

# Wisconsin NG9-1-1 GIS Gap Analysis Project

## Final Report Recommendations

*submitted to the*

**Wisconsin Department of Military Affairs**

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## Executive Overview

In a Next Generation 9-1-1 (NG9-1-1) environment Geographic Information System (GIS) data is mission critical and is utilized to spatially route 9-1-1 calls to the appropriate Public Safety Answering Point (PSAP).

Prior to transitioning to an NG9-1-1 system, local entities, regions, and states must begin the preparation and remediation of the 9-1-1 GIS data to support NG9-1-1. This includes developing GIS standards, determining and performing quality control to ensure all critical errors are resolved, and education of all 9-1-1 GIS data providers and PSAPs at all levels of government.

In preparation for the implementation of an NG9-1-1 system, the State of Wisconsin, Department of Military Affairs (DMA) contracted with GeoComm and AppGeo to:

- Assist DMA in establishing the Wisconsin NG9-1-1 GIS Standard and Best Practices Document based on the National Emergency Number Association (NENA) NG9-1-1 Data Model;
- Develop and host virtual, in-person and one recorded educational session based on the Wisconsin NG9-1-1 GIS Standard and Best Practices;
- Perform an assessment of each local jurisdiction's 9-1-1 GIS data to determine the level of current compliance with the Wisconsin NG9-1-1 GIS Standard; and
- Prepare a final report to include the details of the project.

Based on the GIS Gap Analysis completed as a part of the project, the current statewide GIS accuracy is **85.55%** for all errors identified and **97.75%** for only critical errors requiring resolution to enable NG9-1-1 call routing and location validation. The goal for each PSAP is critical error free GIS data.

Transition to and implementation of NG9-1-1 relies heavily on GIS and as such, during the project, numerous NG9-1-1 GIS related topics were identified that require further investigation. The most important next steps and recommendations are:

- **Continual Coordination between 9-1-1 and GIS Personnel** | Continue to provide education and outreach to the 9-1-1 Authorities, Addressing Authorities, and the GIS Data Providers throughout Wisconsin to ensure coordination continues between all entities to improve the NG9-1-1 GIS data sets.
- **NG9-1-1 GIS Legislation, Governance and Procedures** | Present GIS as a part of NG9-1-1 Legislation to include establishment of data standards, maintenance, and data reporting requirements, consider creating a NG9-1-1 GIS Governance Policy, continue working with local 9-1-1 Authorities, GIS Data Providers, Addressing Authorities and Street Naming Authorities on the importance of NG9-1-1 GIS standard operating procedures for each jurisdiction along with ordinance and resolutions where required.
- **Procure NG9-1-1 GIS Data Management Services** | Acquire NG9-1-1 GIS data management services to support DMA with the transition to, implementation and continued support of the Wisconsin NG9-1-1 system.
- **Standardization of Non-Standard USPS Post Types & Street Names in the Legacy Databases** | Coordinate with the NGCS, Counties and the legacy ALI provider to update all non-standard USPS abbreviations and road names.
- **Determine methodology for Dual Road Names** | Coordinate with the NGCS Implementation Project to determine the method that needs to be utilized for existing dual street names in the street name field and communicate the method to the local GIS Data Providers.
- **Distribute URNs/URIs** | Distribute the Service URN and Service URI values to the GIS Data Providers and 9-1-1 Authority as soon as they are available.

- **Implementation of a GIS Derived MSAG** | Transition each PSAP from a legacy MSAG to a GIS derived MSAG in partnership with the PSAP, GIS Data Providers, NGCS Provider and GIS Management partner, if chosen.
- **Determine Quality Control Exceptions** | Once the NGCS Provider has been selected, a list of exception codes should be distributed to the GIS Data Providers and 9-1-1 Authorities for use within the GIS data sets.
- **Extract – Transform – Load Process: Next Generation Unique ID Creation** | Provide direction to the local GIS Data Providers to add and maintain only the locally assigned ID until the format of the NENA globally unique IDs are decided by NENA.
- **Extract – Transform – Load Process: Auto Population of Field Values** | During the selection of the GIS data management provider, identify if the provider can auto populate any or all the fields listed in the section.
- **Extract – Transform – Load Process: Identification of Existing Scripts and Tools for Schema Transformation** | Investigate the possibility of purchasing or creating scripts and tools for local GIS Data Providers to support the 9-1-1 centers in providing GIS data for NG9-1-1 and CAD. If selected, a GIS data management provider can provide assistance.
- **Continued Coordination with State and Local Partners** | Identify points of contacts for each agency listed in the section and begin discussions with them on how their assistance and guidance can provide value to NG9-1-1.
- **Investigate Funding Resources for NG9-1-1 GIS Data** | Continue to investigate funding opportunities to support the creation, updating, and maintenance of GIS data for NG9-1-1.

Additional details for each item listed above can be found under the [Next Steps and Recommendations](#) section.

## Wisconsin NG9-1-1 GIS Standards

### Purpose

The NG9-1-1 GIS Gap Analysis Project included the creation of an NG9-1-1 GIS Data Standard specifically for Wisconsin and Best Practices surrounding each of the NG9-1-1 required GIS data layers.

The purpose of the document is to provide a common GIS data model and to set minimum accuracy benchmarks for Master Street Address Guide (MSAG), Automatic Location Information (ALI), and GIS data synchronization that must be attained before local data can be integrated into Wisconsin's statewide dataset. NG9-1-1 requires higher levels of GIS data standardization and attribution detail than GIS data used for existing E9-1-1 systems. This document also provides GIS data stewards with recommendations and best practices for creating and maintaining the required GIS data layers that will meet Wisconsin's NG9-1-1 GIS data requirements.

### Definition of Required Data Layers

#### Road Centerlines

Road Centerlines represent the approximate centerline of a real-world roadway. The Road Centerlines GIS data layer utilizes arc-node topology with each road segment having attribute data associated with it that provides the segment's street name, civic address ranges and jurisdictional place names on each side of the segment, and other attribute information.

## Site/Structure Address Points

Site/Structure Address Points represent the approximate location of a site or structure, or in some cases the location of access to a site or structure. Site/Structure Address Points can also represent landmarks. Each address point in the Site/Structure Address Points GIS data layer has attribute data associated with it that provides its street name, address number, jurisdictional place names, associated landmark name, and other attribute information.

Site/Structure Address Points generally provide more precise locations of addresses than can be found geocoding to Road Centerlines, particularly in areas with unusual addressing (e.g. flag lots, odd addresses on the even numbered side of a Road Centerline, even addresses on the odd numbered side of a Road Centerline), large properties with subaddresses (e.g. academic campuses, government complexes, mobile home parks), remote locations where a structure may be located far from the road that it is addressed off of, and landmarks (some of which may not be addressed at all) that are well known features with names that might be the most or only identifiable information about the location.

The location attributes (e.g., Address Number, Street Name, place names) in the Site/Structure Address Points GIS data layer should be consistent with the location attributes (FROM/TO Address range, Street Name, place names) on the left or right side of the road segment in the Road Centerlines GIS data layer where the Address Point is located. However, this may not always be possible, especially in areas of unusual addressing.

## Wisconsin NG9-1-1 GIS Data Model

The [NG9-1-1 GIS Data Model for Wisconsin](#) was designed from the NENA NG9-1-1 GIS Data Model to support both NENA and Wisconsin specific requirements. The NG9-1-1 GIS Data Model was developed in conjunction with the Wisconsin Land Information Association (WLIA) and includes the following GIS Data Layers:

Required:

- Road Centerlines
- Site/Structure Address Points
- PSAP Boundary
- Emergency Service Boundary (EMS, Fire, Law)
- Provisioning Boundary

A template of the NENA NG9-1-1 GIS Data Model can be downloaded from NENA's website at: [https://www.nena.org/resource/resmgr/standards/NG911\\_GIS\\_TEMPLATE\\_FILES\\_201.zip](https://www.nena.org/resource/resmgr/standards/NG911_GIS_TEMPLATE_FILES_201.zip)

DMA is actively working on the development of a Wisconsin NG9-1-1 GIS Data Model template that reflects the additional Wisconsin fields. The Wisconsin template will be posted to the DMA website.

## GIS Data Layer Table Descriptions

Each data layer is described in this document with a table listing the attributes. Detailed attribute descriptions, required data domains, and example field values can be found in the published Wisconsin standard [here](#). The GIS data layer tables are formatted with the following information:

- **Descriptive Name:** Basic description of the data field name that clarifies the intent of the abbreviated name contained in the "Field Name" column.
- **Field Name:** The standardized data field name for GIS data used in an NG9-1-1 system. Local GIS data and the Wisconsin statewide data layers must conform to this standard naming schema.



- **Inclusion:** This column refers to the requirement for a field to be populated in a dataset to comply with the standard.
  - **Mandatory (M)** – An attribute value must be populated in the data field for each record. Mandatory data fields must not be blank.
  - **Conditional (C)** – If an attribute value exists for a record, it must be populated in the data field. If no attribute value exists for a record, the data field is left blank.
  - **Optional (O)** – Not required to be populated in the local data. It is a local decision on whether to populate the data field.
- **Field Type:** The required attribute type, as defined in NENA standards.
  - **P [Text]** – Printable ASCII characters (decimal codes 32 to 126).
  - **E [Text]** – UTF-8 restricted to character sets designated by the 9-1-1 Authority, but not including pictographic characters. This allows for foreign names that require Latin letters not in the ASCII character set (e.g., Latin letters with tilde or grave accents).
  - **U [Text]** – A Uniform Resource Identifier (URI) as described in Section 13, Terminology, and defined in RFC 3986, and also conforming to any rules specific to the scheme (e.g. sip:, https:, etc.) of the chosen URI. Consult with the NG9-1-1 Core Services Provider for requirements.
  - **D [Date]** – Date and time. Information for a record represented as local time with offset from Coordinated Universal Time (UTC) as defined by the W3C “dateTime” datatype described in XML Schema Part 2: Datatypes Second Edition [3]. Since many GIS applications cannot currently utilize this format, local data may store the date and time in the local database date/time format but time must include seconds and may be recorded to 0.1 seconds. Local data stored in a local database date/time format will be converted to the NENA-required format prior to use in NG9-1-1.
  - **N [Short, Long]** – Non-negative Integer, consisting of whole numbers only.
  - **F [Float]** – Floating (numbers that have a decimal place). There is no defined field length of a floating number; it is system dependent. These shall be double-precision fields.
- **Field Width:** The maximum field width, in number of characters.
- **Domains [Yes, No]:** This column indicates if a set of valid values are to be used as attributes.

