



The Professional Consulting Services Communications Consultant E-911

Design Alternatives

Sullivan County, New York

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Appendix A

Paging Technical Note

1. Overview

Blue Wing researched the viable system options based on the work conducted in the first three phases of the project. As noted in this section, these phases defined the resources available to meet the County's needs. Blue Wing provided recommendations for the systems, including operational upgrades, as desired. Blue Wing provided 4 different design plans: upgrade current system, UHF analog conventional solution, UHF Project 25 trunked solution and VHF Project 25 trunked solution. Only the VHF Project 25 trunked solution was reviewed because both sources of VHF spectrum will most likely require the use of Project 25-complaint solutions. The plans provide high-level system concepts for the different options. Blue Wing detailed the future operational and technical enhancements for voice, paging and mobile data. The spectrum plan and associated coverage capabilities have been prepared for a generic spectrum allocation because the spectrum solution has still not been resolved. For each design, the costs associated with the plans have been predicted. In addition, Blue Wing provided a project roadmap showing the general phases of implementation and an approximate time schedule.

2. Technology Options

2.1 Analog Conventional

Conventional analog with modifications can be an effective solution, however, the technology lacks some important features such as AVL and encryption. Conventional offers the most generous simulcast spacing of approximately 15-20 miles between sites. Analog conventional does not require the site to be linked by wideband microwave, which can greatly increase the cost of the interconnect solution. In addition, the product offering is the most cost competitive of all the solutions generally one-half to one-third of digital product offerings.

2.2 Project 25 Conventional

Project 25 conventional is a full-featured technology and provides the features required operationally by the County. However, the Project 25 conventional solution is currently only available with non-linear transmitters that force transmitter sites to be spaced 5-6 miles apart, which will cause significant burden to the design. Linear simulcast is projected to be available by at least one vendor in 2012. The interconnects required for Project 25 conventional are similar to analog conventional and can be accomplished without the need for wideband microwave. The Project 25 conventional, especially VHF-high band, is the most competitively priced digital Project 25 solution. However, because of the site spacing and the requirement for a large number of sites, Project 25 conventional was not reviewed.

2.3 Project 25 Trunked

Project 25 trunked is a full-featured technology and provides the features required operationally by the County. The Project 25 trunked solution is available with linear transmitters that allow the transmitter sites to be spaced 12-15 miles apart and, therefore, a substantial reduction in sites compared with Project 25 conventional. The interconnects required for Project 25 trunked require wideband microwave between the sites. Project 25 trunked is the least competitive marketplace and has the highest prices.

System Feature/Requirement	Analog Conventional	Digital Project 25 Conv.	Digital Project 25 Trunked
Caller Recognition			
Unit ID (UID)	Yes	Yes	Yes
Emergency	Yes	Yes	Yes
Caller Location			
AVL	No	Yes	Yes
Messaging			
Status Messaging (SMU)	Yes	Yes	Yes
Text Messaging	No	Yes	Yes
Security			
Encryption/Scrambling	No	Yes	Yes
System Access	No	Yes	Yes
Data			
19.2K Data/NCIC	No	No	No
Broadband Data	No	No	No
Site Spacing (Max - Miles)	15-20	5-6	12-15
Interconnect Bandwidth	Narrow	Narrow	Wideband
Subscriber Cost	\$500-800	\$1-3K	\$1.5-5K

Table – System Technology Options

3. Spectrum

The spectrum bands reviewed for Sullivan County were VHF-low, VHF-high, UHF and 800 MHz. VHF-low and 800 MHz were not the preliminary focus of the study because of interference and propagation characteristics.

3.1 VHF-Low Band

VHF-low was eliminated for two major reasons. The most important reason is the continued and growing noise floor in VHF-low band. As was shown in the early report, VHF-low has considerable noise levels across the County. VHF-low band is affected from many localized noise sources such as AC conversion and various RF mixing devices. These non-predictable noise sources have increased over the years and make the band a poor performing spectrum today with degrading performance in the future. In addition, VHF-low band does not have a digital roadmap; it will most likely remain analog and will not be eligible for federal grants. The feature set provided for VHF-low band will remain limited and will not provide the features desired by the County. However, VHF-low band provides interoperability with numerous Counties in New York that surround Sullivan County.

3.2 VHF-High Band

VHF-high band is the preferred band for the Sullivan County system. The propagation characteristics are the most favorable in the County's hilly terrain. VHF-high band also has a Project 25 offering, and there are numerous federal, state and surrounding County agencies that operate at VHF-high band. VHF-high band is unfortunately the most difficult to license because of congestion. Preliminary coverage maps are provided to show the coverage at VHF-high band.

3.3 UHF Band

The UHF band is the second-best band for the Sullivan County system. The propagation characteristics are slightly less favorable than VHF-high, but still better than 800 MHz. The UHF band also has a Project 25 offering, and there is a small offering of agencies in Orange County that operate at UHF. The UHF band is slightly easier to license than VHF-high band, but it's still a challenging band. Preliminary coverage maps are provided to show the coverage at UHF band. Based on results of spectrum attainment, the maps can be modified to show the predicted coverage.

