



TDOT
Department of
Transportation

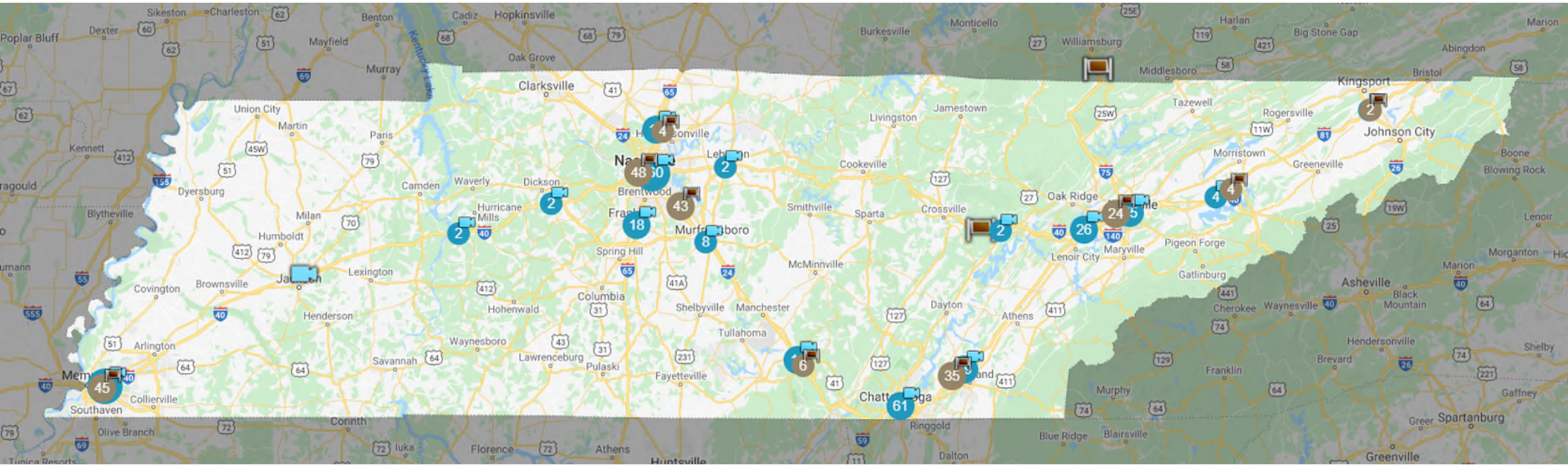


Rural ITS Deployments: Using Analytics to Maximize Resources

ITS TN/TSITE Joint Meeting

October 27, 2021

Current ITS Deployments in Tennessee



20% of Current TDOT ITS deployments are in Rural areas

History of Rural ITS in Tennessee

I-75 Fog Zone – Calhoun, TN (Hiwassee River)

- Fog related incident on December 11, 1990
 - 99 vehicles, 50 injuries, 15 fatalities
- Low Visibility Warning System initially constructed in 1993. Upgraded periodically.
- System components:
 - 3-mile fog detection area, 8-mile warning zones
 - CCTVs, DMS, visibility and speed sensors, changeable speed limit signs, RWIS, HAR, on-ramp swing gates
- Recognized by FHWA as a best practice in road weather management

I-24 - Monteagle Mountain, TN

- Brake check station prior to steep descent.
- 2 runaway ramps w/ detectors and DMS



Importance of Rural ITS in Tennessee

- Deploy ITS infrastructure to save lives and improve operations
 - incident detection and response times
 - Detour traffic during incidents
 - Communication with drivers
- Address unique issues related to weather, freight vehicles, and other factors

Project Example

- I-75 SmartWay ITS Expansion – Campbell County
- Goals
 - Vision Zero – eliminate crashes and increase safety of transportation system
 - Rapid detection
 - Rapid verification
 - Communicate with Motorists
 - Dispatch emergency services and HELP Trucks

Rural ITS Considerations

Where are the needs?

- Safety Analysis

What are the needs?

- Traffic Monitoring, Traveler Information, Road Weather Information, Connected Vehicles

Communications Alternatives

- Wireless, Cellular, Fiber Optics (above and below ground)

