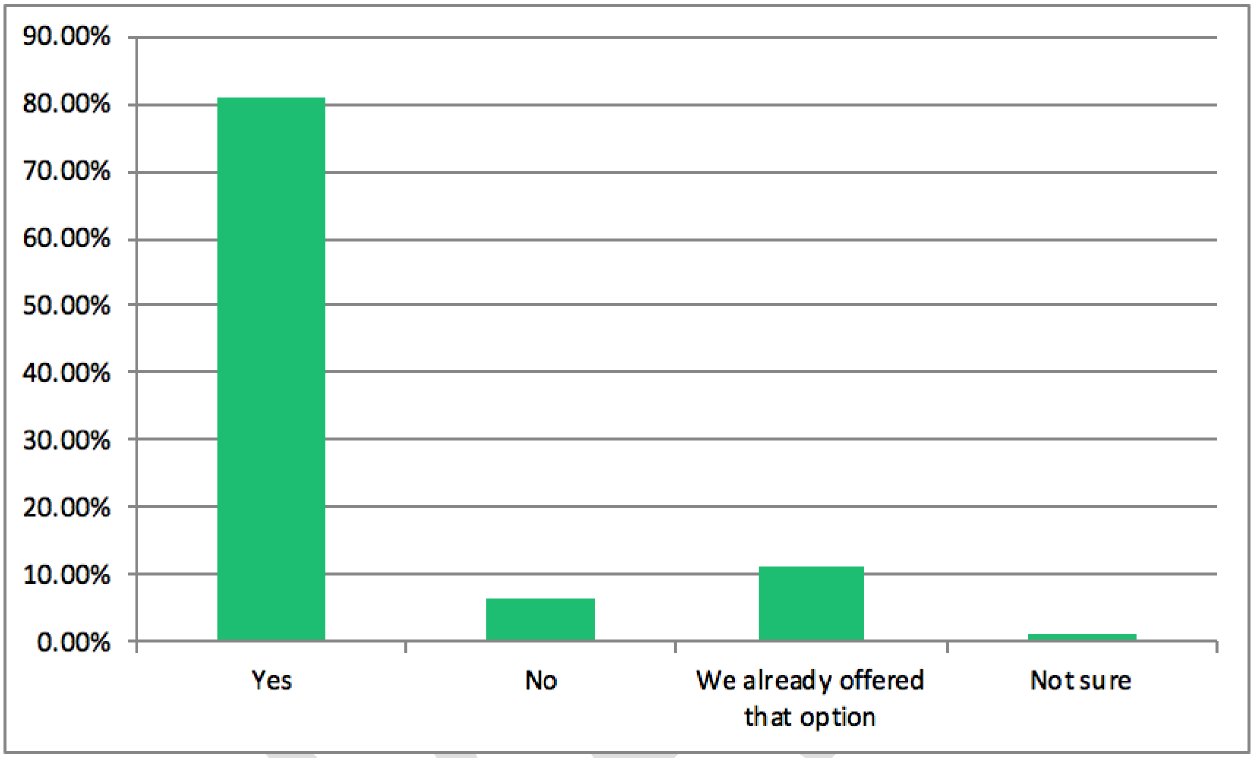
individual items, increasing borrowing limits, or otherwise improving the public's access to electronic materials.

Answered: 80 Skipped: 2



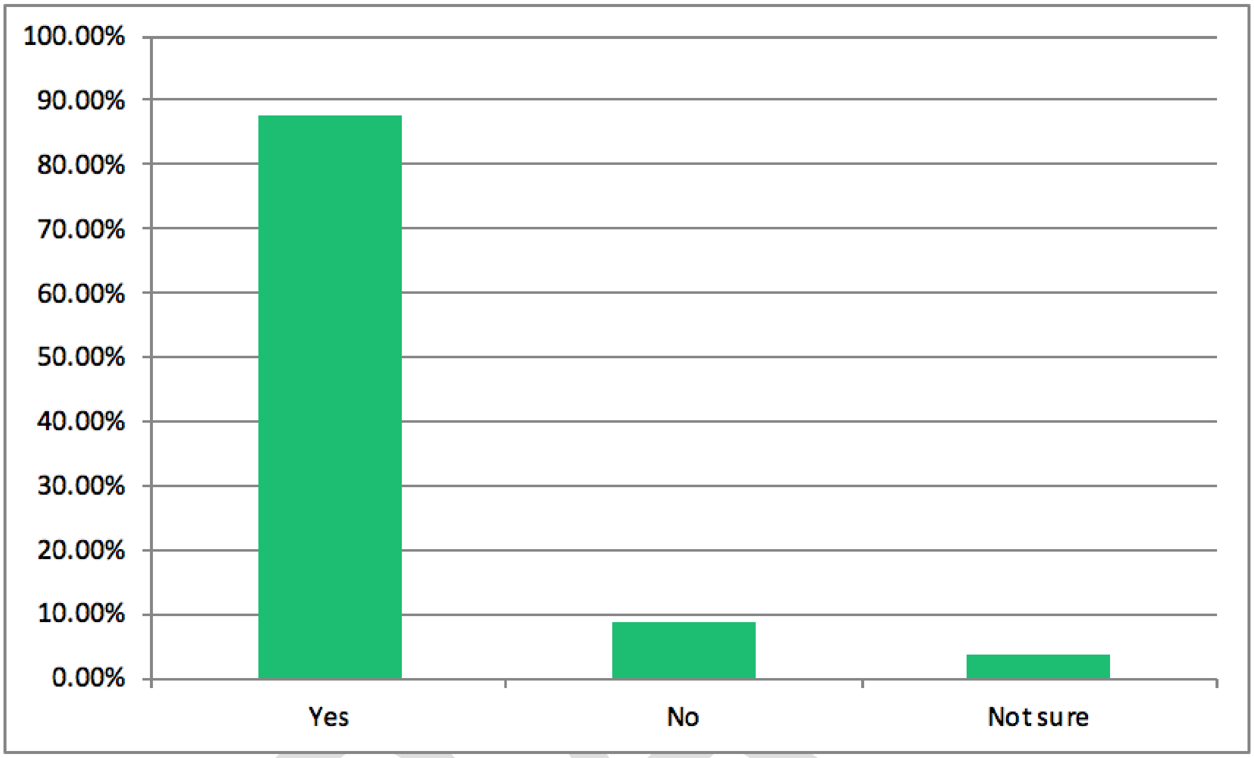
27. During the Covid -19 pandemic, did the library allow users to register for a library card online or by phone, without coming into the building? This includes "online-only" cards that allow patrons to access online resources.

Answered: 79 Skipped: 3



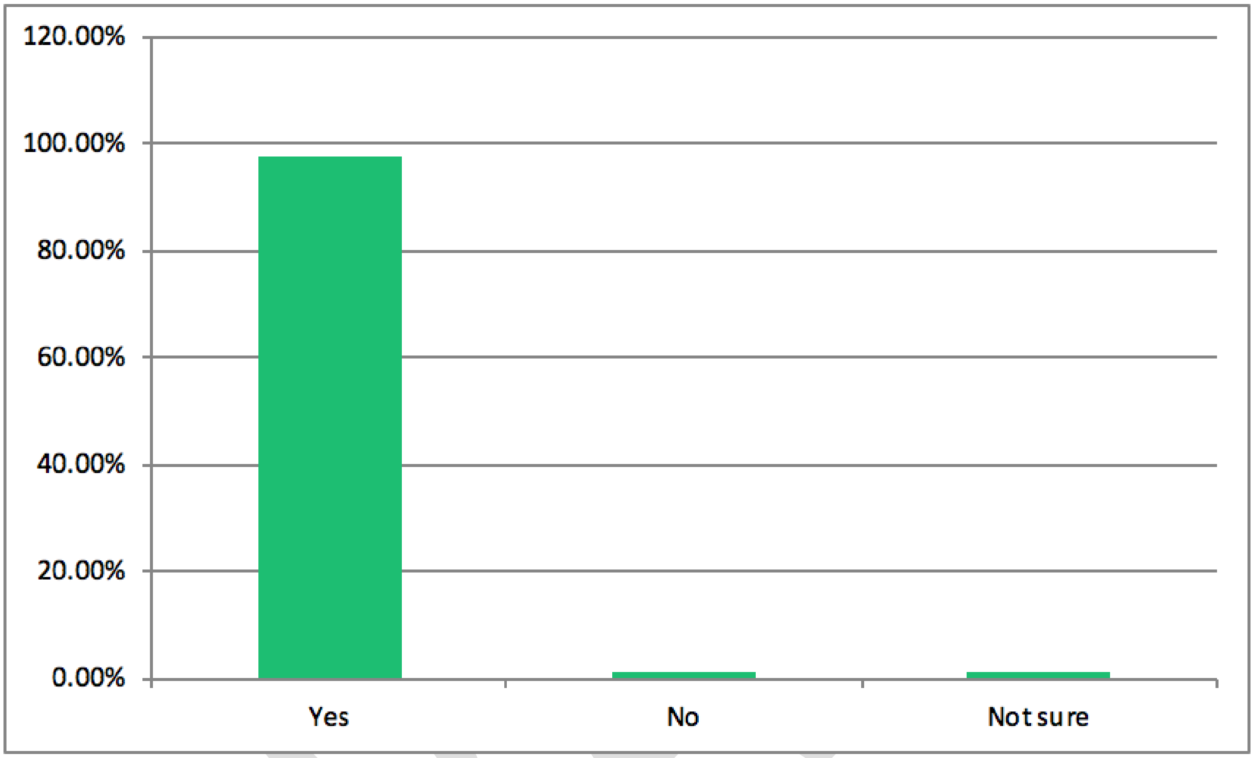
28. Did the library provide reference service via the Internet or telephone when the building was physically closed?

Answered: 80 Skipped: 2



29. Did the library provide 'outside' service for circulation of physical materials during the pandemic? This includes any contactless or minimal contact circulation, such as curbside or vestibule pickup, mailing, or drive-thru.

Answered: 80 Skipped: 2



30. What efforts has your library taken to assist patrons in accessing online resources?

Answered: 76 Skipped: 6

Respondents provided the following responses:

- Made resources more visible on library website
- Providing technical assistance
- Offered tips, tricks, and lessons in newsletters
- Increased PR via social media, email, Front Porch Forum, and posters to advertise resources
- How-to videos and booklets
- Made librarians available via phone for assistance
- Updated website to be more user-friendly

31. Has your library partnered with other entities to assist patrons during the Covid-19 pandemic? (e.g., schools, the town, healthcare providers) If so, please describe said partnerships.

Answered: 68 Skipped: 14

Several responded said that they did not partner with other entities, those who did partner with other entities listed the following:

- Local schools (the overwhelming majority of respondents stated they partnered with schools)
- Vermont Humanities Council
- Town Assistants
- Various organizations that provide meal giveaways
- Nature museums
- Opioid task force
- Mutual aid groups
- Elder care communities

32. Is there anything that could potentially help you to better serve your patrons during the Covid-19 pandemic? Examples might include better bandwidth or signal strength, specific training or resources, updated furnishings or equipment, or anything else you can think of.

Answered: 60 Skipped: 22

A number of respondents indicated that improved bandwidth would help better serve their patrons. The complete list of responses is below.

"Funding for online subscriptions and e-items" *-Dorothy Alling Memorial Library*

"Better signal" *-Butterfield Library, Westminster*

"Laptop computers or ipads for patrons to take home" *-Jaquith Public Library*

"We are hemmed in by the hardware restrictions of Fiberconnect. We would LOVE to add an outdoor WAP to better extend our wifi." *-Kellogg-Hubbard Library*

"Better access to wireless internet, reach farther outside the building, stronger connection to internet, and better cell phone service." *-West Hartford Library*

"If we are still social distancing in the spring, the library would benefit from funds to purchase outdoor furniture and better laptops." *-Solomon Wright Public Library*

"Better exterior Wi-Fi and seating would greatly improve usage" *-Swanton Public Library*

"Better bandwidth; and my I add a comment to an earlier question which didn't seem to have space for it: our outside accommodations for wifi were already pretty good before Covid - bench, shade, electrical outlet" *-Baldwin Memorial*

"I would love to offer tablets or laptops for patrons to borrow and take home." *-Chelsea Public Library*

"More air filtering devices for this 114 year old building for the winter." *-Cobleigh Public Library*

"Updated computers and better signal strength" *-Enosburgh Public Library*

"Updated furnishings, so that we could make room for people to be in the building safely/more space for computers. Our programs are being held in another location because the building is not big enough to be socially distanced here. Also, our wifi barely reaches outside the building, so we could use some boosters to help increase the signal strength, especially in the winter when people do not want to sit outdoors, but would prefer to be in their cars in the parking lot." -*Pettee Memorial*

"We have terrible terrible upload speeds here, and many many patrons in the NEK who do not have either cell signal OR broadband services and terrible speeds. We need every home in the NEK connected to affordable broadband." -*Alice M. Ward Memorial Library*

"Better signal strength in our parking lot, a robust tent for using the internet during bad weather." -*Putney Public Library*

"Having some assess whether our WIFI equipped in positioned properly and working at its best would be great." -*Whiting Library*

"Better bandwidth is always an issue here. I'd love to add a collection of laptops and hotspots to lend, but worry that I wouldn't be able to keep up on maintenance, updates and repairs on these items." -*John G. McCullough Free Library*

"updated laptops or tablets for public use" -*Waterbury Public Library*

"Updated furnishings (interior and exterior); PPE, laptops, wifi hotspots" -*Winooski Memorial Library*

"We need ventilation in our meeting room to allow students to use it as a study space or social service agencies to hold client meetings." -*Rutland Free Library*

"laptops/chromebooks" -*Johnson Public Library*

"We considered lendable hot spots, but found the data plans cost-prohibitive under our own current Covid-19 budget crunch. Staff training on delivering services digitally or in mixed formats would also be a boon." -*Manchester Community Library*

"Laptops and hot spots to check out." -*Fletcher Free Library*

"Hotspots (we aren't in the coverage area of the affordable option), more bandwidth (available but must be agreed upon by our building board and they think we have plenty of bandwidth), wider radius of strong wifi signal in the village" -*Orwell Free Library*

"In spite of being a FiberConnect library, we sometimes have issues with connections, and beyond the village our patrons internet access is extremely spotty. This situation has been terrible for people trying to work from home, especially anyone with children attempting to access schoolwork at the same time. Patrons have had issues with our wifi outside, but I'm not sure if the cause is signal strength or something else. We do not have adequate sneeze guards at our tables/work desks. I do wish that we had equipment that we could lend, or a means of improving access in the hills & hollows around the lakes & ponds where many patrons live. Both cell service and broadband are awful in so many spots in our two communities (Castleton/Hubbardton)." -*Castleton Free Library*

"The ability to check out laptops and additional e-resources like Hoopla, Canopy, and more funds for Overdrive." -*Essex Free Library*

"Better bandwidth, stronger signal. Boosted wifi signal (in terms of strength and distance for our patrons accessing it from outside the building.) Resources or materials (laptops, chromebooks, tablets and wifi hotspots WITH SECURITY OPTIONS) to distribute to our patrons. Outdoor furnishings, windscreens/"weather-proof" tents or awnings or somehow making it possible for our patrons without cars to access our wifi in inclement/snowy weather." -*Bixby Memorial Free Library*

"Our building is 126 years old and we are working on an addition which would have an HVAC system which we don't have now so we are limiting in-person visits to 3 people. It is hard to do more with only 900 sq. feet." -*Jeudevine Memorial Library*

"Bottles of 70% isopropyl alcohol are hard to find." -*Abbott Memorial Library*

"Resources for home schooling both online, print, and dvd, grants for GMLC to purchase more content, DOL providing funding toward subscription services like HULU or Mango," -*Rochester Public Library*

"It would be wonderful to have access to chromebooks to lend to patrons" -*Norman Williams Public Library*

"Funding for laptops to be able to check out. Perhaps wifi hotspots patrons could check out (I don't know much about these). We plan to apply for a DOL grant for $300 to upgrade our router/transmitter to improve our signal within the building and in the parking lot." -*Greensboro Free Library*

"ipads or tablets for training and/or loan, staff time to plan training sessions" -*Martha Canfield Memorial Free Library*

"Better cellphone service and additional furniture for porch area as wi-fi spot" -*Charlotte Library*

"There is always room for improvement when dealing with the public. Stronger internet or hotspots to check out would be huge, as we are in a valley and depending where you reside depends on your service. Laptops to check out would be amazing! Updates children's furniture, would be incredible. Budgets are tight and spending outside line items is difficult. Additional resources are always welcomed" -*Proctor Free Library*

"The internet goes out periodically, perhaps a better amount of signal strength would help." -*Russell Memorial Library*

"more money for digital resources (ebooks and audiobooks, or even something like Kanopy)" -*Baxter Memorial Library*

"Better cell service" -*Westford Public Library*

"Better bandwidth -- our upload speeds are pretty miserable. Being able to have WiFi that extends to the whole town green would be nice as well." -*Platt Memorial Library*

"staff could use tech training to better support devise use, we need a new wifi printer so patrons can print from personal devices" -*Bradford Public Library*

"hotspots with better coverage area....we use Sprint as a carrier because of the expense of an AT&T or Verizon hotspot" -*Hartland Public Library*

"Improving internet and cell service, devices to loan" -*Peacham Library*

"better bandwidth, signal strength, hot spot equipment to lend, devices to lend" -*Whitingham Free Public Library*

"Take home wifi hotspots and laptop computers or tablets" -*Lawrence Memorial Library*

"Hotspots that would actually work at people's homes. The issue with all the hotspots i've looked at is that they would only work at homes where people already have cell service" -*Moore Free Library, Newfane*

"Hot spots and laptops that could be checked out" -*Windsor Public Library*

"more reliable connection speeds especially on remote learning days." -*Deborah Rawson Memorial Library*

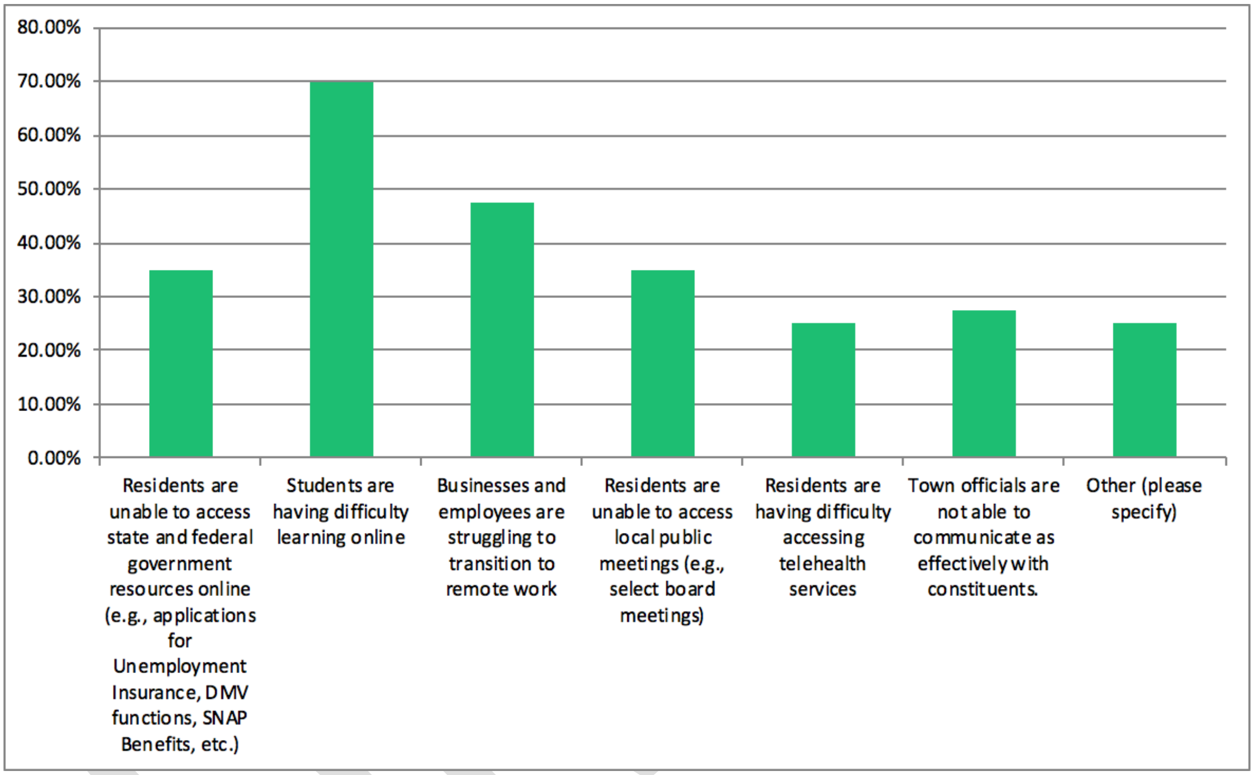
"We would benefit from and will soon receive better Wi-Fi range; we would lend mobile hotspots, tablets, etc. if we were given those resources to lend; we would welcome further training and resources; we would welcome partnership with other agencies." -*Morristown Centennial*

Appendix E: Town Administrator Survey Results

This survey was sent to town managers, town clerks, town administrators, and selectboard chairs across the State of Vermont. Forty-nine of them responded.

3. What are the most challenging issues facing your community during the Covid-19 pandemic? (Select all that apply)

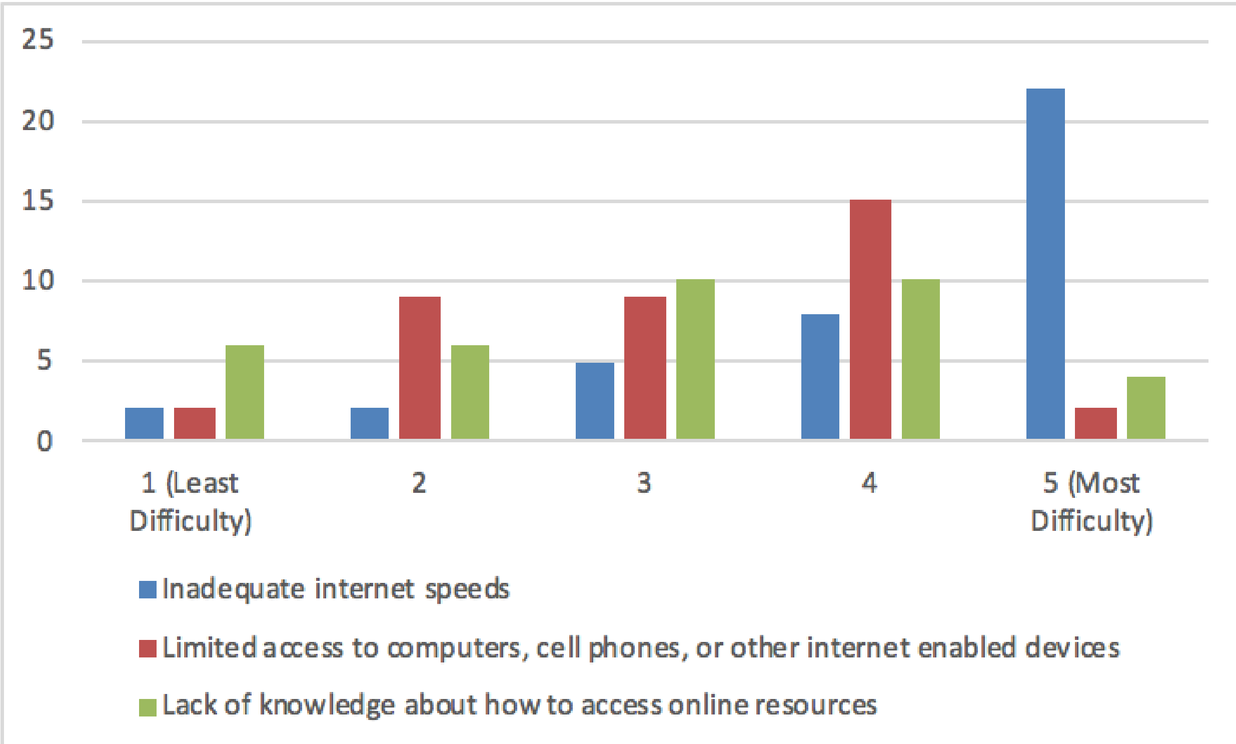
Answered: 40 Skipped: 9



Most respondents who selected "other" added that slow internet was an issue. Some also stated that they were unsure what the most challenging issues are.

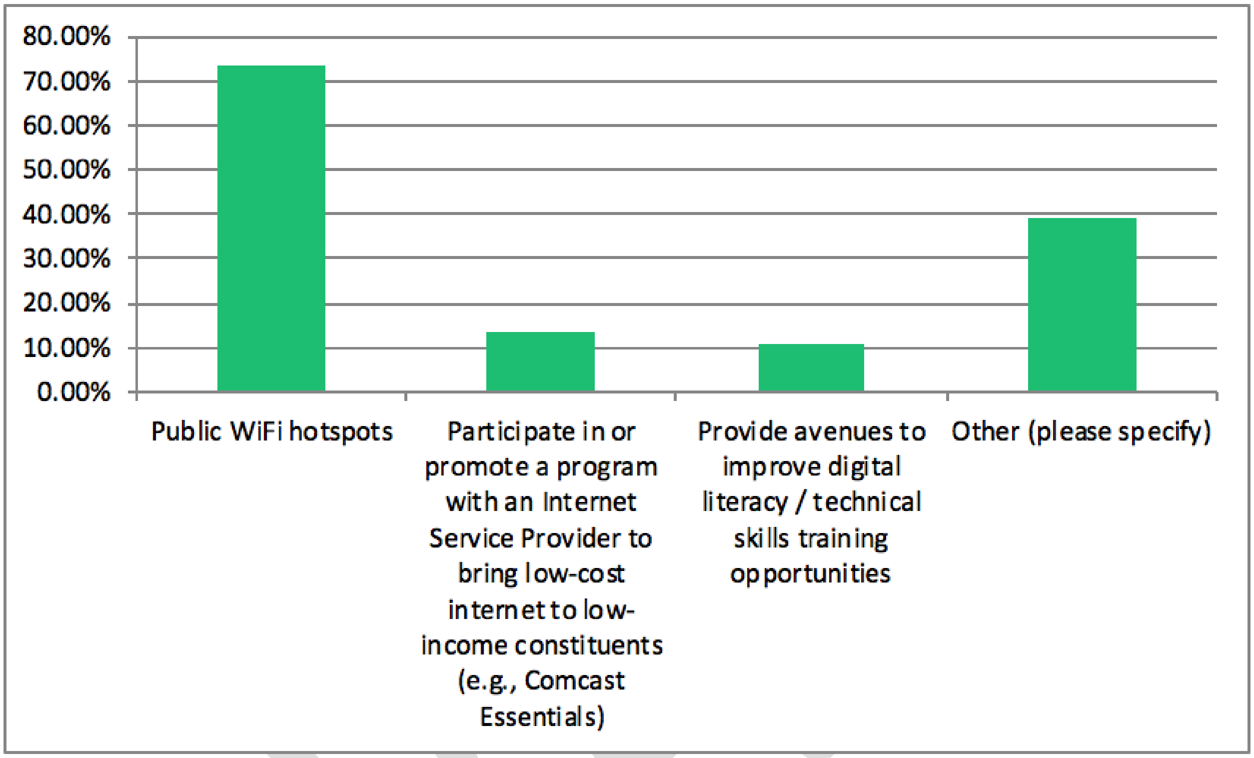
4. Please rank the following reasons of why constituents may have difficulty accessing online resources:

Answered: 41 Skipped: 8



5. In what ways has your town worked to help constituents access online resources and adjust to the Covid-19 pandemic? (Check all that apply)

Answered: 38 Skipped: 11

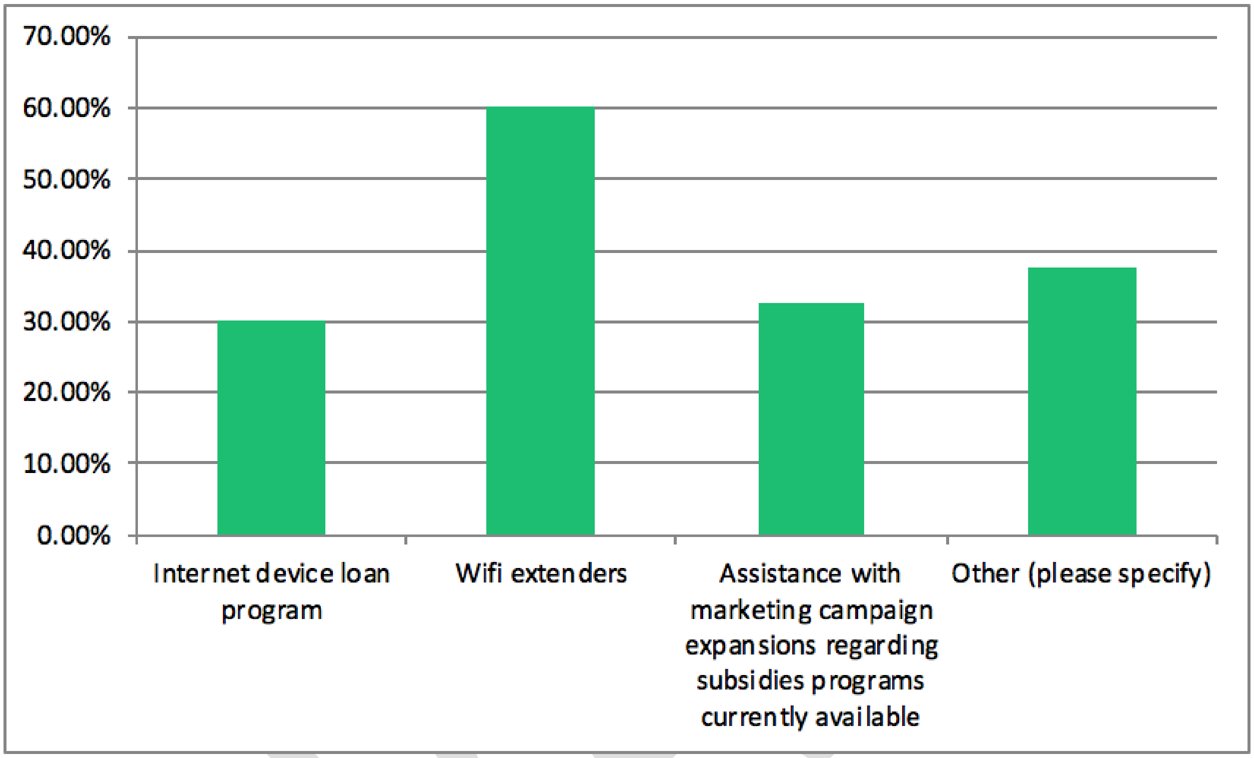


"Other" responses included:

- None
- Digitizing of records
- Joining CUDs
- Increased communication with constituents through advertising

6. What resources from the State of Vermont would allow your town to better serve your constituents and help constituents access online resources?

