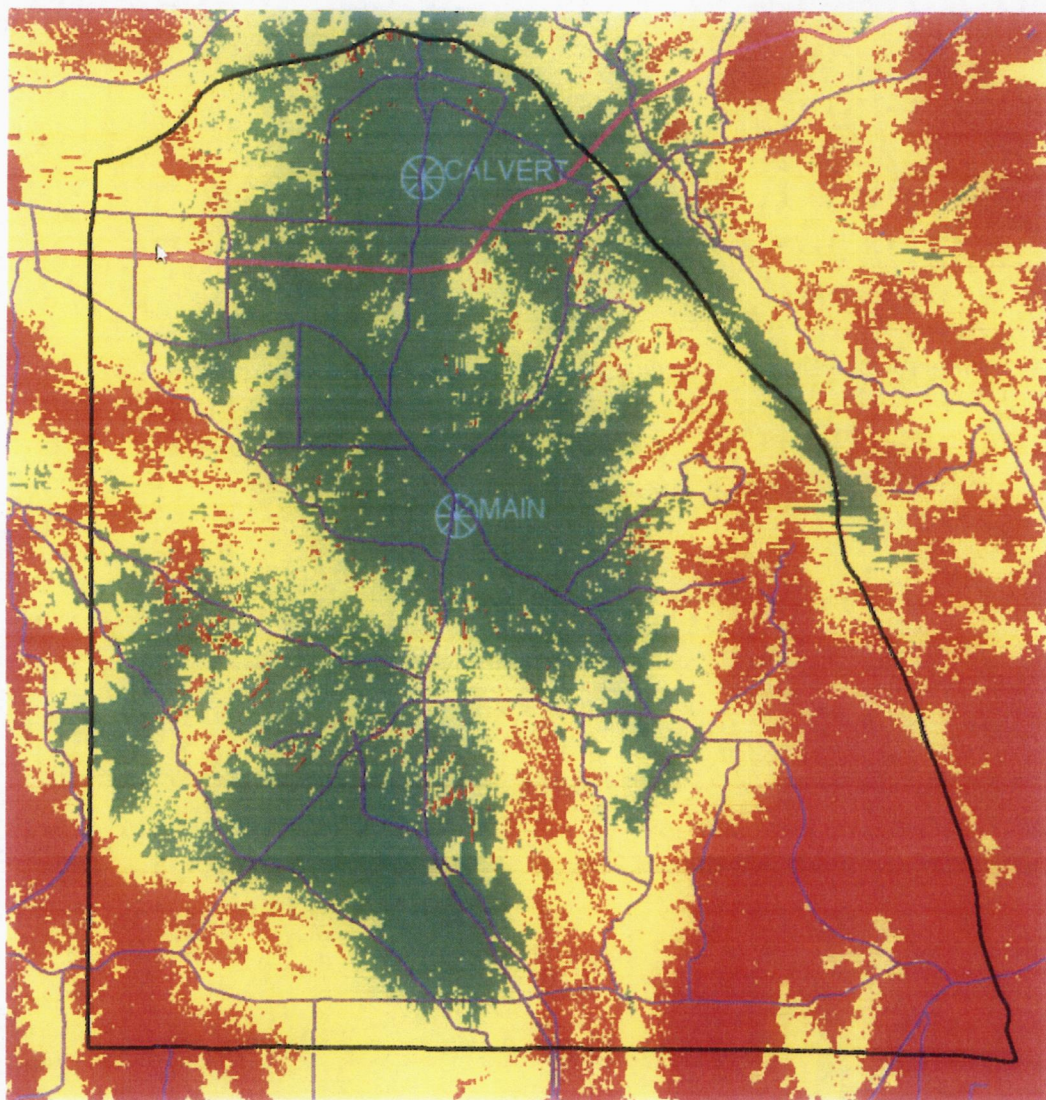


**Portable Coverage – Two Site TALK-IN (Voter) (As Discovered)**



**76.3% Coverage of Marshall County Boundaries meets -95dbm (Yellow)**

**This coverage represents an inbound