PHASED BROADBAND PLAN

Clay, Calhoun, and Roane Counties

DESIGN NINE
broadband planners

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1 PLAN OVERVIEW

This report provides a detailed plan for improved broadband infrastructure for each of three CCRBDC counties. For each county, four separate phases are described, and each phase has:

- Technical detail specific to that phase,
- Site locations for broadband infrastructure,
- Estimated cost of improvements,
- Recommended tasks for each phase, and
- Estimated timelines and schedule.

The execution of each phase will depend on the timing and availability of grant funds, but all of the proposed improvements in each county could be completed in eighteen to thirty-six months. Public/private partnerships with private sector Wireless Internet Service Providers (WISPs) could produce results nearer the eighteen month target. The propagation map on the following page shows the proposed sites and projected coverage for all three counties.

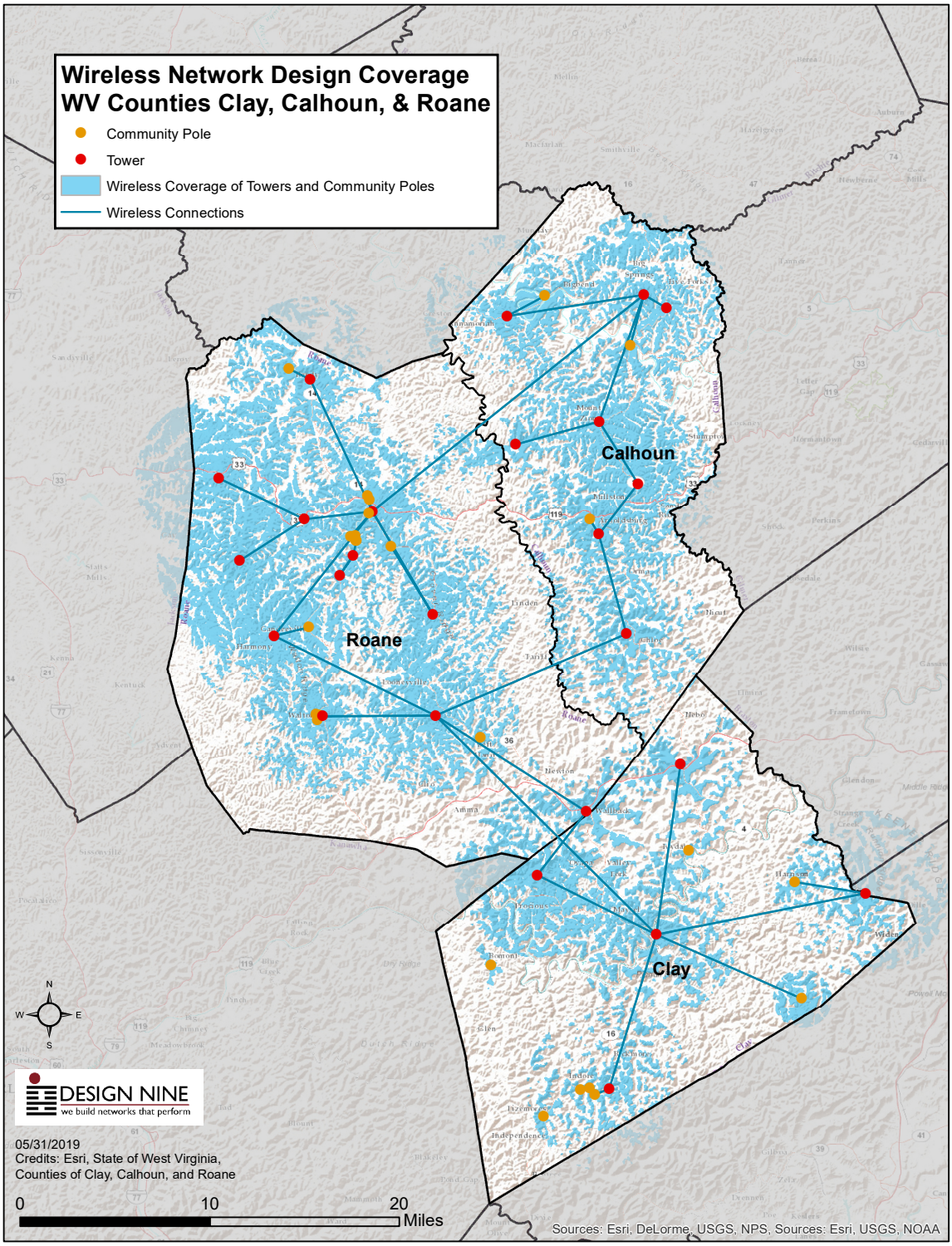
1.1 ESTIMATED TIMELINES FOR COMPLETION

Each phase will have its own timeline, and will vary widely depending on the type of funding. Grant funded projects may need six months to a year to plan and apply for funding, depending on where in the grant cycle the CCRBDC commits to applying for a grant and the length of time that the grant agency takes to review and approve grants.

Tower improvements and construction times can be dependent on weather (more weather related delays are likely in late fall through early spring) and on procurement. Most grant funded projects require careful attention to a public procurement process, which can add 90 to 180 days to the timeline. More detailed timelines are provided for each project phase in this report.

Project Type	Project Execution Planning	Project Procurement	Project Engineering and Construction	Total Estimated Timeline
Improvements to existing towers	2-3 months	3-4 months	2 months	7-9 months
New towers of 180'	4-6 months	4-5 months	4-8 months	12-19 months
Small cell community broadband poles	3 months	2 months	2 months	6 months
Point to point tower backhaul links	2-3 months	3-5 months	1-2 months	6-10 months
Fiber to the home/ business projects	4-6 months	4-6 months	6-12 months	14-24 months

Line of sight has been verified for all all sites on the map.



1.2 OTHER REPORT DOCUMENTS

This report is one of five documents developed for the Clay, Calhoun, and Roane Broadband Development Committee (CCRBDC). The documents are:

Clay County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (21 pages).

Calhoun County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (21 pages).

Roane County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (29 pages).

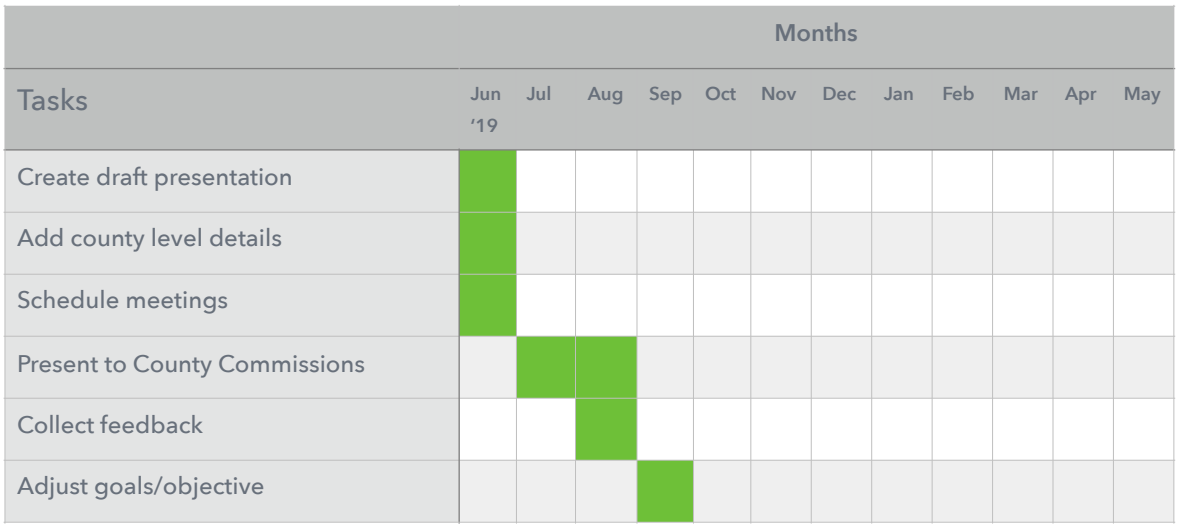
Broadband Recommendations – This report provides an extensive review of key policy, funding, and planning issues, including a review of current service providers in the region, current and future bandwidth needs, marketing recommendations, a gap analysis, potential partnerships, what other communities are doing to improve broadband, and attracting service providers to the region (125 pages).

Phased Broadband Plan (this document) – Contains a phased approach for building out improved broadband infrastructure for each of the three counties (67 pages).

2 PRE-IMPLEMENTATION PHASE

2.1 PRESENT CCRBDC BROADBAND PLAN TO COUNTY COMMISSIONS

Activity	Description	Discussion	Tasks
Presentations to each County Commission	After acceptance of the broadband report, CCRBDC should make a presentation to each County Commission.	The presentation should summarize key findings, including summary results from the broadband surveys.	• Create draft presentation and review among CCRBDC members. • Customize presentation with county level recommendations and survey results. • Schedule meetings with each County Commission, with work sessions preferable to the ordinary public meetings. Work sessions provide more time for Commissioners to ask questions. • Make presentations to County Commissions • Collect feedback • Adjust goals and objectives of the CCRBDC as needed



2.2 ESTABLISH GOVERNANCE ENTITY

A three county development authority to promote improved broadband is the recommended option.

Activity	Description	Discussion	Tasks
Establish the regional ownership entity	There will be substantial management and network efficiencies if the long range plan is to create an inter-connected three county network.	A three county development authority or a nonprofit are both options. A nonprofit is the simplest approach, but a nonprofit may not have as much support from the three County Commissions. A Regional Development Authority would have board members appointed by the respective County Commissions and there would be straight line accountability to each county. A nonprofit could have bylaws that require ex officio board members appointed by each County Commission, but there would be limited direct accountability.	• CCRBDC meets with each County Commission to present the two options and develop a consensus on which option is preferred. • Once a decision has been made, engage legal counsel to develop a corporate charter and bylaws. One of the county attorneys may be able to do this work. • Identify qualified board members for initial terms of service. At least five, and no more than seven board members is recommended. • Some of the board members should have a strong background in business management or grant writing. • Hold the first meeting.

Tasks	Months											
	Jun '19	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Present options to County Commissions												
Determine consensus for preferred option												
Engage attorney												
Charter and bylaws approved												
Identify/appoint board members												
Hold first meeting												

2.3 GOVERNANCE YEAR ONE ACTIVITIES

Activity	Description	Discussion	Tasks
Form Sub-Committees	Working committees will be needed to address key areas of focus	Working committees should be typically only two or three members at most	• Establish Grant working committee to take responsibility for grant development • Establish Awareness working committee to manage Web site, Facebook, other marketing efforts
Set project and funding goals	Define project vision and broad goals. Set one, two, and three year funding goals aligned with report recommendations.	Project and funding goals should be reviewed and updated regularly.	• Develop one paragraph Vision statement. • Develop one page set of short and long term goals.
Identify year one grant opportunities	Meet with regional planning officials and state officials to review grant opportunities.	Set priorities for grant opportunities.	• Identify one or two year one grant opportunities. • Identify public and private grant partners. • Develop timeline for completing grant application.
Begin execution of marketing plan	It will be necessary to have a modest but regular marketing and awareness campaign to ensure that local businesses and residents know that the three counties are engaged in trying to solve the broadband problem	Political support for this effort will be essential. There should be a regular and consistent awareness effort to keep local, state, and Federal legislators up to date with both the needs of the area and the activities that are underway.	• Awareness Committee is developing and maintaining recommended materials. • Web site has been created. • Mailing list for stakeholders and interested parties has been created. • Web site news page is updated regularly. • Facebook page is updated regularly. • Awareness Committee checks Facebook comments weekly and writes responses.

