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Yavapai 9-1-1 System
Geographic Information System
Model for Advancing Public Safety[SM] Assessment

Final Report

PREPARED NOVEMBER 2021 FOR
THE YAVAPAI 9-1-1 SYSTEM AND
THE ARIZONA 9-1-1 PROGRAM

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Executive Summary

The Arizona Department of Administration (ADOA) operates the Arizona 9-1-1 Program (Program), which is responsible for guiding the migration of the state's eighteen 9-1-1 systems—comprised of 81 public safety answering points (PSAPs)—from legacy 9-1-1 technology to Next Generation 9-1-1 (NG9-1-1). The Program commissioned an NG9-1-1 geographic information system (GIS) strategic plan[1] in 2020 as the first step to govern the State of Arizona's (State) geospatial commitments to the NG9-1-1 migration and to provide clarity on the State's role in local NG9-1-1 migration. The *Arizona Next Generation 9-1-1 GIS Strategic Plan* noted:

> The further implementation of a large-scale, enterprise-wide capability such as geospatial data collection, aggregation, validation, and dissemination will require a tremendous effort through a phased approach, significant stakeholder coordination and collaboration, and adequate and sustained funding streams. However, by cooperatively implementing a program in adherence to nationally accepted standards, Arizona will position itself in a forward-thinking mode by facilitating interoperable data sharing practices that create flexibility and sustainability within its 9-1-1 Program.

To achieve the goals outlined in the strategic plan, the Program first must understand the current geospatial capabilities of each 9-1-1 system by individual jurisdiction. To this end, the Program hired Mission Critical Partners, LLC (MCP) to evaluate the readiness of GIS staff and data in each 9-1-1 system to support the migration to and continuing operation of NG9-1-1. The Program specifically seeks a report on the weaknesses and strengths of each 9-1-1 system throughout Arizona to frame a statewide picture for legislators as the Program seeks to fill the full-time positions necessary to fully support GIS capabilities for efficient and effective NG9-1-1 call routing.

NG9-1-1 redefines the fundamental processes used to connect an emergency caller with the correct 9-1-1 center. At the foundation of NG9-1-1 is GIS data and analytics. Harnessing the location and advanced querying capabilities of GIS enables more accurate emergency call routing by leveraging geospatial data generated by a variety of devices—from cell phones to automatic crash detection systems in vehicles—now capable of dialing 9-1-1. This migration to geospatial call routing necessitates the creation of highly accurate and fully attributed GIS data.

MCP used a proprietary methodology called the Model for Advancing Public Safety℠ (MAPS®) to analyze GIS readiness at each 9-1-1 system. MAPS combines the collective body of knowledge gained from MCP's 100-plus specialized public safety subject-matter experts (SMEs) with a variety of mature, broadly accepted public safety and information technology (IT) standards, formalized accreditation programs, and

[1] AZ-DOA GIS Strategic Plan_August 2020_FINAL.pdf (az911.gov)
https://az911.gov/sites/default/files/AZ-DOA%20GIS%20Strategic%20Plan_August%202020_FINAL.pdf

industry best practices. The MAPS assessment enables an entity, such as a county, to easily discern and understand where the organization stands in relationship to several critical factors.

For these MAPS assessments, the Program has chosen to pursue separate analyses and reports for the Tribal communities. As a result, the needs of the Tribal Nations in Yavapai County will not be included in this report. However, gaps in GIS capabilities and data resulting from a lack of coordination between the County and the Tribal Nations will be noted in both reports and the need for State assistance in facilitating collaborative efforts will be reflected in readiness scores for all affected parties. This will allow the State to focus funding and support where it is most needed. All stakeholders will have access to a summary report including Tribal Nation results in the final statewide report.

A key element of MAPS is a color-coded, visual "blueprint" that depicts the status of each factor that was assessed. Green indicates factors that are NG9-1-1 ready and thus not in need of immediate attention, yellow indicates those that are at risk but are transitioning to NG9-1-1, and red indicates factors that are at high risk. The figure below shows the Yavapai 9-1-1 system's scores related to GIS readiness in all eight factors.

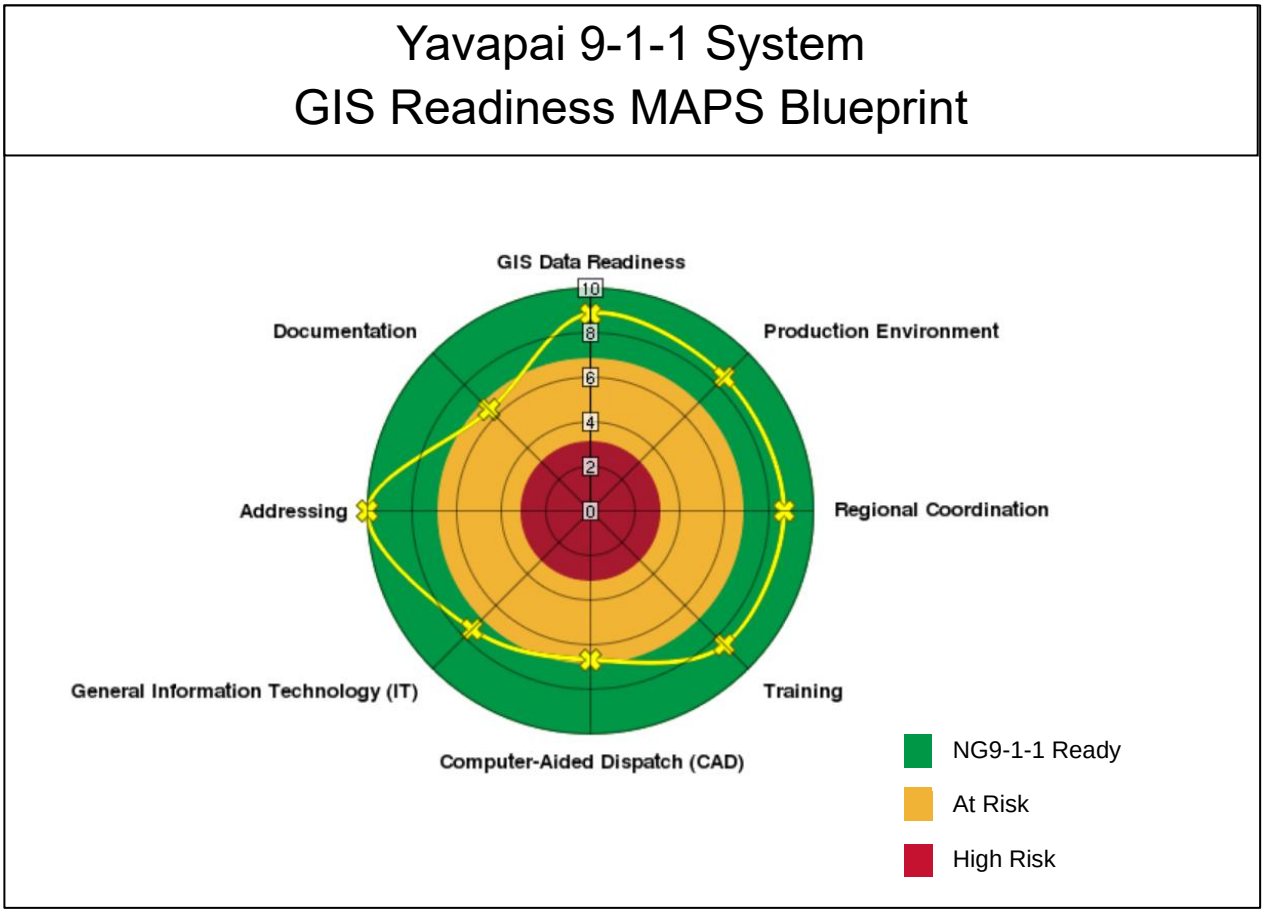
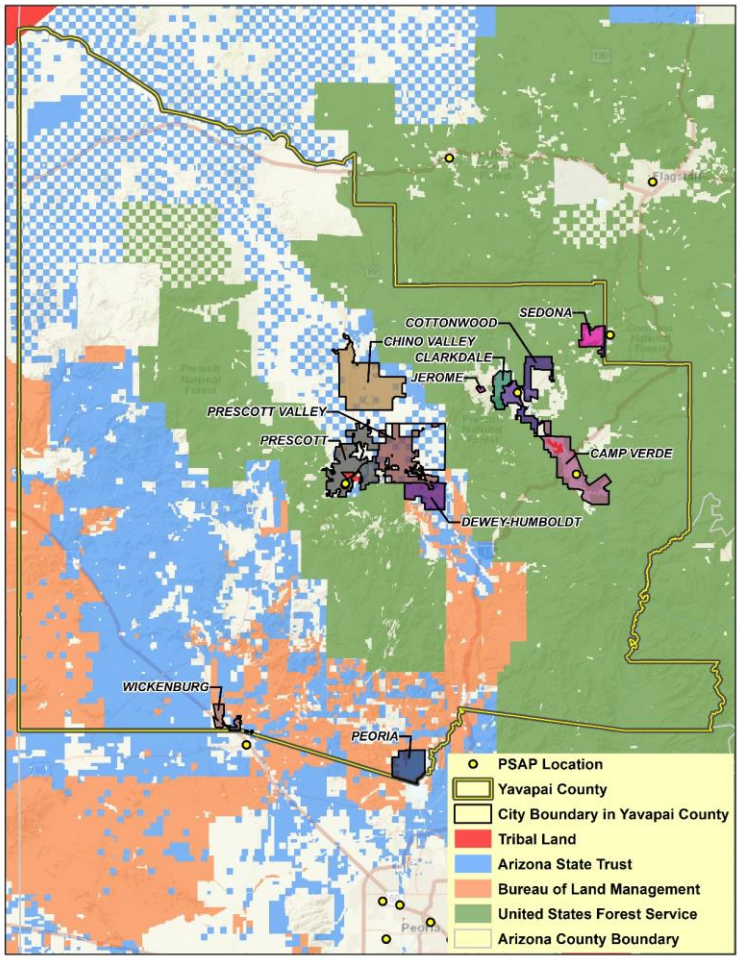


Figure 1: MAPS Scores

Details on the ranking factors and key initiatives the jurisdictions should be undertaking to progress toward NG9-1-1 readiness in each factor are contained within this report. Some results may be surprising and raise concern, but it is important to note the following:

- The State is just beginning the transition to NG9-1-1. No score is unexpected for a GIS program supporting Enhanced 9-1-1 (E9-1-1) services.
- Computer-aided dispatch (CAD) system support is not a requirement of NG9-1-1, and Yavapai County (County) already makes local GIS data available to CAD administrators, though not all 9-1-1 centers currently have CAD mapping.
- Most ranking factors require only minor improvements to fully support NG9-1-1.



A thorough analysis of the jurisdictions' GIS data and operations fueled a detailed needs assessment of the agency's NG9-1-1 GIS readiness. This report presents the findings from the Yavapai 9-1-1 system and all member jurisdictions.

Yavapai County is nestled in central Arizona between Flagstaff and Phoenix. The county is mostly rural and covers 8,128 square miles. Approximately 25% of the county is private land, with the rest of the county consisting of tribal lands, Arizona State Trust property, Bureau of Land Management property, and United States Forest Service lands.

Supporting a population of roughly 235,000 residents, the 9-1-1 system is comprised of four PSAPs: Camp Verde Marshal's Office, Cottonwood Police Department, Prescott Regional Communications, and Yavapai County Sheriff's Office. Part of the city of Sedona is within Yavapai County, and Sedona has a PSAP that dispatches into both Yavapai and Coconino counties.

The County's GIS services are centralized within the county and are provided by a team of GIS professionals. This team supports all County agencies, including the PSAP and provides GIS data for Camp Verde. Other municipalities within the county employ GIS resources, although there is not a dedicated 9-1-1 GIS resource at any of the five PSAPs.

The factors below were examined during the assessment.