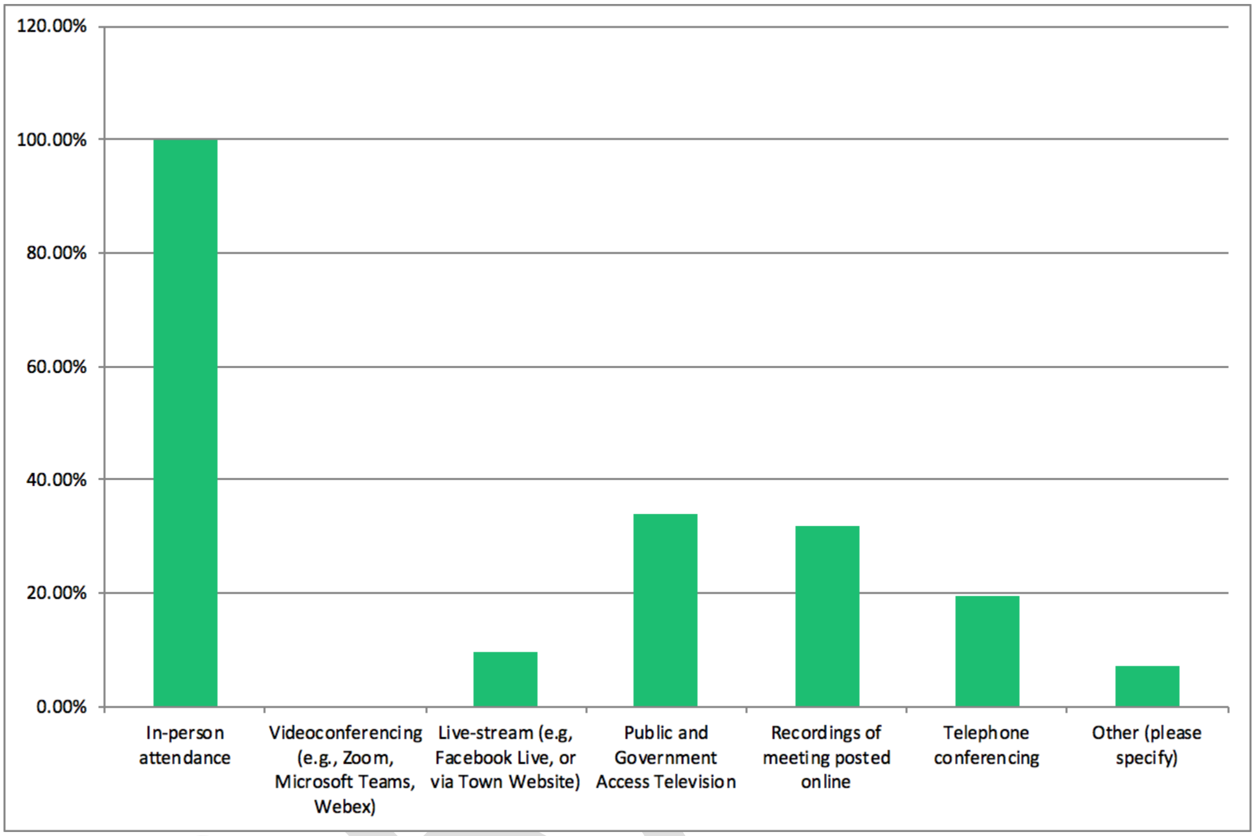
Answered: 40 Skipped: 9



Most “other” responses stated that help from the State with increasing access to broadband and cell service would be useful.

7. BEFORE the Covid-19 pandemic, how could constituents access public meetings (e.g., selectboard meetings, school board meetings, informational meetings)? Select all that apply.

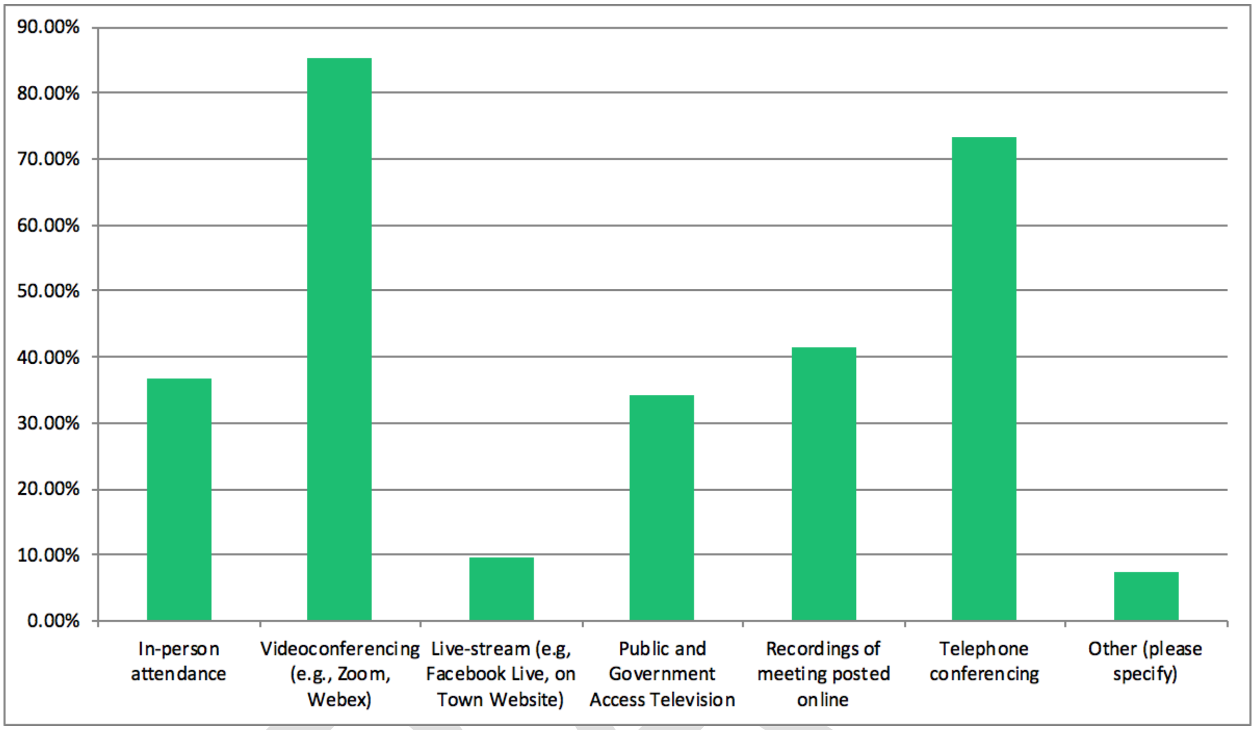
Answered: 41 Skipped: 8



All “other” responses stated that constituents could access meeting minutes posted online.

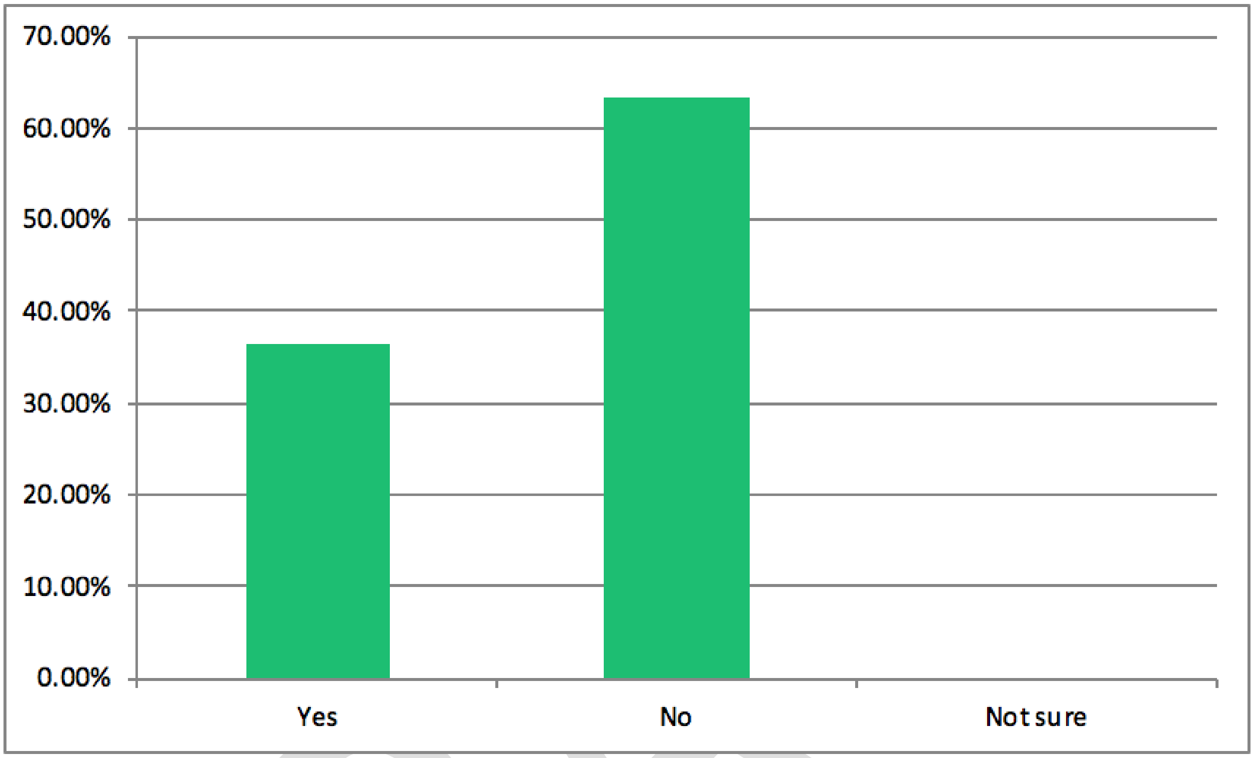
8. DURING the Covid-19 pandemic, how can constituents access public meetings (e.g., selectboard meetings, school board meetings, informational meetings)? Select all that apply.

Answered: 41 Skipped: 8



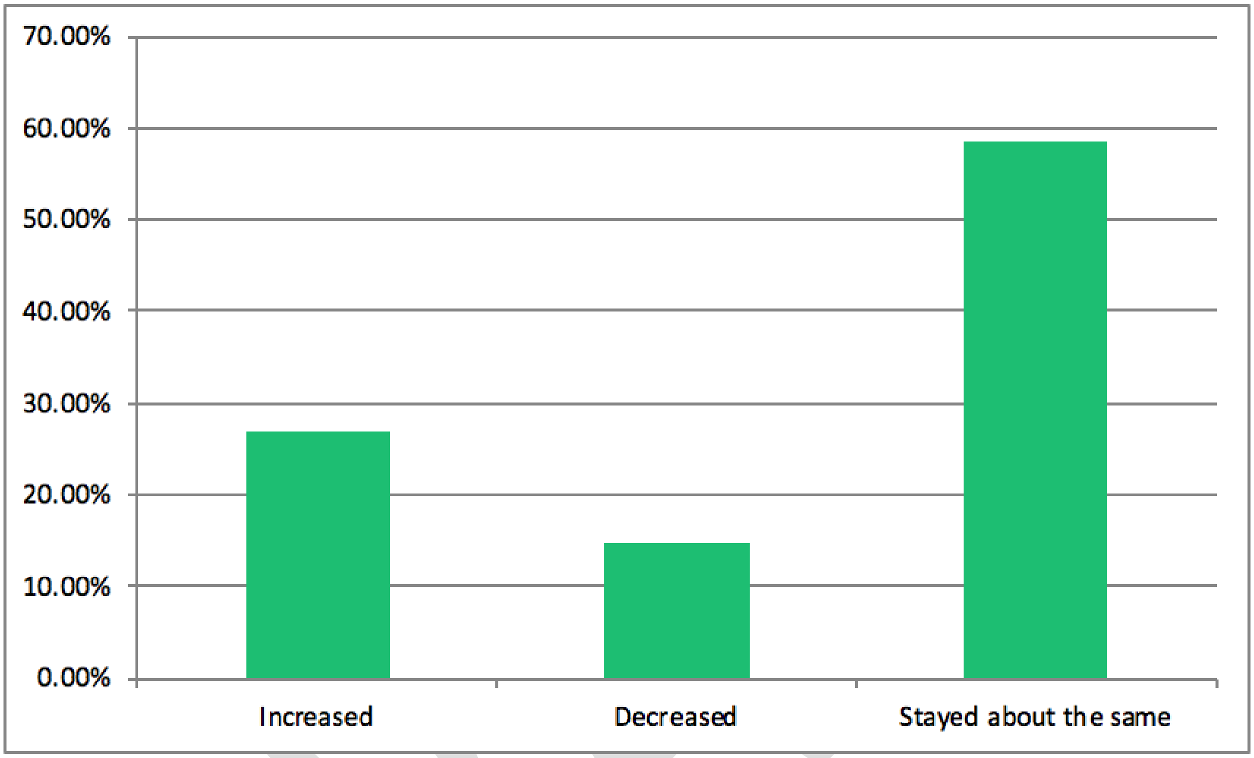
9. Are elected officials attending public meetings in-person currently ?

Answered: 41 Skipped: 8



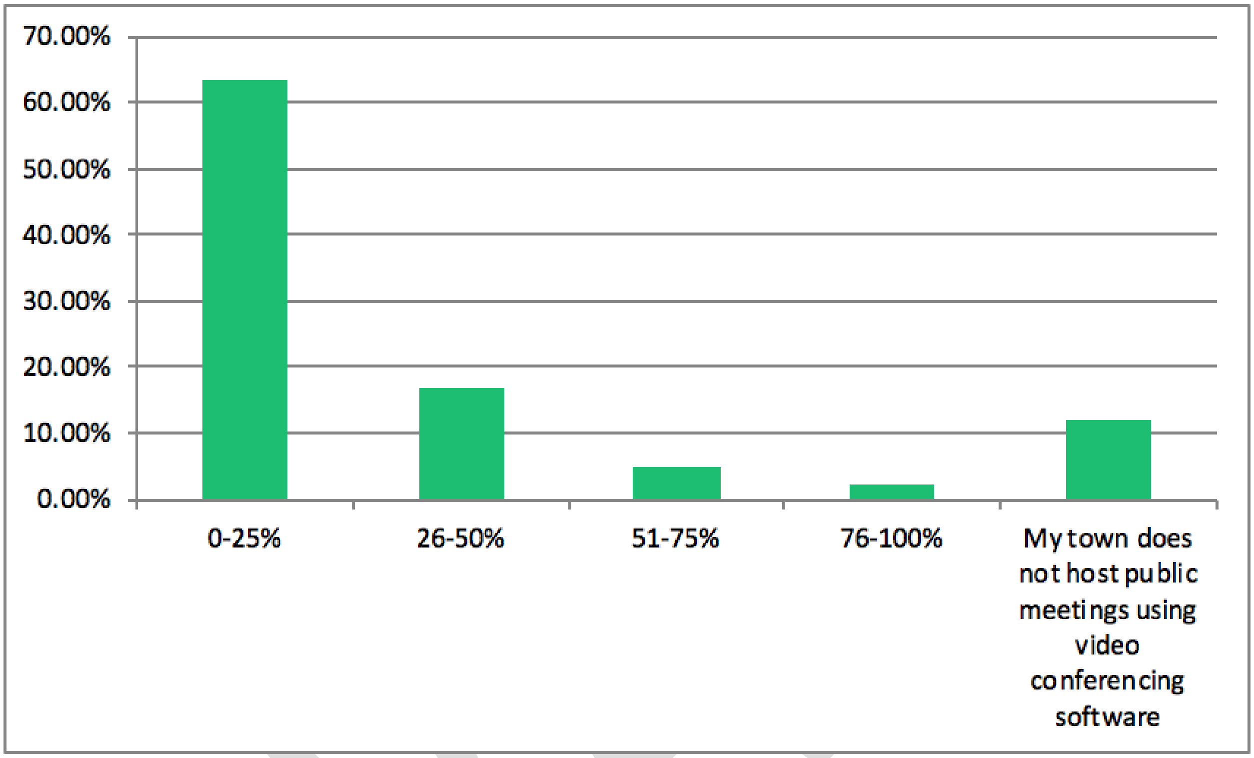
10. Compared to before the Covid-19 pandemic, regardless of being held virtually or in-person, would you say attendance and participation in public meetings has:

Answered: 41 Skipped: 8



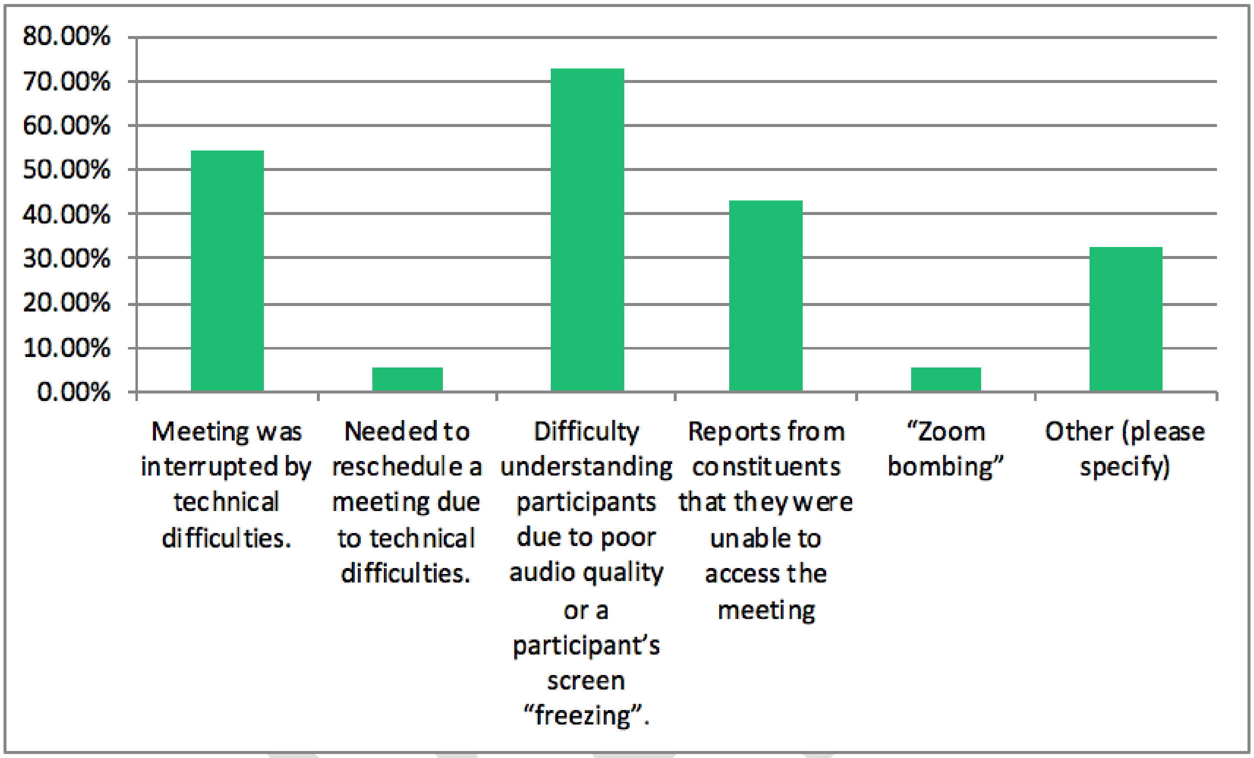
11. If your town hosts public meetings using video conferencing software (e.g., Zoom, Webex), about what percentage of participants are dialing in from a phone?

Answered: 41 Skipped: 8



12. What are the difficulties, if any, with hosting public meetings during the Covid-19 pandemic? (Select all that apply.)

Answered: 37 Skipped: 12

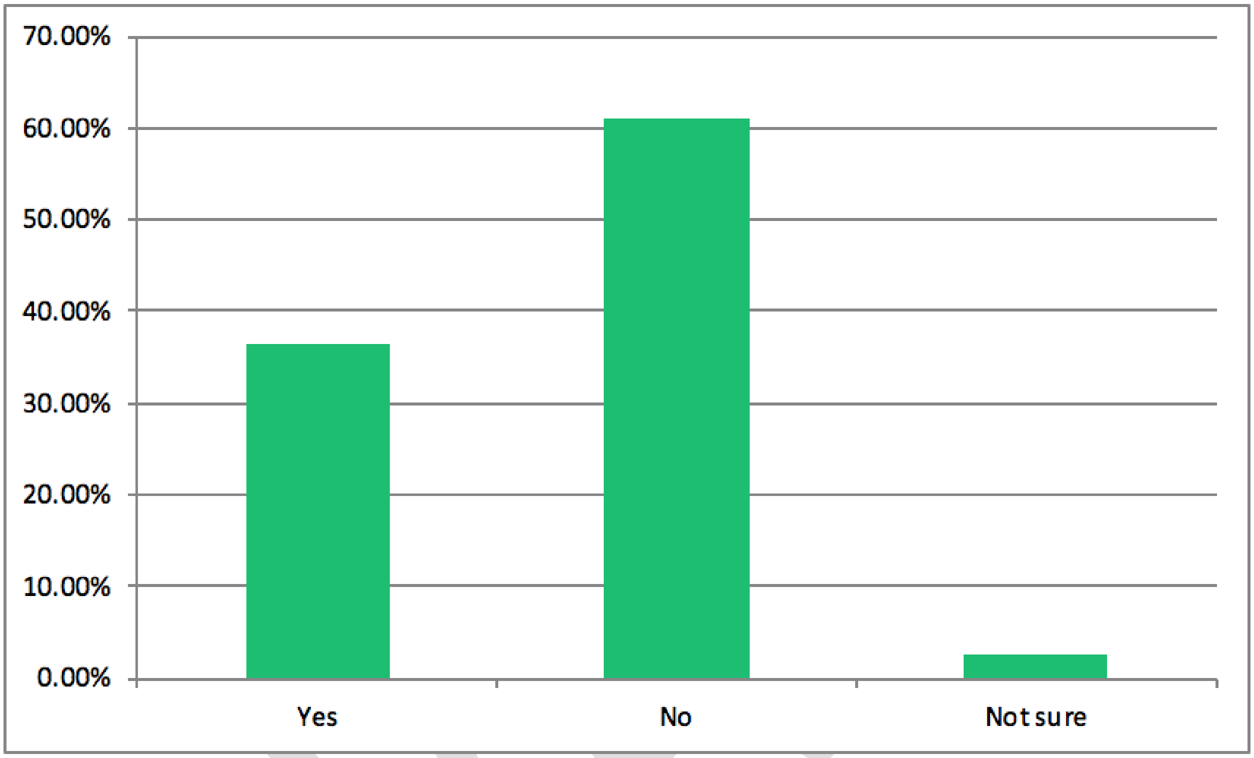


"Other" answers included:

- Excess background noise
- Constituents unable to understand how to use online interface (particularly elderly constituents)

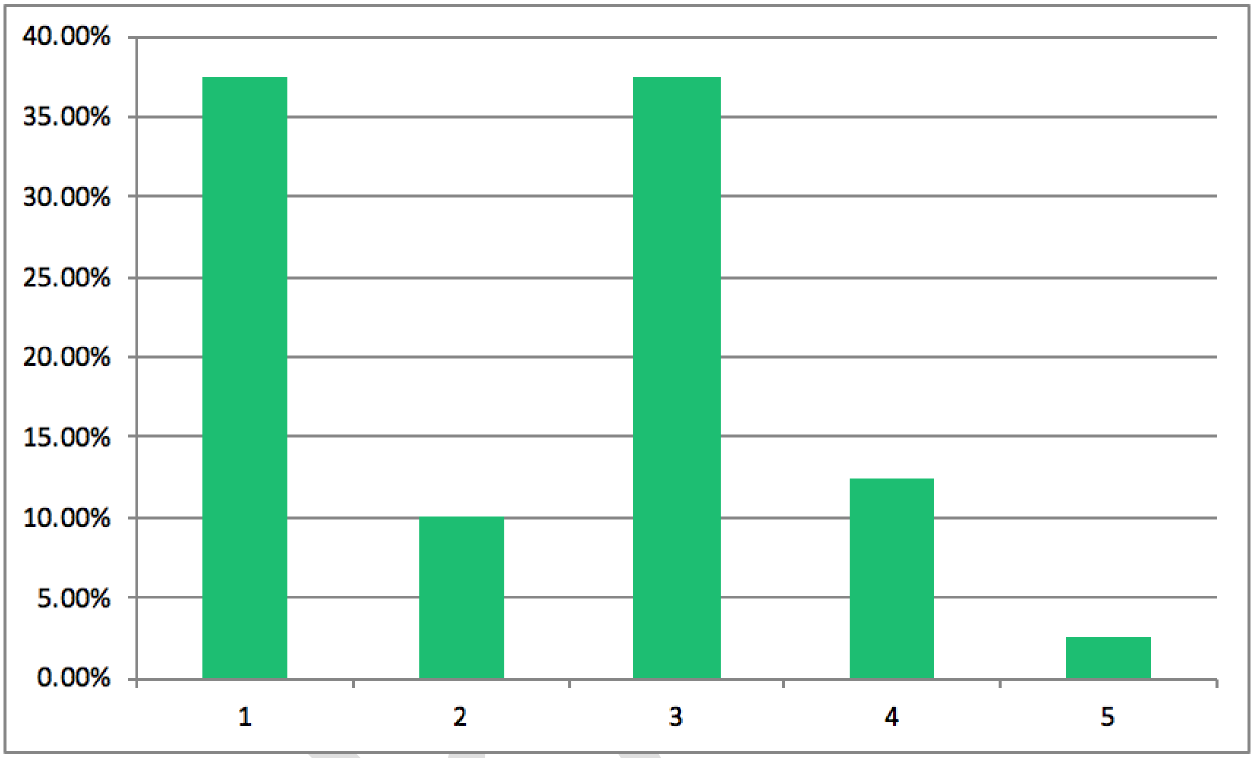
13. Has your town begun planning for an online town meeting, should the pandemic preclude an in-person town meeting this spring?

Answered: 41 Skipped: 8



14. On a scale of 1 to 5, where 1 is not at all confident and 5 is extremely confident, how confident are you that your town could provide an online town meeting that includes all voters at their current levels of connectivity?

Answered: 40 Skipped: 9



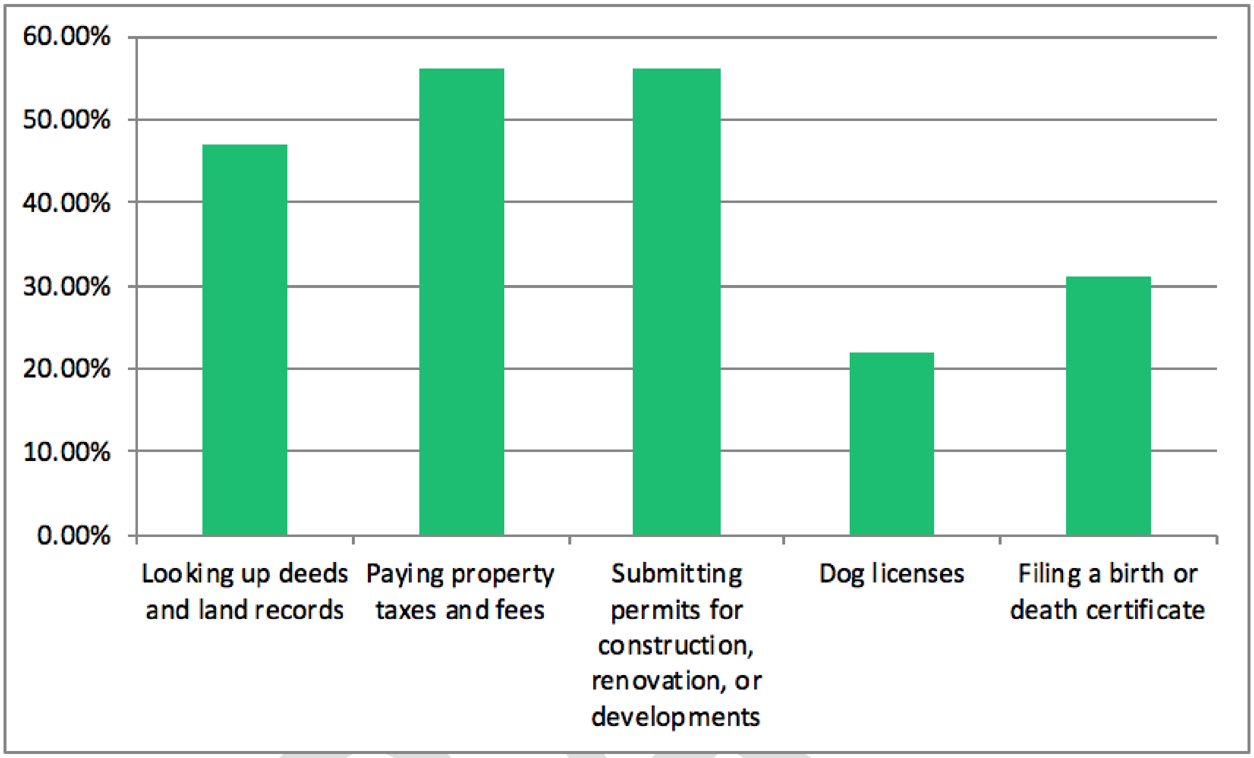
15. What resources would be helpful to your town to ensure all citizens are able to participate in municipal meetings and annual town meetings during the Covid-19 pandemic?

Answered: 36 Skipped: 13

The vast majority of respondents stated that increased high-speed internet access would be most helpful. Other respondents also asked the State to provide guidance as to what the best practices would be for online municipal meetings. How-to videos and technical assistance were also requested.

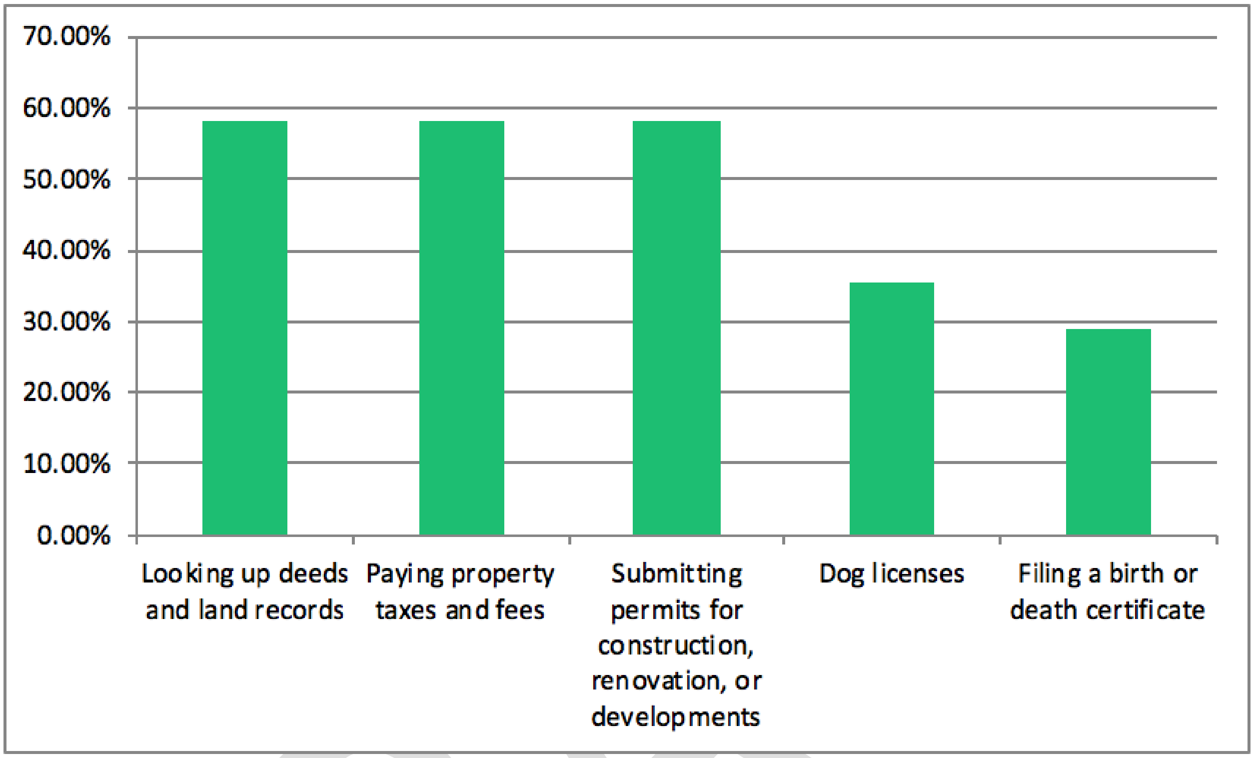
16. BEFORE the pandemic, what municipal functions were available to residents online?