Typical Timeline	Months											
Tasks	Jun '19	Jul	Aug	Sep	Oct	Nov	Dec	Jan '19	Feb	Mar	Apr	May
Establish Grant working committee												
Establish Awareness working committee												
Develop Vision Statement												
Develop short and long term goals												
Identify year one grant opportunities												
Identify grant partners												
Develop timeline for grant application												
Develop/maintain marketing effort												
Set up Web site and content												
Set up stakeholder mailing list												
Update Web site regularly												
Update Facebook page regularly												
Respond regularly to FB inquiries												

2.4 PREPARING FOR TOWER EXPANSION

Activity	Description	Discussion	Tasks
Draft tower site lease agreement	Tower site lease agreements between the property owner and the Broadband Entity will be needed.	One or more of the County attorneys may be able to provide most or all of the legal agreements needed.	• Establish that all three counties will use the same basic agreement. • Identify legal counsel who will provide a draft agreement. • Circulate draft agreement for comments. • Approve lease agreement for use.
Identify prospective tower sites	New towers will be needed in all three counties. The broadband plan identifies the general area where towers will be needed and most effective, but specific tower locations will have to be identified with the assistance of residents in the area and property owners. This will be an ongoing activity for at least the first year.	Height above the surrounding terrain, proximity to roads, and proximity to electric service are factors that have to be evaluated.	• Review broadband plan and prepare a list of sites to survey. • Determine road access and electric service (closer is better). • Meet with property owner to discuss a potential lease. • If site owner is agreeable, add site to list of "grant ready" tower sites.
Identify prospective community pole sites	Many community poles will be needed to provide the maximum amount of wireless broadband availability.	Community poles should only be placed where there is a cluster of nearby residents who are prepared to purchase Internet service from the provider on the pole.	• For each area in a build out phase, identify clusters of typically 12-25 homes. • Identify a local champion willing to talk to neighbors and assess demand. • If demand meets target, add to list for next grant application with community poles.

Typical Timeline	Months											
Tasks	Aug '19	Sep	Oct	Nov	Dec	Jan '20	Feb	Mar	Apr	May	Jun	Jul
Obtain agreement on using one lease for all counties	■											
Identify legal counsel to draft agreement		■										
Circulate draft agreement for comment			■	■								
Obtain approval for site lease agreement					■							
Develop list of potential tower sites	■	■	■	■	■	■	■	■	■	■		
Assess road, electric service access				■	■	■	■	■	■	■	■	
Meet with property owners				■	■	■	■	■	■	■	■	
Add agreeable owners to prospective tower list					■	■	■	■	■	■	■	■
Identify clusters of residents for community poles	■	■	■	■	■	■	■	■	■	■		
Identify a local champion to assess demand			■	■	■	■	■	■	■	■	■	
Add clusters that meet demand to prospect list for community poles						■	■	■	■	■	■	■

2.5 WEB SITE AND FACEBOOK DEVELOPMENT

Activity	Description	Discussion	Tasks
Web site	The effort needs a permanent Web site and a Facebook presence. Commercial hosting that includes email accounts, mailing lists, domain name maintenance, and Web hosting are widely available for under $200/year. JustHost (www.justhost.com) is recommended.	10-12 pages will be adequate, and a Content Management System like WordPress is recommended. This will allow CCRBDC to update the site easily and without programming or HTML experience. Existing Facebook page should be updated with broadband news and/or CCRBDC activities several times a month.	• Appoint two CCRBDC members to manage process and develop Web site and Facebook. Draft content (pages should include Home, About, Contact, News, Plan). • Select a hosting company and register for service. • Review draft content and approve for posting to Web site. • Post material on Web site. • Distribute URL to interested parties, get links placed on County Web sites.

Typical Timeline	Months											
Tasks	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Appoint two CCRBDC members as Web Site Committee	■											
Select hosting company		■										
Develop and review draft content			■	■								
Post approved pages and content to Web site					■	■	■	■	■	■	■	■
Publicize URL, get links on County Web sites, Facebook page						■						

2.6 SERVICE PROVIDER ATTRACTION

Activity	Description	Discussion	Tasks
Attract Internet Service Providers (ISPs, WISPs)	One or more service providers will be needed to lease tower space, lease dark fiber, and to partner for grant funds.	CityNet and Micrologic are excellent candidates and should be approached first. Micrologic has already worked with Upshur County to help deploy a wide area wireless broadband network. Note that given the size of the tri-county area, partnerships with both companies may be needed (for example, one company in Roane, second company in Clay and Calhoun).	• Once the County Commissions have approved the CCRBDC plan, contact CityNet and Micrologic. • Schedule individual meetings with CityNet and Micrologic to present CCRBDC goals and objectives. • Assess interest of both companies in public-private partnership. • If interest is positive, reach agreement on which grant opportunities to pursue jointly and in what area. • Develop an MOU (Memo of Understanding) that identifies what tasks the WISP will perform for grant application and what CCRBDC will perform.

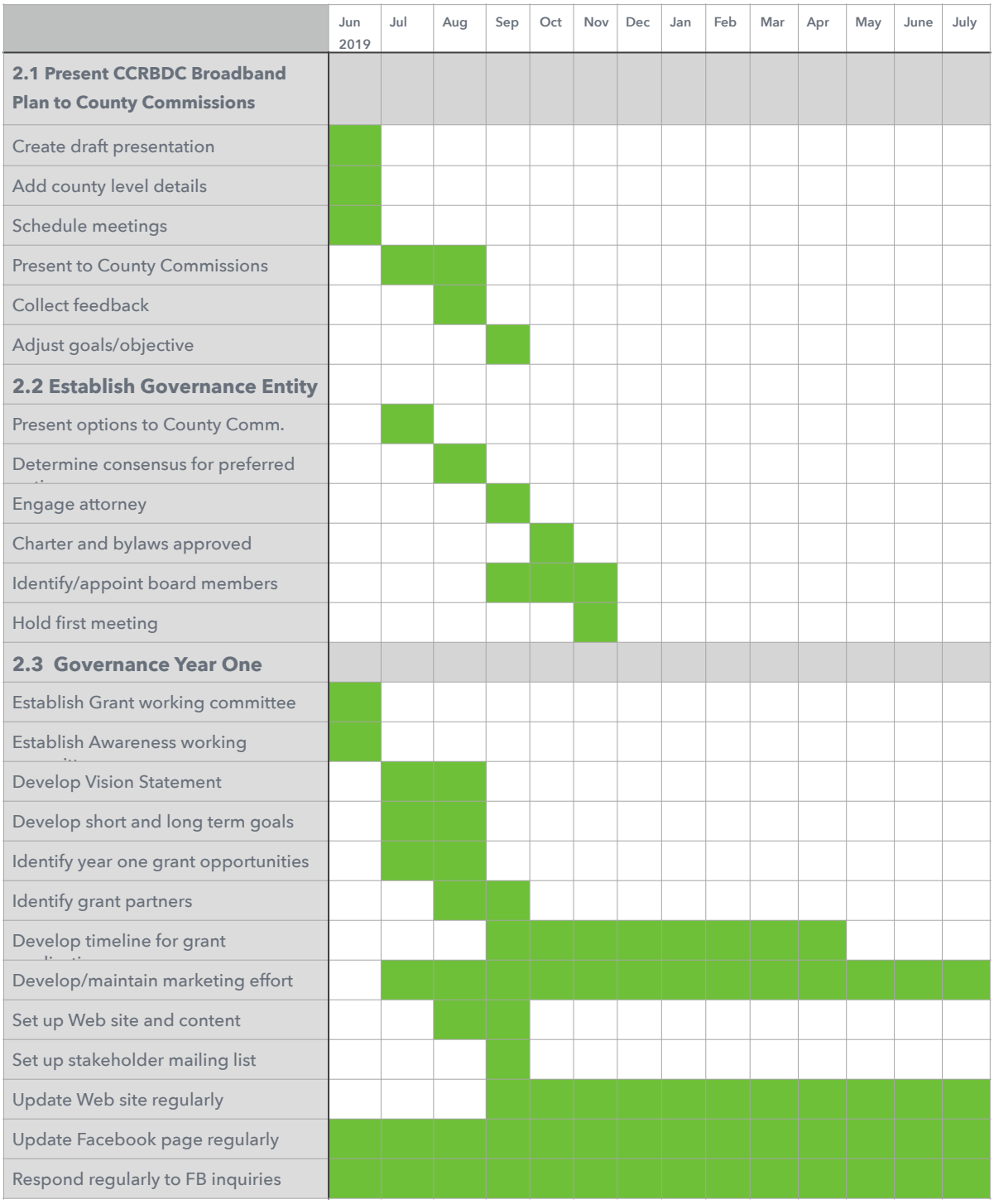
Typical Timeline	Months											
Tasks	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Contact WISPs												
Schedule individual meetings												
Assess interest in partnerships												
Schedule meetings to discuss grant opportunities												
Develop MOUs as needed for grants that will be pursued jointly												

2.7 GRANT APPLICATION ACTIVITIES

Activity	Description	Discussion	Tasks
Develop a grant application	The grant application process, from start to award announcement, can be nine to twelve months.	Broadband grant application requirements have become more stringent over time, with more grant agency oversight and review. Careful planning is essential to develop a successful application.	• Once a grant opportunity has been identified, review grant requirements to determine if CCRBDC can qualify. For example, some grants require two years of financial history. • Identify regional agency that will assist (e.g. Regional Intergovernmental Council, MOVRC). • If an ISP or WISP is needed, begin contacting potential partners. • If CCRBDC qualifies, appoint at least two people to take the lead to prepare application. • Prepare a task list of all grant materials requirements and identify data needed. • Develop a timeline for developing sections of the grant. • Identify requirements for letters of support and matching funds and develop timeline to solicit and collect commitments. • Complete all sections of grant application with assistance from public and private partners. • Submit grant application.

Typical Timeline	Months											
Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Determine grant qualifications												
Identify regional council partner												
Identify ISP or WISP partner if needed												
Appoint CCRBDC team												
Create grant task list												
Prepare timeline and assign tasks to partners												
Identify matching fund requirements and letters of support to solicit and collect as needed												
Complete all sections of the grant application												
Submit grant												
Grant agency review												
Awards announcement												

2.8 CONSOLIDATED TIMELINE/SCHEDULE FOR PRE-IMPLEMENTATION ACTIVITIES



	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
2.4 Preparing for Tower Expansion														
Obtain agreement on using one lease for all counties			■											
Identify legal counsel to draft agreement				■										
Circulate draft agreement for comment					■	■								
Obtain approval for site lease agreement							■							
Develop list of potential tower sites			■	■	■	■	■	■	■	■	■	■		
Assess road, electric service access						■	■	■	■	■	■	■	■	
Meet with property owners						■	■	■	■	■	■	■	■	
Add agreeable owners to prospective tower list							■	■	■	■	■	■	■	■
Identify clusters of residents for community poles			■	■	■	■	■	■	■	■	■	■		
Identify a local champion to assess demand					■	■	■	■	■	■	■	■	■	
Add clusters that meet demand to prospect list for community poles								■	■	■	■	■	■	■
2.5 Web Site and Facebook Development														
Appoint two CCRBDC members as Web Site Committee	■													
Select hosting company		■												
Develop and review draft content			■	■										
Post approved pages and content to Web site					■	■	■	■	■	■	■	■	■	■
Publicize URL, get links on County Web sites, Facebook page						■								
2.6 Service Provider Attraction														
Contact WISPs	■													
Schedule individual meetings		■												
Assess interest in partnerships			■	■										
Schedule meetings to discuss grant opportunities					■									
Develop MOUs as needed for grants that will be pursued jointly						■	■	■	■					

	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
2.7 First Grant Application Activities														
Determine grant qualifications														
Identify regional council partner														
Identify ISP or WISP partner if needed														
Appoint CCRBDC team														
Create grant task list														
Prepare timeline and assign tasks to partners														
Identify matching fund requirements and letters of support to solicit and collect as needed														
Complete all sections of the grant application														
Submit grant														
Grant agency review														
Awards announcement														

2.9 SUMMARY OF RECOMMENDED INFRASTRUCTURE IMPROVEMENTS

If all the infrastructure recommendations in the following sections are built out as described, the table below summarizes the total cost.