GIS Data Readiness—The National Emergency Number Association (NENA) has determined that NG9-1-1 requires the improvement and maintenance of GIS road centerlines and address points—as well as a 9-1-1 center's PSAP, emergency service zone (ESZ) and provisioning boundaries—plus validation and correction of the master street address guide (MSAG) and automatic location identification (ALI) data tables, which together comprise the Enhanced 9-1-1 (E9-1-1) data table.[2] The location, address point, and road centerline spatial datasets must be validated against the legacy E9-1-1 data tables. The 9-1-1 system has made great strides in improving the accuracy of the collective data, but validation efforts fall short of industry best practices, as recommended, to fully support NG9-1-1.

Production Environment—The consistent operation of NG9-1-1 requires GIS service well beyond the capabilities of most government-led GIS groups. Standards for GIS data currency dictate that data errors be corrected and provisioned into the Emergency Services Internet Protocol (IP) network (ESInet)—which transports emergency calls to the appropriate PSAP in an NG9-1-1 environment—within 72 hours. All jurisdictions have implemented processes for supporting E9-1-1 requirements but currently cannot achieve the requisite performance necessary for NG9-1-1. The GIS resources for the County also support the County's PSAP without a memorandum of agreement (MOA) or a more rigid service level agreement (SLA). The four municipal PSAPs do not have dedicated GIS support. Without a dedicated GIS resource supporting the PSAPs, CAD and ESInet GIS data are at risk of not being maintained to NG9-1-1 standards. Further, although the GIS data is standardized, each PSAP requires GIS data customization since the PSAPs do not share a common CAD system.

Regional Coordination—The GIS data supporting NG9-1-1 operations must be validated across the 9-1-1 system's service area footprint and with neighboring external jurisdictions. For example, road centerlines between every jurisdiction must connect seamlessly, and polygons must be drawn without coverage gaps or overlaps. Although the 9-1-1 system does not provide 9-1-1 services to neighboring jurisdictions outside of Yavapai County, the reconciliation of core GIS datasets between the County and neighboring jurisdictions is critical to preventing emergency call-routing issues across Arizona. The County and municipal GIS programs need to improve cooperative data development and sharing efforts to meet the needs of NG9-1-1.

Training—Staff members who are well-trained on GIS applications, as well as tools for non-geospatial data maintenance and general 9-1-1 operations, ensure successful support of the NG9-1-1 migration and ongoing operations. The GIS professionals at all jurisdictions within the county are well-trained in GIS data maintenance and GIS software and analytics. Additional training in NG9-1-1 and legacy 9-1-1 tabular data maintenance is recommended.

Computer-Aided Dispatch—The same statewide GIS data that supports NG9-1-1 operations across Arizona also should, as a best practice, be provisioned into the CAD system(s). The alternate call-routing capabilities of NG9-1-1 rely upon the availability of accurate, actionable GIS data to 9-1-1

[2] NG9-1-1 GIS Data Model - National Emergency Number Association (nena.org)

telecommunicators for all areas covered by a PSAP. The lack of such data greatly reduces the mitigation capabilities of 9-1-1 telecommunicators at the receiving PSAP in a failover situation (i.e., when a PSAP has become overwhelmed or has been rendered inoperable, inaccessible, or uninhabitable and transfers calls to another center). Similarly, the lack of such data also reduces the ability of a 9-1-1 telecommunicator to determine the appropriate PSAP to receive a transferred misrouted call, a common need in 9-1-1 service provisioning. Some PSAPs in the 9-1-1 system do not all utilize mapping and, therefore, cannot make local GIS data available in the CAD system. Of the PSAPs that do use an integrated CAD map, the vintage of GIS data in the systems is widely varied and not regularly scheduled for an update.

General Information Technology—The hardware, software, and systems necessary for GIS operations and data development must be maintained. Desktop computers and data and application servers must be refreshed regularly. Networks internal to the County must provide near-constant connectivity between GIS and 9-1-1 as well as between the County and the municipalities. All GIS data is stored in a spatial database engine (SDE) on a server housed in the County's data center. The County maintains a contract with a third-party vendor to monitor and provide maintenance support to all servers at the data center. Neither GIS nor 9-1-1 have an SLA with County IT or the vendor to ensure data availability.

Addressing—The location-based services in both the next generation core services (NGCS)—emergency call routing function (ECRF) and location validation function (LVF)—and the call processing and call dispatching functions require constant updating as new addresses are created, or existing addresses are changed. Addressing in Yavapai County is split between the County and local addressing authorities within the municipalities. The County is realizing moderate growth. The County uses a standard workflow with some documentation for incorporating new data into the GIS and updates the data when notified of new real estate developments. However, there is not a documented workflow for the transfer of addressing data from the municipalities to the County, and updates generally are provided monthly though they are not scheduled. Developing a standardized workflow across the county is strongly recommended to ensure that all new road centerlines and address points are added to the datasets promptly. The execution of this workflow should be documented in standard operating procedures (SOPs).

Documentation—Processes, workflows, SOPs, strategic plans, and performance documentation supporting continuity of operations must be created and maintained to ensure data quality and availability. Arrangements between municipalities and the County as well as the County and the State and between PSAPs should be memorialized in SLAs. Documentation is lacking across the 9-1-1 system. For continuity, MCP strongly recommends the creation and maintenance of the documentation identified in Section 4.9.

By following the recommendations in this report, the Yavapai 9-1-1 system will achieve and maintain NG9-1-1 readiness in its GIS programs.

1 Introduction

Technological advancements over the last 50 years necessitate a long-overdue fundamental change in the technology used to connect emergency callers to PSAPs. The implementation of NG9-1-1 minimizes the disparity between the communications technology used today and the antiquated systems developed to support 9-1-1 operations dating back to the 1960s. This application will provide robust systems capable of meeting the needs of today's diverse and mobile 911 caller.

At the core of NG9-1-1 is GIS data. This spatially-enabled data drives the analytics that find the 9-1-1 caller—the LVF—and determine the appropriate PSAP to which the emergency call should be routed—the ECRF. The GIS datasets employed to fulfill these functions must be refined to public-safety-grade with exact geospatial accuracy and complete attribution of all information necessary for completing the complex queries.

The ADOA 9-1-1 Program funded a series of GIS capabilities gap analyses and performed a readiness assessment of the GIS program(s) at each 9-1-1 system in the state. The Program hired MCP to evaluate the readiness of GIS staff and data to support the state's transition to NG9-1-1. MCP utilizes a proprietary methodology—MAPS—to assess NG9-1-1 readiness. MAPS combines the collective body of knowledge gained from MCP's 100-plus specialized public safety SMEs with a variety of mature, broadly accepted public safety and IT standards, formalized accreditation programs, and industry best practices.

This MAPS assessment represents the findings for the Yavapai 9-1-1 system and the municipalities therein. The 9-1-1 system is comprised of five PSAPs providing emergency 9-1-1 service to the county and municipalities therein. The MAPS assessment enables the Program and the 9-1-1 system to easily discern and understand where the organization stands in relation to several critical factors. A customized set of rating factors was developed for Arizona and assessed through conversations with the Program and local GIS and 9-1-1 staff. This report details the disparities identified through the MAPS assessment and provides recommendations for eliminating these imbalances to achieve NG9-1-1 readiness.

It is important to note that this assessment is meant to identify disparities in capabilities that risk the migration to and ongoing operation of an NG9-1-1 system. MCP SMEs unanimously agree that GIS staff across the 9-1-1 system perform professionally, have extensive knowledge of the work environment, and do an excellent job executing their responsibilities. The SMEs also agree that the path toward NG9-1-1 readiness can be perplexing and hope that this document provides helpful guidance regarding the state's transition. The MCP team collectively believes that the 9-1-1 system possesses the capabilities and desire to be successful in implementing the recommendations contained in this report—with the end goal of deploying the GIS data and services necessary to migrate the 9-1-1 system's five PSAPs to NG9-1-1.

2 Background

Yavapai County GIS staff perform mapping and spatial database maintenance work for various Yavapai County departments, including public safety. A team of three GIS resources provides server, application, and data development services and is responsible for maintaining all GIS datasets, including address points and road centerlines, both of which are maintained to 9-1-1 standards. Some GIS data is provided by municipal GIS programs within the county. County and municipal GIS staff work cooperatively toward a common goal.

3 Methodology

The Arizona MAPS assessments are customized based on the specific needs and circumstances of Arizona 9-1-1 systems. MCP developed these topics from our extensive experience with NG9-1-1 migrations in other states, the collective knowledge of the MCP team, and through a collaborative effort with the Program. MCP then refined the key factors for implementing NG9-1-1 into operations into the MAPS-facilitated session attended by Yavapai 9-1-1 system stakeholders.

3.1 Project Kickoff/Stakeholder Discussion

Collaboratively, MCP SMEs and the Program worked to identify key factors that are most relevant to the NG9-1-1 transition. This input was considered in the development of the MAPS assessment questions. There was no direct participation in the 9-1-1 system's MAPS factor rankings from stakeholders external to the GIS and public safety programs.

3.2 Industry Standards and Best Practices

The project team relied on industry standards and best practices to identify those that align with the factors being assessed. MCP recognizes the significant contributions that NENA has made in advancing NG9-1-1 standards and builds its recommendations on those that NENA has established. NENA has developed numerous documents during the past 20 years to provide PSAP and GIS professionals with guidelines and requirements for building and maintaining GIS data layers for use in public safety operations.

The NENA documents listed below are recommended for review and reference.

- NENA-STA-012.2-2017 – *NG9-1-1 Additional Data*
- NENA-STA-004.1-2014 – *NENA Next Generation United States Civic Location Data Exchange Format* (CLDXF)
- NENA 02-014 – *GIS and Data Collection Standard*
- NENA 71-501 – *Standard for Synchronizing GIS with MSAG & ALI*
- NENA-INF-014.1-2015 – *Development of Site/Structure Address Point GIS Data for 9-1-1*

- NENA-STA-015.10-2018 – *NENA Standard Data Formats for E9-1-1 Data Exchange & GIS Mapping*
- NENA-STA-006.1.1-2020 – *NENA Standard for NG9-1-1 GIS Data Model*

These documents are available for download at https://www.nena.org/page/Standards.

The 9-1-1 program also has published, in partnership with the Arizona Geographic Information Council (AGIC) 9-1-1 Committee and the Arizona 9-1-1 community, GIS guidelines and best practices for NG9-1-1 in Arizona.[3]

3.3 Question Set Development

A comprehensive question set was developed based on these standards and industry best practices. Key GIS capabilities related to NG9-1-1 and industry best practices for GIS administration were considered in selecting the final question set. These questions focus on eight evaluation factors, depicted in the figure below. To achieve GIS data readiness (Factor 1), the 9-1-1 GIS resources must receive training (Factor 4) and be supported by current and robust technology (Factor 6) in a well-performing production environment (Factor 2). Beyond the GIS team, a high level of regional coordination (Factor 3) is necessary to ensure that GIS data and addressing (Factor 7) are accurate not only within each municipality but across the system, as well as with neighboring systems across Arizona.

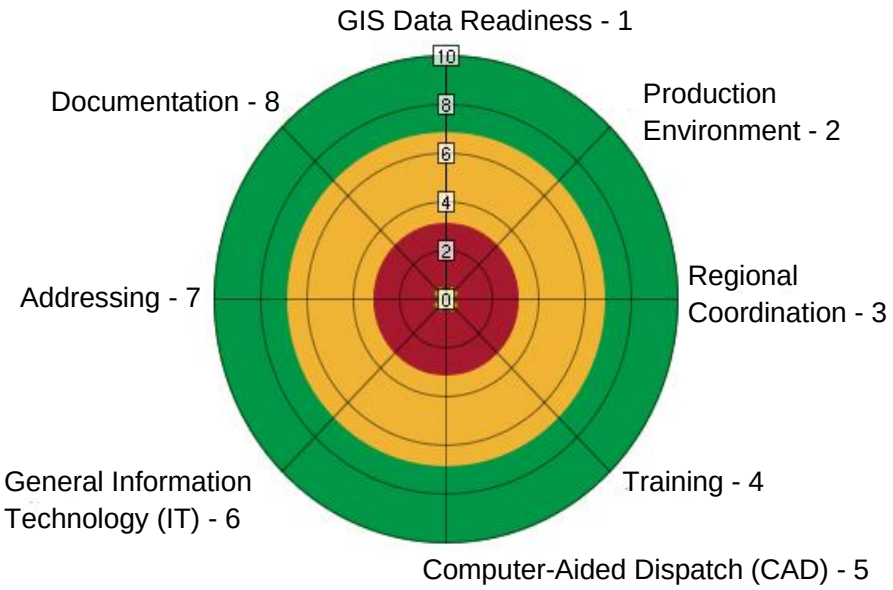


Figure 2: MAPS Factors

[3] https://az911.gov/sites/default/files/AZ_NG911_GIS_Guideline_Best%20Practices_August%202020_2_UPDATED.pdf

The same GIS data that drives the NG9-1-1 call-routing function and LVF also is necessary for alternate routing scenarios (i.e., failover routing to another center when a PSAP has been rendered inoperable, uninhabitable, or inaccessible). To support this advanced capability of NG9-1-1, this data must be aggregated and provisioned into the CAD system within a PSAP (Factor 5). It is important to note that CAD system provisioning is not a NENA requirement but is an industry best practice necessary to support alternate routing scenarios. Finally, all processes and workflows used to maintain the NG9-1-1 GIS data must have proper documentation (Factor 8).