Answered: 32 Skipped: 17



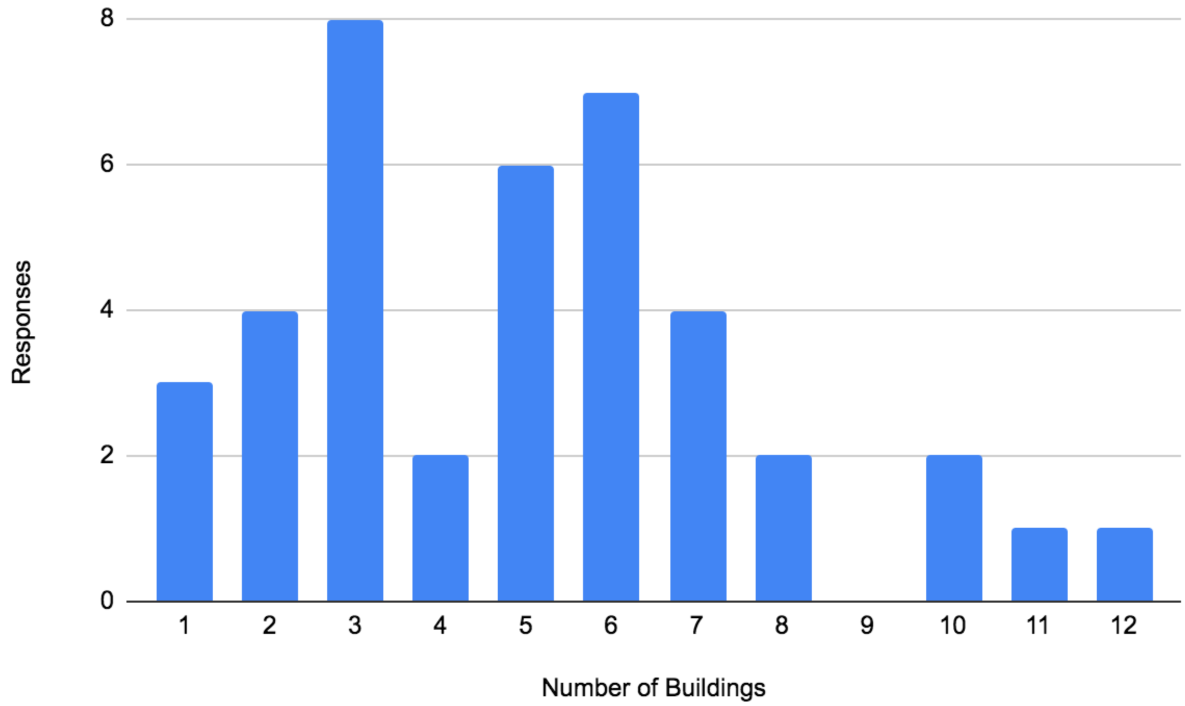
17. DURING the pandemic, which municipal functions are available to residents online?

Answered: 31 Skipped: 18



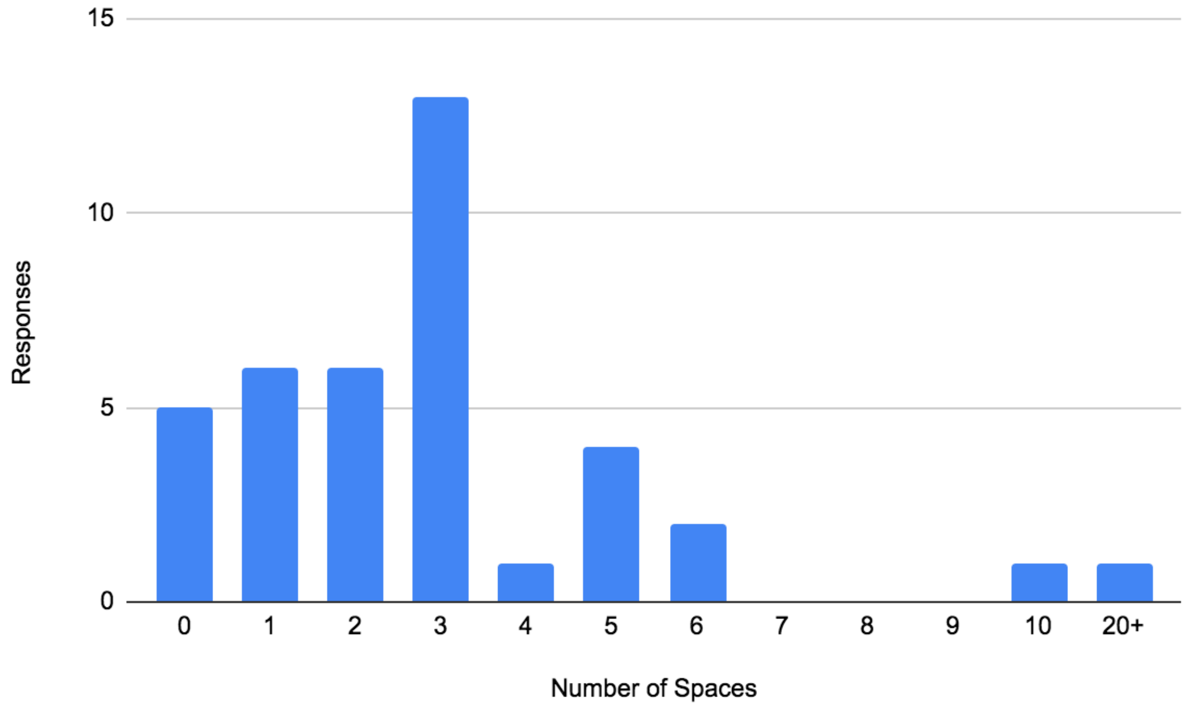
18. Approximately how many buildings in your town are owned or leased by your town?

Answered: 40 Skipped: 9



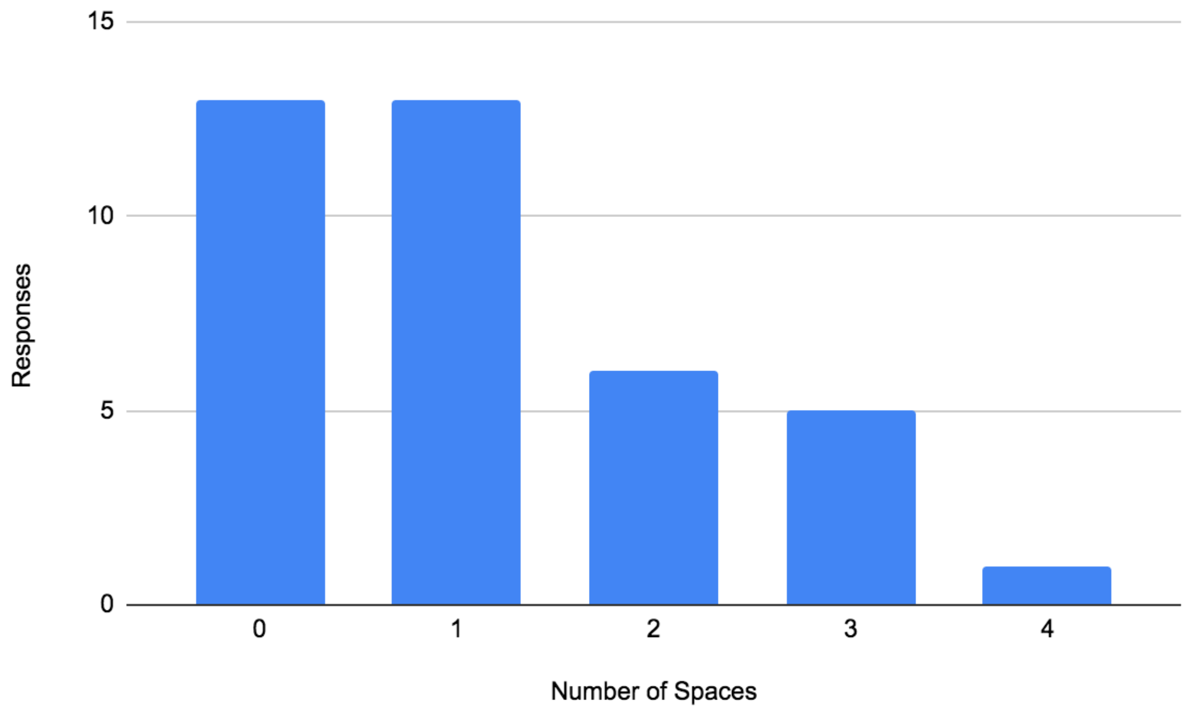
19. How many outdoor spaces of at least one acre (e.g., parks) are owned or leased by your town?

Answered: 39 Skipped: 10



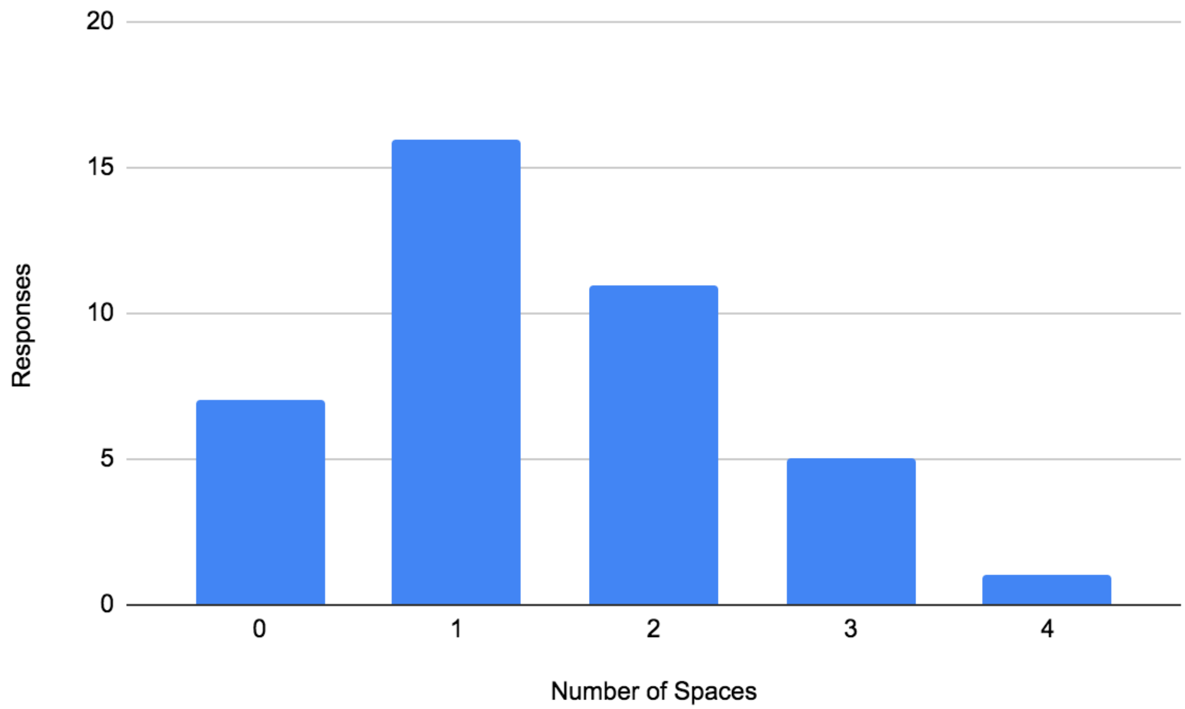
20. BEFORE the Covid-19 pandemic, how many town buildings or outdoor spaces offered public Wi-Fi access?

Answered: 40 Skipped: 9



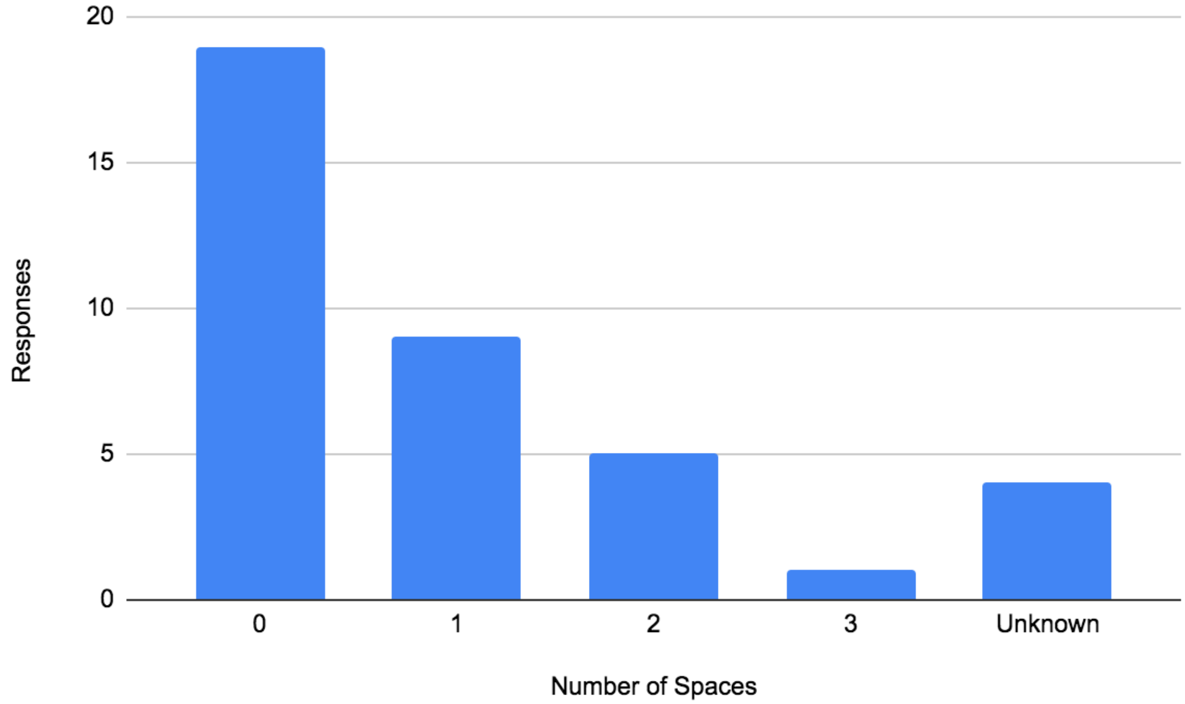
21. DURING the Covid-19 pandemic, how many town buildings or outdoor spaces offer public Wi-Fi access, including places where constituents can connect from a parked vehicle?

Answered: 40 Skipped: 9



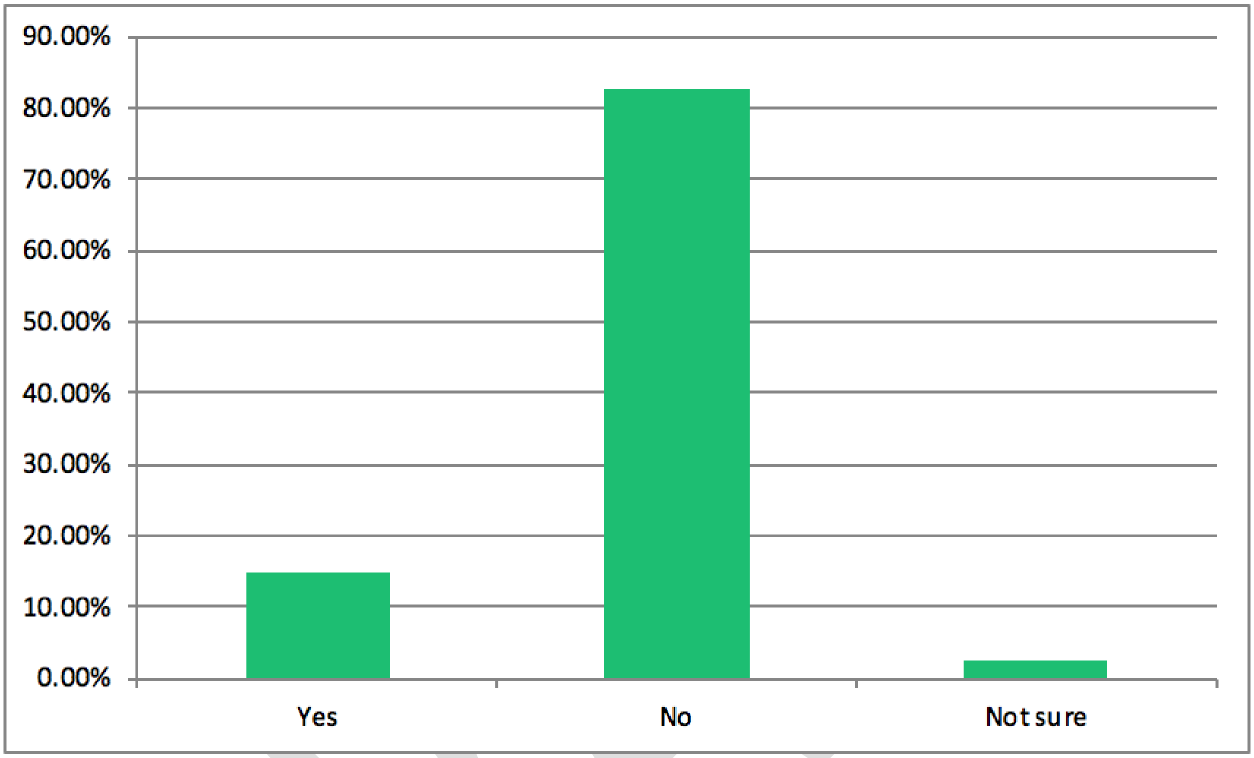
22. Considering town buildings that do not currently offer public Wi-Fi, how many have a fiber internet connection?

Answered: 40 Skipped: 9



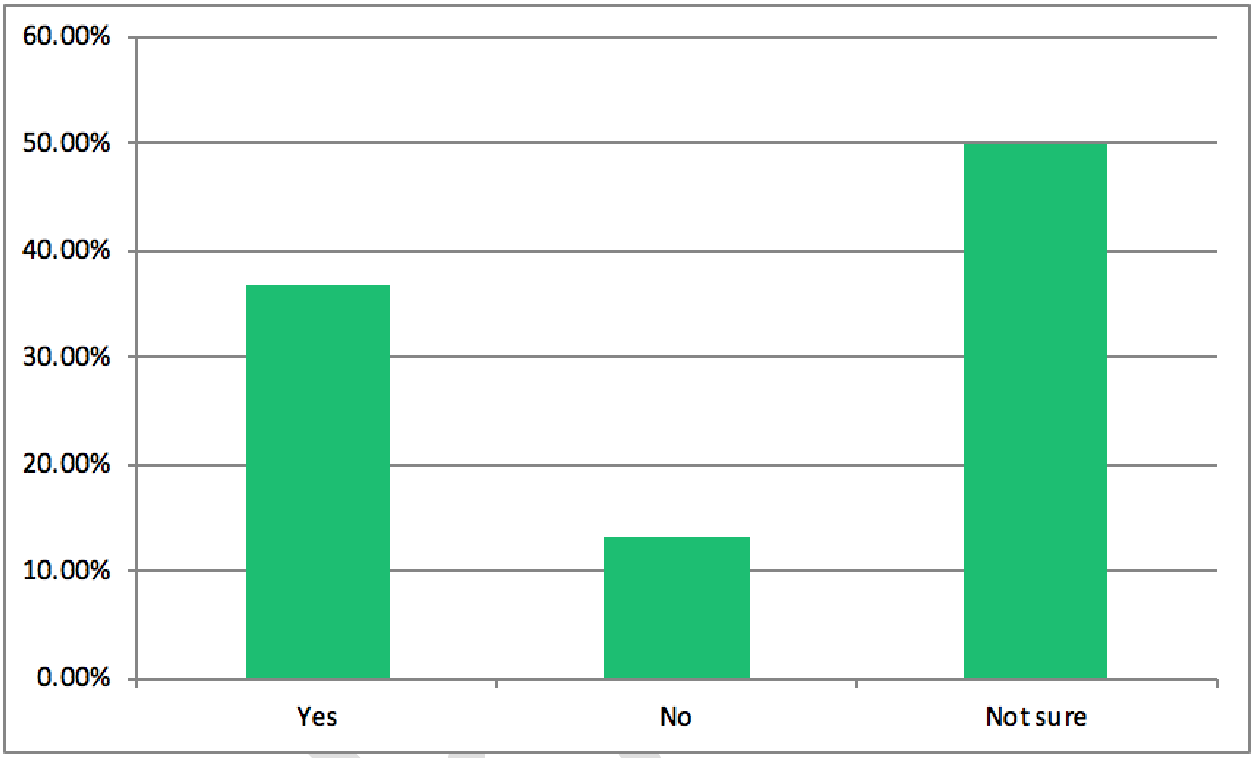
23. Since the start of the Covid-19 pandemic, has the town added equipment to extend or strengthen Wi-Fi signals for these hotspots?

Answered: 40 Skipped: 9



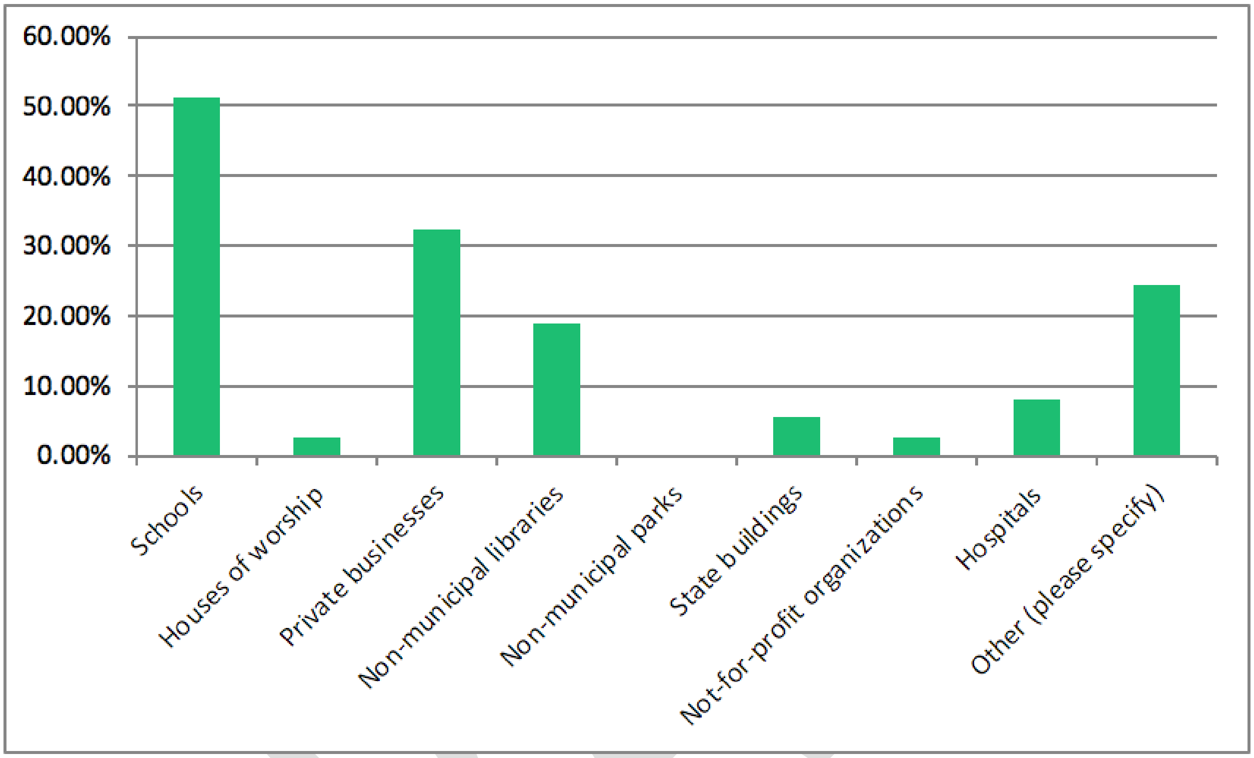
24. If the area around your library has limited broadband or cell service access, would you be willing to participate in a program to install equipment at the library to provide better cell service or broadband to surrounding homes?

Answered: 38 Skipped: 11



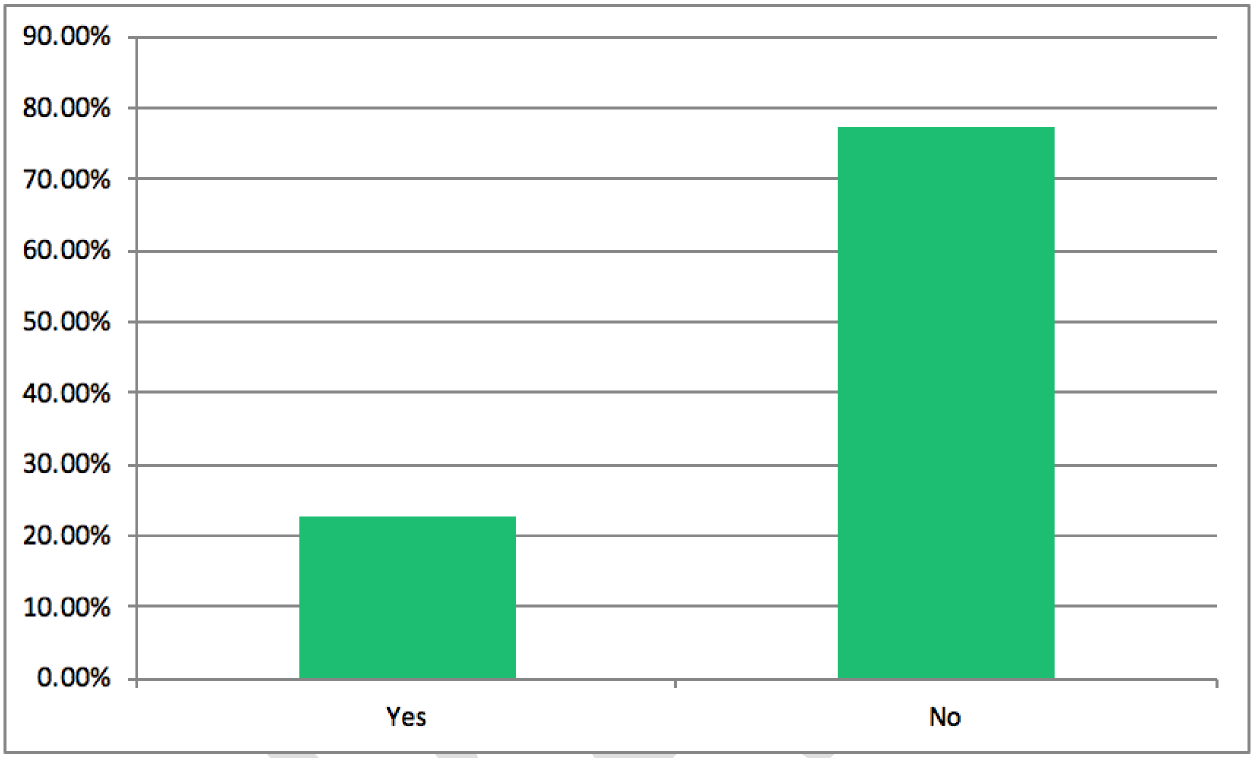
25. Are you aware of free wifi hotspots in your town at the following non-municipal buildings / spaces? (Select all that apply)

Answered: 37 Skipped: 12



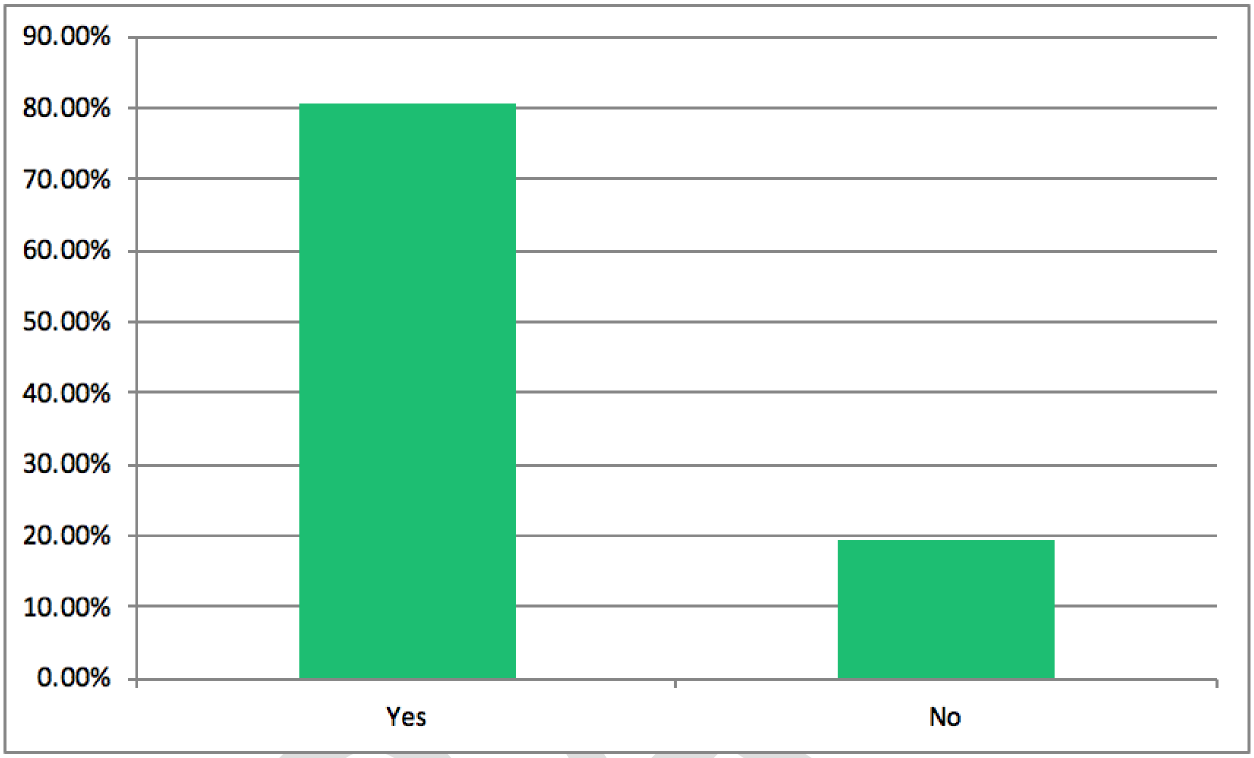
26. Do you believe that there are an adequate number of Wi-Fi hotspots in your town for your constituents?

