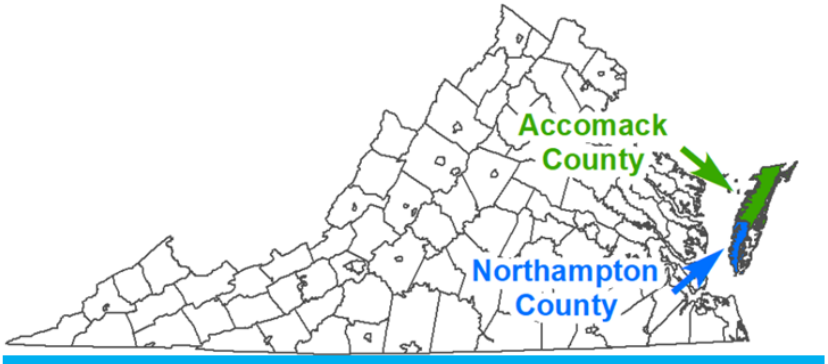
Eastern Shore of Virginia
Rural Broadband Communications

May 06, 2021

Accomac Population: 32,321 in 2019



Northampton Population: 11,710 in 2019

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1 Introduction and Findings

Telecommunications Class 750 for Spring 2021 performed a follow-on analysis of rural broadband communication on the Virginia Eastern Shore as part of their course work. The follow-on analysis was based on the Fall 2020 TCOM 750 class work. The TCOM Graduate Students reviewed current legislative initiatives and incentives, existing providers, emerging solutions and coverage options. The Spring 2021 TCOM Graduate Students were:

- Akram M. Arabi
- Michael Fornah
- Adam Tristan
- Thanh V. Vo

The efforts of the Fall 2020 Graduate students were appreciated and they are acknowledged below.

- Khalid Al-Hassan
- Jennie Tran
- Seid Mohammed
- Bharani Reddy Mallugari
- Kapil Bains

For ease of analysis the Eastern Shore of Virginia was chosen due to its favorable geography for wireless communications and due to the familiarity with several of the participants. Identified provider options, current and future, included[1]:

- Satellite Broadband
    - Hughes
    - Dish Network
    - STARLINK (Space X)
    - O3b mPower by SES
    - OneWeb
- Fiber to the Home (FTTH)
    - Eastern Shore Virginia Broadband Authority (ESVBA)
    - Eastern Shore Communications Corporation (ESCC)
- Last Mile Wireless
    - Neubeam
    - Eastern Shore Communications Corporation (ESCC)
- Cellular Internet/Fixed Wireless
    - T-Mobile/Sprint
    - Verizon
    - AT&T
- Cable Television Providers[2][3]

[1] Note that there are more providers listed in the FCC 477 filings, but the providers listed are the ones most commonly referenced.

[2] Article "Cable's evolutionary path leads to mobile, convergence" detailing cable companies new business approach, website https://www.lightreading.com/cablevideo/cables-evolutionary-path-leads-to-mobile-convergence/d/d-id/764609?, accessed 10 December 2020.

[3] Article "How rising broadband demands might reshape US telecom", website https://www.lightreading.com/opticalip/how-rising-broadband-demands-might-reshape-us-telecom/d/d-

- Charter/Spectrum[4]

Key findings were as follows:

- There is too much emphasis on providing service to concentrated communities and little to no attention paid to more isolated residents. In high density housing areas, there are multiple providers competing, but where homes are more spread out there is little to no coverage.
- The cost of providing service to rural isolated citizens features a low return on investment and alternative approaches to providing services in outlying areas need to be explored.
- Government efforts to stimulate broadband coverage to all residents are generally ineffective as they typically feature a one size fits all approach.
- Accomac and Northampton Counties chartered the Eastern Shore of Virginia Broadband Authority (ESVBA) as a non-profit, but it needs to be more aggressive in pursuing options/partnerships to extend coverage. An example of excellent partnerships are the Dominion-All Points Partnership and the NOVEC-All Points partnership. The fact that ESVBA has re-paid its loans to the counties is not a comforting thought to citizens who do not have service.
- Last Mile wireless providers, Eastern Shore Communications (ESCC) and Neubeam are wary of competition/cooperation with ESVBA and have stated they feel ESVBA will help them develop new markets but then encroach on those areas negating their investments.[5][6]
- We applaud the effort to extend broadband via the Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021 funding request to the commonwealth. Due to its nature transparency is needed. This emphasizes our finding that dense housing areas are favored while more remote areas are ignored.[7] We are also concerned about the plans use of a fiber/coaxial hybrid cable combination service leveraging DOCSIS 3.1 as this provides a degree of vendor lock-in. We would like to see more partner proposals that include ESVBA, Neubeam and ESCC similar to that advocated in Iowa where they stated "Funds to deploy broadband infrastructure must be laser-focused on unserved communities that do not have access to broadband today. It is common sense to connect those who have nothing before a costly effort is made to enhance existing,

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id/764382?, accessed 10 December 2020 describes how customers are flocking to fixed broadband providers like Comcast and Charter in unprecedented numbers.

[4] Article Comcast and Charter announced 5G coverage was expanding", website https://www.fiercewireless.com/operators/comcast-charter-add-nationwide-5g-iphone-12-to-line-ups, accessed 02 November 2020.

[5] Errata (https://www.easternshorepost.com/2019/01/24/internet-provider-says-broadband-authority-poses-unfair-competition/)

- ESVBA "directly competing with us" and causing an "imbalance" in local market, Eastern Shore Communications CEO Ronald Van Geijn said.
- ESVBA acted as a last-mile provider, supplying high-speed internet directly to government organizations and businesses starting in 2010 and homes beginning in 2016.
- "ESVBA is not a middle-mile provider," ESVBA Executive Director Robert Bridgham recently emphasized. A middle-mile provider typically offers wholesale pricing to companies that provide end-users with high-speed internet at retail prices.

[6] Article "Neubeam Lawsuit Against Broadband Authority Dismissed" website https://www.easternshorepost.com/2019/12/12/neubeam-lawsuit-against-broadband-authority-dismissed/, accessed 11 January 2021.

[7] We attempted to contact the Accomac Project Contact Ms. Amy Ford via email (aford@co.accomack.va.us) but had not received a reply at the time of printing of this report.

robust networks in other communities. Quite simply, you shouldn't get a "second helping" before others have had their first."[8]

  - It would be helpful for the counties to explore getting fiber out to more remote areas where Fixed Wireless Access could then be used to provide that last-mile or half-mile distance from the transmitter/tower.

- Citizen frustration with the slow pace of coverage is readily apparent and is not mitigated by piecemeal efforts such as provisioning WiFi hotspots throughout the counties.[9][10]
- The shutdown due to COVID-19 has placed a great burden on public school students who often do not have the means to perform adequate coursework remotely.
- County led efforts to provide broadband to isolated communities are limited in scope.[11]
- Alternatives, such as Starlink satellite broadband SpaceX which provide exceptional speed and low latency are emerging, but not at a scale to make a difference to most citizens. Additionally, their cost is approximately double other broadband options.
- Cable providers are beginning to provide home broadband, but in areas that are not beneficial to rural users[12] and most likely in competition with other existing providers.[13]
- Virginia has the 5th highest cost for broadband service in the United States[14] and for many on the Eastern Shore it is essentially unobtainable with no substantial changes in sight.
  - ESVBA's most inexpensive plan for residential customers is $39.99/month for 10/5 Mbps Download/Upload[15]
  - Local Wireless Providers are charged a discounted and must subsequently add fees to that rate to make the service economically viable for them.
  - Starlink Unlimited service is $99.00/month, but is limited in capacity to approximately 1.5 million customers across the United States.
  - Cellular Service Mobile Hotspot service such as T-Mobile's, where available, can be as low as $10.00/month under their military plan for a limited 2GBits/month of data with additional data for purchase.

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[8] Opinion Article "Opinion: A targeted approach to connecting rural communities to broadband is critical for a more prosperous America", website https://www.desmoinesregister.com/story/opinion/columnists/iowa-view/2021/05/04/rural-broadband-efforts-must-laser-focused/4888466001/, accessed 04 May 2021.

[9] Article "300 miles of broadband down for rural Va. Shore — 1,200 miles to go", website https://www.delmarvanow.com/story/news/local/virginia/2017/12/21/broadband-eastern-shore-virginia/972410001/, accessed 11 January 2021.

[10] Article "Inadequate Internet Service Rouses Ire of Captain's Cove Residents", website https://www.easternshorepost.com/2020/09/17/inadequate-internet-service-rouses-ire-of-captains-cove-residents/, accessed 11 January 2021.

[11] "Application to DHCD Submitted through CAMS - Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021" website https://www.dhcd.virginia.gov/sites/default/files/Docx/vati/2021/applications/accomack-county-application-VATI2021.pdf, accessed 21 April 2021.

[12] Article "Gov. Northam Returns Home for Event on Broadband Expansion for the Shore", website https://www.easternshorepost.com/2020/11/12/gov-northam-returns-home-for-event-on-eastern-shore-broadband-expansion/, accessed 11 January 2021.

[13] Article "T-Mobile in Home Internet", website https://www.theverge.com/2018/9/21/17886574/t-mobile-in-home-internet-sprint-5g-goals-charter-comcast, T-Mobile is planning to offer in-home internet based on 5G service, to be the 4th largest ISP in America by 2024. Its goal is to cover "52% of the zip codes across the county by 2024," "64% of Charter's territory and 68% of Comcast's territory."

[14] Article "Here's Where People Shell Out the Most and the Least for Internet Virginia is 5th highest in Cost.", website https://www.pcmag.com/news/heres-where-people-shell-out-the-most-and-the-least-for-internet, accessed 20 December 2020.

[15] ESVBA Website, https://esvba.com/residential/, accessed 21 January 2021.

- Some of Spectrum's recent pricing includes Spectrum Internet 50/5 with WiFi $74.99, Spectrum Internet 50/5 $69.99, Spectrum Internet 100/10 $69.99, Spectrum Internet 100/10 with WiFi $74.99, Spectrum Internet Ultra 400/20 $94.99 and Spectrum Internet Assist 30/4 ** $17.99.

- Commercial telecom providers such as T-Mobile, Verizon and AT&T are beginning to offer innovative home broadband services, but it is expected to be several years before these are widely deployed, especially on the Eastern Shore. [16][17]
- The rural areas of Virginia's Eastern Shore suffer from the tyranny of distance where it is too expensive to economically extend service to them without some type of subsidy. This is shown in **Figure 1 Cellular Capacity vs Latency vs Coverage Area**.

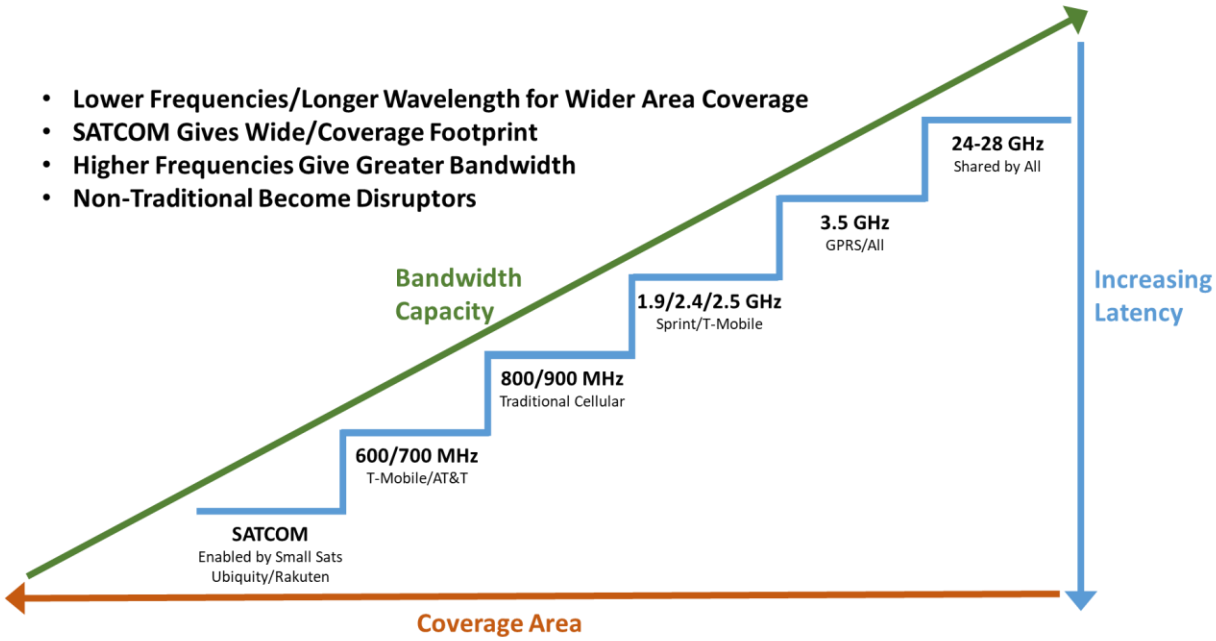

Figure 1 Cellular Capacity vs Latency vs Coverage Area

[16] Article "T-Mobile begins putting 5G into its fixed wireless Internet service", website https://www.lightreading.com/opticalip/t-mobile-begins-putting-5g-into-its-fixed-wireless-internet-service-/d/d-id/766436, accessed 09 January 2021.

[17] Article "Inside T-Mobile's new 'Home Internet' business", website https://www.lightreading.com/mobile/5g/inside-t-mobiles-new-home-internet-business/a/d-id/754548, accessed 09 January 2021.

2 Acknowledgements

George Mason University would like to acknowledge the following individuals and their helpful interactions that are helping to make this updated report even more useful and accurate. In cases where we had extensive conversations, the notes of those are with the person being acknowledged.

