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FIBER AND BROADBAND

Houston-Galveston Area Council

BROADBAND STUDY FINAL REPORT

Ken Demlow

11011 Richmond Ave. #200,
Houston, TX 77042
Main: 719.300.4140 + **Direct:** 720.602.4814
kdemlow@hrgreen.com

EXECUTIVE SUMMARY

The leadership of the Houston Galveston Area Council and the Gulf Coast Economic Development District took an important step in recognizing the need for and making the financial arrangements to complete this regional broadband study. Broadband (for a definition of "broadband" and other telecommunications industry terms, please see the Glossary of Terms in Appendix A) plays a key role in many aspects of people's lives and in how our communities function and deliver services. Understanding broadband strengths and weaknesses and having plans for broadband improvements are particularly relevant at this critical time.

As an essential tool for communication, education, and commerce the internet permeates many aspects of our everyday lives. Reliable and high-speed broadband connectivity is crucial for businesses, schools, and individuals alike, as it enables access to online resources and information, which is necessary to remain competitive and stay informed in today's fast-paced world.

The COVID-19 pandemic also highlighted the importance of broadband access. With more people working from home and relying on the internet for remote work and education, the need for reliable and high-speed broadband has become even more critical. Since the pandemic, access to broadband has become necessary for telecommuting, telemedicine, online learning, social interaction, and much more.

The lack of broadband infrastructure can also have a significant impact on the economic development of a community and a region. Areas without reliable and high-speed broadband may struggle to attract new businesses or maintain existing ones. Broadband access is essential for businesses to remain competitive, as it allows them to reach a wider audience and access online tools and resources. In addition, areas without broadband infrastructure may struggle to attract and retain young people, who increasingly rely on the internet for work, education, and socializing.

Overall, broadband access is necessary for the economic development and social well-being of every person, each community and the entire region. The lack of broadband infrastructure can result in significant economic and social consequences, making it imperative that efforts are made to improve broadband access and connectivity.

Additionally, the federal government is making a historic investment in expanding broadband infrastructure. This study will help communities prepare to apply for an unprecedented amount grant funds through multiple agencies. There are dollars from the American Rescue Plan Act (ARPA), the United States Treasury (capital projects grants), Federal Infrastructure Bill (the Broadband Equity, Access, and Deployment (BEAD) program, the State of Texas Technical Assistance Program (TAP) and dollars that the State of Texas might allocate. Some of these grant programs have had deadlines that have already passed, but the majority of the money has not had the rules of their program defined or implemented. TAP will likely be offered in the Spring of 2024 and BEAD grant windows will open in 2024.

The BEAD program alone is approximately $42 billion. Texas has been notified that the State will receive over $3B. The timeline of this program has not been finally defined, but the rules, grant windows and distribution schedule should be set and communicated in 2024. The State Legislature of Texas has also been discussing providing more State dollars to increase the amount available for grants to improve broadband in Texas.

The timing of this study is important to determine which areas within H-GAC's thirteen counties could be eligible for grants and if there are digital equity issues (which could be access or adoption related) which could also be eligible for their category of grants. Communities could be eligible for grant funds if the State's data indicates that these areas lack either broadband infrastructure or sufficient internet speeds. Those areas that do not match the State's eligibility criteria will be unable to receive broadband funding. There

could be communities that match with eligibility determinations the State has already made. There could also be areas which show up as ineligible in the State's data but reflect eligible in local data. For those, there should be the possibility of a challenge process for the communities to ask that the eligibility status be changed. Lastly, if there are areas that are eligible or could be eligible through a challenge, the communities will need to decide who the grant applicant would be (the City, a private provider or another organization).

THE CHALLENGES IN UNDERSTANDING AND IMPROVING BROADBAND

Knowing the actual strengths and weaknesses of broadband in a community can be challenging. Not all communities in H-GAC's area have the resources and personnel to take the steps necessary to define and clearly understand the broadband strengths and weaknesses in their area. There are multiple steps to take and decisions that have to be made and those all take expertise, time and resources. H-GAC's and GCEDD's vision to secure funding for and lead this broadband study process have been a significant step to make the needed analysis possible.

In addition to the challenge of time and resources needed to study broadband, there are actual factors within the broadband industry that can make the process difficult. For example, data points come from different sources and they often do not agree. Some have been shown to be inaccurate. Also, there are some people and businesses who express their frustration with their connectivity, but there are probably many who do not. Moreover, some broadband issues are related to a lack of infrastructure (or inadequate infrastructure) referred to as "Access" (see the Glossary in Appendix A) while some people do not or cannot utilize broadband infrastructure that is available to them (referred to as "Adoption" – see the Glossary in Appendix A).

Without fully understanding specific community-level broadband challenges, it could be difficult to develop a high-quality, comprehensive plan which addresses the unique needs of communities across the 13-county H-GAC region. This study utilizes a proven process that HR Green has developed to explore the specifics of broadband access and potential adoption challenges in each of the counties. Also, this study culminates in recommendations and actionable steps to improve the detailed broadband concerns that have been found and documented.

The focus of the Broadband Study is to:

- Find out where there are broadband concerns (access or adoption) through a survey of the thirteen-county area and stakeholder meetings.
- Provide information sessions related to specific topics.
- Develop options for improving broadband in areas where there are broadband concerns.
- Work with digital equity agencies to develop options for grant projects.
- Further develop relationships with the providers in the area.
- This Executive Summary contains an overview and recommendations. The remainder of this report provides the detailed information gathered during this study that supports these findings and recommendations.
- To complete these goals, the following steps were collaboratively developed with H-GAC staff:
- Develop an Engagement Plan to lead the survey, survey promotion and stakeholder meetings.
- Create survey promotion materials.
- Build a GIS data repository (including other datasets) and survey results.

- Create a survey and survey portal.
- Perform a market assessment per county that shows the coverage reported by the providers in each county (taken from their Form 477 reporting – for an explanation of 477 reporting please see the Glossary in Appendix A).
- Create contact lists of each working group.
- Lead meetings of the Working Groups (Promotions, Education, Chambers of Commerce, and Digital Equity).
- Conduct meetings with Internet Service Providers (ISPs) – see definition of ISP in the Glossary in Appendix A.
- Conduct meetings with key stakeholders.
- Develop a path for digital equity efforts.
- Create plans for each county to improve broadband.

KEY FINDINGS

The data gathered in the survey and in the stakeholder/working group meetings provides the following findings:

- There are broadband issues in the H-GAC region. This is not a surprise, but it is important that the areas in which there are broadband challenges are now more clearly defined. There are areas that show good broadband coverage, but there are areas within which coverage is problematic. The FCC has defined minimum broadband speeds (to be considered broadband) to be 25 Megabits Per Second (Mbps) download speed (dowloading from the internet) and 3 Mbps upload. In March 2024, the FCC updated those minimum numbers to 100/20, recognizing that to adequately utilize the internet, 25/3 was no longer sufficient. There are connectivity issues in both urban and rural areas.
- There are areas that should be eligible for grants. Coordination of who will apply for those grants and ensuring all areas with connectivity issues apply for grants and have a broadband improvement plan is very important in the BEAD era. With this being the largest amount of grant money being allocated for broadband (in history and most likely in the future), if counties and cities do not work on broadband improvement now, they could be left behind. Furthermore, as technology continues to rapidly advance, the digital divide will grow wider.
- In the more rural counties, in general, the survey results are in fairly close alignment with the FCC Fabric data. Where the FCC Fabric data shows unserved or underserved by terrestrial infrastructure (for a definition of this topic, see the Glossary in Appendix A), the survey often agreed with the reported data shown in the FCC fabric.
- In more populous counties, the agreement between the FCC Fabric data and what the survey results showed is not as consistent.
- The technology defining the adequacy of the connectivity in most of the H-GAC area is a critical factor to understand. Fiber is the most future-proof technology and also has the greatest capacity within the current technology options. There is fiber in the H-GAC study area, but there are significant portions of the study area that do not have much fiber.
- The question that arises from the previous bullet point regarding technology is what technologies will be considered ineligible for grants. For example, it appears that satellites will not be eligible for BEAD grants. Even if they report being able to provide 100/20 speeds, it seems like they will not be eligible

for BEAD grants. Fixed Wireless also faces a similar question. It is considered terrestrial, but it is not wireline. There are questions as to whether this technology will be eligible for grants. DSL and cable face questions regarding proximity to equipment (is there a distance at which service is not adequate and, therefore, should be eligible?).

- Digital equity is an issue in the H-GAC study area. This concern is prominent in both rural and urban areas but can take different forms in each of those densities. The most consistent findings are that rural areas are facing a lack of infrastructure, and urban areas are confronted with challenges that citizens have in accessing existing infrastructure. However, there do appear to be rural areas within which citizens have infrastructure, but they have challenges accessing what is there, and there are urban areas that have not had infrastructure built to them.
- Leaders and citizens realize broadband is an important topic, but it appears that there are challenges to addressing connectivity issues. Survey fatigue seems to be very real across the country and in the study area. Leaders and citizens have a plethora of issues they are dealing with, and although broadband is important, it is competing with many concerns leaders and citizens are dealing with. Broadband is also a complex topic with different technologies and stakeholders, so navigating those factors can be time and energy consuming. These challenges manifested in this study in different forms regarding survey results, meetings and information exchanges. Those challenges are existing realities. The data needed to formulate meaningful study results was achieved, but these challenges do show issues to overcome to address broadband problems. Recognizing that there is a small window to take action over the next year is important to make sure counties and cities do not get left behind.
- During the course of this study, an announcement was made that the funds that were allocated for the Affordable Connectivity Program (ACP) would all be distributed in April of 2024. Enrollment for the program would end in February and payouts would end in April. This poses a significant problem for broadband connectivity. The ACP was put in place to help low income families afford broadband by arranging for a lower cost for several broadband related components. Nationally, 23 million people utilized the program, including more than 1.7 million in Texas and over 300,000 across our region. Even if the internet is available, if a person or family cannot afford to pay the cost, it is counterproductive and may only furher the digital divide.

RECOMMENDATIONS

Based on these findings, to continue to improve broadband in the H-GAC thirteen counties, HR Green provides the following recommendations:

- **Map challenges**. Although a significant amount of the survey results agreed with the FCC Fabric data, there could still be challenges. Counties and cities would be well served to look at their survey results as compared to the fabric data to see if they “feel right”. If community leaders know there are broadband connectivity challenges that are not shown in the maps, more work needs to be done to gain the data necessary to challenge. There are steps communities can take to get more data, for example arranging door-to-door questions in areas that seem incorrect or a community meeting in those areas to ask those questions. If there is something in a map that does not seem right (particularly an area that needs grant dollars but is not currently eligible) it will take data to correct those maps.
- **Decisions and coordination regarding who will apply for grants**. Assuming that all areas that have inadequate broadband will have grant applications and improvement plans is unlikely. Providers will likely evaluate options that make business sense to them, but rarely does a provider have all of the information and capital needed to develop wholistic plans that cover all citizens and businesses. Most often, there is a patchwork that is collaboratively developed if infrastructure is to be built to all citizens and businesses in need. That patchwork usually needs a leader if it is going to happen. That can be an excellent role for the public sector.

- **Decisions regarding whether middle mile is needed and who will build it** (for further definition of these terms, see the Glossary in Appendix A). Middle mile is usually the "transport" between areas or networks that enables them to be part of the larger internet. It often does not make sense for a private provider to build a lot of middle mile because it has fewer retail customers (the most customers are in what is called the "last mile" – which is the network build to the service addresses). Because of those economic considerations, the payback for middle mile can be significantly longer than last mile builds. There can be payback (last mile providers leading middle mile), it just is a longer timeframe. Middle mile can be an important role for regional entities, counties and cities to provide. Those organizations are not trying to maximize profit and their funding mechanisms are used to longer-term payback. If there is middle mile needed (which there very likely will be in several counties), deciding who will build that and initiating that process is often the first step to improve broadband. In the High-Level Design section of this report, a middle mile ring has been designed for each county, including the costs to build. The first step is to determine middle mile need. The next step is to assess the level of provider interest and participation in the middle mile project. The final step would be to complete arrangements, conduct engineering and feasibility assessments, and begin building the middle mile infrastructure..
- **Decisions about who will build last mile**. Similar to grant applications and middle mile development, communities must coordinate who will build the last mile to areas with broadband needs. This is highlighted in a separate recommendation to underscore the importance of a detailed last mile analysis to ensure broadband infrastructure is laid out appropriately and reaches its targeted recipients.
- **Define Digital Equity projects for grant applications**. Improving digital equity issues is also a complex task that takes coordination. The goal is to develop a plan that realistically addresses digital equity issues that includes projects that can seek BEAD grant dollars. There are good steps that have been taken and that are moving forward. As part of this study, organizations who work with people who might have challenges to utilizing available broadband services (most commonly language, economic and age) have been brought into a working group that could continue to work together to develop steps to address digital equity. Also, in collaboration with the Federal Reserve Bank of Dallas and other key partners across the 13-county region, H-GAC has taken a leadership role in a regional work group, the Gulf Coast Digital Inclusion Task Force, to address digital equity issues. Goals and next steps for these groups should be developed that can address digital equity in the study area and form grant fundable projects.
- **The Affordable Connectivity Program (ACP).** There is more detail about Digital Equity and the ACP in the Digital Equity Section of this report. This program has been a key component of digital inclusion and is set to end in April 2024. It has been one of the main ways to help those with economic challenges to utilize existing broadband services. The consequences of losing this program will very likely be significant. It is unclear what options are being considered at the national and state levels, but regional organizations counties and cities should consider ways to address this upcoming concern.
- **Policies**. It is important for counties and cities to evaluate their policies and permit procedures to ensure they meet their broadband goals. All communities are either working to attract broadband or to manage it (and often both). If a community desires to attract broadband, but policies deter investment from providers, that should be brought into alignment. Other communities have multiple broadband providers and need to manage available Right of Way (ROW). Both are important goals, the significant issue is that policies match those goals instead of working against them.
- **Permitting**. One factor that needs to be considered by county and city leaders is that the influx of dollars for broadband will lead to a higher volume of permits and inspection. Each county and city should think through the broadband needs in their areas and the potential number of permits that may be required to meet those needs. They should consider the increased demand that may be placed on staff and processes and plan accordingly.

- **TAP program**. The State of Texas Broadband Development Office (BDO) will be opening a grant window for communities to access technical assistance grant dollars. If counties or cities need further steps in broadband improvement planning and to prepare for grants, there will be competitive grants available. HR Green is on the team that was selected to provide consulting services for the TAP program and is available to help H-GAC broadband study participants apply for those grants.

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ECONOMIC IMPACTS OF BROADBAND STRENGTHS AND WEAKNESSES

The internet's impact on many aspects of the quality of our lives has become very clear during and after the Pandemic. Education, work from home (and home-based businesses), telemedicine, seniors being able to stay in their homes, young people staying in the area they where they grew up, etc. can be greatly affected by the quality of internet connectivity.

Good broadband can also have important impacts on communities. Good connectivity can help community leaders improve the delivery and options of the services they offer. As was discussed in the Smart Connectivity focus meeting in this study, good broadband can provide the platform for applications that can improve safety including examples of communications, sensors, cameras and intelligent traffic management. There can also be applications that provide efficiency for government and citizens like parking monitoring, railroad crossing notifications, leak detection, etc.

There are also communities that have used world class broadband as a factor that brands them. For example, business parks, tech districts, startup clusters, participatory government, data analytics, etc. are all ways that communities can define their image for the entire community or specific areas.

In understanding potential impacts of connectivity, it can be helpful to define "good broadband". It should contain:

- Broadband infrastructure in place that has speeds that can accommodate the needed capacity. The FCC has provided the minimum definition of "broadband" as 25 Mbps download speed and 3 Mbps upload. These are the current minimum speeds to even be considered broadband. Good broadband or broadband that can have a significant positive impact would need to be much higher than that minimum threshold.
- Broadband infrastructure in place that has low latency.
- Service plans that are affordable.
- Programs to help people overcome obstacles to utilizing available broadband (language, economic, age, etc.).

There can also be fairly direct economic impacts of sub-standard versus good internet connectivity.

INCREASING GDP

One challenge that economists have had over the last twenty years was how to measure the economic impact of broadband improvement. We can identify certain quality of life factors like how many people access the internet in the library, request a hot spot or how many cars are in school parking lots for children to do their homework. However, the overall economic impacts can be more difficult to define.

There have been significant studies that have been conducted that do provide important insights. One study that is frequently referenced is "The Evidence Suggests Gigabit Broadband Drives GDP" by the Analysis Group. The full study can be found in Appendix D (and at this website address: https://www.analysisgroup.com/globalassets/content/insights/publishing/gigabit_broadband_sosa.pdf). In this study, Analysis Group determined that broadband could increase GDP by 1.1% in local economies. That might sound like a small number, but when applied to full county economies the implications can be significant.

The chart below that shows each county, its GDP (as is reported by the St. Louis Fed in their website: https://fred.stlouisfed.org/series/GDPALL48473) and the implications of a 1.1% increase in GDP. The

numbers are staggering. This seemingly small increase would translate to a $64B increase in GDP for the region. The implications for individual counties are surprising as well.

These numbers might not be completely accurate, depending on when gigabit service is available and how much of an area is already served by this level of speed, but the numbers do reflect some level of GDP growth that is possible and they are large enough that even a portion of these increases would be significant.

Moreover, the eligibility maps do show a difference between eligible (less than 100 Mbps download/20 Mbps upload) and gigabit connectivity. Ultimately, communities could experience tremendous economic impact by increasing internet speed, capacity, and access.

As the report indicates, these increases come from several sources, including "…productivity growth, facilitating innovation, creating jobs and raising incomes (taken from the introduction of the study)". There can be other economic impacts, also, but GDP growth is an important factor in the consideration of how important good broadband is.

POTENTIAL GDP INCREASE – H-GAC COUNTIES

	GDP	*1.1%	New GDP
Austin	$2,041,857,000	$22,460,427	$2,064,317,427
Brazoria	$21,158,684,000	$232,745,524	$21,391,429,524
Chambers	$3,203,697,000	$35,240,667	$3,238,937,667
Colorado	$1,104,594,000	$12,150,534	$1,116,744,534
Fort Bend	$40,222,539,000	$442,447,929	$40,664,986,929
Galveston	$23,111,257,000	$254,223,827	$23,365,480,827
Harris	$494,705,884,000	$5,441,764,724	$500,147,648,724
Liberty	$2,223,527,000	$24,458,797	$2,247,985,797
Matagorda	$2,858,724,000	$31,445,964	$2,890,169,964
Montgomery	$41,993,798,000	$461,931,778	$42,455,729,778
Walker	$2,645,843,000	$29,104,273	$2,674,947,273
Waller	$4,027,503,000	$44,302,533	$4,071,805,533
Wharton	$2,345,243,000	$25,797,673	$2,371,040,673

FIGURE 1 - GDP INCREASE FROM BROADBAND

These numbers represent incremental increases in GDP from improved broadband. Some GDP related economic impacts can be far greater than 1.1%. One example is Chattanooga, TN. According to the World Economic Forum, Chattanooga "…has gained $2.2B in incremental value from investment, a ratio of more than 4:1 compared to its cost."[i] As importantly (if not more important), Chattanooga has transformed from a struggling city to a vibrant economy and community – mainly from rebranding themselves through broadband investment.

What Chattanooga was able to do might not be able to be replicated by all communities, but the ability to revitalize and rebrand through these types of technology investments can be remarkable.

Good broadband (particularly fiber) also leads other important implications. According to BusinessWire, in an article titled "Fiber Broadband Association Provides Update on the Status of Broadband in the U.S." from August 23, 2022, stated "47% of rural moves are to areas with fiber." The article went on to quote, "Over $78 million per year of additional primary revenue from home-based businesses could be gained from an FTTH [Fiber to the Home] community of 100,000 households."[ii]

HOUSING VALUE

Extensive research has been done to determine the level of impact broadband has on home values. Since 2007, the Fiber Broadband Association has sponsored an in-depth study that evaluates several components of the broadband industry. The full 2023 report can be found at this link: https://fiberbroadband.org/wp-content/uploads/2023/08/The-Status-of-U.S.-Broadband-2023.pdf

In previous editions, the amount that broadband was found to increase home values was 3.1%. 2023 found that this percentage has increased in some areas. Page 10 of the report contains the following data:

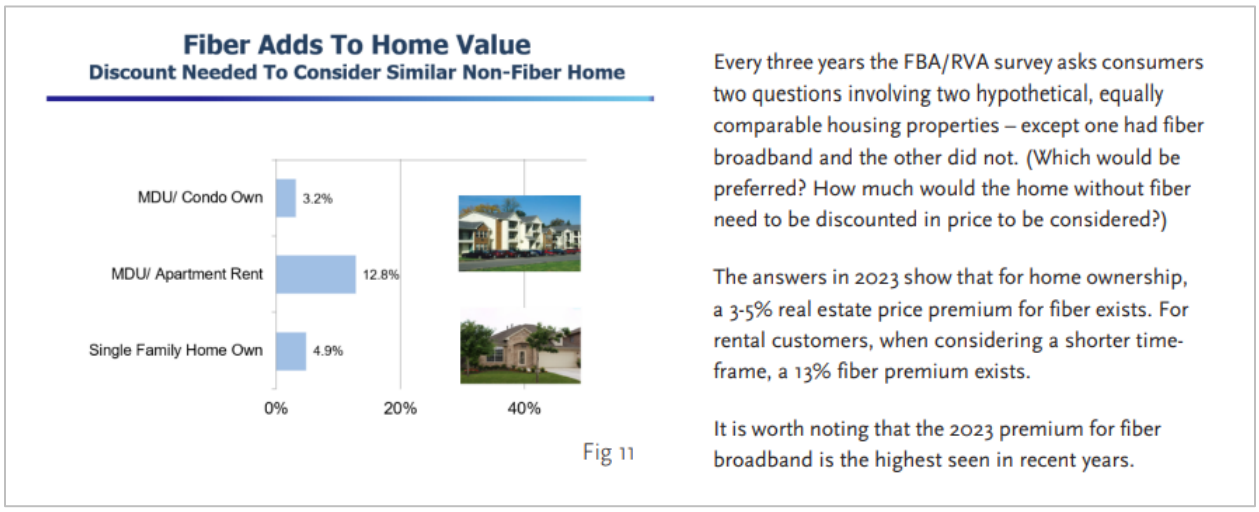

FIGURE 2 - FBA/RVA REPORT FINDINGS OF BROADBAND IMPACTS ON HOME VALUES

Note the last sentence, “It is worth noting that the 2023 premium for fiber broadband is the highest seen in recent years.”

As the potential increase in home values relates to the H-GAC counties, the following analysis was performed. Average home prices were documented from City Data (https://www.city-data.com/county/Wharton_County-TX.html - 2021 data). Applying the historical figure of 3.1% (the lower end of the property value increase from broadband) to the number of addresses that are likely eligible for grants (unserved and underserved as referenced in the High-Level Design section of this report), the potential total increase in property value from reaching those addresses with adequate broadband can be determined. The following chart shows this analysis.

POTENTIAL HOME VALUE INCREASE – H-GAC COUNTIES

	Avg Home Price	3.1% Increase	Eligible Addresses	Total Increase
Austin	$247,477	$7,672	3,905	$29,958,328
Brazoria	$255,600	$7,924	11,334	$89,806,082
Chambers	$283,216	$8,780	3,239	$28,437,435
Colorado	$188,889	$5,856	6,067	$35,525,676
Fort Bend	$319,000	$9,889	7,404	$73,218,156
Galveston	$270,600	$8,389	4,654	$39,040,544
Harris	$232,500	$7,208	10,846	$78,172,545
Liberty	$152,300	$4,721	15,967	$75,384,997

Matagorda	$159,360	$4,940	$5,282	$26,093,925
Montgomery	$293,900	$9,111	$14,529	$132,372,266
Walker	$205,900	$6,383	$5,154	$32,897,467
Waller	$283,216	$8,780	$6,321	$55,496,458
Wharton	$183,147	$5,678	$6,693	$37,999,889

FIGURE 3 - POTENTIAL HOME VALUE INCREASE WITH ADEQUATE BROADBAND

This amount of potential increase in property value across the H-GAC region ($734,403,770 M) is significant. Moreover, this is at the lowest end of the potential property value increase. This amount of increase in property value is important for homeowners and for municipal revenues.

WORKFORCE DEVELOPMENT

One of the most significant impacts of the level of broadband investment in the United States that is often overlooked is job creation. All of the money being invested in broadband requires people to convert money into infrastructure and functioning networks. Examples of these jobs are:

- Engineers to design the networks
- Construction laborers
- Technical construction people, with examples being:
  - Equipment operators
  - Splicers
  - Component installers
  - Network equipment installers and aggregators
- ISP technicians to connect and support customers
- Network operators
- Application developers

The jobs that will be needed in the impending broadband expansion are many. Moreover, these jobs will pay well and could be transformational for individuals, families and communities for generations. Short-term training courses, registered apprenticeship programs, and on-the-job training models will provide thousands of workers with a path to the middle class through broadband expansion and maintenance.

Even with all of this opportunity, there are challenges in workforce development in the broadband industry. As pointed out in a Brookings Institute research paper ("Reimagining The Broadband Technology Workforce" by Nicol Turner Lee and Brady Tavernier) from December 22, 2022, there is very little data available for the broadband industry and there are an unfortunate number of steps being taken to prepare for this historical investment in this industry. You can see the full paper and context at this link: https://www.brookings.edu/articles/reimagining-the-technology-workforce-in-broadband-infrastructure/

The article also references the federal government estimates that this investment in broadband through the Infrastructure Investment and Jobs Act is expected to create 200,000 jobs in the broadband industry. Given the amount of dollars and the many roles that will be needed, this number is likely significantly low.

Pew charitable trust: https://www.pewtrusts.org/-/media/assets/2022/08/beti-memo---workforce.pdf

The end of the article recommends four next steps to be ahead of the dramatic increase in needed skills (taken directly from the article):

1. Federal agencies and workforce practitioners, including O*Net, NIST, and other employee-serving organizations, must develop better taxonomies of broadband occupations and competency-based learning progressions to better measure, train, and narrow the scope of these occupations.
2. People without college or advanced degrees should be the intended targets of IIJA-related job opportunities, which requires a more inclusive workforce development strategy that includes partnerships with community-based organizations for recruitment and supportive services, skills-based hiring practices on behalf of employers, ensuring job placement in occupational pathways that lead to a family-sustaining wage, benefits such as paid sick leave or health insurance, and ongoing career advancement opportunities.
3. Standardized high-quality credentialing and “soft skills” training programs, like those adopted by some private and civic sector employers, should be readily available and serve as models for providing a structured pathway for marginalized workers without college or advanced degrees to acquire valuable and transferable skills in the broadband industry. Employer incentives should also be in place to recruit, train, and hire diverse and under-represented workers in fields that do not require higher education.
4. Union jobs remain an important determinant of relatively high-wage jobs and high-quality working conditions, but many labor unions struggle to achieve equity in their membership and break the historical exclusion by race and gender. There must be intentional efforts to diversify unionized roles within broadband, such as hiring diverse leadership, providing retention support such as childcare, and addressing scheduling barriers for workers who are juggling family and work obligations.

These steps will require collaboration from private companies, government agencies, education institutions and community-based organizations (including the digital equity agencies included in this study). These training programs could provide the workforce needed for southeast Texas and provide employees for needs across the Country.

With a once-in-history funding source for the broadband industry also comes once-in-a-lifetime opportunities – workforce development could be one of those.

CHANGING A COMMUNITY’S BRAND

World class broadband can offer an opportunity for a community to brand or rebrand itself. One example of that is Chattanooga, TN. Not all communities can do what Chattanooga has done, but they offer a great example of what leadership, collaboration and broadband can do.

From significant challenges in the late 1960’s and 1970’s due to a declining industrial base and global energy market changes, Chattanooga had a declining population and other significant challenges. City leadership decided on steps to take to rebrand which included broadband related to (but building on) their electric utility.

Along with significant utility and other investments, they also created a plan to market these changes. For example, they were one of the first communities to actively promote themselves as a “Gig City”. For many years, the City has often described itself as having the fastest connection to the internet in the Western Hemisphere. City leadership are active in inviting people to come visit their broadband and electric utilities.

The results for their economic development have been impressive. They have competed for industry and corporate headquarters and have a solid success rate. The City has also actively fostered a tech and

entrepreneur environment. They host an annual entrepreneurial pitch session that is advertised across the Country and is very competitive to get into.

In addition to their transformation, City leaders have recently announced in conferences that they have had an independent audit that has shown that they have received over $2B in investments in a decade.

Chattanooga's transformation has been inspiring and, again, not all communities would be able to do what they have done. They had several initiatives, but broadband was a central part of their rebranding and rebuilding.

Other communities can develop better connectivity, smart initiatives, tech areas, entrepreneurial opportunities, etc. that can provide a branding or rebranding. Chattanooga's example provides insight into having a plan that includes broadband, good collaboration with the appropriate stakeholders, investment and leaders who will actively tell the story.

The direct correlation with cities and counties in the H-GAC area may not be in the specific details of Chattanooga's story – every community is different. The key concept that can translate to every community is broadband can define aspects of the community's brand in ways that other utilities may not be able to. This can be significant.

Other examples could include if community leaders desire to revitalize a downtown area, a tech zone or WiFi can help that rebranding (based on broadband improvements). If leaders want to attract tech investment or younger tech workers, broadband that is world-class and publicly celebrated can help with that type of new brand. A community in Minnesota desired to promote that they were a great place to retire by focusing on helping seniors stay in their homes and be connected. They helped pay for fiber to the home and created a bus that went around to seniors to help them use their technology. Community rebranding through broadband upgrades, focus and promotion can be transformational.

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[i] https://www.weforum.org/agenda/2022/11/smart-city-internet-infrastructure/

[ii] https://www.businesswire.com/news/home/20220823005213/en/Fiber-Broadband-Association-Provides-Update-on-the-Status-of-Broadband-in-the-U.S.

BROADBAND MARKETPLACE

HR Green has developed the concept of a Broadband Marketplace. When the elements that are represented in the Broadband Marketplace are clarified and brought together, the paths to better broadband can be developed and pursued.

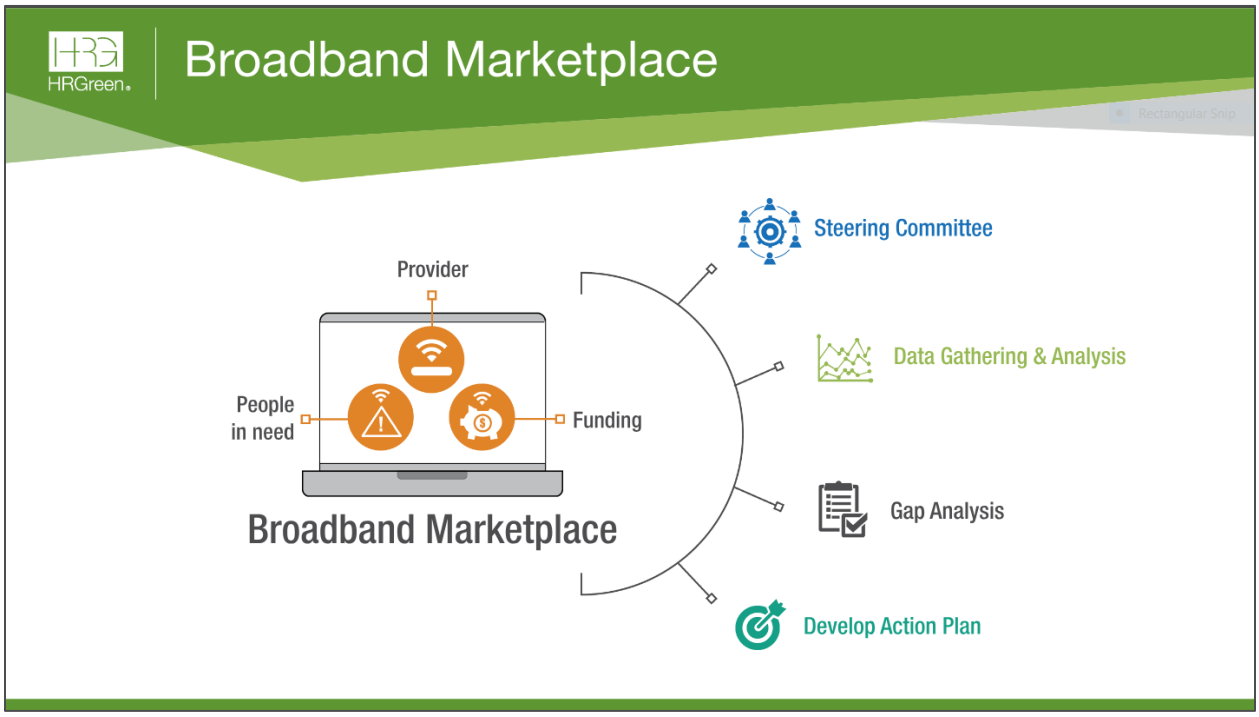


FIGURE 4 - BROADBAND MARKETPLACE

The factors on the right of the above chart are the steps necessary to clarify the existing broadband conditions. With that clearer understanding of broadband needs and options, the participants who can improve broadband can be brought together to work on the steps that need to be taken to create the mutual wins that will lead to improvements.

The coordination of these steps is often best done by the public sector. Government agencies can help the clarifying steps get taken and bring the parties together to create the broadband marketplace. There can be times when providers are not willing or able to provide the supply side of broadband improvement. In the Broadband Marketplace, government leaders can then decide what role the public sector can continue to play in next steps of better broadband.

This study has been done during a backdrop of BEAD grants for broadband improvement. That can and should be considered part of current funding opportunities in the Broadband Marketplace.

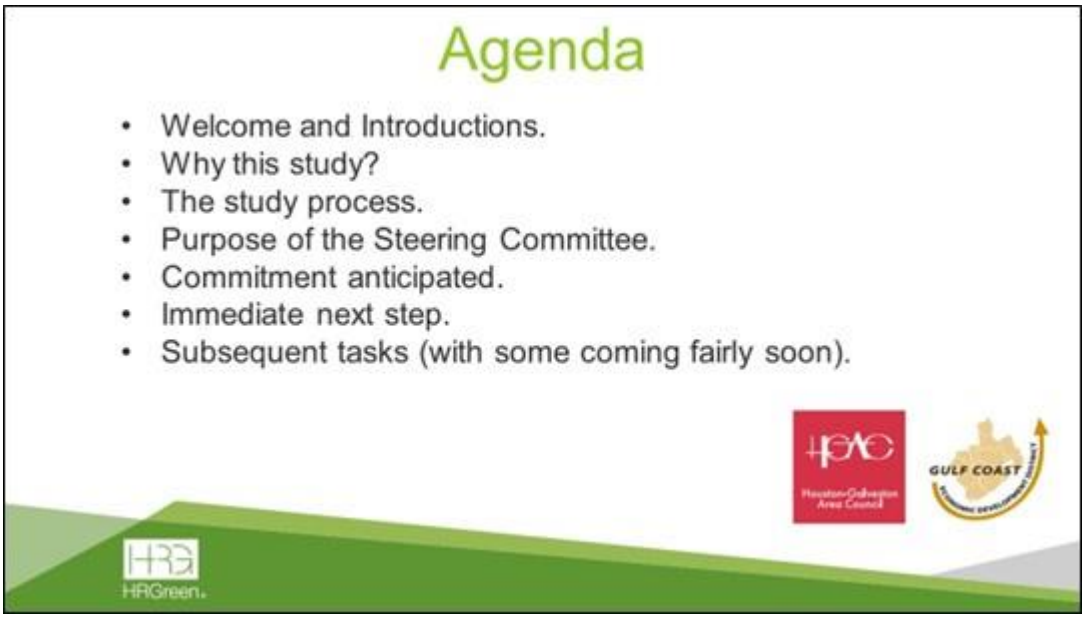
STEERING COMMITTEE

In planning the broadband study, it was determined it would be important to have a Steering committee. With the number of counties and potential cities, identifying who would be involved in the different steps of the study and coordinating those participants would need a project leadership structure. A Steering Committee was formed to provide that guidance. Specifically, the Steering Committee was convened to be a bridge to each community. In that capacity, the Steering Committee was specifically asked to:

- Connect the study team to the right person for specific tasks (survey promotions, stakeholders for meetings, etc.).
- Check the research that HR Green completed for each working group in the project study (ISDs, providers, digital equity agencies, libraries, Chambers of Commerce, etc.).

To determine who would participate in the Steering Committee, an email was sent out to H-GAC contacts in the cities and counties.

Given the role of the Steering Committee, emphasis was placed on participation from all counties and as many cities that could provide a representative.



THE FIRST STEERING COMMITTEE MEETING WAS CONDUCTED ON NOVEMBER 2, 2024.

In the first meeting, emphasis was placed on ensuring the Steering Committee understood the context of this study. The backdrop of the study is that there is a once-in-history grant program for broadband that was part of the Infrastructure Investment and Job Act that was passed by the Federal Government and signed by the President.

The Federal funds are allocated according to the chart below.

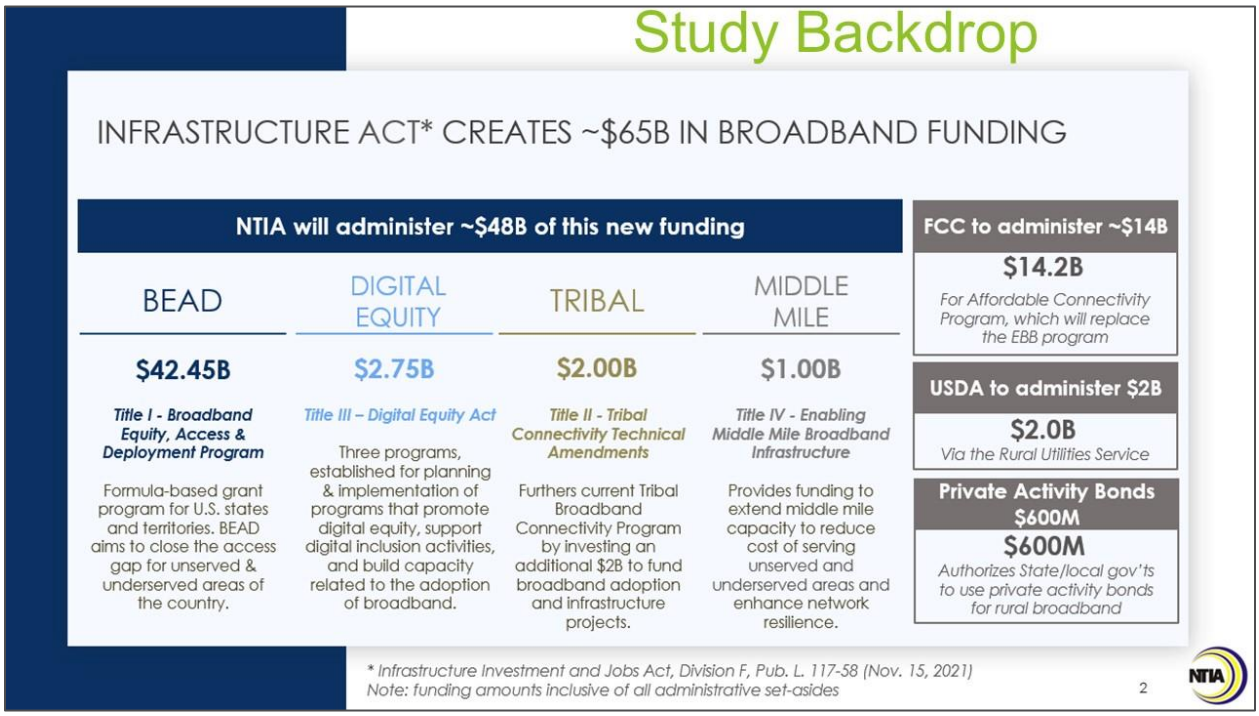


FIGURE 5 - IIJA BROADBAND FUND DISTRIBUTION

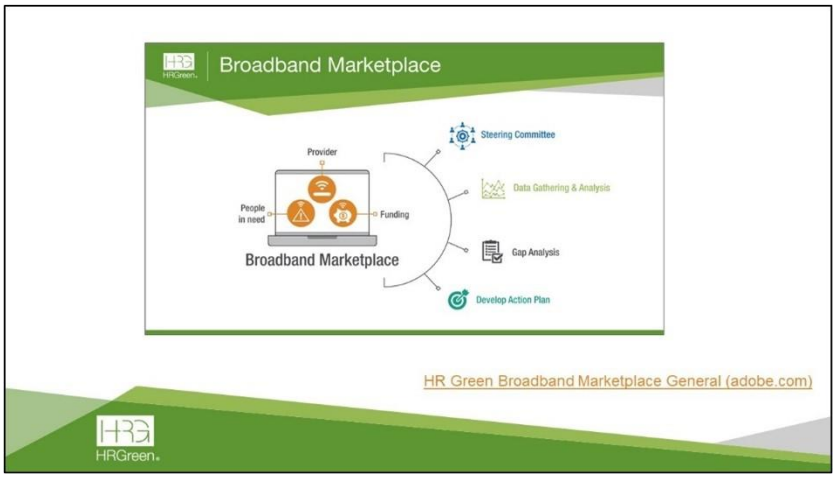
The dollars were allocated to the National Telecommunications and Information Administration (NTIA). For the BEAD portion of the grant money, NTIA decided to allocate the dollars to states based on a population and broadband need formula. The states will then re-grant the money to recipients for projects.

Texas was allocated the largest amount of money at $3.3B. The Texas Legislature appears to be allocating another $1.5B. The State of Texas Broadband Development Office will also use a different funding source to offer a grant-based Technical Assistance Program (TAP).

The TAP program will be in the second quarter of 2024. BEAD grant application windows are expected to open in the fourth quarter of 2024.

Developing plans to take the needed steps to improve broadband (whether through grants or not) and to prepare for grants needs to be done as quickly as possible. This study is an important step in that direction and the Steering Committee will have an important role in the study.

In the first meeting of the Steering Committee was a bigger picture discussion of the process and flow of this study. The Steering Committee was introduced to the role they would play in each step of the process.



A goal of the study process would be to coordinate all the pieces together to form a broadband marketplace. If broadband demand (residential, business and government customers) could be determined and given a way to request service, and the supply side could be coordinated to respond to those needs in applying for grants and improving broadband, a more efficient broadband marketplace could be formed.

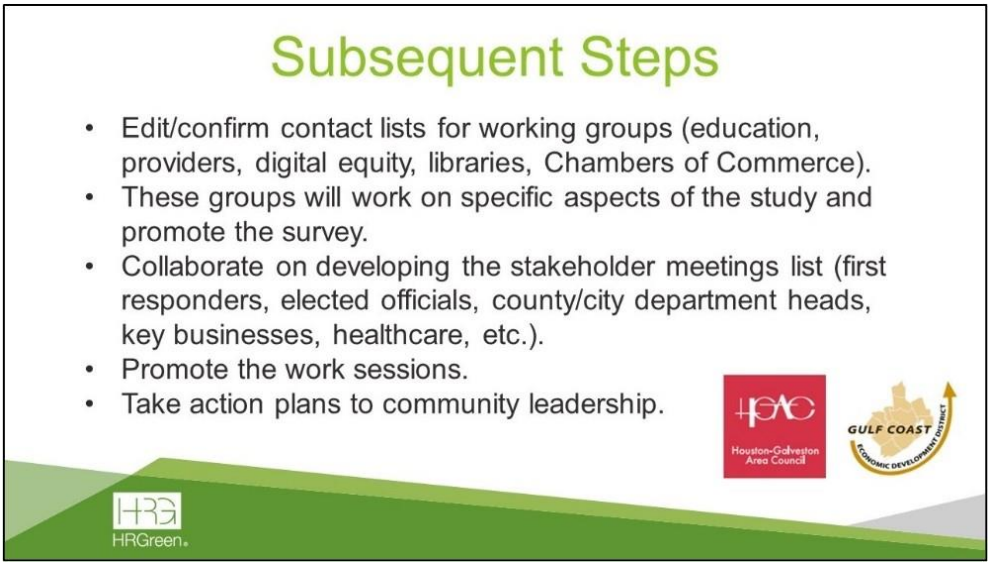
As was discussed earlier and in the first meeting of the Steering Committee, the purpose of the Steering Committee was to be a bridge to their specific community. They would do this through:

- Promoting the survey.
- Helping the study team have the best contacts from the community for the different steps that would be taken (participants in the working groups, promoting the Focus Sessions, reviewing findings).
- Accepting the final work plans.
- Moving the recommendations in the final workplans forward.

With these important roles, the commitment needed from the Steering Committee participants was discussed. Mainly these included virtual one hour meetings (approximately monthly), connecting the study team with the correct people for specific tasks, reviewing and editing lists of working groups and stakeholders and provide any other insights from their communities.

The immediate next steps that the Steering Committee was asked to do were related to the survey. These included:

- Promoting the survey themselves in their interactions.
- Identify a representative from each community (county or city) who can lead survey promotion in their community (typically a Communications Director or Mayor in a smaller community).
- Know where the sample promotional content that HR Green developed is located. H-GAC established a file sharing system for those who would need to access the sample promotional materials (these are shown in the Promotions Group section of this report).



SUBSEQUENT STEPS WERE IDENTIFIED AS PART OF THE FIRST STEERING COMMITTEE MEETING.

A central task of the first Steering Committee meeting was to ask the members to arrange for a person to be assigned to the Promotions Working Group. It was important to initiate the survey and survey results are directly related to the promotions work that representatives from the community are able to do.

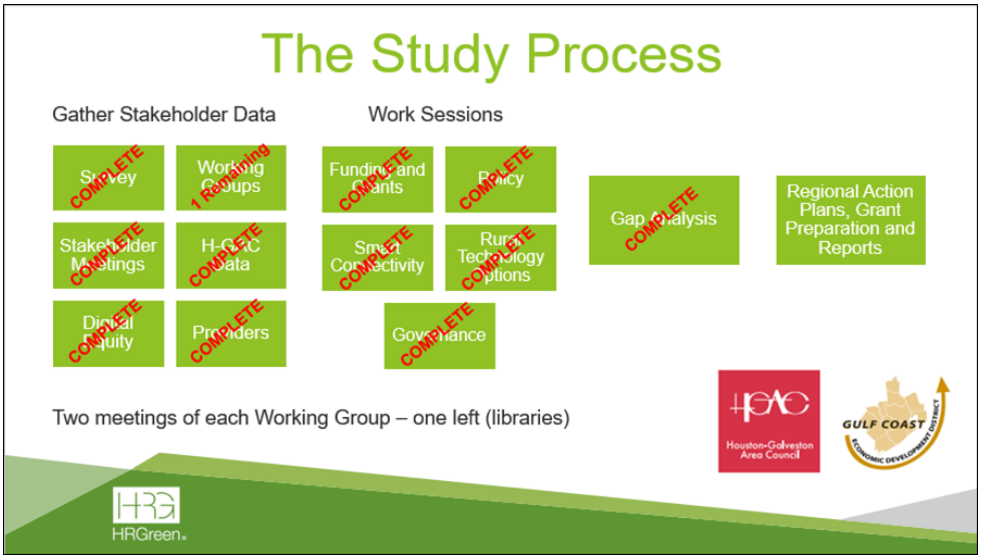
As was noted in the agenda, slides and discussion, the context of the importance of this study and the key role that the Steering Committee has were highlighted and discussed. The context of this study is two-fold. First, broadband has become an integral part of our lives, work, education, health, economic vitality and municipal delivery of services. Therefore, having a good understanding of the broadband strengths and weaknesses in our communities is important to know what steps to take to try to provide the best broadband possible.

Second, this study, particularly at this time, is significant in the ability to prepare for the largest grant funding opportunities for broadband that have ever been available. Gathering the data included in this study and preparing for broadband improvement (including grant possibilities) is the right thing to do at the right time.

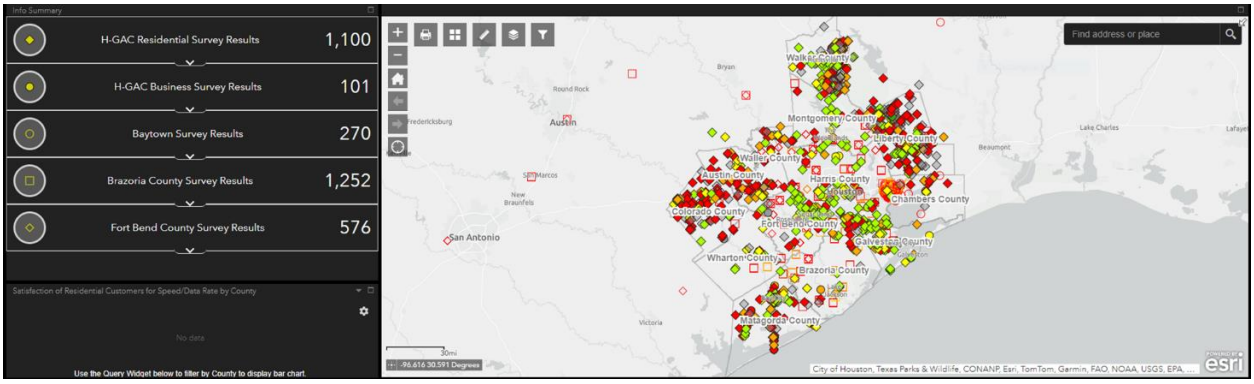
The Steering Committee had three meetings:

- November 2, 2023 – first meeting.
- December 15, 2023 – study interim meeting.
- March 19, 2024 – wrap up meeting

In the March 19, 2024 meeting, final information was presented. One was an update on the tasks of the project. Most of the work of the study had been completed and examples of deliverables of the tasks were shown.



The latest results of the survey were also displayed.



Survey results will be analyzed in greater detail in the Survey Results section, but in the final Steering Committee meeting, it was discussed that the total survey numbers (H-GAC's and incorporation of others that had recently been conducted) were statistically valid. It was important to utilize results from recent surveys in H-GAC communities because of the concerns that there could be confusion among potential survey respondents regarding multiple surveys and survey fatigue. The plan to have a survey and incorporate other recent surveys on broadband in the area proved a successful strategy.

Another significant topic discussed in the Steering Committee's final meeting was the end of the Affordable Connectivity Program. There is more information regarding this topic in the Digital Equity Working Group section of this report, but there will likely be a significant economic challenge for many households in the H-GAC area when this program ends in April 2024. As of January 2024, there were 317, 209 households enrolled in the program in H-GAC member counties, from which they received a reduction in the amount they paid for internet. With that no longer in place (beginning April 2024), digital equity could take a significant step back.

WORKING GROUPS

PROMOTIONS WORKING GROUP

The Steering Committee selected a representative to serve on the Promotions Working Group. Given the Steering Committee was comprised of County and City leaders, representation was requested from all community leaders who could help let people and businesses know to take the survey.

This was a significant group in the study because survey results can be important in subsequent steps. For example, they can be used for a challenge of the eligibility maps when the survey results don't match the eligibility maps. Also, they can be used in developing the action plan in each county. Lastly, they could be used for high-level design of options when necessary.

PROMOTIONS WORKING GROUP COMPONENTS

HR Green has developed a checklist to organize the planning of the Promotions Working Group tasks.

Promotions Working Group Tasks

- Branding (fits client's branding)
  - Logos – GCEDD & H-GAC
  - Colors
  - Fonts
- Language translations
  - Do there need to be any translations?
  - What languages?
  - What pieces?
  - Who will do the translating?
  - Who will pay for it?
- Avenues to promote
  - Social media
  - Print media
  - Other media
  - Email/Newsletters (if applicable)
  - Events
  - Official websites
  - Partners (agencies, schools, banks, businesses, etc.)
- Will anything be printed?
  - Rack cards
  - Surveys
  - Fliers
  - Utility Bill inserts
  - Who will print?
  - Who will approve?
  - Who will pay for it?
- Events
  - Are there any regional, county or city events to have a booth
  - What materials will be given
  - Who will attend (promotions team members)
- Schedule (lay out on a daily or weekly format)
  - Promotions Working Group Meetings
  - Print media, frequency
  - Social media, frequency
  - Other media
  - Utility bill cycles
  - Events per county
  - Printed materials steps (When printed, When distributed to Promotions Working Groups, When offered to the public)
- Results
  - Who will monitor per county
  - Frequency
- Promotion plan adjustments
  - Geography results problems
  - Demographics results problems

Each of these were topics we discussed and evaluated whether they were needed in this project or not. This list was also supplied to the Promotions Working Group to help the members think through the options available to them.

PROMOTIONS MATERIALS

HR Green Marketing developed materials the Promotions Working Group members could use to help them promote the survey.

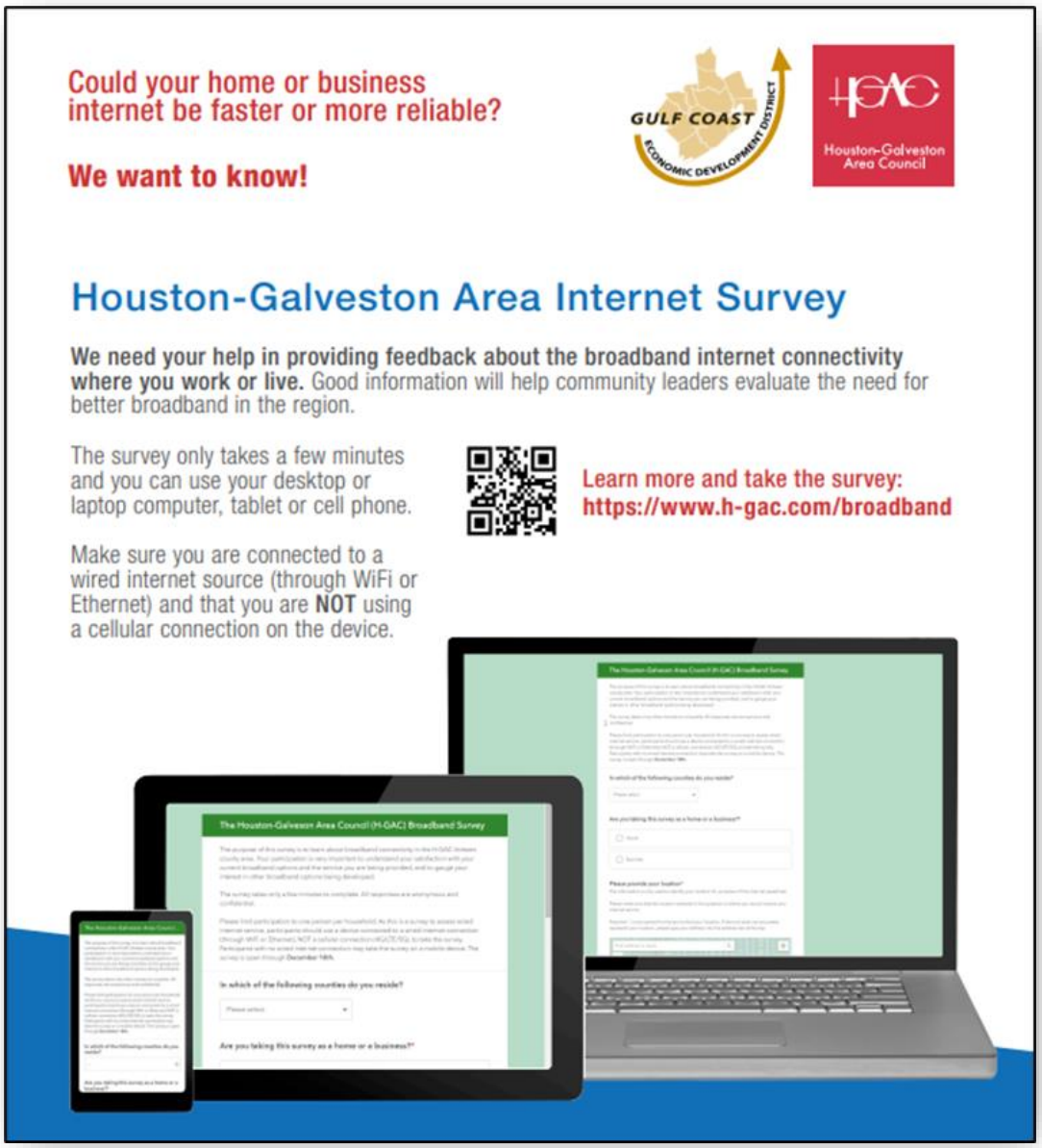


FIGURE 6 - PROMOTIONS GROUP UTILITY STUFFER

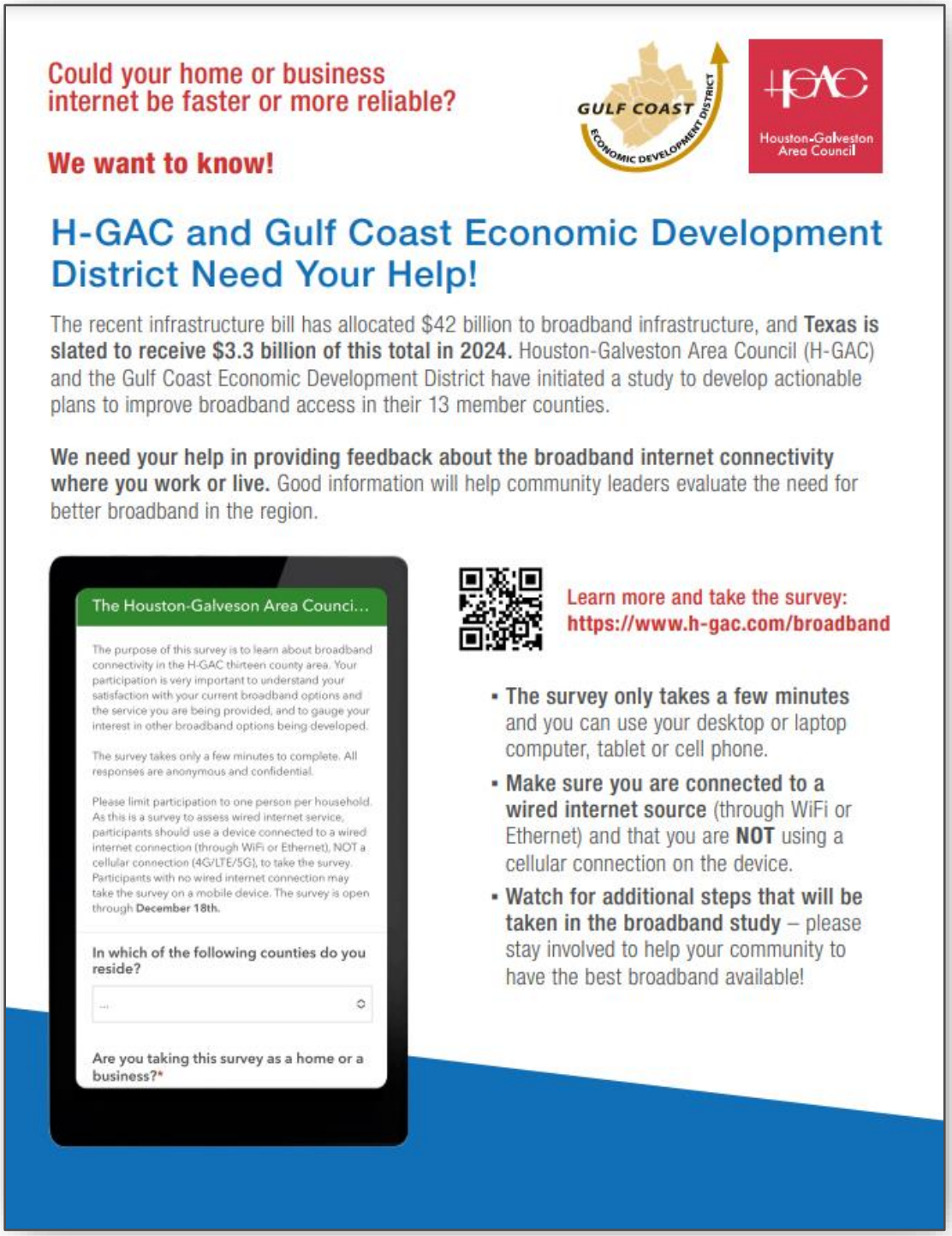
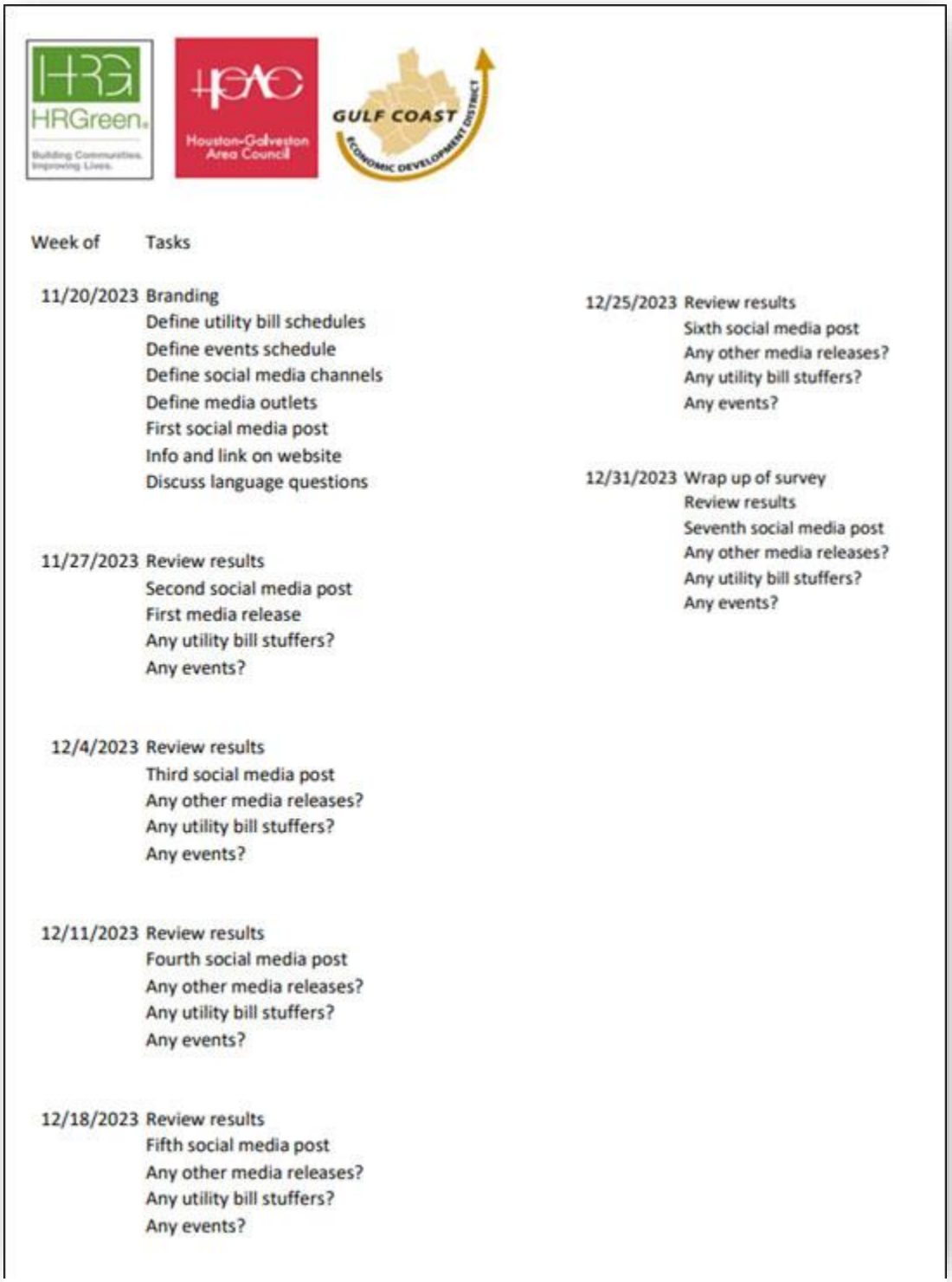


FIGURE 7 - MULTI-USE FLIER



Week of	Tasks
11/20/2023	Branding Define utility bill schedules Define events schedule Define social media channels Define media outlets First social media post Info and link on website Discuss language questions
11/27/2023	Review results Second social media post First media release Any utility bill stuffers? Any events?
12/4/2023	Review results Third social media post Any other media releases? Any utility bill stuffers? Any events?
12/11/2023	Review results Fourth social media post Any other media releases? Any utility bill stuffers? Any events?
12/18/2023	Review results Fifth social media post Any other media releases? Any utility bill stuffers? Any events?
12/25/2023	Review results Sixth social media post Any other media releases? Any utility bill stuffers? Any events?
12/31/2023	Wrap up of survey Review results Seventh social media post Any other media releases? Any utility bill stuffers? Any events?

FIGURE 8 - PROMOTIONS GROUP CALENDAR

With many counties and cities having a social media presence, HR Green's Marketing also developed six sample social media posts the Promotions working group could use as they needed. These could be adapted for any social media platform and were intended to provide a sequence and easy to use path to keep engaging people to take the survey.

Social Media Post 1:

🌐 Exciting News! Houston-Galveston Area Council and the Gulf Coast Economic Development District have launched a study to enhance broadband access in our 13 member counties. Through surveys and stakeholder meetings, we aim to understand challenges and create actionable plans. Your input matters and helps your community secure funding opportunities! Take the survey now: Visit https://www.h-gac.com/broadband for more information.

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 2:

💻 Attention Residents and Businesses! We need your input! Houston-Galveston Area Council and the Gulf Coast Economic Development District are conducting a study to improve broadband access. Your responses will shape actionable plans to secure funding and enhance connectivity. Share your thoughts: https://www.h-gac.com/broadband

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 3:

🚀 Empowering Our Communities! Houston-Galveston Area Council and Gulf Coast Economic Development District are leading the way in broadband access. With your help, we'll develop plans to utilize Texas' $3.3 billion allocation from the infrastructure bill. Take the survey now and be a part of this transformative initiative: https://www.h-gac.com/broadband

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 4:

✳ Calling all Residents and Businesses! Your voice matters in shaping the future of broadband access in our region. Houston-Galveston Area Council and the Gulf Coast Economic Development District are conducting a survey to understand challenges and secure funding. Make a difference, participate now: https://www.h-gac.com/broadband

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 5:

🔗 Bridging the Digital Divide! Houston-Galveston Area Council and the Gulf Coast Economic Development District are on a mission to enhance broadband access. The $42 billion allocation from the infrastructure bill is a game-changer. Help us make informed decisions. Participate in the survey today: https://www.h-gac.com/broadband

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 6:

🌐 Exciting News! Houston-Galveston Area Council and the Gulf Coast Economic Development District have launched a study to enhance broadband access in our 13 member counties. Through surveys and stakeholder meetings, we aim to understand challenges and create actionable plans. Your input matters and helps your community secure funding opportunities! Take the survey now: Visit https://www.h-gac.com/broadband for more information.

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

Social Media Post 7:

✳ Calling all Residents and Businesses! Your voice matters in shaping the future of broadband access in our region. Houston-Galveston Area Council and the Gulf Coast Economic Development District are conducting a survey to understand challenges and secure funding. Make a difference, participate now: https://www.h-gac.com/broadband

#BroadbandAccess #DigitalInclusion #DigitalEquity #FutureReady #BroadbandForAll

UPDATE MEETINGS

The Promotions Working Group had eleven weekly update meetings. In each meeting, an update was given regarding the survey results by County, reminders of tasks to be working on were mentioned and any success stories or challenges were discussed.

Below are the results from the final Promotions Working Group meeting that was on February 5, 2024.

County	Population	Goal	1/4/2024	1/8/2024	1/10/2024	1/15/2024	1/22/2024	1/29/2024	2/5/2024
Austin	30,500	260	72	72	72	72	72	72	74
Brazoria	380,000	625		16	16	19	21	1000	1252
Chambers	49,000	275	8	8	8	11	15	200	270
Colorado	21,000	255	74	74	83	84	87	87	90
Ft. Bend	859,000	1000		13	17	20	87	600	576
Galveston	355,000	400	45	45	45	49	50	53	54
Harris	4,728,000	1500		28	28	28	33	33	33
Liberty	98,000	400	200	203	205	207	210	243	246
Matagorda	36,500	265	31	60	73	115	127	131	131
Montgomery	650,000	500	22	22	22	22	22	26	27
Walker	78,000	375	137	137	137	139	145	180	180
Waller	60,000	300	17	26	26	26	26	26	26
Wharton	42,000	270	6	7	7	7	7	17	18
Totals								**2668**	**2977**

SURVEY GOALS

In the third column from the left, goals for the number of results for each county are displayed. The goal number that was chosen was based on population and approximately what would be needed to have a fully statistically relevant survey result. That is one factor in seeing if results are truly representative of the survey sample. Other factors that determine the effectiveness of promotions are if results are dispersed throughout the survey area and if all demographics are represented as is in the mix of the population.

The total survey number is a statistically relevant response rate for the total region. Some communities did not have the success rate that might have been sought for their county.

DIFFERENT SOURCES OF DATA

Because there have been multiple surveys regarding broadband in the area in recent years, there was also an effort to utilize results from those surveys as opposed to trying to get people to take another survey. Brazoria County, Fort Bend County and the City of Baytown all had survey data that was pulled into H-GAC's portal.

SURVEY RESULTS OVERVIEW

Survey results will be shown in more detail in a section of this report dedicated to each county.

EDUCATION WORKING GROUP

Educators have a unique perspective on broadband, both for their facilities and for their students. Teaching today requires a certain level of connectivity for classroom education, for students doing homework and to conduct the administration of education.

Before the Pandemic, the broadband needs for education were mainly considered to be what was needed for schools to accommodate classroom education, technology centers in the schools for students and the Information Technology needs of administration.

During the Pandemic, when education was required to be done remotely, it became clear that not all students had the broadband needed to connect to a virtual classroom. Some regions, schools and libraries offered hotspots, but that was temporary and very difficult to do for all students in need. It was also common to see cars in parking lots of schools in which students were connected to the school's Wi-Fi to do homework.

Even after students returned to classrooms, a new understanding of the need for connectivity for education has developed. A lot of homework at all education levels is done online now. There are still many students who do not have the connectivity to complete that work and the awareness of that is greater post Pandemic. Virtual education is now a more frequent option when there are weather issues or other reasons why classroom attendance is problematic. More college level education is now offered online. All these examples have highlighted how important connectivity is, and will continue to be, in education and how the digital divide impacts a student's ability to learn.

Similar to the greater challenges facing broadband in the United States, when education is remote from the classroom, students can have either an access or adoption problem. Regarding access, many students (particularly in more rural parts of the region) do not have a reliable source of internet that has the speeds necessary to do the work they are required to do. This is often compounded by more than one person needing internet access in a home (parents working from home or other siblings also needing the internet for schoolwork).

Other families face challenges of connecting to broadband, even when it is available (adoption). These barriers can be financial, language, etc. When a family cannot afford the broadband options available, students do not have the ability to connect remotely for classes or to do homework. Families must then figure out how to connect in other ways for the student to learn. Often, there are not good options, which puts students in a difficult position to meet the education requirements.

Educators see these challenges and have worked on ways to help their students. They also often face tight budgets that limit their resources for their buildings and for ways that can help students connect to the internet. Their perspective and insights into broadband are unique and important. Schools can also request grants for digital equity programs, which could be very relevant in education.

As part of this study, all ISDs and colleges identified in the thirteen-county area were invited to a discussion session on January 31, 2024. The list of schools who received an invitation is in the next chart.

Austin	Bellville ISD
	Brazos ISD
	Sealy ISD
	Blinn College
Brazoria	Alvin Community College
	Brazosport College
	University of Houston – Pearland
	Alvin ISD
	Angleton ISD
	Brazosport ISD
	Columbia-Brazoria ISD
	Damon ISD
	Danbury ISD
	Pearland ISD
	Sweeny ISD
	Angleton Christian School
	Brazosport Christian School
	Parkway Christian Academy
	Living Stones Christian School
	Our Lady Queen of Peach Catholic School
	St. Helen Catholic School
Harris	Houston Christian University
	University of Houston – Victoria at Katy
	University of Houston
	Strayer University
	Lone Star College – University Park
	Our Lady of the Lake University – Houston
	Texas Women's University
	Rice University
	University of St. Thomas
	University of Houston Downtown
	University of Houston – Clear Lake
	University of Texas
	Houston Community College – Katy
	Lone Star College – Cypress Center
	Lone Star College – Cy-Fair
	Lone Star College – Tomball
	Lone Star College – Houston North Victory
	Lone Star College – Houston North
	Houston Community College
	Lone Star College – Atascocita Center
	Lee College
	Aldine ISD
	Alief ISD
	Channelview ISD
	Clear Creek ISD
	Crosby ISD
	Cypress-Fairbanks ISD
	Dayton ISD
	Deer Park ISD
	Galena ISD
	Goose Creek ISD
	Houston ISD
	Huffman ISD
	Humble ISD
	Katy ISD
	Klein ISD
	La Porte ISD
	New Caney ISD
	Pasadena ISD
Chambers	Anahuac ISD
	Barbers Hill ISD
	East Chambers ISD
Colorado	Blinn College – Sealy Campus
	Columbus ISD
	Rice CISD
	Weimar ISD
Fort Bend	Houston Community College – Southwest College
	Houston Community College Stafford
	Wharton County Junior College
	University of Houston College of Technology
	North American University
	University of Houston
	University of Houston at Sugar Land
	Brazos ISD
	Fort Bend ISD
	Houston ISD
	Lamar Consolidated ISD
	Needville ISD
	Stafford MSD
Galveston	Texas A&M University at Galveston
	University of Texas Medical Branch at Galveston
	Remington College – North Houston
	College of the Mainland
	Galveston College
	Ambassadors Preparatory Academy
	Clear Creed ISD
	Dickinson ISD
	Friendswood ISD
	Galveston ISD
	High Island ISD
	Hitchcock ISD
	Santa Fe ISD
	Texas City ISD
Liberty	Lee College Education Center of S. Liberty County
	Cleveland ISD
	Dayton ISD
	Devers ISD
	Hardin ISD
	HULL-DAISETTA ISD
	Liberty ISD
	Tarkington ISD
Matagorda	Wharton County Junior College
	Bay City ISD
	Matagorda ISD
	Palacios ISD
	Tidehaven ISD
	Van Vleck ISD
Montgomery	USTMAX Center – University of St. Thomas
	The Honors College at LSC-Montgomery
	Conroe ISD
	Magnolia ISD
	Montgomery ISD
	New Caney ISD
	Splendora ISD
	Willis ISD
Walker	Sam Houston State University
	SHSU College of Arts and Media
	Huntsville ISD
	New Waverly ISD
Waller	Prairie View A&M University
	Hempstead ISD
	Royal ISD
	Waller ISD
Wharton	Wharton County Junior College
	Wharton ISD

FIGURE 9 - EDUCATION WORKING GROUP

The agenda of the first meeting was:

- Welcome and Introductions.
- Why this study?
- The study process.
- Importance of the Education Working Group.
- Commitment anticipated.
- Next steps.

The notes from the first meeting include:

Twelve participants attended the meeting.

Welcome and Introductions:
- Texas will receive $3.3 billion in grants for broadband funding (with their own contributions, it will be closer to about $5 billion) as part of the $65 billion from the Infrastructure Act. Compared to $7.1 billion allocated during 2008/2009 stimulus funding.

Why this study?
- Clarify what broadband issues exist.
- Formulate action plans to improve broadband.
- Prepare for grants.

The study process:
- Focus sessions will be in February and March to talk about specific broadband topics in the broadband industry.

Importance of the Education Working Group:
- Help us to understand the broadband circumstances of their facilities and students.
- Significance of Challenging the FCC Fabric Map and comparing our survey data with the State Eligibility Maps.
- Collaborate on infrastructure and workforce development.

Commitment:
- Presented Questionnaire and will be emailing this out to the group (requested that they get sent back by end of next week)
- Another meeting and collaboration.

Participant Portion:
- HR Green Project Manager asked if there were any questions about the process:
  - The questionnaire will be sent out everyone via email, along with the survey link.
  - Edgar Chrnko asked if we could send a timeline (covered below).
- Working Group participant asked: When you click over to results, what did the light blue color mean for Liberty County?
  - This color indicates responses tied to Liberty County (just a way to distinguish Liberty from the other counties).
  - Question regarding the number of survey takers. HR Green PM responded this number is statistically significant (i.e. this is really close to being a statistically relevant number). This survey has been promoted well.
  - Working in a small school district, but they were able to develop a QR code that was sent out to the students as her staff didn't realize there were already marketing materials available
- Member asked when the survey is going to close.
  - There will be focus groups over the next couple of months and the survey will be open during all of those.

- Member asked about a timeline:
  - HR Green will put it together and send it to H-GAC to send out. Recommendations and plans need to be sent out by end of February.
    - PM emphasized promoting the survey, but mentioned survey fatigue is a possibility.
    - PM brought up 2021 where we saw a lot of cars in schools' and McDonald's parking lots. Has that gotten better or are people still seeing real connectivity problems that they're trying to overcome?
  - Response: In their rural county, they have terrible connection. They have students who have terrible connection out in the sticks. All the way across the county they have huge connectivity issues.
    - PM mentioned that the team will compare survey data with State Eligibility Map and if there are differences, the data can be challenged. If the information is the same, we can use the information for grants.
- Member asked if school districts can go out for grants.
  - PM responded the rules have not been provided yet, but School districts can at least go out for equity funding bucket of money, but we need to wait for the rules on the funding to come out for funding the infrastructure.
- Member asked: A lot of our students come to campus for Wi-Fi, use computers, printers and our library. And connectivity, well, they are on an island, so it can always be better for everyone.
  - PM emphasized to put this information to the questionnaire. Requested member to put this information down so we are taking this into account.
  - PM asked what counties are seeing for their students?
    - Member from a college: Some of our students don't have access to service. Still an issue is if families can afford the service that is available.
    - PM: More survey results would be helpful from Wharton County and would like to have more conversations.
    - Member: Would be happy to talk about promoting the survey and was already talking to her staff about how to do this!
- PM concluded the meeting and reiterated the email with the fliers, QR codes to promote the survey, and the questionnaire (to be returned by next week)
- H-GAC summarized the need for the preparation to get the funding for broadband. This work is critical and will hopefully lead to funding for everyone.

In the second meeting of the Education Working Group, the following agenda was followed:

- Welcome and Introductions
- Progress So Far
- The study process.
- Importance of the Education Working Group
- The ACP problem
- Next steps

The next steps discussed included: Survey promotion, requesting group members to provide feedback, figure out the best path to continue collaborating through H-GAC, collaborating on infrastructure, and seeing where Erate might be able to be utilized, develop actionable plans for broadband improvement and apply for grants where applicable, and the huge ACP problem.

CHAMBERS OF COMMERCE WORKING GROUP

It is important to have a conduit to the businesses in the region. A working group of the Chambers of Commerce was formed to accomplish that.

Following is the list of invited Chambers of Commerce:

Austin	Bellville Chamber of Commerce
	Seally Chamber of Commerce
Brazoria	Brazoria Chamber of Commerce
	Brazoria County Hispanic Chamber
	Brazosport Area Chamber of Commerce
	Angleton Chamber of Commerce
	West Columbia Chamber of Commerce
Chambers	Winnie Area Chamber of Commerce
	Chambers County Airport
	Mont Belvieu Area Chamber of Commerce
	Bayton Chamber of Commerce
	Anahuac Area Chamber of Commerce
Colorado	Columbus Chamber of Commerce
	Eagle Lake Texas Chamber of Commerce
	Weimar Chamber of Commerce
Fort Bend	Stafford MSD
	Needville Chamber of Commerce
	Central Fort Bend Chamber
	Fort Bend Chamber of Commerce
Galveston	League City Regional Chamber of Commerce
	Texas City – LaMarque
	Galveston Regional Chamber of Commerce
Harris	LaPorte-Bayshore Chamber of Commerce
	Texas City-LaMarque Chamber of Commerce
	Katy Area Chamber of Commerce
Harris, cont.	Cy-Fair Houston Chamber of Commerce
	Caribbean Chamber of Commerce
	Houston West Chamber of Commerce
	USArab Chamber of Commerce
	Houston Metropolitan Chamber of Commerce
	Greater Houston Partnership
	Pasadena Chamber of Commerce
	Deer Park Chamber of Commerce
	Clear Lake Area Chamber of Commerce
	Baytown Chamber of Commerce, Liberty
Liberty	Dayton Chamber of Commerce
	Mont Belvieu Area Chamber of Commerce
Matagorda	Palacios Chamber of Commerce
	Bay City Chamber of Commerce
Montgomery	Montgomery Area Chamber of Commerce
	Conroe Hispanic Chamber of Commerce
	Conroe/Lake Conroe Chamber
	Greater Magnolia Parkway Chamber of Commerce
	The Woodlands Area Chamber of Commerce
	Greater EMC Chamber
Walker	Huntsville Walker County Chamber of Commerce
Waller	Hempstead Chamber of Commerce
	Waller Area Chamber of Commerce
Wharton	El Campo Chamber of Commerce
	Wharton Chamber of Commerce & Agriculture

FIGURE 10 - CHAMBERS OF COMMERCE WORKING GROUP

The Chambers of Commerce Working Group had two meetings. The first contained similar agenda items as the other working groups:

- Welcome and Introductions.
- Why this study? The grant backdrop and opportunities were discussed.
- The study process – including the steps that would be taken to gather data, do a gap analysis and formulate action plans, leading to broadband improvement options and grant preparations.
- Importance of the Chambers of Commerce Working Group.
- Commitment anticipated.
- Next steps.

In the second meeting of the Education Working Group, the following agenda was followed:

- Welcome and Introductions
- Progress So Far
- The study process.
- Importance of the Education Working Group
- The ACP problem
- Next steps

Similar to the other working groups, the next steps discussed included: Survey promotion, requesting group members to provide feedback, figure out the best path to continue collaborating through H-GAC, collaborating on infrastructure, and seeing where Erate might be able to be utilized, develop actionable plans for broadband improvement and apply for grants where applicable, and the huge ACP problem.

LIBRARIES WORKING GROUP

Libraries are key in broadband improvement because they provide broadband services, work daily with populations who might have challenges accessing and using broadband, have access to Erate and regularly develop programming for outcomes they identify as needed.