call to dispatch. Outbound coverage limited to Main Site footprint.**

**Legend:**

Red = Below -95dbm design margin

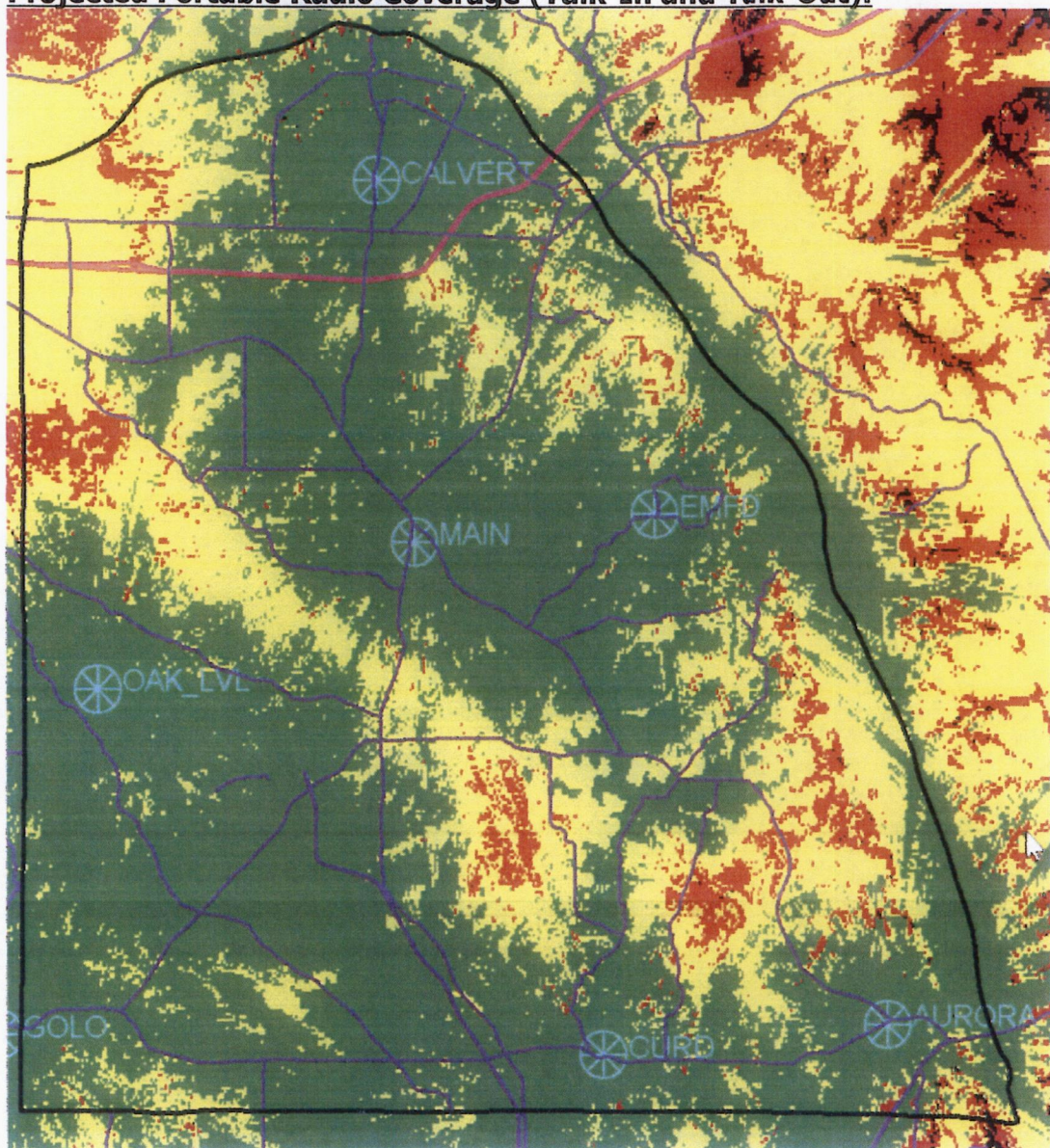
Yellow = Exceeds -95dbm up to -85dbm (10db above design margin)