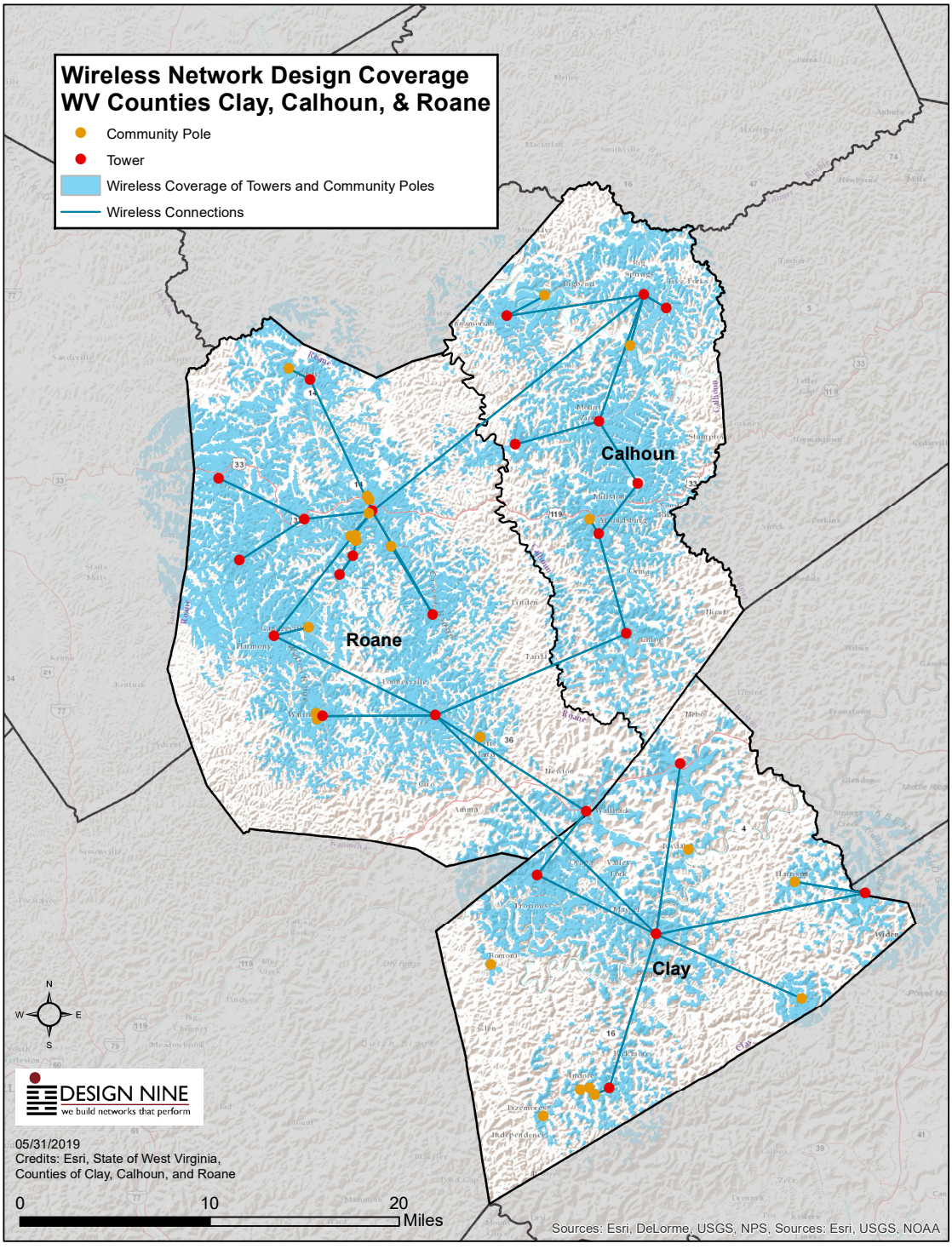
Given the size of the three counties and the expected effort and time needed to raise funds and to apply for grants, a minimum of three years should be anticipated to plan, fund, and construct all towers and backhaul connections. Some residents and businesses could begin receiving service within the first twelve to eighteen months.

The map on the following pages shows the three county network as detailed in the next section (Chapter Three details the phases by county). The terrain in the three counties is very difficult, with many small hills and valleys that block wireless signals. Community poles are going to be an important part of improving wireless broadband access.

Timelines are included for each phase of the county level projects. It is important to note that the timelines represent the start of the work associated with each phase. Applying for a grant for any given phase will likely include additional time for grant preparation and grant review by the granting agency. The time needed for these two activities will vary but could be between three and nine months. For more detail, see Section 2.7.

Project Type	Total
Clay Phase One	$5,000
Clay Phase Two	$345,892
Clay Phase Three	$656,545
Clay Phase Four	$126,770
Calhoun Phase One	$5,000
Calhoun Phase Two	$366,980
Calhoun Phase Three	$330,503
Calhoun Phase Four	$459,535
Roane Phase One	$5,000
Roane Phase Two	$647,194
Roane Phase Three	$463,528
Roane Phase Four	$373,601
Total Estimated Cost	$3,785,548
Cost of Optional Colocation Shelters	$192,375
	$3,977,923

Line of sight has been verified for all all sites on the map.



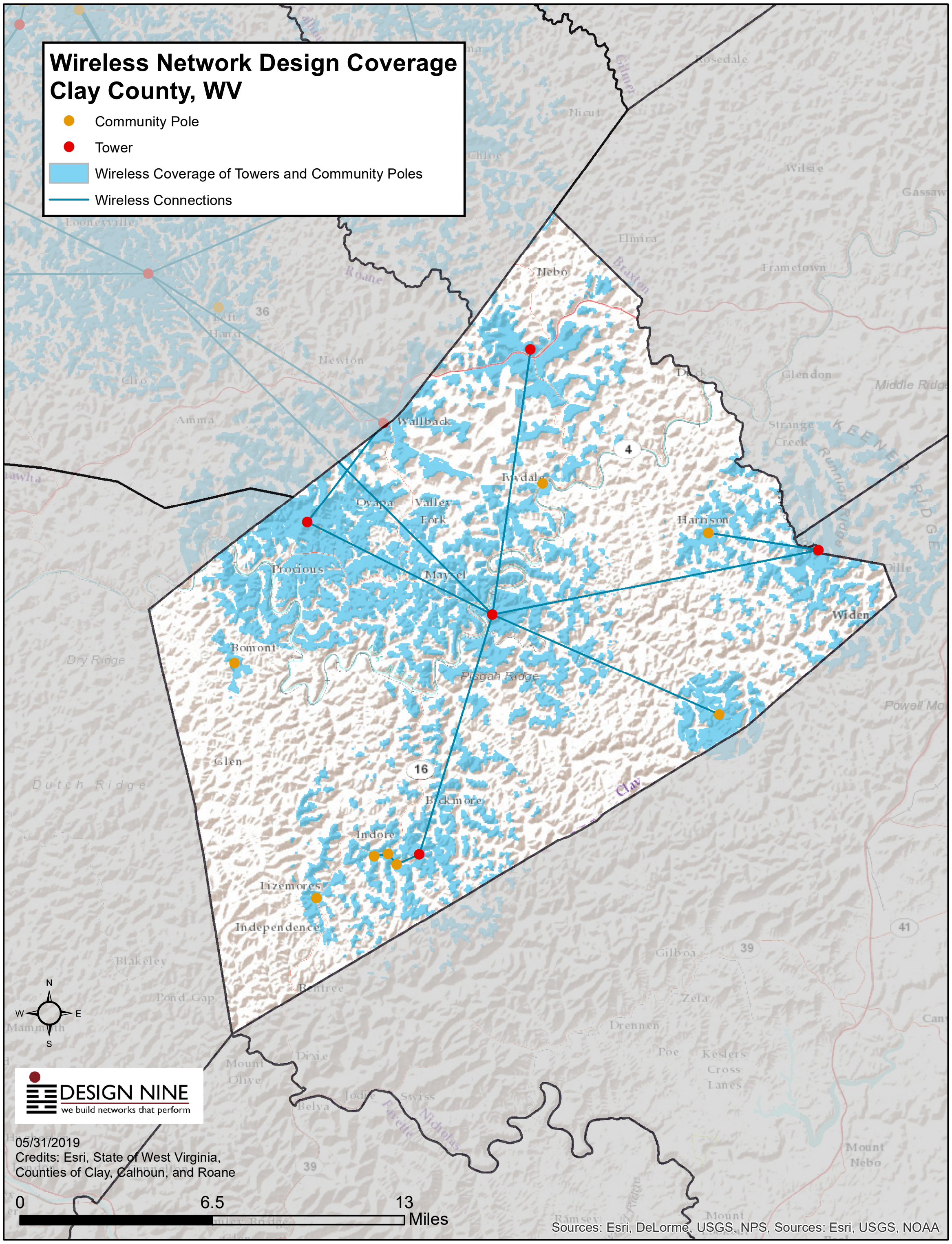
3 CLAY COUNTY PHASED APPROACH

In Clay County, there may be up to two existing towers that may have space available for one or two WISPs. Based on the propagation study for the county, at least four additional 180' towers will be needed to provide additional coverage. The terrain is extremely difficult for wireless propagation, and the tall towers would have to supplemented by at least 30 "small cell" broadband community poles, which would extend the reach of the taller towers.

Not all improvements listed in the table below would have to be completed at once, and it would be realistic to expect that this could take two to three years to raise funds and construct all of the items.

It is important to note that for existing towers, a site survey conducted with the cooperation of the tower owner is required to determine the suitability of a particular tower for WISP use. For existing towers, a structural engineering analysis may also be required. That cost is included in the estimate for improvements to existing towers.

Project Phase	Total
Phase One	$5,000
Phase Two	$345,892
Phase Three	$656,545
Phase Four	$126,770
Estimated Cost of Phases One to Four	$1,134,207
Optional Colocation Shelter	$64,125
	$1,198,332


Wireless Network Design Coverage
Clay County, WV
Community Pole
Tower
Wireless Coverage of Towers and Community Poles
Wireless Connections
Nebo
Wallback
Ivydale
Ovapa
Valley Fork
Procious
Maysel
Harrison
Widen
Bomont
Pisgah Ridge
Glen
Bickmore
Indore
Lizemores
Independence
Dry Ridge
Dutch Ridge
Newton
Amma
Clio
Elmira
Frametown
Glendon
Middle Ridge
Strange Creek
Gilboa
Zela
Drennen
Blakeley
Pond Gap
DESIGN NINE
we build networks that perform
05/31/2019
Credits: Esri, State of West Virginia,
Counties of Clay, Calhoun, and Roane
0
6.5
13
Miles
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA

3.1 PHASE ONE ACTIVITIES

For this initial phase, some administrative costs ($5,000) are included. The assumption is the CCRBDC and regional planning entities would complete these tasks, and the administrative costs could be reduced or eliminated.

A colocation shelter may be needed at one location in the county (near fiber or wireless backhaul) and the cost of a colocation shelter is $64,125. The shelter could be added in Phase Two if needed.