- Eastern Shore of Virginia Broadband Authority
  - Robert Bridgham – President ESVBA, rbridgham@esvba.com
    - Robert Bridgham is the current President of the ESVBA and he was kind enough to join the TCOM 750 class during their weekly Zoom session. He was gracious enough to provide a background on the ESVBA as well as answer a number of questions the class had for him. He noted the ESVBA was formed in 2008 by a joint effort of the Accomac and Northampton Counties. He stated that the ESVBA had a pretty diverse mix of customers with the Virginia Beach Public Schools being one of their largest customers along with the National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF). He noted that approximately 66% of the traffic that the broadband authority carries are for the bulk commercial customers such as Neubeam, ESCC and Charter Spectrum[18].
    - One very interesting discussion involved the broadband initiative program that the broadband authority developed to help small towns on the Eastern Shore pre done reports to get internet in
    - The ESVBA Wireless Internet Service Provider (WISP) program[19][20] charges $3.50 mbit to encourage ISPs to provide service.
    - ESVBA has predictive program to help users find where service is available on their website. [21]
    - Mr. Bridgham also mentioned that FCC 477 forms can be found for census blocks (essentially zip code areas) covered. The TCOM 750 class did follow up on this and the results are found in an Appendix.
  - Patrick Coady- former ESVBA President Pcoady@coady.org
    - Patrick Coady (Pcoady@coady.org) was the first President of the Eastern Shore of Virginia Broadband Authority. In our conversation he mentioned the issues involved in starting up the broadband authority and how proud he was that they were able to retire the startup debt provided by the counties and make the broadband authority a self-supporting organization.
    - Mr. Coady noted that NASA's Wallops Island Flight Facility was a major impetus for putting broadband on the eastern shore and that was a major source of the funding and ability for the broadband authority to be viable. Professor Williams expressed his appreciation for the broadband based on consulting work he performed with the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) where the Wallops Island facility is the backup site for weather processing as well as a key satellite download and upload relay facility. Prior to the installation of the terrestrial broadband connectivity via the broadband authority, NESDIS was required to lease commercial satellite capacity to

[18] It was noted that Bay Creek Communications became Chesapeake Bay Communications which was purchased by Charter Spectrum.
[19] ESVBA WISP Rates, https://esvba.com/wisp-wholesale-services/, accessed 21 April 2021.
[20] WISP EVPL Rules Updated, website https://esvba.com/wisp-evpl-rules-updated/, accessed 21 April 2021.
[21] ESVBA website, https://esvba.com/residential/, accessed 21 April 2021.

accept weather data downloads and then upload them for final processing at Suitland, Maryland. It is noted one of the key objectives of the study was to determine how to re-architect the NESDIS system to transition from 4km to 1km resolution weather data.

- Mr. Coady also mentioned other examples of rural broadband initiatives that he thought were good examples of public/private cooperation. Location he mentioned were Ammon, Idaho; Vermont Cooperative Broadband[22]; Nevada Grants[23] and Rural Utilities Service (RUS) Funding[24]. Another study noted was the 2016 Old Dominion University study on broadband[25] that noted it was vital for economic development.
- In imparting some of the history of the broadband authority, Mr. Coady mentions that Bay Creek Communications, originally the 3rd wireless carrier on the eastern shore, was bought by Charter Spectrum. He noted that the broadband authority held off on pushing fiber to the home (FTTH) for five years to encourage the wireless providers to expand their service and not compete against them. He noted several times that the broadband authority was a self-supporting non-profit entity whose goal was to provide service to the citizens. He also noted that the wireless carriers do receive discounts on their services.
- One area Mr. Coady noted would be very helpful would be a wireless propagation study. The TCOM 750 class notes that all of the providers have a feature where you can input an address to determine service availability but there is not feedback other than a yes or no response.

- Olivia Justice (ojustice@esvba.com) system@sent-via.netsuite.com
- Ted Schockley, Editor - Eastern Shore First Newspaper, Ted@EasternShoreFirst.com
  - Mr. Shockley noted that his business was near Rt 13 and his business had excellent Internet service, but that his home was approximately 5 miles away from Rt 13 and the Internet there was sub-par.
- Donna Bozza, Executive Director, info@cbes.org, Citizens for a Better Eastern Shore, CBES P.O. Box 882, Eastville VA 23347, www.cbes.org, 757-678-7157
- Kelly Lewis, Northampton County GIS, mklewis@co.northampton.va.us
  - Ms. Lewis was extremely helpful in explaining the Northampton County GIS structures and procedures and in obtaining addresses for Northampton County.
- Ann Snyder, Beekeeping Guild of the Eastern Shore of Virginia, bleakhouse14@gmail.com, http://bgesva.org/
- Eastern Shore Communications - Ronald Geijn rvgeijn@esvc.us
- Rob Wittman, Congressman.Wittman@mail.house.gov
- Neubeam, sales@neubeam.com
- Michael Mason, Accomac County Manager, Mmason@co.accomac.va.us
- Accomac Country Supervisors

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[22] Article "A new broadband program could reach up to 10,000 addresses in the next three years", website https://vtdigger.org/2021/03/18/a-new-broadband-program-could-reach-up-to-10000-addresses-in-the-next-three-years/ , accessed 21 April 2021.

[23] Website "Broadband Infrastructure Development Grant", website https://osit.nv.gov/Grants/Broadband_Infrastructure_Development_Grant/, accessed 21 April 2021.

[24] USDA Website https://www.rd.usda.gov/programs-services/all-programs/telecom-programs, accessed 21 April 2021.

[25] 2016 Study "BROADBAND IN VIRGINIA: VITAL FOR ECONOMIC DEVELOPMENT", https://digitalcommons.odu.edu/cgi/viewcontent.cgi?article=1005&context=soc_reports, accessed 21 April 2021.

    - btarr@co.accomack.va.us
    - Ron Wolff rwolff@co.accomack.va.us
        - Ron Wolff was kind enough to communicate several times via phone and email and provided superb insider knowledge of the many problems experienced by residents. He provided invaluable insight to the many media articles and local politics we referenced in the Fall 2020 report where there was missing context.
    - vanessajohnson@co.accomack.va.us
    - pmuhly@co.accomack.va.us
    - hphillips@co.accomack.va.us
    - rcrockett@co.accomack.va.us
    - jphillips@co.accomack.va.us
    - dhart@co.accomack.va.us
    - crmajor@co.accomack.va.us
- Northampton County Supervisors
    - jcoker@co.northampton.va.us
    - dfauber@co.northampton.va.us
    - obennett@co.northampton.va.us
    - dleatherbury@co.northampton.va.us
    - bmapp@co.northampton.va.us
- Commerce and Trade, Secretary of commerce.trade@governor.virginia.gov

3 Analytic Approach

Our analytic process followed a 5-step approach and is shown in Figure 2 The George Mason Approach Followed a 5-Step Process to Acquire the Data, Select Candidate Areas and Determine Coverage Types and Effect. We note that the process used by the counties/Charter Spectrum for the Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021 was different.[26]

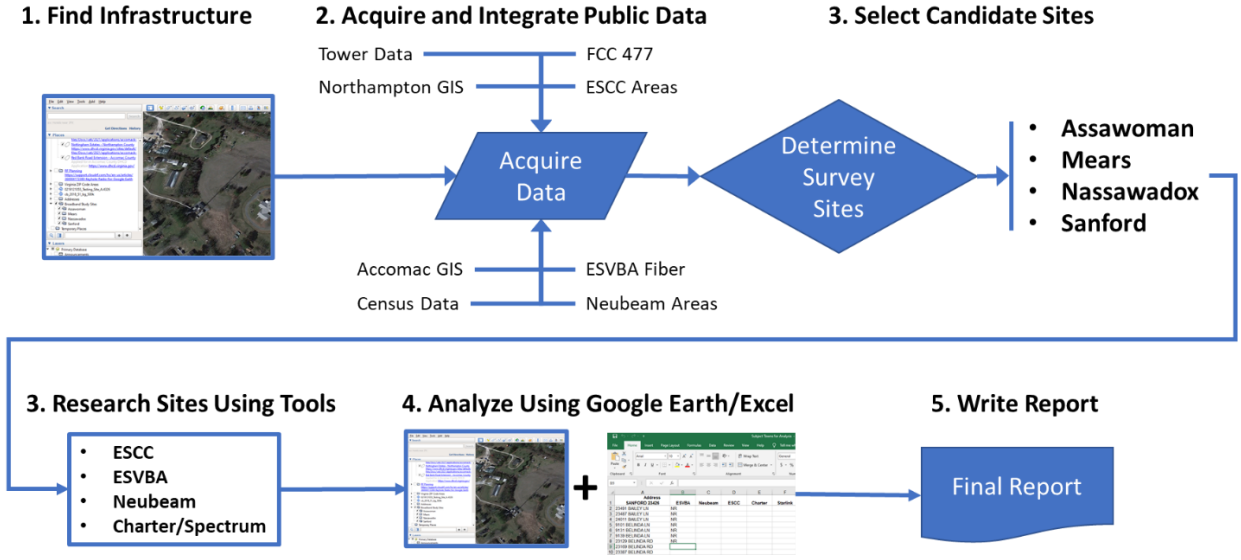

Figure 2 The George Mason Approach Followed a 5-Step Process to Acquire the Data, Select Candidate Areas and Determine Coverage Types and Effect

Our analytic approach began by reviewing visible infrastructure on the Eastern Shore and determining census areas[27][28][29] and United States Postal Service ZIP Code areas. We identified the towns and areas in the two counties and acquired all of the known addresses in the two counties. We also identified via visual

[26] Derived from report page 6 of 13, "Status of Development (planning, preliminary engineering report): This project was physically ridden out by Charter in-house construction staff. They are experienced in looking at such network expansions. They counted the number of existing passings, the mileage from the nearest network tie point and calculated the project cost. The cost is derived from years of company experience, internal (proprietary) template worksheets."

[27] Data.rgj.com, website https://data.rgj.com/american-community-survey/block-group-1-census-tract-901-accomack-county-virginia/population/total-population/yty/15000US510010901001/, accessed 21 April 2021.

[28] Data.gov Census Reporter, website https://censusreporter.org/profiles/15000US510010905001-block-group-1-accomack-va/, accessed 21 April 2021.

[29] US Census Cartographic Boundary Files, website https://www.census.gov/geographies/mapping-files/time-series/geo/cartographic-boundary.html, accessed 21 April 2021.

observation in Google Earth and using corresponding data from Cell Mapper[30] and Cell Reception[31] we were able to accurately locate cell towers in the two counties.

In the Fall 2020 study by the TCOM 750 students we did acquire partial GIS files of the ESVBA based on information they provided via several Requests for Proposals (RFP) where they provided GIS data for existing and planned extensions to their service area. Mr. Robert Bridgham was kind enough to attend a Zoom class and provide a lot of background on the ESVBA and their network. He was reticent to provide more detailed information on the exact routing of the fiber infrastructure, but in some quick field surveys we were able to determine how the fiber is laid with approximate routes. In these field surveys and also using their websites we also were able to determine the locations of most of the Radio Frequency to Home (RFTH) towers utilized by Neubeam and ESCC and approximate coverage areas.

For Accomac County we were able to go to their Accomac County Open Data Portal (https://accomack-county-virginia-open-data-portal-accomack.hub.arcgis.com/datasets/accomack-county-addresses?showData=true) to download all of the county addresses and pick out the addresses using Microsoft Excel to sort them by ZIP Code, town and street. We identified 27,191 unique addresses in Accomac County.

For Northampton County we were able to request the addresses via their Geographic Information Service (GIS) office (https://www.co.northampton.va.us/government/departments_elected_offices/planning_permiting_enforcement/planning/gis_program) and they supplied the GIS files where we again used Microsoft Excel to sort them by ZIP Code, town and street. We identified 9,267 unique addresses in Northampton County.

We did identify discrepancies when we reviewed the Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021 Grant Request (https://www.dhcd.virginia.gov/sites/default/files/Docx/vati/2021/applications/accomack-county-application-VATI2021.pdf) as of the eight sites identified four of them we were not able to find them in our address lists or via Google Earth. But in reviewing the application we found that most were either new developments or were identified with different parameters than what the GIS offices use. By identifying adjacent streets on the overhead views on pages 14-21 of the report we were able to find the proposed developments.

We were also able to acquire all of the Federal Communications Commission (FCC) Form 477 applications at the FCC Open Data site (https://opendata.fcc.gov/Wireline/Fixed-Broadband-Deployment-Data-December-2019/whue-6pnt/data) but given the limited information on the summaries they only enabled us to identify the providers in the two counties who were registered and a relative value of their business scope.

After reviewing the infrastructure and defined areas we selected Assawoman, Mears, Nassawadox and Sanford for the following reasons:

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[30] Website CellMapper.net view of Cell Towers on Virginia's Eastern Shore, website https://www.cellmapper.net/map?MCC=310&MNC=260&type=LTE&latitude=37.662940248196946&longitude=-75.742644260193&zoom=9.863715704468131&showTowers=true&showTowerLabels=true&clusterEnabled=true&tilesEnabled=true&showOrphans=false&showNoFrequencyOnly=false&showFrequencyOnly=false&showBandwidthOnly=false&DateFilterType=None&showHex=false&showVerifiedOnly=false&showUnverifiedOnly=false&showLTECAOnly=false&showENDCOnly=false&showBand=0&showSectorColours=true&mapType=roadmap accessed 21 April 2021.

[31] Website Cell Reception, website http://www.cellreception.com/towers/towers.php?city=accomac&state_abr=va, accessed 21 April 2021.

- Assawoman – Area is generally close to Rt 13 and ESVBA fiber, area is lightly populated, area is poorly served and disadvantaged enough due to challenging power pole location/routing.
- Mears – Centrally located and somewhat distant from Rt 13, but not near enough to gain direct fiber; lightly populated.
- Nassawadox – Adjacent to Rt 13 and well served.
- Sanford – Located directly around ESVBA fiber run; area is well served with Fiber to the Home (FTTH), cable and wireless.

Given the street addresses we accessed the ESVBA, Neubeam, ESCC and Spectrum websites to see what availability the vendors exhibited. Their websites are shown in the following four figures.

