ctc technology & energy

engineering & business consulting

Broadband Strategic Plan

Prepared for Garrett County, Maryland

FINAL| May 2022

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1 Executive summary

Garrett County Government (the "County") is aware that lack of access to high-speed, affordable broadband services is an important issue for many residents in the more rural areas of the County. The County hired CTC Technology & Energy (CTC) to assess the needs for broadband in the County and identify potential strategies to address those needs. CTC performed the following tasks at the County's direction:

- Identified unserved areas of the County, based on data and maps provided by the County, other public data sets, and desk and field surveys.
- Met with key public and private stakeholders to identify broadband needs.
- Met with representatives of internet service providers (ISP) operating in the County (or with potential interest in serving County residents) to learn what market forces or County support might lead them to invest in the County.
- Prepared a high-level design and cost estimate for a fiber optic network deployment to fill the County's identified broadband gaps.
- Analyzed a range of federal and state funding opportunities to identify potential sources of grants or loans (to the County or to ISPs) that might support the expansion of broadband services in unserved areas.
- Developed a series of potential strategies the County could pursue to leverage federal and state funding to support the expansion of broadband service in currently unserved areas.

1.1 A substantial number of Garrett County addresses are unserved with reliable wireline broadband

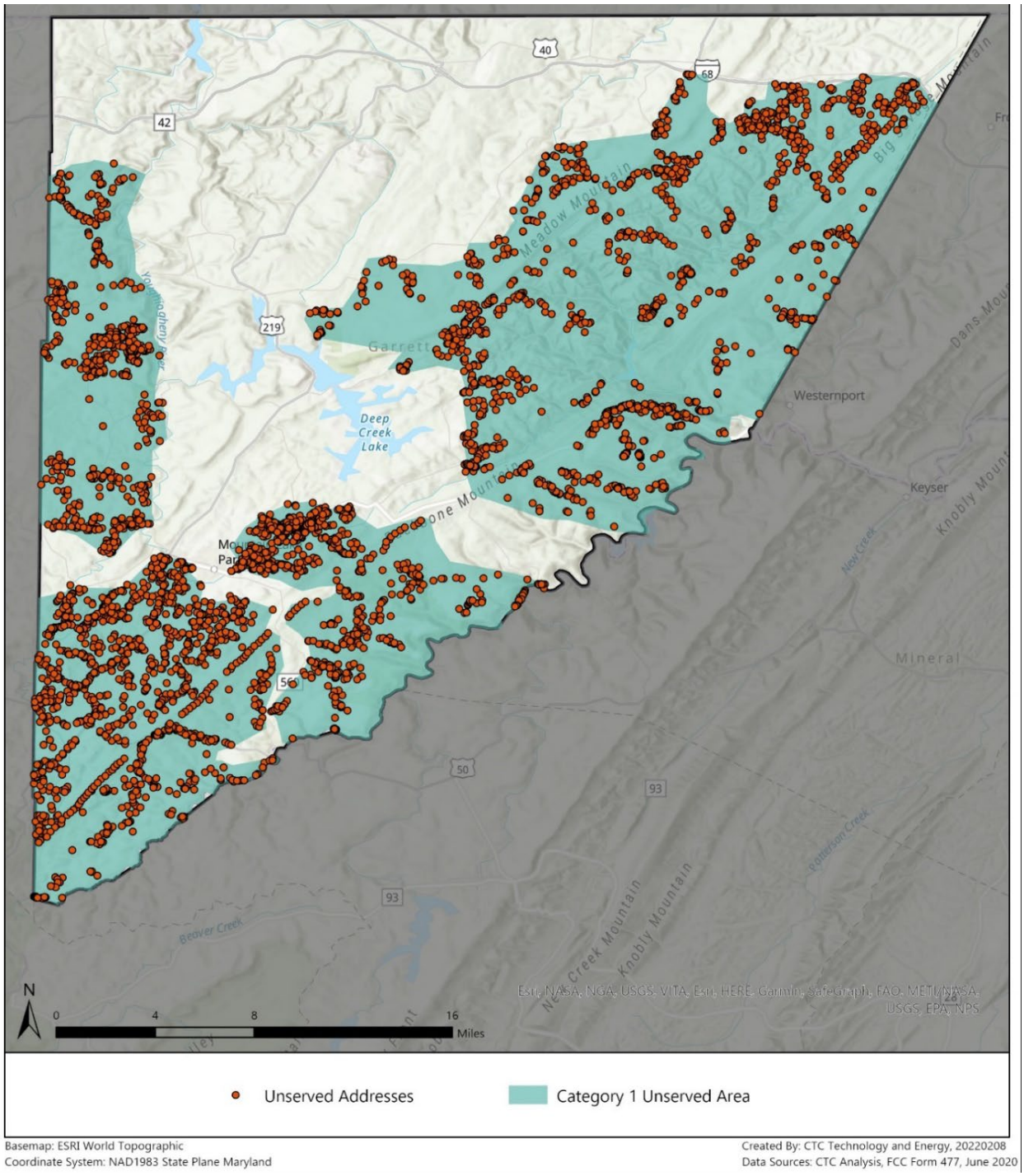
In consultation with the County, CTC conducted a detailed and comprehensive survey of wireline broadband infrastructure to identify unserved areas.

1.1.1 About 4,750 addresses in large, contiguous areas of the County are unserved

Approximately 4,750 unserved address points are located in large, contiguous parts of the County (referred to in this report as Category 1 areas); those areas and address points are illustrated in Figure 1.[1]

[1] The category numbers do not indicate prioritization or emphasis in terms of the County's approach to filling its broadband gaps; the numbers are merely a convenient way to refer to the categories.

Figure 1: Category 1 Unserved Areas and Unserved Addresses



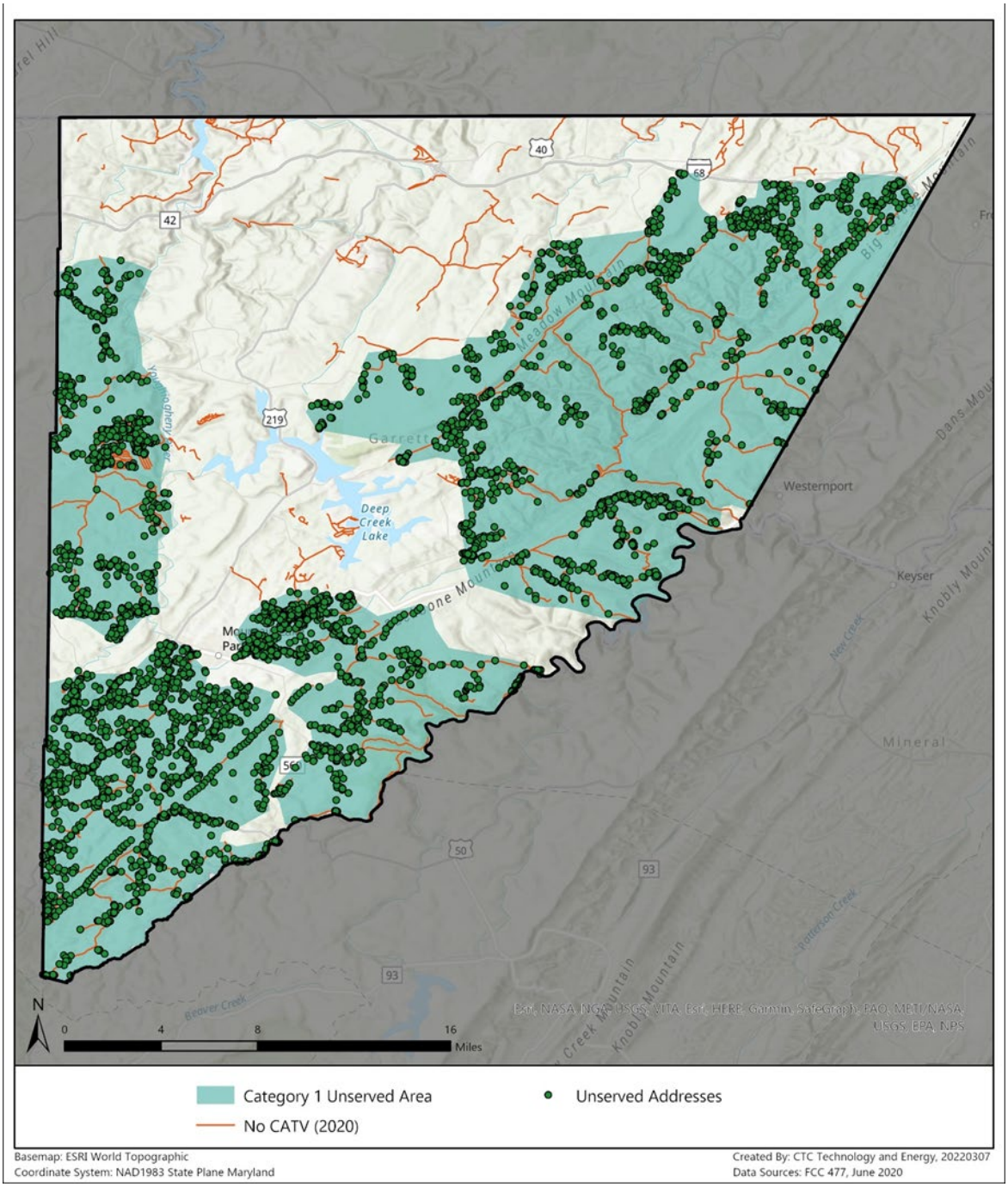
Basemap: ESRI World Topographic
Coordinate System: NAD1983 State Plane Maryland

Created By: CTC Technology and Energy, 20220208
Data Sources: CTC Analysis, FCC Form 477, June 2020

1.1.2 About 1,200 unserved addresses are located in small pockets within the County's otherwise-served areas

Pockets of unserved addresses within the County's served areas (referred to in this report as Category 2 areas) are located mainly on isolated rural roads—illustrated by the orange lines outside of the Category 1 shaded areas in Figure 2.

Figure 2: Category 2 Unserved Isolated Roads



1.1.3 Some homes with long setbacks are unserved despite nearby broadband infrastructure

In addition to the Category 1 and Category 2 unserved locations, other addresses are unserved due to their long driveways. These Category 3 locations are homes or businesses that an ISP is not required to connect—despite the presence of broadband infrastructure on the road passing the property—because the premises is located more than a certain distance from the road (typically 150 to 400 feet, depending on franchise agreement stipulations or an ISP's standard practices).

Whereas the ISP has an obligation to build a service drop from the road to a customer's premises located closer to the road, it is not required to connect these Category 3 addresses at no cost to the subscriber. Incumbents sometimes quote costs for extending drops to such locations in the tens of thousands of dollars. In this scenario, the cost of installing the service drop is often so high as to make service essentially infeasible for residents.

Surveying setback distances was outside of the scope of this engagement, so the number of Category 3 locations in the County is unknown; however, there likely are a fair number of these addresses because long setbacks are typical in the County, as in other rural communities.

1.2 Fixed wireless service in the County does not meet the higher speed thresholds adopted by some federal funding opportunities

Parts of the County have fixed wireless service (see Figure 3). For example, Declaration Networks Group (DNG) provides fixed wireless coverage in some areas of the County through an ongoing partnership between the County and DNG.

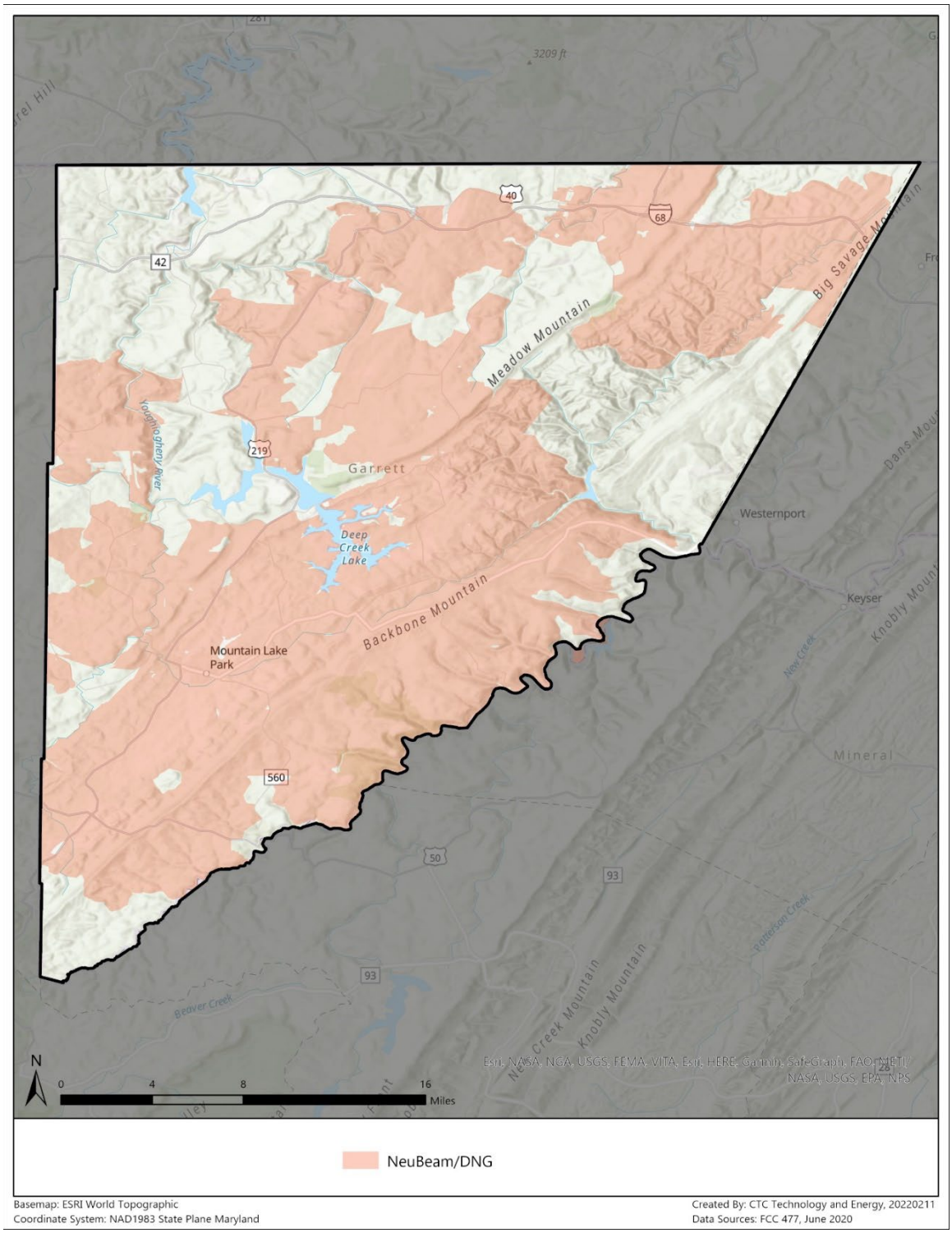
That partnership provided a crucial interim solution in the County at a time when the economics of broadband deployments prevented investments in high-quality wireline service. However, it is difficult for customers on DNG's fixed wireless network to receive adequate broadband service, for a number of reasons, including:

- Numerous topography and geography challenges.
- Wind, which occasionally disorients antennas.
- Trees, which have grown between distribution points and customers (and thus have blocked line of sight between antennas).

As such, the County has received numerous reports that speeds tend to be low, and connectivity inconsistent—something that was borne out in speed test results the County received. While speeds can rise to the minimal 25 Mbps download, 3 Mbps upload (25/3) standard adopted by some federal agencies, they are far below the minimal standard for new deployments set by the

National Telecommunications and Information Administration (NTIA, 100/20) and the U.S. Treasury (100/100). DNG has begun transitioning new construction to fiber when feasible.

Figure 3: Fixed Wireless Providers (Speeds Claimed at and Above 25/3 Mbps)



1.3 Building fiber-to-the-premises in the County's contiguous unserved areas could cost an estimated $38.9 million

The unserved addresses in the County's Category 1 areas (Figure 1, above) are large enough and close enough that a variety of different providers could target some or all of the areas.

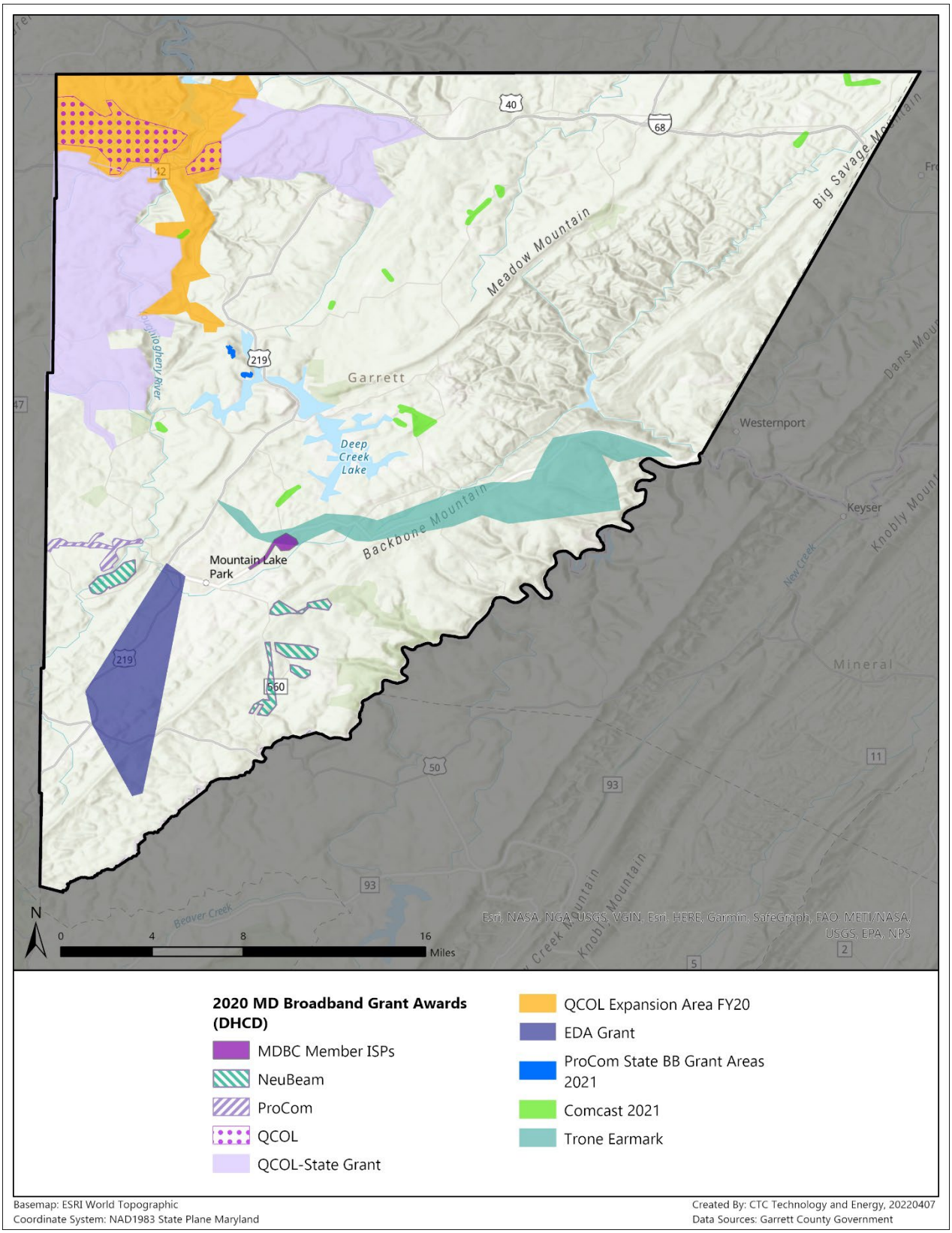
As a candidate solution, CTC's engineers prepared a high-level network design for the deployment of a gigabit-capable fiber-to-the-premises network to serve the homes and businesses in those contiguous areas. We then estimated the cost for deploying that network, including a network backbone, assuming the construction was performed by the County or a partner entity that is not the incumbent telephone, power, or cable company.