3.4 Data Collection Method

ADOA stakeholders and MCP SMEs have partnered on several projects across the state, allowing MCP an intimate view into the Program's GIS-related operations and processes. This knowledge was used to establish a baseline understanding of the relationships between the State and counties and to facilitate the development of the question set.

The MAPS assessment process includes a formal interview of 9-1-1 system stakeholders. MCP reviewed each factor and associated questions with the stakeholder team and recorded responses. MCP SMEs also reviewed all provided GIS data for compliance with NG9-1-1 standards and GIS best practices.

3.5 Data Analysis

MCP SMEs interpreted the national standards and then determined how they should be applied, resulting in a quantifiable assessment that manifests in the MAPS scores and diagram.

Although a sufficient score may be achieved through the averaging of all responses in a factor, it is important to note that a "high risk" score to a single question in a factor may preclude the 9-1-1 system from moving forward with the NG9-1-1 migration until the issue has been mitigated appropriately.

3.6 National Baseline Standards for NG9-1-1 GIS Readiness

The Federal Communications Commission's (FCC) Task Force on Optimal Public Safety Answering Point Architecture (TFOPA) created a high-level NG9-1-1 Readiness Scorecard[4] as a way to measure GIS readiness for NG9-1-1. The TFOPA model assumes a transition from Legacy (today's 9-1-1) to National End State (every PSAP has successfully implemented NG9-1-1). For Arizona's strategic plan, the model was shortened to the Regional End State, representing Arizona as a single region in the national construct. The milestones for NG9-1-1 readiness under the TFOPA model for each stage are shown below.

[4] "Phase II Supplemental Report: NG9-1-1 Readiness Scorecard," Federal Communications Commission, December 2, 2016. https://transition.fcc.gov/pshs/9-1-1/TFOPA/TFOPA_WG2_Supplemental_Report-120216.pdf

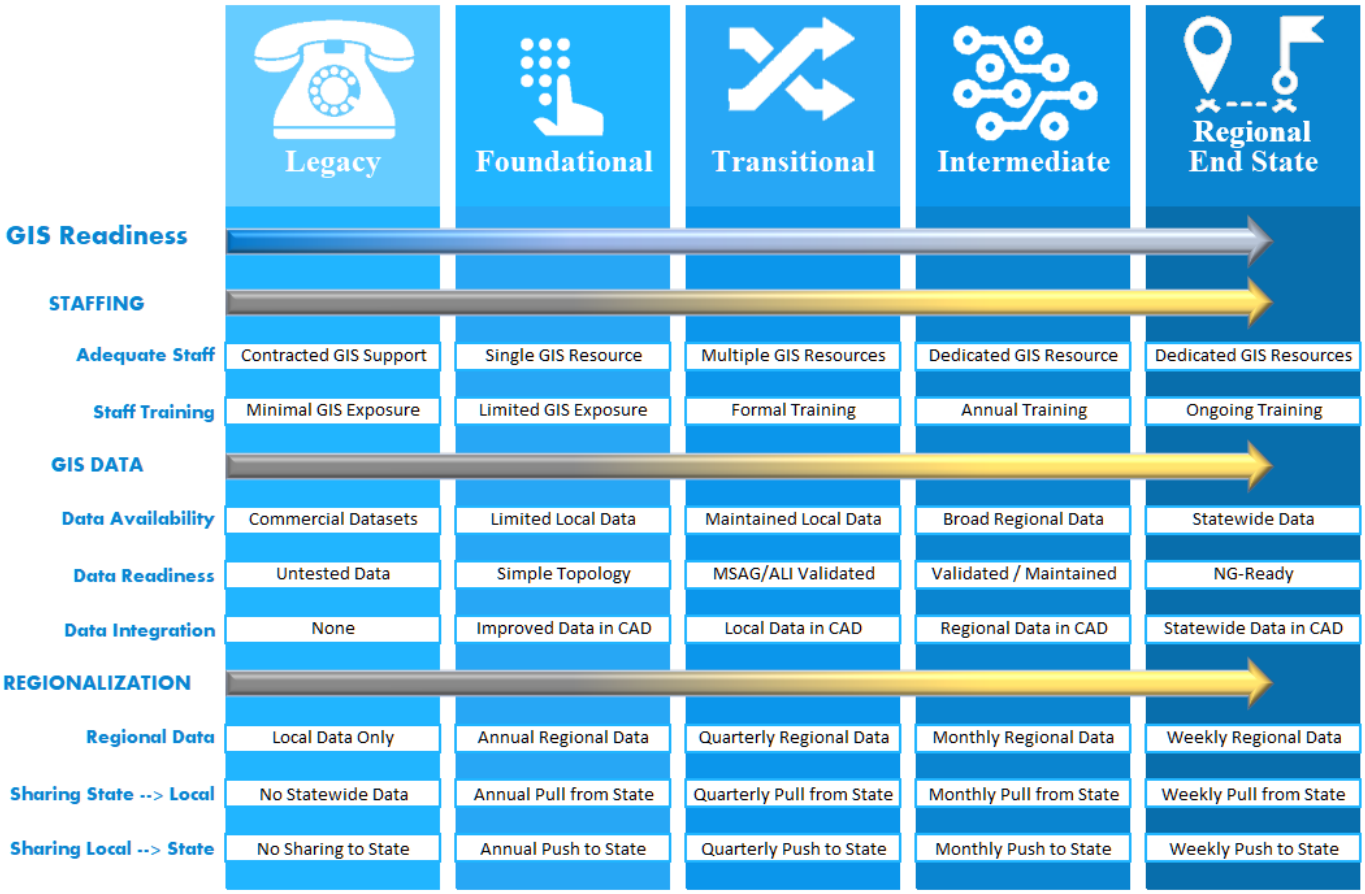


Figure 3: Statewide TFOPA GIS Readiness Scorecard

MCP used this scorecard to establish the metrics to which all 9-1-1 systems in Arizona will be compared to identify gaps in NG9-1-1 GIS readiness.

4 Findings and Analysis

4.1 Summary of Holistic Findings and Analysis

The Yavapai 9-1-1 system achieved respectable scores for internal operations. An overall score of 8.33 (out of 10 possible points) places the 9-1-1 system in a transitional state between legacy 9-1-1 and NG9-1-1. To fully implement Next Generation 9-1-1 Core Services (NGCS)—such as the ECRF and LVF—the County must improve all functions not already solidly within the NG9-1-1-ready range. Scores within individual topics are depicted in the figure below and detailed in this section.

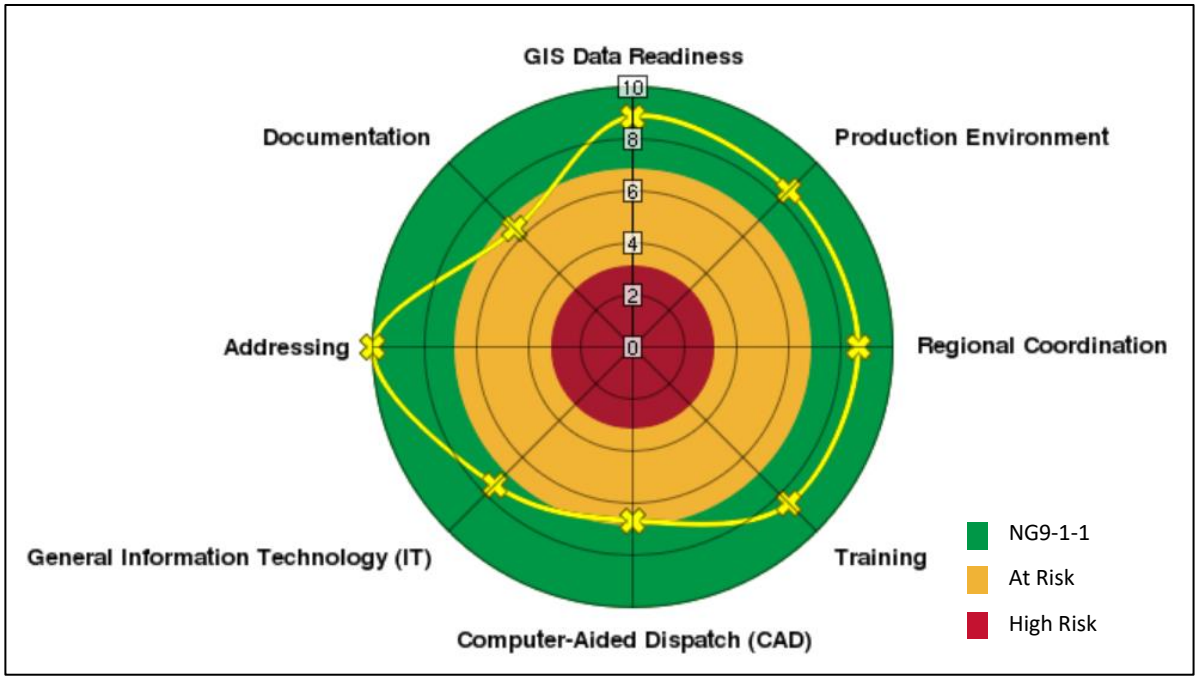


Figure 4: Overall MAPS Score

4.2 GIS Data Readiness

Score: 8.86

GIS data readiness spans both legacy and NG9-1-1 datasets. This requires the improvement and maintenance of the GIS road centerlines and address points as well as the 9-1-1 center's PSAP, ESZ, and provisioning boundaries. Additionally, the tabular MSAG and ALI databases must be validated against the GIS data and errors corrected. The 9-1-1 system's GIS staff understand the intricacies of E9-1-1 GIS data and intend to fully support the updates to the GIS data necessary for NG9-1-1.

GIS staff supports the CAD systems at Yavapai County Sheriff's Office, Prescott Regional Communications, and Sedona Police Department. These jurisdictions already include the fields required by NENA as defined in NENA-STA-006.1-2018 for the road centerline and address point data layers. The countywide aggregated GIS data complies with the Arizona statewide 9-1-1 schema. Other PSAPs in the 9-1-1 system do not utilize GIS mapping in their CAD systems.

Legacy tabular data must be validated against the GIS data before the NG9-1-1 migration. GIS staff must have access to traditional wireline telephone data and also may need access to voice over IP (VoIP), multiline telephone system (MLTS), and private branch exchange (PBX) data. Each service provides unique location challenges that the GIS team must consider when developing data that can be used in an NG9-1-1 environment.

Traditional wireline telephone service utilizes the MSAG and ALI data for location validation. As the errors discovered in this data are corrected, these edits must be communicated to the ALI provider. This is most efficient through a web portal. Intrado provides ALI maintenance for all PSAPs in the 9-1-1 system. The City of Cottonwood's GIS resource maintains the MSAG for the entire county. The County's addressing coordinator and GIS professionals have access to the Intrado unified portal to download fresh ALI copies for validation against the GIS data. Updates to the MSAG are submitted by the GIS staff through the PSAP to Intrado. GIS staff are directly involved in the addressing process in Yavapai County and maintain an addressing toolset used by internal and some municipal staff.