Green = Exceeds -85dbm





**Projected Portable Radio Coverage (Talk-In and Talk-Out):**



**96.1% Coverage of Marshall County Boundaries meets -95dbm (Yellow)**

**This coverage represents an inbound call to dispatch. Outbound coverage is engineered to match the inbound; resulting in the same mapping.**

**Legend:**

Red = Below -95dbm design margin

Yellow = Exceeds -95dbm up to -85dbm (10db above design margin)

Green = Exceeds -85dbm (20+db above design margin)





**Interpretation of above data:**

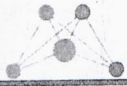
The above information is an audit checklist taken from the 2005 Motorola R56 Standards manual; which can be found online in various forms (digitally). I have printed a reference copy for your use. This book has often been referred to as an "industry standard" - although each manufacturer has their own variant with the same or similar materials. The concepts, suggestions, and specifications are sourced within this guide; as they pertain to each subject-matter and the relevant standards as they apply. Your system infrastructure is largely Motorola based, therefore this standard should have been known to the agencies providing service.

In general terms; the current Marshall County sites are typical of public safety customers whom have not had the benefit of direct or knowledgeable supervision during system construction. Either no followup installation checks were performed, or the work was performed sub-standard but was working at time of installation; thus releasing funding by doing performance-based testing. IE: Radio coverage was tested and shown to have improved, therefore funds were released; as staff did not possess the tools or knowledge to verify the equipment had been properly installed.

As with most continued customers; some communications providers are tasked with commissioning equipment with little to no supervision. This relies on a factor of trust between the provider and the customer - that the job is to be performed completely and performed to industry standards. Unsupervised installations, or assumptions that service providers are going to use industry best-practices are often falsehoods in the telecommunications field. It is not uncommon to have clauses within contracts to deal with such defects, or to require a project manager competent in the tasks at hand to ensure that poor craftsmanship is not tolerated; and that all items purchased have been installed are accounted for.

Typically, better specifications and supervision can aid you in ensuring a properly operating, reliable system. Things such as delegating a project manager/agent to manage your project can ensure that all subcontractors are doing precisely what they are being engaged to do at all phases of construction and during system commissioning. These tasks may involve, for example, requiring inspections of all exo-thermally welded grounding connections (which will be buried); or requiring photographs of all aerial connectors, both before and after weatherproofing seals are applied; as well as each intermediate connection. With digital cameras and modern test instrumentation being as ubiquitous as they are - excuses are further limited by vendors for not taking photographs, proving alignment or installation values, or otherwise proving their craftsmanship.





This type of documentation standard is commonplace in cellular and other critical infrastructure implementations; as well as advanced diagnostic metrics upon installation. There are tests which can "sweep" the coaxial cable and antenna to prove it's functionality meets the manufacturers specifications and is installed properly to the tower. More importantly, this provides a known reference for what it's performance characteristic looked like upon commissioning. Subsequent annual checks can also be kept in a records book, along with the commissioning reference, to analyze any degradation. This can also be helpful should a qualifying event occur (lightning strike, wind storm, tornado, etc) the data can quickly be referred to by an engineer for reference to determine if any substantial damages have occurred.

Modular communications believes that your infrastructure should be built to the highest standards. There are questionable enough circumstances which require personnel to be in the way of harm; lack of ability to summon back-up should not ever be a part of that equation. We have found several single-point-of-failure mechanisms within your existing network which should be rectified prior to any further remediation or replacement efforts.

#### **Draffenville Tower:**

The 300' guyed tower appears to the naked eye to be in good shape. No records are available regarding the last time a complete tower inspection was performed. This tower shows a construction date of 2002. This tower should be inspected by a qualified crew per ANSI/TIA-222 Standards (Revision G as of this writing). It appears that all major elements have been grounded and installed properly; however, actual testing of the ground network and excavation of the guy anchors will yield the status of galvanic corrosion (which is natural and expected) of the structural integrity of this site.

This site was found to have several corroded and disconnected batteries as well as several consumer grade UPS units on-site. Consumer grade UPS units are generally unsuitable for continuous operations such as a public safety dispatch center; however, the counties' units tested instantly failed upon AC power failure, resulting in the equipment plugged into them requiring a reboot period lasting about seven minutes. This will result in a radio outage for users; and should be rectified.

