STATE OF MINNESOTA RESPONSE TO FIRSTNET DATA ELEMENTS REQUEST
SEPTEMBER 30, 2015

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The State of Minnesota provides these documents in response to the FirstNet Data Collection Elements request of March 23, 2015.

INTRODUCTION AND SUBMISSION OVERVIEW

On March 23, 2015 FirstNet published the FirstNet Data Collection Elements that requested the States to provide information as part of the State and Local Implementation Grant Program (SLIGP). Collectively, the datasets became known as the FirstNet Data Elements. Of the five primary data elements, four are requested by September 30, 2015 and the fifth, documentation regarding the State Plan review process, is due on December 31, 2015. This response includes those four elements requested by September 30, 2015.

Most of the data FirstNet has requested is contained in spreadsheets and GIS files that accompany this document. This document introduces those attachments and provides additional details regarding how that data was collected and other important information the State of Minnesota would like to convey to FirstNet for inclusion in FirstNet's RFP. As with all of the State's submissions to FirstNet, the State suggests that this submission is the beginning of an ongoing dialog with FirstNet to fully leverage this opportunity for the State of Minnesota.
The data provided in this submission were developed by collaborative efforts through the active participation of over 1,000 unique public safety agencies at the State, County and Local levels. Approximately 400 agencies participated in the creation of the coverage related deliverables alone.

Key to the success of every wireless network is the level of coverage offered. The Minnesota FirstNet Consultation Project (MnFCP) team leveraged Computer Aided Dispatch (CAD) data and coverage reviews with each and every county within the state. The project team in parallel, along with the support of the Regional Interoperable Coordinators (RICs), also reached out to each of the eleven tribes in the state. Several coverage reviews were held for statewide agencies and four tribal entities requested and then given individual meetings as well. Most tribal entities choose to provide their requirements through the county-level meetings. For each coverage

review, first responders from county, tribal, city and local agencies were invited to an interactive, web-based sessions (over WebEx). Almost 400 sheriffs, fire chiefs, police chiefs, EMTs, officers, firefighters and tribal first responders took part in the coverage reviews.

For first responder agencies in Minnesota, the extent of coverage is of a primary concern. First responders frequently complain that the published commercial carrier coverage maps do not accurately indicate coverage and often exaggerate the level of service. The county-level coverage reviews were designed to uncover these issues. Specifically, the coverage review participants were told to identify the areas that were critical to their daily operations; highlighted as "Critical" in Figure 1. The stakeholders were also directed to highlight important areas that had no commercial wireless data coverage or lacked sufficient coverage for public safety's needs; highlighted as "Extended" in Figure 1. These coverage critical and extended service areas were leveraged heavily in the creation of the proposed Coverage Objective and Phased Deployment of the State of Minnesota included in this submission. Together with the existing commercial carrier service, these critical and extended service areas make up the aggregate Coverage Objective of the state.

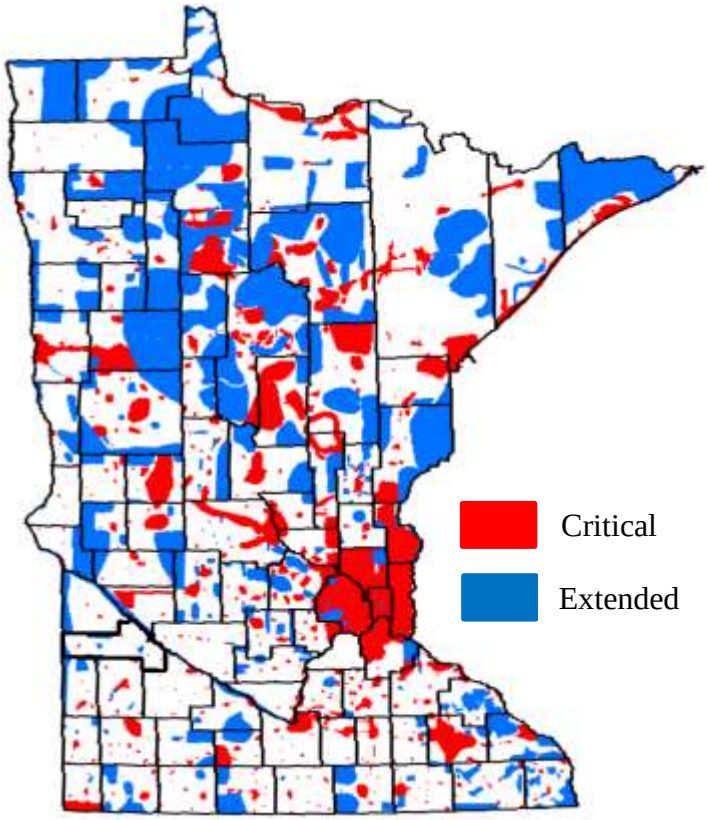


Figure 1: Coverage Review Results

The strategy chosen by the State for the Phased Deployment is referred to as the "Bookends" Strategy. The "Bookends" Strategy prioritizes dense urban areas and important underserved rural areas in early phases with areas that already have adequate commercial service pushed towards the end. In this way FirstNet's and the State's goals are mutually achieved by the prioritization of the build-out in the most populated areas, while rural public safety agencies gain an extended service area by the prioritization of the build-out of the network in areas were commercial service does not exist. It is important to note that **the Bookends Strategy is premised on there being a commercial carrier roaming agreement and service availability throughout the required service area equivalent to the commercial carrier footprint used by the local stakeholder agency**. This will be key to adoption of the FirstNet service prior to the completion of Phase 5.

As a result of the strategy chosen, Band-14[1] service can be offered simultaneously in both urban areas where public safety runs the greatest risk of networks becoming unavailable due to congestion and in rural areas where coverage holes are most prominent. In fact, the analysis shows that at the end of phase 2, more than 94% of all incidents are covered. Furthermore, more than 85,000 incidents (over a three year period) statewide would have better coverage in rural areas.

Due to the extensive consultation process we feel confident that the requirements and priorities documented herein represent the objectives of Minnesota's first responder community.
The MnFCP project team would like to thank the hard work and dedication of all stakeholders who participated in the creation of these deliverables; especially the work and support of the ad hoc Workgroups that was established to help bring the coverage objectives deliverables to closure.

About Minnesota FirstNet Consultation Project (MnFCP)

The primary mission of Emergency Communications Networks' (ECN) Public Safety Wireless Broadband Program is to facilitate the implementation of a dedicated, mission-critical public safety Long Term Evolution (LTE) 4G broadband network to first responders in Minnesota. The Minnesota-FirstNet Consultation Project (MnFCP) is designed to deliver on that goal to Minnesota's First Responders while fulfilling the State's obligations under the 2012 Middle Class Tax Relief and Job Creation Act and the 2013 State and Local Implementation Grant Program.

More information about this project and the state's broadband program is available at:
https://dps.mn.gov/divisions/ecn/Pages/broadband.aspx

MnFCP Approach to Information Gathering

The State's data collection effort consists of face-to-face meetings, online meetings using WebEx, and the use of online survey tools. In general, the State's process was to collect quantitative and text based information from statewide stakeholders using survey tools and in-person and online web meetings for geographic information and qualitative discussions. The State collected both statewide information using Workgroups and local information via the web surveys and online web based meetings. The State commenced these activities prior to FirstNet establishing clear guidance regarding its request, and therefore, the State's data had to be amended to satisfy FirstNet's specific request. In some cases, the State's deliverables is closely aligned, but slightly different from the FirstNet requested data set. The State was fortunate to

[1] Band-14, or Band Class 14, refers to the unique frequency channels assigned to FirstNet for the use by public safety entities/agencies

largely predict FirstNet's request, and fundamentally, the State desired to have all of the information requested and gathered as part of the Minnesota FirstNet Consultation Project (MnFCP).

Tribal Areas

As of the 2010 Decennial Census, there were 101,900 "American Indian and Alaska Native" persons in the state, representing approximately 1.9 percent of the Minnesota population. It is estimated that 21 percent of the Minnesota Indian population live on reservations, with approximately 24 percent live in a county in which the reservation is located. Considering the size of these communities and the inherent rights afforded to tribal entities, the project team made an extensive effort to include each tribal entity into the outreach process to gather their specific requirements for the FirstNet National Public Safety Broadband Network (NPSBN). Each tribal public safety entity received a personal invitation from the RIC for an individual briefing. All points of contacts at tribal first responder agencies were individually invited to the county-level coverage reviews and received individual invitations from the project team for a tribal-only coverage review.

Key to the outreach efforts was the invaluable advice from two key tribal stakeholders: the Chief of Police and the Emergency Manager (and/or their delegates). Wherever possible these key stakeholders were used as main conduits for outreach and the requirements gathering efforts. Seven of eleven tribes were represented either through the county coverage assessments or individual coverage assessments.

On July 24, 2014 the project team organized an outreach session at Leech Lake Reservation. The purpose of the meeting was to develop a series of recommendations and general findings with regard to the FirstNet implementation and the future summarized as follows.[2]

Recommendations

- The State should, wherever possible, facilitate the tribe's interest in operating a public/private partnership with FirstNet.
- The State and FirstNet should resolve legal issues related to tribal sovereignty and develop Tribal Engagement rules.
- It is suggested that FirstNet should investigate potential synergies with Office of Native American Programs (ONAP).

[2] Greater detail on the outcome of this meeting can be found in the *Minnesota Department of Public Safety Minnesota-FirstNet Consultation Project Leech Lake Reservation Special Outreach Report*.

- Wherever possible drive-test data should be used as one of the inputs for assessing coverage. It was noted that the census blocks provided by ConnectedNation (Broadband.gov) did not match tribal boundaries and service availability was inflated in these areas.
- The program should continue to leverage the state's existing governance structure for grant funding initiatives

In addition to this outreach session, several tribes took advantage of individual meetings to assess their coverage and network requirements. The tribes that took advantage of the offer of individual sessions for the collection of requirements included the following:

- Leech Lake Band of Ojibwe
- Mille Lacs Band of Ojibwe
- Red Lake Band of Chippewa
- White Earth Nation who held a multi county review at their facilities

Other tribes held one-on-one meetings with the Regional Interoperability Coordinators and who saw to it that their requirements were passed on during the county-level coverage reviews; these included:

- Bois Forte Band of Chippewa,
- Grand Portage Chippewa
- Lower Sioux Indian Community

It is important to note that the tribal consultation effort is an ongoing effort and that it is likely that additional tribal requirements will be forthcoming prior to the acceptance of the State Plan. Likewise, the State reserves the right to supplement the requirements stated herein, especially with regard to tribal entities, accordingly.