VoIP telephone service has the same look and feel to the subscriber as traditional telephone service but uses the internet rather than dedicated copper cable to deliver calls to homes and businesses. The subscriber may not even know that they are on a VoIP system. Bundled service from an internet provider or cable company uses fixed or static VoIP telephone service. There also are several third-party nomadic and i2 VoIP providers—such as magicJack® and Ooma®—that offer appliances that plug into any internet modem or can operate via a Wi-Fi connection. FCC number portability allows the subscriber to transfer their actual telephone number when switching from traditional to VoIP service. Nearly all static VoIP providers maintain their ALI database, and nomadic VoIP providers also maintain a separate database of user location information, which usually is updated by the subscriber. This poses two problems for GIS. First, many new communities being built today do not offer traditional telephone services. The utilities installed in these subdivisions forego copper-cable telephone service for faster coaxial or fiber-optic cabling or internet-based television and telephone services. These entire neighborhoods most likely will not be found in the traditional ALI database. It will be incumbent upon PSAP leadership to determine if acquiring an ALI export from the VoIP providers will be necessary to fully validate address information within the 9-1-1 system.

More critical is that, because a VoIP telephone needs only an internet connection, the service can be relocated without updating the 9-1-1 address associated with the telephone number. Regardless of the ALI provider, if a subscriber moves and takes their service equipment, the phone likely will work at the new location without updating the location information used to route the emergency call to the appropriate PSAP. This inaccurate location information is sent with the call to the 9-1-1 telecommunicator. GIS staff indicated that the only ALI records being maintained across the 9-1-1 system are in the Intrado ALI database. PSAPs should be aware of the possibility of an increased risk to location services in 9-1-1 and NG9-1-1 without the inclusion of VoIP ALI records in the data maintenance plan. VoIP ALI records should be acquired for areas with very recent growth where traditional telephone service was never offered. For these areas, the VoIP ALI is the only source for address validation records to compare to the GIS data.

The MLTS and PBX phone systems used in commercial and campus settings are preprogrammed with their location information before being installed. Most MLTS/PBX systems enable the digits 9-1-1 to be dialed and routed to a PSAP. Kari's Law requires MLTS in the United States to enable users to dial 9-1-1 directly, without having to dial a prefix to reach an outside line, and to provide for notification (e.g., to a front desk or security office) when a 9-1-1 call is made.[5] However, the vast majority of these systems

[5] FCC Fact Sheet – Kari's Law - https://docs.fcc.gov/public/attachments/DOC-353961A1.pdf

and/or phone service providers do not provide granular location information with the emergency call to enable emergency responders to know the actual location of the incident.

The first step for GIS staff in transitioning to NG9-1-1 is to establish a schema for the data necessary for NG9-1-1. The 9-1-1 system already has implemented the NENA-recommended schema for NG9-1-1. Currently, GIS data is translated from the County's schema to the NENA NG9-1-1 schema using an extract, transform, load (ETL) process written and maintained by the County.

Once the GIS data has been developed and tested for compliance with NENA NG9-1-1 standards, the County's GIS staff performs validation testing of the GIS, MSAG, and ALI data. The County reports a 97% match rate between the GIS data and the legacy ALI table. The County does have the staff necessary to maintain this match rate, but not within the industry-recommended 72-hour timeframe at the current staffing level for all jurisdictions. Staffing recommendations can be found in Section 4.3 – Production Environment.

The current process that the 9-1-1 system has in place meets the needs of a legacy 9-1-1 environment and will support the migration to NG9-1-1. However, NG9-1-1 operations will not be sustained without additional staff and training. The improvements noted below are recommended or required for the 9-1-1 system to proceed with the implementation of NGCS.

Table 1: GIS Data Improvements

Improvement	Criticality
Acquire and validate VoIP ALI records.	Recommended
Inventory MLTS/PBX phone systems and assess the risk level.	Strongly recommended
Increase County GIS staffing by at least one analyst position—dedicated to 9-1-1—to support additional data development, maintenance, and validation testing efforts. Additional GIS staff at each PSAP may be necessary if the centers, or at a minimum the CAD systems, are not consolidated given the unique requirements of each.	Strongly recommended
Perform validation testing on the complete dataset for the entire 9-1-1 system at least quarterly. Test monthly in high-growth areas.	Strongly recommended
Update the County's NG9-1-1 data and addressing standards as revisions are made to the NENA GIS data model and related standards.	Required

To achieve GIS data readiness, the 9-1-1 system should focus on remedying the deficiencies outlined in the table above and illustrated in the figure below.

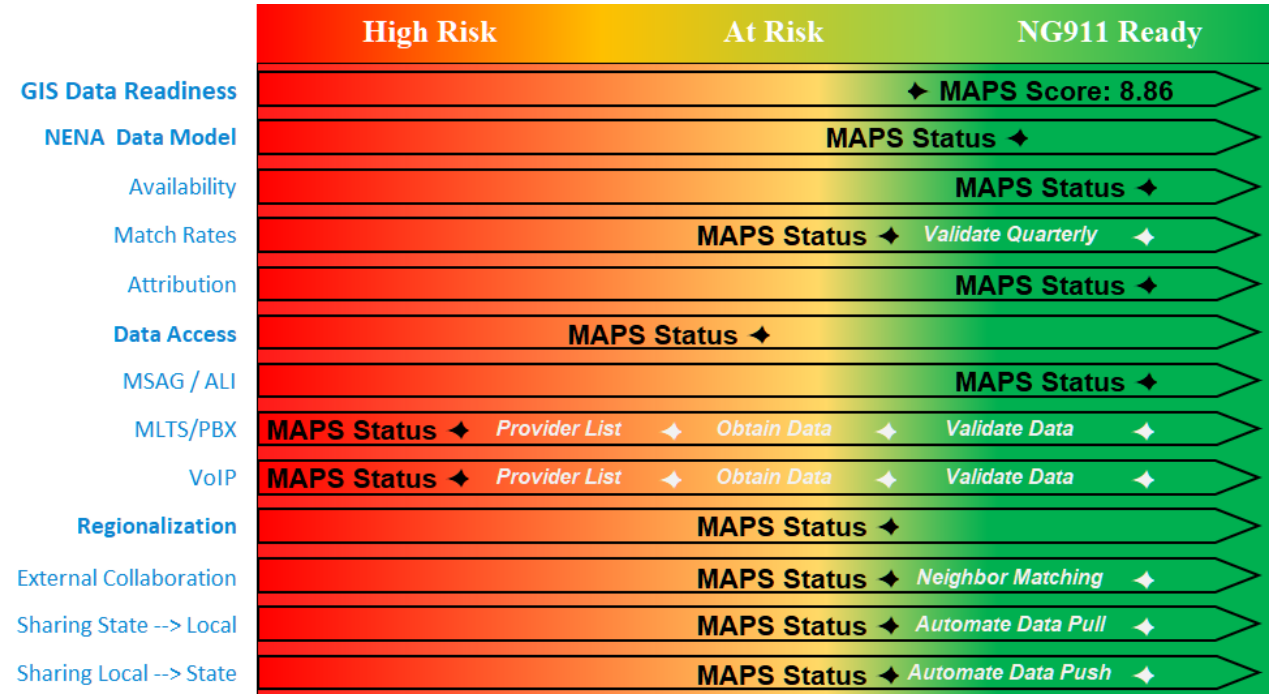


Figure 5: GIS Data Readiness

4.3 Production Environment

Score: 8.50

A robust GIS program is necessary to support the substantial demands of the NG9-1-1 environment. Industry best practices dictate that every PSAP has dedicated GIS services. The 9-1-1 system relies upon already taxed GIS resources from other departments to support operational GIS needs.

While the score for this assessment factor is within the requirements for maintaining E9-1-1 services, the migration to NG9-1-1 will require additional GIS support. PSAPs currently using GIS mapping in their CAD systems should employ a full-time GIS resource dedicated to supporting both the migration to NG9-1-1 and preparing the GIS data for the CAD system. This also will provide coverage for critical GIS data updates during vacations, illness, or staff turnover. PSAPs not currently utilizing GIS data and mapping capabilities within their CAD systems should plan for the addition of mapping capabilities and the additional staff necessary to support both NG9-1-1 and GIS mapping within the CAD system.

To ensure compliance with NG9-1-1 GIS data standards, municipalities within the county either shall be responsible for maintaining the NG9-1-1 required GIS datasets to NENA standards or relinquish this responsibility to the County. The County must be authorized by the municipality to act on its behalf when editing addresses and road centerlines. This support should be formalized in an MOA between the County and the respective municipality. If a municipality chooses to retain GIS data maintenance, an SLA between the County and the municipality detailing the accuracy, currency, and completeness of each NG9-1-1 GIS

dataset should be drafted to ensure the proper maintenance of the GIS data supporting NGCS. The Program should support the development and execution of SLAs with document templates and standard language.

The 9-1-1 system must maintain a coordinated rolling three-year plan that estimates future effort levels and staffing needs. This document should be supported by an accounting of each staff member's hours worked maintaining GIS data for the ESInet and CAD system as well as other special projects related to public safety. There are opportunities within the county to consolidate 9-1-1 and GIS operations. The greatest limiting factor is the disparities between CAD systems and the time commitment to maintaining each system separately.

For the migration to and continuous operation of an NG9-1-1 system, GIS staff members must support the needs of the ESInet and those of the PSAPs regarding legacy and NG9-1-1 operations. GIS staff has plans in place to provide for the current needs of the legacy 9-1-1 system. Without a full-time GIS resource in each PSAP, the GIS resources have indicated that they will not be able to meet the 72-hour turnaround time for data maintenance required in an NG9-1-1 environment. GIS still will need to support CAD applications at the PSAPs with local and regional mapping data in the NG9-1-1 environment. The County and municipal GIS staff are not identified as emergency service personnel and are not required to respond to requests outside of normal business hours, which adds further risk to the GIS data update schedule.

The County centralizes GIS data in SDE on a single server with redundancy. The GIS servers are in the County's data centers. There is no disaster recovery plan beyond a standard daily server backup. The County's IT staff and contracted services support the GIS servers.

The production environment at the County cannot support the migration to NG9-1-1 without hiring and fully training at least one additional GIS resource at the County and either hiring additional GIS resources at each jurisdiction to support 9-1-1 or consolidating 9-1-1 GIS data management at the County, which would require increasing the County's GIS staffing needs by a total of two full-time employees. The limited GIS resources in the County are insufficient to maintain operations after full implementation to NG9-1-1 is completed. The improvements noted below are recommended or required for the 9-1-1 system to proceed with the implementation of NG9-1-1 NGCS.

Table 2: Production Environment Improvements

Improvement	Criticality
Track and document staff hours spent supporting 9-1-1 specific GIS data development and maintenance.	Strongly recommended
Add additional GIS resources at the PSAPs to meet demands for CAD system coordination, 72-hour turnaround times, and to perform special projects.	Strongly Recommended
Implement MOA or SLA with IT for server maintenance and availability.	Strongly Recommended

Improvement	Criticality
Update disaster recovery and continuity of operations (COOP) plans to reflect changes in operations implemented according to this report.	Strongly Recommended
Implement MOA or SLA between County and each municipality, identifying GIS data development and maintenance responsibilities.	Strongly Recommended

To provide a fully NG9-1-1-capable production environment, the 9-1-1 system should focus on remedying the deficiencies outlined in the table above and illustrated in the figure below.