The 12kw generator unit was installed in approximately 2001; however, when we attempted to start and run the generator, it took four attempts to get the unit to crank and start. The oil filter indicated a service in 2017; however, it is unknown if the starting problem is related to the electronics or age of the unit.

There is a consumer-grade air conditioner unit mounted in the gable-end of the building, powered on throughout the winter. Aside from not providing year-round temperature and humidity controls; this unit is generally energy inefficient. Consider





upgrading this unit to a mini-split type unit, which has an inverter to provide suitable heat in the winter, as well as sufficient cooling of the room in the summer. Equipment is able to operate reliably at 55F in the winter, and 78F in the summer.

Accessing the building was problematic. It was suggested the sheriffs' office implement a form of access control; either by providing a lock-box for contractor use on site and controlling the combinations from dispatch (most expedient and least costly) or requiring a set of keys be signed out at the dispatch center. All current keys should be made invalid or recalled to prevent unauthorized entry.

#### **Calvert City Tower:**

This 220' guyed tower shows a construction date of 1/1/1980 as it was entered into the FAA database. This tower has several concerns; the most critical being that two of the three guy anchors are encased in trees and brush for approximately 1/3 the length of the tower. These will need to be removed professionally by a tower crew as to not topple the structure; and measures should be taken to prevent future vegetation from re-growing within 20 feet of the guy anchor structures. This tower should be inspected by a qualified crew per ANSI/TIA-222 Standards (Revision G as of this writing).

The interior of the shelter has a space heater, and was warm (78 deg F) on our arrival, with the exterior temperature at approximately 25F. There is no air conditioner facility at this site, nor is there a stand-by generator. A manual generator is on site and operated by the water district when required. There is no DC or AC Generator backup power for any equipment on site.

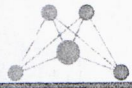
Ancillary equipment on site includes some wireless network equipment which is poorly installed and ungrounded, as well as several cross-band repeaters comprised of Motorola CM200 or R1225 mobile radios. There is a CDR500 mounted to the wall, although it is also unlabeled.

None of the sheriffs' equipment (microwave, nor antenna) is grounded. There is no lightning protection on the antenna. It has been mentioned that this equipment has been replaced more than once. Inspection suggests this is due to a non-compliant installation practices, and remedial action should be taken ASAP.

#### **Cedar Tower:**

This 330' guyed tower shows a construction date of 1/1/1988 as it was entered into the FAA Database. This tower is currently in use as a FM broadcast station. We were unable to enter the shelter, but it is recommended we discontinue use of this shelter due to the mixed-use nature of the shelter as a storage facility.





**Dispatch Tower:**

This tower is likely original to the dispatch center. The 57' tower is sitting atop a mesh-steel roof panel; and is short-guyed in place with guy wires. The structure does not appear to comply with ANSI/TIA222 Standards; and likely was non-compliant upon it's initial installation. This tower has considerable loading by various WISP-type panel antennas, as well as several disconnected (abandoned) cables and dishes. I suggest any ancillary equipment not necessary for public safety personnel be removed from this tower as expeditiously as possible; and having a qualified tower company fully evaluate the current installation to make further recommendations. The tip height on this structure is at one-hundred feet above ground, which may allow for connectivity to the Draffenville site directly – if the structure can physically support the equipment. There is no rooftop cable management; nor is there proper lightning protection at the building entry. There are lightning arrestors within the sheriffs' office, but their implementation is not up to specification.

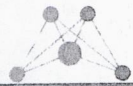
**Dispatch Center:**

There is a (3) position Motorola MIP5000 Dispatch center with (10) IP to Tone Remote gateways. There are two consumer level Ethernet switches in use. The rack which contains all of the critical communications equipment for the dispatch center is located in the main dispatch room. There are local microphones for each radio, should the dispatch console fail. There is no back-up two-tone paging encoder; which would be used to alert Fire and EMS personnel of a call using pager devices.