Statewide Workgroups

The Statewide Emergency Communications Board (SECB) and the project team established four subject matter-specific workgroups to define base NPSBN user requirements. These volunteers were pulled from the stakeholder community through the Regional Emergency Communications/Services Boards (RECBs/RESBs). The four subject matter areas were:

- Applications and Next Generation 911 (NG911)
- Devices
- Service Area and Coverage

- System and Security

The work product of these Workgroups is documented in the attached Launch Requirements document. In addition, as discussed below, these groups determined the approach for detailed data gathering of local data. Details regarding the composition, process, assumptions, and other factors regarding these Workgroups can be found in the attached Launch Requirements document.

Coverage Reviews

The Service Area and Coverage workgroup approved a process to collect coverage objectives for each county. The process involved online interactive sessions to determine important areas for public safety wireless service in each county. During these sessions, each county identified their critical, required and extended service areas. The "critical" and "extended" service areas were highlighted directly on mapping software during the sessions. The "required" service area was determined by the Service Area and Coverage workgroup to be the commercial carrier coverage. During each coverage review, a considerable amount of time was devoted to identifying the critical service areas. Stakeholders were careful to ensure compliance with the workgroup guidance and utilize the same methodology.

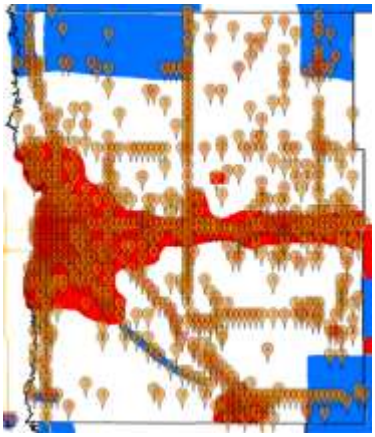


Figure 2: Coverage Review Example Clay County

As a guiding reference the CAD data was heavily utilized as a method for identifying and prioritizing the coverage requirements throughout the State. The coverage review process commenced long before FirstNet's request for Coverage Objectives and was fully leveraged in the creation of the State of Minnesota's Coverage Objective and Phased Build Out maps attached in this submission.

Service Area Types

The Service Area and Coverage workgroup determined the basis for evaluating the NPSBN coverage or service areas. The Service Area workgroup defined three different service types:

- Critical Service Area (the area of Highest Priority); defined as:
  - Where FirstNet coverage is desired first and where it is needed the most; where public safety grade service is of the most value
  - An area of highest-activity based on historical CAD incident data records
  - An area with critical infrastructure, anchor institution, or public venue

- Required Service Area (the area where day-to-day service is required; the "Need"); defined as:
  - The current commercial cellular service footprint
  - The baseline for the minimum coverage expectation; the minimum coverage required to adopt the FirstNet service
- Extended Service Area (the areas where they public safety would like to see the wireless service extended; the "Want"); defined as:
  - The area where commercial carriers do not serve, or where the coverage is not sufficient for the needs of public safety, and
  - The area where deployable or satellite is not acceptable

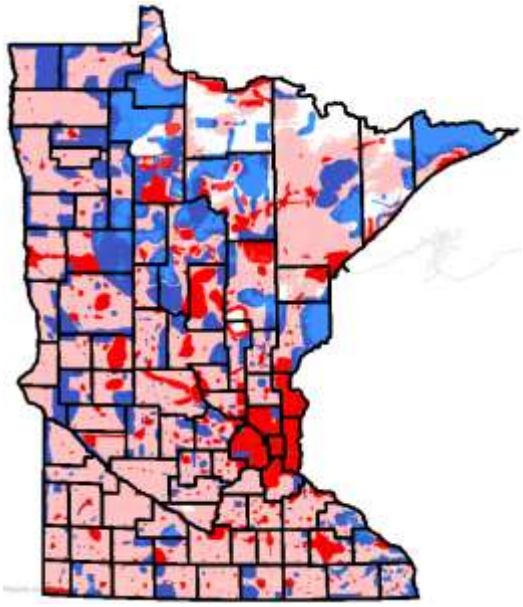


Figure 3: Aggregated Coverage Review Results

The complete recommendations of the Service Area and all workgroups are summarized in the accompanied report entitled *Launch Requirements for Minnesota Public Safety Broadband Network*.

Initially, the intention of the State was to use the carrier's published coverage maps to determine the "required service area." However, most stakeholders indicate that advertised carrier coverage maps do not often portray actual coverage holes and are overly optimistic, depicting coverage on maps where it is not always available. In the figure to the left the commercial carrier is portrayed in **PINK**, the Extended Service Areas, defined as areas where commercial coverage is non-existent or inadequate, is portrayed in **BLUE**. The image indicates that there are substantial areas where the carrier claims coverage, but clearly does not provide adequate coverage in the view of the public safety stakeholders. Stakeholders, especially those working in more rural areas, report that coverage, or the lack thereof, is the most significant issue with regard to their adoption of wireless data services.

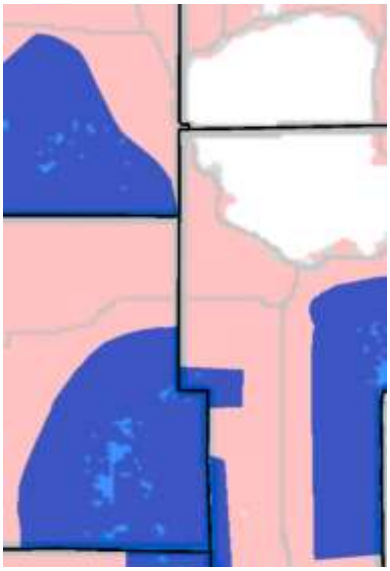


Figure 4: Required and Extended Service Areas - Example

Anecdotal reports from stakeholders show that up to one third of the state of Minnesota lacks sufficient 4G wireless data coverage, and 4G service is particularly inconsistent in northern parts of the state.

It is important to note that the area that remains in pink is not the perceived commercial coverage extent. The blue areas with underlying pink "commercial coverage" often represent spotty or inconsistent coverage. Therefore, matching commercial coverage in these areas is not the resulting pink area on the map above. As discussed above, the "required service area" is the minimum acceptable service area of the State of Minnesota, however, these maps should not be used to determine that area. Instead, testing or other methods should determine the true and accurate extent of commercial coverage.

CAD Data

One effective approach to understanding where NPSBN coverage is required is to map the areas where responses have occurred in the past. By looking at a map of where incidents have occurred *in the past*, we can better-understand where users are most likely to be in the future. The project team's approach was to develop a heat map that displayed where first responders spend the majority of their time in each jurisdiction of the State.

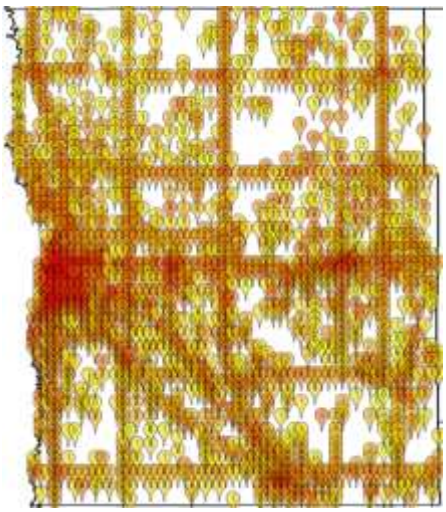


Figure 5: Heat Map of Incidents

Generating these maps required collecting incident data reflecting the history of responses typically over a period of three years. Extensive call records are generally kept by 911 call centers or public safety answering points (PSAPs) through CAD and Records Management Systems (RMS). These systems tie in several components; such as voice recorders, GPS/Automatic Vehicle Location, messaging and Geographical Information System (GIS) at a minimum. The project team collected CAD data records from 92 out of 104 PSAPs across the state; four (4) of these datasets were unusable. Eleven (11) PSAPs were unable to provide data; partly because they were transitioning to a new vendor and did not have the support of the old vendor and partly because they did not respond to the team's requests. (See Appendix 2: Summary of Missing CAD Data for more details)

It should be noted that there are several PSAPs in the state without CAD systems. For some of these PSAPs, data from law enforcement's records management systems were used instead.

Statewide, there are many different vendors and systems deployed within the state's 104 PSAPs. Likewise, the incident data records are stored on widely varying formats. Therefore the very first step in the process is to normalize the data into a consistent format.

Depending on the CAD system, several datasets needed to be purged of duplicative records that may have captured irrelevant or redundant information on the individual incidents. In some cases these duplicate records are agency specific providing greater resolution of each agency's

involvement in the incident. Typically, these duplicative records occur more often in CAD systems found in major metropolitan areas and, if left uncorrected, would tend to overstate the total metropolitan area incident rates by a significant factor. The duplicative records are typically caused by:

- Multiple calls to the same incident
- Changes in dispatched units at the scene; ramp-up or scale-down
- Duplicative record keeping at separate agencies

Not all PSAP data can be incorporated into the same dataset without adjustments to normalize the data. When normalized, data from each participating PSAP is represented on an equal basis with incidents reported from all other PSAPs. For example, while the project team asked for three years of data from each PSAP, not every PSAP had three years of data to provide. In some limited cases, the team received only a few months of data. If the team received six months of data for a particular PSAP, the team extrapolated the six months' worth of data to represent three years so that the PSAP's data could be compared with the PSAPs that did provide three years of data.

As another example not all PSAP data included longitude and latitude data. Some data included latitude and longitude geo-coordinates with each record, while others only included only addresses. Converting addresses to geo-coordinate points is an imperfect process that is highly dependent on the quality of the address information. To correct for imperfections in geocoded data, the project team used a mathematical "geocoding efficiency" factor to render the results properly.

To take into account the impact of the incident on wireless data networks, the project team developed a proxy for the incident impact by reviewing various factors relative to the incident. This included the incident duration, the responding unit type (law enforcement vs fire vs. Emergency Medical Services (EMS), the priority of the incident, the typical application used to support the incident as well as typical operating procedures. Through this process, we were able to associate an Incident Impact value to each incident. The incident impact value as well as several other relevant values (units dispatched, agency dispatched, incident duration, are then aggregated over quarter square mile bins rendered to the same reference point and projection as the FirstNet baseline objectives.

Aggregation of the Data

Looking at rendered results from a single county PSAP provides only a limited view of the true incident activity in the region. In all regions of the state, mutual aid from neighboring jurisdictions and state agencies occurs regularly day-to-day and month-to-month. To generate a more comprehensive picture of incident activity, the team combined all PSAP CAD data sources

throughout the state to generate aggregated results. In Figure 6 we indicate the counties and PSAPs who could not provide CAD data for this analysis. However what can be seen in the aggregated statewide CAD data, even in county who could not provide data we are able to show some incidents based upon mutual aid calls for service from outside the county and overlapping incidents from the Minnesota State Patrol.