3.4 800 MHz

The 800 MHz band was not seriously considered as a solution because of the poor propagation characteristics in terrain such as Sullivan County. It was predicted that to potentially receive the required coverage, an 800 MHz solution would require at a minimum of over 20 tower sites, which would be cost prohibitive for the County. Preliminary coverage maps were created to show the coverage at 800 MHz. 800 MHz provides a digital roadmap, but other Counties adjacent to Sullivan County are not using 800 MHz.

4. Coverage

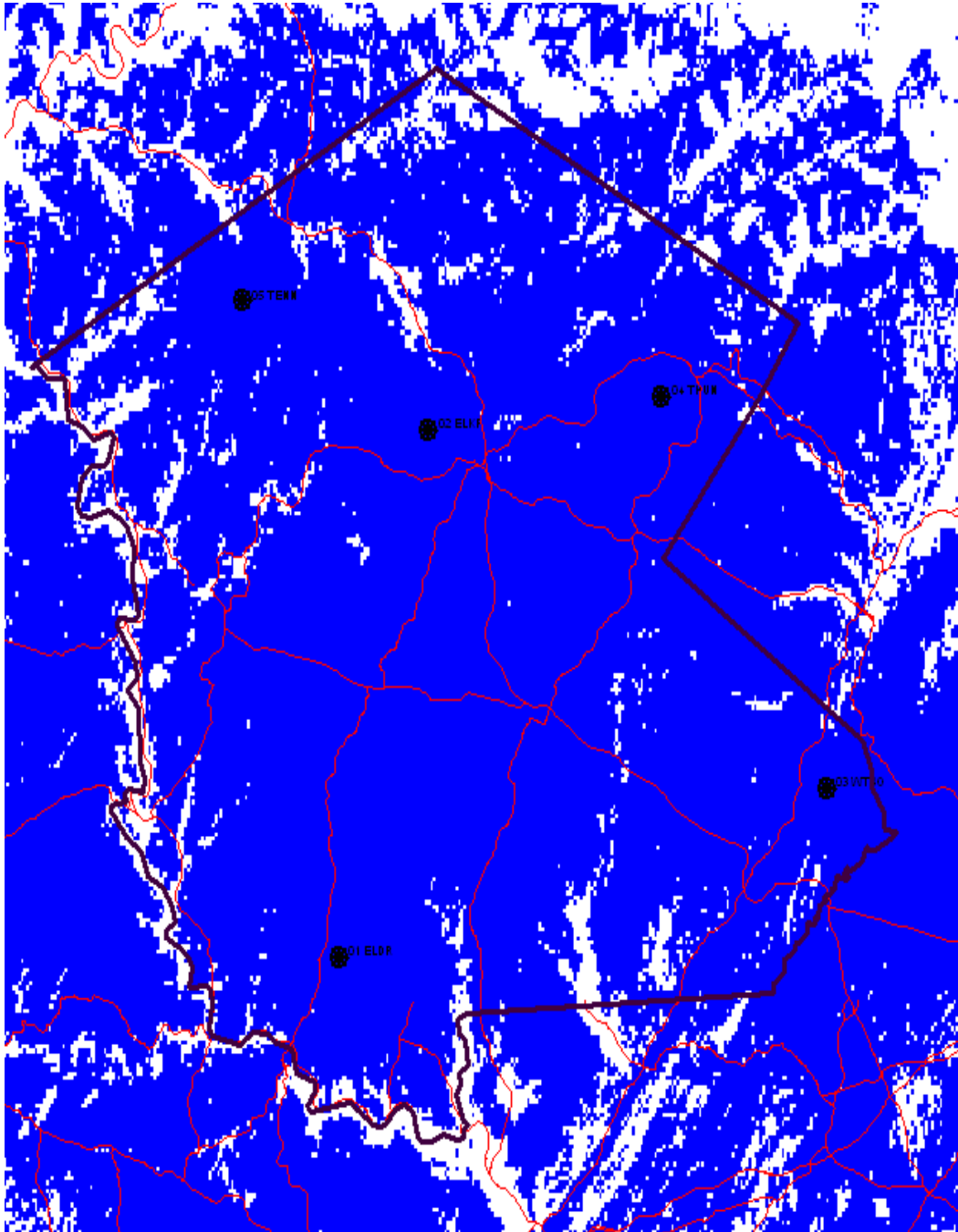
The following are preliminary coverage maps for VHF-high band and UHF. The maps provide preliminary coverage and will require adjustments to account for licensing constraints and simulcast considerations. When the final band is chosen, final coverage maps will be created and sites chosen to support the frequency limitations and the simulcast constraints.