The libraries who were asked to join the Libraries Working Group included:

Austin	Knox Memorial Library
	West End Public Library
	Bellville Public Library
	Gordon Memorial Library
Brazoria	Sweeny Library
	West Columbia Library
	Brazoria Library
	Lake Jackson Library
	Brazosport College Library
	Freeport Branch Library
	Clute Branch Library
	Brazoria County Law Library
	Angleton Library
	Brazoria County Library System
	Danbury Community Library
	West Pearland Library
	UHCL Pearland Library
	Manvel Library
	Alvin Library
	Pearland Tom Reid Library
Chambers	Sam and Carmena Goss Memorial
	Chambers County Library
	Juanita Hargraves Memorial Branch
Colorado	Weimar Public Library
	Sheridan Memorial Library
	Nesbitt Memorial Library
	Garwood Veteran's Memorial Library
	Eula & David Wintermann Library
Fort Bend	Albert George Branch Library
	George Memorial Library
	Cinco Ranch Branch Library
	FBC Willie Melton Law Library
	First Colony Branch Library
	Mamie George Branch Library
	Missouri City Branch Library
	Sienna Branch Library
	Sugar Land Branch Library
	University Branch Library
	Mission Bend Branch Library
	Stimley-Blue Ridge Neighborhood Library
Galveston	Galveston County Law Library
	David Glenn Hunt Memorial Library
	Jack K Willimas Library
	Rosenberg Library
	Moody Medical Library
	Friendswood Public Library
	Dickinson Public Library
Harris, cont.	Kingwood Branch Library
	Atascocita Branch Library
	Harris County Public Library
	Melcher Neighborhood Library
	Park Place Regional Library
	South Houston Branch Library
	Parker Williams Library
	Clear Lake City-County Freeman Branch Library
	North Channel Library
	La Porte Library
	Hillendahl Neighborhood Library
	Oak Forest Neighborhood Library
	West University Branch Library
	Aldine Branch Library
	Lone Star College-North Harris Library
	Moody Neighborhood Library
	Heights Neighborhood Library
	Houston Public Library – Central Library
	Ring Neighborhood Library
	Scenic Woods Regional Library
	Tuttle Neighborhood Library
	Lone Star College – CyFair Library
	Harris County Robert W. Hainsworth Law Library
	Lanier Theological Library
	Barbara Bush Branch Library
Liberty	Liberty Municipal Library
	Sam Houston Regional Library and Research Center
	Austin Memorial Library
	Jones Public Library
	Tarkington Community Library
Matagorda	Palacios Library Inc.
	Blessing Library
	Bay City Public Library
	Sargent Library
Montgomery	Charles B Stewart – West Branch Library
	RF Meador Branch Library
	Montgomery County Memorial Library – Central Library
	Montgomery County Law Library
	RB Tullis Branch Library
	Malcom Purvis Library
	Lone Star College – Tomball Community Library
	Gysta Group Video Library (basketball training videos)
	George & Cynthia Woods Mitchell Library
	Jones Library (private library of Woodlands Methodist Church)
	South Regional Library
Walker	New Waverly Public Library
	Newton Gresham Library

Harris	Mae S Bruce Library
	Hitchcock Public Library
	Erma Wood Carlson Library
	HCPL – Maud Smith Marks Branch
	Baldwin Boettcher Branch Library
	High Meadows Library
	Octavia Fields Branch Library
	Huntsville Public Library
Waller	Waller County Library
	John B. Coleman Library
	Melanee Smith Memorial Library
	Brookshire-Pattison Branch
Wharton	East Bernard Library
	Wharton County Library

FIGURE 11 - LIBRARIES WORKING GROUP

The Libraries Working Group had two meetings. The first contained similar agenda items as the other working groups:

- Welcome and Introductions.
- Why this study? The grant backdrop and opportunities were discussed.
- The study process – including the steps that would be taken to gather data, do a gap analysis and formulate action plans, leading to broadband improvement options and grant preparations.
- Importance of the Libraries Working Group.
- Commitment anticipated.
- Next steps.

In the second meeting of the Library Working Group, the following agenda was followed:

- Welcome and Introductions
- Progress So Far
- The study process.
- Importance of the Libraries Working Group
- The ACP problem
- Next steps

Similar to the other working groups, the next steps discussed included: Survey promotion, requesting group members to provide feedback, figure out the best path to continue collaborating through H-GAC, collaborating on infrastructure, and seeing where Erate might be able to be utilized, develop actionable plans for broadband improvement and apply for grants where applicable, and the huge ACP problem.

DIGITAL EQUITY WORKING GROUP

Digital Equity is a significant issue in all areas of the world and the United States. Because so many critical aspects of our lives rely in some way on connectivity (education, work, telehealth, etc.), when someone cannot access that connectivity, there are consequences. There are multiple reasons why a person cannot access the internet that can include a lack of infrastructure, devices, affordability, language, age, etc.

Helping the vulnerable members of our society to bridge this digital divide can have obstacles. The National Digital Inclusion Alliance (NDIA) framed the challenge this way:

> *The term "bridging the digital divide" comes with a natural assumption that there is one digital divide and it can be bridged. Digital inclusion practitioners working with disadvantaged populations understand acutely the many technological divides that exist. We also recognize there will be more. Digital equity goals must be set, reached and then reset and reached again. Repeat. The reason for this is twofold – (1) Technology is constantly changing. As society adapts to new technology, the most vulnerable members of our communities will always be in danger of being left behind. (2) All of us are always learning. There will always be a need for another digital literacy class.*

It is critical that we keep in mind the need to continue to work towards digital equity, which includes the efforts of digital inclusion. NDIA clarifies the distinction between these two (both of which are important in the work for digital equity) as, "The simplest way to think of the intersection of these two terms is that Digital Equity is the "what" (goals) and Digital Inclusion is the "how" (activities)." (referenced from the NIDA website: https://www.digitalinclusion.org/blog/2016/08/24/digital-equity-and-digital-inclusion/#:~:text=The%20simplest%20way%20to%20think,%E2%80%9Chow%E2%80%9D%20(activities)

There is a lot of effort that needs to continue to be made to work towards digital equity. According to Pew Research, real challenges exist with being able to connect to the internet and participate in the digital world. In the Chart below, the numbers of those who do not have connectivity (particularly at home) and the differences in who has access and who does not can and should issue a call to action (digital inclusion). This chart is referenced from their website: https://www.pewresearch.org/internet/2024/01/31/americans-use-of-mobile-technology-and-home-broadband/

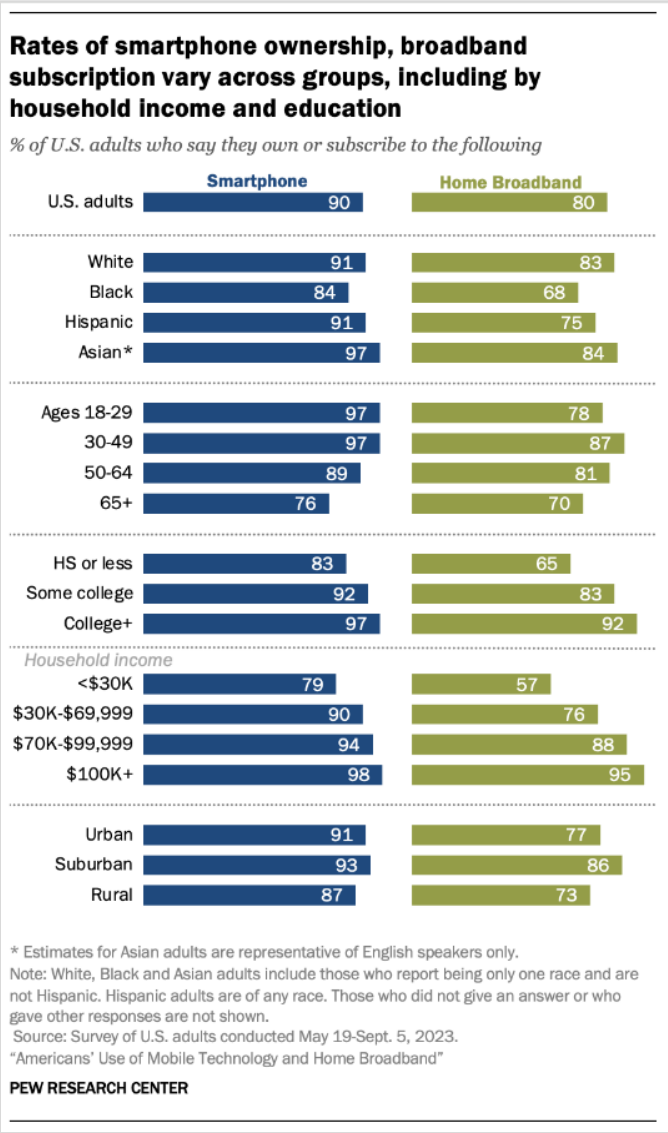


FIGURE 12 - VARIATIONS IN DIGITAL ACCESS

The implications of this digital divide are enormously important. When students cannot access the internet at home, many facets of their education will suffer. There are now many jobs that have some level of working from home. Telemedicine is a rapidly growing industry and relies on having good, reliable connectivity. Many seniors are able to stay in their homes longer because they have the ability to connect with outside caregivers.

These all require good broadband. When that is not available, these possibilities become challenging or unavailable.

Referencing the Economic Impacts section of this report, there are documented economic advantages for individuals and communities when good broadband is available. The opposite is also real for those who do not have that connectivity.

As part of this study, a Digital Equity Working Group was formed with three goals:

- Be a connection point with those who might have challenges connecting to broadband for the study and for the survey.
- Collaborate with other agencies and other digital equity groups.
- Work towards collaborative efforts for programs that could be funded through BEAD grants.

The Digital Equity Working Group had two meetings. The first contained similar agenda items as the other working groups:

- Welcome and Introductions.
- Why this study? The grant backdrop and opportunities were discussed.

- The study process – including the steps that would be taken to gather data, do a gap analysis and formulate action plans, leading to broadband improvement options and grant preparations.
- Importance of the Digital Equity Working Group.
- Commitment anticipated.
- Next steps.

In the second meeting of this Working Group, the following agenda was followed:

- Welcome and Introductions.
- Progress So Far.
- The study process.
- Importance of the Digital Equity Working Group moving forward.
- The ACP problem.
- Next steps.

Similar to the other working groups, the next steps discussed included: Survey promotion, requesting group members to provide feedback, figure out the best path to continue collaborating through H-GAC, collaborating on infrastructure, develop actionable plans for broadband improvement and apply for grants where applicable, and the huge ACP problem.

The Digital Equity Working Group was formed with the backdrop of another group that H-GAC was and continues to be involved in and leading: The Gulf Coast Digital Inclusion Task Force. This group was formed with help from the Dallas Federal Reserve, which has been involved in similar initiatives in Texas. This group helped assemble members in the region and is actively working on actionable steps to take in the region for digital inclusion, ways to fund ongoing efforts and options for developing an ongoing structure in the region to deal with digital equity issues.

With H-GAC's guidance, participation from others in the region and with collaboration with the Digital Equity Working Group in this study, ongoing progress can be achievable.

The members of the study Digital Equity Working Group are in the chart on the following page. All that had contact information were invited to be part of this working group.

Austin	Boys and Girls Club of Austin County
	Brookshire Clinic
	Area Agency on Aging
	HOA Meals on Wheels
	SE TX Housing Corp.
	Salvation Army
	Texana Center
	The WorkForce
	United Way for Greater Austin
	Youth and Family Services
Brazoria	Brazoria County Community Supervision & Corrections
	Historical Commission
	Housing and Urban Development
	Actions, Inc. of Brazoria County
	Boys & Girls Club of Brazoria County
	Juvenile Justice Department
	Gulf Coast Regional Airport
	United Way of Brazoria County
Chambers	CASA of Liberty and Chambers County
	Chambers County Historical Commission
	Community Hot Meal Program
	Love Network of Baytown
	Marcelous-Williams Resource Center
Harris, cont.	Sharpstown Community Center
	Tracy Gee Community Center
	Trinin Mendenhall Community Center
	Steve Radack Community Center
	Richard & Meg Weekly Community Center
	Elite Boys and Girls Club
	City Boys & Girls Club
	Spring Branch Boys & Girls Club
	Boys & Girls Club - Greater Houston
	Boys & Girls Club of Greater Houston
	Boys & Girls Club of Greater Houston
	Boys & Girls Club - Greater Houston
	United Way of Greater Houston
	United Way of Greater Houston - Bay Area Service Center
	Alliance for Community Assistance Ministries
	Lone Star College - North Harris ESL/ESOL Department
	Lone Star College - CyFair ESL/ESOL Program
	English as a Second Language at Rice University
	Rosie Siller's English and Citizenship
	HCC - English Class
	American Intensive English
	Horizon Outreach
	Make Me Over New, Inc.

	Mid-Chambers Christian Caring Center
	Workforce Solutions Gulf Coast
	United Way of Greater Baytown Area & Chambers County
Colorado	Robert R. Wells, JR Airport
	Wharton County Junior College Senior Citizen Program
	Columbus WIC Office
	Weimar The First United Methodist Church WIC Office
Fort Bend	Pinnacle Senior Center
	Historical Commission
	Community Supervision and Corrections Department
	Fort Bend Seniors Meals on Wheels
	Fifth Street Head Start
	East Fort Bend Human Needs Ministry, Inc
	Richmond Rosenberg Boys & Girls Club
	Mission Bend Boys & Girls Club of Greater Houston
	Stafford Boys & Girls Club
	Fort Bend Boys & Girls Club
	Fort Bend Meals on Wheels and Much Much More
	Catholic Charities Mamie George Community Center
	Bonbrook Plantation Community Center
	EV-Greatwood Community Center
	Club at New Territory
	Landmark Community Center
	Meadows Place Community Center
	Four Corners Community Center
	United Way of Greater Houston - Fort Bend Center
Galveston	Senior Services
	Bayside Community Center
	Dickinson Community Center
	Wayne Johnson Community Center
	Interfaith Ministries for Greater Houston
	Houston-Galveston Area Council - Area Agency on Aging
	City of League City Community Center
	Jimmie Walker Community Center
	Thelma Webber Community Center
	Sanders Community Center
	Galveston Island Community
	United Way Galveston County Mainland
	United Way Galveston
	United Way of Greater Baytown Area & Chambers County
Harris	Harris County Housing Authority
	Harris County Resources for Children and Adults
	Harris County Area Agency on Aging
	Bay Area Meals on Wheels
	Harris County-Precinct One- Community Centers
	Christia V. Adair Community Center
	Mason Community Center
	Mac Gregor Community Center
	Marian Park Community Center
	Bayland Community Center
	Burnett Bayland Community Center
Harris, cont.	Workers Defense Project
	Workforce Solutions
	Genesys Works
	The Platform Youth
	Capital IDEA Houston
	Career & Recovery Resources
	SERJobs
Liberty	Liberty County Housing Authority
	Liberty County A.J. "Jack" Hartel Building
	Cleveland Senior Citizens Center
	South Liberty County Meals on Wheels - Grace Initiative
Matagorda	Boys & Girls Club of Bay City
	Boys & Girls Club of Palacios
	Economic Action Committee of the Gulf Coast
	Housing Authority of the City of Palacios
	Bay City Housing Authority
	Sweeny Community Center
	Van Vleck Community Center
	Markham Community Center
	Midfield Community Center
	Blessing Community Center
Montgomery	Montgomery Meals on Wheels
	Montgomery County Adult Probation
	Conroe North Houston Regional Airport
	Montgomery County Housing Authority
	Family Services of Greater Houston Montgomery County Office
	Volunteers of America Texas
	United Way of Greater Houston Montgomery County Center
	Decker Prairie Community Center
	South County Community Center
	Tamina Park Community Building
	EMC Community Development Center
	Grangerland Community Center
	Oscar Johnson Jr Community Center
	Lone Star Community Center
	North Montgomery County Community Center
	Lone Star College - Montgomery ESL/ESOL Program
	Lone Star College - Kingwood ESL/ESOL Program
Walker	Boys & Girls Club of Walker County
	Senior Center of Walker County
	Community Supervision and Corrections Department
	Walker County Housing Authority
	Hunstville Housing Authority
Waller	Meals on Wheels
	Fort Bend Seniors Meals on Wheels
	United Way Greater Houston Waller County Center
	Rosenberg Housing Authority
Wharton	Wharton County Junior College Senior Citizen Program
	Boys & Girls Club of America
	Wharton County Historical Commission
	Wharton County Housing Authority
	Hungerford Community Center

FIGURE 13 - DIGITAL EQUITY WORKING GROUP

AFFORDABLE CONNECTIVITY PROGRAM

The Affordable Connectivity Program (ACP) was instituted during the Pandemic to help make broadband affordable for eligible households. According to the FCC website (https://www.fcc.gov/acp):

> *The Affordable Connectivity Program is an FCC benefit program that helps ensure that households can afford the broadband they need for work, school, healthcare and more. The benefit provides a discount of up to $30 per month toward internet service for eligible households and up to $75 per month for households on qualifying Tribal lands. Eligible households can also receive a one-time discount of up to $100 to purchase a laptop, desktop computer, or tablet from participating providers if they contribute more than $10 and less than $50 toward the purchase price. The Affordable Connectivity Program is limited to one monthly service discount and one device discount per household.*

One of the topics discussed in the last meeting of the Steering Committee and the second meeting of all of the working groups (including the Digital Equity Working Group) was the sunset of the Affordable Connectivity Program. The statistics for the need of the program are significant:

- More than 1.7 million households are enrolled in Texas.
- Enrollments ended in February 2024, funding is over in April 2024.

It is unclear what the specific ramifications will be of this program ending, but there could be a significant impact on digital equity if the numbers of people who have qualified for and utilized this program no longer receive the cost offsets the ACP provided.

From the FCC website, the number of households utilizing the ACP per county in the H-GAC region were:

County Name	Total Subscribers
Austin	793
Brazoria	10,903
Chambers	1,278
Colorado	1,146
Ft. Bend	22,855
Galveston	13,841
Harris	236,735
Liberty	5,174
Matagorda	1,898
Montgomery	16,418
Walker	2,304
Waller	1,802
Wharton	2,062

https://www.usac.org/about/affordable-connectivity-program/acp-enrollment-and-claims-tracker/#enrollment-and-claims-by-zip-code-and%20-county

Addressing the issue of the end of the ACP program is an important topic to deal with and is included with the Recommendations of this study.

PROVIDERS WORKING GROUP

Internet Service Providers (ISP) most often play a central role in broadband improvement. Typically, because they build and operate broadband networks, they are usually the ones to make the investment in broadband infrastructure and they are usually the entities that apply for most grants.

As part of this study, the Providers Working Group was formed with four goals:

- Keep them informed of what is happening and what their role is.
- Seek their input on tasks in the study.
- Work towards collaborative efforts for coverage for everyone.
- Prepare for grants.

The Providers Working Group had two meetings. The first contained similar agenda items as the other working groups:

- Welcome and Introductions.
- Why this study? The grant backdrop and opportunities were discussed.
- The study process – including the steps that would be taken to gather data, do a gap analysis and formulate action plans, leading to broadband improvement options and grant preparations.
- Importance of the Providers Working Group.
- Commitment anticipated.
- Next steps.

In the second meeting of this Working Group, the following agenda was followed:

- Welcome and Introductions.
- Progress So Far.
- The study process.
- Importance of the Providers Working Group moving forward.
- The ACP problem.
- Next steps.

Similar to the other working groups, the next steps discussed included: Survey promotion, requesting group members to provide feedback, figure out the best path to continue collaborating through H-GAC, collaborating on infrastructure, develop actionable plans for broadband improvement and apply for grants where applicable, and the huge ACP problem.

The public sector also has key roles in broadband improvement in four ways:

- Coordinate efforts and plans to ensure everyone has good broadband and no one is left behind.
- Coordinate grant applications and letters of support.
- Ensure that permits meet the community's goals and is fair and equal to providers.
- Step in when the private sector does not see a reason to build to certain areas or addresses.

CITIZEN AND BUSINESS SURVEY

INTRODUCTION TO THE SURVEY

States utilize the FCC data to determine eligibility for their grant programs. If the data is correct, then the system is fine. However, the FCC data is widely known to have problems as the data is self-reported from the providers and is not knowingly checked before it is entered into the FCC system. Due to these known flaws, a community survey gathering speed test data (actual speed tests recorded from the H-GAC area) is used to help determine if the FCC data is acceptable.

Since the available data on broadband speeds and coverage is known to be poorly representative of the reality of broadband in many locations, this survey of residents and business owners helps decision makers better understand community needs. The large-scale statistically significant public survey asked questions to determine the community's internet services, usage patterns, current market conditions and deficiencies, and desire for improved service in the community. Identifying questions were also asked about the household composition and demographic information. Some of the questions asked are what is important to them personally, what do they value about communications services, what is important to the community; and, most importantly, how strongly they feel H-GAC needs to help facilitate better broadband.

The survey garnered 1,203 responses, of which 1,101 were residential and 102 were businesses responses. For the full list of survey questions, please see **Appendix B**.

These findings help to illustrate today's conditions and indicate a need for more robust broadband services in some areas of the H-GAC area. Identification of needs in the survey results will facilitate the development of network model alternatives that may be helpful to mitigate some of the most significant gaps between the community's capabilities and needs. The questions relating to the community's broadband vision will facilitate an understanding of what role H-GAC could take in facilitating broadband service.

SURVEY FINDINGS

Urban Areas are Well-Served, while Rural Areas are Likely to Be Unserved or Underserved.

Figure 14 shows the distribution of survey results by download speed in all 13 counties within the H-GAC area. Please note that all of the survey results are analyzed in charting survey results, while the map data may have geocoding outliers due to technical or user errors. When measured against the federal definition of Broadband, the residents of the H-GAC communities report major gaps. The survey respondents were asked to take a speed test through an online tool and report their actual speeds. While this method is reliant on variables such as the quality of in-home networking equipment, the results are generally accurate to show actual speed of service received, if not precise, to the Mbps level.

The overall map shows that, in general, speeds reflect what is being seen nationally. More urban areas have higher speeds because ISPs invest more because they know they will get a higher return based on population density. Rural areas tend to have lower speeds because the costs to reach more sparse populations are much higher (often creating a business model that does not work). Specific findings will be discussed in greater detail, but on the surface, the H-GAC area follows national broadband trends.

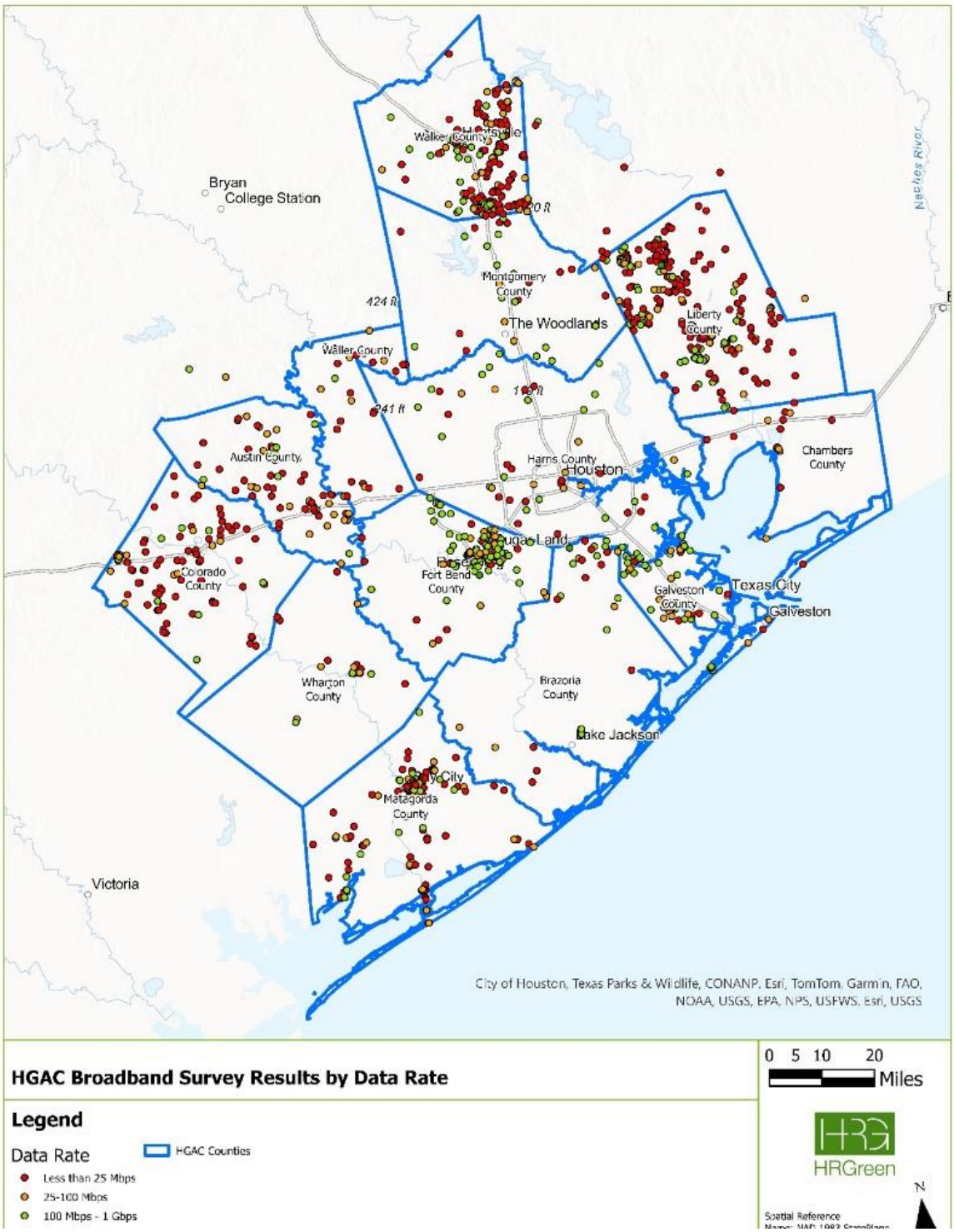


FIGURE 14 - SURVEY RESULTS BY DATA RATE

Due to the large study area comprising all 13 counties, there were numerous companies providing internet service, with some providing service to select locations.

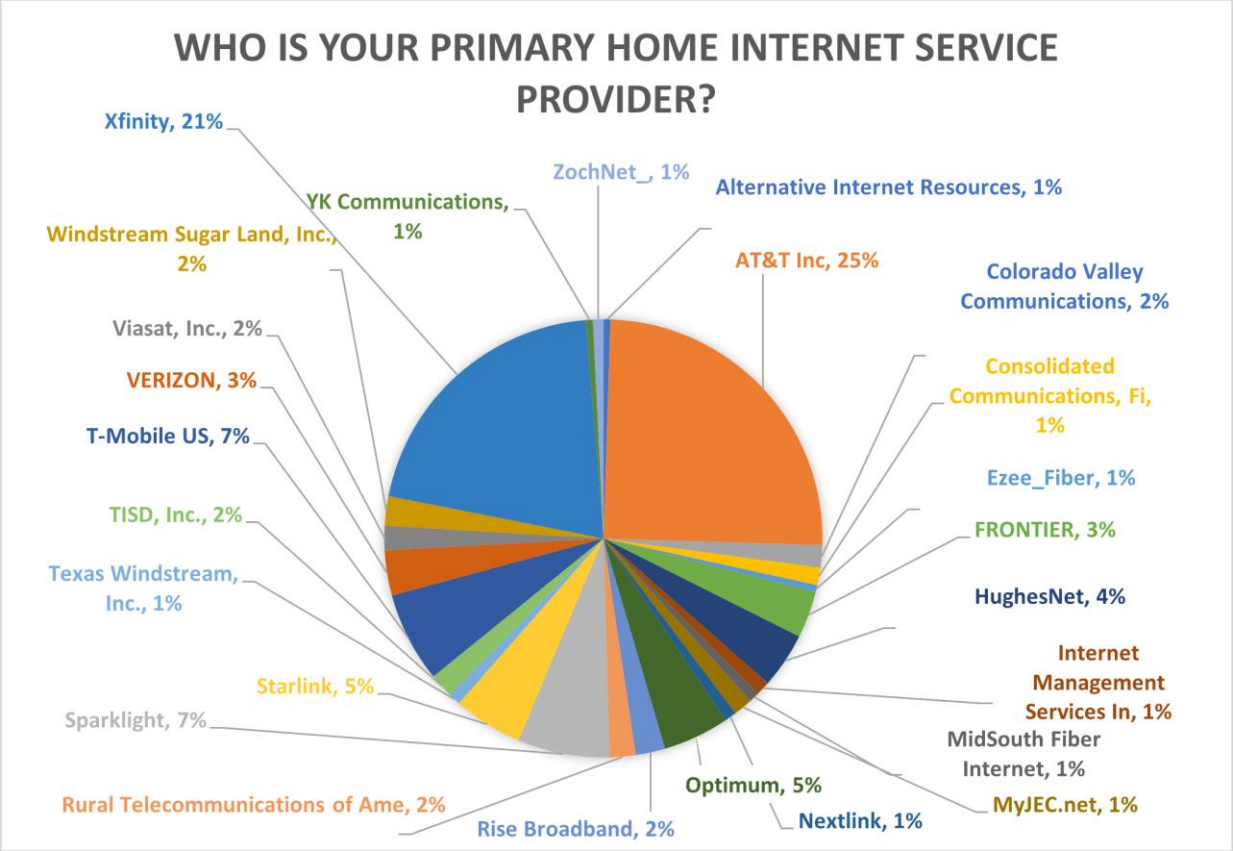


FIGURE 15 - INTERNET SERVICE PROVIDERS OF SURVEY RESPONDENTS (HOME)

Overall for home services, AT&T and Xfinity are the primary internet service providers with more than twenty-four percent (24%) and twenty percent (20%), respectively, of all service subscriptions, with the next largest providers, Sparklight and T-Mobile, each only serving seven percent (7%) of the survey respondents.

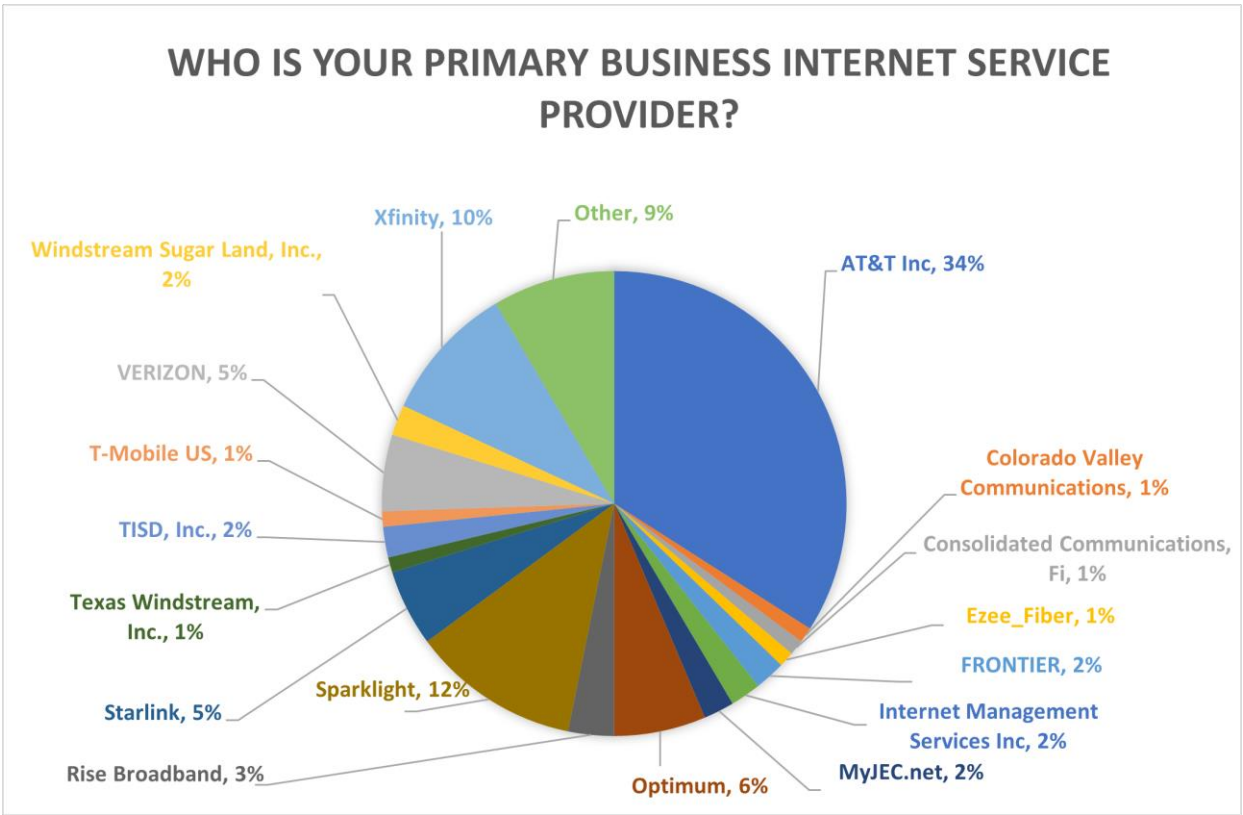


FIGURE 16 - INTERNET SERVICE PROVIDERS OF SURVEY RESPONDENTS (BUSINESS)

For business services, AT&T is the largest primary internet service provider claiming thirty-four percent (34%) of all service subscriptions. Note that any service provider accounting for less than one percent (1%) of subscriptions were excluded from the graph.

Survey respondents were also asked about the likelihood of them recommending their home service provider to a friend or colleague. The majority of respondents who responded indicated they were neutral, with a total of twenty-eight percent (28%) saying they were likely or very likely to recommend the service and twenty-two percent (22%) saying they were unlikely or very unlikely to recommend it.

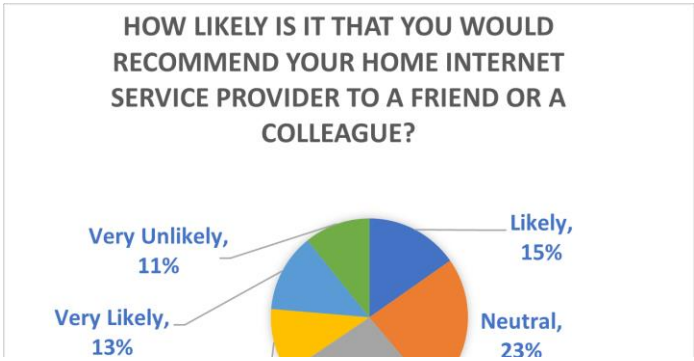


FIGURE 17 - LIKELIHOOD TO RECOMMEND HOME ISP

Survey respondents were also asked about the likelihood of them recommending their home service provider to a friend or colleague. The majority of respondents who responded indicated they were neutral, with a total of twenty-eight percent (28%) saying they were likely or very likely to recommend the service and twenty-two percent (22%) saying they were unlikely or very unlikely to recommend it.

When asked the same question regarding business service provider, the majority of respondents also indicated they were neutral. Similarly, a total of thirty-two percent (32%) said they were likely or very likely to recommend the service and thirty-one percent (31%) saying they were unlikely or very unlikely to recommend it.

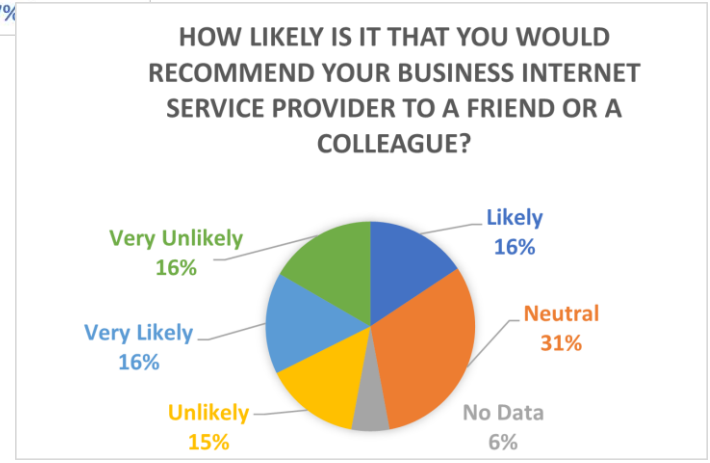


FIGURE 18 - LIKELIHOOD TO RECOMMEND BUSINESS ISP

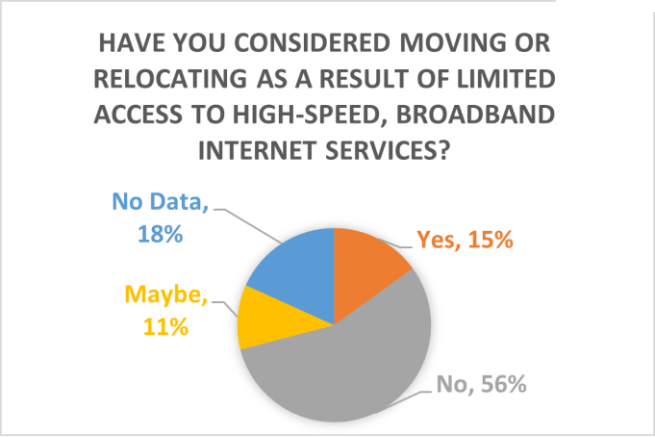


FIGURE 19 - LIKELIHOOD OF MOVING DUE TO INTERNET SERVICE QUALITY

Another survey question relates to whether dissatisfaction with internet service can incentivize residents to move to a different area, with the majority indicating no, but twenty-six (26%) answering that maybe or yes, they have considered moving as a result.

USAGE

Aggregated by the number of mentions, the usage statistics for the City's residents for home services include a variety of internet applications, the most common ones being email, shopping, social media, and streaming video. Those who work full or part time from home make up approximately five percent (5%) of the responses, while telehealth and online education is approximately eight percent (8%) of internet usage.

HOME INTERNET USAGE IN THE H-GAC AREA

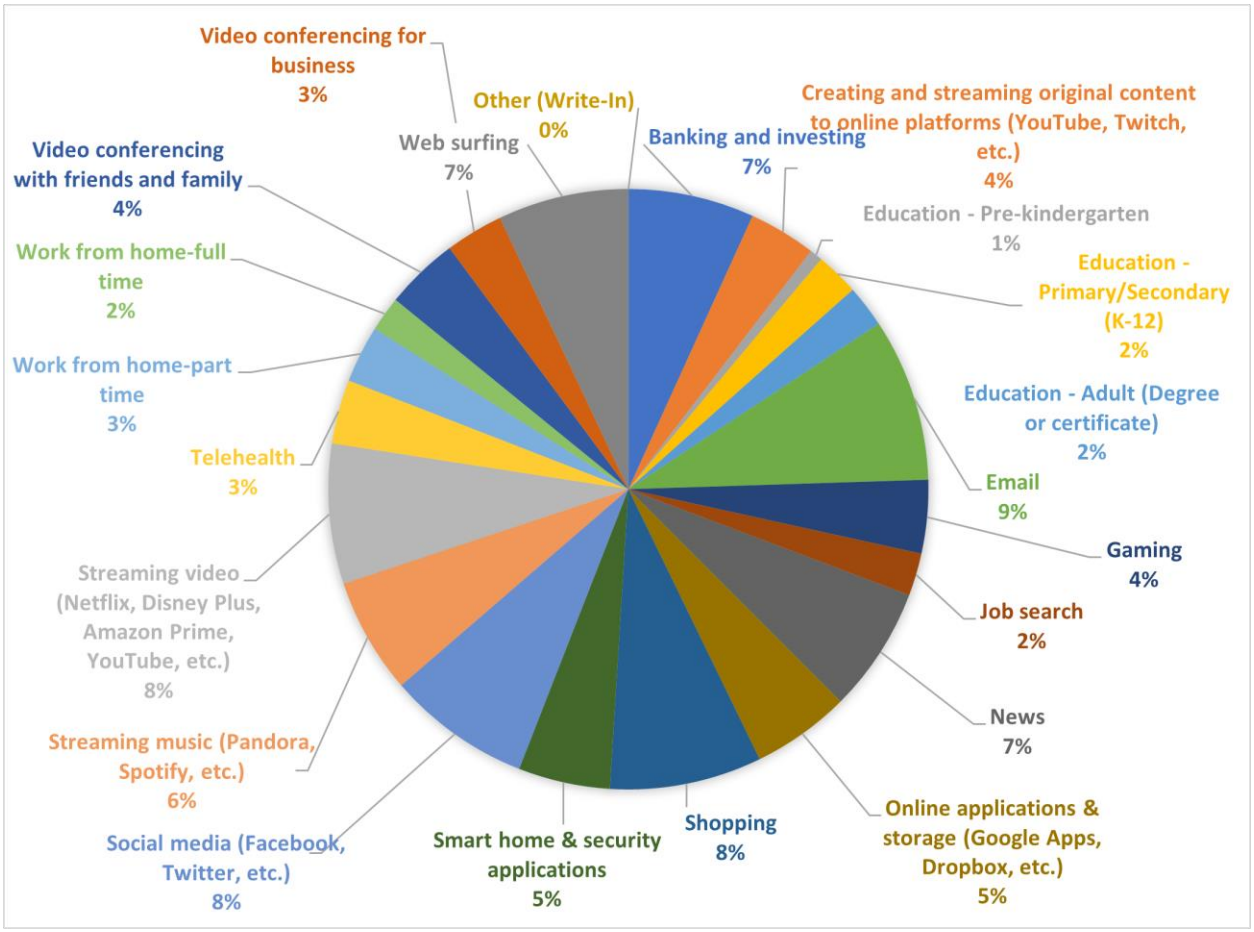


FIGURE 20 - USAGE OF HOME INTERNET APPLICATIONS

Aggregated by the number of mentions, the usage statistics for the City's residents for business services include a variety of internet applications, the most common ones being email, company website, data management, back-up, or storage, social media, video conferencing, and education and professional development. Wi-Fi hotspots for staff/employees and customers are approximately eight percent (8%) of the responses, while operations in the cloud is approximately five percent (5%) of internet usage.

HOW DO YOU USE BROADBAND INTERNET AT YOUR BUSINESS?

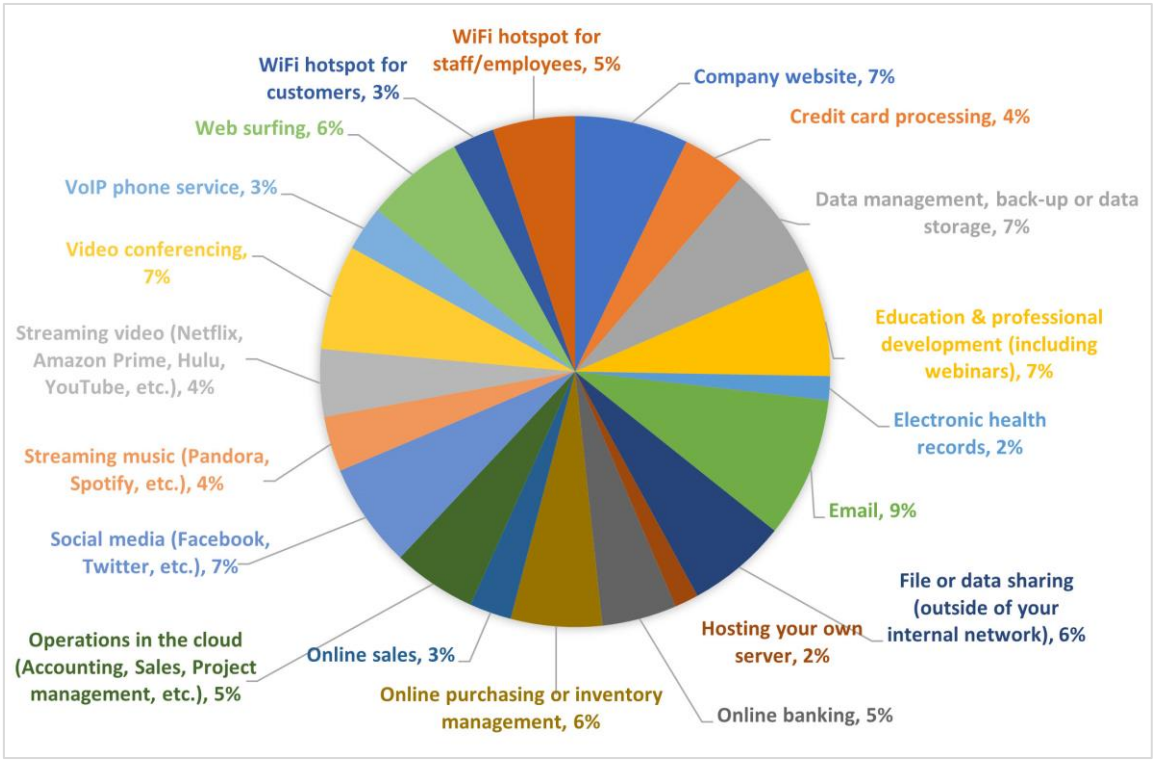


FIGURE 21 - USAGE OF BUSINESS INTERNET APPLICATIONS

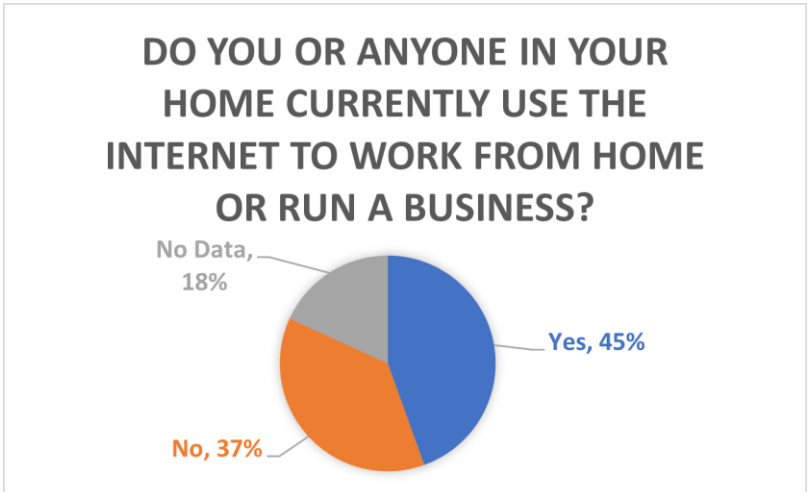


FIGURE 22 - WORK FROM HOME STATISTICS

In another question respondents were asked if anyone in their home is currently working from home or running a business. This question reflects the remote work culture instigated by the pandemic, as seen with the results being close to nearly half of respondents answering "yes".

SERVICE INTERRUPTIONS ARE NOT MANAGEABLE IN H-GAC COMMUNITIES

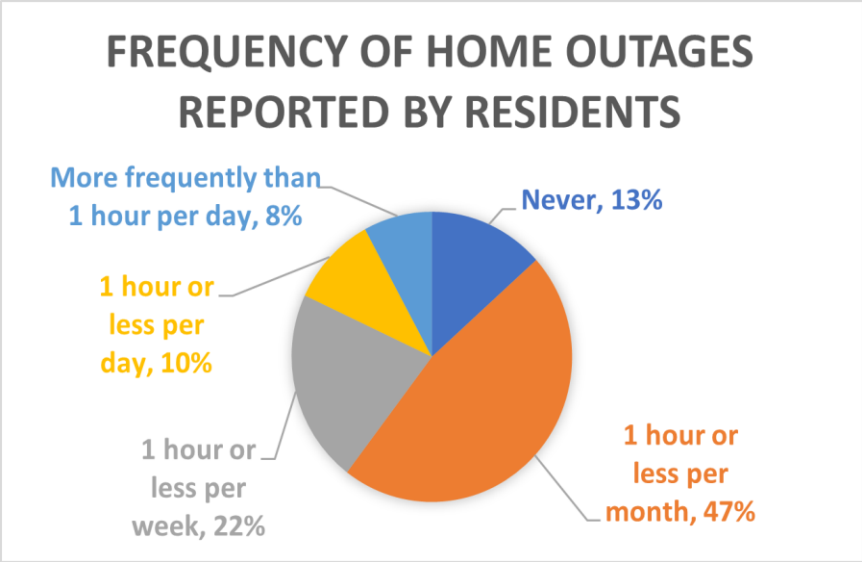


FIGURE 23 - FREQUENCY OF HOME OUTAGES

Less than half of survey respondents indicated that home service interruptions are relatively common. A significant percentage, twenty-two, (22%) of residential service subscribers have experienced an outage for an hour or less a week, with ten (10%) experiencing them more than one hour or less a day, and eight (8%) experiencing an outage more frequently than 1 hour per day. Forty-seven (47%) of residential service subscribers have outages for an hour or less a month.

On the other hand, many survey respondents indicated that business service interruptions are relatively common. A significant percentage, twenty-five (25%) of business service subscribers have experienced an outage for an hour or less a week, with ten (10%) experiencing them more than one hour or less a day, and twenty-three (23%) experiencing an outage more frequently than 1 hour per day. Thirty-two (32%) of business service subscribers have outages for an hour or less a month.

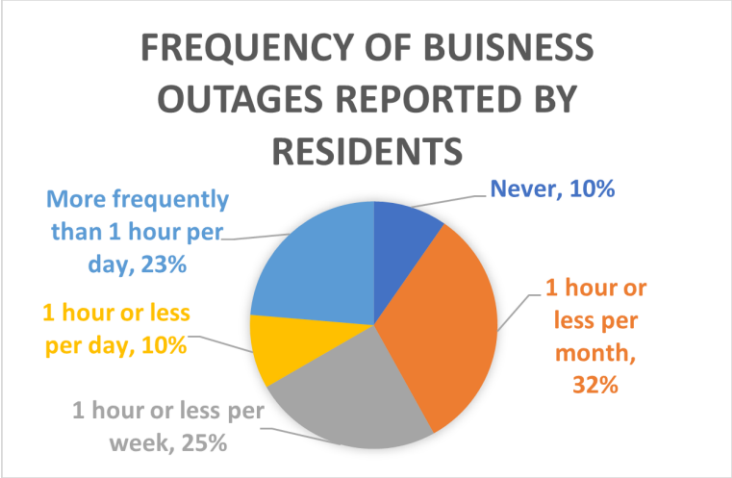


FIGURE 24 - FREQUENCY OF BUSINESS OUTAGES

SATISFACTION VS IMPORTANCE OF SERVICE CATEGORIES

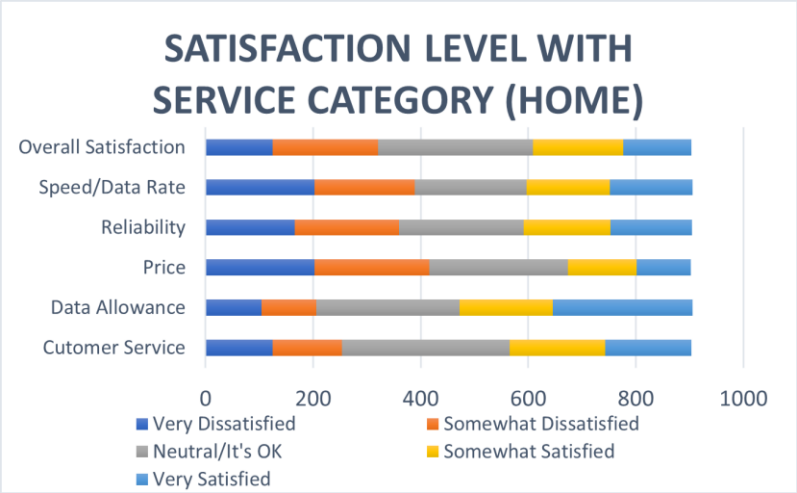


FIGURE 25 - SATISFACTION LEVEL WITH SERVICE CATEGORY (HOME)

The colored bar graphs in Figure 25 shows level of satisfaction in each of the following service categories (overall satisfaction, speed/data rate, reliability, price, data allowance, customer service), with the lighter blue color indicating very satisfied in the category. The majority of respondents range from feeling “ok” to “highly dissatisfied” about these categories. Note that data allowance is not a concern for the respondents as shown by the width of “very satisfied” and “somewhat satisfied”.

Figure 26 to the right shows that similarly to home services, most respondents range from feeling “ok” to “very dissatisfied” about these categories, with the exception of data allowance. Data allowance is the category they are content with as noted by the widths of the “satisfied” and “highly satisfied” bars.

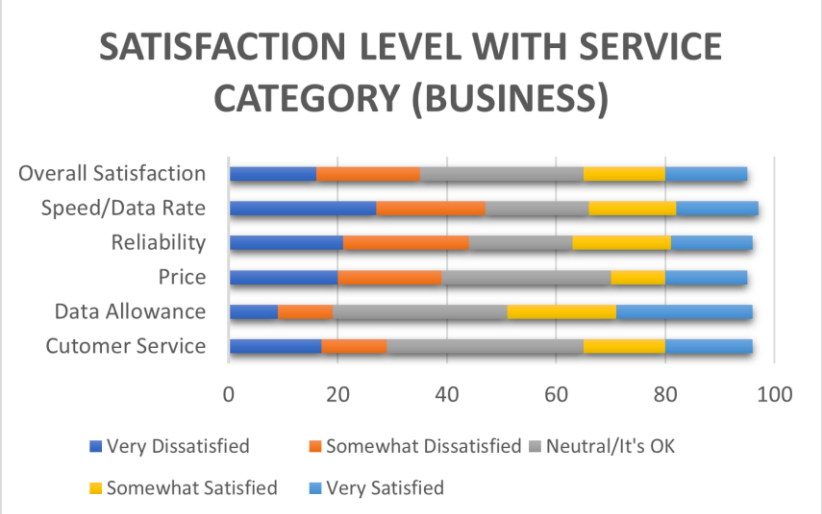


FIGURE 26 - SATISFACTION LEVEL WITH SERVICE CATEGORY (BUSINESS)

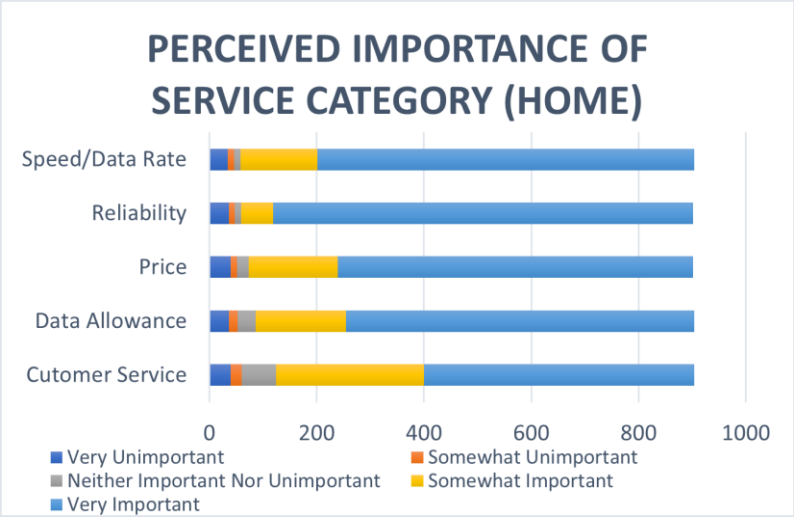


FIGURE 27 - IMPORTANCE PER SERVICE CATEGORY (HOME)

Figure 27 shows how important the service category is to the individual respondents. Here, the lighter blue color shows a service category is very important to an individual respondent. The perceived importance for business service is in the following ranked order: reliability, speed/data rate, price, data allowance, and customer service. These perceived importance rankings show that respondents would like relatively reliable service, and the cost of said service to be aligned.

In Figure 28, the perceived importance for business service is in the following ranked order: reliability, speed/data rate, data allowance, price, and customer service. These perceived importance rankings show that respondents would like to have relatively reliable service, and the speed/data rate to be in line with their expectations for the service.

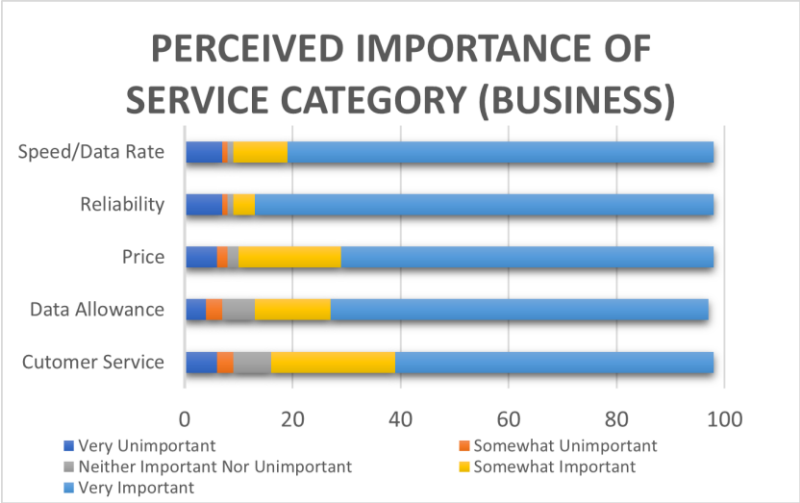


FIGURE 28 - IMPORTANCE PER SERVICE CATEGORY (BUSINESS)

Figure 29 through Figure 32 provide a visual representation of the respondents' demographics. The respondents are characterized by a slight lean toward female respondents and a relatively even distribution of ages, although most were over the age of 35 years old. The income reported was household income and not an individual's income. The income of the respondents is distributed relatively even across each income bracket. Similarly, the majority of the respondents have a higher education. Typically, this distribution is intuitive as the higher educated are also typically more concerned with being connected and more likely to leverage current technologies.

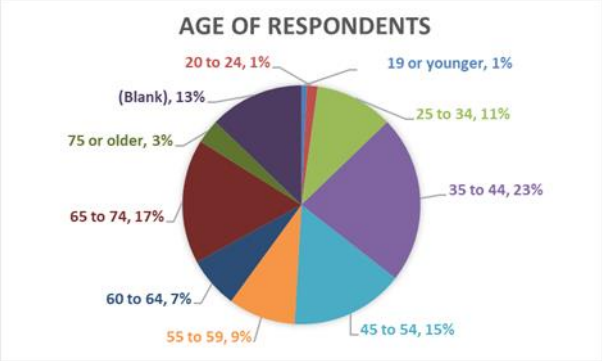


FIGURE 29 - AGE OF RESPONDENTS

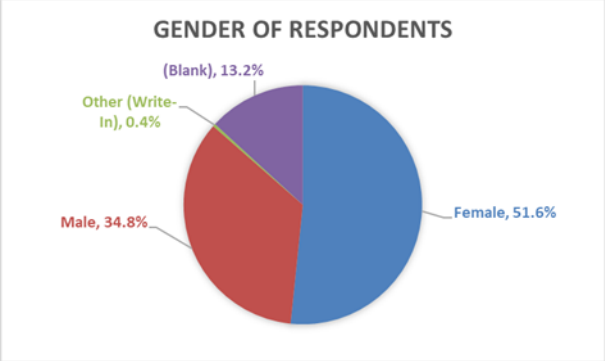


FIGURE 30 - GENDER OF RESPONDENTS

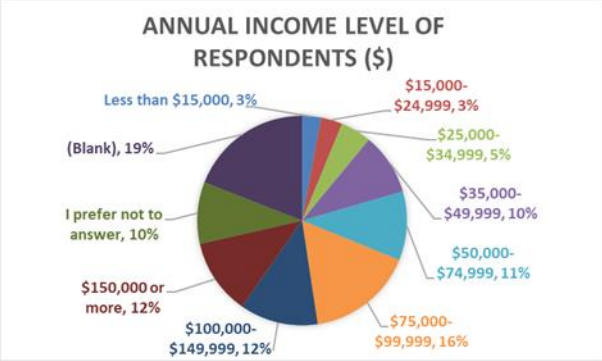


FIGURE 31 - ANNUAL INCOME LEVEL OF RESPONDENTS

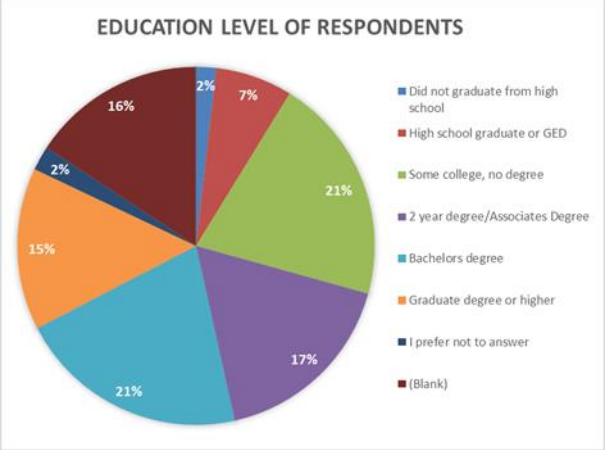


FIGURE 32 - EDUCATION LEVEL OF RESPONDENTS

LEVEL OF SUPPORT FOR COMMUNITY INVOLVEMENT TO FACILITATE BROADBAND SERVICE

Survey respondents were questioned to determine their support for public action to promote broadband service for their community. Eighty-six (86%) of respondents consider Internet to be an essential public infrastructure and an essential utility like electricity, water, and transportation.

In relation to the priorities that have moved online during the pandemic, respondents were asked about the importance they place on broadband services supporting remote work, health care, and education in the community, with the following results:

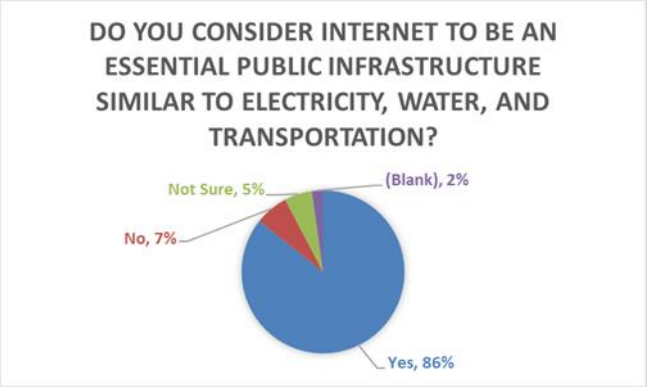


FIGURE 33 - INTERNET AS AN ESSENTIAL INFRASTRUCTURE

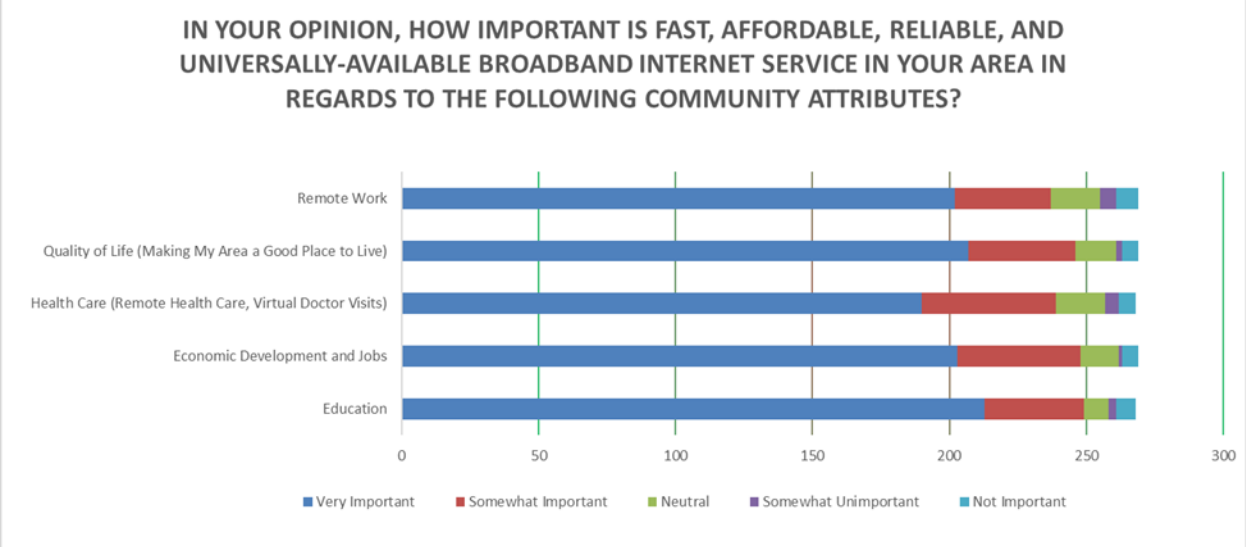


FIGURE 34 - ISP COMMUNITY ATTRIBUTES

These results indicate that the community strongly believes that Internet that provides access to a higher quality of life, education, and jobs is very important or somewhat important, and when asked how well providers are meeting these needs, approximately 40% of respondents indicated that they met the bare minimum or not at all.

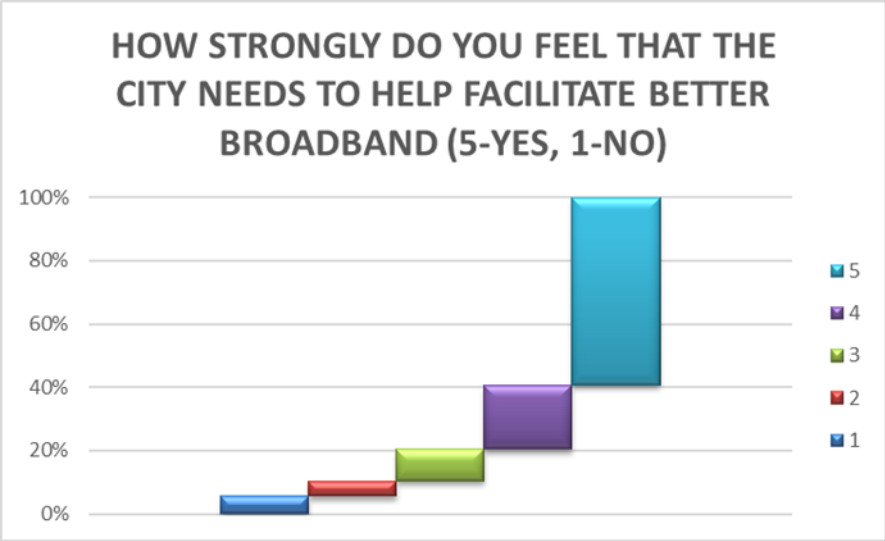


FIGURE 35 - RATE OF CURRENT PROVIDERS MEETING COMMUNITY NEEDS

CROSS COMPARATIVE ANALYSIS OF FCC DATA AND SURVEY FINDINGS

The following exhibits demonstrate the broadband service quality reported in each of the 13 H-GAC Counties by regulatory sources. The "Fabric" data is determined by provider-submitted biannual Broadband Data Collection reporting for each address within the specified county. For each county, a wired and fixed wireless technologies map was pulled from Broadband Money, as well as an all-technologies map. This data was then compared to the actual survey results to show if discrepancies exist between what providers are claiming is available versus what is truly available in H-GAC Counties. It is evident that there are unserved and underserved areas within each county when comparing the all-technologies map with the wired and fixed wireless maps. If the Counties had enough participants, they may go ahead and use their survey data to challenge the "Fabric" data and show what is truly available in each County. Please see the Action Plans for each county for a further analysis of this data.

AUSTIN COUNTY

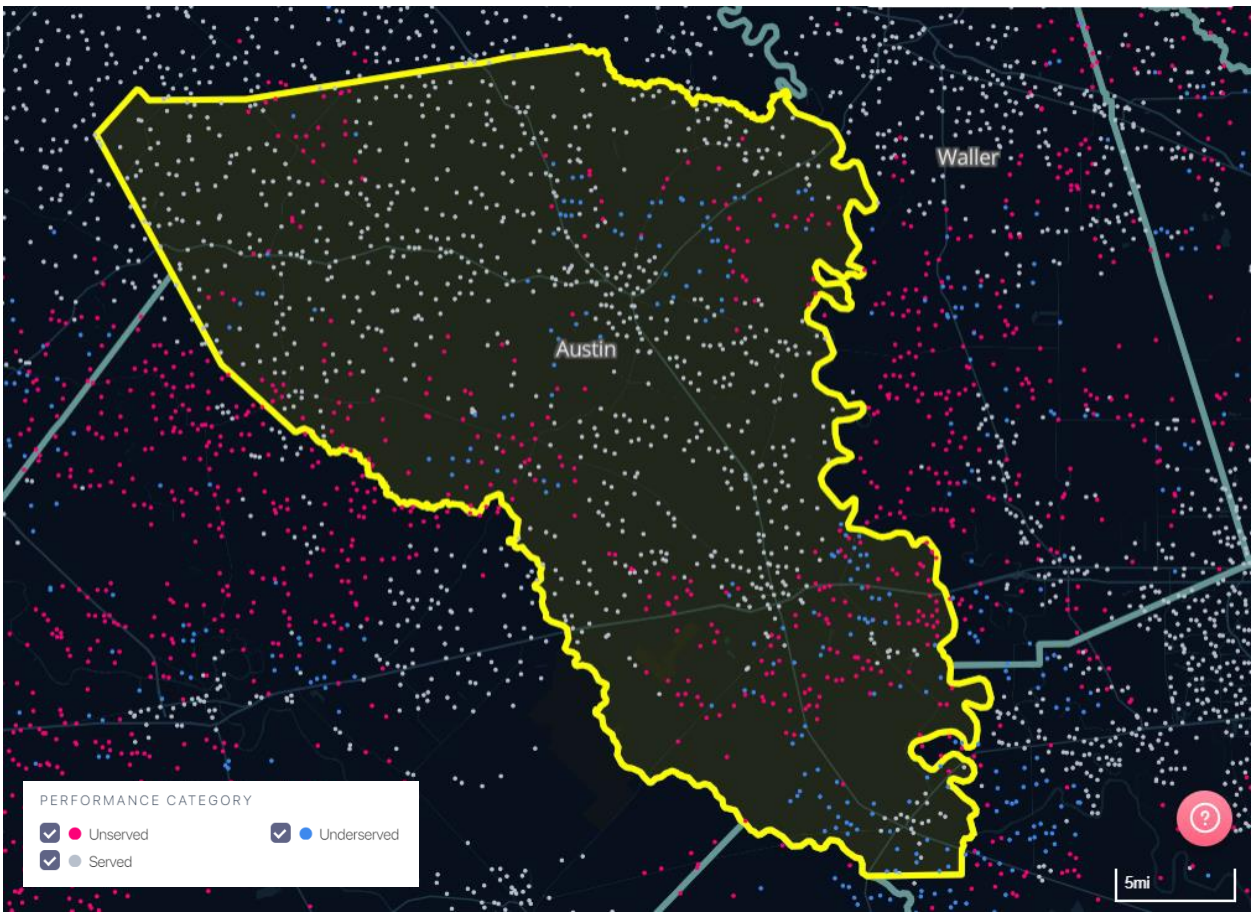


FIGURE 37 - AUSTIN COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

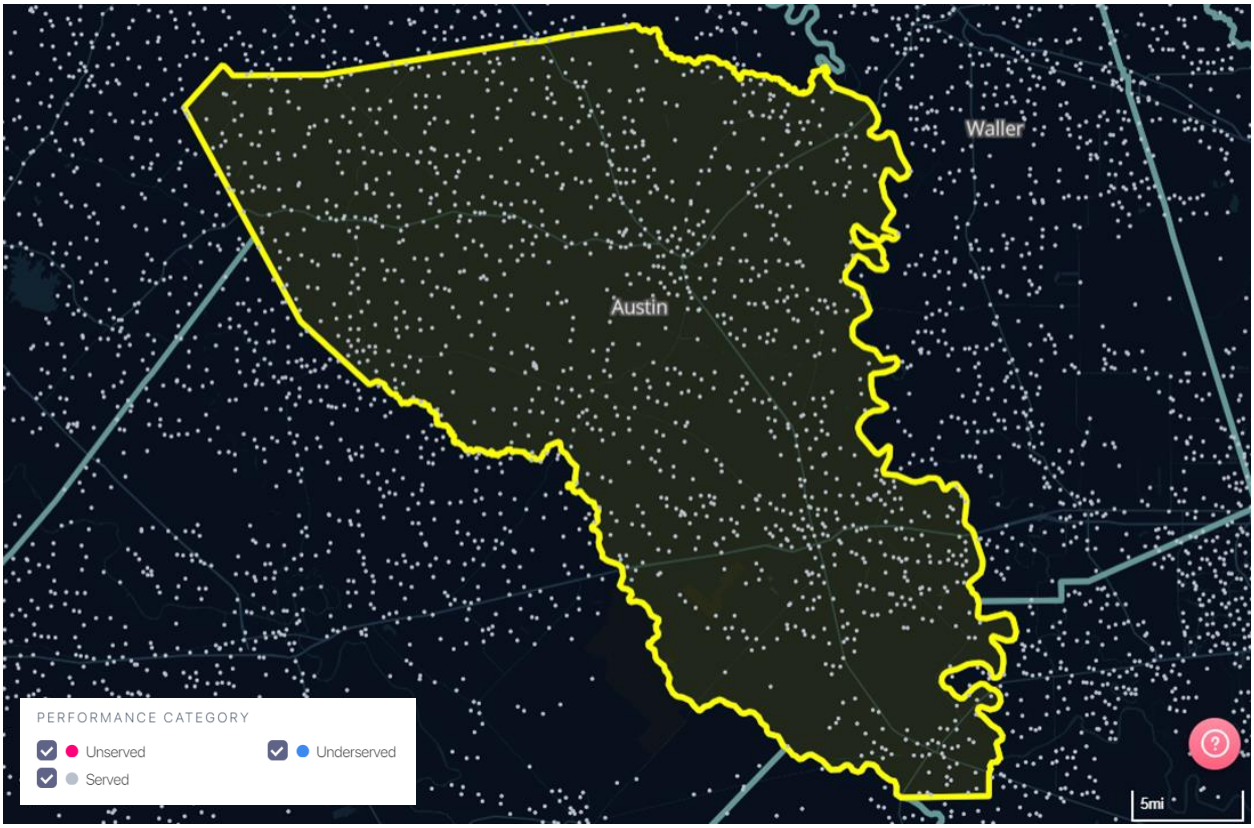


FIGURE 38 - AUSTIN COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

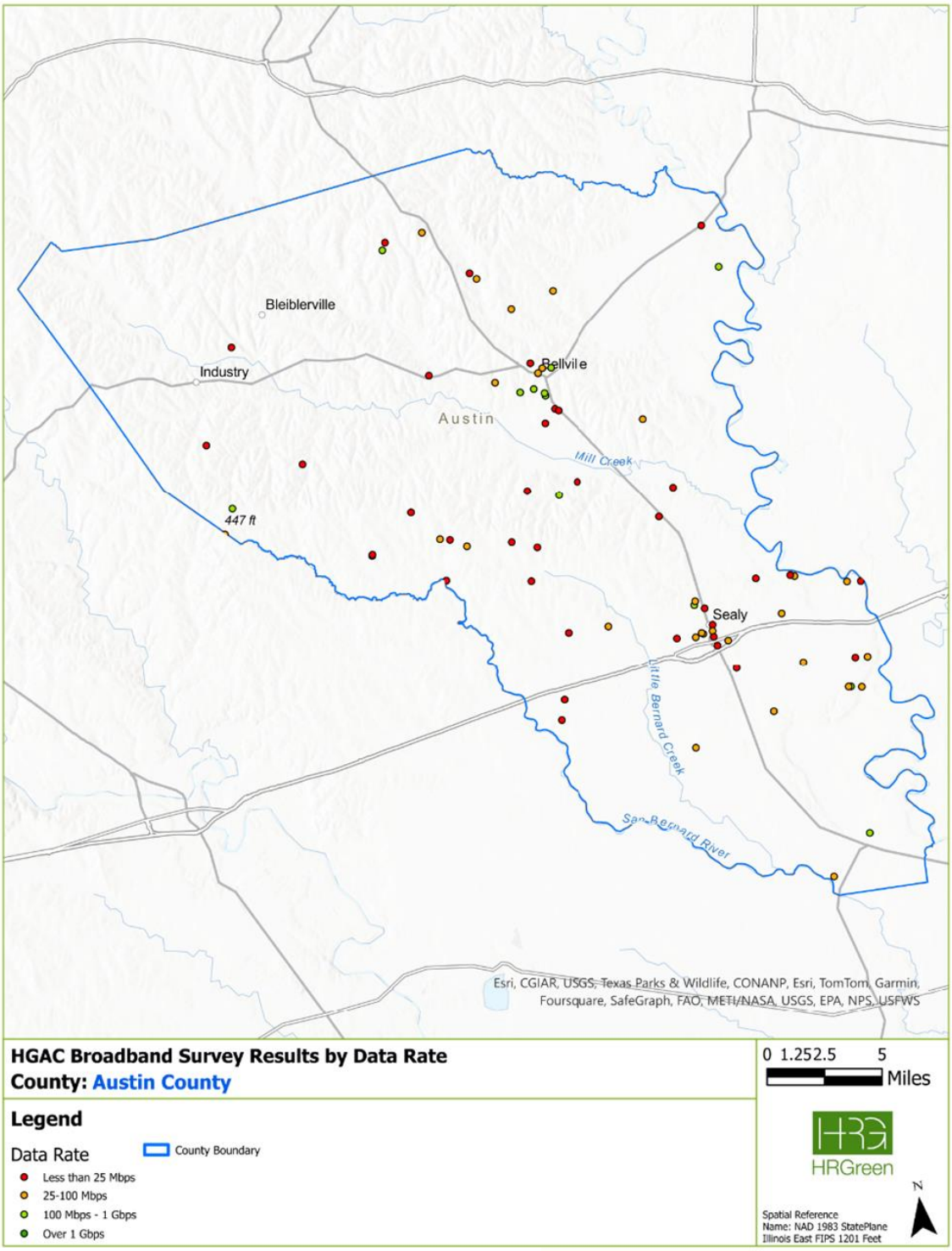


FIGURE 39 - AUSTIN COUNTY'S SURVEY RESULTS PERFORMANCE MAP

BRAZORIA COUNTY

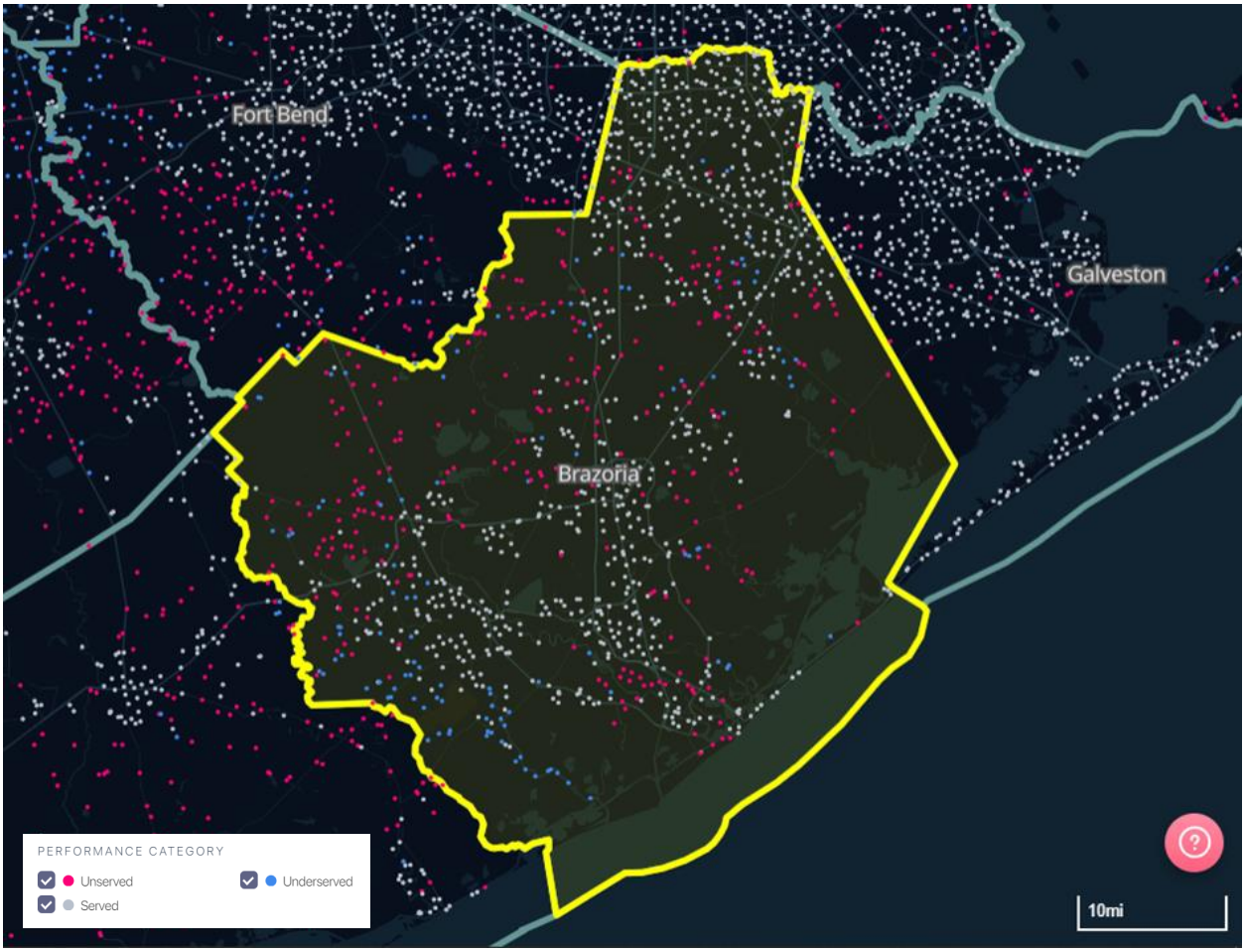


FIGURE 40 - BRAZORIA COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

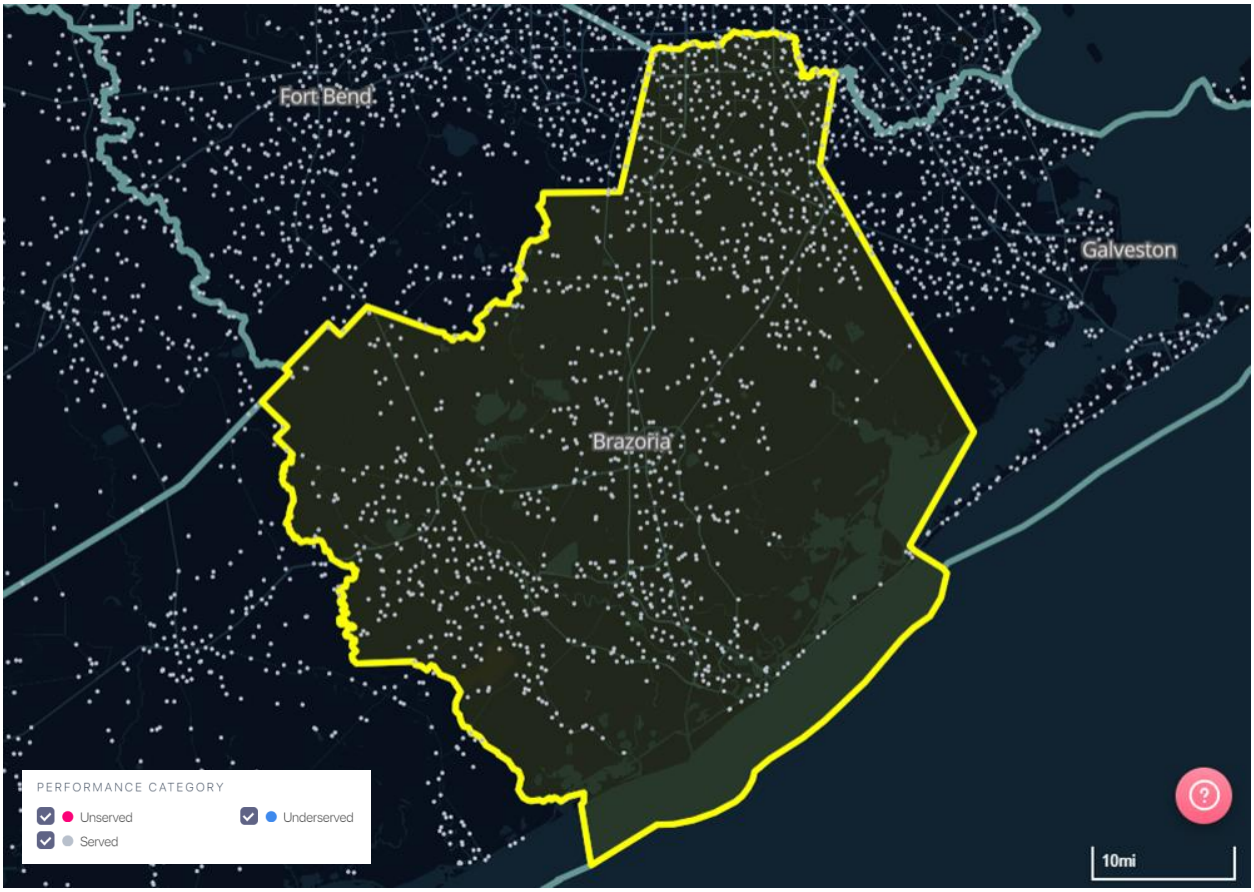


FIGURE 41 - BRAZORIA COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

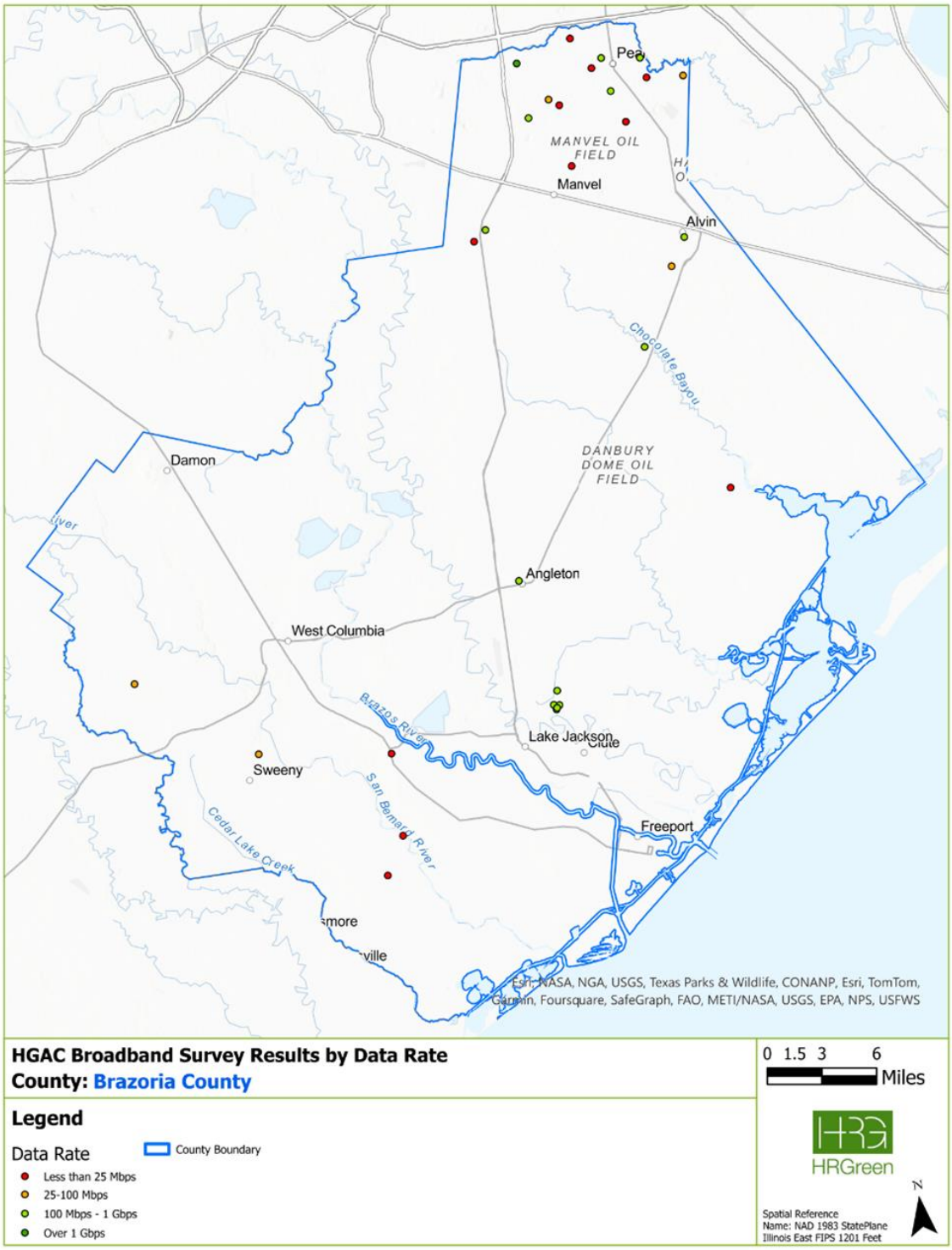


FIGURE 42 - BRAZORIA COUNTY'S SURVEY RESULTS PERFORMANCE MAP

Brazoria County received survey results from a previous study. Many of the results from that survey were outside of the County. This map shows the total results from both surveys in Brazoria County. Although the data is limited, they do seem to align with the FCC data, except in the northern part of the County. The survey results appear to show more need than the FCC map.