### Road Centerline Schema

Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Road Centerline NENA Globally Unique ID	RCL_NGUID	M	P	254	No
Left Address Number Prefix	AdNumPre_L	C	P	15	No
Left FROM Address	FromAddr_L	M	N	6	Yes
Left TO Address	ToAddr_L	M	N	6	Yes
Right Address Number Prefix	AdNumPre_R	C	P	15	No
Right FROM Address	FromAddr_R	M	N	6	Yes
Right TO Address	ToAddr_R	M	N	6	Yes
Street Name Pre Modifier	St_PreMod	C	E	15	No
Street Name Pre Directional	St_PreDir	C	P	9	Yes
Street Name Pre Type	St_PreTyp	C	E	50	Yes
Street Name Pre Type Separator	St_PreSep	C	E	20	Yes
Street Name	St_Name	M	E	60	No
Street Name Post Type	St_PosTyp	C	E	50	Yes
Street Name Post Directional	St_PosDir	C	P	9	Yes
Street Name Post Modifier	St_PosMod	C	E	25	No
Full Street Name*	FullStNm	M	E	245	No
Abbreviated Full Street Name*	abFullStNm	O	E	175	No
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2	Yes
Legacy Street Name	LSt_Name	C	P	75	No



Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Legacy Street Name Type	LSt_Type	C	P	4	Yes
Legacy Street Name Post Directional	LSt_PosDir	C	P	2	Yes
Postal Code Left	PostCode_L	O	P	7	Yes
Postal Code Right	PostCode_R	O	P	7	Yes
Postal Community Name Left	PostComm_L	O	P	40	Yes
Postal Community Name Right	PostComm_R	O	P	40	Yes
Country Left	Country_L	M	P	2	Yes
Country Right	Country_R	M	P	2	Yes
State Left	State_L	M	P	2	Yes
State Right	State_R	M	P	2	Yes
County Left	County_L	M	P	40	Yes
County Right	County_R	M	P	40	Yes
Incorporated Municipality Left	IncMuni_L	M	E	100	Yes
Incorporated Municipality Right	IncMuni_R	M	E	100	Yes
Unincorporated Community Left	UnincCom_L	O	E	100	No
Unincorporated Community Right	UnincCom_R	O	E	100	No
Neighborhood Community Left	NbrhdCom_L	O	E	100	No
Neighborhood Community Right	NbrhdCom_R	O	E	100	No
Additional Code Left	AddCode_L	C	P	6	No
Additional Code Right	AddCode_R	C	P	6	No
One-Way	OneWay	O	P	2	Yes
Speed Limit	SpeedLimit	O	N	3	Yes
Road Class	RoadClass	O	P	15	No
Date Updated	DateUpdate	M	D	-	No
Effective Date	Effective	O	D	-	No
Expiration Date	Expire	O	D	-	No
Discrepancy Agency ID	DiscrpAgID	M	P	75	No
Parity Left	Parity_L	M	P	1	Yes
Parity Right	Parity_R	M	P	1	Yes
ESN Left	ESN_L	C	P	5	Yes
ESN Right	ESN_R	C	P	5	Yes
MSAG Community Name Left	MSAGComm_L	C	P	30	No
MSAG Community Name Right	MSAGComm_R	C	P	30	No
Validation Left	Valid_L	O	P	1	Yes
Validation Right	Valid_R	O	P	1	Yes

\*Wisconsin specific addition to the NG9-1-1 GIS Data Standard

### Site/Structure Address Points Schema

Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Site NENA Globally Unique ID	Site_NGUID	M	P	254	No
Road Centerline NENA Globally Unique ID	RCL_NGUID	M	P	254	No
Address Number Prefix	AddNum_Pre	C	P	15	No
Address Number	Add_Number	C	N	6	Yes
Address Number Suffix	AddNum_Suf	C	P	15	No
Complete Landmark Name	LandmkName	C	P	150	No
Mile Marker/Milepost	Milepost	C	P	150	No
Building	Building	O	P	75	No
Floor	Floor	O	P	75	No
Unit	Unit	O	P	75	No
Room	Room	O	P	75	No
Seat	Seat	O	P	75	No
Additional Location Information	Addtl_Loc	O	E	225	No
Street Name Pre Modifier	St_PreMod	C	E	15	No
Street Name Pre Directional	St_PreDir	C	P	9	Yes
Street Name Pre Type	St_PreTyp	C	E	50	Yes
Street Name Pre Type Separator	St_PreSep	C	E	20	Yes
Street Name	St_Name	C	E	60	No
Street Name Post Type	St_PosTyp	C	E	50	Yes
Street Name Post Directional	St_PosDir	C	P	9	Yes
Street Name Post Modifier	St_PosMod	C	E	25	No
Full Street Name*	FullStNm	M+	E	245	No
Abbreviated Full Street Name*	abFullStNm	O	E	175	No
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2	Yes
Legacy Street Name	LSt_Name	C	P	75	No
Legacy Street Name Type	LSt_Type	C	P	4	Yes
Legacy Street Name Post Directional	LSt_PosDir	C	P	2	Yes
Postal Code	Post_Code	O	P	7	Yes
ZIP Plus 4	Post_Code4	O	P	4	Yes
Postal Community Name	Post_Comm	O	P	40	Yes
Country	Country	M	P	2	No
State	State	M	P	2	Yes
County	County	M	P	40	Yes
Incorporated Municipality	Inc_Muni	M	E	100	Yes
Unincorporated Community	Uninc_Comm	O	E	100	No
Neighborhood Community	Nbrhd_Comm	O	E	100	No
Additional Code	AddCode	C	P	6	No
Placement Method	Placement	O	P	25	Yes
Place Type	Place_Type	O	P	50	No
Additional Data URI	AddDataURI	C	U	254	No
Structure*	Structure	C	P	3	Yes
Date Updated	DateUpdate	M	D	-	No
Effective Date	Effective	O	D	-	No
Expiration Date	Expire	O	D	-	No
Discrepancy Agency ID	DiscrpAgID	M	P	75	No
ESN	ESN	C	P	5	Yes
MSAG Community Name	MSAGComm	C	P	30	No
Longitude	Long	O	F	-	No
Latitude	Lat	O	F	-	No
Elevation	Elev	O	N	6	No

\*Wisconsin specific addition to the NG9-1-1 GIS Data Standard

+The inclusion for this field will need to be updated to Conditional (C) in the next version as the Street Name element itself is Conditional.

### PSAP Boundary Schema

Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Emergency Service Boundary NENA Globally Unique ID	ES_NGUID	M	P	254	No
State	State	M	P	2	Yes
Agency ID	Agency_ID	M	P	100	Yes
Service URI	ServiceURI	M	U	254	Yes
Service URN	ServiceURN	M	U	50	No
Service Number	ServiceNum	O	P	15	No
Agency vCard URI	AVcard_URI	M	P	254	No
Display Name	DsplayName	M	P	60	Yes
Date Updated	DateUpdate	M	D	-	No
Effective Date	Effective	O	D	-	No
Expiration Date	Expire	O	D	-	No
Discrepancy Agency ID	DiscrpAgID	M	P	75	No

### Emergency Service Boundary Schema

Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Emergency Service Boundary NENA Globally Unique ID	ES_NGUID	M	P	254	No
State	State	M	P	2	Yes
Agency ID	Agency_ID	M	P	100	Yes
Service URI	ServiceURI	M	U	254	Yes
Service URN	ServiceURN	M	U	50	No
Service Number	ServiceNum	O	P	15	No
Agency vCard URI	AVcard_URI	M	P	254	No
Display Name	DsplayName	M	P	60	Yes
Date Updated	DateUpdate	M	D	-	No
Effective Date	Effective	O	D	-	No
Expiration Date	Expire	O	D	-	No
Discrepancy Agency ID	DiscrpAgID	M	P	75	No

### Provisioning Boundary Schema

Descriptive Name	Field Name	Inclusion	Type	Field Width	Domain
Provisioning Boundary NENA Globally Unique ID	PB_NGUID	M	P	254	No
Date Updated	DateUpdate	M	D	-	No
Effective Date	Effective	O	D	-	No
Expiration Date	Expire	O	D	-	No
Discrepancy Agency ID	DiscrpAgID	M	P	75	No

## Quality Control, GIS Synchronization and Accuracy Benchmarks

The most important part of preparation and maintenance of NG9-1-1 GIS data is synchronization and quality control.

Quality Control is an all-encompassing management approach that combines technical, qualitative and human resources to evaluate the quality of GIS data to meet the requirements of a system. Each GIS data layer, individually and in relation to each other, is analyzed to determine where integrity issues exist.

Integrity issues for NG9-1-1 GIS Data is categorized into two categories: critical and non-critical. Critical issues will cause issues with NG9-1-1 call routing and location validation functions and will not be accepted into the NG9-1-1 Core Service components. Non-critical issues have the potential to cause

issues with both of these functions, however additional features within the system will ensure the calls are correctly routed. Non-critical errors may be identified by the NG9-1-1 Core Service Provider but will not prevent the data from being provisioned into the system.

Prior to and during transition to a NG9-1-1 system, the 9-1-1 GIS data and the E9-1-1 routing databases, ALI and MSAG, must continue to be quality controlled through data synchronization. It is important to utilize the legacy street name elements within the Road Centerlines and Site/Structure Address Points datasets for synchronization with the legacy E9-1-1 databases. Integrity issues identified during the data synchronization process may need to be resolved through updates to the ALI and/or MSAG and the GIS data.

The process for quality control can be dependent on a variety of factors, however the major factors are the software utilized to perform the analysis and the format of the GIS data. Resolution of all errors identified as **Critical** errors, is of utmost importance. For NG9-1-1, 98% is often cited as a benchmark for resolution of GIS data errors and ALI to Road Centerlines errors, with a goal to continually improve the GIS data and achieve 100% resolution of all errors. Accuracy requirements should be discussed with Wisconsin's NextGen Core Service (NGCS) Provider.

## Definitions of Commonly Used Quality Control Terms

Many terms are used for quality control that represent a group of fields within the GIS data. These groups of terms are listed below.

### **Street Name Elements:**

**Description:** All the CLDXF (fully spelled out) street name fields and/or all the legacy (abbreviated) street name fields in both the Road Centerlines and Site/Structure Address Points feature classes.

**CLDXF:** Street Name Pre Modifier, Street Name Pre Directional, Street Name Pre Type, Street Name Pre Type Separator, Street Name, Street Name Post Type, Street Name Post Directional, Street Name Post Modifier

**Legacy:** Legacy Street Name Pre Directional, Legacy Street Name, Legacy Street Name Type, Legacy Street Name Post Directional

### **Zone:**

**Description:** Any field or combination of fields used to ensure location uniqueness.

**CLDXF:** May include Country, State, County, Incorporated Municipality

**Legacy:** May include MSAG Community Name and ESN

### **Address Elements:**

**Description:** All the address and subaddress elements including Address Number Prefix, Address Number, Address Number Suffix, Building, Floor, Unit, Room, Seat, Additional Location Information.

## General Quality Control Checks for NG9-1-1

The following checks should be performed during quality control on all GIS data layers.

- Field format validation (Critical): Check to identify where fields are not formatted to meet the WI NG9-1-1 GIS Data Standard.
- Unique Identifier (Critical): Check to identify duplicate unique identifiers within individual or all source feature classes.

- Missing mandatory field values (Critical): Check to identify where mandatory field attribution, as defined in the WI NG9-1-1 GIS Data Standard, is missing.
- Field values outside of domain: Check to identify where field values are outside of the acceptable domain values as defined by the WI NG9-1-1 GIS Data Standard. This check may be *Critical* for certain fields defined by the Core Service Provider.

## Boundary Quality Control Checks for NG9-1-1

The following checks should be performed during quality control on all boundary layers including Provisioning Boundary, PSAP Boundary and Emergency Service Boundaries; may also include County Boundary, Incorporated Municipality Boundary, Unincorporated Community Boundary and Neighborhood Community Boundary where available. Overlap errors are critical only for the Provisioning Boundary, PSAP Boundary and Emergency Service Boundaries.

- Boundary has overlaps (Critical): Check to identify where overlaps exist between polygons in each boundary feature class.
- Boundary does not cover the Provisioning Boundary (Critical): Check to identify where Emergency Service Boundaries do not cover the Provisioning Boundary in its entirety.
- Boundary has gap: Check to identify where gaps exist between polygons in each boundary feature class.

## Site/Structure Address Point Quality Control Checks for NG9-1-1

The following checks should be performed during quality control on the site/structure address point data layer.

- Address found multiple times (Critical): Check to identify where site/structure addresses occur multiple times in a single Site/Structure Address Points dataset. This check analyzes all the street name elements, address elements and zone(s) to determine duplication of address points.
- Site/Structure Address Points outside Provisioning Boundary (Critical): Check to identify where site/structure address points exist outside of the Provisioning Boundary.
- Site/Structure Address Point full address does not match parsed values: Check to identify where the individual parsed address fields of an address do not match the full address field.
- Site/Structure Address Point zone attribution against intersecting polygon attribution: Check to identify discrepancies between a site/structure address point's zone attribution (incorporated municipality) and the associated boundary (incorporated municipal boundary) it intersects within a buffer distance around the site/structure address point.