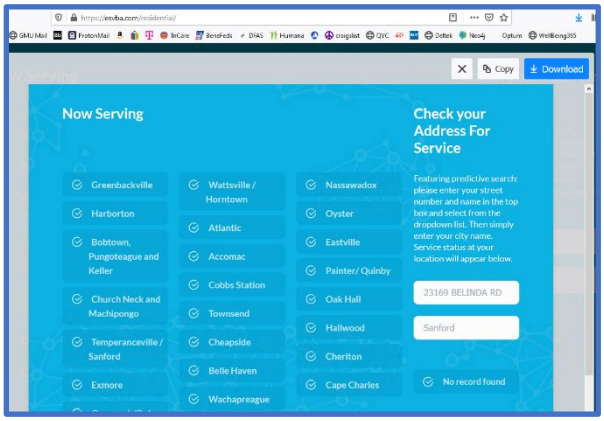

Figure 5 ESVBA Address Search Feature

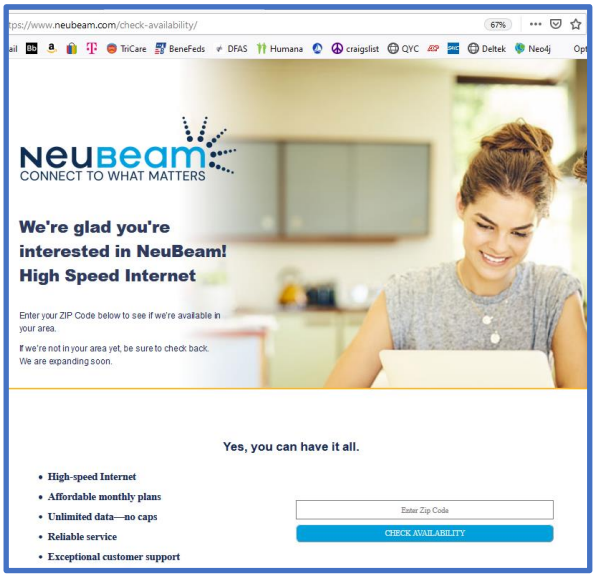

Figure 4 Neubeam Address Search Feature

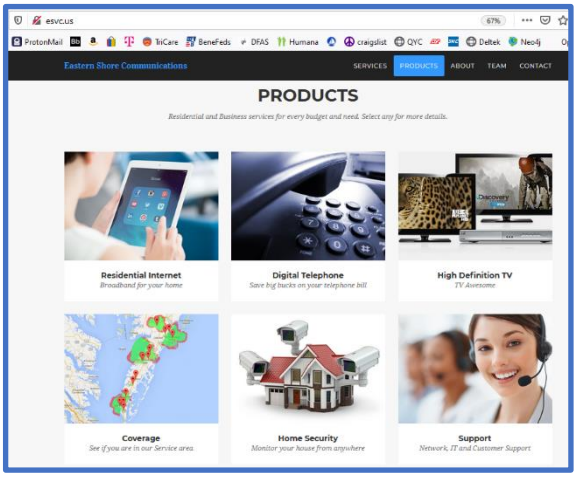

Figure 3 Eastern Shore Communications Site (Note residential search feature was down when screenshot taken)

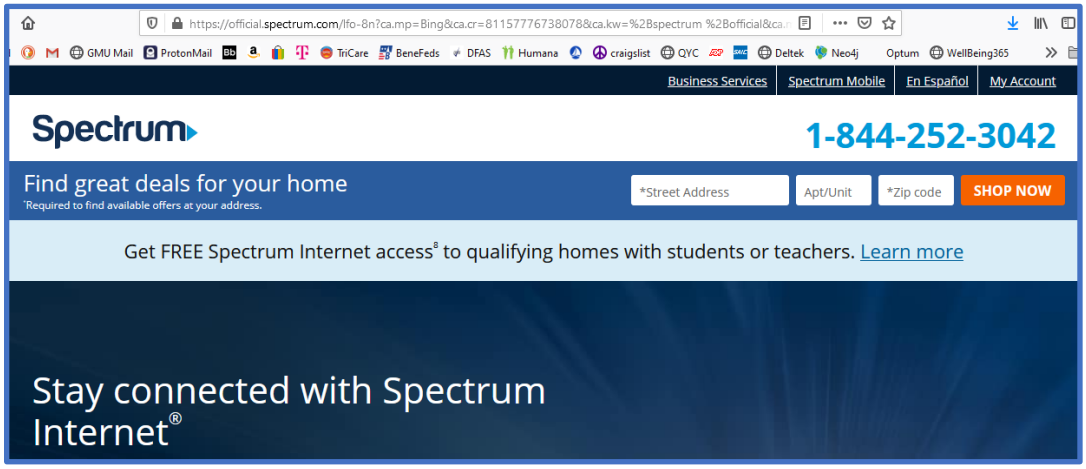

Figure 6 Charter/Spectrum Internet Coverage Search Page

4 Radio Frequency (RF) Modeling

One comment we heard from several people contacted was a desire to see more RF modeling to help plan out point-to-point wireless (PTP) deployments. We do expect that the two wireless providers Neubeam and ESCC use an RF planning tool. For our purposes, while we acknowledge it is not an idea tool, we did find CloudRF[32] that we embedded into Google Earth to be a good starting point for mapping out RF PTP deployments. In the course of this study, we generated an extensive Google Earth[33] dataset that we would like to see in the public domain and hosted on one or both of the counties' websites. Google Earth uses the Keyhole Markup Language (KML) which is an open standard for documenting Geographic Information System (GIS) data. There is also a variant on KML files which is the KMZ file which is simply a compressed version.

Figure 7 CloudRF Set-Up Screens for Transmitter, Antenna, Receiver, Propagation Model and Output Format shown from Left to Right

CloudRF has an interactive layer for Google Earth called 'Keyhole Radio'. This allows you to perform planning directly in Google Earth without the need for a web browser. CloudRF has an overlay for Google Earth that calculates RF propagation and stores the results in the Google Earth KML file. CloudRF requires a subscription plan, but the expense is extremely modest for limited uses. For the model we generated for Mears, Virginia we purchased a limited usage plan for $5.00 that gave us the ability to model up to 3 sites.

The CloudRF output for Mears, Virginia is shown in Figure 8 below. The settings used as input into the model are listed in the Table 1 below. We chose CloudRF as a demonstration that RF modeling tools are readily available. We note the results are misleading as if we had chosen a plan that featured the 5Ghz transmit frequency that Neubeam and ESCC use the coverage area would be greatly reduced, but that is a subject for another study where more realistic parameters are known. We situated the transmitter just East of Mears Station and 2.80 miles from Router 13. We note for the VATI application[34] the average cost to pull residential fiber is approximately $56,677 per mile to pass 337 homes to provide Internet in those subdivisions. Of those 8 subdivisions covered the total miles were 10.16 from the Internet access point to the distribution point. With this in mind we note that even with the difficulties encountered in wireless point-to-point connectivity it can be cost effective.

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[32] "Keyhole Radio for Google Earth", website https://cloudrf.com/docs/keyhole-radio-for-google-earth/, accessed 04 May 2021.

[33] "Google Earth, website https://www.google.com/earth/, accessed 04 May 2021.

[34] Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021, website https://www.dhcd.virginia.gov/sites/default/files/Docx/vati/2021/applications/accomack-county-application-VATI2021.pdf, accessed 15 April 2021.

Table 1 RF Modeling Parameters used in CloudRF used for Mears, Virginia 23409

Communications Category	Parameter	Value
Transmitter	Frequency	1000 MHz
	RF Power	30 watts
	Bandwidth	100 MHz
	Height AGL	50 Feet
Antenna	Template	OEM Half-wave dipole
	Polarization	Vertical
Receiver	Height(s) AGL	6 feet
	Gain	2.14 dBi
	Units of Measurement	Received Power (dBm)
	Sensitivity	-90 dBm
Model	Propagation Model	ITM/Longley Rice (<20GHz)
	Reliability %	95%
	Terrain conductivity	Forest
	Radio climate	Maritime Temperate (land)
	Clutter Mode	Sofl/NLOS
	My clutter	Off
Output	Terrain Resolution	20m/66ft
	Colours[35]	Rainbow (24)
	Radius	5km

[35] CloudRF is based out of the United Kingdom and uses their spelling.

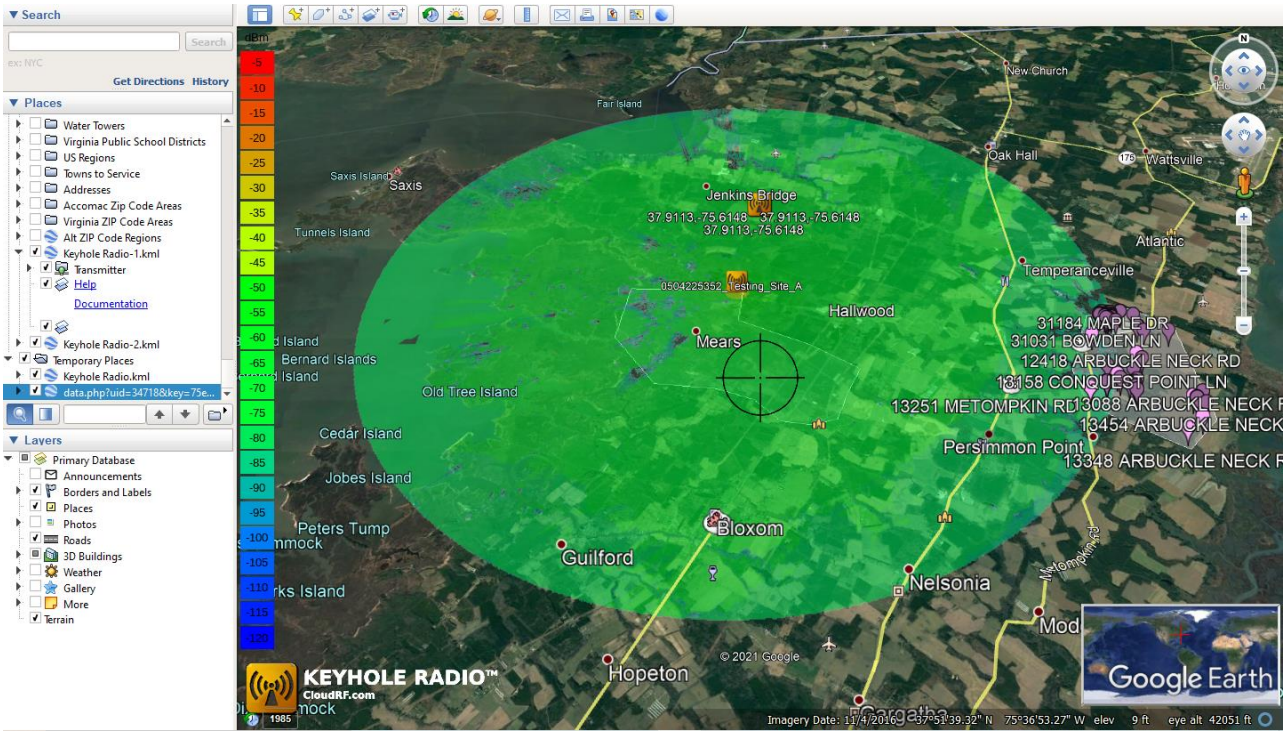

Figure 8 CloudRF Propagation Model Results for Mears, Virginia 23409 using the Parameters listed in Table 1.

5 Point-to-Point Wireless Technology

The last-mile has traditionally been referred to as the hardest part of deploying any service to remote customers. With the cost of physically laying infrastructure as well as the cumbersome process and the disruption to constituencies and infrastructure it is usually a daunting task. Virginia's Eastern Shore is fortunate to have at least two wireless providers in ESCC and Neubeam who have last-mile distribution technologies and a process for determining how to efficiently extend their business footprints. We were also impressed by the ESVBA approach in providing towns with "boilerplate" Request for Proposal (RFP documents to help the towns plan for and acquire Internet services for their towns.

In our limited onsite surveys, we noted that Neubeam has employed some point-to-point links and would like to see more of this.[36] One residential antenna identified in Smith Beach is an mANT30 PA Parabolic dish antenna[37] that works at 5GHz with 30dBi gain. This model includes a precision alignment mount and is designed to be mounted on a pole as illustrated. We understand this is how Neubeam increases the range of their coverage. Neubeam has also advertised their coverage via point-to-point link to Vaucluse Shore and Wilsonia Neck.

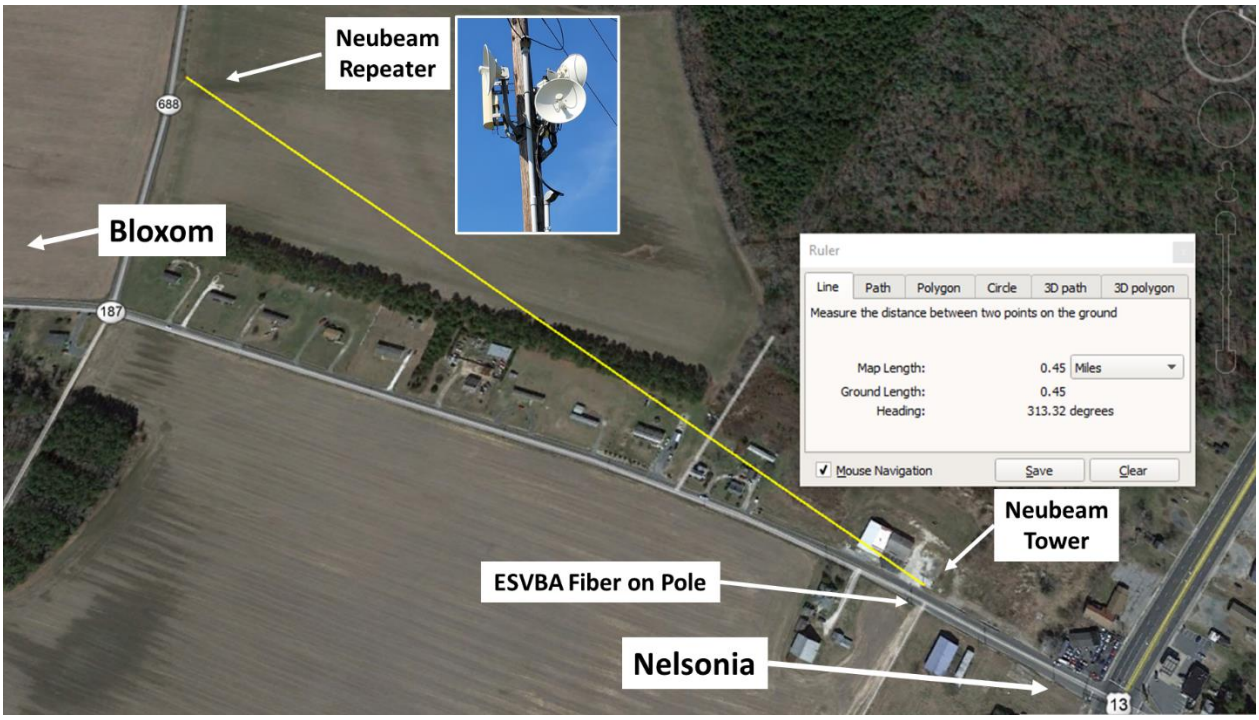

Figure 9 Neubeam has employed 5GHz Repeaters – Nelsonia Site and Repeater Shown

Based on our observations, with the use of 5Ghz the upper limit for transmitting a signal with that equipment is approximately ½ mile in areas such as the Nelsonia site where there is little to no interfering vegetation between the main town and the repeater.