The total estimated capital cost for the County or a partner to construct a fiber-to-the-premises network to serve the unserved areas is $38.9 million, assuming a take-rate (i.e., percentage of potential customers subscribing to the service) of 60 percent. See Section 4 for more details.

1.4 The County's current and pending efforts, including projects that have already received funding, will be making a substantial contribution to filling the unserved gap

The County has been actively involved in expanding broadband access in the past two years. Figure 4 shows areas for which the County and its respective partner have already received funding awards or have an application in progress. As these enter construction and are completed, the number of unserved addresses in the County will be reduced.

Figure 4: Recent Grant-Funded Initiatives in Garrett County



1.5 The Rural Digital Opportunity Fund auction will deliver a subsidy for broadband expansion

The completion of the Federal Communications Commission's (FCC) Rural Digital Opportunity Fund auction in 2020 means that funding will support the expansion of broadband service in a portion of the County.

The auction awarded subsidies to bidders that committed to building new broadband infrastructure and delivering service in currently unserved areas nationwide. The auction format was designed to select the best possible technologies available when pitting bidders against each other by offering a higher share of federal subsidies to bidders that promised to deliver higher-speed services.

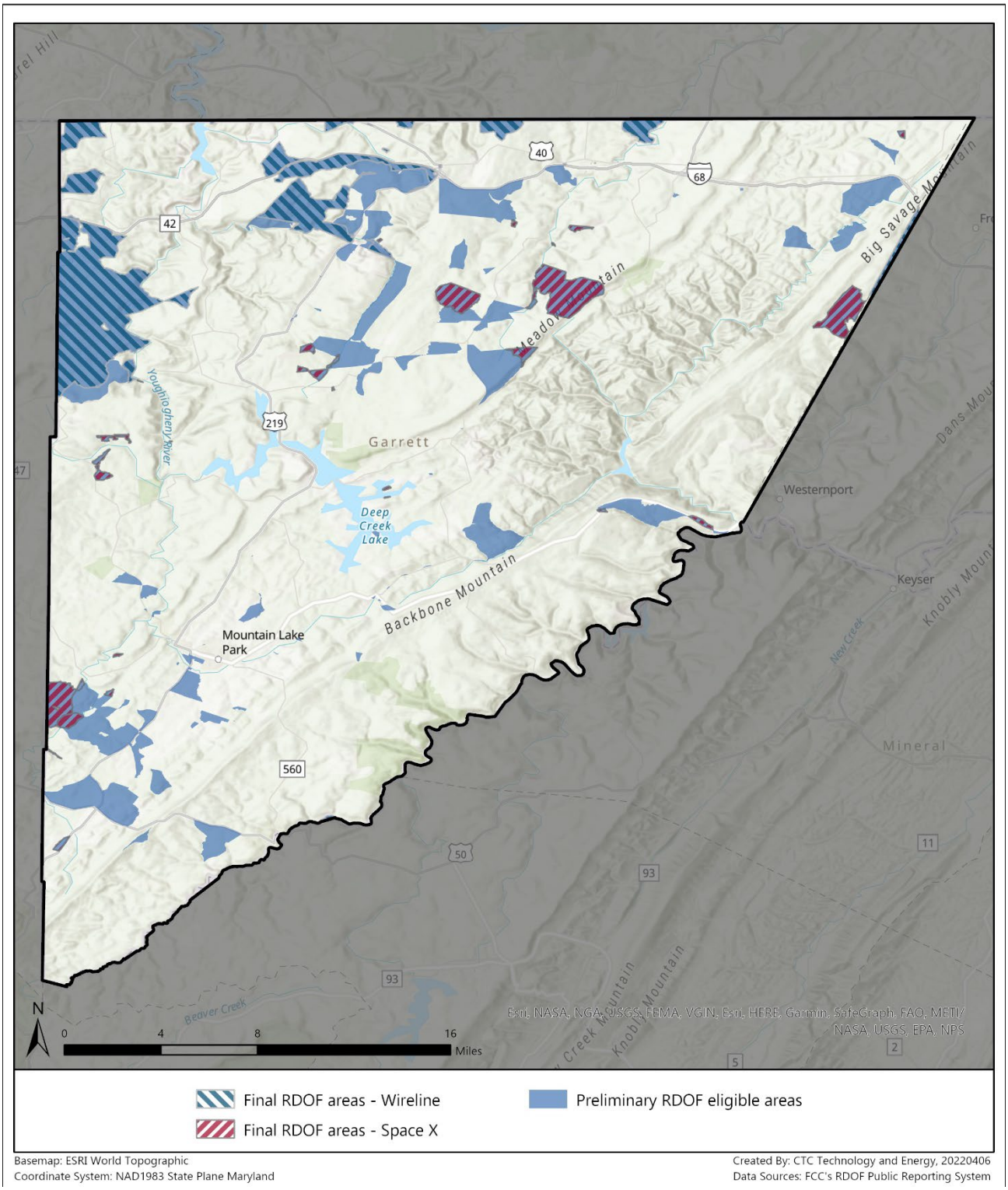
The FCC relied on its inaccurate coverage maps to identify areas eligible for the auction,[2] so most unserved areas in Garrett County were not deemed eligible for the auction. The FCC released these initially eligible areas and allowed a brief challenge window for incumbents to claim they were already serving them. However, the FCC did not allow counter-challenges or adopt a verification methodology—so challenges were mostly accepted and eligible areas reduced.

When final eligible areas were announced, Garrett County saw its auction-eligible areas substantially reduced because Declaration Networks Group (DNG) had successfully challenged many of the initially eligible areas with claims that the company delivered 25/3 fixed wireless service to at least a single address in those census blocks. The comparison between the initial and final RDOF-eligible areas can be seen in Figure 5.

Even so, the major winning bidder in the County was awarded subsidies to build fiber that will serve about 617 addresses. Almost all the eligible Rural Digital Opportunity Fund awards in the County went to Talkie, which committed to provide gigabit speeds with fiber optic technology. The FCC has since authorized Talkie for certification. A few areas (see Figure 5) were won by SpaceX for its Starlink low orbit satellite service. Many federal, as well as the state of Maryland, do not consider satellite service as broadband and focus on terrestrial fixed wireline, and in some cases fixed wireless infrastructure. The County should consider such areas as unserved as a matter of policy and funding eligibility.

[2] ISPs self-report their coverage at a census block level on the FCC's Form 477. If even a single address *could* be served in a census block, the ISP can report the entire block as served—and the entire block would then be ineligible for the RDOF auction.

Figure 5: Initially Eligible and Awarded RDOF Areas in Garrett County



1.6 Multiple private partners may be interested in collaborating with the County

CTC interviewed representatives of six incumbent providers and two other regional providers about their interest in extending their services in the County. These outreach efforts established that many potential partners seem highly interested in constructing broadband infrastructure in unserved parts of the County—assuming they receive sufficient public financial support.

Most of these entities deploy and operate gigabit-capable, fiber-to-the-premises networks. For example, Procom, an established West Virginia-based fiber-to-the-premises ISP that has seen rapid recent growth, has accelerated its expansion initiatives with the County.

One of the ISPs—Comcast—typically deploys hybrid fiber-coaxial infrastructure, which currently only supports up to 35 Mbps upstream due to limitations in the DOCSIS 3.1 technical standard Comcast has implemented. However, Comcast, too, has begun to deploy fiber-to-the-premises in "greenfield" builds (i.e., construction in new areas without nearby network infrastructure from which the company would otherwise extend).

The County has previously partnered with Declaration Networks Group (DNG/NeuBeam—a fixed wireless provider), Procom and QCOL (small, regional fiber-to-the-premises providers), and Comcast.

In addition, Talkie won several areas in the Rural Digital Opportunity Fund auction (see Section 1.5 for more details) auction and has reported that it is eager to further expand as well. Talkie won relatively low levels of subsidy in the auction—which means it has an incentive to connect the areas so it can pick up additional potential subscribers—and possibly additional public support through a partnership with the County.

Each of the above partners have expressed strong interest in further partnerships. In addition to these ISPs, Shentel and ThinkBig were identified as promising potential partners. Shentel could expand from its existing service area in the southern part of the County. ThinkBig could lease a connection to enter the County from another Maryland jurisdiction, as it has done in several other communities in Maryland.

1.7 Significant new federal funding sources could further help expand infrastructure and digital equity initiatives in the County

Unserved portions of Garrett County face the same challenges as other rural communities in attracting broadband infrastructure investment. Nationwide, even in the most affluent rural and semi-rural areas—from the horse farms around Lexington, Kentucky, to the ski communities outside of Aspen and Telluride, Colorado, to the resort areas on the Chesapeake Bay—the economics simply do not exist for rural broadband deployment absent substantial government funding. The private sector will not build costly infrastructure to reach all homes and businesses

in low-density areas simply because the potential return on investment is insufficient to justify the investment.

The same dynamics apply to virtually all areas of rural infrastructure development. In the case of broadband, the issues are starker because broadband is traditionally thought of as an area of private investment, rather than public investment. The challenging economics result from the lack of density of homes—and, in many cases, the fact that homes are located on large parcels of land; long driveways or setbacks from the road greatly increase the cost to deploy wired infrastructure to those homes.

New federal and state broadband funding has fundamentally changed the economics of rural broadband deployment. Maryland's Office of Statewide Broadband will help coordinate the expansion of high-speed internet across the state by managing the influx of federal funds to support the deployment of broadband.

The $1 trillion Infrastructure Investment and Jobs Act (IIJA)—including $65 billion in broadband funding—was signed into law on November 15, 2021. Over the coming months, the agencies responsible for administering the funds will release requests for comments; develop frameworks and rules; and issue notices of funding opportunities—including for the kinds of programs that could address gaps identified in the County. The biggest source of broadband funding within the IIJA is the $42.5 billion Broadband Equity, Access, and Deployment (BEAD) program for high-speed infrastructure; Maryland will receive an initial minimum distribution of $100 million in BEAD funding.[3] And a new $14.2 billion Affordable Connectivity Program (ACP) will provide a $30 monthly subsidy toward a broadband subscription for eligible low-income residents.

Additionally, the Department of the Treasury's Coronavirus Capital Projects Fund, created previously under the American Rescue Plan Act (ARPA), provides $10 billion to states for projects addressing broadband availability, affordability, and access. Maryland received an allocation of more than $171 million through the Capital Projects Fund. The Office of Statewide Broadband has until September 24, 2022, to submit a formal grant plan describing how the state's allocation will be used.[4]

Finally, the Treasury is administering the Coronavirus State and Local Fiscal Recovery Funds (two separate programs), which are distributing $350 billion in emergency funding to eligible state, local, territorial, and Tribal governments. These funds are highly flexible. While the state has not determined how to structure the part of its State Fiscal Recovery Fund allocation that will be

[3] "Grants Overview: Infrastructure Investment and Jobs Act Overview: Broadband Equity, Access, and Deployment (BEAD) Program," BroadbandUSA, National Telecommunications and Information Administration, https://broadbandusa.ntia.doc.gov/resources/grant-programs (accessed December 6, 2021).
[4] Frequently Asked Questions, Capital Projects Fund. Dept. of the Treasury. Coronavirus Capital Projects Fund FAQs (treasury.gov) (accessed December 4, 2021).

earmarked for broadband, the County may use parts of its Local Fiscal Recovery Fund allocation for a wide range of broadband-related uses. Since the state's infrastructure grants are likely to require matching funds from the County and a private partner, the County might use some of its Local Fiscal Recovery Fund allocation as a match.

1.8 Recommendations

1.8.1 Continue and accelerate an incremental approach to serving the County

While the cost estimate for covering all unserved areas in the County may preclude the County from having the problem resolved with a single project, the significant anticipated funding opportunities can substantially accelerate the timeline for solving this problem. Depending on how the state decides to administer its Coronavirus Capital Projects Fund and BEAD funding, it is possible the County could target the remaining areas for grant funding within the next couple of years.

1.8.2 Expand on the success of the pilot conduit installation project

The County should consider expanding its digging assistance and long driveway grant program. The County invested in equipment that would allow it to dig trenches on its own. Long driveways and shared private roads can be substantial impediments to connectivity in rural areas. The pilot program has demonstrated that reducing costs for ISPs and customers through County-participating digging and conduit efforts leads to connectivity of otherwise stranded locations. This is in no small part due to the uniquely collaborative relationships the County has developed with its many incumbent ISPs. Expanding these initiatives could allow providers such as Comcast to fill gaps in its existing coverage and incentivize smaller providers to pick up opportunities to edge out from their existing footprints. The County should continue to expand and build on the success of the program to further eliminate deployment barriers.

1.8.3 Target Category 1 unserved areas with most competitive wireline bidders

A multi-award RFP approach for identifying partners for different areas of the County could be the most efficient way to identify the most competitive partner for each area. The County has large areas of unserved addresses that can be contiguously—or almost contiguously—connected, and it has several service providers that can access just about any of these areas. This means that the nearest provider need not be the most cost-effective one, and the County should explore business and cost arrangements that could reduce its share of grant-required matching funds.

1.8.4 Target Category 2 unserved areas with nearby incumbents

Broadband deployment costs are typically lower for edge-out and fill-in approaches by incumbent providers than for deployment in areas farther way from existing network assets. Some existing providers could offer highly competitive per passing costs by constructing line extensions to areas close to their existing or planned infrastructures, or by expanding the

boundaries of their existing network coverage outward from their current edges (i.e., an edge-out strategy).[5]

1.8.5 Target Category 3 homes with pilot cost-sharing grant

Category 3 homes that are passed by broadband infrastructure on an adjoining public road—but that have long setbacks or driveways—have few affordable options to get connected. Traditional grant programs typically do not consider such isolated single address locations. The County should consider setting up a cost-sharing grant fund to subsidize broadband connections to such locations. The grant funds could be deployed with modest amounts for a pilot period to gauge residents' interest and evaluate funding request levels. Coordinating the effort with ISPs would facilitate the use of such funds.

1.8.6 Invest in future-proof technologies where feasible

In the past, fixed wireless was the only economically feasible solution for a County with very limited network infrastructure. The partnership with DNG served the County well. But with the availability of more significant amounts of public funding, the economic calculus has shifted—and future-proof technology, which for all practical purposes means fiber-to-the-premises, should be a priority. Only after all future-proof solutions with public grant support are exhausted should fixed wireless be considered. The Treasury makes clear that it prefers fiber and sets 100 Mbps symmetrical as the minimal standard. NTIA's grant funding is required to be technology neutral, but it too emphasizes the need for future-proof investments.

1.8.7 Strategically target state and federal funding opportunities

1.8.7.1 Last-mile

The vast majority of public funding opportunities are specifically directed toward last-mile deployments. The County would be eligible for state-administered federal infrastructure funding as well as future iterations of USDA's ReConnect.[6] The County's allocation of State and Local Fiscal Recovery Funds from the American Rescue Plan Act (ARPA) may be used for broadband and are particularly flexible, lending themselves to either last-mile of middle-mile projects, and may be used as match for some state and federal grant opportunities. There are no particular areas of the County that are more optimal for one rather than another funding source—although final rules regarding future grant opportunities have not yet been developed.

[5] A new broadband provider would likely be less competitive in offering cost-effective solutions to serving these isolated areas because it would not have existing plant adjacent to the isolated roads.

[6] The application window for round three of the ReConnect program closed on February 22, 2022; we anticipate future rounds, but the timing is unknown and USDA may wait until new, more accurate federal maps of unserved areas are available—or until other federal funding pools have been allocated.

1.8.7.2 Middle-mile

The County could develop its own middle-mile infrastructure which could lower costs for providers to extend service. As noted earlier, the County's unserved areas are located in rather large clusters with multiple providers potentially able to reach them without having to construct long backhaul lines or new middle-mile infrastructure. But additional middle-mile infrastructure could allow other providers to "parachute" in from more distant network points of presence. And if the middle-mile infrastructure were open access, it could provide multiple ISPs with opportunities to serve new areas.

The County's recently EDA-funded Table Rock project is a good example of this approach: The County is building a fiber run from the Oakland area down to Table Rock, picking up multiple businesses along the way, and has confirmed interest from multiple ISPs interested in using the fiber to pick up customers along the way. This fiber could be further extended with middle-mile funding from the EDA, the Appalachian Regional Commission (ARC), the state, or NTIA. As in the Table Rock project, a fiber extension would mean that the County, state, or Maryland Broadband Cooperative (MdBC) would be the formal owners.

The Table Rock project has the Maryland DoIT owning the fiber run and MdBC managing access for private ISPs. The County gets indefeasible right of use (IRU) fiber for its own needs without having to worry about entering the business of providing service or being responsible for maintenance and operation.

Since EDA likes to build on its own funding initiatives, extension of the EDA-funded Table Rock route could be a good project to pursue.

If pursuing extension of middle-mile infrastructure, the County could focus on connecting and running infrastructure through the Category 1 areas and/or prioritizing its rural business and farm community.