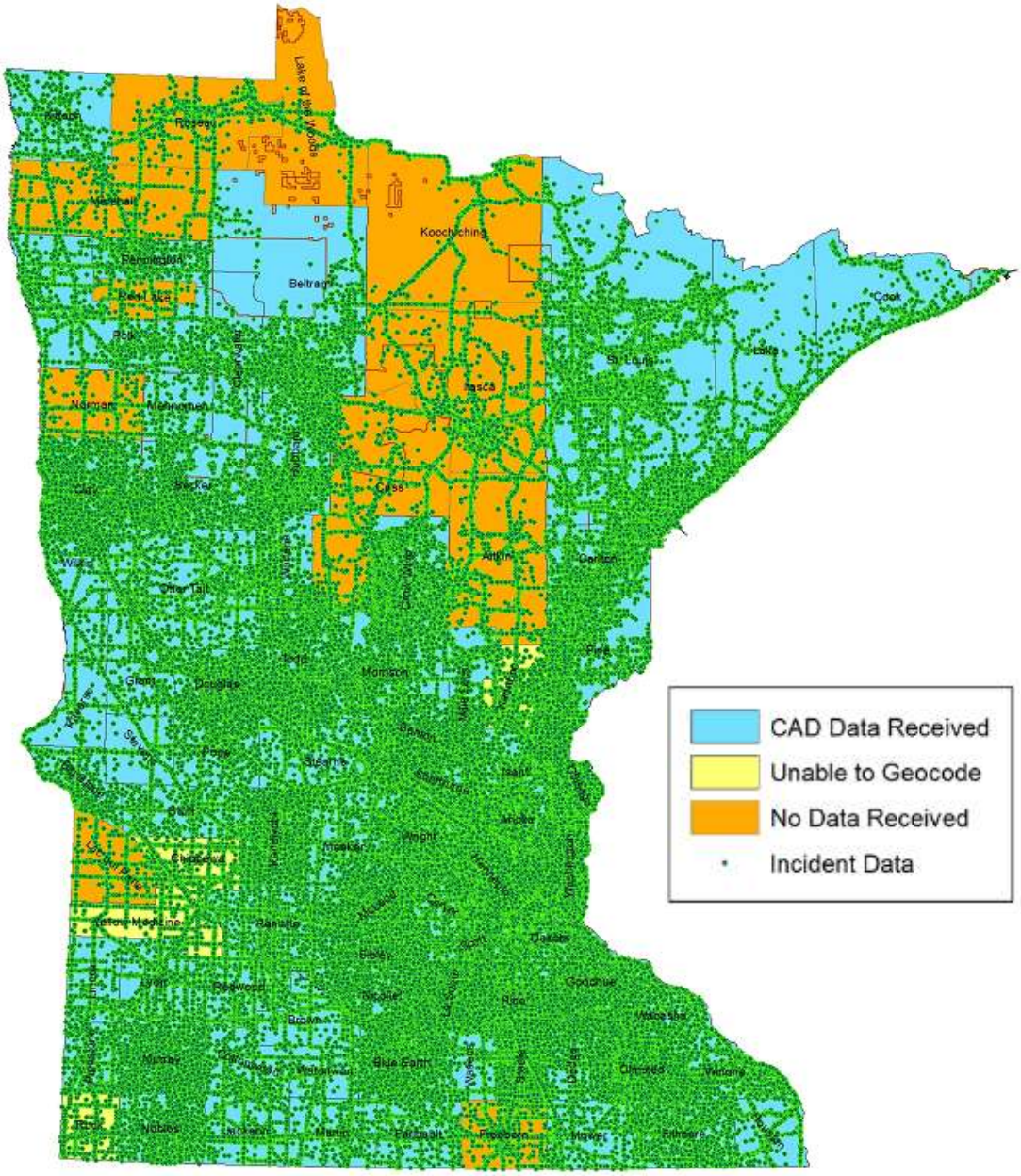
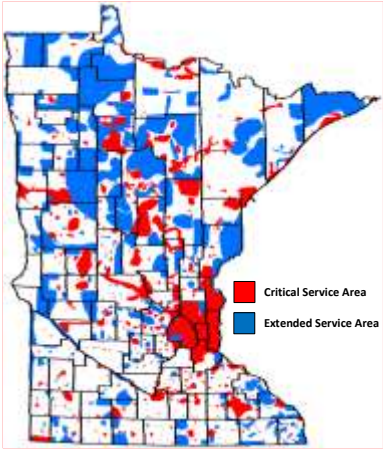


Figure 6: Aggregated Statewide CAD Data (2010 – 2013)

Coverage Review Sessions



The MnFCP project team conducted coverage review sessions with each county in the State of Minnesota. During these sessions, the project team would identify the typical use cases for wireless data as well as wireless device configuration deployed. Our purpose was to develop an understanding of what it would take for the agencies to adopt the FirstNet service. The primary topic of these discussions was coverage. Specifically, an online geographical information program was used as a basis for capturing the coverage requirements. The GIS application included known critical infrastructure and CAD data provided by public safety agencies. Using these data sets, the parties drew the critical and extended service areas based on the criteria defined by the statewide workgroup. Required service areas referenced the published service areas of the carriers since as the Workgroups determined that the carrier coverage maps, although over-optimistic in their prediction, were an adequate initial proxy for their footprint.

The CAD data displayed during the coverage reviews was an aggregated set of received call records that was assembled from the PSAP CAD systems. CAD systems combine the call logging and record keeping with GIS components, Automatic Vehicle Location (AVL-GPS), messaging and dispatch. The CAD data records are a wealth of information with regard to discovering where emergency events occur as well as the types of events to which first responders respond.

The project team collected CAD data records from 92 out of 104 PSAPs across the state; 4 of these datasets, the team was unable to use. Eleven (11) PSAPs were unable to provide data; partly because they were transitioning to a new vendor and did not have the support of the old vendor and partly because they did not respond to the team's requests.

The CAD data records were extensively analyzed. First they were cleansed for errors and redundancies. Next they were normalized for consistency. Lastly they were aggregated within quarter square mile bins. This bin size was chosen because it represented the smallest likely dense urban cell from a single LTE base station. In this manner the data can aggregate upward for less dense areas of the state.

The project team reviewed the FirstNet baseline data and found some correlation with incident density when averaged over large areas. However, when reviewed at a micro level, the level of a neighborhood for example, orders of magnitude of difference were found between neighborhoods throughout different areas of the state. Part of this may be due to the resolution of the data; FirstNet uses a one square mile bin to demonstrate the coverage objectives; whereas the project team based its calculations and requirements on a quarter square mile bin.

Wireless data networks are an integrated component of public safety operations.

Online Surveys

Online surveys provide agency by agency text based responses for information gathering. The surveys collect data such as contact information for appropriate personnel, the number of staff in the respondent's agency, existing wireless data spending, and other information. The State of Minnesota began collecting online survey data in 2014, long before the publication of the Mobile Data Survey tool and FirstNet's adoption of the tool for SLIGP data collection. Fortunately, most of the data sought by FirstNet was included in the State's original data collection plan and was underway by the publication of the FirstNet Data Elements request. Minnesota's responses to the survey data were modified to match the FirstNet request to the extent possible. The data files provided in the attachments regarding the survey data also include descriptions of the data and information regarding how the original Minnesota surveys were matched to the FirstNet fields.

ELEMENT 1: COVERAGE OBJECTIVES

The following sections detail the State of Minnesota approach to the development of these coverage objectives. One's user equipment and use case significantly affects the apparent "coverage" level experienced by the end-user. For example, a user who has an in-car laptop connected to a vehicle modem and external antenna will report much better "coverage" than a user sitting in the same vehicle using a handheld cell phone. Furthermore, a user inside of a building will report much worse "coverage" than a user outside of the building. In all cases there is no difference in the radio signal from the tower site. However, the "coverage" experienced by the end user is very different in each case.

In Minnesota, stakeholders indicate that a significant portion all existing data applications are vehicle-based but that nearly all agencies rely on smartphones and tablets to some degree. Furthermore, many agencies indicate a strong desire to roll out future applications that can be used on a variety of portable devices including laptops, tablets and smartphones which are used in vehicles, outdoors and in buildings. Stakeholders will require service in all of these environments.

Several agencies will require the new FirstNet service to eventually meet the level of coverage provided by ARMER (the state's Land Mobile Radio voice network). The minimum baseline coverage requirement of the ARMER system is 95 percent on a county-by-county basis. In reality, the ARMER system provides much better coverage in nearly all cases and sets a very high expectation for the user community in Minnesota.

FirstNet Baseline Objectives Map

On March 23, 2015, FirstNet released coverage objective maps for all states and territories. The data request states "Using the FirstNet Coverage Objective baseline, identify gaps or issues with the coverage objective and adjust the map accordingly." The State of Minnesota reviewed this coverage baseline and determined that was not a satisfactory depiction of its coverage objectives.

Figure 7: FirstNet Baseline Objective Map

FirstNet's map includes four distinct characterizations; "High", "Moderate", "Low" and "Non-Terrestrial". The "High" category is an area with "a high likelihood for public safety response"; correspondingly, the "Moderate" category has a "moderate" likelihood and the "Low" category a "low" likelihood for public safety response. The fourth category is "Non-Terrestrial", implying that the service could be provided by earth to satellite communications. These "Non-Terrestrial" areas are depicted in **Grey** on the map; but not shown on FirstNet's legend. The table below depicts the land mass associated with each of these areas.

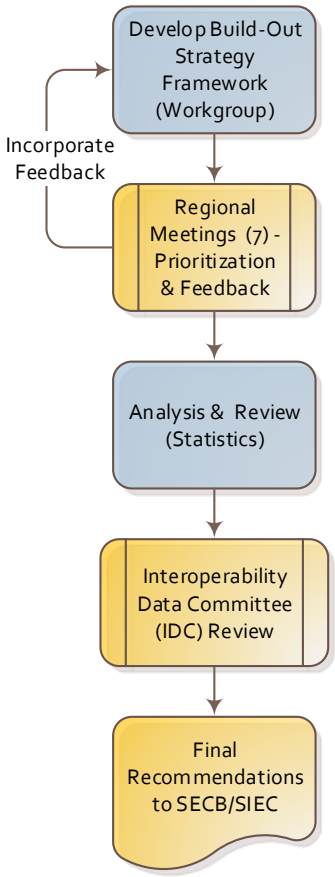
Table 1: FirstNet Baseline Objectives – Area Served

Objective	Area	% of State
High Concentration	863 sq. mi.	1%
Moderate Concentration	4,660 sq. mi.	5%
Low Concentration	42,865 sq. mi.	51%
Non-Terrestrial	36,785 sq. mi.	43%

The workgroup expressed concern with these maps and the throughput levels identified in the Draft RFP. The extent of terrestrial coverage is not deemed competitive with the commercial carriers in the State. The State estimates that the largest carrier footprints cover more than 90% of the State of Minnesota. As the State mentioned during its initial consultation with FirstNet, satellite or non-permanent coverage is not acceptable, especially where services from commercial providers already exist. These types of services should be used only in very remote areas or where infrastructure has failed.