The following table represents a summary of the propagation characteristics of the various two bands reviewed in simulcast operations. Using non simulcast operations, as is currently being used by the County, no one site has greater than 60ish% mobile coverage and most are substantially less.

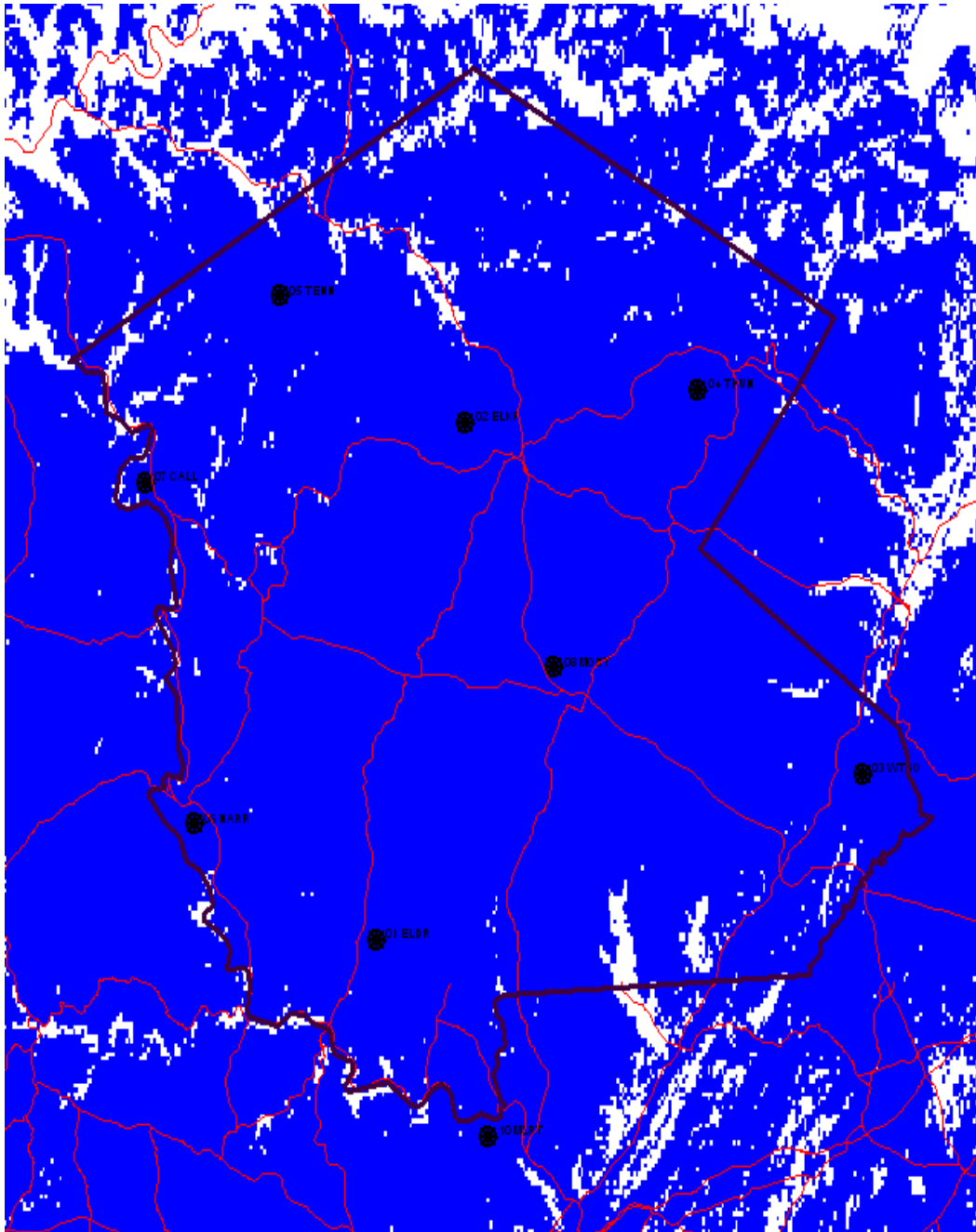
Criteria, 95/95 DAQ 3.4	5 Original Sites	Plus Monticello and 3 River Sites	Plus North/South Central Sites
VHF-High, Mobile	91.5	96.4	97.5
VHF-High, Portable	70.9	85.3	87.5
UHF, Mobile	79.5	87.2	89.8
UHF, Portable	62.6	72.5	76

The coverage maps below are provided for the VHF-high band and the UHF options.