Answered: 40 Skipped: 9



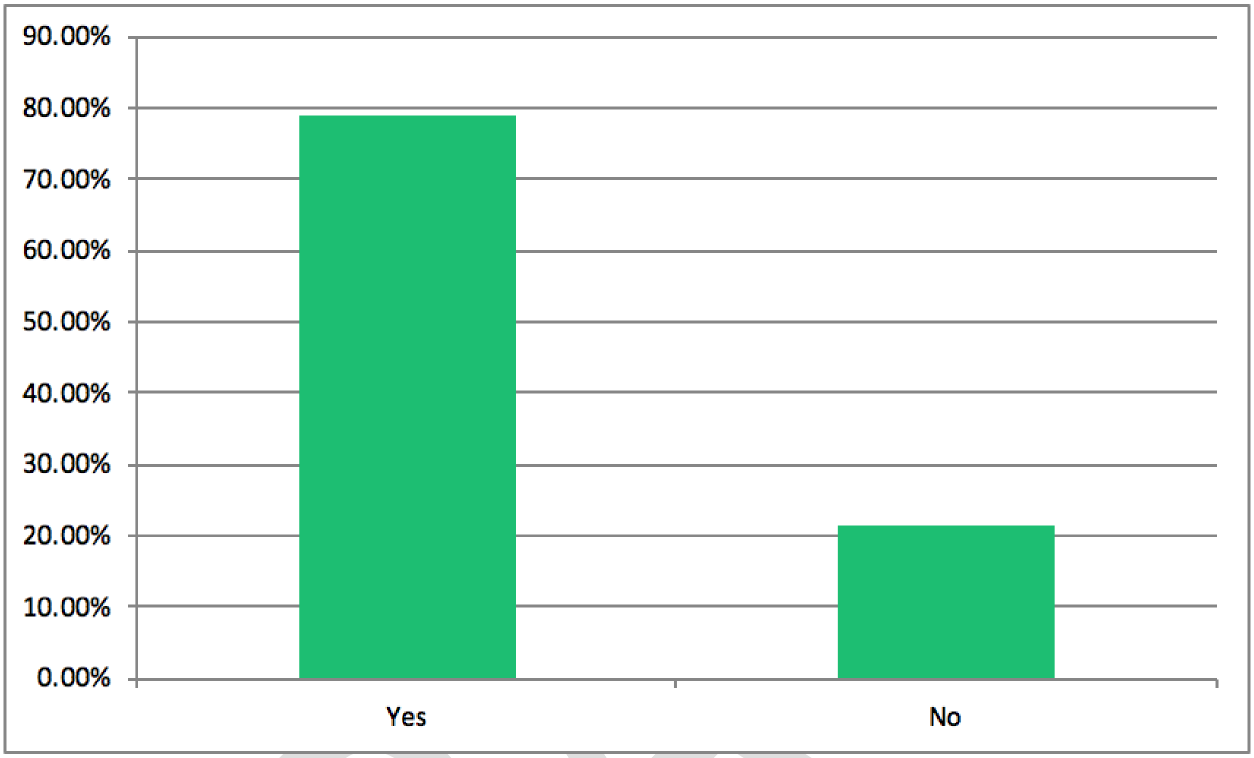
27. Are you aware of towns forming Communication Union Districts (CUD) to provide broadband?

Answered: 41 Skipped: 8



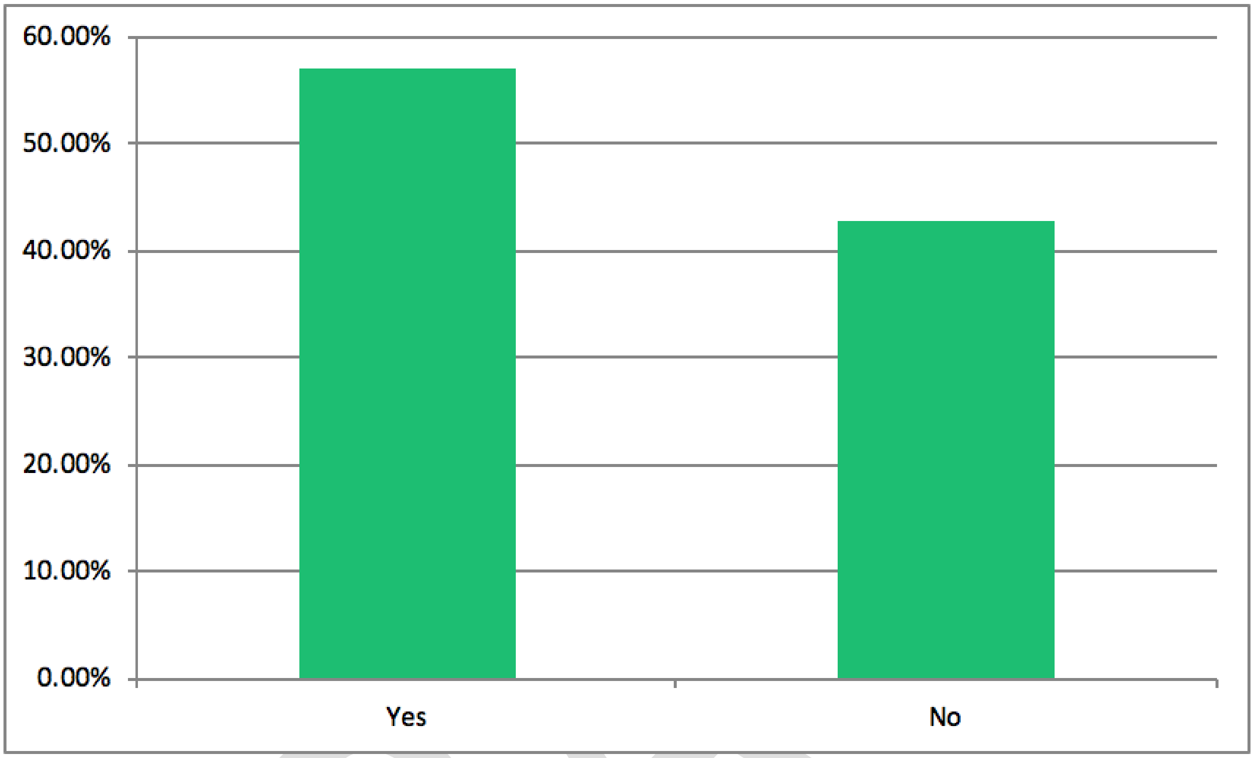
28. Has your town joined a CUD?

Answered: 33 Skipped: 16



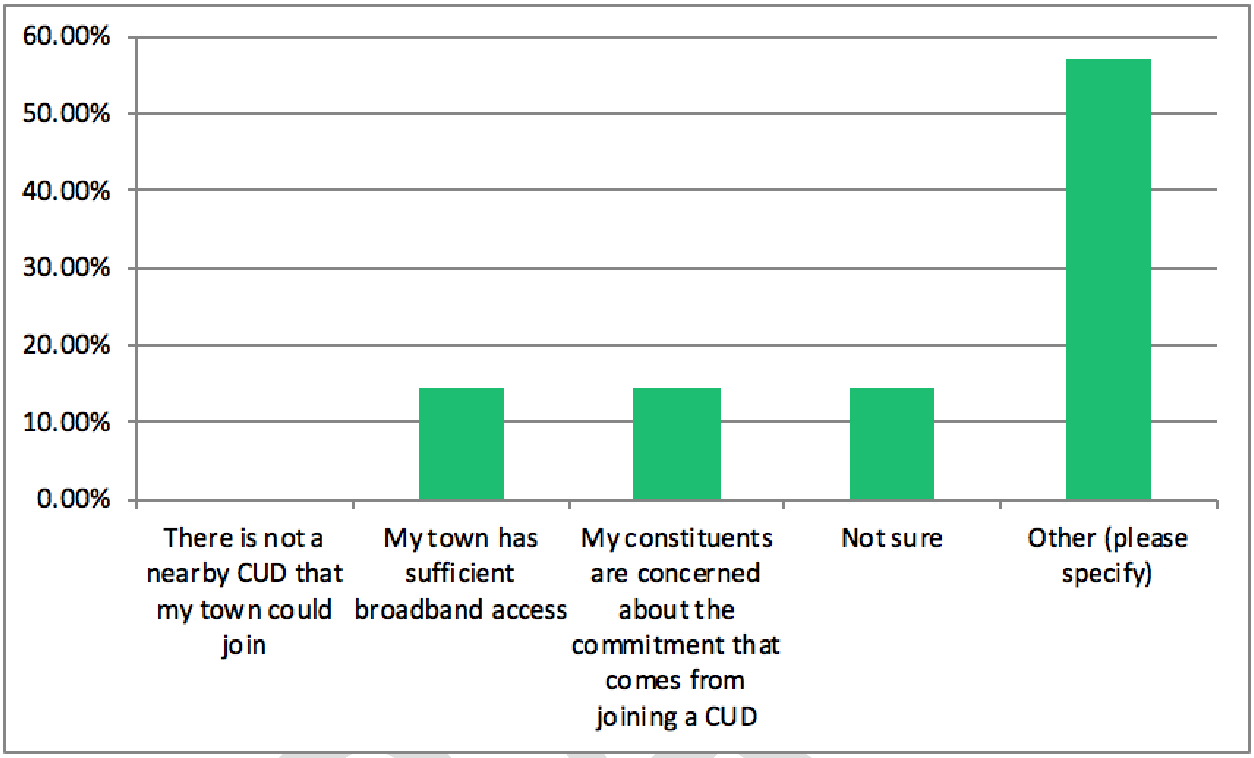
29. Is your town actively considering joining a CUD?

Answered: 7 Skipped: 42



30. Why hasn't your town joined a CUD?

Answered: 7 Skipped: 42

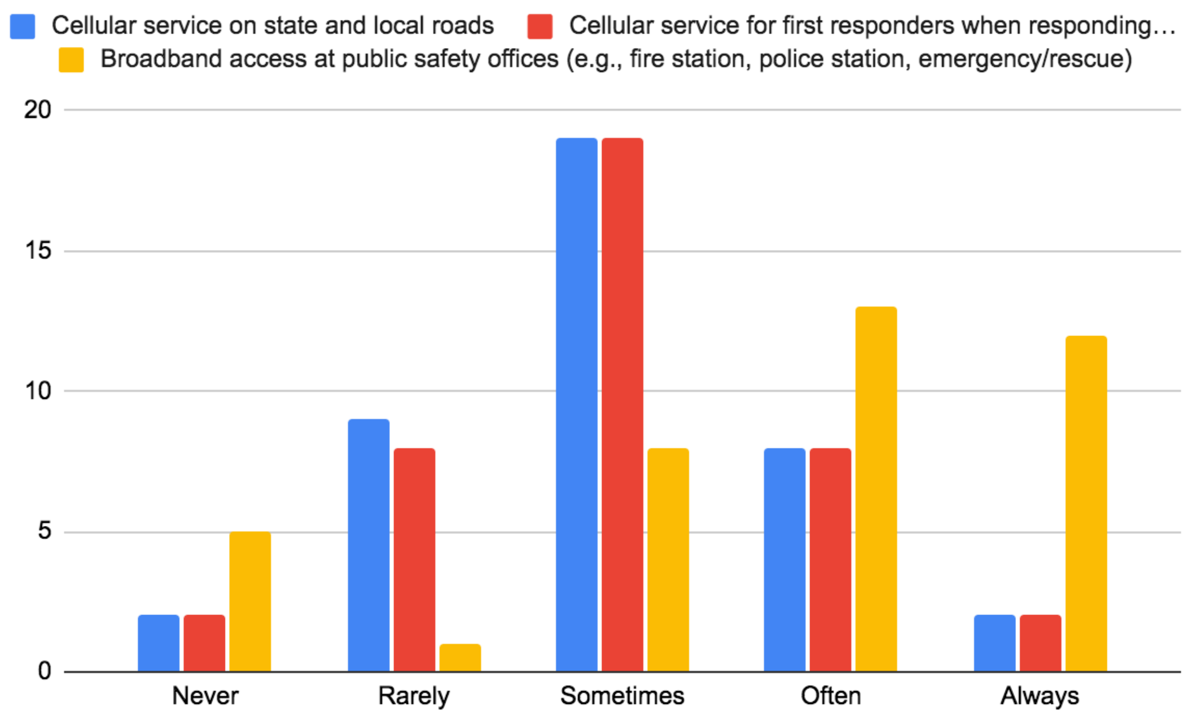


"Other" responses include:

- Still learning about CUDs
- Would prefer to install fiber independently

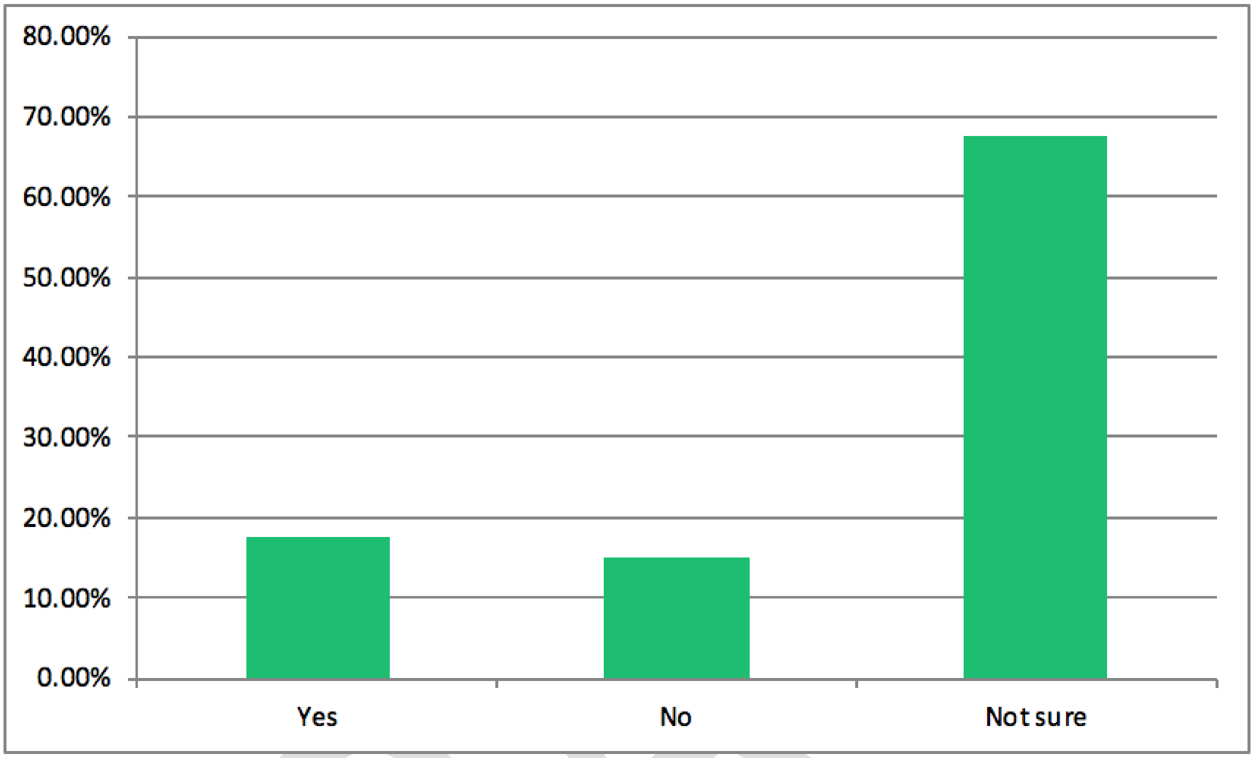
31. How often does the following existing telecommunication coverage meet your town's public safety needs?

Answered: 40 Skipped: 9



32. Have your town's public safety departments adopted FirstNet?

Answered: 40 Skipped: 9



33. Regarding telecommunications access (e.g., internet access, cellular service), what challenges have your public safety departments and staff faced during the Covid-19 pandemic?

Answered: 34 Skipped: 15

The vast majority of respondents stated that lack of cell coverage and internet access were the biggest challenges.

34. What other thoughts, questions or concerns do you have relating to broadband access in your town?

Answered: 24 Skipped: 25

The vast majority of respondents stated that broadband access needs to be increased quickly and affordably.

Appendix F: Summary of ISP Pricing – Vermont and Other States

Vermont Pricing

The table below summarizes the pricing, speed, and availability of services delivered by internet service providers in Vermont:

Provider	Starting price*	Download speed range	Tech	State availability
Xfinity	**$39.99/mo.**	Up to 300 Mbps	Cable	97%
Spectrum	**$49.99/mo.**	Up to 200 Mbps	Cable	39%
CenturyLink	**$49.00/mo.**	Up to 80 Mbps	DSL	93%
Burlington Telecom	**$55.00/mo.**	Up to 150 Mbps	Fiber	28%
Vermont Telephone Company	**$34.95/mo.**	Up to 1,000 Mbps	Fiber	2%
Consolidated Communications	**$62.00/mo.**	Up to 100 Mbps	DSL, fiber	1%
Viasat	**$70.00/mo.**	Up to 12 Mbps	Satellite	99%
HughesNet	**$99.99/mo.**	Up to 25 Mbps	Satellite	56%

*Pricing per month plus taxes for length of contract. Additional fees and terms may apply. Pricing varies by location and availability. All prices subject to change at any time. May or may not be available based on service address. Speeds may vary. As of 09/24/20.

Source: https://www.allconnect.com/local/vt

Pricing in Neighboring States

The following tables include prices presented on the providers' websites:

Table 8: Xfinity/Comcast Pricing

(Mbps)	VT	NH	ME	MA	CT	RI
25	$49.95	$49.95	$49.95	$49.95	$49.95	-
100	$39.99	$77.95	$77.95	$77.95	$77.95	-
200	$54.99	$39.99	$39.99	$39.99	$39.99	-
300	$59.99	$59.99	$59.99	$59.99	$59.99	-
600	$69.99	$69.99	$69.99	$69.99	$69.99	-
1000	$79.99	$79.99	$79.99	$79.99	$79.99	-
2000	$299.95	$299.95	$299.95	$299.95	$299.95	-

Table 9: Consolidated Communications

(Mbps)	VT	NH	ME	MA	CT	RI
10	-	-	-	$27.00	-	-
20	$37.09	-	$37.09	-	-	-
25	-	-	-	$43.95	-	-
40	$47.59	-	$47.59	-	-	-
50	-	$49.89	-	$46.95	-	-
100	-	$62.00	-	-	-	-
1000	-	$74.55	-	-	-	-

The following tables include prices presented on the BroadbandNow website:

Pricing by Provider – National

Table 10: Charter Spectrum

Speed	Price/Month
100/10	$49.99
400/20	$69.99
940/35	$109.99

Table 11:Viasat

Speed	Data Cap in GB	Price/Month
12/3	12	$50
12/3	25	$75
12/3	50	$100
25/3	Unlimited	$150

Table 12:HughesNet

Speed	Data Cap in GB	Price/Month
25/3	10	$49.99
25/3	20	$59.99
25/3	30	$89.99
25/3	50	$139.99

Pricing by Provider – State-Level

Vermont

Table 13:VTel

Speed (Mbps)	Price/Month
1000 (Fiber Optic Internet)	$34.95
1000 (GigE Solo)	$69.95
1000 (GigE Gamer)	$79.95
10,000	$399.95

Table 14:ECFiber

Speed (Mbps)	Price/Month
25	$72.00
100	$104.00
300	$134.00
800	$164.00

Table 15:Burlington Telecom

Speed (Mbps)	Price/Month
5	$40.00
150	$55.00
300	$65.00
1000	$70.00

Table 16:Waitsfield & Champlain Valley Telecom

Speed (Mbps)	Price/Month
10	$46.95
25	$53.95
50	$63.95
100	$76.95
500	$91.95
1000	$103.95

New Hampshire

Table 17:Granite State Communications

Speed (Mbps)	Price/Month
25	$49.95
50	$69.95
100	$89.95

Table 18:Tamworth Wireless Cooperative

Speed (Mbps)	Price/Month
1	$29.99
2	$49.99
3	$69.99
4	$89.99

Maine

Table 19:Coastline Wireless

Speed (Mbps)	Price/Month
20	$39.99
40	$54.99
60	$69.99

Table 20:RedZone

Speed (Mbps)	Price/Month
25	$44.99

Massachusetts

Table 21: Starry Internet

Speed (Mbps)	Price/Month
100	$30
200	$50

Table 22: Net Blazr Inc.

Speed (Mbps)	Price/Month
200	$39.95
1000	$59.95

Table 23: Shrewsbury Electric and Cable Operations

Speed (Mbps)	Price/Month
100	$54.95
200	$69.95
300	$99.95

Connecticut

Table 24: Thames Valley Communications

Speed (Mbps)	Price/Month
6.6	$29.99
110	$39.99
330	$59.99
1000	$79.99

Rhode Island

We did not identify any independent ISPs based in Rhode Island.

Appendix G: Unserved Premises Suitable for Line Extensions

To identify premises suitable for line extensions (see Section 8.2.2.2), we used VT Public Service Department data to identify how many premises in each town are served by 25/3 or not. Using a GIS layer of existing residential cable plant and fiber plant, we ran a geospatial analysis to determine how many unserved premises were within half a mile, and then within a mile, of the existing infrastructure. We then calculated how many unserved premises fell within that 0.5 mile or 1 mile "buffer" that extended beyond the existing plant, as well as how many road miles fell within the same buffer. This allowed us to understand the number and density of unserved premises in every town that could be covered by building on roads within half a mile or a mile of existing plant.

After running this calculation for every town, we then sorted towns by the percentage coverage of 25/3 service they already had. Our assumption was that the "pockets" of unserved premises that should be targeted would be found in towns with robust existing covers; a town with only 50 percent coverage was likely to have large, contiguous unserved areas, whereas a town with 90 percent coverage was less likely.

After removing the towns with 100 percent coverage, like Springfield, we arrived at a list of towns that were almost fully covered, but still had unserved premises within 0.5 or 1 mile of existing plant. The table below lists the 39 towns with more than 85 percent existing coverage, and with premises that according to the analysis could be served by line extensions. Maps following the table illustrate the unserved premises in the towns.

Table 25: Details on Line Extensions by Town

Town	County	Total Premises	Premises Served by 25/3	Estimated % of Road Miles Covered by Cable/Fiber	Unserved Premises	Unserved Prems Within 0.5 Mile of Any cable/fiber	Unserved Prems Within 1 Mile of Any Cable/Fiber	Unserved Road Miles	Density of Unserved Road Miles
ANDOVER	Windsor	471	470	99.13	1	1	1	0.40	2.50
ATHENS	Windham	259	258	97.45	1	1	1	0.48	2.10
BARRE TOWN	Washington	3357	3268	96.28	89	86	89	2.51	35.51
BENNINGTON	Bennington	6151	6083	85.03	68	39	50	12.37	4.04
BRIDGEWATER	Windsor	647	610	90.18	37	31	37	5.85	6.32
BROOKFIELD	Orange	750	712	88.91	38	38	38	8.75	4.34
BUELS GORE	Chittenden	16	14	90.62	2	1	2	0.31	6.55

Town	County	Total Premises	Premises Served by 25/3	Estimated % of Road Miles Covered by Cable/Fiber	Unserved Premises	Unserved Prems Within 0.5 Mile of Any cable/fiber	Unserved Prems Within 1 Mile of Any Cable/Fiber	Unserved Road Miles	Density of Unserved Road Miles
BURLINGTON	Chittenden	11817	11807	95.76	10	10	10	1.16	8.59
CHARLOTTE	Chittenden	1891	1636	87.32	255	247	255	11.04	23.10
CHESTER	Windsor	1759	1758	99.22	1	1	1	0.73	1.36
CLARENDON	Rutland	1191	1154	93.67	37	37	37	3.35	11.06
COLCHESTER	Chittenden	6461	6333	87.63	128	71	127	10.39	12.23
DANBY	Rutland	793	791	99.41	2	2	2	0.32	6.16
ESSEX	Chittenden	7324	7165	86.24	159	127	159	10.49	15.16
GRAND ISLE	Grand Isle	1316	1306	89.88	10	5	6	4.63	1.29
HARTLAND	Windsor	1625	1582	97.18	43	43	43	2.45	17.59
HIGHGATE	Franklin	1833	1794	90.04	39	35	39	8.27	4.72
IRA	Rutland	225	212	87.97	13	10	13	2.35	5.53
KILLINGTON	Rutland	1387	1377	94.24	10	9	10	3.34	3.00
LEICESTER	Addison	699	673	86.90	26	21	25	3.91	6.39
MIDDLETOWN SPRINGS	Rutland	450	447	99.25	3	3	3	0.28	10.85
MONTPELIER	Washington	2900	2894	98.75	6	6	6	0.29	20.97
MOUNT HOLLY	Rutland	1123	1107	98.12	16	16	16	1.43	11.20
NEWPORT CITY	Orleans	1883	1868	95.05	15	8	15	0.87	17.22
PLYMOUTH	Windsor	841	744	90.68	97	48	85	6.66	12.77
POMFRET	Windsor	578	500	85.92	78	75	78	9.14	8.53
RICHMOND	Chittenden	1756	1667	87.78	89	82	89	6.60	13.48
ROCKINGHAM	Windham	2176	2119	91.73	57	46	57	5.82	9.79
RUTLAND	Rutland	1842	1821	97.53	21	21	21	0.95	22.18
SHARON	Windsor	750	689	87.34	61	60	61	8.34	7.31
SHREWSBURY	Rutland	609	590	92.96	19	12	19	4.93	3.85
SOUTH BURLINGTON	Chittenden	7010	6971	94.69	39	38	38	2.27	16.74

Town	County	Total Premises	Premises Served by 25/3	Estimated % of Road Miles Covered by Cable/Fiber	Unserved Premises	Unserved Prems Within 0.5 Mile of Any cable/fiber	Unserved Prems Within 1 Mile of Any Cable/Fiber	Unserved Road Miles	Density of Unserved Road Miles
SOUTH HERO	Grand Isle	1539	1510	85.48	29	13	25	6.49	3.85
SWANTON	Franklin	3110	2916	85.54	194	180	185	11.73	15.78
THETFORD	Orange	1416	1308	90.49	108	105	108	7.12	15.17
VERNON	Windham	886	837	86.28	49	30	49	4.35	11.27
WELLS	Rutland	964	945	91.80	19	16	19	3.29	5.77
WEST WINDSOR	Windsor	740	656	92.75	84	84	84	3.39	24.81
WILLISTON	Chittenden	4361	4241	85.77	120	104	120	9.60	12.51
						Total unserved miles		186.63	
						Cost at 30,000/ mile		$5,598,974	