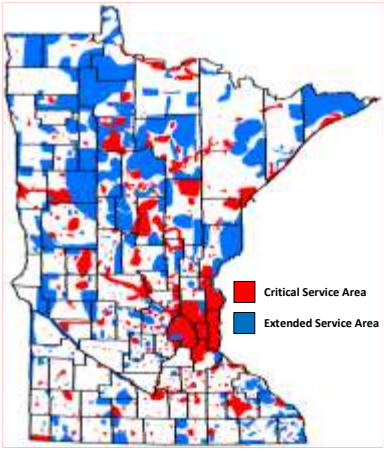
Coverage Objectives and Phased Deployment Process

The creation of the coverage objectives development process began with an "ad hoc" workgroup that was specifically established to develop the coverage related documentation requested by FirstNet. The workgroup was charged with developing and approving a process by which the State would establish the coverage objective and phased deployment per the instructions of FirstNet. The RECBs/RESBs were leveraged to weigh in on these objectives. The feedback from the regional meetings was used to modify the approach until the final product was developed. Over the seven regions, the project team presented options for the phased coverage objectives to 262 participants to gather feedback. The statewide strategy underwent several changes based on this feedback. Upon the completion of the regional meeting, the MnFCP project team aggregated the regional baselines to establish the State's overall coverage strategy. The team then presented the findings to the Interoperable Data Committee (IDC) (The role of this committee is to advise the SECB on all wireless broadband and data sharing issues) and the SECB for final review and approval.



The following sections provide the overview of the Coverage Objectives and the Phased Deployment strategy of the State of Minnesota. Maps of these data are provided in GIS form as part of this submission.

Element 1a: Coverage Objectives



The net coverage objective for the State of Minnesota is the combination of the Critical, Required, and Extended service areas defined during the Coverage Reviews described above or 95% of each county, whichever is greater. The aggregate statewide coverage reviews demonstrates consistency and thoughtfulness by all stakeholders at all levels of government; local, county and state. This is evident by the fact that the participating stakeholder remained judicious with the identification of the critical service areas. In the aggregated totals for the Critical Service Area, only 13% of the State was deemed critical. This area represents over 88% of all incidents within the State, hence the criteria which define "critical" areas as "the area of highest-activity" was largely met.

Additional Coverage Objectives

As described above, the State of Minnesota was concerned with previous documentation provided by FirstNet regarding throughput levels and in-building coverage. In light of this concern, the State decided to provide specific requirements regarding what the areas defined as "covered" means. Minnesota's Draft RFP comments contain a number of these requirements and objectives as do the Minnesota Launch Requirements document, also attached. This section provides a summary of all of those previously provided requirements as well as some additional coverage "quality" direction developed since our July 27, 2015 submission to the Draft RFP. It is important to note that the ad hoc Workgroups that deliberated over these issues identified a difference between Band 14 coverage and overall coverage to allow FirstNet latitude for achieving the net coverage desired. Band 14 coverage was prioritized by the Workgroups in areas where commercial services were deemed the least adequate – in areas where congestion caused availability issues as well as areas where commercial coverage was unreliable or non-existent.

Table 2: Additional Coverage Requirements

Criteria	Minimum Acceptable Req.	Objective/Goal
•Amount of Band 14 Coverage	FirstNet shall provide sustainable Band 14 coverage in all critical and extended services areas defined by the State of Minnesota Coverage Objectives and according to the Phased Deployment schedule.	FirstNet should cover all critical, required and extended service area as defined by the State of Minnesota Coverage Objectives. FirstNet should deliver coverage milestones faster than described in the State of Minnesota Phased Deployment objectives.

Criteria	Minimum Acceptable Req.	Objective/Goal
•Quality (indoor / outdoor, Mbps, seamless)	FirstNet shall provide sustainable indoor coverage and throughput no less than commercial levels. FirstNet shall deliver a minimum of 4 Mbps (DL) and 1 Mbps (UL) for a single user over 95% of each Critical Service Area for each county. FirstNet shall provide single user throughput equivalent or greater than typical commercial carrier service in all other areas (RSA and ESA) but not less than 756 kbps DL and 268 kbps UL in any area where coverage is required. FirstNet shall provide for roaming on all indoor solutions via roaming as a minimum but must provide band 14 indoor DAS solutions for all major venues including stadiums, arenas and convention centers. FirstNet shall provide service that transitions between Band 14 and roaming coverage must be seamless for all devices including hand held form factors.	FirstNet should provide through-put that leverages capacity from other spectrum bands (non-Band 14) to address the net capacity needs of public safety in a major emergency. FirstNet should provide in-building coverage that delivers a minimum of 256 kbps uplink to a body worn portable device for 95 % of the interior of each building (includes above and below ground areas).

Criteria	Minimum Acceptable Req.	Objective/Goal
•Growth and Deployables	FirstNet shall maintain sustainable equivalent or better net coverage to the commercial carriers. FirstNet shall provide deployable systems (e.g., MCUs or COWs) for pre-planned and unplanned emergencies equivalent to the programs offered by the commercial cellular carriers.	FirstNet should describe details regarding a program that allows investments from state and local governments to partially or wholly finance addition coverage. FirstNet should provide specific metrics for annual growth and coverage that clearly and definitively establish commitments to grow the coverage of the system. FirstNet should offer deployable systems that provide specific and rapid response times and allow for public safety influence over pre-planned event participation. The plan shall address the guaranteed "in service" time lag for various parts of the country. FirstNet should deliver emergency coverage and capacity within four hours anywhere in the Continental United States and should offer drones and similar solutions to address emergency coverage.

Criteria	Minimum Acceptable Req.	Objective/Goal
•Net Required Coverage including - Roaming	FirstNet shall provide a sustainable net aggregate (combined roaming, indoor and Band 14) coverage that addresses the required service area, as defined in the Coverage Objectives, at IOC-1 (6 months after award). FirstNet shall provide net coverage that achieves 95% coverage by county. FirstNet shall prioritize Required, Extended and Critical service areas as defined in the Strategic Build-Out no later than Final Operating Capacity (FOC). FirstNet shall also provide sustainable international roaming with industry leading Canadian coverage.	FirstNet should allow roaming with the two industry leading national carriers.

Element 1b: Phased Deployment

Through the development of the State's response to FirstNet's request for a Phased Deployment[3], the project team and stakeholders developed the "Bookends" Strategy. This strategy prioritizes dense urban areas and sparsely populated rural areas in the initial phases and eventually meeting in the more suburban or denser rural areas in the final phases. In this way FirstNet's and the State's goals are mutually achieved by the prioritization of the build-out in the most populated areas, while rural public safety agencies gain improvements over commercial service early in FirstNet's roll-out.[4] The following table provides a summary of the approach by phase.

[3] "Provide a description of the proposed incremental deployment phases that would achieve the desired coverage objectives identified in 1a."
[4] The strategy is premised on a commercial carrier who can provide roaming service throughout the required service area (carrier footprint).

Table 3: Phase Deployment Strategy

"Bookends" Strategy	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Critical Service Areas (incident density)	✓	✓			
Extended Service Areas (incident density)	✓	✓	✓	✓	✓
Interstates (with buffer, road count)	✓	✓			
US & State Roads (with buffer, road counts)			✓	✓	✓
Required Service Area (incident density)			✓	✓	✓

Within an individual data element, other factors are used to distribute the net area of that element across phases in order to achieve twenty percent of the net coverage objective in each phase. For example, Critical Service Areas are broken up by phase according to the incident density of each area, with higher incident densities occurring in earlier phases. Likewise, Interstate and other road coverage is phased according to road counts. In addition to the above categories, the work group considered specific rail lines carrying HAZMAT (Bakken Oil and other sensitive materials). The workgroup considers these lines critical infrastructure and important to serve. However, because the rail lines fall within the buffer area of the US and State Roads, they were generally served in earlier phases, and therefore, the rail lines are not specifically delineated in the strategy.

The Phase 1 coverage objective is implied to be the resultant coverage requirement at the end of end of Phase 1. Likewise, Phase 5 represents the aggregate coverage objective at the end of Phase 5, or the end of the contract term as identified in FirstNet's RFP. In counties where 95 percent coverage is not achieved in the map (as a result of the critical, required, and extended service areas), the remaining area to create the resultant 95 percent coverage should be delivered by Phase 5. The phases provided by the State of Minnesota represent annual enhancements based on statements made by FirstNet in various presentation although the state will gladly accept multiple phases within one year period as well.

The table below represents the percent of total CAD incidents that occur within the footprint of each phase's coverage objective as well as the population and land area covered by each phase.

Table 4: Percent Incidents, Population, and Land Area By Phase

	Percent of Incidents Covered	Population	Land Area
Phase 1	91%	66%	21%
Phase 2	94%	81%	40%
Phase 3	99.4%	93%	60%
Phase 4	99.9%	98.8%	80%
Phase 5	100%	100%	95%

As the table depicts, by the end of Phase 3, more than 99 percent of the CAD incidents over the past three years occur within the footprint of the coverage objective. This area also represents 93 percent of the total population of the State of Minnesota, yet it only represents 60 percent of the total land area.

Survey Data Summaries

As described above, surveys were distributed to collect data pertaining to the agencies' current spending, purchasing habits, and potential barriers to wireless data adoption. These online surveys were leveraged to provide the following FirstNet Data Elements in this submission:

Table 5: FirstNet Data Elements – Reference Table

FirstNet Dataset Number	Data Set Name
2a	Public Safety Entity (PSE) Info
2b	Devices
2c	Users & Devices Summary
2d-i.	Operational Areas[5]
3a	Applications
3b	Data Usage
4a	Current Providers
4b	Barriers

The following sections represent a summary of the survey data including elements of the survey that differ from the FirstNet request. Minnesota believes some of these data sets are enlightening and will help FirstNet understand the perspectives of the Minnesota stakeholders and what it will take to be successful.

[5] Survey data was used to determine agency names and user populations.