[36] Article "Broadband internet service expanding on Virginia's Eastern Shore", website https://www.13newsnow.com/article/news/local/virginia/eastern-shore/broadband-internet-service-expanding-on-virginias-eastern-shore/291-577634607, accessed 29 April 2021.

[37] mANT30 PA Product Information, website https://mikrotik.com/product/MTAD-5G-30D3-PA, accessed 21 April 2021.

6 Recommendations

The TCOM 750 graduate students from the Spring generally align with the TCOM 750 Fall class recommendations. From the VITA application We recommend ed the following actions to enhance Virginia's Eastern Shore Broadband options.

- Leverage existing ESVBA fiber and treat ESVBA as the default.
- Extend the ESVBA Fiber Plant with using ANEC infrastructure – we still believe ANEC is a powerful potential partner to all the broadband providers.
- Investigate and leverage Facebook's Fiber deployment by a robot or similar solution
    - NetEquity Networks was spun off from Facebook with its technology to be available 2021
    - Cost as low as $2/meter; with 1610 meters in a mile this comes to a cost of $3200 per mile that compares very favorably to the cost of $56,677 per mile.
- Expand and formalize partnerships with wireless broadband service providers such as Neubeam and ESCC. This would be a good approach for the Commonwealth to investigate and codify via legislation.
- Ensure Neubeam and ESCC and other private provider investments are protected by franchise agreements. This would be a good approach for the Commonwealth to investigate and codify via legislation
- Mandate companies work in a collaborative manner to qualify for incentives.
- Leverage Eastern Shore Chamber of Commerce and others as a Key Partner/Arbiter.
- For those households who chances of getting broadband in the next several years provide assistance in signing up for Starlink or other emerging satellite broadband services.

Table 2 Options for Connecting Homes to the Internet using Distance as a Discriminator

Category	Backbone Provider	Middle-Mile Carriers	Last-Mile Provider
Homes < 500 meters from fiber backbone	ESVBA	ESVBA	ESVBA
Homes (5+) < 1 mile from fiber backbone	ESVBA	ANEC/NetEquity	ESVBA
Homes (< 5) < 5 miles from fiber backbone	ESVBA	ANEC/NetEquity	Neubeam, ESCC, Spectrum
Neighborhood (5+) < 5 miles from fiber backbone	ESVBA	ANEC/NetEquity	ESVBA
Neighborhood (5+) 5+ miles from fiber backbone	ESVBA	ANEC/NetEquity	Neubeam or ESCC
Remote Homes 5+ miles from fiber backbone; no near neighbors	Starlink	N/A	Starlink[38]

[38] Potentially eligible for support from FCC Rural Broadband fund.

7 Appendix A - Accomac and Northampton County Coverage Options by Zip Code

In **Table 3 Accomac and Northampton Counties Zip Codes and Providers**, a list was assembled of various options. No effort was made to validate the quality of the offered services; all representations were accepted with the caveat they may not be 100% accurate. The survey results are organized by Zip Code/Town/County and then by ESVBA Coverage, local wireless providers ESCC and Neubeam, Cable/Satellite/Wired providers, and proximity to fixed infrastructure.

Table 3 Accomac and Northampton Counties Zip Codes and Providers[39][40]

ZIP Code	City	County	Popul-ation	ESVBA Coverage [41]	ESCC [42]	Neubeam [43]	Cable/ Sat TV/ DSL[44] Other Internet
23301	Accomac	Accomac	1831			Yes	Viasat, Verizon
	Accomac to Centerville	Accomac		Proposed			
23302	Assawoman	Accomac	155	Proposed		No	Viasat
23303	Atlantic	Accomac	741			Yes	Viasat, Verizon
23306	Belle Haven[45]	Accomac	1,088	Proposed		Yes	Viasat, Verizon
23308	Bloxom[46]	Accomac	2,106	Proposed		Yes	Viasat
	Bobtown[47]	Accomac		Proposed			
	Cashville	Accomac		Proposed			
23336	Chincoteague Island	Accomac	2,941	Yes		Yes	Spectrum, Viasat, Verizon
23337	Wallops Island	Accomac	377			Yes	Viasat, Verizon
23341	Craddockville	Accomac	0	Proposed		Yes	
23345	Davis Wharf	Accomac	0			No	

[39] Website "ACCOMACK County, VA ZIP Codes, " https://www.zip-codes.com/county/va-accomack.asp, Accessed 08 January 2021

[40] Website "NORTHAMPTON County, VA ZIP Codes," https://www.zip-codes.com/county/va-northampton.asp, Accessed 08 January 2021

[41] WSVBA Dashboard, website https://esvba.com/about/esvba-status-dashboard/, accessed 11 January 2021.

[42] Website http://www.esvc.us/, accessed 08 January 2021

[43] Website https://www.neubeam.com/check-availability/, accessed 08 January 2021

[44] Website "Compare Cable TV and Internet Deals", https://www.cabletv.com/compare-providers?zip=23301, accessed 08 January 2021

[45] Cats Bridge ESVBA Proposed Service Extension

[46] Bloxom East, Bloxom to Guilford, ESVBA Proposed Service Extensions

[47] Country Club Road, Bobtown Road to Savageville Road ESVBA Proposed Service Extensions

ZIP Code	City	County	Popul-ation	ESVBA Coverage [41]	ESCC [42]	Neubeam [43]	Cable/ Sat TV/ DSL[44] Other Internet
23356	Greenbackville	Accomac	1,246			Yes	Viasat
23357	Greenbush[48][49][50]	Accomac	776	Proposed		Yes	Viasat
23358	Hacksneck	Accomac	152			No	Viasat, Verizon
23359	Hallwood	Accomac	776		Yes	Yes	Viasat, Verizon
23389	Harborton	Accomac	137			Yes	Viasat
23395	Horntown	Accomac	645			No	
23396	Oak Hall	Accomac	0			No	Viasat
23399	Jenkins Bridge	Accomac	0			No	
23401	Keller	Accomac	212			Yes	Viasat
23404	Locustville	Accomac	0			Yes	
23407	Mappsville	Accomac	411			No	Viasat
23409	Mears	Accomac	84			No	
23410	Melfa	Accomac	2,015			Yes	Viasat, Verizon
23412	Modest Town	Accomac	0			No	
23414	Nelsonia[51]	Accomac	100	Proposed		Yes	Viasat
23415	New Church	Accomac	1,893			Yes	
23416	Oak Hall	Accomac	356			Yes	Viasat, Verizon
23417	Onancock	Accomac	4,047			Yes	Viasat, Verizon
23418	Onley	Accomac	863			Yes	Viasat, Verizon
23420	Painter	Accomac	2,376			Yes	Viasat, Verizon
23421	Parksley[52]	Accomac	4,255	Proposed		Yes	Viasat, Verizon

[48] Deep Creek and New Branch to Deep Creek ESVBA Proposed Service Extensions
[49] Chescosonessex North ESVBA Proposed Service Extension
[50] Plantation ESVBA Proposed Service Extension
[51] Nelsonia to Gargatha, Centerville to Gargatha, ESVBA Proposed Service Extensions
[52] Hopkins to Parksley ESVBA Proposed Service Extension

ZIP Code	City	County	Popul-ation	ESVBA Coverage [41]	ESCC [42]	Neubeam [43]	Cable/ Sat TV/ DSL[44] Other Internet
23422	Pungoteague[53]	Accomac	278	Proposed		Yes	Viasat
23423	Quinby	Accomac	344			Yes	Viasat
23426	Sanford	Accomac	225			No	Viasat
23427	Saxis	Accomac	243	Proposed		No	Viasat
	Silver Beach[54]	Accomac		Proposed			
23440	Tangier	Accomac	727			No	
23441	Tasley	Accomac	171			Yes	Viasat
23442	Temperanceville	Accomac	1,059			Yes	Viasat, Verizon
23480	Wachapreague	Accomac	328			Yes	Viasat
23483	Wattsville[55]	Accomac	0	Proposed		Yes	
23488	Withams	Accomac	201			No	Viasat
23307	Birdsnest	Northampton	769	Proposed		No	Viasat, Verizon
23310	Cape Charles	Northampton	4,736			Yes	Spectrum, Viasat, Verizon
23313	Capeville[56]	Northampton	78	Proposed		Yes	Viasat
23316	Cheriton[57]	Northampton	342	Proposed		Yes	Spectrum
23347	Eastville[58]	Northampton	671			Yes	Viasat
23350	Exmore	Northampton	3,403			Yes	Viasat, Verizon
23354	Franktown	Northampton	207	Proposed		Yes	Viasat, Verizon
23398	Jamesville	Northampton	153			No	Viasat
23405	Machipongo[59]	Northampton	973	Proposed		Yes	Viasat, Verizon

[53] Pungoteague Rd, Big Pine Rd, Boston to Pungoteague, ESVBA Proposed Service Extensions
[54] Also, Silver Beach Tower Site, ESVBA Proposed Service Extension
[55] Mill Dam Rd, ESVBA Proposed Service Extension
[56] Capeville, Capeville Pt2, Seaview to Capeville, ESVBA Proposed Service Extensions
[57] Cheriton-Exmore ESVBA Proposed Service Extension
[58] Smith Beach and Smith Beach Pt2 ESVBA Proposed Service Extensions
[59] Wilson Neck, ESVBA Proposed Service Extension

ZIP Code	City	County	Popul-ation	ESVBA Coverage [41]	ESCC [42]	Neubeam [43]	Cable/ Sat TV/ DSL[44] Other Internet
23408	Marionville	Northampton	77			No	Viasat
23413	Nassawadox[60]	Northampton	840	Proposed		Yes	Viasat, Verizon
23419	Oyster	Northampton	0			No	
23429	Seaview	Northampton	0	Proposed		No	
23443	Townsend	Northampton	0			No	
23482	Wardtown	Northampton	0			No	
23486	Willis Wharf	Northampton	140			Yes	Viasat

[60] Nassawadox to Hare Valley ESVBA Proposed Service Extension

8 Appendix B - Smith Beach Survey

A drive through survey was conducted on Smith Beach in Northampton County. There we observed a Neubeam transmission tower and numerous local residential receive antenna throughout the community. An overhead view of the community as shown in . The primary RF to Home (RFTH) pole shown in **Figure 11 Neubeam Microwave Antenna, Local Antennas and Service Box Serving Smith Beach** majority of the community is on Rt 666 and Toms Lane and every home appeared to have a receiver dish similar to the one shown in **Figure 12 Typical RF to Home (RFTH) Residential Installation – a 6' Pole with a Directional or Flat Panel Antenna**.

The Flat Panel antenna is a Cambium Networks PMP 450 antenna that features GPS synchronization, advanced scheduling algorithms, the cnMedusa™ technology that provides Multi-User MIMO (Multiple-Input, Multiple-Output) capability for nearly infinite beamforming patterns in the uplink and downlink and MU-MIMO in each direction as well. cnMedusa increases capacity per sector by allowing simultaneous data transfer to multiple subscriber modules (SM) within a sector for 5 GHz and 3 GHz bands and is certified for use in the new CBRS (U.S.) spectrum.[61]

Figure 10 Smith Beach in Northampton County Overhead View

The other residential antenna we observed was a Cambium Networks ePMP™ Force 200 5 GHz parabolic reflector antenna. This model adds a subscriber module and point-to-point (PTP) radio to provides superior throughput of over 200 Mbps of real user data. Long range deployment is enabled by the 25 dBi antenna. Configurable Modes of operation ensure robust adaptivity to both symmetrical and asymmetrical traffic while providing high performance and round-trip latency as low as 2 – 3 ms.[62]

[61] Website "PMP 450 – The Ultimate in Point-to-Multipoint Performance", https://www.cambiumnetworks.com/products/pmp-450/, accessed 27 April 2021.
[62] Website "ePMP Force 200 5 GHz", https://www.cambiumnetworks.com/products/epmp/force-200-5-ghz/, accessed 27 April 2021.

Our overall impression after visiting Smith Beach was the community was well served with broadband connectivity.

Figure 11 Neubeam Microwave Antenna, Local Antennas and Service Box Serving Smith Beach

Figure 12 Typical RF to Home (RFTH) Residential Installation – a 6' Pole with a Directional or Flat Panel Antenna

9 Appendix C – Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021[63]

An interesting ongoing request by the counties of Accomac and Northampton is the 2021 request for funding from the Commonwealth of Virginia to extend service to 8 communities, 1 in Accomac County and 7 in Northampton County. This is a partnership with cable company Charter Spectrum with an 80/20 split in funding with the grant to provide 80% and Charter Spectrum to provide 20%. Charter Spectrum is to manage the service on behalf of the counties.