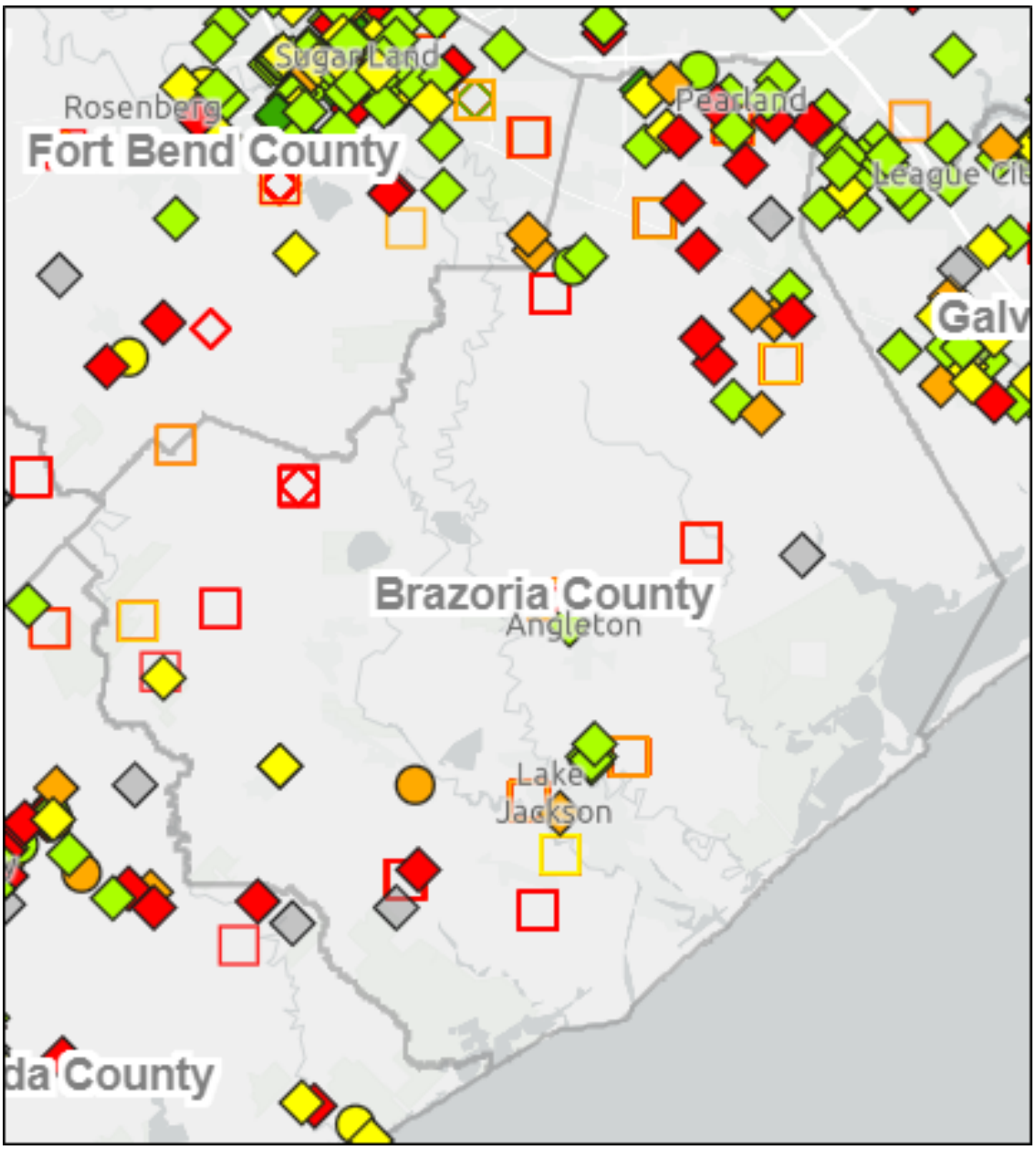


FIGURE 43 - BRAZORIA COUNTY TOTAL SURVEY RESULTS (H-GAC AND PREVIOUS)

CHAMBERS COUNTY

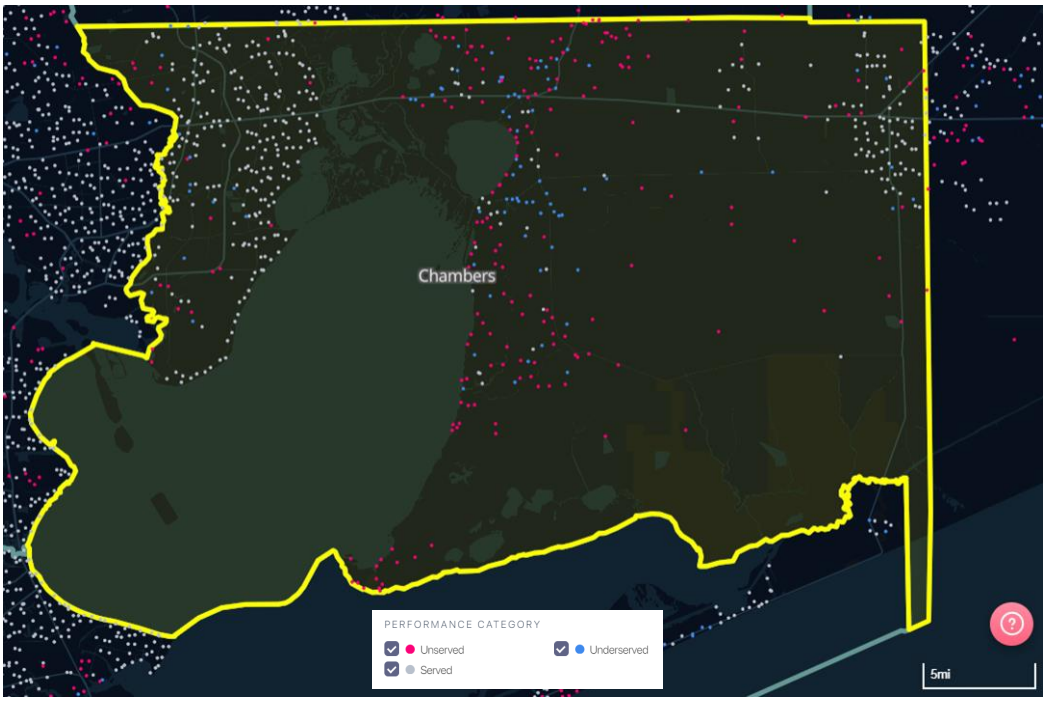


FIGURE 44 - CHAMBERS COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

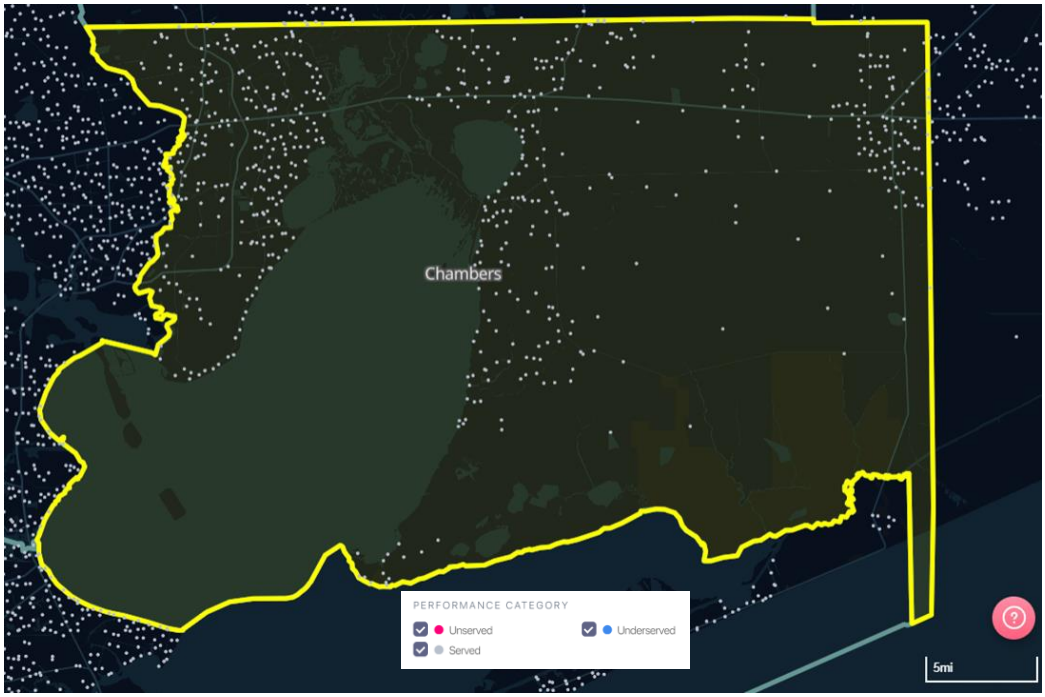


FIGURE 45 - CHAMBERS COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

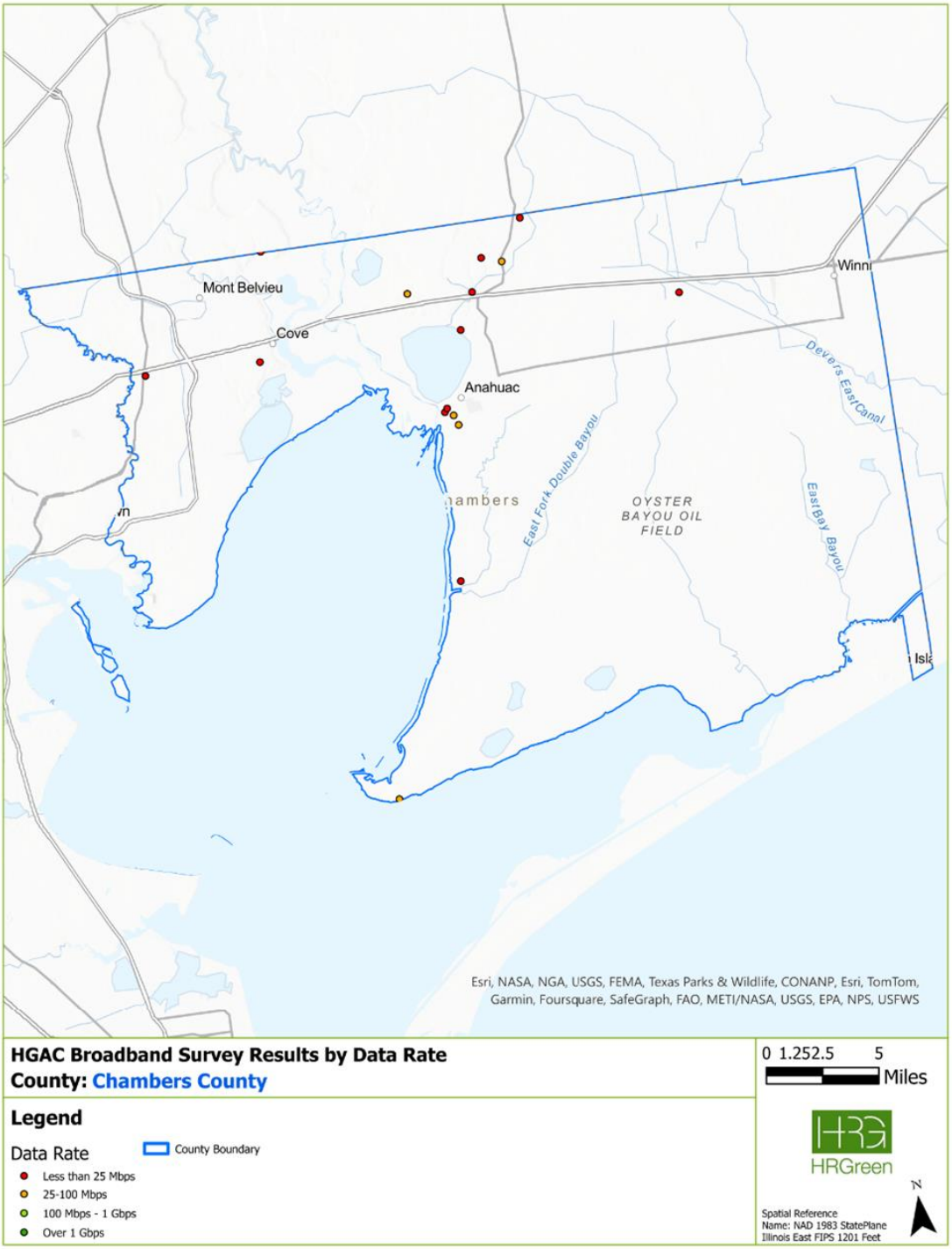


FIGURE 46 - CHAMBERS COUNTY'S SURVEY RESULTS PERFORMANCE MAP

COLORADO COUNTY

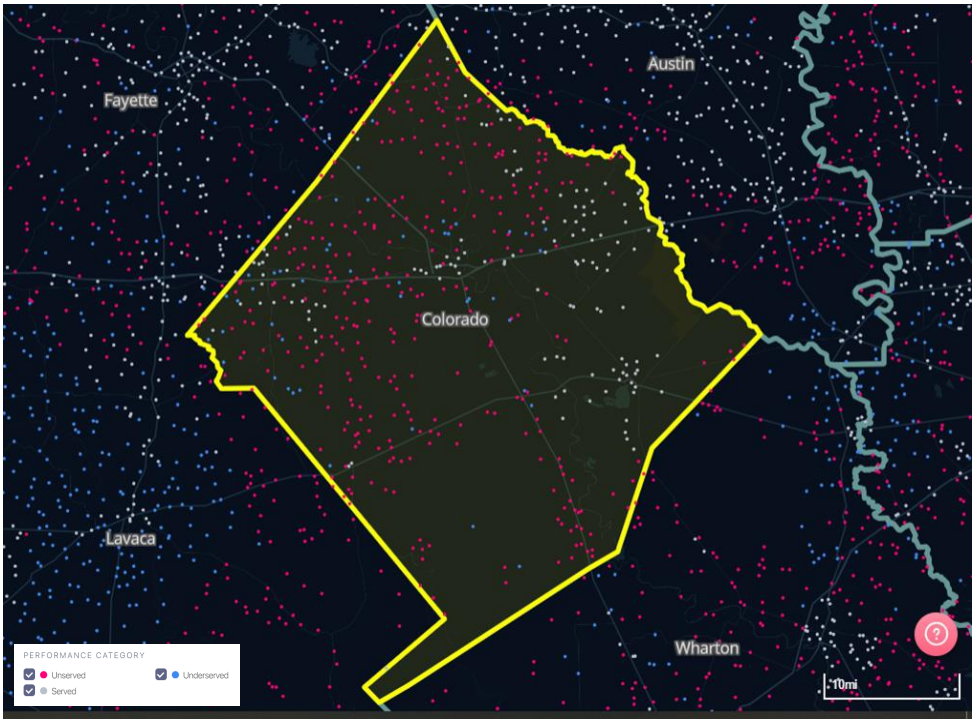
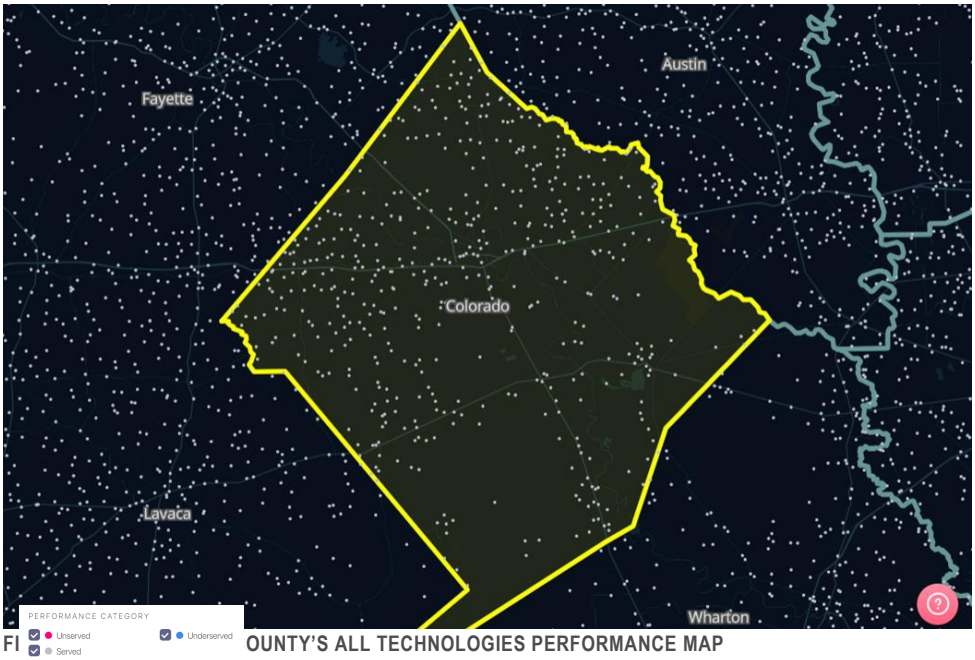


FIGURE 47 - COLORADO COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP



FI OUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

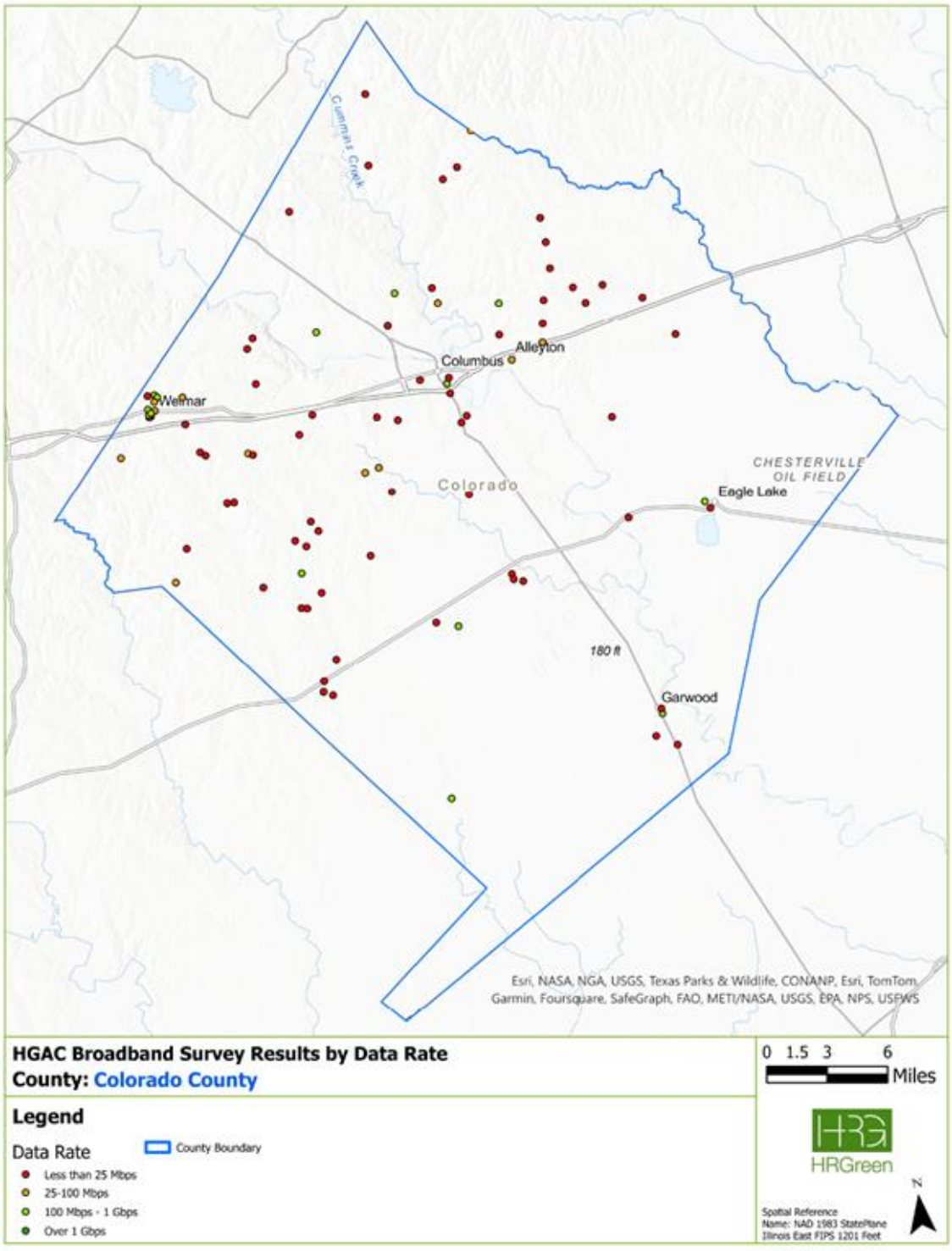


FIGURE 49 - COLORADO COUNTY'S SURVEY RESULTS PERFORMANCE MAP

FORT BEND COUNTY

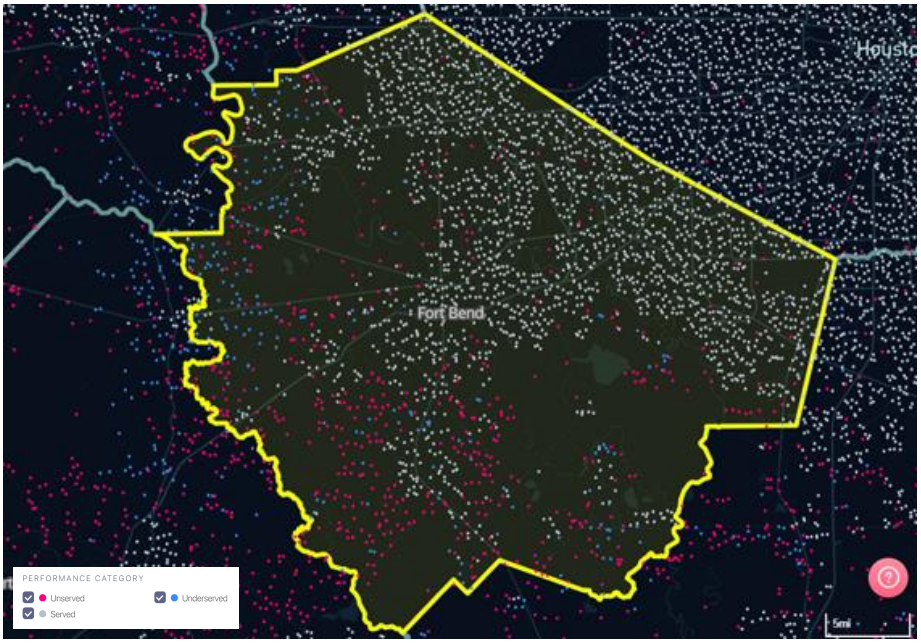


FIGURE 50 - FORT BEND COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

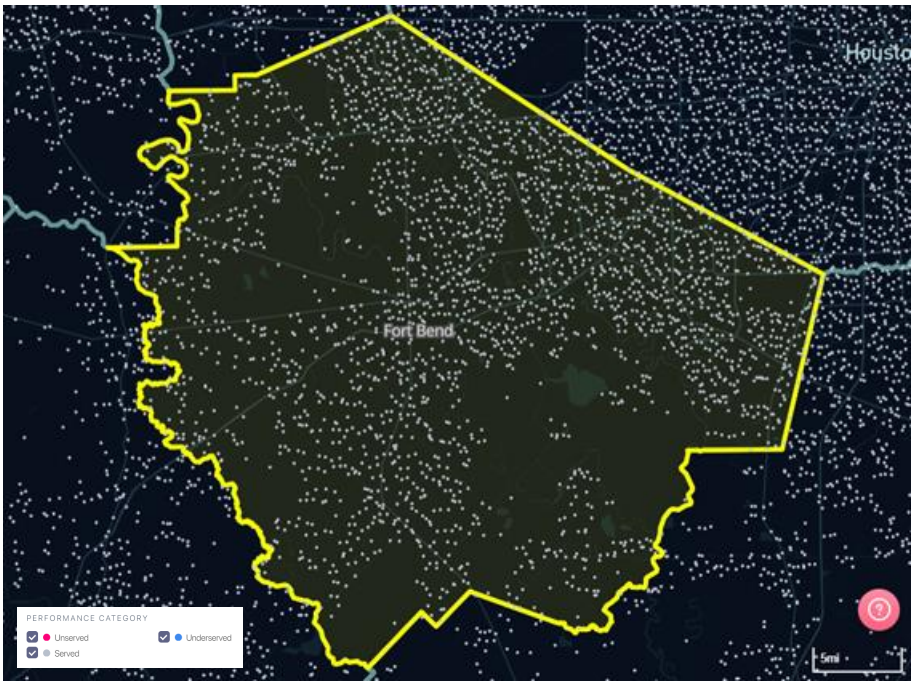


FIGURE 51 - FORT BEND COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

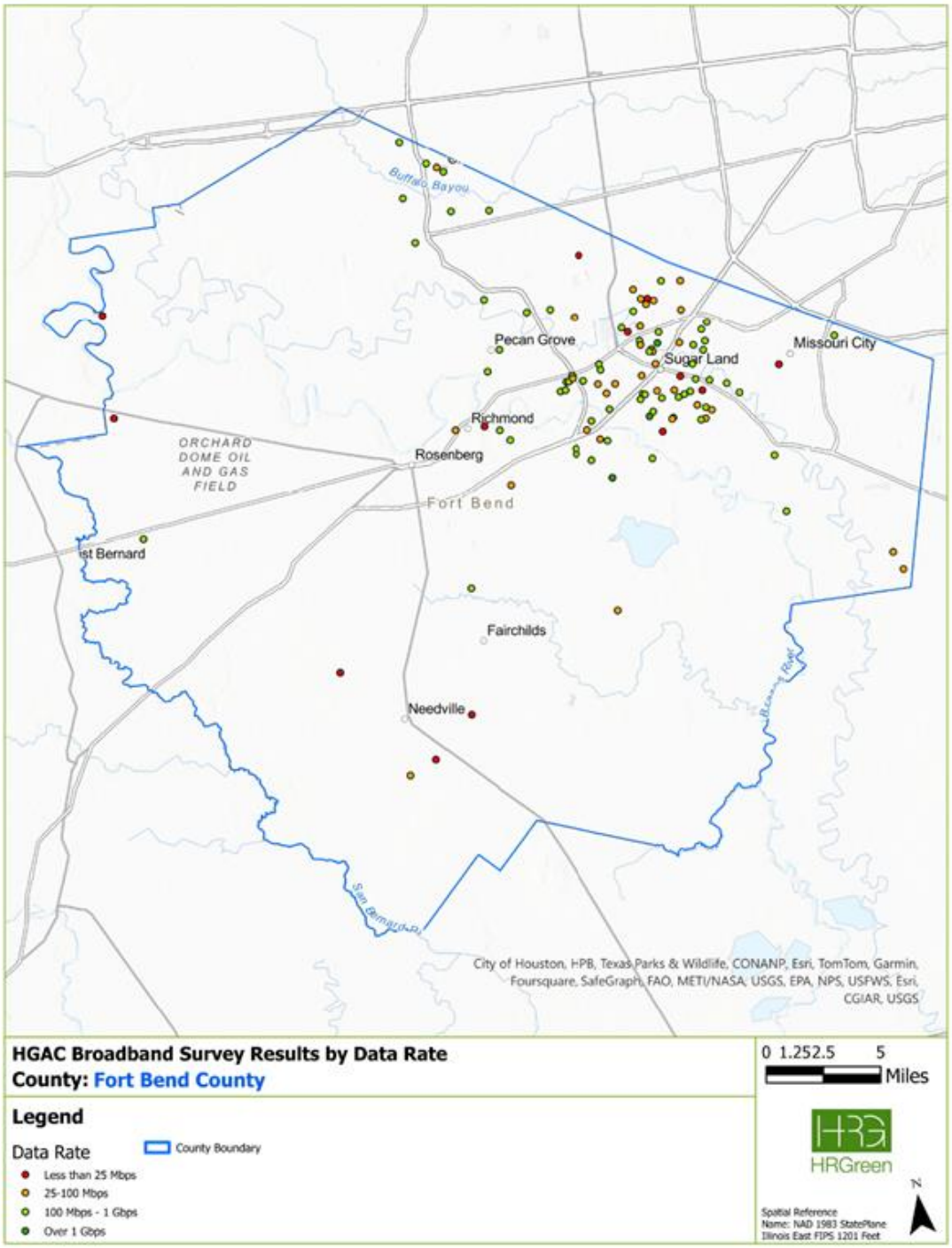


FIGURE 52 - FORT BEND COUNTY'S SURVEY RESULTS PERFORMANCE MAP

GALVESTON COUNTY

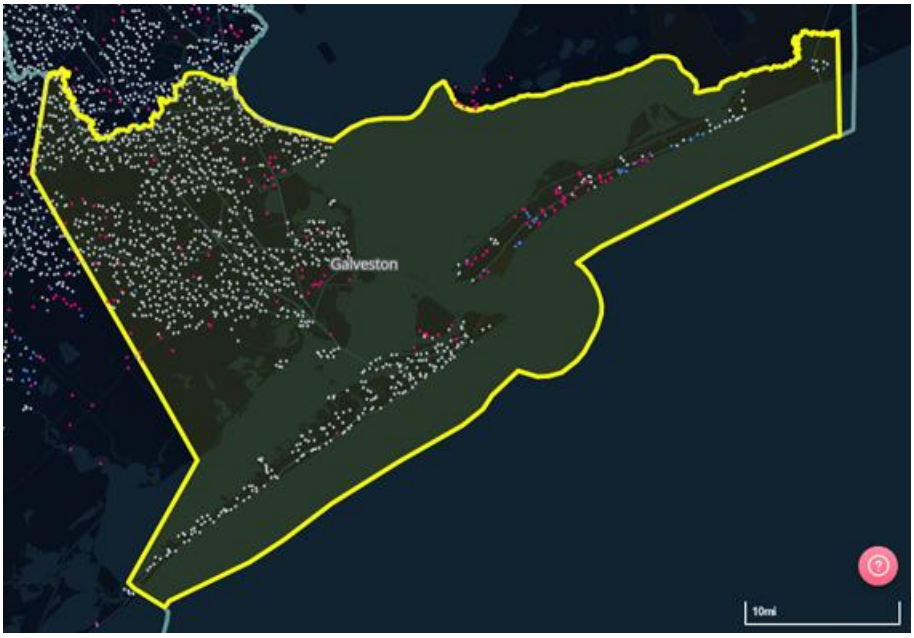


FIGURE 53 - GALVESTON COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

FIGURE 54 - GALVESTON COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

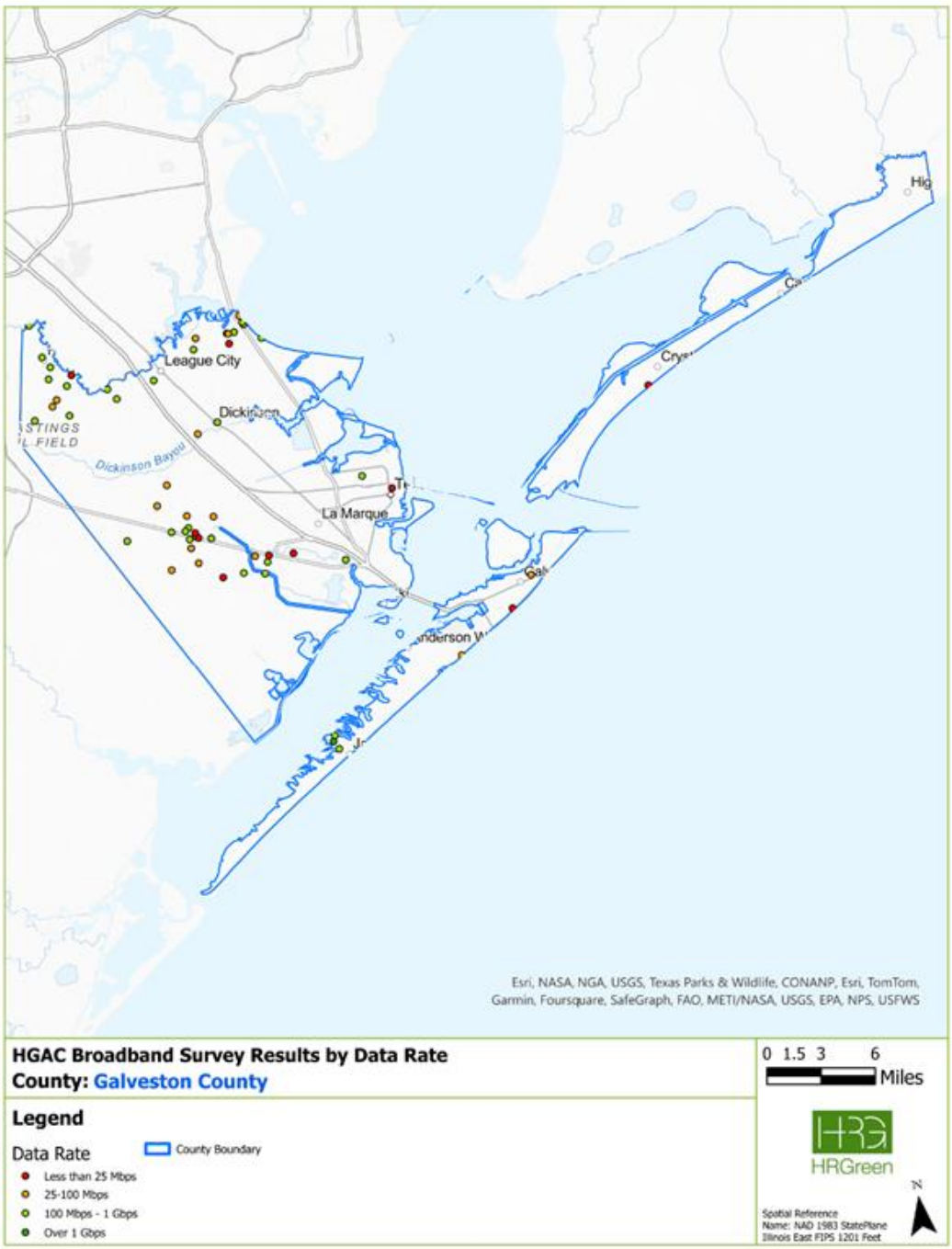


FIGURE 55 - GALVESTON COUNTY'S SURVEY RESULTS PERFORMANCE MAP

HARRIS COUNTY

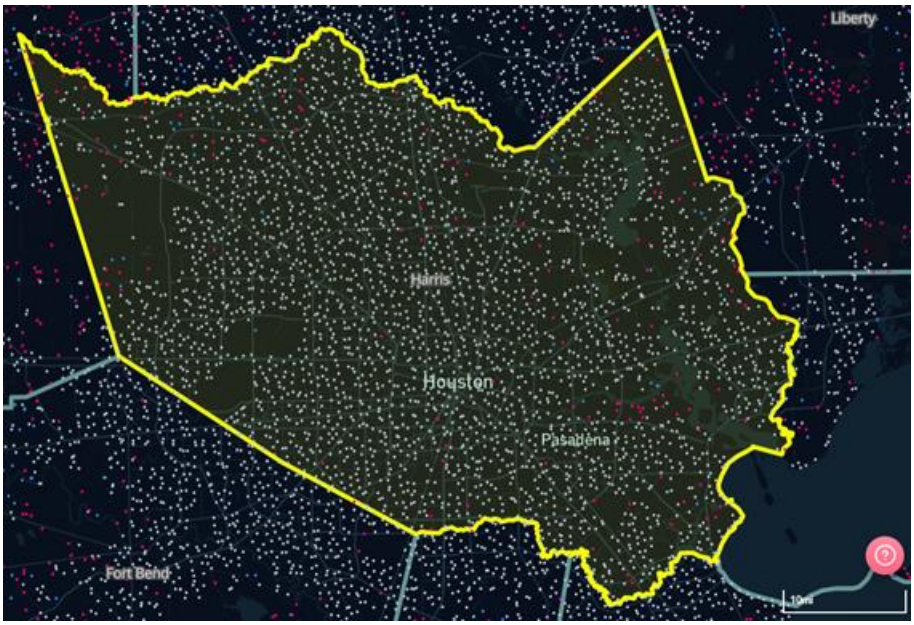


FIGURE 56 - HARRIS COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

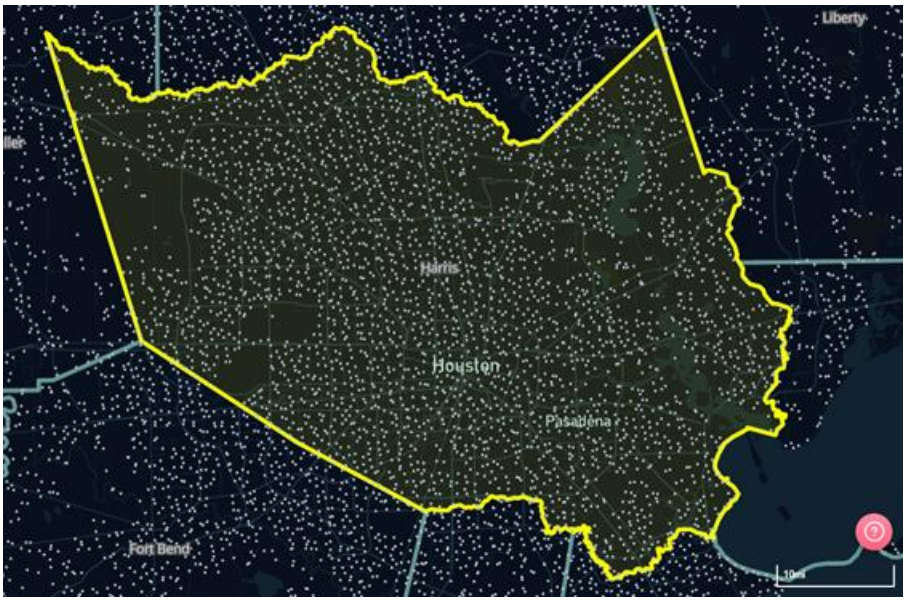


FIGURE 57 - HARRIS COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

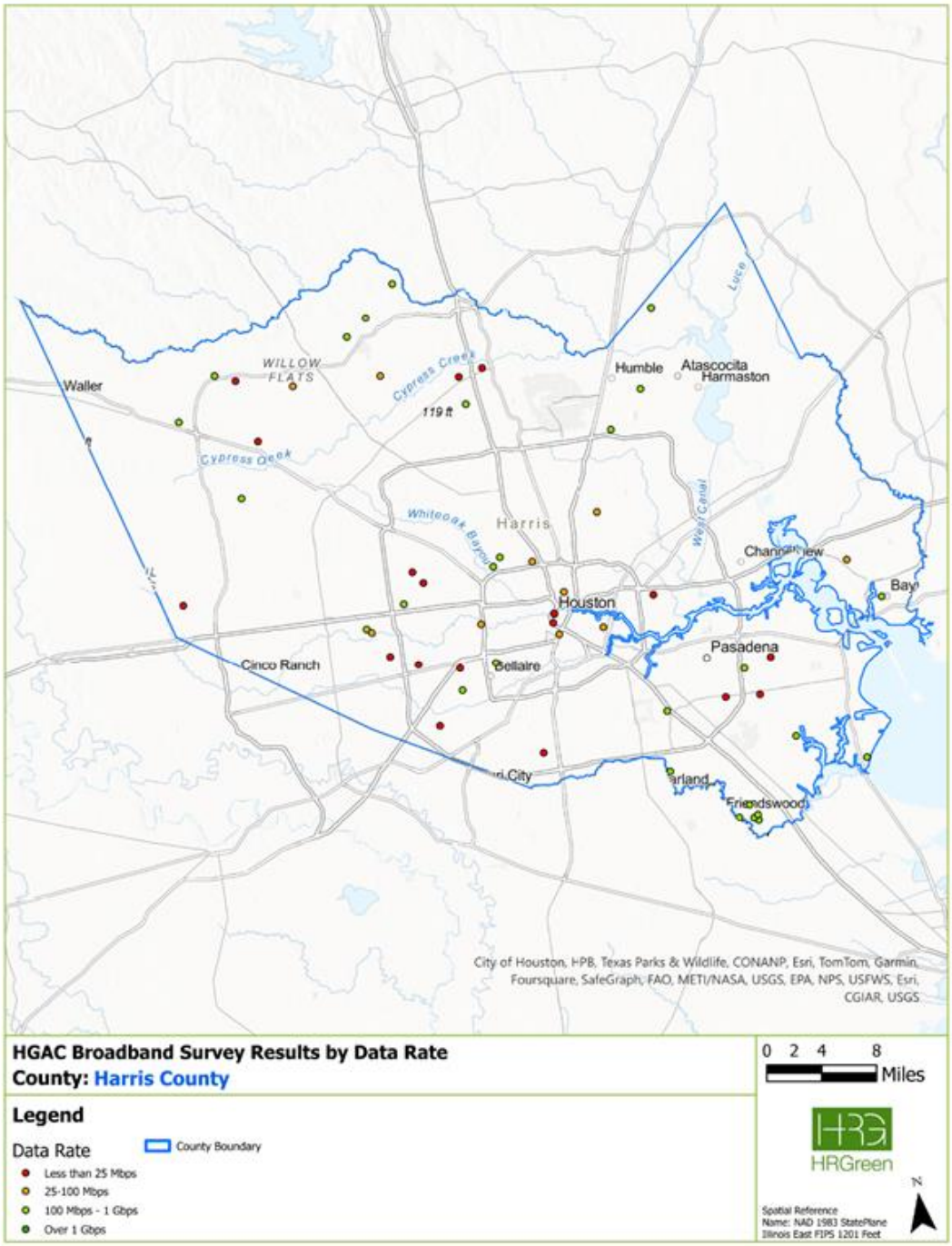


FIGURE 58 - HARRIS COUNTY'S SURVEY RESULTS PERFORMANCE MAP

LIBERTY COUNTY

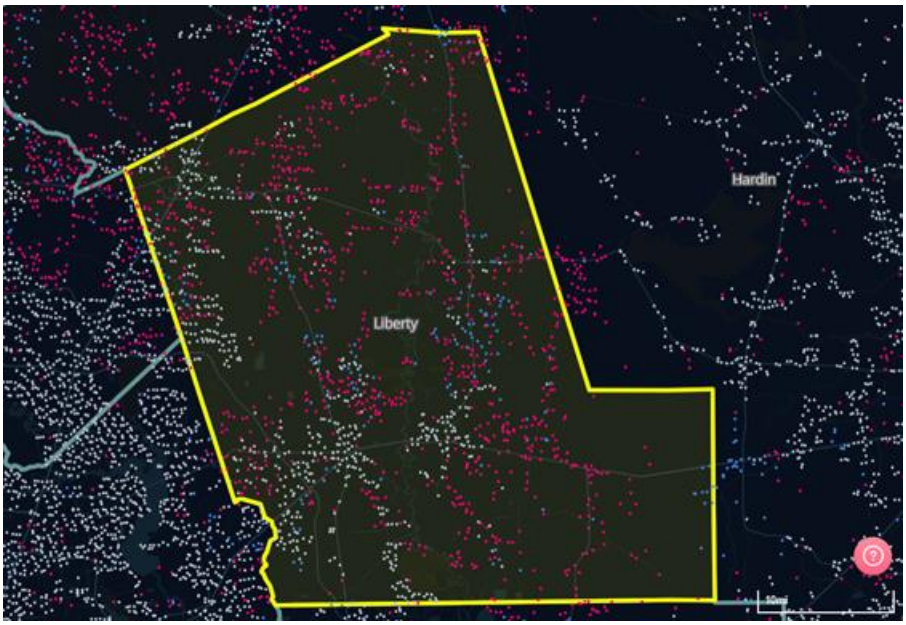


FIGURE 59 - LIBERTY COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

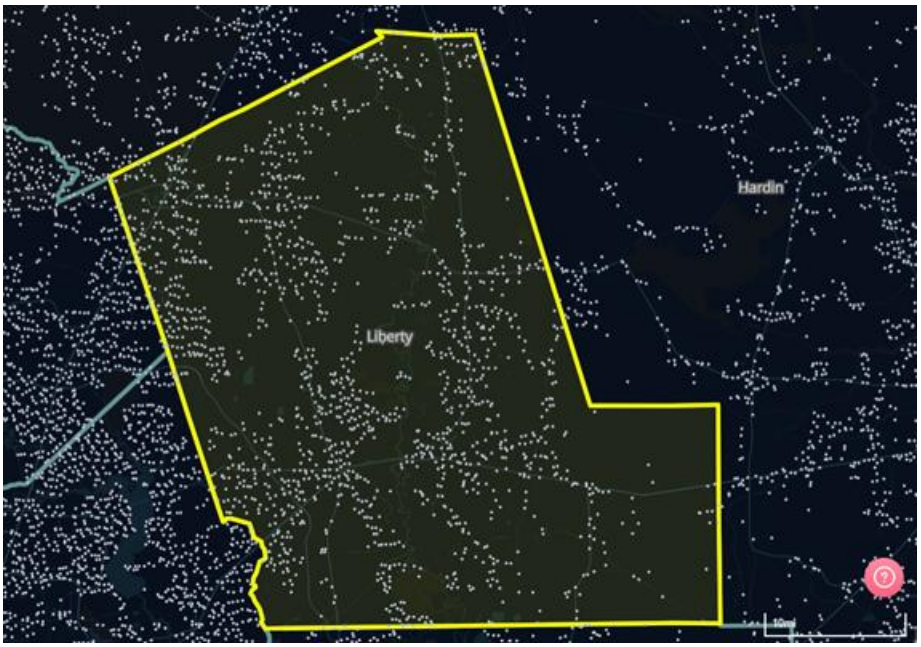


FIGURE 60 - LIBERTY COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

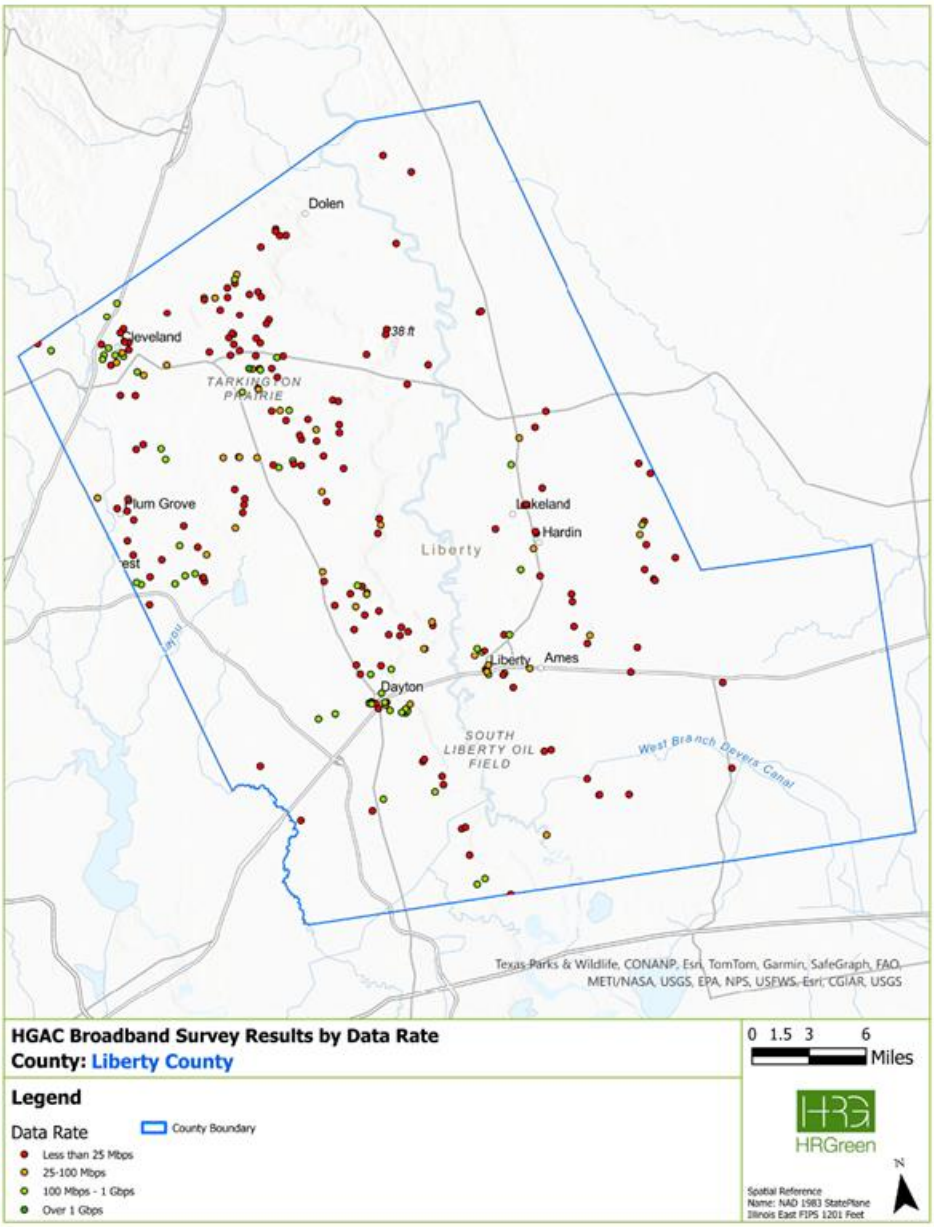


FIGURE 61 - LIBERTY COUNTY'S SURVEY RESULTS PERFORMANCE MAP

MATAGORDA COUNTY

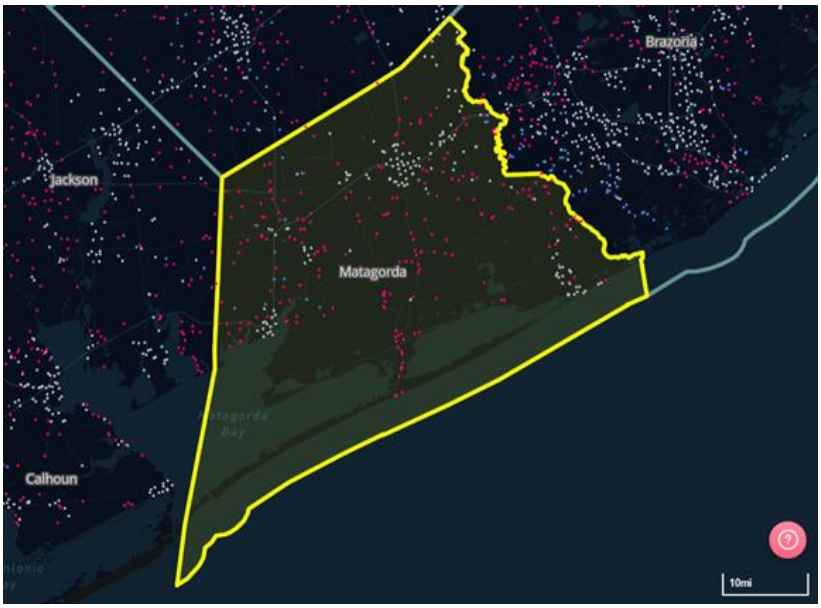


FIGURE 62 - MATAGORDA COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

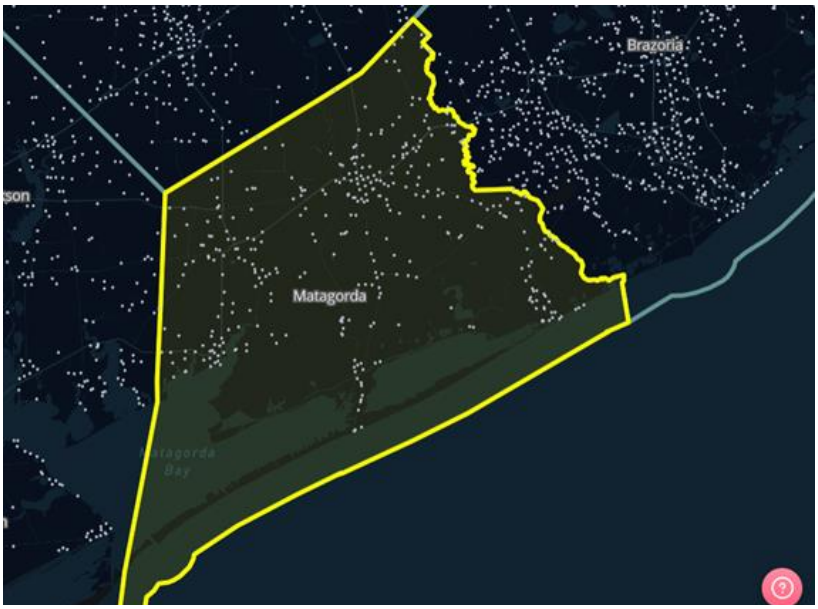


FIGURE 63 - MATAGORDA COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

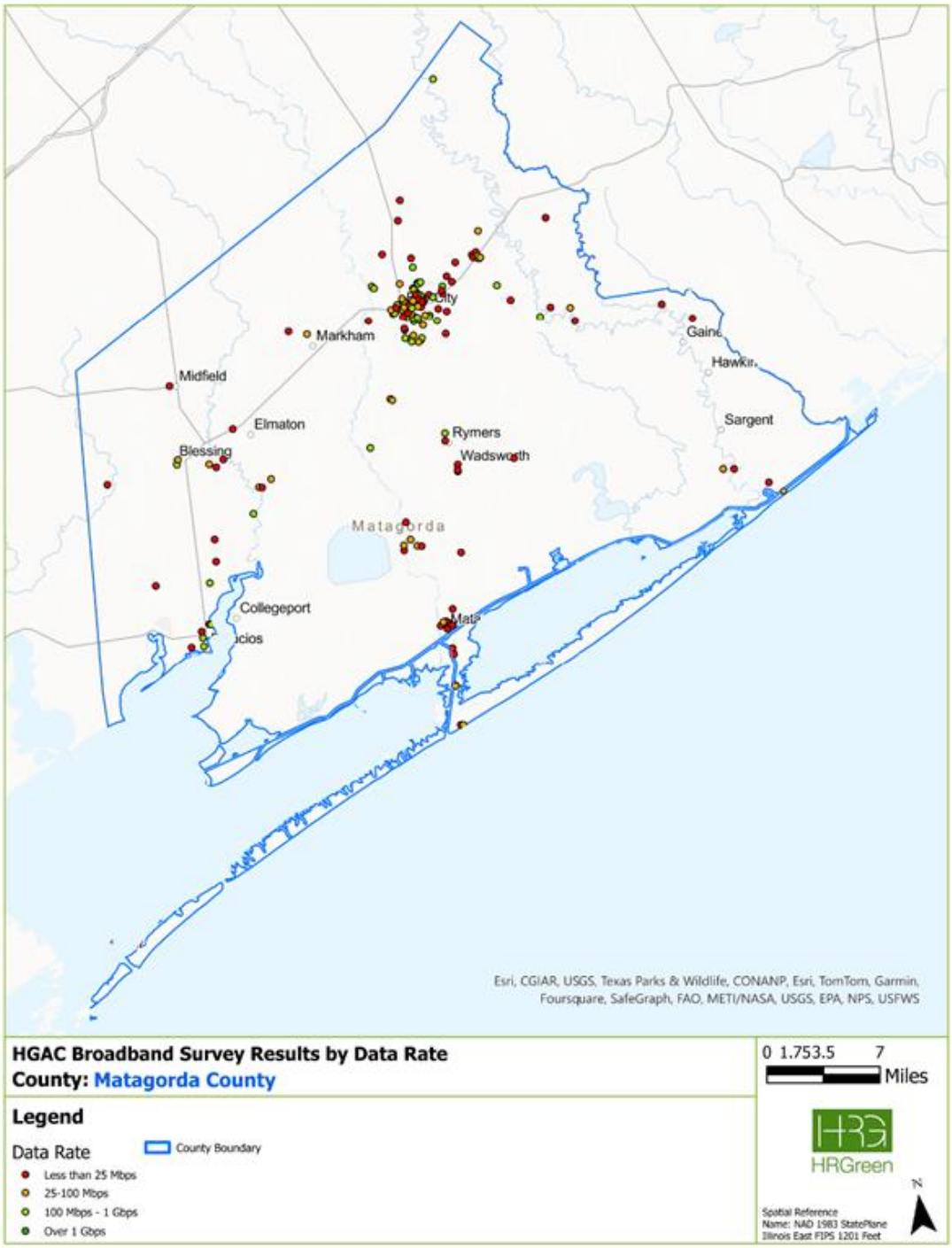


FIGURE 64 - MATAGORDA COUNTY'S SURVEY RESULTS PERFORMANCE MAP

MONTGOMERY COUNTY

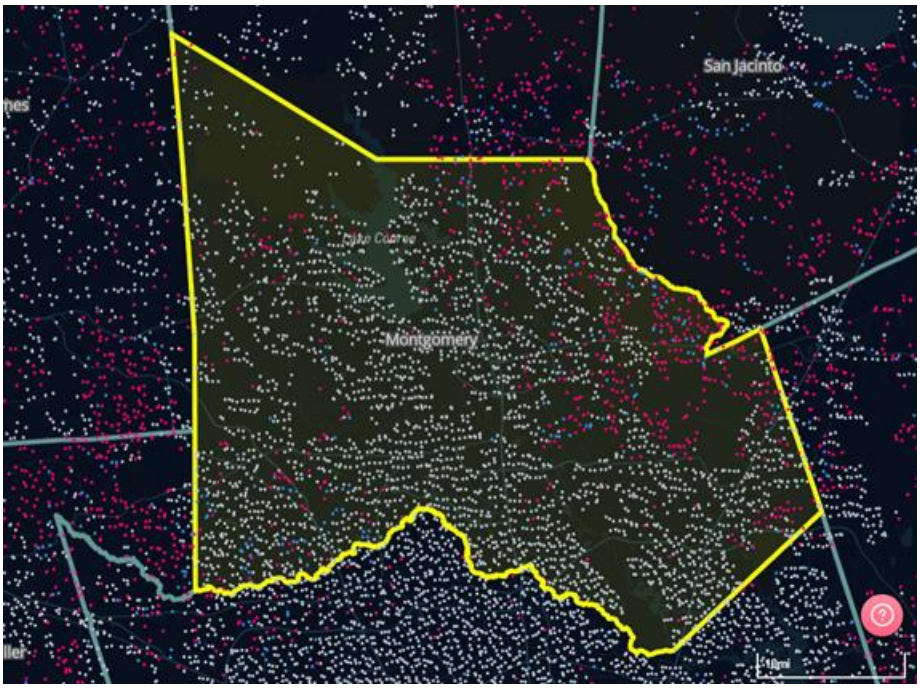


FIGURE 65 - MONTGOMERY COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

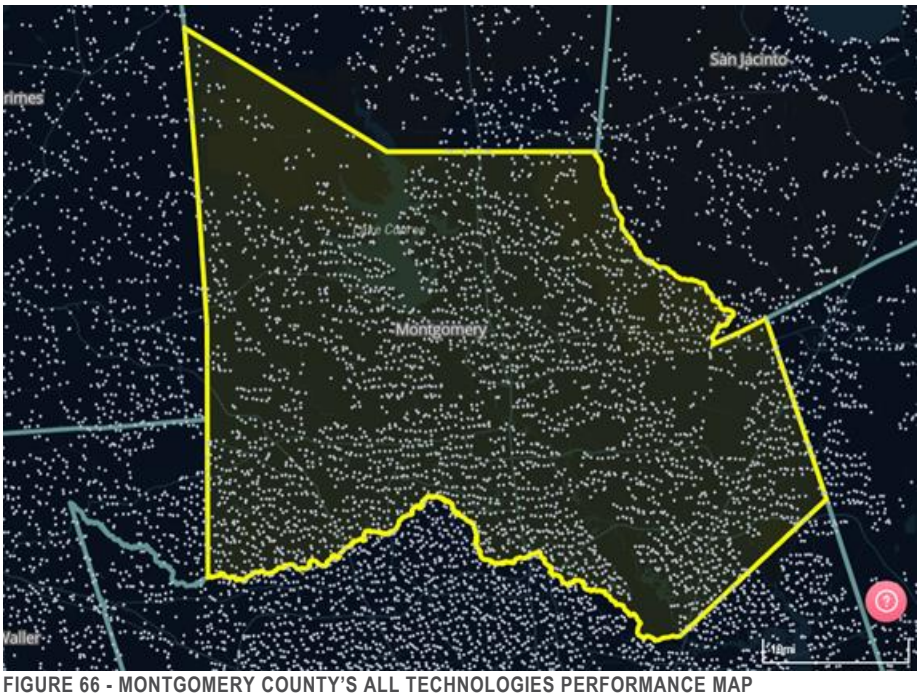


FIGURE 66 - MONTGOMERY COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

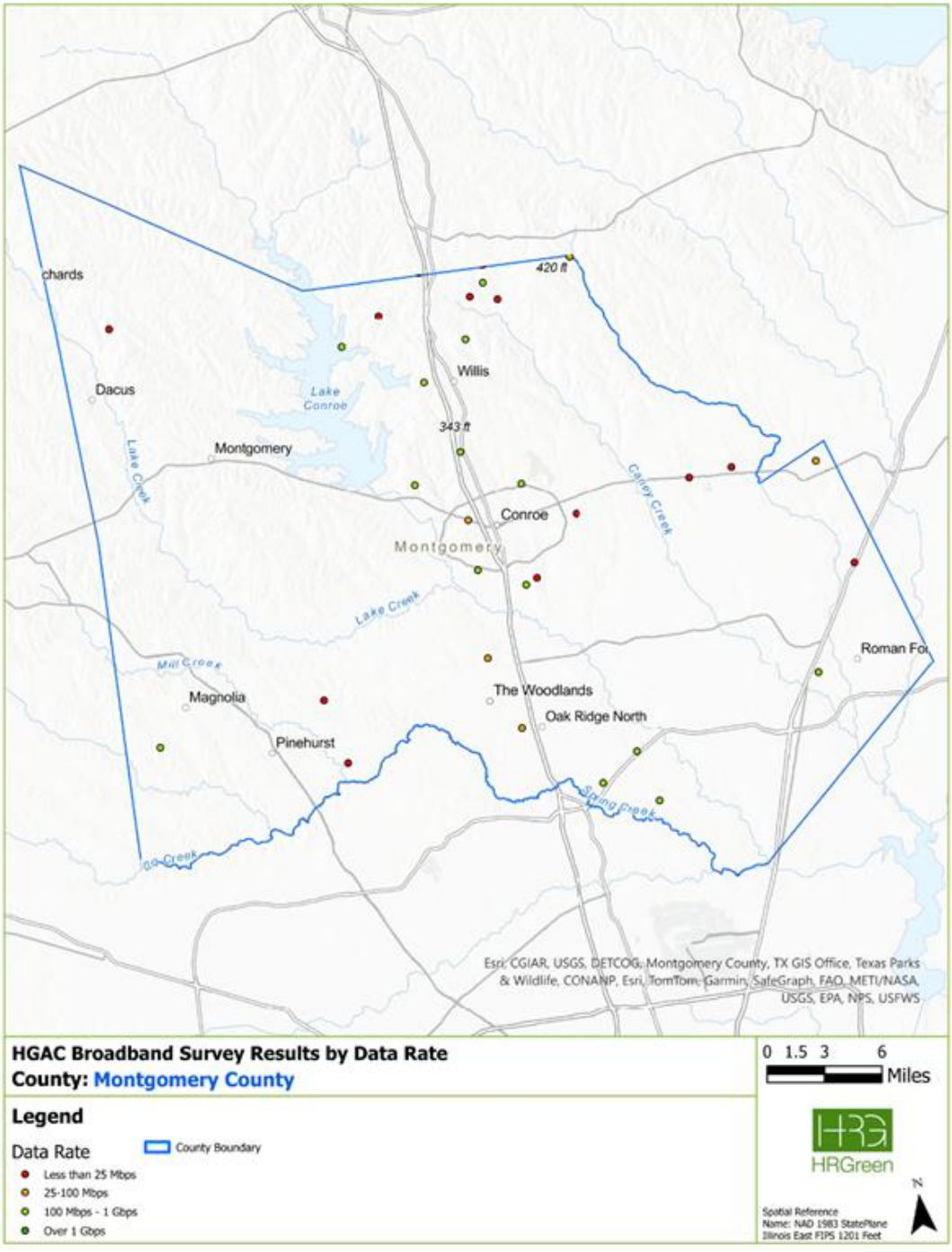


FIGURE 67 - MONTGOMERY COUNTY'S SURVEY RESULTS PERFORMANCE MAP

WALKER COUNTY

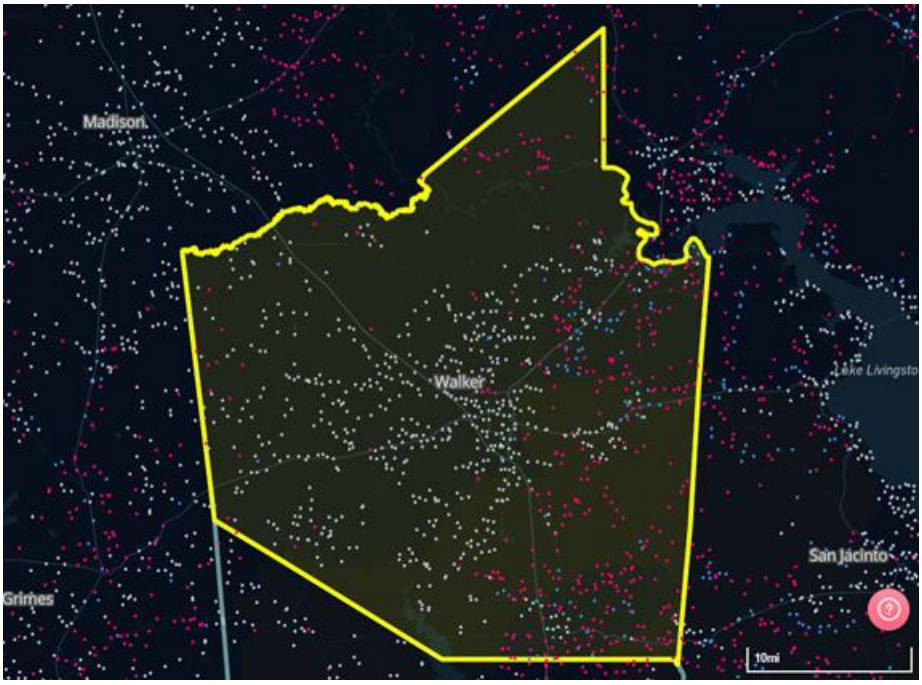


FIGURE 68 - WALKER COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

FIGURE 69 - WALKER COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

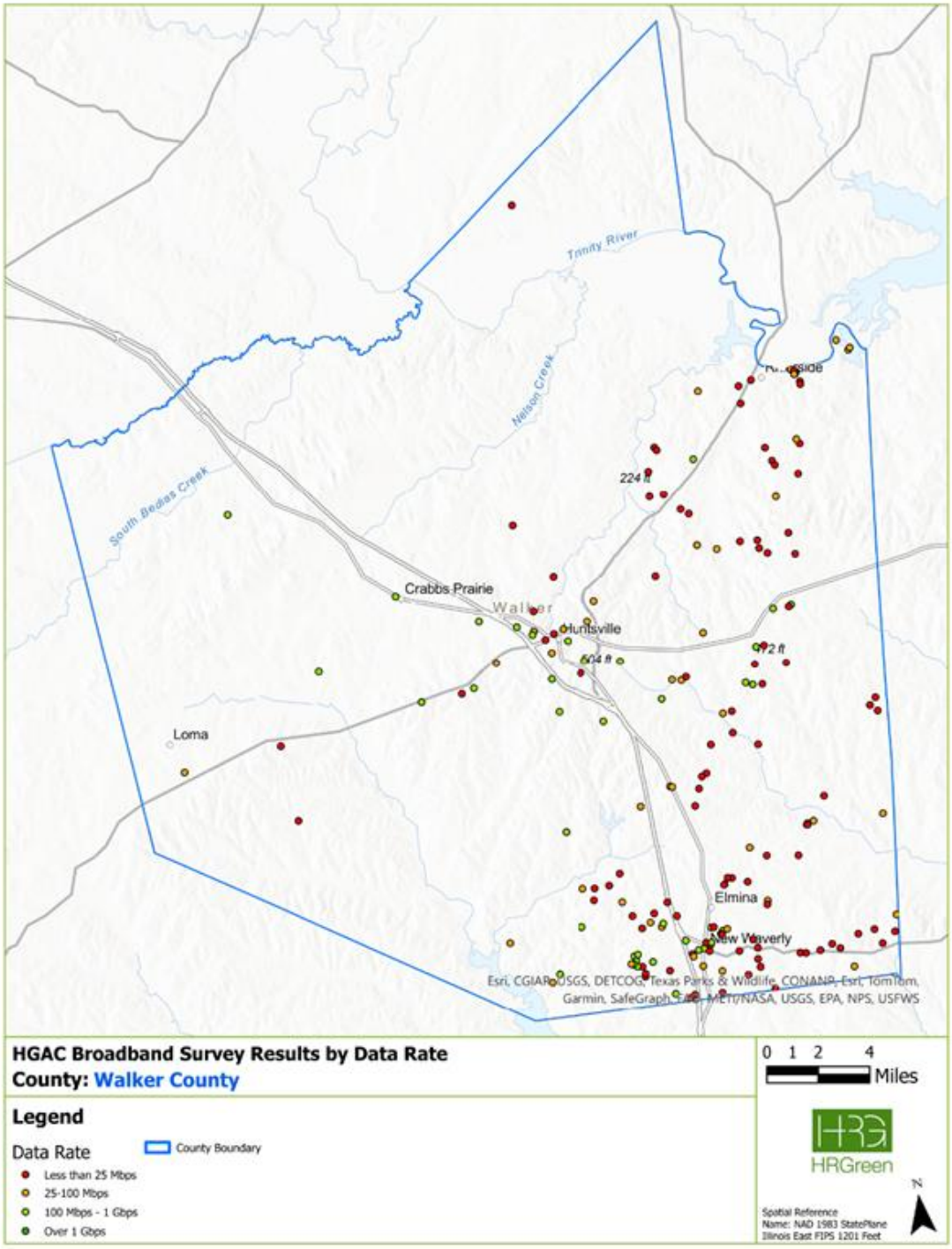


FIGURE 70 - WALKER COUNTY'S SURVEY RESULTS PERFORMANCE MAP

WALLER COUNTY

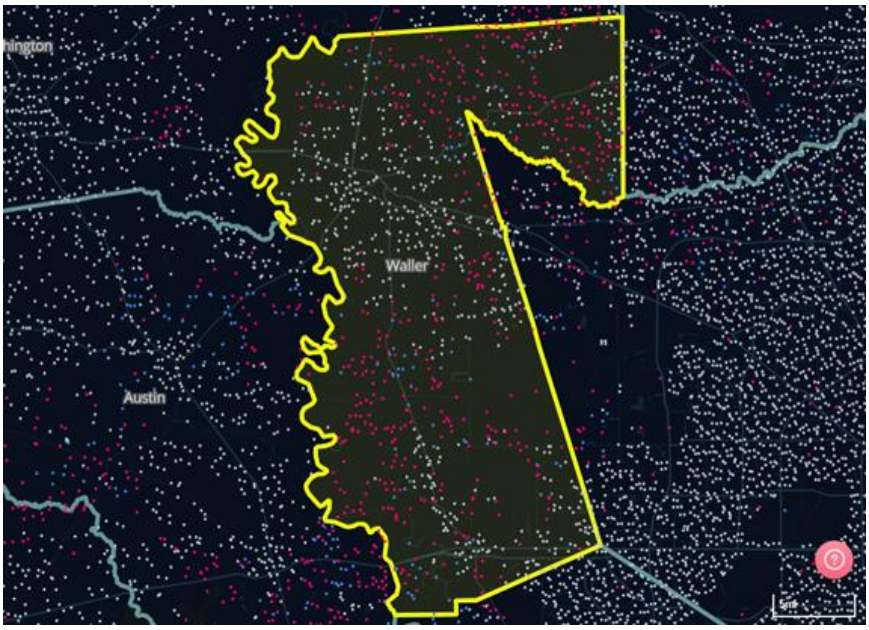


FIGURE 71 - WALLER COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

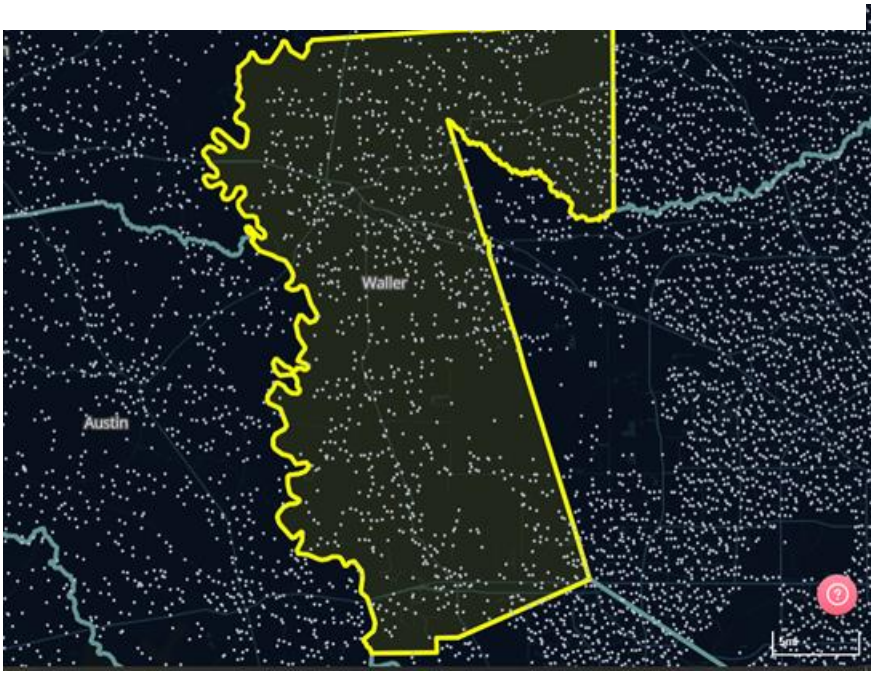


FIGURE 72 - WALLER COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

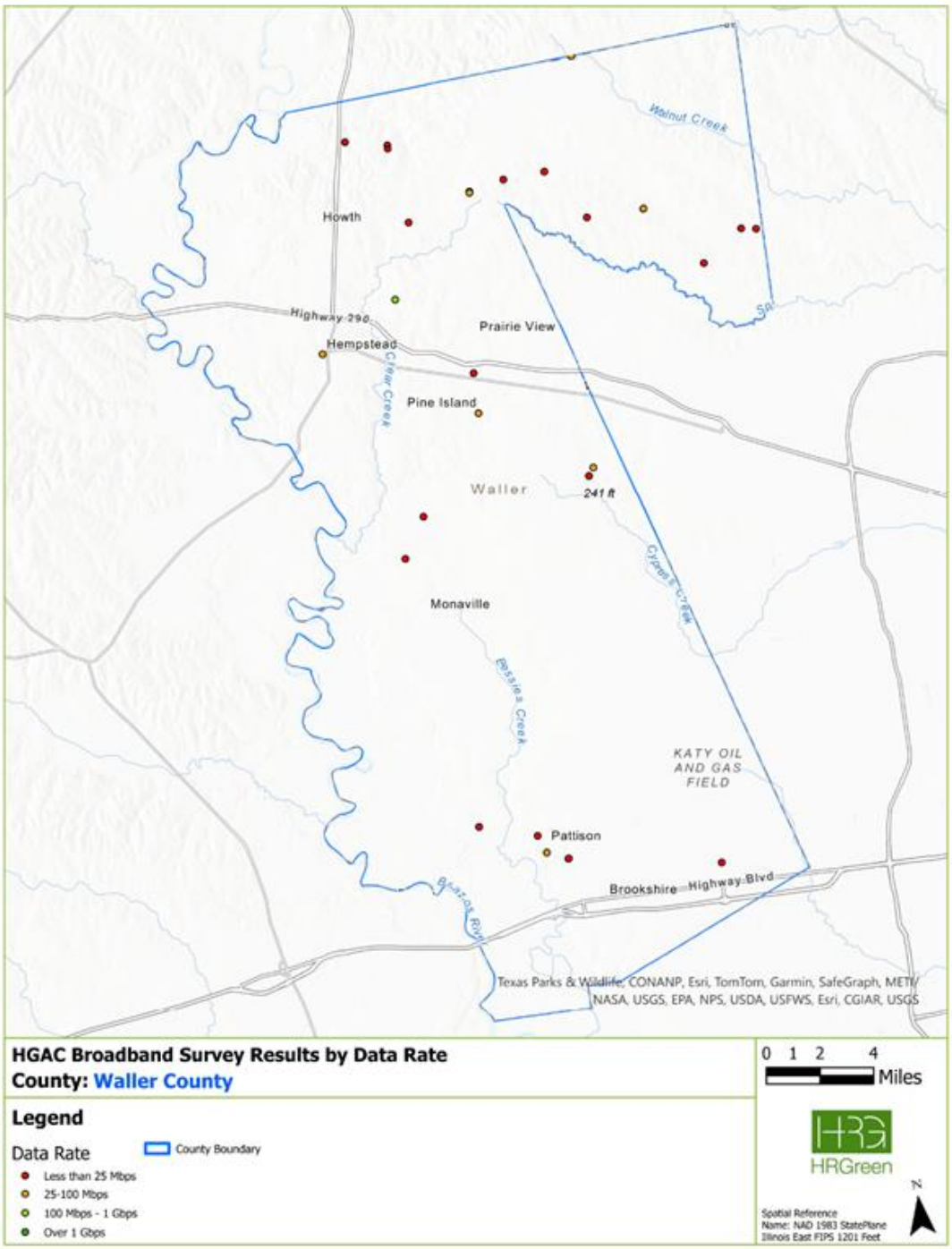


FIGURE 73 - WALLER COUNTY'S SURVEY RESULTS PERFORMANCE MAP

WHARTON COUNTY

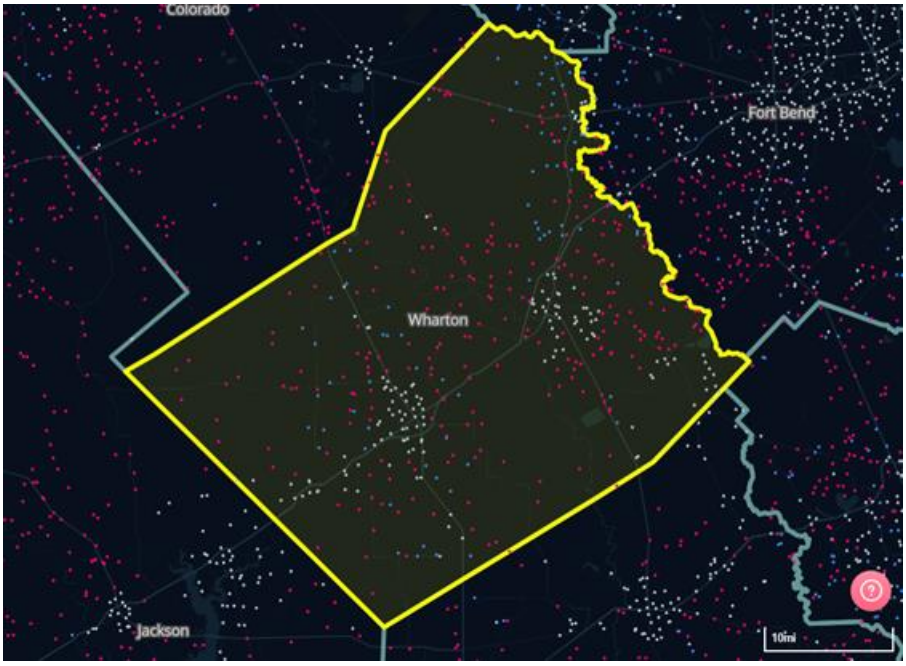


FIGURE 74 - WHARTON COUNTY'S WIRED AND FIXED WIRELESS TECHNOLOGIES PERFORMANCE MAP

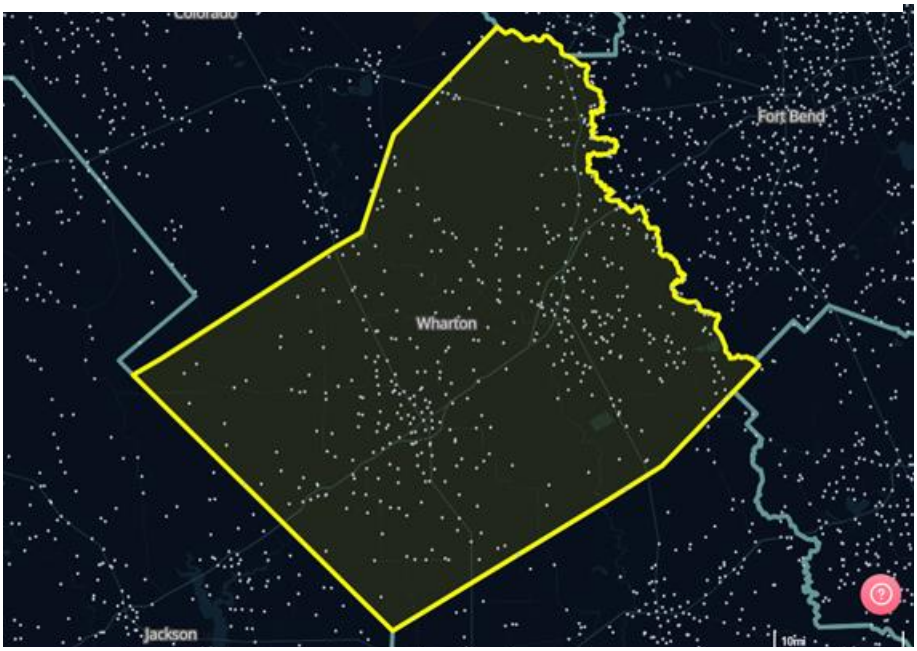


FIGURE 75 - WHARTON COUNTY'S ALL TECHNOLOGIES PERFORMANCE MAP

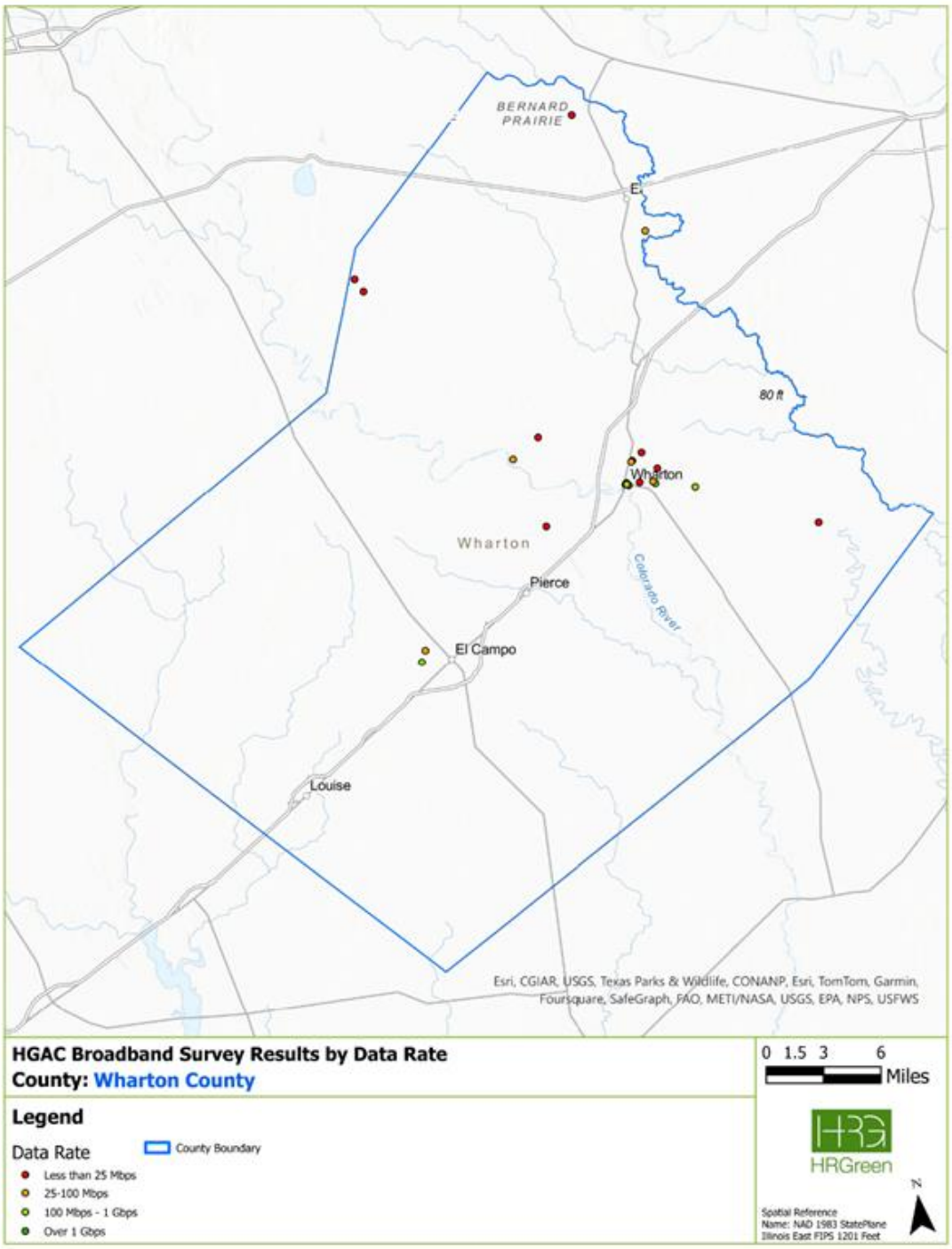


FIGURE 76 - WHARTON COUNTY'S SURVEY RESULTS PERFORMANCE MAP

STAKEHOLDER ENGAGEMENT

Stakeholder meetings are important in the broadband study process. The survey conducted as part of the study provides one source of actual customer data. Although incredibly important, survey data does not tell the whole story of actual needs. Interviews with government agencies, education leaders, and other key stakeholders can help clarify what other challenges there are in current connectivity and what future capacity might be needed.