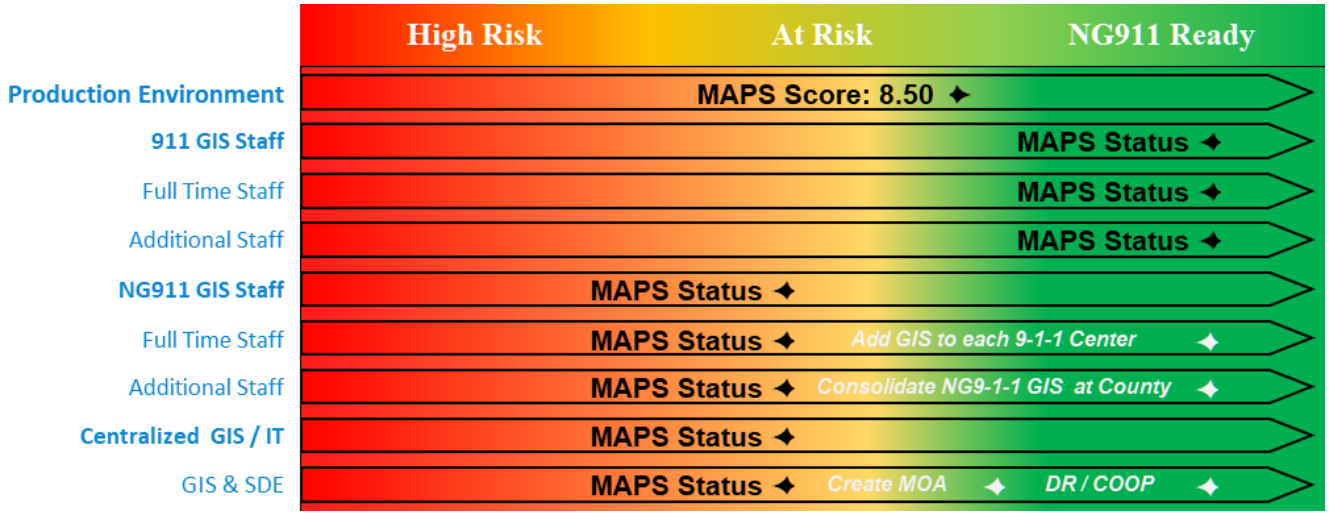


Figure 6: Production Environment Readiness

4.4 Regional Coordination

Score: 8.67

The implementation of NG9-1-1 is meant to expand the operations of a PSAP beyond that of a singular entity to incorporate failover functionality (alternate routing) to strengthen the ability of the 9-1-1 community to respond to citizens' needs. In the NG9-1-1 environment, GIS data does not end at the PSAP boundary. Rather, the GIS data must be coordinated across multiple PSAP boundaries, not only within the Yavapai 9-1-1 system's area of responsibility (AoR) but also with neighboring systems across the state.

The County has fostered a collaborative environment between its agencies and with the municipalities but has yet to resolve GIS data beyond the 9-1-1 system boundary. The statewide NG9-1-1 GIS project in Arizona will soon require complete reconciliation of PSAP and provisioning polygons and road centerlines across the state. An important step in the statewide coordination of GIS data is the implementation of snap-to points for road centerline vertices at these boundaries.

Established NENA standards[6] govern the development of road centerlines and address points, as well as PSAP, ESZ, and provisioning polygons. The standards dictate that all road centerlines should be broken at intersections with other roads and all three polygon boundary type edges. The County has developed and maintains snap-to points at intersections with neighboring jurisdictions to ensure that edits to the linework do not break the connection of one centerline to the adjoining centerline on the other side of the breakpoint. This continuity of geometry is referred to in the GIS community as topological integrity. Topology is one of the primary tests performed on GIS data when assessing it for NG9-1-1 readiness. Topological integrity will be tested on individual jurisdictions' data as well as on an aggregated statewide dataset. The to-be-implemented statewide snap-to points aid in ensuring the preservation of topological integrity within and beyond the Yavapai County PSAP boundary.

PSAP polygons, which primarily will be responsible for 9-1-1 call routing in the NG9-1-1 environment, must be coordinated between PSAPs in Arizona and neighboring states. The placement of PSAP boundary lines is at the discretion of the PSAP director and should be drawn to reduce call transfers between centers. Each time a PSAP boundary is modified, coordination between the neighboring PSAPs and the County is necessary to ensure synchronization with all parties.

Processes at the County supporting regional coordination are supplemented by contracted services and are sufficient to meet the needs of legacy E9-1-1 operations. However, the improvements noted below are recommended or required for the County to support the migration to and continuing operation of NG9-1-1.

Table 3: Regional Coordination Improvements

Improvement	Criticality
Coordinate PSAP and ESZ polygon creation and maintenance with all neighboring jurisdictions and reassess yearly.	Required
Coordinate road centerline creation, maintenance, and address range validation with all neighboring jurisdictions.	Strongly recommended
Incorporate snap-to points in boundary resolution workflows.	Recommended
Validate all address points for jurisdiction against State guidelines and national standards at least quarterly for full attribution and against overlap.	Strongly recommended
Participate in the statewide data validation and distribution program once implemented at the state level.	Required

[6] NENA GIS Data Collection and Maintenance Standards, NENA 02-014
NENA Standard for NG9-1-1 GIS Data Model, NENA-STA-006.1-2018
NENA Standard Data Formats for E9-1-1 Data Exchange & GIS Mapping, NENA-STA-015.10-2018

In addition to the 9-1-1 system recommendations above, the *Arizona Next Generation 9-1-1 GIS Strategic Plan* identified State-level initiatives in Section 3.5 to assist the 9-1-1 systems in preparing for and continuously supporting the GIS needs of NG9-1-1. Highlights from the *Arizona Next Generation 9-1-1 GIS Strategic Plan* are provided below as a reference to guide the County's mitigation efforts.

Core Principle	Focus Areas	Initiatives
Governance	Collaboration	• The Program to oversee Governance and ensure collaborative efforts are encouraged and maintained • Create an NG9-1-1 GIS Technical Advisory Committee as a forum for coordinating GIS efforts across Arizona to achieve a greater return on investment • AGIC to maintain a consistent coordination forum to benefit the regions and individual jurisdictions
	Technical	• The Program, in collaboration with the NG9-1-1 GIS Technical Advisory Committee, to help guide the NG9-1-1 GIS Strategic Plan implementation • Promote the use of the TFOPA scorecard at the local level as a progress-tracking tool • Influence the further development of the AZGeo GIS platform, which will include coordinating with other agencies and providing guidance on the design, review, and dissemination of maps and data files; full system redundancy and elaborate security must be designed into the platform as core components
	Operations	• The Program, in collaboration with the NG9-1-1 GIS Technical Advisory Committee, to update the NG9-1-1 GIS Strategic Plan annually

To achieve complete regional coordination, the County should focus on remedying the deficiencies outlined in Table 3 and illustrated in the figure below.

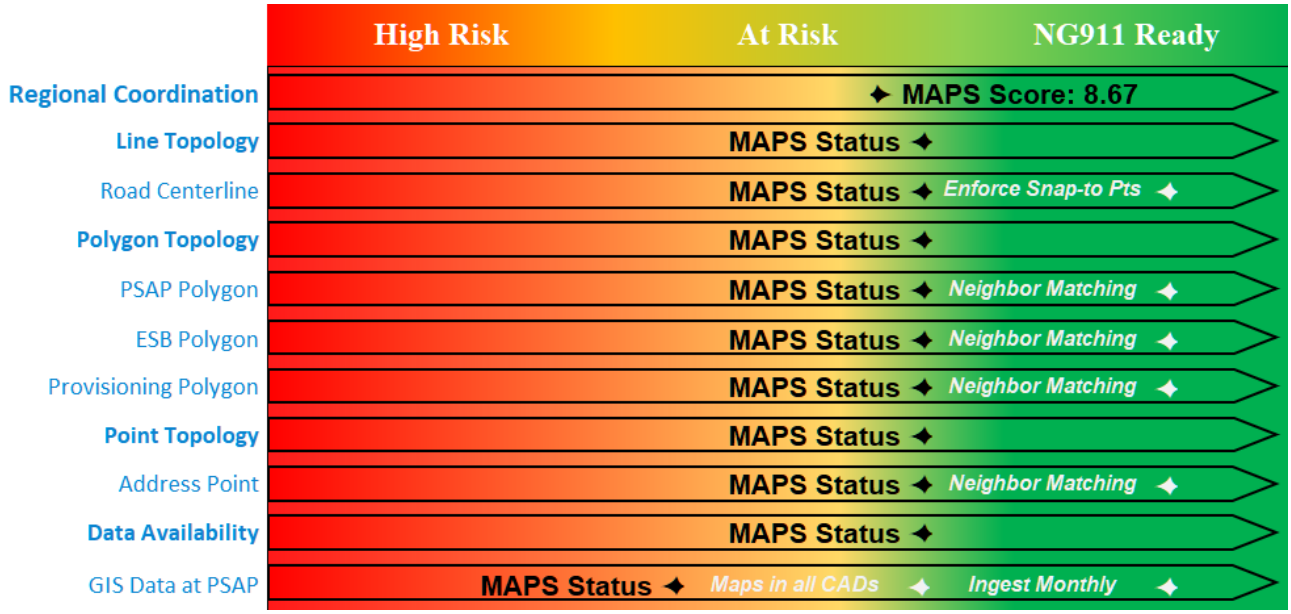


Figure 7: Regional Coordination Readiness

4.5 Training

Score: 8.50

The GIS community, like most technology sectors, is rapidly advancing and ever-changing. GIS professionals must receive regular training on the advancements within the software and relational database management systems (RDBMS) used to create, maintain, store, and distribute GIS data. The migration to NG9-1-1 presents new requirements, standards, software, and training opportunities for GIS personnel. The GIS professionals are fully capable and willing to maintain the GIS data supporting E9-1-1, but not all are fully trained on the needs of NG9-1-1. Further, the jurisdictions should embrace the benefits of cross-training GIS staff, as they are hired, to fully support the PSAPs.

A large part of implementing new GIS programs, such as NGCS support, requires educating leadership on the effort and reasons for reallocating resources or requesting additional staff. Unfortunately, not all leaders across the 9-1-1 system understand the importance of GIS to 9-1-1 service and the NG9-1-1 migration, nor are they all willing to support the effort.

Training for GIS staff is sufficient to meet the needs of legacy 9-1-1 but will need to be expanded to support NG9-1-1 operations. Additionally, the improvements noted below are recommended or required for the County to enhance training for this team.

Table 4: Training Improvements

Improvement	Criticality
Increase internal awareness for NG9-1-1 GIS needs through outreach, education, and planning sessions.	Recommended
Provide SOP, workflow, and NG9-1-1 training to new GIS staff as they are hired.	Required

The Program, through the *Arizona Next Generation 9-1-1 GIS Strategic Plan*, has committed to improving awareness and understanding of NG9-1-1. As noted in the plan:

> *The complexities of developing GIS data for NG9-1-1, combined with the requirements it places on non-GIS staff, will require immediate and ongoing training for staff, external data stewards of peripheral datasets, and the larger NG9-1-1 stakeholder community. This training and technical assistance should include disseminating information to counties, other state agencies, Tribal leadership, and PSAPs wanting to minimize duplication of geospatial data creation and maintenance efforts or to provide a level of information sharing for the State's benefit. As Arizona begins the transition to NG9-1-1, the Program should begin to focus on longer term strategic initiatives for geospatial data development and sustainment.*

Core Principle	Focus Areas	Initiatives
Staffing & Training	Collaboration	• Support public safety GIS programs at the local level through training and large-scale data development and maintenance programs • Disseminate information, gather user requirements, and raise capability awareness of all stakeholders to maintain a sustainable program
	Technical	• Develop training requirements through coordination with both internal and external stakeholders
	Operations	• Create a senior-level position within the Program to coordinate local and State efforts and oversee the implementation of the NG9-1-1 GIS Strategic plan • Create additional positions as needed to support the senior-level position

Core Principle	Focus Areas	Initiatives
		• Promote the adoption of GIS standards based on NENA's Civic Location Database Exchange Format (CLDXF) standard for all public safety GIS datasets • Provide education, training and collaboration opportunities for all data stewards to ensure program success

To ensure that all GIS staff are trained to fully support NG9-1-1, the County should focus on remedying the deficiencies outlined in Table 4 and illustrated in the figure below.