Application ID: 75708122020132024

Program Name: Virginia Telecommunications Initiative 2021

Project Name: Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021

Organization Name: County of Accomack, VA

Organization Address: 23296 Courthouse Ave. Accomac, VA 23301-0620

Project Contact Name: Amy Ford

Project Contact Phone: (757) 787-5714

Project Contact Email: aford@co.accomack.va.us

Profile Manager Name: Michael Mason

Profile Manager Phone: (757) 787-5716

Profile Manager Email: mmason@co.accomack.va.us

Total Requested Amount: $460,820.00

Table 4 Accomac/Northampton Budget Breakdown for Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021

	DHCD Request	Other Funding	Total
Total:	$460,820.00	$115,205.00	$576,025.00

This is a regional project submittal that includes eight (8) different projects, 2 in Accomack County and 6 in Northampton County. Both Accomack and Northampton County have been designated Rural Counties through the2010 Census by the US Government Office of Management and Budget. In total, there are 19 incorporated towns on the Eastern Shore all of which have access to high-speed broadband. Outside of the incorporated towns, in the more rural portions of both Accomack and Northampton, is largely where the digital divide occurs. Broadband speeds are not widely available outside of the towns due to the remoteness of the locations. Wireless internet is problematic due to the topography of the Eastern Shore which is flat and heavily wooded. A recent survey of students conducted by the Accomack County Public School Division indicated that approximately 24% of students of had no access to the internet at all.

The 8 projects selected have all submitted requests to the counties for service in their areas. The counties certify there is no other terrestrial provider serving this area with broadband speed at or above 25/3.

[63] Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021, website https://www.dhcd.virginia.gov/sites/default/files/Docx/vati/2021/applications/accomack-county-application-VATI2021.pdf, accessed 15 April 2021.

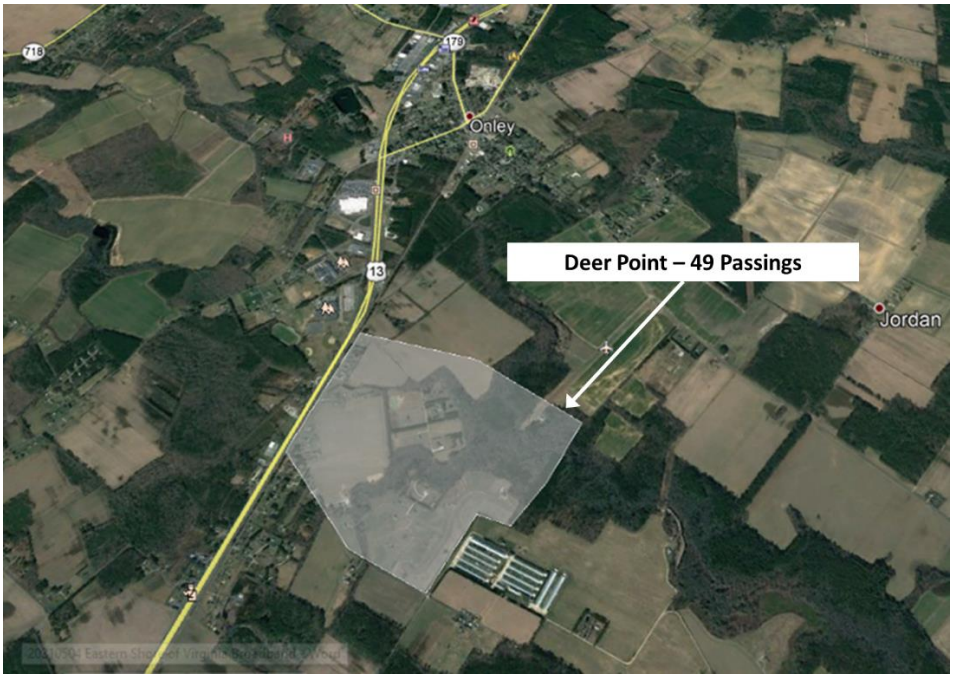

Figure 13 Deer Point: This is a rural area in Accomack County. This project would serve approximately 49 residential passings.

Figure 14 Red Bank Road: This is a rural area in Accomack County. This project would serve approximately 30 residential passings.

Figure 15 Lucille Lane (8 passings) and Kiptopeke Condominium Association (19 passings): These are two rural areas in Northampton County.

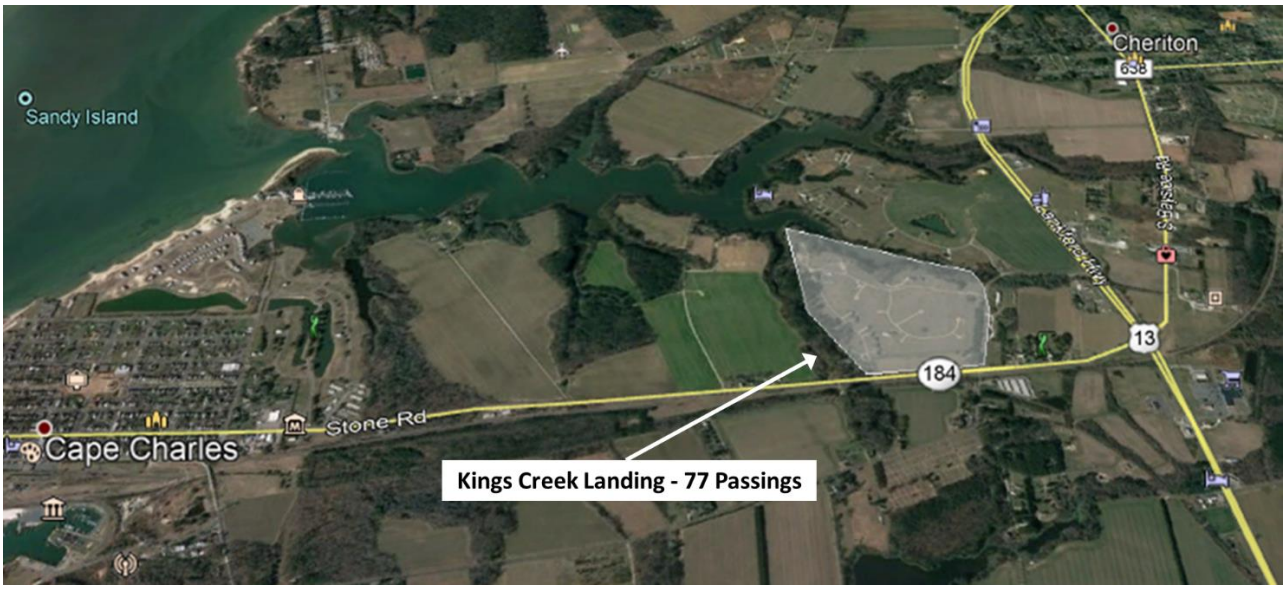

Figure 16 Kings Creek Landing (77 passings): This is a rural area Northampton County.

Figure 17 Nottingham Estates (55 passings), Arlington Chase (42 passings), and Bay Ridge (57 passings): These are 3 rural area in Northampton County.

Table 5 Accomack/Northampton Regional Broadband Ext. Project (VATI) 2021 Cost Breakdown Excerpt

Northampton County	**Aerial Miles**	**UG Miles**	**Total Miles**	**Passings**	**Labor Cost**	**Material Cost**	**Total Cost**	**HPM[64]**	**Cost / Mile**	**Cost / Passing**
Lucille Lane	0	0.22	0.22	8	$7,358	$4,906	$12,264	36.36	$55,745	$1,533
Kiptopeke Condos	0	0.39	0.39	19	$12,877	$8,585	$21,462	48.72	$55,031	$1,130
Nottingham Estates	0	0.7	0.7	55	$24,338	$16,225	$40,563	78.57	$57,947	$738
Arlington Chase	1.1	1.3	2.4	42	$60,908	$40,605	$101,513	17.50	$42,297	$2,417
Kings Creek Landing	0	1.5	1.5	77	$48,565	$32,377	$80,942	51.33	$53,961	$1,051
Bay Ridge	0.61	2.1	2.71	57	$78,521	$52,348	$130,869	21.03	$48,291	$2,296
Total	1.71	6.21	7.92	258	$232,567	$155,046	$387,613	32.58	$48,941	$1,502
Accomack County	**Aerial Miles**	**UG Miles**	**Total Miles**	**Passings**	**Labor Cost**	**Material Cost**	**Total Cost**	**HPM**	**Cost / Mile**	**Cost / Passing**
Deer Point	0.39	1.15	1.54	49	$43,998	$29,332	$73,330	31.82	$47,617	$1,497
Red Bank Rd	1.55	1.09	2.64	30	$69,050	$46,033	$115,083	11.36364	$43,592	$ 3,836
Total	**1.94**	**2.24**	**4.18**	**79**	**$113,048**	**$75,365**	**$188,413**	**18.90**	**$45,075**	**$2,385**

[64] HPM = Houses Per Mile; (Total Miles/ Passings = HPM). Not defined in the report.

10 Appendix D - Assawoman, Virginia 23302 Study Area

Assawoman is a rural area in Accomac County. There were 60 identified residential addresses. Based on our coverage analysis, Assawoman covers approximately 3 square miles. Charter Spectrum covers approximately 0.1 square mile essentially covering the housing area on Holly Acres Lane and Maple Drive where there are 20 homes, and additional 5 Homes on Atlantic Road which we assume is where their network feed is coming from. All of the other residences were covered by satellite or Neubeam DSL service. Coverage determined by address can be found in **Table 6 Assawoman, Virginia 23302 Addresses and Reported Coverage by Providers as of 15 April 2021**.

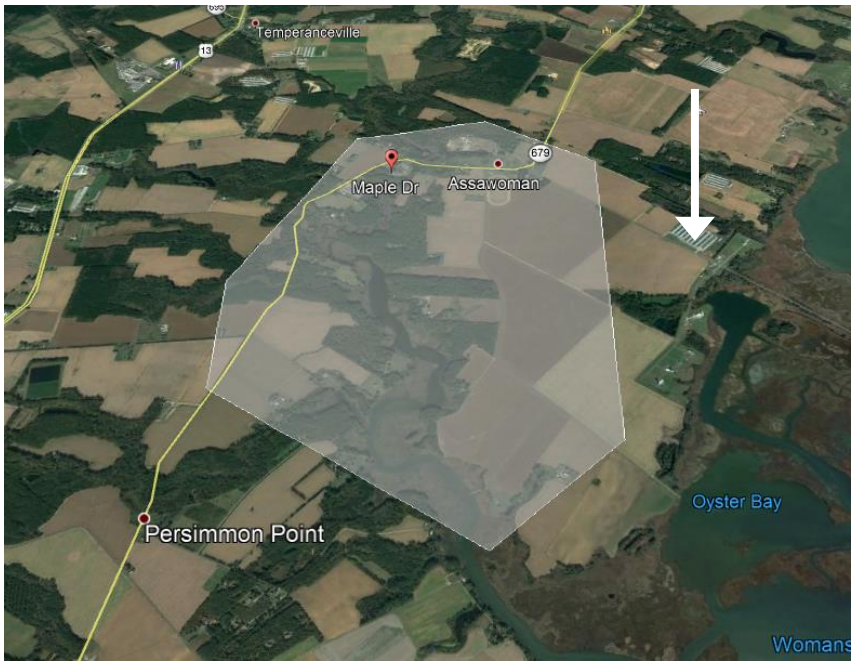

Figure 18 Assawoman, Virginia 23302 Coverage (60 Homes/3 square miles) by Neubeam DSL, HughesNet, ViaSat as of 15 April 2021

Figure 19 Assawoman, Virginia 23302 Coverage (25 Homes/0.1 square miles) by Charter Spectrum as of 15 April 2021

Table 6 Assawoman, Virginia 23302 Addresses and Reported Coverage by Providers as of 15 April 2021

Assawoman 23302	Neubeam	ESCC	Charter Spectrum	Starlink	Verizon	Hughes Net GeoSat	VIASAT GeoSat
12078 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12234 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12382 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12418 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12494 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13088 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13186 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13196 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13302 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13348 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13450 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13454 ARBUCKLE NECK RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12213 ATLANTIC RD	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12265 ATLANTIC RD	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12323 ATLANTIC RD	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12337 ATLANTIC RD	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12354 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12356 ATLANTIC RD	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12383 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12389 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12395 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12401 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12491 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12497 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps

Assawoman 23302	Neubeam	ESCC	Charter Spectrum	Starlink	Verizon	Hughes Net GeoSat	VIASAT GeoSat
12539 ATLANTIC RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
31031 BOWDEN LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
31042 BOWDEN LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13036 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13037 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13042 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13064 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13068 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13085 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13127 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13158 CONQUEST POINT LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
31053 CONQUEST FARM LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
31069 CONQUEST FARM LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
31072 CONQUEST FARM LN	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
12038 HOLLY ACRES LN	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
12050 HOLLY ACRES LN	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31158 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31168 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31181 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31184 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31189 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31195 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31199 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31208 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31215 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31216 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps

Assawoman 23302	Neubeam	ESCC	Charter Spectrum	Starlink	Verizon	Hughes Net GeoSat	VIASAT GeoSat
31219 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31223 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31224 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31229 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31230 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31233 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31258 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
31268 MAPLE DR	5-30 Mbps DSL		100-940 Mbps	Future		25 Mbps	12-30 Mbps
13069 METOMPKIN RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps
13251 METOMPKIN RD	5-30 Mbps DSL			Future		25 Mbps	12-30 Mbps

11 Appendix E - Mears, Virginia 23409 Study Area

Mears, Virginia was surveyed and there were 76 addresses listed by the county for the area. The team survey results for provider coverage are listed in **Table 7 Mears, Virginia 23409 Addresses and Reported Coverage by Providers.** Coverage was a bit substandard with the only offerings by Neubeam offering 5-30 Mbps Digital Subscriber Loop (DSL) service, Eastern Shore Communications Corporation 10 Mbps Fixed Wireless Access (FWA) and HughesNet Geo Satellite 25 Mbps service. Given the topography and close proximity to Rt 13 with Bethel Church Road at 2.17 miles it would seem to be an easy improvement to pull fiber to a central area in Mears for improved connectivity.