1.8.8 Actively collect data on service performance to track funding eligibility

While some upcoming infrastructure funding is expected to be flexible, DNG claims service of 25/3 in large parts of the County. While Treasury disregards fixed wireless technology altogether, NTIA and FCC's funding programs are required to be technology-neutral. In fact, DNG challenged large areas in the runup to the FCC's Rural Digital Opportunity Fund auction, claiming they already served them—which resulted in areas becoming ineligible in the auction.

By collecting performance data, the County can demonstrate which areas and address locations are unable to deliver the minimal performance that would render a particular grant program ineligible for those areas in the County.

The County can collect such data in multiple ways:

1. **Use online speed surveys.** Speed surveys can collect data on actual rather than provider-claimed performance.
2. **Use mail surveys.** Mail surveys can also provide a source for such information but would require consent from survey participants to publish their answers for their address location, or to aggregate data within a certain location buffer if respondents do not wish for their responses to be identified by their location.
3. **Ask for detailed maps of service coverage (and non-coverage) and performance metrics from ISPs.** Such cooperation from ISPs is more likely with grant partners, and the County can require making such information available as a condition of entering into broadband infrastructure partnerships.
4. **Await new maps from the FCC.** It is not clear when the FCC will have its improved maps available, but when they are, they will add potentially important new data to the County's efforts. It is not clear, however, how reliable the new data will be as there currently is not an enforcement mechanism in case of inaccurate data provision. Recent discussions indicate a field testing and verification program, but it is not clear whether there will be sufficient staffing to support a robust program like that.

1.8.9 Consider conducting an RFI/RFP process

Considering the large and closely positioned Category 1 areas that could make broadband expansion attractive for a variety of potential partners (all of which might have competitive proposals), a formal RFI and/or RFP process could potentially allow the County to reduce its share of matching funds for any future grant partnerships; it is possible that one or more providers could propose to absorb a higher proportion of capital costs in order to secure those areas and prevent competitors from moving in to the Category 1 unserved areas.

Because remaining Category 2 areas are relatively close to Category 1 areas and/or potential bidders' current service areas, such a process could also effectively maximize the prospects of getting all unserved areas targeted.

The County can structure an RFP to be multi-award, encouraging respondents to target all areas or only the ones that are most viable for the respondent.

A muti-award RFP framework can also target other policy-based preferences for the County and be structured to evaluate bids based on:

- Fiscal soundness and experience of the proposer.
- Per passing costs (and the allocation of those costs among the respondent, the County, and an external grant funder).

- Proposed network technology and speed.
- Speed of deployment of the infrastructure.
- Low-cost subscription plan availability and participation in the federal Affordable Connectivity Program (ACP), which subsidizes subscription costs for eligible low-income households.
- Willingness to participate in awareness campaigns to encourage participation in subsidy programs like the ACP.

Formalizing the RFP process would allow the County to quickly take advantage of upcoming grant opportunities by having already selected partners who could help alleviate the burden of matching funds.

1.8.10 Include an ongoing performance testing process and subscriber data reporting as condition of partnerships for last-mile service provision

Grant partnerships can be highly attractive for potential partners and can therefore provide leverage for the County to negotiate additional terms. One of the frustrations of local, state, and County governments—including Garrett County—is the lack of performance data from ISPs serving residents in the jurisdiction. Speed tests and subscriber reports are not systematic enough to yield strong conclusions and ISPs rarely allow joint testing with standardized methodologies without contractually based requirements. This makes it more difficult for the County to track whether ISPs are delivering on promised speeds reliably, complying with any relevant grant-based performance commitments, or leaving gaps in their claimed service areas that could be targeted for upgrades or future broadband expansion. One of the conditions for entering a grant partnership with the County could therefore be to accept ongoing performance testing.

Likewise, data from such partners on which locations are connected, which are activated, and which participate in low-cost or subsidy programs can help the County develop future infrastructure expansion projects and initiatives to encourage adoption of high-speed broadband connectivity for low-income households.

1.8.11 Consider pursuing Appalachian Regional Commission funding to coincide with EDA grants

Garrett County is designated by the ARC as a transitional county for the 2022 fiscal year.[7] If the County were to jointly submit applications for ARC and EDA grants, ARC funds could possibly be used as matching funds. In certain situations, EDA and ARC may be permitted to supplement the

[7] "Interactive Map of County Economic Status and Distressed Areas, FY 2022," Appalachian Regional Commission, https://www.arc.gov/match-requirements-for-arc-grants/ (accessed February 15, 2022).

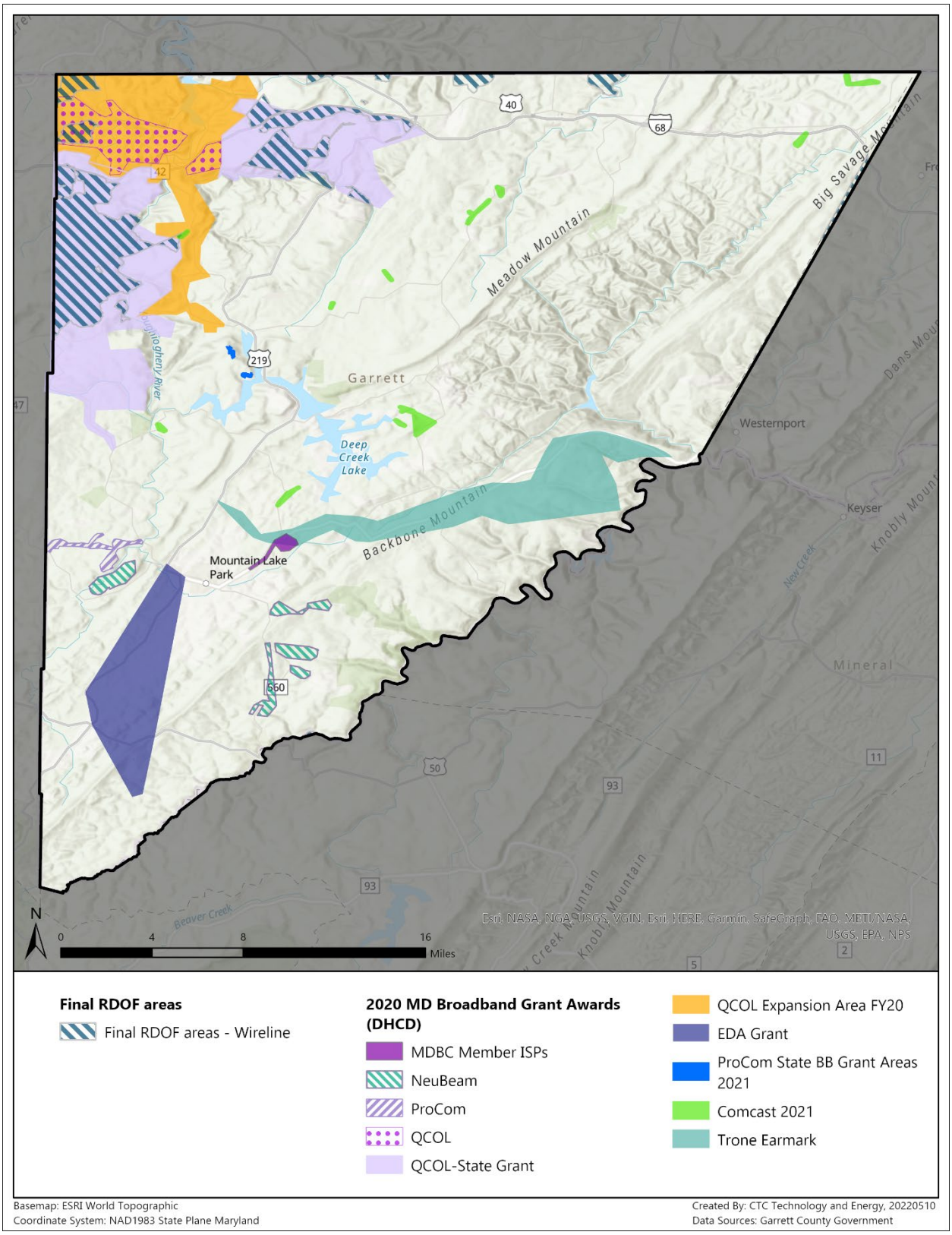
other grant's federal matching expectation. The County should check its contracts to confirm whether they are eligible for this type of supplemental funding.

2 The County has made strong progress on expanding broadband infrastructure

The County has been very active in pursuing grant opportunities to expand broadband access and developing collaborative relations with its ISPs. The County embarked on a refresh of its planning effort in 2020 with state funding. As part of this effort, the County successfully pursued five state grants with private partners in 2020 – 2021.

Figure 6 shows the significant progress the County has made in targeting unserved areas. This effort—along with this study's detailed address-level broadband coverage data—make it significantly easier for the County to continue to find ways to extend high-speed, reliable, and future proof broadband connectivity to all County locations.

Figure 6: Grant-Funded, Grant-Applied, and RDOF-Awarded Areas[8]



2.1 Previous broadband planning initiatives

The County has sought to extend broadband connectivity to its unserved rural areas for more than a decade. Until a few years ago, the County suffered from the same dynamics that applied to virtually all areas of rural infrastructure development: the low density makes the high capital costs of broadband deployment in rural areas difficult to justify for private providers. The challenging economics result from the lack of density of homes—and, in many cases, the fact that homes are located on large parcels of land; long driveways or setbacks from the road greatly increase the cost to deploy wired infrastructure to those homes.

In addition, broadband was traditionally thought of as an area of private investment, rather than public investment, so there was little public funding available to correct this market failure by subsidizing private providers or having the County build its own network.

In 2012, the County developed a strategic plan to address this challenging broadband landscape, and the planning effort led to a partnership with DNG to deploy fixed wireless broadband in several areas of the County with three ARC-grant-funded projects.

2.2 New planning efforts and the changing landscape of rural broadband economics

New federal and state broadband funding has fundamentally changed the economics of rural broadband deployment. Maryland's Office of Statewide Broadband helps coordinate the expansion of high-speed internet across the state by managing the influx of federal funds to support the deployment of broadband.

Federal funding, some of which has or will be flowing through the Office of Statewide Broadband, makes more robust and future proof broadband deployments economically viable. For example, the County's initial solution with DNG's fixed wireless technology delivered very basic speeds to rural areas; that approach is gradually being replaced with broadband solutions that can substantially address the broadband infrastructure needs of County residents and businesses over the next decades.

[8] Space X bid for and won several RDOF areas but they are not considered to be served by some grants, so their RDOF territory is not displayed in the map.

3 About 4,750 addresses in large, contiguous areas of the County are unserved with broadband—as are 1,200 addresses on isolated roads

A comprehensive survey of wireline broadband infrastructure in the County found approximately 4,750 unserved address points in large, contiguous areas (referred to in this report as Category 1 areas). There are also about 1,200 unserved addresses in small pockets within the County's otherwise-served areas, mainly on isolated rural roads; these locations are referred to in this report as Category 2 areas.[9]

The methodology for this analysis comprised several different steps. First, we used County data and maps along with Form 477 data to generate initial maps showing potential areas with lack of service. Results from a County speed test and survey were layered on top of these results. Particular focus was placed on areas of interest: areas with high likelihood of lack of service and boundaries of Category 1 areas. A comprehensive desktop and field survey was conducted, with outside plant engineers surveying almost all roads in the County, noting cable—and in some cases fiber—physical plants.

Copper cables that deliver DSL service were ignored because in rural areas, DSL does not reach broadband speeds. Walkouts and field inspections also disregarded signs of fixed wireless connectivity. These are very difficult to identify from a roadside or from Google Earth Street View photos, and the presence of an antenna on the rooftop or property of one house does not imply the presence or serviceability in an adjoining property—unlike with wireline infrastructure. Fixed wireless infrastructure was therefore based on reporting by customers and speed test results.

3.1 Current service in the County

Garrett County has long had significant areas with poor or non-existent broadband service. As in many rural areas, the lack of sufficient population density has worked against deploying relatively expensive high-bandwidth wireline infrastructure. But Garrett County is particularly challenged being the most rural of all Maryland counties: 99.3 percent of the County is rural.[10] It is the second-largest County in the state by geographic area but has fewer than 30,000 residents.

Without a nearby metropolitan market, that low population density makes it even more difficult to attract competitive market-based providers. Cable providers typically deploy in cities where they have community-wide franchise agreements that require them to build comprehensively inside the jurisdictional boundaries. They then expand outward to suburban communities with sufficient density to justify a return-on-investment projection.

[9] The category numbers do not indicate prioritization or emphasis in terms of the County's approach to filling its broadband gaps; the numbers are merely a convenient way to refer to the categories.

[10] https://www.oceancitytoday.com/news/state/most-rural-counties-in-maryland/collection_c7acb796-30e8-5cb4-bb97-e2fe9adacc35.html (accessed February 14, 2022).

Fiber optic providers typically deploy more opportunistically, often overbuilding cable in lucrative areas of urban spaces. They may also deploy opportunistically in clusters that are near an existing backbone, and/or can piggy-back on infrastructure installed for large enterprise customers to pick up residential customers along the way. In the past, too, fiber optic construction was relatively expensive compared with cable and later hybrid fiber-coaxial, so rural fiber optic providers were relatively rare.

Fiber, cable, and wireless services are reflected in the figures below.

Figure 7: Claimed Broadband Speeds at and Above 25/3 Mbps (by Technology)

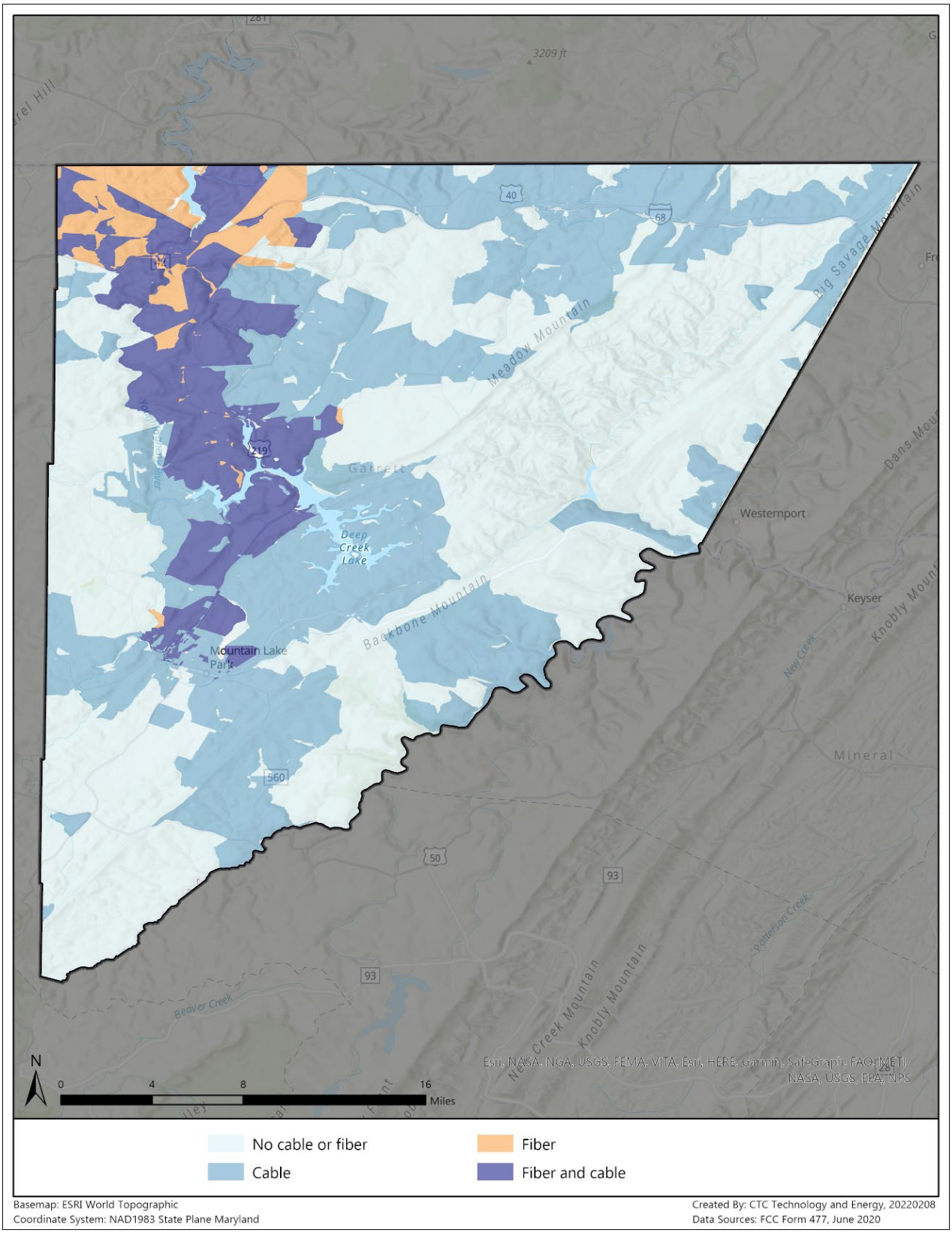


Figure 8: Claimed Speeds at and Above 25/3 Mbps (Fiber ISPs)