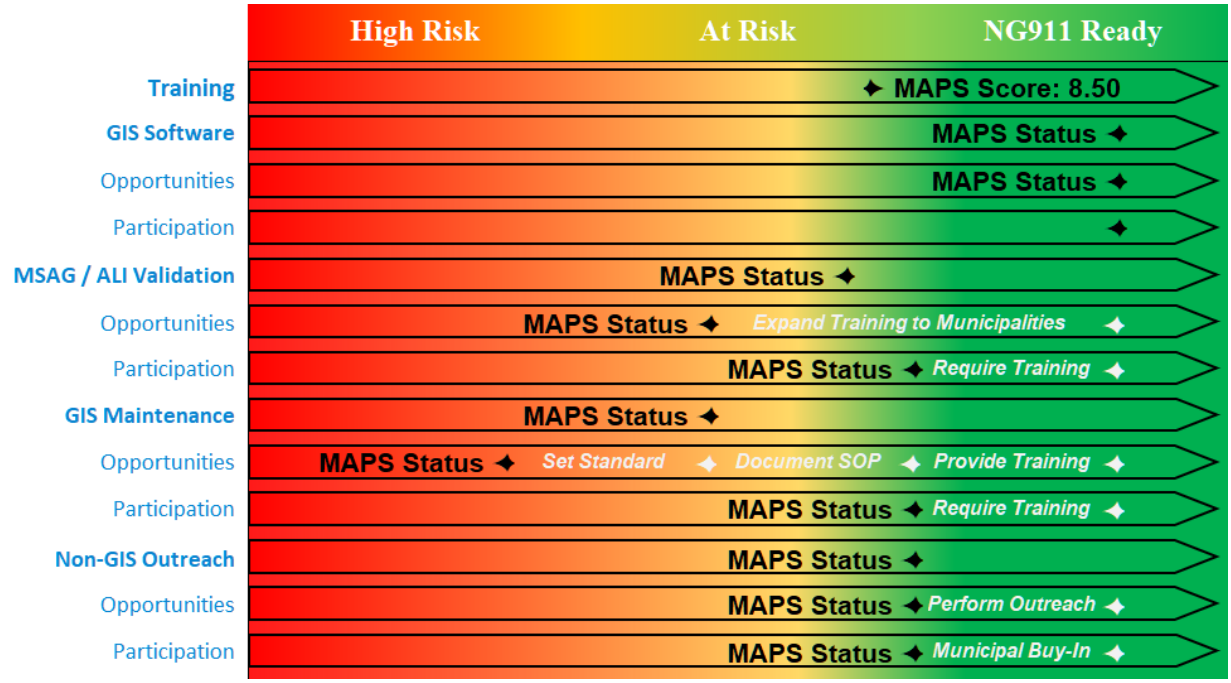


Figure 8: Training Readiness

4.6 Computer-Aided Dispatch

Score: 6.67

The same GIS data supporting the SI on the ESInet should be used in the CAD system to enhance local call-processing and call-dispatching efforts, as well as providing the CAD system map display necessary to facilitate alternate call-routing support across the region. Sharing these data will enable the PSAPs to utilize the ESInet to automatically reroute (i.e., alternate route) emergency calls for any reason. The alternate PSAP receiving these calls may be unfamiliar with the geography of Yavapai County. By making

the GIS data available to the receiving PSAP, the 9-1-1 system increases the capabilities of the 9-1-1 telecommunicators to successfully handle these calls.

Of the five PSAPs in the Yavapai 9-1-1 system, only two fully utilize GIS mapping in their CAD systems. The Sedona Police Department and Prescott Regional Communications both have an integrated CAD map. Camp Verde has a Spillman CAD system with geovalidation but no mapping. The validation component is supported by the CAD system vendor and does not use the County's GIS data. All PSAPs have access to a VESTA® map application that is integrated with the Lumen phone system, which is supported by a third-party vendor due to staffing constraints. Fully integrating GIS mapping into the CAD systems will improve 9-1-1 call processing and response capabilities.

The County's GIS data is updated daily and is available for use in all CAD systems and the NG9-1-1 environment via REST services. This process supports the existing CAD environments but is insufficient for the web-based CAD to which at least some of the PSAPs plan to migrate. Further, the TriTech CAD mapping update process is arduous and time-consuming, resulting in less frequent updates. Meanwhile, the Program has not begun to aggregate 9-1-1 GIS data to make it available from a single source. The County must seek out and validate 9-1-1-specific GIS data from neighboring jurisdictions individually. The Program has identified ubiquitous GIS data for 9-1-1 as a priority in the *Arizona Next Generation 9-1-1 GIS Strategic Plan*.

Core Principle #3—GIS Data Uniformity
GIS data, as the foundation of NG9-1-1, must be uniform across the state and interoperable between PSAPs, between NGCS providers, and coordinated with neighboring PSAPs in other states to realize a seamless, statewide 9-1-1 system.

The integration of NG9-1-1 GIS data with CAD systems is not mandatory for the successful migration to NG9-1-1. However, to fully realize the benefits of NG9-1-1, the 9-1-1 system's five PSAPs must implement regional GIS data into the CAD systems and maintain this data regularly. The improvements noted below are recommended or required for the PSAPs to enhance the CAD environments as related to NG9-1-1.

Table 5: CAD Improvements

Improvement	Criticality
Coordinate GIS data updates with all neighboring jurisdictions to ensure that the most recently aggregated GIS data is being used.	Recommended
Coordinate with the State to identify the need for statewide 9-1-1 data validation and aggregation to support the CAD function. Make local 9-1-1 GIS data available through the State's AZGeo portal.	Strongly Recommended

Improvement	Criticality
Update the CAD systems to support GIS mapping and refresh the GIS data immediately as new data becomes available.	Recommended

The Program understands the need to coordinate GIS data across the state and beyond. The *Arizona Next Generation 9-1-1 GIS Strategic Plan* highlights this commitment and details several initiatives at the State level to assist the 9-1-1 systems in coordinating GIS data. As noted in the plan:

> *Legacy 9-1-1 systems function as individual silos across the U.S. The introduction of NG9-1-1 represents a paradigm shift to seamless 9-1-1 operations across local, regional, and state boundaries. To support the interoperability between 9-1-1 systems in Arizona, the GIS data also must be refined across jurisdictional boundaries to create a statewide dataset. Jurisdictions bordering other states will coordinate data development with local jurisdictions beyond Arizona.*

Core Principle	Focus Areas	Strategic Initiatives
Data Uniformity	Collaboration	• Identify data stewards at every jurisdiction • Sponsor in-depth assessments within each 9-1-1 System to ensure NG9-1-1 readiness • Assist the Program and NG9-1-1 GIS Technical Advisory Committee in developing templates for interlocal agreements (ILAs) and service level agreements (SLAs) • Develop SOPs for data creation and maintenance of NG9-1-1 GIS datasets • NG9-1-1 GIS Technical Advisory Committee (see Governance) to lead the standardization effort
	Technical	• Establish statewide datum • Provide a toolset for geospatial data validation • Assess AZGeo infrastructure supporting GIS data storage and delivery to confirm alignment with this strategic plan • Utilize automated cross-jurisdictional validation hardware and software • Build, maintain, and ensure periodic updates to all databases using, or integrated into, the GIS cross-jurisdictional validation platform • The State (through AZGeo), SCO, or the development of a new system within the Program, should provide a toolset for validating road centerline and address point geospatial data

Core Principle	Focus Areas	Strategic Initiatives
		against the legacy ALI and MSAG data tables, and implement a training program for the use of this toolset
	Operations	• Create a centralized catalog of NG9-1-1-specific geospatial data in AZGeo • Define a geospatial data-sharing methodology to reduce data update lag

To support alternate routing and better situational awareness for 9-1-1 telecommunicators through the CAD system, the County should focus on remedying the deficiencies outlined in Table 5 and illustrated in the figure below.

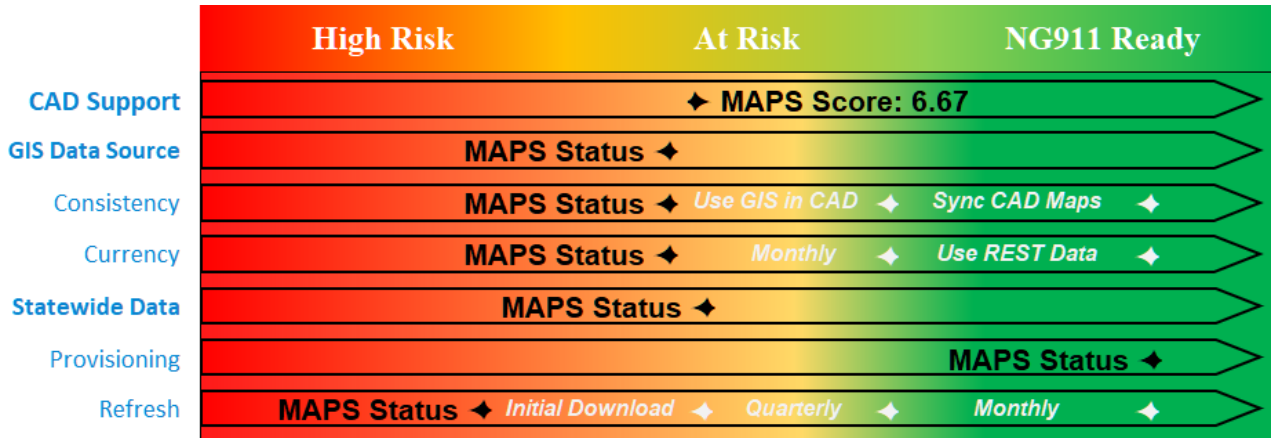


Figure 9: CAD Readiness

4.7 General Information Technology

Score: 8.00

GIS rendering and data editing require a high degree of computing power. The server and desktop hardware supporting GIS must perform well above the requirements of a personal computer (PC) used for standard word processing or accounting. The software used by GIS professionals is improving rapidly. Indeed, the capabilities of the software can improve exponentially even with minor releases. To meet deadlines and perform the advanced validation tasks necessary for NG9-1-1, GIS staff must have access to up-to-date hardware and software.

The jurisdictions maintain ample licenses of Esri software, the industry standard for GIS, but with separate Esri accounts. The County's enterprise license agreement includes both desktop software and server-side database and management tools. The County maintains the addressing GIS application at the current

software version release from Esri. Licensing will need to be revisited based on staffing recommendations and whether the 9-1-1 system consolidates 9-1-1 and/or GIS operations.

The GIS staff's PCs are refreshed approximately on a three-year rotation. The GIS PCs meet or exceed the recommended minimum configuration for spatial data rendering and advanced analytics capabilities. The County hosts its NG9-1-1 data locally on a SQL[7] SDE virtual server, and that hardware is refreshed every five years, subject to funding availability. The environment is available to all County agencies, including the PSAP. The other PSAPs in the 9-1-1 system can access the GIS data via the REST services.

Network operations at the county are monitored by County employees, and on-call support is available. This network monitoring and maintenance includes server operating systems and physical hardware but does not currently include GIS applications on the server. Additionally, the PSAPs and GIS staff should review the current support agreement and update it as necessary to include an SLA to ensure system availability with minimal downtime and coverage of the GIS server. This will protect against outages affecting access to GIS servers and data that can negatively impact the PSAPs' abilities to push updates to the ESInet within the requisite 72-hour window.

The systems and software used at the County meet or exceed current industry standards. However, the NG9-1-1 environment dictates higher system security, redundancy, and recovery capabilities than are maintained within the 9-1-1 system. The improvements noted below are recommended or required for the 9-1-1 system to enhance its general IT posture.

Table 6: General IT Improvements

Improvement	Criticality
Ensure that near-term and long-term planning and budgeting continue to cover the GIS software and server licensing.	Required
Verify and improve data recovery capabilities to public-safety-grade.	Strongly recommended
Review and update network operations agreements. Add a level of service requirement to the contract as necessary to support NG9-1-1.	Strongly recommended

To facilitate the transition to NG9-1-1 utilizing IT services, the County should focus on remedying the deficiencies outlined in the table above and illustrated in the figure below.

[7] Structured query language.