In an effort to receive connectivity from as broad a spectrum of stakeholders as possible, City staff assembled contact information for individuals in the following roles:

PUBLIC SECTOR
Police
Fire & EMS
HR
Administration
Public Works
Engineering
Parks and Rec
Planning/Zoning
Economic Development
Finance
Public Affairs
Legal
Information Technology Services

OTHER STAKEHOLDERS
Sterling Municipal Library
Goose Creek Consolidated ISD
Lee College
Harris County Broadband Office
Houston-Methodist Baytown
Economic Development Foundation
Center Point
TGS Cedar Port
Chambers of Commerce
Baytown Young Professionals Council
United Way of Greater Baytown
Texas Broadband Development Office
Friendswood Development Company

BOARDS & COMMISSIONS
Planning & Zoning
Parks & Recreation Advisory Board
Baytown Area Water Authority
Community Development Advisory Committee
Strategic Planning Advisory Committee
Library Board
Baytown MDD
City Council
Baytown Police Strategic Planning Committee

CIVIC & NEIGHBORHOOD ASSOCIATIONS
West Baytown Civic Association
Arts Culture Entertainment District
Kiwanis Club
Rotary Club
Lakewood Civic Association
Pilot Club Baytown
Lions Club
Baytown Civic Academy Participants
Comprehensive Plan Committee
Central Heights
Meridian Estates
Country Club Estates
Crockett Park
Country Club Gardens
Baytown Police Advisory Committee (BPAC)
Baybrook Place
Shady Hill Villa
Glen Meadow
Treasure Cove

FIGURE 77 - BROADBAND STUDY STAKEHOLDERS

Two meetings were held, one for County and City stakeholders and another for First Responders. The goals of these meetings were:

- Inform the stakeholders of the study and where they fit in.
- Encourage them to promote the survey.
- Find out from them what their current connectivity is like in their different uses of broadband.
- Also, find out from them their future plans that could either be helped by good broadband or hinder those plans if broadband is not adequate to support those opportunities.

TECHNOLOGY OPTIONS

In light of the ongoing evolution of broadband funding at both state and national levels, as well as the economic realities associated with broadband deployment costs, it is essential to gain insights into the relative advantages, costs, and considerations of various broadband technologies.

To bridge the rural broadband gap, targeted efforts, creative approaches, and cooperative efforts between federal, state, and local entities are essential to ensure equitable access to fiber-based broadband services to everyone, regardless of their geographic location. Rural areas often encounter difficulties in receiving fiber-based broadband services due to several factors:

- **Upfront Capital Costs**: The high capital cost involved with the installation of fiber broadband infrastructure requires significant upfront investment. This includes the construction cost to install the fiber, which can be particularly high in rural areas due to the larger distances and difficult terrains.
- **Return on Investment**: Urban areas generally have a larger pool of potential customers compared to rural areas. This means the revenue generated from offering broadband services in rural areas is frequently insufficient to justify the significant upfront cost.
- **Middle-Mile Fiber Routes**: Fiber close to homes and businesses in rural areas is often middle-mile fiber. Telecom companies are usually reluctant to break into these fiber cables because they are often seen as too valuable to serve last-mile customers.
- **Inadequate Data**: Widespread fabric data on the locations of broadband assets are not widely available or accurate. This situation forces many states to find creative ways to justify their utilization of federal funding. However, without precise representation and data illustrating how residents in rural, urban, and tribal lands are adversely impacted by the absence of accessible and sufficient high-speed broadband, certain populations will be left without adequate online connectivity.

This underscores the critical importance of understanding technology options from both a cost perspective and infrastructure placement to enable informed decisions, efficient resource allocation, and long-term success.

PERFORMANCE CRITERIA

While broadband network performance is often assessed based on throughput (or speeds), a comprehensive evaluation of these technologies should also take into account additional technical components. These components determine their suitability for emerging use cases, such as two-way video (videoconferencing), distance learning, telemedicine, and other applications.

For the purpose of this review, we can categorize technologies based on the following criteria:

AREA OF COVERAGE

Fixed Wireless and Satellite Broadband: These technologies offer the advantage of covering extensive geographic areas from a single point of presence, such as a tower or orbiting station.

Copper, Coaxial, and Fiber: These technologies require direct connections and physical networks at each individual service point.

COST TO SUBSCRIBERS

For lower-income households and small businesses, broadband service plans can pose a significant barrier to adoption. Therefore, evaluating the cost of service is crucial when considering technical solutions.

DEPLOYMENT COST

Deploying broadband technology typically involves substantial capital investment. Business plans aim to cover deployment costs, interest, operating expenses, and long-term profitability (usually spanning 4-20+ years).

Costs vary significantly, with high-capital deployments associated with fiber and coaxial cable, while lower-cost options include fixed wireless and satellite technologies.

THROUGHPUT/SPEED/DATA RATE

This refers to the amount of data successfully delivered through the network over a communication channel between two points.

SERVICE RELIABILITY

Definition: Service reliability refers to the frequency of potential outages that can disrupt consistent access to a network service.

Wireless Considerations: Wireless services inherently exhibit lower reliability due to their propagation characteristics, which are significantly influenced by obstacles, clutter, and weather conditions.

LATENCY

Explanation: Latency represents the delay in the time it takes for a unit of data to travel from its source to its destination across a network.

Impact: High latency can affect real-time applications, such as Voice over IP (VoIP), video conferencing, and virtual desktop infrastructure.

JITTER

Definition: Jitter refers to the variation in latency during data transfer.

Significance: It is a critical metric for assessing a network's ability to consistently handle real-time data traffic.

PACKET LOSS

Meaning: Packet loss measures the rate of unsuccessful attempts to transfer data units to their intended destination.

The following table demonstrates each of the described technologies within the given evaluation criteria on a scale of Good = Green, Average = Orange, and Poor = Red.

	Fiber	Coaxial Cable	Digital Subscriber Link	Fixed Wireless	GEO Satellite	LEO Satellite	Cellular Broadband
Area of Coverage							
Cost to Subscribers							
Deployment Cost							
Throughput/Speed/ Data Rate							
Service Reliability							
Latency							
Jitter							
Packet Loss							

TECHNOLOGY TYPES

Each technology type brings its own set of pros and cons in terms of coverage, service capacity, and installation and deployment simplicity. Fiber is usually superior in most aspects, but it's also the priciest to install. On the other hand, satellite technology is widely available, but it falls short on many quality metrics required for robust and reliable customer service.

FIBER

Fiber optic deployments depend on networks that transform data-carrying electrical signals into light and transmit this information directly over tiny glass fibers, roughly the thickness of a human hair. The main benefit of fiber optic cables is their ability to transport vast amounts of data at nearly light speed, resulting in symmetrical, low latency service capable of extremely high speeds. Fiber deployments are often seen as the "gold standard" due to the aforementioned technical benefits. Fiber deployment providers often offer service plans of 100/100 Mbps or 1,000/1,000 Mbps (or Gigabit service).

Fiber deployments are carried out using either buried or aerial construction methods. Buried fiber is the safest method and avoids many of the risks of aerial deployment because they are immune to the effects of wind and ice damage. However, a fiber line may occasionally get cut by a contractor due to lack of knowledge of the fiber location or through careless digging. To avoid these risks, fiber must be protected and discoverable, which sometimes becomes an afterthought for an agency. On the other hand, many providers prefer to deploy aerial cables on public rights of way and existing utility pole infrastructure. Aerial deployments create more risk of service disruption but the initial capital deployment for aerial fiber can be as much as 40 to 50 percent less than the cost of a buried deployment.

Fiber optic service does have many technical advantages, but the cost of deploying the physical infrastructure and supporting electronics necessary to operate the network can make fiber optic too costly

for many rural and remote areas. This can be especially true in areas where geology includes rock and other difficult-to-dig areas.

COAXIAL CABLE

Most of the homes and businesses served by the incumbent cable providers are receiving their video and broadband on a technology known as Data Over Cable Service Interface Specification, DOCSIS 3.1, most commonly known as coaxial cable. DOCSIS was launched by the cable industry to convert its original video distribution plant to a system capable of carrying not only video, but two-way transmission of data to and from customer premises. DOCSIS relies on a hybrid of coaxial cable and fiber optic cable to deliver services.

Like fiber optic networks, DOCSIS service technology relies on either buried or aerial distribution of cables to carry data and video to customer premises. The implementation of DOCSIS 3.1 allowed the cable industry to compete with new fiber-to-the-home providers by significantly increasing download speeds for customers. The technology is capable of up to 10Mbps (10 Gigabit) speeds, but most cable service plans currently available in the market feature 100 Mbps or 250 Mbps offerings.

One of the limitations of a coaxial cable plant is the significant expansion of available upload speeds. Many cable providers, in fact, still offer uploads speeds between 3 and 35 Mbps. This capacity has been sufficient for many of the historic uses of broadband, but many emergent uses (telemedicine, video conferencing, remote learning) rely on both up and download capacity and there have been reports of dissatisfaction with DOCSIS in this more symmetrical environment.

The cable industry is also investing in direct fiber-to-the-premises for business and enterprise customers, while initiating the deployment of the next DOCSIS evolution to increase both download and upload speeds.

DIGITAL SUBSCRIBER LINK (DSL)

DSL service was implemented by the incumbent telephone companies as a replacement for dial up internet. The technology has seen several upgrades and is capable of supporting asymmetrical (higher speeds for download than upload) speeds of up to 25 Mbps download /3 Mbps upload, the current standard for being considered “served” by broadband.

One concern with DSL is the use of “up to” speeds when compared to actual speeds realized by customers. Because DSL is reliant on existing copper pair telephone lines, physical proximity to transmitting equipment is a key factor in determining actual speeds. While customers who are close to DSL gear receive speeds near the advertised speeds, there is a significant degradation of DSL speeds as customers move further away from the point of presence.

DSL, on the other hand, continues to provide some of the lowest cost of services in the industry. The typical DSL internet bill is in the $50-$60 range, which compares favorably with the pricing of satellite service providers.

FIXED WIRELESS

These networks use microwave signals that are used to connect customers via a dedicated wireless Internet connection to a point of presence (PoP) to foster an internet connection. This connection network is known as backhaul and it can be transmitted over either federally licensed spectrum or via unlicensed spectrum.

Unlike the wired services outlined above, fixed wireless simply relies on an exterior antenna to provide homes and businesses with broadband level services. Fixed wireless signals are usually connected at the tower to a backhaul fiber network to carry the signal onward to the internet. Fixed wireless is less advantageous than fiber and coaxial technologies because clutter (obstacles like trees) or weather events may negatively impact metrics such as speeds, latency, and path loss. However, compared to satellite service, fixed wireless is more advantageous in the same metrics as above. Additional advantages include

installation which is free from trenching and construction, scalable bandwidth, path and network diversity, and straight forward Ethernet hand-offs. However, fixed wireless has some limitations such as the service often requires line-of-sight access between two fixed sites and the cost per unit of bandwidth tends to be higher than other forms of broadband.

Fixed wireless internet broadband is frequently a positive alternative to traditional DSL service, offering higher connectivity speeds than those available from DSL providers. Because it is not dependent on physical connections, it is well suited to rural and remote settings. Many wireless providers offer low latency and higher data allowances that are available from satellite providers that are a traditional alternative to DSL in rural and remote geographies.

SATELLITE BROADBAND

GEO SATELLITE

Most known satellite internet service has been traditionally provided from geostationary orbit (GEO) satellites that orbit at exactly 22,236 miles above the earth, but recent technology is enabling service from other orbits as well, most notably Low Earth Orbit (LEO) - less than 1,200 miles in altitude. Medium Earth Orbit (MEO) satellites, such as GPS, are in between at approximately 12,550 miles in altitude.

Geostationary Earth Orbit (GEO) satellites have been used as an internet service technology by providers such as Viasat and Hughes Network Systems for decades.

GEO satellite service represents an improvement over early dial up and copper-based technologies, which only offered speeds up to 10/1Mbps. Because of this, adoption of GEO satellite service has been primarily in geographies described above as remote, and in some rural and remote areas it represents the only available alternative that meets the 25/3Mbps FCC standard for broadband.

With GEO satellite internet, a consumer can receive .5 Mbps download and 80 Kbps (less than 1 Mbps) upload speeds[iii]. These data rates are typically lower than any other internet service technology, except dial-up which is now an exceedingly rare service.

A report by the Congressional Research Service in August 2021 notes a number of key challenges with GEO satellites as a technology that supports future-forward broadband needs[iv]. These include distance that data must travel to a satellite in orbit and back results in lower data rate, higher latency, and a lack of reliability in using many real-time applications, such as video conferencing. The latency of GEO providers averages nearly 636 milliseconds (ms) for the two large commercial providers. For comparison, reliable online gaming requires latency less than 20 ms.

For decades, satellite constellations have been lauded as terrestrial alternatives, hoping to replace commercial wireline and wireless networks while experiencing a boom-and-bust economy. Due to high start-up costs, launch costs, and a slowness to respond to communications technology upgrades, notable satellite internet companies such as Teledesic, Iridium, and Globalstar filed for bankruptcy protection throughout the 1990s and 2000s. More recently, Intelsat, OneWeb, Speedcast, and Global Eagle continue to experience bankruptcy issues[v].

LEO SATELLITE

While GEO satellite broadband has been available for dozens of years, a number of companies announced (or are already deploying – such as Starlink) constellations of low-earth orbit (LEO) satellites to improve on the traditional challenges with existing satellite provider services. Due to the constellation's closer distance to the earth, LEO satellite service promises to significantly improve on speed of service issues, with a particular focus on latency and upload speed improvements.

Speculation on LEO internet service focuses on its promise to provide broadband service similar in quality achieved with wireline or terrestrial wireless technology. Technology holds the potential to resolve the digital divide in areas with challenging topography where it is difficult to deploy terrestrial infrastructure and to provide service to mobile users (in cars, airplanes, at sea).

LEO satellites operate at much lower altitudes compared to MEO and GEO satellites but require a network of thousands of satellites that orbit at a height of 300+ miles above earth. The vastly larger number of satellites allow the allocation of more network resources, but also require frequent handovers between satellites when communicating with ground receivers.

This relatively low orbit[1] proximity to earth's surface reduces latency when compared to higher satellite orbits but is still a much longer distance than cellular (LTE/5G) networks. Weather and the consumer's line of sight to the satellite can also greatly vary service quality and reliability.

CELLULAR BROADBAND

The advancements in mobile networks, from 4G and LTE to the current 5G, have opened up possibilities for some users to forego conventional wired or wireless broadband services. Instead, they can depend solely on their mobile phones or cellular hotspots for home internet access. Cellular broadband is primarily designed for use on the move, especially in areas with high traffic. The quality of service can greatly differ based on factors such as the coverage area, signal strength, hardware and software technology, coding and modulation schemes, the number of active users, applications, and many other variables that can significantly affect its consistent use and dependability. In rural and remote locations where other options might not be available, cellular broadband can serve as a viable choice. However, fixed-line internet services are generally more dependable.

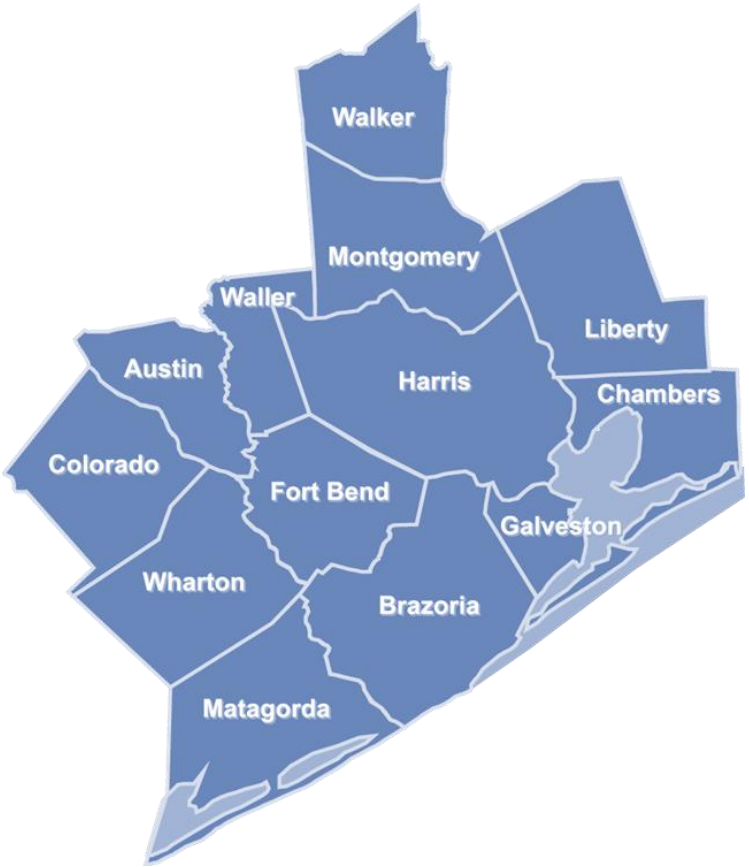
CELLULAR COVERAGE

Cellular networks have become an increasingly common source for basic internet service. Given its role in broadband, a high-level examination of cellular coverage is included in this study. HR Green did not conduct a detailed analysis of cellular coverage in each county but has collected FCC information on reported cellular coverage. The below images and data were taken from the FCC National Broadband Map. Because of the way they are reported, they generally appear to show good coverage. That is probably not the experience that citizens and business have, but this shows what coverage is reported and who the providers are.

[1] Low as compared to middle-earth orbit or geocentric earth orbits

MOBILE NETWORK COVERAGE IN THE 13 H-GAC COUNTIES

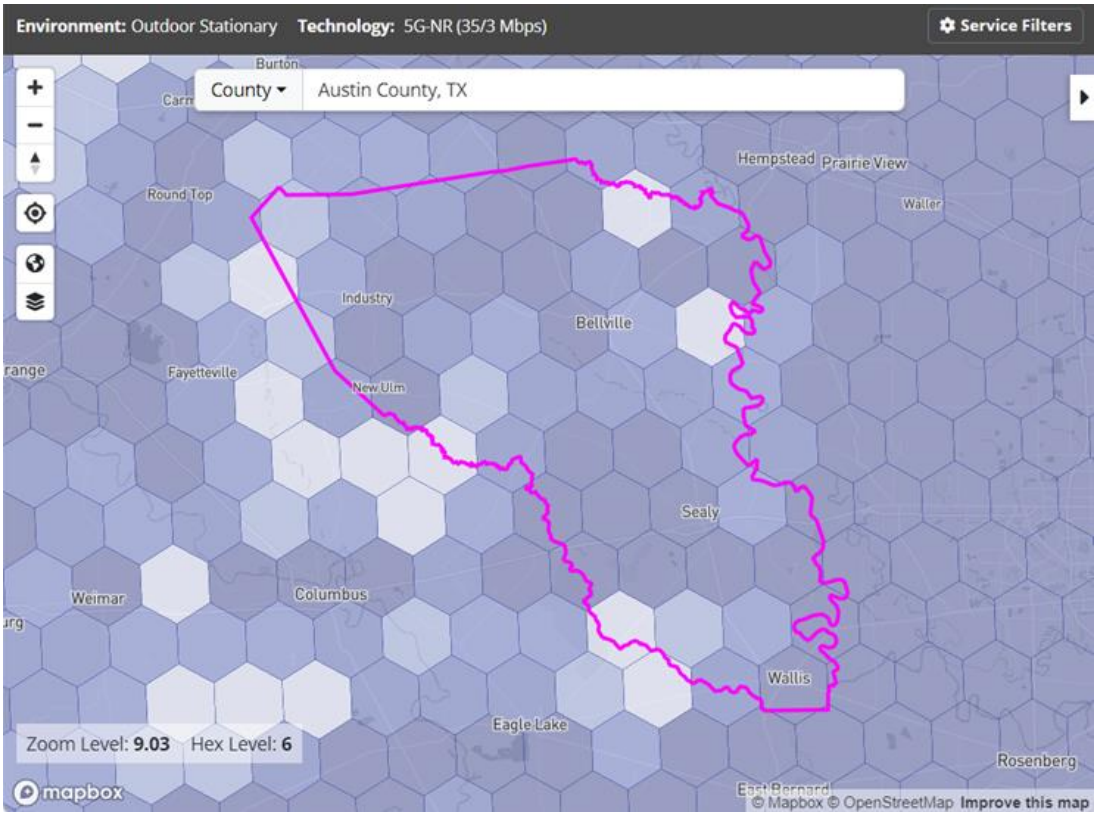
The following pages detail the availability of 5G-NR service in the 13 constituent counties of H-GAC using the most up to date FCC map data. We are purposely choosing to highlight the availability of this particular type of mobile network coverage because while older technologies, like 4G, tend to cover a larger percentage of the areas in question, they deliver substantially lower download and upload speeds. Per the FCC, maps, 4G coverage tends to provide service speeds of around 5 Mbps download and 1 Mbps upload, while 5G-NR can provide speeds of around 35 Mbps download and 3 Mbps upload. This is significant because while technically "covered", the user experience for users of devices connecting to a 4G network with 5/1 service speeds will be substantially poorer than those of users whose devices are connected to a 35/3 service, yet both fall short of the 100/20 standard for terrestrial networks. In other words, while all the Counties in H-GAC are reported to have near 100% 4G coverage, and as detailed below, substantial 5G-NR coverage, residents of these areas who must rely on mobile internet service are at a significant disadvantage to those with terrestrial broadband access.



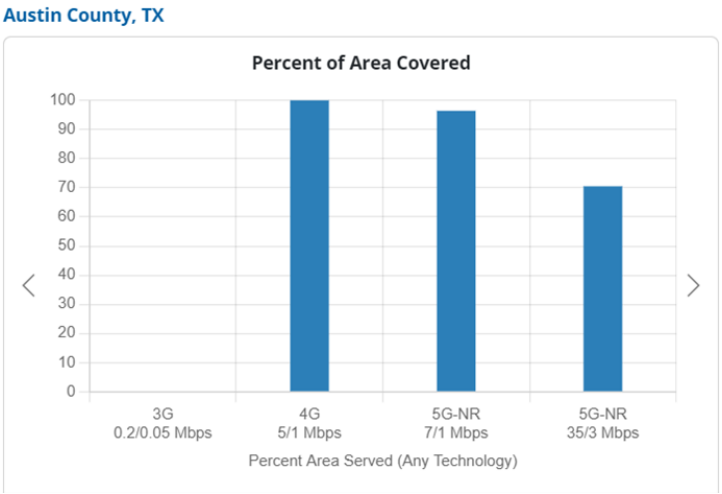
Rules for BEAD grants have not been released at the time of the preparation of this report, but it does not appear that cellular coverage will be eligible for or impact BEAD grants.

For reference, 5G-NR (for New Radio) is a fifth-generation mobile network radio access technology. Similar to Long Term Evolution fourth generation (4G LTE) network standards, it is based on Orthogonal Frequency Division Multiplexing (OFDM) and was created by the 3rd Generation Partnership Project (3GPP) as the new standard air interface to replace 4G LTE.

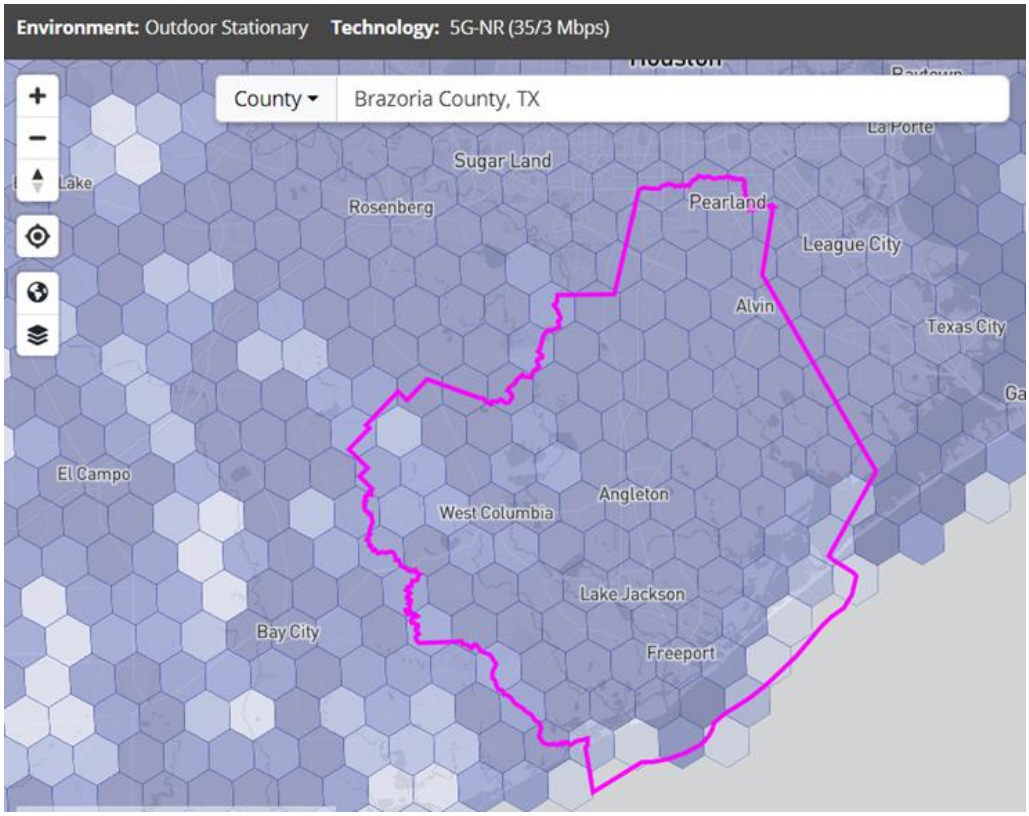
AUSTIN COUNTY



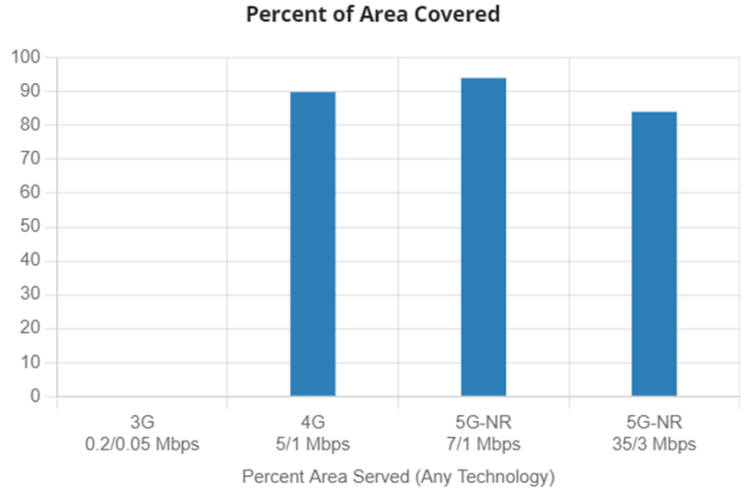
Per the FCC, Austin County is 70.52% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the relatively more densely populated areas of Sealy, Wallis, Bellvile, New Ulm and Industry, with service availability dropping off outside of them. For residents of these interstitial regions between population centers, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



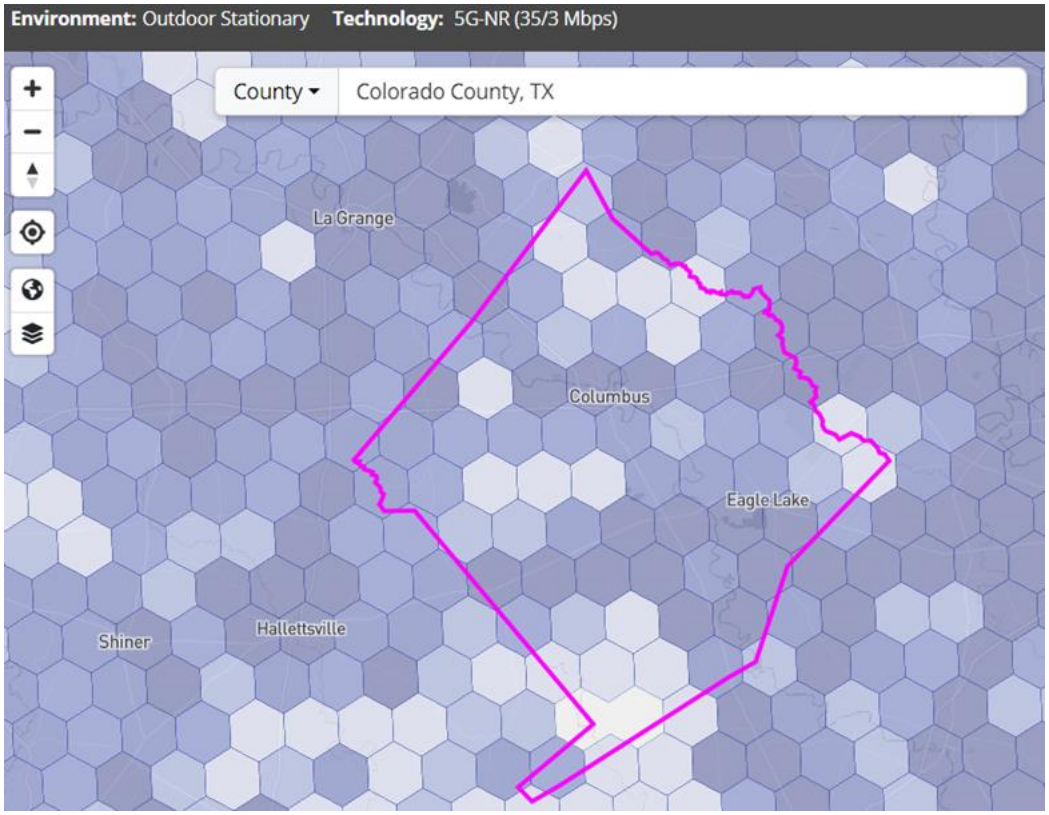
BRAZORIA COUNTY



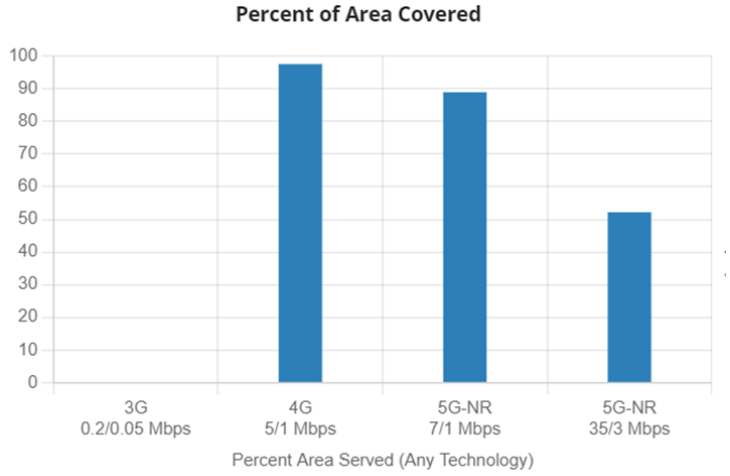
Per the FCC, Brazoria County is 84% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the relatively more densely populated areas of Freeport, Lake Jackson, Angleton, and to a lesser extent, West Columbia. The western edge of the County and the coastline have the least amount of access. For residents of the interstitial regions between population centers and on the coast and western edge, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



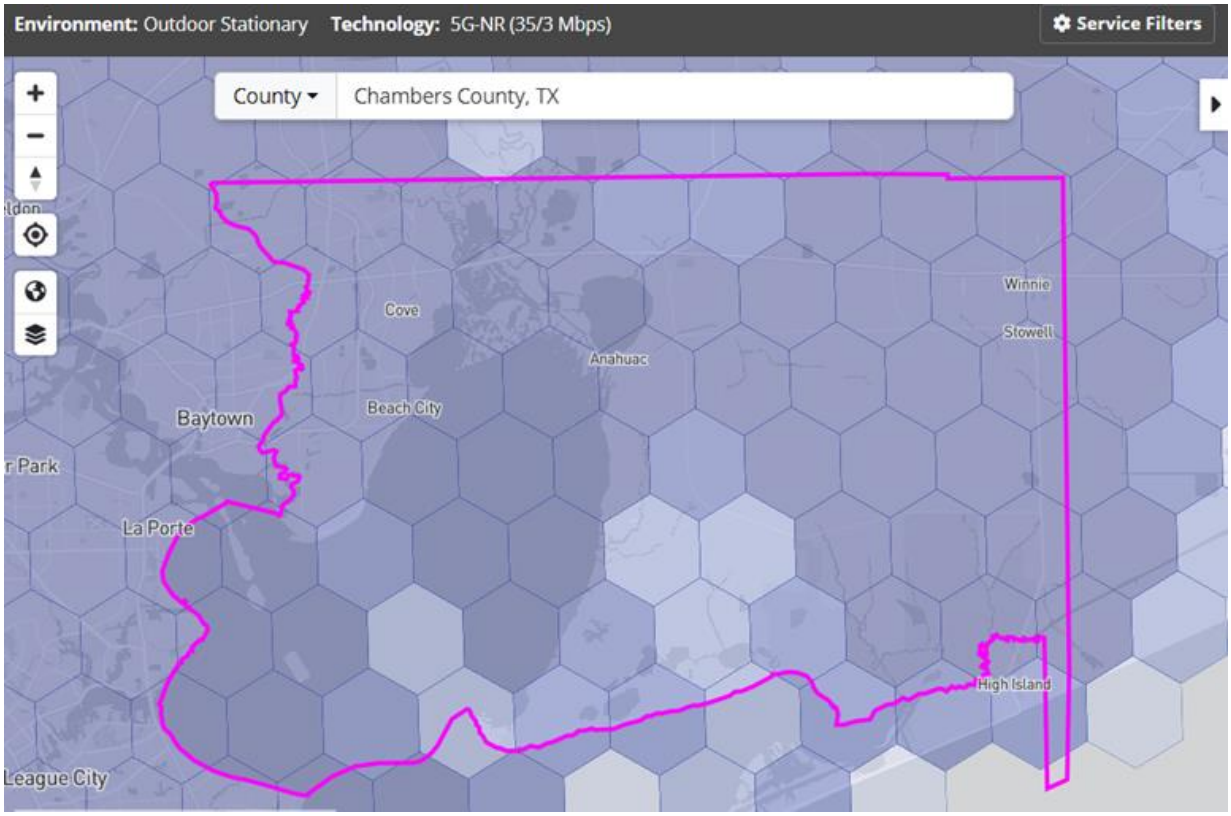
COLORADO COUNTY



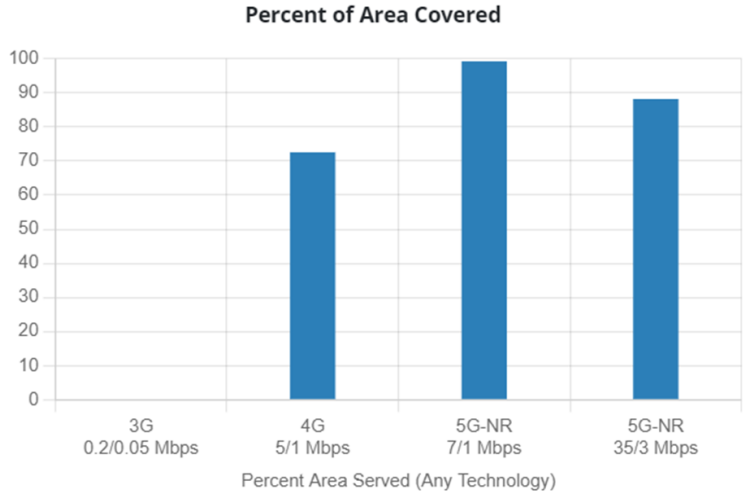
Per the FCC, Colorado County is only 52.17% covered by 5G-NR, as detailed in the above map, with coverage being strongest in Columbus and Eagle Lake. For residents of the interstitial regions between these population centers and the very poorly served areas in the south and north of the County, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



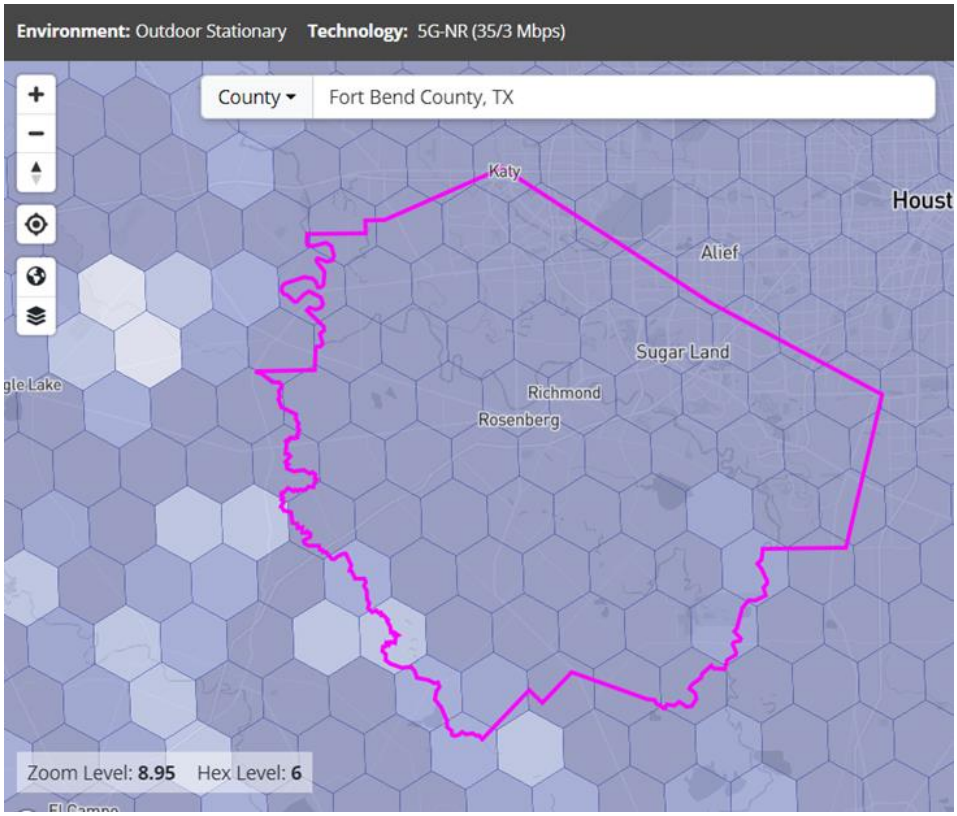
CHAMBERS COUNTY



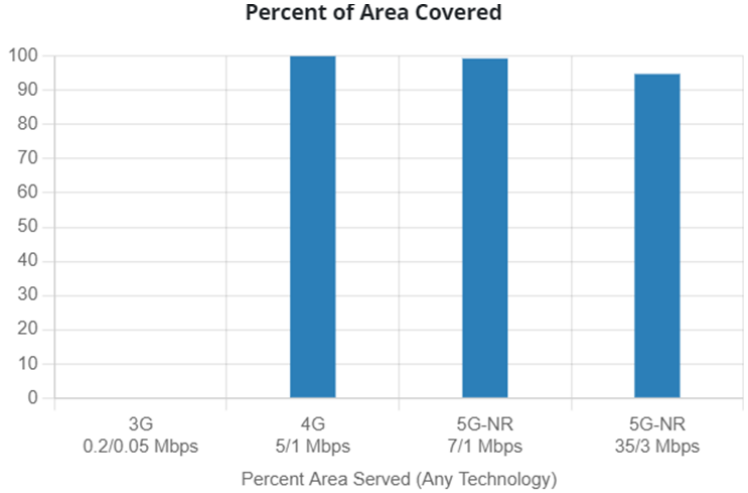
Per the FCC, Chambers County is only 88.15% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the relatively more populous areas of Beach City, Cove, Anahuac, Winnie, Stowell and High Island. For residents of the interstitial regions between these population centers and the poorly served area in the central part of the County, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



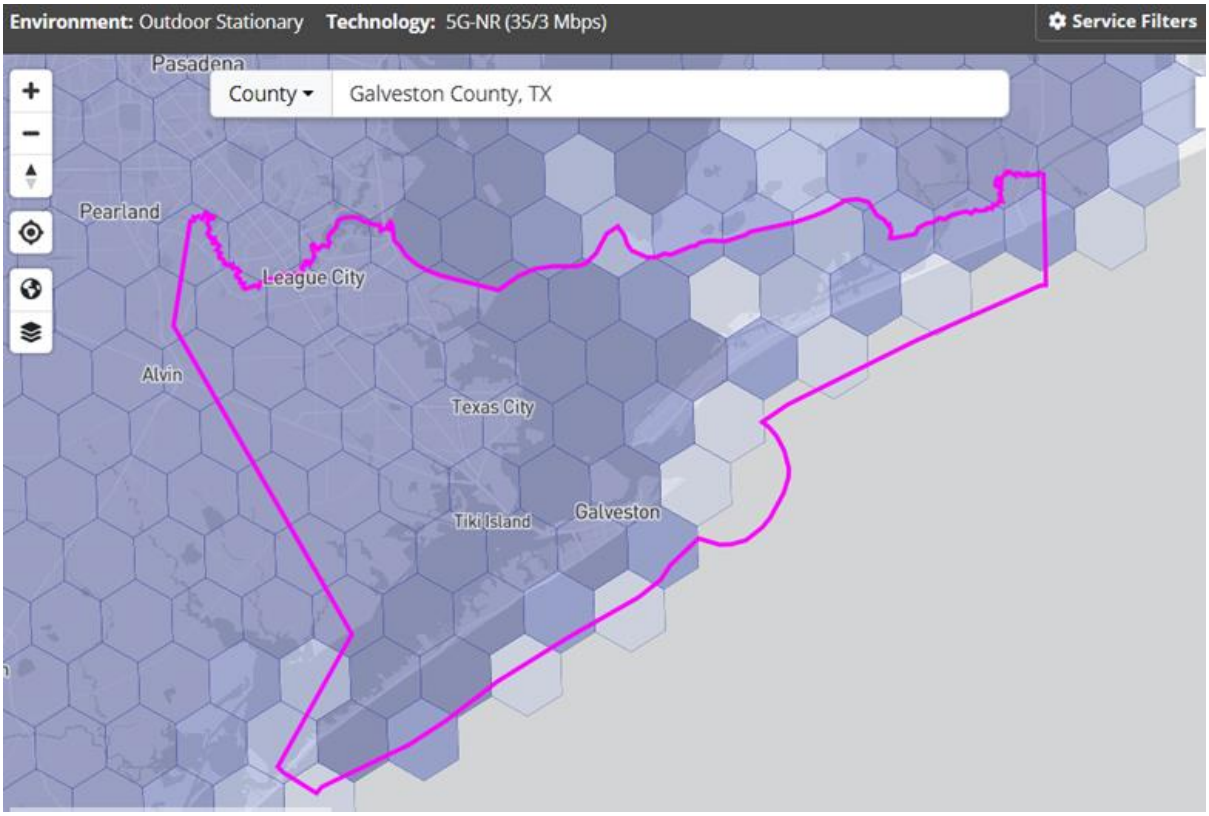
FORT BEND COUNTY



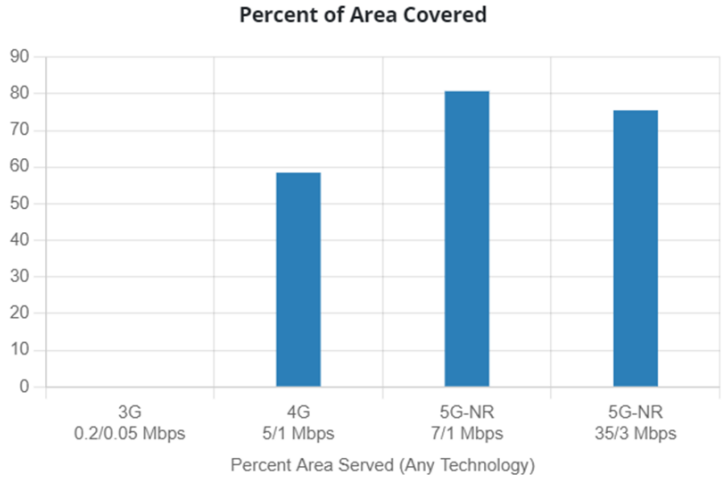
Per the FCC, Fort Bend County is 94.76% covered by 5G-NR, as detailed in the above map, with coverage being relatively strong throughout most of the county with the exception of the southwestern edge and the isolated coverage gap pockets south of Sugar Land. While this level of coverage indicates that almost all Fort Bend County residents have access to 5G-NR mobile networks, it does not necessarily mean mobile connections would provide a satisfactory user experience capable of replacing terrestrial broadband for household internet, as 35/3 falls well short of the 100/20 standard for broadband.



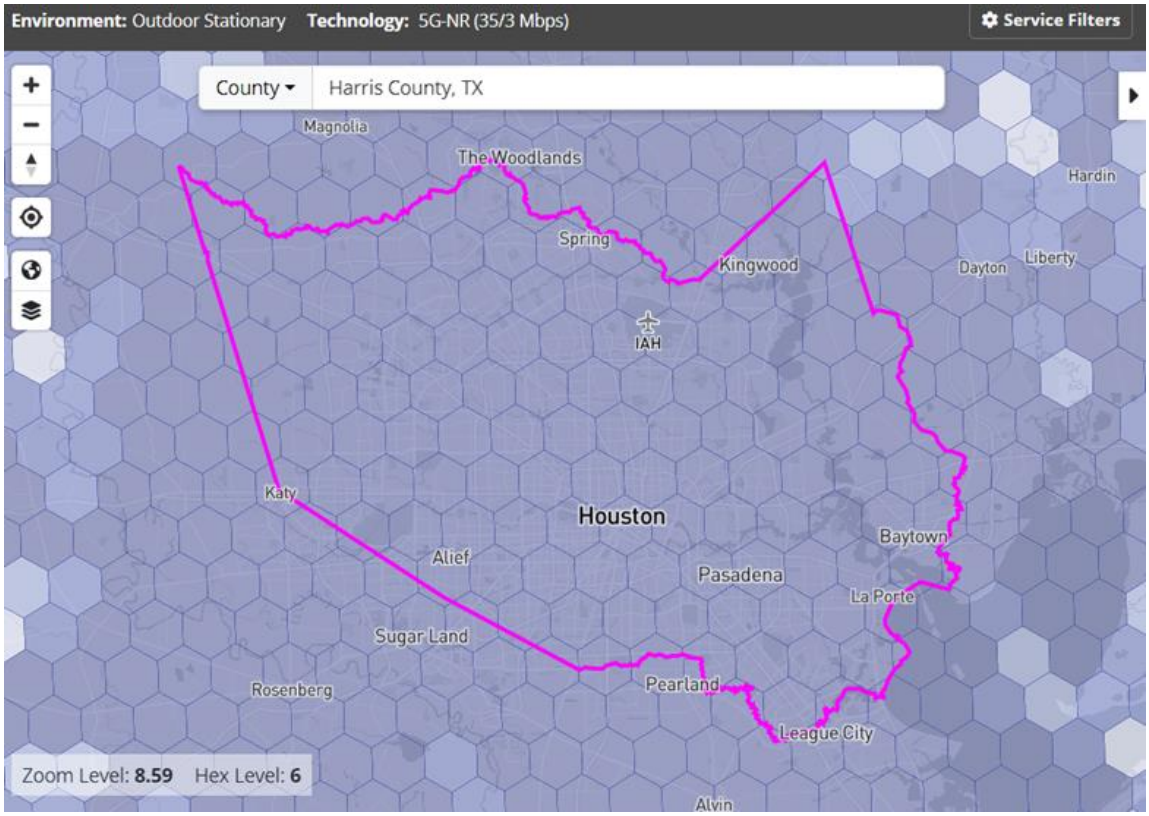
GALVESTON COUNTY



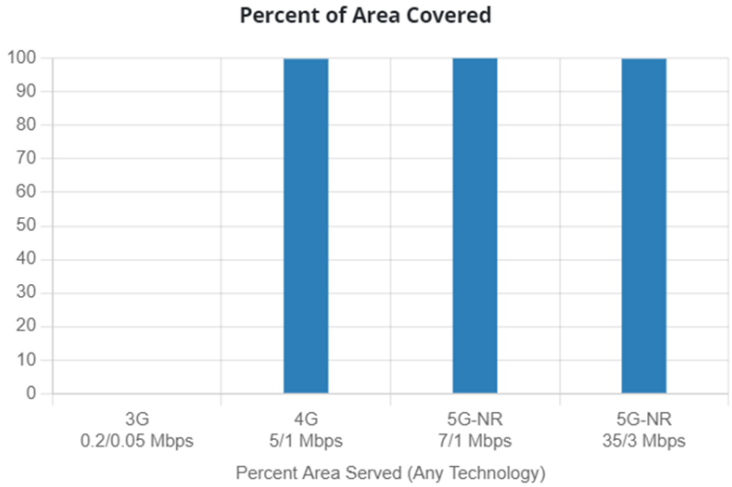
Per the FCC, Galveston County is only 74,47% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the more populous areas of Galveston, Texas City, League City, and Tiki Island. For residents of the interstitial regions between these population centers and the poorly served area in the western and northern coastal parts of the County, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



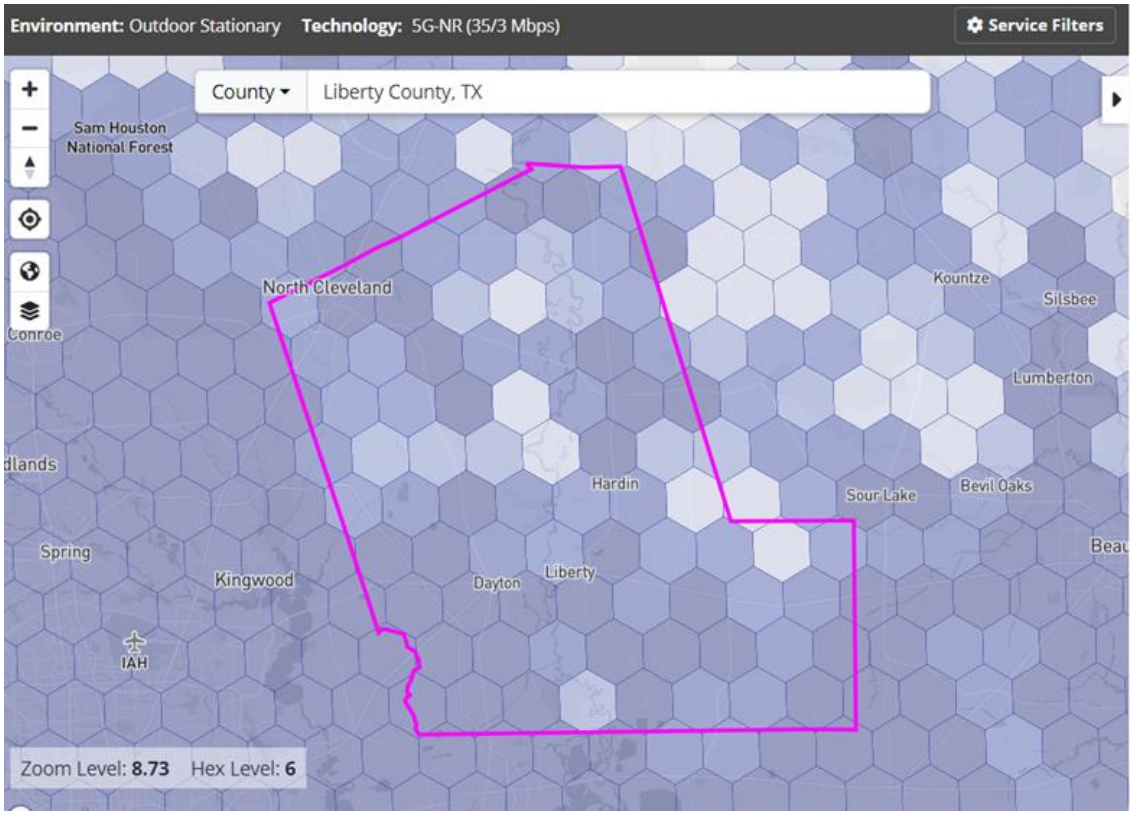
HARRIS COUNTY



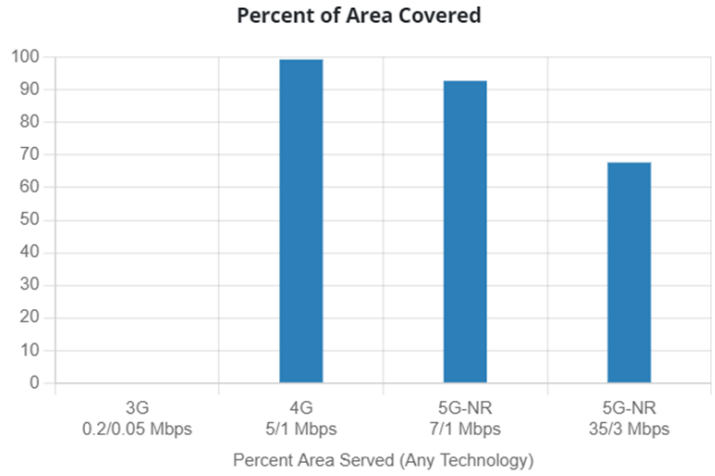
Per the FCC, Harris County is 99.83% covered by 5G-NR, as detailed in the above map, with coverage being strong throughout the county. While this level of coverage indicates that essentially all Harris County residents have access to 5G-NR mobile networks, it does not necessarily mean mobile connections would provide a satisfactory user experience capable of replacing terrestrial broadband for household internet, as 35/3 falls well short of the 100/20 standard for broadband.



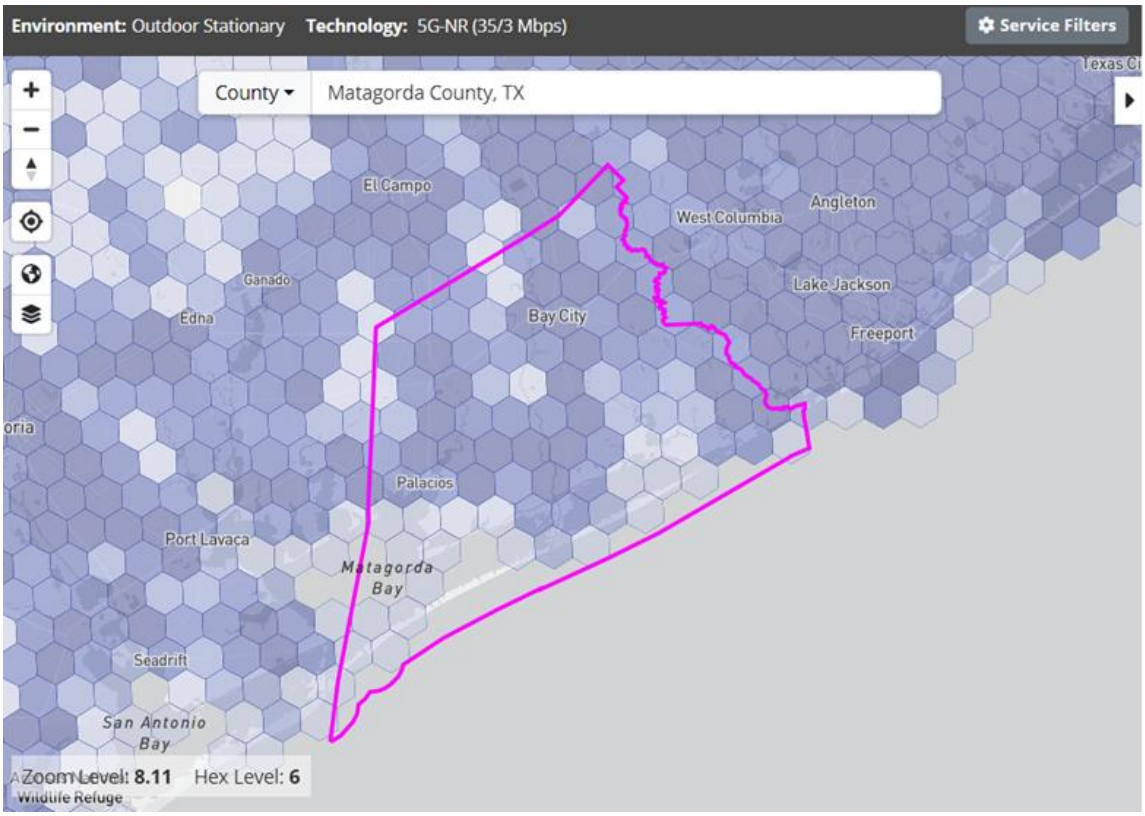
LIBERTY COUNTY



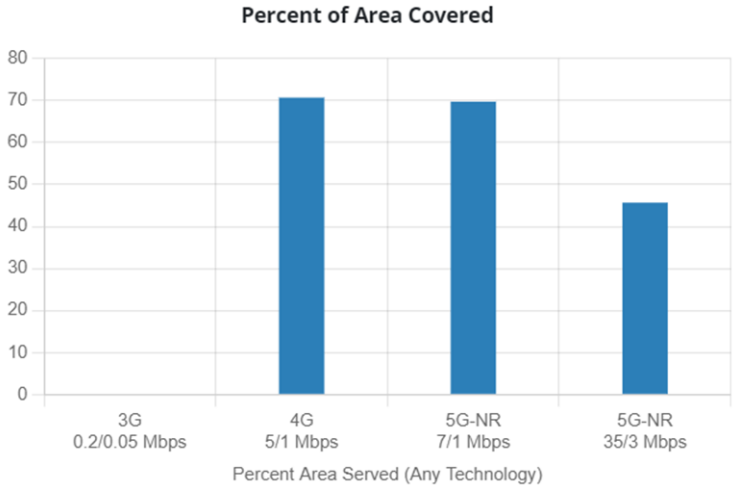
Per the FCC, Liberty County is only 67.69% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the communities of North Cleveland, Hardin, Dayton, and Liberty. For residents of the interstitial regions between these population centers and the very poorly served patches in the County, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



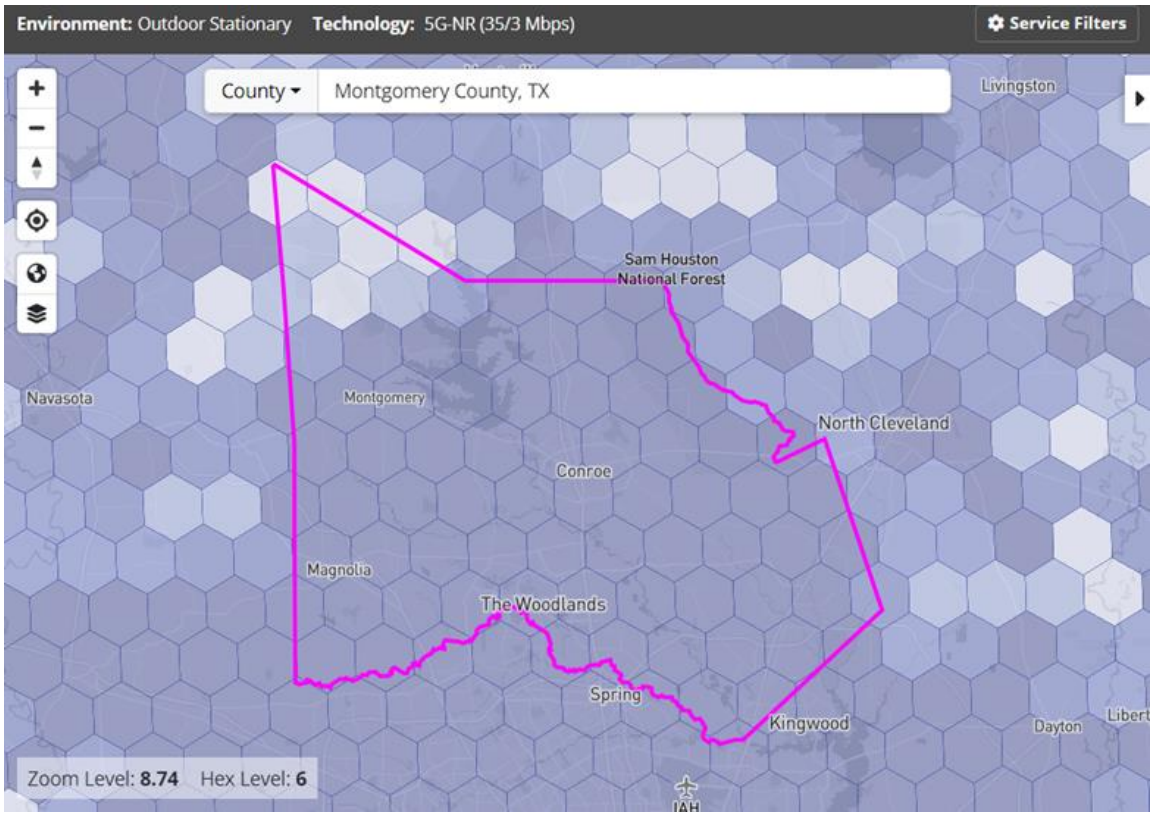
MATAGORDA COUNTY



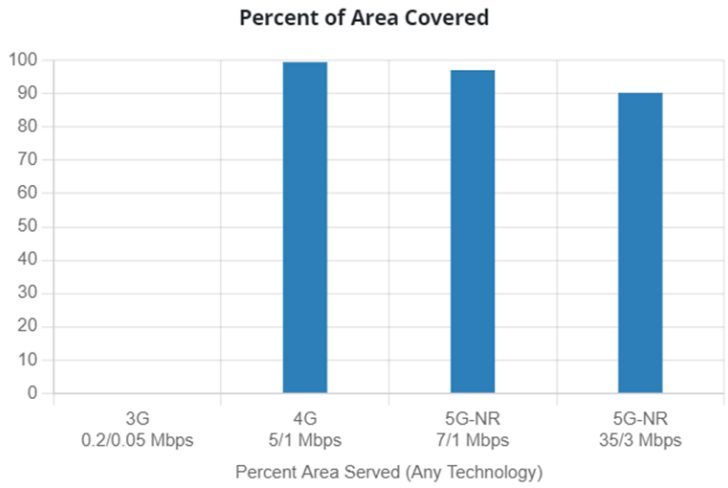
Per the FCC, Matagorda County is only 45.67% covered by 5G-NR, as detailed in the above map, with coverage being strongest in the community of Bay City . For residents of the interstitial regions between these population centers and the very poorly served coastal areas of the County, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



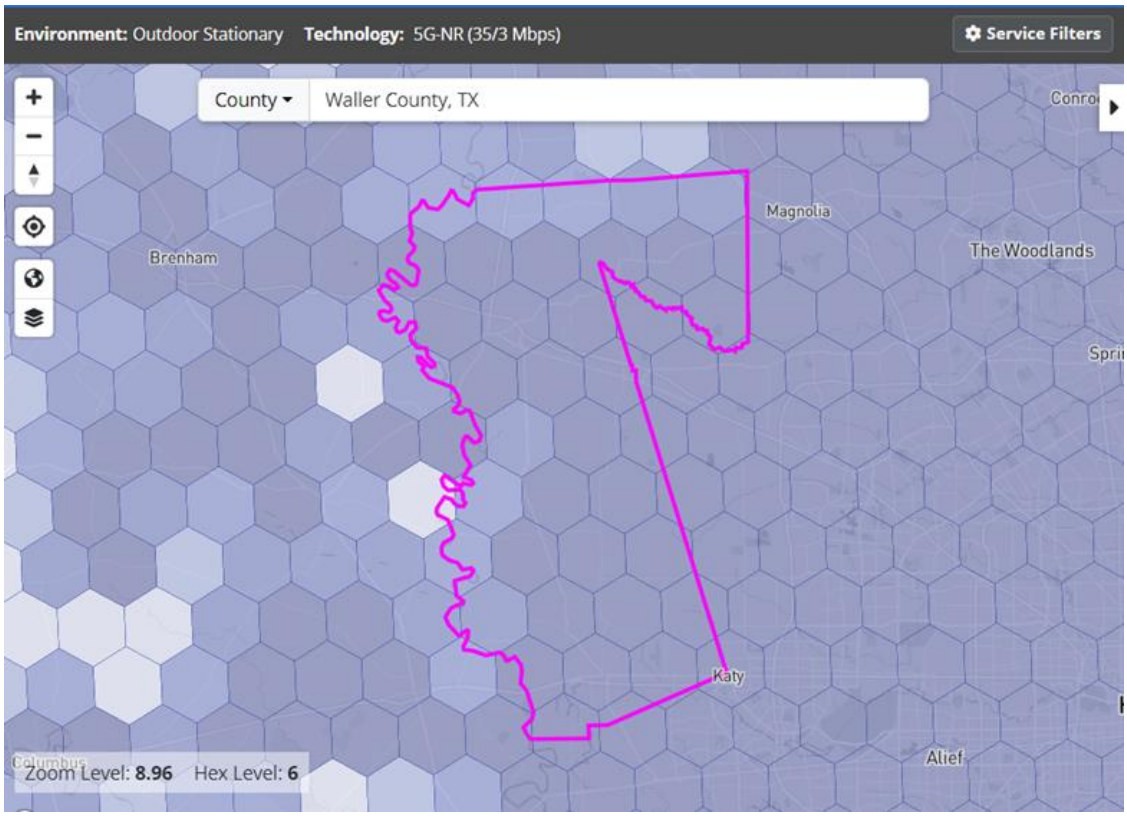
MONTGOMERY COUNTY



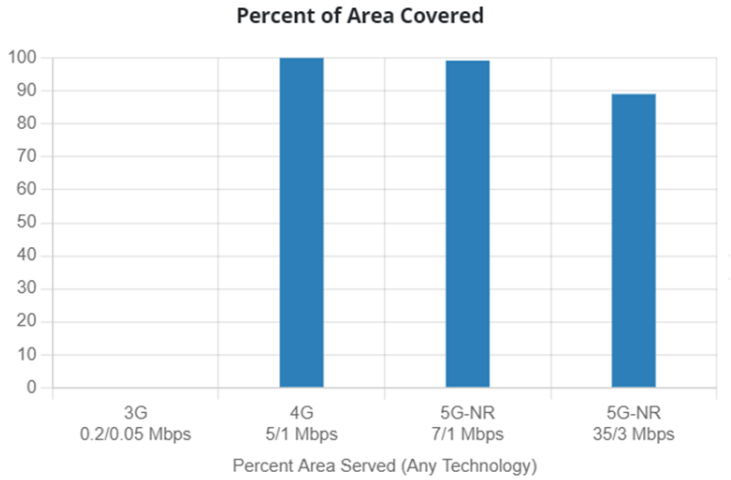
Per the FCC, Montgomery County is 90.25% covered by 5G-NR, as detailed in the above map, with generally strong coverage throughout, except for the north east corner of the County. Regardless, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



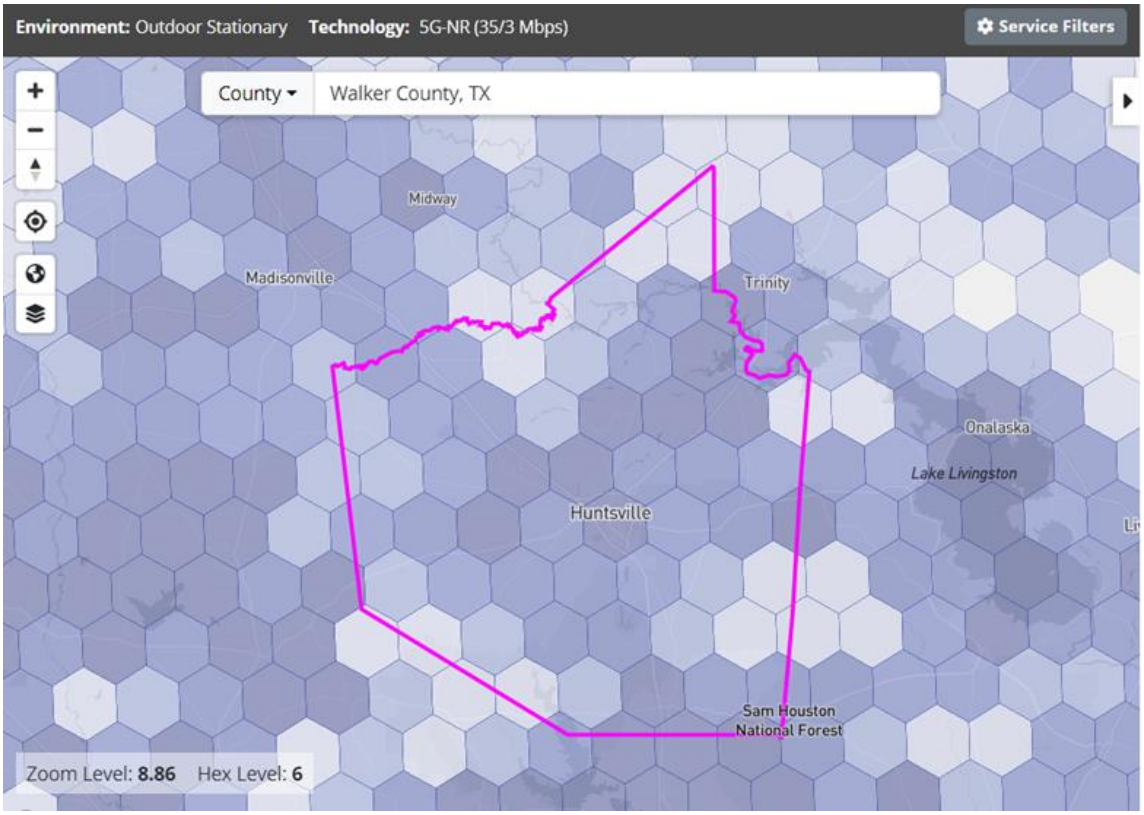
WALLER COUNTY



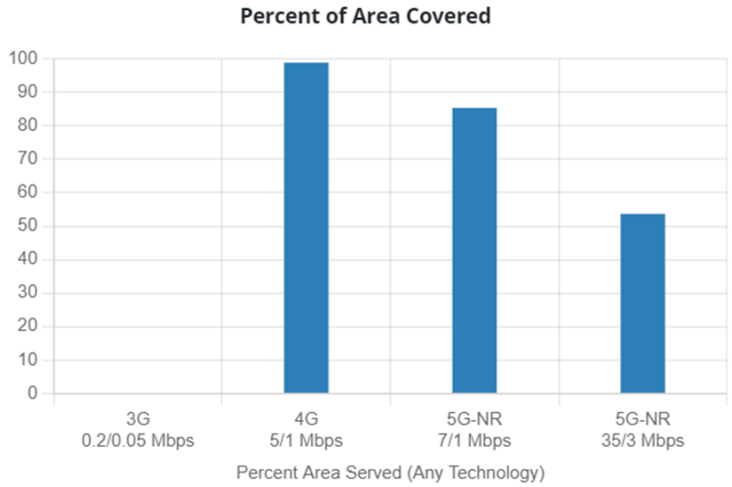
Per the FCC, Waller County is 89.05% covered by 5G-NR, as detailed in the above map, with generally strong coverage throughout, except for the northern and western edges of the County. Regardless, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they can connect to a mobile network.



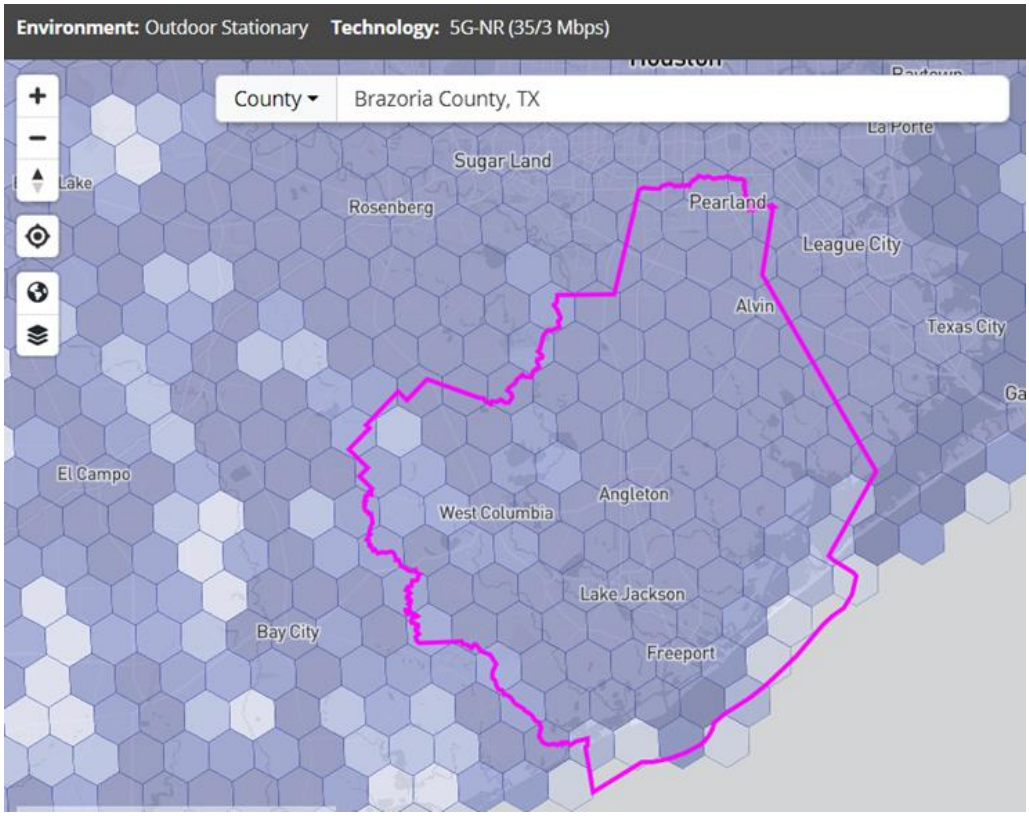
WALKER COUNTY



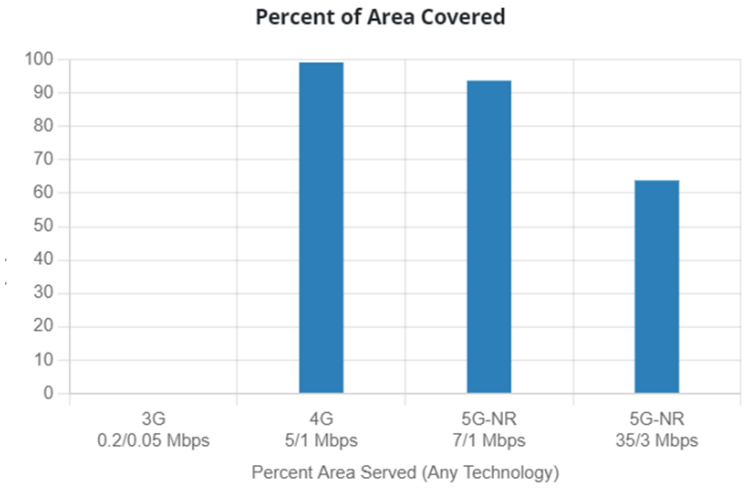
Per the FCC, 35/3 5G-NR Coverage in Walker County is only 53.68%, as detailed in the above map, with generally insufficient coverage throughout, except for the area immediately surrounding Huntsville. For most residents, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they are able to connect to a mobile network, which many likely cannot.



WHARTON COUNTY



Per the FCC, 35/3 5G-NR Coverage in Wharton County is only 63.83%, as detailed in the above map, with generally insufficient coverage throughout, except for the area immediately surrounding El Campo as well as a portion of the northeast and southeast corners of the County. For most residents, mobile broadband likely does not represent a viable alternative to terrestrial broadband service as it will likely fall well short of the 100/20 standard, even if they are able to connect to a mobile network, which many likely cannot.



CITIZENS BROADBAND RADIO SYSTEM (CBRS)

In researching options for varied communications needs (traffic signals, AMI, emergency response, WiFi, downtown, extending network, etc.) a technology that is currently being deployed across the Country seemed like a possible option for communities in the H-GAC area: CBRS. This is an intriguing possibility because, as will be discussed in this document, it can be a secure way to have one system segment and carry multiple communications needs that most communities have and potentially extend networks to some degree.

These types of systems (and others) are also referred to as private LTE networks. This technology will not likely be eligible for BEAD grants but are being discussed to inform communities of a promising and lower cost option to improve broadband if BEAD grants are not available (particularly in rural areas)..

UNDERSTANDING THE TECHNOLOGY

The Citizens Broadband Radio Service (CBRS) is a band of radio-frequency spectrum from 3.5GHz to 3.7GHz that the Federal Communications Commission (FCC) has designated for sharing among three tiers of users: incumbent users, priority access licensees and general authorized access, which is unlicensed.