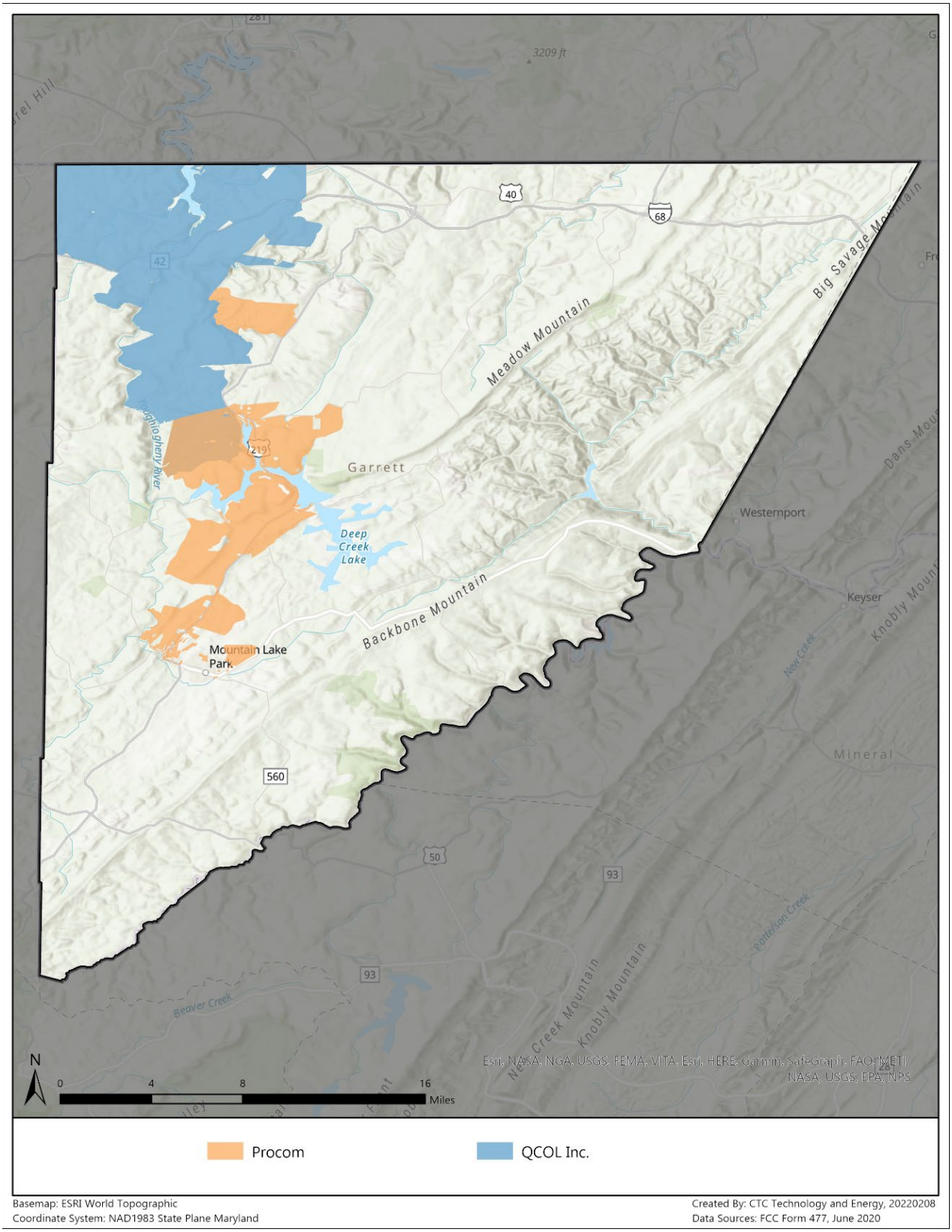


Figure 9: Claimed Speeds at and Above 25/3 Mbps (Cable Providers)

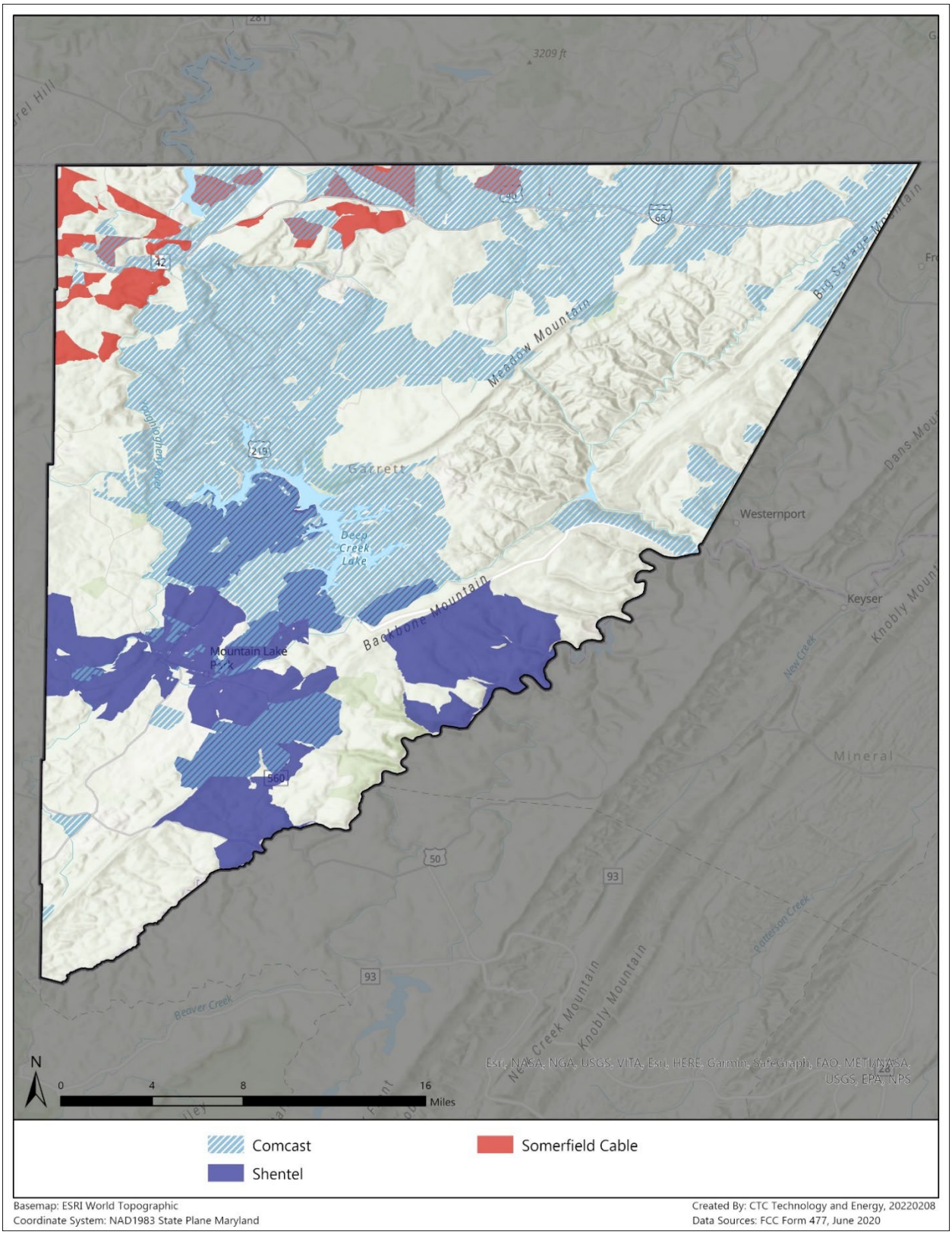
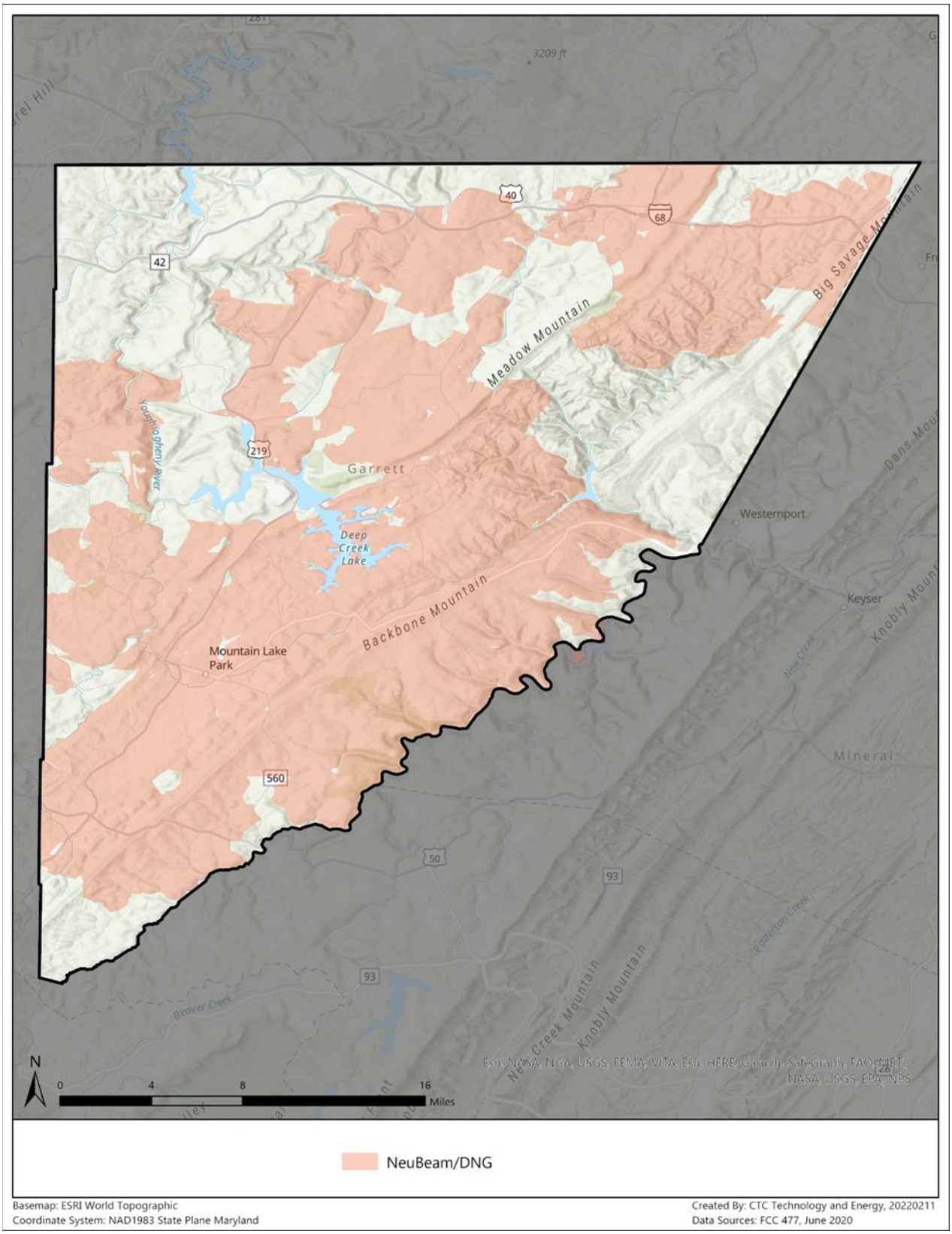


Figure 10: Claimed Speeds at and Above 25/3 Mbps (Fixed Wireless ISPs)



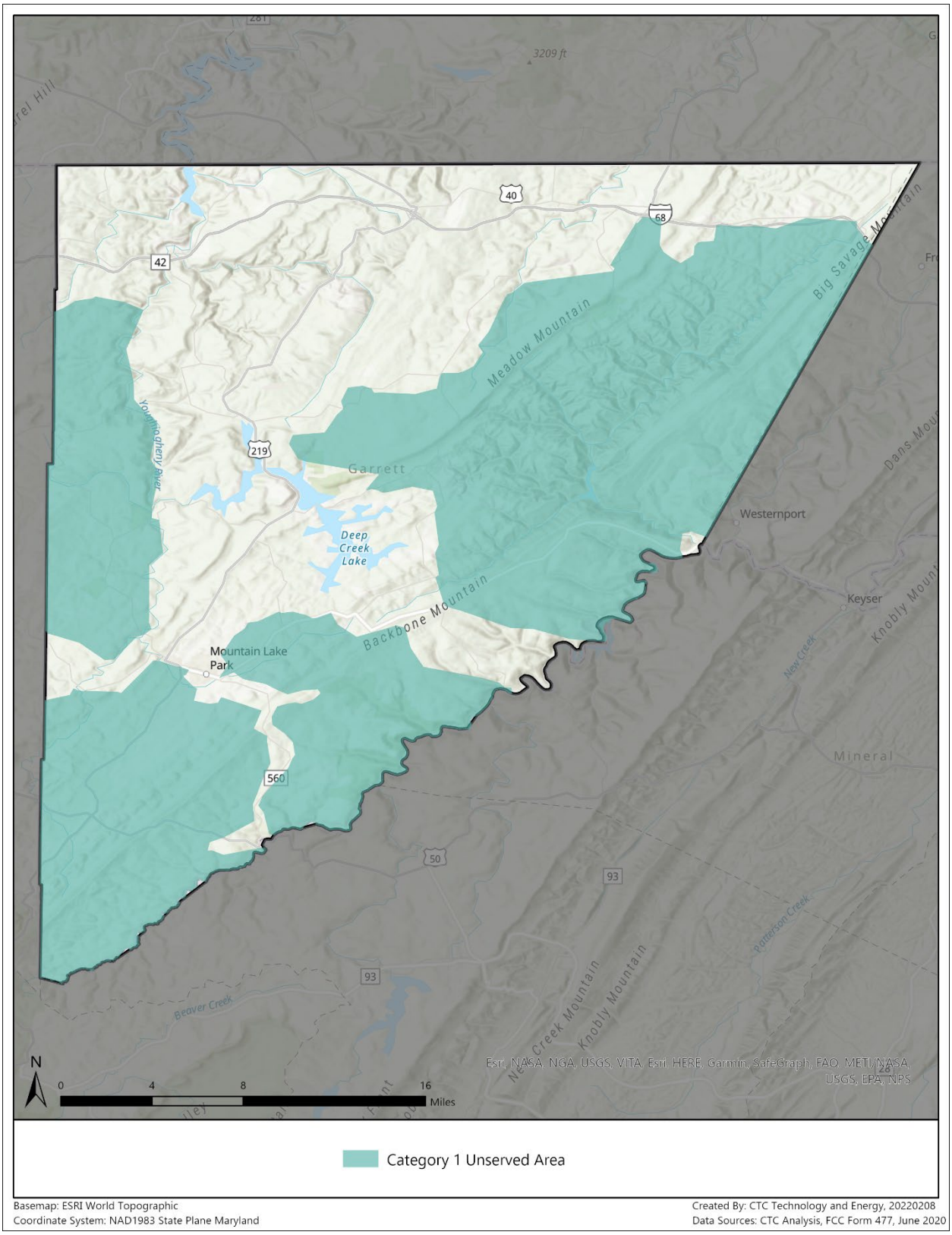
3.2 Unserved Category 1: Contiguous geographic areas

Typically, in counties with rural areas, most unserved households are in relatively large, contiguous areas. Figure 11 illustrates the County's several, large contiguous areas lacking broadband service.

These contiguous unserved areas reflect market forces. Cable and fiber-to-the-premises ISPs typically expand from urban areas outward and opportunistically where there is sufficient housing density to justify extending a line from their existing infrastructure into new areas. Both cable and fiber-to-the-premises ISPs also frequently pick up customers along backbone and middle-mile fiber they construct to reach customers in other locations. As recent grant-funded partnerships have demonstrated, however, fiber-to-the-premises ISPs are often eager to expand when public funding can alter the return on investment to their benefit, and many cable providers are switching from hybrid fiber-coaxial to fiber-to-the-premises for builds into new areas.

Garrett County's distribution of Category 1 areas is somewhat unique. Most counties have a few such areas with lack of service where urban and suburban areas stop. Broadband providers opportunistically add denser clusters of locations in rural areas, often close to a fiber backbone. Since many counties have several urban centers, Category 1 areas often are spread out between them. This is not the case in Garrett County. The lack of large urban centers in and around the County and the low density in general mean that Category 1 areas are actually fairly close to each other and the distance between Category 1 contiguous areas and clusters of unserved Category 2 locations is relatively small. This has implications for potential partners because they have more opportunity to string together expansion areas without having to construct long fiber runs across served areas to connect them.

Figure 11: Category 1 Unserved Areas



3.3 Unserved Category 2: Addresses on isolated roads

Analysis indicates that the County's approximately 1,200 Category 2 unserved premises primarily are located on isolated, low-density roads that fall within areas that are otherwise served. In other words, while the larger areas around these homes are generally served, the homes are on roads that do not have infrastructure.

To identify the County's Category 2 locations, all addresses in the County were snapped to a map of the road network (i.e., address points were moved to the closest road possible). Addresses were then identified as part of Category 2 if:

1. They were on a road segment categorized as not having cable service and
2. They were not within a Category 1 area.

The isolated unserved premises are typically on roads that are particularly long relative to the number of potential broadband customers on the road. Providers have not had business reasons to build 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, the cable companies are not obligated to build infrastructure on those roads under the terms of their cable franchise agreements with the County.

These addresses are prime candidates for line extensions from existing nearby ISPs. In parallel with focusing on the larger Category 1 areas for infrastructure grants that are best suited for contiguous areas, the state typically offers a line extension grant opportunity for Category 2 locations. Line extensions are also eligible projects under ARPA Coronavirus State and Local Fiscal Recovery Funds rules, so the County's allocation of these funds could also be applied to such projects.

4 Fiber-to-the-premises infrastructure to fill gaps in unserved areas would have high capital cost but relatively low ongoing operating costs

As discussed in Section 2, an analysis of County-provided data and extensive field and desk surveys identified an estimated 4,750 unserved homes and businesses in large, contiguous areas (referred to in this report as Category 1 locations) that could be served by a new ISP or by the incumbent providers.

As a candidate solution, CTC's engineers prepared a high-level network design for the deployment of a gigabit-capable fiber-to-the-premises network to serve homes and businesses in the large Category 1 contiguous areas. We then estimated the cost for deploying that network, including a network backbone, assuming the construction was performed by the County or a partner entity that is not the incumbent telephone, power, or cable company.

The total estimated capital cost for the County or a partner to construct a fiber-to-the-premises network to serve the unserved areas is $38.9 million, assuming a take-rate (i.e., percentage of potential customers subscribing to the service) of 60 percent; details are shown in Table 1.[11]

Table 1: Estimated Total Fiber Deployment Cost for the Unserved Areas

Cost Component	Estimated Cost
Outside Plant	$34.5 million
Central Network Electronics	$1.2 million
Fiber Service Drop Installations	$1.8 million
Customer Premises Equipment	$1.4 million
Total Estimated Cost	*$38.9 million*

We estimated a cost per passing—essentially the cost of building a network independent of connections to any specific homes or business—by dividing the outside plant cost (i.e., the cost of constructing fiber alongside the roads in front of the 4,750 unserved homes and businesses) by the number of homes and businesses. We estimate the average outside plant cost per passing will be approximately $7,270 (Table 2).

[11] These numbers have been rounded. The take-rate affects the electronics and drop costs, but also may affect other parts of the network, because the County or its partner may make different design choices based on the expected take-rate. A 60 percent take-rate is possible in environments where a new provider delivers service in a previously unserved area. Market research would be required to estimate a more accurate take-rate at assumed service costs.