Each dispatch position should be powered by a minimum of two commercial UPS units; in such a way that if one UPS position fails; either the CAD – or the Radio Dispatch Console system fails – but not both simultaneously. The rack powering dispatch has a small UPS connected; however, the use of Astron ferro-resonant power supplies with a switched-mode UPS is not an approved NFPA 1221 method for dispatch operations. It is suggested that the rack (with mobile radios) be powered via DC power supply, and a sealed-lead-acid battery power supply be established with sufficient capacity to allow transfer to generator power during an outage.

In addition to these concerns, there are no less than five models of radio equipment in use; several of which have the protective covers removed. This cover is intended to be in place to draw air past the heat sink on the radio transmitter and through the power supply. It is also worthy of noting that much of this equipment is beyond end of life (EOL). A singular, common radio platform should be chosen, and deployed across the entire rack for all channels in use. It is suggested that all radios be programmed in such a way that a dispatcher may change channels to allow a 'momentary work around' - should a radio fail while in operation.





The conceptually proposed radio system will deliver its interface via Ethernet and microwave technology to an industry-standard DFSI (Digital Fixed System Interface); a standard in which the consumer level current (Motorola) console is not capable of interfacing to. A DFSI-to-Analog 4-Wire interface unit is available; and will be quoted – however, it is suggested that the existing console be upgraded to a public-safety grade installation simultaneously. This will ensure that dispatch has full-duplex audio (Per NFPA1221 specification) which will provide the ability to over-ride a 'stuck microphone' or communicate with field units, should one occur. The console and furniture should be properly grounded, powered, and provide sufficient backup facilities that provide sufficient redundancies for current NFPA1221 operational standards – such as a redundant backup radio with tone remote encoder; as well as accommodation for possible future needs based upon call volume assessments and trending.

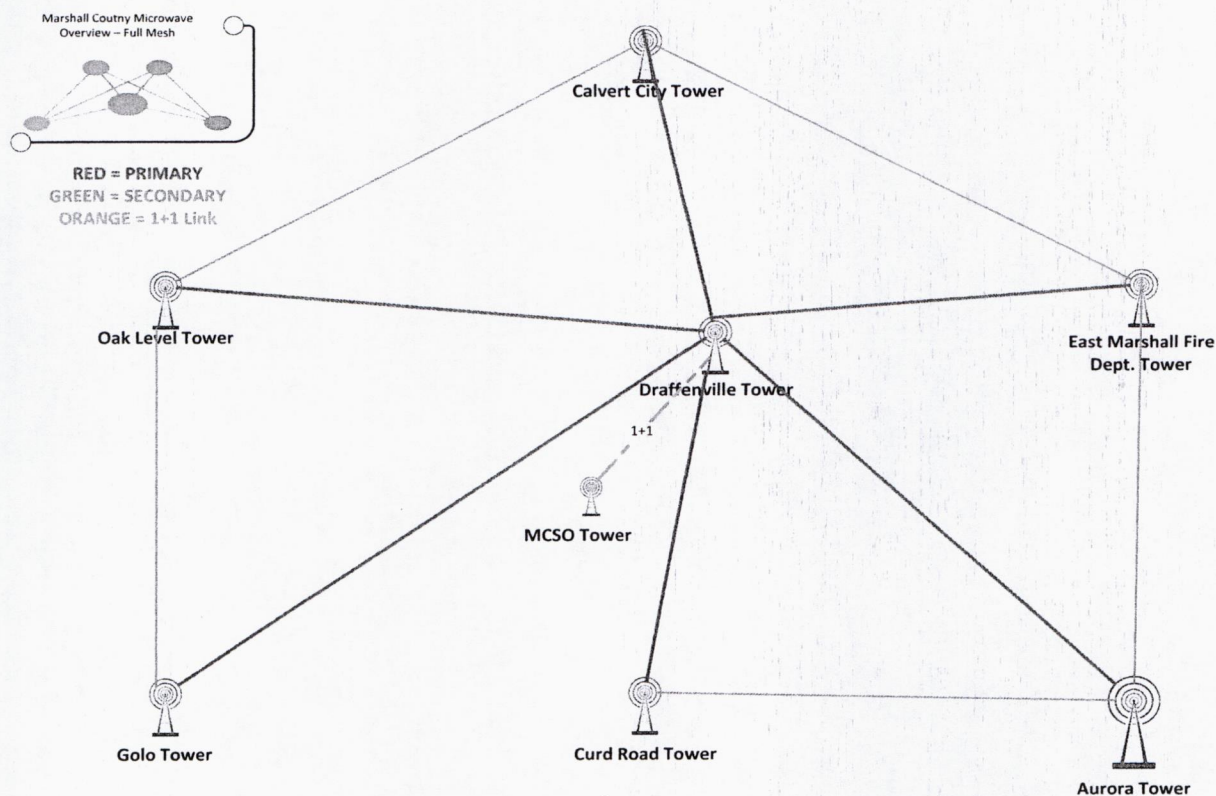
The quality of work at this facility does not meet industry standards for primary public safety answering point site installation and implementation. This center is largely non-compliant with NFPA1221 guidelines – in reference specifically to the suitability of space, independence from remainder of building, the lack of physical security mandated for a PSAP of this vantage; and the difficulty in retrofitting such a space into compliance. All of these considerations should be weighed when determining the suitability of the available space within the facility and the future needs of the county.