## Road Centerline Quality Control Checks for NG9-1-1

The following checks should be performed during quality control on the road centerline data layer.

- Road centerline segments have overlapping address range values (Critical): Check to identify where road segments have overlapping address ranges in a given zone. The zone must be defined by the governing entity.
- Road centerline outside Provisioning Boundary (Critical): Check to identify where road segments exist outside of the Provisioning Boundary.
- Road centerline segment crosses a boundary layer: Check to identify where road segments cross a boundary and a split should occur. All boundaries where attribute values change should be

included in the quality control. Includes, but may not be limited to, Incorporated Municipality Boundary, County Boundary, Provisioning Boundary, Emergency Service Boundaries.

- Road centerline segment FROM value is higher than the TO value: Check to identify where road segment address ranges have a higher FROM value than TO value.
- Road centerline segment has incorrect line directions: Check to identify where road segments are drawn in the opposite direction of addressing.
- Road centerline has incorrect one-way value: Check to identify where roads are spatially continuous but one-way values are inconsistent or incorrect.
- Road centerline has range gaps: Check to identify where theoretically/potentially ranged road centerlines have address range gaps; zero ranged roads are ignored. *Only for counties with potential ranging, if applicable.*
- Road centerline segment parity issue: Check to identify where a road segment has a mixture of even and odd address ranges on the same side of the segment and conflicts with the Parity Left and Parity Right field values.
- Road centerline segment not snapped to adjacent segments: Check to identify where road segments are not snapped to an adjacent segment.
- Road centerline segment has zero in address range value: Check to identify where road segment address ranges have a zero in one address range value and the other has a nonzero value.
- Road centerline zone attribution against intersecting polygon attribution: Check to identify discrepancies between a road centerline's zone attribution (incorporated municipality) and the associated boundary (incorporated municipal boundary) it intersects within a buffer distance around the road centerline.

## Site/Structure Address Point to Road Centerline Synchronization Checks for NG9-1-1

The following synchronization should be performed during quality control on the site/structure address point data layer to the road centerline data layer.

- Fail on full street name: Check to identify where the site/structure address point's street name elements and road segment's street name elements are not identical.
- Fail on zone: Check to identify where the site/structure address point's address number and street name elements match the road segment but are not found in the same zone.
- Fail on address range: Check to identify where the site/structure address point's street name elements and zone match the road segment, but the address number falls outside of the road segment's address ranges.
- Fail on block: Check to identify where the site/structure address point's street name elements, zone and address number match the road segment, but the site/structure address point does not fall on the correct block.
- Fail on parity: Check to identify where the site/structure address point's street name elements, zone and address number match the road segment, but the site/structure address point falls on the wrong side of the road segment.

## ALI and MSAG Synchronization Checks for Transition to NG9-1-1

A continued synchronization of the ALI and MSAG databases used in legacy 9-1-1 is important throughout the transition to a NG9-1-1 system. Telephone providers will continue to use a version of the

legacy databases to validate to for an extended period of time. The following synchronizations between the legacy databases and GIS data will ensure that the two databases remain in sync. The goal for synchronization per the NENA standards is 98% between the ALI database and the Road Centerline data layer.

*ALI to Road Centerlines Synchronization*

- Fail on full street name: Check to identify where the ALI street name elements and road segment's street name elements are not identical.
- Fail on zone: Check to identify where the ALI address number and street name elements match the road segment but are not found in the same zone.
- Fail on address range: Check to identify where the ALI street name elements and zone match the road segment, but the address number falls outside of the road segment's address ranges.

*ALI to Site/Structure Address Points Synchronization*

- Fail on full street name: Check to identify where the ALI street name elements and site/structure address point's street name elements are not identical.
- Fail on zone: Check to identify where the ALI address number and street name elements match the site/structure address point but are not found in the same zone.
- Fail on address range: Check to identify where the ALI street name elements and zone match the site/structure address point, but no exact address number match can be made.
- Fail on address number suffix: Check to identify where the ALI address number, street name elements and zone match the site/structure address point, but no exact address number suffix match can be made.

*MSAG (Low and High) to Road Centerlines*

- Fail on full street name: Check to identify where the MSAG street name elements and the road segment's street name elements are not identical.
- Fail on zone: Check to identify where an MSAG address range (high or low) and street name elements match the road segment but are not found in the same zone.
- Fail on address range: Check to identify where the MSAG street name elements and zone match the road segment, but no exact address range value match can be made.

## Wisconsin NG9-1-1 GIS Educational Sessions

Following the development of the Wisconsin NG9-1-1 GIS Standard and Best Practices document, AppGeo along with WI DMA and GeoComm designed educational sessions that were conducted in five (5) virtual sessions and one (1) in person session at the WIPSCOM Conference. At the conclusion of the virtual educational sessions, a recording was developed for those who were not able to attend, those who are new to 9-1-1 and GIS and those wanting a refresher.

Audience/Location	Date	Number of Attendees
Wisconsin Land Information Association Conference	February 15, 2021	60 (+/-)
Northwest & Northeast Region	March 2, 2021	44
West Central & Southwest Region	March 3, 2021	38
East Central & Southeast Region	March 9, 2021	50
Open to all regions	March 11, 2021	18
WIPSCOM Conference	May 11, 2021	25 (+/-)



## Educational Session Topics

The recorded educational session can be found at <https://www.youtube.com/watch?v=OszwTMxwLKI> and the PowerPoint slide deck can be found at [https://dma.wi.gov/DMA/divisions/oec/library/2021/WI\\_DMA\\_Education\\_Seminar\\_Presentation\\_20210303.pdf](https://dma.wi.gov/DMA/divisions/oec/library/2021/WI_DMA_Education_Seminar_Presentation_20210303.pdf).

### Educational Sessions Topics:

- Welcome and Introductions
- Wisconsin NG9-1-1 GIS Project Information
- GIS Data Use in NG9-1-1
  - What is Next Generation 9-1-1 (NG9-1-1)
  - Where is GIS Data Used in NG9-1-1
  - Why Do We Need Standardized Data
  - NENA NG9-1-1 GIS Data Model
  - GIS Data Layers in NG9-1-1 | Required, Strongly Recommended, Other
  - How Long will Transition to NG9-1-1 Take?
- Wisconsin NG9-1-1 GIS Technical Standards Document
- Parsing Addresses into NENA Compliant Fields
- Quality Control Checks
- Best Practices
  - General Considerations
  - Road Centerlines
  - Site/Structure Address Points
- Questions and Comments

## Local GIS Data Assessment Results

GeoComm performed an extensive quality control on each jurisdiction in Wisconsin. The following counties were individually processed:

- |               |              |               |
|---------------|--------------|---------------|
| ○ Adams       | ○ Green      | ○ Outagamie   |
| ○ Ashland     | ○ Green Lake | ○ Ozaukee     |
| ○ Barron      | ○ Iowa       | ○ Pepin       |
| ○ Bayfield    | ○ Iron       | ○ Pierce      |
| ○ Brown       | ○ Jackson    | ○ Polk        |
| ○ Buffalo     | ○ Jefferson  | ○ Portage     |
| ○ Burnett     | ○ Juneau     | ○ Price       |
| ○ Calumet     | ○ Kenosha    | ○ Racine      |
| ○ Chippewa    | ○ Kewaunee   | ○ Richland    |
| ○ Clark       | ○ La Crosse  | ○ Rock        |
| ○ Columbia    | ○ Lafayette  | ○ Rusk        |
| ○ Crawford    | ○ Langlade   | ○ Sauk        |
| ○ Dane        | ○ Lincoln    | ○ Sawyer      |
| ○ Dodge       | ○ Manitowoc  | ○ Shawano     |
| ○ Door        | ○ Marathon   | ○ Sheboygan   |
| ○ Douglas     | ○ Marinette  | ○ St Croix    |
| ○ Dunn        | ○ Marquette  | ○ Trempealeau |
| ○ Eau Claire  | ○ Menominee  | ○ Vernon      |
| ○ Florence    | ○ Milwaukee  | ○ Vilas       |
| ○ Fond du Lac | ○ Monroe     | ○ Walworth    |
| ○ Forest      | ○ Oconto     | ○ Washburn    |
| ○ Grant       | ○ Oneida     | ○ Washington  |

- o Waukesha
- o Waupaca
- o Waushara
- o Winnebago
- o Wood

Taylor County did not participate in the local data assessment due to a recent assessment for their NG9-1-1 system by another vendor.

## Quality Control Process Utilized

The following process was utilized by WI DMA and GeoComm for quality control in Wisconsin.

1. GeoComm along with the WLIA NG9-1-1 GIS Task Force established the quality control checks that would be utilized as a part of the project.
2. The WLIA NG9-1-1 GIS Task Force identified three (3) pilot jurisdictions – Crawford, Douglas and Waukesha Counties – to process through quality control and review the results to ensure all checks were applicable.
3. GeoComm individually requested each jurisdiction upload a copy of their GIS data, ALI and MSAG to GeoComm for review.
4. GeoComm reviewed all resources provided and documented them in a crosswalk; if questions arose while reviewing the data, GeoComm reached out to the jurisdiction for further information.
5. GeoComm processed quality control on each jurisdiction.
6. Upon completion and GeoComm review of quality control results, two (2) recommendation reports in Excel and PDF were developed in preparation of a jurisdiction conference call to review the results.
7. GeoComm notified each jurisdiction that their assessment was complete and provided a matrix of available times. After receiving time availability for all participants, GeoComm scheduled the jurisdiction call.
8. WI DMA, when available, and GeoComm completed each jurisdiction call to brief out on the results and reports.
9. Upon completion of conference calls, GeoComm distributed the results and reports to each jurisdiction via email and Sharefile.

## Quality Control Checks Utilized

Quality control checks to be utilized were discussed and chosen by the WLIA NG9-1-1 GIS Task Force.

General Quality Control Checks		
QC Check	Description	Layer to Check
Critical Fields are Missing Value(s)	Check identifies where mandatory fields are missing values. This check can be run on Road Centerlines, SSAPs, Polygons, or ALI	Road Centerline
		Site/Structure Address Points
		Provisioning Boundary
		County Boundary
		EMS Boundary
		Fire Boundary
		Law Boundary
		PSAP Boundary
Complex Geometry	Check identifies complex geometries. Identifies geometries which may not be supported by an application	Incorporated Municipality Boundary
		Road Centerline
		Site/Structure Address Points
		Provisioning Boundary
		County Boundary

	consuming the data. The check also identifies features having too many vertices, or complex polygon geometry types such as true curves, circular arcs, and Bezier curves.	EMS Boundary Fire Boundary Law Boundary PSAP Boundary Incorporated Municipality Boundary
MultiPart Geometry	Check identifies multipart features	Road Centerline Site/Structure Address Points Provisioning Boundary County Boundary EMS Boundary Fire Boundary Law Boundary PSAP Boundary
Critical Values Outside Domain	Check identifies values outside the acceptable list of value (Country, State, County, Parity, Legacy Pre & Post Direction, Legacy Type, CLDXF Pre & Post Direction, CLDXF Pre & Post Type, CLDXF Pre Modifier, PSAP URI)	Road Centerline Site/Structure Address Points Provisioning Boundary County Boundary EMS Boundary Fire Boundary Law Boundary PSAP Boundary Incorporated Municipality Boundary

Ingestion Validation Quality Control Checks		
QC Check	Description	Layer to Check
Field Format Validation	Check identifies where fields are not properly formatted.	All
Project, Tolerance and Resolution Check	Check identifies where datasets provided by the user have inconsistent projections.	All
Field Mapping Validation	Check verifies that the source data is consistent with existing field mapping information provided by the user.	All
UniqueID	If a unique ID field is provided, this check identifies where a source unique ID provided by the client is not actually unique. Applicable for every layer.	All