Table 2: Estimated Outside Plant Cost per Passing for the Unserved Areas[12]

Cost Component	Estimated Cost
Outside Plant	$34.5 million
Passings	4,750
Outside Plant Cost per Passing[13]	*$7,270*

These cost estimates—and the estimated operating costs described below (Section 4.5)—provide data relevant to assessing the financial viability of network deployment; they enable financial modeling to determine the approximate revenue levels necessary for the County or a partner to service any debt incurred in building the network. They also provide a baseline against which to evaluate the cost of incremental and non-fiber optic approaches.

4.1 Capital cost estimates are derived from a customized outside plant network design

To develop and refine the range of assumptions that will have an impact on the network design and construction costs, a CTC engineer used data from our extensive field surveys and performed desk survey of the identified unserved areas of the County using Google Earth Street View. The engineer reviewed available green space and the presence and condition of utility poles. Based on this analysis, we developed customized estimates of per-mile costs for construction on utility poles and for underground construction where poles are not available.

Table 3 summarizes the conditions determined through our desk survey; the factors are described in detail below.

[12] Unrounded numbers are used in the engineering calculations; these are then rounded in the discussion.
[13] This is the average cost to construct the outside plant portion of the fiber-to-the-premises network for each home and business in the unserved areas.

Table 3: Construction Cost Factors Developed in Desk Survey of Unserved Areas

Cost Factor	Finding in Unserved Areas
Aerial Construction	99%
Poles per Mile	22
Average Moves Required per Pole[14]	1
Poles Requiring Make-Ready	2%
Cost Per Move	$350
Poles Requiring Replacement	1%
Average Pole Replacement Cost	$7,000
Intermediate Rock Underground	4%
Hard Rock Underground	2%

Make-ready is the work required to create space on an existing utility pole for an additional attachment. Existing attachments often have to be moved or adjusted to create the minimum clearance required by code to add an additional attachment. Each move on the pole has an associated cost (i.e., for contractors going out to perform the move). When a utility pole is not tall enough to support another attachment or the pole is not structurally capable of supporting the attachment, a pole replacement is required. The pole replacement cost is then charged to the new attacher.

Where utility poles do not exist, underground construction is required. One of the challenging variables with underground construction is the prevalence of rock. Softer stones and boulders (intermediate rock) require the use of a specialized boring missile that is more expensive than traditional boring. Hard rock requires even more specialized equipment such as rock sawing. The cost of boring through rock is added to the cost of traditional boring. We expect moderate levels of hard or intermediate rock in some portions of the County due to its mountainous terrain.

CTC's outside plant engineer noted that the quality of the poles and pole attachments in the County vary, as they do in many cities and counties—but that overall, most of the electrical utility poles have space for an additional attachment.

In many parts of the County's unserved areas, the telecommunications cables (i.e., telephone lines) are installed on short telecommunications poles, typically on the opposite side of the road from the electric distribution cables installed on taller electric utility poles. The cost estimate assumes the County could attach fiber to the electric utility poles in the communications space

[14] The average moves per pole is the average number of existing attachments on the utility pole that need to be moved to create space and clearance in the communications space to support a new attachment for the fiber-to-the-premises network.

below the electrical cables. Based on our experience, the County's utility pole lines appear more favorable for new pole attachment than the average utility pole—which will correspond to a lower-than-average aerial construction cost. In contrast, installing the fiber on the telecommunications poles would require substantial make-ready and poles replacements to make clearance for the attachment.

The figures below show samples of poles in various conditions in the County's unserved areas. In Figure 12, for example, make-ready is required to move existing cables to make space for a new attachment. This pole has multiple cables in the communications space which will require make-ready and possible pole replacement to create the desired clearance.

Figure 12: Utility Pole Requiring Make-Ready

Figure 13 shows a pole line that has only one existing attachment in the communications space on the power poles. Where make-ready is low, as in this case, the cost of aerial construction is less than in high make-ready areas.

Figure 13: Low-Make-Ready Pole Line in Unserved Area

Figure 14 shows a separate short telecommunication pole that already has two telecommunications cables attached. The height of the pole would likely not allow an additional attachment to the pole without pole replacement.

Figure 14: Short Telecommunications Pole

4.2 The network architecture can support multiple subscriber models and classes of service

We developed a conceptual, high-level fiber-to-the-premises outside plant network design that is aligned with best practices in the industry and is open to a variety of electronic architecture options.[15]

Figure 15, below, shows a logical representation of the fiber-to-the-premises network architecture we recommend based on the conceptual outside plant design. The drawing illustrates the primary functional components in the fiber-to-the-premises network, their positions relative to one another, and the flexibility of the architecture to support multiple subscriber models and classes of service.

The recommended architecture is a hierarchical data network that provides scalability and flexibility, both in terms of initial network deployment and its ability to accommodate the increased demands of future applications and technologies without requiring expensive new construction. This hierarchical fiber-to-the-premises data network can be described by a range of characteristics:

- **Capacity** – ability to provide efficient transport for subscriber data, even at peak levels.
- **Availability** – high levels of redundancy, reliability, and resiliency; ability to quickly detect faults and re-route traffic.
- **Failsafe operation** – physical path diversity in the network backbone to minimize operational impact resulting from fiber or equipment failure.
- **Efficiency** – no traffic bottlenecks; efficient use of resources.
- **Scalability** – ability to grow in terms of physical service area and increased data capacity, and to integrate newer technologies without new construction.
- **Manageability** – simplified provisioning and management of subscribers and services.
- **Flexibility** – ability to provide different levels and classes of service to different customer environments; can support an open access network or a single-provider network; can provide separation between service providers on the physical layer (separate fibers) or logical layer (separate Virtual Local Area Network (VLAN) or Virtual Private Network (VPN) providing networks within the network).

[15] The network's outside plant is both the most expensive and the longest-lasting portion. The architecture of the physical plant determines the network's scalability for future uses and how the plant will need to be operated and maintained; the architecture is also the main determinant of the total cost of the deployment.

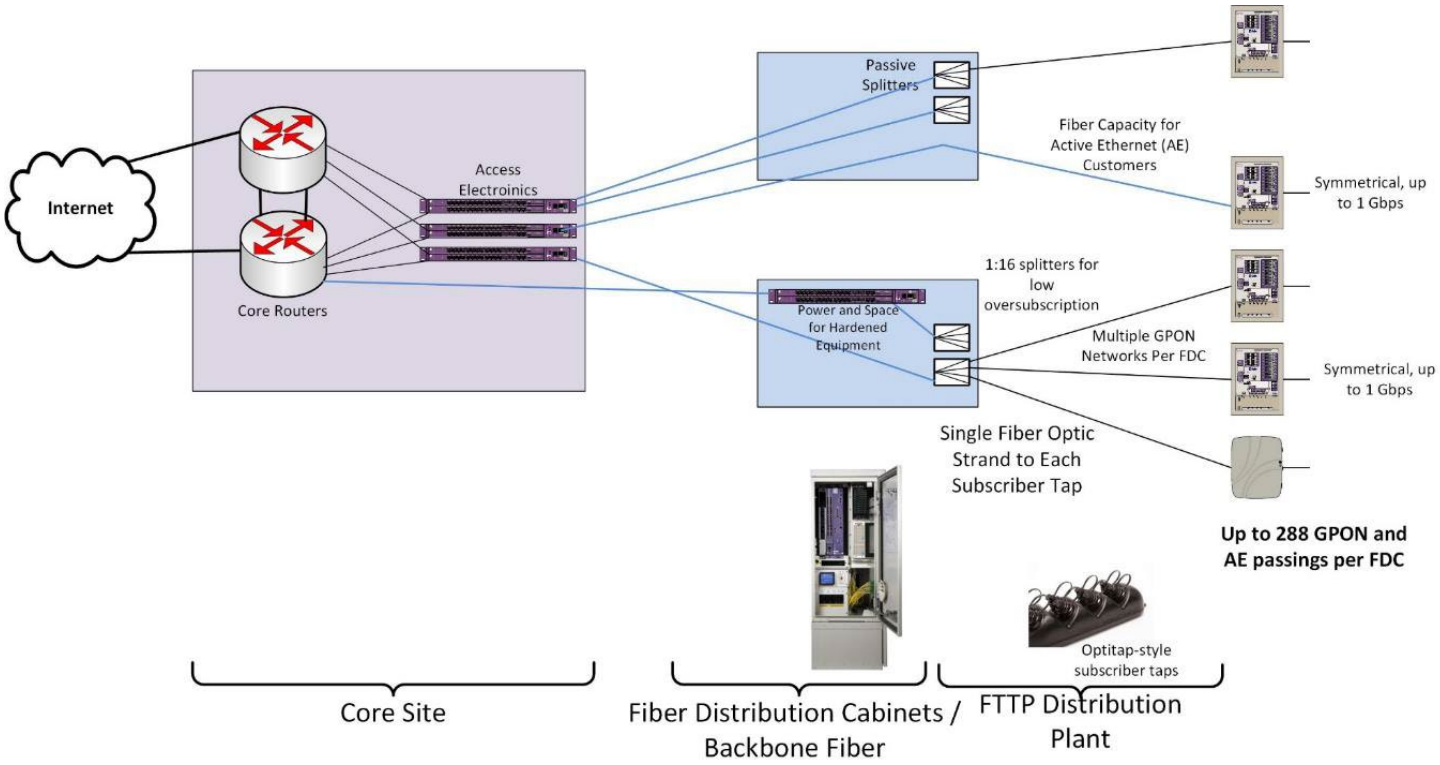
- **Security** – controlled physical access to all equipment and facilities, plus network access control to devices.

This architecture offers scalability to meet long-term needs. It is consistent with best practices for either a standard or an open-access network model to provide customers with the option of multiple network service providers. This design would support the current industry standard gigabit passive optical network technology. It could also provide the option of direct Active Ethernet services.[16]

The design assumes placement of manufacturer-terminated fiber tap enclosures within the public right-of-way or easements, providing watertight fiber connectors for customer service drop cables, and eliminating the need for service installers to perform splices in the field. This is an industry-standard approach to reducing both customer activation times and the potential for damage to distribution cables and splices. The model also assumes that the County or a partner obtains easements or access rights to private drives to access homes as needed.

[16] The architecture enables the network to provide direct unshared Active Ethernet connections to 5 percent of customers, which is appropriate for a select group of high-security or high-capacity commercial users (e.g., banks, wireless small cell facilities). In extreme cases, the network can provide more customers with Active Ethernet with the addition of electronics at the fiber distribution cabinets on an as-needed basis.

Figure 15: High-Level Fiber-to-the-Premises Architecture



4.3 Network design assumptions include constructing 622 miles of fiber

We used a range of unit cost assumptions when developing our estimated fiber construction costs (Table 4). Cost estimates are based on other, similar fiber-to-the-premises projects.

Table 4: Unit Cost Estimate Assumptions

Description	Unit	Assumption
Placement of 2-inch conduit using directional boring	$/foot	$12.50
Pull-box placement, 24"x36"x36" Tier 22	Each	$1,050
Aerial cable installation per foot	$/foot	$1.50
Traffic control and work area protection per foot	$/foot	$.25
Tree trimming	$/foot	$.25
Make-ready per foot	$/foot	$0.32
288-count cable	$/foot	$2.05
Aerial fiber installation materials	$/foot	$1.30

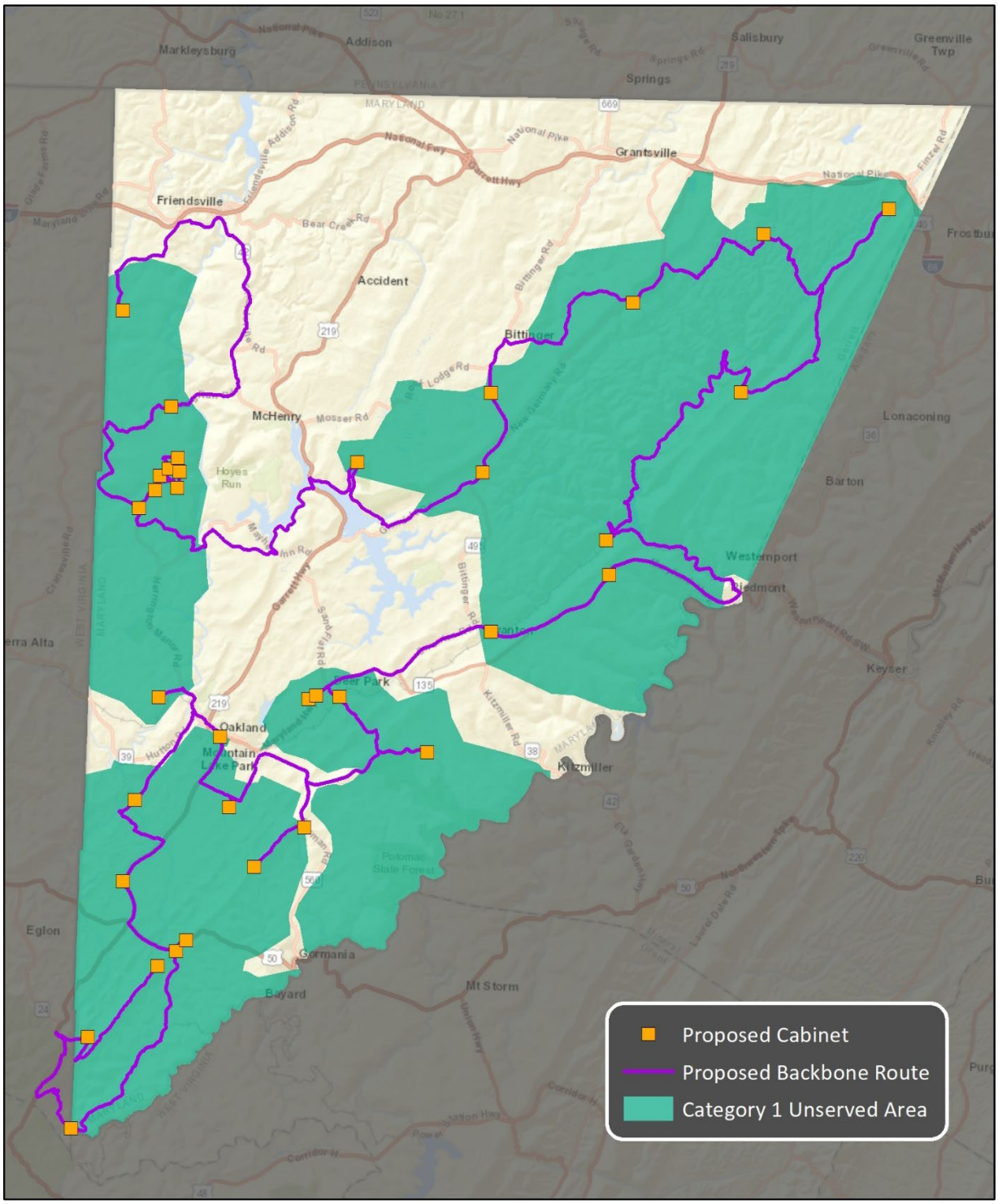
The network design and cost estimates assume the County, or a partner will:

- Use existing County land to locate a core facility.[17] The cost estimate includes the facility costs with adequate environmental and backup power generators to house network electronics and provide backhaul to the internet.
- Construct approximately 184 miles of backbone network[18] to connect the unserved communities to the core via 35 fiber distribution cabinets. The fiber distribution cabinets will be best located in the public right-of-way or on County-owned land that provides adequate space for the hosting and maintenance of the cabinet (Figure 16).
- Construct approximately 438 miles of fiber optics from the fiber distribution cabinets to approximately 4,750 homes and businesses (i.e., from termination panels in the fiber distribution cabinet to tap locations in the public right-of-way or on easements near the home or business).
- Obtain easements or access rights to private roads where public rights-of-way do not exist.

[17] This is rarely needed if a private ISP is building as it will simply bring connectivity back to its own network core electronics site. Likewise, should the County decide to offer services, it has its own NOC it could expand. The assumption simply states that no additional cost needs to be factored in for this purpose that requires purchasing land.

[18] The backbone construction costs are included in the cost of the fiber-to-the-premises network.

Figure 16: Candidate Fiber-to-the-Premises Network



The fiber-to-the-premises network design was developed with the following criteria based on the above assumptions and required characteristics of the hierarchical fiber-to-the-premises network:

- Fiber will vary between 12- and 288-count based on the projected need in the area.
- Fiber will be installed in the communications space of the electric utility poles where poles are present, and in newly constructed underground conduit in other areas.
- Fiber will be installed in the public right-of-way or in an easement on the side of the road.
- The network will target up to 288 passings per fiber distribution cabinet.
- Fiber distribution cabinets will support hardened network electronics and provide backup power and an active heat exchange.[19]
- The network routes will avoid the need for distribution plant to cross major roadways and railways.

As with any utility, the design and associated costs for construction vary with the unique physical layout of the service area—no two streets are likely to have the exact same configuration of fiber optic cables, communications conduit, underground vaults, and utility pole attachments. Costs also vary by soil conditions, such as the prevalence of subsurface rock; the condition of utility poles; the feasibility of aerial construction involving the attachment of fiber infrastructure to utility poles; and the number of crossings of bridges, railways, and highways.

A key point to understand is that aerial construction (i.e., attaching fiber infrastructure to existing utility poles) could offer significant savings compared to all-underground construction but increases uncertainty around cost and timeline. Under some circumstances, costs related to pole remediation and make-ready construction can make aerial construction cost-prohibitive in comparison to underground construction. However, as discussed in Section 4.1, our desk survey found that the majority of poles likely have sufficient space and capacity, and that the amount of needed make-ready is very low. We also observed that tree trimming will be very low, helping to decrease the cost of aerial construction.

We assume the fiber will be strand-mounted in the communications space on the existing electrical utility poles. Splice cases, subscriber taps, and drops will also be attached to the strand, which will facilitate maintenance and customer installation.

[19] These hardened fiber distribution cabinets reflect an assumption that the network's operational and business model will require the installation of provider electronics in the fiber distribution cabinets that are capable of supporting open access among multiple providers. We note that the overall fiber-to-the-premises cost estimate would decrease if the hardened fiber distribution cabinets were replaced with passive fiber distribution cabinets (which would house only optical splitters) and the providers' electronics were housed only at the hub facility.

While generally allowing for greater control over timelines and more predictable costs, underground construction is subject to uncertainty related to congestion of utilities in the public right-of-way—which cannot be fully mitigated without physical excavation and/or testing. In the County, however, congestion of utilities appears to be reasonable for most areas, which makes underground construction more viable than is typically the case.

While anomalies and unique challenges will arise regardless of the design or construction methodology, the project's relatively large scale (i.e., constructing 622 miles of fiber) is likely to provide ample opportunity for variations in construction difficulty to yield relatively predictable results on average.

