COMMONWEALTH OF PENNSYLVANIA

NG911 GIS DATA MODEL AND BEST PRACTICES GUIDE

Version 2

Abstract: This document defines the GIS data information, formats, and requirements used in Pennsylvania's Next Generation 9-1-1 (NG911) Core Services (NGCS). It provides the first update to and consolidation of PEMA's two original NG911 GIS best practices guides, originally published in 2019. Additionally, PEMA conducted a careful review of version 2.0 of the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022) [1], which was published in October 2022, and aligned this document to the updated NENA standards, where applicable. Other items that appeared in the updated NENA standard but needed further validation and discussion before being adopted by PEMA and its GIS stakeholders are identified in section 8 below as future work items. Though this document largely maintains continuity with the NENA standard, it also defines Pennsylvania-specific data model elements and includes best practices for navigating NG911 GIS challenges that are specific to the Commonwealth. This guide serves as the Commonwealth of Pennsylvania's NG911 GIS data model standard and is intended to assist Pennsylvania county 911 authorities and NG911 GIS data stewards as they make the transition to NG911 service. As a note, this guide is intended to be a living document, subject to future revisions and updates. It is strongly recommended that PEMA and its county GIS partners continuously review updated NENA guidance and revisit and update this guide regularly to maintain continuity with evolving standards. We suggest beginning the next update in the fall of 2025.

Prepared by: Pennsylvania Emergency Management Agency (PEMA), with support from the members of the Pennsylvania NG911 GIS Working Group.

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1. Executive Summary

Purpose and Background

This document defines the GIS data information, formats, requirements, and related information used in Next Generation 9-1-1 (NG911) Core Services (NGCS) and serves as the Commonwealth of Pennsylvania's NG911 GIS Data Model standard. It includes an update to and consolidation of the Pennsylvania Emergency Management Agency's original NG911 GIS Best Practices Guides, which were published in 2019. These include the following:

- Public Safety Answering Point (PSAP) Emergency Service and Provisioning Boundaries Best Practices Document [2]

- Road Centerlines and Site/Structure Address Points Best Practices Document [3]

This document is based on the National Emergency Number Association's (NENA) Standard for NG9-1-1 GIS Data Model Version 2.0 (NENA-STA-006.2-2022) [1], but it also contains data model elements that are specific to Pennsylvania's NG911 system. These Pennsylvania-specific data model elements are identified in the body of the document where they occur. Additionally, Appendix A includes a summary comparison of NENA and Pennsylvania specific data model elements. This update is intended to provide a consolidated reference guide for Pennsylvania's county 911 Authorities and GIS data stewards for use in building, maintaining, and sharing their local GIS data to support NG911 service, including supporting geospatial call routing.

Per Pennsylvania's current 911 legislation, counties are required to provide 911 service to their residents. This can be accomplished by either operating a countywide 911 system or through participating in a regional 911 system. Pennsylvania has 61 Public Safety Answering Point's (PSAPs) providing 911 service, handling approximately 14 million calls for service annually. Additionally, Pennsylvania's approach to NG911 GIS data development relies on local 911 Provisioning Authorities, typically county governments, but sometimes regional actors (e.g., regional PSAPs), in building, maintaining, and sharing NG911-ready data to support geospatial call routing.

For a Provisioning Authority's data to be considered NG911-ready, it needs to be free of critical errors, which can prevent or delay geospatial call routing. Additionally, all boundary layers need to be coincident with those of neighboring jurisdictions, free of any unintentional gaps or overlaps. Finally, the Road Centerlines or Site/Structure Address Point layers should meet or exceed an Automatic Location Identification database (ALI) to layer synchronization rate of 98% or greater. For a detailed list of critical errors and warning errors that are screened for via GIS Data Hub, please see Appendix B.

Within the Commonwealth's NG911 system, each Provisioning Authority submits the NG911 GIS data for their area of geographic responsibility. When a Provisioning Authority's GIS layers are NG911-ready, they are coalesced with corresponding layers from other counties with NG911-ready data to form a set of regional, and what will eventually become statewide, NG911 GIS data layers that can support geospatial call routing. More specifically, GIS data is used to validate a 911 caller's location and route their call to the proper Public Safety Answering Point (PSAP). This guide primarily supports this outcome and is based on national standards developed by the National Emergency Number Association (NENA).