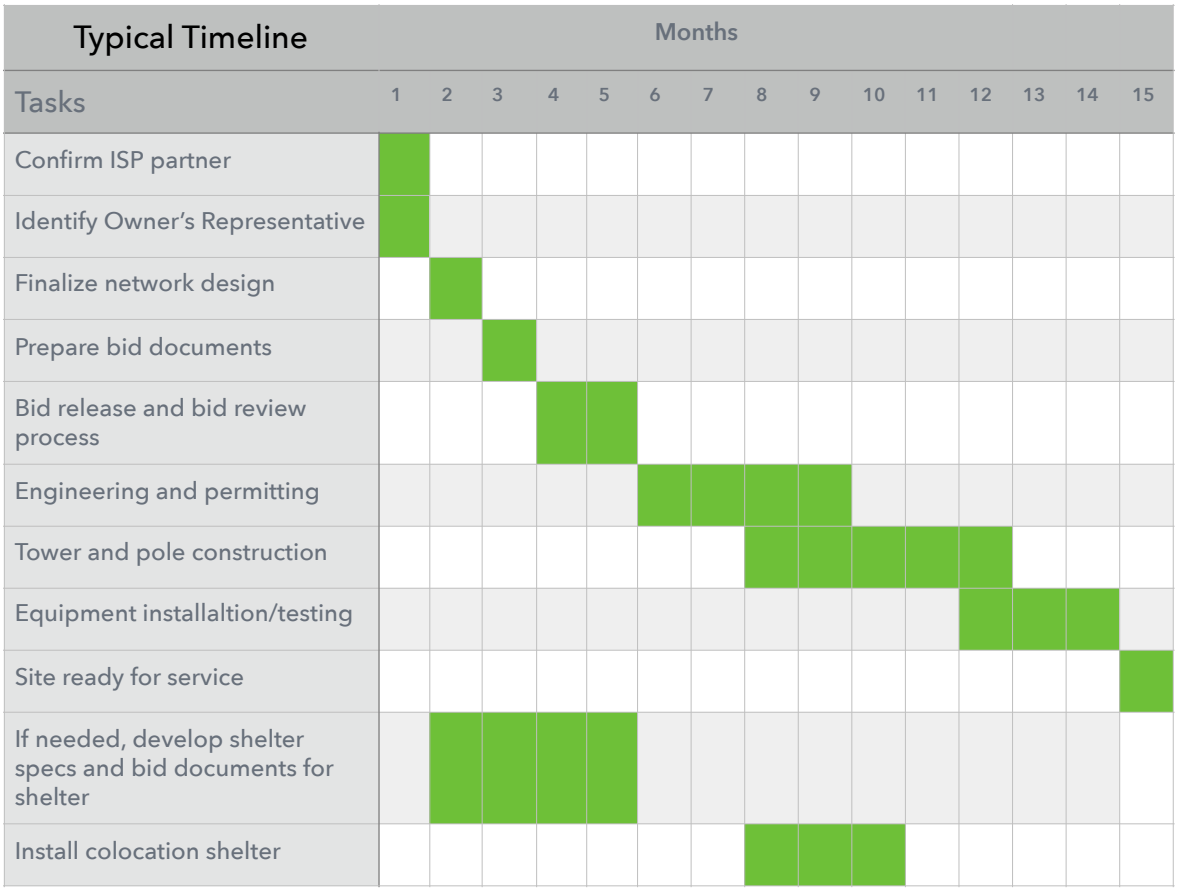
Activity	Description	Discussion	Tasks
Issue Clay County partnership RFP	For many of the grant opportunities, a private sector ISP like Micrologic or CityNet will be needed.	The RFP should be short and should not require large amounts of work from respondents. For best response, allow at least 45-60 days for ISPs to submit a response.	• Start RFP development by obtaining sample RFPs from other localities. • Develop draft RFP and have it reviewed. • Issue RFP • Review responses and conduct interviews as needed • Select best candidate
Assess and inventory prospective tower sites in Clay County	Grant applications for wireless towers require specific locations for towers.	Use report data to identify where towers are needed.	• Appoint two people from each county to lead tower site effort. • Assemble a list of locations from report data. • Begin meeting with property owners to determine willingness to provide space for tower and availability of road access and electric service. • Collect site agreements
Colocation shelter site identification and development in Clay County	In each county, a colocation shelter may be needed for service providers to place certain network equipment and to interconnect to other providers. Consultation with WISP partners is recommended.	Shelters should be located near existing tower or fiber assets. Must have 24/7/365 physical access.	• Identify candidate sites near schools and/or county buildings. • Meet with K12 and county officials to identify best location. • Obtain colocation site agreement

Typical Timeline	Months											
Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Obtain sample ISP partner RFPs												
ISP RFP development and review												
Issue RFP for ISP partner(s)												
Review responses and conduct interviews												
Select ISP partner(s)												
Appoint site identification team												
Collect prospective sites												
Meet with property owners												
Collect site agreements												
Identify prospective sites for colocation facility												
Meet with county and K12 officials on colocation site possibilities												
Obtain colocation site agreement												

3.2 PHASE TWO NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Two Tower Development	This phase consists of one new tower, and improvements to two existing towers. These include sites at Clay, Big Otter, and Wallback.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.
Colocation Shelter development	If a colocation shelter is deemed necessary, this cost could be included in a grant request for this phase.	An easement or MOU will be needed for the shelter location.	• Identify final site for shelter. • Ensure that site has defined wireless or fiber backhaul for WISP use. • Include shelter costs in grant application. • Bid out shelter, shelter site prep and construction, and electric service as a single procurement.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CLAY	2	Clay Tower	Tower Fit-up (Private)	LTE/Unlicensed	PTP Bickmore/Fola PTP Swandale PTP Walnut Grove PTP Big Otter PTP Looneyville PTP Procious	$61,678.80
CLAY	2	Big Otter Tower	New Tower	LTE/Unlicensed	PTP Clay Tower	$220,316.30
CLAY	2	Wallback Tower	Tower Fit-up (Private)	LTE/Unlicensed	PTP Procious PTP Looneyville	$63,896.40
				Total Estimated Cost		$345,892



3.3 PHASE THREE NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Three Tower Development	This phase consists of three new towers. These include sites at Procius, Walnut Grove, and Bickmore/ Fola.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

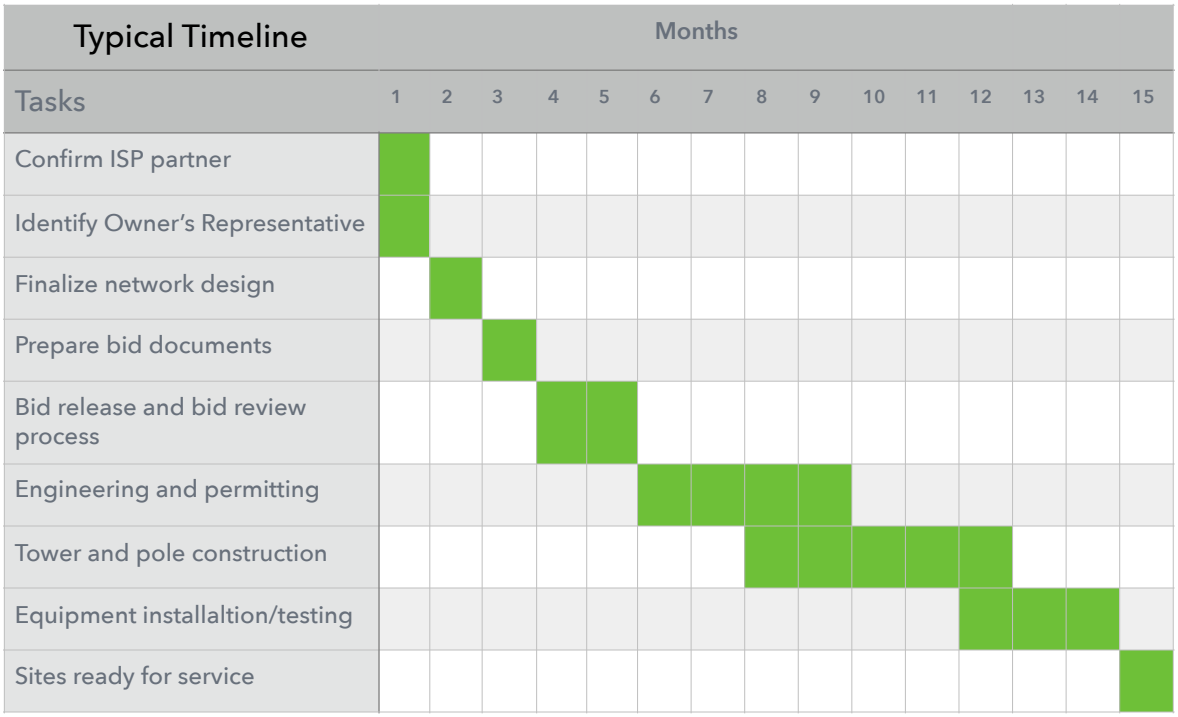
County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CLAY	3	Procious Tower	New Tower	LTE/Unlicensed	PTP Clay Tower	$220,316
CLAY	3	Walnut Grove Tower	New Tower	LTE/Unlicensed	PTP Clay Tower	$215,913
CLAY	3	Bickmore / Fola Tower	New Tower	LTE/Unlicensed	PTP Clay Tower	$220,316
				Estimated Cost		$656,545

Typical Timeline	Months														
Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Confirm ISP partner															
Identify Owner's Representative															
Finalize network design															
Prepare bid documents															
Bid release and bid review process															
Engineering and permitting															
Tower and pole construction															
Equipment installaltion/testing															
Sites ready for service															

3.4 PHASE FOUR NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Four Pole Development	This phase consists of six community poles. These include sites at Indore (three), Lizemores, H. E. White Elementary School, and Swandale.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CLAY	4	Indore Pole 1	New Pole	Omni	PTP Bickmore Fola	$24,094
CLAY	4	Indore Pole 2	New Pole	Omni	PTP Indore 1	$24,094
CLAY	4	Indore Pole 3	New Pole	Omni	PTP Indore 2	$24,094
CLAY	4	Lizemores Neighborhood Pole	New Pole	Omni	None	$17,794
CLAY	4	H. E. White ES Neighborhood Pole	New Pole	Omni	None	$17,794
CLAY	4	Swandale Road Pole	New Pole	Omni	PTP Clay Tower	$18,902
					Estimated Cost	$126,770



4 CALHOUN COUNTY PHASED APPROACH

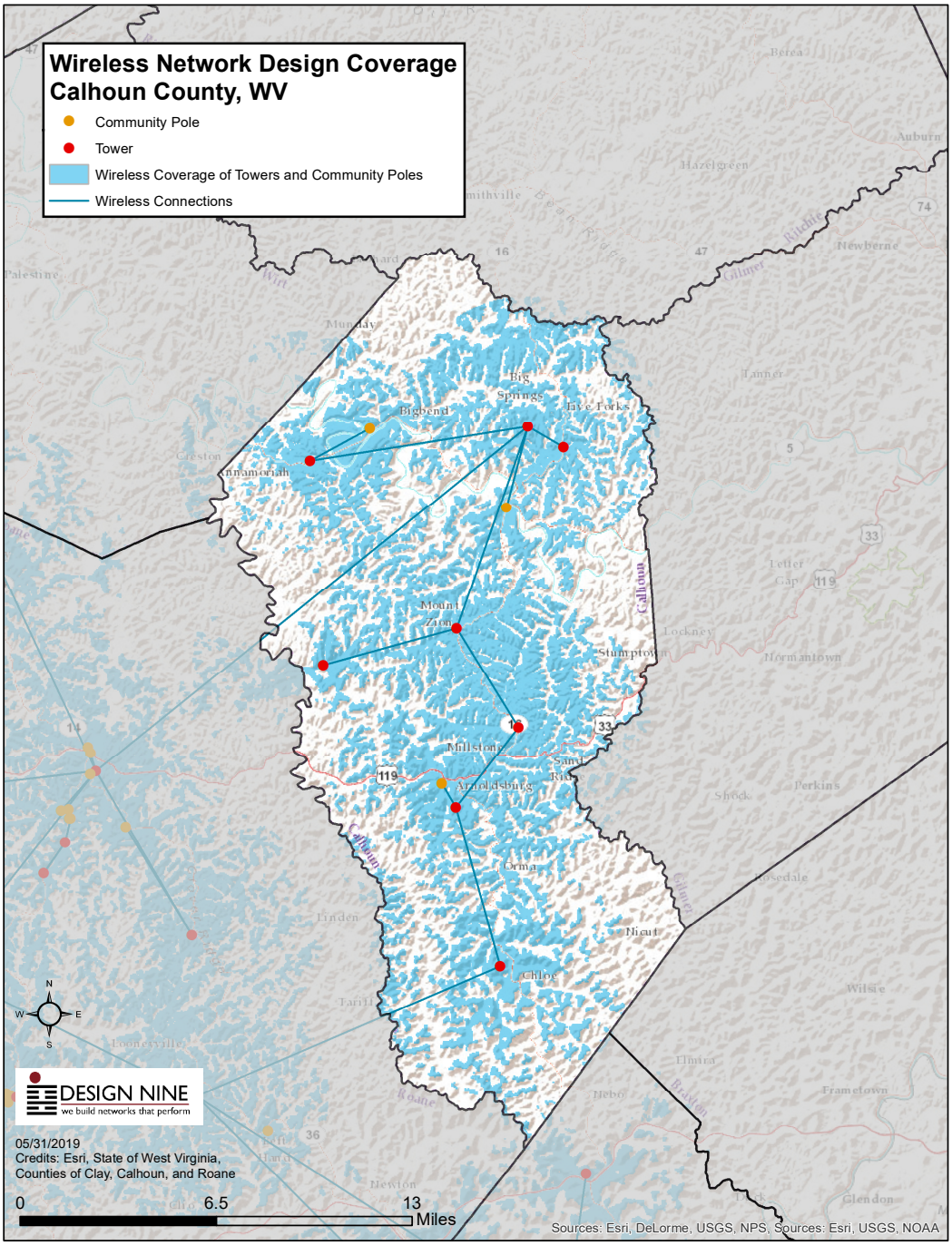
In Calhoun County, there may be up to three existing towers that may have space available for one or two WISPs. Based on the propagation study for the county, at least four additional 180' towers may be needed to provide additional coverage. The terrain is extremely difficult for wireless propagation, and the tall towers would have to supplemented by at least 20 "small cell" broadband community poles, which would extend the reach of the taller towers.