#### **Identification of Potential Sites**

Sites listed below have been modeled with theoretical capabilities which would resolve communications issues being experienced by Marshall County Sheriffs' Office on portable radio throughout the county. Where possible; newly constructed or existing sites are used to minimize cost of deployment and modernization.

1. Draffenville Tower (Existing – 300' Guyed Tower)
2. Calvert City Tower (Existing – 220' Guyed Tower)
3. East Marshall Tower (WKRECC – New 180' Self Supported)
4. Aurora Tower (Either new, or use existing water tank)
5. Curd Road (WKRECC – New 140' Self Supported)
6. Golo Tower (WKRECC – New 180' Self Supported)
7. Oak Level (WKRECC – Existing 200' Guyed Tower)

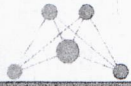




### Network Description and Philosophy:

The above depiction shows the available sites in rough geographical correlation to one another; as well as logical connections between the sites. Preliminary engineering studies have been performed at tower elevations sufficient enough to verify that line-of-sight is available and connectivity will remain high (99.995% or better). Since there are multiple links presented at each site in a redundant fashion; the likelihood of dual ring failure is minimal. We recognize that it may not be cost effective to build all of the 'secondary' (red) network, however, connections to Curd road, Golo, and Calvert would be recommended at a bare minimum to ensure sufficient redundancy within the network.





**Categorized coverage:**

Boundary		≥ -85	≥ -95
Marshall_County		70.4%	96.1%
0.0%	No_Data_Available	0.0%	0.0%
8.6%	Water	61.8%	98.3%
0.0%	Snow_&_Ice	0.0%	0.0%
0.0%	Wetland	83.3%	100.0%
0.0%	Openland	75.0%	100.0%
0.0%	Rangeland	100.0%	100.0%
0.8%	Transportation	78.5%	100.0%
41.6%	Agricultural	81.9%	99.6%
2.0%	Residential	84.1%	99.5%
46.2%	Forest	60.6%	92.4%
0.3%	Mixed_Urban/Buildings	80.0%	97.4%
0.4%	Commercial/Industrial	89.1%	98.8%
0.0%	High_Density_Urban	0.0%	0.0%

The coverage statistics shown break down the classification of each 1 arc-second (roughly 3' x 3') tile within the county per US Geological Survey data. Per the counties desires, the design shows **greater than 95% coverage at the minimum acceptable signal level (-95dbm) throughout the county.**

**Costing / Rough Order of Magnitude:**

**Estimated 8 site radio system (includes dispatch equipment) w/ all microwave links, licensing, hardware and software license keys – assumes use of Aurora Water tank (no tower construction) and all existing radio sites are able to meet code with \$20,000 or less in improvements:**