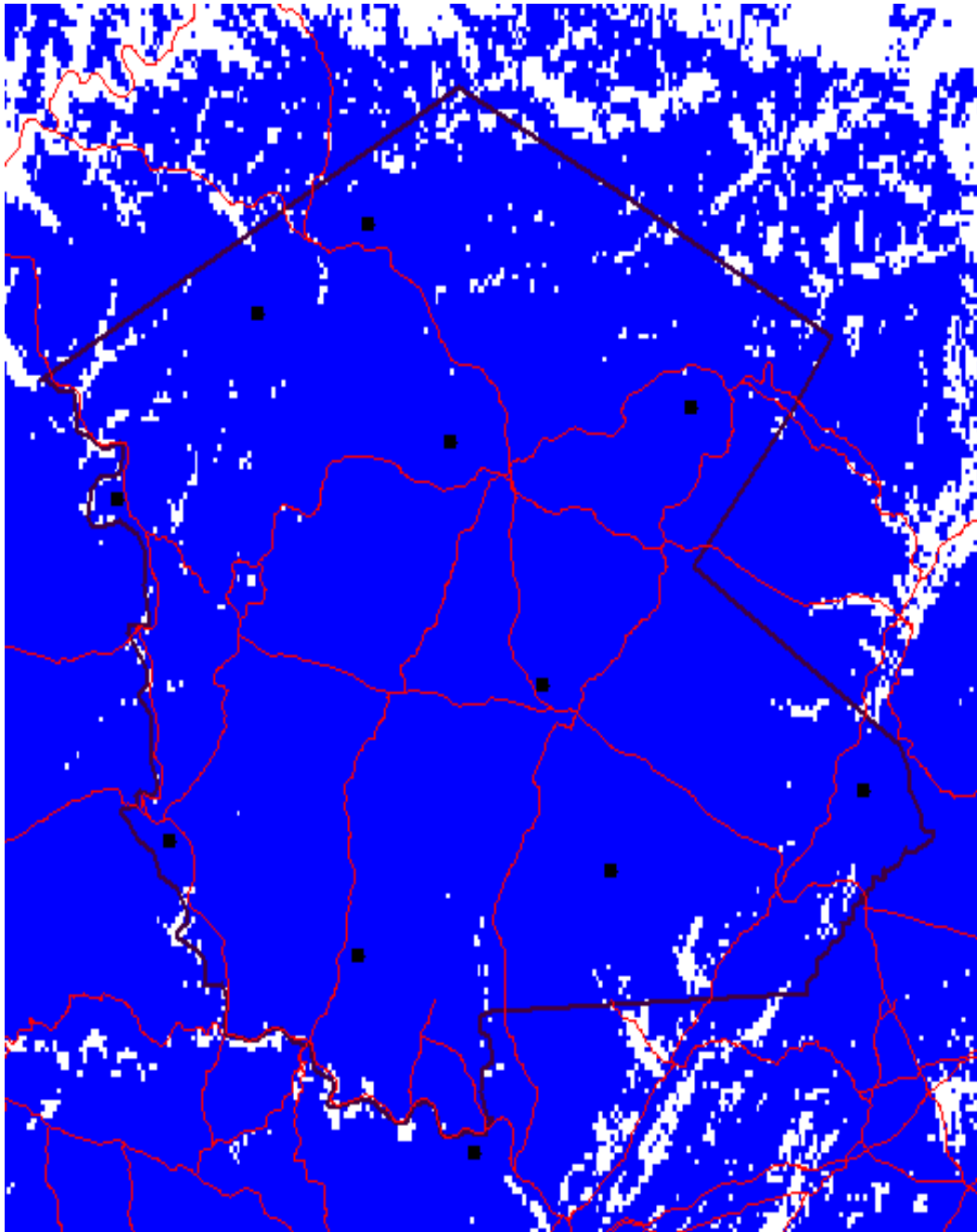
Coverage Maps VHF-High Band Mobile Coverage