Boundary Quality Control Checks		
QC Check	Description	Layer to Check
Polygons Have Gaps - Esri Topology Tools	Using Esri topology tools, this check identifies where gaps exist in a polygon boundary layer using Esri Topology Tools. This check can be run on any	EMS Boundary
		Fire Boundary
		Law Boundary
		PSAP Boundary

	municipal or service area boundary.	
Polygons Have Overlaps - Esri Topology Tools	Using Esri topology tools, this check identifies where overlaps exist in a polygon boundary layer. This check can be run on any municipal or service area boundary.	EMS Boundary
		Fire Boundary
		Law Boundary
		PSAP Boundary
Does Not Cover Authoritative Boundary - Esri Topology Tools	Using Esri topology tools, this check identifies where a Fire, Law, Medical, PSAP or County boundary does not cover the Authoritative Boundary using Esri Topology Tools.	EMS Boundary
		Fire Boundary
		Law Boundary
		PSAP Boundary
		County Boundary
Does Not Cover SSAP or RCL	Check identifies where the Authoritative Boundary does not cover RCLs or SSAP.	Road Centerline
		Site/Structure Address Points

Road Centerline Quality Control Checks		
QC Check	Description	Layer to Check
Cross a Boundary Layer	Check identifies where roads cross a boundary layer.	EMS Boundary
		Fire Boundary
		Law Boundary
		PSAP Boundary
		County Boundary
		Incorporated Municipality Boundary
From Value Higher Than To	Check identifies where road ranges have a higher 'from' value than 'to' value.	
Full Address Does Not Match Concatenation of Parsed Out Values	Check identifies where the individual parsed fields of an address do not match a provided full street field. To be ran parsed and combined street fields must be provided.	
Has Incorrect Direction	Check identifies where roads are not drawn in the direction of increasing address.	
Overlapping Address Range Values	Check identifies where roads have overlapping address ranges in a given community or zone.	
Parity Issue	Check identifies where roads have a mixture of even and odd ranges on one side of the street.	
Has Stacked Segments	Check identifies where road centerlines are on top of one another or 'stacked'.	
Not Snapped to Adjacent Segments	Check identifies where roads are not snapped to adjacent segments.	
Has Zero In Range Value	Check identifies where road ranges have a zero From Value and nonzero To Value, or a zero To Value and a nonzero From Value.	
Zone Attribution Against Intersecting Polygon Attribution	Check identifies discrepancies between a centerline's zone attribution and the associated boundary it intersects within a buffer distance around the road centerline. Zone used: Incorporated Municipality	

Site/Structure Address Points Quality Control Checks	
QC Check	Description

Address Found Multiple Times	Check identifies where an SSAP address occurs multiple times in the dataset.
Full Address Does Not Match Concatenation of Parsed Out Values	Check identifies where the individual parsed fields of an address do not match the full address field. To run this check, both parsed fields and a combined full address field must be provided. By default building, floor, unit are utilized but can be configured to not be utilized.
SSAP Attribution Comparison Against Polygon Attribution (Zone Check)	Check identifies where the attribution for a zone value on a site structure address point (SSAP) is not consistent with the attribution the address point falls within.
Synchronization issues between SSAP and Road Centerlines	This check compares SSAPs to Road Centerlines. It identifies addresses that do not have a matching street name or range in the road centerline layer or are spatially located on the wrong side of the road based on road centerline address ranging.
Sub checks include:	
Fail on Full Street Name	No house number No matching street name found
Fail on Zone	Address found only in a different ESN Address found only in a different community and ESN Address found only in a different community
Found Multiple Times	Address matches multiple road segments
Fail on Address Range	Address falls in a gap in the compatible ranges Address could not be found in compatible ranges Address is higher than compatible ranges Address is lower than compatible ranges
Fail on Block	Address falls along the wrong range block
Fail on Parity	Address falls on the wrong side (odd on even; even on odd)

<b>ALI to Road Centerline and Site/Structure Address Point Synchronization Checks</b>	
QC Check	Description
Critical Fields are Missing Value(s)	Check identifies where mandatory fields are missing values. Checks for Address Number, Street Name, ESN & MSAG Community
<b>ALI to Site/Structure Address Points</b>	
Fail on Full Street Name	No matching street name found
Fail on Zone	Address found only in a different ESN Address found only in a different community and ESN Address found only in a different community
Found multiple times	Address matches multiple road segments
Fail on Address Number	Address lies between existing house numbers Address is lower than compatible ranges Address is higher than compatible ranges
Fail on Address Number Suffix	Address found with different house number suffix
Fail on Unit Designation	Address found with a different unit designation
<b>ALI to Road Centerlines</b>	
Fail on Full Street Name	No matching street name found
Fail on Zone	Address found only in a different ESN Address found only in a different community and ESN Address found only in a different community
Found multiple times	Address matches multiple road segments
Fail on Address Range	Address falls in a gap in compatible ranges

	Address is higher than compatible ranges Address is lower than compatible ranges
--	---

<b>ALI to Road Centerline and Site/Structure Address Point Synchronization Checks</b>	
<b>QC Check</b>	<b>Description</b>
Critical Fields are Missing Value(s)	Check identifies where mandatory fields are missing values. Checks for High/Low Range, Street Name, ESN & MSAG Community
MSAG to Road Centerline (High and Low Ranges Processed Separately)	
No matching street name found	The street name in the MSAG was not found in the roads file.
No house number	High or low range not populated in MSAG record
Address is higher than compatible ranges	The street name exists in the road centerline layer, but the low or high range number of the MSAG record cannot be found in the road centerline ranges.
Address is lower than compatible ranges	The street name exists in the road centerline layer, but the low or high range number of the MSAG record cannot be found in the road centerline ranges.
Address falls in a gap in the compatible ranges	The street name exists in the road centerline layer, but the low or high range number of the MSAG record cannot be found in the road centerline ranges.
Address could not be found in compatible ranges	The street name exists in the road centerline layer, but the low or high range number of the MSAG record cannot be found in the road centerline ranges.
Address found only in a different ESN	The street name exists in the roads file, but the MSAG ESN is different than the road centerline.
Address found only in a different community and ESN	The street name exists in the roads file, but the MSAG Community and ESN is different than the road centerline.
Address found only in a different community	The street name exists in the roads file, but the MSAG Community is different than the road centerline.

## Resources Received for Quality Control

Each jurisdiction that participated only submitted the GIS data, ALI and MSAG available in their current 9-1-1 environment. Not every county submitted all the required resources for the assessment. The chart below contains an overview on the number of counties who submitted each GIS data layer, ALI and MSAG.

Resources	Counties Submitting	Counties NOT Submitting
Provisioning Boundary	66	6
PSAP Boundary	68	4
Emergency Service Boundaries – EMS	68	4
Emergency Service Boundaries – Fire	70	2
Emergency Service Boundaries – Law	69	3
Road Centerlines	71	1
Site Structure Address Points	70	2
Incorporated Municipalities*	71	1
County*	66	6
ALI	69	3
MSAG	68	4

\*Layer is strongly recommended and not mandatory.

## Current GIS Accuracy for NG9-1-1

GIS data accuracy is a gauge to determine the amount of effort required for each jurisdiction to be prepared for the implementation of an NG9-1-1 system that utilizes the GIS data for NG9-1-1 call routing and location validation. Each county in Wisconsin was assessed and the individual results for GIS error counts and features were aggregated and totaled to calculate a statewide accuracy for NG9-1-1. The goal to enable NG9-1-1 call routing is for each jurisdiction to be critical error free (0) for all mandatory GIS data layers in order to achieve an overall accuracy of 100%. More information on critical errors can be found in the [Quality Control, GIS Synchronization and Accuracy Benchmarks](#) and [Remediation Recommendations for Jurisdictions](#) sections.

The current statewide GIS accuracy is **85.55%** for all errors identified and **97.75%** for only the critical errors requiring resolution for NG9-1-1 call routing and location validation.

Resources	Current Accuracy	
	All Errors	Critical Errors
Provisioning Boundary	80.16%	80.16%
PSAP Boundary	0.00%	0.00%
Emergency Service Boundaries – EMS	15.88%	15.88%
Emergency Service Boundaries – Fire	38.57%	38.57%
Emergency Service Boundaries – Law	45.53%	45.53%
Road Centerlines	85.20%	88.21%
Site Structure Address Points	86.25%	90.16%
Incorporated Municipalities*	86.24%	86.24%
County Boundary*	63.20%	63.20%

Information about the remediation and estimated accuracy post-remediation can be found below.



## Current ALI & MSAG to GIS Data Accuracy for Transition to NG9-1-1

The primary benchmark utilized by NGCS providers is the ALI to Road Centerline at or above 98%. While the traditional legacy ALI and MSAG will be converted to GIS-based resources within the NG9-1-1 environment, most systems will utilize a version of legacy databases during transition. Below is a chart containing the current accuracy of the ALI and MSAG synchronization in Wisconsin.

Resources	Current Accuracy
ALI to Road Centerline	65.58%
ALI to Site/Structure Address Points	51.58%
MSAG to Road Centerline	52.98%

## Remediation Recommendations for Jurisdictions

Each jurisdiction was provided extensive documentation on the quality control errors and remediation steps to update the existing GIS data to meet the NG9-1-1 GIS data benchmarks. The information below provides both an overarching step in the process and the number of total errors across all jurisdictions. Errors are categorized into **Critical**, those that are not acceptable in the NG9-1-1 environment, and **Non-Critical**, those that should be corrected for sound GIS data but will be acceptable within the NG9-1-1 environment.

### Critical Error Remediation Recommendations

Remediation Recommendation	Number of Errors
Add and populate the mandatory fields	3,205,945
Correction of extra spaces in mandatory fields	<i>Included above</i>
Globally unique IDs	<i>Not analyzed</i>
Duplicate unique IDs (only a handful of counties were analyzed)	432
Correct values outside of domain	947,357
Correct features outside or not fully covered by provisioning boundary	42,556
Correct boundary gaps and overlaps	10,588
Correct range overlaps	150,032
Correct ALI to Road Centerline errors	701,557
Migration of legacy street name elements to CLDXF street name elements	<i>Not analyzed</i>
Road Centerline   Segment Multipart/Complex Geometry	21,440
Site/Structure Address Point   Duplicates	115,387

### Non-Critical Error Remediation Recommendations

Remediation Recommendation	Number of Errors
Boundary   Multipart/Complex Geometry	1,162
Site/Structure Address Points to Road Centerline Synchronization Errors	664,826
Road Centerline   Range FROM higher than TO	9,974
Road Centerline   Range Parity	20,696
Road Centerline   Segment Topology Snapping	19,748
Road Centerline   Stacked Segments	4,462
Road Centerline   Full Street Name does not Match Parsed Values	18,720
Road Centerline   Zone Attribute does not Match Polygon Attribute	127,508
Site/Structure Address Point   Full Address does not Match Parsed Values	127,495
Site/Structure Address Point   Zone Attribute does not Match Polygon Attribute	549,090
ALI to Site/Structure Address Point Synchronization Errors	986,990

### ***Predictive Accuracy Post Remediation***

An overall estimate of accuracy based on correction of all critical errors for the statewide GIS data is approximately 97.75%. The best practice benchmark utilized by most states is 98% for overall GIS accuracy. Individual county predicted accuracy can be found in [Appendix C](#).

### **Maintenance Recommendations**

Maintenance begins when remediation of NG9-1-1 GIS data is critical error free and the ALI to road centerline synchronization is at or above 98%. The process of quality control and synchronization is a vital process within maintenance and must be continued. The following items should be considered in maintenance and after reaching the transition goal.