The Spectrum Access System (SAS) manages the authentication network for all CBRS devices. Currently there are five SAS providers authorized to manage the network: Amdocs, CommScope, Federated Wireless, Google and Sony. The National Telecommunications and Information Administration of the Department of Commerce grants authorization to become a SAS provider upon technical standards review, which will be periodically updated.

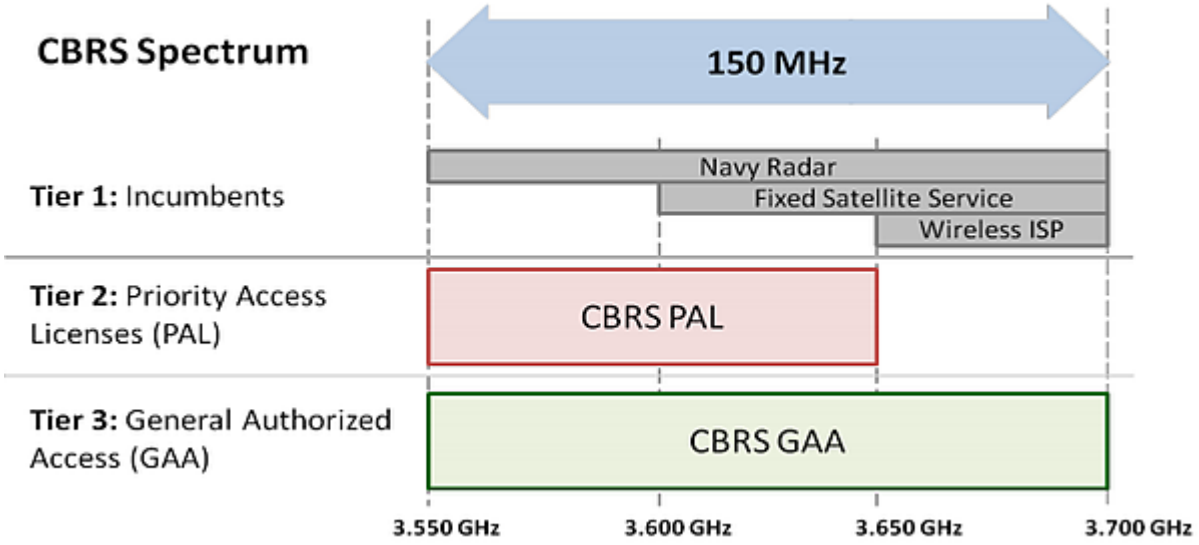


FIGURE 78 - BAND PLAN FOR CBRS SPECTRUM ALLOCATIONS

The three levels of license access include:

1. Incumbents: The incumbents are those who have historically held exclusive rights to the band: satellite ground stations and the Navy. The Navy has used these frequencies primarily for their operations for their shipborne radar operations making coordination zones along coastal regions of

continental United States. The incumbent's spectrum usage is the prioritized tier. Environmental Sensing Capability (ESC) devices placed along coastlines are designed to sense Navy radar when it appears and inform the SAS. The SAS triggers a two-hour keep-off timer to shut down any CBRS usage in a 10 MHz channel, power-down the devices to an acceptable level, or move to another channel the neighboring co-channel CBRS devices in the predefined geographic area to prevent interference to the Navy radar.

2. Priority Access License (PAL): Priority licenses were auctioned by the FCC in the summer of 2020. PALs may operate so long as they don't interfere with the incumbents and tolerate interference from the incumbents. These licenses are currently granted for a period of ten years. In total, 22,631 licenses were auctioned off with bidding totals reaching approximately $4.6 billion.
3. Generally Authorized Access (GAA): Generally authorized access gives users the right to use the band as long as they don't interfere with the other two categories of users. GAA users can use all the 15 10 MHz channels – the entire 150 MHz of the band, versus PAL users have priority of a portion – 70 MHz of that spectrum. GAA unlicensed devices and operations are subservient to PAL and incumbent devices.

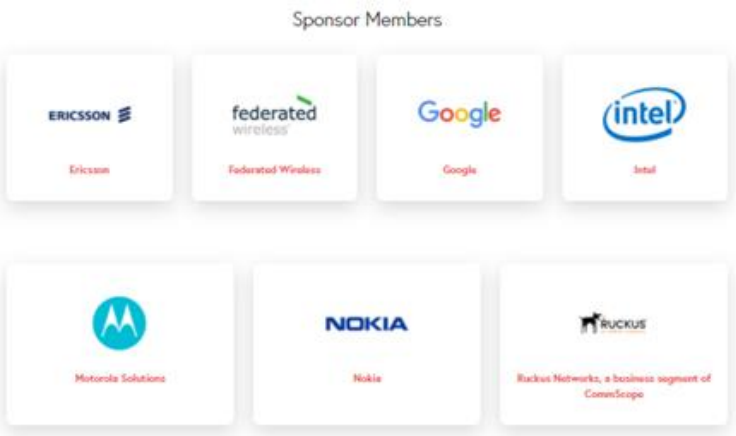
The band is also scheduled for expansion. The Department of Defense (DoD) recently announced that it has devised a spectrum sharing framework to expand CBRS in the 3.45-3.55 GHz frequencies which will become available for future Commission auction, potentially as early as December 2021. Other federal efforts are also in place to study potential use of adjacent bands for mixed commercial use.

CBRS USE CASES

The band is considered one of the first role models for flexible use licenses – a mixture between unlicensed Wi-Fi and an exclusive license, enabling an open access managed license network. It lends itself well to regional ecosystems of compatible devices such as large business or manufacturing networks for internal operations. For example, as NetworkWorld writes: ""…the upshot for IT pros is that it could enable enterprises to build their own private 4G/5G networks. Moreover, CBRS technology allows the owner to, in essence, divide their spectrum into slices, so that they can aggregate data (e.g. RF communications) into one network." While manufacturing of CBRS devices is a relatively new industry, especially in light of continuously developing standards, it is likely that a robust applications industry will develop in the next few years.

With the larger companies in telecommunications involved in CBRS, there are test cases and authentication processes for communities to develop and prove CBRS networks.

CBRS vendors have clearly communicated that fiber has a role in CBRS. They have noted that like any transmitter/receiver system, fiber can be important in backhaul to increase capacity.



This technology has strong backing that has brought it to this point. This graphic is from their website (https://www.cbrsalliance.org/about-the-cbrs-alliance/) and shows the depth of the industry muscle that has been researching and developing what is available today. These are some of the biggest names and companies in broadband.

Those are just the Sponsor members. The Full members include: American Tower, AT&T, Boingo, CableLabs, CASA Systems, Charter, Comcast, Corning, Cox, Crown Castle, Dell, Facebook, Fujitsu, Microsoft, Mobilitie, Qualcomm, Samsung, etc. Again, the biggest names in the industry have supported and been working on this technology.

In very summary form, the community secures the spectrum, then installs a network that resembles a 5G network. Then, they commission the uses and have a dashboard that shows them what is happening on each slice. The system is said to be fairly simple to monitor. But there does need to be some arrangement for maintenance of the equipment – either by municipal employees or contracted with a maintenance company.

In a Wall Street Journal article titled ,"Private 5G Networks Are Bringing Bandwidth Where Carriers Aren't" (https://www.wsj.com/articles/private-5g-networks-are-bringing-bandwidth-where-carriers-arent-11604725218?mod=tech_listb_pos4), the author states "Private networks are geographically constrained areas of coverage, intended to keep a local set of sensors, machines and computers in sync, and allow communications with the rest of the world as needed." To show the magnitude and amount of work being done on these networks, the article goes on to say, "In a December 2019 report, analysts at Deloitte predicted that by the end of 2020, more than 100 companies world-wide will have begun testing their own private 5G networks. That includes organizations such as Ford Motor Co., Corning Inc., BMW AG, BASF SE, China's state-owned Shandong Energy Group, and the U.S. military, which by itself is pouring $600 million into five different projects."

POSSIBLE USE CASES

This spectrum band could be particularly relevant to Fulshear for several reasons:

- CBRS can bring multiple communications needs into one system (SCADA, Advanced Metering Systems (AMI), traffic signal controllers, sensors, cellular, RF systems, etc. This aggregation can save dollars that are paid for each individual communication system for service and for maintenance.
- CBRS networks might be able to provide redundancies.
- With CBRS systems in place, other uses can be considered – sensors, parking, etc. These uses can often be added with only an incremental cost of the end point device.
- This type of network could be used to extend networks in some circumstances.
- CBRS can improve cellular connectivity.
- CBRS can also be utilized to improve first responder and emergency management connectivity (while also being secure).

CONSIDERATIONS

One consideration is ensuring that the "slices" adequately separate the uses. Data and feedback indicate that they do, but communities will want to ensure that those security measures are adequate for desired use cases. HR Green subject experts in SCADA and metering raised this as an issue to be proven. As will be discussed below, CBRS equipment vendors have offered a way to conduct a proving method for each use a community might consider.

A second consideration related to security is what spectrum is used. Some communities will likely utilize the unlicensed spectrum. CBRS equipment vendors can provide descriptions of and examples of proven successful security measures. Communities will want to explore those and ensure that they are adequate for the community's needs.

A third important consideration for communities in the H-GAC area is in an incumbent protection zone, as outlined by the figure below:

FIGURE 79 - CBRS PROTECTION ZONES

Protection zones are associated with the use of Navy Radar and require greater coordination with priority users. The SAS providers are charged with deploying ESC sensors along the coast to sense the Navy radar and shut down, lower the power, or switch the channel of any potentially-interfering CBRS devices in the vicinity. This aspect is not likely to significantly affect operations, but it may have an impact for certain frequencies, particularly PAL license frequencies because they operate within the same frequencies as the Navy radar. GAA frequencies, on the other hand, have an additional 5 channels of the CBRS band (3.65-3.7 GHz) where the Navy radar does not operate.

In subsequent discussions with CBRS vendors, they have researched available spectrum and identified spectrum that would not interfere with Navy communications needs.

CONCLUSION

The CBRS band could be a good option for communities to aggregate uses, create redundancy, deploy sensors/Smart City operations and extend networks. The frequencies in the band have good propagation characteristics, a lot of data capacity, and its mixed-use model is expected to produce a diverse ecosystem of devices. In addition, a CBRS network is relatively cheap – devices are low powered, the GAA spectrum is free, and it can be designed to interoperate with existing infrastructure. Due to the emerging use of this model and the recent allocation of this band, these advantages have some associated risks to address:

- CBRS vendors can provide test cases for communities and industries that have begun utilizing this technology.

- There has been considerable lab work and implementations, but the manufacturing and innovation CBRS devices will continue to develop for a few years, so adaptability of equipment is a topic to understand.
- The level to which a CBRS system can be used to extend networks would need to be validated for each possible use.
- A lot has been put into place, but there are some uncertainties about SAS operations and subsequent updating of technical standards that communities will want to understand.
- Fully understanding security will be important – there has been a lot of work done on CBRS security, so communities will want to fully understand security options and protocols.
- An important function of CBRS is to enable multiple applications to utilize the network, so communities will want to prove that their uses will not interfere with other communications systems.
- CBRS experts have examples that have validated that power back up equipment can be used to keep connectivity available during power outages. If communities would like to utilize CBRS for maintaining communications when the electric grid is down, the options and costs would need to be explored.

There are steps communities can take to prove these concepts and mitigate these risks. CBRS vendors can provide test case results of both functionality and security. Additionally, CBRS vendors can perform proof of concept steps, like setting up equipment in a community and, actually, running the community's applications over this temporary network.

Because of the variables above, HR Green is not in a position to recommend CBRS as the solution for all communities and their multiple needs. It has potential, but the above questions need to be addressed. When it might be a consideration, we recommend proving the concept through direct discussions with a major CBRS vendor (or more formal RFP process to evaluate various options). This would provide the communities with opportunities to more fully evaluate vendor provided details on the above questions and to demonstrate how their system would handle actual data.

[iii] Federal Communications Commission. "Lands of Opportunity: Bringing Telecommunications Services to Rural Communities," July 2006. https://transition.fcc.gov/indians/opportunity.pdf

[iv] Congressional Research Service. "Low Earth Orit Satellites: Potential to Address the Broadband Digital Divide," August 31, 2021. https://crsreports.congress.gov/product/pdf/R/R46896

[v] SpaceNews."Op-Ed | Satellite Bankruptcies circa 2000 vs. 2020: We've Come a Long Way!," April 15, 2021. https://spacenews.com/op-ed-satellite-bankruptcies-circa-2000-vs-2020-weve-come-a-long-way/

FOCUS SESSIONS

As part of the H-GAC Broadband Study, five Focus Sessions were conducted. Each session had a specific topic designed to help attendees become more familiar with that particular aspect of the broadband industry. The invitation that went out to community leaders contained these descriptions:

- Policy: 3/8/24 at 10:00 a.m. – we will discuss the policies that are utilized across the Country to accomplish broadband goals. Some communities want to attract more broadband investment from private providers others want to manage an influx of broadband infrastructure permits. This session will address both scenarios and offer specific policies for each.
- Funding and Grants: 3/11/24 at 3:00 p.m. – there are several grant programs that are or will be available this year to help reduce the costs of broadband infrastructure and services. Whether a community is going to apply for those directly or rely on a private provider to see those funds, it is important to know what they are, their timelines and what the community can do to help work towards these dollars come to your area.
- Governance: 3/12/24 at 10:00 a.m. – some communities see a need to pursue broadband grants themselves and/or build some of their own broadband related infrastructure (conduit, a ring, a partial network or a full network). Others want to work with private internet service providers to have them build all of the needed infrastructure. Still others are willing to invest some money, existing broadband infrastructure or alter their policies to incentivize providers to make broadband infrastructure investment in their community. All of these scenarios require an understanding of the involvement of the community and what the community can want in return. The arrangement the community makes with the providers is called governance (who will provide and receive what in infrastructure deployment) and we will explore the various governance models in this focus session.
- Rural Technology Options: 3/13/24 at 4:00 p.m.– many rural areas have specific challenges in connectivity. The cost to reach those areas is dramatically higher than more urban areas while the revenue that is generated is much lower because of fewer customers available to pay for broadband services. There are different technologies available to reach those areas, but there can be tradeoffs in the quality and reliability of services. The Rural Technology Options session will discuss the different technology options and explore the cost and service implications each provides.
- Smart connectivity: 3/14/24 at 11:00 a.m. – there is a once-in-a-lifetime (or longer) influx of grant money for broadband that is coming soon. An important question that all communities have the opportunity to explore is what can be done with this fiber. Whether the community or a private provider gets the grants and owns the infrastructure, there will be an unprecedented amount of new broadband infrastructure being installed all across the area. This session will explore attainable possibilities of uses for this new infrastructure that each community can consider – whoever owns it. What can your community do with this infrastructure to improve delivery of services, offer greater protection for your citizens, attract people and businesses, etc.? This session will explore real possibilities you can consider.

POLICY FOCUS SESSION

The Policy Focus Session Contained the following presentation.

Colocation policies

4

Can apply to **both Wired and Wireless infrastructure** (Conduit/Fiber/Small Cells)

- Joint-Build Initiatives with the Private Sector
- Synchronize scheduling of deploying assets
- Save expenses of digging with coordinated builds, less traffic congestion, faster deployment
- Require builders with open trenches and boring projects to deploy conduit and/or fiber on behalf of the community

Underground Wired (Fiber):
Dig Once / Shadow Conduit

When new roads are being built or opened for maintenance and conduit is not already in place, "dig once" policies that involve the installation of an oversized conduit bank within the right-of-way to accommodate future users—reducing the need to tear up the streets each time a new broadband provider wants to bring service to an area.

Aerial Fiber & Wireless:
One-Touch Make-Ready

Many broadband cables are installed using the power infrastructure already in place. The process to make a pole ready is usually: a new broadband provider negotiates access to poles in a given area, then waits until other providers or entities that have equipment attached to those poles to move their equipment one after another.

With one-touch policies, governments can ensure that the installation of each line – power, telephone, internet – takes future use into consideration.

HGAC Broadband Policy Workshop

Incentivizing deployment within preferred public right-of-way locations

5

Openly Available GIS map of Preferred Locations:

- Preferred RoW corridors
- Building rooftops
- Poles & intersections
- Available for leasing existing shadow conduit or dark fiber
- Fiber friendly policies
- Co-location program
- Identify fiber-related assets:
  - GIS layers, records, conduits, strands, agreements, splice points, vaults, etc.
- Look for abandoned infrastructure
- Identify underutilized capacity
- AGAIN: DEFINE OWNERSHIP OF EVERYTHING IN YOUR STREETS
- Identify community partners and seek mutual benefit

Can result in expedited permitting process and faster time to market

Exploring street cut and pavement degradation fee exemptions and other complementary initiatives

- Pavement degradation policy
- Street cut fee policy
- Traffic control policy

Why have a broadband management process?

- Increase Ubiquity
- Have Broadband Ready for New Buildings
- Protect RoW
- Future-Proof Technology
- Solves shared problems
- Facilitate provider engagement
- Operationalizing the system
- Attract partnerships

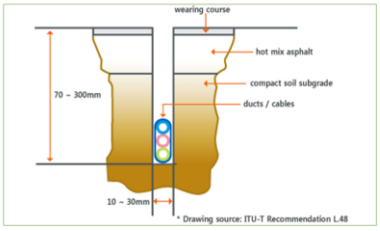
HGAC Broadband Policy Workshop

Microtrenching

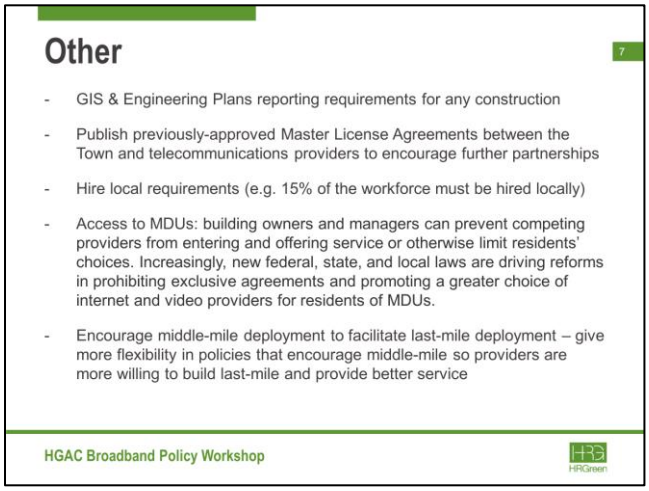
6

Microtrenching: the process for deploying fiber that cuts thin, shallow channels into pavements, sidewalks, or existing joints, in lieu of wider, deeper trenches or underground bores.

- Less expensive Alternative
- Improved public safety, lower likelihood of striking other buried infrastructure
- Reduced disruption in the Rights-of-Way
- Some cities ban it due to pavement degradation, but areas where it is acceptable can be identified
- Example of trade off between departmental vs. citywide objectives



HGAC Broadband Policy Workshop

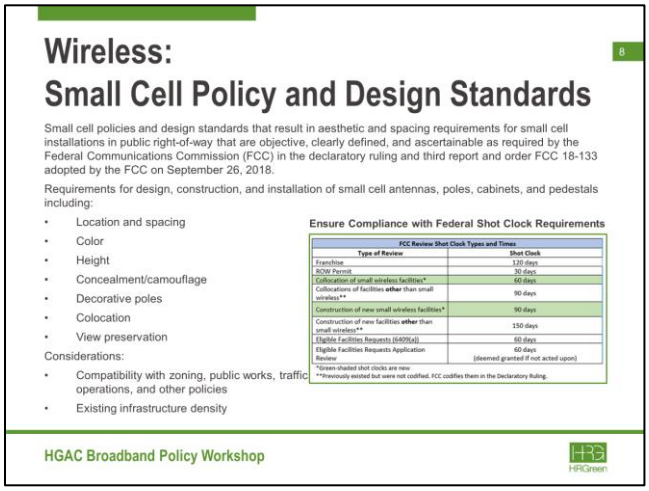


Other

7

- GIS & Engineering Plans reporting requirements for any construction
- Publish previously-approved Master License Agreements between the Town and telecommunications providers to encourage further partnerships
- Hire local requirements (e.g. 15% of the workforce must be hired locally)
- Access to MDUs: building owners and managers can prevent competing providers from entering and offering service or otherwise limit residents' choices. Increasingly, new federal, state, and local laws are driving reforms in prohibiting exclusive agreements and promoting a greater choice of internet and video providers for residents of MDUs.
- Encourage middle-mile deployment to facilitate last-mile deployment – give more flexibility in policies that encourage middle-mile so providers are more willing to build last-mile and provide better service

HGAC Broadband Policy Workshop



Wireless:
Small Cell Policy and Design Standards

8

Small cell policies and design standards that result in aesthetic and spacing requirements for small cell installations in public right-of-way that are objective, clearly defined, and ascertainable as required by the Federal Communications Commission (FCC) in the declaratory ruling and third report and order FCC 18-133 adopted by the FCC on September 26, 2018.

Requirements for design, construction, and installation of small cell antennas, poles, cabinets, and pedestals including:

- Location and spacing
- Color
- Height
- Concealment/camouflage
- Decorative poles
- Colocation
- View preservation

Considerations:

- Compatibility with zoning, public works, traffic operations, and other policies
- Existing infrastructure density

Ensure Compliance with Federal Shot Clock Requirements

FCC Review Shot Clock Types and Times	
Type of Review	**Shot Clock**
Franchise	120 days
ROW Permit	30 days
Collocation of small wireless facilities*	60 days
Collocations of facilities **other** than small wireless**	90 days
Construction of new small wireless facilities*	90 days
Construction of new facilities **other** than small wireless**	150 days
Eligible Facilities Requests (6409(a))	60 days
Eligible Facilities Requests Application Review	60 days (deemed granted if not acted upon)

*Green-shaded shot clocks are new
**Previously existed but were not codified. FCC codifies them in the Declaratory Ruling.

HGAC Broadband Policy Workshop

Recommended Action Steps

9

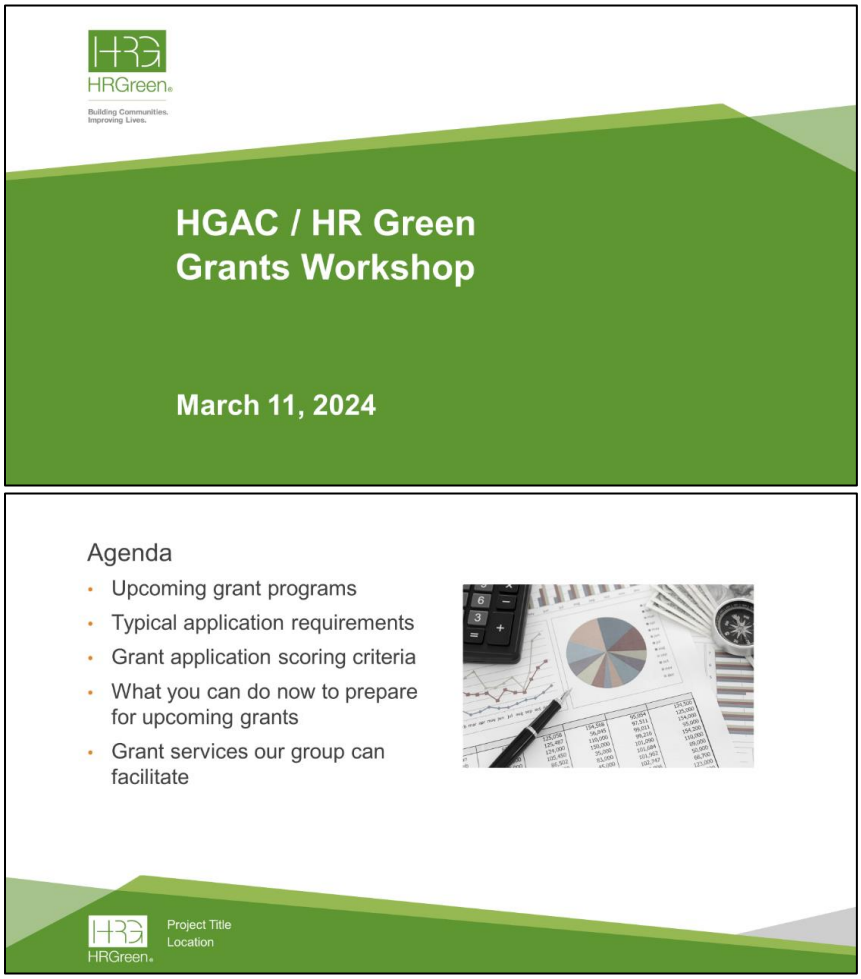
- Create a Template Policy for use by counties
- Adopt a colocation program to incentivize private sector investment
- Consider use of funding & grants to create broadband infrastructure in partnership with private sector
- Establish a local steering committee (public and private sector representatives)
- Evaluate existing options for encoding policies and requirements:
  - Ordinances
  - Master Plan
  - Zoning
  - Formal Department Policy
  - Application Form Details
  - Inspection Checklists

HGAC Broadband Policy Workshop

There was also a discussion of policies to manage Right of Way (ROW) and permitting volume when multiple providers seek to place their infrastructure in the community ROW and there is concern that there could be a shortage of ROW.

GRANTS AND FUNDING FOCUS SESSION

The Grants and Funding Focus Session Contained the following presentation.



Upcoming Grant Programs

- Broadband Equity, Access, and Deployment (BEAD) and Bringing Online Opportunities to Texas (BOOT) - $3.3 Billion in Texas
  - Initial Proposal Awaiting NTIA Approval, Guidelines expected April-May, Application Windows in Summer
- IIJA Digital Opportunity Program
- Texas Pole Replacement Program
- USDA ReConnect

INFRASTRUCTURE ACT* CREATES ~$65B IN BROADBAND FUNDING

NTIA will administer ~$48B of this new funding

BEAD	DIGITAL EQUITY	TRIBAL	MIDDLE MILE
$42.45B	**$2.75B**	**$2.00B**	**$1.00B**
Title I - Broadband Equity, Access & Deployment Program	***Title III – Digital Equity Act***	***Title II - Tribal Connectivity Technical Amendments***	***Title IV - Enabling Middle Mile Broadband Infrastructure***
Formula-based grant program for U.S. states and territories. BEAD aims to close the access gap for unserved & underserved areas of the country.	Three programs, established for planning & implementation of programs that promote digital equity, support digital inclusion activities, and build capacity related to the adoption of broadband.	Furthers current Tribal Broadband Connectivity Program by investing an additional $2B to fund broadband adoption and infrastructure projects.	Provides funding to extend middle mile capacity to reduce cost of serving unserved and underserved areas and enhance network resilience.

FCC to administer ~$14B
$14.2B
For Affordable Connectivity Program, which will replace the EBB program

USDA to administer $2B
$2.0B
Via the Rural Utilities Service

Private Activity Bonds
$600M
Authorizes State/local gov'ts to use private activity bonds for rural broadband

* Infrastructure Investment and Jobs Act, Division F, Pub. L. 117-58 (Nov. 15, 2021)
Note: funding amounts inclusive of all administrative set-asides

2

Typical Application Requirements

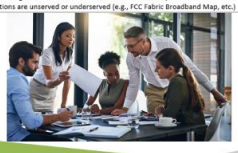
- Number of unserved/underserved households counts
- Economic/demographic data like median household income
- Need narrative
- High/Mid/Low-level design separated by CPE, cabinets, conduit, fiber, other OSP, backhaul/middle-mile
- Financial projections – construction and operations
- Planning and construction schedule
- Anticipated personnel and/or P3 partners
- Matching funds (25-50%)
- Help with Coordination on requested edits post submittal

Serviceable User Segments: Please state the number of premises passed or covered by the broadband infrastructure for the speed tiers identified below.

Premises in Service Area by User Segment

		Unserved (lacking wireline or licensed fixed wireless above 25/3 Mbps)			Underserved (having wireline or licensed fixed wireless above 25/3 Mbps but below 100/20 Mbps)		
Current Speed (Mbps)		<25/3	<25/3	<25/3	<100/20	<100/20	<100/20
Project-enabled Speed		≥100/20	≥100/100	≥1G/1G	≥100/20	≥100/100	≥1G/1G
Premise Type	Homes						
	Businesses						
	Community Institutions						
	Farms						
Total Premises by Speed							

Basis for Concluding Unserved or Underserved Status: Please explain the data used to substantiate the targeted locations are unserved or underserved (e.g., FCC Fabric Broadband Map, etc.)

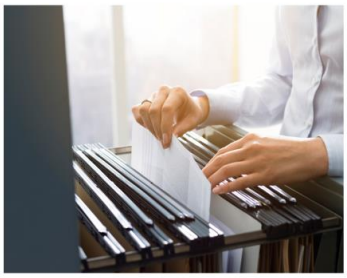


Grant Application Scoring Criteria - Example

A) Project Impact				
Broadband Impact: The degree of: a) unserved and underserved locations passed by wireline or covered by fixed wireless or alternative technologies; b) unserved locations relative to underserved locations; c) the magnitude of speed increase relative to existing service speeds	16	8.00%	36	18%
Comprehensive Community Impact: The degree to which the network serves the broader community, including community institutions, government facilities, backhaul for commercial mobile and public safety networks, backhaul to data centers, network resiliency and redundancy, etc.	12	6.00%		
Socioeconomic Development: Opportunities for the project to foster DISTINCT and UNIQUE social and economic development across targeted communities (e.g., housing development, business or population retention, community institution connectivity, infrastructure resiliency or redundancy, public safety, local employment, community programs to drive online adoption for telehealth or distance learning, etc.)	8	4.00%		
B) Community Engagement				
Local and Regional Community Partnerships: Partnerships with local and regional community organizations, businesses, government entities, and other broadband service providers to help achieve the project mission and maximize community impact	8	4.00%	16	8%
Community Support: The degree of community support from beneficiaries (e.g., connected residents, businesses, community institutions), community leaders, and other local interests	8	4.00%		
C) Economic Efficiency				
Matching Contribution Degree: The degree to which the matching contribution is above the minimum 25% requirement	12	6.00%	36	18%
Financial Need: Demonstration that absent subsidy support, the project could not move forward after considering total capital investment, reasonable non-state match, other business case inputs (e.g., recurring revenues and costs) to yield a reasonable return on investment for a publicly funded project. Also considers the fairness of the match being contributed in light of these factors.	8	4.00%		
Project Cost Efficiency: Demonstration that the collective set of decisions across technology selection, network design, procurement processes, and strategic planning yields the most cost-effective budget	8	4.00%		
Leveraging of Existing Assets: Leverage of existing and planned network assets and facilities that would otherwise require expenditure (e.g., middle-mile)	8	4.00%		
D) Project Readiness				
Network and Technology Details: Details of network design, route map, technology architecture, and integration with regional networks	8	4.00%	24	12%
Detailed Budget: Detailed itemized budget that lists the quantity and cost for every line item and brief narrative on purpose and reasonableness of expenditure	8	4.00%		
Detailed Project Schedule: Details of project activities, milestones, target dates, dependencies, and identification of all major risks and detailed risk mitigation plan	8	4.00%		
E) Organization Qualifications				
Organizational Experience and Capability: Demonstrated experience and capabilities in executing similar projects	8	4.00%	16	8%
Local and/or Regional Workforce Participation: Prior experience with and planned strategy for hiring local staff and leveraging local/regional firms and contractors to design, plan, deploy, and operate the project	8	4.00%		
F) Serving Offerings: Price and Range				
Pricing Competitiveness: The degree to which prices are commensurate with rates in competitive, urban markets	12	6.00%	24	12%
Diverse Set of Service Offerings: The breadth of service offerings to accommodate a diverse set of customer segments and other supporting services	12	6.00%		
G) Adoption Assistance Programs				
Low Price Option: The availability of a low-cost option for a 100/20 Mbps.	12	6.00%	24	12%
Digital Inclusion Programs: Programs and strategies to enable adoption, including devices, digital literacy, outreach, enrollment assistance in federal subsidy programs, community networks, etc.	12	6.00%		
H) *Project Sustainability*				
Financial Viability: Assessment of business case (e.g., comprehensive, detailed showing of revenue and cost elements) and financial strength of applicant	12	6.00%	24	12%
Network Capacity and Scalability: Total capacity available today and capability of network to efficiently scale to accommodate future bandwidth demand	12	6.00%		
	200	100%	200	100%

What Can I Do Now to Prepare?

- Find private sector partners (where are they interested to deploy?)
- Analyze survey results and community input
- Socioeconomic benefit
- Last mile unserved and underserved addresses
- High Level Design and Cost Estimates
- Letters of Support
- Bank Letters of Credit
- Historical financial records (usually 2-3 years)
- Permitting procedures (including environmental), design guidelines
- Matching funds required or able to supply to strengthen application



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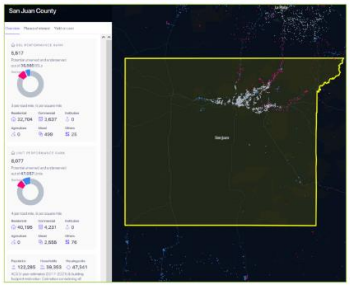
Tasks Our Grants Groups Performs



- Collect addresses for grant eligibility
- Coordinated High-Level Designs (HLD) with our design team
- Coordinates developing high-level costing of proposed new broadband infrastructure with our design team
- Work with our clients to coordinate support letters (and dollars when applicable)
- Work with our clients to develop the wording for the narrative sections of the grant application
- Regranting programs when needed (example being Yamhill County Oregon)
- Grant award compliance

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HR Green Grant Prep Services

Landing Page: https://info.hrgreen.com/broadband-grant#plan

Precision Guidance for Your Community to Make the Most of BEAD Funding Allocation

With more than $42 billion in grant funding flowing to state broadband programs, it is crucial that you act now to plan effectively. Don't miss out on this unique chance to secure funding for your community's broadband projects.

SOLUTIONS FOR EVERY COMMUNITY

- Broadband **CONNECT** →
- Broadband **PLAN** →
- Broadband **COMPLETE** →

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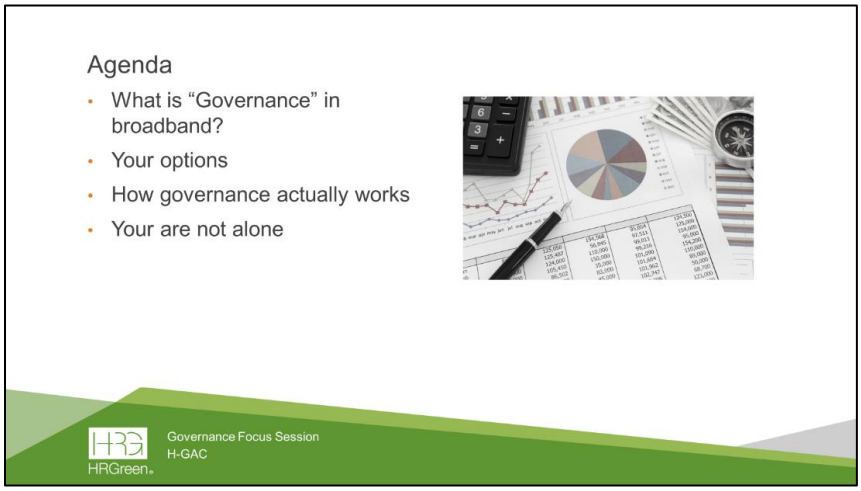
FIBER AND BROADBAND

GOVERNANCE FOCUS SESSION

The Governance Focus Session Contained the following presentation.



What Is "Governance" In Broadband?

- Who owns infrastructure
- What each participant put in
- What each participant receive

City Main Business Model Options for Broadband Expansion

		Own Rights of Way, Utility Infra.	Own Middle Mile	Own Last Mile	Operate Infrastructure	Service Customer	Example City
1	Full Municipal Broadband	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Chattanooga
2	Publicly-owned, Privately-Serviced	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity (City or Utility)	Public Entity / Service Provider	Service Providers (One or Several)	Westminster
3	Hybrid Ownership	Public Entity (City or Utility)	Public Entity (City or Utility)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Lincoln
4	Private Developer Open Access[1]	Public Entity (City or Utility)	Private Developer	Private Developer	Private Developer	Several Service Providers	Fullerton
5	Full Private Broadband	Public Entity (City or Utility)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Service Providers (One or Several)	Boston

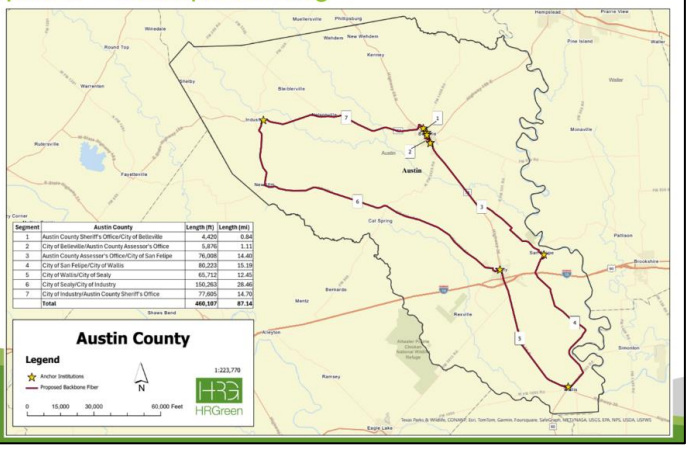
Note: 1) Private Developer is defined as private company that builds, owns and operates the network infrastructure and offers open access to it to several retail SPs that provide service on the top

https://www.us-ignite.org/wp-content/uploads/2020/07/USIgnite_Altman-Solon_Whitepaper-on-Broadband-Models_FINAL_7-9-2020.pdf

Your Options (Common Examples)

- Own:
  - Own, operate and maintain network – retail model
  - Own a ring for your assets – lease out excess capacity
  - Own and contribute excess capacity in components
  - Contribute dollars
- Partner
  - Help coordinate providers – total coverage
  - RFEI
  - Help partner get grants
  - Policy and permitting
- Let the private sector take care of it

Your Options – Example of Ring



Segment	Austin County	Length (ft)	Length (mi)
1	Austin County Sheriff's Office/City of Bellville	4,420	0.84
2	City of Bellville/Austin County Assessor's Office	5,876	1.11
3	Austin County Assessor's Office/City of San Felipe	76,008	14.40
4	City of San Felipe/City of Wallis	80,223	15.19
5	City of Wallis/City of Sealy	65,712	12.45
6	City of Sealy/City of Industry	150,263	28.46
7	City of Industry/Austin County Sheriff's Office	77,605	14.70
	Total	460,107	87.14

How Governance Actually Works

- Win/Win is important – think partners, not adversaries
- Know what you need – and communicate those things
- Think through what you can offer (money, infrastructure, support, policy and permitting, etc.)
- You do not have to own to participate – and, you can own, but not operate and maintain
- Trading is common – everyone just needs to be fair
- Your attorney will need to be involved
- Consultants can be helpful

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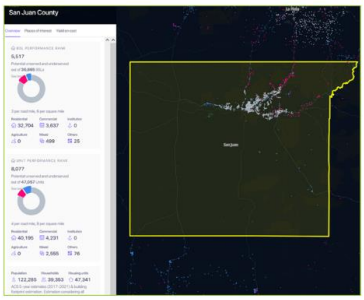
You Are Not Alone

- H-GAC's Study
  - Current coverage
  - Options to improve broadband
  - Grant preparation
  - Governance
  - Policy
- BDO Tap Program
- H-GAC
- Consultants
- Other communities



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RURAL TECHNOLOGY FOCUS SESSION

The Rural Technology Focus Session Contained the following presentation.

HRGreen
Building Communities. Improving Lives.

HGAC / HR Green
Rural Technology Focus Session

March 13, 2024

Agenda

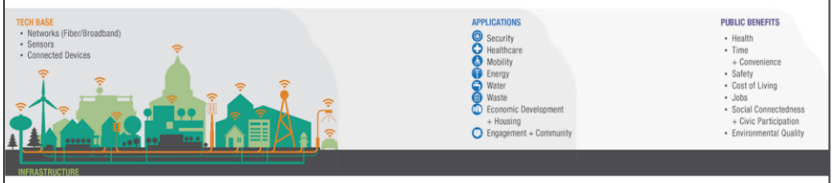
- Why is Rural Technology important?
- Rural Technology options
- You are not alone

Why Is Rural Broadband Technologies Important?

- Math
  - Cost to deploy
  - Number of subscribers
  - Revenue per subscriber
  - ROI
- This is why we have the current coverage issues we have now
- How do you change the math?
  - Grants
  - The technology

Why Is Rural Broadband Technologies Important?

Start with the technology base:



Rural Broadband Technologies

- Type of technology
- Positives and negatives

	Fiber	Coaxial Cable	Digital Subscriber Link	Fixed Wireless	GEO Satellite	LEO Satellite	Cellular Broadband
Area of Coverage							
Cost to Subscribers							
Deployment Cost							
Throughput/Speed/ Data Rate							
Service Reliability							
Latency							
Jitter							
Packet Loss							

Rural Broadband Technologies

Initial Cost

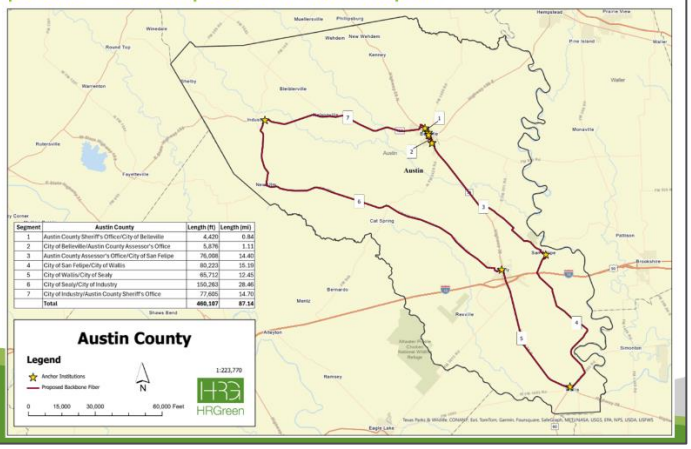
Satellite – Cellular – Fixed Wireless – DSL – Cable – Fiber

Reliability

Your Options

- Choosing from existing options
  - What technology fits
  - Own verses a provider partner (see Governance Focus Session)
  - Manage provider process
- Temporary solution vs longer term
- Change the math

Your Options – Examples in Final Report



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	Total	460,187	87.14

You Are Not Alone

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- H-GAC
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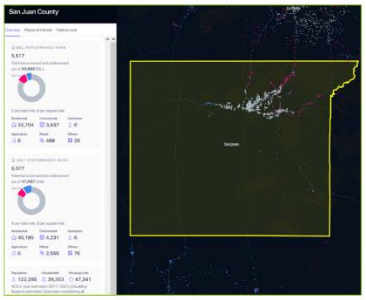
- Consultants
- Other communities



FIBER AND BROADBAND

SMART COMMUNITY FOCUS SESSION

The Smart Community Focus Session Contained the following presentation.

HRGreen
Building Communities. Improving Lives.

HGAC / HR Green
Smart Community Focus Session

March 14, 2024

Agenda

- Defining "Smart Community"
- The path
- Examples
- You are not alone

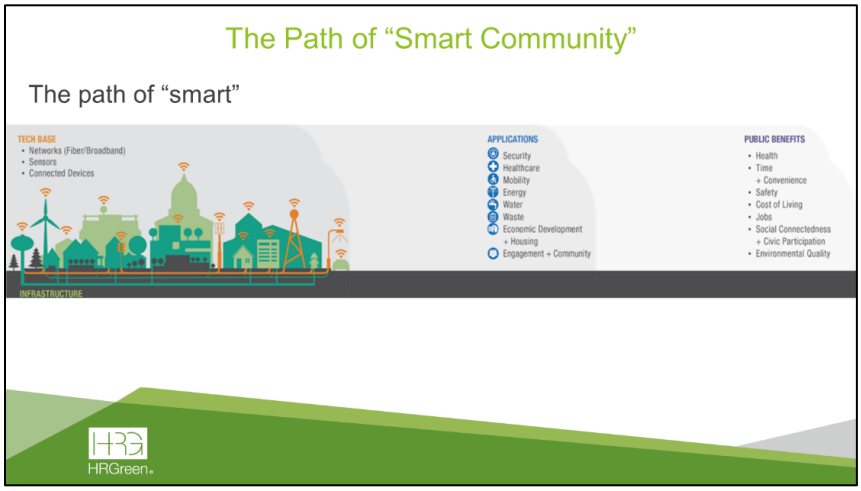
HRGreen
Governance Focus Session
H-GAC

Defining "Smart Community"

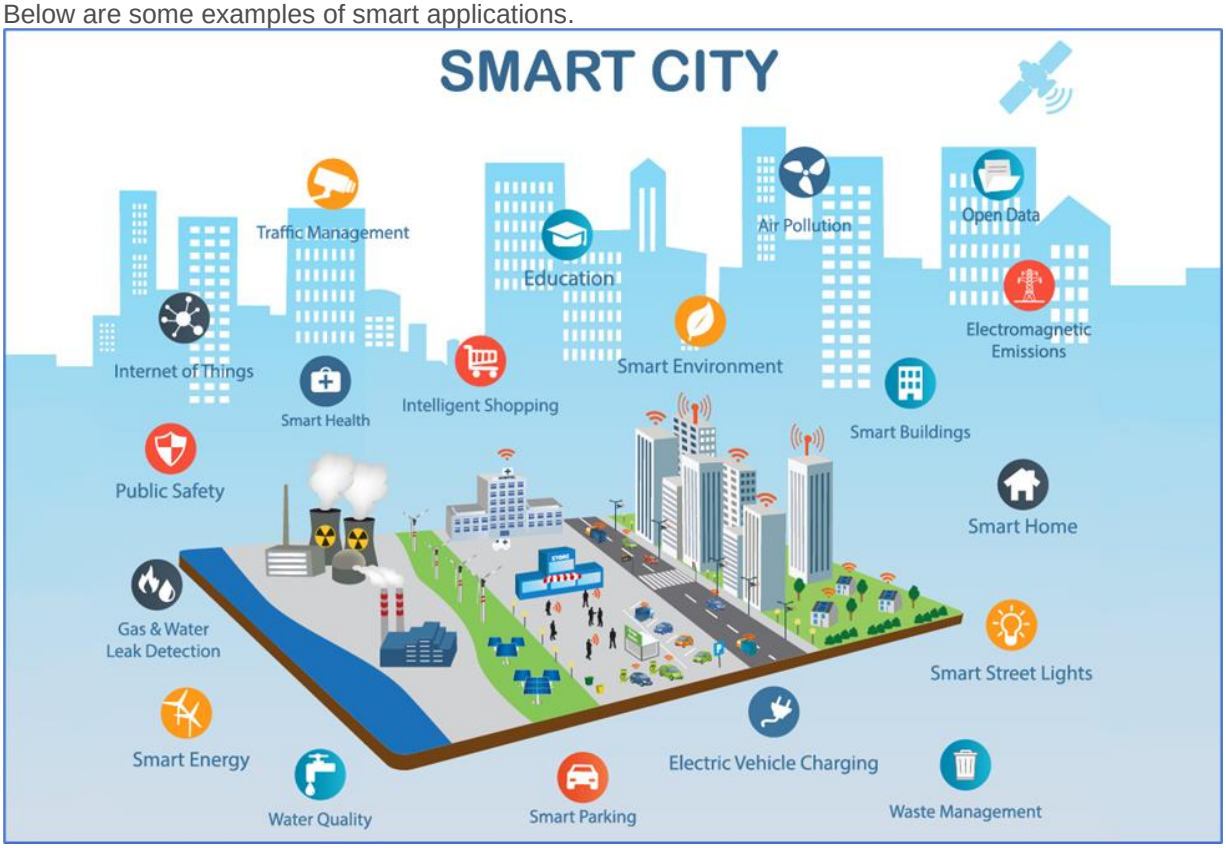
Beginning definition of "Smart Community":

The integration of infrastructure, technology and data to improve safety, efficiency, delivery of municipal services and management of city assets.

HRGreen



Below are some examples of smart applications.



The Path of "Smart Community"

Components:

- Tech base (infrastructure)
- Applications (use cases and prioritization can be very important)
- Data analysis and management – dashboards
- Analysis of the public benefit

The Path of "Smart Community"

Most Typical Categories:

- Security
- Energy
- Utilities
- Transportation
- Navigation

Examples of "Smart Community"

ITS – HR Green's Tyler Wiles discussed and showed examples of how smart connectivity can be used in traffic control systems and how excess capacity and security can be built into those systems to offer connectivity for other applications, businesses and citizens.

Examples of Smart Connectivity

- Traffic congestion
- Leak detection
- Air quality
- Water management
- Security
- Weather
- Accident avoidance
- Parking management
- Pedestrian movement
- Energy management
- Communications
- Lighting
- First responder
- Irrigation
- Refuse management
- Micro-grids

HRGreen®

You Are Not Alone

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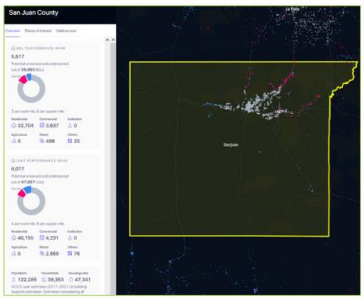

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HIGH-LEVEL DESIGN

In this section, we provide two ways to conceptualize and determine costs for specific ways to improve broadband in each county: Middle mile and last mile (for definitions of these terms, see the Glossary in Appendix A). Middle mile often poses a problem in improving broadband because it can be a significant cost with potentially low revenue. For example, if a network is being planned for a subdivision of houses, that last mile has to connect back to another network or another path to the internet. There could be a way to connect that is close to the subdivision, and therefore, not costly. However, if there are no other paths to the internet that are close, it can be very expensive to build the necessary infrastructure to make this connection.

HR Green's collected addresses for specific stakeholders in each county and created a high-level design with high-level costs to connect those locations with fiber. This provides three important pieces of data:

A ring with excess capacity. By connecting the facilities listed for each county, a ring can be developed that can provide middle mile. This ring can provide capacity that can save last mile providers significant costs, helping them to have a business model that makes sense for them to invest in the last mile. ISPs typically pay a monthly charge to use the middle mile – which can help the business case to build the middle mile.

Connecting facilities with the ring. All of the end points in the segments in these rings connect a county or city facility (or other relevant stakeholder). This could save recurring costs for connectivity for the facilities, which could also help the business case for building the ring. As of the writing of this report, the rules have not been published for the BEAD grants, but because the ring connects facilities and provides excess capacity for middle mile, these could be eligible for grants (also helping the business case for these rings).

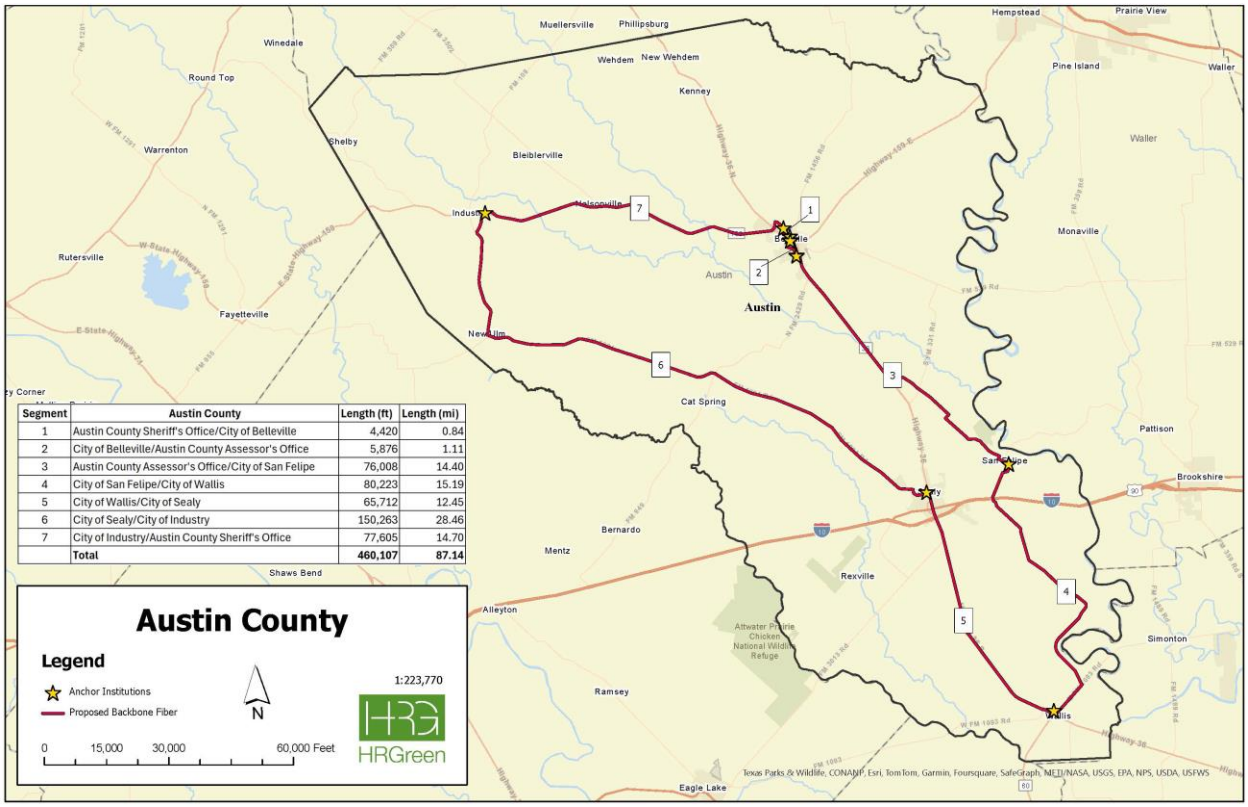
Segments. These rings are designed in segments so that the information can be used in multiple ways. Each segment has cost information – if a certain facility would not benefit from being on a ring (it does not need connectivity, already has good broadband or does not need redundancy), then the other segments can still be used and costs for other options are fairly straightforward to calculate).

In this study, it is not possible to create high-level designs for all of the potential last mile networks. To provide a way to develop costs, we have used a software tool to determine addresses that are in need of improved broadband (from FCC data) and determined high-level costs that could be expected per address.

The same format and wording has been utilized for each county to ensure that when a county views their data, it contains the same layout, format and wording are readily available for their individual review.

AUSTIN COUNTY

Below are the HLD for Austin County, segment costs in a spreadsheet and a chart with potential costs.



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7	City of Industry/Austin County Sheriff's Office	77,605	14.70
	Total	**460,107**	**87.14**

FIGURE 80 - AUSTIN COUNTY MIDDLE MILE POSSIBILITY

The inset box in the above map there are seven segments with both end points in the description. Austin County's anchor institutions include County and City facilities.

In the chart on the next page are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Austin County Sheriff's Office/City of Belleville	$173,573	$179,225	$197,268
2	City of Belleville/Austin County Assessor's Office	$231,071	$239,215	$265,093
3	Austin County Assessor's Office/City of San Felipe	$2,863,096	$2,930,002	$3,149,387
4	City of San Felipe/City of Wallis	$3,021,829	$3,092,448	$3,324,009
5	City of Wallis/City of Sealy	$2,477,457	$2,536,109	$2,728,207
6	City of Sealy/City of Industry	$5,654,646	$5,785,834	$6,216,302
7	City of Industry/Austin County Sheriff's Office	$2,925,693	$2,995,154	$3,222,596
	Austin County Design Totals	**$17,347,365**	**$17,757,987**	**$19,102,861**

FIGURE 81 - AUSTIN COUNTY MIDDLE MILE HIGH-LEVEL COST OPTIONS

The map below shows the unserved addresses in red and underserved in blue (from FCC data).

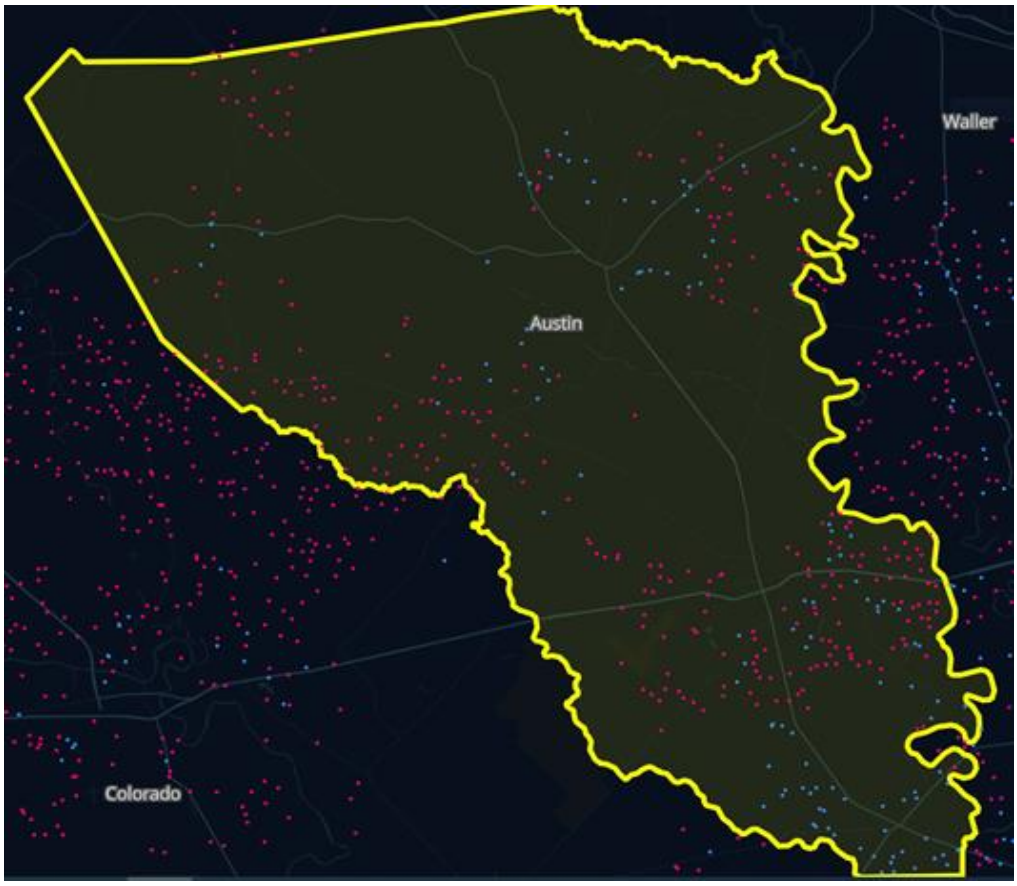


FIGURE 82 - AUSTIN COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $17,058 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$66,610,941.00

FIGURE 83 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

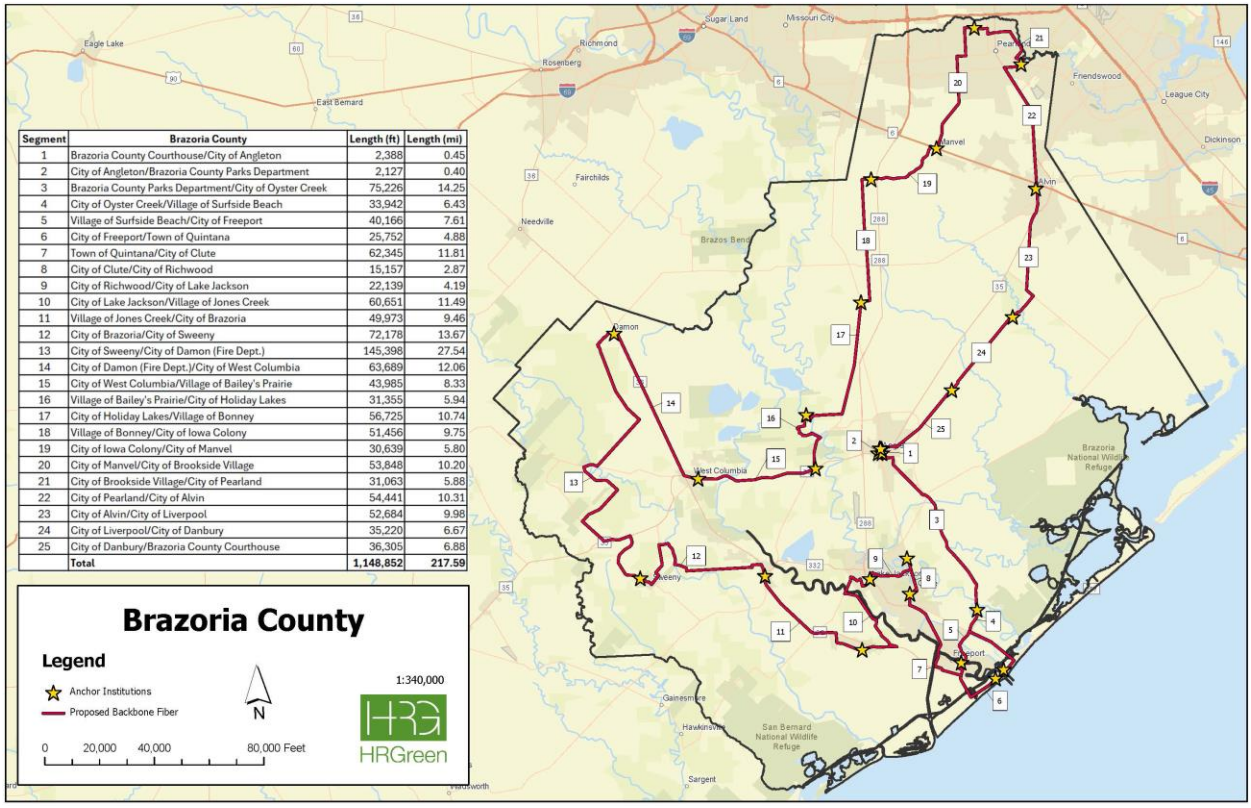
This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

BRAZORIA COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as Austin County. There number of anchor institutions included was solely a function of availability of locations and addresses.

As stated above, the intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.



Segment	Brazoria County	Length (ft)	Length (mi)
1	Brazoria County Courthouse/City of Angleton	2,388	0.45
2	City of Angleton/Brazoria County Parks Department	2,127	0.40
3	Brazoria County Parks Department/City of Oyster Creek	75,226	14.25
4	City of Oyster Creek/Village of Surfside Beach	33,942	6.43
5	Village of Surfside Beach/City of Freeport	40,166	7.61
6	City of Freeport/Town of Quintana	25,752	4.88
7	Town of Quintana/City of Clute	62,345	11.81
8	City of Clute/City of Richwood	15,157	2.87
9	City of Richwood/City of Lake Jackson	22,139	4.19
10	City of Lake Jackson/Village of Jones Creek	60,651	11.49
11	Village of Jones Creek/City of Brazoria	49,973	9.46
12	City of Brazoria/City of Sweeny	72,178	13.67
13	City of Sweeny/City of Damon (Fire Dept.)	145,398	27.54
14	City of Damon (Fire Dept.)/City of West Columbia	63,689	12.06
15	City of West Columbia/Village of Bailey's Prairie	43,985	8.33
16	Village of Bailey's Prairie/City of Holiday Lakes	31,355	5.94
17	City of Holiday Lakes/Village of Bonney	56,725	10.74
18	Village of Bonney/City of Iowa Colony	51,456	9.75
19	City of Iowa Colony/City of Manvel	30,639	5.80
20	City of Manvel/City of Brookside Village	53,848	10.20
21	City of Brookside Village/City of Pearland	31,063	5.88
22	City of Pearland/City of Alvin	54,441	10.31
23	City of Alvin/City of Liverpool	52,684	9.98
24	City of Liverpool/City of Danbury	35,220	6.67
25	City of Danbury/Brazoria County Courthouse	36,305	6.88
	Total	1,148,852	217.59

FIGURE 84 - BRAZORIA COUNTY MIDDLE MILE OPTION

The inset box in the above map there are twenty-five segments with both end points in the description. Brazoria County's anchor institutions include County and City facilities.

In the chart on the next page are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Brazoria County Courthouse/City of Angleton	$96,792	$101,545	$116,390
2	City of Angleton/Brazoria County Parks Department	$87,360	$91,997	$106,432
3	Brazoria County Parks Dept/City of Oyster Creek	$2,832,280	$2,898,839	$3,116,995
4	City of Oyster Creek/Village of Surfside Beach	$1,281,932	$1,313,586	$1,416,888
5	Village of Surfside Beach/City of Freeport	$1,514,041	$1,550,299	$1,668,938
6	City of Freeport/Town of Quintana	$973,922	$998,256	$1,077,584
7	Town of Quintana/City of Clute	$2,347,570	$2,402,884	$2,584,140
8	City of Clute/City of Richwood	$577,444	$593,392	$644,960
9	City of Richwood/City of Lake Jackson	$836,937	$857,823	$925,921
10	City of Lake Jackson/Village of Jones Creek	$2,285,588	$2,340,153	$2,518,744
11	Village of Jones Creek/City of Brazoria	$1,886,124	$1,932,266	$2,082,968
12	City of Brazoria/City of Sweeny	$2,720,571	$2,785,781	$2,999,140
13	City of Sweeny/City of Damon (Fire Dept.)	$5,469,092	$5,596,278	$6,013,547
14	City of Damon (Fire Dept.)/City of West Columbia	$2,401,003	$2,458,760	$2,647,674
15	City of West Columbia/Village of Bailey's Prairie	$1,658,448	$1,698,244	$1,828,436
16	Village of Bailey's Prairie/City of Holiday Lakes	$1,182,819	$1,211,481	$1,305,169
17	City of Holiday Lakes/Village of Bonney	$2,137,284	$2,188,263	$2,355,131
18	Village of Bonney/City of Iowa Colony	$1,940,474	$1,987,273	$2,140,308
19	City of Iowa Colony/City of Manvel	$1,156,930	$1,185,275	$1,277,836
20	City of Manvel/City of Brookside Village	$2,027,676	$2,075,533	$2,232,331
21	City of Brookside Village/City of Pearland	$1,172,262	$1,200,795	$1,294,022
22	City of Pearland/City of Alvin	$2,053,977	$2,103,945	$2,267,220
23	City of Alvin/City of Liverpool	$1,985,622	$2,032,964	$2,187,931
24	City of Liverpool/City of Danbury	$1,328,864	$1,361,084	$1,466,396
25	City of Danbury/Brazoria County Courthouse	$1,372,956	$1,407,505	$1,520,068
	Brazoria County Design Totals	**$43,327,969**	**$44,374,224**	**$47,795,167**

FIGURE 85 - BRAZORIA COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $43M to the 288 option at $48M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

Also, there could be many segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the next map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

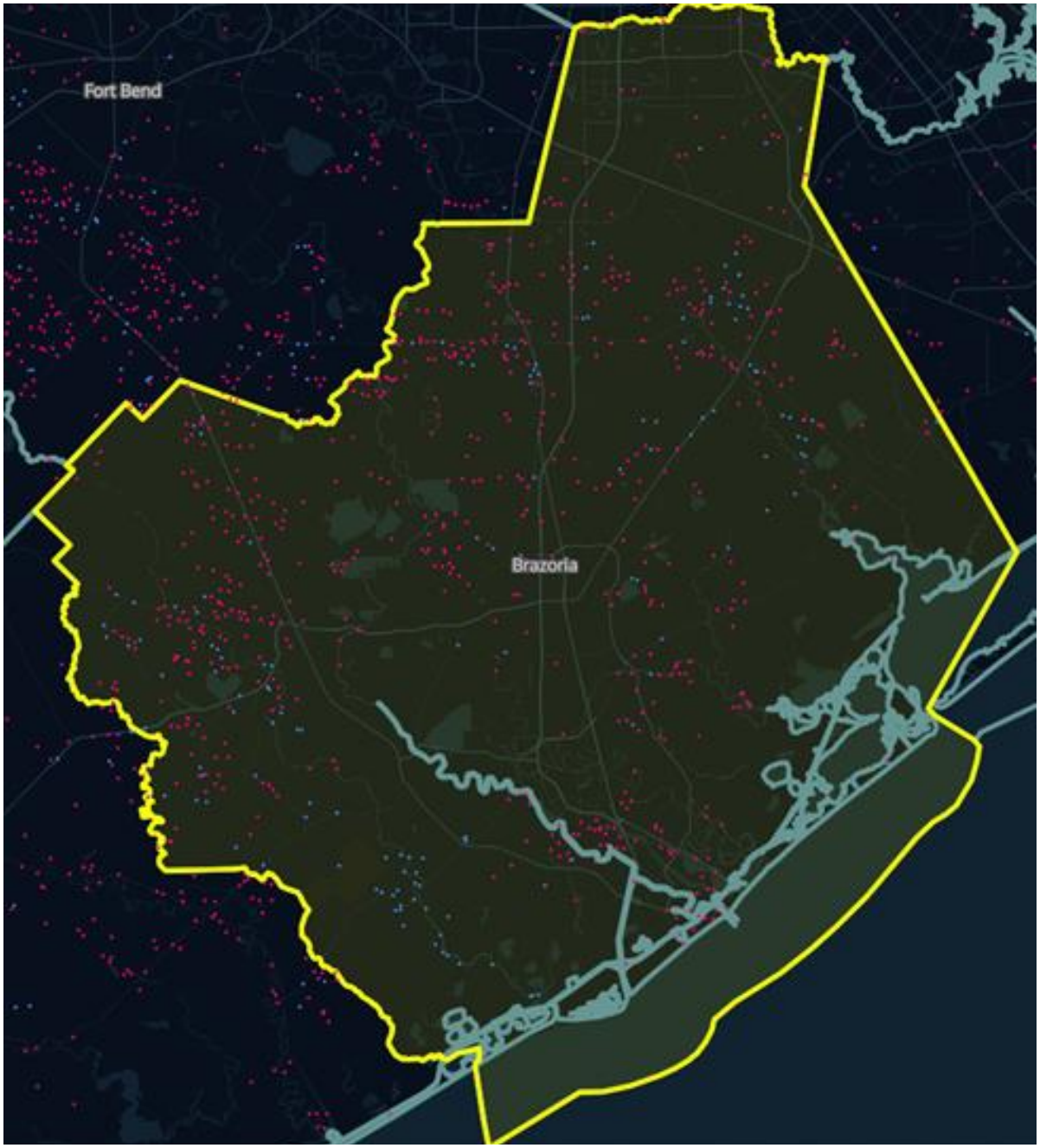


FIGURE 86 - BRAZORIA COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$66,610,941.00

FIGURE 87 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

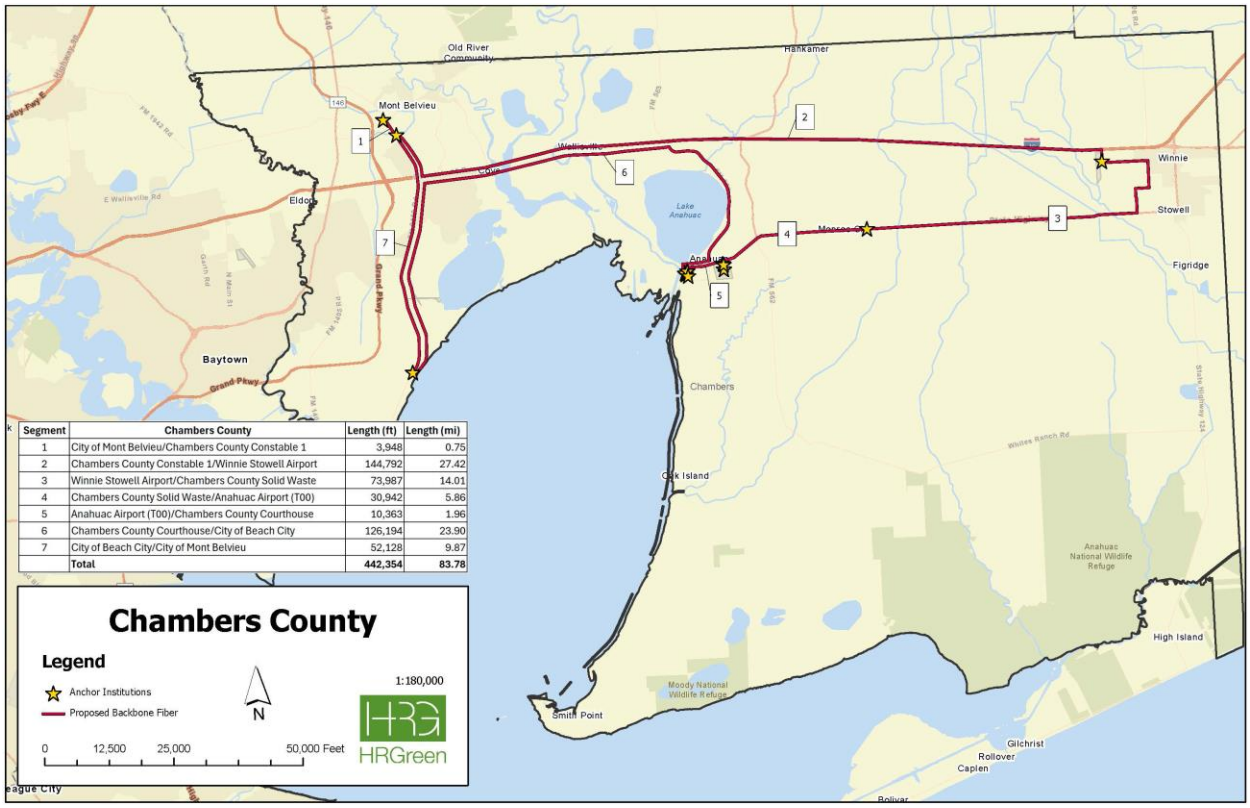
These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used

CHAMBERS COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.



Segment	Chambers County	Length (ft)	Length (mi)
1	City of Mont Belvieu/Chambers County Constable 1	3,948	0.75
2	Chambers County Constable 1/Winnie Stowell Airport	144,792	27.42
3	Winnie Stowell Airport/Chambers County Solid Waste	73,987	14.01
4	Chambers County Solid Waste/Anahuac Airport (T00)	30,942	5.86
5	Anahuac Airport (T00)/Chambers County Courthouse	10,363	1.96
6	Chambers County Courthouse/City of Beach City	126,194	23.90
7	City of Beach City/City of Mont Belvieu	52,128	9.87
	Total	**442,354**	**83.78**

FIGURE 88 - CHAMBERS COUNTY MIDDLE MILE OPTION

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the above map there are seven segments with both end points in the description. Chambers County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Mont Belvieu/Chambers County Constable 1	$156,507	$161,950	$179,249
2	Chambers County Constable 1/Winnie Stowell Airport	$5,449,779	$5,576,697	$5,993,014
3	Winnie Stowell Airport/Chambers County Solid Waste	$2,789,292	$2,855,303	$3,071,508
4	Chambers County Solid Waste/Anahuac Airport (T00)	$1,170,440	$1,198,919	$1,291,955
5	Anahuac Airport (T00)/Chambers County Courthouse	$399,623	$411,602	$450,083
6	Chambers County Courthouse/City of Beach City	$4,752,063	$4,863,357	$5,228,235
7	City of Beach City/City of Mont Belvieu	$1,967,325	$2,014,421	$2,168,513
	Chambers County Design Totals	$16,685,030	$17,082,249	$18,382,558

FIGURE 89 - CHAMBERS COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $17M to the 288 option at $18M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

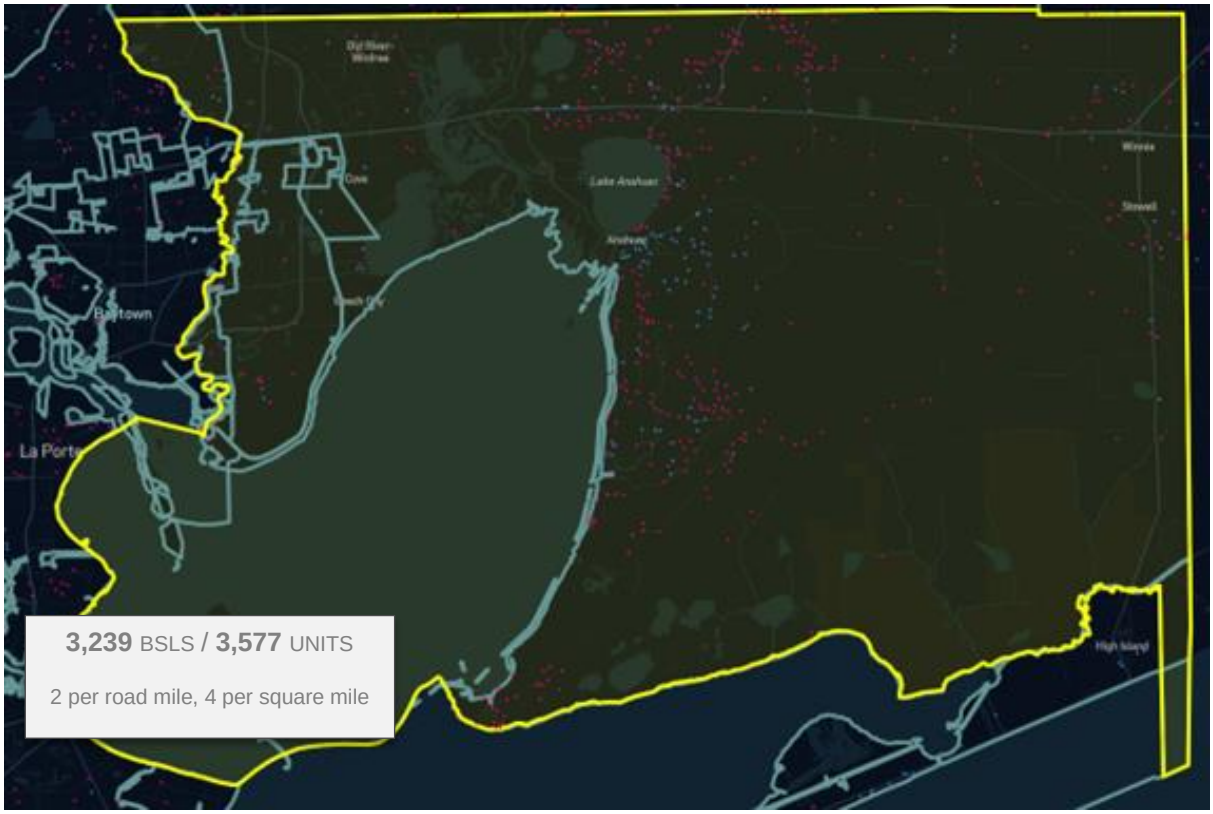


FIGURE 90 - CHAMBERS COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $19,510 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$63,191,931.08

FIGURE 91 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

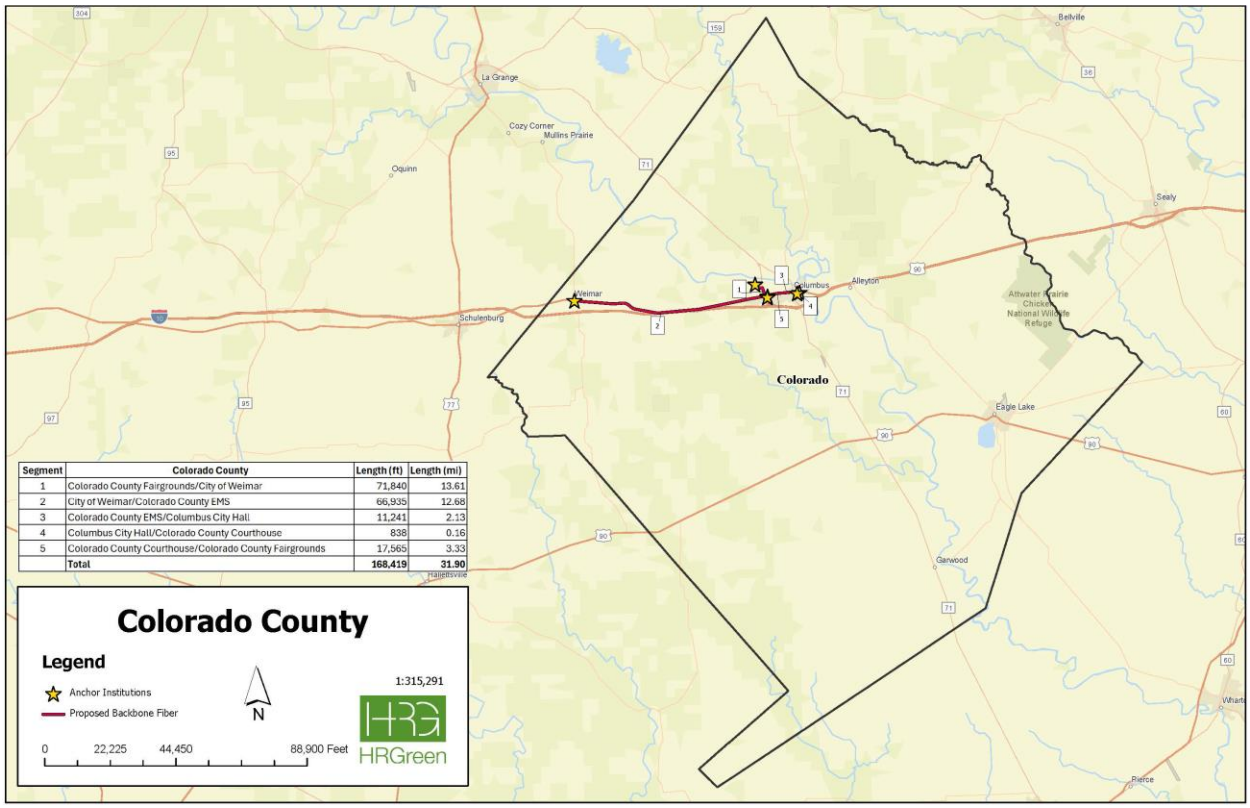
This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

COLORADO COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives



Segment	Colorado County	Length (ft)	Length (mi)
1	Colorado County Fairgrounds/City of Weimar	71,840	13.61
2	City of Weimar/Colorado County EMS	66,935	12.68
3	Colorado County EMS/Columbus City Hall	11,241	2.13
4	Columbus City Hall/Colorado County Courthouse	838	0.16
5	Colorado County Courthouse/Colorado County Fairgrounds	17,565	3.33
	Total	**168,419**	**31.90**

FIGURE 92 - COLORADO COUNTY MIDDLE MILE OPTIONS

In the inset box in the above map there are five segments with both end points in the description. Colorado County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Colorado County Fairgrounds/City of Weimar	$2,706,058	$2,769,270	$2,976,553
2	City of Weimar/Colorado County EMS	$2,522,399	$2,581,592	$2,775,613
3	Colorado County EMS/Columbus City Hall	$432,128	$444,496	$484,360
4	Columbus City Hall/Colorado County Courthouse	$42,601	$46,668	$59,075
5	Colorado County Courthouse/Colorado County Fairgrounds	$667,816	$684,830	$740,188
	Colorado County Design Totals	$6,371,003	$6,526,857	$7,035,789

FIGURE 93 - COLORADO COUNTY MIDDLE MILE COST OPTIONS

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

With potential costs ranging from the 96 fiber count option at $6.4M to the 288 option at $7M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

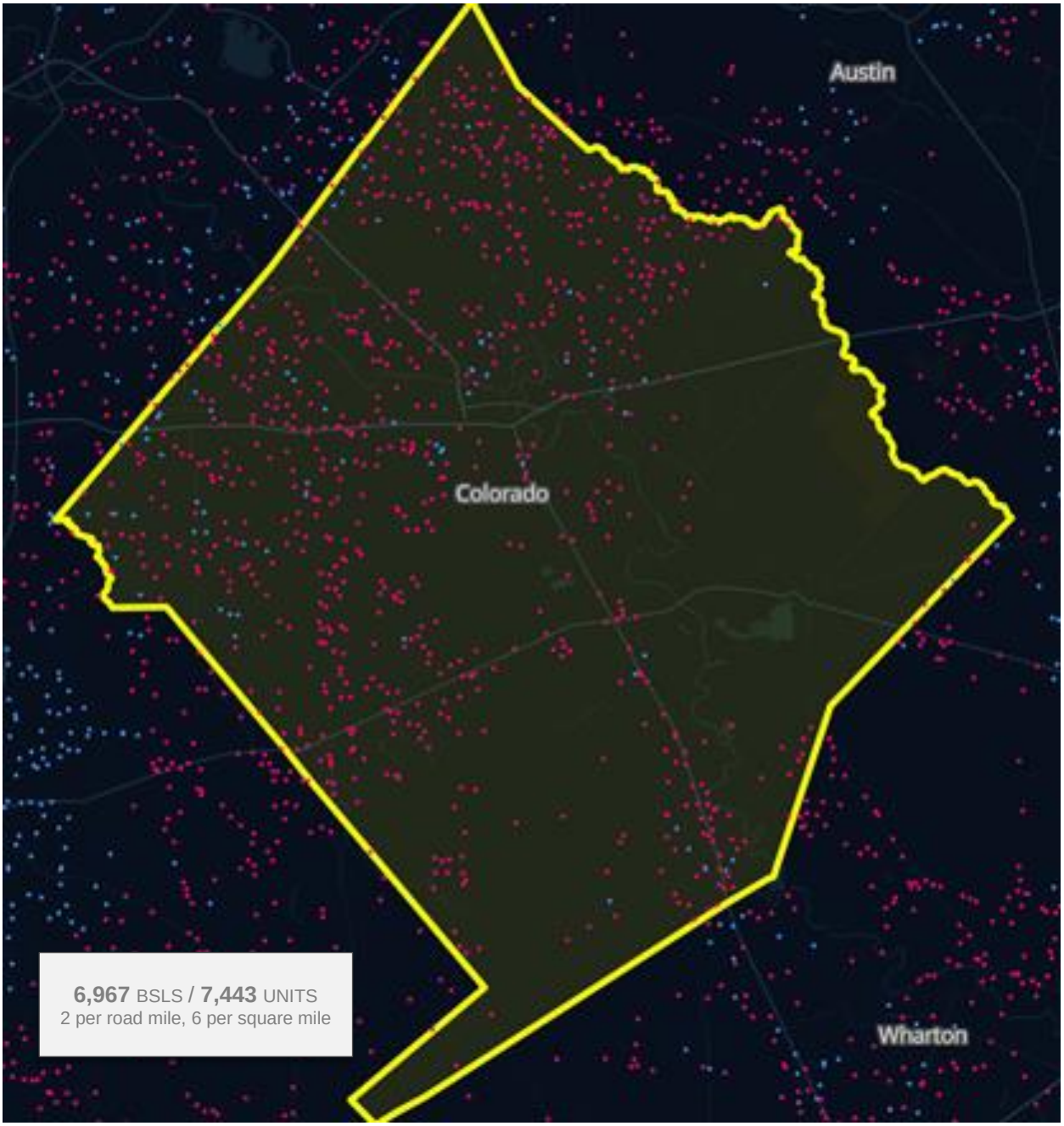


FIGURE 94 - COLORADO COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved.