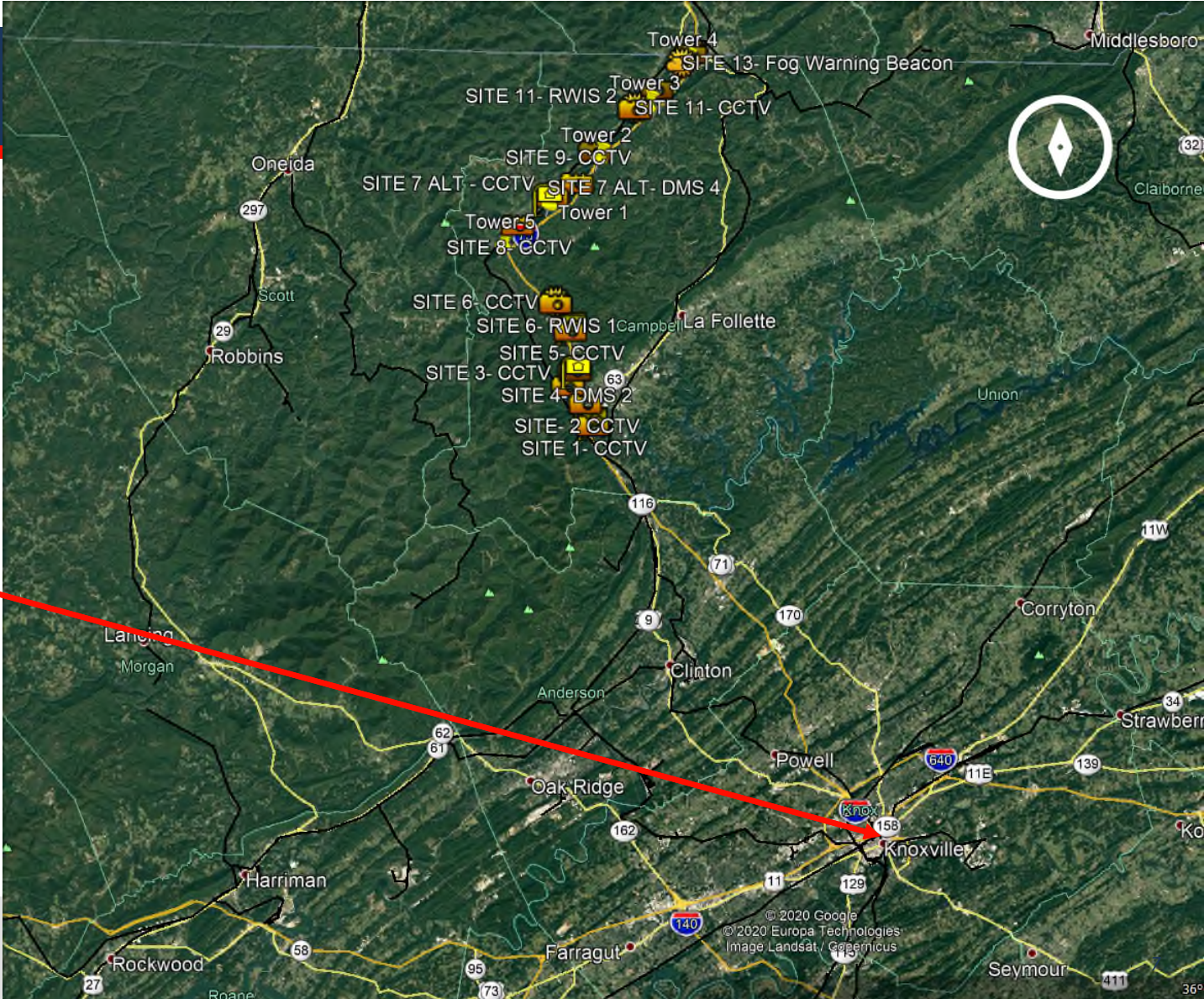
Power Alternatives

- Grid (above and below ground), Solar, Fuel Cells, Wind, Thermoelectric, Remote Line Power