5 Site Design – Original Sites

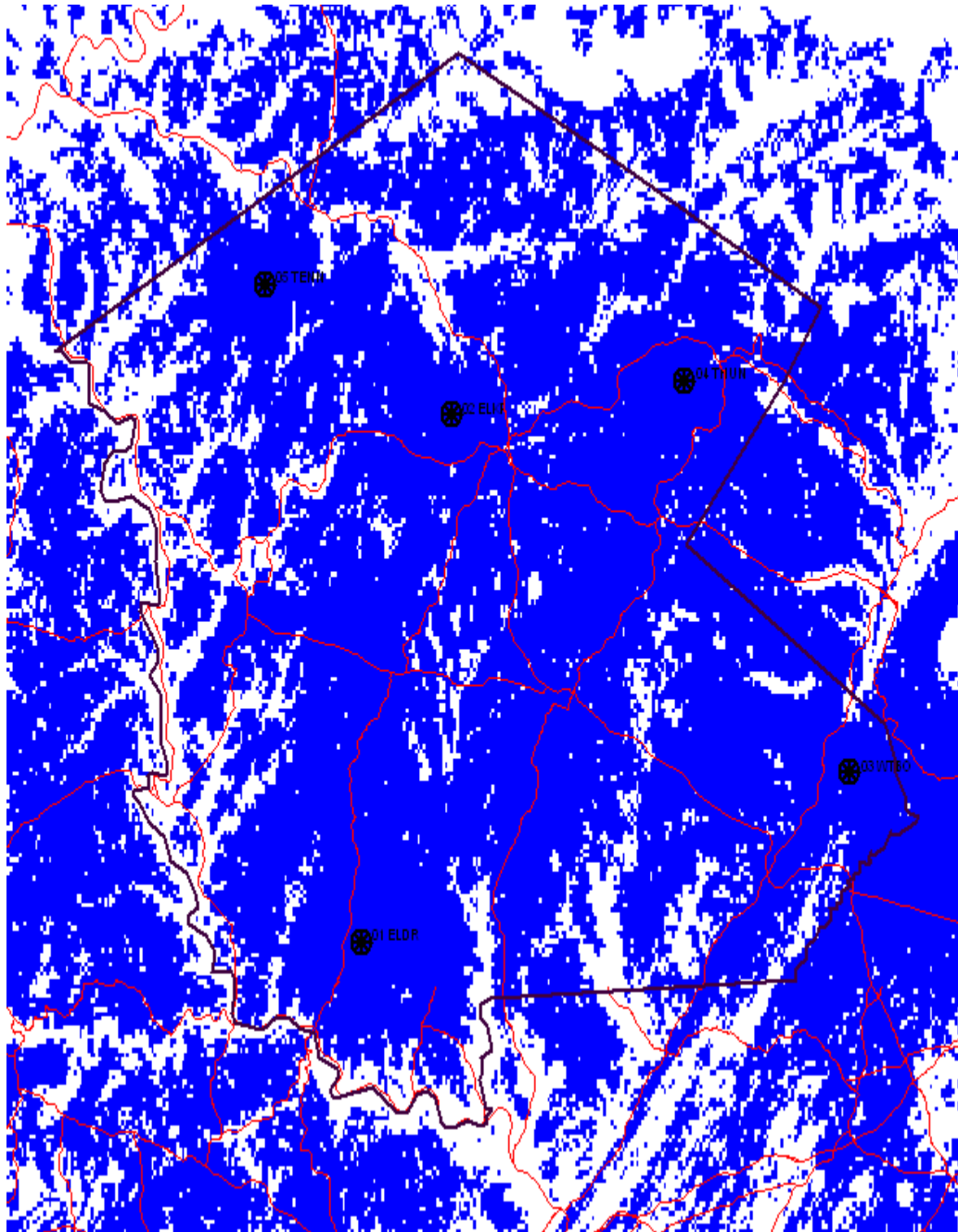


9 Site Design – Original Sites/Monticello/3 River Sites

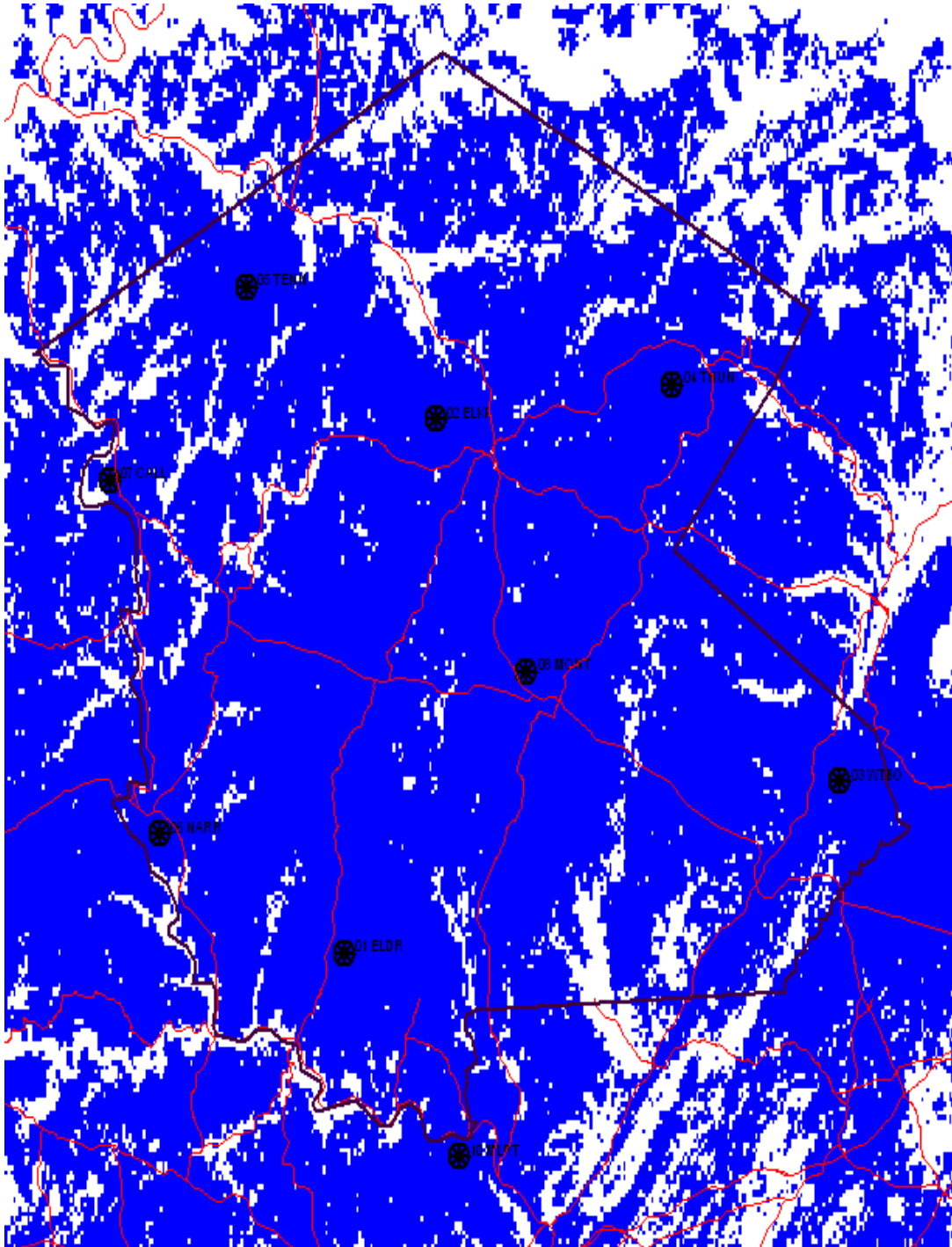


11 Site Design – Original Sites/Monticello/3 River Sites/North-South Central Sites

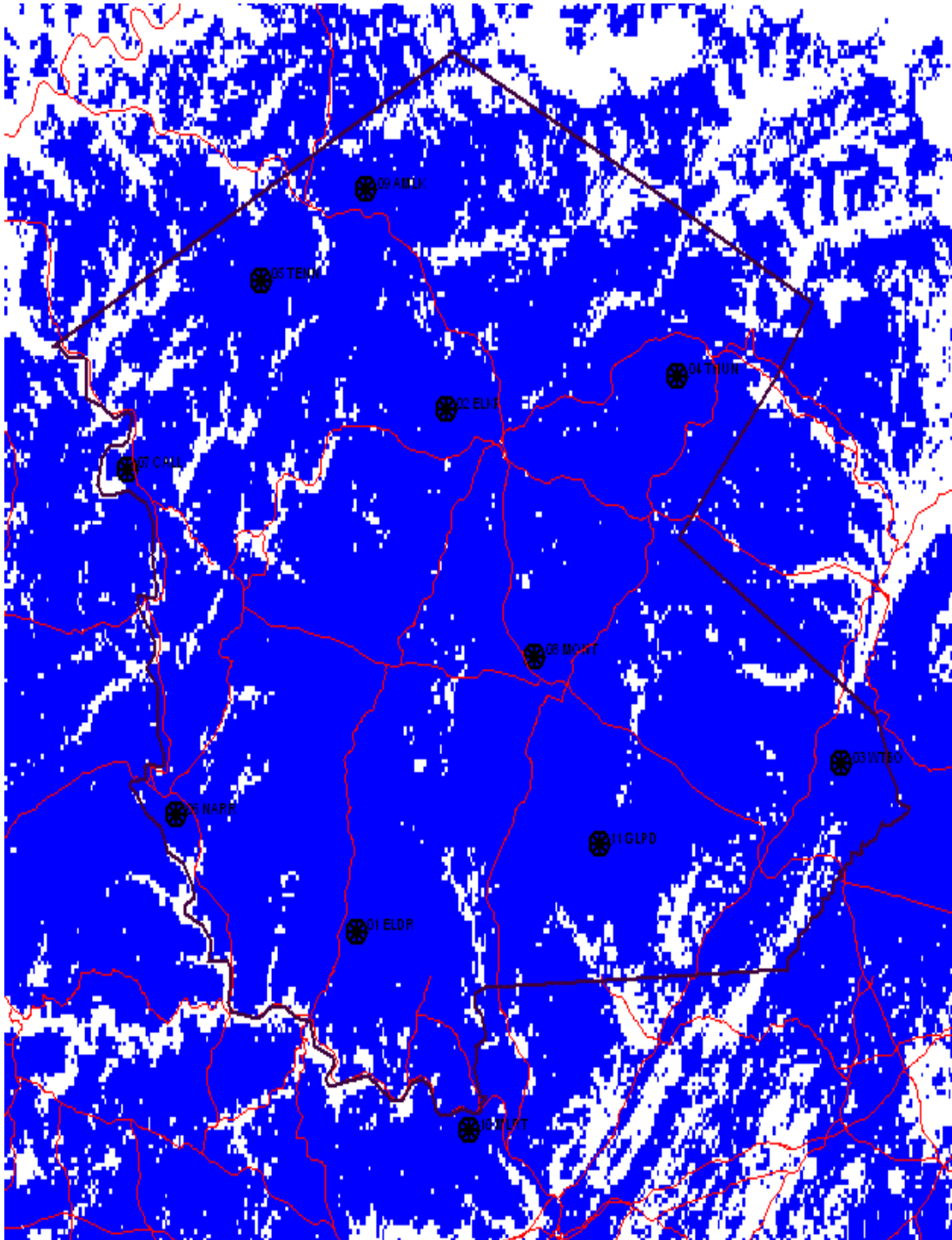
Coverage Maps UHF 95% Mobile Coverage



5 Site Design – Original Sites



9 Site Design – Original Sites/Monticello/3 River Sites



11 Site Design – Original Sites/Monticello/3 River Sites/North-South Central Sites

5. Interconnect

The site interconnect requirements have been reviewed for the three different technology options: analog conventional, Project 25 conventional and Project 25 trunked. Assuming hot-standby microwave redundancy, both the analog conventional and Project 25 conventional could be carried mostly over a narrowband microwave such as the 960 MDS microwave the County has currently installed. The design alternatives all would contain a 6 GHz core microwave system. Project 25 trunked requires one or two T1 connections at each site, which is greater than the 960 product is able to carry and, therefore, a wideband microwave at 6 GHz or 10/11 GHz would be required. The channel plan of the final system would be developed to determine capacity that would be required to connect the final system configuration.

6. Channels

6.1 Channel Requirements

The communications channel requirements were reviewed. The chart below outlines the results if the goals of the process and the frequency search are successful. The channels are broken down into four areas: paging, communications; tactical both wide-area and on-scene, interoperation both currently used channels and national interoperation channels. The specific purposes of the channels are presented in the Operational Enhancements documents.