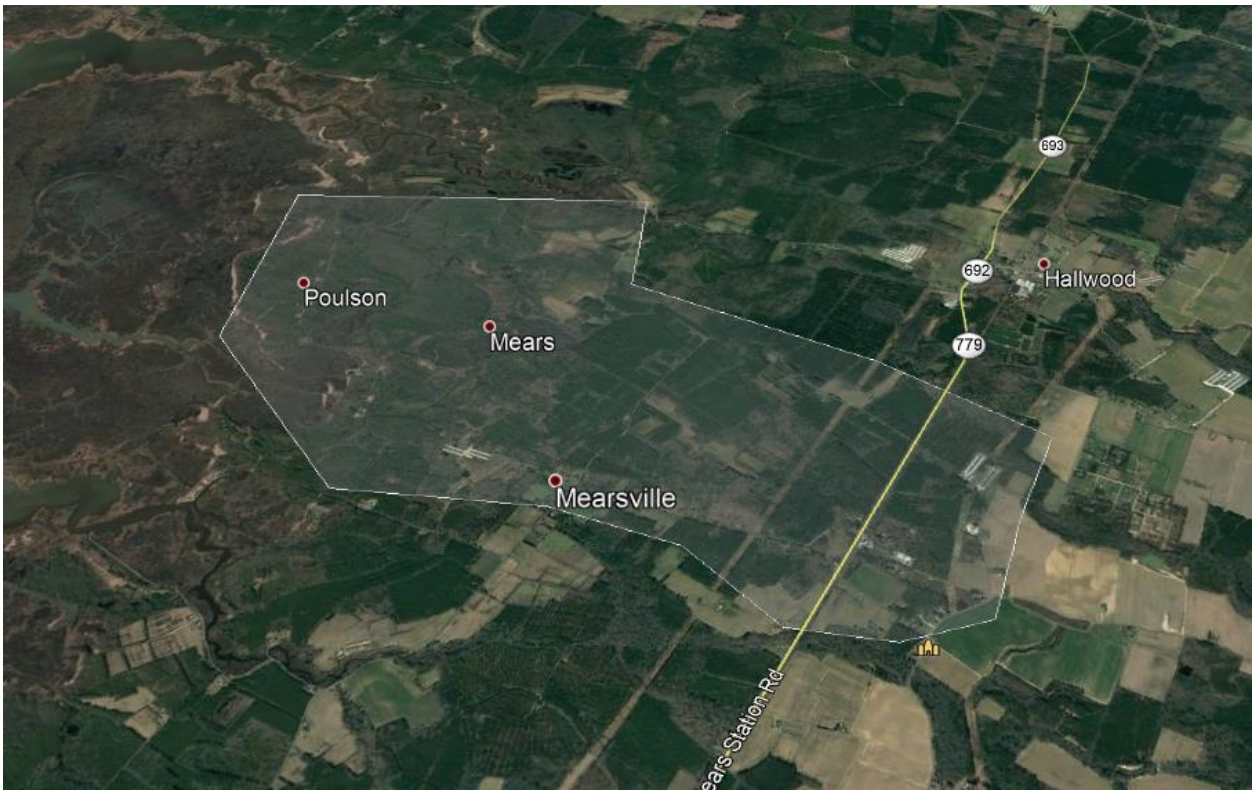

Figure 20 Mears, Virginia 23409 Neubeam Coverage Area (~4.5 square miles) as of 15 April 2021

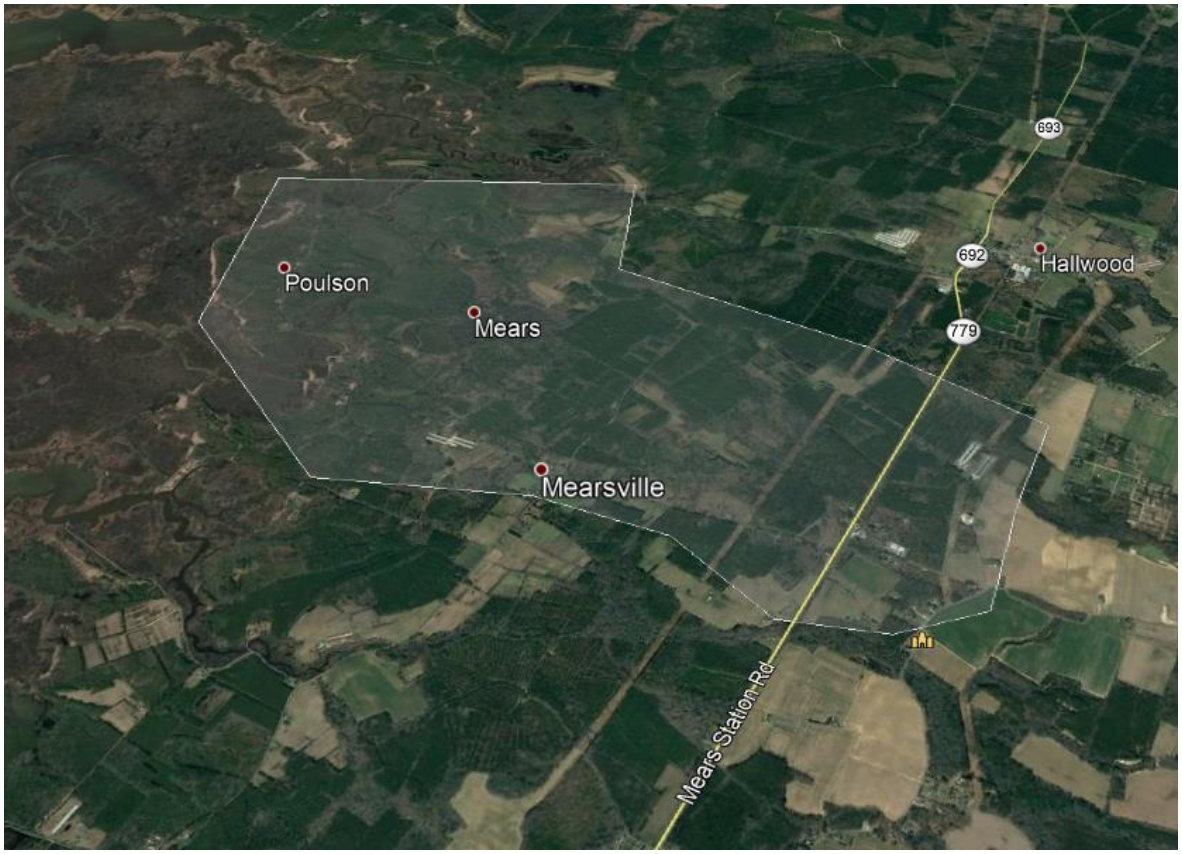

Figure 21 Mears, Virginia 23409 Eastern Shore Communications Reported Coverage Area (~4.5 square miles) as of 15 April 2021

Table 7 Mears, Virginia 23409 Addresses and Reported Coverage by Providers as of 15 April 2021

Mears 23409	ESVBA	Neubeam	ESCC	Charter	Starlink	Verizon	Hughes Net Geo Satellite
13452 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13522 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13684 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13700 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13720 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13740 BETHEL CHURCH RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
12214 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
12969 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13013 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps

Mears 23409	ESVBA	Neubeam	ESCC	Charter	Starlink	Verizon	Hughes Net Geo Satellite
13148 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13231 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13238 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13278 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13337 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13360 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13512 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13543 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13619 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13637 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13654 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13877 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13897 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13969 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
14019 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
14091 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
14115 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
14129 CATTAIL RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
12490 DIVIDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
12492 DIVIDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13124 DIVIDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26041 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26095 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26129 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26153 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26187 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps

Mears 23409	ESVBA	Neubeam	ESCC	Charter	Starlink	Verizon	Hughes Net Geo Satellite
26243 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26257 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26275 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26444 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26482 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26518 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26542 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27161 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27193 GLADDING RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13390 MEARS STATION RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13516 MEARS STATION RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13536 MEARS STATION RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26271 REDINGTON DR		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26322 REDINGTON DR		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27066 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27072 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27073 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27077 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27078 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27091 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27101 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27112 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27113 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27117 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27119 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27124 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps

Mears 23409	ESVBA	Neubeam	ESCC	Charter	Starlink	Verizon	Hughes Net Geo Satellite
27144 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27156 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27168 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27230 TURKEY RUN RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13161 WINTERVILLE RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13166 WINTERVILLE RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
13176 WINTERVILLE RD		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26260 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26508 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
26980 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27030 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27038 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27058 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27060 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps
27302 WHITES XING		5-30 Mbps DSL	10 Mbps FWA		Future		25 Mbps

12 Appendix F - Nassawadox, Virginia 23413 Study Area

Nassawadox, Virginia was surveyed and there were 182 addresses on 16 streets listed by the county for the area. The team survey results for provider coverage are listed **in Table 8 Nassawadox, Virginia 23413 Addresses and Reported Coverage by Providers as of 15 April 2021**. Coverage was good with ESVBA, Neubeam and Charter Spectrum all advertising service for the area. Given the topography and close proximity to Rt 13 we expected good coverage.

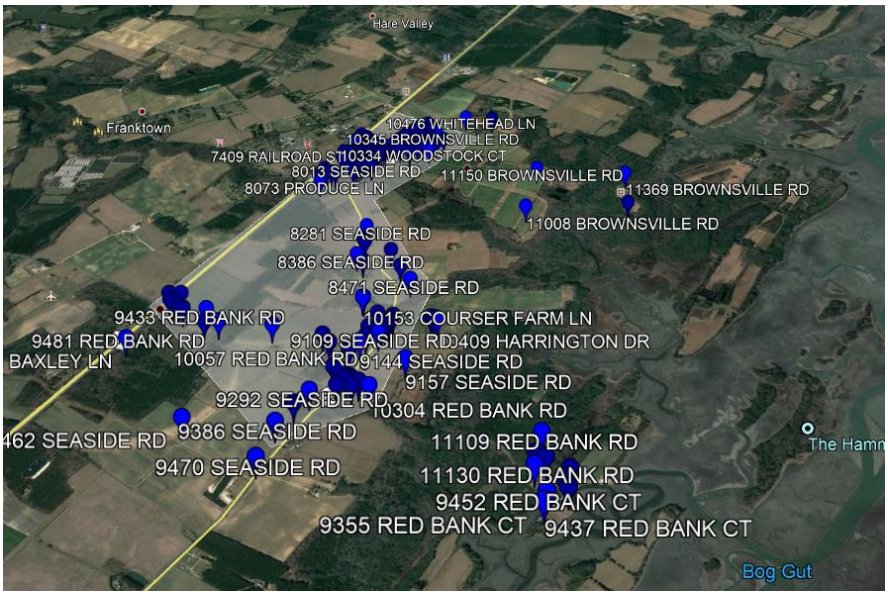

Figure 22 Nassawadox Virginia 23413 Charter Spectrum (4.13 square miles) as of 15 April 2021

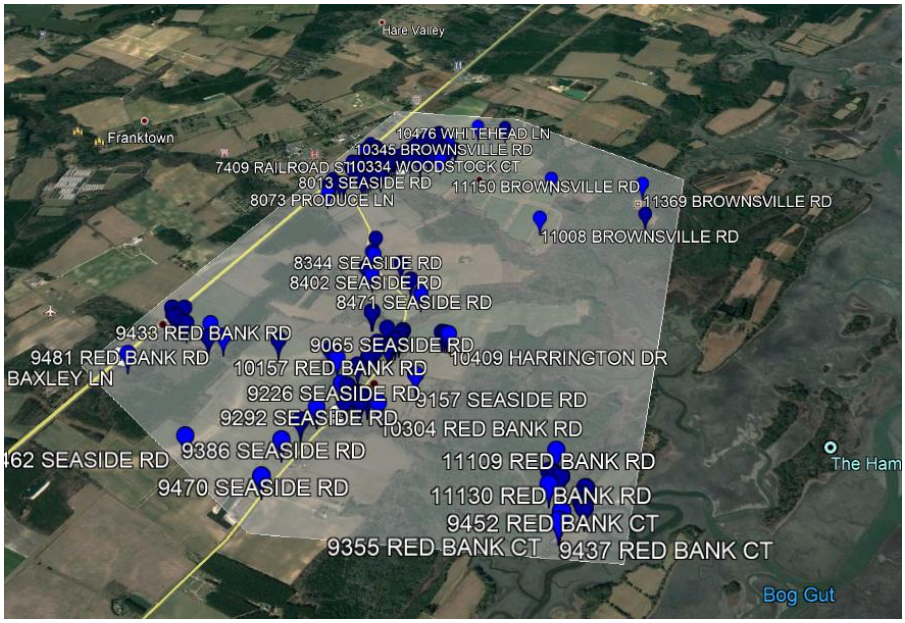

Figure 23 Nassawadox Virginia 23413 ESVBA/Neubeam Reported Coverage (1.33 square miles) as of 15 April 2021

Table 8 Nassawadox, Virginia 23413 Addresses and Reported Coverage by Providers as of 15 April 2021

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
9031 BAXLEY LN		FWA		GIG E account	Future	GeoSat
9133 BAXLEY LN	0.78 miles	FWA			Future	GeoSat
9147 BAXLEY LN		FWA			Future	GeoSat
9205 BAXLEY LN		FWA			Future	GeoSat
10287 BROWNSVILLE RD	.03 miles	FWA		GIG E	Future	GeoSat
10308 BROWNSVILLE RD	0.1 miles	FWA		GIG E	Future	GeoSat
10309 BROWNSVILLE RD	0.08 miles	FWA		GIG E	Future	GeoSat
10319 BROWNSVILLE RD	0.09 miles	FWA		GIG E	Future	GeoSat
10320 BROWNSVILLE RD	0.11 miles	FWA		GIG E account	Future	GeoSat
10333 BROWNSVILLE RD	0.11 miles	FWA		GIG E	Future	GeoSat
10342 BROWNSVILLE RD	0.15 miles	FWA		GIG E	Future	GeoSat
10345 BROWNSVILLE RD	0.13 miles	FWA		GIG E	Future	GeoSat
10372 BROWNSVILLE RD	0.2 miles	FWA		GIG E	Future	GeoSat
11008 BROWNSVILLE RD	0.72 miles	FWA			Future	GeoSat
11150 BROWNSVILLE RD	0.53 miles	FWA			Future	GeoSat
11332 BROWNSVILLE RD	0.94 miles	FWA			Future	GeoSat
11369 BROWNSVILLE RD	0.75 miles	FWA			Future	GeoSat
10208 CHAPEL LN	0.05 miles	FWA		GIG E	Future	GeoSat
7501 COOPER SMITH CT	0.1 miles	FWA		GIG E	Future	GeoSat
7502 COOPER SMITH CT	0.08 miles	FWA		GIG E	Future	GeoSat
7503 COOPER SMITH CT	0.1 miles	FWA		GIG E	Future	GeoSat
7504 COOPER SMITH CT	0.08 miles	FWA		GIG E	Future	GeoSat
7505 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat

[65] Distances listed are the distance from the ESVBA Network Extension obtained from the .kmz Google Earth file from their Request for Proposal (RFP).