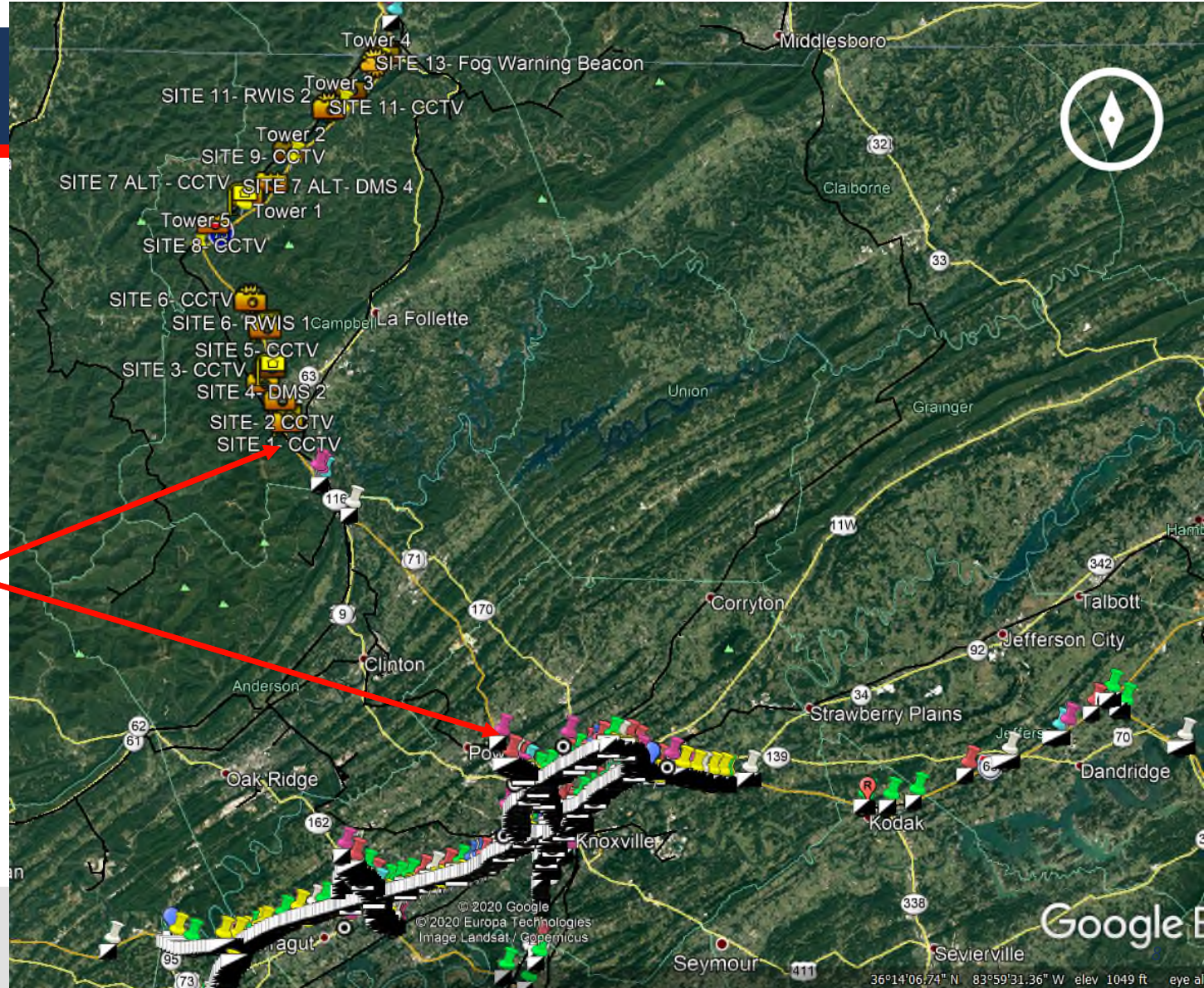
Geographic Location

Knoxville



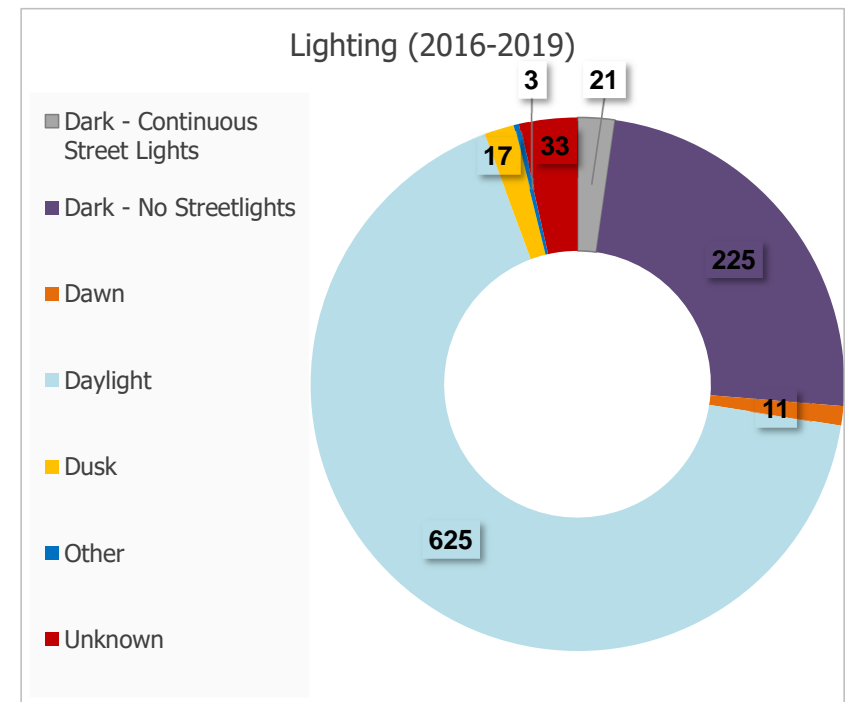
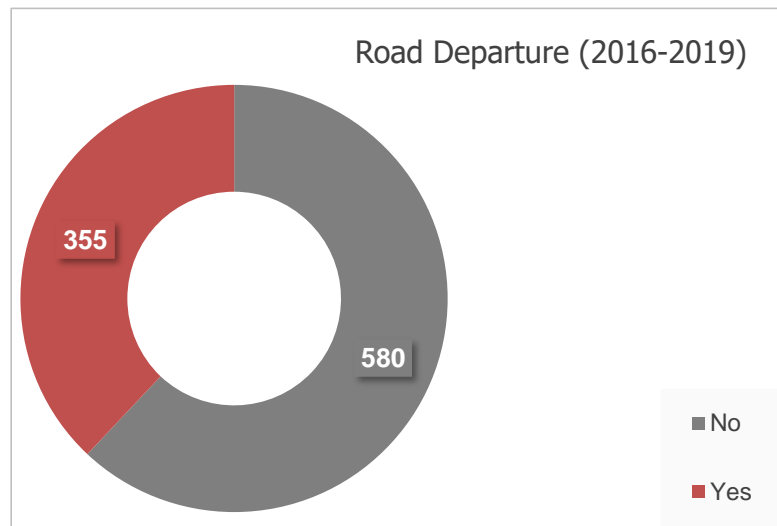
Geographic Location

Disconnect



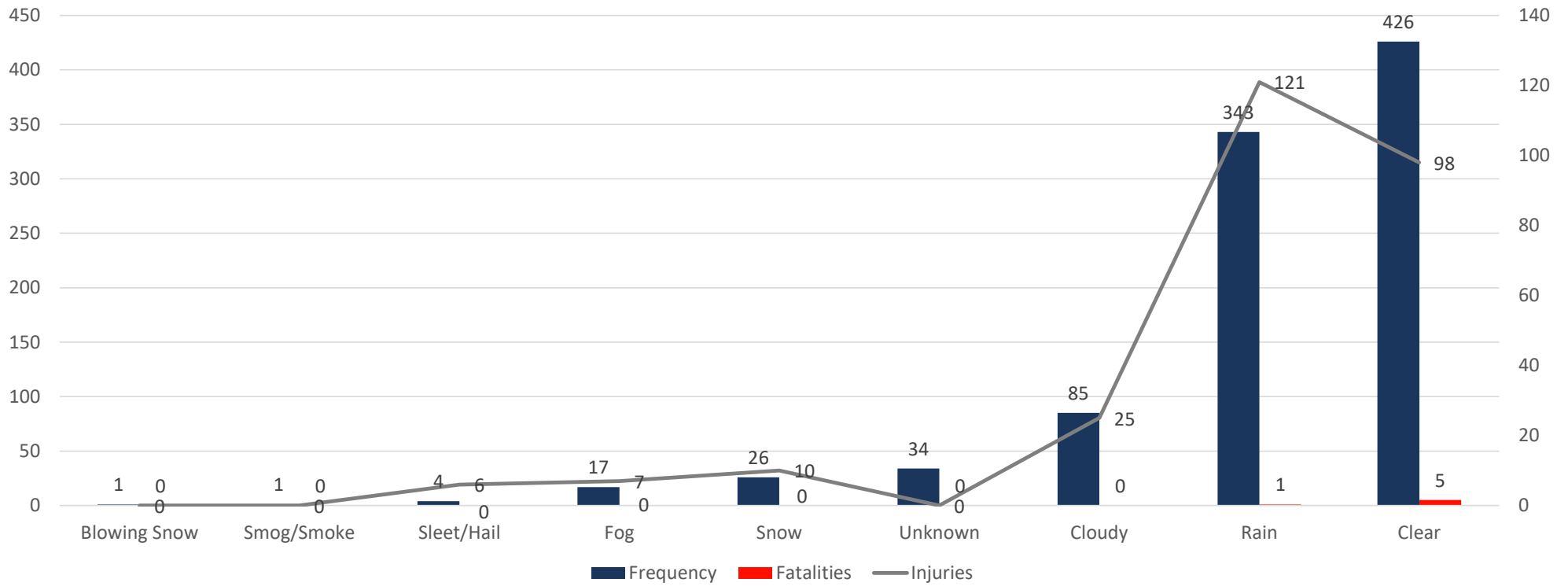
Safety Analysis Methodology

- 2016-2019 Crash Data
- Focus on Fatal and Serious Injury Collisions
- Identify Crash Hotspots
- ½ Mile Radius Clusters