Survey responses from over 1,300 agencies were analyzed, with the responding agencies categorized in the following chart. **The overall response rate was approximately 52%. The majority of the agencies that did not respond appear to be volunteer agencies. Therefore, one needs to take this into account when considering the following results:**

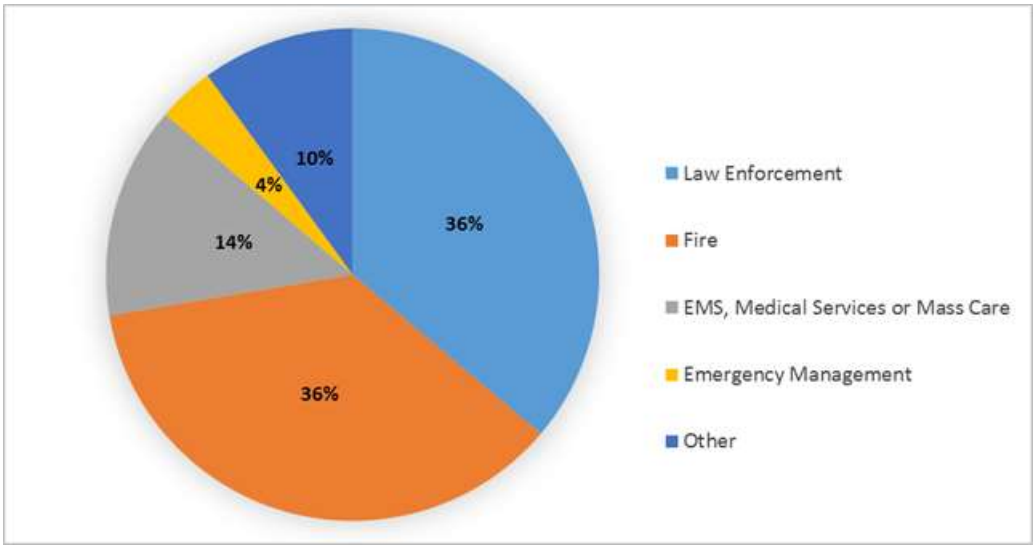


Figure 8: Percent of Survey Responses by Agency Type

Law Enforcement (Sheriff and Police Departments) and Fire Department representatives provided the majority of the responses, followed by EMS. Other responding agencies were grouped together, and included:

- Departments of Transportation,
- Minnesota State Patrol
- Bureau of Criminal Apprehension
- Department of Corrections
- Public Works Departments,
- Public Schools and
- Utilities.

Out of the roughly 52% of the agencies that responded and, a majority of survey responses indicate that their agencies or departments pay for, or reimburse for wireless service. This data underscores the need for FirstNet to have a solution to market, sell, and service devices and service to individuals that receive service through their agency. It should noted that a relatively

large number of volunteer agencies had not responded to this question and that the majority of volunteer agencies are presumed to use their personal devices for mission critical activities.

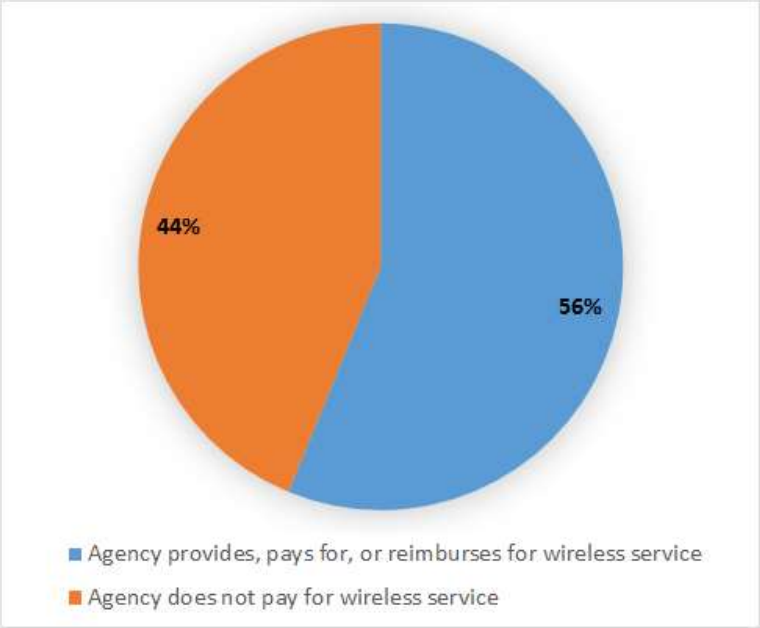


Figure 9: Financial Responsibility for Wireless Services

In fact, as the chart above shows, some of the 56 percent of the respondents have their agency reimburse for the service. But in those cases, the user probably makes the decision on which vendor to use, and therefore, the total percentage of end-user "contracted" devices would be higher.

The survey made an effort to quantify the means by which agencies purchase their wireless services; the most predominate method was through the Statewide Contract. However as what can be seen by the figure below; local individual and General Services Administration (GSA) contracts are common as well. [Note: this chart represents the responses from only 23% of the agencies within the State].

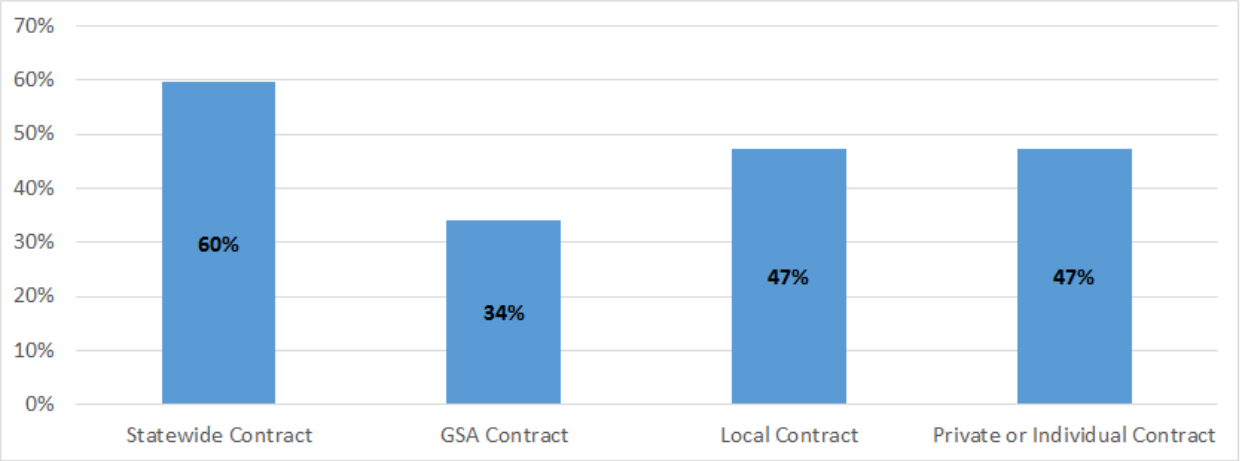


Figure 10: Purchasing Vehicles used for Wireless Data Services

The survey also gathered information on the types of devices the agencies prefer to purchase. In the case of smartphones and tablets, consumer-grade devices are preferred over ruggedized devices. Because the preference is largely for consumer-grade smartphones and tablets, it will be very important for FirstNet to offer these types of devices on their network in order to gain interest from public safety users.

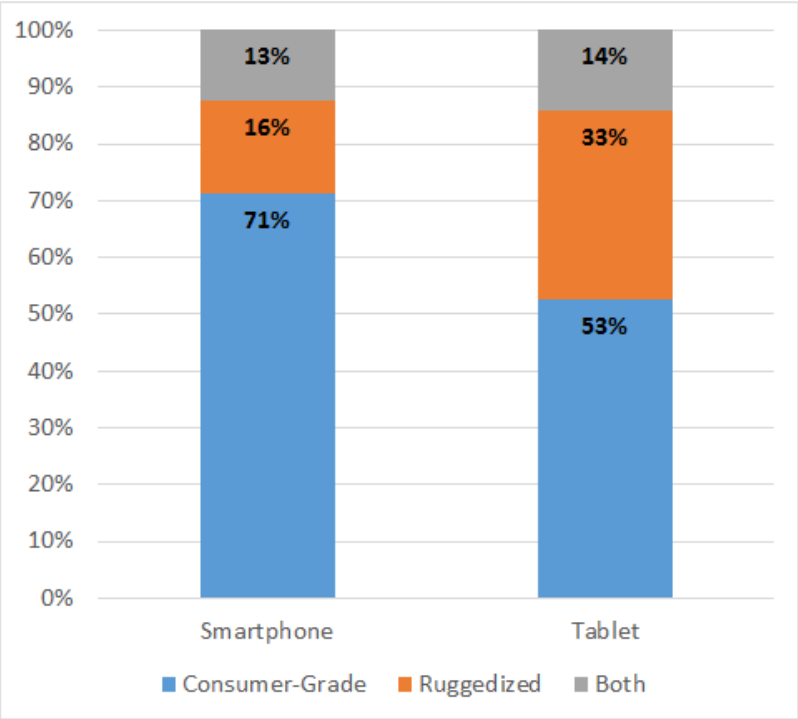


Figure 11: Device Purchasing Preferences

Additionally, many agencies plan to increase the number of devices in service by 2016. The survey results indicated that smartphones are the most widely used wireless device, however, more agencies expect an increase in tablets.

Table 6: Expected Device Growth

Device Type	Percent of Agencies Expecting Increase
Tablets	54%
Smartphones	52%
Toughbooks	39%
Mobile Hotspots	34%
USB Modems	31%
Vehicular Modems	28%

The State of Minnesota survey captured barriers that may prevent users from subscribing to wireless data service. The figures below display the percent of survey respondents who identified various barriers to their agencies' adoption of wireless service.

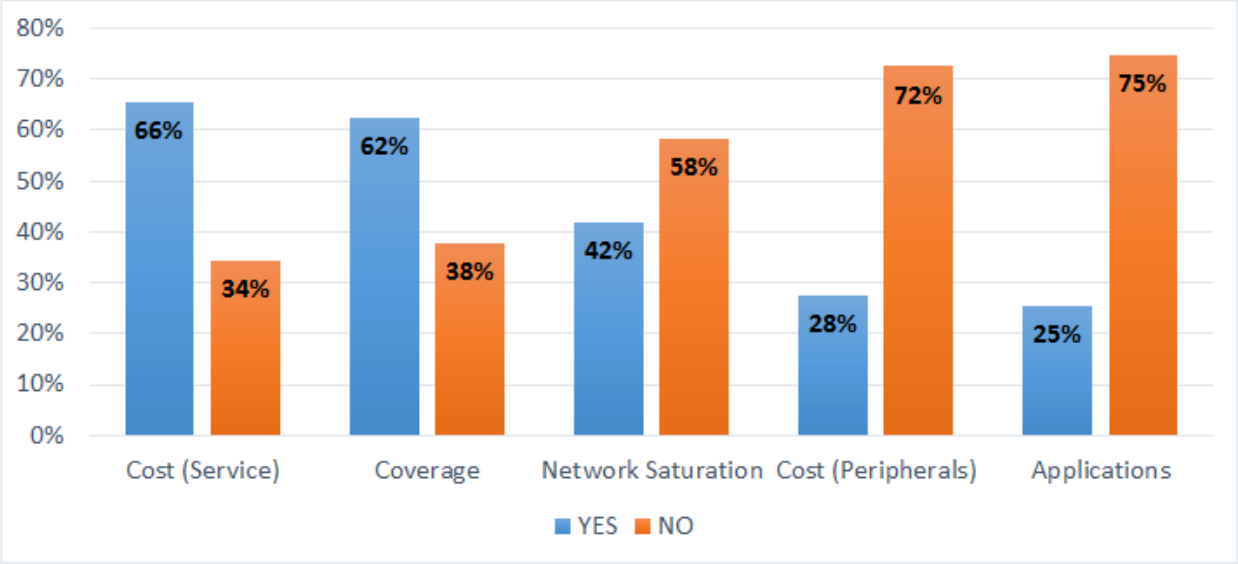


Figure 12: Barriers to Wireless Adoption

It is important to note that this survey was conducted prior to the issuance of FirstNet's data elements, and therefore, it is not a precise match of the FirstNet barriers to adoption options. The following graph provides the same data using only rural agencies.