System Feature/Requirement	Upgrade Current System	Analog Conv. System	Digital Project 25 Trunked
Channels			
Paging			
Dedicated paging channel	Yes	Yes	Yes
Communications			
Dedicated channel for each EMS and Fire	Yes	Yes	Yes
Overflow communications channel	No	Yes	No
Tactical			
1-8 tactical channels, preferably some wide-area channels	Yes	Yes	Yes
Interop			
Maintain current Fire, EMS and LE interop channels	Yes	Yes	Yes
Add national calling/tactical VHF,UHF and 800 MHz	Yes	Yes	Yes

Table – Channel Types

6.2 Channels Quantity

The table below outlines the channel requirements under each design option.

System Feature/Requirement	Upgrade Current System	Analog Conv. System	Digital Project 25 Trunked
Talk Paths			
Wide-Area			
4-6	No	Yes	Yes
On-Scene			
3-8	No	Yes	Yes

7. System Improvements

7.1 Communications Sites

As discussed in earlier reports, all of the existing Sullivan County communications sites would require new building and towers. The current building and towers, although adequate, would not provide the County the facilities for the next 20 years. In addition, it was assumed that all new sites would require new buildings and towers. It may be possible that some of these building may require collocation, but at this time it was assume new sites would be built.

System Feature/Requirement	Upgrade Current System	Analog Conv. System	Digital Project 25 Trunked
Communication Sites			
Upgraded Existing Sites			
New Building	5	5	5
New Tower	5	5	5
New Sites			
New Building	1	VHF-4/ UHF-6	VHF-4/ UHF-6
New Tower	1	VHF-4/ UHF-6	VHF-4/ UHF-6

7.2 Existing System Upgrade

This section highlights the upgrades that would occur to the existing system. These upgrades could be completed with existing channels at existing site location with the exception of paging which would require a new channel. In addition, VHF pairing of the EMS and Sheriff channel to allow for a repeater based operation, instead of simplex.