The NENA Standard for NG9-1-1 GIS Data Model Version 2.0 (NENA-STA-006.2-2022) [1] serves as the primary authoritative source for this document. This standard provides a robust framework for developing and maintaining uniform statewide NG911 layers that are built, maintained, and shared by Provisioning Authorities (primarily individual counties). The standards further help ensure Pennsylvania's NG911 data is aligned with data from other states and jurisdictions who are also adhering to NENA's guidance, supporting the long-term goal of future interoperability of NG911 systems among jurisdictions inside Pennsylvania and those outside of the state. Where applicable, references to elements that are from the NENA standard are cited throughout this document for easy reference.

It is important that Provisioning Authorities adhere to the standards defined in this document. NG911 requires higher levels of GIS data accuracy, standardization, and attribution detail than GIS data used for existing legacy Enhanced 911 (E911) systems. This is because in an NG911 environment GIS data plays a primary role. It is used for enabling geospatial call routing and must meet a high bar for accuracy to ensure 911 calls are accurately routed to the correct PSAP. To assist Provisioning Authorities in meeting or exceeding this bar, this document provides minimum accuracy standards that must be attained before their GIS data can be integrated into Pennsylvania's statewide NG911 system.

As of the time of publication, Pennsylvania has begun its migration to NG911 service. Some jurisdictions will have already made the transition to NG911 service. As such, to address emerging questions and concerns resulting from transitioning into a post-migration environment, this guide includes two new appendices, including:

- Appendix D: Best Practices for Building, Maintaining, And Sharing GIS Data When a PSAP or Service Boundary Extends Beyond a Provisioning Boundary

- Appendix E: PSAP Boundary, Provisioning Boundary, and Service Boundary Layer Change Management Process Checklist

Note: the data structures defined in this document are related to, but different from, the data structures defined in the NENA i3 Standard for Next Generation 9-1-1, Appendix B (NENA-STA-010.3b-2021) [4].

Pennsylvania's Approach to NG911 GIS

Since the initial publication of PEMA's Best Practices Guides in 2019, there have been important developments regarding Pennsylvania's approach to implementing NG911 service. In 2020, following a rigorous search, PEMA selected Comtech to provide statewide NG911 service. To support this project, Comtech brought on GeoComm to operate a statewide Spatial Interface (SI) solution called GIS Data Hub. The purpose of GIS Data Hub is to provision a functional element of the NG911 system, the Emergency Call Routing Function (ECRF), with GIS data. As identified in section 1 of the NENA GIS Data Model standard [1], in contrast to the SI, this document describes the structure (e.g., field names, field data types, domains) of GIS data. This data model is compatible with the SI provisioning process. For additional resources on GIS Data Hub, see Appendix C of this document.

As a general migration note, PEMA started migrating PSAPs to NG911 service on a regional basis, starting in the Fall of 2022. As of this publication, migration is expected to continue through 2024, when all regions are expected to be onboarded to the statewide service. As of August 2022, all Provisioning Authorities inside the Commonwealth are up and running with GIS Data Hub.

The Role of GIS Data in NG911

This section provides a summary of the role of GIS in NG911 and is aligned with a summary provided in the NENA Standard for NG9-1-1 GIS Data Model version 2.0 (NENA-STA-006.2-2022, see pages 2-3) [1]. Spatial (GIS) data drives NG911. Spatial data is often grouped into layers or feature classes. Layers are homogenous collections of common features, each having the same spatial representation and a common set of attribute columns. Spatial data in this document consists of the following vector (discrete) layer types:

- Points – discrete locations such as address points and premise locations
- Lines – linear features such as roads
- Polygons – geographic coverage areas such as service boundaries

While local government, public safety entities, and Public Safety Answering Points (PSAPs) use GIS address points, road centerlines, boundaries, and many other data layers in many different ways, the transition to NG911 introduces and sometimes requires new uses of existing data and the creation of new data layers. **Required** layers MUST be available for Next Generation Core Services (NGCS) to process a 911 call on the ESInet, in particular the Emergency Call Routing Function (ECRF) and Location Validation Function (LVF), and for functionality of the GIS Data Hub Spatial Interface (SI). **Strongly Recommended** layers may aid in NGCS functionality, may be used for call taking and dispatch operations, and are used in other operations. The **Recommended** layers will not be provisioned into the LVF or ECRF but are beneficial for PSAP map display and 911 call taking.