Not all improvements listed in the table below would have to be completed at once, and it would be realistic to expect that this could take two to three years to raise funds and construct all of the items.

It is important to note that for existing towers, a site survey conducted with the cooperation of the tower owner is required to determine the suitability of a particular tower for WISP use. For existing towers, a structural engineering analysis may also be required. That cost is included in the estimate for improvements to existing towers.

Project Type	Total
Phase One	$5,000
Phase Two	$366,980
Phase Three	$330,503
Phase Four	$459,535
Total Estimated Cost	$1,162,018
Optional Colocation Shelter	$64,125
	$1,226,143

Line of sight has been verified for all all sites on the map.



4.1 PHASE ONE ACTIVITIES

For this initial phase, some administrative costs ($5,000) are included. The assumption is the CCRBDC and regional planning entities would complete these tasks, and the administrative costs could be reduced or eliminated. A colocation shelter may be needed at one location in the county (near fiber or wireless backhaul) and the cost of a colocation shelter is $64,125. The shelter could be added in Phase Two if needed.

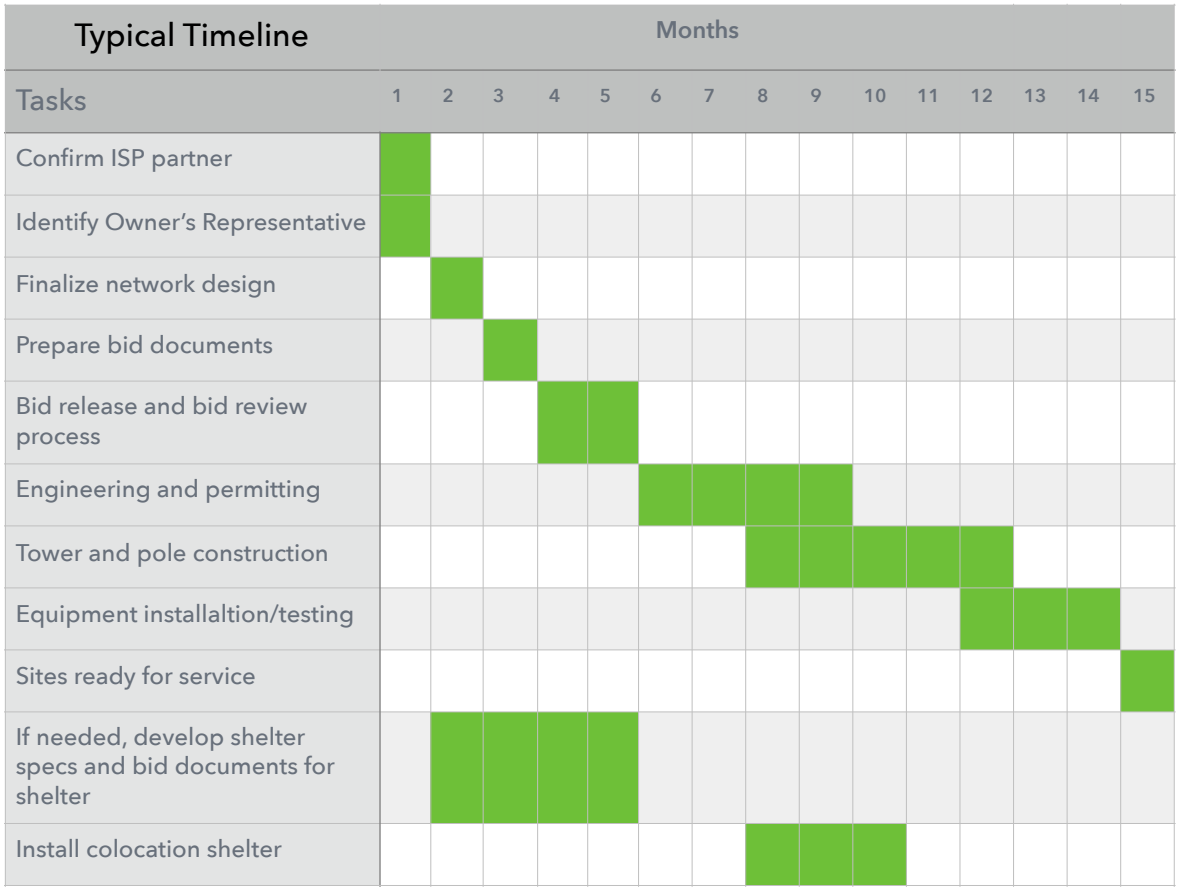
Activity	Description	Discussion	Tasks
Issue Calhoun County partnership RFP	For many of the grant opportunities, a private sector ISP like Micrologic or CityNet will be needed.	The RFP should be short and should not require large amounts of work from respondents. For best response, allow at least 45-60 days for ISPs to submit a response.	• Start RFP development by obtaining sample RFPs from other localities. • Develop draft RFP and have it reviewed. • Issue RFP • Review responses and conduct interviews as needed • Select best candidate
Assess and inventory prospective tower sites in Calhoun County	Grant applications for wireless towers require specific locations for towers.	Use report data to identify where towers are needed.	• Appoint two people from each county to lead tower site effort. • Assemble a list of locations from report data. • Begin meeting with property owners to determine willingness to provide space for tower and availability of road access and electric service. • Collect site agreements
Colocation shelter site identification and development in Calhoun County	In each county, a colocation shelter will be needed for service providers to place certain network equipment and to interconnect to other providers.	Shelters should be located near existing tower or fiber assets. Must have 24/7/365 physical access.	• Identify candidate sites near schools and/or county buildings. • Meet with K12 and county officials to identify best location. • Obtain colocation site agreement

Typical Timeline	Months											
Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Obtain sample ISP partner RFPs												
ISP RFP development and review												
Issue RFP for ISP partner(s)												
Review responses and conduct interviews												
Select ISP partner(s)												
Appoint site identification team												
Collect prospective sites												
Meet with property owners												
Collect site agreements												
Identify prospective sites for colocation facility												
Meet with county and K12 officials on colocation site possibilities												
Obtain colocation site agreement												

4.2 PHASE TWO NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Two Tower and Pole Development	This phase consists of one new tower, improvements to two existing towers and one community pole. These include sites at Arnoldsburg (two), Millstone, and Chloe.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.
Colocation Shelter development	If a colocation shelter is deemed necessary, this cost could be included in a grant request for this phase.	An easement or MOU will be needed for the shelter location.	• Identify final site for shelter. • Ensure that site has defined wireless or fiber backhaul for WISP use. • Include shelter costs in grant application. • Bid out shelter, shelter site prep and construction, and electric service as a single procurement.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CALHOUN	2	Arnoldsburg ES Pole	New Pole	Omni	BH Arnoldsburg South	$17,794
CALHOUN	2	Arnoldsburg South Tower	Tower Fit-up (Private)	LTE/Unlicensed	BH Arnoldsburg South	$67,979
CALHOUN	2	Millstone Tower	Tower Fit-up (Private)	LTE/Unlicensed	BH Arnoldsburg South	$67,191
CALHOUN	2	Chloe Tower	New Tower	LTE/Unlicensed	BH Arnoldsburg South	$220,316
				Total Estimated Cost		$373,280



4.3 PHASE THREE NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Three Tower and Pole Development	This phase consists of one new tower, improvements to one existing private tower, and two community poles. These include sites at Mt. Zion, Left Bank Road, Pleasant Hill School, and Grantsville.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

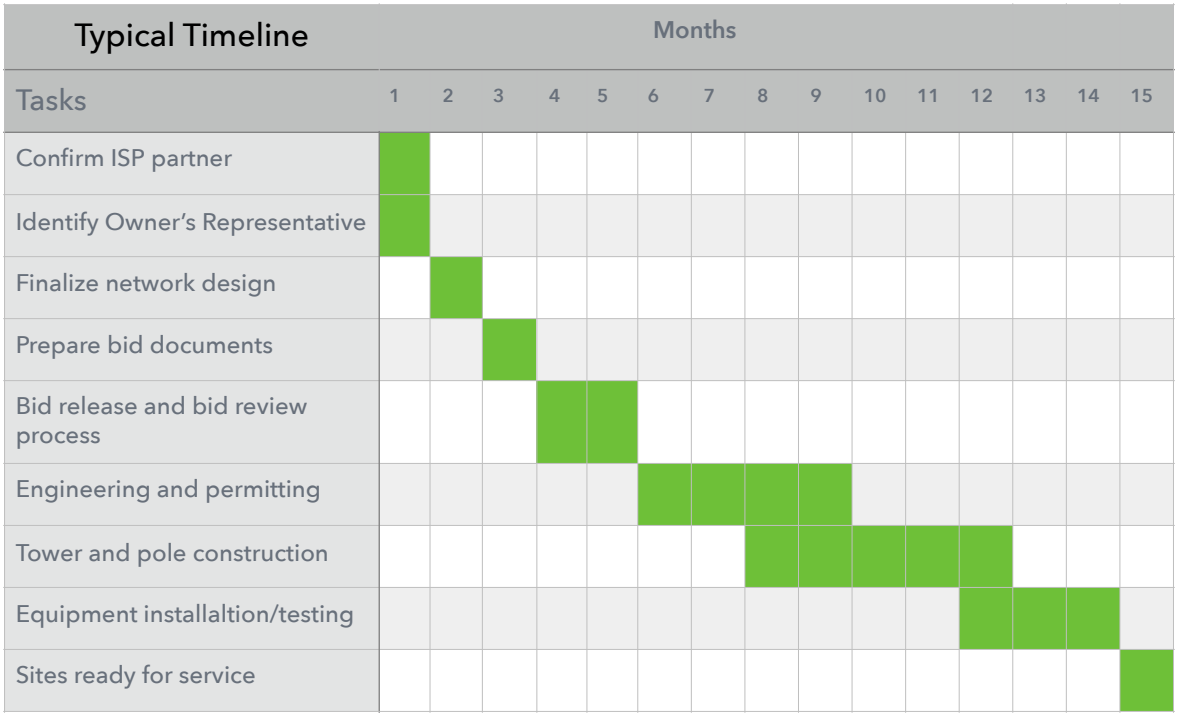
County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CALHOUN	3	Mt. Zion Tower	New Tower	LTE/ Unlicensed	BH Left Bank Road	$220,316
CALHOUN	3	Left Bank Road Tower	Tower Fit-up (Private)	LTE/ Unlicensed	BH Left Bank Road	$67,191
CALHOUN	3	Pleasant Hill School Omni	New Pole	Omni	BH Left Bank Road	$24,094
CALHOUN	3	Grantsville Omni	New Pole	Omni	BH Left Bank Road	$18,902
				Total Estimated Cost		$330,503

Typical Timeline	Months														
Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Confirm ISP partner															
Identify Owner's Representative															
Finalize network design															
Prepare bid documents															
Bid release and bid review process															
Engineering and permitting															
Tower and pole construction															
Equipment installaltion/testing															
Sites ready for service															

4.4 PHASE FOUR NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Four Tower and Pole Development	This phase consists of two new towers and one community pole. These include sites at Annamoriah, Big Bend, and Rocksdale.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
CALHOUN	4	Annamoriah Tower	New Tower	LTE/Unlicensed	BH Grantsville	$220,316
CALHOUN	4	Big Bend Omni	New Pole	Omni	BH Annamoriah	$18,902
CALHOUN	4	Rocksdale New Tower	New Tower	LTE/Unlicensed	BH Mt. Zion	$220,316
				Total Estimated Cost		$459,535


Typical Timeline
Months
Tasks
1
2
3
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8
9
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11
12
13
14
15
Confirm ISP partner
Identify Owner's Representative
Finalize network design
Prepare bid documents
Bid release and bid review process
Engineering and permitting
Tower and pole construction
Equipment installaltion/testing
Sites ready for service