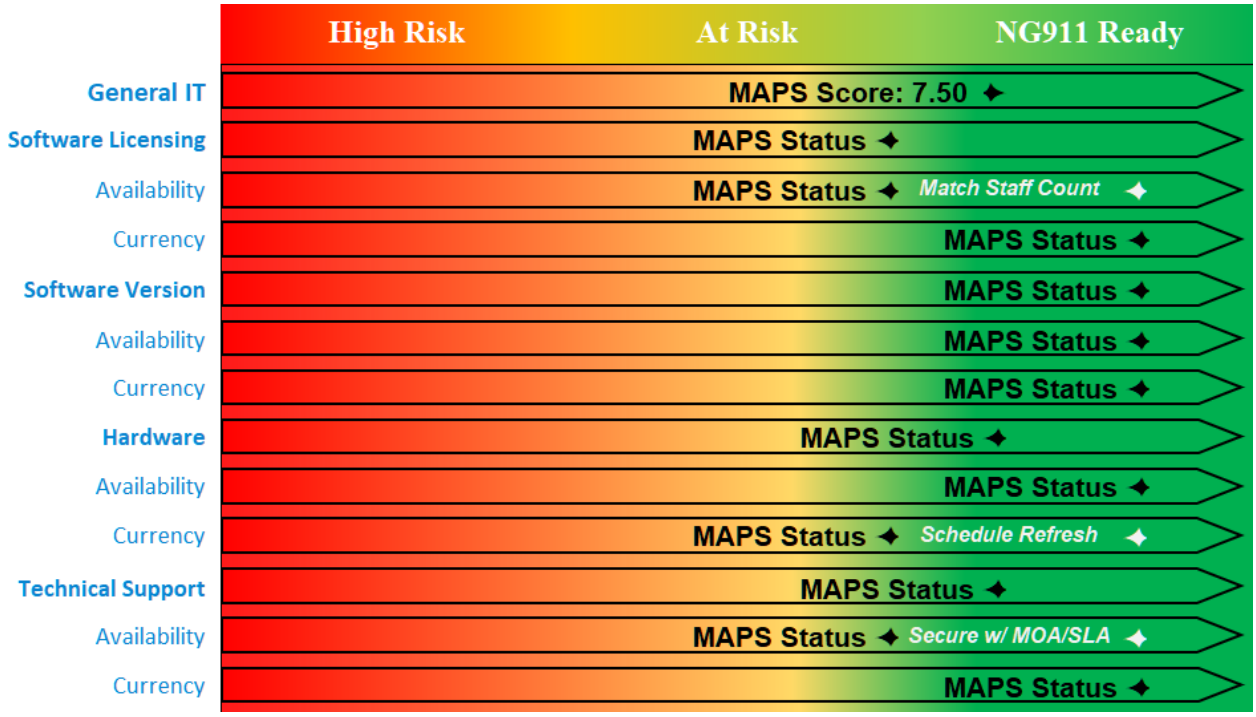


Figure 10: General IT Readiness

4.8 Addressing

Score: 9.50

Every step in providing 9-1-1 services relies upon location. Address standards, from creation to display of addresses on the 9-1-1 telecommunicator's screen, are vital to the 9-1-1 mission. The processes used to create, verify, and manage addressing must meet 9-1-1 standards and best practices. The address data also must be kept current, ahead of real estate development in the conceptual stages of construction, to provide 9-1-1 services to the men and women building the new roads and homes.

The addressing process in the 9-1-1 system is well coordinated with formal addressing workflows. The County maintains an application for managing new address point creation and relaying the data to the County. The Prescott Regional Communications jurisdictions generally submit GIS data monthly rather than using the County's addressing application. To meet NG9-1-1 standards, these updates must be submitted daily by Prescott and Prescott Valley. In addition to the documentation referenced in Section 4.9 Documentation, the County and the independent jurisdictions therein would greatly benefit from a countywide addressing ordinance to standardize addressing and assist 9-1-1 in locating emergency callers.

Address creation and maintenance are mostly standardized in the 9-1-1 system. Minimal improvements to the address creation and maintenance processes between the County and municipalities are necessary.

The improvements noted below are recommended or required for the County to enhance its addressing capabilities.

Table 7: Addressing Improvements

Improvement	Criticality
Establish a weekly address update schedule for all addressing authorities.	Required
Re-validate road centerlines and address points after construction to ensure accuracy.	Recommended
Create, distribute, and follow addressing SOP.	Strongly recommended
Develop countywide addressing ordinance.	Strongly recommended

To better standardize the addressing practices and results across the region, the County should focus on remedying the deficiencies outlined in the table above and illustrated in the figure below.

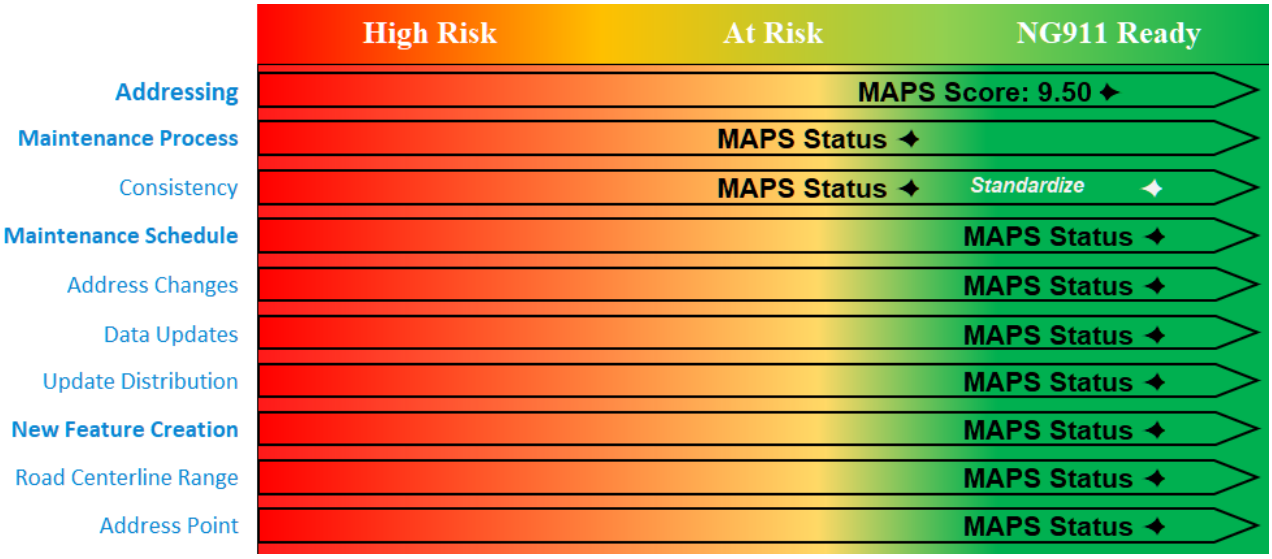


Figure 11: Addressing Readiness

4.9 Documentation

Score: 6.40

The migration to NG9-1-1 is complex and requires careful planning. The processes for creating and maintaining GIS data may change, sometimes drastically, to meet the demands of the NG9-1-1

environment. Mitigating the many risks to the success of this undertaking necessitates the development of, and strict adherence to, documents regarding workflows, SOPs, strategic planning, and industry standards.

At the top of the list for documents is a strategic plan. This plan will identify the short-term and long-term goals for GIS data. Comparing these goals with the current capabilities and availability of staff members will justify staff-augmentation requests. The strategies for GIS data should support the goals and schedule of the broader public safety program. Finally, the strategic plan must align with the overall strategy outlined in the *Arizona Next Generation 9-1-1 GIS Strategic Plan*. It is important to annually maintain the 9-1-1 system's strategic plan to ensure continued alignment with the State, show progress toward strategic goals, and facilitate budgeting and staffing projections. The GIS resources spend most of their time reacting to the current needs of all departments requesting GIS services, which limits their ability to undertake strategic efforts. Annual goals are set by GIS staff that may or may not align with local public safety needs or the overall NG9-1-1 strategy for the state. All GIS staff should collaborate on a strategic plan for the 9-1-1 system and identify short- and long-term goals focused on mediating gaps identified in this report.

Consistency is key to the validation of individual and aggregated GIS datasets. SOPs for the creation, maintenance, distribution, and refresh of GIS data assist greatly in meeting the requirements of the NG9-1-1 environment. SOPs are especially important in mitigating the risks to productivity due to staff turnover. The 9-1-1 system has created some written SOPs and the standard processes are well practiced by existing staff. The informal addressing policy does not include a strict GIS workflow for jurisdictions not using the County addressing tool.

Current, accurate, and fully attributed GIS data is quintessential to the operation of the NG9-1-1 system. The loss of GIS data or services for any length of time could prove disastrous to the public safety mission. GIS staff maintains a disaster-recovery plan to ensure that the data, systems, and staff can update the GIS data used for location validation and emergency call routing. The County's COOP plan includes the needs of GIS.

The PSAPs do not have an MOA with their respective GIS groups for data maintenance. An MOA would protect the data provisioning process in the ESInet and continue to provide current GIS data to the CAD systems through staff turnover. With the introduction of the more-stringent specifications for NG9-1-1, MCP recommends implementing an SLA over an MOA. The SLA should reflect the current level of service being provided by the GIS staff. All agreements should be reviewed annually and updated appropriately.

Proper, complete, and current documentation will greatly assist the jurisdictions in mitigating staff turnover, breakdowns in intergovernmental relationships, and other unforeseen obstacles that may jeopardize the NG9-1-1 migration. The improvements noted below are recommended or required for the 9-1-1 system to improve its documentation posture.

Table 8: Documentation Improvements

Improvement	Criticality
Create a GIS strategic plan coincident with the broader public safety strategy for the 9-1-1 system and with the State's GIS strategic plan.	Strongly recommended
Review, update, distribute, and enforce the use of SOPs for data development, maintenance, and distribution.	Strongly recommended
Review, update, distribute, and enforce the use of error-correction workflows.	Strongly recommended
Create MOAs and SLAs governing existing services provided by GIS.	Strongly recommended

To ensure continuity across the state and through staff turnover as well as enforce consistency in the NG9-1-1 GIS data, the 9-1-1 system should focus on remedying the deficiencies outlined in the table above and illustrated in the figure below.