The upgraded system would include an additional site at Monticello. Additional channels and sites could be included to add coverage capability to the frequencies, but additional frequency and operational review would be required to ensure the licensing of the expand use.

The existing systems upgrade assumed that the majority of the current conventional network would remain, however, with upgrades to the configuration such as simulcast, voting and individual base station instead of the combination stations that exist today.

Fire with the exception moving to a new VHF-High band paging frequency would remain at VHF-low band. However, new base stations with independent operations from the other base stations and additional base stations at Monticello would be added to the system with the wide-area tactical channels being voted. EMS paging would be moved and accomplished on the paging channel.

EMS would remain at VHF-High band and preferably an additional frequency would be paired with the paired with the dispatch channel. The dispatch channel would also be voted and simulcasted. As with fire, new base stations with independent operations from the other base stations and additional base stations at Monticello would be added to the system.

Law Enforcement would remain at VHF-High band and preferably an additional frequency would be paired with the paired with the dispatch channel. The 911 dispatch channel would also be voted and simulcasted. As with fire, new base stations with independent operations from the other base stations and additional base stations at Monticello would be added to the system.

County DPW would have new base stations installed at the sites given the new site were all licensable.

National Interoperation Channels would be added to 5 sites with in the system for interoperation at VHF-High, UHF and 800.