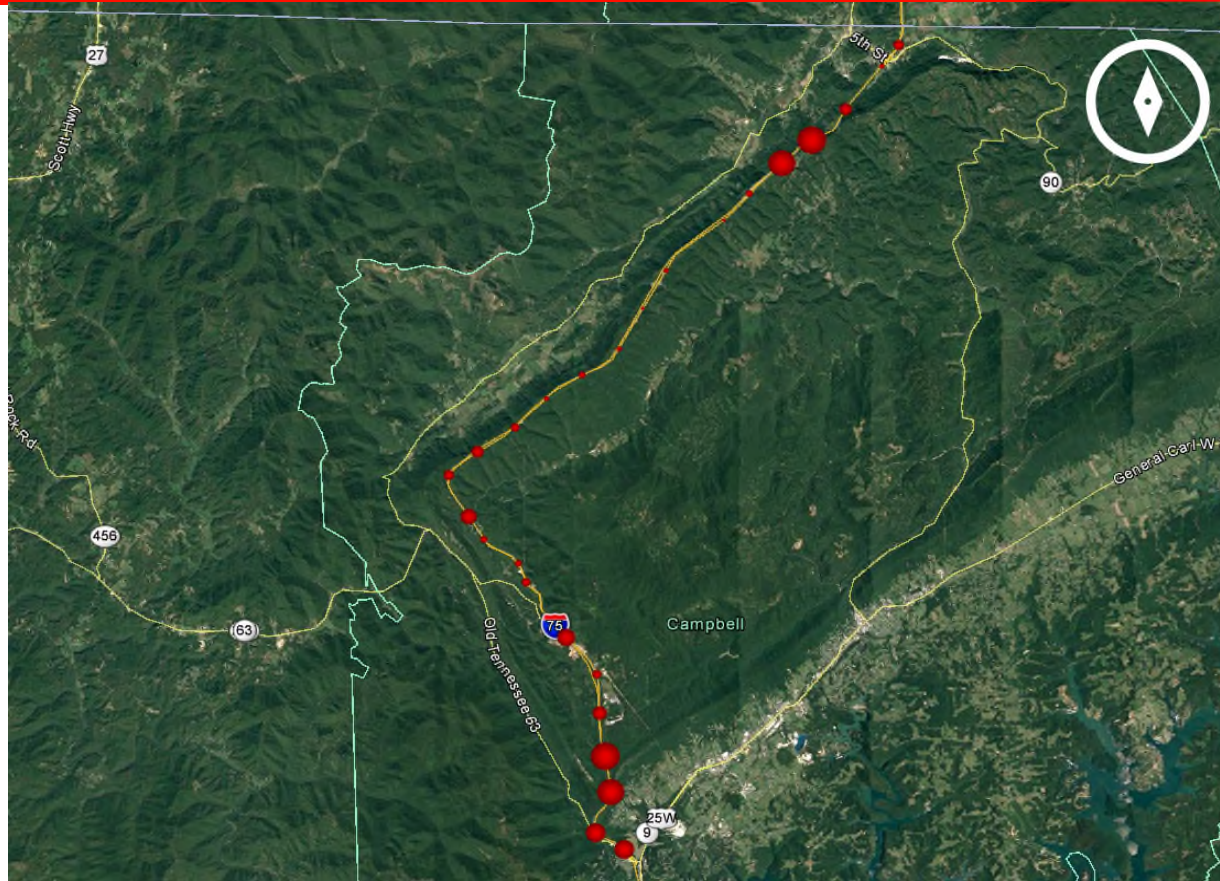


Safety Analysis Methodology

Weather Condition (2016-2019)