5 ROANE COUNTY PHASED APPROACH

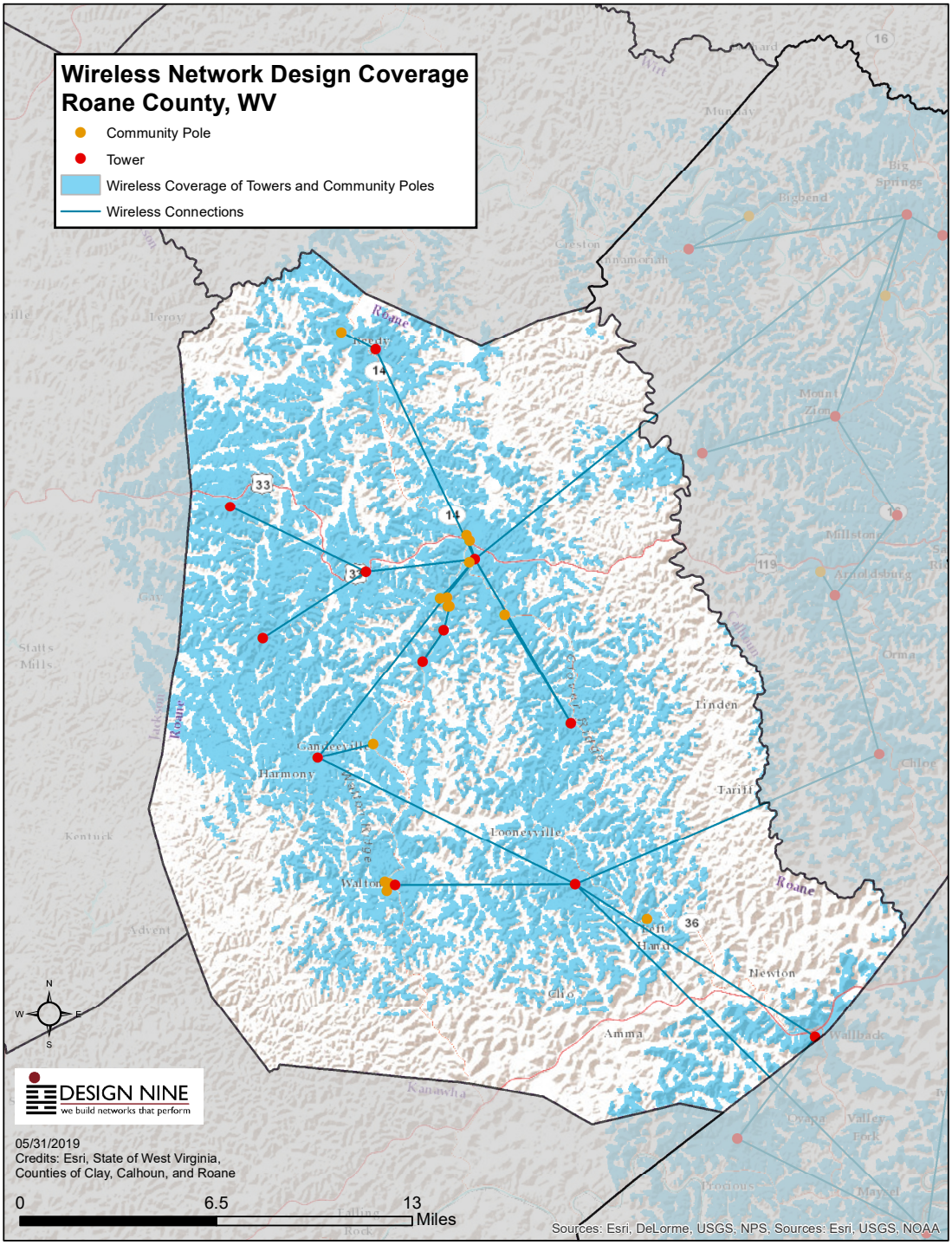
In Roane County, there may be up to five existing towers that may have space available for one or two WISPs. Based on the propagation study for the county, at least four additional 180' towers may be needed to provide additional coverage. The terrain is extremely difficult for wireless propagation, and the tall towers would have to supplemented by at least 35 "small cell" broadband community poles, which would extend the reach of the taller towers.

Not all improvements listed in the table below would have to be completed at once, and it would be realistic to expect that this could take two to three years to raise funds and construct all of the items.

It is important to note that for existing towers, a site survey conducted with the cooperation of the tower owner is required to determine the suitability of a particular tower for WISP use. For existing towers, a structural engineering analysis may also be required. That cost is included in the estimate for improvements to existing towers.

Project Type	Total
Phase One	$5,000
Phase Two	$647,194
Phase Three	$463,528
Phase Four	$373,601
Total Estimated Cost	$1,489,323
Optional Colocation Shelter	$64,125
	$1,553,448

Line of sight has been verified for all all sites on the map.



5.1 PHASE ONE ACTIVITIES

For this initial phase, some administrative costs ($5,000) are included. The assumption is the CCRBDC and regional planning entities would complete these tasks, and the administrative costs could be reduced or eliminated. A colocation shelter may be needed at one location in the county (near fiber or wireless backhaul) and the cost of a colocation shelter is $64,125. The shelter could be added in Phase Two if needed.

Activity	Description	Discussion	Tasks
Issue Roane County partnership RFP	For many of the grant opportunities, a private sector ISP like Micrologic or CityNet will be needed.	The RFP should be short and should not require large amounts of work from respondents. For best response, allow at least 45-60 days for ISPs to submit a response.	• Start RFP development by obtaining sample RFPs from other localities. • Develop draft RFP and have it reviewed. • Issue RFP • Review responses and conduct interviews as needed • Select best candidate
Assess and inventory prospective tower sites in Roane County	Grant applications for wireless towers require specific locations for towers.	Use report data to identify where towers are needed.	• Appoint two people from each county to lead tower site effort. • Assemble a list of locations from report data. • Begin meeting with property owners to determine willingness to provide space for tower and availability of road access and electric service. • Collect site agreements
Colocation shelter site identification and development in Roane County	In each county, a colocation shelter will be needed for service providers to place certain network equipment and to interconnect to other providers.	Shelters should be located near existing tower or fiber assets. Must have 24/7/365 physical access.	• Identify candidate sites near schools and/or county buildings. • Meet with K12 and county officials to identify best location. • Obtain colocation site agreement

Typical Timeline	Months											
Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Obtain sample ISP partner RFPs												
ISP RFP development and review												
Issue RFP for ISP partner(s)												
Review responses and conduct interviews												
Select ISP partner(s)												
Appoint site identification team												
Collect prospective sites												
Meet with property owners												
Collect site agreements												
Identify prospective sites for colocation facility												
Meet with county and K12 officials on colocation site possibilities												
Obtain colocation site agreement												

5.2 PHASE TWO NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Two Tower and Pole Development	This phase consists of two new towers and six community poles. These include sites at Spencer, Roane High School (3), Roane Speed, Reddy (2), Clover, and Clay Road.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.
Colocation Shelter development	If a colocation shelter is deemed necessary, this cost could be included in a grant request for this phase.	An easement or MOU will be needed for the shelter location.	• Identify final site for shelter. • Ensure that site has defined wireless or fiber backhaul for WISP use. • Include shelter costs in grant application. • Bid out shelter, shelter site prep and construction, and electric service as a single procurement.

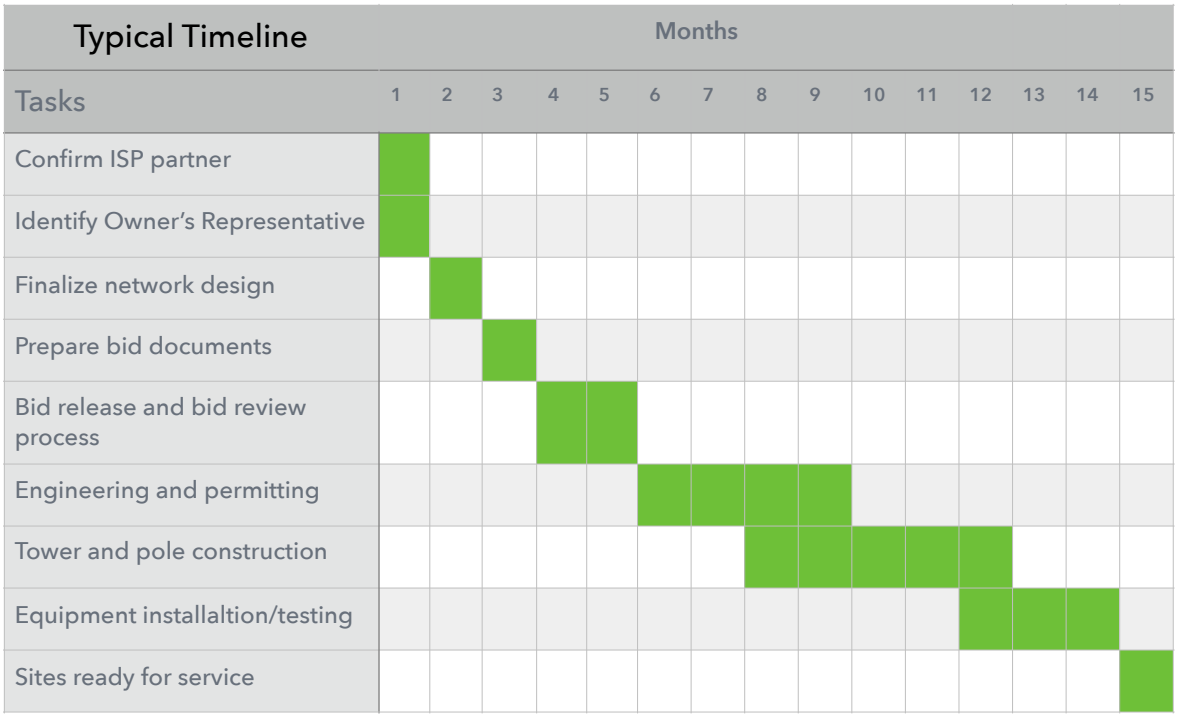
County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
ROANE	2	Spencer Tower	Tower Fit-up (Private)	LTE/ Unlicensed	PTP Reedy PTP Left Bank PTP Clover PTP Gandyville	$67,191
ROANE	2	Roane HS New Pole 1	New Pole	Omni	PTP Spencer Tower	$24,094
ROANE	2	Roane HS New Pole 2	New Pole	Omni	PTP Roane HS	$24,094
ROANE	2	Roane HS New Pole 3	New Pole	Omni	PTP 2	$24,094
ROANE	2	Roane Speed New Pole 4	New Pole	Omni	PTP 3	$24,094
ROANE	2	Reedy Tower	New Tower	LTE/ Unlicensed	PTP Spencer Tower PTP Reedy Pole √	$220,316
ROANE	2	Reedy Neighborhood Pole	New Pole	Omni	PTP Reedy Tower	$24,094
ROANE	2	Clover Tower	New Tower	LTE/ Unlicensed	PTP Spencer Tower	$220,316
ROANE	2	Clay Road New Pole	New Pole	Omni	PTP Clover Tower	$18,902
				Total Estimated Cost		$647,194

Typical Timeline	Months														
Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Confirm ISP partner															
Identify Owner's Representative															
Finalize network design															
Prepare bid documents															
Bid release and bid review process															
Engineering and permitting															
Tower and pole construction															
Equipment installaltion/testing															
Sites ready for service															
If needed, develop shelter specs and bid documents for shelter															
Install colocation shelter															

5.3 PHASE THREE NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Three Tower and Pole Development	This phase consists of one new tower, improvements to two existing private towers, and four community poles. These include sites at Walton, Walton Elementary School, Walton Library, Walton High School, Looneyville, Geary Elementary School, and Gandeeville.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
ROANE	3	Walton Tower	Tower Fit-up (Private)	LTE/Unlicensed	PTP Looneyville	$62,787.60
ROANE	3	Walton ES Pole	New Pole	Omni	PTP Looneyville	$24,093.50
ROANE	3	Walton Library Pole	New Pole	Omni	PTP Walton HS/MS	$24,093.50
ROANE	3	Walton HS/MS Pole	New Pole	Omni	PTP Looneyville	$24,093.50
ROANE	3	Looneyville Tower	Tower Fit-up (Private)	LTE/Unlicensed	PTP Chloe PTP Gandeeville PTP Wallback PTP Clay	$83,728.80
ROANE	3	Geary ES Neighborhood Pole	New Pole	Omni	None	$18,902.30
ROANE	3	Gandeeville Tower	New Tower	LTE/Unlicensed	PTP Spencer PTP Looneyville	$225,828.80
				Total Estimated Cost		$463,528



5.4 PHASE FOUR NETWORK EXPANSION

Activity	Description	Discussion	Tasks
Phase Four Tower and Pole Development	This phase consists of one new tower, improvements to two existing private towers, and one community pole. These include sites at Gandeevillie, Weather Ridge, Zion Ridge, and Cox Fork Road.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a tower or pole. For the two sites with existing towers, a similar MOU granting permission to place equipment at and on the tower will be needed.	• Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for tower construction and equipment purchases. • Bid procurement process, including bid release and bid review. • Engineering and permitting. • Tower and pole construction and existing tower improvements. • Network equipment installation, configuration, and testing. • Sites ready for service.