The assumptions that are used to generate these costs are shown below and also include an amount of $16,579 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$115,507,289.40

FIGURE 95 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

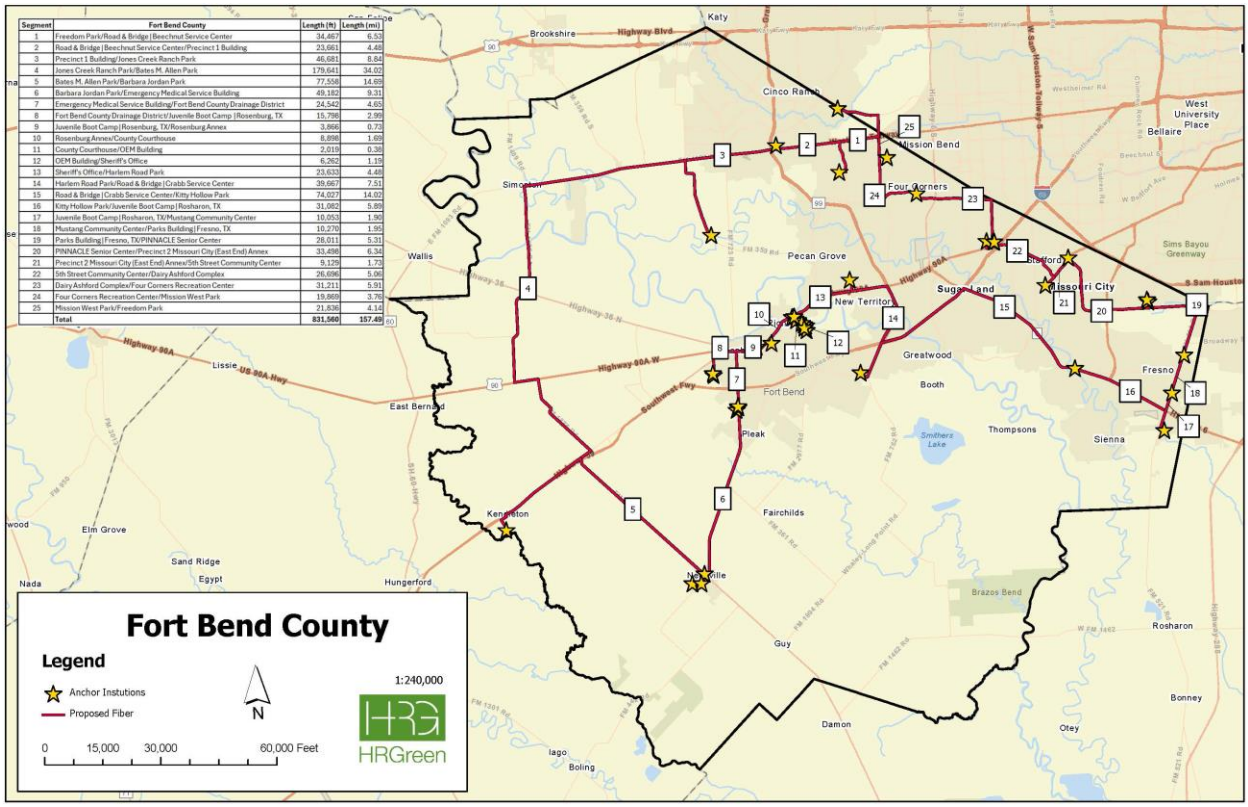
This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

FORT BEND COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.



Segment	Fort Bend County	Length (ft)	Length (mi)
1	Freedom Park/Road & Bridge | Beechnut Service Center	34,467	6.53
2	Road & Bridge | Beechnut Service Center/Precinct 1 Building	23,661	4.48
3	Precinct 1 Building/Jones Creek Ranch Park	46,681	8.84
4	Jones Creek Ranch Park/Bates M. Allen Park	179,641	34.02
5	Bates M. Allen Park/Barbara Jordan Park	77,558	14.69
6	Barbara Jordan Park/Emergency Medical Service Building	49,182	9.31
7	Emergency Medical Service Building/Fort Bend County Drainage District	24,542	4.65
8	Fort Bend County Drainage District/Juvenile Boot Camp | Rosenburg, TX	15,798	2.99
9	Juvenile Boot Camp | Rosenburg, TX/Rosenburg Annex	3,866	0.73
10	Rosenburg Annex/County Courthouse	8,898	1.69
11	County Courthouse/OEM Building	2,019	0.38
12	OEM Building/Sheriff's Office	6,262	1.19
13	Sheriff's Office/Harlem Road Park	23,633	4.48
14	Harlem Road Park/Road & Bridge | Crabb Service Center	39,667	7.51
15	Road & Bridge | Crabb Service Center/Kitty Hollow Park	74,027	14.02
16	Kitty Hollow Park/Juvenile Boot Camp | Rosharon, TX	31,082	5.89
17	Juvenile Boot Camp | Rosharon, TX/Mustang Community Center	10,053	1.90
18	Mustang Community Center/Parks Building | Fresno, TX	10,270	1.95
19	Parks Building | Fresno, TX/PINNACLE Senior Center	28,011	5.31
20	PINNACLE Senior Center/Precinct 2 Missouri City (East End) Annex	33,498	6.34
21	Precinct 2 Missouri City (East End) Annex/5th Street Community Center	9,129	1.73
22	5th Street Community Center/Dairy Ashford Complex	26,696	5.06
23	Dairy Ashford Complex/Four Corners Recreation Center	31,211	5.91
24	Four Corners Recreation Center/Mission West Park	19,869	3.76
25	Mission West Park/Freedom Park	21,836	4.14
	Total	831,560	157.49

FIGURE 96 - FT BEND COUNTY MIDDLE MILE OPTIONS

In the inset box in the above map there are twenty-five segments with both end points in the description. Fort Bend County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Freedom Park/Road & Bridge|Beechnut Service Center	$1,303,483	$1,335,370	$1,439,498
2	Road & Bridge|Beechnut Service Center/Precinct 1 Building	$899,409	$922,817	$998,855
3	Precinct 1 Building/Jones Creek Ranch Park	$1,764,090	$1,806,928	$1,946,905
4	Jones Creek Ranch Park/Bates M. Allen Park	$6,755,529	$6,910,807	$7,420,765
5	Bates M. Allen Park/Barbara Jordan Park	$2,924,001	$2,993,441	$3,220,809
6	Barbara Jordan Park/Emergency Medical Service Building	$1,855,250	$1,899,195	$2,043,108
7	Emergency Medical Service Building/Fort Bend County Drainage District	$932,001	$955,799	$1,033,222
8	Fort Bend County Drainage District/Juvenile Boot Camp |Rosenburg, TX	$603,204	$619,436	$672,013
9	Juvenile Boot Camp|Rosenburg, TX/Rosenburg Annex	$153,566	$158,973	$176,145
10	Rosenburg Annex/County Courthouse	$341,790	$351,272	$381,904
11	County Courthouse/OEM Building	$86,042	$90,632	$104,897
12	OEM Building/Sheriff's Office	$245,758	$254,073	$280,557
13	Sheriff's Office/Harlem Road Park	$898,389	$921,785	$997,778
14	Harlem Road Park/Road & Bridge|Crabb Service Center	$1,498,583	$1,534,620	$1,652,474
15	Road & Bridge|Crabb Service Center/Kitty Hollow Park	$2,790,761	$2,856,790	$3,073,059
16	Kitty Hollow Park/Juvenile Boot Camp|Rosharon, TX	$1,175,509	$1,204,050	$1,297,307
17	Juvenile Boot Camp|Rosharon, TX/Mustang Community Center	$388,416	$400,257	$438,251
18	Mustang Community Center/Parks Building|Fresno, TX	$396,257	$408,194	$446,529
19	Parks Building|Fresno, TX/PINNACLE Senior Center	$1,062,990	$1,090,171	$1,178,596
20	PINNACLE Senior Center/Precinct 2 Missouri City (East End) Annex	$1,268,468	$1,299,926	$1,402,529
21	Precinct 2 Missouri City (East End) Annex/5th Street Community Center	$355,026	$366,458	$402,998
22	5th Street Community Center/Dairy Ashford Complex	$1,010,127	$1,034,879	$1,115,692
23	Dairy Ashford Complex/Four Corners Recreation Center	$1,179,667	$1,208,265	$1,301,726
24	Four Corners Recreation Center/Mission West Park	$756,160	$776,042	$840,569
25	Mission West Park/Freedom Park	$828,319	$849,071	$916,692
	Fort Bend County Design Totals	$31,472,793	$32,249,254	$34,782,879

FIGURE 97 - FORT BEND COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $31.5M to the 288 option at $34.8M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

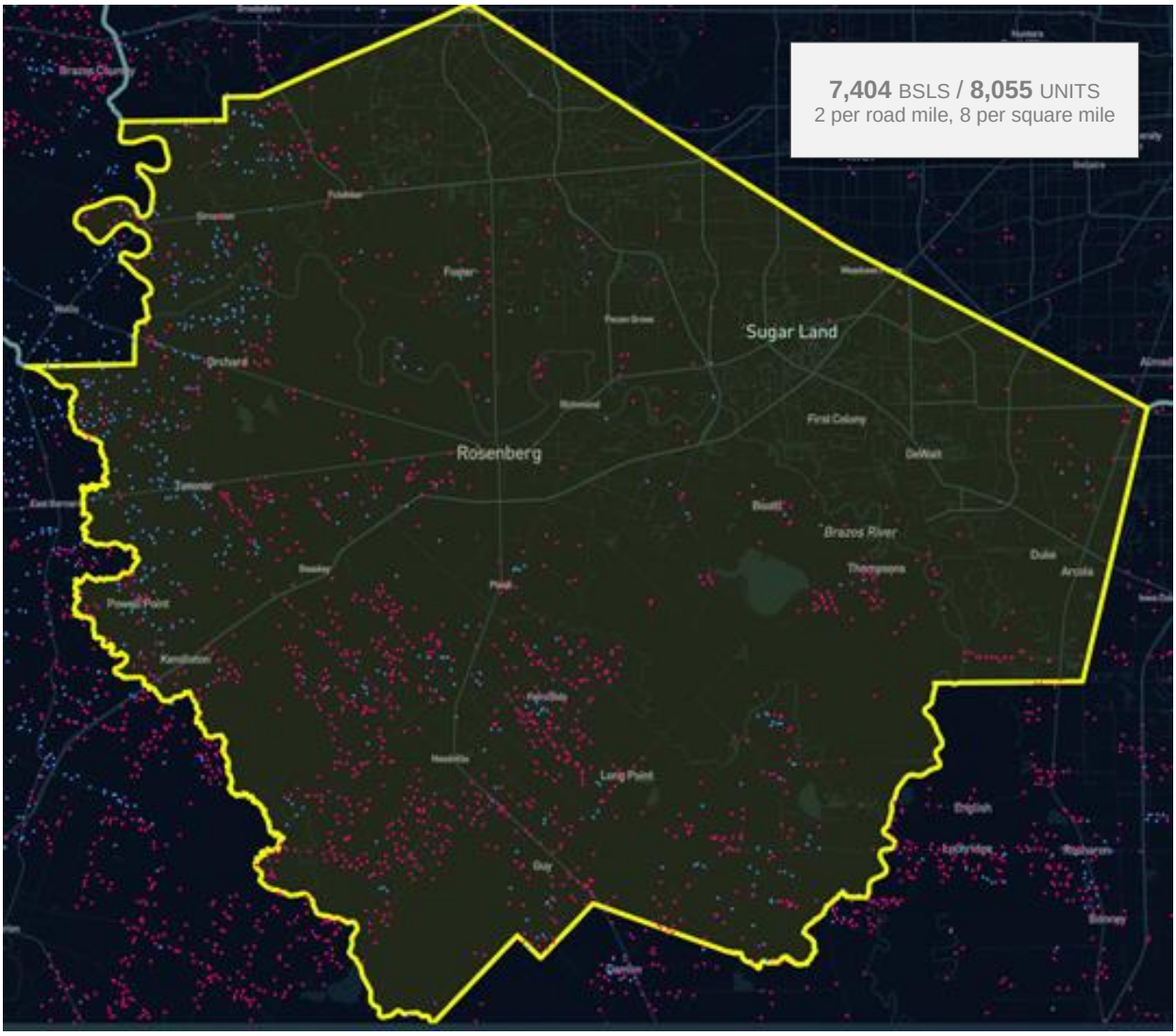


FIGURE 98 - FORT BEND COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $25,985 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$192,394,682.04

FIGURE 99 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

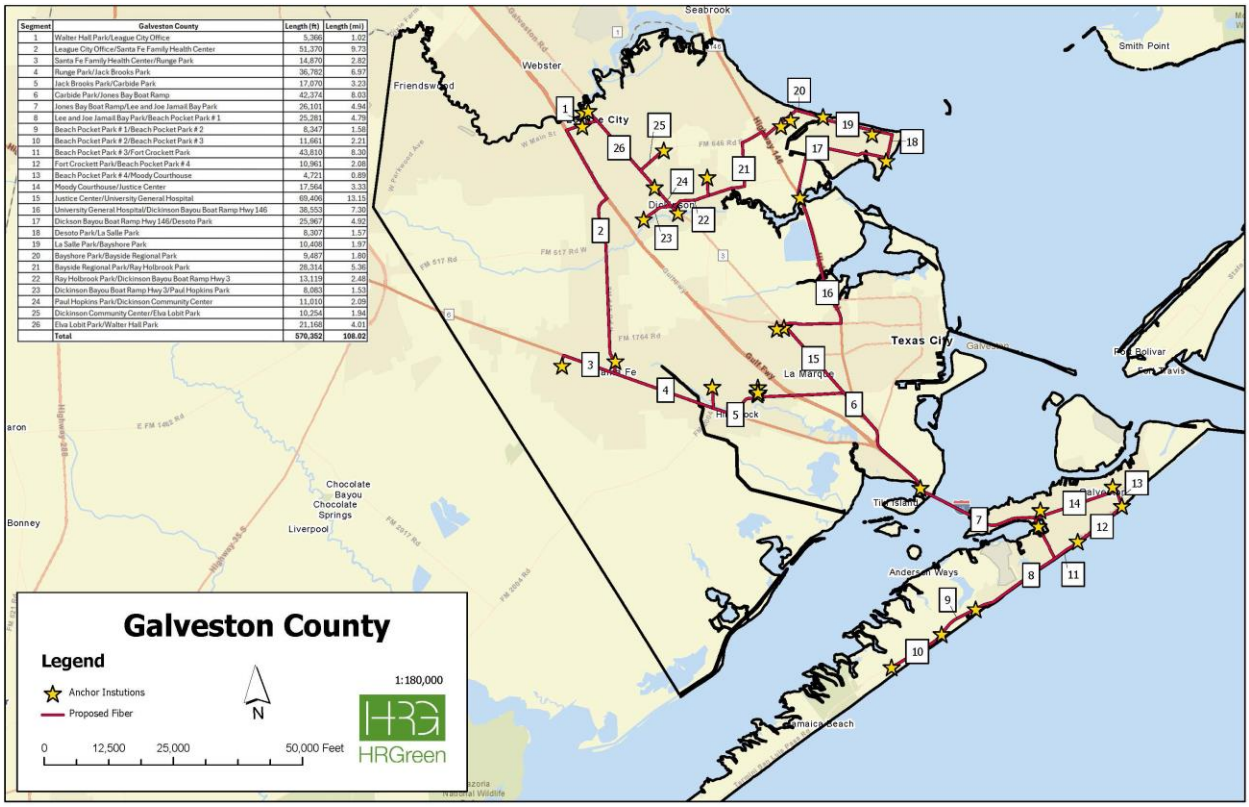
These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

GALVESTON COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.



Segment	Galveston County	Length (ft)	Length (mi)
1	Walter Hall Park/League City Office	5,366	1.02
2	League City Office/Santa Fe Family Health Center	51,370	9.73
3	Santa Fe Family Health Center/Runge Park	14,870	2.82
4	Runge Park/Jack Brooks Park	36,782	6.97
5	Jack Brooks Park/Carbide Park	17,070	3.23
6	Carbide Park/Jones Bay Boat Ramp	42,374	8.03
7	Jones Bay Boat Ramp/Lee and Joe Jamail Bay Park	26,101	4.94
8	Lee and Joe Jamail Bay Park/Beach Pocket Park # 1	25,281	4.79
9	Beach Pocket Park # 1/Beach Pocket Park # 2	8,347	1.58
10	Beach Pocket Park # 2/Beach Pocket Park # 3	11,661	2.21
11	Beach Pocket Park # 3/Fort Crockett Park	43,810	8.30
12	Fort Crockett Park/Beach Pocket Park # 4	10,961	2.08
13	Beach Pocket Park # 4/Moody Courthouse	4,721	0.89
14	Moody Courthouse/Justice Center	17,564	3.33
15	Justice Center/University General Hospital	69,406	13.15
16	University General Hospital/Dickinson Bayou Boat Ramp Hwy 146	38,553	7.30
17	Dickson Bayou Boat Ramp Hwy 146/Deseto Park	25,967	4.92
18	Desoto Park/La Salle Park	8,307	1.57
19	La Salle Park/Bayshore Park	10,406	1.97
20	Bayshore Park/Bayside Regional Park	9,487	1.80
21	Bayside Regional Park/Ray Holbrook Park	28,314	5.36
22	Ray Holbrook Park/Dickinson Bayou Boat Ramp Hwy 3	13,119	2.48
23	Dickinson Bayou Boat Ramp Hwy 3/Paul Hopkins Park	8,083	1.53
24	Paul Hopkins Park/Dickinson Community Center	11,010	2.09
25	Dickinson Community Center/Elva Lobit Park	10,254	1.94
26	Elva Lobit Park/Walter Hall Park	21,168	4.01
	Total	570,352	108.02

FIGURE 100 - GALVESTON COUNTY MIDDLE MILE OPTIONS

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the above map there are twenty-six segments with both end points in the description. Galveston County's anchor institutions include County and City facilities. You can see them more clearly in the chart below.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Walter Hall Park/League City Office	$212,642	$220,562	$245,637
2	League City Office/Santa Fe Family Health Center	$1,939,921	$1,986,681	$2,139,580
3	Santa Fe Family Health Center/Runge Park	$568,904	$584,726	$635,843
4	Runge Park/Jack Brooks Park	$1,392,776	$1,427,536	$1,540,850
5	Jack Brooks Park/Carbide Park	$649,922	$666,717	$721,295
6	Carbide Park/Jones Bay Boat Ramp	$1,602,033	$1,641,116	$1,768,773
7	Jones Bay Boat Ramp/Lee and Joe Jamail Bay Park	$989,094	$1,013,582	$1,093,458
8	Lee and Joe Jamail Bay Park/Beach Pocket Park # 1	$958,691	$982,817	$1,061,402
9	Beach Pocket Park # 1/Beach Pocket Park # 2	$321,880	$331,118	$360,883
10	Beach Pocket Park # 2/Beach Pocket Park # 3	$447,307	$459,861	$500,385
11	Beach Pocket Park # 3/Fort Crockett Park	$1,654,673	$1,694,391	$1,824,307
12	Fort Crockett Park/Beach Pocket Park # 4	$421,975	$434,218	$473,639
13	Beach Pocket Park # 4/Moody Courthouse	$189,311	$196,945	$221,005
14	Moody Courthouse/Justice Center	$667,787	$684,800	$740,156
15	Justice Center/University General Hospital	$2,617,330	$2,679,465	$2,882,918
16	University General Hospital/Dickinson Bayou Boat Ramp Hwy 146	$1,457,563	$1,493,107	$1,609,208
17	Dickson Bayou Boat Ramp Hwy 146/Desoto Park	$984,250	$1,008,679	$1,088,343
18	Desoto Park/La Salle Park	$320,460	$329,680	$359,384
19	La Salle Park/Bayshore Park	$401,234	$413,232	$451,784
20	Bayshore Park/Bayside Regional Park	$367,946	$379,537	$416,639
21	Bayside Regional Park/Ray Holbrook Park	$1,073,962	$1,101,278	$1,190,180
22	Ray Holbrook Park/Dickinson Bayou Boat Ramp Hwy 3	$500,745	$513,943	$556,761
23	Dickinson Bayou Boat Ramp Hwy 3/Paul Hopkins Park	$312,339	$321,460	$350,810
24	Paul Hopkins Park/Dickinson Community Center	$423,774	$436,039	$475,539
25	Dickinson Community Center/Elva Lobit Park	$395,682	$407,612	$445,922
26	Elva Lobit Park/Walter Hall Park	$804,429	$824,886	$891,456
	Galveston County County Design Totals	$21,676,627	$22,233,988	$24,046,157

FIGURE 101 - GALVESTON COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $22M to the 288 option at $24M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

FIGURE 102 - GALVESTON COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $23,999 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$111,693,146.85

FIGURE 103 – ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate

them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

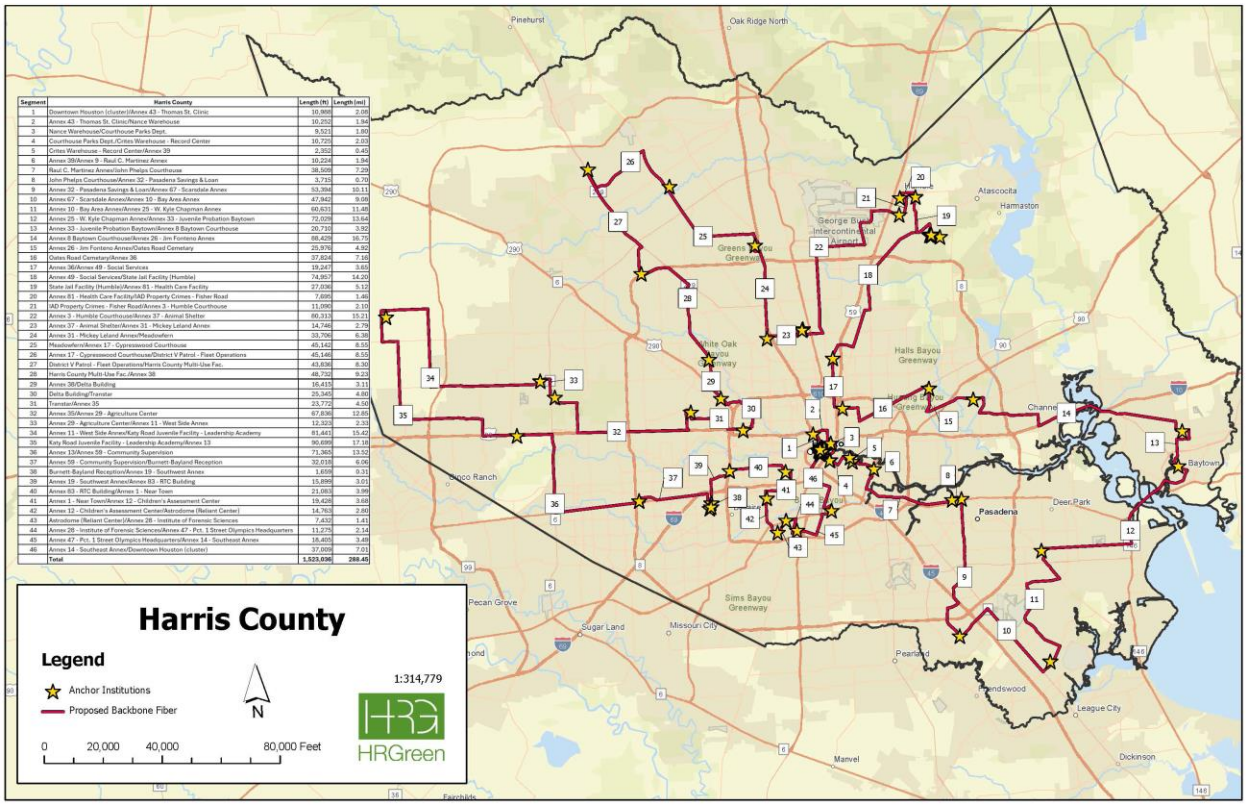
- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

HARRIS COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the below map there are 46 segments with both end points in the description. Harris County's anchor institutions include County and City facilities.



Segment	Harris County	Length (ft)	Length (mi)
1	Downtown Houston (cluster)/Annex 43 - Thomas St. Clinic	10,988	2.08
2	Annex 43 - Thomas St. Clinic/Nance Warehouse	10,252	1.94
3	Nance Warehouse/Courthouse Parks Dept.	9,521	1.80
4	Courthouse Parks Dept./Cntes Warehouse - Record Center	10,725	2.03
5	Cntes Warehouse - Record Center/Annex 29	2,352	0.45
6	Annex 29/Annex 9 - Raul C. Martinez Annex	10,224	1.94
7	Raul C. Martinez Annex/John Phelps Courthouse	38,509	7.29
8	John Phelps Courthouse/Annex 32 - Pasadena Savings & Loan	3,710	0.70
9	Annex 32 - Pasadena Savings & Loan/Annex 67 - Scarsdale Annex	53,394	10.11
10	Annex 67 - Scarsdale Annex/Annex 10 - Bay Area Annex	47,942	9.08
11	Annex 10 - Bay Area Annex/Annex 25 - W. Kyle Chapman Annex	60,631	11.48
12	Annex 25 - W. Kyle Chapman Annex/Annex 33 - Juvenile Probation Baytown	72,029	13.64
13	Annex 33 - Juvenile Probation Baytown/Annex 8 Baytown Courthouse	20,710	3.92
14	Annex 8 Baytown Courthouse/Annex 26 - Jim Fontano Annex	88,429	16.75
15	Annex 26 - Jim Fontano Annex/Oates Road Cemetary	25,976	4.92
16	Oates Road Cemetary/Annex 36	37,824	7.16
17	Annex 36/Annex 49 - Social Services	19,247	3.65
18	Annex 49 - Social Services/State Jail Facility (Humble)	74,957	14.20
19	State Jail Facility (Humble)/Annex 81 - Health Care Facility	27,036	5.12
20	Annex 81 - Health Care Facility/IAD Property Crimes - Fisher Road	7,695	1.46
21	IAD Property Crimes - Fisher Road/Annex 3 - Humble Courthouse	11,090	2.10
22	Annex 3 - Humble Courthouse/Annex 37 - Animal Shelter	80,313	15.21
23	Annex 37 - Animal Shelter/Annex 31 - Mickey Leland Annex	14,746	2.79
24	Annex 31 - Mickey Leland Annex/Meadowfern	33,706	6.38
25	Meadowfern/Annex 17 - Cypresswood Courthouse	45,142	8.55
26	Annex 17 - Cypresswood Courthouse/District V Patrol - Fleet Operations	45,146	8.55
27	District V Patrol - Fleet Operations/Harris County Multi-Use Fac.	43,838	8.30
28	Harris County Multi-Use Fac./Annex 38	48,750	9.23
29	Annex 38/Delta Building	16,415	3.11
30	Delta Building/Transtar	25,340	4.80
31	Transtar/Annex 35	23,772	4.50
32	Annex 35/Annex 29 - Agriculture Center	67,836	12.85
33	Annex 29 - Agriculture Center/Annex 11 - West Side Annex	12,323	2.33
34	Annex 11 - West Side Annex/Katy Road Juvenile Facility - Leadership Academy	81,441	15.42
35	Katy Road Juvenile Facility - Leadership Academy/Annex 13	90,699	17.18
36	Annex 13/Annex 59 - Community Supervision	71,365	13.52
37	Annex 59 - Community Supervision/Burnett-Bayland Reception	32,018	6.06
38	Burnett-Bayland Reception/Annex 19 - Southwest Annex	1,659	0.31
39	Annex 19 - Southwest Annex/Annex 83 - RTC Building	15,899	3.01
40	Annex 83 - RTC Building/Annex 1 - Near Town	21,063	3.96
41	Annex 1 - Near Town/Annex 12 - Children's Assessment Center	19,428	3.68
42	Annex 12 - Children's Assessment Center/Astrodome (Reliant Center)	14,763	2.80
43	Astrodome (Reliant Center)/Annex 28 - Institute of Forensic Sciences	7,432	1.41
44	Annex 28 - Institute of Forensic Sciences/Annex 47 - Pct. 1 Street Olympics Headquarters	11,275	2.14
45	Annex 47 - Pct. 1 Street Olympics Headquarters/Annex 14 - Southeast Annex	18,405	3.48
46	Annex 14 - Southeast Annex/Downtown Houston (cluster)	37,009	7.01
	Total	1,523,036	288.45

FIGURE 104 - HARRIS COUNTY MIDDLE MILE OPTIONS

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

With potential costs ranging from the 96 fiber count option at $58M to the 288 option at $64M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	Downtown Houston (cluster)/Annex 43 - Thomas St. Clinic	$422,956	$435,211	$474,676
2	Annex 43 - Thomas St. Clinic/Nance Warehouse	$395,615	$407,545	$445,852
3	Nance Warehouse/Courthouse Parks Dept.	$369,202	$380,808	$417,966
4	Courthouse Parks Dept./Crites Warehouse - Record Center	$413,448	$425,586	$464,637
5	Crites Warehouse - Record Center/Annex 39	$98,076	$102,813	$117,602
6	Annex 39/Annex 9 - Raul C. Martinez Annex	$394,598	$406,515	$444,778
7	Raul C. Martinez Annex/John Phelps Courthouse	$1,455,954	$1,491,478	$1,607,509
8	John Phelps Courthouse/Annex 32 - Pasadena Savings & Loan	$148,094	$153,434	$170,367
9	Annex 32 - Pasadena Savings & Loan/Annex 67 - Scarsdale Annex	$2,013,864	$2,061,521	$2,217,605
10	Annex 67 - Scarsdale Annex/Annex 10 - Bay Area Annex	$1,809,658	$1,853,053	$1,995,014
11	Annex 10 - Bay Area Annex/Annex 25 - W. Kyle Chapman Annex	$2,287,417	$2,341,972	$2,520,531
12	Annex 25 - W. Kyle Chapman Annex/Annex 33 - Juvenile Probation Baytown	$2,717,778	$2,782,923	$2,996,048
13	Annex 33 - Juvenile Probation Baytown/Annex 8 Baytown Courthouse	$787,121	$807,375	$873,225
14	Annex 8 Baytown Courthouse/Annex 26 - Jim Fonteno Annex	$3,330,421	$3,408,368	$3,663,929
15	Annex 26 - Jim Fonteno Annex/Oates Road Cemetery	$984,567	$1,008,999	$1,088,678
16	Oates Road Cemetery/Annex 36	$1,431,196	$1,466,417	$1,581,370
17	Annex 36/Annex 49 - Social Services	$733,465	$753,071	$816,619
18	Annex 49 - Social Services/State Jail Facility (Humble)	$2,824,370	$2,890,811	$3,108,543
19	State Jail Facility (Humble)/Annex 81 - Health Care Facility	$1,027,758	$1,054,508	$1,141,399
20	Annex 81 - Health Care Facility/IAD Property Crimes - Fisher Road	$298,329	$307,279	$336,019
21	IAD Property Crimes - Fisher Road/Annex 3 - Humble Courthouse	$426,649	$438,950	$478,575
22	Annex 3 - Humble Courthouse/Annex 37 - Animal Shelter	$3,025,077	$3,095,736	$3,327,438
23	Annex 37 - Animal Shelter/Annex 31 - Mickey Leland Annex	$564,433	$580,200	$631,122
24	Annex 31 - Mickey Leland Annex/Meadowfern	$1,275,979	$1,307,529	$1,410,459
25	Meadowfern/Annex 17 - Cypresswood Courthouse	$1,707,711	$1,749,867	$1,887,423

26	Annex 17 - Cypresswood Courthouse/District V Patrol - Fleet Operations	$1,707,837	$1,749,995	$1,887,557
27	District V Patrol - Fleet Operations/Harris County Multi-Use Fac.	$1,655,637	$1,695,367	$1,825,324
28	Harris County Multi-Use Fac./Annex 38	$1,838,965	$1,882,710	$2,025,914
29	Annex 38/Delta Building	$625,503	$642,009	$695,557
30	Delta Building/Transtar	$961,030	$985,184	$1,063,871
31	Transtar/Annex 35	$903,394	$926,852	$1,003,062
32	Annex 35/Annex 29 - Agriculture Center	$2,559,853	$2,621,294	$2,822,277
33	Annex 29 - Agriculture Center/Annex 11 - West Side Annex	$471,967	$484,813	$526,378
34	Annex 11 - West Side Annex/Katy Road Juvenile Facility - Leadership Academy	$3,070,716	$3,143,722	$3,382,744
35	Katy Road Juvenile Facility - Leadership Academy/Annex 13	$3,418,109	$3,498,909	$3,763,586
36	Annex 13/Annex 59 - Community Supervision	$2,688,923	$2,751,926	$2,958,462
37	Annex 59 - Community Supervision/Burnett-Bayland Reception	$1,214,221	$1,245,025	$1,345,299
38	Burnett-Bayland Reception/Annex 19 - Southwest Annex	$73,028	$77,459	$91,157
39	Annex 19 - Southwest Annex/Annex 83 - RTC Building	$606,843	$623,120	$675,856
40	Annex 83 - RTC Building/Annex 1 - Near Town	$801,367	$821,787	$888,224
41	Annex 1 - Near Town/Annex 12 - Children's Assessment Center	$740,015	$759,702	$823,534
42	Annex 12 - Children's Assessment Center/Astrodome (Reliant Center)	$565,041	$580,815	$631,764
43	Astrodome (Reliant Center)/Annex 28 - Institute of Forensic Sciences	$288,049	$296,882	$325,208
44	Annex 28 - Institute of Forensic Sciences/Annex 47 - Pct. 1 Street Olympics Headquarters	$433,353	$445,735	$485,652
45	Annex 47 - Pct. 1 Street Olympics Headquarters/Annex 14 - Southeast Annex	$703,038	$722,272	$784,495
46	Annex 14 - Southeast Annex/Downtown Houston (cluster)	$1,400,974	$1,435,834	$1,549,505
	Harris County Design Totals	$57,671,599	$59,103,381	$63,772,811

FIGURE 105 - HARRIS COUNTY MIDDLE MILE COST OPTIONS

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

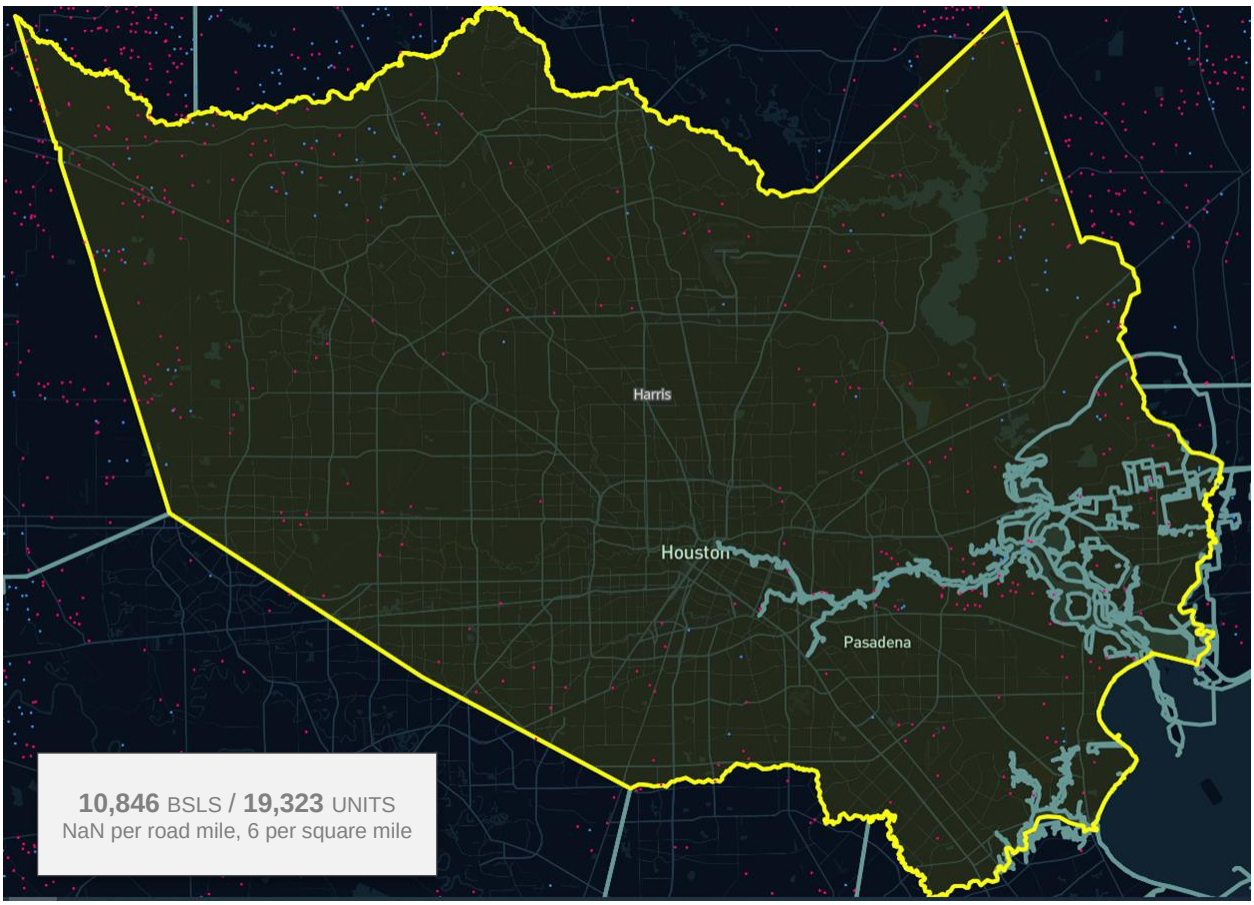


FIGURE 106 - HARRIS COUNTY UNSERVED AND UNDERSERVED ADDRESSES

It is difficult to determine a high-level cost for Harris County because of the size of the County, number of people and the distribution of unserved locations. It appears that there are between 8,000 – 11,000 unserved addresses in Harris County. The Texas Association of Counties lists the number of road miles in Harris County as 13,259,324. To build to all of the underserved addresses, the routes and miles to connect them would be between $150,000,000 to $250,000,000. There is such a wide range because of the variables in routes, distances and obstacles.. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved.

Cost per Mile	Cost on Drop
$35,000	$1,250

FIGURE 107 – ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

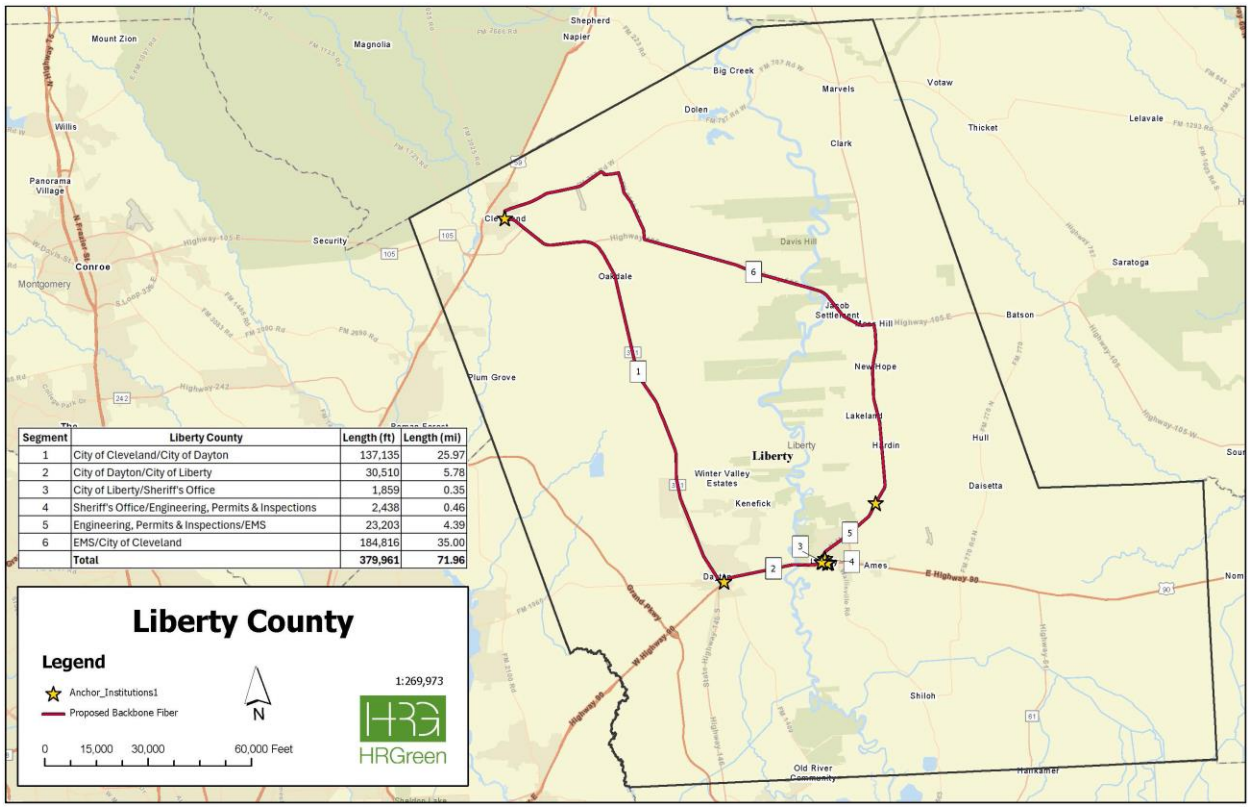
These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

LIBERTY COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.



Segment	Liberty County	Length (ft)	Length (mi)
1	City of Cleveland/City of Dayton	137,135	25.97
2	City of Dayton/City of Liberty	30,510	5.78
3	City of Liberty/Sheriff's Office	1,859	0.35
4	Sheriff's Office/Engineering, Permits & Inspections	2,438	0.46
5	Engineering, Permits & Inspections/EMS	23,203	4.39
6	EMS/City of Cleveland	184,816	35.00
	Total	**379,961**	**71.96**

FIGURE 108 - LIBERTY COUNTY MIDDLE MILE OPTIONS

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the i nset box in the above map there are six segments with both end points in the description. Liberty County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Cleveland/City of Dayton	$5,161,007	$5,280,839	$5,674,019
2	City of Dayton/City of Liberty	$1,154,851	$1,183,139	$1,275,497
3	City of Liberty/Sheriff's Office	$80,239	$84,757	$98,770
4	Sheriff's Office/Engineering, Permits & Inspections	$101,195	$105,970	$120,895
5	Engineering, Permits & Inspections/EMS	$882,853	$906,059	$981,376
6	EMS/City of Cleveland	$6,953,801	$7,115,066	$7,644,253
	Liberty County Design Totals	$14,333,946	$14,675,831	$15,794,810

FIGURE 109 - LIBERTY COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $14.3M to the 288 option at $16M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

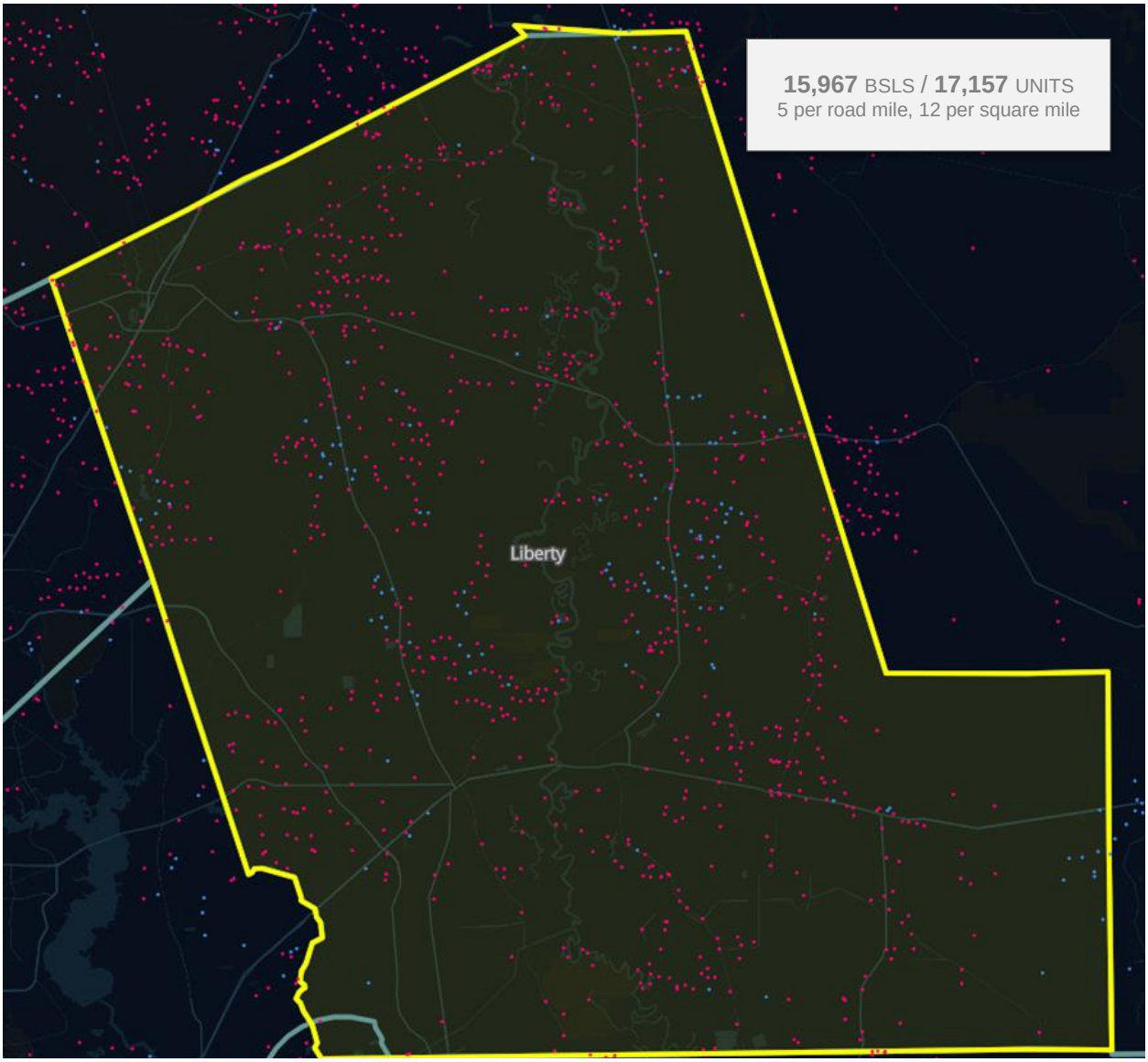


FIGURE 110 - LIBERTY COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $8,027 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$128,167,260.67

FIGURE 111 – ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

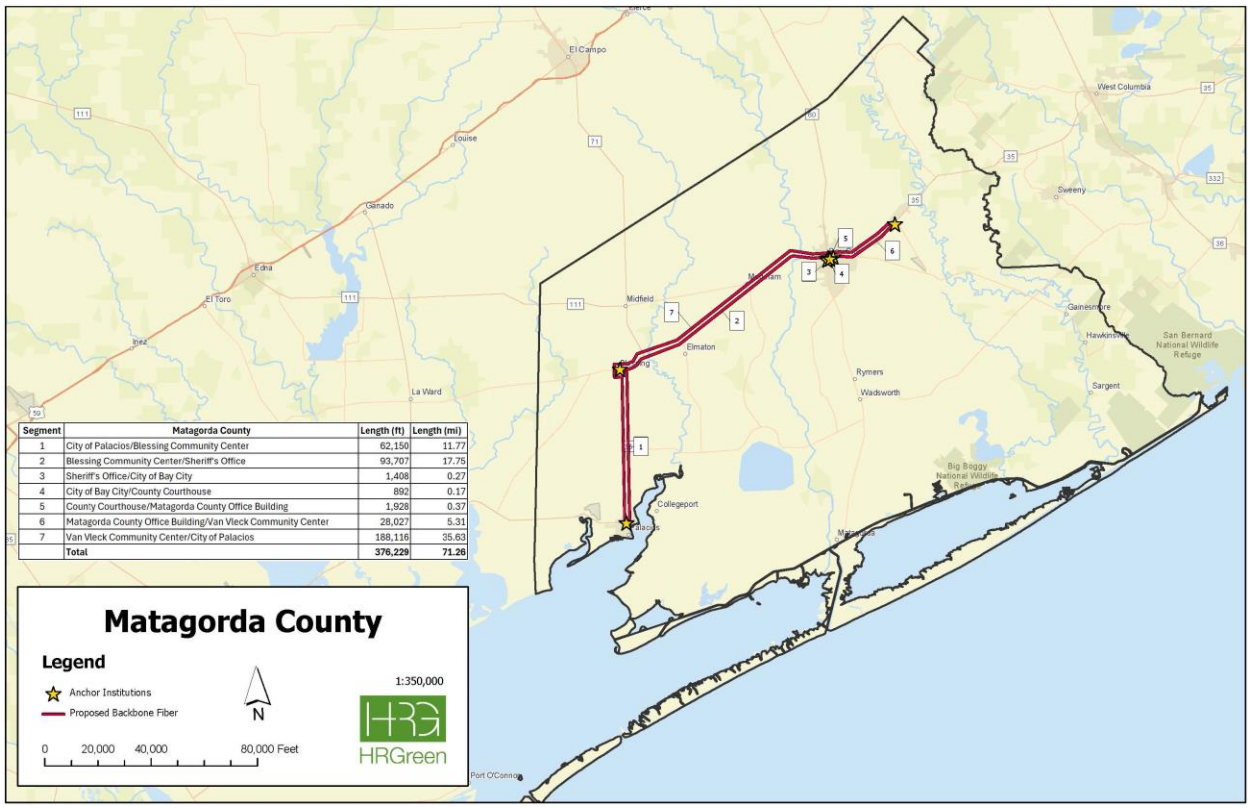
These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

MATAGORDA COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.



Segment	Matagorda County	Length (ft)	Length (mi)
1	City of Palacios/Blessing Community Center	62,150	11.77
2	Blessing Community Center/Sheriff's Office	93,707	17.75
3	Sheriff's Office/City of Bay City	1,408	0.27
4	City of Bay City/County Courthouse	892	0.17
5	County Courthouse/Matagorda County Office Building	1,928	0.37
6	Matagorda County Office Building/Van Vleck Community Center	28,027	5.31
7	Van Vleck Community Center/City of Palacios	188,116	35.63
	Total	**376,229**	**71.26**

FIGURE 112 - MATAGORDA COUNTY MIDDLE MILE OPTIONS

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the above map there are seven segments with both end points in the description. Matagorda County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Palacios/Blessing Community Center	$2,343,074	$2,398,302	$2,579,250
2	Blessing Community Center/Sheriff's Office	$3,528,344	$3,610,475	$3,879,885
3	Sheriff's Office/City of Bay City	$63,197	$67,516	$80,820
4	City of Bay City/County Courthouse	$44,561	$48,652	$61,144
5	County Courthouse/Matagorda County Office Building	$82,747	$87,296	$101,418
6	Matagorda County Office Building/Van Vleck Community Center	$1,063,594	$1,090,783	$1,179,234
7	Van Vleck Community Center/City of Palacios	$7,074,573	$7,237,297	$7,771,676
	Matagorda County Design Totals	$14,200,089	$14,540,321	$15,653,427

FIGURE 113 - MATAGORDA COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $14M to the 288 option at $16M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

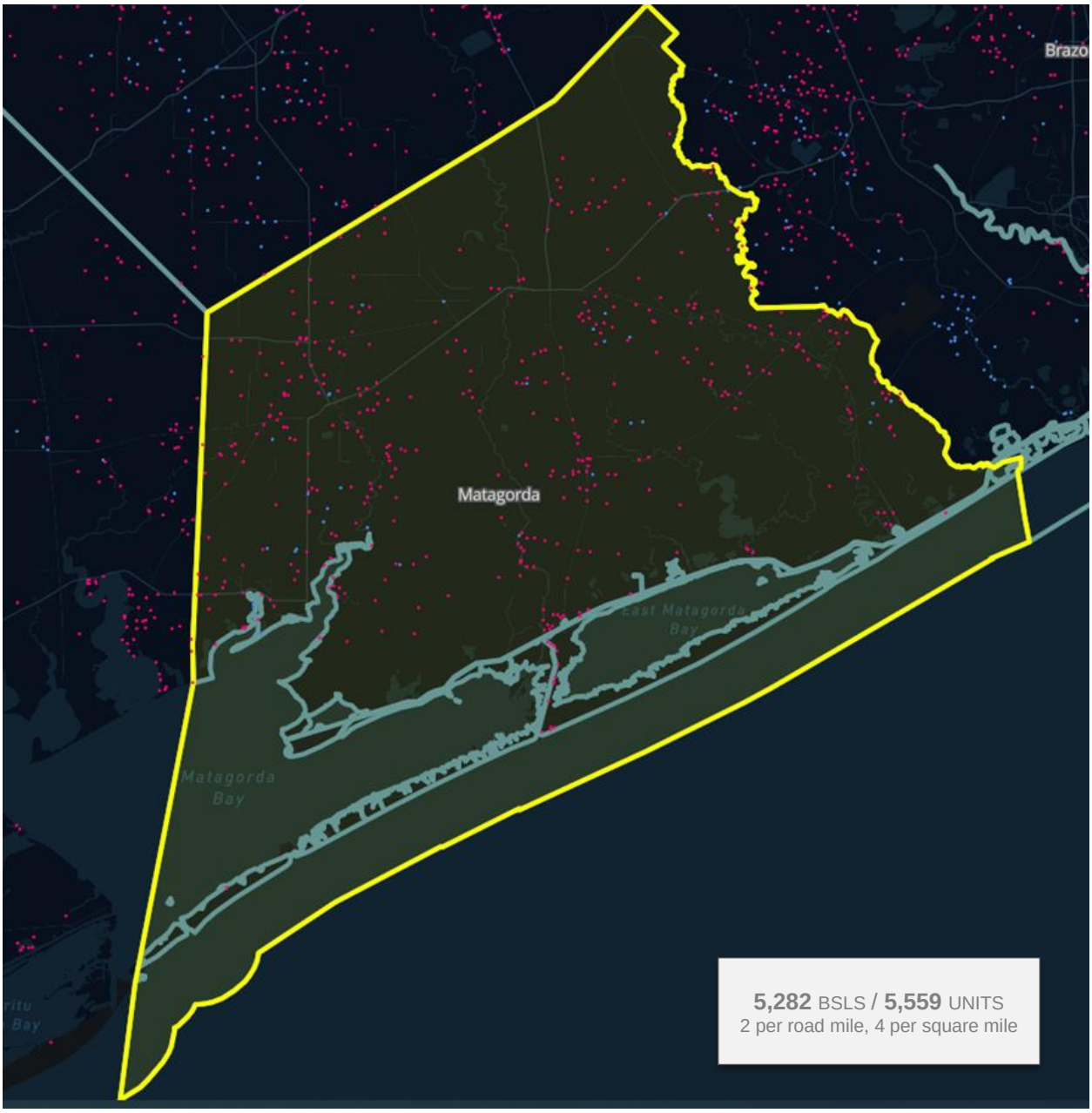


FIGURE 114 - MATAGORDA COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $20,421 per passing

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$107,862,302.44

FIGURE 115 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

MONTGOMERY COUNTY

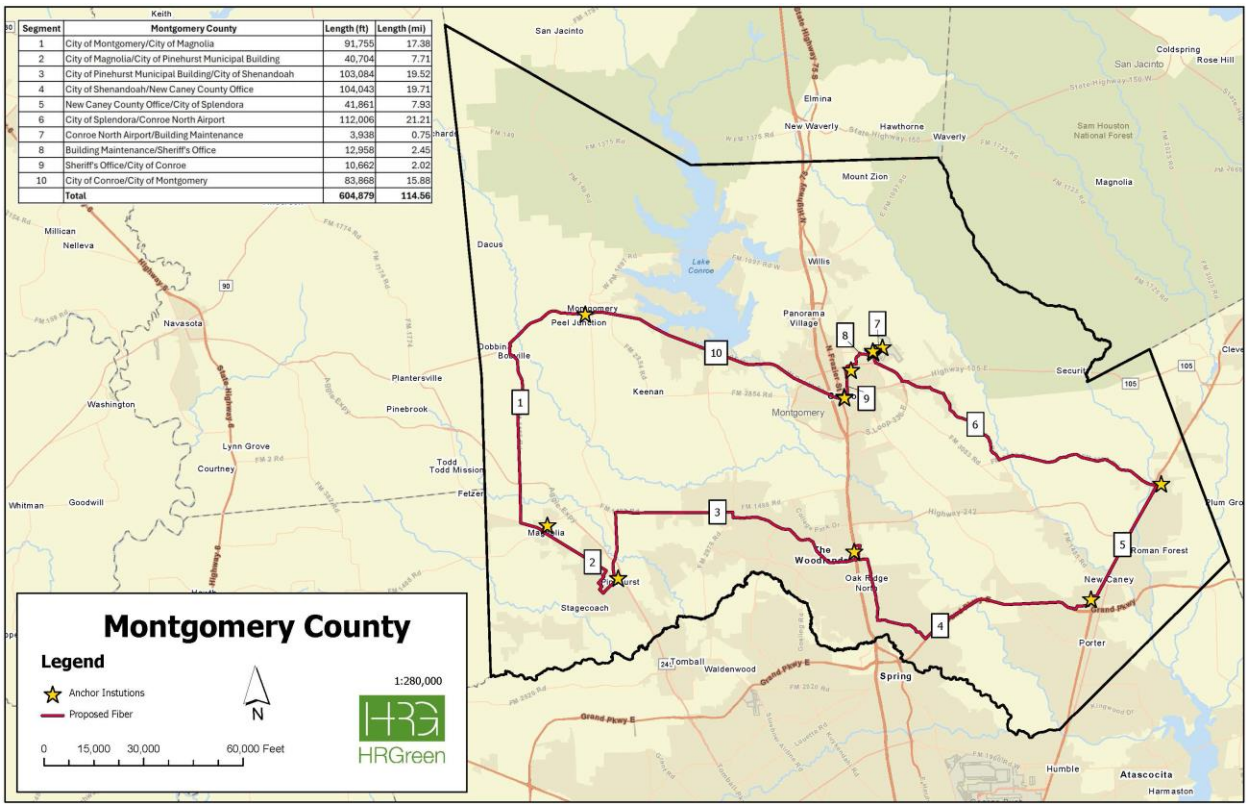


FIGURE 116 - MONTGOMERY COUNTY MIDDLE MILE OPTIONS

In the above map are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the above map there are ten segments with both end points in the description. Montgomery County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the

industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Montgomery/City of Magnolia	$3,457,010	$3,538,277	$3,804,614
2	City of Magnolia/City of Pinehurst Municipal Building	$1,540,902	$1,579,246	$1,704,275
3	City of Pinehurst Municipal Building/City of Shenandoah	$3,880,000	$3,969,977	$4,265,229
4	City of Shenandoah/New Caney County Office	$3,919,527	$4,011,777	$4,314,081
5	New Caney County Office/City of Splendora	$1,582,725	$1,621,581	$1,748,430
6	City of Splendora/Conroe North Airport	$4,215,256	$4,312,878	$4,633,257
7	Conroe North Airport/Building Maintenance	$156,157	$161,596	$178,881
8	Building Maintenance/Sheriff's Office	$494,938	$508,066	$550,631
9	Sheriff's Office/City of Conroe	$411,197	$423,308	$462,260
10	City of Conroe/City of Montgomery	$3,159,183	$3,233,263	$3,476,103
	Montgomery County Design Totals	**$22,816,895**	**$23,359,969**	**$25,137,760**

FIGURE 117 - MONTGOMERY COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $23M to the 288 option at $25M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

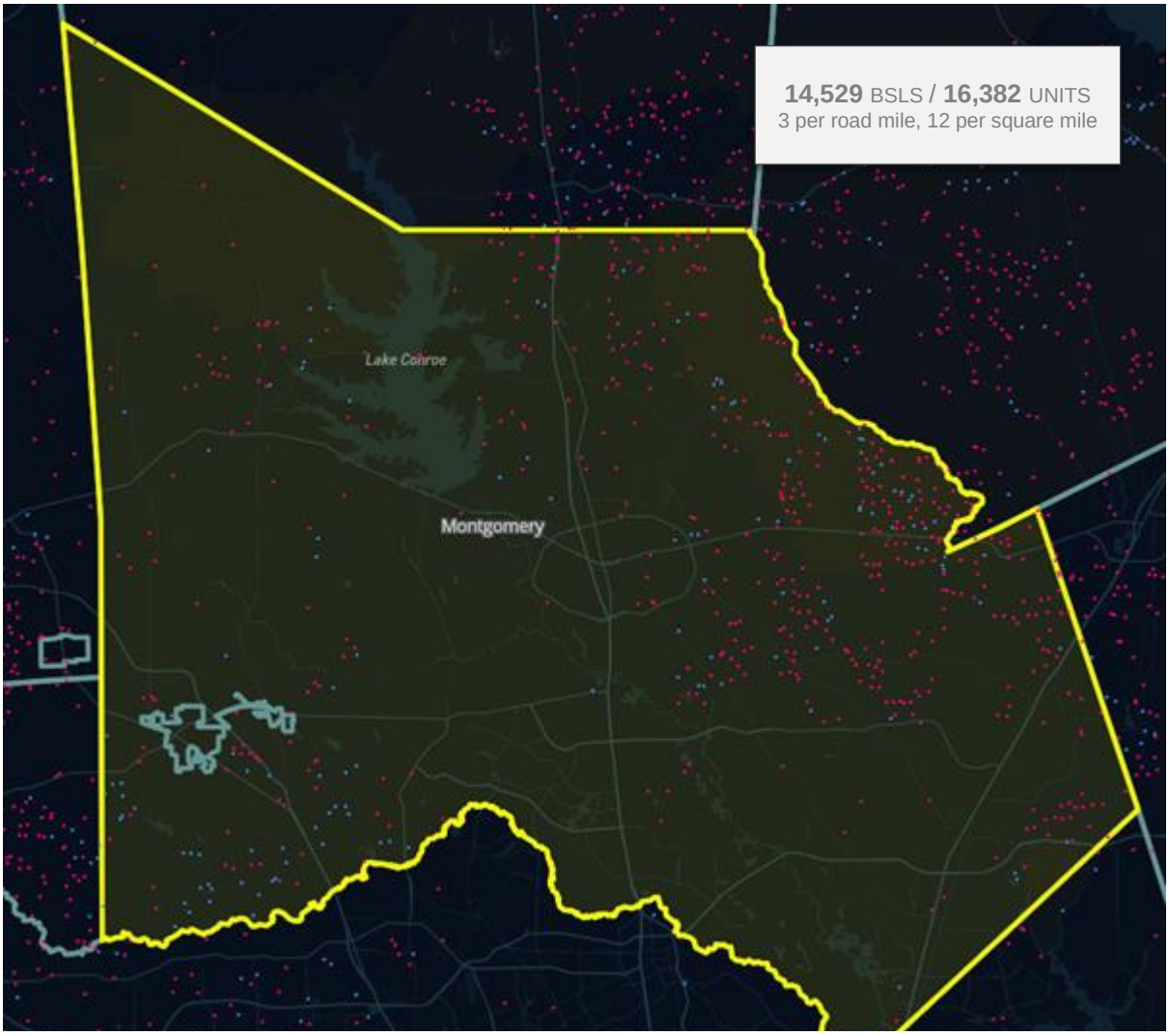


FIGURE 118 - MONTGOMERY COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $13,121 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$190,637,257.24

FIGURE 119 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate

them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used

WALKER COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the below map there are nine segments with both end points in the description. Walker County's anchor institutions include County and City facilities.

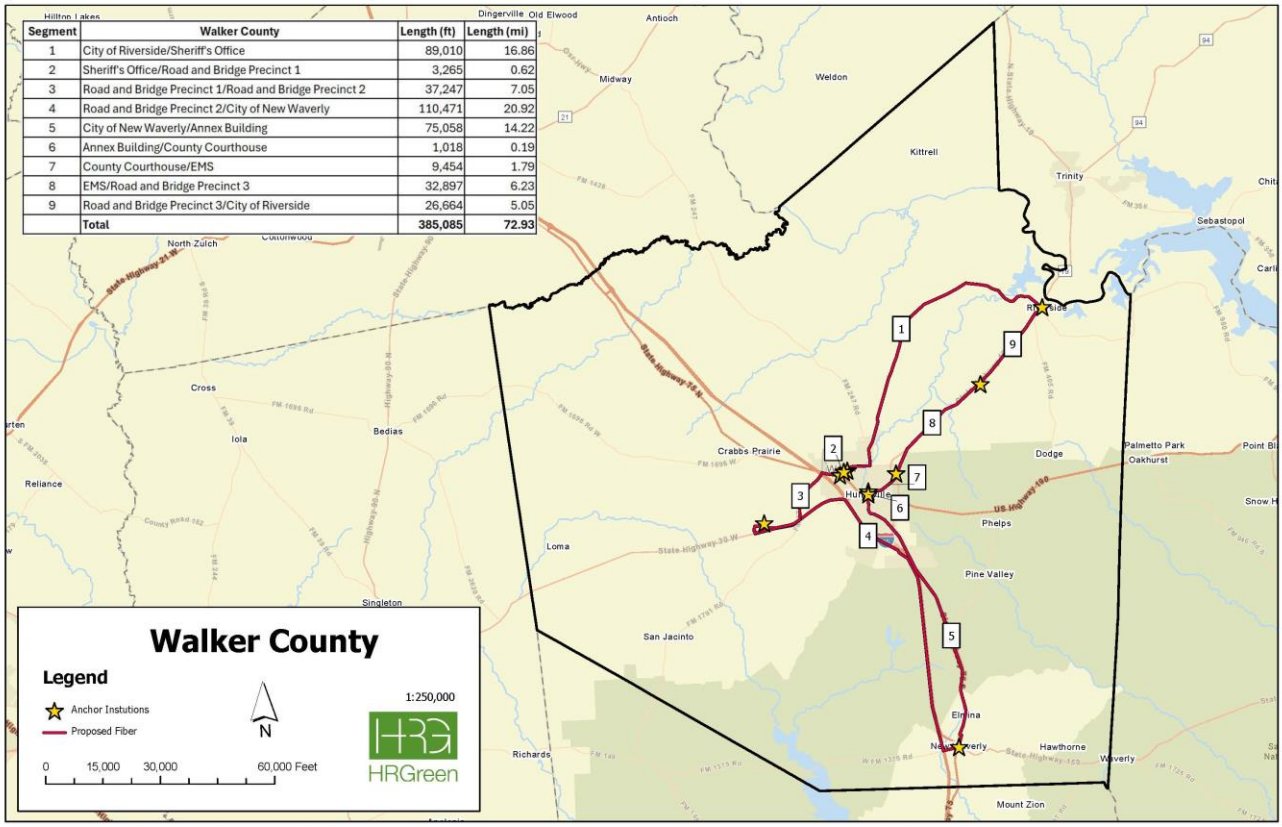


FIGURE 120 - WALKER COUNTY MIDDLE MILE OPTIONS

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Riverside/Sheriff's Office	$3,352,180	$3,430,384	$3,686,859
2	Sheriff's Office/Road and Bridge Precinct 1	$131,829	$136,970	$153,195
3	Road and Bridge Precinct 1/Road and Bridge Precinct 2	$1,409,590	$1,444,556	$1,558,602
4	Road and Bridge Precinct 2/City of New Waverly	$4,159,012	$4,255,955	$4,573,918
5	City of New Waverly/Annex Building	$2,828,779	$2,895,264	$3,113,155
6	Annex Building/County Courthouse	$49,091	$53,238	$65,927
7	County Courthouse/EMS	$366,779	$378,356	$415,407
8	EMS/Road and Bridge Precinct 3	$1,245,976	$1,277,168	$1,378,825
9	Road and Bridge Precinct 3/City of Riverside	$1,009,446	$1,034,184	$1,114,945
1	City of Riverside/Sheriff's Office	$3,352,180	$3,430,384	$3,686,859
	Walker County Design Totals	$14,552,682	$14,906,074	$16,060,834

FIGURE 121 - WALKER COUNTY MIDDLE MILE COST OPTIONS

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

With potential costs ranging from the 96 fiber count option at $14.5M to the 288 option at $16M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

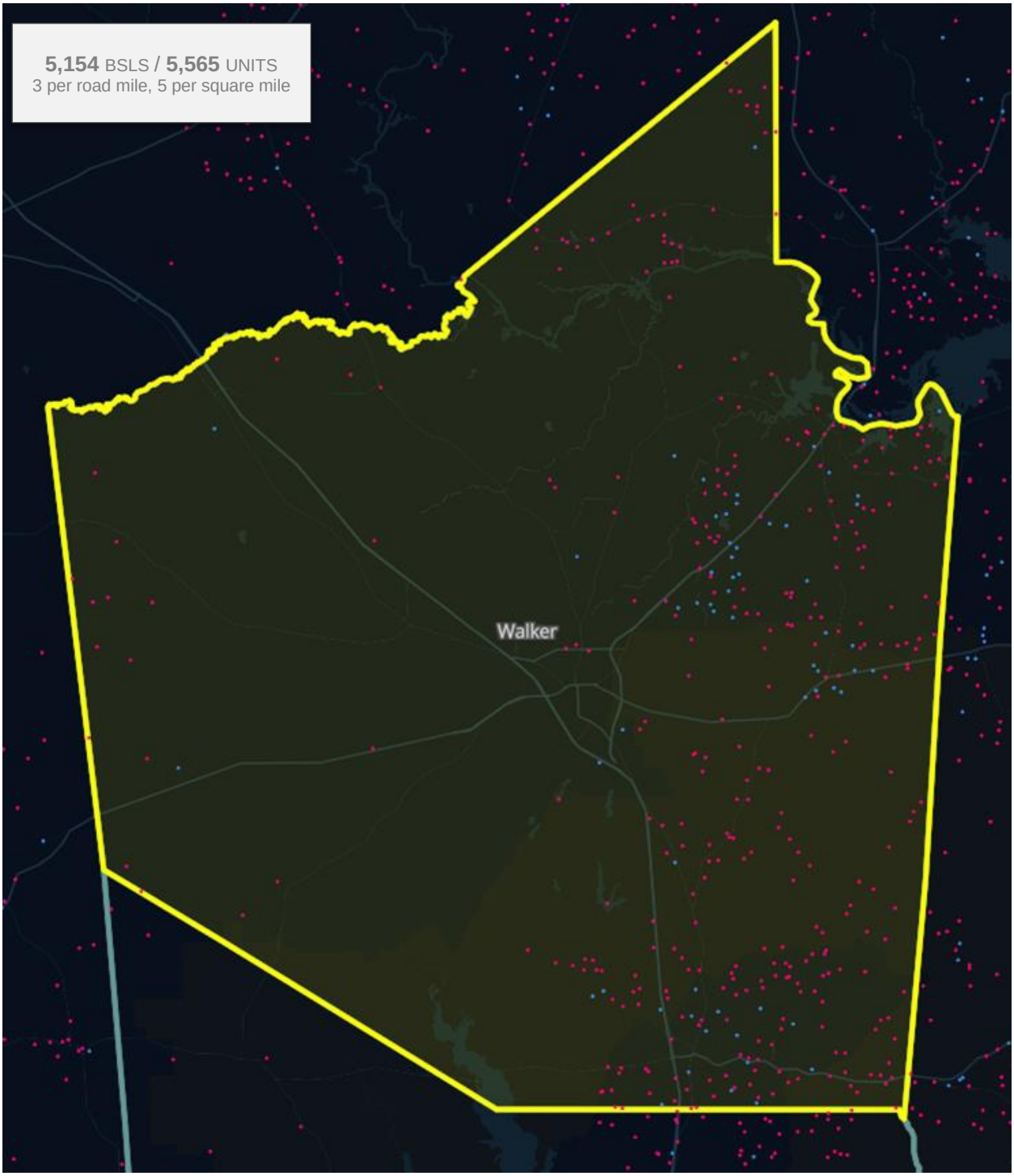


FIGURE 122 - WALKER COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $14,472 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$74,590,409.43

FIGURE 123 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

WALLER COUNTY

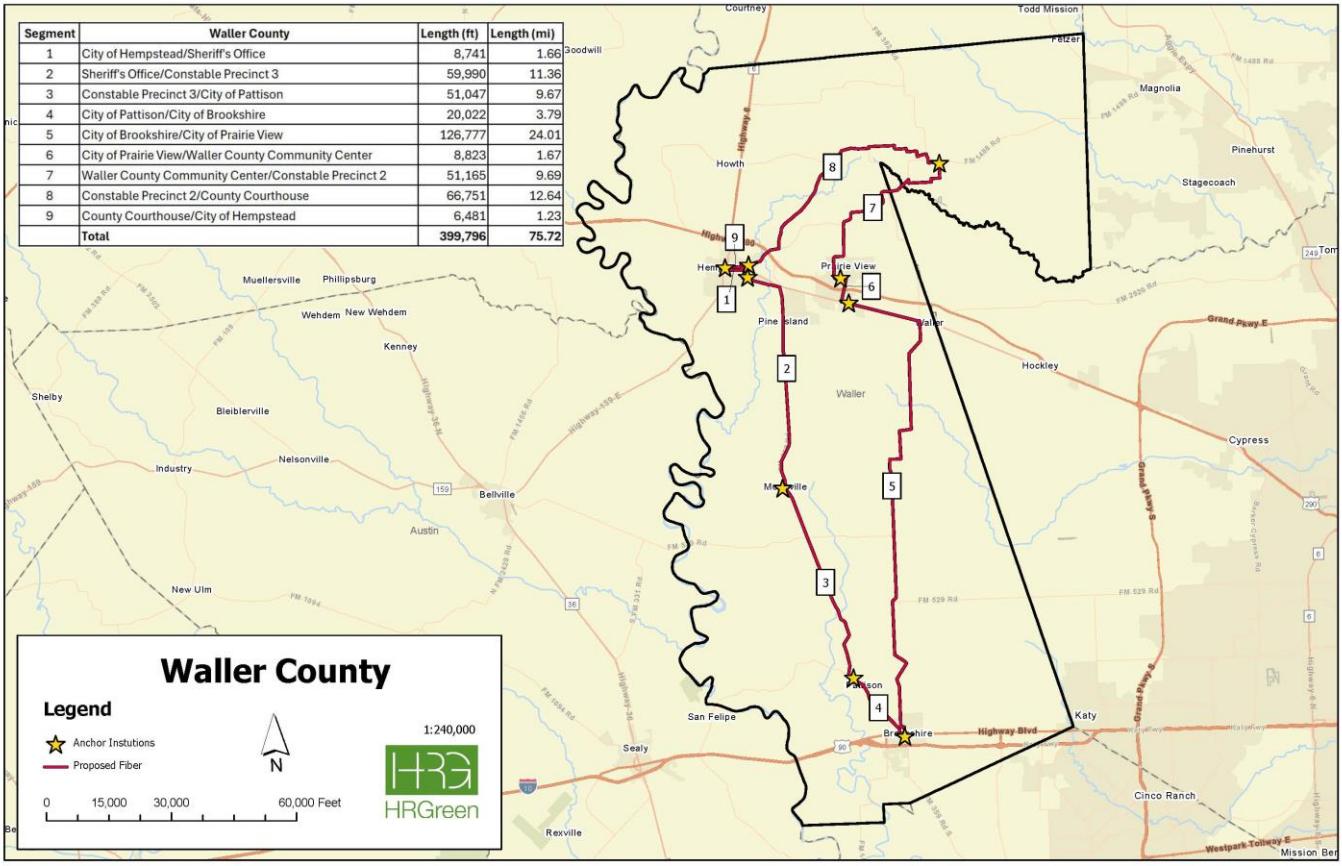


FIGURE 124 - WALLER COUNTY MIDDLE MILE OPTIONS

Above are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the above map there are nine segments with both end points in the description. Chambers County's anchor institutions include County and City facilities.

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of Hempstead/Sheriff's Office	$336,118	$345,531	$375,915
2	Sheriff's Office/Constable Precinct 3	$2,263,511	$2,317,783	$2,495,334
3	Constable Precinct 3/City of Pattison	$1,928,250	$1,974,868	$2,127,258
4	City of Pattison/City of Brookshire	$762,258	$782,208	$846,976
5	City of Brookshire/City of Prairie View	$4,773,110	$4,884,662	$5,250,457
6	City of Prairie View/Waller County Community Center	$339,091	$348,540	$379,054
7	Waller County Community Center/Constable Precinct 2	$1,932,531	$1,979,201	$2,131,777
8	Constable Precinct 2/County Courthouse	$2,515,767	$2,574,880	$2,768,612
9	County Courthouse/City of Hempstead	$253,674	$262,086	$288,915
	Waller County Design Totals	$15,104,311	$15,469,758	$16,664,298

FIGURE 125 - WALLER COUNTY MIDDLE MILE COST OPTIONS

With potential costs ranging from the 96 fiber count option at $15M to the 288 option at $17M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the below map. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

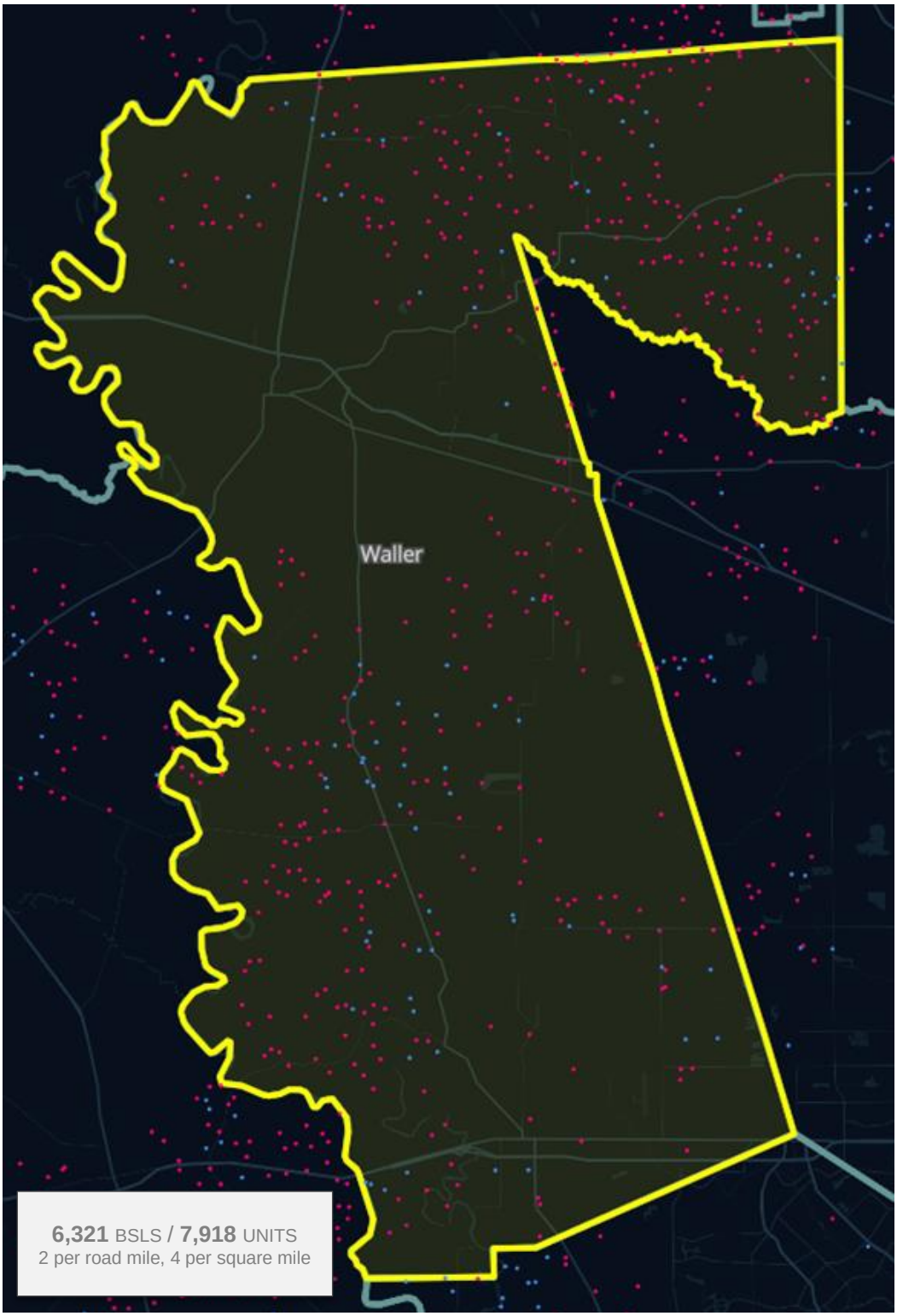


FIGURE 126 - WALLER COUNTY UNSERVED AND UNDERSERVED ADDRESSES

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $8,371 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$52,910,857.99

FIGURE 127 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

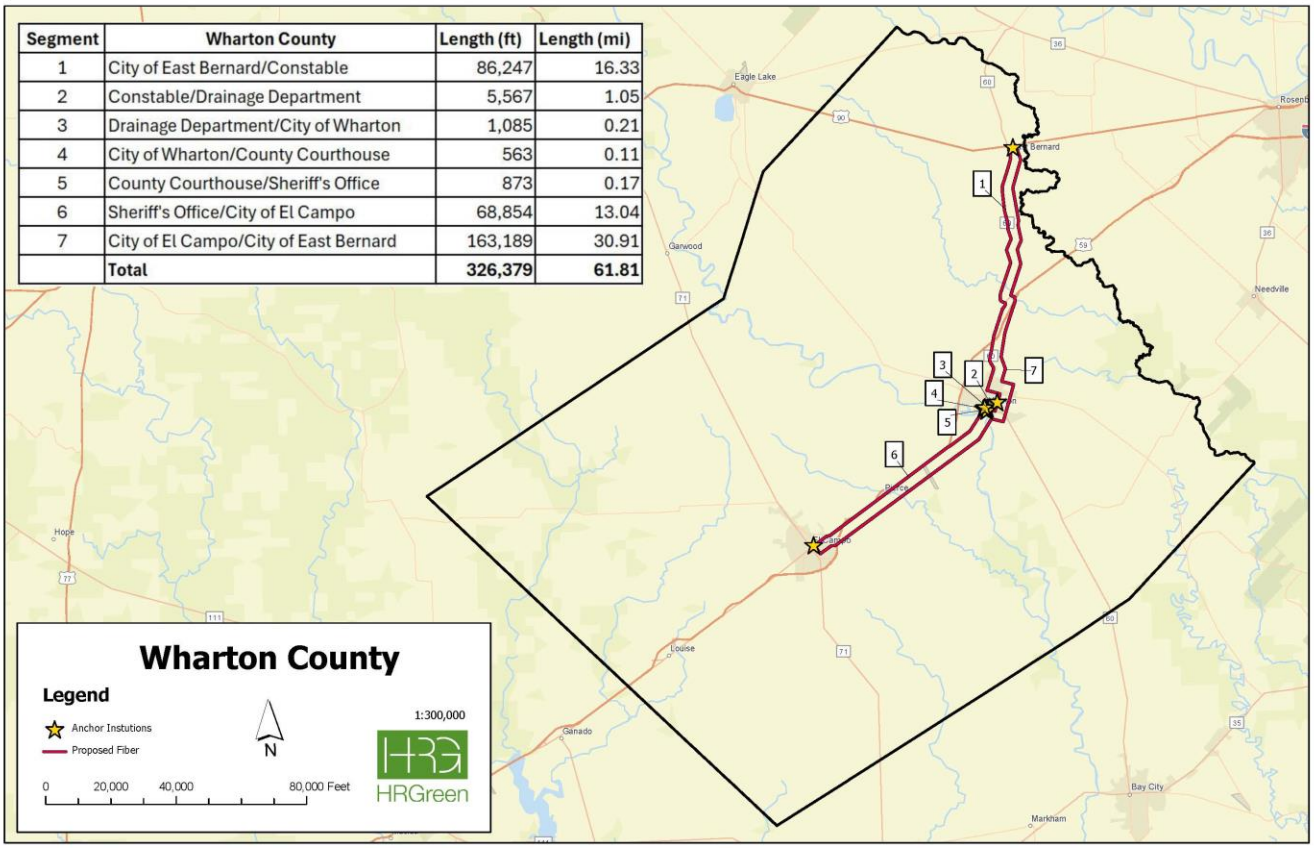
- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

WHARTON COUNTY

Below are the HLD, segment costs and general entire build costs documented in a similar way and with the same assumptions as previous counties. There number of anchor institutions included was solely a function of availability of locations and addresses.