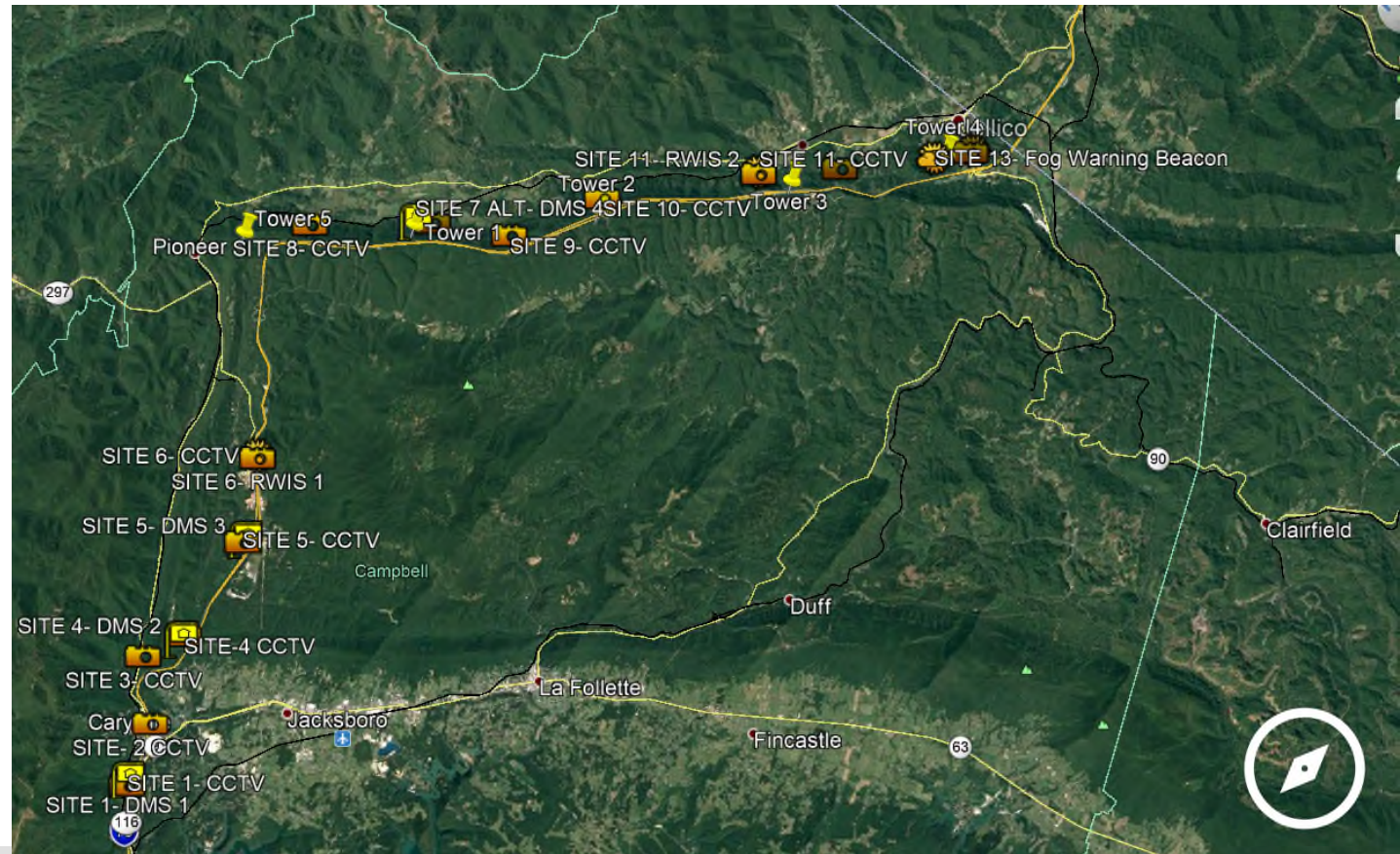


Safety Analysis: Hotspots



User Needs

1. Traffic Monitoring
2. Traveler Information
3. Road Weather Information
4. Connected Vehicles
5. \$14M Budget



Communications

1. Traffic Monitoring
2. Traveler Information
3. Road Weather Information
4. Connected Vehicles

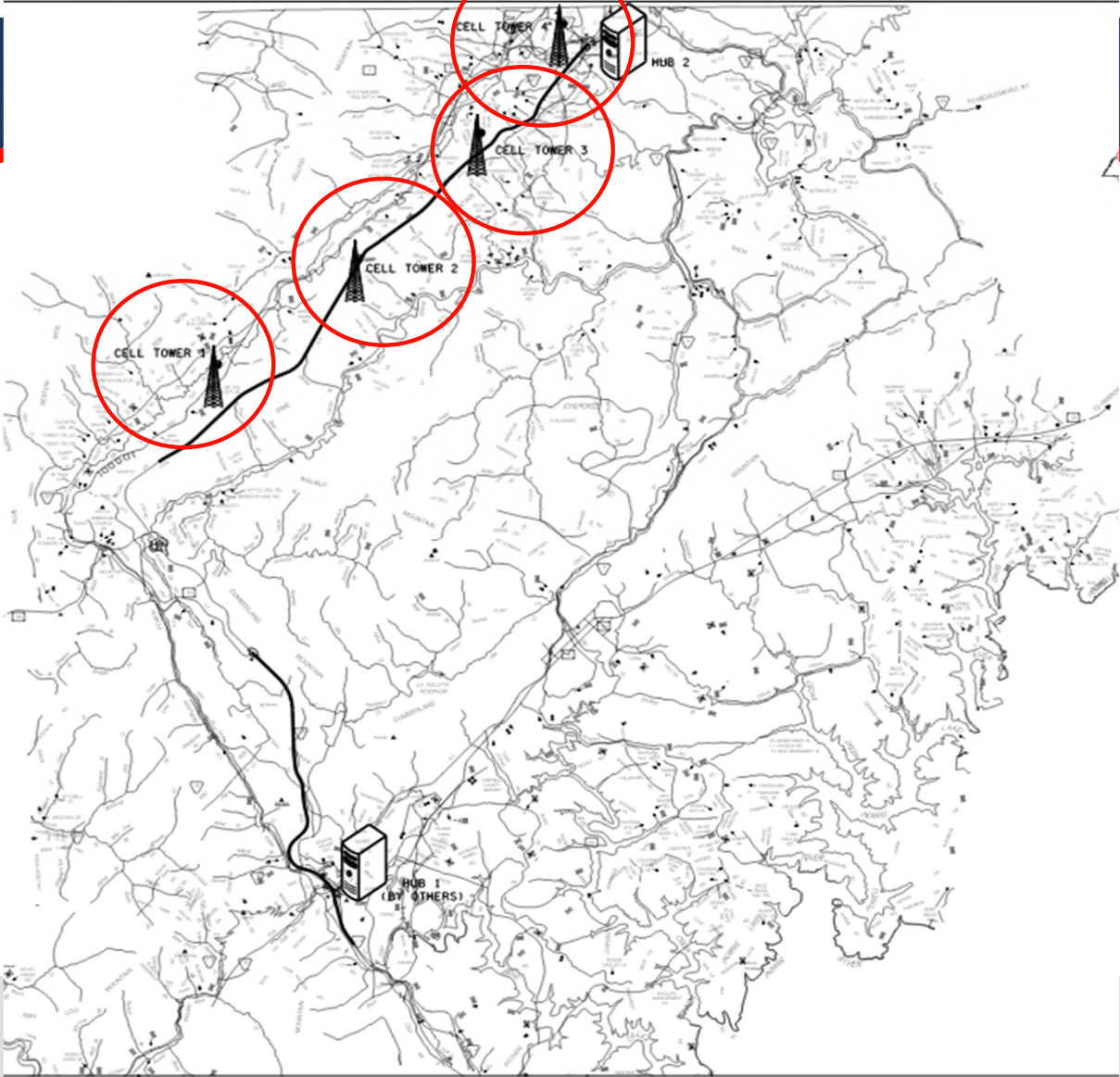


Full Corridor Fiber Optic Comms

\$16.4 Million

	Unit Cost	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 8	Site 7 Alt	Site 9	Site 10	Site 11	Site 12	Site 13	Total Quantity	Total Item Cost
Typical Project Cost	\$ 1,650,000.00	1													1	\$ 1,650,000.00
Underground Backbone Fiber – Conduit (All Sites)	\$11,290,276.80	1													1	\$ 11,290,276.80
Underground Backbone Fiber – Conduit (Sites 1-6)	\$ 3,662,138.70														0	\$ -
Underground Backbone Fiber – Conduit (Sites 8-13)	\$ 5,351,418.60														0	\$ -
Aerial Fiber Backbone (Sites 8-13)	\$ 1,094,858.60														0	\$ -
Wireless Point-to-Point Radio Communications (Sites 8 – 13)	\$ 534,600.00														0	\$ -
ITS Communications Hub	\$ 86,377.50	1													1	\$ 86,377.50
Typical Single Run Guardrail	\$ 30,263.75	2			2	2			2						8	\$ 242,110.00
Typical Truss DMS Site	\$ 322,091.00	1			1	1			1						4	\$ 1,288,364.00
Typical Pedestal DMS Site	\$ 261,591.00														0	\$ -
Typical 50' CCTV Site	\$ 68,651.00	1	1									1	1		4	\$ 274,604.00
Typical 80' CCTV Site	\$ 85,151.00	1			1	1	1	1	1	1	1			1	9	\$ 766,359.00
Typical 110' CCTV Site	\$ 123,651.00														0	\$ -
Typical Additional CCTV Camera	\$ 7,700.00														0	\$ -
Typical Infrared CCTV Camera	\$ 17,050.00														0	\$ -
Typical RDS at CCTV	\$ 12,210.00	1	1	1	1	2	1		1	1	1	1	1	1	13	\$ 158,730.00
Typical ESS at CCTV	\$ 11,000.00														0	\$ -
Typical Standalone RWIS Site	\$ 88,000.00						1					1		1	3	\$ 264,000.00
Typical Electrical Service – Grid Power	\$ 32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$ 420,777.50
Typical Solar Power Connection (1 Day Autonomy)	\$ 38,500.00														0	\$ -
Total Cost															\$ 16,441,598.80	

Cell Towers



Cell Tower Communications

EQUIPMENT

Final Configuration Summary

THE FINAL EQUIPMENT CONFIGURATION WILL REPRESENT ALL OF TENANT'S ENTITLEMENTS, INCLUDING ANY RESERVED SPACE, IF APPLICABLE, UPON FULL EXECUTION OF THE ASSOCIATED LEASE OR AMENDMENT.

- Antenna: 2 Redline Communications AN-80i @ 150' [Tip:150.5'] [Base:149.5'], 11.4" x 16.9" x 1.8", Weight: 11 lbs. [Radio/ODU]
- Ground Space: 1, 4' x 4', SBA Shelter Space: No, Provided by: Tenant [Concrete Pad]
- Cables: , 2 lines Cat 5 @ 0.24"
- Frequency: , RX: 3.5 GHz WIMAX band, 4.9 GHz public safety band and license-exempt 5.4 and 5.8 GHz bands, TX: 3.5 GHz WIMAX band, 4.9 GHz public safety band and license-exempt 5.4 and 5.8 GHz band
- Mount Equipment: 2 Redline Communications Mounting Kit for AN-80i antenna @ 150' [Mounting Kit for AN-80i antenna]

Select Equipment Category:

- Antenna (2)
 Mount Equipment (2)
 Dish
 ODU / Coupler
 Ice Shield
 TMA-TTA
 RRU / RRH
 RRU Module
 DC Surge Suppressor / COVP / OVP
 Other Cable (2)
 Fiber / Junction Box
 Diplexer
 Combiner
 RET / ACU / RCU
 Filter
 PDU (Mounted on ground)
 BIAS-T
 Ground Space (1)
 Generator
 AC Unit
 GPS Receiver
 Transmitter
 Transmitter Cabinet
 Battery Bank
 Other
 Frequency