The NENA Standard for NG911 GIS Data Model (NG911 GIS Data Model), which the PEMA NG911 GIS Data Model is based on, outlines a process for building standardized, accurate, and current GIS data.

The NG911 system makes use of a new location conveyance format, called the "Presence Information Data Format-Location Object" or PIDF-LO. The PIDF-LO serves as the representation of the location of the device calling 911 and allows for civic and geospatial information. PIDF-LO is an international format. The United States profile/version of PIDF-LO for civic locations is the NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard (NENA-STA-004.1.1-2014) [5]. This document conforms to CLDXF for the representation of addresses in the United States NG911 environments. However, there are fields described in this document that provide additional information beyond what CLDXF describes.

This GIS Data Model for NG911 is designed to support the location conveyed in the PIDF-LO so that it supports both validation of the location information against the local 911 Authorities' GIS data as well as routes the 911 call to the appropriate responding PSAP. The process of validating the location information that is contained in the PIDF-LO occurs in the Location Validation Function (LVF) of the NG911 system before the call is made. The location information within the PIDF-LO is used to route the 911 call to the appropriate PSAP and takes place within the Emergency Call Routing Function (ECRF) of the NG911 system.

The LVF and ECRF require standardized GIS data to perform their respective roles. GIS data provided in accordance with this standard are used as input to GIS Data Hub. The GIS Data Hub's role is to then provision to the ECRF (and other Functional Elements). The Master Street Address Guide (MSAG) Conversion Service (MCS) will also make use of the information contained in the GIS data, in particular legacy attributes. In addition, public safety mapping applications use these GIS layers, allowing the PSAP to properly view the location of a 911 call on the map display and dispatch the correct emergency service(s) to the appropriate location.

The primary reasons to utilize this standard are to:

- Promote the creation of complete, consistent, high-quality, authoritative county-level GIS data that can then be coalesced with data from all other Provisioning Authorities in Pennsylvania to support the Commonwealth's NG911 system
- Establish standardized GIS data provisioning requirements and structure for all users in Pennsylvania while also meeting national standards of the NENA GIS Data Model, supporting data interoperability
- Establish provisioning guidelines for GIS data needed to support existing E911 systems, while transitioning into NG911 systems
- Enable validation of the 911 civic location information against the local 911 Authorities' GIS data using the Location Validation Function (LVF)
- Enable routing of the 911 call to the appropriate destination, using the local 911 Authorities' GIS data provisioned to the Emergency Call Routing Function (ECRF)
- Provide the data to determine the correct emergency responding agencies
- Enable compatibility and interoperability between GIS datasets at scale, including county, state, and national datasets, while standardizing consistent data elements for software
- Provide an approach to common challenges that Provisioning Authorities face in building, maintaining, updating, and sharing GIS data for NG911 purposes

Benefits

Adherence to this document provides a standardized, interoperable GIS data model that benefits users and providers of GIS data in the following manner:

- Enables the validation of civic locations before a 911 call is made
- Provides the data structure that allows the NG911 functionality that routes calls to the correct destination
- Maintains or improves support for accurate plotting of 911 calls in public safety mapping applications for call handling purposes and has potential multiplier effects for improving the accuracy of aggregated datasets supporting an array of other applications and functions
- Provides a framework to help migrate existing GIS datasets to NG911 systems
- From a state perspective, this process streamlines data maintenance
- Enhances interoperability and data sharing
- Reduces confusion and ambiguity that can result from non-standardized data

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APPENDICES

2. Document Terminology

This section defines keywords. The conventions for using these keywords are based on those established in the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022, see page 12) [1]. The terms defined below will appear throughout this document in UPPERCASE to convey emphasis beyond the normal usage of these keywords according to the definitions listed below. The definitions provided are based on IETF RFC 2119 [18]. Any of these words used in lowercase do not carry special significance beyond normal usage.

1. MUST, SHALL, REQUIRED: These terms mean that the definition is a normative (absolute) requirement of the specification.

2. MUST NOT: This phrase, or the phrase "SHALL NOT", means that the definition is an absolute prohibition of the specification.