The intent is not necessarily to recommend that all of these segments be built or that these are the best routes. They represent one design concept and could be changed based on need (for middle mile and last mile) or more detailed route information. However, the segments and segment costs do provide options and information for alternatives.

In the inset box in the below map there are seven segments with both end points in the description. Chambers County's anchor institutions include County and City facilities.



Segment	Wharton County	Length (ft)	Length (mi)
1	City of East Bernard/Constable	86,247	16.33
2	Constable/Drainage Department	5,567	1.05
3	Drainage Department/City of Wharton	1,085	0.21
4	City of Wharton/County Courthouse	563	0.11
5	County Courthouse/Sheriff's Office	873	0.17
6	Sheriff's Office/City of El Campo	68,854	13.04
7	City of El Campo/City of East Bernard	163,189	30.91
	Total	**326,379**	**61.81**

FIGURE 128 – WHARTON COUNTY MIDDLE MILE OPTIONS

In the chart below are the high-level costs to build each segment and the total costs for the entire ring. HR Green HLD costing tools incorporate industry and recent project cost information to determine an estimate of costs per segment.

The three columns of costs represent different options (96, 144 or 288 fiber bundles). There are three fiber counts to provide options of extra capacity.

Costs could vary dramatically due to market changes in materials and labor. It is fairly likely there will be significant fluctuations in costs for labor and materials as demand increases as the grant dollars enter the industry. The costs in the spreadsheet represent outside plant labor and material costs – they do not include network equipment or operations of the network.

With potential costs ranging from the 96 fiber count option at $12.3M to the 288 option at $14M, it would not necessarily be expected for the County to build this middle mile ring. However, given that there are addresses being connected and the level of need for last mile, it is possible that it could be eligible for grants. Also, depending on the need, it could be important to confirm what last mile providers might need it and what they are able to pay for using it.

There could be several segments that are not needed. Some locations might already have good broadband and redundancy. For others, the area that they are in might not need middle mile. However, the costs and lengths could be used to formulate a general understanding of other options.

Seg. No.	Segment Description	Estimated 96ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 144ct Total Backbone Segment and Laterals w/ Splicing Cost	Estimated 288ct Total Backbone Segment and Laterals w/ Splicing Cost
1	City of East Bernard/Constable	$3,250,808	$3,327,789	$3,579,917
2	Constable/Drainage Department	$219,910	$227,918	$253,310
3	Drainage Department/City of Wharton	$51,508	$55,684	$68,479
4	City of Wharton/County Courthouse	$32,654	$36,599	$48,573
5	County Courthouse/Sheriff's Office	$43,873	$47,956	$60,418
6	Sheriff's Office/City of El Campo	$2,596,624	$2,658,515	$2,861,099
7	City of El Campo/City of East Bernard	$6,140,236	$6,282,689	$6,750,128
1	City of East Bernard/Constable	$3,250,808	$3,327,789	$3,579,917
	Wharton County Design Totals	$12,335,613	$12,637,150	$13,621,924

FIGURE 129 - WHARTON COUNTY MIDDLE MILE COST OPTIONS

If there are other segments or layouts that could be needed, it would be recommended that an actual HLD be done at some point before the discussions of those options get too specific.

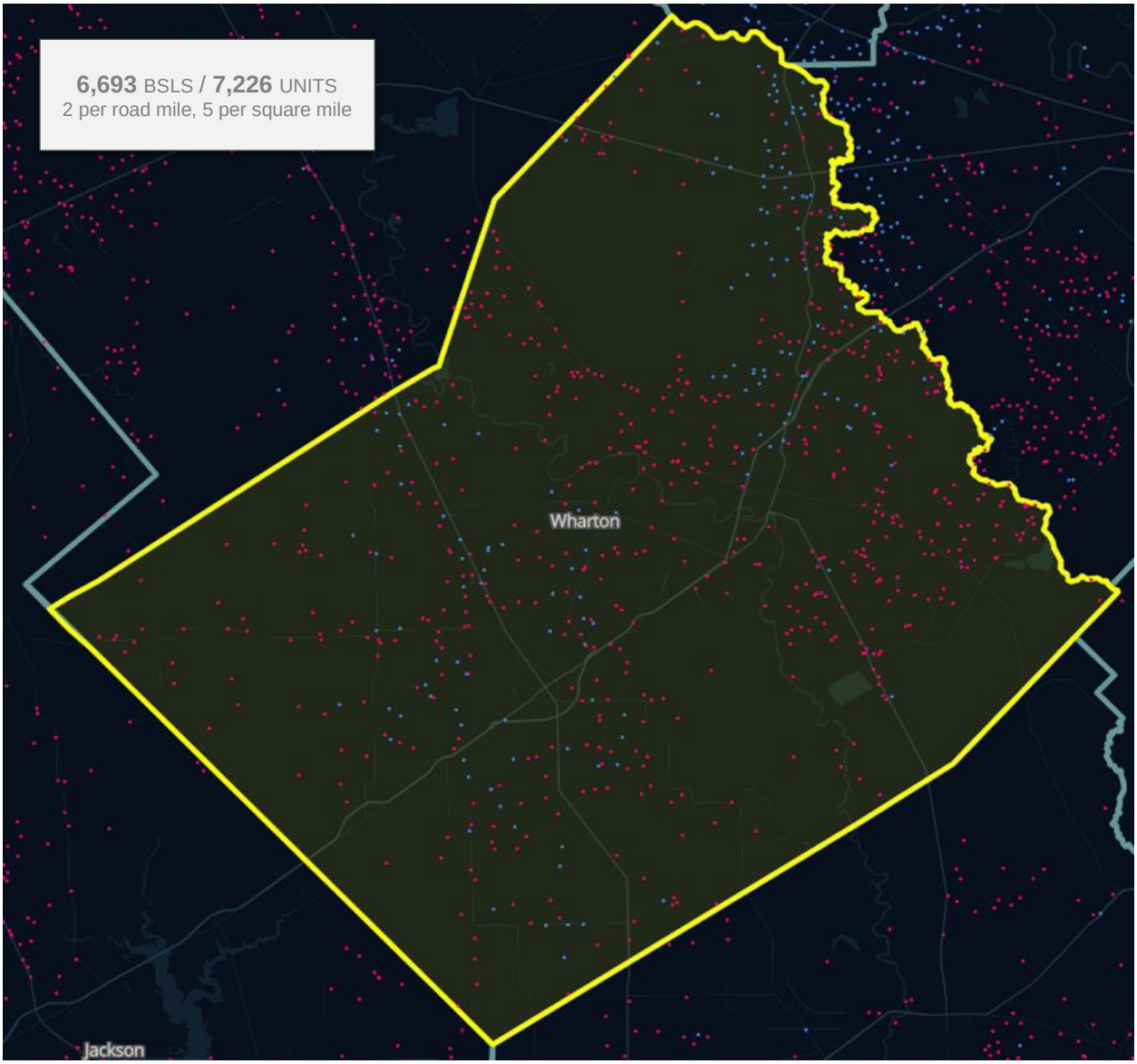


FIGURE 130 - WHARTON COUNTY UNSERVED AND UNDERSERVED ADDRESSES

To determine costs for last-mile needs, the FCC eligibility map was utilized and is shown in the above. To provide high-level costs for addresses, the number of unserved (red) and underserved (blue) addresses were identified and included in the inset box.

Utilizing average costs, a high-level total cost can be determined. This number is a general cost and is meant to provide an order of magnitude budget to build to every address that is unserved and underserved. The assumptions that are used to generate these costs are shown below and also include an amount of $19,331 per passing.

Cost per Mile	Cost on Drop	Total Cost
$35,000	$1,250	$129,380,474.22

FIGURE 131 - ASSUMPTIONS AND TOTAL HIGH-LEVEL COSTS

These assumptions and costs are somewhat high, intentionally. HR Green's design team evaluated them and determined that they are reasonably accurate, based on the assumptions that were used to calculate them. They should be able to be lowered with specific high-level designs and value engineering. It is possible that they could be significantly lower if certain conditions are met.

This number can be helpful for the following modeling:

- The assumptions can be manipulated if there are more details that are provided (if there were middle mile assets to lower the cost to get to dispersed addresses, if there were concentrations of addresses (the farther they are apart, the more expensive per passing), with a specific high-level design that was developed to maximize potential savings, etc.).
- These numbers can be used to scale for different arrangements of addresses. Again, if there are concentrations of addresses, a lower per passing number could be used.

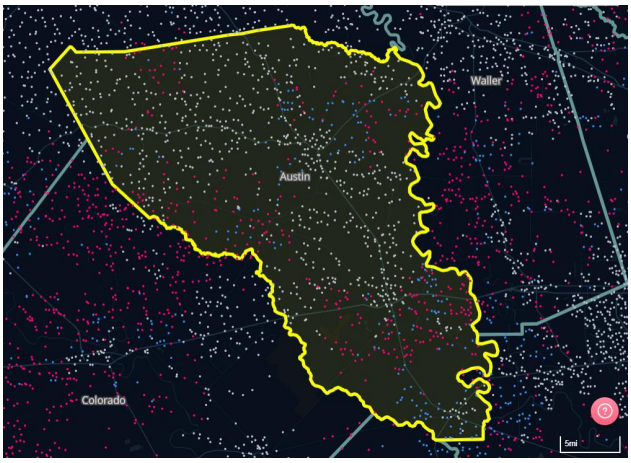
BROADBAND ACTION PLANS PER COUNTY

AUSTIN COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Austin County.

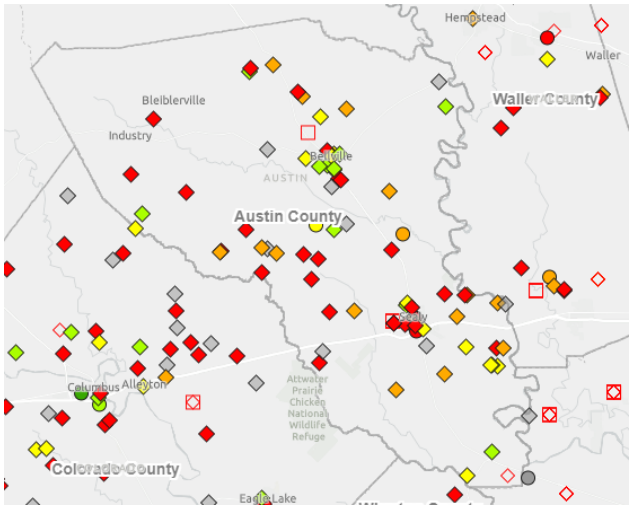
BROADBAND ISSUES

Austin County had 74 responses in the survey. Although that number of results does not provide a full picture of broadband needs, it does give some indication that there are broadband issues in the County.



Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served



Austin County Residential Survey Results
Download Speed (in Mbps)

◆	> 1,000 Mbps	◆	> 25 – Mbps
◆	> 100 – 1,000 Mbps	◆	0 – 25 Mbps
◆	> 50 – 100 Mbps	◆	Other

When compared with the grant eligibility map, there do appear to be consistencies in where broadband challenges exist (along the west, southwest, southern and some in the northeast).

The survey results and the eligibility map do appear to have some agreement that there are internet speed challenges in Austin County and where those exist.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 3,905 addresses should be grant eligible.

If County and City leaders feel that there are other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Austin County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Austin County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 14 providers (among all technologies) who have reported providing some services in Austin County. These providers include:

- Rural Telecommunications of America
- Industry Telephone Company
- AT&T Inc
- VERIZON
- ZochNet
- Alternative Internet Resources
- T-Mobile US
- Skynet
- Nextlink
- Evolve Cellular, Inc.
- Rise Broadband
- HughesNet
- Starlink
- Viasat, Inc

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

POLICY

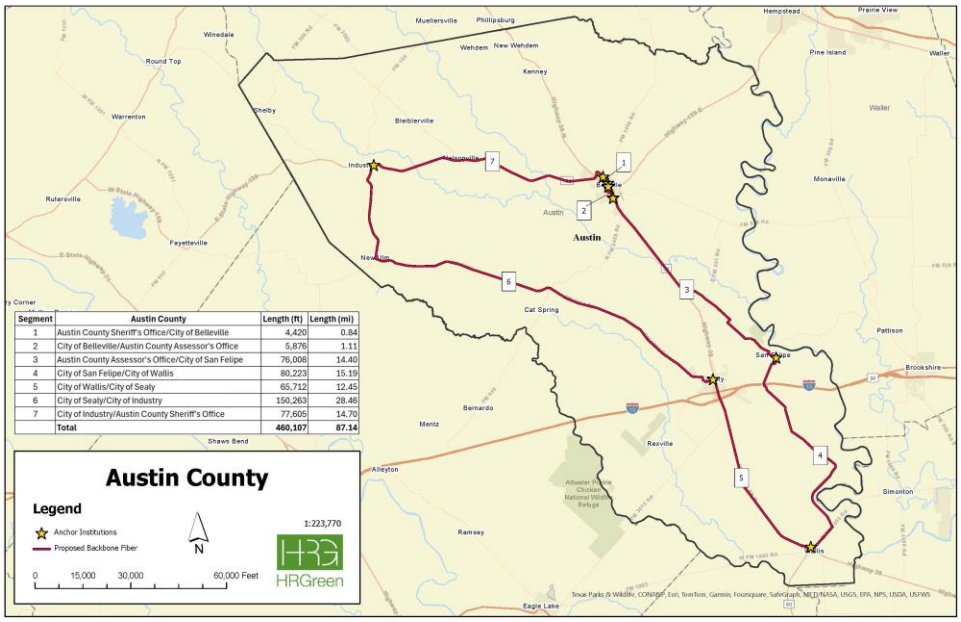
Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Austin County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand. Particularly in the western and southern parts of the County, middle mile could be a reason why there are the number of unserved addresses.

If middle mile is needed for any other above reasons, the middle mile possibilities in the above map (from the HLD section of this report – see that section for segment cost information) could provide options and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).



Segment	Austin County	Length (ft)	Length (mi)
1	Austin County Sheriff's Office/City of Belleville	4,420	0.84
2	City of Belleville/Austin County Assessor's Office	5,876	1.11
3	Austin County Assessor's Office/City of San Felipe	76,008	14.40
4	City of San Felipe/City of Wallis	80,223	15.19
5	City of Wallis/City of Sealy	65,712	12.45
6	City of Sealy/City of Industry	150,263	28.46
7	City of Industry/Austin County Sheriff's Office	77,605	14.70
	Total	**460,107**	**87.14**

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Austin County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report).

Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

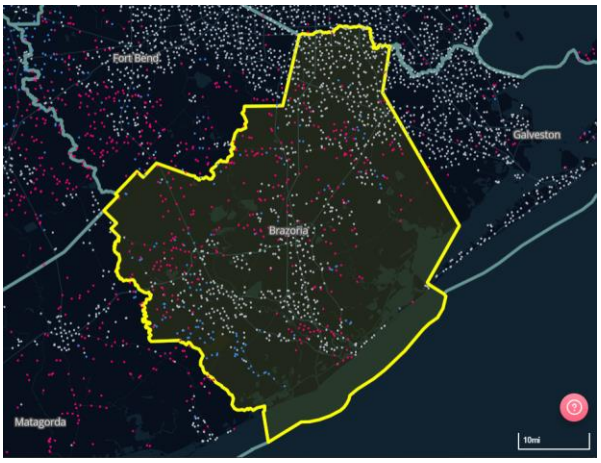
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

BRAZORIA COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Brazoria County.

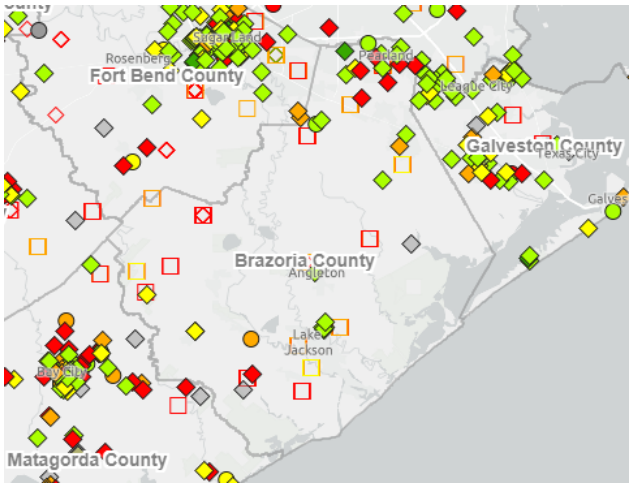
BROADBAND ISSUES

Brazoria County conducted a broadband survey in 2023, which received 1,252 results. In H-GAC's survey another 32 people responded to H-GAC's survey. Many of the results from the 2023 survey were outside of the County, but the combination of the results of H-GAC's survey and the responses within the County from the previous survey do provide some helpful data.



Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served



Brazoria County Residential Survey Results
Download Speed (in Mbps)

> 1,000 Mbps		> 25 – Mbps	
> 100 – 1,000 Mbps		0 – 25 Mbps	
> 50 – 100 Mbps		Other	

The survey results and the eligibility map do appear to have some agreement in what broadband problems exist in the County, except in the far northern part of the County. There probably are not enough survey results in that area to win a challenge, but it does appear that survey results show more broadband issues than the FCC maps.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 11,344 addresses should be grant eligible.

If County and City leaders feel that the northern part of the County or other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Brazoria County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Brazoria County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 14 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T
- Xfinity
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Rise Broadband
- Always ON
- Verizon
- Sparklight
- Starlink
- Windstream
- BTEL
- MyJEC.net
- Brightspeed

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

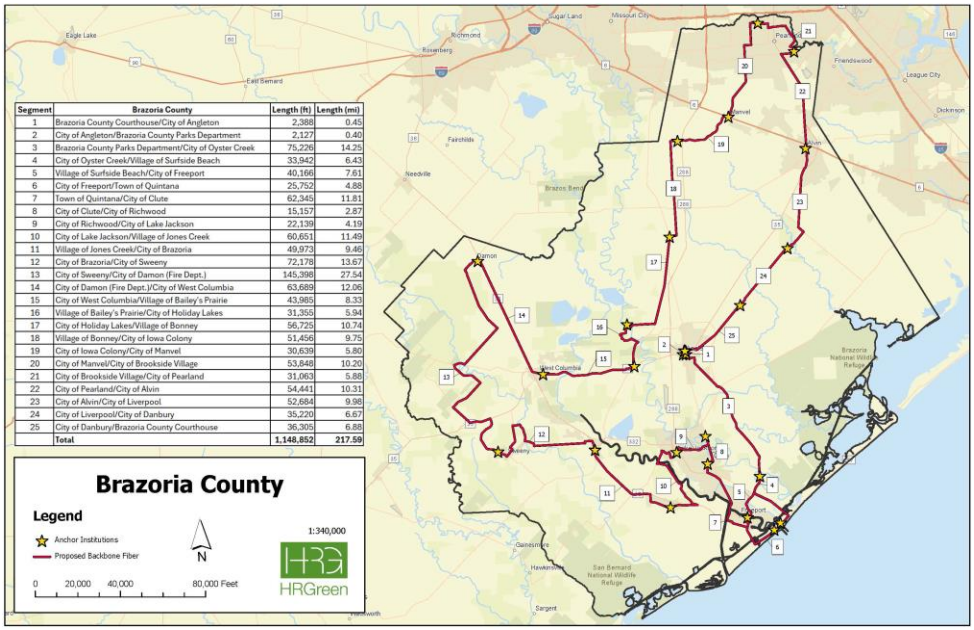
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Brazoria County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Segment	Brazoria County	Length (ft)	Length (mi)
1	Brazoria County Courthouse/City of Angleton	2,388	0.45
2	City of Angleton/Brazoria County Parks Department	2,127	0.40
3	Brazoria County Parks Department/City of Oyster Creek	75,226	14.25
4	City of Oyster Creek/Village of Surfside Beach	33,942	6.43
5	Village of Surfside Beach/City of Freeport	40,166	7.61
6	City of Freeport/Town of Quintana	25,752	4.88
7	Town of Quintana/City of Clute	62,345	11.81
8	City of Clute/City of Richwood	15,157	2.87
9	City of Richwood/City of Lake Jackson	22,139	4.19
10	City of Lake Jackson/Village of Jones Creek	60,651	11.49
11	Village of Jones Creek/City of Brazoria	49,973	9.46
12	City of Brazoria/City of Sweeny	72,178	13.67
13	City of Sweeny/City of Damon (Fire Dept.)	145,398	27.54
14	City of Damon (Fire Dept.)/City of West Columbia	63,689	12.06
15	City of West Columbia/Village of Bailey's Prairie	43,985	8.33
16	Village of Bailey's Prairie/City of Holiday Lakes	31,355	5.94
17	City of Holiday Lakes/Village of Bonney	56,725	10.74
18	Village of Bonney/City of Iowa Colony	51,456	9.75
19	City of Iowa Colony/City of Manvel	30,639	5.80
20	City of Manvel/City of Brookside Village	53,848	10.20
21	City of Brookside Village/City of Pearland	31,063	5.88
22	City of Pearland/City of Alvin	54,441	10.31
23	City of Alvin/City of Liverpool	52,684	9.98
24	City of Liverpool/City of Danbury	35,220	6.67
25	City of Danbury/Brazoria County Courthouse	36,305	6.88
	Total	1,148,852	217.59

Particularly in the western, north central and east central regions of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built.

If middle mile is needed for any of the above reasons, the middle mile HLD in the above map (copied from the HLD section of this report) could provide options and alternatives for middle mile (see the HLD section for cost information per segment).

If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

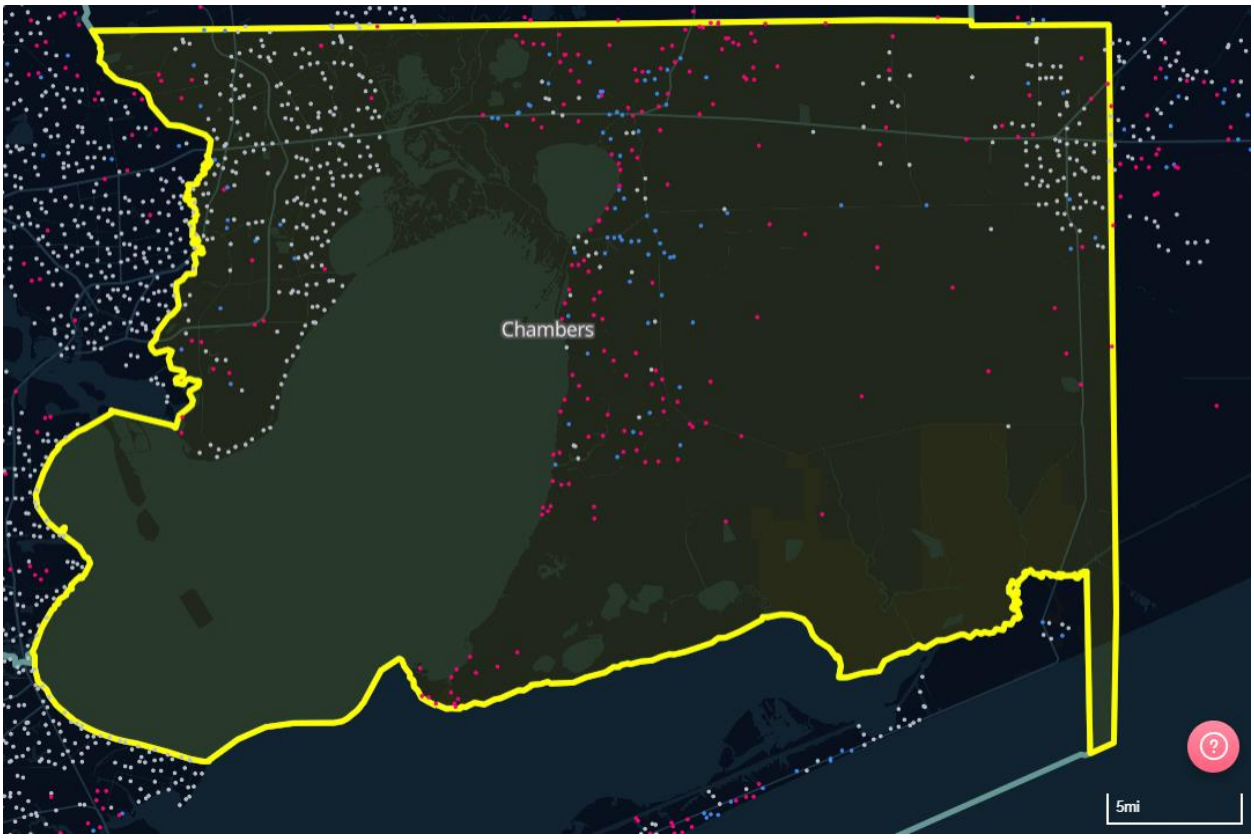
CHAMBERS COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Chambers County.

BROADBAND ISSUES

Chambers County received 15 responses in the broadband study survey and approximately that many more in a survey that the City of Baytown conducted. Almost all of the survey responses were from customers who are unserved with a few who are underserved.

With this low number of responses, unless the County wants to take steps to get better data, the County will need to rely on the FCC data maps. The current eligibility map is below.



There is one area that appears to show differing broadband need. In the data from the City of Baytown survey, addresses on the east side of the Chambers County line show unserved, but those addresses mostly show served on this map. It is not clear how many addresses could be impacted.

An important question for Chambers County is whether or not the FCC map seems correct. The County can choose to accept the broadband eligibility shown in the FCC map or decide to do further investigation into areas that could have greater broadband issues than are shown.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 3,239 addresses should be grant eligible.

If County and City leaders feel that the northwestern edge of the County or other areas should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Chambers County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Chambers County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 12 providers (among all technologies) who have reported providing some services in the County. These providers include:

- Verizon
- Viasat
- HughesNet
- Rise Broadband
- Always ON
- Xfinity
- Optimum
- MBLink
- Starlink
- Windstream
- T-Mobile 5G Home Internet
- Southern Broadband

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

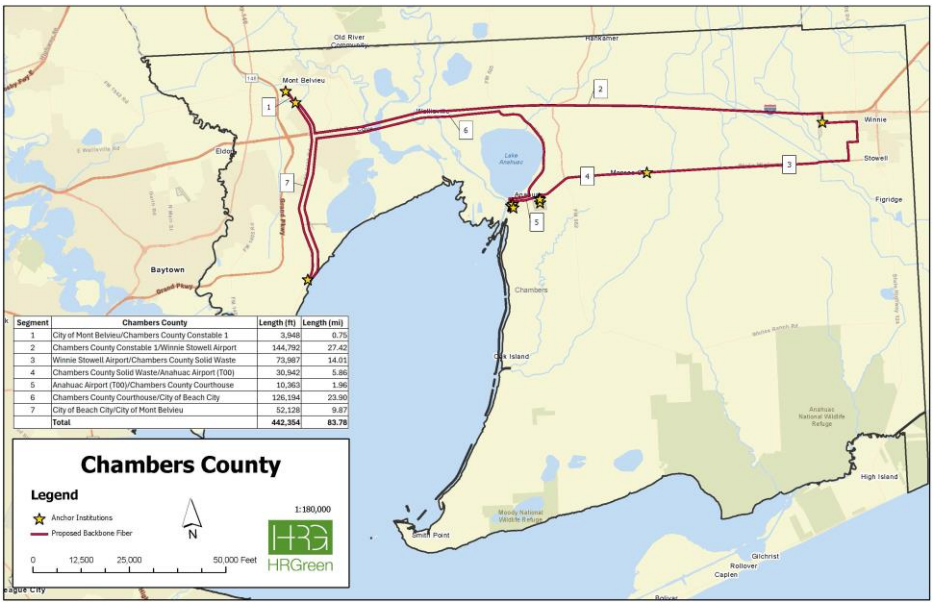
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Chambers County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Particularly in the north, central and eastern regions of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built.

If middle mile is needed for any other above reasons, the middle mile HLD in that section can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

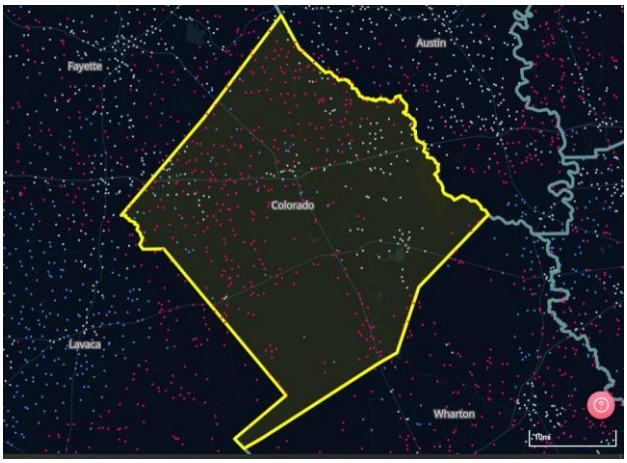
FIBER AND BROADBAND

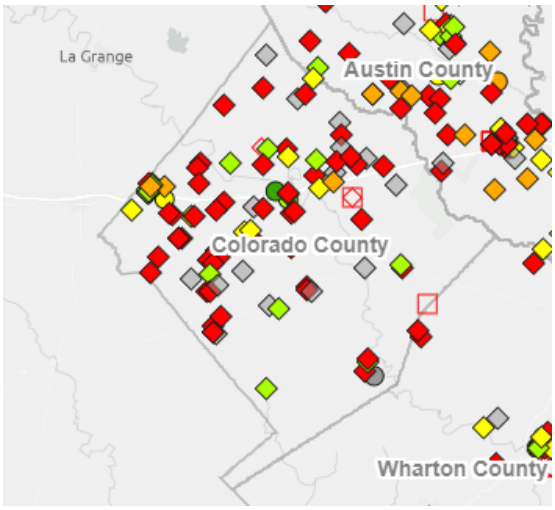
COLORADO COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Colorado County.

BROADBAND ISSUES

Colorado County received 95 responses in the broadband study survey. The survey results are below on the left and the current eligibility map is on the right.





Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

Colorado County Residential Survey Results
Download Speed (in Mbps)

> 1,000 Mbps		> 25 – Mbps	
> 100 – 1,000 Mbps		0 – 25 Mbps	
> 50 – 100 Mbps		Other	

The survey results appear to validate the eligibility map. In addition, there are many other addresses that are unserved and underserved in the eligibility map. The County can choose to accept the broadband eligibility shown in the FCC map or, if the County and cities know of any other areas or addresses that are unserved or underserved, the County could decide to do further investigation into areas that could have greater broadband issues than are shown. It does not appear that would be needed, but that is an option of other broadband issues have surfaced.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 6,967 addresses should be grant eligible.

If County and City leaders feel that the northwestern edge of the County or other areas should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Colorado County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Colorado County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 13 providers (among all technologies) who have reported providing some services in the County. These providers include:

- Windstream
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Rise Broadband
- Verizon
- Always ON
- Southern Broadband
- Starlink
- Xfinity
- Optimum
- MBLink
- Spectrum

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

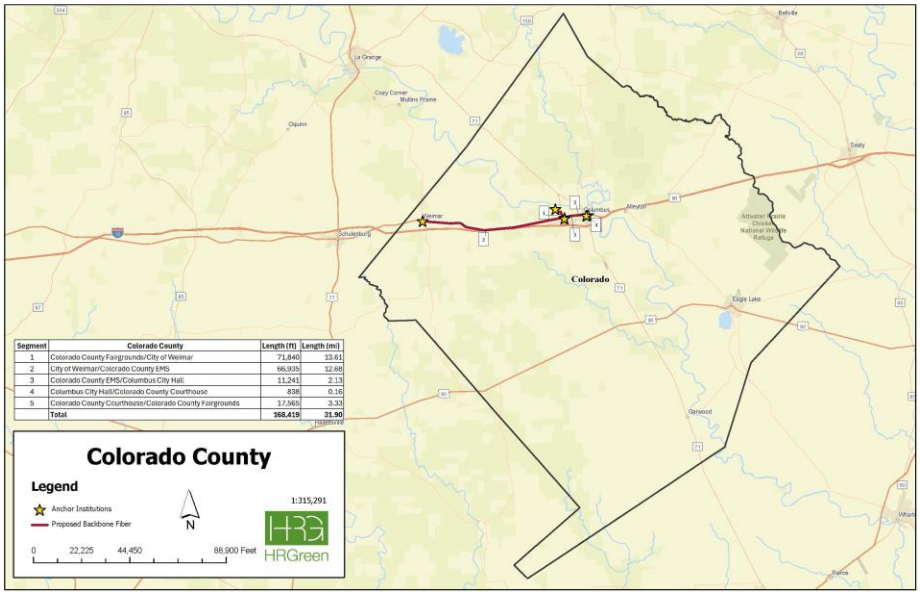
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Colorado County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Segment	Colorado County	Length (ft)	Length (mi)
1	Colorado County Fairgrounds/City of Weimar	71,840	13.61
2	City of Weimar/Colorado County EMS	66,935	12.68
3	Colorado County EMS/Columbus City Hall	11,241	2.13
4	Columbus City Hall/Colorado County Courthouse	838	0.16
5	Colorado County Courthouse/Colorado County Fairgrounds	17,565	3.33
	Total	168,419	31.90

Particularly in the north, west, central and southern regions of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built.

If the County (possibly in collaboration with cities and providers) could coordinate a middle mile ring, that could have significant impacts on last mile options.

It is fairly likely that lack of middle mile could be a problem in Colorado County. The middle mile option segments that were developed in the HLD section for Colorado County in this report would probably need to be expanded to solve the County's middle mile issues. The segments in the HLD were based on addresses that were available. Other facilities and addresses that could benefit from better connectivity would need to be added to the middle mile already designed.

If middle mile is needed for any other above reasons, the middle mile HLD in the HLD section of this report can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify and expand the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

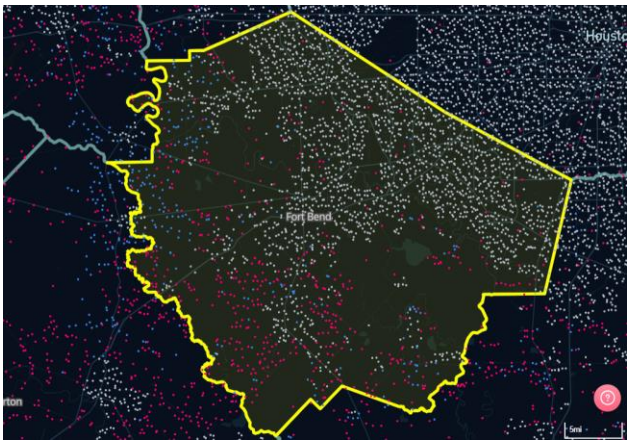
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

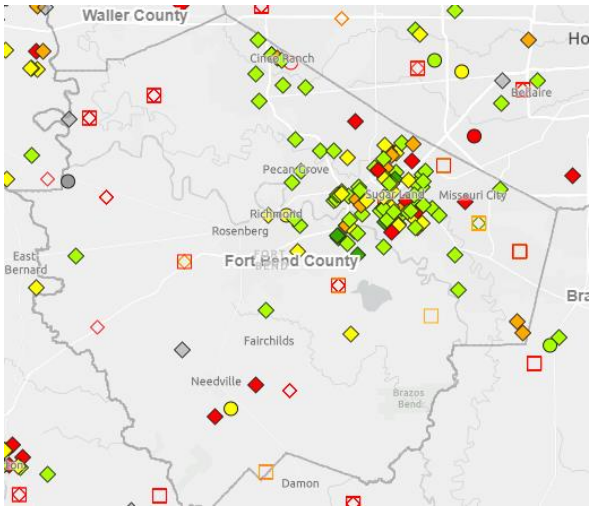
FORT BEND COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Fort Bend County.

BROADBAND ISSUES

Fort Bend County conducted a broadband survey in 2022, which received 572 results. In H-GAC's survey 119 people responded. The combined results are shown in the map on the left below. The map on the right is from the Cross Comparison section of this report and shows unserved in red and underserved in blue.





Broadband Eligibility Performance Criteria		
Unserved	Underserved	Served

Fort Bend County Residential Survey Results Download Speed (in Mbps)			
	> 1,000 Mbps		> 25 – Mbps
	> 100 – 1,000 Mbps		0 – 25 Mbps
	> 50 – 100 Mbps		Other

The survey results and the eligibility map do appear to have some agreement in what broadband problems exist in the County – particularly in the western and southern areas. One area that is not clear is the southeastern part of the County – there are mixed results throughout that portion of the County.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 7,404 addresses should be grant eligible.

If County and City leaders feel that there are other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Fort Bend County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Fort Bend County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 11 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Xfinity
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Always ON
- Verizon
- Starlink
- Windstream
- Frontier
- Rise Broadband

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

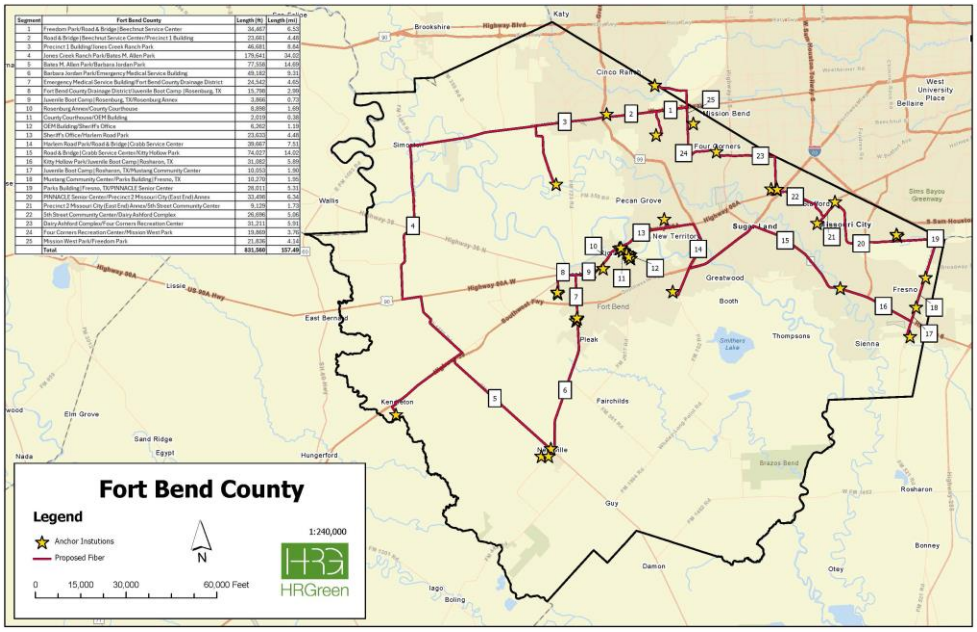
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Fort Bend County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Particularly in the western and southern regions of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built. Several segments have been included in the east and northeastern areas; those may not be needed and could be removed.

If middle mile is needed for any of the above reasons, the middle mile HLD in the above map (copied from the HLD section of this report) could provide options and alternatives for middle mile (see the HLD section for cost information per segment). There may need to be more segments in the southeast.

If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

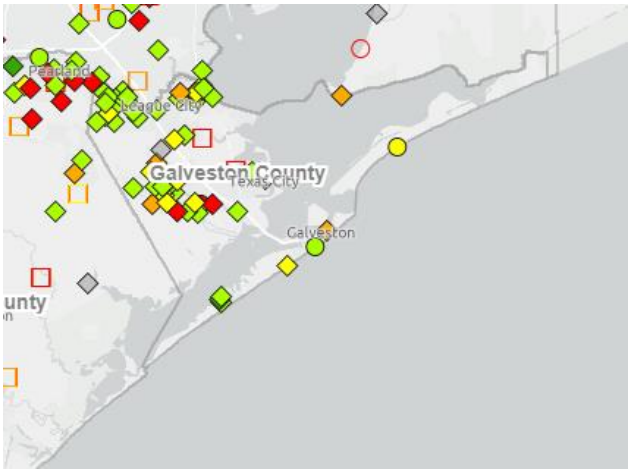
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

GALVESTON COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Galveston County.

BROADBAND ISSUES

Galveston County received 66 responses in the broadband study survey. The survey results are below on the left and the current eligibility map is on the right.



Broadband Eligibility Performance Criteria		
Unserved	Underserved	Served

Galveston County Residential Survey Results Download Speed (in Mbps)			
> 1,000 Mbps		> 25 – Mbps	
> 100 – 1,000 Mbps		0 – 25 Mbps	
> 50 – 100 Mbps		Other	

The survey results appear to be fairly aligned with the eligibility map. In addition, there are many other addresses that are unserved and underserved in the eligibility map. The County can choose to accept the broadband eligibility shown in the FCC map or, if the County and cities know of any other areas or addresses that are unserved or underserved, the County could decide to do further investigation into areas that could have greater broadband issues than are shown. It does not appear that would be needed, but that is an option if other broadband issues have surfaced.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 4,654 addresses should be grant eligible.

If County and City leaders feel there are other areas in the County that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Galveston County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Galveston County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 10 providers (among all technologies) who have reported providing some services in the County. These providers include:

- Xfinity
- Frontier
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Always ON
- Verizon
- Southern Broadband
- Starlink
- AT&T Internet

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

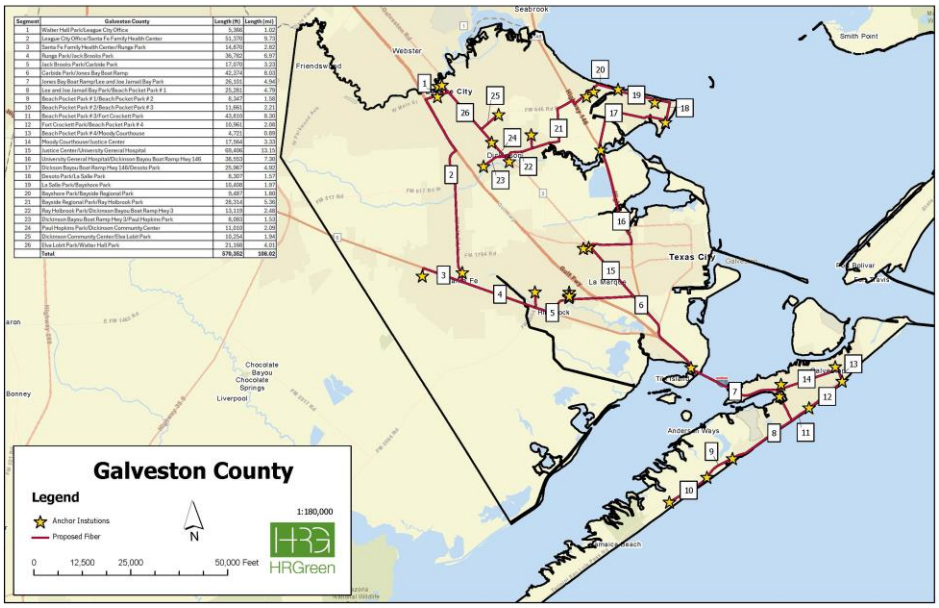
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Galveston County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Particularly in the north, east, southeast (around Texas City) and Bolivar Peninsula areas of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built.

Particular attention needs to be paid to getting connectivity to Galveston and Bolivar Peninsula – connections across water can be challenging.

If the County (possibly in collaboration with cities and providers) could coordinate a middle mile ring, that could have significant impacts on last mile options.

It is fairly likely that lack of middle mile could be a problem in Galveston County. The middle mile option segments were developed in the HLD section for the County in this report.

If middle mile is needed for any other above reasons, the middle mile HLD in the HLD section of this report can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify and expand the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify the scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

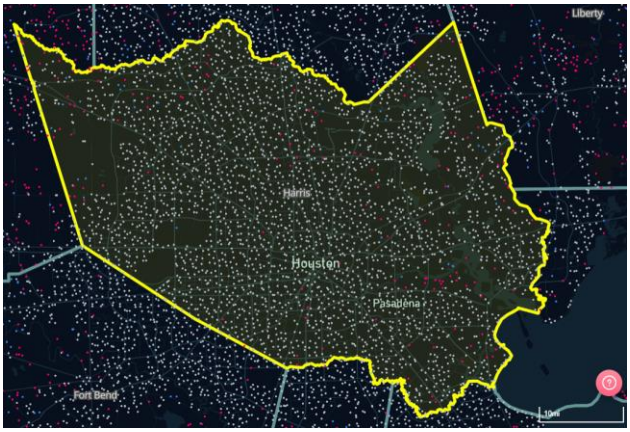
COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

HARRIS COUNTY

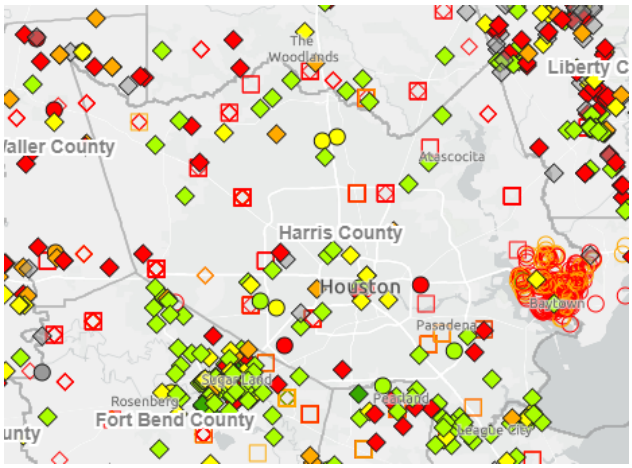
Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Harris County. Harris County has a Broadband Office that is active in broadband improvement and has actively participated in this study. Continuing to work with their broadband office will be important in improving broadband in the County.

As of March 2024, Harris County received approximately 360 survey results.



Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served



Harris County Residential Survey Results
Download Speed (in Mbps)

◆	> 1,000 Mbps	◆	> 25 – Mbps
◆	> 100 – 1,000 Mbps	◆	0 – 25 Mbps
◆	> 50 – 100 Mbps	◆	Other

The survey results are shown in this map. Responses came from the H-GAC survey, a survey that was conducted in Baytown in 2023 and results from other area surveys.

The results are geographically diverse and provide some insight into broadband in the County.

BROADBAND ISSUES

The addresses that are shown as unserved and underserved in the eligibility maps are fairly spread out. There are pockets in the northwest, northeast and north and northwest of Pasadena.

The survey results are also fairly distributed, but do not appear to contradict the eligibility map.

There appear to be quite a few more addresses that show as unserved and underserved in the eligibility map than in the survey results. The County can choose to accept the broadband eligibility shown in the FCC map or, if the County and cities know of any other areas or addresses that are unserved or underserved, the County could decide to do further investigation into areas that could have greater broadband issues than are shown. It does not appear that would be needed, but that is an option of other broadband issues have surfaced.

The Baytown area has conducted a study and is in the process of making arrangements to improve broadband in their area.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 10,846 addresses should be grant eligible.

If County and City leaders feel there are other areas in the County that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Harris County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Harris County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 14 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Xfinity
- Verizon
- Viasat
- T-Mobile 5G Home Internet
- SCT Broadand
- Tachus
- Ezee Fiber
- HughesNet
- Always ON
- Consolidated
- Starlink
- Spectrum
- Rise Broadband

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

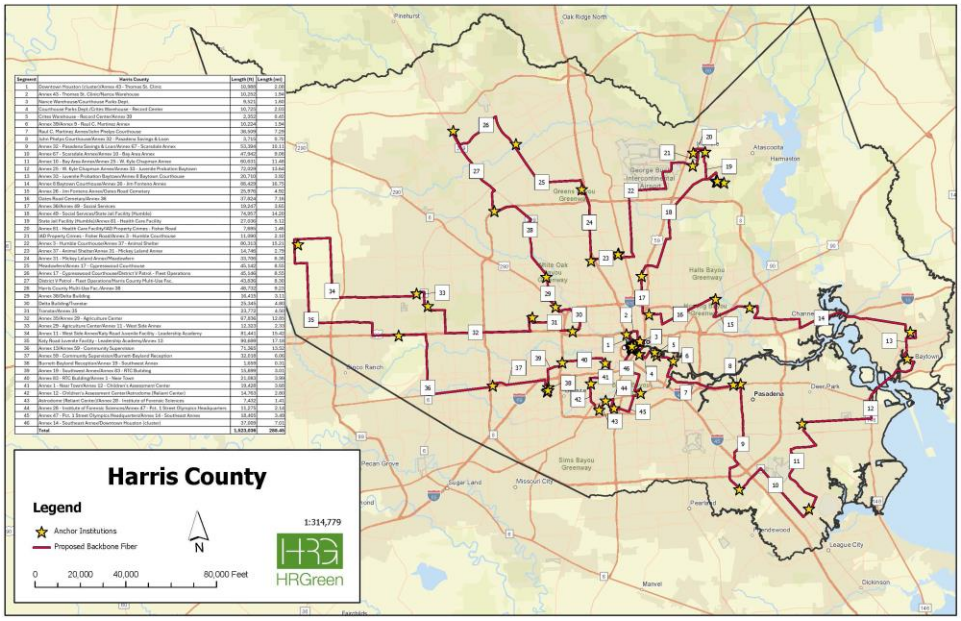
Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Harris County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.

Given the number of providers in Harris County (middle mile and last mile), it is challenging to know if middle mile is a problem for unserved and underserved areas previously identified in the Broadband Issues section. Also, the Harris County Broadband Office has been leading the development of an inventory of the connectivity of facilities in the County. This will significantly help in the identification of where middle mile might be needed for government facilities. Those two elements (private middle mile and facilities that need connectivity) will determine a majority of middle mile need.

It will also be important to determine what available capacity exists in current middle mile and the terms by which it can be utilized.



If middle mile is needed for any other above reasons, the middle mile HLD in the HLD section of this report can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify and expand the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with three inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds; 3. Is there available and affordable capacity in existing middle mile.

Recommended Next Steps Regarding Middle Mile/Ring: Utilize the developing connectivity inventory to better understand public agency needs for middle mile. Arrange follow-up meetings with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants

will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

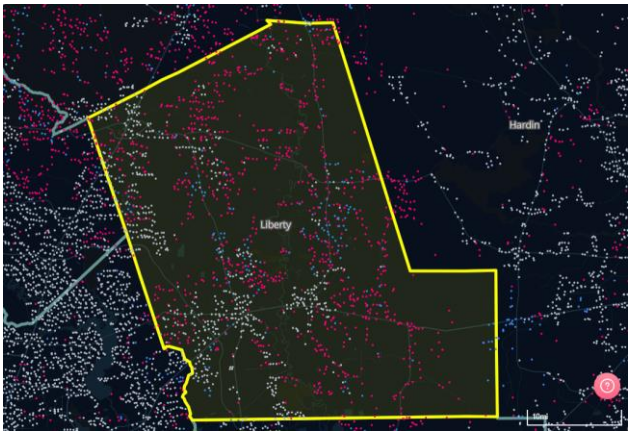
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

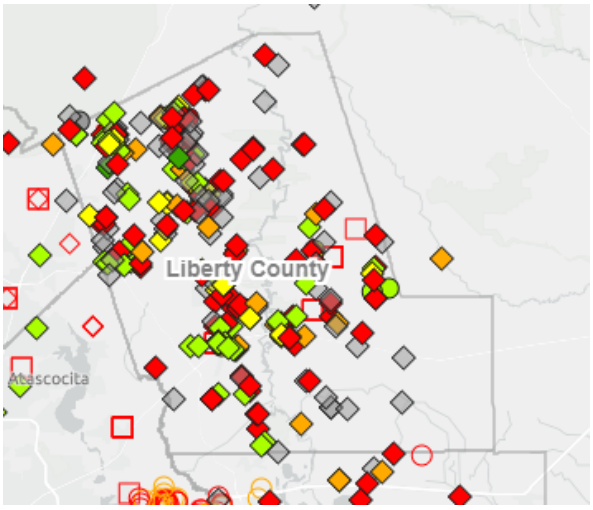
LIBERTY COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Liberty County.

BROADBAND ISSUES

Liberty County had 263 responses in the survey.





Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

Liberty County Residential Survey Results
Download Speed (in Mbps)

> 1,000 Mbps		> 25 – Mbps	
> 100 – 1,000 Mbps		0 – 25 Mbps	
> 50 – 100 Mbps		Other	

That number of results provides a good picture of broadband needs for many parts of the County.

When compared with the grant eligibility map, the unserved and underserved addresses appear to align fairly closely.

What is perhaps most striking in the maps is the number of unserved and underserved addresses in the eligibility map. With the good amount of survey results to confirm the eligibility maps, Liberty County could be in a good position to receive significant BEAD grants.

If there are other areas the County feels should be eligible that are currently not registered as unserved or underserved, the County could take additional steps to develop the data necessary to prove that. From the current data and maps, it does not appear that would be necessary, unless the County has received feedback that would indicate further verification steps are necessary.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 15,967 addresses should be grant eligible.

As mentioned above, if County and City leaders feel that there are other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could

be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Liberty County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree. With the level of unserved and underserved addresses, Liberty County should coordinate grant efforts to ensure grant applications are submitted for this significant part of the County.

PROVIDER INVOLVEMENT

There are multiple providers in and around Liberty County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 12 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Viasat
- HughesNet
- Always ON
- Sparklight
- Starlink
- Xfinity
- T-Mobile 5G Home Internet
- Optimum
- Verizon
- Rise Broadband
- Frontier

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

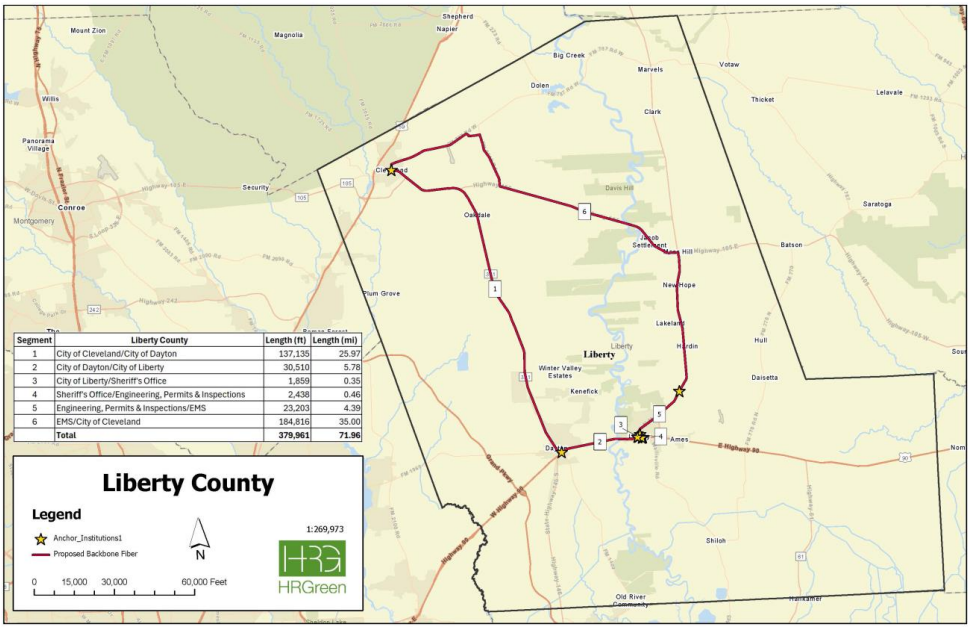
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

With as many unserved and underserved addresses as there are in Liberty County, lack of middle mile could be a contributing factor. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Segment	Liberty County	Length (ft)	Length (mi)
1	City of Cleveland/City of Dayton	137,135	25.97
2	City of Dayton/City of Liberty	30,510	5.78
3	City of Liberty/Sheriff's Office	1,859	0.35
4	Sheriff's Office/Engineering, Permits & Inspections	2,438	0.46
5	Engineering, Permits & Inspections/EMS	23,203	4.39
6	EMS/City of Cleveland	184,816	35.00
	Total	379,961	71.96

Middle mile segments might need to extend to the north and south.

If middle mile is needed for any other above reasons, the middle mile possibilities in the above map (from the HLD section of this report – see that section for segment cost information) could provide options and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Austin County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report).

Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

There are several steps that could be taken to prepare for BEAD grants and given the level of unserved and underserved addresses in Liberty County, TAP dollars could be important to position for the significant grant dollars the County appears to be eligible for.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify the scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

MATAGORDA COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Matagorda County.

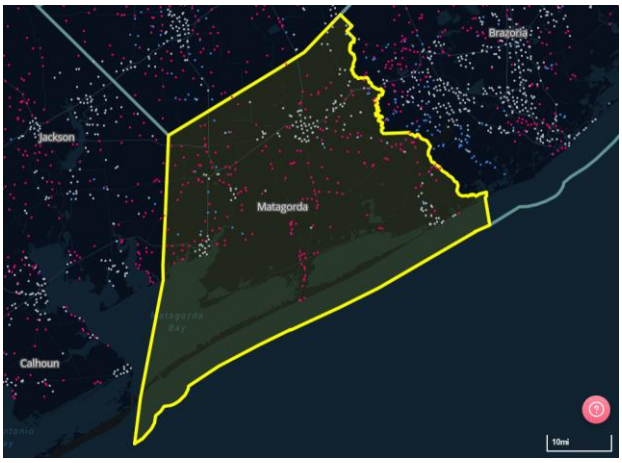
BROADBAND ISSUES

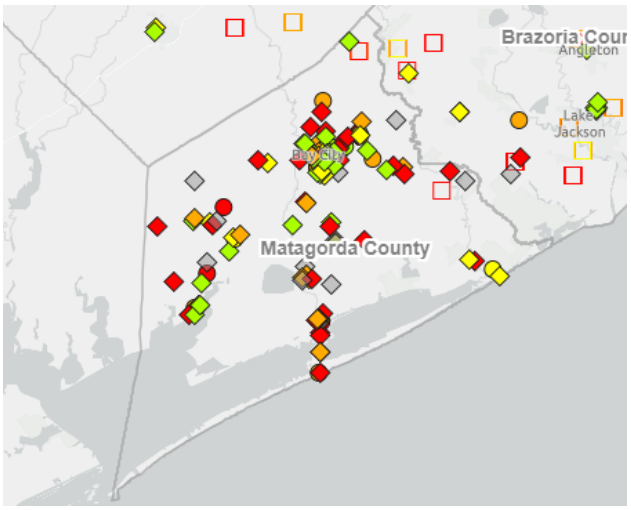
Matagorda County had 134 responses in the survey.

That number of results provides a good picture of broadband needs for many parts of the County.

When compared with the grant eligibility map below, the unserved and underserved addresses appear to align fairly closely. What is perhaps most striking in the maps is the number of unserved and underserved addresses in the eligibility map. With the good amount of survey results to confirm the eligibility maps, Matagorda County could be in a good position to receive significant BEAD grants.

If there are other areas the County feels should be eligible that are currently not registered as unserved or underserved, the County could take additional steps to develop the data necessary to prove that. From the current data and maps, it does not appear that would be necessary, unless the County has received feedback that would indicate further verification steps are necessary.





Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

Matagorda County Residential Survey Results
Download Speed (in Mbps)

◆	> 1,000 Mbps	◆	> 25 – Mbps
◆	> 100 – 1,000 Mbps	◆	0 – 25 Mbps
◆	> 50 – 100 Mbps	◆	Other

The area that seems to have the greatest difference between these maps is Bay City. The eligibility maps shows it as served and the survey results show several results that are not as well served.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 5,282 addresses should be grant eligible.

As mentioned above, if County and City leaders feel that there are other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could

be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Matagorda County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree. With the level of unserved and underserved addresses, Matagorda County should coordinate grant efforts to ensure grant applications are submitted for this significant part of the County.

PROVIDER INVOLVEMENT

There are multiple providers in and around Matagorda County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 12 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Always ON
- TISD
- Sparklight
- MyJEC.net
- Starlink
- TISD
- Wharton County Electric Cooperative
- Nextlink Internet

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

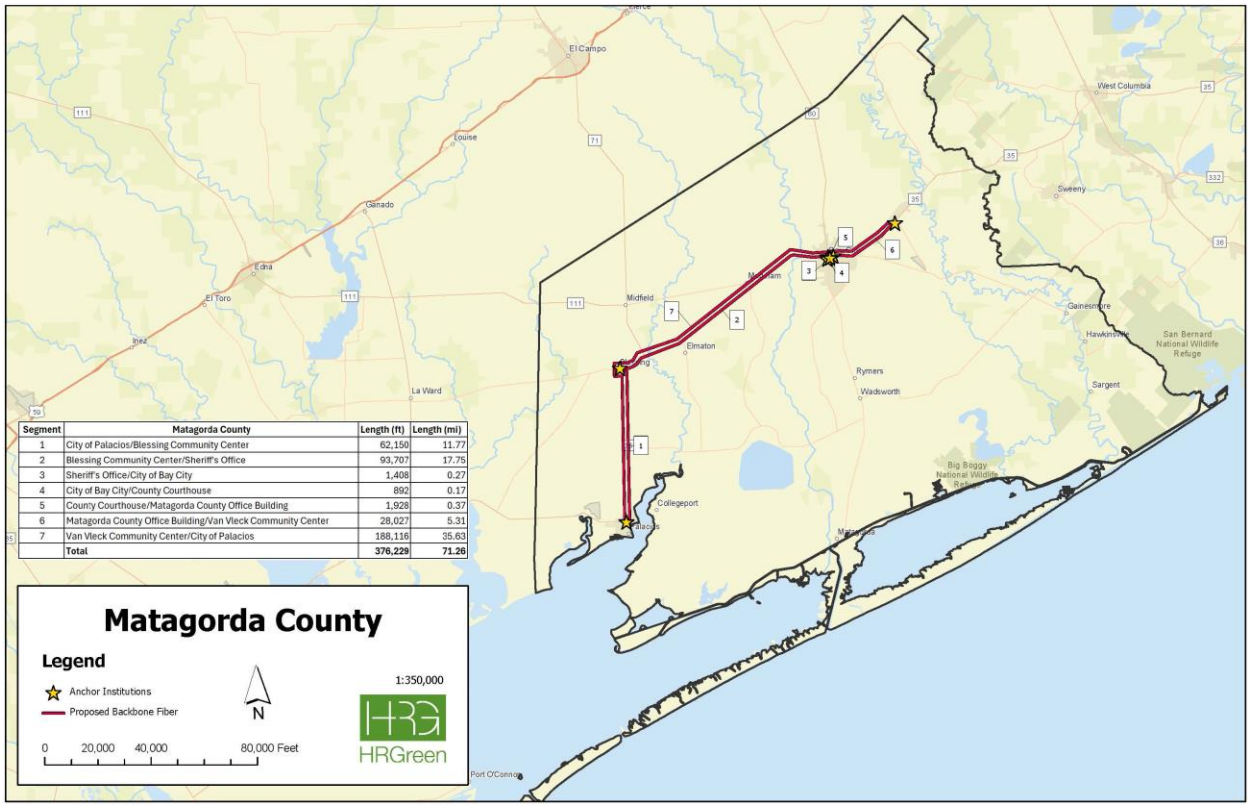
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

With as many unserved and underserved addresses as there are in Matagorda County, lack of middle mile could be a contributing factor. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Segment	Matagorda County	Length (ft)	Length (mi)
1	City of Palacios/Blessing Community Center	62,150	11.77
2	Blessing Community Center/Sheriff's Office	93,707	17.75
3	Sheriff's Office/City of Bay City	1,408	0.27
4	City of Bay City/County Courthouse	892	0.17
5	County Courthouse/Matagorda County Office Building	1,928	0.37
6	Matagorda County Office Building/Van Vleck Community Center	28,027	5.31
7	Van Vleck Community Center/City of Palacios	188,116	35.63
	Total	**376,229**	**71.26**

Middle mile segments might need to extend significantly. This HLD was designed with addresses available for existing government facilities. At minimum, segments running northeast along the southern part of the County, extending further into the northeast corners and southeast to that part of the County might all be necessary.

If middle mile is needed for any other above reasons, the middle mile possibilities in the above map (from the HLD section of this report – see that section for segment cost information) could provide options and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economics, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Austin County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

There are several steps that could be taken to prepare for BEAD grants and given the level of unserved and underserved addresses in Matagorda County, TAP dollars could be important to position for the significant grant dollars the County appears to be eligible for.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify the scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

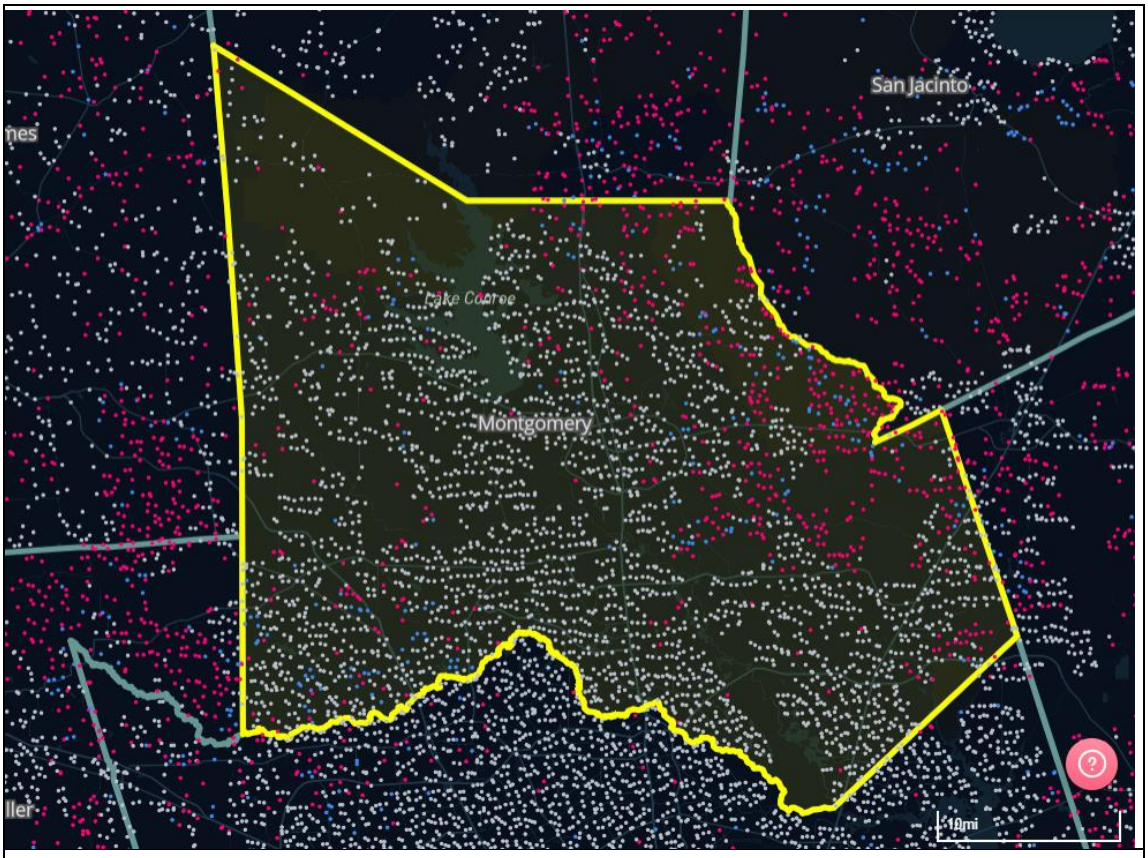
MONTGOMERY COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Montgomery County.

BROADBAND ISSUES

Montgomery County received 27 responses in the broadband study survey

With this low number of responses, unless the County wants to take steps to get better data, the County will need to rely on the FCC data maps. The current eligibility map is below.



Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

An important question for Montgomery County is whether or not the FCC map seems correct. The County can choose to accept the broadband eligibility shown in the FCC map or decide to do further investigation into areas that could have greater broadband issues than are shown.

There does appear to be a significant amount of broadband need on in the eastern and northeastern parts of the County. There are addresses in the western part of the County that show need, but they are mixed

in with addresses that are served in a way that is hard to determine why they are unserved and underserved and what can be done to improve service.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 14,529 addresses should be grant eligible.

If County and City leaders feel that the northwestern edge of the County or other areas should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Montgomery County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

There appears to be a large number of eligible addresses – the County should coordinate grant applications to make sure all of these needs have grant applications submitted for them.

PROVIDER INVOLVEMENT

There are multiple providers in and around Montgomery County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 11 providers (among all technologies) who have reported providing some services in the County. These providers include:

- Optimum
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Xfinity
- Verizon
- Always ON
- Tauchus Fiber Internet
- Consolidated
- Starlink
- AT&T Internet

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband

needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

POLICY

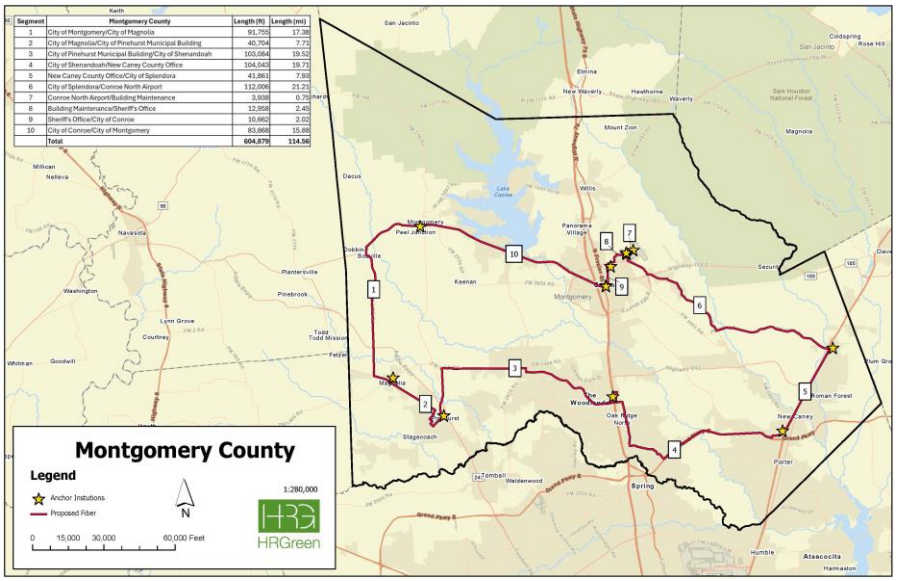
Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Montgomery County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.

Particularly in the western and southwestern parts of the County (see the above broadband issues maps), middle mile might be a reason last mile has not been built. It may be important to develop other segments that reach northwest and northeast for those unserved areas.



If middle mile is needed for any other above reasons, the middle mile HLD in that section can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economics, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify the scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

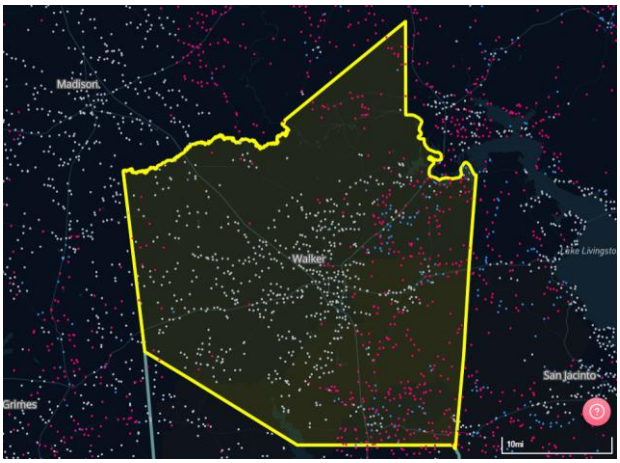
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

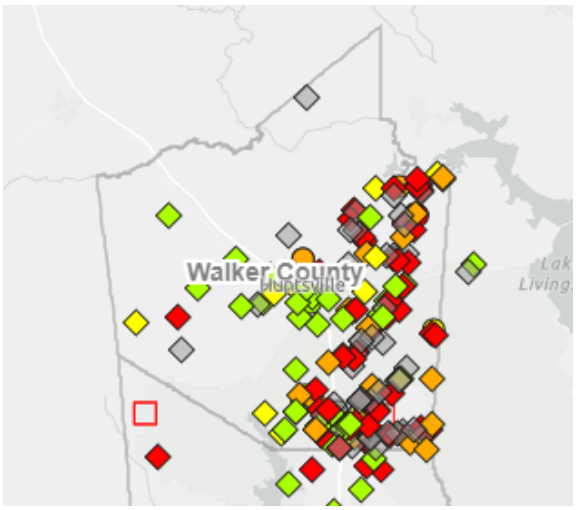
WALKER COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Walker County.

BROADBAND ISSUES

Walker County had 182 responses in the survey. That number of results provides a good picture of broadband needs for many parts of the County.





Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

Austin County Residential Survey Results
Download Speed (in Mbps)

◆	> 1,000 Mbps	◆	> 25 – Mbps
◆	> 100 – 1,000 Mbps	◆	0 – 25 Mbps
◆	> 50 – 100 Mbps	◆	Other

When compared with the grant eligibility map, the unserved and underserved addresses appear to align fairly closely. It appears that many of the people who know they need broadband improvement took the survey.

There are two things that are important to notice in these maps. The first is there is a significant number of unserved and underserved addresses in the eligibility map. With the good amount of survey results to confirm the eligibility maps, Walker County could be in a good position to receive significant BEAD grants. The second is there is an area in the north that has eligibility, but no survey responses. In this case, the County can rely on the eligibility map (since it shows need) in coordinating grant applications.

If there are other areas the County feels should be eligible that are currently not registered as unserved or underserved, the County could take additional steps to develop the data necessary to prove that. From the current data and maps, it does not appear that would be necessary, unless the County has received feedback that would indicate further verification steps are necessary.

GRANT ELIGIBILITY

From the above maps, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 5,154 addresses should be grant eligible.

As mentioned above, if County and City leaders feel that there are other areas that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Walker County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree. With the level of unserved and underserved addresses, Walker County should coordinate grant efforts to ensure grant applications are submitted for this significant part of the County.

PROVIDER INVOLVEMENT

There are multiple providers in and around Walker County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 10 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Optimum
- Windstream
- Always ON
- Nextlink Internet
- MidSouth Fiber Internet
- Starlink

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

POLICY

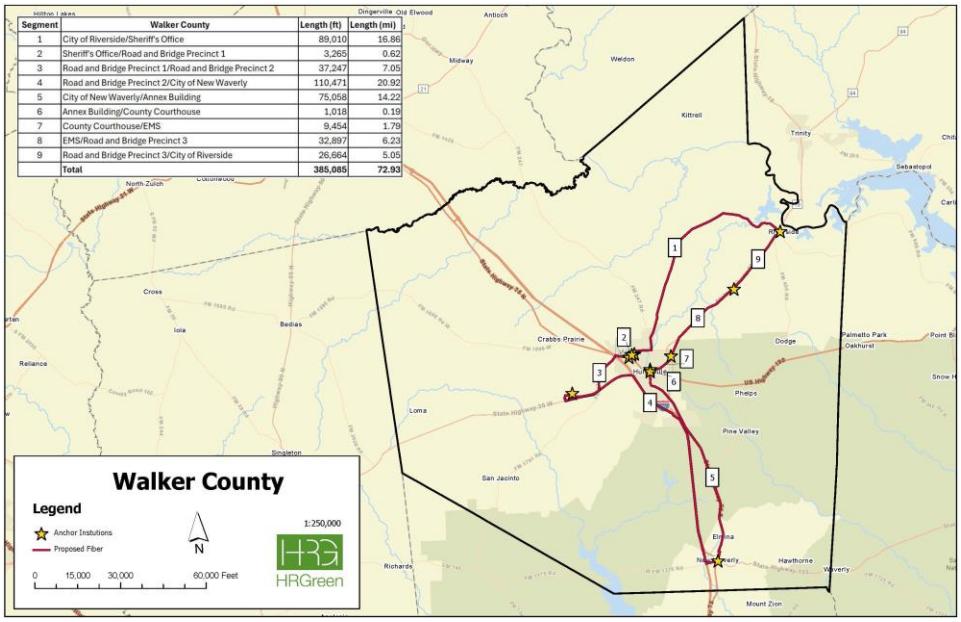
Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

With as many unserved and underserved addresses as there are in Walker County, lack of middle mile could be a contributing factor. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.

Segment	Walker County	Length (ft)	Length (mi)
1	City of Riverside/Sheriff's Office	89,010	16.86
2	Sheriff's Office/Road and Bridge Precinct 1	3,265	0.62
3	Road and Bridge Precinct 1/Road and Bridge Precinct 2	37,247	7.05
4	Road and Bridge Precinct 2/City of New Waverly	110,471	20.92
5	City of New Waverly/Annex Building	75,058	14.22
6	Annex Building/County Courthouse	1,018	0.19
7	County Courthouse/EMS	9,454	1.79
8	EMS/Road and Bridge Precinct 3	32,897	6.23
9	Road and Bridge Precinct 3/City of Riverside	26,664	5.05
	Total	385,085	72.93



Middle mile segments might need to extend to the south and east.

There are also addresses along the western side of the county. It is difficult to know why those are unserved without the survey data. If they do not have infrastructure, middle mile might need to extend closer to them.

If middle mile is needed for any other above reasons, the middle mile possibilities in the above map (from the HLD section of this report – see that section for segment cost information) could provide options and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Austin County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

There are several steps that could be taken to prepare for BEAD grants and given the level of unserved and underserved addresses in Liberty County, TAP dollars could be important to position for the significant grant dollars the County appears to be eligible for.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify a scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

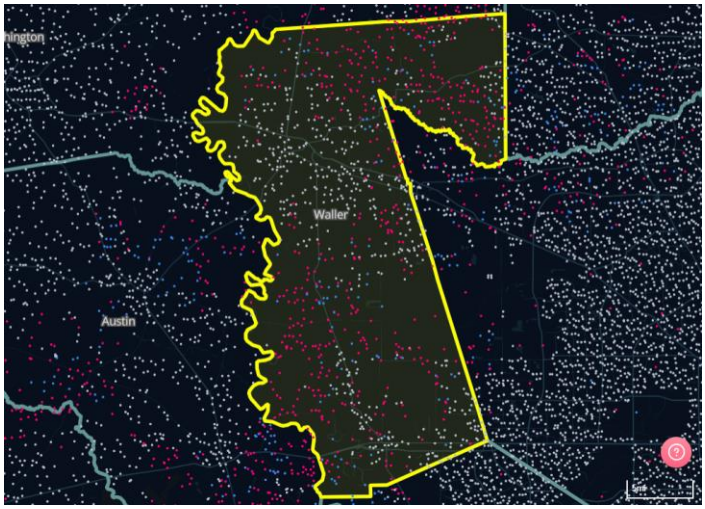
Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

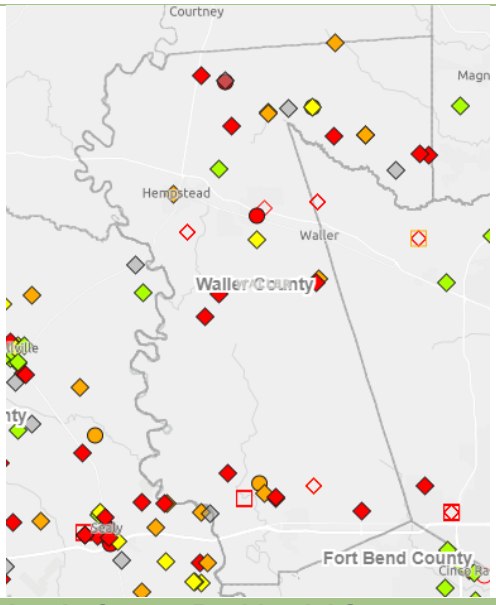
WALLER COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Waller County.