Antenna

Qty:	2
Type:	Radio/ODU
Manufacturer:	Redline Communications
Model:	AN-80i
Dimensions:	11.4" x 16.9" x 1.8"
Weight:	11 lbs.
Base:	149.5'
Center:	150'
Tip:	150.5'
Down Tilt:	0°
Orientation:	0° & 0°

TOTAL CONTRACTED SPACE

	Final (ft ²)
Ground Space Total:	16

Cell Tower Communications

FIELD APPROVAL

Requestor:	sbsite\ecianton	Request Date:	11/1/2019 5:04:33 PM
SS Validated By:	sbsite\jstempel	Validated On:	11/6/2019 3:40:25 PM
Approver:	sbsite\jstempel	Approval Date:	11/6/2019 3:48:20 PM
Is Approved:	Yes	Tower Extension Needed:	No
Structural Required:	Yes (Full SA)	Tenant Structural Cost:	\$2,500.00
Comments:	New tenant lease.		

All mount changes/replacements must be included on application if required. Applications with new equipment being installed require CD's to be uploaded to the application for review and approval by Regional Ops Site Manager prior to construction.

Coax Route and Configuration will be determined pursuant to the Structural Analysis completed for this application

Coax Painting Required:	No		
Coax Comments:	na		
Ground Space Requested:	Yes	Ground Space Approved:	Yes
Total Ground Space:	16 sqft	Ground Space Expansion Needed:	No
Push Fence Out?:	No	SBA Generator:	No
Site Visit Required:	Yes	Site Visit Assigned To:	John Leonard
Tenant Using SBA Shelter:	No	AM Detune / Intermod Req:	No
Separate Tenant Meter:	Yes		
Const Drawing Req:	Yes	Lease Exhibit Req:	Yes

PM View of Site Leases

SBA Lease #	Carrier	Lease Status	Termination Status
TN00932-B-01	AT&T	Active	
TN00932-B-02	T-Mobile Sprint	Active	Pending
TN00932-B-03	AT&T	Terminated	Terminated
TN00932-B-04	T-Mobile Sprint	Active	
TN00932-B-05	T-Mobile	Active	
TN00932-B-06	Verizon	Active	

COMMENTS

	DATE	VER#	AUTHOR	COMMENT
+	5/21/2020 10:14:54 AM	1	sbsite\ecianton	Placing on hold until receive project update from customer.
+	10/28/2019 4:52:21 PM	1	zdomingue	No ground equipment is required

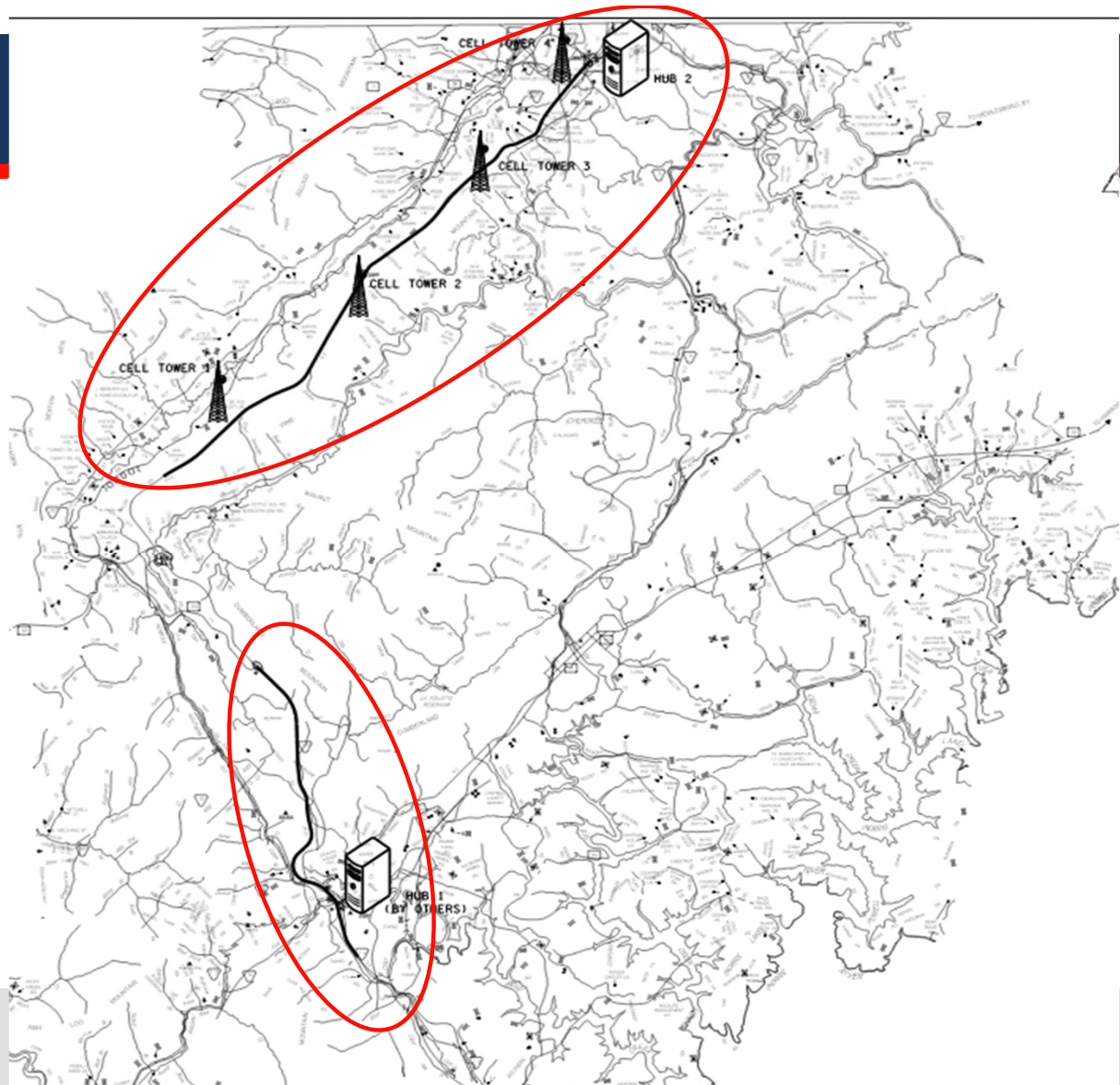
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Fiber Optic/Wireless Hybrid Comms