Figure 126: Unserved Premises Suitable for Line Extensions in Andover

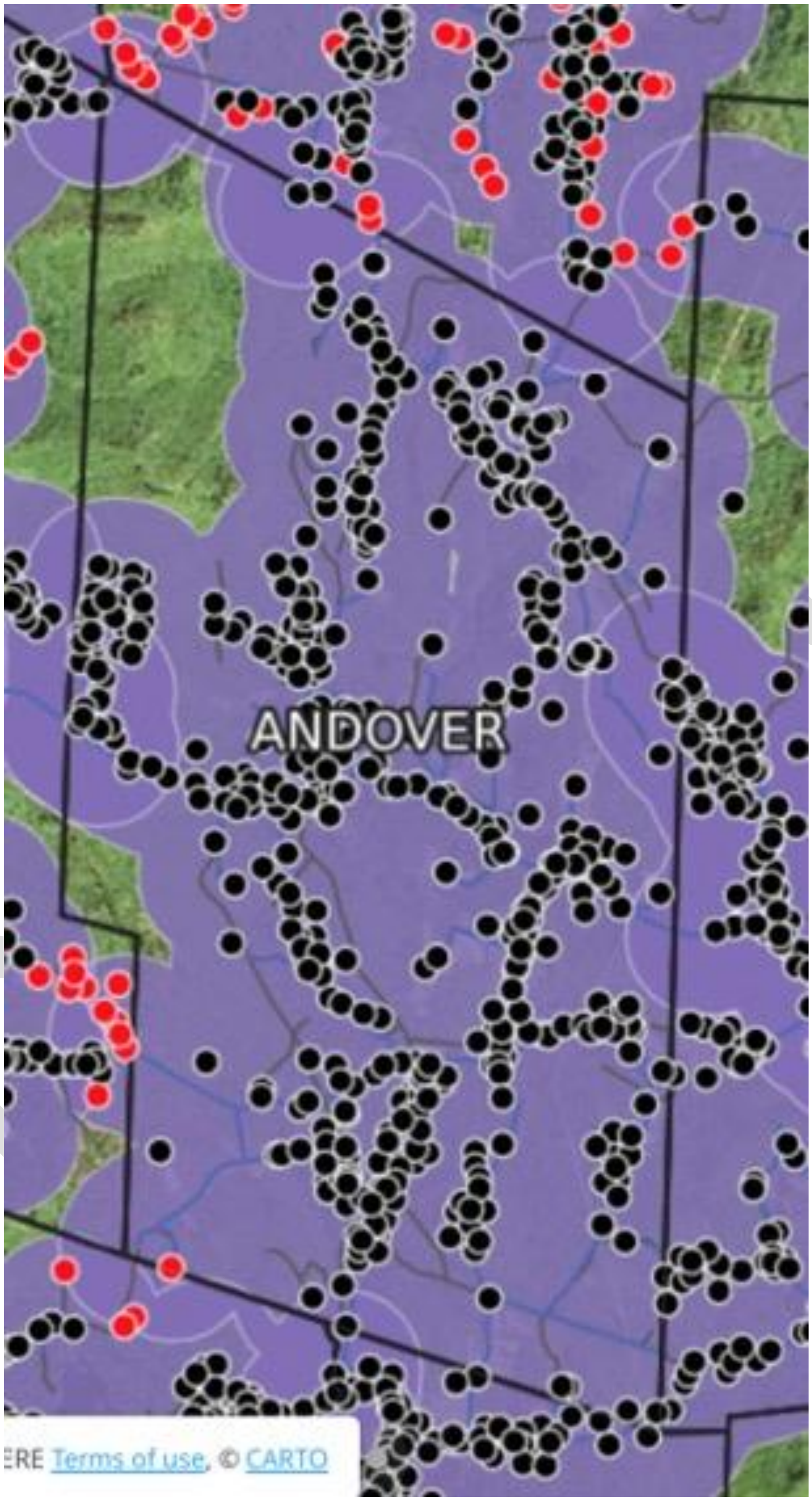


Figure 127: Unserved Premises Suitable for Line Extensions in Athens

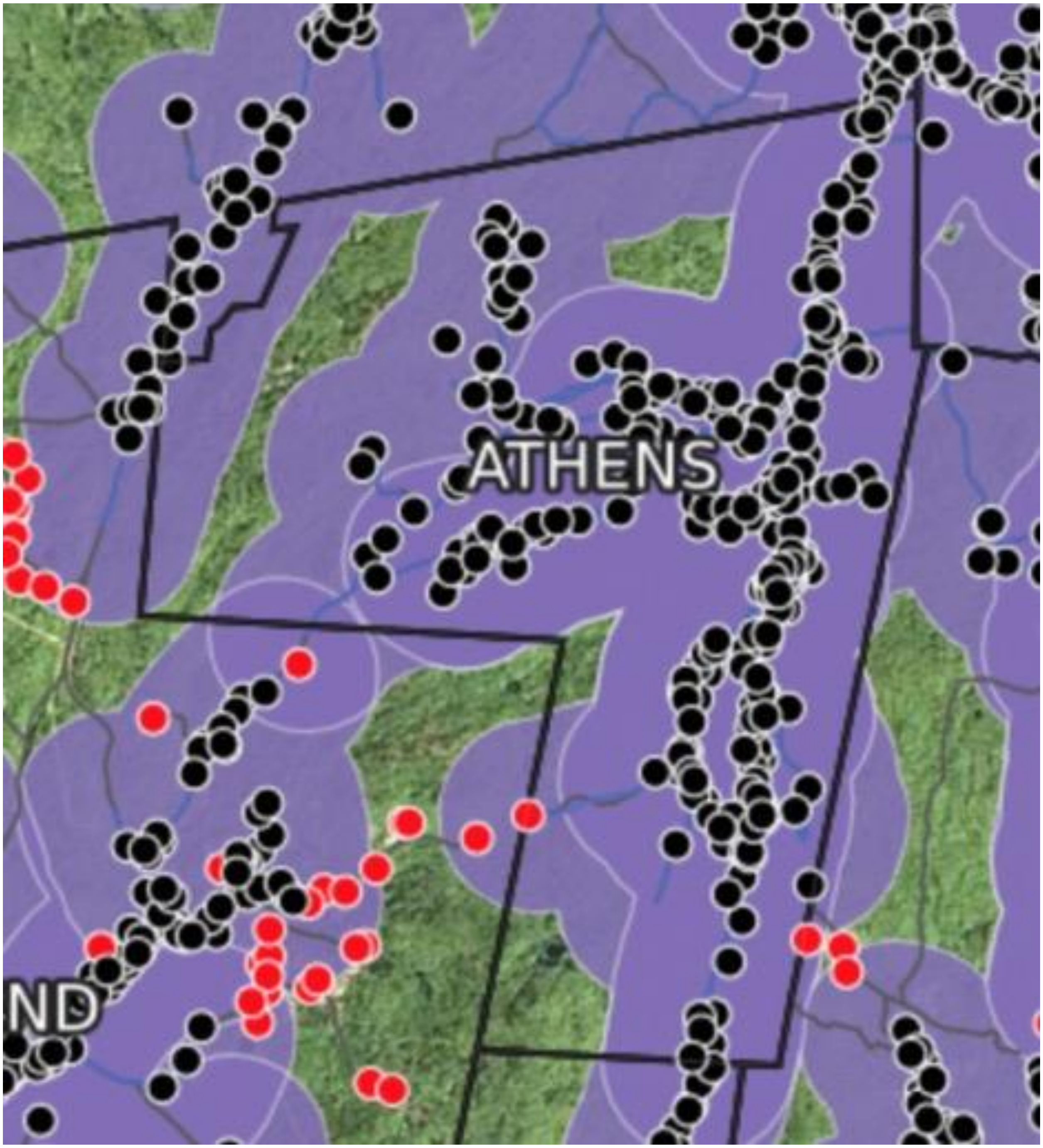


Figure 128: Unserved Premises Suitable for Line Extensions in Town of Barre

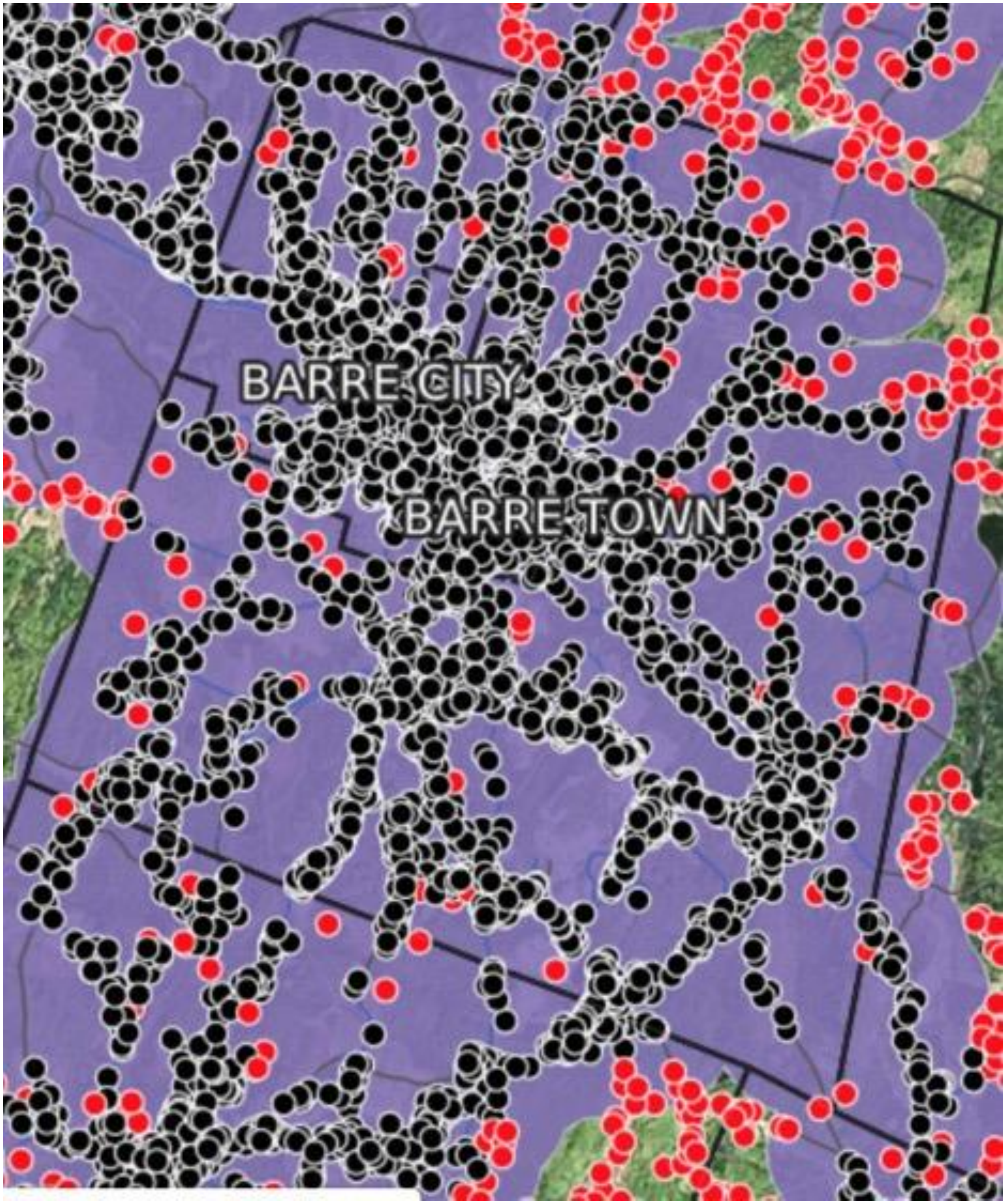


Figure 129: Unserved Premises Suitable for Line Extensions in Bennington

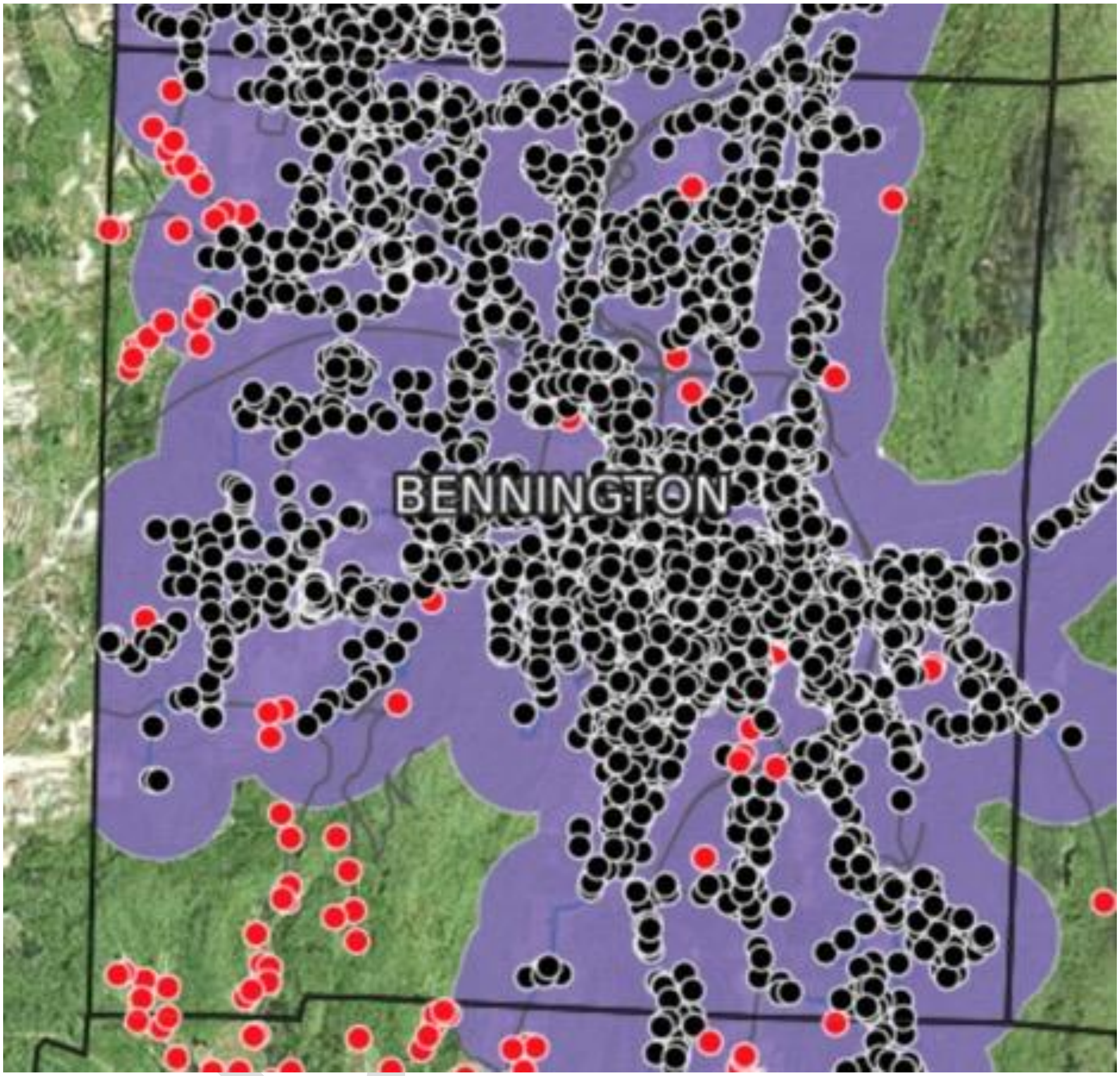


Figure 130: Unserved Premises Suitable for Line Extensions in Bridgewater

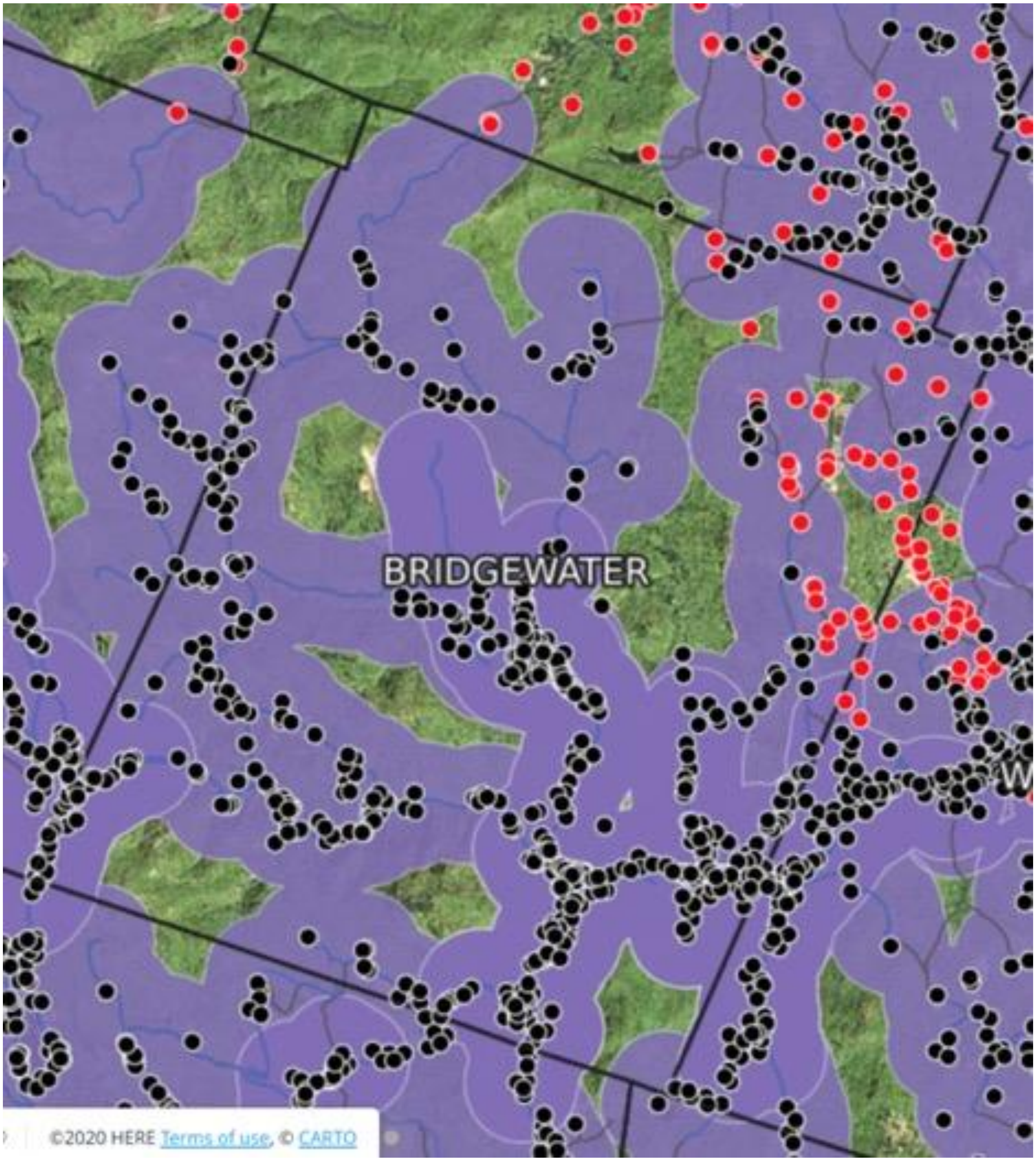


Figure 131: Unserved Premises Suitable for Line Extensions in Brookfield

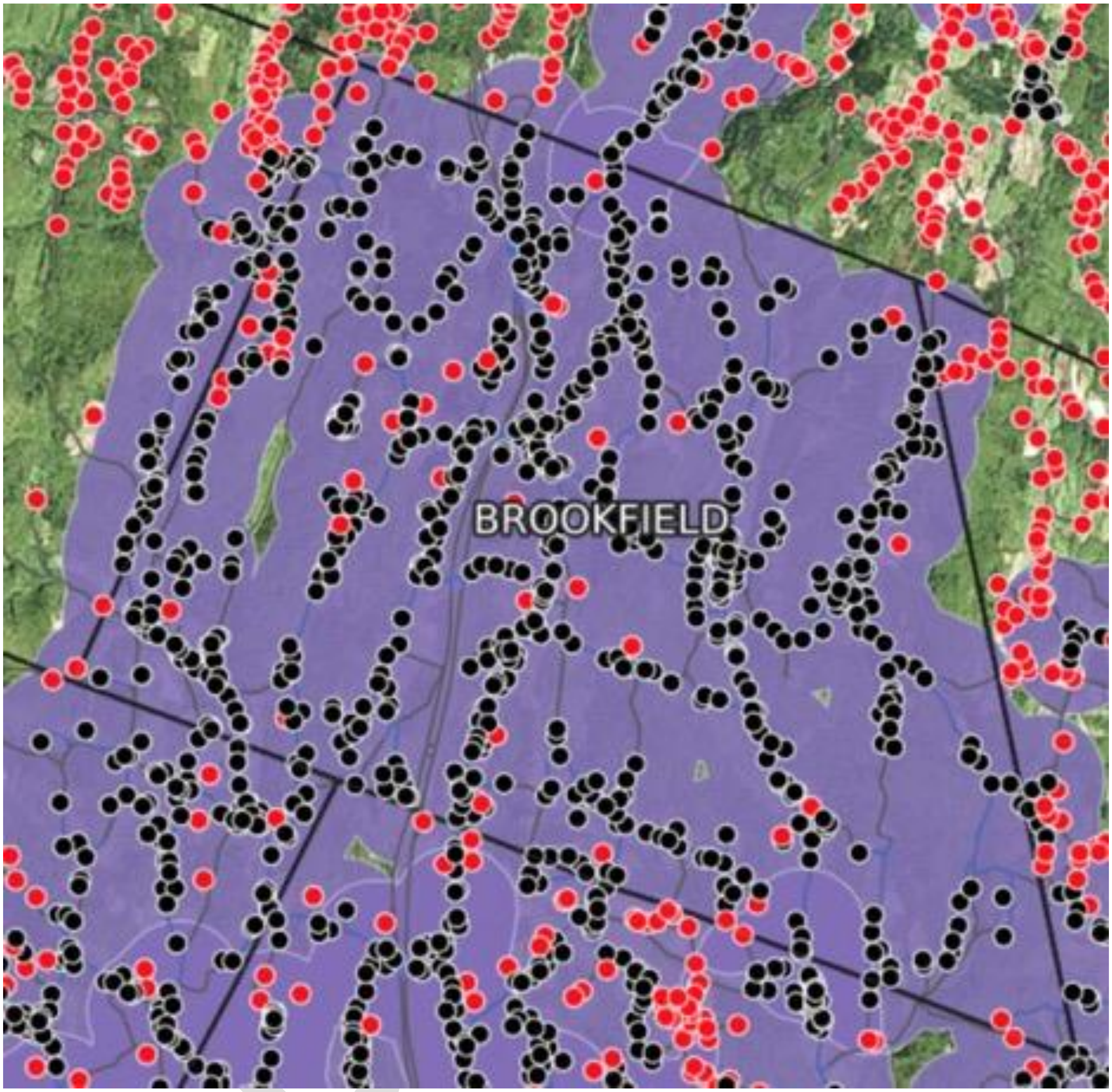


Figure 132: Unserved Premises Suitable for Line Extensions in Buels Gore

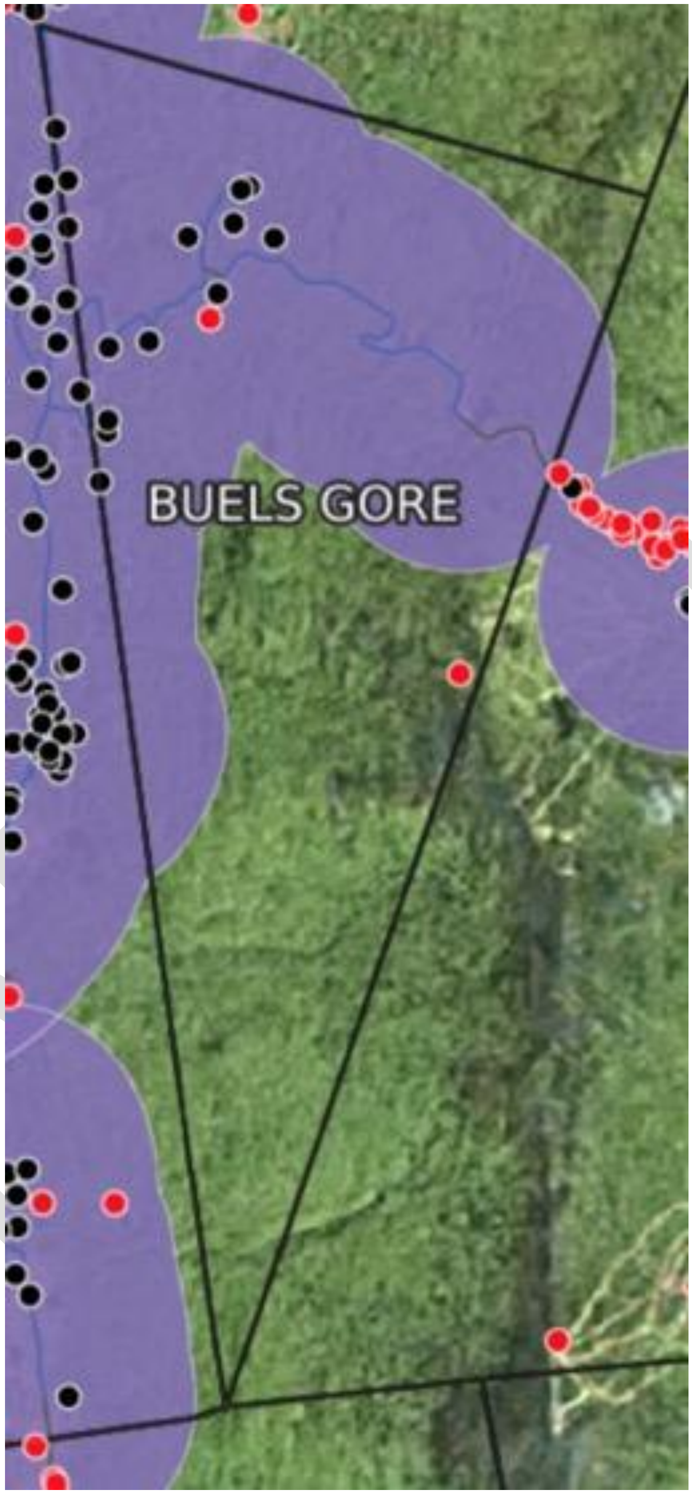


Figure 133: Unserved Premises Suitable for Line Extensions in Burlington

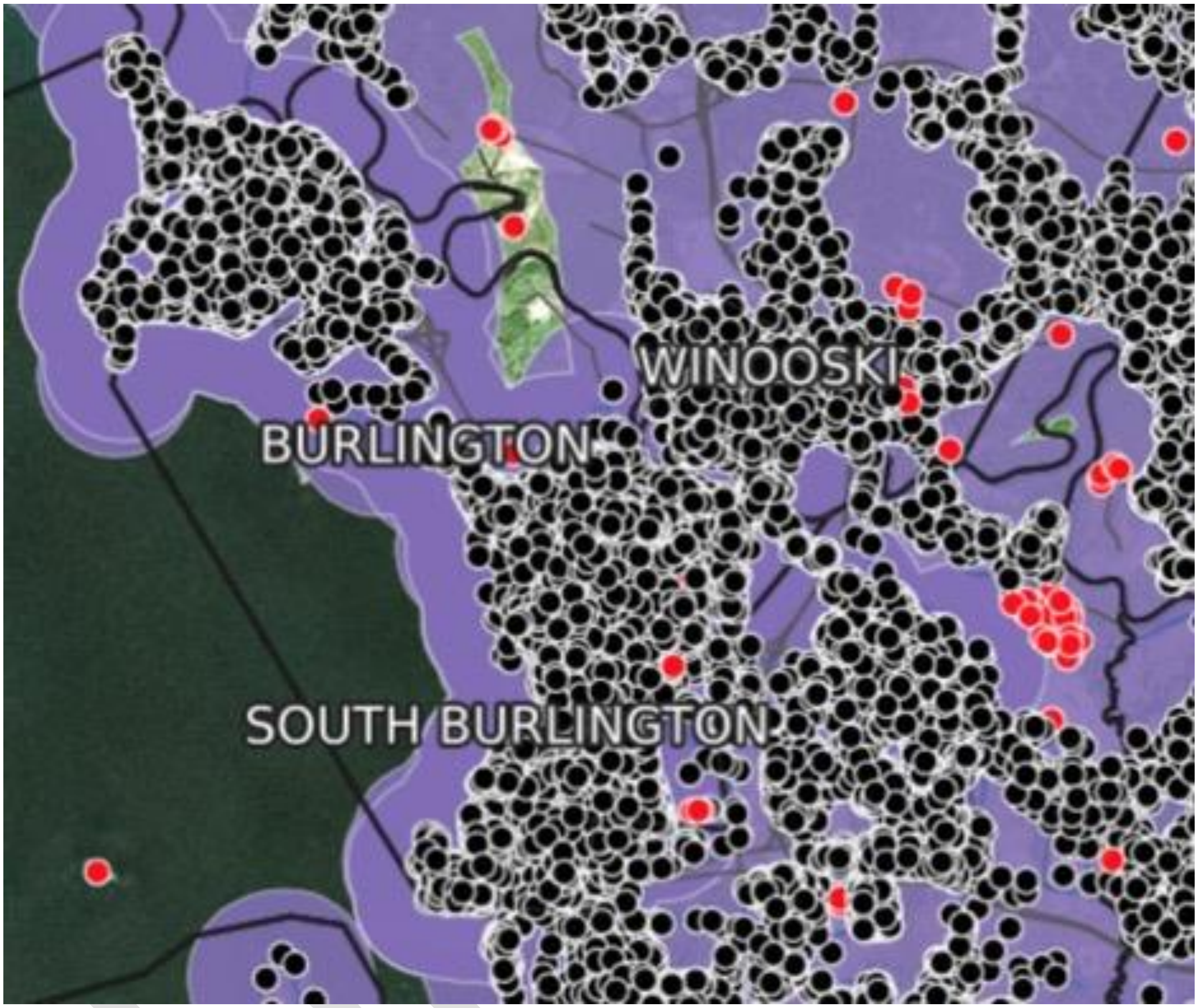


Figure 134: Unserved Premises Suitable for Line Extensions in Charlotte

Figure 135: Unserved Premises Suitable for Line Extensions in Chester

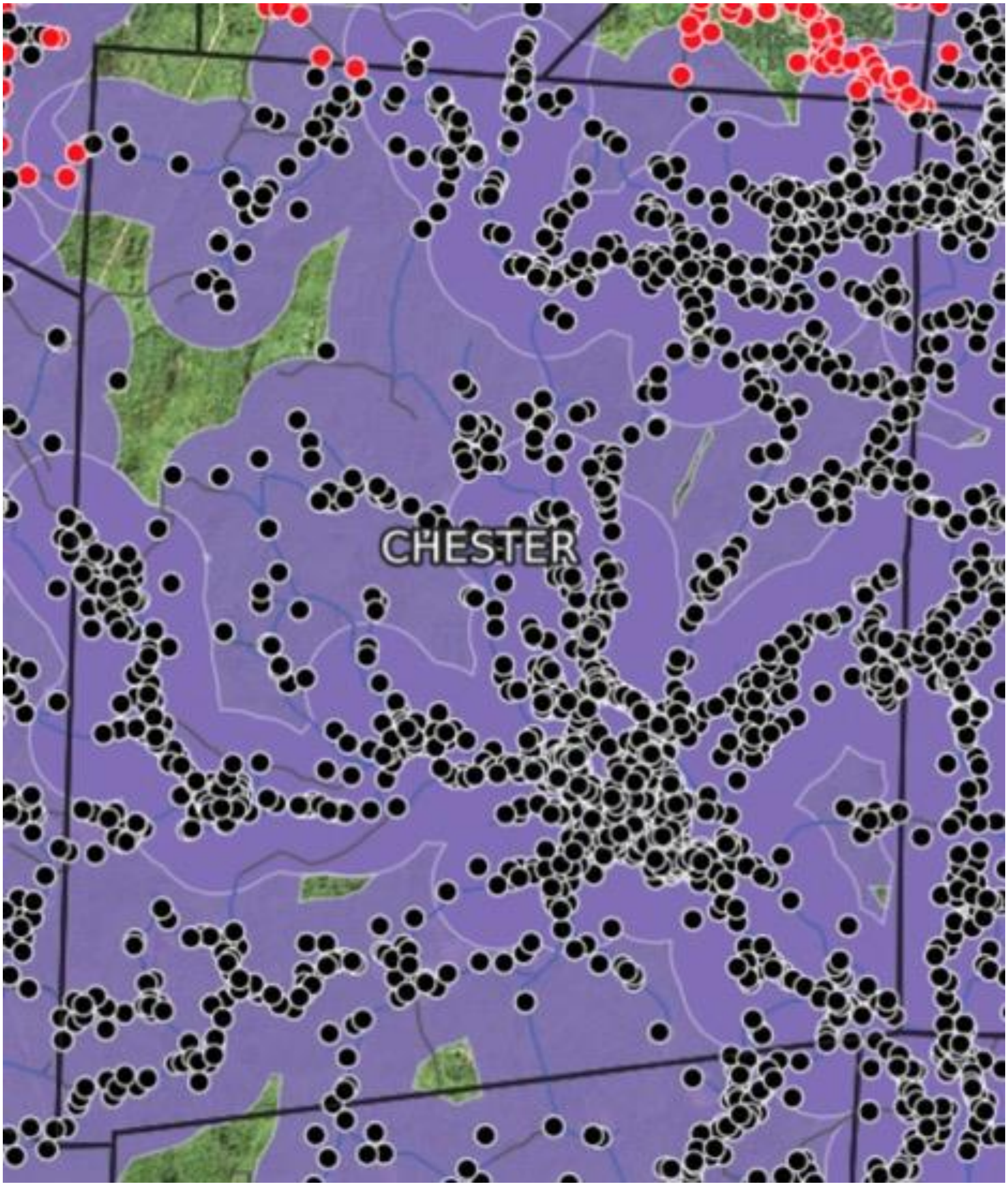


Figure 136: Unserved Premises Suitable for Line Extensions in Clarendon

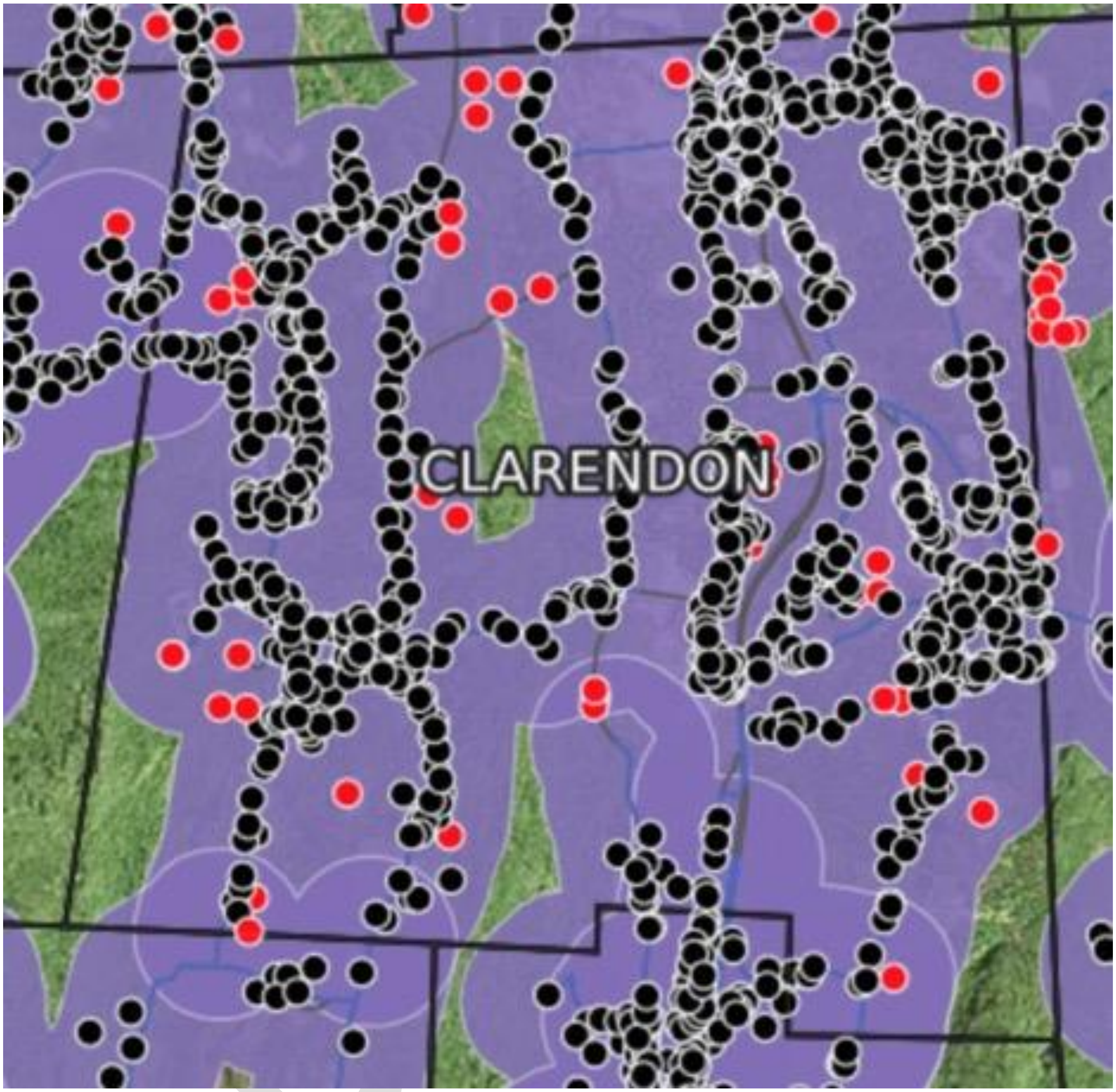


Figure 137: Unserved Premises Suitable for Line Extensions in Colchester

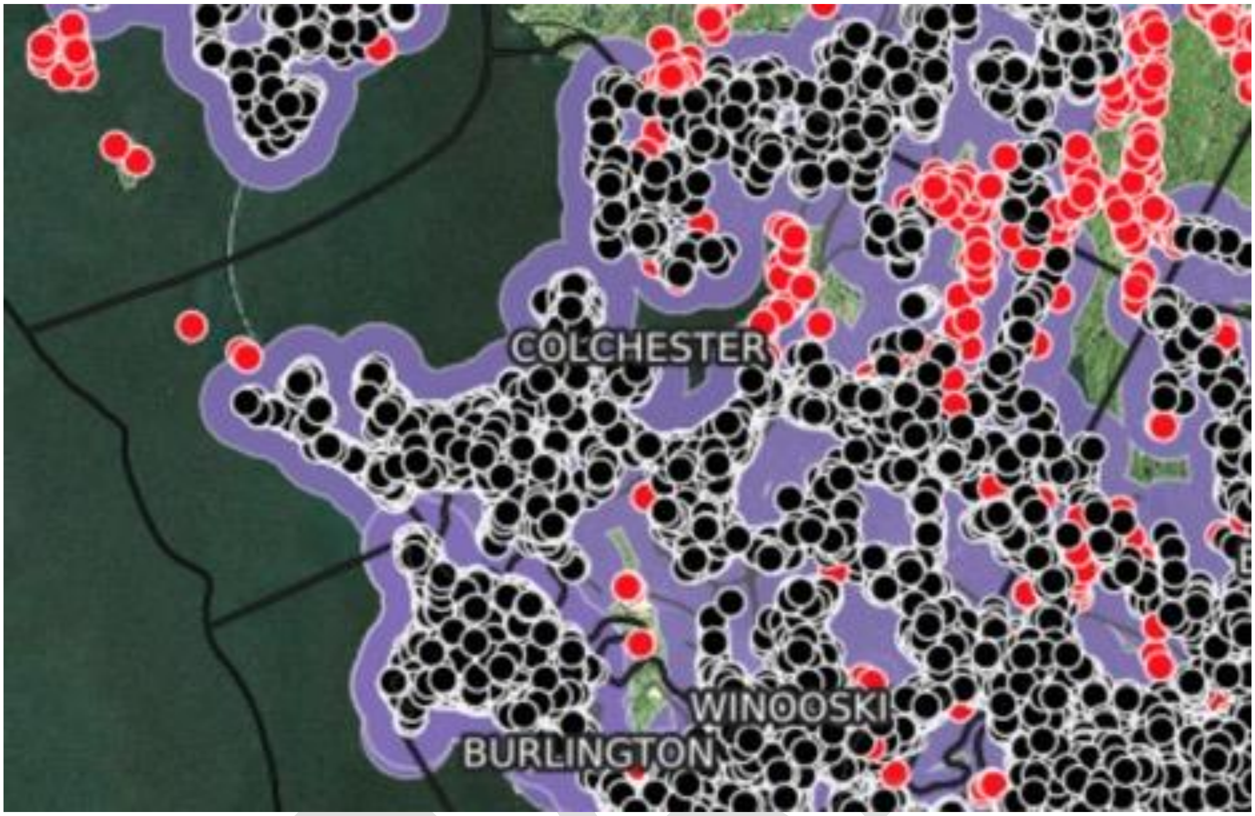


Figure 138: Unserved Premises Suitable for Line Extensions in Danby

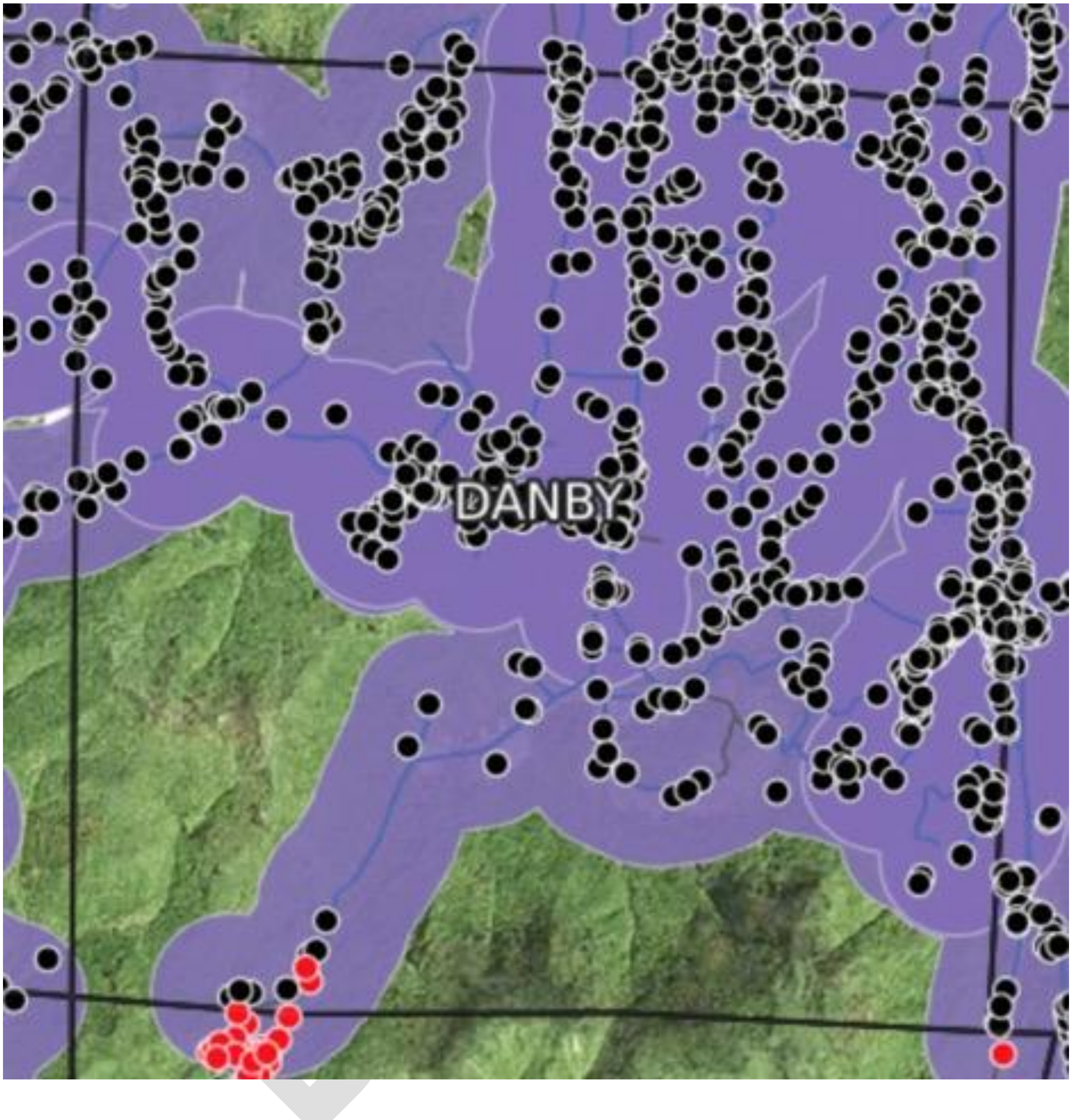


Figure 139: Unserved Premises Suitable for Line Extensions in Essex

Figure 140: Unserved Premises Suitable for Line Extensions in Grand Isle

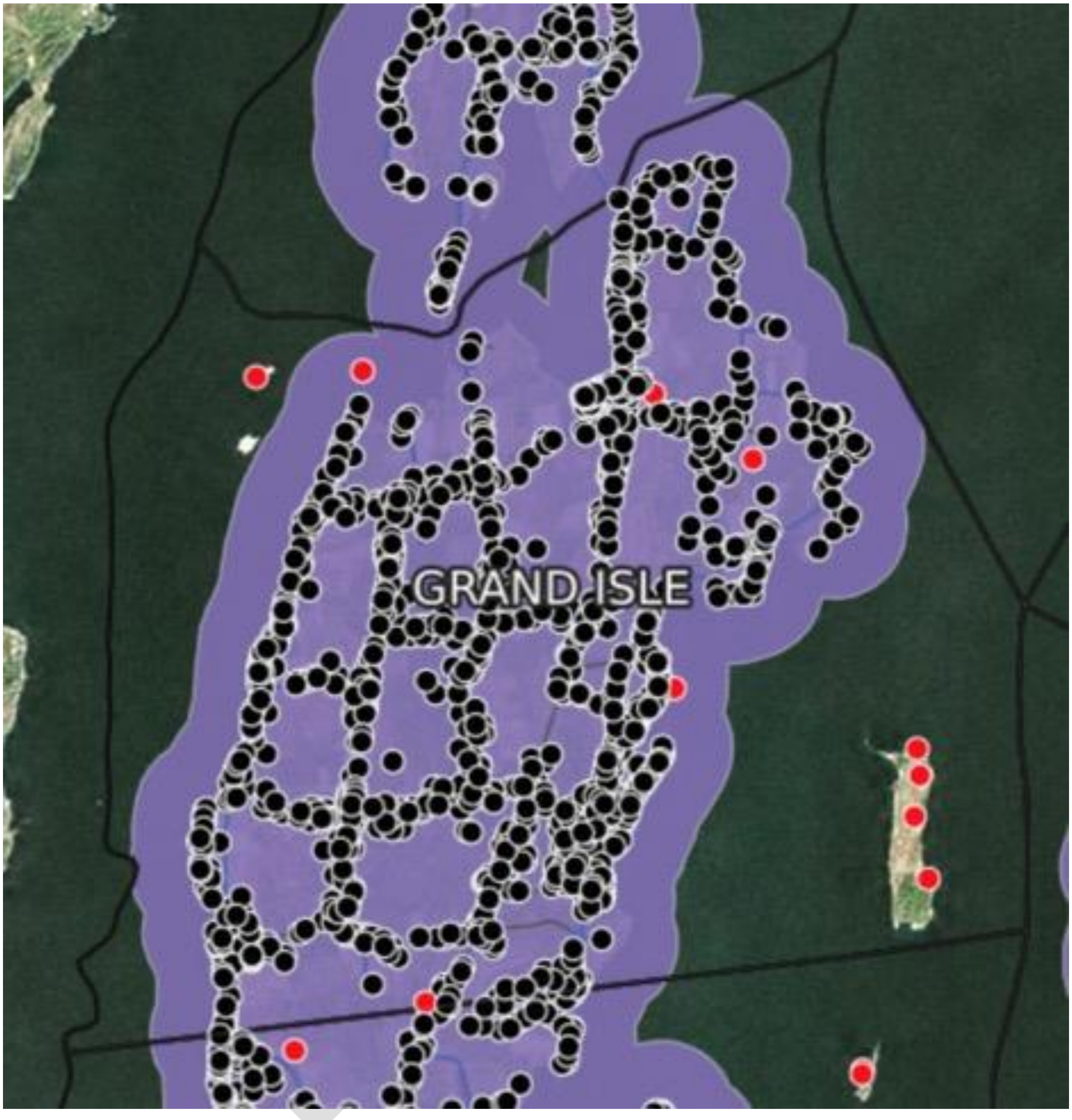


Figure 141: Unserved Premises Suitable for Line Extensions in Hartland