#### ***Road Centerline Maintenance Recommendations***

- Split Centerlines at all other road intersections and boundaries – Fire, Law, EMS
- Add Elevation for under / overpasses, where applicable
- Align centerlines with bordering cities, counties and state; ensuring segments are “snapped” to the neighboring jurisdictions borders
- Convert 0-0 ranges to NULL-NULL, where possible
- Request centerlines from military installations, where applicable
- Populate Validation Left / Right fields

#### ***Site/Structure Address Points Maintenance Recommendations***

- Correct duplicate address points through subaddressing elements
- Create access point, where applicable
- Align address points to structures
- Create points for subaddress, where not already available

#### ***General Maintenance Recommendations***

- Create basic metadata

## **Next Steps and Recommendations**

### **Continual Coordination between 9-1-1 and GIS Personnel**

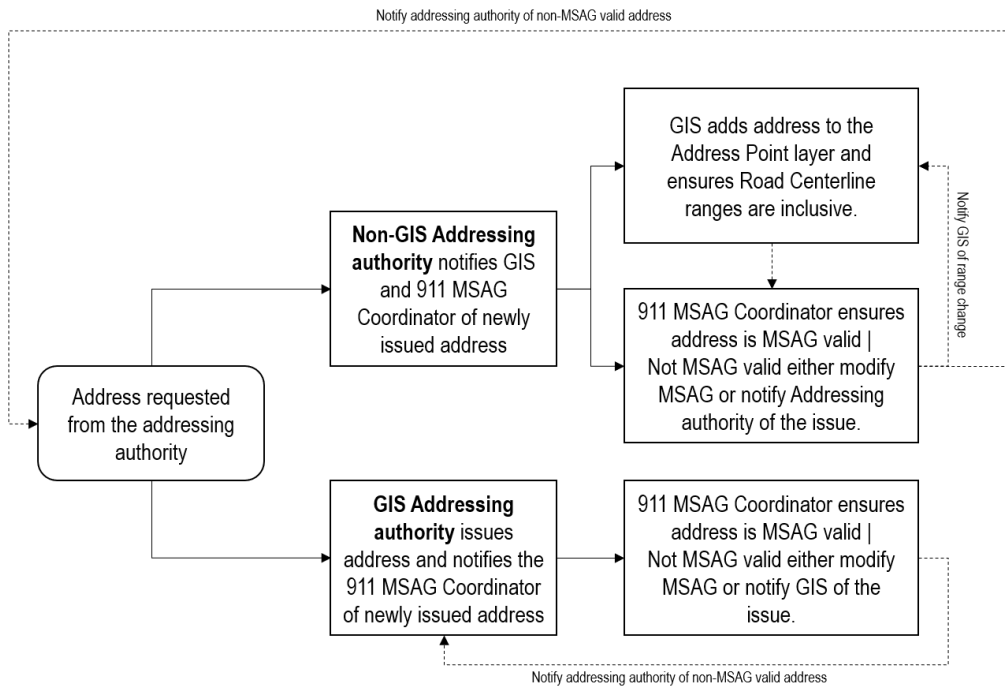
A key success component of NG9-1-1 is the coordination between 9-1-1 and GIS personnel. Neither organization can maintain the data and information required for NG9-1-1 systems alone; there must be collaboration and coordination. In particular, the MSAG Coordinators within 9-1-1 and the GIS personnel must build and maintain a strong communication plan to ensure the MSAG (Master Street Address Guide) and road centerlines are kept in alignment. When the MSAG Coordinator makes changes in the MSAG for new addresses that come through the provider’s service order requests, the MSAG Coordinator must notify GIS so that the changes are also made to the Road Centerline.

As transition occurs, it is likely that the NGCS provider will implement a GIS derived MSAG, an MSAG built from the Road Centerline data of each jurisdiction. As the GIS derived MSAG becomes reality, the ALI, or TN listing, will be validated by the GIS derived MSAG and not through the legacy MSAG currently maintained by the MSAG Coordinator. Once complete transition to NG9-1-1 has taken place, the locations will be validated, and the calls will be routed using GIS data and the ALI will transition to a Location Database.

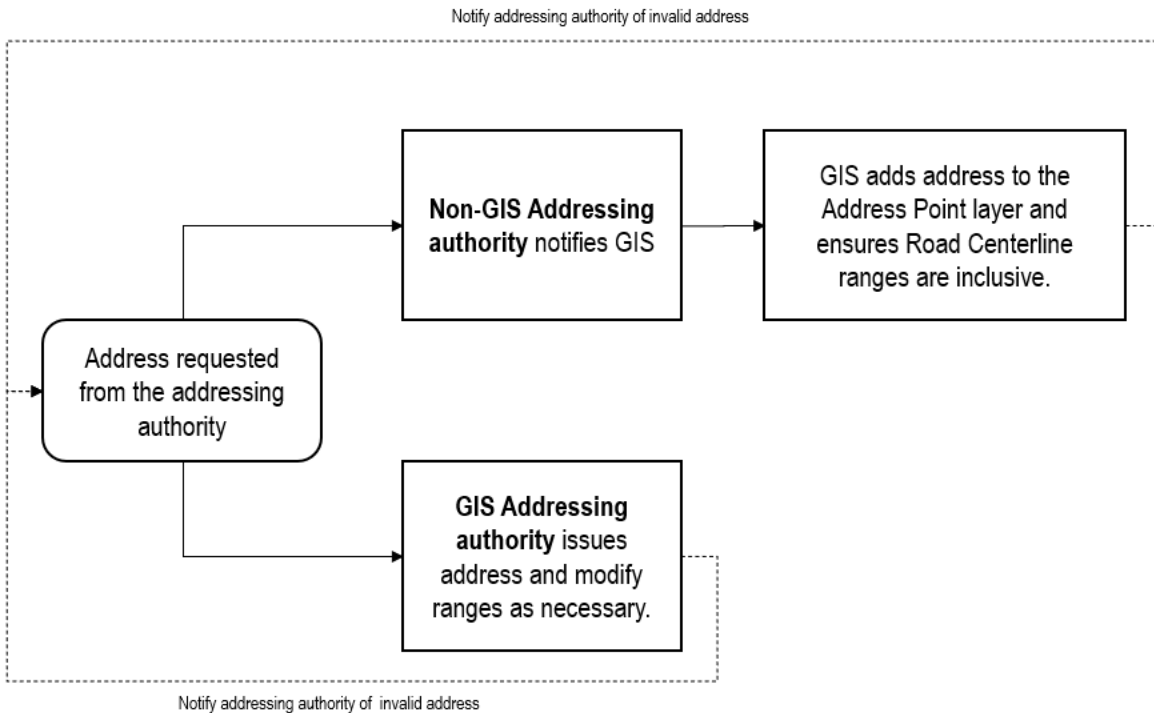
The flowcharts below depict an example of the communication between 9-1-1 and GIS for pre and post transition to NG9-1-1 for maintenance of the E9-1-1 MSAG, the transitional GIS derived MSAG, and NG9-1-1 GIS data.

Along with the MSAG and address validation, it is important for 9-1-1 and GIS to work together in the maintenance of response boundaries including but not limited to the PSAP, EMS, Fire and Law boundaries. If either entity is notified of a change in the boundary, they must notify the other to ensure all data resources are kept in sync.

**Coordination before and during transition to NG9-1-1**



### Coordination after transition to NG9-1-1



**RECOMMENDATION:** Continue to provide education and outreach to the 9-1-1 Authorities, Addressing Authorities, and the GIS Data Providers throughout Wisconsin to ensure coordination continues between all entities to improve the NG9-1-1 GIS data sets.

### NG9-1-1 GIS Legislation, Governance and Procedures

DMA should consider presenting legislation specific to NG9-1-1 GIS to ensure the mission critical nature of GIS is acknowledged and can be enforced. Few states have initiated legislation for GIS in NG9-1-1, with Kansas being an example in [House Bill No. 2084](#). This example includes adding authorization to the Kansas 911 coordinating council to establish data standards, maintenance policies and data reporting requirements for GIS data. The bill also includes penalties should the GIS data not be maintained accurately.

Along with legislation, Kansas has a [NG911 GIS Governance Policy](#) that further defines governance, organization, strategic planning, standards and guidelines, communication, training and compliance. The Kansas examples are now being used as reference for a number of other states.

Maintenance of the NG9-1-1 GIS data is vital and coordination between all partners is one of the most important components of highly accurate GIS data. It is recommended that each 9-1-1 Authority, their GIS Data Provider and all Addressing and Street Naming Authorities within the PSAP area establish standard operating procedures. The standard operation procedures should include workflows for each component from Street Naming to addressing to NG9-1-1 GIS data updates and submission to the NGCS. If not already established, ordinances and resolutions at a local level may be required for enforcement.

**RECOMMENDATION:**

- Present GIS as a part of NG9-1-1 Legislation to include establishment of data standards, maintenance, and data reporting requirements.

- Consider creating a NG9-1-1 GIS Governance Policy.
- Continue working with local 9-1-1 Authorities, GIS Data Providers, Addressing Authorities and Street Naming Authorities on the importance of NG9-1-1 GIS standard operating procedures for each jurisdiction along with ordinance and resolutions where required.

## Procure NG9-1-1 GIS Data Management Services

The process of preparing GIS data to support NG9-1-1 is complex and time demanding. Procuring NG9-1-1 GIS data management services is a valuable asset for states where agencies leading the NG9-1-1 effort do not have dedicated GIS personnel to support the transition to, implementation and continual support of NG9-1-1. The State of Wisconsin should strongly consider acquiring NG9-1-1 GIS data management services to assist in providing ongoing project management support, tools for quality control and extract, transform and load (ETL) processes, development of NG9-1-1 related GIS data layers, auto population of attributes, updates to Wisconsin specific NG9-1-1 GIS documentation and other related NG9-1-1 GIS tasks. The State should also consider the impact an additional contract will have on existing staff and determine if additional personnel is needed or if a partnership with an existing state agency, such as the State Cartographers Office, would be beneficial to assist in the management of the NG9-1-1 GIS Data Management Services.

### RECOMMENDATION:

- Acquire NG9-1-1 GIS data management services to support DMA with the transition to, implementation and continued support of the Wisconsin NG9-1-1 system.
- Assess the impact an additional contract at DMA will have on existing staff and determine if additional staff or a partnership with another agency with GIS staff would be required to assist in the management of the NG9-1-1 GIS Data Management Services.

## Development of Stitch Points for Road Centerlines Meeting at Boundaries

One of the most important aspects of NG9-1-1 is a seamless, nationwide road centerline dataset. Each state must lead the effort to ensure that the road centerline is seamless statewide. This process can only be accomplished with guidance and support from the State of Wisconsin.

GIS data is maintained by numerous entities (counties, cities, regions) in disparate systems. The exact geographic location where road centerline segment endpoints meet at borders between the GIS data managing entities is impossible to match without a reference layer to indicate the exact location to both entities. Stitch points or border points can be created to assist in the effort of creating a topologically accurate, seamless, statewide dataset.

The boundaries to align to are:

- State Boundary
- County Boundary
- PSAP Boundary
- Incorporated Municipality Boundary

If a street name and ranging is carried across PSAP boundaries, a discussion between the PSAPs is needed to ensure the address ranges have no gaps or overlaps at the PSAP boundary and the ranges each PSAP is responsible for are located on the road segments within their PSAP boundary. Street names should be assigned by the appropriate local authority starting with the incorporated municipality then by the county, state and federal government, as appropriate. The local Street Naming Authorities should work closely with the Addressing Authorities, GIS Data Providers, and 9-1-1 Authorities to ensure duplicate street names are not being utilized in multiple locations in the same jurisdiction.

Road Centerlines topology should be checked against boundary datasets to ensure that Road Centerlines are snapped to the boundaries. Some Road Centerlines follow incorporated municipal

boundaries (e.g., County Line Road). Segmentation of these roads must match node for node with the corresponding boundary alignment. While County and PSAP boundaries within the State of Wisconsin should already be topologically correct for NG9-1-1, border states are likely to have a conflict with boundary delineation. Wisconsin borders the following states:

- Illinois
- Iowa
- Minnesota
- Michigan

When aligning road centerline data with these other states, care should be used to ensure that there are no overlaps or gaps in data. Working directly with the bordering jurisdictions will greatly reduce issues with the data.