We assume underground construction will be done using an industry-standard approach for this type of environment, which consists primarily of horizontal, directional drilling to minimize public right-of-way impact and to provide greater flexibility to navigate around other utilities. The design model assumes a single 2-inch, flexible, high-density polyethylene (HDPE) conduit over underground distribution paths, and dual 2-inch conduits over underground backbone paths to provide scalability for future network growth.

Costs for aerial and underground placement were estimated using available unit cost data for materials and estimates on the labor costs for placing, pulling, and boring fiber based on construction in comparable markets. The material costs were known, with the exception of unknown economies of scale and inflation rates and barring any shortages or supply disruptions restricting material availability and increasing costs. The labor costs associated with the placement of fiber were estimated based on comparable construction projects.

4.4 Total capital costs include outside plant construction, electronics, and service drop installation

4.4.1 Outside plant cost components

The cost components for outside plant construction include the following tasks:

- ***Engineering*** – includes system-level architecture planning, preliminary designs, and field walk-outs to determine candidate fiber routing; development of detailed engineering prints and preparation of permit applications; and post-construction "as-built" revisions to engineering design materials.
- ***Quality Control / Quality Assurance*** – includes expert quality assurance field review of final construction for acceptance.
- ***General Outside Plant Construction*** – consists of all labor and materials related to "typical" underground or aerial outside plant construction, including conduit placement,

utility pole make-ready construction, aerial strand installation, fiber installation, and surface restoration; includes all work area protection and traffic control measures inherent to all roadway construction activities.

- ***Special Crossings*** – consists of specialized engineering, permitting, and incremental construction (material and labor) costs associated with crossings of railroads, bridges, and interstate / controlled access highways.
- ***Backbone and Distribution Plant Splicing*** – includes all labor related to fiber splicing of outdoor fiber optic cables.
- ***Backbone Hub, Termination, and Testing*** – consists of the material and labor costs of placing hub shelters and enclosures, terminating backbone fiber cables within the hubs, and testing backbone cables.

The assumptions, sample designs, and cost estimates were used to extrapolate an outside plant infrastructure cost of $56,000 per mile.

The distribution plant covers approximately 622 miles, leading to a total outside plant cost of approximately $34.5 million. This leads to an average outside plant cost per passing of approximately $7,270. Table 5 and Table 6 provides a breakdown of the estimated outside plant costs.

Table 5: Estimated Outside Plant Costs[20]

Cost Per Plant Mile[21]	Distribution Plant Mileage	Total Cost	Estimated Passings	Cost per Passing[22]
$56,000	622	$34.5 million	4,750	$7,270

[20] Unrounded numbers are used in the engineering calculations; these are then rounded in the table and the discussion.
[21] The cost per plant mile is the average cost of constructing a mile of outside plant for the fiber-to-the-premises network.
[22] The cost per passing is the average cost to construct the outside plant for the fiber-to-the-premises network to pass each premises within the unserved areas.

Table 6: Breakdown of Outside Plant Costs

Category	Outside Plant Costs
OSP Engineering	$5.0 million
Quality Control/Quality Assurance	3.8 million
General OSP Construction Cost	21.5 million
Special Crossings	1.6 million
Backbone and Distribution Plant Splicing	1.2 million
Backbone Hub, Termination, and Testing	1.4 million
Total Estimated Cost	*$34.5 million*

The actual cost to construct fiber-to-the-premises to every unserved premises in the County could differ from the estimate due to changes in the assumptions underlying the model. For example, if make-ready and pole replacement costs are too high, the network would have to be constructed underground—which could significantly increase the cost of construction. A non-uniform take-rate (i.e., the percentage of passed customers that choose to purchase a service) across different areas could also influence costs. Further and more extensive analysis would be required to develop a more accurate cost estimate across the entire County.

Actual costs will also vary from this estimate due to factors that cannot be precisely known until the detailed design is completed, or until construction commences. These factors include:

- Costs of private easements.
- Utility pole replacement and make-ready costs.
- Variations in labor and material costs.
- The County or its partner's operational and business model.

We have incorporated suitable assumptions to address these items based on our experience in similar markets.

4.4.2 Central network electronics costs

Central network electronics equipment to serve the unserved area will cost an estimated $1.2 million, assuming a 60 percent take-rate.[23] (These costs may increase or decrease depending on take-rate, and the costs may be phased in as subscribers are added to the network.) The network electronics consist of the core and distribution electronics to connect subscribers to the fiber-to-

[23] The take-rate affects the electronics and drop costs, but also may affect other parts of the network, because the County or its partner may make different design choices based on the expected take-rate. A 60 percent take-rate is possible in environments where a new provider delivers service in a previously unserved area. Market research would be required to estimate a more accurate take-rate at assumed service costs.

the-premises network at the core and the fiber-to-the-premises access electronics located at the fiber distribution cabinets. Table 7 lists the estimated costs for each segment.

Table 7: Estimated Central Network Electronics Costs

Network Segment	Cost
Core and Distribution Electronics	$700,000
Fiber-to-the-Premises Access Electronics	$500,000
Total Estimated Cost	*$1.2 million*

The electronics are subject to a seven- to 10-year replacement cycle, as compared to the 20- to 30-year lifespan of a fiber investment.

4.4.2.1 Core and distribution electronics

The core electronics connect the network to the internet. The core electronics consist of high-performance routers, which handle all the routing on both the network and to the internet. The core routers have modular chassis to provide high availability in terms of redundant components and the ability to "hot swap" line cards in the event of an outage.[24] Modular routers also provide the ability to expand the routers as demand for additional bandwidth increases.

The cost estimate design envisions running networking protocols, such as hot standby routing protocol, to ensure redundancy in the event of a router failure. Additional connections can be added as network bandwidth increases. The core sites would also tie to the distribution electronics using 10 Gbps links. The links to the distribution electronics can also be increased with additional 10 Gbps and 40 Gbps line cards and optics as demand grows on the network. The core networks will also have 10 Gbps to ISPs that connect the network to the internet.

The cost of the core routing equipment is approximately $700,000. In addition, the network requires operations support systems, such as provisioning platforms, fault and performance management systems, remote access, and other operational support systems for operations. For a network of this scale, an operations support system costs approximately $100,000 to acquire and configure. (We have not included that cost in the totals above because the system might be the responsibility of the County's partner.)

[24] A "hot swappable" line card can be removed and reinserted without the entire device being powered down or rebooted. The control cards in the router should maintain all configurations and push them to a replaced line card without the need for reconfirmation.

4.4.2.2 Fiber-to-the-premises access electronics

The access network electronics at the fiber distribution cabinets connect the subscribers to the network by connecting the backbone to the fiber that goes to each premises. These electronics are commonly referred to as optical line terminals. We recommend deploying access network electronics that can support both gigabit passive optical network and Active Ethernet subscribers to provide flexibility within the fiber distribution cabinet service area. We also recommend deploying modular access network electronics for reliability and the ability to add line cards as more subscribers join in the service area. Modularity also helps reduce initial capital costs.

The cost of the access network electronics for the network is estimated at approximately $500,000. These costs are based on a take-rate of 60 percent and include optical splitters at the fiber distribution cabinets aligned to that take-rate. An alternative design places the optical line terminals at the core location, with the fiber distribution cabinets containing only splitters. As the County or its partner examines more closely the specific electronics architecture, this alternative may be a suitable approach—and would reduce the size of the fiber distribution cabinets and provide a small cost savings.

4.4.3 Service drop installation and customer premises equipment (per-subscriber costs)

Each activated subscriber would also require a fiber drop cable installation and related customer premises equipment, which would cost on average roughly $1,130 per subscriber, or $3.2 million total—again, assuming a 60 percent take-rate.

Customer premises equipment is the subscriber's interface to the network; for gigabit passive optical networks, these electronics are referred to as an optical node terminal. For this cost estimate, we selected customer premises equipment that both terminates the fiber from the network and provides only Ethernet data services at the premises (however, there are a wide variety of additional customer premises equipment offering other data, voice, and video services). The customer premises equipment can also be provisioned with wireless capabilities to connect devices within the customer's premises. Using the assumed take-rate of 60 percent, we estimated the cost for customer premises equipment and installation to be $500 per subscriber, or approximately $1.4 million systemwide.

The drop installation cost is the biggest variable in the total cost of adding a subscriber. A short aerial drop can cost as little as $250 to install, whereas a long underground drop installation can cost upward of $5,000. Based on the prevalence of aerial and underground utilities, and sample designs, we estimate an average of approximately $630 per drop installation (or approximately $1.8 million systemwide, assuming a 60 percent take-rate). The drop installation follows the existing utilities; if the existing utilities in the public right-of-way are aerial, the drop would be installed aerially (and vice versa for underground). Average drop distances are extrapolated from

sample designs developed for similar rural fiber-to-the-premises projects. Actual drop costs will vary for each premises.

The numbers provided in Table 8, below, are averages and will vary depending on the type of premises and the internal wiring available at each premises.

Table 8: Per-Subscriber Cost Estimates

Construction and Electronics Required to Activate a Subscriber	Estimated Average Cost
Drop Installation and Materials	$630
Subscriber Electronics (Optical Node Terminal)	$200
Electronics Installation	$200
Installation	$100
Total Estimated Cost	*$1,130*

4.5 Annual fiber-to-the-premises technical operating costs would total approximately $771,000

Some of the ongoing costs of operating a fiber-to-the-premises network include fiber maintenance, fiber locating, pole attachment fees, and equipment replacement (Table 9). These estimates include costs directly related to the maintenance and operations of the physical and network electronics layers of the network, but do not include costs associated with higher-layer services and other fixed administrative expenses that would otherwise be incurred regardless of the technical approach to network transport.

Table 9: Estimated Annual Fiber-to-the-Premises Technical Operating Costs

Description	Annual Cost
Fiber Maintenance	$350,000
Fiber Locating	$11,000
Pole Attachment Fees	$245,000
Equipment Replacement Fund	$165,000
Total	*$771,000*

Regular fiber maintenance includes any required adds, moves, and changes. For example, if a roadway is widened a pole line may be moved or undergrounded, requiring the County to relocate this fiber. We estimate that 1 percent of the total outside plant capital costs, or about $350,000, would be required annually for fiber maintenance.

Fiber locating includes the marking of underground utilities as part of the state's "Miss Utility" process.[25] Each underground utility is responsible for locating and marking its infrastructure in the right-of-way. We estimate the cost at $1,800 per mile of underground construction annually for utility locates, or $11,000 annually for the estimated 6 miles of underground plant.

For every pole to which the fiber network attaches, the County or its partner must pay the pole owner an attachment fee for maintenance of the utility pole line. We estimate a pole attachment fee of $20 per pole per year or a total of approximately $245,000 annually for approximately 614 miles of aerial plant. Pole attachment fees are estimated and would be negotiated with the pole owners as part of the pole attachment process.

We also recommend establishing an equipment replacement fund, into which the County or its partner would put a portion of the necessary funds to replace the network electronics. We recommend planning on replacing the network electronics every seven years, requiring the County or its partner to place approximately $165,000 into the equipment fund annually.

[25] Miss Utility, https://www.missutility.net/maryland/.

5 State and federal funding might enable the County to fill some of its broadband gaps

Federal and state funding sources represent an important element of large-scale broadband deployments for unserved areas. Maryland's Office of Statewide Broadband will help coordinate the expansion of high-speed internet across the state by managing the influx of federal funds to support the deployment of broadband.

Determining which funding programs the County should target will depend on the identification of a willing partner, the County's ability and willingness to contribute capital to the effort, and the timing of the grants. That said, the state's grant program provides a very attractive funding option because the state is faithful to the federal 25/3 broadband definition of unserved and does not have exclusions—meaning that the County could target some of the areas that are ineligible for federal grants.

The greater the extent to which the County can cultivate relationships to rapidly and creatively adapt partnership arrangements in target areas, the more likely the County will be able to take advantage of such opportunities.

5.1 State of Maryland broadband funding

The Office of Statewide Broadband (OSB), formerly the Governor's Office of Rural Broadband, focuses on efforts to extend access to broadband service to every Marylander, "regardless of their zip code."[26] OSB currently oversees multiple grant programs that seek to eliminate the gaps in the state's broadband access and adoption.

5.1.1 Connected Communities Grant Program

The Connected Communities Grant Program (MD-GAPS) is designed to assist local community-based non-profits, organizations, and anchor institutions in creating "Gap Networks" and "Community Networks" to address affordability challenges. The grants will range from $25,000 to $250,000 for up to 100 percent of costs for construction, deployment, expansion, or continuation of networks. A total of $5 million is available for this program; applications for funding were accepted through March 15, 2022. Because the state's funding source is the American Rescue Plan Act of 2021, federal rules apply to the program.[27]

[26] "Office of Statewide Broadband," Maryland Department of Housing and Community Development, https://dhcd.maryland.gov/Broadband/Pages/default.aspx (accessed February 11, 2022).
[27] "MD-GAPS: Connected Communities," Notice of Funding Availability, Maryland Department of Housing and Community Development, https://dhcd.maryland.gov/Broadband/Pages/MD-GAPS.aspx (accessed February 11, 2022).

5.1.2 Digital Inclusion Grant Program

Maryland's Digital Inclusion Grant Program (MD-DIG) will provide funding to local jurisdictions, anchor institutions, and 501(c) entities for digital inclusion planning and implementation. Applicants can receive up to 100 percent financial assistance for the implementation, expansion, or continuation of broadband. The awards will range from $10,000 to $75,000. OSB accepted applications through March 15, 2022. Because the state's funding source for the program is the American Rescue Plan Act of 2021, federal rules apply to this program.[28]

5.1.3 Maryland Emergency Broadband Benefit Program

This subsidy program will provide $15 per month to low-income households in addition to the $30 per month provided by the federal Affordable Connectivity Program (ACP). The subsidy will be paid directly to the ISP, which will reduce the subscriber's monthly bill.[29]

5.2 FCC Rural Digital Opportunity Fund

The $20.4 billion Rural Digital Opportunity Fund will be distributed via a two-phase auction; winning bidders will receive subsidies over a 10-year span to support the buildout of high-speed broadband networks in unserved areas of the country.

The first phase of the Rural Digital Opportunity Fund auction was $9.2 billion and was awarded on November 25, 2020, to 180 bidders. Phase I targeted census blocks that are entirely unserved by voice and broadband with download speeds of at least 25 Mbps.[30] Figure 17 (below) illustrates the County's initially eligible and awarded areas; the County's awarded areas are described in Section 1.4.

Phase II is supposed to award $11.2 billion in subsidies. That number includes the original set-aside for Phase II in addition to the funds unspent in Phase I. However, the FCC indicated that new, more accurate maps developed under the Broadband Data Collection (BDC) initiative will need to be finalized before that happens.[31] It is also unclear whether there will be sufficient areas available after all the other public funding opportunities have been executed to justify a massive auction format. As a result, the County's eligible areas for Phase II are not yet known, and the prospects for a future auction are uncertain.

[28] "MD-DIG: Digital Inclusion," Notice of Funding Availability, Maryland Department of Housing and Community Development, https://dhcd.maryland.gov/Broadband/Pages/MD-DIG.aspx (accessed February 11, 2022).
[29] "Office of Statewide Broadband: Maryland Emergency Broadband Benefit Program," Department of Housing and Community Development, State of Maryland, https://dhcd.maryland.gov/Broadband/Pages/default.aspx (accessed February 9, 2022).
[30] "Fact Sheet – Rural Digital Opportunity Fund Information," FCC, https://www.fcc.gov/auction/904/factsheet (accessed February 10, 2022).
[31] "Fact Sheet – Rural Digital Opportunity Fund Information," FCC, https://www.fcc.gov/auction/904/factsheet (accessed February 10, 2022).

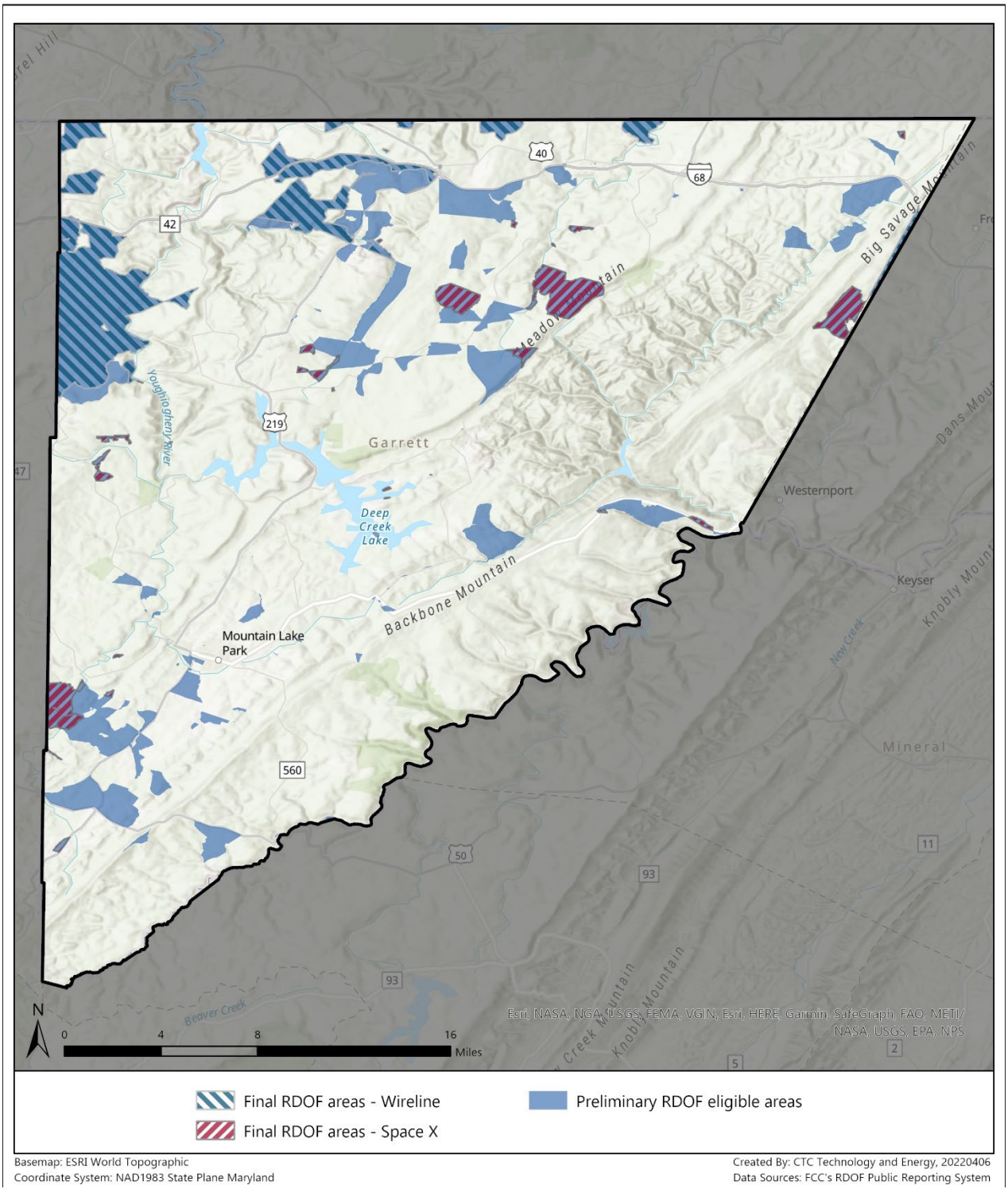
Unlike USDA or state funding programs, the Rural Digital Opportunity Fund does not involve a discovery and documentation process for delineating unserved areas. Instead, it relies on carrier-reported coverage data to the FCC with some further restrictions. The FCC weighted applications for participation in the auction based on proposed speeds and latencies, with preference given to those bidders willing to commit to offering faster speeds and lower latency service.[32] The bidders willing to commit to providing an area with the fastest service at the lowest subsidy amount won the available support.[33]

The areas eligible for bidding in the Rural Digital Opportunity Fund excluded previously funded and executed projects that included the same areas; additionally, areas funded by RDOF are excluded from a number of subsequent other federal, and some state, programs, unless they were won by satellite providers, which in many cases is not included under grant program definitions of existing or previously funded broadband service.