\$9.0 Million

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Underground Backbone Fiber – Conduit (Sites 8-13)	\$ 5,351,418.60								1						0	\$ -
Aerial Fiber Backbone (Sites 8-13)	\$ 1,094,858.60								1						0	\$ -
Wireless Point-to-Point Radio Communications (Sites 8 –13)	\$ 534,600.00								1						1	\$ 534,600.00
ITS Communications Hub	\$ 86,377.50		1											1	2	\$ 172,755.00
Typical Single Run Guardrail	\$ 30,263.75	1			1	1			1						4	\$ 121,055.00
Typical Truss DMS Site	\$ 322,091.00														0	\$ -
Typical Pedestal DMS Site	\$ 261,591.00	1			1	1			1						4	\$ 1,046,364.00
Typical 50' CCTV Site	\$ 68,651.00		1	1									1	1	4	\$ 274,604.00
Typical 80' CCTV Site	\$ 85,151.00	1			1	1	1		1	1	1			1	8	\$ 681,208.00
Typical 110' CCTV Site	\$ 123,651.00							1							1	\$ 123,651.00
Typical Additional CCTV Camera	\$ 7,700.00														0	\$ -
Typical Infrared CCTV Camera	\$ 17,050.00														0	\$ -
Typical RDS at CCTV	\$ 12,210.00	1	1	1	1	2	1		1	1	1	1	1	1	13	\$ 158,730.00
Typical ESS at CCTV	\$ 11,000.00	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$ 143,000.00
Typical Standalone RWIS Site	\$ 88,000.00														0	\$ -
Typical Electrical Service – Grid Power	\$ 32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$ 420,777.50
Typical Solar Power Connection (1 Day Autonomy)	\$ 38,500.00														0	\$ -
Total Cost																\$ 8,988,883.20

Split Fiber Rings



Fiber Optic/Wireless Hybrid Comms

\$14.3 Million

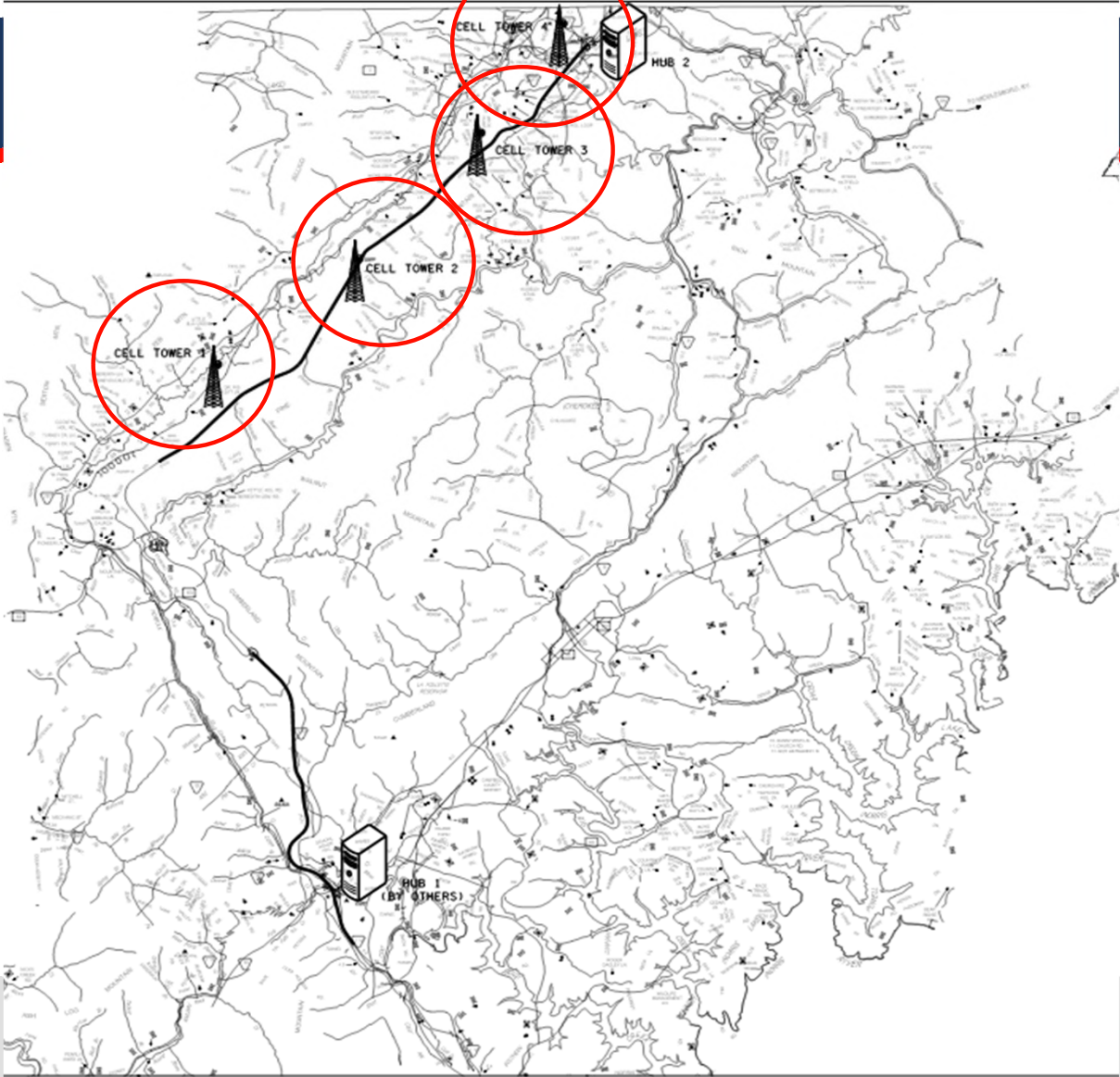
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Typical ESS at CCTV	\$ 11,000.00														0	\$ -
Typical Standalone RWIS Site	\$ 88,000.00						1					1		1	3	\$ 264,000.00
Typical Electrical Service – Grid Power	\$ 32,367.50	1	1	1	1	1	1	1	1	1	1	1	1	1	13	\$ 420,777.50
Typical Solar Power Connection (1 Day Autonomy)	\$ 38,500.00														0	\$ -
Total Cost																\$ 14,251,256.80



Power

1. Underground Grid
2. Aerial Grid
3. Solar
4. Fuel Cells
5. Wind
6. Thermoelectric
7. Remote Line Power

Power Availability



I-75 SmartWay ITS Deployment Current Progress

1. Preliminary and ROW Plans Complete
2. Construction Plans Underway
3. \$13M Construction Estimate
4. FY 2022 Letting



Other Rural ITS Deployments

I-40 Smart Fiber – ITS Expansion

2020 INFRA Grant Award recipient

Project Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Lay the foundations of technology infrastructure for future connected and automated vehicles
- Lay the foundation for future broadband expansion

Project Scope

- Approximately 143 miles of fiber optic communications.
- ITS Devices at strategic locations
 - CCTV cameras
 - Dynamic message signs
 - Road weather sensors
 - Connected vehicle roadside units