BROADBAND ISSUES

Waller County received 54 responses in the broadband study survey. The survey results are below on the left and the current eligibility map is on the right. Although there were not enough survey results to define areas of broadband need, the survey results appear to be fairly aligned with the eligibility map.





Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

Austin County Residential Survey Results
Download Speed (in Mbps)

> 1,000 Mbps		> 25 – Mbps	
> 100 – 1,000 Mbps		0 – 25 Mbps	
> 50 – 100 Mbps		Other	

In addition, there are many other addresses that are unserved and underserved in the eligibility map. The County can choose to accept the broadband eligibility shown in the FCC map or, if the County and cities know of any other areas or addresses that are unserved or underserved, the County could decide to do further investigation into areas that could have greater broadband issues than are shown. It does not appear that would be needed, but that is an option if other broadband issues have surfaced.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 6,321 addresses should be grant eligible.

If County and City leaders feel there are other areas in the County that should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Waller County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

PROVIDER INVOLVEMENT

There are multiple providers in and around Waller County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 11 providers (among all technologies) who have reported providing some services in the County. These providers include:

- AT&T Internet
- Xfinity
- Verizon
- Viasat
- HughesNet
- Rise Broadband
- Always ON
- Alternative Interent Resources
- Consolidated
- Nextlink Internet
- Starlink

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

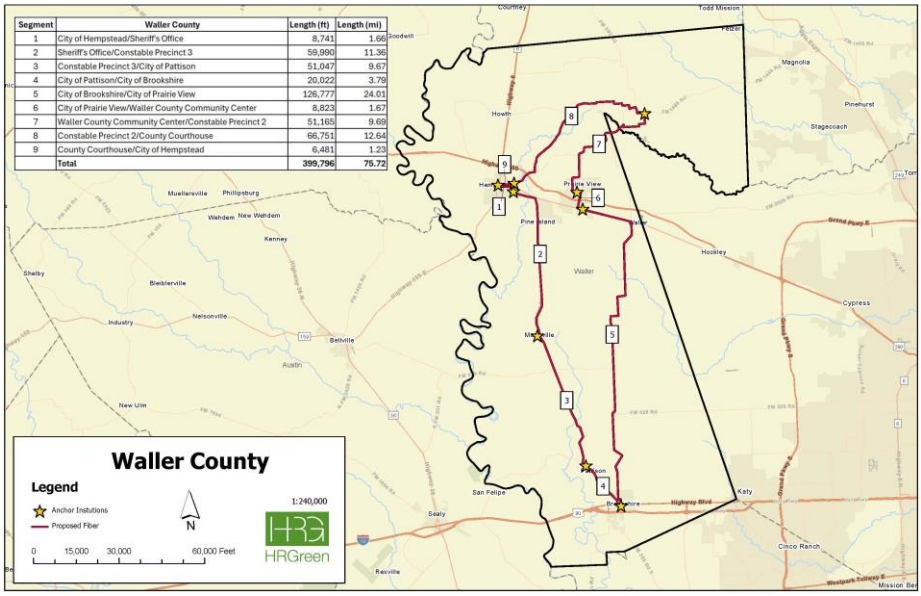
POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

MIDDLE MILE/RING

Middle mile might be an issue in Waller County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand.



Segment	Waller County	Length (ft)	Length (mi)
1	City of Hempstead/Sheriff's Office	8,741	1.66
2	Sheriff's Office/Constable Precinct 3	59,990	11.36
3	Constable Precinct 3/City of Pattison	51,047	9.67
4	City of Pattison/City of Brookshire	20,022	3.79
5	City of Brookshire/City of Prairie View	126,777	24.01
6	City of Prairie View/Waller County Community Center	8,823	1.67
7	Waller County Community Center/Constable Precinct 2	51,165	9.69
8	Constable Precinct 2/County Courthouse	66,751	12.64
9	County Courthouse/City of Hempstead	6,481	1.23
	Total	399,796	75.72

Particularly in the northeast and southwest, middle mile might be a reason last mile has not been built. Also, middle mile night need to be extended further east in the northeast part of the County.

If the County (possibly in collaboration with cities and providers) could coordinate a middle mile ring, that could have significant impacts on last mile options.

It is fairly likely that lack of middle mile could be a problem in Waller County. The middle mile option segments were developed in the HLD section for the County in this report.

If middle mile is needed for any other above reasons, the middle mile HLD in the HLD section of this report can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify and expand the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with two inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economics, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the

report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

The State of Texas Broadband Development Office will open a grant window for technical assistance related to broadband improvement and BEAD grant preparation. The key to receiving these grant dollars will be the identification and clear articulation of specific steps that are needed in planning for broadband improvement and grants, with a compelling story as to what these steps will accomplish.

Recommended Next Steps Regarding the BDO TAP program: Determine what tasks need more work (from the other recommendations in this section) and clarify the scope and costs for those tasks. The grant window will likely open in May 2024, so watching for that, reading the rules and preparing to apply for those grants will be important. Collaboration with H-GAC on a possible regional approach could increase the likelihood of the grant being awarded.

COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

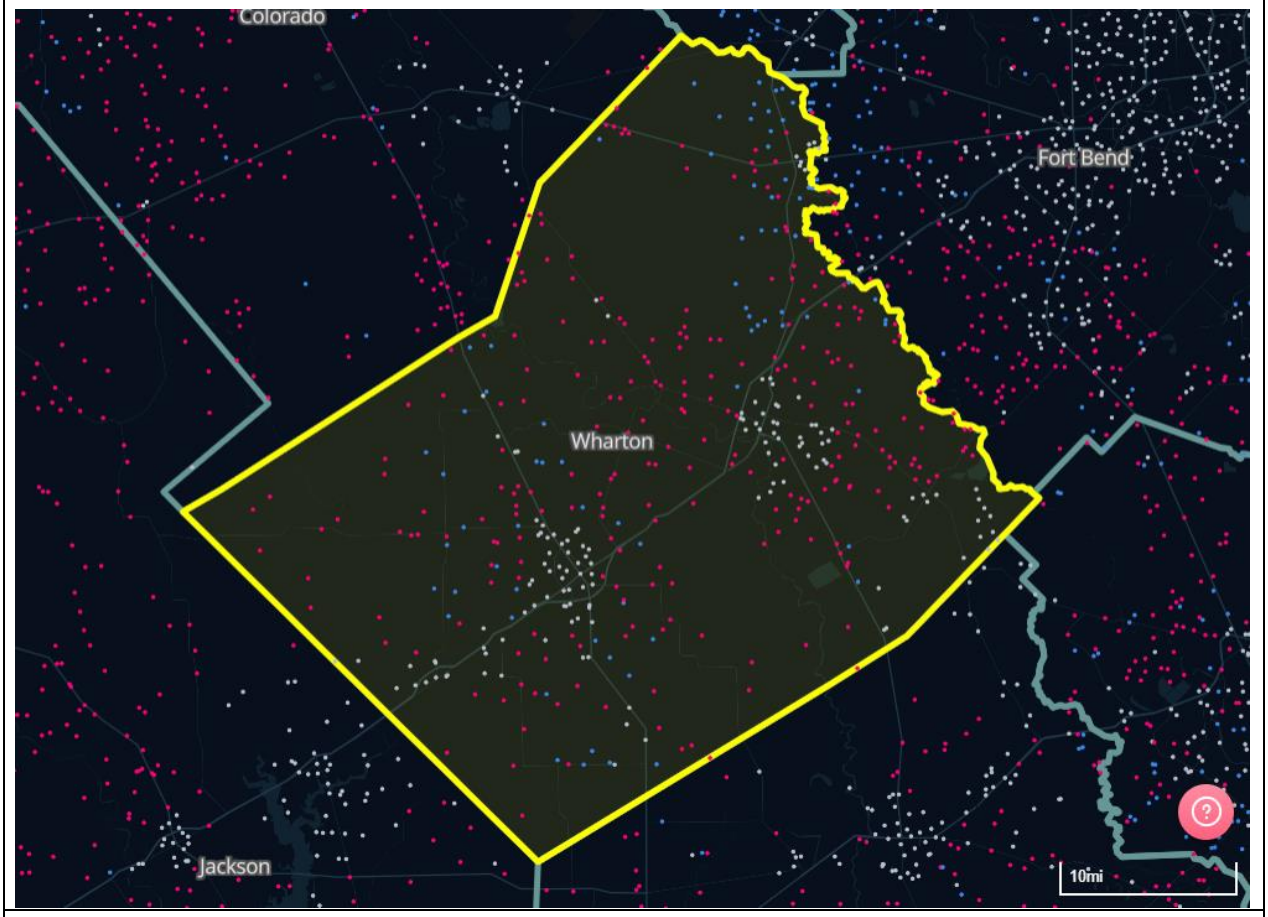
WHARTON COUNTY

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following actionable next steps for Wharton County.

BROADBAND ISSUES

Wharton County received 19 responses in the broadband study survey

With this low number of responses, unless the County wants to take steps to get better data, the County will need to rely on the FCC data maps. The current eligibility map is below.



Broadband Eligibility
Performance Criteria

Unserved	Underserved	Served

An important question for Wharton County is whether the FCC map seems correct. The County can choose to accept the broadband eligibility shown in the FCC map or decide to do further investigation into areas that could have greater broadband issues than are shown.

There does appear to be a significant amount of broadband need throughout the County.

GRANT ELIGIBILITY

From the above map, there do appear to be addresses and fairly significant areas that should be eligible for grants. From the High-Level Design Options section of this report, it appears that 6,693 addresses should be grant eligible.

If County and City leaders feel that the areas along 59 from the southeastern border of the County to Wharton or other areas should be grant eligible, further survey work would need to be done to have enough data to challenge the existing maps. It could be possible to target those areas with more focused survey efforts, which could include targeted social media, door to door canvassing, public meetings in those specific places, etc.

Recommended Next Steps Regarding Grant Eligibility: If Wharton County leadership think the eligibility maps are incorrect, further survey steps need to be taken before the challenge process begins. Having a discussion with city leaders in which the maps are reviewed would be good to see if they agree.

There appears to be a large number of eligible addresses – the County should coordinate grant applications to make sure all of these needs have grant applications submitted for them.

PROVIDER INVOLVEMENT

There are multiple providers in and around Wharton County. It appears from their filings that there is not a lot of fiber, but there are cable providers and some fixed wireless. Our Market Assessment indicated there are 10 providers (among all technologies) who have reported providing some services in the County. These providers include:

- Viasat
- T-Mobile 5G Home Internet
- HughesNet
- Always ON
- Resound Networks
- Nextlink Internet
- Starlink
- AT&T Internet
- Sparklight
- Wharton County Electric Cooperative

All of the service providers in the H-GAC area were brought together in the Provider Working Group. They had two meetings in which this study was discussed and the need to collaborate on broadband improvements and grant applications.

These efforts should be continued at the county and city level. Providers will play an important role in broadband improvement and grant applications. It is critically important to know what their plans are and what help they need. A significant concern is if government officials do not coordinate the broadband improvement and grant efforts, there will be people and businesses in your community that will be technologically left behind. With the amount of money in the BEAD grant cycle, there will not be another opportunity like this for broadband improvement.

Recommended Next Steps Regarding Provider Involvement: Establish a regular meeting with providers to further develop relationships, receive their input and coordinate their broadband improvement and grant plans. It is important for the County to understand what the providers are going to do to ensure that all addresses with broadband needs have an improvement and grant plan. If there are areas with broadband needs in which the providers do not plan to make improvements or apply for grants, County officials will need to develop an alternative plan (attracting other providers or building infrastructure).

In these meetings, relevant topics like policy, middle mile, digital equity and the ACP program can be discussed.

POLICY

Counties and cities need to evaluate their policies to see if they are in line with broadband goals. In this study, a policy focus session was conducted to discuss this issue and best practices for policies related to broadband.

Recommended Next Steps Regarding Policies: Conduct a meeting of County and City leadership to discuss broadband related policies to see if there is alignment with broadband goals. It is also recommended that policies be discussed with providers to see if they can point out policies that would keep them from investing in broadband infrastructure in the County.

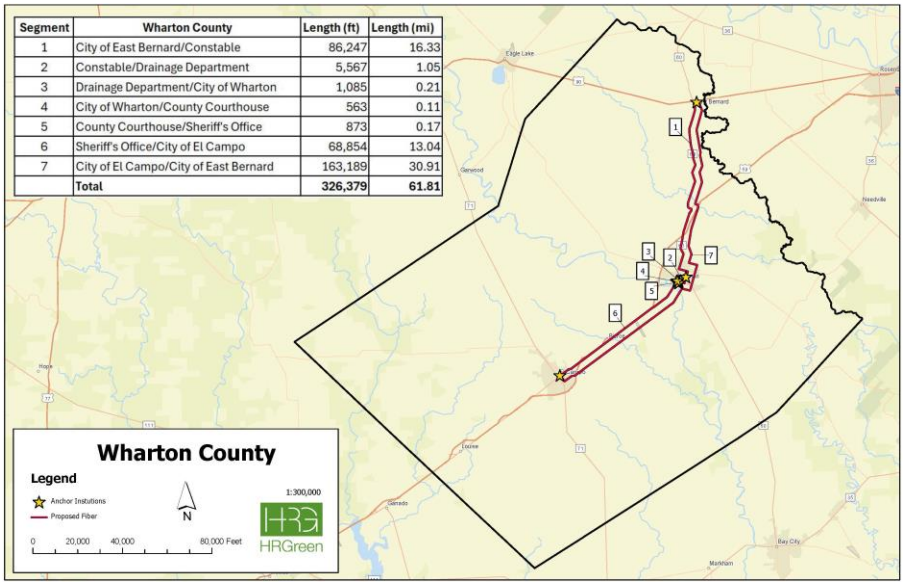
MIDDLE MILE/RING

Middle mile might be an issue in Wharton County. Questions of whether County and city facilities are connected and if middle mile is available for last mile extensions (to areas with broadband needs) are important to define and understand. Throughout the County, middle mile might be a reason last mile has not been built.

It will be important to determine where middle mile is the issue. There will likely be a need to develop middle mile segments to other parts of the County – potentially a ring around the entire County.

The map to the left was developed from available addresses for government facilities. Other relevant addresses for a ring will likely be needed.

Segment	Wharton County	Length (ft)	Length (mi)
1	City of East Bernard/Constable	86,247	16.33
2	Constable/Drainage Department	5,567	1.05
3	Drainage Department/City of Wharton	1,085	0.21
4	City of Wharton/County Courthouse	563	0.11
5	County Courthouse/Sheriff's Office	873	0.17
6	Sheriff's Office/City of El Campo	68,854	13.04
7	City of El Campo/City of East Bernard	163,189	30.91
	Total	**326,379**	**61.81**



If middle mile is needed for any other above reasons, the middle mile HLD in that section can provide an option and alternatives for middle mile. If it is determined that middle mile is needed, next steps would be to clarify the route, determine the costs for that route (that can roughly be done with the information provided) and determining the way to pay for it (grants, revenue and other funding source).

The first step is to determine if there is a need for middle mile. This can be done with three inputs: 1. Whether County and city facilities are connected; 2. Talk with providers to see if lack of middle mile is a deterrent to last mile builds; 3. Develop other segments based on other facility addresses.

Recommended Next Steps Regarding Middle Mile/Ring: Conduct a meeting with County and city officials to determine if there are facilities that need connectivity. Conduct a meeting with providers to ask if they have middle mile needs. If the answer to those questions indicates that there is a need for middle mile, then determining route, costs, revenue and funding will be needed. HR Green can help with these steps and TAP funds (see below) could be used for these purposes (if applied for and awarded).

DIGITAL EQUITY

This is an important topic that it is important to address. If there are areas that do not have broadband infrastructure, then the above steps can help rectify them. However, as has been discussed in previous sections of this report, there can be barriers to using broadband, even when it is available (economic, language, age to name a few).

In this study, a Digital Equity Working Group was established that included agencies in Brazoria County that could be involved in addressing digital equity (see the Digital Equity Working Group section of the report). Also, H-GAC is part of the leadership of the Gulf Coast Digital Inclusion Task Force that is working on this issue in the region.

Addressing digital equity issues will take collaboration. Identifying the needs, developing plans to address those needs and engaging those populations will require a concerted effort.

Recommended Next Steps Regarding Digital Equity: There are regional and local steps recommended for digital equity improvement. Convening a follow up meeting of the digital equity agencies in the County could be helpful to continue to identify specific digital equity issues in the County and to begin to develop ways to address those issues. It is important to remember that there will be grants available for specific projects to improve digital equity issues. Working to identify specific steps the County and/or agencies that can address digital equity issues, then applying for BEAD grants to accomplish those steps could be transformational in the County.

WORKFORCE DEVELOPMENT

As has been discussed in multiple sections of this study, there are not enough trained people to do the work that this grant funding will need. If communities can develop workforce development strategies and steps, significant good could be accomplished for the area and the Country. This can be done at the County level, city level and with H-GAC in the region.

Recommended Next Steps Regarding Workforce Development: Actively collaborate with H-GAC for resources and coordination. Convene a meeting of training providers and workforce agencies in the County. Develop steps for digital equity improvement, particularly plans that can form grant applications for BEAD.

BDO TAP PROGRAM

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COLLABORATION

Many of these recommendations require collaboration between local and regional agencies will be necessary to improve broadband and be awarded TAP and BEAD grants. Coordinating the meetings included in these recommendations will be important to help collaboration take place. As opposed to additional specific recommendations regarding collaboration, the main recommendation is to develop a calendar of the meetings needed to foster specific collaborations.

NEXT STEPS SUMMARY AND CHECKLIST

Flowing from the recommendations in the Executive Summary of this final report, HR Green recommends the following Next Steps:

- Post Recordings and Documents.
- Explore ACP replacement alternatives.
- Prepare eligibility map challenges.
  - TAP program:
  - Define county and regional projects.
  - Apply for TAP funds.
- Decide if any Working Groups (Digital Equity, Education, Chambers of Commerce, Libraries, Providers) need subsequent meetings.
- Grant Coordination:
  - Are all areas covered?
  - Providers – their expansion and grant plans.
  - Preparing for letters of support, narrative writing, HLDs, etc.
- Digital Equity – coordinate county, regional and State efforts.
- Workforce Development options and coordination.
- Processes to decide middle mile needs.
- Grant Preparation – ReConnect, TAP, watching for the BEAD notice of funding.
- Regional collaboration.

APPENDIX A: GLOSSARY

Access – infrastructure that delivers broadband – if there is infrastructure available to a potential customer (through any technology), that potential customer has access.

Access Point – a device that allows wireless devices to communicate with a wired network using Wi-Fi or related standards. Sometimes referred to as AP, Wireless Access Point, or WAP. Access Points contain both a radio and a wired network connection, and relay communications between the two.

Adoption – customer decision to purchase broadband services that are available. Access describes that broadband connectivity is available – adoption describes whether a person chooses to subscribe to services. People may choose not to utilize available broadband services because they cannot afford it, language barriers, not understanding the technology, etc.

Backhaul - is the fiber that carries aggregated user data from the network's central office to internet connection points located at carrier hotels.

Backbone/network backbone – in telecommunications, a generic term referring to the part of a network that interconnects all sites on the network, and, therefore, handles the majority of the network traffic. Smaller networks are attached to the backbone through aggregation sites by means of additional circuits and network devices, such as routers.

Bandwidth/high bandwidth – transmission capacity of an electronic pathway such as a communications circuit. Network bandwidth is described in terms of how much data can move across the network within a given amount of time and is typically expressed in bits per second (bps). Examples of measurements include kbps, Mbps or Gbps. The "high" in "high bandwidth" is always relative to current norms for different circumstances. High Bandwidth is a term that typically means a bandwidth at the top end or above what is commercially available at a given location.

Bits vs. Bytes – Bits are the measure of speed it takes the smallest unit of data to be carried across the internet. Bytes are the unit of measure of volume of data.

Broadband – a marketing term that refers to high bandwidth Internet access. Traditionally, it meant "any band- width greater than dial up." Broadband data transmission is digital, meaning that text, images, and sound are all transmitted as "bits" of data. In the context of this project, Broadband refers to providing Internet connectivity at much higher bandwidth than has been available and affordable to most libraries. The FCC, in 2015, defines broadband to the home to be anything above 25 Mbps, in the sense that anything less than 25 Mbps to the home would not qualify as "broadband."

Capacity/high capacity – is the complex measurement of the maximum amount of data that may be transferred between network locations over a network, also known as throughput. "High" is again relative to current norms and measured in bits per second (bps).

CBRS – Citizens Broadband Radio Service – a wireless network capable of 4G and 5G connectivity that can be segmented to carry different applications (internet, Public Works related applications, public safety communications, etc.)

Co-location – refers to the way information technology hardware and resources are located or installed in a shared or common location. In this context, networking hardware resources owned by an organization are located outside the organization's physical premises and "co-located" with other organizations' hardware, often through a commercial service provider.

Commercial networks/carriers (providers) – any entity engaged in the business of providing telecommunications services that are regulated by the Federal Communications Commission or other governmental body. These are generally for-profit companies.

Digital Divide – According to the National Digital Inclusion Alliance (NDIA) the Digital Divide can be defined as: "…the gap between those who have affordable access, skills, and support to effectively engage online and those who do not. As technology constantly evolves, the digital divide prevents equal participation and opportunity in all parts of life, disproportionately affecting people of color, Indigenous peoples, households with low incomes, people with disabilities, people in rural areas, and older adults." The NDIA refers to the Digital Divide as the problem, Digital Equity as the goal and Digital Inclusion as the Work.

Dark Fiber – installed fiber not currently being used.

Digital Equity – According to the NDIA Digital Equity can be defined as: "…a condition in which all individuals and communities have the information technology capacity needed for full participation in our society, democracy, and economy. Digital equity is necessary for civic and cultural participation, employment, lifelong learning, and access to essential services." The NDIA refers to the Digital Divide as the problem, Digital Equity as the goal and Digital Inclusion as the Work.

Digital Inclusion – According to the NDIA, Digital Inclusion refers to: …the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and Communication Technologies (ICTs). This includes five elements: 1. Affordable, robust broadband internet service; 2. Internet-enabled devices that meet the needs of the user; 3. Access to digital literacy training; 4. Quality technical support; and 5. Applications and online content designed to enable and encourage self-sufficiency, participation and collaboration. The NDIA refers to the Digital Divide as the problem, Digital Equity as the goal and Digital Inclusion as the Work.

Digital Subscriber Line (DSL) – a family of technologies that are used to provide Internet access by transmitting digital data over telephone lines. It may be either symmetric (same bandwidth both direction), or asymmetric (different bandwidth each direction). The service may be implemented simultaneously over the same lines used to provide voice service.

Federal Communications Commission (FCC) – the federal agency responsible for regulating interstate communications by radio, television, wire, satellite, and cable. The FCC also participates in international communications standards coordination and policy development.

FCC 477 – as part of the requirements to be a telecommunications utility, service providers are required to regularly submit specific information about the telecommunications services they provide. This information includes details like what census blocks within which they provide service, what speeds they offer, what technology they use, etc.

Fiber/fiber-optic cable – fiber optic technology converts electrical signals carrying data to light and transmits the light through transparent glass fibers. A variety of fiber optic cable types are available, depending on the application. Supported distances vary based on cable type, transmitter source (laser or LED), data rate, etc.

Internet Service Provider (ISP) – a communications carrier that provides access to the Internet. ISPs are not necessarily directly connected via an Internet exchange; they may in turn acquire connectivity from another ISP.

Last mile connection – a term used by the telecommunications industry to refer to the final leg of a network to the customer, generally from the provider's last POP to the customer.

Local Area Network (LAN) – a computer network that interconnects computers within a limited area such as a building or small group of adjacent buildings.

Long Term Evolution (LTE) – in telecommunication, a standard for wireless communication of high-speed data for mobile phones and data terminals.

Market Assessment – A review of FCC provider reported data. Private providers are required to report certain details of their coverage in FCC Form 477. The Market Assessment is an HR Green Report of Findings with analysis of the data directly from FCC and third party reporting organizations.

Megabits per second – see "Bandwidth" and "Throughput."

Middle mile – at a high-level, networks are comprised of middle mile and last mile. Middle mile connects networks together and, ultimately, to the rest of the internet. Last mile extends from the middle mile to the customer.

Node - connection point that can receive, create, store, or send data along a network

Overbuild - to create a network that goes into competition with incumbent provider, often through building new fiber in an area that already has another technology.

Point-to-Point – a microwave broadband application that requires line-of-sight from a transmission point to an end point. This technology is less expensive to install and can provide good service (depending on equipment and usage).

Population Density – population density will be classified as either urban, rural or remote. For the definition of eligibility for their grants and loans, Rural Utility Services defines rural in two ways: any area not within a city or town with population exceeding 20,000 or an urbanized area adjacent to a city greater than 50,000 and any area not within boundaries of any city, village, or borough with population exceeding 5,000. For this analysis, "rural" will mean either unincorporated or in a community less than 5,000. Remote will mean population density less than one person per twenty acres.

Right of Way (ROW) – the land set aside for public passage or use (street, sidewalk, trail, utilities, etc.) which is owned or controlled by a governmental entity.

Terrestrial Broadband Infrastructure – broadband infrastructure that has equipment in or anchored to permanent structures – these can include fiber, cable, DSL and fixed wireless.

Throughput – rate of data transmission per unit time; see "Capacity/High Capacity". The most common throughput measurements include:

- Kilobits per second (Kbps) – a transmission rate; 1,000 bits per second. 1,000 kbps = 1 Mbps. Kilo is the unit prefix for 103.
- Megabits per second (Mbps) – a data transmission rate; 1,000,000 bits per second. 1,000 Mbps = 1 Gbps. Mega is the unit prefix for 106.
- Gigabits per second (Gbps) – a data transmission rate; 1,000,000,000 bits per second. 1 Gbps = 1,000 Mbps or 1,000,000 kbps. Giga is the unit prefix for 109.

Wired or wireless infrastructure – wired infrastructure is infrastructure that has a physical wire or line run to the premise (fiber, cable or DSL). Wireless includes the technologies that do not have a physical line (point-to-point, radio frequency, etc.)

Wi-Fi (Wireless Fidelity) – a local area wireless technology that allows an electronic device to participate in computer network using specific wireless frequencies and protocols. Current standards use the 2.4 GHz and 5 GHz unlicensed industrial, scientific, and medical radio bands. Sometimes referred to as Wireless LAN or WLAN.

HRGreen
FIBER AND BROADBAND

APPENDIX B: ENGAGEMENT PLAN

H-GAC Broadband Study
Communities/Stakeholders Engagement Plan – Initial

OVERVIEW

One key component of the Broadband Study is engagement with the citizens, businesses and other specific stakeholders in the thirteen counties that make up H-GAC. Their information and feedback are important to provide two key measures to understand what is currently happening with broadband in H-GAC's thirteen counties. One measure of whether there is good broadband is whether there is infrastructure that can provide a minimum of 100 Megabits per second (Mbps) download speed and 10 Mbps upload. The other is whether people have barriers to accessing the infrastructure if it is available. Many people have financial, language and expertise struggles that prohibit them from utilizing available internet.

The thirteen counties in the broadband study are:

- Austin
- Brazoria
- Chambers
- Colorado
- Fort Bend
- Galveston
- Harris
- Liberty
- Matagorda
- Montgomery
- Walker
- Waller
- Wharton

This plan provides the details of how the citizens, businesses and specific stakeholders will be engaged to receive detailed data from them about their current connectivity and their future needs for broadband. The two main avenues to get this data are a survey of citizens and businesses and stakeholder meetings.

STEPS

For the thirteen counties within H-GAC, the summarized steps needed for engagement will consist of (these will be examined in more detail below):

- Survey:
  - Forming and working with promotions groups from each county to promote the survey.
  - Setting up a portal for the survey
  - Determining survey dates – start on or before October 16, 2023.
- Stakeholder meetings, including the following groups:
  - Citizens.
  - Businesses.
  - Anchor institutions - Mainly quasi-government: Libraries, Post Office, education, health and can include key businesses either in Baytown or thinking about locating to Baytown.
  - Public entities – see lists below.

In our outreach to these groups, our primary goals are to find out each entity or household's:

- Current service (provider, capacity, speed, price) – or if they do not have service.
- Satisfaction with their current service.
- Concerns with their current service or options (reliability, capacity, price).
- Anticipated needs for connectivity in the future.

The following *Engagement Plan* outlines the strategies and tactics we recommend for informing the organizations and households about the study, encouraging their participation and the specific questions we will ask to find out the above information.

The key partner in these efforts is Baytown's Communications team. The ways that they connect with the citizens and businesses (social media, newsletters, email lists, events, etc.) are key in promoting the survey and other forms of interaction.

BRANDING AND MESSAGING

In preparation for starting the survey and stakeholder meetings, branding and messaging must be defined. The specifics to decide on are:

- The branding H-GAC wants on the survey related materials:
  - The survey itself.
  - Promotional materials - see list in the Promotions Working Group section.
  - The materials that go out to stakeholder meeting participants.
  - Participation in stakeholder meetings.
  - Participation in the provider meetings.
- The messaging H-GAC want to communicate. The goal of messaging is to clarify for recipients what the goals are of this process. The preliminary messaging is:
- Encourage businesses, organizations and residents to take the online survey.
- Encourage businesses, organizations and residents to attend focus group or public meetings.

The key messages to communicate include:

- The reason why the Gulf Coast Economic Development District is conducting a Broadband Study and why this survey and stakeholder meetings are an important part of that study is (including potential benefits to businesses, organizations and citizens).
- (Sample messaging): The Gulf Coast Economic Development District is conducting a broadband study to develop actionable plans to work towards improving broadband in the H-GAC thirteen counties. Through a survey, stakeholder meetings and topic work sessions, the study will determine where there are broadband problems (access and adoption). Based on that data, action plans will be developed that can be used to improve broadband and apply for grants.
- This survey is not the same as the State of Texas BDO survey or other area surveys. We need them to take our survey.

STRATEGIES

- **Survey:**
  - A significant key to the success of this project will be the surveys. The key to getting enough responses to receive statistically valid response rates is promotion. Thus, the form of the survey (virtual only, printed, etc.) how those will be made available and how it is promoted (mainly through Communications team channels) become very important.
  - See the Promotions Working Group Tasks worksheet in Appendix E.
  - The survey is, typically, online only. It is possible to have a printed version, but that carries some challenges:
    - Additional costs (printing, mailing, etc.). They could be included in county and/or city utility bills when that is available and that can sometimes be done at no additional cost. Aligning the link and promotional materials with the utility bill schedule is an important step.
    - If there is a printed version, does it need to be in multiple languages? If so, those costs are not included in our costs.
  - Draft list of survey questions – See Attachment A & B.
  - It is also possible to do some door or door or phone canvassing, but those can become very costly.
  - When there are H-GAC, county or city events, a booth can be set up to promote the survey.
  - The survey will be open on October 16 or before and be open for 30 – 45 days.
  - Distribution:
    - Working with county and city personnel to promote the survey and coordinate stakeholder meetings is a key to the success of getting the data necessary to understand broadband issues. The most effective approach is, typically, to develop a promotions working group consisting of the following:
      - H-GAC communications personnel.
      - County Judge offices.

Austin County	Tim Lapham
Brazoria County	Matt Sebesta Jr.
Chambers County	Jimmy Sylvia Jr.
Colorado County	Ty Prause
Fort Bend County	KP George
Galveston County	Mark Henry
Harris County	Lina Hidalgo
Liberty County	Jay Knight
Matagorda County	Bobby Seiferman
Montgomery County	Mark J. Keough
Walker County	Colt Christian
Waller County	Trey Duhon III
Wharton County	Phillip S. Spenrath

      - County and city communications personnel in each community.
      - County and city social media

- The degree to which the counties and cities promote the survey will determine the level of data that we receive.
- Websites from H-GAC, each county and city.
- Social media accounts of H-GAC, each county and city.
- Email lists – if the counties, cities, utilities, Chambers of Commerce, etc. have email lists, emails can be sent that include the survey link. Do those email lists exist?
- Media –PSA's can be sent to newspapers and radio (see sample in Attachment D)
- If there are events in the City while the survey is open, the survey can be promoted there.
- Do any promotional materials need to be translated into different languages? If so, translation costs are not in our current budget.

- Audience:
  - All residents in the thirteen counties.
  - All businesses in the thirteen counties.
  - Both – those operating businesses from their homes.

Stakeholder meetings:

- Anchor Institutions – these will be done in group or individual meetings with questions very similar to the surveys. We meet with them to discuss their specific needs, timelines and if they own any broadband infrastructure – see Attachment C for sample questions.
  - Schools.
  - Libraries.
  - Health Care.
- Public entities– these will be done in group or individual meetings with questions very similar to the survey questions. We meet with them to discuss their specific needs, timelines and if they own any broadband infrastructure – see Attachment C for sample questions.
  - Fire.
  - Police.
  - Emergency Management.
  - County and city departments (Administration, Public Works/Engineering, Planning, IT, Finance, Utilities, Economic Development, Parks, Emergency Management, Police).
  - City departments (where applicable).
- Other key stakeholders – examples of these could be Chambers of Commerce, Business leaders, major developers (particularly if there are new planned commercial or residential developments that might need broadband service).
- We will need to finalize this list.
- Digital Equity organizations. Working with these entities is intended to seek their help in reaching people who might have challenges in getting broadband and/or taking the survey due to economic issues, language barriers, The below is a preliminary list of potential digital equity partners.

Social Service Agencies in Southeast Texas
Libraries - in each county (Houston below)
Agencies in each county
Southeast Texas Family Resources
Family Services of Southeast Texas
Area Agency on Aging-Southeast TX
United Way of Southeast TX
Salvation Army

Catholic Charities of SE TX
Catholic Charities of the Archdiocese of Galveston-Houston
Lutheran Social Services of SE TX
211 Southeast Texas
BakerRipley - Houston
Houston Area Urban League
Houston Food Bank
Interfaith Ministries for Greater Houston
Star of Hope Mission
Volunteers of America - Texas Gulf Coast
YWCA Greater Houston
Harris County Social Services Department
Houston Area Community Services
Texas Health and Human Services Department
Caritas Social Enterprises
Neighborhood Centers
Civic Heart Community Services

Language Service Agencies in Southeast Texas
Southeast Texas Translation and Interpretation Services (SETTIS)
Immigrant Legal Services Collaborative (ILSC)
Southeast Texas Literacy Council (SETLC)
Communities in Schools of Southeast Texas (CISSET)
Refugee Services of Texas (RST)
Hispanic Business Association of Southeast Texas
Hispanic Housing & Education Corporation
Houston Hispanic Chamber of Commerce
Fundación Latino Americana De Acción Social
The Institute of Hispanic Culture of Houston

- Outcomes sought for stakeholder meetings:
  - Current broadband strengths and deficiencies.
  - Who their provider is (or, if no provider – why).
  - What they currently pay.
  - Whether their current service is adequate.
  - What they like and dislike today.
  - Do they have any needs for the future.
  - What they do with Internet services.
  - Predicted take rate and optimum monthly cost they would be willing to pay – to develop feasibility of options and to use to talk with potential provider partners.
- Whether they want the City taking an active role in improving broadband.
- Demographic questions (their location, age, ethnicity, etc.).

Providers:

- We will also develop a list of providers in the region to have H-GAC, counties and cities confirm.
- We will meet with them two or three times during the study to:
  - Let them know what is happening in this study process.

- Seek information from them about coverage and assets.
- Discuss options to improve broadband with them.

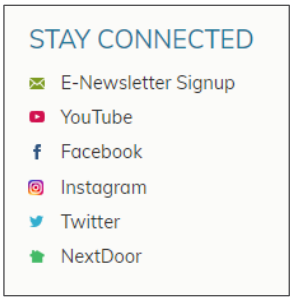
- They will be an important part of the process, particularly as they will likely be part of the development of plans and grant submissions.

WEBSITES

- GCEDD and H-GAC websites.
- County and city website.
- School District websites.
- Chambers of Commerce.
- Digital equity organization websites.
- Other economic development websites?

Can we use these?

SOCIAL MEDIA



- **Facebook**
  - H-GAC and GCEDD Facebook pages.
  - County and city government Facebook pages.
  - County and city Parks and Recreation Facebook pages.
  - School District Facebook pages.
  - Sheriff and Police Department Facebook pages.
  - Fire Department Facebook pages.

- **Chambers of Commerce**
  - Websites.
  - Facebook pages.

Which of these can we use? Promotion will consist of posts that we will work with Communications to develop.

PUBLIC MEETING

- These can be good to answer questions and to generate interest in the survey. They are best done in person, but they can be done virtually (or both). We find attendance is lower in the virtual setting, but they can still be beneficial. As with the surveys, the key is promotion.
- Are there any community events that will happen within the timeline of the survey?
- Will we have any public meetings and/or have a presence at any events?

SCOPE FOR ARRANGING THE "STEERING COMMITTEE"

There are a few reasons why we will need some form of Steering Committee. The main seven are:

- Coordination of broadband improvement efforts.

- Forming and coordinating the survey promotions group.
- Provide input on digital equity organizations and efforts.
- Provide input on and coordination for stakeholder meetings.
- Provide input on and promotion of Work Sessions (Governance, Broadband Related Policy, Smart Connectivity, Rural Technology Options and Funding/Grants).
- Review broadband improvement recommendations and next steps to coordinate implementation.

Because there are a lot of groups doing a lot of work to promote broadband, one of the important tasks in this project is to coordinate those efforts – trying to keep from duplicating work and/or confusing the public. A Steering Committee of the right leaders can help that happen. Here are some guiding thoughts on who should be in this group:

- County Judges (or a person in their office they assign) – someone who knows what is being done in their county and who has authority to coordinate with the other counties.
- City leadership (possibly City Managers or someone at that level) – they need to have the same level of authority for their city as the County leadership.
- It should not be internet or telecommunications providers – they will have their own working group.

These leaders will likely meet monthly (approximately). Their meetings will probably be virtual for ease of scheduling. Their first task will be to identify the person in their agency who will lead the promotions efforts for their community (probably the Communications Director).

After that, they will review the results of the survey in their area and will meet to coordinate broadband improvement efforts and the other initiatives listed in the seven reasons for a Steering Committee above.

FIBER AND BROADBAND

ATTACHMENT A

Residential Broadband Survey

The purpose of this survey is to learn about broadband connectivity in the H-GAC thirteen county area. Your participation is very important to understand your satisfaction with your current broadband options and the service you are being provided, and to gauge your interest in other broadband options being developed.

The survey takes only a few minutes to complete and your feedback is very important.

Please limit your responses to one survey per household and please take the survey from a device connected to your home broadband service (instead of a device connected to cellular service).

If you are a business decision-maker or owner, please participate in our business survey as well.

Your individual answers are anonymous and confidential, so please answer as honestly as possible. Thank you for your input!

Do you live in one of these counties in Texas: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller or Wharton?

Please enter your location (map).

INTERNET

Does your home subscribe to internet service?

No: Why not? (availability, price, do not need)

Yes: Which company do you use (list)?
Speed test link
Overall satisfaction with provider (very dissatisfied to very satisfied)
Rate satisfaction with home internet service
- Customer service
- Data allowance
- Price
- Reliability
- Speed/Data Rate

What ways does your household use internet (list)?
How many connected devices?
How is your internet provided – if known (fiber, cable, DSL, Point to Point, Satellite)
How likely would you be to recommend your provider to a friend?
Do you have any comments, questions or concerns about your current internet service?

TELEVISION

Does your home subscribe to television service?

Yes:

Which provider (list)?
What is your overall satisfaction with your television provider (scale)

LANDLINE PHONE

Do you subscribe to landline telephone service?

Yes:
Which provider (list)?
What is your overall satisfaction with your telephone provider (scale)

Approximately what is the total monthly cost (rounded to the nearest dollar) of ALL services (internet, television and landline telephone) that you receive at home (do not include the cost of your cellular plan)?

SOUTHEAST TEXAS' BROADBAND FUTURE

In your opinion, how important is fast, affordable, reliable and universally available broadband in helping to improve the following community attributes?
Quality of life (scale: Not Important, Somewhat Important, Very Important)
Education (for children and adults): (scale)
Economic Development and jobs (including work at home and home based business): (scale)
Health Care (remote health care): (scale)

How well do you think the current providers meet these needs: (1-10 scale)

When considering a company for broadband services (internet, television and telephone), how important are the following characteristics of that company?
Is locally owned: (scale)
Provides excellent customer service: (scale)
Is involved in the community: (scale)
Uses the best available technology: (scale)
Price: (scale)

If a new provider (public or private) built a fiber network in your area, offering superior service for a competitive price, how likely would you be to switch from our current provider(s)? 1 – 10 scale

Additional comments, questions or concerns?

Tell us about yourself:
Gender
Age (drop down box of ranges)
What is the range of your current household income? (drop down box of ranges)
What is the highest level of education you have completed? (drop down box of ranges)

We appreciate you taking the time to participate in this survey!

HRGreen
FIBER AND BROADBAND

ATTACHMENT B

Business Broadband Survey

The purpose of this survey is to learn about broadband connectivity **at your workplace**. Your participation is very important to understand your satisfaction with your current broadband options and the service you are being provided, and to gauge your interest in other broadband options being developed.

The survey takes only a few minutes to complete and your feedback is very important.

Please limit your responses to one survey per business and please take the survey from a device connected to your business broadband service (instead of a device connected to cellular service).

If you live in Southeast Texas, please participate in our residential survey as well.

Your individual answers are anonymous and confidential, so please answer as honestly as possible. Thank you for your input!

Is your business in one of these counties in Texas: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller or Wharton??

Please enter your location (map).

Where is your business? Storefront or In My Home

What is the primary industry sector of your business?

- Agriculture
- Banking/Financial Services
- Bar/Restaurant
- Church or Religious Organization
- Construction
- Education
- Government/Public Service/Non-Profit
- Health Care
- Hospitality
- Import/Export
- Manufacturing
- Professional Services (Including Accounting, Legal and Insurance)
- Rental Housing
- Retail Sales
- Other – write in

Is your business served by fiber optics – if known?

Does your business subscribe to internet service?

No: Why not? (availability, price, do not need)

Yes: Which company do you use (list)?
Speed test
Do you offer internet/wifi to the public?

How many devices are connected to the internet at your business? Include PC's, tablets, smart phones and any other device that uses internet connection.

How do you use internet at your business?

- Company website
- Credit Card processing
- Data management (backup or data storage)
- Education and professional development (including webinars)
- Electronic health records
- Email
- File or data sharing
- Hosting your own server
- Online banking
- Online purchasing or inventory
- Online sales
- Operations in the cloud (accounting, sales, project management, etc.)
- Social media
- Streaming music
- Streaming video
- Video conferencing
- Video security
- Web surfing
- Other

Have you had employees work from home during Covid-19?

If you have had employees work from home during Covid-19, do you foresee that they might continue to work from home? (yes, no, maybe, not sure)

Overall satisfaction with provider (very dissatisfied to very satisfied)

Rate satisfaction with business internet service

- Customer service
- Data allowance
- Price
- Reliability
- Speed/Data Rate

How likely would you be to recommend your provider to a peer?

How important is internet service to your business **today**? (scale)

How important do you think **improved** internet service will be to your business **in the next few years**?

Over the past few years, have internet speeds and services kept up with your business needs?

Do you have any comments, questions or concerns about your current internet service?

Do you subscribe to landline telephone service?

- Yes: Which provider (list)?

What types of telephone service does your business use – if known?
- Traditional phone lines
- DID
- PRI
- Hosted VoIP
- Hosted PBX
- SIP Trunking
- Other

How many telephone lines does your business have? Include voice, fax, security systems, etc.

What is your overall satisfaction with your telephone provider (scale)

Approximately what is the total monthly cost (rounded to the nearest dollar) of ALL services (internet, television and landline telephone) that you receive at your business (do not include the cost of your cellular plan)?

SOUTHEAST TEXAS' BROADBAND FUTURE

In your opinion, how important is fast, affordable, reliable and universally available broadband in helping to improve the following City attributes?
- Quality of life (scale: Not Important, Somewhat Important, Very Important)
- Education (for children and adults): (scale)
- Economic Development and jobs (including work at home and home based business): (scale)
- Health Care (remote health care): (scale)

How well do you think the current providers meet these needs: (1-10 scale)

When considering a company for broadband services (internet, television and telephone), how important are the following characteristics of that company?
- Is locally owned: (scale)
- Provides excellent customer service: (scale)
- Is involved in the community: (scale)
- Uses the best available technology: (scale)
- Price: (scale)

If a new provider (public or private) built a fiber network in Baytown, offering superior service for a competitive price, how likely would you be to switch from our current provider(s)?
- 1 – 10 scale

Additional comments, questions or concerns?

We appreciate you taking the time to participate in this survey!

ATTACHMENT C

Anchor Institution/Public Sector Input Questions

Who is your current provider(s)?

What service(s) do you have (particularly up/down speed and capacity)?

Do you have redundancy that you are comfortable with (and - do you know if your redundancy is on the same fiber as their provider)?

What are your current uses?

Do you feel like their service is reliable?

Do you feel like it is adequate?

Are there any ways that you think your current service is holding you back?

Costs:

- Do you feel like your pricing is fair (are you getting what you pay for)?
- How much are you currently paying?
- What is your contract term (when does it expire)?
- What price point would compel you to make a change?

Are you currently utilizing e-rate?

If so, can you change your e-rate arrangements for another provider?

Are there any uses/applications that you are considering that you think will increase your needs?

Are there any other considerations that you are thinking about with your broadband service?

THERE WILL BE ADAPTATIONS OF THESE QUESTIONS TO SPECIFIC DEPARTMENTS

FIBER AND BROADBAND

ATTACHMENT D

Sample Press Release

FOR IMMEDIATE RELEASE **DATE:**

THE GULF COAST ECONOMIC DEVELOPEMNT DISTRICT IS SOLICITING INPUT REGARDING BROADBAND SERVICES FOR RESIDENTS AND BUSINESSES

The Gulf Coast Economic Development District has initiated a discovery study to gain a clearer understanding of broadband needs in our member counties and to develop an area Broadband Master Plan. An online survey is now available to gather specific information from residents and businesses. The survey will be available through XXXXXXX and may be accessed at: xxxxxxxxxxxxxxxxxxxxx.

The leaders in the region understand that broadband is a critical service for businesses, organizations and citizens. This survey and Broadband Master Plan will allow the leadership in the region to gain a clearer understanding of what steps may be required to gain and maintain a competitive advantage in terms of broadband, and to make sure that the community's needs are met. The initial phase of the study includes gathering input from area residents, businesses and key stakeholders to compare against industry data.

"We want to take the steps to make sure our citizens and businesses have the connectivity they need to thrive in Southeast Texas. We also view broadband as a competitive issue in keeping the communities in our area as top destinations to work and live," said XXXXXXXXXXXXX. "To do that, we have to start by having a good picture of what connectivity we currently have and what connectivity issues our citizens and businesses have which will help us determine what next steps to take."

"We will be gathering input through XXXXXXXXXXXXXXXXXX," said XXXXXXXXXXXXXXXXX. "We'd like as many residents and businesses as possible to complete the survey, so we have a clear picture of the needs and gaps in service. Our project consultant, HR Green, will also be interviewing key stakeholders, including government representatives and leaders from various industries during that time to gather additional information."

The survey and analysis will be completed this fall. GCEDD has contracted with HR Green, a national engineering firm with offices in Texas, to complete this initial discovery phase.

###

Contact: XXXXXXXXXXX, Title XXXXXXXXXXXXX at XXXXXXXXXXXXXXXX or (XXX) XXX-XXXX

ATTACHMENT E

Promotions Working Group Tasks

Branding (fits client's branding)
- Logos - GCEDD & H-GAC
- Colors
- Fonts

Language translations
- Do there need to be any translations?
- What languages?
- What pieces?
- Who will do the translating?
- Who will pay for?

Avenues to promote
- Social media
- Print media
- Other media
- Email/Newsletters (if counties do them)
- Events
- Official websites
- Partners (agencies, schools, banks, businesses, etc.)

Will anything be printed?
- Rack cards
- Surveys
- Fliers
- Utility Bill Inserts
- Who will print?
- Who will approve?
- Who will pay for?

Events
- Are there any regional, county or city events to have a booth?
  - What materials will be given?
- Who will attend (promotions team members)?

Schedule (lay out on a daily or weekly format)
- Promotions Working Group Meetings
- Print media
  - Frequency
- Social media
  - Frequency
- Other media
- Utility bill cycles
- Events per county
- Printed materials steps
  - When printed
  - When distributed to Promotions Working Groups
  - When offered to the public

Results
- Who will monitor per county?
- Frequency

Promotion plan adjustments
- Geography results problems
- Demographics results problems

APPENDIX D: EARLY EVIDENCE SUGGESTS GIGABIT BROADBAND DRIVES GDP

Early Evidence Suggests Gigabit Broadband Drives GDP

David Sosa
Principal

EXECUTIVE SUMMARY

Over the past 20 years the Internet has been an economic catalyst, enabling productivity growth, facilitating innovation, creating jobs and raising incomes in the U.S. and around the world. Numerous studies have documented the benefits of the first transformative leap in Internet connectivity speeds, as "always on" broadband was deployed, replacing dial-up Internet. At the dawn of the next generation of Internet connectivity, we investigate whether the deployment of gigabit broadband, which represents a 100-fold increase in throughput speeds for households and small businesses, can be expected to produce economic benefits similar to the previous transition from dial-up to "always on" broadband. Although gigabit broadband is in its infancy, we have an initial opportunity to empirically examine the relationship between availability of gigabit broadband services and economic activity at the community level. Our study suggests that communities where gigabit broadband was widely available enjoyed higher GDP, relative to similar communities where gigabit broadband was not widely available. The 14 communities with widely available gigabit broadband that we studied enjoyed over $1 billion in additional GDP when gigabit broadband became widely available, relative to communities where gigabit broadband was not widely available.

INTRODUCTION

Beginning in the late 1990s, Internet connectivity was transformed by disruptive broadband technologies – "always on" DSL and cable modem services – which dramatically increased throughput speeds relative to dial-up connections. As consumers and small businesses adopted these first generation broadband services, the improved broadband connectivity to the Internet facilitated the development of new inventions, new and improved goods and services, new processes, new business models, and has increased competitiveness and flexibility in the economy. More generally, broadband has demonstrated the ability to fundamentally change how and where economic activity is organized.

Many studies have quantified the benefits to consumers and economies from the initial deployment of broadband networks and adoption of high speed broadband connections by businesses and consumers. These studies have evaluated the effect of current broadband offerings on a range of economic metrics, including consumer surplus, employment and GDP. As policymakers have shifted to focus on the next generation of connectivity – gigabit broadband – advocates of the technology have argued that the introduction of the transformative general purpose technology will provide a significant contribution to economic growth and competition, similar to the previous generation of broadband. However, some skeptics have argued that the expected incremental benefits of the next generation of broadband may be overstated.

Although gigabit broadband is in its infancy, we have an initial opportunity to empirically examine the relationship between availability of gigabit broadband services and economic activity at the community level. In this report, we describe the results of this initial study. Our initial results suggest incremental economic benefits from widely available gigabit broadband on the order of an additional 1.1 percent GDP, which are consistent with the measured economic benefits from the introduction of first generation broadband technologies.

BACKGROUND

With the advent of broadband services in the second half of the 1990s, economists and policy analysts began a decade-long examination of the economic benefits of high-speed Internet connectivity. In one of the first comprehensive studies, Crandall & Jackson (2003) examined the economic benefits of broadband. They hypothesized that the deployment of first generation broadband Internet connections would facilitate continued improvements in information technology, with significant positive effects on the economy, including lower input costs, increased labor productivity, and new and more efficient production processes. Their study concludes that the long run benefits of first generation broadband services may be a one percent or higher increment to GDP.[2] Following Crandall & Jackson, other researchers have also investigated the economic benefits of first generation broadband. Lehr, Gillett, Sirbu & Osorio (2005) concluded that communities with broadband experienced faster job and firm growth, and realized higher market rates for rental housing (a proxy for property values) than non-broadband communities.[3] Ford and Koutsky (2006) also examined the impact the introduction of first generation broadband had on economic activity. They concluded that broadband is likely to be a significant contributor to economic growth, based on evidence that economic growth doubled in a Florida city after an extensive broadband network was installed.[4] Crandall, Lehr & Litan (2007) also studied the effects of broadband on both output and employment. They concluded that broadband increased private employment by 0.2 to 0.3 percent per year and that broadband has had a positive impact on GDP as well.[5] The OECD (2007) has noted additional evidence from several firm-level studies for various OECD countries, including Sweden and the U.K., of the economic benefits of broadband.[6]

GIGABIT BROADBAND

According to Akamai's State of the Internet Report, at the end of 2013, American consumers experienced average broadband speeds of 10 Mbps and average peak speeds of 44 Mbps. However, among all industrialized nations, the U.S. ranked 10th in both performance categories; average speed was 50 percent of the first-ranked country (South Korea) and average peak speed was 65 percent of the first-ranked country (Hong Kong).[7] Over the past several years, new services using fiber-to-the-home (FTTH) technology that offers speeds up to 1,000 Mbps (gigabit) have been deployed in several communities across the U.S. These services, which represent the next generation of broadband, deliver Internet speeds more than 100 times faster than what is available today to most Americans. These dramatically higher speeds allow users to access higher quality data intensive services and will enable the next generation of new technologies.

As broadband has become an important factor in economic growth and job creation, the quality of broadband services, including availability and throughput speeds, has become a major topic of discussion. As discussed earlier, the benefits of previous waves of Internet connectivity have been well documented. The evidence of a 'broadband bonus' in the macroeconomic statistics has been shown by numerous researchers in the transition from dial-up Internet to first generation "always on" broadband. Now we are faced with the question of the macroeconomic impact of the deployment of optical fiber and gigabit connections. An open question is "do we really need a hundredfold increase in Internet connectivity?" Gigabit skeptics posit that there appears to be a declining return to additional bandwidth. Gigabit

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[2] Robert Crandall & Charles Jackson, "The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access," in: Shampine, A.L. (ed.), Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies (2003) Haupauge, NY: Nova Science Press.

[3] Sharon Gillett, William Lehr, Carlos Osorio & Marvin Sirbu, "Measuring Broadband's Economic Impact," *Broadband Properties*, vol. 24, no. 12, 2006.

[4] George Ford & Thomas Koutsky, "Broadband and Economic Development: A Municipal Case Study from Florida," *Review of Urban and Regional Development Studies*, Vol. 17, 2006.

[5] Robert Crandall, William Lehr & Robert Litan, "The Effects of Broadband Deployment on Output and Employment: A Crosssectional Analysis of U.S. Data," *Issues in Economic Policy*, Vol. 6, 2007.

[6] OECD, "Broadband and the Economy," Ministerial Background Report DSTI/ICCP/IE(2007)3/FINAL.

[7] David Belson (2014), Q4 2013 Executive Summary, Akamai's State of the Internet, Vol. 6, No.4, <http://www.akamai.com/dl/akamai/akamai-soti-q413-exec-summary.pdf >

advocates make the opposite case: gigabit broadband will allow the development and deployment of high-value applications which cannot be delivered in any other way, suggesting additional bandwidth carries considerable returns.

Past studies have framed the analysis of economic benefits from broadband in two categories: direct benefits from infrastructure investment and direct consumer expenditures on broadband services; and indirect benefits such as cost savings, productivity gains and incremental economic activity from new products and services facilitated by broadband.[8] Although it is very early in the development of gigabit services, we expect that to the extent there are economic benefits from the next generation of broadband connectivity, these benefits will be realized in similar patterns as first generation broadband. We would expect to see direct benefits realized in the near term and indirect benefits as gigabit broadband becomes more widespread and widely adopted. In this brief, we report the results of a study of several U.S. communities where gigabit broadband services have recently become widely available.

DATA AND METHODOLOGY

For this study we have constructed a panel dataset of metropolitan statistical area (MSA) level economic data obtained from the National Telecommunication and Information Administration (NTIA), the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS). NTIA provides data about the percentage of homes passed by broadband service providers offering gigabit broadband. We used the NTIA data to identify MSAs in which more than 50 percent of households have access to gigabit broadband in the years 2011 and 2012. Then, we matched this data with the 2011 and 2012 GDP per capita and unemployment data provided by the BEA and BLS to analyze the relationship between the availability of gigabit broadband and output at the MSA level.

This unique dataset allowed us to examine whether MSAs with high levels of gigabit broadband availability enjoyed higher GDP per capita than other similar communities where gigabit broadband was not widely available. In other words, do we find evidence that gigabit broadband has a positive impact on economic activity? We focused our analysis on 14 MSAs, in nine states, in which more than 50 percent of households have access to gigabit broadband service (see Table 1 below). On average, 70 percent of households in these 14 communities had access to gigabit broadband in 2012.

We compared these MSAs to 41 other similarly sized MSAs in the same nine states. Gigabit broadband was not widely available in the 41 communities in the control group. On average, only one percent of households in these communities had access to gigabit broadband. By limiting the dataset to geographically proximate MSAs we obtained a control group of MSAs that are more comparable to the MSAs with high gigabit broadband availability. Similarly, we further limited our sample to MSAs with populations of less than one million.

The dataset that we created allowed us to analyze the variation in the GDP per capita across MSAs and over the period 2011-2012. There are numerous factors that affect GDP per capita, and differences in these factors across MSAs and over time will drive variation in GDP per capita. However, it is difficult to observe or accurately measure many of these factors. We use a year and MSA fixed effects regression model to control for these unobserved, time-invariant MSA-specific GDP drivers, such as industry mix, geography or resource endowments, and MSA-invariant year specific GDP drivers. Therefore, the results that we provide about the impact of gigabit broadband on GDP control for MSA and year specific effects.

RESULTS

In order to measure the economic impact of gigabit connection we examined economic output in relation to unemployment, MSA and year fixed effects, and whether or not gigabit broadband was widely available. If the widespread availability of gigabit broadband speeds (defined as more than 50 percent of households

[8] International Telecommunications Union (ITU) & United Nations Educational, Scientific and Cultural Organization (UNESCO), Broadband: A Platform for Progress (June 2011).

have access to gigabit services) has a positive impact on economic activity we should observe higher output levels in areas that adopted gigabit broadband.

Using a fixed effects panel data regression model that controls for idiosyncratic differences across MSAs and over time, we found that in MSAs where gigabit broadband service was introduced between 2011 and 2012, GDP per capita levels were significantly higher. More specifically, our model suggests that for the MSAs with widely available gigabit services, the per capita GDP is approximately 1.1 percent higher than in MSAs with little to no availability of gigabit services. These results suggest that the 14 gigabit broadband communities in our study enjoyed approximately $1.4 billion in additional GDP when gigabit broadband became widely available. Extending the results to the 41 MSAs in our study that did not have widely available gigabit broadband suggests foregone GDP in 2012 of as much as $3.3 billion.

Regression Results

	Dependent Variable (GDP per capita)
Gigabit Broadband Availability Greater Than 50%	0.011* (0.007)
Unemployment	-0.005 (0.007)
Observations	110
R_2	0.142
F Statistic	2.857** (df = 2, 52)

Note: *p<0.1; **p<0.05; ***p<0.01

CONCLUSION

Beginning in 2011, the NTIA has published statistics on the availability of gigabit broadband. These data have allowed us to conduct one of the first empirical studies of the benefits of next generation Internet connectivity on economic activity. Looking at 14 communities in nine states, we conclude that next generation broadband is likely to have a substantial impact on economic output and, consequently, consumer welfare. These gains are likely due to numerous factors, including the direct effect of infrastructure investment and increased expenditures, as well as early shifts in economic activity (e.g., job creation and occupational changes) and productivity gains. For example, recent reporting on gigabit broadband service in Chattanooga, Tennessee has attributed 1,000 new jobs, increased investment, and "a new population of computer programmers, entrepreneurs and investors" to gigabit broadband.9 As more communities adopt gigabit broadband and the economy adapts to this new technology, economists will be able to extend the research on the economic impact of gigabit broadband.

[9] Edward Wyatt, "Fast Internet Is Chattanooga's New Locomotive," *New York Times* (February 3, 2014)

Table 1

Metropolitan Statistical Areas (MSA)
Household Access to Gigabit Broadband Services

State	< 50%	> 50%
Alabama	Anniston---Oxford---Jacksonville, AL Auburn---Opelika, AL Decatur, AL Dothan, AL Florence---Muscle Shoals, AL Gadsden, AL Huntsville, AL Montgomery, AL Tuscaloosa, AL	Mobile, AL
Georgia	Albany, GA Athens---Clarke County, GA Augusta---Richmond County, GA---SC Brunswick, GA Columbus, GA---AL Dalton, GA Gainesville, GA Hinesville---Fort Stewart, GA Macon, GA Rome, GA Savannah, GA Valdosta, GA Warner Robins, GA	Chattanooga, TN---GA
Tennessee	Clarksville, TN---KY Cleveland, TN Jackson, TN Johnson City, TN Kingsport---Bristol---Bristol, TN---VA Knoxville, TN Morristown, TN	
Minnesota	Duluth, MN---WI La Crosse---Onalaska, WI---MN Mankato---North Mankato, MN Rochester, MN St. Cloud, MN	
North Dakota		Bismarck, ND Fargo, ND---MN Grand Forks, ND---MN
South Dakota		Rapid City, SD Sioux Falls, SD
Oregon	Albany, OR Grants Pass, OR	Bend---Redmond, OR Corvallis, OR Eugene---Springfield, OR Medford, OR Salem, OR
Utah	Logan, UT---ID Ogden---Clearfield, UT Provo---Orem, UT	St. George, UT
Connecticut	New Haven---Milford, CT Norwich---New London, CT	Bridgeport---Stamford---Norwalk, CT

APPENDIX E: FIBER BROADBAND ASSOCIATION 2023 REPORT

2023 CONSUMER RESEARCH

The Status of U.S. Broadband: The Growing Preference to Fiber Broadband

BASED ON NEW 2023 CONSUMER RESEARCH & PAST CONSUMER STUDIES (2007-2022)

MICHAEL C. RENDER, RVA LLC

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AUGUST 14, 2023

I. FORWARD

The global pandemic demonstrated that high-speed broadband is no longer a luxury but a necessity for every home, business, or anchor institution. As a result, the Biden Administration has made the deployment of fiber broadband infrastructure and national imperative. At the end of 2022, there were 63 million unique homes with access to Fiber-To-The-Home so we are nearly halfway to achieving the President's objective of connecting every American by 2030. The Bipartisan Infrastructure Law includes $42.45 billion in broadband infrastructure funding that is being administrated through the NTIA BEAD (Broadband Equity and Deployment) program. This federal broadband infrastructure funding program prioritizes fiber projects. On June 26, 2023, President Biden announced the state-by-state allocation of this funding, and we anticipate that nearly as much fiber will be deployed during the next 5-years as has been deployed throughout history. This Consumer Research Study clearly demonstrates the importance and preference of Fiber by consumers across every measurement and category.

Consumers want Fiber to be able to work from home, healthcare, education, safety, and higher home values, to just mention a few benefits. This study also highlights the Net Promoter Score and market share benefits that network operators enjoy by investing in fiber broadband deployment. One of the most interesting outcomes of this study is that the preference and value of fiber is continuing to increase year-over-year. We expect that trend to continue as fiber becomes more available to consumers.

I hope you find the outcomes and insights from this report to be useful. We are in one of the most exciting periods in telecommunications history as we believe that as we work to get every American connected with Fiber by the end of the decade, it will enable exciting innovations, digital equity, and raised the quality of life for generations to come.

Gary Bolton
President and CEO
The Fiber Broadband Association

II. STUDY METHODOLOGY AND PURPOSE

This report is primarily built on consumer research which has been annually sponsored by the Fiber Broadband Association (FBA) since 2007. Each year, RVA has conducted a study focusing on Internet use among U.S. (and Canadian) online consumers. Sample sizes have ranged from 2,000 - 4,500. The 2023 edition, conducted in May, had a sample size of 4,000.

This FBA/ RVA study is one of the longest running and most comprehensive U.S. consumer Internet research in existence. Besides covering a wide range of questions, it includes important methodology innovations, such as directly sampling in real-time a respondent's speed, latency, and now jitter (variations of latency). There is no other known nationwide random sampling of speeds and latency by broadband type. (Data from speed testing services, although important, is not randomly sampled. Such data can be biased somewhat in that: a) those subscribing to higher speed tiers are more likely to take speed tests; b) speed tests can come from both home and business locations.)

Last year's FBA/ RVA Consumer Broadband Report (2022) focused on measurable performance advantages of fiber broadband or FTTH (fiber-to-the-home) versus other delivery methods in terms of speeds, latency, and jitter. The report also showed statistically significant fiber impact differences in terms of household economics, sustainability, quality of life, and sustainability – many of which are especially important for lower income families.

The 2023 Consumer Broadband Report focuses on the underlying importance of broadband to consumers and consumer preference for broadband delivery methods.

[8] https://www.speedtest.net/global-index/united-states

III. THE BACKGROUND NEED

A. The Current Need: The Importance Of Broadband To Daily Life

It is generally understood that high quality broadband is critical to daily life in 2023.

Broadband importance can be measured in various ways. In response to a question about the importance of home amenities, very high speed and reliable Internet was named the second most important amenity for a single family home – trailing only a laundry room. Good home Wi-Fi connectivity was also important at the fifth position.

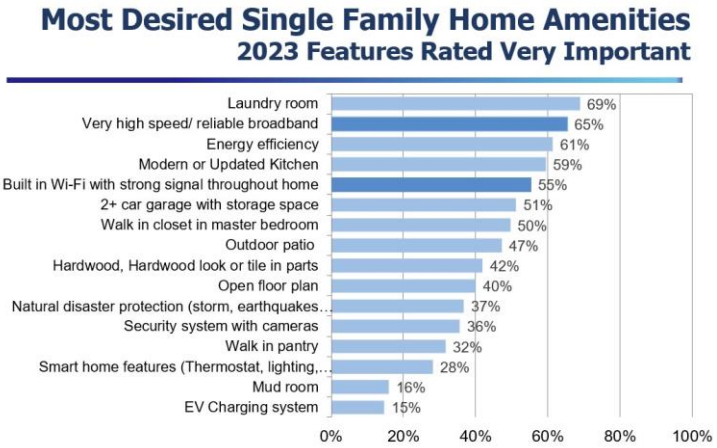

Fig. 1

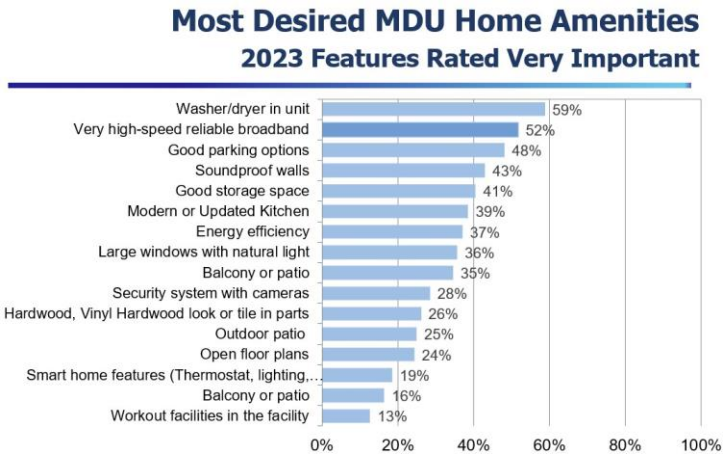

Fig. 2

For those in a multi-dwelling unit, such as an apartment or condominium, the top two responses were the same, with high speed and reliable Internet in second position.

B. The Future Need: Desired Future Broadband Applications

As important as broadband is today, it will only increase in importance in the future. Based on past history and logic, the number of applications used and the performance requirements (bi-directional high bandwidth, low latency and high reliability) will continue to increase over time.

In response to a question about the importance of potential future broadband applications, top interest came for applications related to virtual medicine, life independence for seniors, and safety and security. There was also significant interest in applications related to education, shopping, employment, and entertainment.

It is interesting that all of these potential applications require a significant upstream component – probably requiring as much upload as download capacity. Fiber broadband has always had a significant advantage in upstream capacity over other Internet delivery methods.

Percent Interested In Potential Applications
Applications Perceived To Be Somewhat Or Very Important

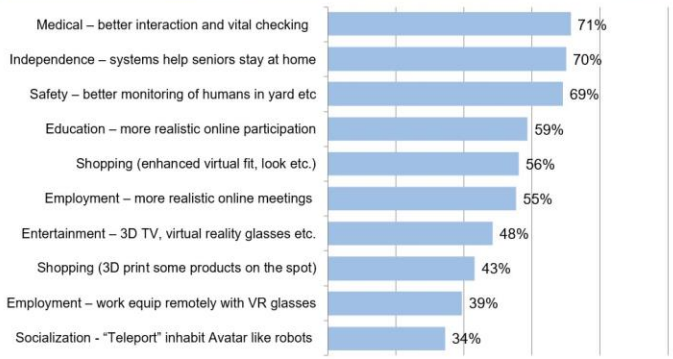

Fig. 3

Reviewing interest in potential applications by gender and age segments (cross-tabulation), two general observations can be made. Most importantly, younger individuals have more interest than older, and males have slightly more interest than females. This norm is broken in cases where the application seems to have particular importance to a segment. For example, older females have the highest interest in applications enabling independence.

Many of these differences are, no doubt, more generational than age related. As an example, the current Gen-Z and Millennial interest will likely be maintained as these groups age.

Percent Interested In Potential Applications
By Gender And Age Segments

	Males under 35	Males 35-64	Males 65+	Females under 35	Females 35-64	Females 65+
Medical – better interaction and vital checking	75%	70%	66%	75%	74%	66%
Independence – systems help seniors stay at home	74%	67%	66%	67%	73%	77%
Safety – better monitoring of humans in yard etc	78%	67%	57%	76%	74%	66%
Education – more realistic online participation	75%	61%	39%	75%	62%	44%
Shopping (enhanced virtual fit, look etc.)	70%	59%	40%	67%	59%	42%
Employment – more realistic online meetings	75%	62%	28%	71%	64%	33%
Entertainment – 3D TV, virtual reality glasses etc.	72%	54%	31%	57%	51%	28%
Shopping (3D print some products on the spot)	63%	45%	28%	49%	46%	34%
Employment – work equip remotely with VR glasses	61%	47%	16%	52%	44%	17%
Socialization - "Teleport"/ inhabit Avatar like robots	66%	41%	14%	45%	36%	15%

Fig. 4

IV. THE POSITION OF FIBER BROADBAND

A. The Current Position: Technology Market Share

Reviewing recent movement in market share based on FBA/ RVA consumer surveys, it is clear that the fiber broadband or FTTH share continues to accelerate, while the cable modem (DOCSIS) share is declining. "Other" share (primarily fixed wireless and mobile- only households) increased in 2022, likely due to the introduction of 5G technology.

Currently Cable leads in market share at about 47%, while Fiber is second at about 23%, but continued fiber gain seems inevitable.

One note regarding cable share: A common question. regarding this data is, "how can cable share only 47% when some other sources seem to show cable share at close to 70%?"

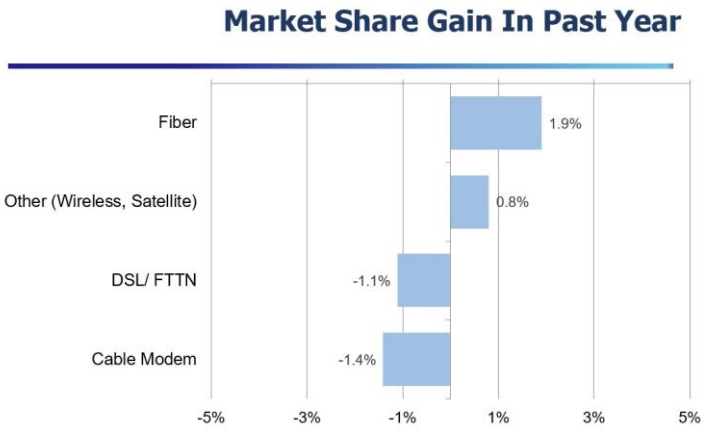

Fig. 5

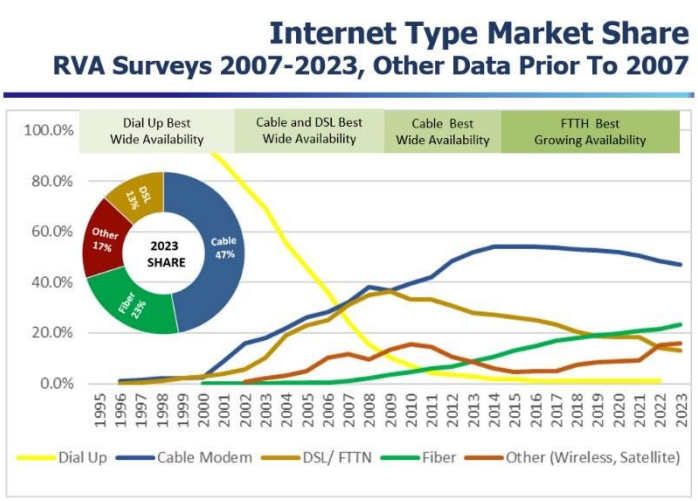

Fig. 6

The answer lies in the difference in what is being reported. The high cable share number occurs when comparing the sum of the cable numbers of the top publicly traded cable companies (service delivered by either cable modem or FTTH technology) to a base of only all publicly traded wireline companies. (One additional factor: the data for cable companies often includes 7-13% non residential connections.)

A more complete and accurate cable market share figure would be to measure all residential cable users as a percent of all household Internet users (i.e. all wireline users, fixed wireless users, and mobile-only home Internet users), which would give a result of about 54%.

Further, only considering cable customers who are supplied service by traditional cable modem (i.e. not including those served by FTTH technology) gives a share of about 47%.

B. The Shifting Position: Recent Broadband Churn To Fiber

New customers for any company or delivery type can come from new household formations (or new-to-the Internet households) or from customers switching from one provider or delivery technology to another.

In the past two years, approximately 17% of respondents with existing Internet reported making a change of providers. In this process of switching, many also changed their delivery method. The primary technology beneficiary of churn in the past two years was fiber broadband, picking up 15% points of the group of 17% of churners. Wireless followed at 11%. The primary loser to churn was cable modem, losing by 14% points.

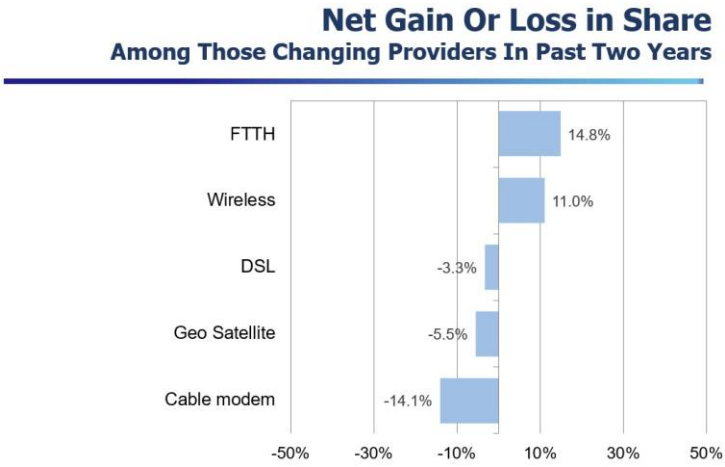

Fig. 7

The loss for cable comes even though cable modem has about twice the current coverage as FTTH, and the fact that many cable companies have been upgrading to DOCSIS 3.1 or beyond and moving fiber deeper into the network.

Wireless share improvement came from 5G bandwidth improvement, especially in areas where low quality DSL, low quality cable modem, wireless, or satellite were the only previous choices to the consumer.

V. THE UNDERLYING PREFERENCE TO FIBER BROADBAND

A. User Satisfaction: Net Promoter Scores

Net Promoter Scores, an important and well accepted measure of customer satisfaction, continue to be highest for FTTH in 2023, though wireless has jumped to second place – probably because 5G speeds represented a significant improvement over other low-end Internet delivery methods the consumer used prior to the change. Cable was third in NPS at 10%.

One side note, NPS scores from a blind third party (such as RVA) are often somewhat lower than NPS scores from surveys sponsored by specific companies. (Customers responding to an invitation from the service provider itself often upwardly bias their answers somewhat

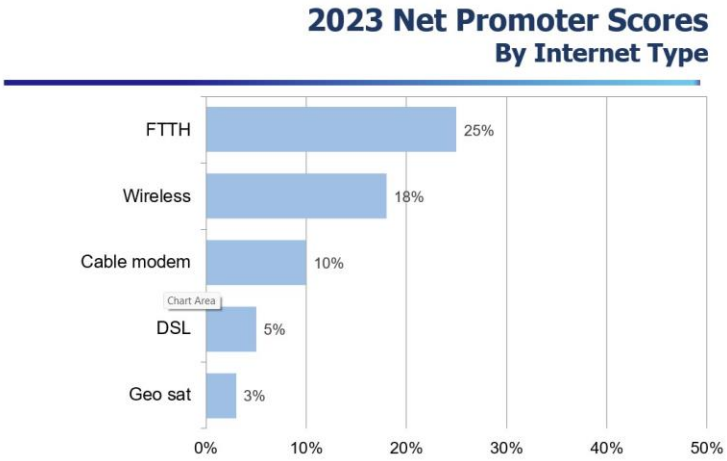

Fig. 8

B. Perceived Superiority: Perception Of The Best Delivery Technology

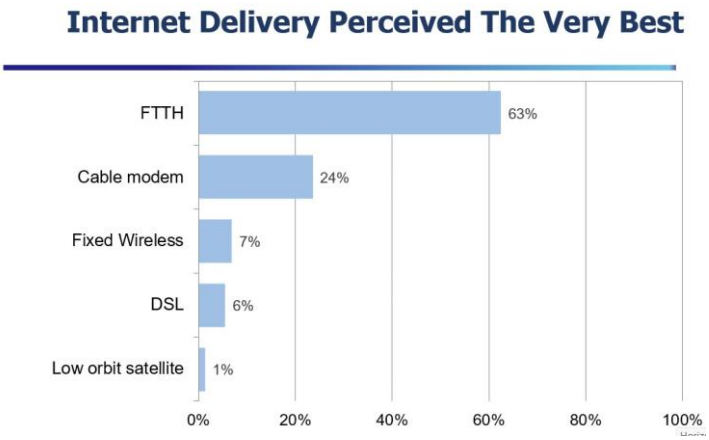

Fig. 9

When all respondents were asked what service to the home was the very best in terms of speed and reliability, fiber broadband won by a large majority, and was 2.5 times higher than the second candidate – cable modem.

This level of consumer preference represents a strong indicator that fiber will continue to increase in share over time, especially as fiber availability continues to increase.

Internet Delivery Perceived The Very Best
By Type Of Current Service Provider

	Competitive	Rural Electric	Tier 2/3 ILEC	Large ILEC	Satellite	Small Cable	Municipal	Large MSO	Wirelesss
FTTH	97%	92%	85%	76%	73%	70%	64%	54%	53%
Cable modem	3%	8%	7%	9%	0%	20%	18%	36%	20%
Fixed wireless	0%	0%	3%	5%	9%	7%	18%	5%	17%
DSL	0%	0%	4%	9%	0%	2%	0%	3%	5%
Low orbit satellite	0%	0%	1%	1%	18%	2%	0%	2%	5%

Fig. 10

While customers of all types of Internet providers rated FTTH the very best, there were some differences. It appears those customers who have experienced fiber (i.e., their current provider type often delivers service via fiber) were more likely to rate FTTH best. A second correlation may be the performance level of current broadband. For example, satellite customers who have likely not experienced fiber but have poor current performance tend to rate FTTH as best (perhaps based on their own investigative research)

C. Perceived Value: Fiber Real Estate Premiums

Fiber Adds To Home Value
Discount Needed To Consider Similar Non-Fiber Home

Fig. 11

Every three years the FBA/RVA survey asks consumers two questions involving two hypothetical, equally comparable housing properties – except one had fiber broadband and the other did not. (Which would be preferred? How much would the home without fiber need to be discounted in price to be considered?)

The answers in 2023 show that for home ownership, a 3-5% real estate price premium for fiber exists. For rental customers, when considering a shorter time- frame, a 13% fiber premium exists.

It is worth noting that the 2023 premium for fiber broadband is the highest seen in recent years.

D. Switching Intent: Likelihood Of Switching To Fiber If Available

When consumers were specifically asked how likely they would be to switch to a new Gigabit fiber provider entering their market, a total of 33% said they would be very likely to switch overall.

Based on past RVA market research, those who say they are very likely to switch correlates well with actual take-rates in the first few years.

The likelihood of switching services correlates with the performance of the customer's existing Internet delivery technology – those with lower performing technologies are generally more likely to switch.

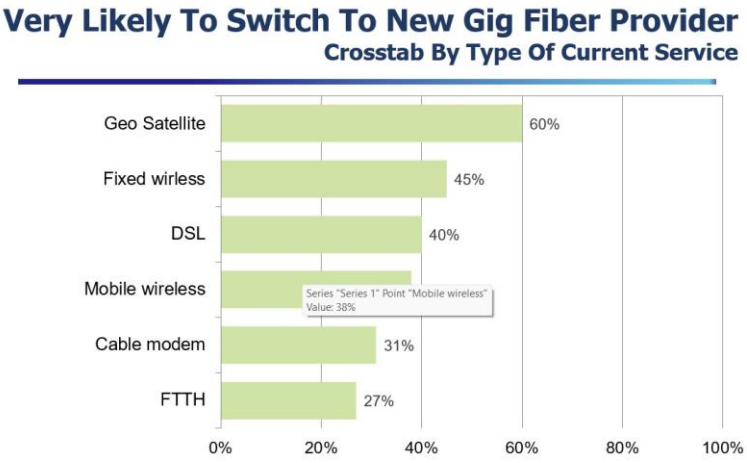

Fig. 12

While lowest, it should be noted that about 26% of fiber (FTTH) customers said they would be very likely to switch to a new fiber provider. This means that some FTTH users with a choice of two fiber providers can and do switch based on their previous experience with the current provider and perceptions of a new provider. The clear message to current FTTH providers is to develop world-class customer service on top of having the best delivery product.

VI. STUDY CONCLUSIONS

Two primary conclusions come from this year's consumer study:

A. Broadband is extremely important.

- High quality broadband is listed second most important for home and apartment amenities
- The need for higher bandwidth and performance will only grow over time. Consumers are interested in many future applications that will require even higher quality broadband.

B. Preference to fiber broadband is extremely strong.

- FTTH is gaining market share on cable modem every year, while cable is declining
- FTTH was selected most often among churning customers recently – despite being often less available
- FTTH has the highest NPS scores
- FTTH is perceived to be the very best delivery method by a wide majority
- About one third indicated they would be very likely to switch to FTTH if a new FTTH provider was available

The level of consumer support for fiber broadband is rather striking. This data, combined with continually increasing FTTH availability, would certainly suggest continued market share growth for fiber broadband, and potential serious trouble ahead for cable share.

While smaller and mid-sized cable operators are migrating quickly to FTTH, the large MSOs are deploying FTTH to new builds (green field) and in areas where they face competition. In non-competitive areas, cable companies are hopeful that DOCSIS 4.0 upgrades, beginning in late 2023, will at least slow the churn to fiber. Of course, the 4.0 activity and results remain to be seen. While such a move will improve cable upload speeds and reliability somewhat, FTTH will still clearly be the highest performing method – and with much more room for continuing performance upgrades in future years.

VII. INDEX OF GRAPHS

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