[32] Federal Communication Commission, "Rural Digital Opportunity Fund, Connect America Fund - A Rule by the Federal Communications Commission on 03/10/2020," https://www.federalregister.gov/documents/2020/03/10/2020-03135/rural-digital-opportunity-fund-connect-america-fund (accessed March 2020).

[33] Federal Communication Commission, "Rural Digital Opportunity Fund, Connect America Fund," 84 FR 43543, August 21, 2019, https://www.federalregister.gov/documents/2019/08/21/2019-17783/rural-digital-opportunity-fund-connect-america-fund (accessed November 2019).

Figure 17: Initially Eligible and Awarded RDOF Areas



5.3 Coronavirus Capital Projects Fund

The Treasury's Coronavirus Capital Projects Fund (CPF) is a $10 billion program authorized under the American Rescue Plan Act of 2021 that will provide flexible funding opportunities for a wide range of broadband-related projects to be administered at the state level.

Maryland will receive $171 million and administer the funds through the Office of Statewide Broadband (OSB). The OSB will have until September 24, 2022, to submit a formal grant plan describing how the state's allocation will be used.[34]

The program will allow funds to be used for costs that fit into one of three major categories:

1. Broadband Infrastructure Projects: "Construction and deployment of broadband infrastructure designed to deliver service that reliably meets or exceeds symmetrical speeds of 100 Mbps so that communities have future-proof infrastructure to serve their long-term needs."

2. Digital Connectivity Technology Projects: "Purchase or installation of devices and equipment, such as laptops, tablets, desktop personal computers, and public Wi-Fi equipment, to facilitate broadband internet access for communities where affordability is a barrier to broadband adoption and use." You read that right: Affordability matters. Those who can't afford to pay for services, even if available, are considered unserved.

3. Multi-Purpose Community Facility Projects: "Construction or improvement of buildings designed to jointly and directly enable work, education, and health monitoring located in communities with critical need for the project."

5.4 Coronavirus State and Local Fiscal Recovery Funds

The U.S. Treasury has released final rules for the Coronavirus State and Local Fiscal Recovery Funds (SLFRF) program.[35] Established by the American Rescue Plan Act (ARPA), this program will distribute $350 billion in emergency funding to eligible state, local, territorial, and Tribal governments. The state was allocated $3.7 billion;[36] Garrett County received $5.6 million.[37]

[34] Frequently Asked Questions, Capital Projects Fund. Dept. of the Treasury. Coronavirus Capital Projects Fund FAQs (treasury.gov) (accessed December 4, 2021).
[35] "Fact Sheet: The Coronavirus State and Local Fiscal Recovery Funds Will Deliver $350 Billion for State, Local, Territorial, and Tribal Governments to Respond to the COVID-19 Emergency and Bring Back Jobs," U.S. Department of the Treasury, May 10, 2021, https://home.treasury.gov/system/files/136/SLFRP-Fact-Sheet-FINAL1-508A.pdf (accessed September 27, 2021).
[36] "Coronavirus State and Local Fiscal Recovery Funds: Allocations for States," U.S. Department of the Treasury, Allocation for States (treasury.gov) (accessed February 3, 2022).
[37] "Coronavirus State and Local Fiscal Recovery Funds: Allocation for Counties," U.S. Department of the Treasury, fiscalrecoveryfunds_countyfunding_2021.05.10-1a-508A.pdf (treasury.gov) (accessed February 3, 2022).

Congress created this program with no limitations on how it could be spent on broadband. When Treasury announced its interim final rules, however, those guidelines included new restrictions that were not part of the authorizing legislation. The interim rules said the Fiscal Recovery Funds should not be targeted for areas where there is "reliable" 25/3 Mbps broadband service. Treasury has since clarified that these funds can be used in areas that already have 25/3 if the funds are primarily targeted for areas where 25/3 is not available. In its final rules, however, Treasury expanded eligibility beyond speed and allowed lack of affordability to be a legitimate basis for funding construction in what would otherwise be considered served locations.

Based on the legislation that created it, this program can fund broadband deployments and digital inclusion strategies designed to facilitate such connectivity and has been designed to enable states and localities "to fund lasting infrastructure that will be able to accommodate increased network demand" to fit their needs.[38] Treasury provided final rules establishing certain minimum requirements on how recipients can use funds for broadband deployments;[39] it also provided suggestive guidance about the range of digital inclusion projects that can use program funds. Key guidance includes the following:

- **Infrastructure projects must support 100 Mbps symmetrical speeds unless geographical, topographical, or fiscal constraints make it impractical.** For the purposes of the Fiscal Recovery Funds, Treasury's approach to broadband infrastructure matches some of the most forward-thinking states' broadband grant programs. In its final rules, Treasury expects the funds to be used on broadband deployments that are capable of at least 100/100 Mbps speeds to address Americans' modern communications needs. The program also strongly suggests that projects focus on fiber deployments, because fiber has the capability of affordably meeting the steady annual increase in broadband capacity demands faced by our nation's networks.

  The final rules also outline a scenario in which symmetrical 100 Mbps service may be considered "impractical due to geographical, topographical, or financial constraints,"[40] and in that case, require projects to provide 100/20 Mbps service with the ability to scale to 100 Mbps symmetrical. This appears to be a concession to incumbent cable providers who can cost-effectively extend to unserved locations from their current network footprint and are on a roadmap to symmetrical speeds. Most cable companies have implemented DOCSIS 3.1. DOCSIS stands for Data Over Cable Service Interface

[38] "Coronavirus State and Local Fiscal Recovery Funds, Final Rule," Department of the Treasury, 31 CFR Part 35, RIN 1505-AC77, released January 27, 2022, page 83, https://www.govinfo.gov/content/pkg/FR-2022-01-27/pdf/. Final Rule, "Final Rule."

[39] "Coronavirus State and Local Fiscal Recovery Funds Frequently Asked Questions," pages 11-12, U.S. Department of the Treasury.

[40] Overview of the Final Rules, page 39, U.S. Department of the Treasury.

Specification. It's the international standard used to transfer data over cable TV systems, which allows for any cable modem to work with any cable TV system. The DOCSIS 3.1 standard was specified in 2016 and takes better advantage of hybrid cable and fiber infrastructure to deliver gigabit download speeds. Cable providers in the US currently limit upstream to 35 to 50 Mbps. Field upgrades would allow them to deliver gigabit speeds upstream and would also put them on a long-term roadmap to DOCSIS 4.0's 10/6 Gbps capability.

- **Projects must address areas that lack 25/3 Mbps.** The final rules state that projects will be expected to address unserved and underserved areas, defined as those that do not yet have access to speeds of at least 25/3 Mbps. Treasury encourages recipients to prioritize projects that are designed to provide service to locations not currently served by a connection that delivers 100/20 Mbps. The manner in which this goal is phrased suggests wide latitude in designing projects—as long as they also address unserved locations.

- **Projects must offer a low-income subsidy program.** The final rules require service providers to either participate in the FCC's Affordable Connectivity Program (ACP) or offer a broad-based affordability program that provides benefits commensurate to the ACP. Treasury also encourages broadband services to include at least one low-cost option without data usage caps at speeds sufficient for a household with multiple users.

- **Projects are encouraged to prioritize affordability as well as local broadband solutions.** After noting that the U.S. has some of the most expensive broadband service in the world,[41] the program's final rules place special emphasis on ensuring that the resulting broadband service provided over the funded network is affordable. The "Treasury also encourages recipients to prioritize support for broadband networks owned, operated by, or affiliated with local governments, non-profits, and co-operatives—providers with less pressure to turn profits and with a commitment to serving entire communities."[42]

- **Projects are encouraged to prioritize last-mile connectivity.** While Treasury underscores this, states and localities are not precluded from setting their own priorities, and other initiatives that could improve affordability by investing in capacity bottlenecks such as middle-mile or data center builds could be funded.

[41] "Even in areas where broadband infrastructure exists, broadband access may be out of reach for millions of Americans because it is unaffordable, as the United States has some of the highest broadband prices in the Organisation for Economic Co-operation and Development (OECD)." Final Rules, page 24, U.S. Department of the Treasury.

[42] Final Rules, pages 76-77, U.S. Department of the Treasury.

- **Infrastructure projects are expected to meet strong labor standards.** This includes project labor agreements, community benefit agreements, and wages at or above the prevailing rate with local hire provisions. Treasury will seek information from recipients on workforce plans and practices; this reporting will support transparency and competition. Treasury notes it will release additional guidance related to workforce reporting requirements at a later date, but expect fair (high) wage provisions, benefits, and local sourcing as key components.

- **Projects can address a wide array of broadband-related concerns.** In addition to infrastructure, these State and Local Fiscal Recovery Fund dollars can also be used for an array of other initiatives that respond to the public health and economic impacts of the pandemic. While Treasury leaves the door open for a wide variety of fundable initiatives, it offers the general guidance that recipients should "identify a need or negative impact of the Covid-19 public health emergency and, second, identify how the response program, service, or other intervention addresses the identified need or impact."[43]

- **Allocations from these funds can be leveraged as matches for other broadband grant opportunities.** Because these funds are considered locally administered, if you are already targeting a federal grant or state grant opportunity that requires matching funds, the Fiscal Recovery Funds can be leveraged for that purpose.

5.5 Infrastructure Investment and Jobs Act

The $1 trillion Infrastructure Investment and Jobs Act (IIJA)—including $65 billion in broadband funding—was signed into law on November 15, 2021. In the coming months, the agencies responsible for administering the funds will release requests for comments; develop frameworks and rules; and issue notices of funding opportunities—including for the kinds of programs that could address gaps identified in the County.

The U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA) will administer $48.2 billion of the broadband funding:[44]

1. *Broadband Equity, Access, and Deployment (BEAD) Program:* $42.45 billion "for broadband deployment, mapping, and adoption projects."
2. *Digital Equity Act Programs:* $2.75 billion "for grant programs that promote digital inclusion and equity to ensure that all individuals and communities have the skills, technology, and capacity needed to reap the full benefits of our digital economy."

[43] Overview of the Final Rule, page 32, U.S. Department of the Treasury.
[44] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).

3. *Tribal Broadband Connectivity Program:* $2 billion in funding for programs.
4. *Enabling Middle Mile Broadband Infrastructure Program:* $1 billion "for the construction, improvement or acquisition of middle mile infrastructure."

Of these, BEAD and the digital equity programs represent opportunities for securing funding—based on the local prioritization and, potentially, a successful grant application to the competitive element of the digital equity program. Also, the IIJA allocates an additional $14 billion to the Affordable Connectivity Program—a subsidy that likely will go directly to low-income broadband subscribers.

5.5.1 Broadband Equity, Access, and Deployment (BEAD) Program

Maryland will receive a minimum of $100 million in BEAD funding—representing the initial minimum distribution to each state.[45] Additional allocations will be distributed based on a state's unserved and high-cost areas.

NTIA reports that "the first priority for funding is for providing broadband to unserved areas (those below 25/3 Mbps), followed by underserved areas (those below 100/20 Mbps), and then serving community anchor institutions (1/1 Gbps)."[46] A subgrantee that receives funding to deploy a network will be required to ensure the network is capable of delivering at least 100/20 Mbps service within four years of the date of the subgrant—and to offer a low-cost service for low-income subscribers.[47]

However, the law also indicates that BEAD grants can be applied broadly to address broadband needs, including for broadband planning (up to 5 percent of funding), connecting anchor institutions, supporting broadband adoption efforts, and constructing infrastructure to serve low-income families in multi-dwelling buildings.[48]

Timing of this funding is highly dependent on the FCC's completion of the new broadband mapping, which is how the overall allocations will be calculated for each eligible entity. Expect the rules to be issued within six months (NTIA has 180 days from the signing of the bill to issue the rules), without details on timing if the FCC has not yet completed their efforts.

5.5.2 State Digital Equity Planning Grant Program

NTIA's digital equity program comprises three elements:

[45] "Grants Overview: Infrastructure Investment and Jobs Act Overview: Broadband Equity, Access, and Deployment (BEAD) Program," BroadbandUSA, National Telecommunications and Information Administration, https://broadbandusa.ntia.doc.gov/resources/grant-programs (accessed December 6, 2021).
[46] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).
[47] IIJA, p. 771, https://www.congress.gov/bill/117th-congress/house-bill/3684 (accessed November 17, 2021).
[48] IIJA, p. 767, https://www.congress.gov/bill/117th-congress/house-bill/3684 (accessed November 17, 2021).

1. State Digital Equity Planning Grant Program ($60 million).
2. State Digital Equity Capacity Grant Program ($1.44 billion).
3. Digital Equity Competitive Grant Program ($1.25 billion).

NTIA has stated that these programs aim "to promote the meaningful adoption and use of broadband services across the targeted populations in the Act, including low-income households, aging populations, incarcerated individuals, veterans, individuals with disabilities, individuals with a language barrier, racial and ethnic minorities, and rural inhabitants."[49]

The State Digital Equity Capacity Grant funding will then be distributed in annual grants to each state over five years "to implement digital equity projects and support the implementation of digital equity plans."[50]

5.5.3 Enabling Middle Mile Broadband Infrastructure Program

NTIA will also oversee a new direct grant program related to middle mile infrastructure expansion. The Middle Mile Broadband Infrastructure Program (MMBIP) is a means of maximizing the ability of eligible entities to enter into creative partnerships with providers or entities that have the ability to provide last mile solutions but may lack the incentive to build the backbone necessary to reach the harder to reach places in rural America. Additionally, the program seeks "to promote broadband connection resiliency through the creation of alternative network connection paths that can be designed to prevent single points of failure on a broadband network."

Eligible areas include anywhere that lacks service of at least 25/3 Mbps and terrestrial or fixed wireless is eligible (mapping data should be leveraged to prove eligibility). Grantees will have to prioritize:

- Connecting resulting infrastructure to last mile networks that will provide services to households in unserved areas.
- Connecting non-contiguous tribal trust lands.
- Offering wholesale service at reasonable rates on carrier-neutral basis.

Grantees will also have to ensure that the infrastructure proposed can deliver gigabit speeds for the eventual last mile connections to anchor institutions and provide direct interconnections that

[49] "Grants," NTIA, https://ntia.gov/category/grants (accessed November 17, 2021).
[50] BroadbandUSA, "NTIA's Role in Implementing the Broadband Provisions of the 2021 Infrastructure Investment and Jobs Act," NTIA, https://broadbandusa.ntia.doc.gov/news/latest-news/ntias-role-implementing-broadband-provisions-2021-infrastructure-investment-and (accessed November 17, 2021).

will "facilitate the provision of broadband service to anchor institutions located within 1,000 feet of the middle mile infrastructure."

Expect to see rules issued by May 2022. Once issued, awards are expected to be made within nine months and grantees will be expected to complete construction within five years of the award (which may be extended). Eligible entities are States and divisions of local government as well as Tribal entities and territories, nonprofits, and cooperatives. Partnerships are encouraged.

5.6 Economic Development Administration

The Department of Commerce's Economic Development Administration (EDA) oversees the Economic Development Assistance program, which has delivered funds to distressed communities for many years. Public broadband projects in economically distressed communities are eligible for funding under the Public Works and Economic Adjustment Assistance (PWEAA) programs—which do not require that an area is unserved but do require that jobs be created or saved as a direct result of the proposed project.

The County already won an EDA grant for the Table Rock project described earlier, and EDA likes to build on previous project investments to expand on job-retaining capabilities.

The Coronavirus Aid, Relief, and Economic Security (CARES) Act added $1.5 billion to the EDA's existing program, representing a significant opportunity, both because of the size of the allocation and its breadth of eligibility relative to the original EDA grant program.[51] The grants were made available to local and state governments, non-profits, and other non-commercial entities that have a compelling case for using infrastructure projects (including broadband initiatives) to ameliorate the economic effects of the Covid-19 crisis.

Another $3 billion in funding was made available with the ARPA legislation. EDA is requiring a low, 20 percent local match—as opposed to the typical 50 percent match required in its traditional programs—as long as the project can be justified as coronavirus mitigation-related.[52]

A proposed project must demonstrate that it will positively affect the economic prospects of the area in the form of adding or saving jobs.

[51] More detailed guidance regarding this program is available at https://www.ctcnet.us/blog/1-5-billion-in-new-grant-funding-available-from-economic-development-administration-for-broadband-other-projects/.
[52] https://eda.gov/arpa/

6 Recommendations for next steps regarding broadband infrastructure

The following infrastructure-related recommendations are based on the data and analysis described above.

6.1 Continue and accelerate an incremental approach to serving the County

While the cost estimate for covering all unserved areas in the County may preclude the County from having the problem resolved with a single project, the significant anticipated funding opportunities can substantially accelerate the timeline for solving this problem. Depending on how the state decides to administer its Coronavirus Capital Projects Fund and BEAD funding, it is possible the County could target the remaining areas for grant funding within the next couple of years.