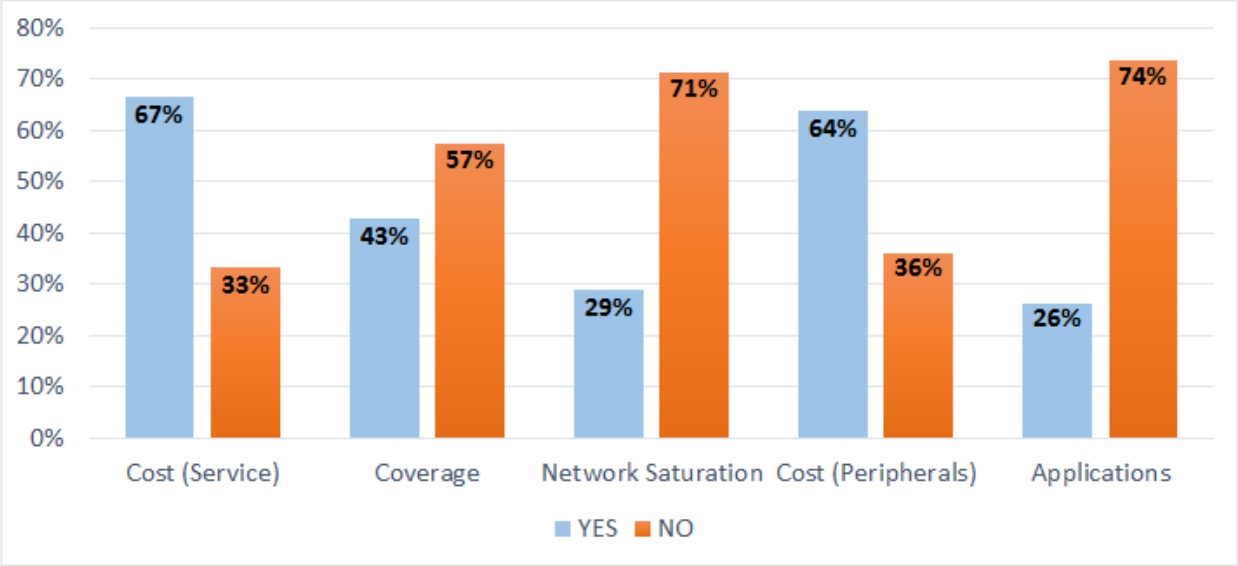


Figure 13: RURAL COUNTIES: Barriers to Wireless Adoption (Excluding Metro-Region Agencies)

Notably, the exclusion of Metro-region agencies changed the impact of various attributes. Interestingly, the cost of peripherals became a very significant barrier to adoption in rural counties, but it is not significant overall. Another interesting factor is that coverage is a barrier to fewer survey respondents in the rural counties than the statewide respondents. In rural areas the number one barrier to adoption is the cost of service; a significantly higher barrier than the lack of coverage. Network saturation was more of an issue to the statewide response and was a barrier to fewer respondents in rural counties. This suggests that many users outside of urban areas will not be persuaded to subscribe to the NPSBN solely based on priority, preemption, or even coverage footprint.

Respondents were also given the opportunity to specify additional barriers. Of the very limited number of write-in responses (fewer than 50), the most often repeated were that the agency had either not given consideration to it, or that there was **no perceived need for wireless data service**.

The final component of the survey was to identify how the cost of FirstNet's network may impact the number of devices the agency has in service if they were to subscribe to the network. Overwhelmingly, agencies responded that a decrease in cost from commercial rates would allow them to increase devices, whereas an increase in cost would cause many not to subscribe to the service at all.

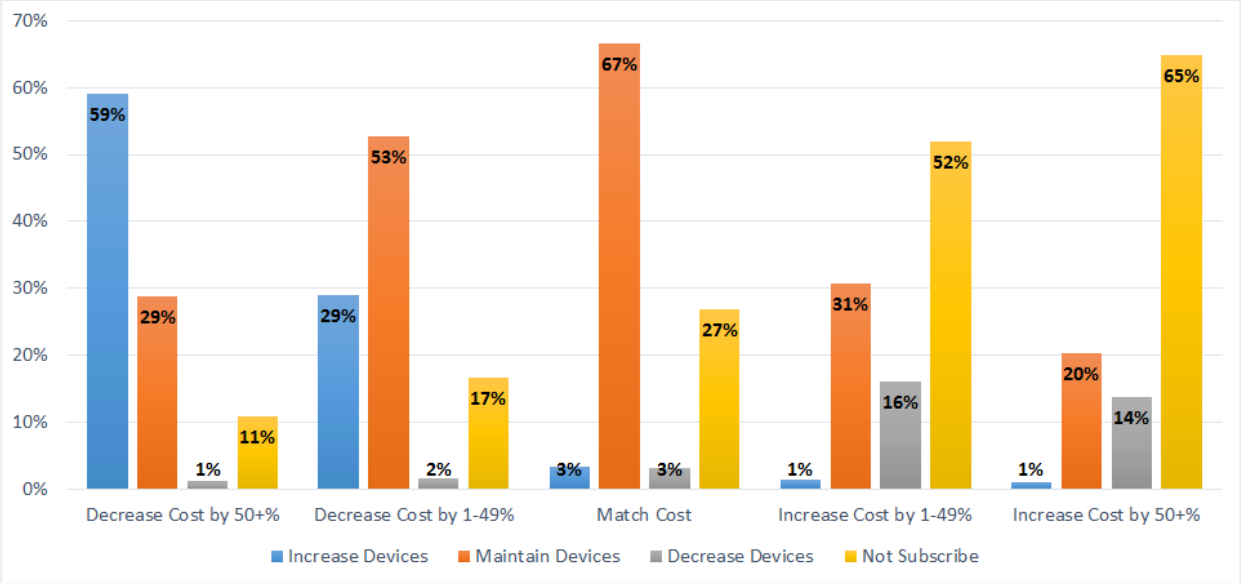


Figure 14: Effect of Network Cost on Device Counts

The data also highlight several other important factors. For example, despite a decrease in service costs of 50 percent or more, 11 percent of the respondents still indicated they would not subscribe. These are likely the users that have little need or interest in wireless data. Likewise, if the service were similarly priced, 27 percent of the respondents would not subscribe. This suggests that some other compelling feature is required in order to motivate the user to migrate to the FirstNet service. The data also highlight the fact that subscribership can increase dramatically with lower service costs, bringing more data and presumably improved public safety operations.

Despite the emphasis on maintaining a low cost for service, an additional survey that assessed a narrower public safety audience found that 75% would prefer to pay a slightly higher fixed rate, rather than to pay for data usage. Seventy-two percent of responses to that survey report having unlimited data plans.

Element 2D-I: Operational Area

The State of Minnesota provides the Operational Area requested by FirstNet in GIS form as an attachment. The information collected was a collaboration between the MnFCP project team and the State NG911 GIS program. The MnFCP project team collected user populations for the public safety entities throughout the state that were added to the geographic operational areas or emergency services zones as defined by the NG911 program. This aggregated data was presented to the state and local stakeholders for review.

ELEMENT 2D-II: CALLS FOR SERVICE

As discussed above, the MnFCP team collected CAD data from stakeholders to assist with the development of the critical and important service areas. The data was also used to prioritize coverage for the Phased Deployment as discussed above. FirstNet's request for Calls for Service is intended to help "validate coverage objectives, provide insights on data usage and aid in capacity estimations." The State of Minnesota provides the aggregated CAD data to serve as the validation of coverage objectives and in aiding the capacity estimations. The figure to the right depicts the incident "heat map" for a single county in the State of Minnesota.

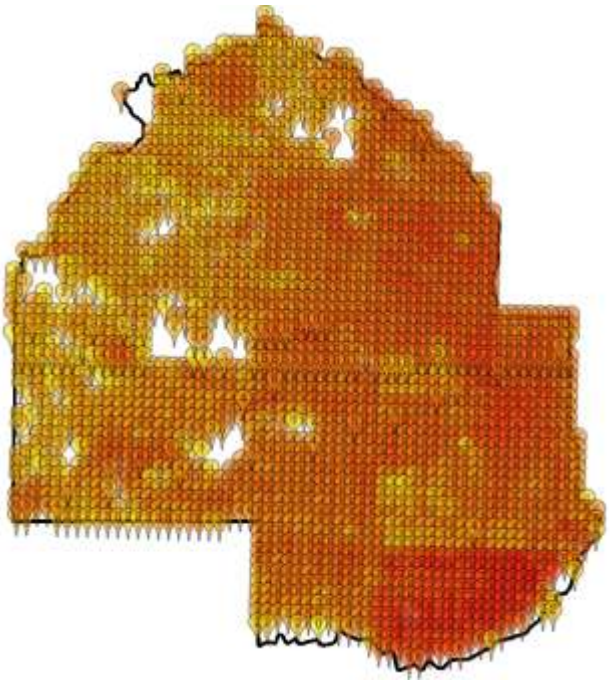


Figure 15: CAD Data Example - Hennepin County

The statistics regarding the coverage of incidents per phase can be found above as well as in Annex 1 below. The statistics show that by Phase 1, more than 90 percent of the incidents are "covered." The figure below shows that the vast majority of all incidents occur in a very small percentage of the state. Accounting for "incident impact", as defined above, the effects of a smaller area are even more significant.