County	Phase	Location	Type	Access Equipment	Point to Point Links	Estimated Cost
ROANE	4	Gandeeville Neighborhood Pole	New Pole	Omni	PTP Gandeeville Tower	$18,902.30
ROANE	4	Weather Ridge Road	New Tower	LTE/Unlicensed	PTP Spencer	$220,316.30
ROANE	4	Zion Ridge Road Tower	Tower Fit-up (Private)	LTE/Unlicensed	PTP Weather Ridge	$67,191.30
ROANE	4	Cox Fork Road	Tower Fit-up (Private)	LTE/Unlicensed	PTP Weather Ridge	$67,191.30
				Total Estimated Cost		$373,601

Typical Timeline	Months														
Tasks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Confirm ISP partner															
Identify Owner's Representative															
Finalize network design															
Prepare bid documents															
Bid release and bid review process															
Engineering and permitting															
Tower and pole construction															
Equipment installaltion/testing															
Sites ready for service															

6 NETWORK ELEMENT COST TABLES

6.1 ABOUT COST STUDIES

NOTE: The costs contained in these estimates represent the best information available, based on similar costs from other projects, from vendor price lists, and/or estimates from contractors and construction firms. These estimates are generally reliable for up to six to twelve months. Note also that the time of year that the work is bid out can have a substantial effect on the estimate. We use an average weighted value for most costs to try to compensate for this, but as an example, construction work bid out in spring or early summer may have higher costs than a project bid out in late fall or early winter.

6.2 NETWORK CONSTRUCTION COST FACTORS

The cost estimates are developed using the categories below. For each category, the items, labor, and activities associated with that category are calculated, using vendor price quotes, prices for labor and materials from previous construction projects, and other sources of cost information.

Buildings, Improvements, and Prefabricated Shelters

This category includes any buildings and shelters constructed as well as improvements to the buildings such as redundant HVAC systems, power improvements, fire suppression systems, security and surveillance systems, etc.

Outside Plant Construction Materials

Network construction includes the outside plant materials needed to build the network. Items like conduit, pedestals, cabinets, hand holes, and splice enclosures are all included in network construction.

Outside Plant Construction Labor

Labor is typically included with network construction for the bidding process but is separated here to help identify money that could be saved by leveraging local labor resources. Labor includes the placement of pedestals and hand holes, the underground or aerial placement of conduit, the construction of foundations (pads) for various structures throughout the network, and more. Several material costs such as concrete and gravel are included in labor depending on the type of job to be performed.

Network Equipment, Software, and Related Costs

Network equipment includes any network electronics that will be used in the network such as routers, switches, and CPE. Network equipment also includes some items that do not use any AC power but fall into a similar category such as patch panels, and patch cables. The equipment cost will vary widely depending on the type of architecture chosen.

Administrative and Legal

Specialized legal counsel will be required to review contracts with service providers, contractors, and other participants in the project. Legal costs can vary with a particular location and tend to go down over time. The most legal work is needed early in the first construction phase to develop business contracts with service providers, to review construction and vendor contracts, and to broker lease agreements for use of public or private property (where network equipment like cabinets or shelters have to be located).

Leases, permits, and rights of way

Some costs will be incurred based on the permitting requirements of the project. If the City is able to place the colocation facility and any cabinets in public right of way or on City properties at no charge, the cost of leases will be lower. If cabinets or shelters have to be placed on private property, the cost of the land or long term leases will increase. The cost of permits needed for crossing wetlands, streams, other sensitive areas, and MNDOT permits are also included in this category. Formal leases and negotiated lease payments are more desirable than providing some form of free access to services.

Project Management

Project management for a community network build requires thorough and detailed planning, experience in procuring construction materials for the project, and the ability to oversee and convey project information to contractors through the duration of the project, including construction inspection work (ensuring construction contractors have done their job properly).

Network Design and Engineering

This work include a full design of the outside plant network, cabinet and shelter specifications, and extensive detail (blueprints) that specifies how all fiber cable, towers, buildings, and network equipment is to be installed. These documents have to be completed prior to bidding out any construction work, and are usually included as part of a construction bid package. The detail includes fiber optic cable route determination and size determination, active and passive network equipment selection and placement planning, splicing layouts and documentation, network configuration planning, and all engineering necessary to complete construction.

Network Integration and Testing

Some configuring and testing will take place after the network is built and before it is ready for use. In a dark network this involves labeling and documenting the routes of individual fiber strands, and testing of any other features of the network such as generators, air conditioners, and locks. In an active network the testing and integration includes integration requirements for a dark fiber network plus the configuring and installation of switches, routers, and other network equipment. Work in this category requires a skilled professional who is familiar with the network architecture and the business model (e.g. open access).

Miscellaneous

This category provides a small budget for miscellaneous expenses that will arise during the course of construction (e.g., bid advertisement costs, inventory tags, etc.).

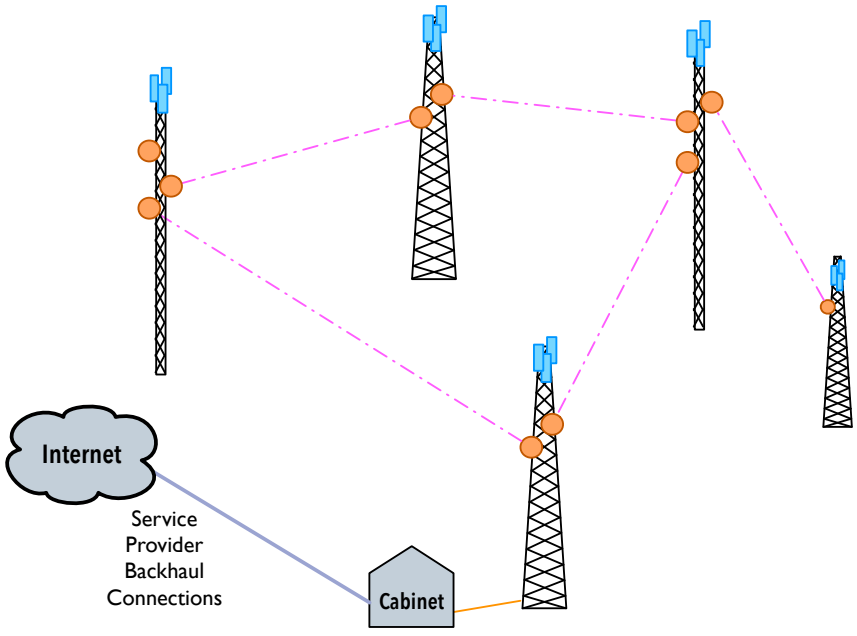
Contingencies

The Contingency category is included and calculated as a percentage of the total estimated cost (e.g., 5% of total cost) to provide flexibility in managing the overall budget. Equipment costs can and do change between the time an estimate is made and construction commences. Labor costs can vary depending upon the time of year the work starts, the state of the local economy, and the state of the national economy. Material costs and lead times can vary based on demand on certain industries, energy costs, and location.

6.3 ABOUT WIRELESS TOWER COST ESTIMATES

The line items for each named tower include the cost of the tower, site preparation, estimated cost of electric service, generator cost and placement, cost of the tower, and labor to assemble and erect the tower, and backbone equipment.

This section of the report provides an estimate of the cost of using existing towers to provide improved Internet access. The diagram below shows the logical design of a five tower network. Four of the five towers have adequate line of sight between the towers to build a fully redundant ring between the towers, which will provide much more reliable service (that is, a single tower or equipment failure will not affect service).



Any placement of new towers should be preceded by a careful viewshed analysis (how much area/users are likely to be able to receive service). Site acquisition and site preparation costs can affect the overall cost of such a project. Existing county properties (e.g. fire/rescue stations, county parks, dump transfer sites, etc.) may be candidates for towers. Note that existing towers may require an engineering study to confirm that additional antennas can be added without exceeding the tower load limits.

6.4 EXISTING TOWER IMPROVEMENTS

For towers currently owned by the counties, and/or State-owned towers (where permission is obtained to lease space) or other stakeholders that might be candidates for project use, modest upgrades to equipment at the base of the tower would make them "broadband-ready."

Upgrades to existing towers typically may include adding or upgrading generators, additional cabinet or shelter space for service provider equipment, and sometime fencing and physical access changes.

Note that this estimate represents a "worst case" scenario. If the site already has a generator that can be used by a new WISP co-locating on the tower, that could reduce the cost by as much as $7,500. If no road improvements are needed and existing electric service does not require a new H-frame and meter, another savings of up to about $3,000 is possible. If the tower has a current certification (i.e. had a formal engineering inspection), additional savings are possible, bringing the 'best case" cost to about $11,000 to $12,000.

TOWER SITE DEVELOPMENT AND IMPROVEMENTS-1

ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Tower Study / Survey	1	$4,500	$7,000	$5,750
Site Development (Clearing, Road Improvements, etc.)	1	$0	$1,500	$750
Small Telecom Cabinet AMPROD AM47P-2636-24RU OR EQUIVALENT, ALUMINUM CABINET - FRONT AND REAR DOORS- HVAC/HEAT - ADJUSTABLE RACK RAILS 19"	1	$6,000	$7,500	$6,750
10kW Liquid Propane Generator	1	$4,000	$6,000	$5,000
Cabinet Foundation and Installation	1	$2,500	$4,000	$3,250
New Power Service / Installation ASSUMES POWER AVAILABLE ON SITE, New meter placement required to support WISP equipment	1	$1,500	$2,500	$2,000
Power System Installation Labor	1	$300	$500	$400
Generator Installation Labor	1	$1,250	$1,700	$1,475
Propane Service Installation TANK FURNISHED / INSTALLED BY LOCAL GAS PROVIDER	1	$750	$1,250	$1,000
Total:				$26,375

6.5 COLOCATION SHELTER

One colocation shelter may be needed in each county to provide a meet-me point for service provider equipment and related backhaul network equipment.

Co-location facility

ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Small Telecom Shelter	1	$15,000	$30,000	$22,500
Foundation	1	$2,500	$5,000	$3,750
Crane Rental & Installation	1	$1,000	$2,500	$1,750
10kW Liquid Propane Generator	1	$4,000	$6,000	$5,000
New Power Service / Installation Assumes power available on site, New meter placement required to support equipment	1	$1,500	$2,500	$2,000
Power System Installation Labor	1	$300	$500	$400
Generator Installation Labor	1	$1,250	$1,700	$1,475
Propane Service Installation - Tank furnished & installed by local propane provider.	1	$750	$1,250	$1,000
Handholes, fiber construction NRC, patch panels, etc.	1	$10,000	$15,000	$12,500
Racks, locks, cameras, monitoring devices, etc.	1	$5,000	$7,500	$6,250
Project management, site engineering	1	$7,500	$7,500	$7,500
Total:				$64,125

6.6 NEW TOWER

New towers have a range of configurations and cost options. This estimate is for a new 180' tower with no radio equipment (that is, the cost of the bare tower). If located on existing county properties, the time needed to plan for construction can be shortened. If site acquisition or a site lease (of private property) is required, purchase or lease negotiations can add several months to the process. Note that a full permitting process may be required even if a new tower is placed on existing county-owned property. The permit process can add sixty to one hundred and twenty days to the time needed to put a new tower in service.