6.2 Target Category 1 unserved areas with most competitive wireline bidders

A multi-award RFP approach for identifying partners for different areas of the County could be the most efficient way to identify the most competitive partner for each area. The County has large areas of unserved addresses that can be contiguously—or almost contiguously—connected, and it has several service providers that can access just about any of these areas. This means that the nearest provider need not be the most cost-effective one, and the County should explore business and cost arrangements that could reduce its share of grant-required matching funds.

6.3 Target Category 2 unserved areas with nearby incumbents

Broadband deployment costs are typically lower for edge-out and fill-in approaches by incumbent providers than for deployment in areas farther away from existing network assets. Some existing providers could offer highly competitive per passing costs by constructing line extensions to areas close to their existing or planned infrastructure, or by expanding the boundaries of their existing network coverage outward from their current edges (i.e., an edge-out strategy).[53]

6.4 Target Category 3 homes with pilot cost-sharing grant and digging assistance

Category 3 homes that are passed by broadband infrastructure on an adjoining public road—but that have long setbacks or driveways—have few affordable options to get connected. Traditional grant programs typically do not consider such isolated single address locations. The County should consider setting up a cost-sharing grant fund to subsidize broadband connections to such locations. The grant funds could be deployed with modest amounts for a pilot period to gauge

[53] A new broadband provider would likely be less competitive in offering cost-effective solutions to serving these isolated areas because it would not have existing plant adjacent to the isolated roads.

residents' interest and evaluate funding request levels. Coordinating the effort with ISPs would facilitate the use of such funds.

In coordination with these efforts, the County should also continue to expand its trenching efforts to assist ISPs in reaching rural residents and businesses. The County has purchased digging equipment that allows it to trench on behalf of ISPs or users to reduce costs of line extensions and long drops. The pilot digging program has collaborated with Comcast to dig trenches that then enabled Comcast to lay down wires and provide service to otherwise unreachable areas. Continuing and expanding the County's trenching program could enable the County to reduce the cost of incumbent provider network extensions and long to connect homeowners on long driveways and private roads to the infrastructure in the public right-of-way. It could also incentivize smaller providers to engage in opportunities to expand their existing footprints.

6.5 Invest in future-proof technologies where feasible

In the past, fixed wireless was the only economically feasible solution for a County with very limited network infrastructure. The partnership with DNG served the County well. But with the availability of more significant amounts of public funding, the economic calculus has shifted—and future-proof technology, which for all practical purposes means fiber-to-the-premises, should be a priority. Only after all future-proof solutions with public grant support are exhausted should fixed wireless be considered. The Treasury makes clear that it prefers fiber and sets 100 Mbps symmetrical as the minimal standard. NTIA's grant funding is required to be technology neutral, but it too emphasizes the need for future-proof investments.

6.6 Strategically target state and federal funding opportunities

The vast majority of public funding opportunities are specifically directed toward last-mile deployments. The County would be eligible for state-administered federal infrastructure funding as well as future iterations of USDA's ReConnect.[54] The County's allocation of State and Local Fiscal Recovery Funds from the American Rescue Plan Act (ARPA) may be used for broadband and are particularly flexible, lending themselves to either last-mile of middle-mile projects, and may be used as match for some state and federal grant opportunities. There are no particular areas of the County that are more optimal for one rather than another funding source—although final rules regarding future grant opportunities have not yet been developed.

The County could also develop its own middle-mile infrastructure which could lower costs for providers to extend service. As noted earlier, the County's unserved areas are located in rather large clusters with multiple providers potentially able to reach them without having to construct

[54] The application window for round three of the ReConnect program closed on February 22, 2022; we anticipate future rounds, but the timing is unknown and USDA may wait until new, more accurate federal maps of unserved areas are available—or until other federal funding pools have been allocated.

long backhaul lines or new middle-mile infrastructure. But additional middle-mile infrastructure could allow other providers to "parachute" in from more distant network points of presence. And if the middle-mile infrastructure were open access, it could provide multiple ISPs with opportunities to serve new areas.

The County's recently EDA-funded Table Rock project is a good example of this approach: The County is building a fiber run from the Oakland area down to Table Rock, picking up multiple businesses along the way, and has confirmed interest from multiple ISPs in using the fiber to pick up customers along the way. This fiber could be further extended with middle-mile funding from the EDA, the Appalachian Regional Commission (ARC), the state, or NTIA. As in the Table Rock project, a fiber extension would mean that the County, state, or Maryland Broadband Cooperative (MdBC) would be the formal owner.

The Table Rock project has the Maryland DoIT owning the fiber run and MdBC managing access for private ISPs. The County gets IRU fiber for its own needs without having to worry about entering the business of providing service or being responsible for maintenance and operation.

Since EDA likes to build on its own funding initiatives, extension of the EDA-funded Table Rock route could be a good project to pursue.

If pursuing extension of middle-mile infrastructure, the County could focus on connecting and running infrastructure through the Category 1 areas and/or prioritizing its rural business and farm community.

6.7 Actively collect data on service performance to track funding eligibility

While some upcoming infrastructure funding is expected to be flexible, DNG claims service of 25/3 in large parts of the County. While Treasury disregards fixed wireless technology altogether, NTIA and FCC's funding programs are required to be technology-neutral. In fact, DNG challenged large areas in the runup to the FCC's Rural Digital Opportunity Fund auction, claiming they already served them—which resulted in areas becoming ineligible in the auction.

By collecting performance data, the County can demonstrate which areas and address locations are unable to deliver the minimal performance that would render a particular grant program ineligible for those areas in the County.

The County can collect such data in multiple ways:

1. **Use online speed surveys.** Speed surveys can collect data on actual rather than provider-claimed performance. The County deployed such an effort, and it was instrumental in identifying areas of need that were incorporated into the mapping for this report.

2. **Use mail surveys.** Mail surveys can also provide a source for such information but would require consent from survey participants to publish their answers for their address location, or to aggregate data within a certain location buffer if respondents do not wish for their responses to be identified by their location.
3. **Ask for detailed maps of service coverage (and non-coverage) and performance metrics from ISPs.** Such cooperation from ISPs is more likely with grant partners, and the County can require making such information available as a condition of entering into broadband infrastructure partnerships.
4. **Await new maps from the FCC.** It is not clear when the FCC will have its improved maps available, but when they are, they will add potentially important new data to the County's efforts. It is not clear, however, how reliable the new data will be as there currently is not an enforcement mechanism in case of inaccurate data provision. Recent discussions indicate a field testing and verification program, but it is not clear whether there will be sufficient staffing to support a robust program like that.

6.8 Consider conducting an RFI/RFP process

Considering the large and closely positioned Category 1 areas that could make broadband expansion attractive for a variety of potential partners (all of which might have competitive proposals), a formal RFI and/or RFP process could potentially allow the County to reduce its share of matching funds for any future grant partnerships; it is possible that one or more providers could propose to absorb a higher proportion of capital costs in order to secure those areas and prevent competitors from moving in to the Category 1 unserved areas.

Because remaining Category 2 areas are relatively close to Category 1 areas and/or potential bidders' current service areas, such a process could also effectively maximize the prospects of getting all unserved areas targeted.

The County can structure an RFP to be multi-award, encouraging respondents to target all areas or only the ones that are most viable for the respondent.

A muti-award RFP framework can also target other policy-based preferences for the County and be structured to evaluate bids based on:

- Fiscal soundness and experience of the proposer.
- Per passing costs (and the allocation of those costs among the respondent, the County, and an external grant funder).
- Proposed network technology and speed.
- Speed of deployment of the infrastructure.

- Low-cost subscription plan availability and participation in the federal Affordable Connectivity Program (ACP), which subsidizes subscription costs for eligible low-income households.[55]
- Willingness to participate in awareness campaigns to encourage participation in subsidy programs like the ACP.

Formalizing the RFP process would allow the County to quickly take advantage of upcoming grant opportunities by having already selected partners who could help alleviate the burden of matching funds.

6.9 Include an ongoing performance testing process and subscriber data reporting as condition of partnerships for last-mile service provision

Grant partnerships can be highly attractive for potential partners and can therefore provide leverage for the County to negotiate additional terms. One of the frustrations of local, state, and County governments—including Garrett County—is the lack of performance data from ISPs serving residents in the jurisdiction. Speed tests and subscriber reports are not systematic enough to yield strong conclusions and ISPs rarely allow joint testing with standardized methodologies unless contractually required to do so. This makes it more difficult for the County to track whether ISPs are reliably delivering on promised speeds, complying with any relevant grant-based performance commitments, or leaving gaps in their claimed service areas that could be targeted for upgrades or future broadband expansion. One of the conditions for entering a grant partnership with the County could therefore be to accept ongoing performance testing.

Likewise, data from ISP partners on which address locations are connected, which are activated, and which participate in low-cost or subsidy programs can help the County develop future infrastructure expansion projects—as well as initiatives to encourage adoption of high-speed broadband by low-income households.

6.10 Consider pursuing Appalachian Regional Commission funding to coincide with EDA grants

Garrett County is designated by the ARC as a transitional county for the 2022 fiscal year.[56] If the County were to jointly submit applications for ARC and EDA grants, ARC funds could possibly be used as matching funds. In certain situations, EDA and ARC may be permitted to supplement the

[55] The State has also previously made an additional benefit on top of the federal subsidy available in the form of a Maryland Emergency Broadband Benefits program, and it is possible it could revive such a program. It did not provide any significant overhead or burden on subscribers or ISPs. ISPs could simply get reimbursed up to an additional $15 for their subscribers that were in the federal program.

[56] "Interactive Map of County Economic Status and Distressed Areas, FY 2022," Appalachian Regional Commission, https://www.arc.gov/match-requirements-for-arc-grants/ (accessed February 15, 2022).

other grant's federal matching expectation. The County should check its contacts to confirm whether they are eligible for this type of supplemental funding.

7 Recommendations for programmatic efforts to increase broadband adoption

The following recommendations focus on steps the County and its stakeholders might take to address broadband adoption gaps in Garrett County.

7.1 A moderate investment by the County, community organizations, or through federal or state grants in a community engagement effort could help Garrett County facilitate expanded enrollment in subsidy and existing low-cost broadband services to maximize participation

The federal government's Lifeline program and Affordable Connectivity Program (ACP) and Comcast's Internet Essentials program offer opportunities for qualifying residents to receive low-cost service or a monthly subsidy for broadband service. The creation of the ACP provides the most significant means to providing a broadband subsidy to eligible low-income residents, whether through Comcast, Verizon, or a fixed wireless provider. (The monthly ACP subsidy could fully cover a low-income resident's Internet Essentials service.)

The County could consider implementing or facilitating a multi-channel engagement strategy with existing resources or through a contractor to inform eligible households about these programs and to provide enrollment support as necessary. Outreach methods might include flyers, text-messaging campaigns, calls to residents to raise awareness, and setting up a call-in line for residents to seek help.

The following are best practices, all of which may be fundable through federal and state grant programs, and or facilitated with community organizations:

1. **Develop clear multilingual communications.** These should consist of flyers and appropriate scripts for both outreach and sign-up support calls. All materials should clearly indicate how residents requiring language assistance can get the help they need.
2. **Create network maps of all the ways your organization intersects the public.** Understand which organizations have the trust and respect of the community and the methods they use for ensuring their messages reach the public. Develop an understanding of how populations you are trying to reach (such as those signing up for Medicaid or SNAP benefits) typically get information from these organizations. Mirror the placement and style of these established communication channels. For instance, place flyers about ACP, and the sign-up support contact information in a community center bulletin where other assistance program is provided.
3. **Set up an inbound and outbound communications help desk.** Garrett County could set up a call center, contract with, or assist in facilitating an established call center support organization to lead the effort.

The goal of this multi-channel engagement strategy is to ensure all residents can not only get help when they seek it but also are proactively informed of these programs and provided with sign-up assistance if they need it.

Table 10 provides the estimated costs of staffing, marketing, and operations for a call center and related communications efforts to increase community awareness of these opportunities, using the assumption of one full-time staff member or equivalent. This could be county organized or community lead and funded with the County's facilitation and coordination.

The first section provides Year One costs; the second section provides annual costs for the initiative in subsequent years. The numbers are based on CTC's experience with similar initiatives. As noted above, the County could—as an alternative to setting up a new initiative—leverage and expand existing resources or hire a contractor to handle the process.

Table 10: Estimated Budget to Help Residents Enroll in Low-Cost and Subsidy Programs[57]

Year One	**Budget**
Creation and distribution of informational materials such as web pages, flyers, inserts, and mailers	$5,000
Call center technology and software licenses	$20,000
One full time staff member ($40 hourly rate)	$83,200
Year One Total Cost	**$108,200**
Estimated cost per household if 2,000 households are assisted	*$54*
Year 2 and Subsequent Years	**Budget**
Creation and distribution of flyers, inserts, and mailers	$2,500
Maintenance of call center and equipment	$10,000
One full time staff member ($40 hourly rate)	$83,200
Annual Costs for Year Two and Onward	**$95,700**
Estimated cost per household if 2,000 households are assisted	*$43*

7.2 Garrett County could provide free internet service to low-income residents through a bulk-purchase agreement with Comcast for Internet Essentials

Although individual residents could enroll in the ACP and receive a subsidy that would cover the cost of their Internet Essentials subscription, the County could consider a bulk-purchase agreement with Comcast that would provide low-income residents with Internet Essentials service—while eliminating the hurdles that residents would otherwise face in terms of qualifying for ACP and enrolling in Comcast's program. County staff who interact with potentially eligible

[57] Numbers are derived from CTC's experience designing and operating call centers to support broadband subsidy programs on behalf of state government entities.

populations can help identify potential recipients and consider in what context a bulk purchase could make sense, then engage with Comcast to discuss terms.

7.3 Subject to discussions with state officials, the County could potentially construct a digital community center with funding from the Coronavirus Capital Projects Fund

Garrett County could use Coronavirus Capital Projects Fund money (see Section 5.3) to finance projects such as a Digital Community Center to provide access to computers, high-speed broadband, private rooms for telehealth appointments, and skills training.

To receive funding, a Digital Community Center would need to be capable of supporting remote work, education, and telehealth.

7.4 The County could expand device and skills programs

To address the device gap among low-income County residents (i.e., to provide computing devices to residents who lack one—and thus cannot adopt broadband service), the County could forge partnerships with, or replicate programs offered by, organizations such as Comp-U-Dopt, PCs for People, Tech Soup, and Tech Goes Home. These organizations have a variety of successful and scalable models for reselling, refurbishing, or offering new laptops and other devices and training to partner organizations.

Assuming a purchase cost of $200 per refurbished or new laptop, the cost of providing devices to the roughly 1,913 households that lack a computer[58] would be approximately $383,000 (Table 11).

Table 11: Estimated Budget for One-Time Device Purchase Program

Program	Budget
Obtain 1,913 (based on the 2019 American Community Survey estimate that 15.4% of the 12,425 households in Garrett County lack a computer)	$382,600
Estimated cost per household	*$200*

The County might also consider promoting other opportunities available to low-income residents. Comcast currently offers Internet Essentials subscribers the option to purchase new Dell laptops or Chromebooks for $149.99.[59] This opportunity could be publicized on the County's

[58] "Quick Facts: Garrett County, Maryland," U.S. Census Bureau, https://www.census.gov/quickfacts/fact/table/garrettcountymaryland/PST045221 (accessed February 9, 2022).
[59] "Low-cost Computer," Comcast. Low Cost Computer (internetessentials.com) (accessed January 20, 2022).

low-cost internet program flyers and through the sign-up assistance call center described in Section 7.1.

In addition to access to devices and affordable broadband, residents require digital skills in order to fully take advantage of the opportunities that come with a broadband connection. The County might consider providing funding to a nonprofit that trains people to become part of a corps of tech-savvy community outreach specialists to help older residents or others in need to learn basic digital skills.

7.5 The County could convene a digital equity coalition of public and private stakeholders to provide ongoing programmatic guidance

Implementing solutions like the ones above will require a broader effort than the County alone can reasonably take on. Experiences in other jurisdictions suggest that solutions to digital inequities must involve a broad range of public and private community stakeholders. We recommend that the County play a convening role to incent and establish a coalition tasked with actively promoting digital equity and inclusion. Potential partners could include local libraries, the Garrett County Chamber of Commerce, the Garrett County Department of Business Development, Garrett Regional Medical Center, and other educational, economic, faith, and service organizations. Representatives of the partners could develop an operational plan for the coalition.

This coalition could be charged with proposing programmatic interventions by the County. It could identify volunteer "navigators" to boost broadband adoption and effective use through direct work with community members in need. It is important to develop such coalitions to engage stakeholders and drive change, as a Benton Foundation report[60] noted. Potential models for such an effort include the Digital Inclusion Alliance San Antonio (DIASA),[61] which is cultivating and promoting public policies and initiatives that prioritize digital equity; the Portland Digital Inclusion Network,[62] a coalition of community organizations interested in raising awareness about digital equity barriers and developing solutions to bridging the digital divide; and the Digital Empowerment Community of Austin, a network of community stakeholders in Austin, Texas, working on different facets of the digital equity issues there.

[60] https://www.benton.org/sites/default/files/growinghealthy_ecosystems.pdf
[61] https://digitalinclusionsa.org/
[62] https://www.portlandoregon.gov/oct/73860

Appendix A: Digital equity guides and resources

Numerous coalitions have formed to support digital inclusion work happening at the grassroots and to help scale successful solutions. They have developed the following guidebooks and resource pages to help individuals pursuing digital equity learn what is working in other communities and develop their own plan of action.

Digital Inclusion Coalition Guidebook reports on lessons learned from six established community-wide digital inclusion coalitions in an effort to help local communities implement their own digital inclusion coalition.

Digital Inclusion Start-Up Manual provides guidance for communities looking to increase access and use of technology in disadvantaged communities through digital literacy training, affordable home broadband, affordable devices, and tech support.

NDIA's Resource Page includes link to strategy guides, local government plans and reports, sources of data and research on the digital divide.

National Collaborative for Digital Equity's (NCDE's) Guide to CRA Grantmaking for Digital Equity and Economic Inclusion offers a detailed description of how banks can meet Community Reinvestment Act (CRA) obligations through investments in digital equity.

NCDE's Digital Equity Resource Page provides links to sources of free and low-cost broadband, devices, apps, software, and technical support, as well as other digital literacy, education, and professional development resources.