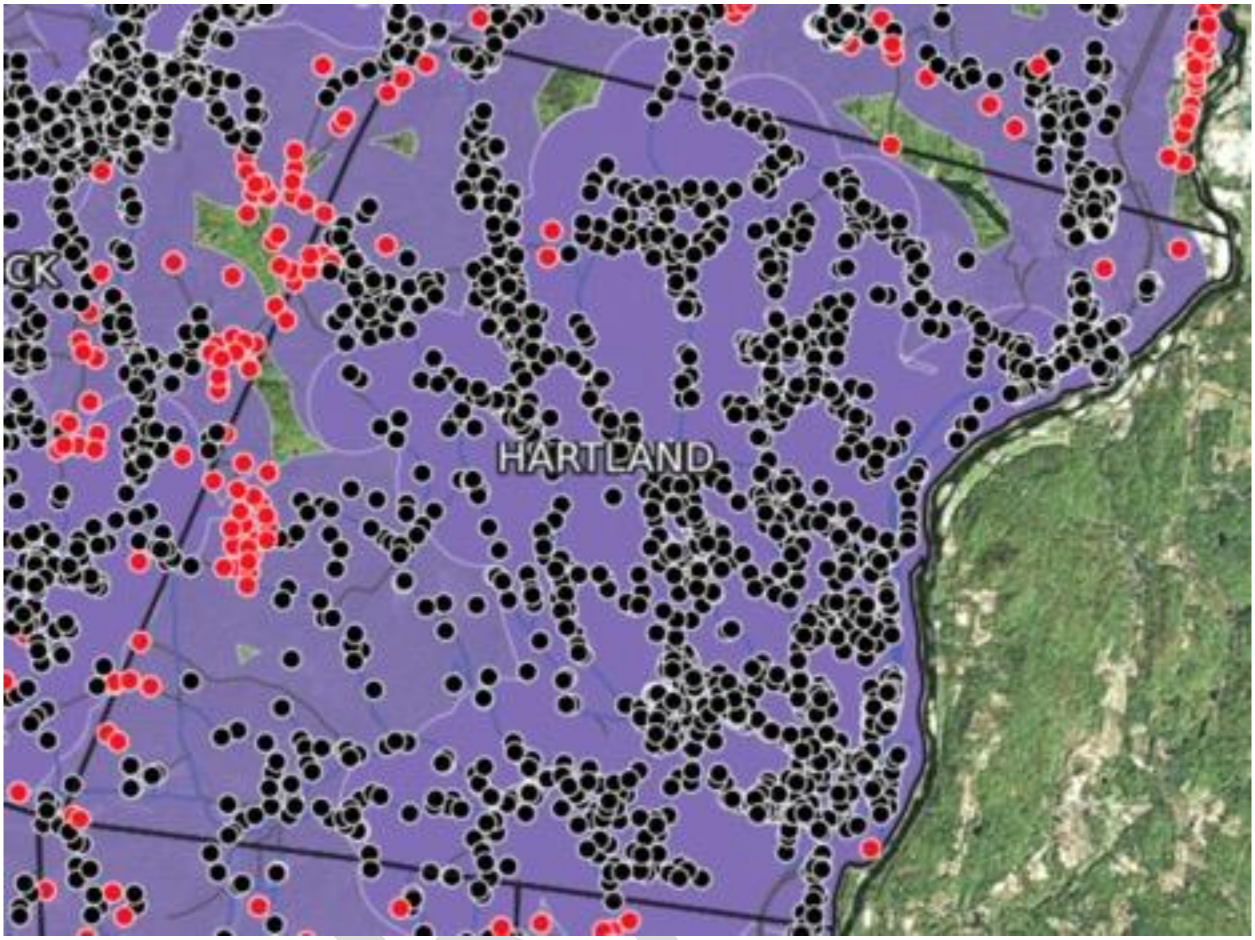


Figure 142: Unserved Premises Suitable for Line Extensions in Highgate

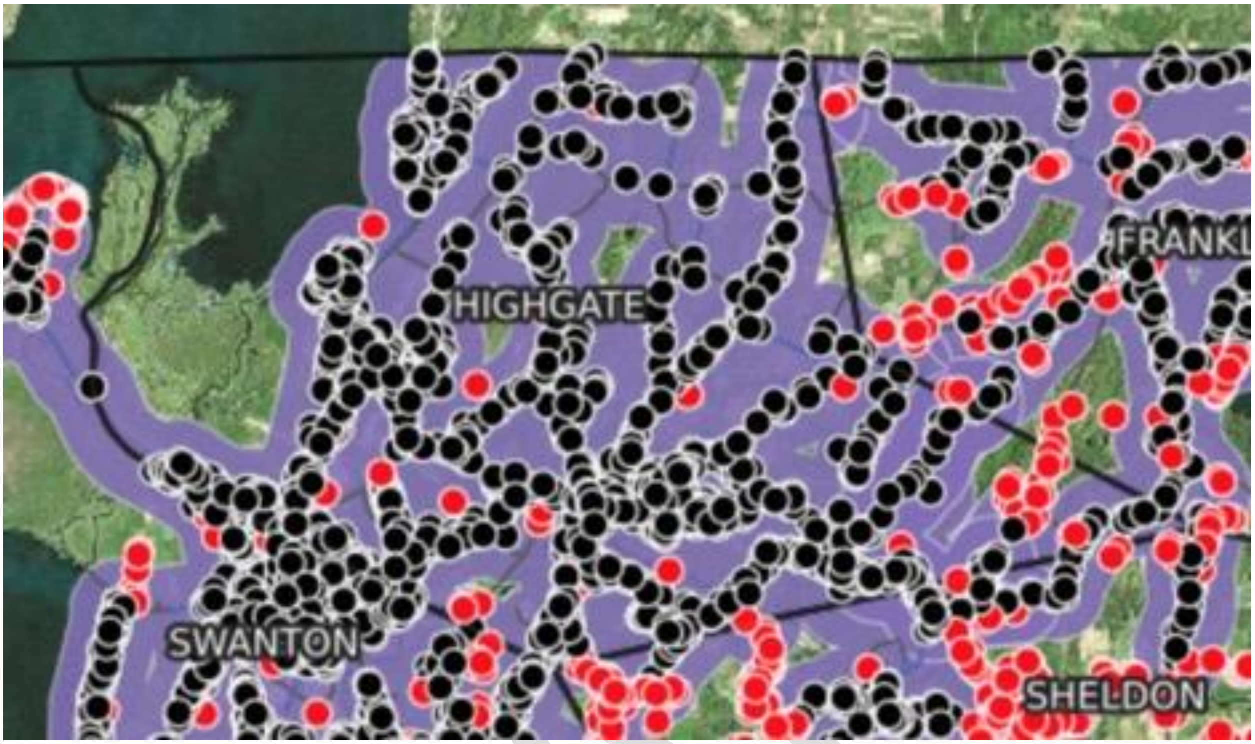


Figure 143: Unserved Premises Suitable for Line Extensions in Ira

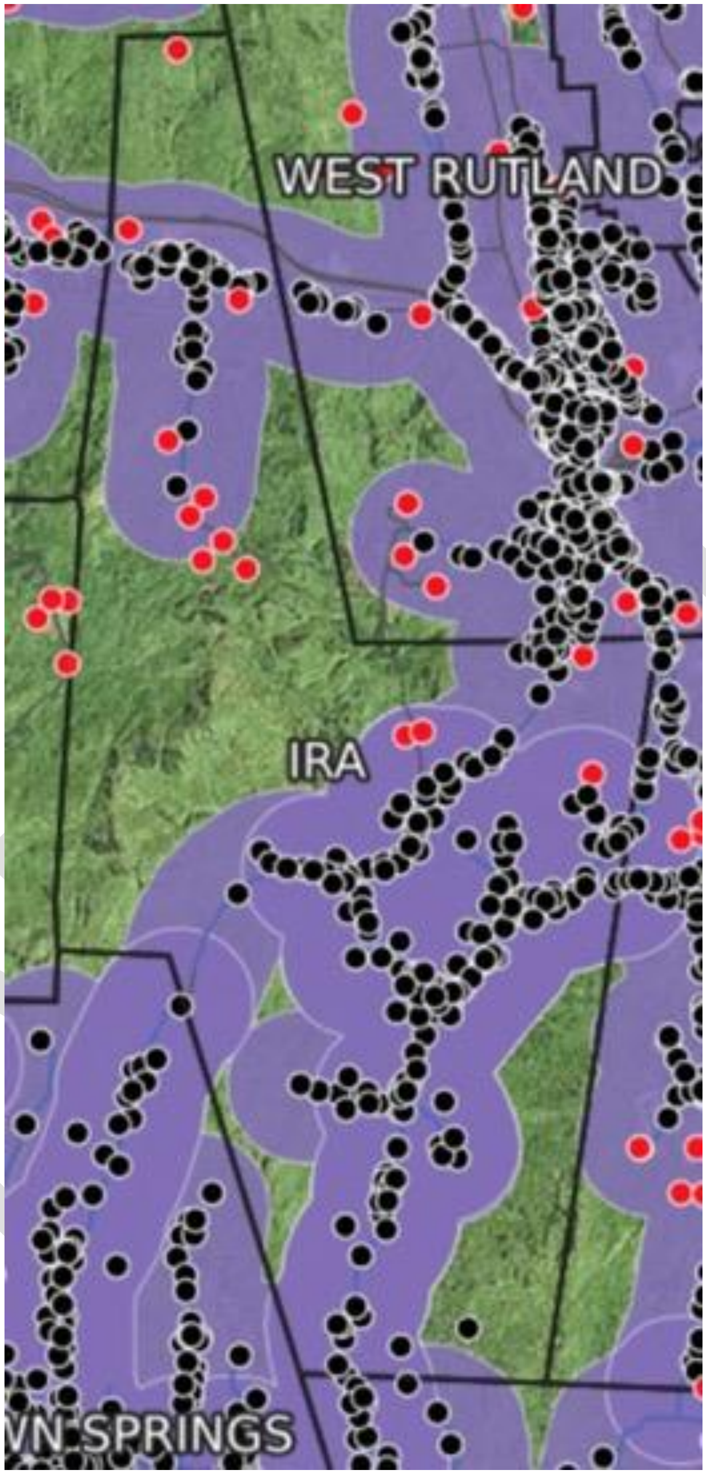


Figure 144: Unserved Premises Suitable for Line Extensions in Killington

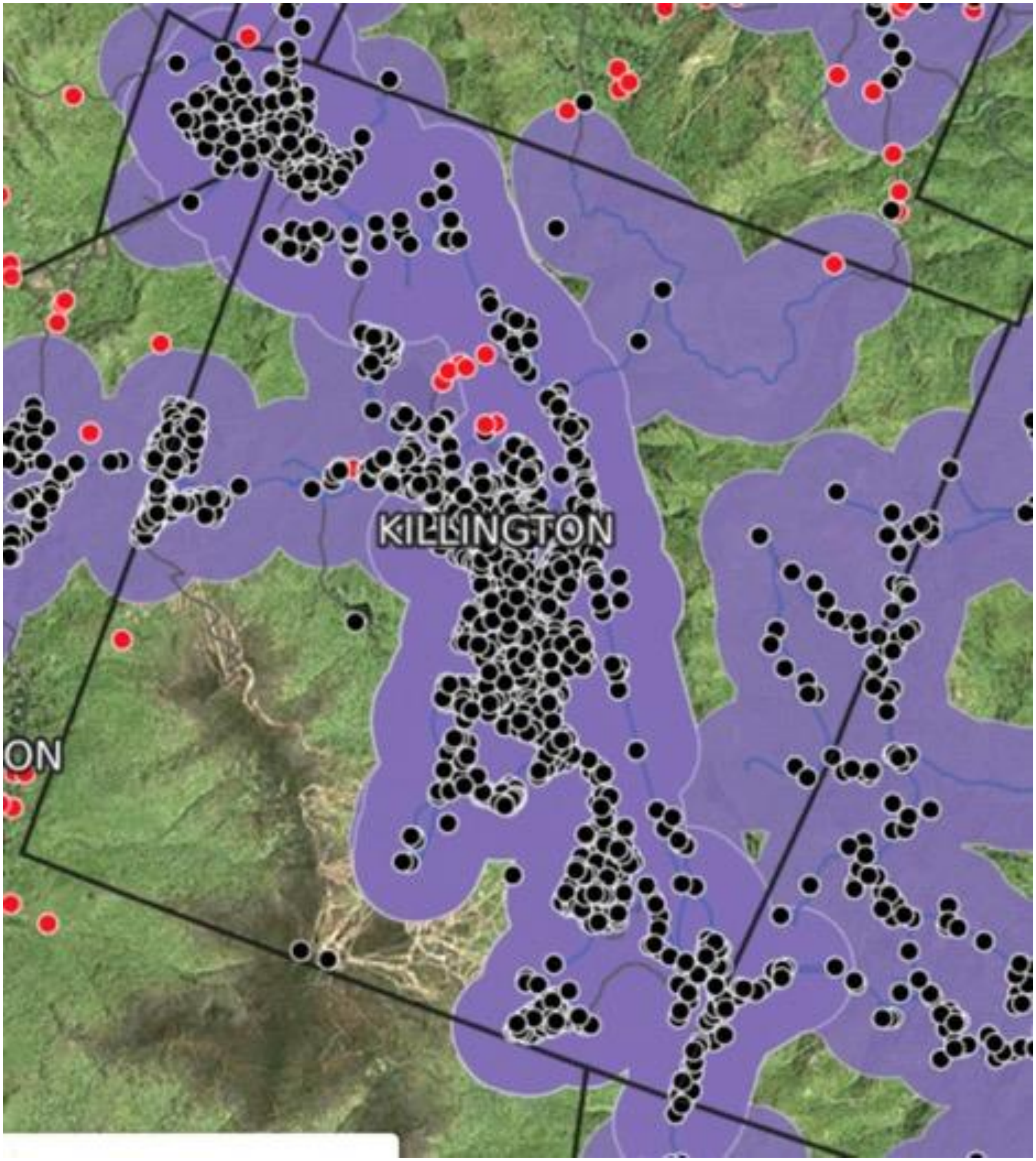


Figure 145: Unserved Premises Suitable for Line Extensions in Leicester

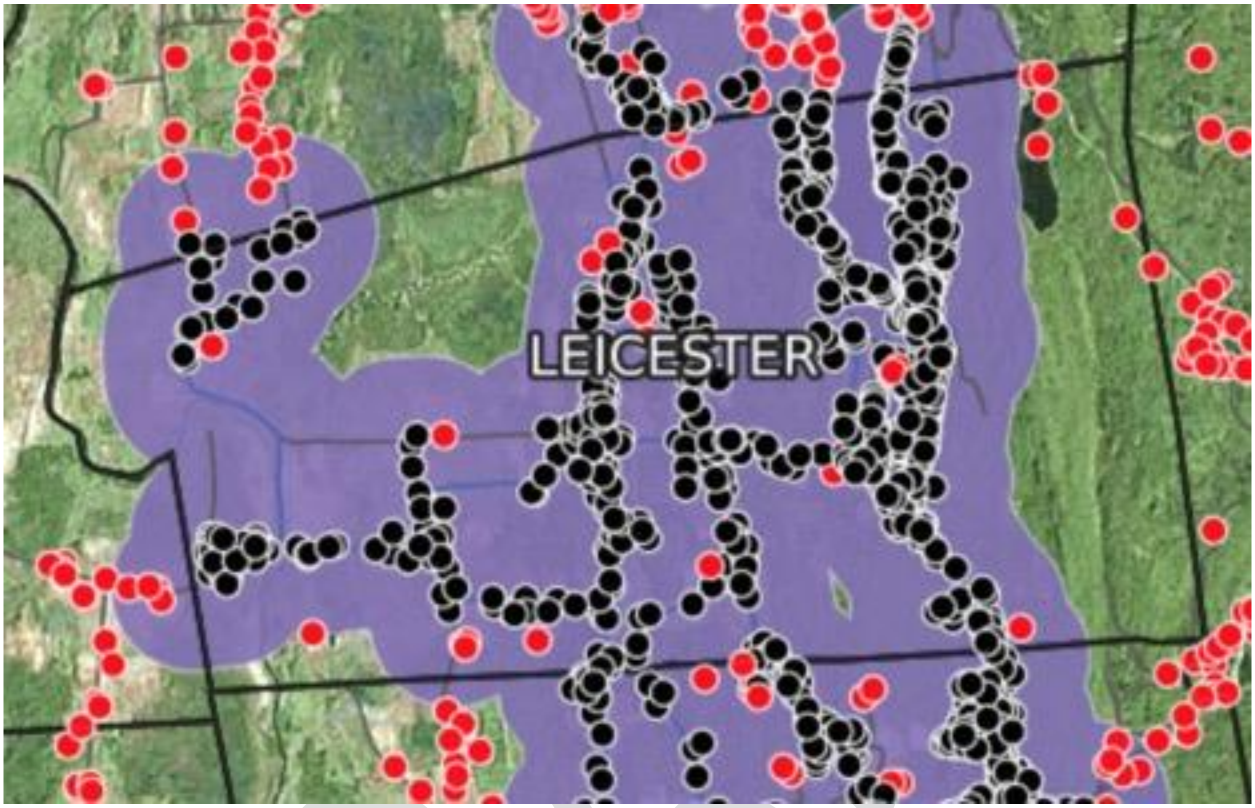


Figure 146: Unserved Premises Suitable for Line Extensions in Middletown Springs

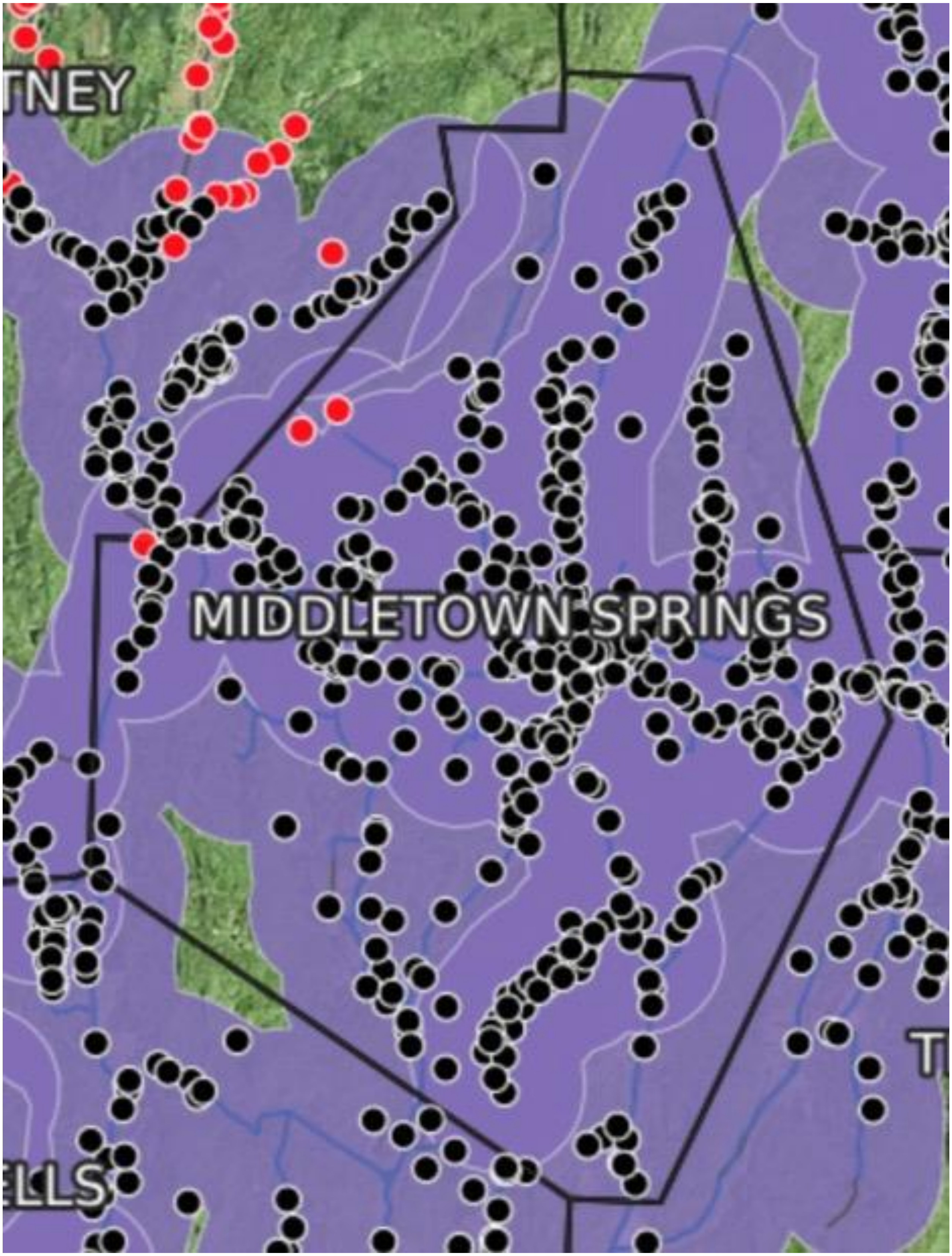


Figure 147: Unserved Premises Suitable for Line Extensions in Montpelier

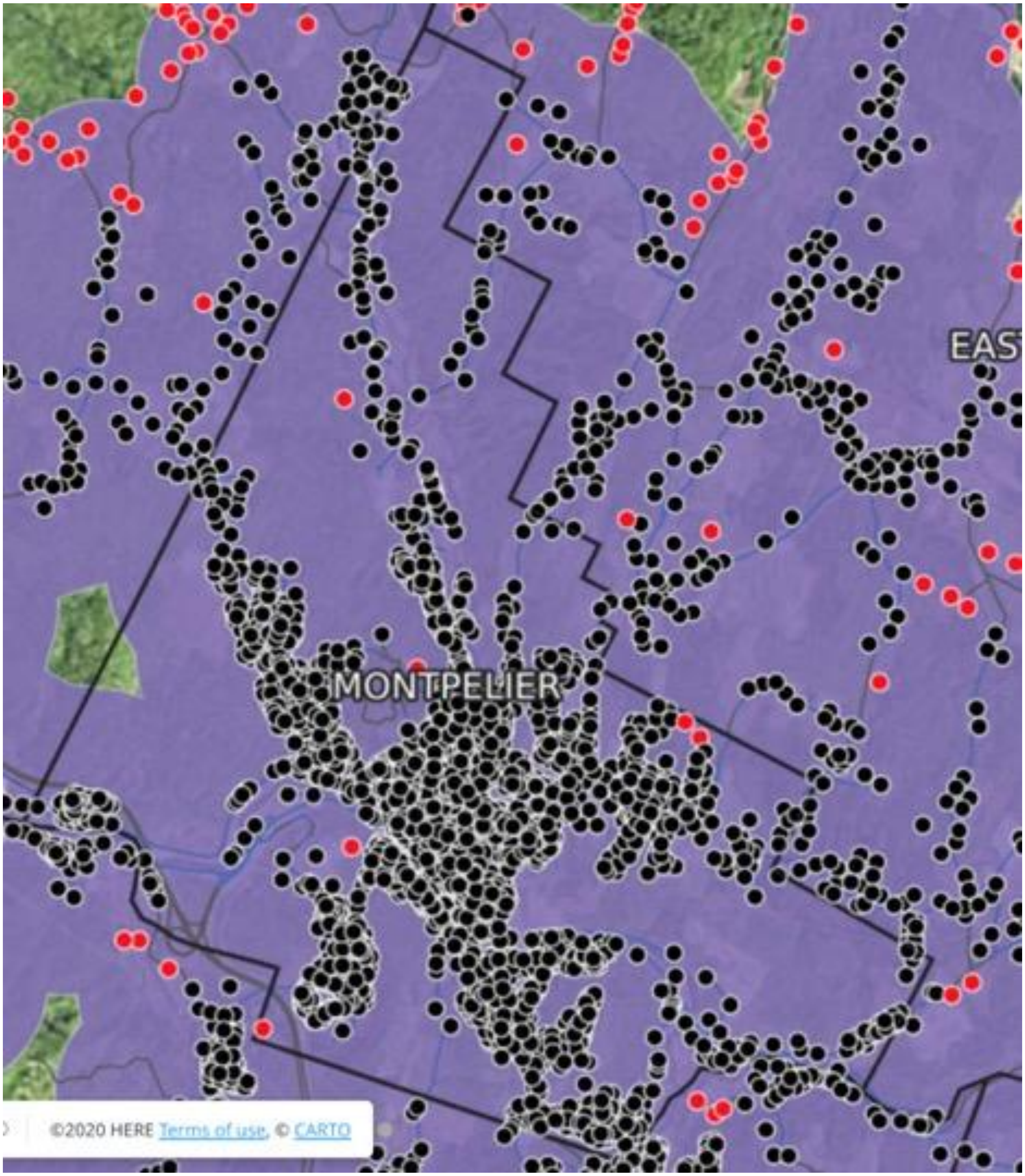


Figure 148: Unserved Premises Suitable for Line Extensions in Mount Holly

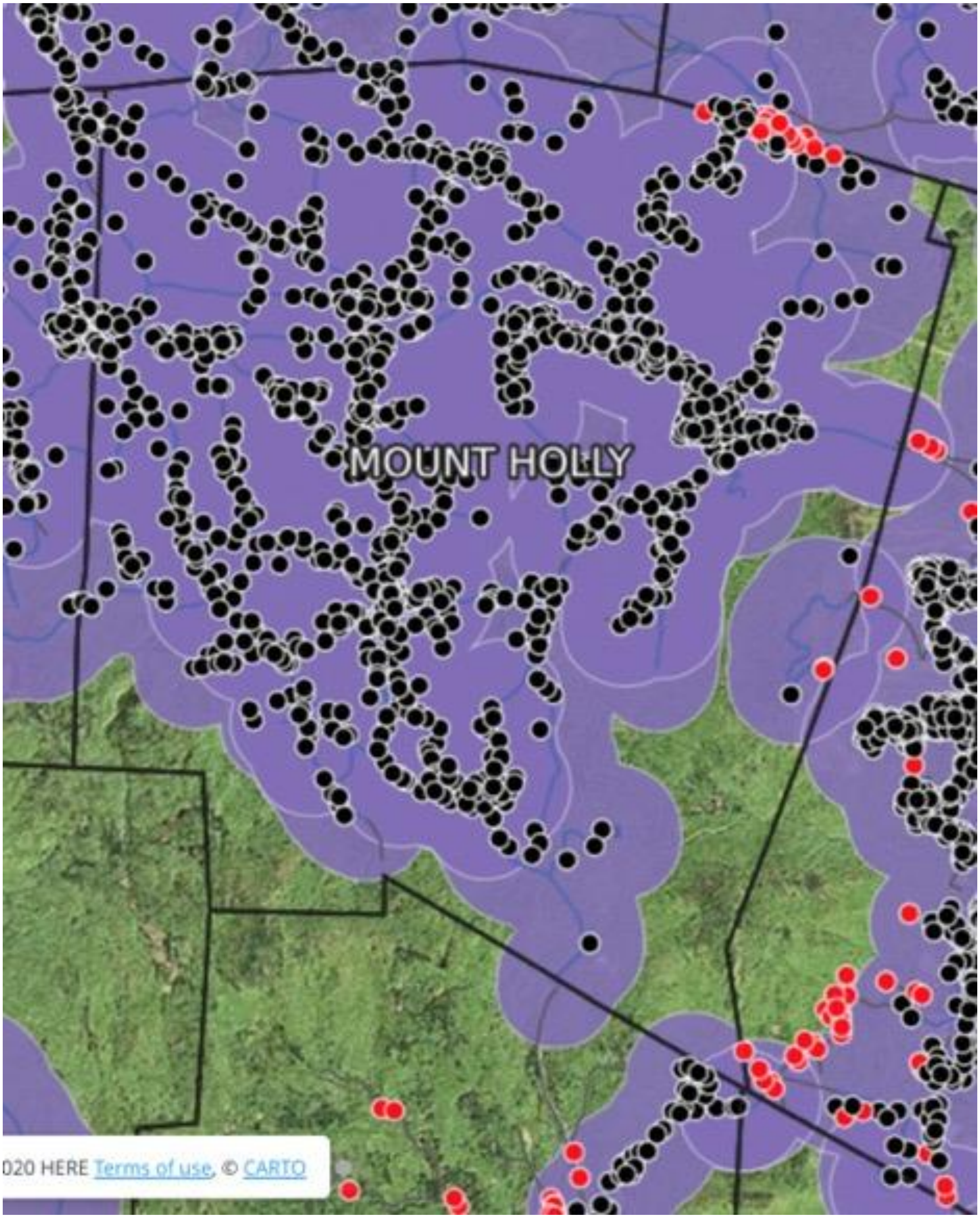


Figure 149: Unserved Premises Suitable for Line Extensions in Newport City

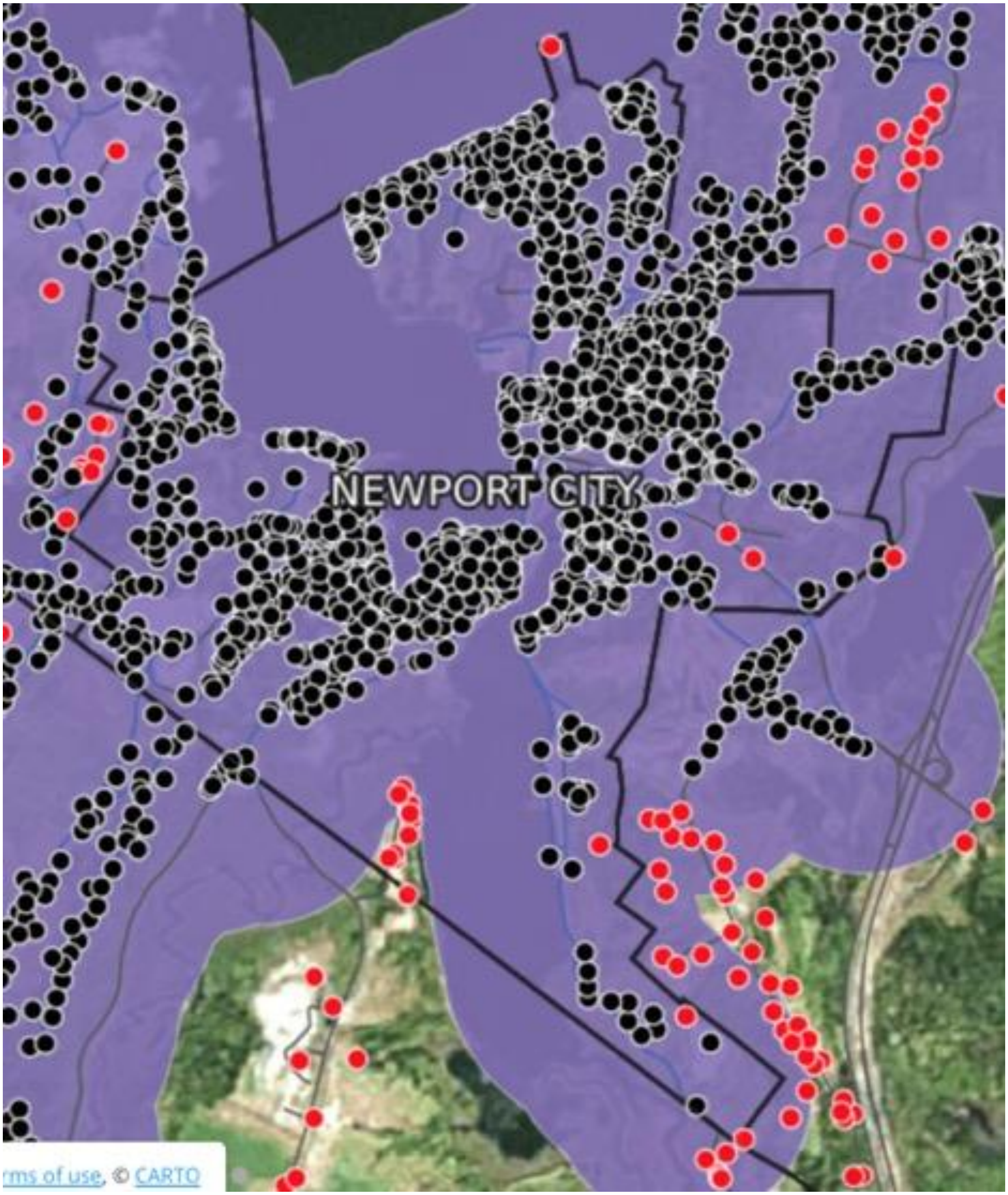


Figure 150: Unserved Premises Suitable for Line Extensions in Plymouth

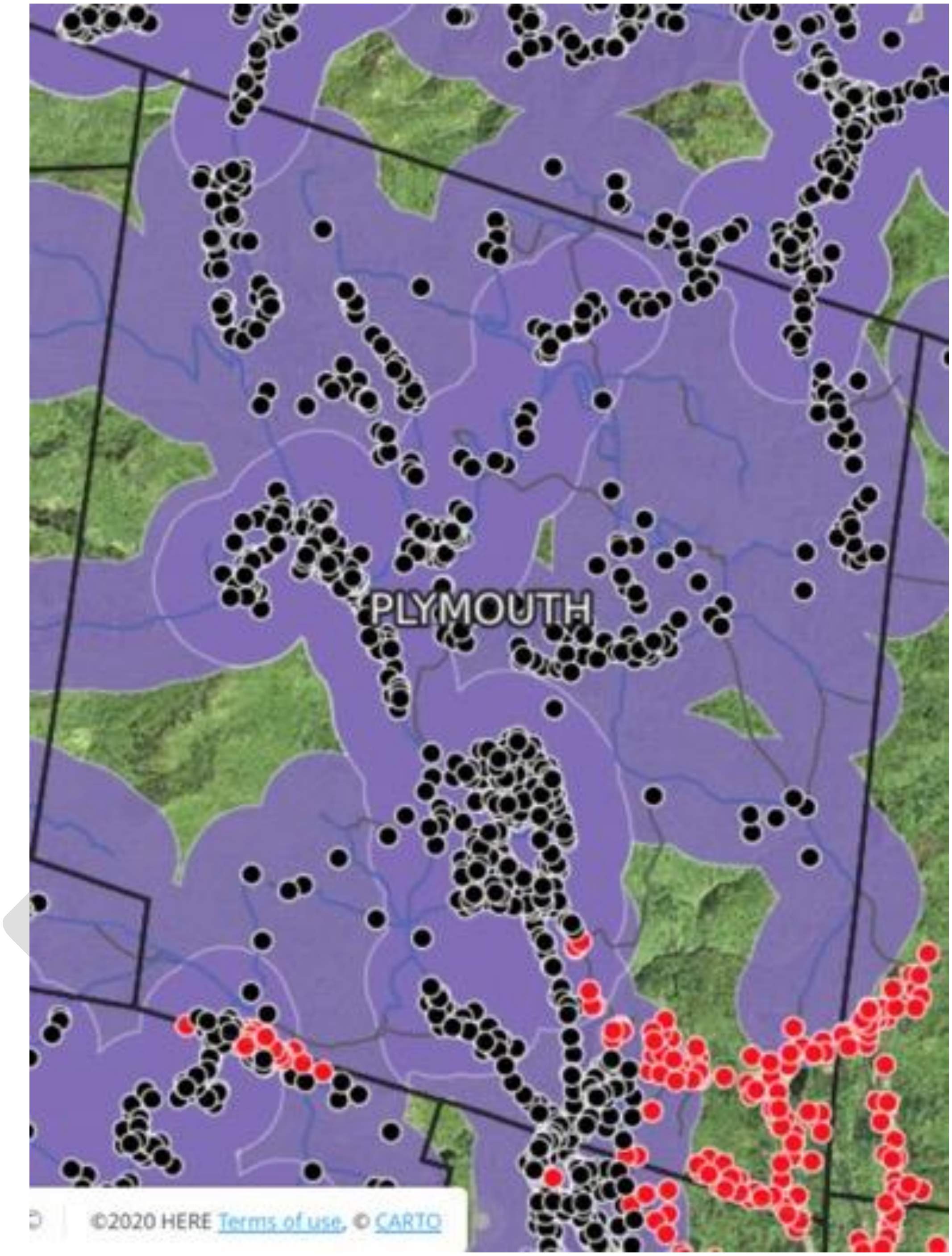


Figure 151: Unserved Premises Suitable for Line Extensions in Pomfret

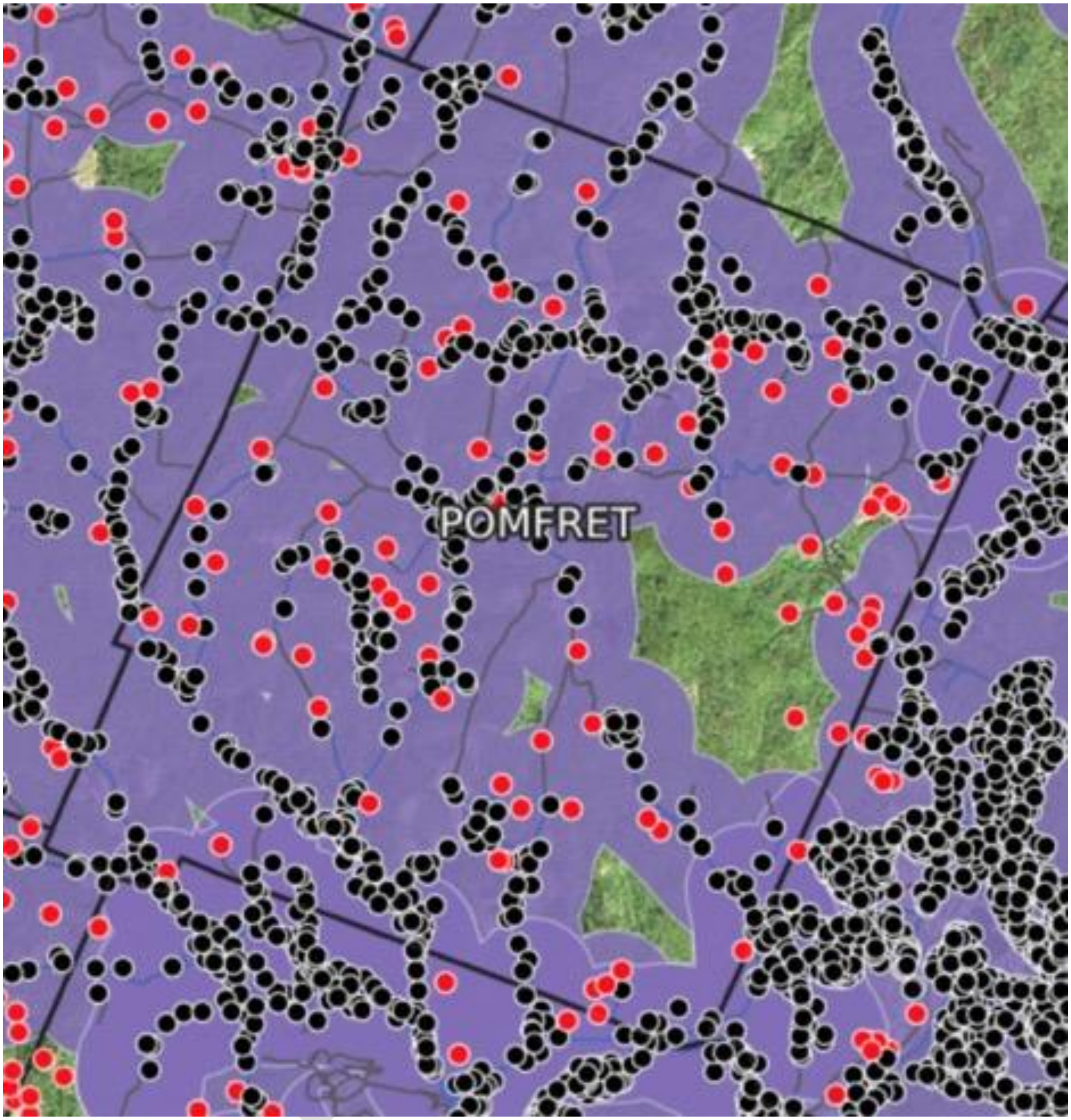


Figure 152: Unserved Premises Suitable for Line Extensions in Richmond

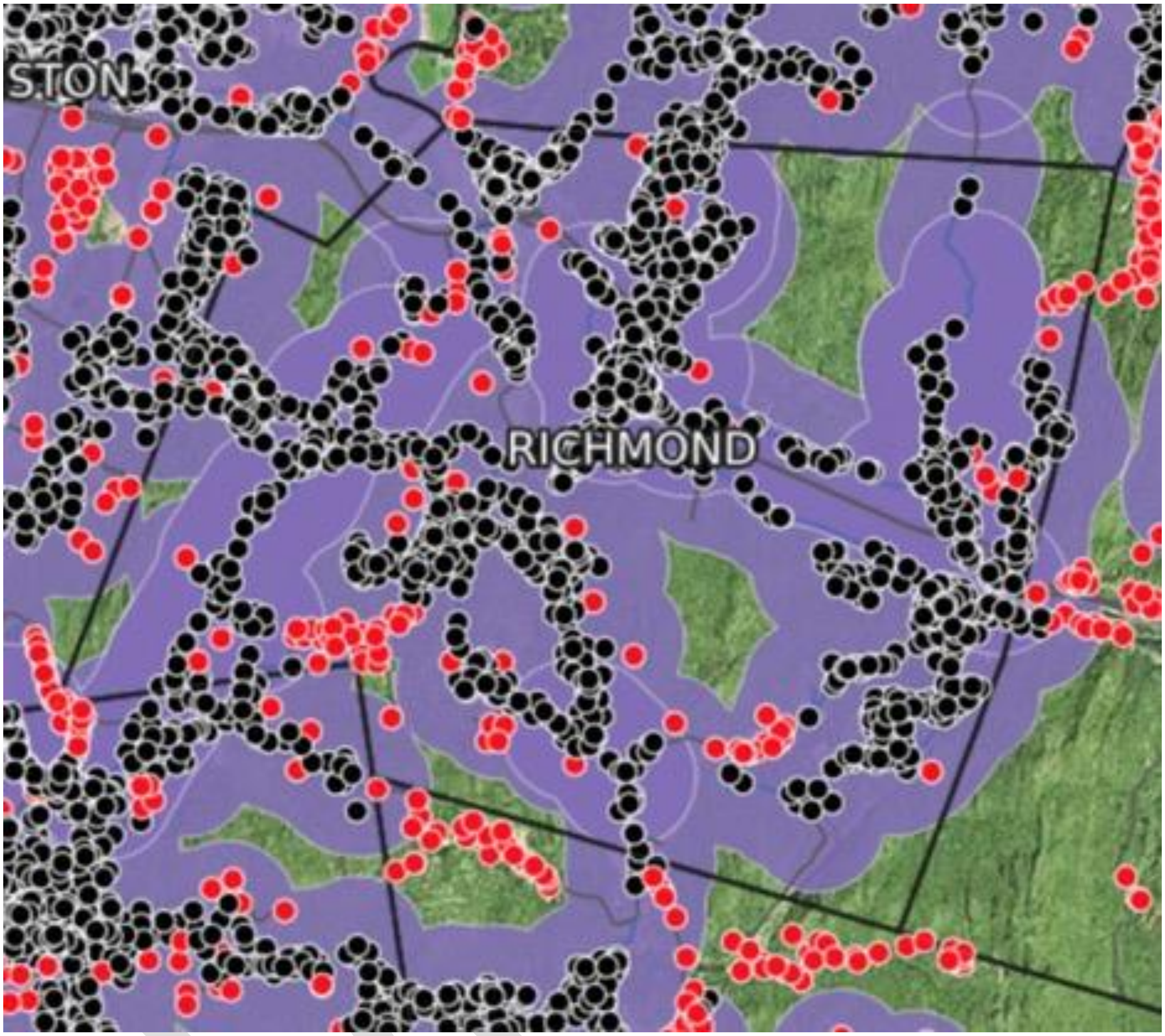


Figure 153: Unserved Premises Suitable for Line Extensions in Rockingham

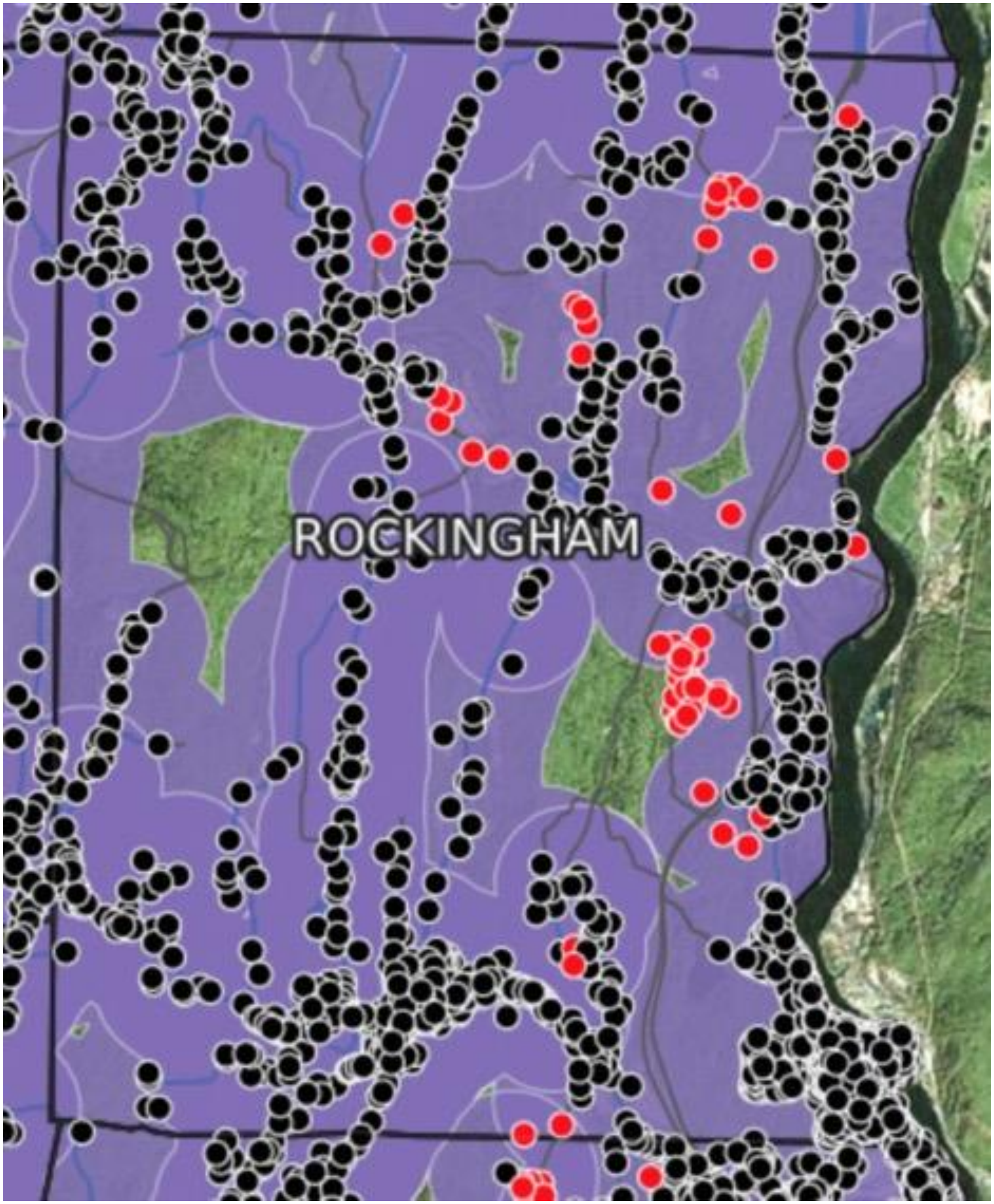


Figure 154: Unserved Premises Suitable for Line Extensions in Rutland

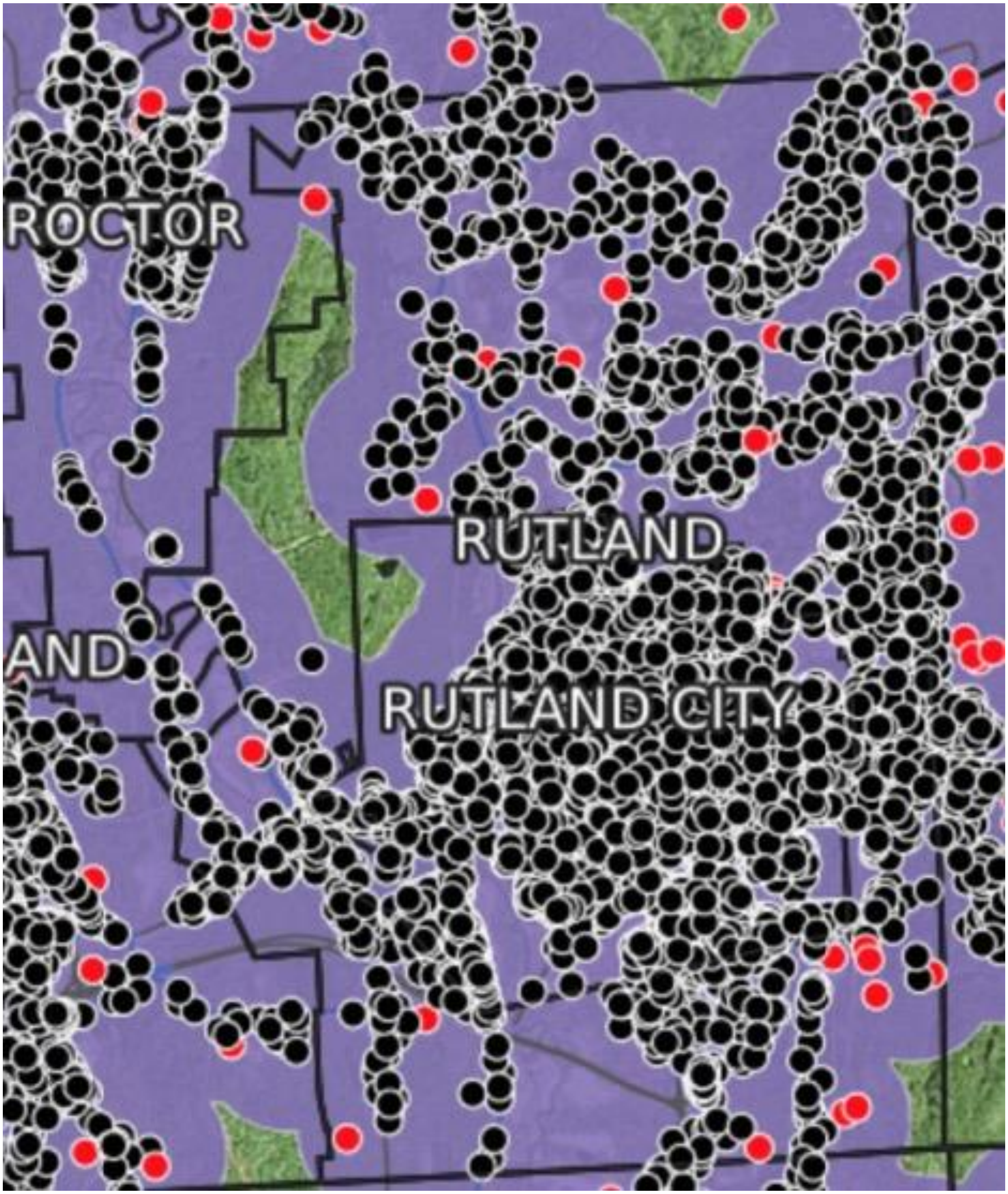


Figure 155: Unserved Premises Suitable for Line Extensions in Sharon

Figure 156: Unserved Premises Suitable for Line Extensions in Shrewsbury

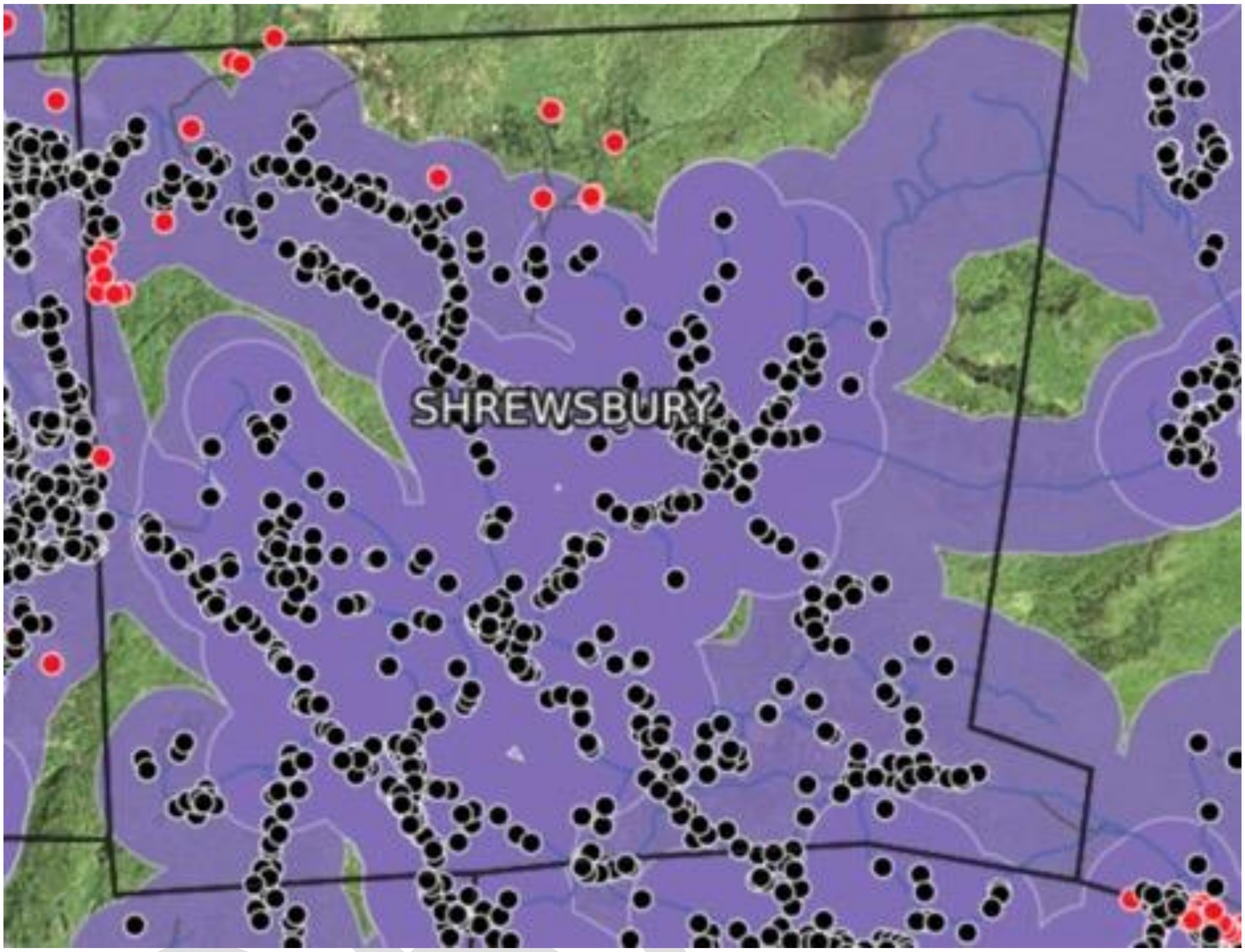