#### RECOMMENDATIONS:

- Develop guidance and workflows to reduce duplicate street names in each authoritative street naming/addressing area to eliminate adverse effects on 9-1-1.
- Coordinate with the surrounding state's 9-1-1 and GIS offices to share state provisioning boundaries so counties along the borders can align well before NG9-1-1 is implemented.
- Develop and share guidance with counties and incorporated municipalities on how to align boundaries and create stitch point for Road Centerline segments. Most NGCS providers allow a seven (7) to eight (8) square feet tolerance for boundary gaps and overlaps.

### Implement the use of Wisconsin Specific Fields

In the development of the WI NG9-1-1 Data Model a few non-NENA NG9-1-1 GIS Data Model fields were added to support Wisconsin's needs. Additional information and guidance must be provided to the local jurisdictions by DMA and the WLIA NG9-1-1 GIS Task Force to ensure accurate attribute population.

These include:

- Full Street Name (Road Centerlines and Site/Structure Address Points)
  - The Street Name with all Pre/Post Modifiers, Pre/Post Directionals, Pre Type Separator, and Pre/Post Types concatenated
- Abbreviated Full Street Name (Road Centerlines and Site/Structure Address Points)
  - The Full Street Name with abbreviations (where appropriate) used for the Pre/Post Modifiers, Pre/Post Types, and Pre/Post Directionals.
- Road Centerline NENA Globally Unique ID (Site/Structure Address Points)
  - The NENA Globally Unique ID (NGUID) for the Road Centerline segment that the Address Point record is associated with.

In conjunction with these Wisconsin specific fields, a modified version of the NENA NG9-1-1 GIS Data Model template will need to be created to support local GIS. The modified version must include the Wisconsin specific fields listed above and the domains as listed in the [Creation and Maintenance of Wisconsin Specific Domains to Support Local GIS](#) Section.

Based on discussions with the NGCS Provider, a revision to the current WI NG9-1-1 Data Model is needed to add the following fields. These fields will be used to hold data for the combined address/range prefixes and address number/range, which will allow one-to-one synchronization to the ALI and MSAG and be available for a future GIS derived MSAG and MSAG Conversion Service (MCS).

- Combined Address Number | Address Number Prefix + Address Number
- Combined Left From Address | Left Address Number Prefix + Left FROM Address
- Combined Left To Address | Left Address Number Prefix + Left TO Address
- Combined Right From Address | Right Address Number Prefix + Right FROM Address
- Combined Right To Address | Right Address Number Prefix + Right TO Address

#### RECOMMENDATIONS:



- Add the fields listed to the WI NG9-1-1 GIS Data Model for interoperability with the legacy databases.
- Determine a method to include the population of these fields with the Extract, Transform and Load (ETL) process established by Wisconsin.

## Creation and Maintenance of Wisconsin Specific Domains to Support Local GIS

The WLIA NG9-1-1 GIS Task Force identified fields that contain domains. These domains are lists of acceptable values. It is recommended that the Wisconsin DMA and other state agencies, responsible for collecting local GIS data, work together to identify the organization(s) who will be responsible for the maintenance of the identified domains.

The following domains are part of the WLIA schemas utilized to create the WI NG9-1-1 GIS Data Model:

- Direction Domain (DirectionDomain) | Street Name Pre Directional and Street Name Post Directional (*Layers: Road Centerlines and Site/Structure Address Points*)
- Abbreviation Direction Domain (abvDirectionDomain) | Legacy Street Name Pre Directional and Legacy Street Name Post Directional (*Layers: Road Centerlines and Site/Structure Address Points*)
- FIPS State Domain (FIPSStateDomain) | State Left, State Right and State (*Layers: Road Centerlines, Site/Structure Address Points, PSAP Boundary and Emergency Service Boundary*)
- FIPS Municipality Domain (FIPSMunicipalityDomain) | Incorporated Municipality Right, Incorporated Municipality Left, Incorporated Municipality (*Layers: Road Centerlines and Site/Structure Address Points*)
- One Way (OneWayDomain) | One-Way (*Layer: Road Centerlines*)
- Speed Limit (SpeedLimitDomain) | Speed Limit (*Layer: Road Centerlines*)
- Yes No (YesNoDomain) | Validation Left, Validation Right and Structure (*Layers: Road Centerlines and Site/Structure Address Points*)

The following domains are maintained by NENA:

- Street Name Pre Types and Street Name Post Types Registry | Street Name Pre Type and Street Name Post Type (*Layers: Road Centerlines and Site/Structure Address Points*)
- Street name Pre Type Separators Registry | Street Name Pre Type Separator (*Layers: Road Centerlines and Site/Structure Address Points*)
- Parity | Parity Left and Parity Right (*Layer: Road Centerlines*)
- Site/Structure Address Point Placement Method Registry | Placement Method (*Layer: Site/Structure Address Point*)
- NENA urn:nena:service:sos Registry | Service URN (*Layer: PSAP Boundary and Emergency Service Boundary*)

The following domains are maintained by the US Postal Service (USPS):

- Legacy Street Name Type (USPS Publication 28, Appendix C1) | Legacy Street Name Type (*Layers: Road Centerlines and Site/Structure Address Points*)
- Postal Code (USPS City State File Production) | Postal Code Left, Postal Code Right and Postal Code (*Layers: Road Centerlines and Site/Structure Address Points*)
- ZIP Plus 4 (USPS City State File Production) | ZIP Plus 4 (*Layer: Site/Structure Address Points*)
- Postal Community Name (USPS City State File Production) | Postal Community Name Left, Postal Community Name Right and Postal Community Name (*Layers: Road Centerlines and Site/Structure Address Points*)

The following domains were identified as a part WI NG9-1-1 GIS Data Model and a maintenance entity must be identified:



- County Domain (NG911CountyDomain) | County Left, County Right, County (*Layers: Road Centerlines and Site/Structure Address Points*)

#### **RECOMMENDATIONS:**

- Determine what organization will be responsible for maintaining the County Domain.
- Ensure surrounding states' border county names are added to the County Domain and that the domain includes the word "County" with the county name.
- Ensure surrounding state's bordering incorporated municipalities are added to the Incorporated Municipalities (FIPSMunicipalityDomain) domain.
- Create a Road Class domain to be used in Wisconsin and determine the organization who will be responsible for maintaining.
- Determine a state-level review process of proposed changes to the domain values in the NENA Registries; a single entity on behalf of the State of Wisconsin and the counties will submit any additions.
- Investigate creating Wisconsin specific domains for Postal Codes and Postal Community Names in partnership with the USPS. These domains should be maintained at a state level to reduce duplication of cost and maintenance effort.

#### **Provide Assistance in Populating the MSAG Community Attributes**

The most significant gap within the legacy data attributes of the local GIS datasets is the absence of the MSAG Community values in the Road Centerline and Site/Structure Address Points. The absence of these fields and values is directly related to the heavy usage of CAD systems which do not utilize the native ALI spill (ESN) to identify the responders to dispatch. These fields and values are necessary for interoperability between the existing legacy system and the NG9-1-1 system. In the planned Wisconsin implementation, the legacy system will continue to be utilized to route 9-1-1 calls with spatial routing failures and are required for the implementation of GIS derived MSAGs.

Counties with no MSAG Community in both the Road Centerline and Site/Structure Address Points:

- Adams County
- Brown County
- Calumet County
- Columbia County
- Crawford County
- Dane County
- Dodge County
- Door County
- Douglas County
- Eau Claire County
- Fond du Lac County
- Forest County
- Green County
- Green Lake County
- Iron County
- Jefferson County
- Kewaunee County
- La Crosse County
- Lafayette County
- Langlade County
- Lincoln County
- Manitowoc County
- Marinette County
- Marquette County
- Menominee County
- Milwaukee County
- Monroe County
- Oconto County
- Oneida County
- Outagamie County
- Pierce County
- Portage County
- Price County
- Rock County
- Rusk County
- Shawano County
- Trempealeau County
- Vernon County
- Washington County
- Waukesha County
- Waushara County
- Wood County

Counties with one (1) MSAG Community field in the Road Centerline (two are required) and present in the Site/Structure Address Points:

- Barron County
- Iowa County

Counties with MSAG Community in the Road Centerline but not present in the Site/Structure Address Points:

- Ozaukee County
- Waupaca County

Counties with MSAG Community in the Site/Structure Address Points but not present in the Road Centerline:

- Bayfield County
- Marathon County
- Pepin County
- Sheboygan County
- St. Croix County
- Winnebago County

**RECOMMENDATION:** Provide assistance to populate the MSAG Community values and encourage the counties listed above to participate in the project.

## Information and Assistance Needed from the Selected NG9-1-1 Core Service Provider

### *Standardization of Non-Standard USPS Post Types & Street Names in the Legacy Databases*

During the GIS Assessment GeoComm identified several counties where the MSAG and ALI contain non-US Postal Service standard abbreviations such as AV, instead of AVE, and LA, instead of LN. It was also identified that a few counties, such as Dodge, have abbreviated road names such as UNIV, instead of UNIVERSITY. These counties have previously requested updates through their existing provider, Intrado, but have not been allowed to update these road names. It is recommended that the NGCS along with DMA and the impacted counties work with legacy ALI provider to update these abbreviations and road names.

**RECOMMENDATION:** Coordinate with the NGCS, Counties and Intrado to update all non-standard USPS abbreviations and road names.

### *Determine methodology for Dual Road Names*

During the development of the WI NG9-1-1 GIS Standard it was identified that many counties have dual roads names in their street name field, e.g., 75TH AVE COUNTY RD M. At the time of the development of the standard and best practices document the Statewide NGCS Provider had not yet be selected. While it was assumed that both street names would remain in the street name field, this needs to be coordinated and confirmed with the NGCS Provider.

**RECOMMENDATION:** Coordinate with the NGCS Implementation Project to determine the method that needs to be utilized for existing dual street names in the street name field and communicate the method to the local GIS Data Providers.

### *Distribute URNs/URIs*

Due to the dependence on the NGCS Provider for the Service URN and Service URI the local GIS Data Providers were instructed to wait for these values before populating these fields. It is recommended that as soon as these values are available from the NGCS Provider, DMA should distribute them to the GIS Data Providers and 9-1-1 Authority for population.

**RECOMMENDATION:** Distribute the Service URN and Service URI values to the GIS Data Providers and 9-1-1 Authority as soon as they are available.

### *Implementation of a GIS Derived MSAG*

A GIS derived MSAG is a tabular database of GIS data, typically the Road Centerline dataset. This tabular data is utilized to initially replace and then continually update the MSAG stored by the legacy data provider. A GIS derived MSAG reduces duplication of work by transitioning the MSAG maintenance of adding and updating street names and ranges to the GIS Data Provider while keeping the ALI correction requests to the existing MSAG Coordinator. This process will ultimately reduce the number of ALI correction requests submitted by the telephone providers through the use of a comprehensive and accurate GIS derived MSAG. To implement a GIS derived MSAG, the NGCS Provider may need to implement additional steps and software.

**RECOMMENDATION:** Transition each PSAP from a legacy MSAG to a GIS derived MSAG in partnership with the PSAP, GIS Data Providers, NGCS Provider and GIS Management partner, if chosen.

### *Determine Quality Control Exceptions*

Throughout the project many local jurisdictions requested the use of exception codes to mark GIS features as exceptions. Exception codes are utilized, at the feature level, to allow real world situations, identified as errors through the quality control process to be omitted or removed from a specific check. Features may have multiple exceptions. The use of exceptions should only be used to accommodate real-world situations that are identified as errors in the quality control process. Caution should be used when setting exceptions for features within a GIS dataset and should only be used when there is a viable exception that will cause an error to be identified. The 9-1-1 Subcommittee, in conjunction with the WLIA NG9-1-1 GIS Task Force should provide additional guidance on the use of these. Exception codes are also dependent on the NGCS Provider and should not be determined until a provider is selected.

**RECOMMENDATION:** Once the NGCS Provider has been selected, a list of exception codes should be distributed to the GIS Data Providers and 9-1-1 Authorities for use within the GIS data sets.