**\$1,302,015.00 (Rough order of Magnitude)**

**Replace existing 3 Position MIP5000 with Avtec Scout w/ 8 Radio channels, Dedicated select speakers for existing radio channels, ScoutCare warranty, and replacement radio rack within dispatch facility – Assumes existing radio tower on PD is capable of passing structural analysis and that no new antennas are required:**

**\$225,555.00 (Rough order of Magnitude)**

**Actual costing assumptions attached to this report; all pricing is rounded 'up' - the costing is provided for generic components. Design of preferred site components is the responsibility of the final bidder.**



# Marshall County ROM

## Marshall County ROM

Site Remediation	\$20,000.00	3	\$60,000.00
Microwave Link (Non Redundant, Licensed)	\$21,350.00	11	\$234,850.00
Microwave Link (1+1 Redundant, Licensed)	\$30,600.00	1	\$30,600.00
Microwave Licensing	\$1,750.00	13	\$22,750.00
SCADA System & Sensors	\$7,500.00	8	\$60,000.00
Implementation & Deployment of SCADA	\$2,250.00	8	\$18,000.00
Site Cabling (RF Jumpers, Revisions)	\$2,500.00	8	\$20,000.00
Simulcast Radio Repeater (25Watt)	\$20,000.00	8	\$160,000.00
Combiner Hardware	\$17,500.00	7	\$122,500.00
Dual Antennas, Feed Lines, GPS Ant, Surge Arrestors	\$7,700.00	7	\$53,900.00
Site Enclosures (Oak Level, Curd Rd, Aurora, EMFD, Golo)	\$4,500.00	5	\$22,500.00
Site Racking (Draffenville, Calvert City)	\$3,000.00	2	\$6,000.00
Site HVAC Installation (Draffenville, Calvert City)	\$3,000.00	2	\$6,000.00
Site DC Power Generator (All RF Sites)	\$5,500.00	7	\$38,500.00
Fuel Delivery (Fill tanks)	\$350.00	7	\$2,450.00
DC Battery – Per Site (400ah array)	\$3,000.00	7	\$21,000.00
DC Battery Management / Charger	\$1,000.00	8	\$8,000.00
DC to DC Converters (12-48vdc)	\$1,350.00	8	\$10,800.00
DC Distribution Panel	\$1,150.00	8	\$9,200.00
DC Lighting	\$150.00	8	\$1,200.00
DC Surge Arrestor	\$250.00	8	\$2,000.00
Site Routers	\$1,350.00	8	\$10,800.00
Misc. Cabling (DC Power, Ethernet)	\$650.00	8	\$5,200.00
Ground Buss Bar	\$275.00	8	\$2,200.00
Lighting Arrestors	\$200.00	8	\$1,600.00
Freight and Delivery	\$1,350.00	8	\$10,800.00
System Staging	\$6,500.00	8	\$52,000.00
Tower Lighting (To LED) - Draffenville Tower / Calvert Tower	TBD	TBD	
Tower Hardware (Brackets, masts, clamps, etc.)	\$1,500.00	8	\$12,000.00
Tower Evaluations	\$2,350.00	8	\$18,800.00
Installation of Antenna and Microwave	\$10,000.00	8	\$80,000.00
Radio Infrastructure Integration and deployment	\$10,000.00	8	\$80,000.00
	\$1,183,650.00		
	<b><u>\$1,302,015.00</u></b>		
3 Position Dispatch Console	\$39,000.00	3	\$117,000.00
P25 Capable Mobile Radio	\$1,350.00	10	\$13,500.00
Backroom Equipment Upgrades & Materials	\$25,000.00	1	\$25,000.00
Licenses for options and features	\$18,500.00	1	\$18,500.00
Radio Dispatch Console Integration and deployment Inc.			
remediation of grounding and cleaning up dispatch cabling.	\$22,500.00	1	\$22,500.00
Factory Staging	\$4,500.00	1	\$4,500.00
Freight and Delivery	\$1,350.00	1	\$1,350.00
Dispatcher Training Services (2 days)	\$1,350.00	2	\$2,700.00
	\$205,050.00		
	<b><u>\$225,555.00</u></b>		
	Dispatch Console		
	+10% Contingency		