Figure 157: Unserved Premises Suitable for Line Extensions in South Burlington

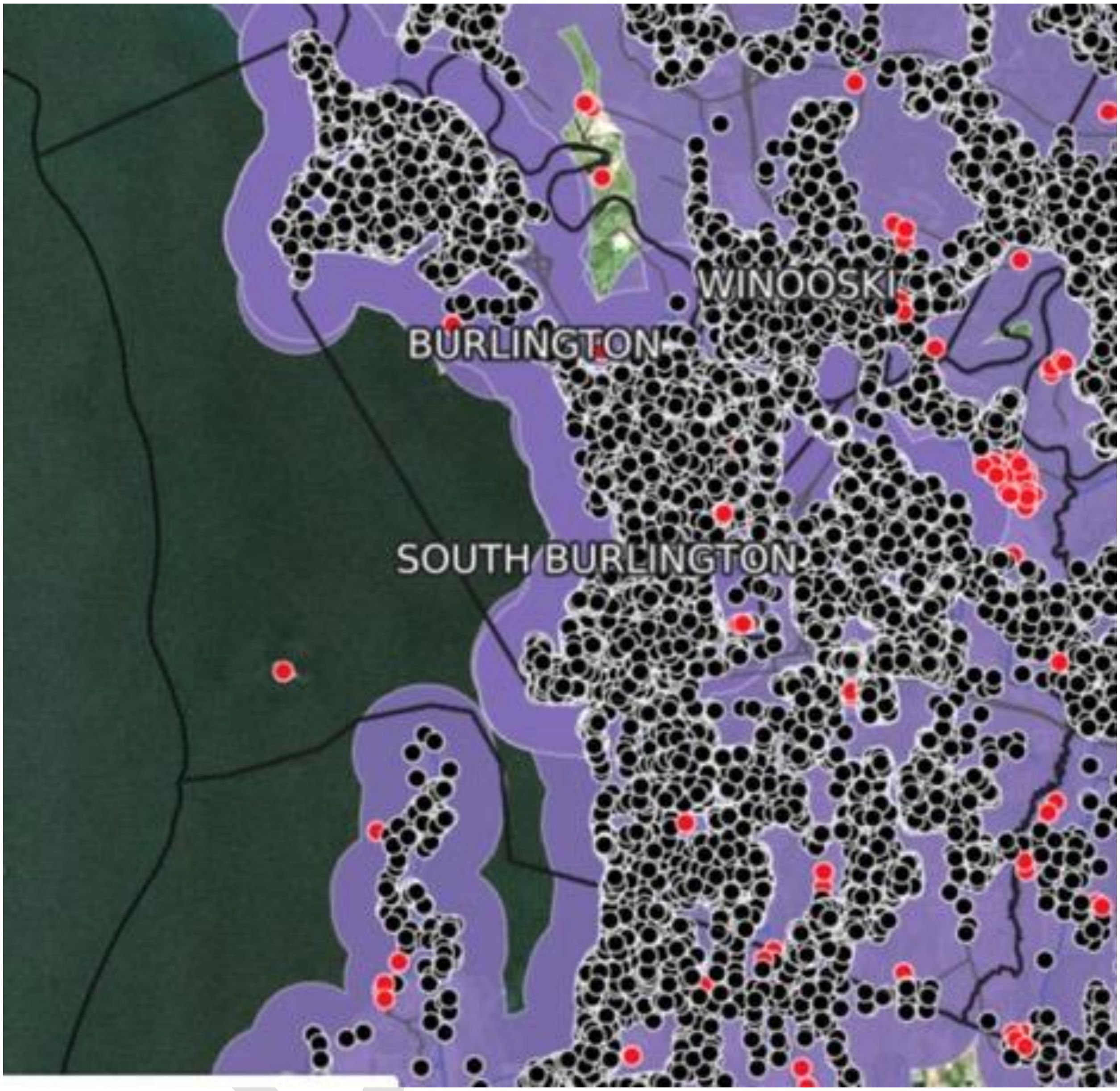


Figure 158: Unserved Premises Suitable for Line Extensions in South Hero

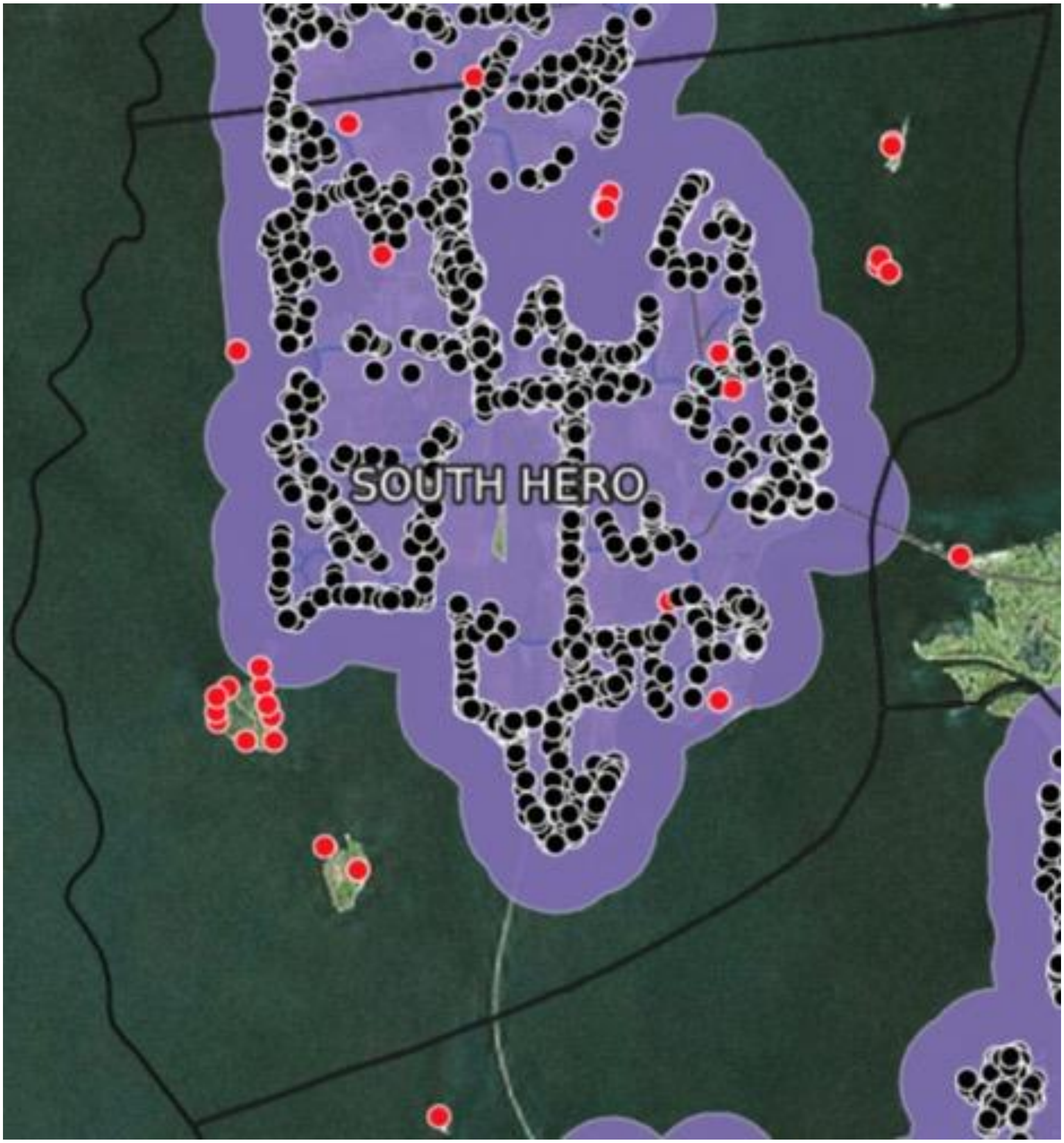


Figure 159: Unserved Premises Suitable for Line Extensions in Swanton

Figure 160: Unserved Premises Suitable for Line Extensions in Thetford

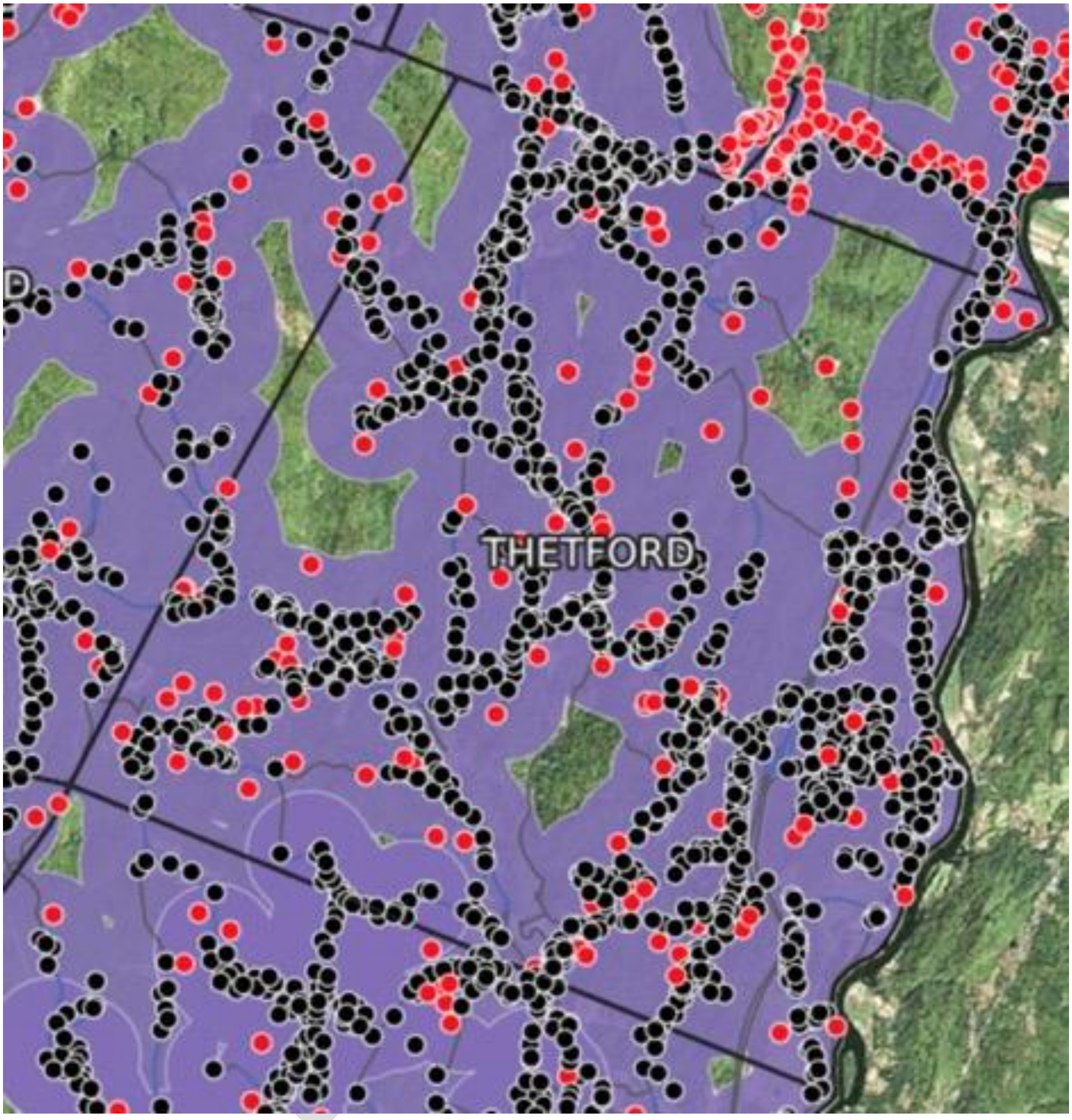


Figure 161: Unserved Premises Suitable for Line Extensions in Vernon

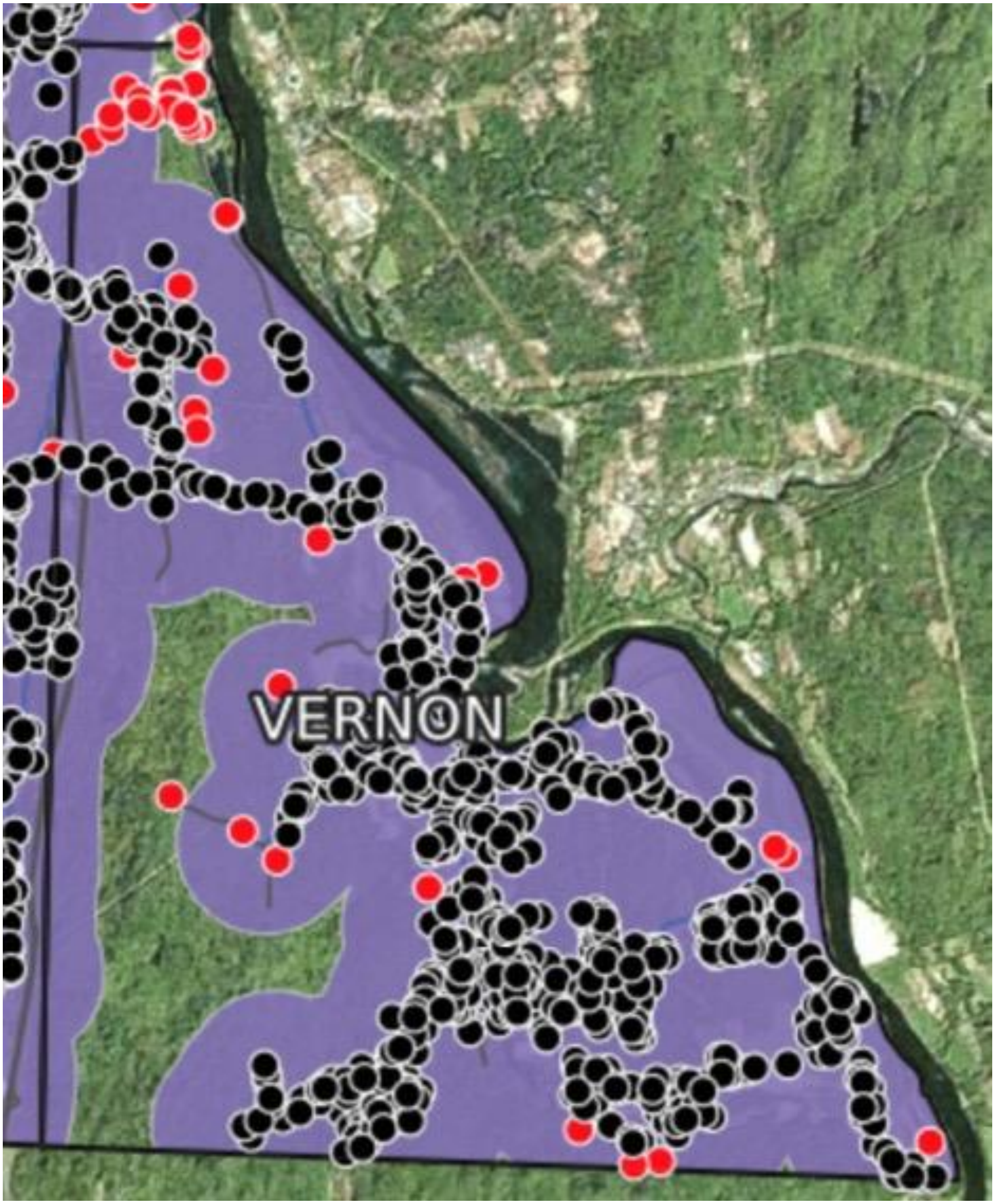


Figure 162: Unserved Premises Suitable for Line Extensions in Wells

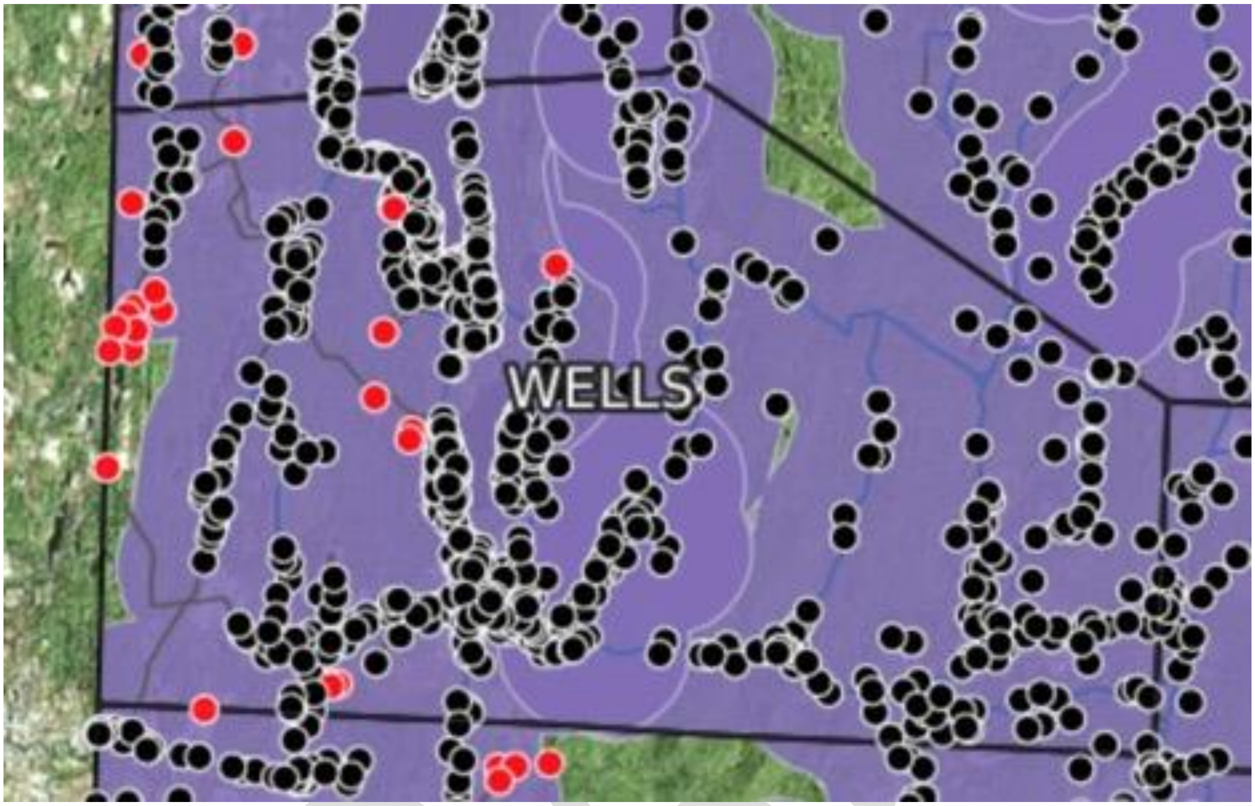
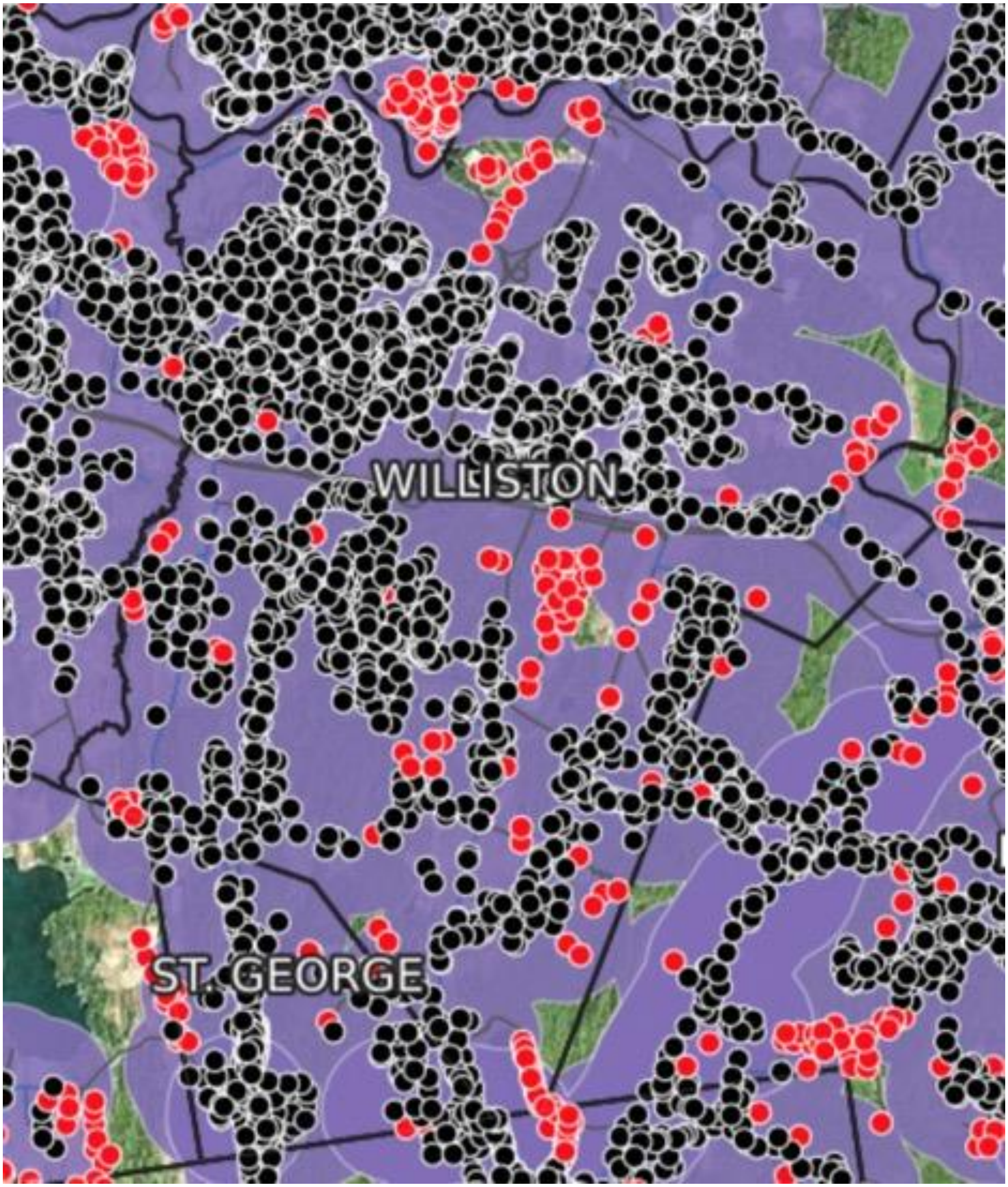


Figure 163: Unserved Premises Suitable for Line Extensions in West Windsor

Figure 164: Unserved Premises Suitable for Line Extensions in Williston



Appendix H: Interviews Conducted for This Study

State Agencies and Departments

- Agency of Commerce and Community Development: Kenneth Jones, *Economic Analyst*
- Agency of Digital Services: Frank Costantino, *ADS Manager – IT Shared Services*
- Agency of Education: Jess DeCarolis, Lisa Helme
- Agency of Natural Resources: Billy Costner
- Agency of Transportation: Costa Pappis, *Policy and Planning Manager*
- Department of Buildings and General Services: Marc O'Grady
- Department of Libraries: Jason Broughton, Joshua Muse, Thomas McMurdo
- Department of Public Safety: Terry Lavalley, *Director of Radio Services*
- Department of Public Service: Clay Purvis, Rob Fish, June Tierney, *Commissioner*
- Department of Vermont Health Access: Chris Brynga
- Vermont Enhanced 911 Board: Barb Neal, *E911 Board Director*

CUDs

- NEK Community Broadband: Evan Carlson, Christine Hallquist