### *Continue Work with the FGDC on Grid Address Parsing*

The use of the nearly statewide grid addressing system in Wisconsin poses some unique scenarios and special circumstances for NG9-1-1. During the development of the standards and best practices document, it was discovered that the Federal Geographic Data Committee (FGDC) had used Wisconsin addresses as their examples, however the examples do not reflect the actual usage of address number prefix in Wisconsin. These examples from the FGDC were utilized in the development of the NENA NG9-1-1 GIS Data Model which also reflects these non-utilized Wisconsin examples. It was recommended that the WLIA NG9-1-1 GIS Task Force contact the FGDC to begin discussions on changing the Wisconsin examples to align with how it is used and attributed in the state. Initial contact and discussion with FGDC occurred in late 2020 and early 2021.

**RECOMMENDATION:** Continue working with FGDC to resolve the Wisconsin examples used for addressing prefixes and work with NENA to ensure that all NENA examples are updated to reflect what is officially utilized in Wisconsin.

## Provide Guidance on Creation of Metadata for NG9-1-1 GIS Data

Metadata is information about data and every 9-1-1 data layer maintained by a local jurisdiction needs to have metadata. The minimum requirements and elements will need to be determined by the State of Wisconsin in conjunction with the NGCS Provider, GIS Management partner, and the WLIA NG9-1-1 GIS Task Force. The Federal Geographic Data Committee has defined mandatory fields and will serve as a starting point.

**RECOMMENDATION:** Work with the NGCS Provider, GIS Management partner (if applicable), and WLIA NG9-1-1 GIS Task Force to determine mandatory metadata elements for NG9-1-1.

## Implement an Effective and Efficient State Extract – Transform – Load Process

### *Next Generation Unique ID Creation*

NENA Globally Unique IDs are a combination of three (3) items – a layer identifier, a locally assigned ID and the Agency Identifier. At the time of this report there is discussion in the NENA NG9-1-1 GIS Data Model version 2 workgroup on a proposed change to the elements used to create the globally unique ID. The two elements with proposed changes are the layer identifier and the Agency Identifier. The basic concept behind the change is to transition these unique ID to an i3 format. E.g., urn:emergency:uid:gis:RCL:123:co.monroe.wi.us

Due to this potential change in the GIS Data Model later this year or early next year and NGCS Provider planned to start soon, it is recommended that the State of Wisconsin hold this topic until further information is provided through the GIS Data Model update. If this is not acceptable by the stakeholders, the State could implement a temporary solution by establishing suggested layer prefixes (e.g., RCL, SSAP, PSAP, etc.) and direct the GIS Data Providers to utilize a current local DNS for the Agency Identifier (e.g., co.monroe.wi.us).

**RECOMMENDATION:** Provide direction to the local GIS Data Providers to add and maintain only the locally assigned ID until the format of the NENA globally unique IDs are decided by NENA.

### *Auto Population of Field Values*

There are numerous fields within the NG9-1-1 GIS Data Model that could be auto populated if the tools implemented by the State of Wisconsin allow. The following fields have the possibility of auto populating:

- Country
- State: some cases like Road Centerlines along the state boundary cannot be auto populated and must be populated at the local level.
- County: some cases like Road Centerlines cannot be auto populated due to bordering roads and if a local GIS Data Provider submits for more than one county the values must be populated at the local level.
- Discrepancy Agency ID
- Agency ID
- Service URI
- Service URN

**RECOMMENDATION:** During the selection of the GIS data management provider, identify if the provider can auto populate any or all of the fields listed above.

### *Identification of Existing Scripts and Tools for Schema Transformation*

Throughout the project several jurisdictions identified the need for the development of ETL (extract, transform, load) scripts and tools to assist the individual jurisdictions with migrating their individual, local

schema to the WI NG9-1-1 GIS Data Model and the variety of CAD systems utilized at the local level. It is recommended that DMA work with the WLIA NG9-1-1 GIS Task Force to identify available scripts and tools or build these for use by local GIS Data Providers. Some GIS data management providers can provide these ETL processes during the QC and merging process.

**RECOMMENDATION:** Investigate the possibility of purchasing or creating scripts and tools for local GIS Data Providers to support the 9-1-1 centers in providing GIS data for NG9-1-1 and CAD. If selected, a GIS data management provider can provide assistance.

### Continued Coordination with State and Local Partners

DMA and the WLIA NG9-1-1 GIS Task Force should begin coordination with the following agencies:

- State Cartographer's Office: This office may be the most suitable for maintaining the domains and registries needed for NG9-1-1.
- US Postal Service: Many local jurisdictions have existing partnerships with their local US Postal Service offices however the state's NG9-1-1 initiative may benefit from a partnership between the state and the regional office in their area. The US Postal Services has many databases and tools that can be used to support NG9-1-1.
- State Patrol and Department of Transportation: Coordination with the State Patrol and Department of Transportation would benefit the state NG9-1-1 initiative by identifying state name buildings and structures along highways without 9-1-1 addresses and provide further guidance on naming on and off ramps and crossover medians.
- Addressing Authorities: DMA and the WLIA NG9-1-1 GIS Task Force should provide training and guidance on the importance of addressing and NG9-1-1 along with example ordinances that can be implemented to streamline addressing and the flow of information to 9-1-1. DMA has initiated a project to provide jurisdictions with Addressing Workflow Workshops to assist where needed.
- Street Naming Authorities: DMA and the WLIA NG9-1-1 GIS Task Force should provide training and guidance on the importance of street naming and NG9-1-1 along with example ordinances that can be implemented to streamline street naming and the flow of information to 9-1-1.

**RECOMMENDATION:** Identify points of contacts for each agency and begin discussions with them on how their assistance and guidance can provide value to NG9-1-1.

### Develop Additional Guidance for Address Point Placement

During the development of the standards and best practices document there was no clear guidance from NENA, other federal organizations, or the State of Wisconsin on how to place address points for multi-story sites and subaddresses. Additional guidance may be provided in the near future with the development of the 3D data workgroup currently underway at NENA. The State of Wisconsin should keep apprised of the situation and closely monitor NENA for additional guidance. It is also recommended that the State of Wisconsin survey the 9-1-1 centers and request input on how or if their CAD system can handle stacked points or if they should be staggered.

#### RECOMMENDATIONS:

- Keep apprised of the work being undertaken at NENA for additional guidance on Site/Structure Address Point placement relating to stacked or staggered recommendations.
- Conduct a survey of the 9-1-1 centers to determine if locally used CAD systems can handle stacked points.

### Develop Additional Guidance for a Road Name Alias Table

During the development of the standards and best practices document, discussion was held on the viability of implementing an Alias Street Name Table. At the time of publication there was no NGCS Provider that could implement and utilize an Alias Street Name Table and there was no further guidance

available from NENA. Most CAD systems utilized by local 9-1-1 centers can and do use Alias Street Name Tables. It is recommended that DMA survey local 9-1-1 centers on the utilization of Alias Street Name Tables and gather the schema utilized in each CAD used across the state. Once the information is acquired, DMA along with the WLIA NG9-1-1 GIS Task Force should review the information and add the table and its requirements to the WI NG9-1-1 GIS Data Standard.

**RECOMMENDATION:** Gather information from the local 9-1-1 centers on the use and schema of the Alias Street Name Table. Using the information gathered review and add the appropriate details to the WI NG9-1-1 GIS Data Standard.

### Investigate Funding Resources for NG9-1-1 GIS Data

The largest identified gap for creating, updating, and maintaining NG9-1-1 GIS data is the lack of sufficient funding. DMA has requested grant funding appropriations from the state legislature but at the time of publication it was unknown if these grant funds will be approved. DMA should continue to investigate funding opportunities at the state and federal level to assist the local GIS Data Providers and 9-1-1 Authorities in the creation, updating, and maintenance of GIS data for NG9-1-1. It was also noted that having additional funding available for orthoimagery would greatly benefit the local GIS Data Providers with updating and maintaining the NG9-1-1 GIS data.

**RECOMMENDATION:** Continue to investigate funding opportunities to support the creation, updating, and maintenance of GIS data for NG9-1-1.

### Other Recommendations

- Develop a strategy for populating optional data fields within the WI NG9-1-1 GIS Data Model.
- Provide guidance for mile marker / mileposts for navigable water ways and river miles.
- Update the WI NG9-1-1 GIS Data Model to change the Full Street Name field in the Site/Structure Address Points from mandatory to optional as Street Name is conditional and not required for Site/Structure Address Points.
- Discuss Wisconsin specific additions to the WI NG9-1-1 GIS Data Model and monitor the NENA NG9-1-1 GIS Data Model for updates.
- Keep apprised of the ever-changing NENA documents and standards specifically the i3 standard, NG9-1-1 GIS Data Model standard, the Civic Location Data Exchange Format (CLDXF) standard, the GIS Data Stewardship working group, the GIS Data Transition working group and the 3D working group.



## Appendix A | USPS Publication 28 Street Suffixes and Directionals

GIS data attributes should follow these NENA USPS street suffixes publication standards.

### Street Suffixes

GIS data attributes should follow these USPS street suffixes publication standards.

ALY	CLB	CVS	FRG	HLS	LGT	NCK	PSGE	SHR	TRL	WAYS
ANX	CLF	CYN	FRGS	HOLW	LGTS	OPAS	PT	SHRS	TRLR	WL
ARC	CLFS	DL	FRK	HTS	LK	ORCH	PTS	SKWY	TRWY	WLS
AVE	CMN	DM	FRKS	HVN	LKS	OVAL	RADL	SMT	TUNL	XING
BCH	CMNS	DR	FRST	HWY	LN	PARK	RAMP	SPG	UN	XRD
BG	COR	DRS	FRY	INLT	LNDG	PARK	RD	SPGS	UNS	XRDS
BGS	CORS	DV	FT	IS	LOOP	PASS	RDG	SPUR	UPAS	
BLF	CP	EST	FWY	ISLE	MALL	PATH	RDGS	SPUR	VIA	
BLFS	CPE	ESTS	GDN	ISS	MDW	PIKE	RDS	SQ	VIS	
BLVD	CRES	EXPY	GDNS	JCT	MDWS	PKWY	RIV	SQS	VL	
BND	CRK	EXT	GLN	JCTS	MEWS	PKWY	RNCH	ST	VLG	
BR	CRSE	EXTS	GLNS	KNL	ML	PL	ROW	STA	VLGS	
BRG	CRST	FALL	GRN	KNLS	MLS	PLN	RPD	STRA	VLY	
BRK	CSWY	FLD	GRNS	KY	MNR	PLNS	RPDS	STRM	VLYS	
BRKS	CT	FLDS	GRV	KYS	MNRS	PLZ	RST	STS	VW	
BTM	CTR	FLS	GRVS	LAND	MSN	PNE	RTE	TER	VWS	
BYP	CTRS	FLT	GTWY	LCK	MT	PNES	RUE	TPKE	WALK	
BYU	CTS	FLTS	HBR	LCKS	MTN	PR	RUN	TRAK	WALK	
CIR	CURV	FRD	HBRS	LDG	MTNS	PRT	SHL	TRCE	WALL	
CIRS	CV	FRDS	HL	LF	MTWY	PRTS	SHLS	TRFY	WAY	

### Street Directionals

N	NE
E	SE
S	NW
W	SW



## Appendix B | NENA Resources for CLDXF Standard Field Attributes

### Pre and Post Directional Values

North	Northeast
South	Northwest
East	Southeast
West	Southwest

### Street Name Pre and Post Types

NENA Registry System | Street Name Pre Types and Street name Post Types

<http://technet.nena.org/nrs/registry/StreetNamePreTypesAndStreetNamePostTypes.xml>

### Street Name Pre Type Separators

NENA Registry System | Street Name Pre Type Separators

<http://technet.nena.org/nrs/registry/StreetNamePreTypeSeparators.xml>

## Appendix C | Final NG9-1-1 GIS Cost Estimates

### Overview

This document contains final cost estimates for NG9-1-1 GIS Data preparation and GIS components within a NG9-1-1 i3 environment. The information has been developed using information gathered during the WI NG9-1-1 GIS data assessment project and information from the proposed core service provider. The cost estimate is broken into categories starting with the required tasks and ending with supplemental tasks that may or may not be implemented in Wisconsin.