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
7506 COOPER SMITH CT	0.1 miles	FWA			Future	GeoSat
7507 COOPER SMITH CT	0.1 miles	FWA			Future	GeoSat
7508 COOPER SMITH CT	0.1 miles	FWA			Future	GeoSat
7509 COOPER SMITH CT	0.1 miles	FWA		GIG E	Future	GeoSat
7510 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7515 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7516 COOPER SMITH CT	0.1 miles	FWA		GIG E	Future	GeoSat
7517 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7518 COOPER SMITH CT	0.1 miles	FWA		GIG E	Future	GeoSat
7519 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7520 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7522 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
7524 COOPER SMITH CT	0.1 miles	FWA		GIG E account	Future	GeoSat
10152 COURSER FARM LN	0.11 miles	FWA			Future	GeoSat
10153 COURSER FARM LN	0.11 miles	FWA			Future	GeoSat
10171 COURSER FARM LN	0.11 miles	FWA			Future	GeoSat
10196 COURSER FARM LN	0.11 miles	FWA			Future	GeoSat
10082 FRANKTOWN RD	0 miles	FWA			Future	GeoSat
10083 FRANKTOWN RD	0 miles	FWA		GIG E	Future	GeoSat
10086 FRANKTOWN RD	0 miles	FWA			Future	GeoSat
10099 FRANKTOWN RD	0 miles	FWA		GIG E account	Future	GeoSat
10117 FRANKTOWN RD	0 miles	FWA		GIG E account	Future	GeoSat
10125 FRANKTOWN RD	0 miles	FWA		GIG E	Future	GeoSat
10371 HARRINGTON DR	0.16 miles	FWA			Future	GeoSat
10383 HARRINGTON DR	0.17 miles	FWA			Future	GeoSat
10395 HARRINGTON DR	0.18 miles	FWA			Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
10409 HARRINGTON DR	0.19 miles	FWA			Future	GeoSat
10142 MILL ST	0.13 miles	FWA			Future	GeoSat
10147 MILL ST	0.08 miles	FWA		GIG E	Future	GeoSat
10150 MILL ST	0.13 miles	FWA			Future	GeoSat
10153 MILL ST	0.08 miles	FWA			Future	GeoSat
10159 MILL ST	0.07 miles	FWA		GIG E	Future	GeoSat
10169 MILL ST	0.06 miles	FWA		GIG E	Future	GeoSat
10179 MILL ST	0.04 miles	FWA		GIG E	Future	GeoSat
8073 PRODUCE LN	0.13 miles	FWA		GIG E	Future	GeoSat
7389 RAILROAD ST	0.14 miles	FWA		GIG E	Future	GeoSat
7401 RAILROAD ST	0.14 miles	FWA			Future	GeoSat
7409 RAILROAD ST	0.14 miles	FWA			Future	GeoSat
9333 RED BANK RD	0.87 miles	FWA			Future	GeoSat
9335 RED BANK RD	0.87 miles	FWA		GIG E	Future	GeoSat
9354 RED BANK RD	0.81 miles	FWA			Future	GeoSat
9355 RED BANK CT	0.8 miles	FWA			Future	GeoSat
9361 RED BANK RD	0.8 miles	FWA			Future	GeoSat
9362 RED BANK RD	0.8 miles	FWA		GIG E	Future	GeoSat
9384 RED BANK RD	0.76 miles	FWA		GIG E account	Future	GeoSat
9396 RED BANK RD	0.74 miles	FWA			Future	GeoSat
9433 RED BANK RD	0.66 miles	FWA			Future	GeoSat
9436 RED BANK RD	0.62 miles	FWA			Future	GeoSat
9437 RED BANK CT	0.94 miles	FWA			Future	GeoSat
9442 RED BANK CT	0.94 miles	FWA			Future	GeoSat
9451 RED BANK CT	0.95 miles	FWA			Future	GeoSat
9452 RED BANK CT	0.9 miles	FWA			Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
9461 RED BANK CT	0.95 miles	FWA			Future	GeoSat
9466 RED BANK CT	0.97 miles	FWA			Future	GeoSat
9481 RED BANK RD	0.57 miles	FWA			Future	GeoSat
10057 RED BANK RD	0.37 miles	FWA			Future	GeoSat
10147 RED BANK RD	0.17 miles	FWA			Future	GeoSat
10157 RED BANK RD	0.13 miles	FWA			Future	GeoSat
10244 RED BANK RD	0.03 miles	FWA			Future	GeoSat
10254 RED BANK RD	0.03 miles	FWA			Future	GeoSat
10264 RED BANK RD	0.03 miles	FWA			Future	GeoSat
10274 RED BANK RD	0.07 miles	FWA			Future	GeoSat
10282 RED BANK RD	0.08 miles	FWA			Future	GeoSat
10304 RED BANK RD	0.13 miles	FWA			Future	GeoSat
11109 RED BANK RD	0.79 miles	FWA			Future	GeoSat
11115 RED BANK RD	0.77 miles	FWA			Future	GeoSat
11125 RED BANK RD	0.79 miles	FWA			Future	GeoSat
11130 RED BANK RD	0.82 miles	FWA			Future	GeoSat
11137 RED BANK RD	0.82 miles	FWA			Future	GeoSat
11183 RED BANK RD	0.93 miles	FWA			Future	GeoSat
11184 RED BANK RD	0.93 miles	FWA			Future	GeoSat
10228 ROGERS DR	0.15 miles	FWA			Future	GeoSat
10248 ROGERS DR	0.11 miles	FWA			Future	GeoSat
10258 ROGERS DR	0.1 miles	FWA		GIG E	Future	GeoSat
10268 ROGERS DR	0.08 miles	FWA		GIG E	Future	GeoSat
10280 ROGERS DR	0.07 miles	FWA		GIG E	Future	GeoSat
10296 ROGERS DR	0.03 miles	FWA		GIG E	Future	GeoSat
7579 SEASIDE RD	0.04 miles	FWA		GIG E account	Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
7595 SEASIDE RD	0.04 miles	FWA		GIG E	Future	GeoSat
7601 SEASIDE RD	0.04 miles	FWA		GIG E	Future	GeoSat
7615 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
7653 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
7667 SEASIDE RD	0.03 miles	FWA		GIG E account	Future	GeoSat
7677 SEASIDE RD	0.03 miles	FWA			Future	GeoSat
7697 SEASIDE RD	0.03 miles	FWA			Future	GeoSat
7709 SEASIDE RD	0.04 miles	FWA		GIG E account	Future	GeoSat
7723 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
7733 SEASIDE RD	0.03 miles	FWA		GIG E account	Future	GeoSat
7739 SEASIDE RD	0.01 miles	FWA			Future	GeoSat
7745 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
7746 SEASIDE RD	0.01 miles	FWA		GIG E account	Future	GeoSat
7755 SEASIDE RD	0.02 miles	FWA		GIG E	Future	GeoSat
7763 SEASIDE RD	0.02 miles	FWA		GIG E	Future	GeoSat
7771 SEASIDE RD	0.02 miles	FWA		GIG E account	Future	GeoSat
7780 SEASIDE RD	0.02 miles	FWA		GIG E	Future	GeoSat
7781 SEASIDE RD	0.02 miles	FWA		GIG E	Future	GeoSat
7792 SEASIDE RD	0.02 miles	FWA		GIG E account	Future	GeoSat
7793 SEASIDE RD	0.01 miles	FWA		GIG E	Future	GeoSat
7810 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
7813 SEASIDE RD	0.02 miles	FWA		GIG E	Future	GeoSat
7820 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
8001 SEASIDE RD	0.01 miles	FWA		GIG E	Future	GeoSat
8007 SEASIDE RD	0.01 miles	FWA		GIG E	Future	GeoSat
8008 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
8013 SEASIDE RD	0.01 miles	FWA		GIG E account	Future	GeoSat
8016 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
8021 SEASIDE RD	0 miles	FWA		GIG E	Future	GeoSat
8024 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
8031 SEASIDE RD	0 miles	FWA		GIG E account	Future	GeoSat
8047 SEASIDE RD	0.01 miles	FWA			Future	GeoSat
8281 SEASIDE RD	0.01 miles	FWA		GIG E account	Future	GeoSat
8337 SEASIDE RD	0 miles	FWA			Future	GeoSat
8344 SEASIDE RD	0 miles	FWA			Future	GeoSat
8386 SEASIDE RD	0.06 miles	FWA			Future	GeoSat
8387 SEASIDE RD	0.06 miles	FWA			Future	GeoSat
8402 SEASIDE RD	0.07 miles	FWA			Future	GeoSat
8461 SEASIDE RD	0.04 miles	FWA		GIG E	Future	GeoSat
8471 SEASIDE RD	0.06 miles	FWA		GIG E account	Future	GeoSat
9049 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9056 SEASIDE RD	0.04 miles	FWA			Future	GeoSat
9059 SEASIDE RD	0.03 miles	FWA			Future	GeoSat
9065 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9073 SEASIDE RD	0.03 miles	FWA			Future	GeoSat
9085 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9095 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9100 SEASIDE RD	0.04 miles	FWA			Future	GeoSat
9109 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9124 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9144 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9157 SEASIDE RD	0.18 miles	FWA			Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
9168 SEASIDE RD	0.04 miles	FWA			Future	GeoSat
9202 SEASIDE RD	0.02 miles	FWA			Future	GeoSat
9226 SEASIDE RD	0.04 miles	FWA			Future	GeoSat
9251 SEASIDE RD	0.03 miles	FWA		GIG E account	Future	GeoSat
9292 SEASIDE RD	0.03 miles	FWA			Future	GeoSat
9332 SEASIDE RD	0.03 miles	FWA		GIG E	Future	GeoSat
9386 SEASIDE RD	0.04 miles	FWA		GIG E	Future	GeoSat
9462 SEASIDE RD	0.33 miles	FWA			Future	GeoSat
9470 SEASIDE RD	0 miles	FWA			Future	GeoSat
10174 SHELL ST	0.07 miles	FWA		GIG E	Future	GeoSat
10178 SHELL ST	0.07 miles	FWA		GIG E	Future	GeoSat
10185 SHELL ST	0.08 miles	FWA			Future	GeoSat
10186 SHELL ST	0.05 miles	FWA		GIG E	Future	GeoSat
10192 SHELL ST	0.05 miles	FWA		GIG E account	Future	GeoSat
10193 SHELL ST	0.07 miles	FWA			Future	GeoSat
10197 SHELL ST	0.07 miles	FWA			Future	GeoSat
10198 SHELL ST	0.04 miles	FWA		GIG E	Future	GeoSat
10211 SHELL ST	0.06 miles	FWA			Future	GeoSat
10475 WHITEHEAD LN	0.03 miles	FWA			Future	GeoSat
10476 WHITEHEAD LN	0.03 miles	FWA			Future	GeoSat
10264 WOODSTOCK CT	0.08 miles	FWA		GIG E	Future	GeoSat
10281 WOODSTOCK CT	0.12 miles	FWA		GIG E	Future	GeoSat
10294 WOODSTOCK CT	0.14 miles	FWA		GIG E	Future	GeoSat
10319 WOODSTOCK CT	0.16 miles	FWA		GIG E account	Future	GeoSat
10334 WOODSTOCK CT	0.21 miles	FWA		GIG E	Future	GeoSat
10345 WOODSTOCK CT	0.16 miles	FWA		GIG E	Future	GeoSat

Nassawadox 23413	ESVBA[65]	Neubeam	ESCC	Charter Spectrum	Starlink	HughesNet
10356 WOODSTOCK CT	0.21 miles	FWA		GIG E	Future	GeoSat
10366 WOODSTOCK CT	0.16 miles	FWA		GIG E	Future	GeoSat
10376 WOODSTOCK CT	0.14 miles	FWA		GIG E	Future	GeoSat

13 Appendix G - Sanford, Virginia 23426 Study Area

Sanford, Virginia was chosen as a study area as the team felt it should have good coverage since spot checks revealed that ESVBA fiber had been pulled out to Saxis, Virginia and it was expected that many of the homes would have good coverage. Charter Spectrum, Neubeam and ESVBA all advertised service to the area.