ITEM/PROJECT	Units	UNIT COST LOW	UNIT COST HIGH	TOTAL (AVG)
Labor and Contracting: $82,640.00				
Site Development (Clearing, Road Improvements, etc.)	1	$15,000.00	$15,000.00	$15,000.00
New Power Service / Installation	1	$1,250.00	$3,450.00	$2,350.00
180' Guyed Tower Construction Labor & Contracting	1	$50,000.00	$74,750.00	$62,375.00
Cabinet Installation Labor	1	$600.00	$1,150.00	$875.00
Power System Installation Labor	1	$300.00	$575.00	$437.50
Generator Installation Labor	1	$1,250.00	$1,955.00	$1,602.50
Materials: $35,735.00				
180' Guyed Tower Construction Materials	1	$17,500.00	$27,500.00	$22,500.00
Small Telecom Cabinet	1	$4,000.00	$6,000.00	$5,000.00
Cabinet Foundation and Installation Materials	1	$1,000.00	$1,500.00	$1,250.00
10kW Liquid Propane Generator	1	$4,000.00	$6,000.00	$5,000.00
Spare Fuses	1	$10.00	$20.00	$15.00
Power System Installation Materials	1	$20.00	$40.00	$30.00
Samlex 1000W Inverter	1	$350.00	$450.00	$400.00
Samlex SEC1230-UL Battery Charger	1	$200.00	$300.00	$250.00
100ah 12v Non Spillable Backup Battery	4	$250.00	$350.00	$1,200.00
DC Voltage Monitoring Device	1	$40.00	$60.00	$50.00
Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$40.00
Total:				$118,375.00
Project Management, Network Engineering, Testing				$23,675.00
Site Engineering, Surveying, Viewshed Analysis, Etc.				$9,500.00
Misc Fees, Technical Services				$7,500.00
Contingency				$11,837.50
TOTAL:				$170,887.50

6.7 NEW COMMUNITY POLE

A single wooden utility pole (or inexpensive steel lattice tower) with a line of site wireless connection to a 180' tower and local access radios could provide access to any residence with line of sight within a half mile or more. This would spread the cost of pole construction and equipment costs across several households or businesses. There are many areas in the region where there is a cluster of homes along a relatively short stretch of road. All of those homes could share the use of a single local utility pole access site.

If there were twenty homes that could receive service and the cost of the pole and equipment was $12,000, each household connected would have a one time cost of $600. There could be a matching grant program where each County could provide 50% of the cost of putting the pole and equipment in place, and the balance would have to be developed from other sources. Some localities are using this concept to offer WISPs exclusive access to the pole in return for a portion of the construction costs.

Pole costs vary depending upon what equipment is installed. Point to point link radio costs vary with distance from a nearby tower. More information is contained in Sections 6.9 and 6.10.

1	ITEM/PROJECT	UNITS	COST (LOW)	COST (HIGH)	BEST ESTIMATE
2	Site Development (Clearing, Road Improvements, etc.)	1	0	2000	$1,000
3	3x3 NEMA Box	1	$300.00	$600.00	$450
4	New Power Service / Installation	1	$500.00	$1,250.00	$875
5	60' Wooden Utility Pole Construction Materials	1	$2,500.00	$3,500.00	$3,000
6	Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$40
7	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,000.00	$3,000.00	$2,500
8			Total for pole installation		$7,865
9	Omni access radios and equipment	1			$7,429
10	Project management, procurement management	1			$2,500
11				Total for pole with omni antenna	$17,794
12	Point to point radio equipment if needed	1	$1,109.00	$6,300.00	$3,705
13				Average cost for pole with omni and point to point radio link	$21,498

6.8 ACCESS SECTOR RADIOS

At tower sites two wireless distribution technologies will be utilized. A 5GHz unlicensed system will provide broadband speeds to users connecting with clear line of site. A fixed wireless LTE solution, built on the same technologies as mobile LTE, will be utilized for customers with clear and near clear line of sight. LTE broadband equipment typically operates on 3.65GHz frequencies, and is a licensed technology. For would be subscribers that can not establish a connection additional ongoing deployment of neighborhood poles and similar solutions will be required.

Item	Units	Unit Cost	Total
LTE BASE STATION	3	$3,200.00	$9,600.00
LTE SECTOR ANTENNA	3	$275.00	$825.00
LTE CPE RADIO	30	$300.00	$9,000.00
CABLING ETC	1	$1,000.00	$1,000.00
LTE CPE MOUNTS	30	$13.00	$390.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	3	$249.00	$747.00
Ubiquiti 60-120 sector antenna Adjustable width sector antenna for fixed wireless broadband.	3	$170.00	$510.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	30	$129.00	$3,870.00
CPE Mounting Hardware (J-Mounts)	30	$13.00	$390.00
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	1	$189.00	$189.00
UPS – Battery backup systems will allow the WiFi hotspot to operate for a short time without grid power. For the hotspots, this is optional, but a plus when considering natural disasters or other emergency scenarios.	1	$300.00	$300.00
Cabling	1	$135.00	$135.00
Shipping			$1,347.80
Installation Costs for Access Points - Per Site	1	$2,000.00	$2,000.00
			$30,303.80

6.9 ACCESS OMNI RADIO

At neighborhood pole sites an unlicensed radio and 360° omni antenna will be installed. The system can be upgraded to 3 access points if it becomes necessary but initially the omni is better suited because of cost and frequency availability. Coverage from the neighborhood pole sites is modeled at 2.5km as a conservative estimate for visibility, however given clear line of sight the wireless signal can extend beyond that.

Item	Units	Unit Cost	Total
UniFi Wireless BaseStation XG Wi-Fi hotspot for parked users	1	$1,499.00	$1,499.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	3	$249.00	$747.00
Ubiquiti 360° Omni AP	1	$170.00	$170.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	15	$129.00	$1,935.00
CPE Mounting Hardware (J-Mounts)	15	$13.00	$195.00
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	1	$189.00	$189.00
UPS Battery backup systems will allow the WiFi hotspot to operate for a short time without grid power. For the hotspots, this is optional, but a plus when considering natural disasters or other emergency scenarios.	1	$300.00	$300.00
Cabling	1	$135.00	$135.00
Shipping			$258.50
Installation Costs for Access Points - Per Site	1	$2,000.00	$2,000.00
			$7,428.50

6.10 POINT TO POINT LINKS

The three tables below show three different backhaul radio pairs, with two unlicensed sets (AirFiber 24, AirFiber 5XHD) and one licenses radio set (AirFiber 11FX). Each set uses different frequencies and perform better at different distances. The licensed radios are less susceptible to interference and have higher bandwidth. A regional backhaul network between towers has several desirable characteristics:

- It reduces the cost to providers of being able to affordably offer service on all the towers.
- It increases the reliability and robustness of the WISP services because of the ring design (on at least four of the towers).
- County government data and/or public safety services could also be carried on the backhaul network to provide improved access to some remote facilities.
- K12 schools may be interested in having a redundant network to improve reliability of their existing fiber connections. This can be especially important during periods when online standardized testing is taking place.

AirFiber 24 Pair	Units	Unit Cost	Total
AirFiber 24HD	2	$3,000.00	$6,000.00
Shipping at 5%	1		$300.00
TOTAL			$6,300.00

AirFiber 5XHD Pair	Units	Unit Cost	Total
AF5XHD Radio	2	$429.00	$858.00
AirFiber X Antenna 5GHz, 23dBi Slant 45	2	$99.00	$198.00
Shipping at 5%	1		$52.80
TOTAL			$1,108.80

ItemAirFiber 11FX Pair Including Licensing	Units	Unit Cost	Total
AF11X Radio	2	$799.00	$1,598.00
AF11-CA Adapter Kit	2	$49.00	$98.00
AF11FX Duplexer	4	$199.00	$796.00
AF11 X Antenna 11GHz, 35dBi	2	$379.00	$758.00
FCC Licensing	1	$2,000.00	$2,000.00
Shipping @ 5%	1		$262.50
TOTAL			$5,512.50

16.11 FIBER TO THE HOME COST ESTIMATE

A neighborhood in Spencer was selected as a case study for fiber to the home. A "dark fiber" design is used to minimize the initial cost (all network electronics would be supplied by a private sector ISP) and to minimize ongoing day to day maintenance and responsibilities.

The costs identified in the study should be similar for other areas of the three counties where homes are relatively close together. This neighborhood could easily be connected to a regional wireless network for the Internet access via an ISP.

As noted in the previous section on Preliminary Design Modeling, a high performance microwave (wireless) link can be used to distribute Internet service to a cluster of homes or to a downtown business area where fiber is used to connect the buildings/homes in the cluster.

The table below provides a summary of the project, with about two and a quarter miles of fiber passing an estimated 175 homes with a 60% take rate, or about 105 homes connected with fiber via a fiber cable from the street to the home.

Spencer WV Neighborhood Pilot Route Overview

0	ITEM/PROJECT	VALUE
1	Miles of Fiber / Conduit Installed	2.21
2	Number of Handholes Installed	53
3	Splice Closures Installed	44
4	Cabinets Installed	1
5	Number of Customers Connected	105
6	Take Rate - Percentage of the Buildings Passed who are connected with a drop and ONT	60%
7	Aerial - Percentage of construction labor expected to be installed on utility poles.	0%
8	Trenching - Percentage of construction installed by trenching (Mini-ex, bucket, hand dig, trencher).	20%
9	Boring - Percentage of construction installed by boring or other HDD methods.	40%
10	Slot Cutting - Construction installed in streets using diamond saws and similar specialty equipment.	0%
11	Rock Saw - Construction method used to install conduit in ROW where rock prevents the use of other methods.	0%
12	Direct Bury - Percentage of construction installed by direct bury methods (plow, vibratory plow,	40%
13	Aerial Info	No Aerial Construction Estimated for this Neighborhood.
14	FOSCs	Fiber Optic Splice Closures (FOSCs) placed for every 4 buildings passed. (4 drops to a FOSC)
15	Other Notes	Estimated labor rates are based upon common rates seen for recent medium sized rural projects.

The table below provides a summary of estimated network design, engineering, and construction costs for the project. With 175 homes passed, the cost per home passed is estimated at about $2,126, and the cost of each home connected is an additional $1,055. It is possible that the cost of the fiber drop installation from the street to the home could be lower if a qualified local or regional firm could be identified to do the work.

Spencer WV Neighborhood Pilot Cost Summary

0	ITEM/PROJECT	ESTIMATED
1	Spencer WV Neighborhood Pilot Construction Materials	$50,902.07
2	Spencer WV Neighborhood Pilot Distribution Labor	$186,224.40
3	Spencer WV Neighborhood Pilot Structures, Cabinets, and Equipment	$21,415.00
4	Spencer WV Neighborhood Pilot Drop Construction	$110,775.00
5	Network Construction Subtotal	$369,316.47
6	Project Management, Network Engineering, Integration, and Testing	$55,397.47
7	Engineering, Permitting	$12,155.00
8	Misc Fees, Advertising, Technical Services	$2,500.00
9	Bookkeeping and Administration	$750.00
10	Other Costs Subtotal	$70,802.47
11	Project Total	$440,118.94
12	Contingency at 10%	$44,011.89
13	Project Total (with contingency)	$484,130.83

16.12 ESTIMATED TIMELINES FOR COMPLETION

Each kind of project will have its own timeline, and will vary widely depending on the type of funding. Grant funded projects may need six months to a year to plan and apply for funding, depending on where in the grant cycle the CCRBDC commits to applying for a grant and the length of time that the grant agency takes to review and approve grants.

Tower improvements and construction times can be dependent on weather (more weather related delays are likely in late fall through early spring) and on procurement. Most grant funded projects require careful attention to a public procurement process, which can add 90 to 180 days to the timeline.

Project Type	Project Execution Planning	Project Procurement	Project Engineering and Construction	Total Estimated Timeline
Improvements to existing towers	2-3 months	3-4 months	2 months	7-9 months
New towers of 180'	4-6 months	4-5 months	4-8 months	12-19 months
Small cell community broadband poles	3 months	2 months	2 months	6 months
Point to point tower backhaul links	2-3 months	3-5 months	1-2 months	6-10 months
Fiber to the home/ business projects	4-6 months	4-6 months	6-12 months	14-24 months