The upgrades suggested would include replacing all of the current towers, shelters and upgrading the site electrical and grounding. In addition, a more robust and capable 6GHz microwave interconnect system would be recommended with MW spurs to sites using 960 MHz. Most of the suggested upgrades would provide the base infrastructure for future system enhancements.

System Feature/Requirement	Upgrade Current System
Basic Upgrades	
Separate Alerting/Dispatching Channel	Yes
Install all fixed T1/R1 base stations	Yes
Use Simulcast Transmit and Voted Receive Communications	
EMS	Yes
Fire	Yes, Voted Only
Law Enforcement	Yes
Similar Main and Backup Dispatch Environment	Yes
Enhanced Upgrades	
Upgrade to Digital Paging	Yes
Use of Enhanced System Feature Sets	No
Expanded Interoperability Channels National Interop Channels	Yes
Dispatch Center to Dispatch Center Interoperability Communications	Yes

7.3 New System Enhancements

Sullivan County has basically two different new system options, either Analog Conventional or Digital Project 25 Trunked. Within each flavor of system options, the County can either use VHF-High band or UHF depending upon band availability. Feature enhancements are fairly limited in conventional systems and will not drastically change with the change in bands. However, the County will gain significant feature enhancements with a migration to a trunked system, although basic voluntary signaling enhancements could be implemented. The most important distinguishing feature areas are system capabilities in guaranteed caller recognition and security. The trunked system operates as a network, which provides much more control over system access and subscriber capabilities. Also, the trunked system will offer a much enhanced and simplified method to add and segment user groups, which is currently in most cases extremely difficult. Overall, conventional system design can be a cost-effective and affordable solution, however, if needs are going to change significantly, a trunked system offers much greater flexibility for future growth.

System Feature/Requirement	Analog Conv. System	Digital Project 25 Trunked
Enhanced Feature Set		
Caller Recognition		
Unit ID (UID)	Yes	Yes
Emergency	Yes	Yes
Caller Location		
AVL	No	Yes
Messaging		
Status Messaging (SMU)	No	Yes
Text Messaging	No	Yes
Security		
Encryption/Scrambling	No	Yes
System Access	No	Yes
Data		
19.2K Data/NCIC	No	No
Broadband Data	No	No
Expandability		
Providing Additional Coverage	Yes	Yes
Ease of adding additional talk paths	No	Yes

8. Timeline

The timeline for implementation of the upgrade of the County's project is very dependent on the acquisition of the required spectrum and to a lesser degree the acquisition of sites. However, the sites that provide potentially the most difficulty in the Delaware River valley can be added to the system potentially after the majority of the system is installed. Therefore, the schedule below provides a high-level view of the rollout of the system. Blue Wing highly recommends that the County develop a clear spectrum strategy before moving forward with other elements of the system development.

ACTIVITY	2010	2011	2012
RESOURCE ALLOCATION			
Determine Frequency Plan	Sprg/Smr		
Determine Final Site Plan	Sprg/Smr		
FINAL DESIGN			
Design Recommendations	Smr/Fall		
Implementation Schedule	Smr/Fall		
PRE-BID SPECIFICATION PREPARATION			
Site Approval	Fall		
Spectrum Approval	Fall	Winter	
BID SPECIFICATION DEVELOPMENT			
Site Development Bid Specification		Winter	
Interconnect Bid Specification		Winter	
Radio System Bid Specification		Winter	
SYSTEM PROCUREMENT			
Site Procurement		Spring	
Interconnect Procurement		Spring	
Radio System Procurement			Sprg/Smr
SYSTEM INSTALLATION, TESTING AND CUTOVER			
Site Implementation		Sprg/Smr	
Interconnect Implementation		Smr/Fall	
Radio System Implementation		Winter	Sprg/Smr
Training			Summer
System Cutover			Summer

Table – Project Schedule

9. Conclusion

Overall, Sullivan County has very realistic and pragmatic needs objectives to improve the Public Safety/Public Service communications systems. The focus of the upgrades has been and should be paging and voice, as the data needs will be best served via commercial cellular service. Unfortunately, even the modest channel requirements that the County desires have been difficult to obtain. As with many systems in the region, the next and most important step for the County is to determine the spectrum plan. Blue Wing has investigated both the traditional methods and most of the non-traditional methods, with some potential solutions still to be played out. The spectrum choice will have the greatest impact on the solution and might require or limit only certain types of systems to be developed. In many ways, the Sullivan County project could be viewed as two separate projects; Existing System Upgrade and New System. The majority of existing system upgrades would carry over and provide significant value for any new system and, therefore, the existing system upgrades could begin prior to finalizing the new system direction. Blue Wing recommends that the County over the next few months focus mainly on new spectrum acquisition, to gain direction on the path for the new system, and, potentially, review current and new site availability to ensure the two most difficult hurdles are overcome before moving forward and finalizing the technology direction.