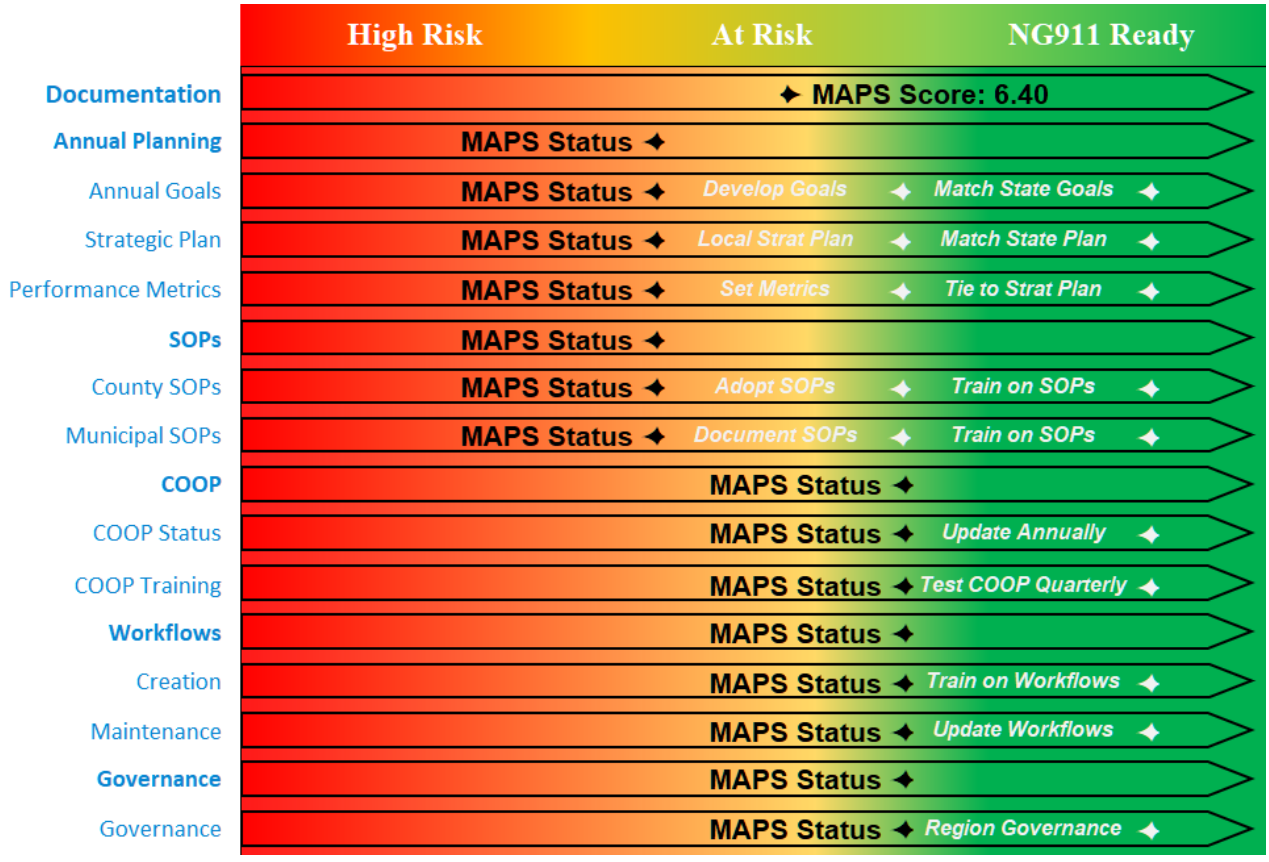


Figure 12: Documentation Readiness

5 Additional Recommendations

Proper planning is critical to the success of the NG9-1-1 migration. Short-term project planning and long-term strategic planning are vital and will identify the need for additional resources, further coordination with neighboring jurisdictions, and drive outreach and education efforts. The Yavapai 9-1-1 system should invest in the annual maintenance of a GIS strategic plan to support NG9-1-1. Not only will this benefit all GIS users, but it also will aid leadership in planning for the future needs of NG9-1-1 operations. The inclusion of leadership in the development of a strategic plan is a good outreach tool for developing an understanding of the GIS efforts to advance NG9-1-1 migration. Leaders who understand the needs of GIS and NG9-1-1 and see progress as measured against the strategic plan are more likely to support and fund GIS and NG9-1-1 efforts.

The strategic plan should identify the need to remedy the gaps identified in this assessment. Additionally, the strategic plan should include an annual projects plan. This plan will guide the efforts of GIS staff for the year. These projects should be accompanied by milestones and clearly defined goals, tied back to the recommendations in this assessment.

6 Conclusion

While great strides are being made in various aspects of the 9-1-1 system's mission, there are some areas where improvements could be beneficial—both immediately and for the long-term continued success of the organizations—that will move it toward the "ideal" state, which the MAPS program defines as an NG9-1-1-ready, or best-in-class public safety organization.

The first step in improving an already great public safety GIS program is to identify areas of risk and translate them into opportunities. Now that the 9-1-1 system has completed the MAPS assessment, recommendations have been made to improve upon the foundational work that is already in place and to establish metrics for measuring future progress. A summary of recommendations can be found in Appendix A.

Some areas assessed have new recommendations; however, most recommendations are to review and assess the current model, plans, and practices, and update them as necessary to improve cohesiveness for employees and to align better with industry standards and best practices. The MAPS program is intended to help:

- The jurisdictions understand where their strengths and weaknesses lie
- Drive future investment and highlight risk
- Establish metrics for measuring future progress
- Plan a course for the future with "stepping-stone" projects that will help the 9-1-1 system reach its long-term goals and vision

With this assessment and the recommendations herein, the 9-1-1 system is poised for success in its migration to NG9-1-1.

Appendix A – Consolidated Recommendations

GIS Data Readiness	
Improvement	Criticality
Acquire and validate VoIP ALI records.	Recommended
Inventory MLTS/PBX phone systems and assess the risk level.	Strongly recommended
Increase County GIS staffing by at least one analyst position—dedicated to 9-1-1—to support additional data development, maintenance, and validation testing efforts. Additional GIS staff at each PSAP may be necessary if the centers, or at a minimum the CAD systems, are not consolidated given the unique requirements of each.	Strongly recommended
Perform validation testing on the complete dataset for the entire 9-1-1 system at least quarterly. Test monthly in high-growth areas.	Strongly recommended
Update the County's NG9-1-1 data and addressing standards as revisions are made to the NENA GIS data model and related standards.	Required

Production Environment	
Improvement	Criticality
Track and document staff hours spent supporting 9-1-1 specific GIS data development and maintenance.	Strongly recommended
Add additional GIS resources at the PSAPs to meet demands for CAD system coordination, 72-hour turnaround times, and to perform special projects.	Strongly Recommended
Implement MOA or SLA with IT for server maintenance and availability.	Strongly Recommended
Update disaster recovery and COOP plans to reflect changes in operations implemented according to this report.	Strongly Recommended
Implement MOA or SLA between County and each municipality, identifying GIS data development and maintenance responsibilities.	Strongly Recommended

Regional Coordination	
Improvement	Criticality
Coordinate PSAP and ESZ polygon creation and maintenance with all neighboring jurisdictions and reassess yearly.	Required
Coordinate road centerline creation, maintenance, and address range validation with all neighboring jurisdictions.	Strongly recommended
Incorporate snap-to points in boundary resolution workflows.	Recommended
Validate all address points for every jurisdiction at least monthly for full attribution and against overlap.	Strongly recommended
Participate in the statewide data validation and distribution program once implemented at the state level.	Required

Training	
Improvement	Criticality
Increase internal awareness for NG9-1-1 GIS needs through outreach, education, and planning sessions.	Recommended
Provide SOP, workflow, and NG9-1-1 training to new GIS staff as they are hired.	Required

Computer-Aided Dispatch	
Improvement	Criticality
Coordinate GIS data updates with all neighboring jurisdictions to ensure that the most recently aggregated GIS data is being used.	Recommended
Coordinate with the State to identify the need for statewide 9-1-1 data validation and aggregation to support the CAD function. Make local 9-1-1 GIS data available through the State's AZGeo portal.	Strongly Recommended
Update the CAD systems to support GIS mapping and refresh the GIS data immediately as new data becomes available.	Recommended

General Information Technology	
Improvement	**Criticality**
Ensure that near-term and long-term planning and budgeting continue to cover the GIS software and server licensing.	Required
Verify and improve data recovery capabilities to public-safety-grade.	Strongly recommended
Review and update network operations agreements. Add a level of service requirement to the contract as necessary to support NG9-1-1.	Strongly recommended

Addressing	
Improvement	Criticality
Establish a weekly address update schedule for all addressing authorities.	Required
Re-validate road centerlines and address points after construction to ensure accuracy.	Recommended
Create, distribute, and follow addressing SOP.	Strongly recommended
Develop countywide addressing ordinance.	Strongly recommended

Documentation	
Improvement	Criticality
Create a GIS strategic plan coincident with the broader public safety strategy for the 9-1-1 system and with the State's GIS strategic plan.	Strongly recommended
Review, update, distribute, and enforce the use of SOPs for data development, maintenance, and distribution.	Strongly recommended
Review, update, distribute, and enforce the use of error-correction workflows.	Strongly recommended
Create MOAs and SLAs governing existing services provided by GIS.	Strongly recommended

Appendix B – Table of Acronyms

Acronym	Term	Definition
ALI	Automatic Location Identification	Tabular reference for the current 911 system. Defines destination PSAP for every landline telephone number and cellular tower
CAD	Computer-Aided Dispatch	A computer-based system that aids PSAP telecommunicators by automating selected dispatching and record-keeping activities
CLDXF	Civic Layer Data Exchange Format	A set of data elements that describe detailed street address information. All components are spelled out – no abbreviations
COOP	Continuity of Operations Plan	A plan to implement Continuity of Operations to ensure that Primary Mission Essential Functions continue to be performed during a wide range of emergencies, including localized acts of nature, accidents and technological or attack-related emergencies
E9-1-1	Enhanced 9-1-1	A telephone system which includes network switching, database and Public Safety Answering Point premise elements capable of providing automatic location identification data, selective routing, selective transfer, fixed transfer and a call back number
ECRF	Emergency Call Routing Function	A functional element in an ESInet; the ECRF is a Location to Service Translation (LoST) protocol server where location information (either civic address or geo-coordinates) and a Service Uniform Resource Name (Service URN) serve as input to a mapping function that returns a Uniform Resource Identifier (URI) used to route an emergency call toward the appropriate PSAP for the caller's location or toward a responder agency
ESInet	Emergency Services IP Network	Managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG911 services
ESZ	Emergency Service Zone	A geographical area that represents a unique combination of emergency service agencies (e.g., law enforcement, fire/rescue and emergency medical service) that is within a specified 911 governing authority's jurisdiction
ETL	Extract, Transform, Load	Three database functions that are combined into one tool to pull data out of one database, properly map the fields to the schema of a second database, and place it into the other database
FCC	Federal Communications Commission	An independent U.S. government agency overseen by Congress, the commission is the United States' primary authority for communications law, regulation and technological innovation

Acronym	Term	Definition
GIS	Geographic Information System	A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced
ILA	Interlocal Agreement	An agreement among governmental jurisdictions or privately owned systems, or both, within a specified area to share 9-1-1 system costs, maintenance responsibilities, and other considerations
IP	Internet Protocol	The method by which data is sent from one computer to another on the ESInet, Internet or other networks
IT	Information Technology	The use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data
LVF	Location Validation Function	A functional element in an NGCS that is a LoST protocol server where civic location information is validated against the authoritative GIS database information
MLTS	Multi-Line Telephone System	Communications equipment comprised of common control unit(s), telephone sets, control hardware and software and adjunct systems used typically in enterprise settings such as hotels, government agencies, commercial offices, and campuses
MOA	Memorandum of Agreement	A document written between parties to cooperatively work together on an agreed upon project or meet an agreed upon objective
MSAG	Master Street Address Guide	Tabular reference for address validation in the current 911 system. Defines all possible addresses within a jurisdiction
NENA	National Emergency Number Association	Standards body for 911 and NG911
NG911	Next Generation 911	NG911 refers to an initiative aimed at updating the 911 service infrastructure in the United States and Canada to improve public emergency communications services in a growingly wireless mobile society
NGCS	Next Generation Core Services	The base set of services needed to process a 911 call on an ESInet. Includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services and typical IP services such as DNS and DHCP. The term NGCS includes the services and not the network on which they operate
PBX	Private Branch Exchange	A private telephone switch that is connected to the Public Switched Telephone Network
PSAP	Public Safety Answering Point	The entity responsible for receiving 911 calls and processing those calls according to a specific operational policy
RDBMS	Related Database Management System	Software that gives users the ability to update, query and administer a relational database

Acronym	Term	Definition
REST	Representational State Transfer	An interface that transmits domain-specific data over HTTP without an additional messaging layer such as SOPA or session tracking via HTTP cookies
RMS	Records Management System	Public Safety RMS are often interfaced to public safety communication centers. RMSs are sometimes accessed directly through computer systems deployed within communication centers for research and analysis purposes
SDE	Spatial Database Engine	An umbrella term that describes how virtualization and abstracting workloads from the underlying hardware can be used to make information technology (IT) infrastructures more flexible and agile
SI	Spatial Interface	A standardized interface between the GIS and the functional elements that consume GIS data, such as the ECRF and/or LVF
SLA	Service Level Agreement	A contract between a service provider and the end user that defines the level of service expected from the service provider
SOP	Standard Operating Procedure	A written directive that provides a guideline for carrying out an activity
SQL	Structured Query Language	A standardized programming language that's used to manage relational databases and perform various operations on the data in them
TFOPA	Task Force on Optimal Public Safety Answering Point Architecture	The Federal Task Force directed to study and report findings and recommendations on structure and architecture in order to determine whether additional consolidation of PSAP infrastructure and architecture improvements would promote greater efficiency of operations, safety of life, and cost containment while retaining needed integration with local first responder dispatch and support
VoIP	Voice Over Internet Protocol	Telephone service provided through the internet rather than traditional telephone lines. This includes FIOS™, cable service such as Comcast and Time Warner, and purchased devices like Ooma, Google Voice, or Magic Jack