Figure 24 Sanford, Virginia 23426 Neubeam Coverage Area (~4.2 square miles, 175 homes)

Figure 25 Sanford, Virginia 23426 Charter/Spectrum Coverage Area (~1.8 square miles, 162 homes)

Figure 26 Sanford, Virginia 23426 Eastern Shore of Virginia Broadband Authority (ESVBA) Coverage Area (~1.1 square miles, 153 homes)

Table 9 Sanford, Virginia 23426 Addresses and Coverage Reported by Provider as of 15 April 2021

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
23491 BAILEY LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23487 BAILEY LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24011 BAILEY LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
9101 BELINDA LN		5-30 Mbps	100-940 Mbps		Future		GeoSat
9131 BELINDA LN		5-30 Mbps	100-940 Mbps		Future		GeoSat
9139 BELINDA LN		5-30 Mbps	100-940 Mbps		Future		GeoSat
23129 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
23169 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
23387 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
23483 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
23593 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
24031 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
24045 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
24261 BELINDA RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
7445 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
7450 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
7470 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
8020 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
8062 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
8145 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
8152 FLAG POND RD		5-30 Mbps	100-940 Mbps		Future		GeoSat
8360 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
8372 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
8382 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9018 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9034 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9084 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9100 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9116 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
9144 MARSH MARKET RD	10-100 Mbps Fiber	5-30 Mbps			Future		GeoSat
7441 MATTHEWS RD		5-30 Mbps			Future		GeoSat
7448 MATTHEWS RD		5-30 Mbps			Future		GeoSat
8083 MATTHEWS RD		5-30 Mbps			Future		GeoSat
20819 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
22513 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23136 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23144 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23194 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23199 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
23218 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23223 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23226 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23231 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23241 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23242 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23249 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23250 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23256 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23262 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23265 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23270 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23273 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23276 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23279 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23288 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23296 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23297 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23305 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23308 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23319 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23320 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23326 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23335 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23338 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23349 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
23356 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23372 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23396 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23406 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23415 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23424 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23437 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23451 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23467 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23474 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23481 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23482 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23499 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23505 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23506 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23514 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23515 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23522 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23523 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23527 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23532 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23533 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23543 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23548 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23551 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23558 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
23561 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23568 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23571 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23580 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23589 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23592 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23621 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23624 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23633 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23640 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23644 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23645 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23653 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23661 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23668 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23673 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23683 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23684 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23699 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23700 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23709 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23710 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23718 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23727 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23742 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
23751 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
23759 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24045 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24103 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24107 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24151 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24152 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24179 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24199 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24226 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
24312 SAXIS RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
7314 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
7321 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8176 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8179 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8197 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8211 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8220 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8235 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8242 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8252 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8255 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8262 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8270 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8282 SHAD LANDING RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
9017 SNYDER LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
9026 SNYDER LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
9041 SNYDER LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8373 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8374 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8379 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8380 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8396 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8412 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8422 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8426 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8430 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8432 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8434 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8448 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8457 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8458 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8473 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8477 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8478 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8493 SUGARHILL LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8107 TALL PINES LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8124 TALL PINES LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8193 TALL PINES LN	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8074 WAYNES DR	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8078 WAYNES DR	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8084 WAYNES DR	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8382 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

Sanford 23426	ESVBA	Neubeam	Charter	ESCC	Starlink	Verizon	HughesNet
8394 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8410 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8417 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8429 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat
8439 WHITES RD	10-100 Mbps Fiber	5-30 Mbps	100-940 Mbps		Future		GeoSat

14 Appendix H - Charter Spectrum Presence in the Four Study Areas

While we did not have time to research all of the providers, and especially Charter Spectrum, from the four towns we did survey, we found that if there is a concentration of homes Charter Spectrum was likely to serve them. One concern we have is that the plan is to use a fiber/coax cable combination service leveraging DOCSIS 3.1 which is somewhat proprietary to Charter Spectrum and different from what the other providers on the Eastern Shore use; this could make switching providers in the future expensive. We draw the following conclusion.

- Assawoman – Charter Spectrum presence is limited to three streets – a portion of Atlantic Road that services 5 homes and we assume their backbone feed is coming from, Maple Drive and Holly Acres Lane where 20 receive service. Charter Spectrum services 25 of the 61 homes listed in Assawoman and only 0.1 square miles out of the nearly 2.83 square miles we saw service in.

Figure 27 Assawoman, Virginia 23302 Coverage (25 Homes/0.1 square miles) by Charter Spectrum as of 15 April 2021

- Mears – Charter Spectrum provides no service in Mears. Mears has no density of homes like those, for example, on Maple Drive/Holly Acres in Assawoman. Most homes in Mears are spread out on the 8 separate roads.
- Nassawadox – Charter Spectrum had a presence on 13 of the 15 roads in Nassawadox. We note that Nassawadox is adjacent to Rt 13. There were competing services such as ESVBA and Neubeam in the area and we note Charter Spectrum's has had apparent success compared to those lower priced offerings.

Figure 28 Nassawadox, Virginia 23413 Coverage (90 Homes/1.33 square miles) by Charter Spectrum as of 15 April 2021

- Sanford – Sanford is on the road leading to Saxis and has 13 roads within it and of those roads Charter Spectrum had available service on 11. Of the 174 addresses, 94 were on Saxis Road, 18 on Sugarhill Lane, 14 on Shad Landing, 11 on Belinda Lane, 7 on Flag Pond, 6 on Whites Drive, 3 on Bailey's Lane, 3 on Snyder Lane, 3 on Tall Pine, and 3 on Wayne's Drive 3. Charter Spectrum did not cover the 9 homes on Marsh Market or the 3 on Matthews Road. For Sanford, Neubeam featured the widest coverage, followed by Charter Spectrum and then followed by the ESVBA. Charter Spectrum did branch out off the main road to cover Belinda Lane, Belinda Road and Flag Pond Road which we found commendable.

Table 10 Analysis of Charter Spectrum Coverage in the Study Areas

	Area in Square Miles	Spectrum Area Coverage in Square Miles	Percent of Area Covered	Total Homes	Homes with Spectrum Service Potential	Percent Covered
Assawoman 23302	**2.81**	**0.1**	**3%**	**60**	**25**	**41%**
Mears 23409	**4.47**	**0**	**0%**	**77**	**0**	**0%**
Sanford 23426	**4.14**	**1.78**	**42%**	**174**	**162**	**93%**
Nassawadox 23413	**4.13**	**1.33**	**32%**	**182**	**90**	**49%**

15 Appendix I – Accomac and Northampton County Key Locations and Distance to Adjacent Populated Areas and Rt 13 Internet Cabling

For much of Accomac and Northampton Counties, many areas are less than 5 miles or less from Rt 13. Rt 13 is the major transportation artery that goes from Maryland down to the Bay Bridge tunnel. The ESVBA fiber is located adjacent to Rt 13. Some sample distances are shown in **Table 11 Selected Towns Adjacent to Rt 13 and Respective Distances from the Populated Chesapeake Bay and Atlantic Ocean Areas**

Table 11 Selected Towns Adjacent to Rt 13 and Respective Distances from the Populated Chesapeake Bay and Atlantic Ocean Areas

Town	Distance to Rt 13	Distance to Bay[66]	Distance to Atlantic[67]
New Church	0	10	5.27
Oak Hall	0	4.77	4.38
Temperanceville	0	7.35	3.20
Mappsville	0	4.53	2.55
Nelsonia	0	4.10	2.70
Gargatha	0	4.64	2.70
Metompkin	0.64	5.93	1.87
Greenbush	0	5.03	4.80
Tasley	0.27	5.43	4.78
Onley	0.30	6.80	4.83
Melfa	0	6.64	4.63
Keller	0	7.25	4.31
Painter	0	7.52	3.95
Belle Haven	0.76	7.27	3.85
Exmore	0	6.39	4.18
Franktown	1.19	5.67	2.01
Birdsnest	0	4.80	1.69

[66] Distance measurement terminated at marshland or other uninhabitable point
[67] Distance measurement terminated at marshland or other uninhabitable point

Town	Distance to Rt 13	Distance to Bay[66]	Distance to Atlantic[67]
Machipongo	0	4.54	1.29
Eastville	0.46	3.09	2.04
Simpkins	0.41	3.39	2.00
Cheriton	0.38	2.15	2.68
Capeville	0.63	2.5	1.5

16 Appendix J - FCC 477 Data for Accomac and Northampton Counties

In a search of the FCC 477 database on 02 April 2021, there were 30,201 entries. The results by provider are listed in the table below.

Table 12 Summary of FCC Filings for Accomac and Northampton Counties

Provider ID	Provider Name	Holding Company Name	Census Block FIPS Code	Technology Code	Comment	Count
53788	Level 3 Communications, LLC	CenturyLink, Inc.	5.10011E+14	50	Commercial Service to Wallops	**2**
54009	Eastern Shore of Virginia Broadband Authority	https://apps2.fcc.gov/form477/login.xhtml	5.10011E+14	43	ESVBA providing Charter Connectivity	**1**
54076	MCI Communications Corporation	Verizon Communications Inc.	5.11319E+14	43	MCI/Verizon - Charter	**18**
54400	XO Communications Services, LLC	Verizon Communications Inc.	5.11319E+14	43	XO - Charter	**2**
54694	HNS License Sub, LLC	Hughes Network Systems, LLC	5.11319E+14	43	HNS - Charter	**1**
54694	HNS License Sub, LLC	Hughes Network Systems, LLC	5.10011E+14	43	HNS - Comcast	**5**
54694	HNS License Sub, LLC	Hughes Network Systems, LLC	5.10011E+14	43	HNS - Cox	**2**
54694	HNS License Sub, LLC	Hughes Network Systems, LLC	5.10011E+14	60	HNS - GCI	**4711**
54895	PAETEC Communications, Inc.	Windstream Holdings, Inc.	5.11319E+14	60	PAETEC - GCI	**4**
55262	VSAT Systems, LLC	VSAT Systems, LLC	5.11319E+14	60	Skycasters - GCI	**392**

Provider ID	Provider Name	Holding Company Name	Census Block FIPS Code	Technology Code	Comment	Count
55262	VSAT Systems, LLC	VSAT Systems, LLC	5.10011E+14	60	Skycasters - HNS	**4716**
55396	Bloosurf	Pocomoke Holdings	5.11319E+14	60	Bloosurf - HNS	**392**
55396	Bloosurf	Pocomoke Holdings	5.10011E+14	11	Bloosurf - Windstream	**4**
55396	Bloosurf	Pocomoke Holdings	5.10011E+14	10	Bloosurf - Verizon	**497**
55574	COMCAST CABLE COMMUNICATIONS, LLC	Comcast Corporation	5.10011E+14	10	Comcast - Verizon	**5**
56004	ViaSat, Inc.	ViaSat, Inc.	5.10011E+14	10	ViaSat - Verizon	**1816**
56004	ViaSat, Inc.	ViaSat, Inc.	5.10011E+14	70	ViaSat - ESCC	**32**
56004	ViaSat, Inc.	ViaSat, Inc.	5.10011E+14	70	Pocomoke Holdings and Viasat	**892**
56004	ViaSat, Inc.	ViaSat, Inc.	5.10011E+14	60	ViaSat - ViaSat	**3727**
56539	Verizon Virginia LLC	Verizon Communications Inc.	5.10011E+14	60	Verizon - ViaSat	**2297**
57713	Eastern Shore Communications, LLC	Eastern Shore Communications, LLC	5.11319E+14	60	ESVBA - ViaSat	**31**
57821	Chesapeake Bay Communications	Chesapeake Bay Communications, LLC	5.11319E+14	60	CBC - ViaSat	**10**

Provider ID	Provider Name	Holding Company Name	Census Block FIPS Code	Technology Code	Comment	Count
58623	Charter Communications, Inc.	Charter Communications	5.11319E+14	60	Charter - ViaSat	**400**
58623	Charter Communications, Inc.	Charter Communications	5.10011E+14	50	Charter - ESVBA	**2533**
58623	Charter Communications, Inc.	Charter Communications	5.10011E+14	60	Charter - VSAT	**8**
59258	Virginia Broadband, LLC	Virginia Broadband, LLC	5.10011E+14	60	Va Broadband - VSAT	**7**
59349	GCI Communication Corp.	GCI Holdings LLC	5.10011E+14	60	GCI - VSAT	**5092**
59349	GCI Communication Corp.	GCI Holdings LLC	5.1002E+14	70	GCI - Va Broadband	**7**
59349	GCI Communication Corp.	GCI Holdings LLC	5.10011E+14	70	GCI - Chesapeake Bay	**10**
61674	Declaration Networks Group, Inc	Declaration Networks Group, Inc.	5.10011E+14	70	Neubeam - Neubeam	**2587**
					Total Connections	**30201**

17 Appendix K -Acronyms and Abbreviations

AGL	Above Ground Level
ANEC	Accomac and Northampton Electric Cooperative
AT&T	American Telephone and Telegraph
BGES	Beekeepers Guild of the Eastern Shore
CBES	Citizens for a Better Eastern Shore Non-Profit Organization
dBi	decibel isotropic; forward gain of an antenna measured on a logarithmic scale
dBm	Unit to indicate power level expressed in decibels with reference to one milliwatt.
DSL	Digital Subscriber Loop; outdated services that uses multiple frequencies on Plain Old Telephone System (POTS) copper wires to transmit and receive data.
ESCC	Eastern Shore Communications Corporation
ESVBA	Eastern Shore of Virginia Broadband Authority
FCC	Federal Communications Commission
FCC 477	Online Broadband data collection mechanism managed by the FCC
FTTH	Fiber to the Home
FWA	Fixed Wireless Access
GBps	Giga Bits Per Second; Giga is equivalent to a billion.
GCI	General Communication Inc. is a telecommunications corporation operating in Alaska.
Ghz	Gigahertz; 1000 MHz
GIS	Geographic Information System
HNS	Hughes Network Systems; satellite communications provider
HPM	Houses Per Mile; term used in VITA application to show coverage (Total Miles/Passings=HPM)
ITM	Irregular Terrain Model, also referred to as Longley-Rice
Km	Kilometer
KML	Keyhole Markup Language GIS file designator
KMZ	KML compressed GIS file designator
LLC	Limited Liability Corporation
Mbit	Mega bit or 1 million bits
MBps	Mega Bits per second where Mega is equivalent to 1 million
MCI	Microwave Communications Incorporated; Telecommunications company now part of Verizon
MHz	Megahertz or one million cycles per second
Ms	Millisecond or 1000^{th} of a second

NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information Service
NLOS	Non-Line of Sight
NOAA	National Oceanic and Atmospheric Administration
OEM	Original Equipment Manufacturer
POTS	Plain Old Telephone System
PTP	Point-to-Point
RF	Radio Frequency
RFP	Request for Proposal
RFTH	RF to Home
RUS	Rural Utilities Service
TCOM	Telecommunications; Graduate class designation at George Mason University
UG	Underground (miles)
VATI	Virginia Telecommunications Initiative; grants for telecommunications initiatives
VSAT	Very Small Aperture Terminal; satellite communications
Watts	Unit of power defined as a derived unit of 1 $kg \cdot m^2 \cdot s^{-3}$ or 1 joule per second.
WFF	Wallops Flight Facility