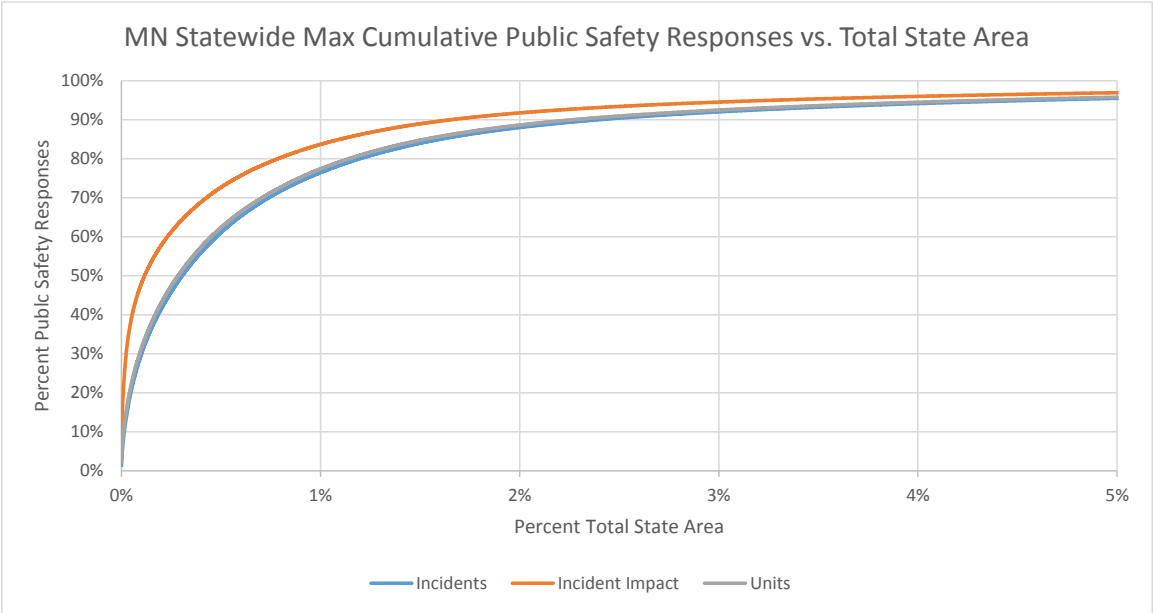


Figure 16: Distribution of Incident Data across a Geographical Area

Looking at the distribution of incidents over the area of the State we find that 5% of the area of the state represent over 96% of the total number of incidents in the state. It is clear that in this concentrated area, a dedicated public safety grade wireless data network would be of substantial benefit to the state. However, we would not want FirstNet to construe from this data that the remaining 95% of the state is unimportant. During each review session for this work product, the stakeholders reminded the project team that a major incident impacting life and property can occur anywhere.

Element 3b: Data Usage

The project team reviewed and analyzed more than 18 million records for over 9.3 million incidents. The wealth and value of this aggregated dataset is indisputable. From it we intend to extrapolate data usage through an extensive analysis. We will use the data to calculate the busy hour throughput requirements, daily and monthly usage, average and peak active users and will geo-locate the results. The traffic profile analysis will include trends analysis for the calendar years leading up to the launch of the NPSBN in 2017. The project team intends to deliver the results of this analysis to FirstNet by the end of 2015.

Additional Information: Launch Requirements

In addition to the requested information, the State of Minnesota also provides an updated version of the State's "Launch Requirements." This document contains more details regarding the

process employed for data collection and consensus building for the State's requirements as well as highly detailed requirements. The State had provided an advance copy of these Launch Requirements as part of the Draft RFP comments and provides an updated version of these Launch Requirements, updated with coverage related objectives and requirements developed since that July 2015 version. The State of Minnesota recommends that FirstNet use these launch requirements in its RFP to the extent possible.

CONCLUSION

In conclusion, the State of Minnesota wishes to thank FirstNet for the opportunity to submit this document and the attached data sets. The State hopes that this document can serve as a beginning to ongoing discussions to further public safety communications for our stakeholder. The State looks forward to these discussions and to help find the best path forward for public safety and offers is full support to provide additional details to assist in FirstNet' development of its RFP, plans, and other activities.

ANNEX 1: STATEWIDE MAPS BY PHASE

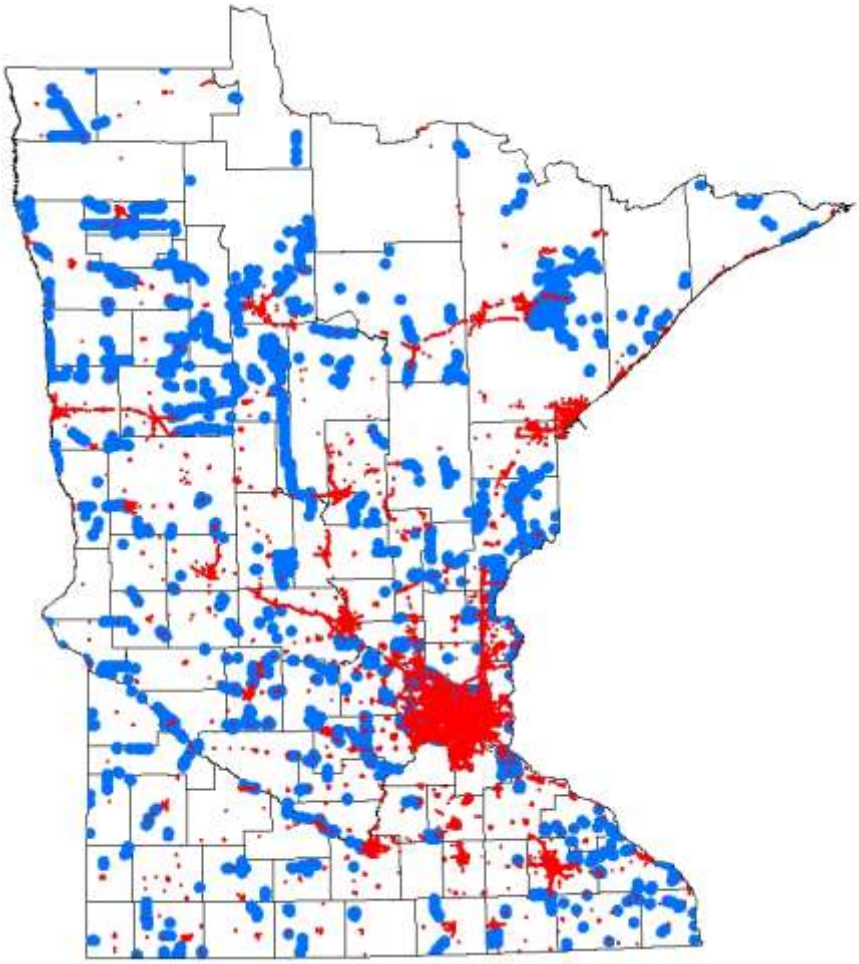
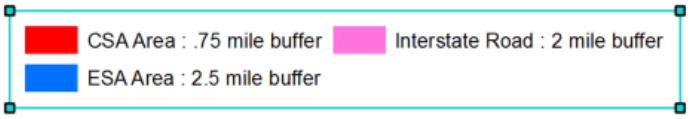
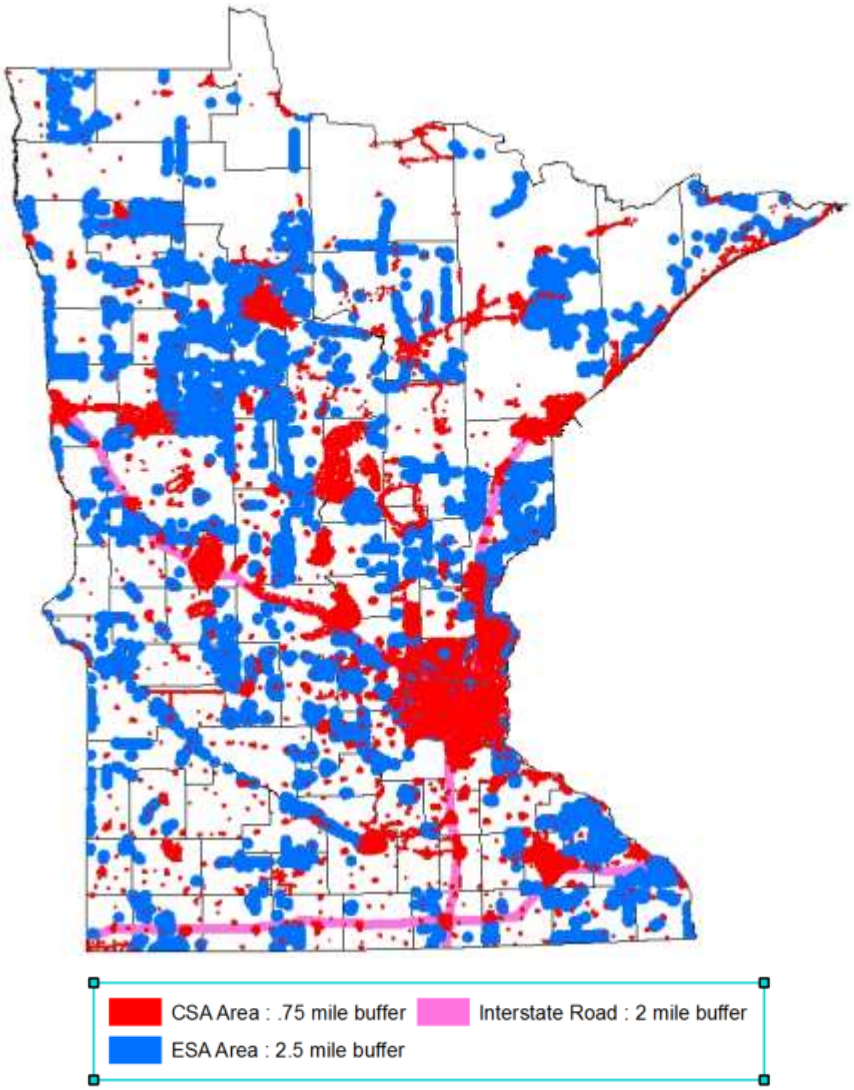


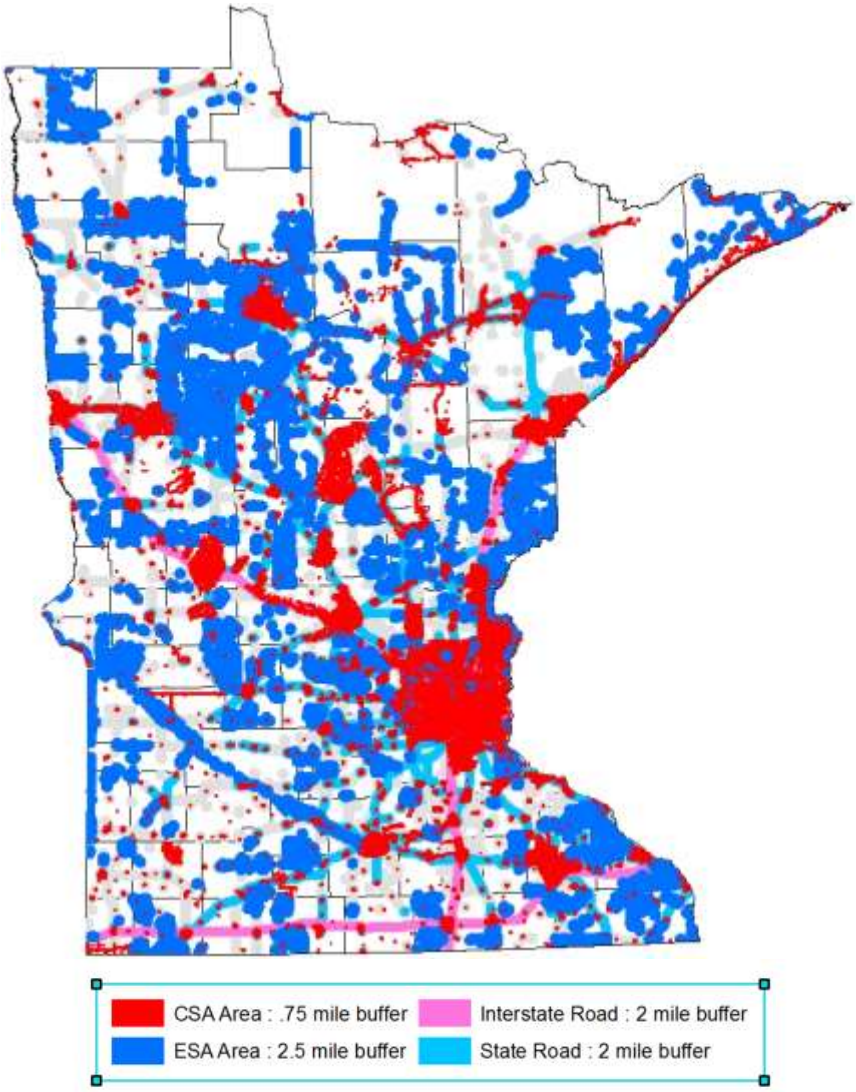
Figure 17: Phase 1 Statewide Coverage Objectives Map