Other Rural ITS Deployments

CRRSAA Rural ITS Expansion

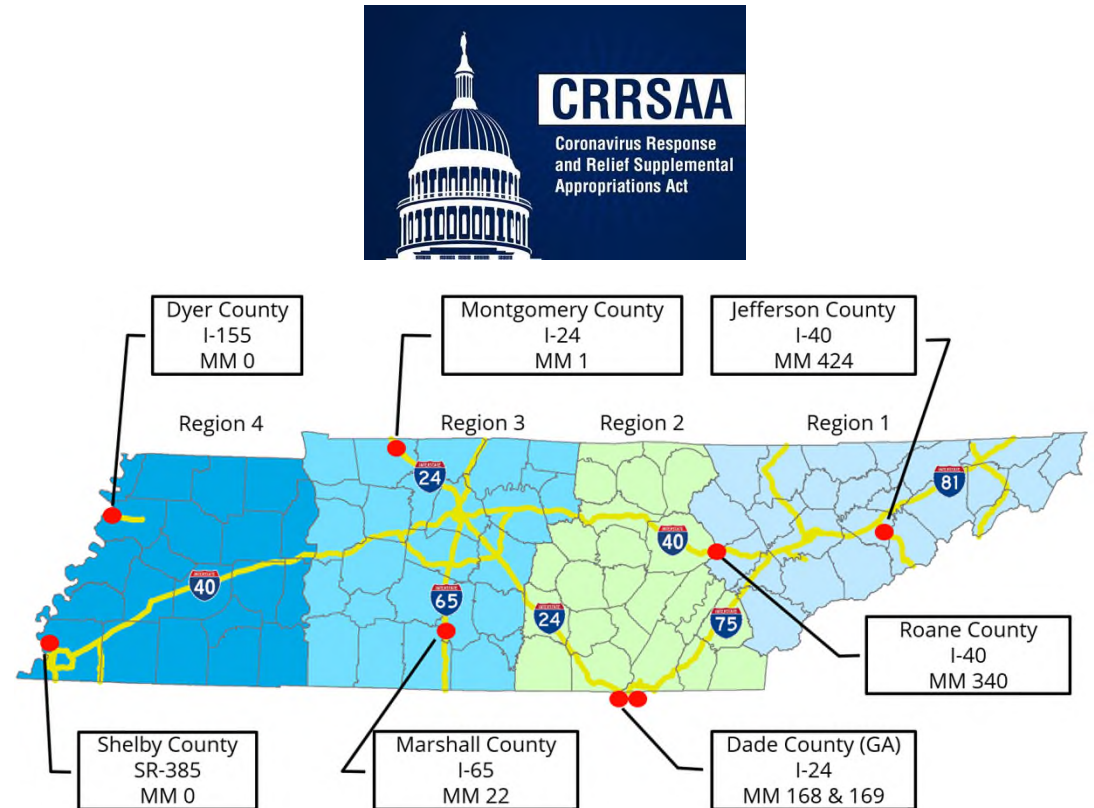
Funding from the Coronavirus Response and Relief Supplemental Appropriations Act (CRRSAA)

Project Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Smaller, individual deployments with standardized devices and minimal footprint

Project Scope

- 8 locations selected (2 per TDOT Region)
 - 1-2 CCTV cameras
 - Dynamic message sign
 - Road weather sensor
 - Connected vehicle roadside unit



Other Rural ITS Deployments

Improve Act - Rural ITS Expansions

Cocke County, I-40

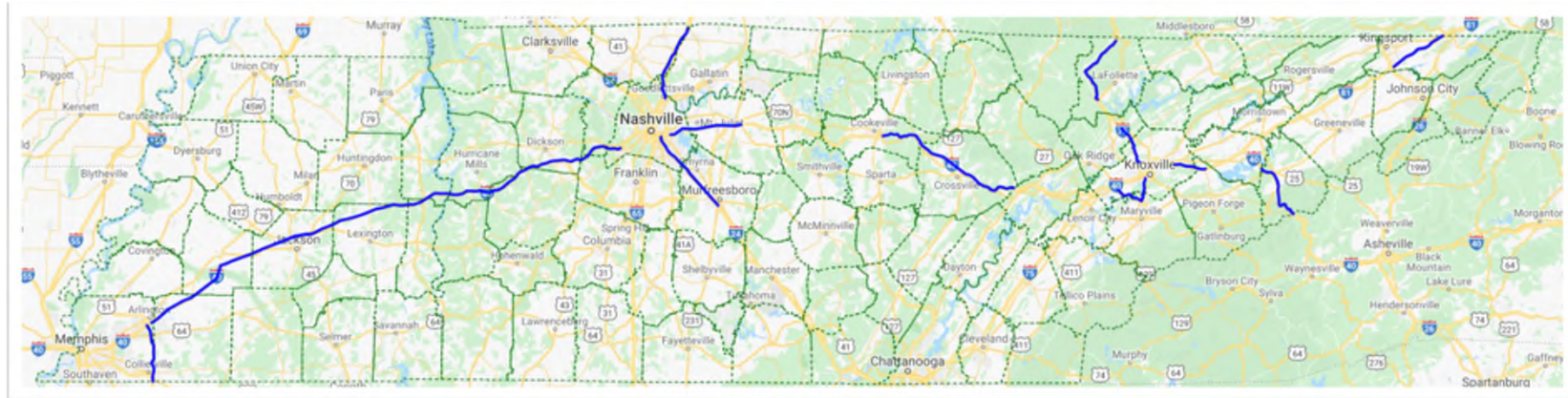
- From the Jefferson County Line to the North Carolina State Line (22 miles)
- Fiber Optic Communications
- 12 CCTVs, 2 DMS, Radar and Road weather sensors

Sullivan County, I-81

- From I-26 to the Virginia State Line (19 miles)
- Fiber Optic Communications
- 20 CCTVs, 3 DMS, Radar sensors

Cumberland and Putnam Counties, I-40

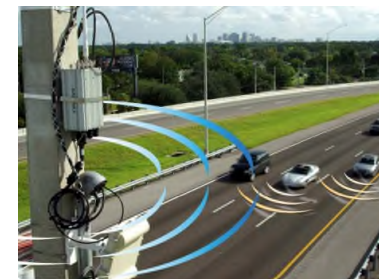
- From near MM 285 to near SR-299 (53 miles)
- Fiber Optic Communications
- 43 CCTVs, 8 DMS, Radar and Road weather sensors



Future Rural ITS Opportunities

Program Goals

- Deploy ITS infrastructure to save lives and improve operations today
- Lay the foundation of technology infrastructure for future ITS expansions involving:
 - CCTVs, DMS, and Traffic Sensors
 - Connected and Automated Vehicles
- Bridge existing TDOT fiber communications gaps to provide network resiliency and center to center communications for the Regional TMCs
- Explore leveraging TDOT ITS projects to support rural broadband expansion efforts



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TM

Thank You!