### NG9-1-1 GIS Data Preparation

Accurate, complete GIS data to support NG9-1-1 is vitally important. Preparing and updating the existing 9-1-1 GIS data may be overwhelming for local GIS Data Providers for various reasons from limited knowledge to limited personnel to the complexity of the requirements.

There are two (2) paths for NG9-1-1 GIS data preparation:

- Minimum | Creating and/or updating of only the minimum required GIS data layers for call routing
  - Provisioning boundary
  - PSAP boundary
  - Road centerlines
- Complete | Creating and/or updating all required NENA NG9-1-1 GIS layers:
  - Provisioning boundary
  - PSAP boundary
  - Emergency service boundaries (EMS, Fire, Law Enforcement)
  - Road centerlines
  - Site/structure address points

The estimates below are for the creations and/or updating of NG9-1-1 GIS data for all PSAPs in Wisconsin completed by a vendor. Local GIS Data Providers may choose to prepare the data in-house. The cost of in-house preparation will include software, hardware and personnel and are not included in this estimate. The estimate does not include ongoing maintenance required once the data has met the NG9-1-1 GIS benchmarks.

#### Estimates:

Minimum requirements estimate: \$1,425,000.00

All requirements estimate: \$2,610,000.00

### Creation of a Wisconsin NG9-1-1 GIS Geodatabase Template

Development of a geodatabase template based on the Wisconsin NG9-1-1 data standards/schema, similar to the NENA GIS geodatabase, will benefit local GIS Data Providers who will maintain the NG9-1-1 geodatabase locally. The template will also benefit the creation and ongoing maintenance of a statewide NG9-1-1 geodatabase. The template must include all fields and domains as documented in the Wisconsin NG9-1-1 GIS data model.

**Estimate:** \$2,800.00

## GIS Validation Tools

Implementation of a set of validation tools that can provide high level, frequent quality control for each PSAP's NG9-1-1 GIS data is a requirement.

The validation tools should include:

- An easy-to-use user interface
- All quality control checks required for NG9-1-1 and the State
- Transformation of all local schemas into the WI NG9-1-1 GIS data model
- Auto population of mandatory NG9-1-1 GIS fields: single or calculated on other existing field attributes
- Easy-to-use reporting in various formats: spreadsheet and GIS, at a minimum
- Merging of local GIS data into a seamless statewide dataset
- Quality control checks of the statewide dataset: boundary gaps, overlaps, range overlaps, globally unique IDs
- Provisioning to the NG9-1-1 core components (Spatial Interface)\*

\*The Spatial Interface can be separate from the GIS Validation Tools and a cost estimate for the component along can be found below and the GIS Cost Table.

### Estimates:

One-time cost (set-up): \$82,317.99

Ongoing yearly cost (monthly data submissions): \$202,541.23

### Notes:

After implementation of NG9-1-1 the requirement for submission is based on changes. Any changes that affecting call routing must be submitted and provisioned to the NG9-1-1 system within 72 hours. It is recommended that all entities have the ability to submit daily.

Ongoing yearly cost (monthly data submissions): \$260,000.00

Prior to implementation, all individual PSAP NG9-1-1 GIS data must be merged into a statewide geodatabase in order to be provisioned as single statewide, seamless GIS data layers. Additional statewide quality control checks as listed above are required.

Estimated one time cost (set-up): \$162,500.00

Estimated yearly cost: \$410,000.00

## NG9-1-1 GIS Data Implementation Strategy and Planning

An NG9-1-1 GIS data implementation strategy and plan will provide the State with guidance needed to successfully complete preparedness and implement GIS for NG9-1-1.

The strategy and plan should include:

- Determination of benchmarks required for transition
- Defining responsibilities of all stakeholders: local, state and NG9-1-1 vendors
- Development of an NG9-1-1 GIS transition project plan including all major milestones

### Estimate:

One-time cost: \$11,765.40

## GIS Derived MSAG

A GIS derived MSAG, while not a requirement for NG9-1-1, can be a vital component of the transition to reduce duplication of effort – maintenance of two (2) databases, legacy MSAG maintained by the PSAP and GIS data maintained by the GIS Data Provider – and increase the accuracy of legacy ALL validation. The implementation of a GIS derived MSAG is highly recommended. The length of time that a GIS derived MSAG will be needed is dependent on the telephone companies utilization of an MSAG; at the current time there is no defined end date.

**Estimates:**

One-time cost (set-up): \$42,500.00

Ongoing yearly cost: \$72,500.00

## Spatial Interface

Depending on the path and the tools chosen by the State a Spatial Interface (SI) may need to be acquired separately. Some NG9-1-1 GIS Validation Tool providers can provide the SI component along with the quality control and merging tools or it can be provided with the Emergency Call Routing Function (ECRF). *The estimates below may or may not be required depending on other component capabilities implemented in the State.*

**Estimates:**

One-time cost (set-up): \$151,000.00

Ongoing yearly cost: \$377,500.00

## Additional NG9-1-1 GIS Components

Depending on the path chosen by the State in the implementation of the i3 system additional components may be needed or required in the future.

### *MSAG Conversion Service (MCS)*

A GIS based service that translates civic address between the NG9-1-1 format and legacy format used for cross system interoperability.

**Estimates:**

One-time cost (set-up): \$7,250.00

Ongoing yearly cost: \$260,000.00

### *i3 GeoCoding Service (GCS)*

A GIS based service that locates a civic address through either a road centerline or site/structure address point and used for visualization in map displays used by 9-1-1.

**Estimates:**

One-time cost (set-up): \$11,500.00

Ongoing yearly cost: \$295,000.00

### *Map Data Services (MDS)*

A GIS based service that provides the statewide GIS data to map displays used by 9-1-1. This service eliminates the necessity of storing large statewide GIS datasets locally and provides up-to-date GIS data continually.

**Estimates:**

One-time cost (set-up): \$19,750.00

Ongoing yearly cost: \$1,600,000.00

## Additional 9-1-1 Support Services

### *Conversion of Statewide NG9-1-1 GIS Data to Support Local CAD Systems*

Many PSAPs in Wisconsin utilize Computer Aided Dispatching (CAD) and the ability to utilize regional or statewide, seamless GIS data layer is extremely beneficial. GIS Data Management vendors may offer services to translate statewide NG9-1-1 geodatabases into the format needed for the CAD systems. As NG9-1-1 is implemented, the state may find that providing the statewide NG9-1-1 GIS data layers in the most common CAD formats is required.

#### **Estimates for Ten (10) CAD Systems:**

One-time cost (set-up): \$67,500.00

Ongoing yearly cost: \$75,500.00

### *Local GIS Data Workflow Workshops*

Each local jurisdiction is responsible for addressing structures in support of 9-1-1, however there are rarely defined workflows on sharing of the addressing information to 9-1-1. The lack of defined workflows reduces both the accuracy and completeness of GIS data supporting 9-1-1. As the State transitions to NG9-1-1, where GIS data is a requirement for call routing, every effort should be taken to ensure workflows are discussed, documented, and communicated to all stakeholders.

The workshops should include:

- An address workflow meeting with the 9-1-1 Authority and all addressing authorities within the authoritative area
  - Acquire information from each entity to determine the submission process of new/updated addresses to 9-1-1
- Creation of workflow(s) and supporting documentation for each 9-1-1 Authority
- Review of the workflow(s) and approval by all stakeholders
- Finalize and distribute workflow(s) to all stakeholders

#### **Estimate:**

One-time cost per 9-1-1 Authority: \$15,687.20

## Cost Estimate Table

Component	One-Time Estimate	Yearly Ongoing Estimate
NG9-1-1 Data Preparation of Local GIS Data   Minimum Requirements	\$1,425,000.00	
NG9-1-1 Data Preparation of Local GIS Data   Complete Requirements	\$2,610,000.00	\$500,000.00
Creation of a Wisconsin NG9-1-1 GIS Geodatabase Template	\$2,800.00	
GIS Validation Tools	\$82,317.99	
Monthly submissions		\$202,541.23
Daily submission		\$260,000.00
Merged Statewide, Seamless NG9-1-1 GIS Data Layers	\$162,500.00	\$410,000.00
NG9-1-1 GIS Data Implementation Strategy and Planning	\$11,765.40	
GIS Derived MSAG	\$42,500.00	\$72,500.00
Spatial Interface <sup>†</sup>	\$151,000.00	\$377,500.00
MSAG Conversion Service (MCS)	\$7,250.00	\$260,000.00
i3 GeoCoding Service (GCS)	\$11,500.00	\$295,000.00
Map Data Services (MDS)	\$19,750.00	\$1,600,000.00
Conversion of Statewide NG9-1-1 GIS Data to Support Local CAD Systems   10 Outputs	\$67,500.00	\$75,500.00
Local GIS Data Workflow Workshops   Per 9-1-1 Authority	\$15,687.20	

<sup>†</sup>This component may be part of the GIS Validation Tools.

### **Cost estimate for Path One (minimum)**

Path One (minimum) is the cost estimate for implementation of just the minimum requirement, services and tools to support i3 call routing.

One-time Cost: \$1,823,617.99

Ongoing Cost: \$1,490,041.23

- NG9-1-1 Data Preparation of Local GIS Data | Minimum Requirements
  - Ongoing maintenance
- Creation of a Wisconsin NG9-1-1 GIS Geodatabase Template
- GIS Validation Tools | Monthly submissions
- Merged Statewide, Seamless NG9-1-1 GIS Data Layers
- Spatial Interface

### **Cost estimate for Path Two (recommended)**

Path Two (recommended) is the cost estimate for implementation of all components recommended through lessons learned and best practices.

One-time Cost: \$3,062,883.39

Ongoing Cost: \$1,620,000.00

- NG9-1-1 Data Preparation of Local GIS Data | Complete Requirements
  - Ongoing maintenance

- Creation of a Wisconsin NG9-1-1 GIS Geodatabase Template
- GIS Validation Tools | Daily submissions
- Merged Statewide, Seamless NG9-1-1 GIS Data Layers
- NG9-1-1 GIS Data Implementation Strategy and Planning
- GIS Derived MSAG
- Spatial Interface

### **Cost estimate for Path Three (complete)**

Path Three (complete) is the cost estimate for implementation of all NG9-1-1 GIS components and supporting activities.

One-time Cost: \$3,639,499.39

Ongoing Cost: \$3,850,500.00

- NG9-1-1 Data Preparation of Local GIS Data | Complete Requirements
  - Ongoing maintenance
- Creation of a Wisconsin NG9-1-1 GIS Geodatabase Template
- GIS Validation Tools | Daily submissions
- Merged Statewide, Seamless NG9-1-1 GIS Data Layers
- NG9-1-1 GIS Data Implementation Strategy and Planning
- GIS Derived MSAG
- Spatial Interface
- MSAG Conversion Service (MCS)
- i3 GeoCoding Service (GCS)
- Map Data Services (MDS)
- Conversion of Statewide NG9-1-1 GIS Data to Support Local CAD Systems
  - 10 Outputs
- Local GIS Data Workflow Workshops
  - Thirty (30) 9-1-1 Authorities



## Appendix D | County Current and Predicted Accuracy

To request individual county data for current and predicted accuracy numbers, please contact the DMA, Office of Emergency Communications at [interop@wisconsin.gov](mailto:interop@wisconsin.gov)

**Current GIS Accuracy for NG9-1-1 by County**

**Predicted | GIS Data Accuracy for Resolution of All Critical Errors**

**Predicted | Overall Data Accuracy for Resolution of All Critical Errors**