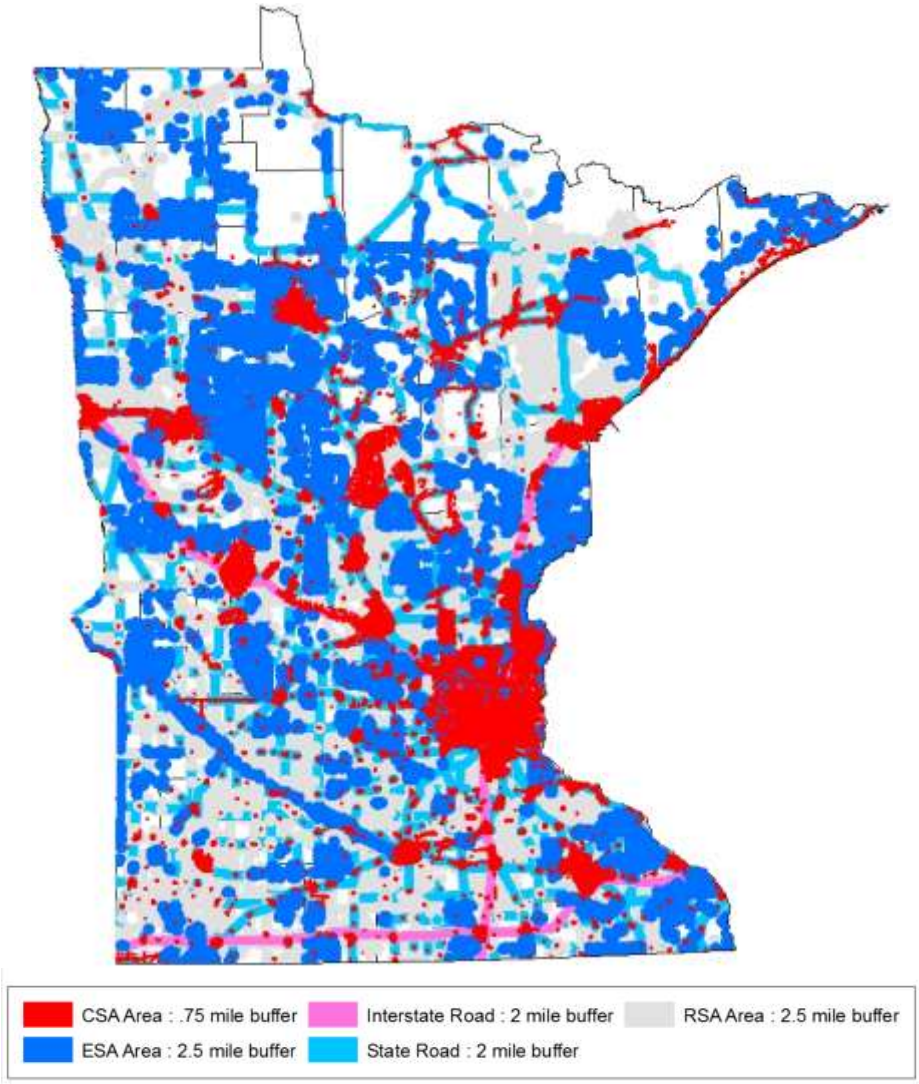
Phase 1 Results:	Totals	Percentage
Percent of Incidents Covered	N / A	91%
Affected Population	3,507,509	66%
Land Area Covered	20,432 sq.mi.	21%



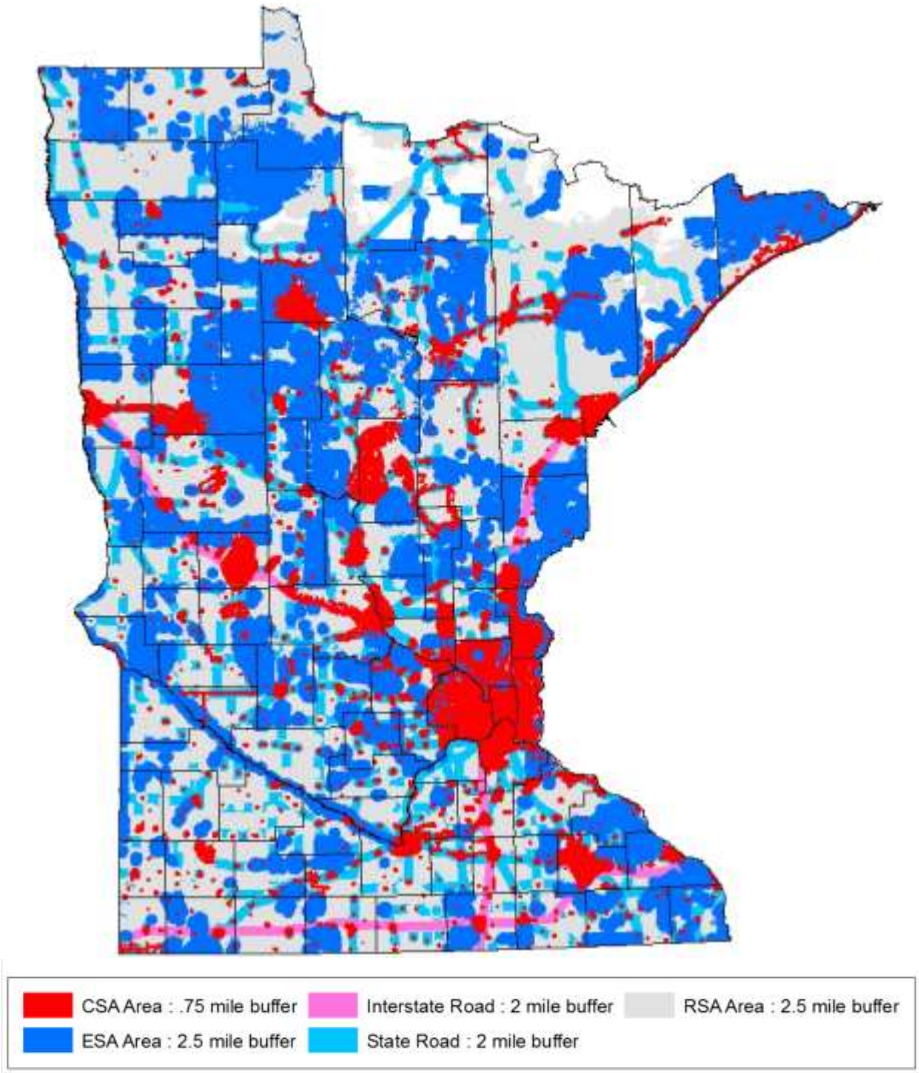
Phase 2 Results:	Totals	Percentage
Percent of Incidents Covered	N / A	94%
Affected Population	4,301,581	81%
Land Area Covered	43,514 sq.mi.	40%



Phase 3 Results:	Totals	Percentage
Percent of Incidents Covered	N / A	99.4%
Affected Population	4,958,693	93%
Land Area Covered	61,970 sq.mi.	60%



Phase 4 Results:	Totals	Percentage
Percent of Incidents Covered	N / A	99.9%
Affected Population	5,239,827	98.8%
Land Area Covered	79,986 sq.mi.	80%



Phase 5 Results:	Totals	Percentage
Percent of Incidents Covered	N / A	100%
Affected Population	5,239,827	100%
Land Area Covered	79,986 sq.mi.	95%

APPENDIX 1: LIST OF ATTACHMENTS

FirstNet Reference	Filename	Notes
1a: Coverage Objectives	MnFCP 1a Coverage Objectives.zip	This zip file contains the ESRI formatted GIS files that constitute the net coverage objectives of the State of Minnesota
1b: Phased Deployment	MnFCP 1b Phased Deployment.zip	This zip file contains the ESRI formatted GIS files of the phased deployment objectives of the State of Minnesota in five phases.
2a: PSE Info	MnFCP 2a PSE Info.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page provides any notes or other information that provides context to the State's submission.
2b: Devices	MnFCP 2b Devices.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page provides any notes or other information that provides context to the State's submission.
2c: Users & Devices Summary	MnFCP 2c Users and Devices Sumamry.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page provides any notes or other information that provides context to the State's submission.
2d-i: Operational Areas	MnFCP 2d-i Operational Areas.zip	This zip file contains the ESRI formatted GIS files that constitute the operational areas of the State of Minnesota
2d-ii: Calls for Service	MnFCP 2d-iiCalls for Service.xls	This zip file contains the ESRI formatted GIS files of the aggregated CAD data of the State of Minnesota.
3a: Applications	MnFCP 3a Applications.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page provides any notes or other information that provides context to the State's submission.
3b: Data Usage	MnFCP 3b Data Usage.xls	This Excel file contains data usage information. See info tab in the Excel file for additional information.
4a: Current Providers	MnFCP 4a Current Providers.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page

		provides any notes or other information that provides context to the State's submission.
4b: Barriers	MnFCP 4b Barriers.xls	This Excel file contains the requested data according to the FirstNet template. Two tabs are provided, info and data. The info page provides any notes or other information that provides context to the State's submission.
N/A	MnFCP Launch Requirements v9-30-2015.pdf	The State of Minnesota submits this updated Launch Requirements document (a previous version was submitted with the State's Draft RFP comments). This new version includes security requirements.

APPENDIX 2: SUMMARY OF MISSING CAD DATA

Five county PSAPs could not provide CAD data because they were in the middle of migration to a new vendor and the prior vendor would not provide the incident data. Five county PSAPs did not respond to the request and we could not ascertain whether CAD data was available. An additional five county PSAPs ran into technical problems extracting the necessary fields and hence we could not geocode the incident locations. Lastly one PSAP reported that they did not have a CAD system.