- Southern Vermont CUD: Tim Scoggins, Sheila Kearns

Internet Service Providers

- AT&T: Owen Smith
- Burlington Telecom: Mike Loucy
- Charter Spectrum: Jennifer Young, Melinda Kinney, Michael Chowaniece, Paul Wolf
- Consolidated Communications: Erika Smith
- Comcast Xfinity: John Sutich and Alicia Matthews
- FirstLight: Mary Burgess, Debby Bunce
- Microsoft Airband: Fatema Kothari, Sidney Roberts, Erica Myers
- RTO Wireless: Steve Hubbard
- Vermont Telephone Company: Michel Guité
- Waitsfield & Champlain Telecom: Kurt Gruendling

Utilities

- Green Mountain Power: Brian Otley and Liz Miller
- Vermont Electric Power Company (VELCO): Dan Nelson and Kerrick Johnson
- Washington Electric Cooperative: Patty Richards

Healthcare Sector

- Bi-State Primary Care Association: Helen Labun
- Dartmouth-Hitchcock: Mary L. Lowry
- Northeast Telehealth Resource Center: Reid Plimpton, MPH
- UVM Health Network: Todd Young
- Vermont Information Technology Leaders: Caroline Stone, Beth Anderson
- Vermont Program for Quality Health Care: Seema Kumar, Hillary Wolfley

Elected Officials

- Representative Laura Sibilia
- Representative Tim Briglin
- Senator Ann Cummings

Other Stakeholders

- Addison County Economic Development Corporation: Fred Kenney
- Brattleboro Development Credit Corporation: Laura Sibilia
- Center for Media and Democracy/CCTV: Lauren-Glenn Davitian
- Central Vermont Economic Development Corporation: Jamie Stewart
- Greater Burlington Industrial Corporation: Sam Anderson, Seth Bowden
- League of Cities and Towns: Karen Horn, Abby Hall
- Northeastern Vermont Development Association: David Snedeker
- Rutland Economic Development Corporation: Tyler Richardson
- Vermont Economic Development Authority: Cassie Polhemus