3. SHOULD: This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.

4. SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED" means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.

5. MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option "must" be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option "must" be prepared to interoperate with another implementation which does not include the option (except, of course, for the features the option provides).

3. Technical/Operational Description

This section identifies standards and recommendations related to metadata, spatial reference, standardized data fields, and case sensitivity. These recommendations are aligned with those described in the NENA Standard for NG9-1-1 GIS Data Model version 2.0 (NENA-STA-006.2-2022, see pages 17 – 18) [1]. Additionally, this section includes Pennsylvania-specific guidance regarding data formatting requirements for provisioning data to GIS Data Hub, Pennsylvania's Spatial Interface (SI) solution.

3.1. Metadata

Metadata is a file of information that captures the basic characteristics of the data and information resource. It represents the who, what, when, where, why, and how of the resource. Metadata is strongly recommended to be included and available for each GIS data layer described in this document.

Provisioning Authorities are encouraged to use or transition to ISO 19115 and other associated ISO metadata standards as they are able. More information about ISO metadata standards is available on the Federal Geographic Data Committee's website [8].

3.2. Spatial Reference

Local NG911 GIS layers may be stored in any valid projection, but the statewide NG911 GIS layers used for enabling geospatial call routing will be maintained in the World Geodetic System of 1984 (WGS84). This is because all GIS data in i3 must be maintained in the WGS84 format to support interoperability between all systems and sites, as referenced in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4]. While NG911 requires that data be converted to WGS84 prior to integration into the statewide NG911 GIS layers, Provisioning Authorities have a few options to assist them in meeting this requirement.

If data is not locally maintained in WGS84, PEMA STRONGLY ENCOURAGES Provisioning Authorities to utilize the HubHelper GDH Upload Packager tool for provisioning their NG911 data into GIS Data Hub. All GIS Data Hub users have access to this tool. To ensure their data is transformed into WGS84, local data authorities should ensure they check the "Reproject All Feature Classes" button in the tool prior to upload. This will ensure data is reprojected to WGS84. For more information on how to use the HubHelper tool, please see Appendix C.

- WGS84 geodetic parameters are specified by the European Petroleum Survey Group (EPSG) as follows:
    - For 2-dimensional geometries the geodetic parameters are required to follow EPSG:4326
    - For 3-dimensional geometries the geodetic parameters are required to follow EPSG:4979

Note: WGS84 (GPS) elevation is measured as height above the ellipsoid, which varies significantly from height above the geoid (approximately Mean Sea Level).

3.3. Standardized Data Fields

In the Enhanced 9-1-1 (E9-1-1) system, GIS and MSAG data are usually confined to a particular jurisdiction or region. As long as that data is consistent within that particular jurisdiction or region it does not matter how closely these datasets conform to a data standard.

In Pennsylvania's NG911 GIS system, GIS data layers that are built and maintained by Provisioning Authorities will be coalesced into a set of corresponding statewide layers that will be used to support geospatial call routing and all PSAPs in the Commonwealth will have access to these aggregated datasets. For this reason, it is essential that ALL Provisioning Authorities define their GIS data layers and attributes as they are specified in this document. It should be noted that GIS Data Hub, Pennsylvania's Spatial Interface solution, accommodates fields and layers that have slightly different names from those specified in this standard, providing GIS data stewards with some flexibility. Provisioning Authorities that prefer to use field and layer names outside of this standard MUST notify GeoComm and ensure these names can be field mapped into GIS Data Hub prior to upload.

While Provisioning Authorities enjoy some latitude around nomenclature, all fields SHALL follow the same standards regarding attribution based on whether this standard categorizes a field as Mandatory (M), Conditional (C), Strongly Recommended (SR – Pennsylvania specific), or Optional (O). Additionally, field attributions SHALL conform to field type and field width specifications as outlined in this document.

3.4. Case Sensitivity

All systems compliant with this standard that receive and store data MUST preserve case. Fields using a domain of values MUST adhere to the casing rules of that domain. Legacy fields specified in this standard namely, "Legacy Street Name," "Legacy Street Name Post Directional," "Legacy Street Name Pre Directional," "Legacy Street Name Type," and "MSAG Community Name" (including left and right siblings), MUST be all UPPERCASE. For all other fields that are not governed by domains, values SHOULD be provided using mixed casing (i.e., combination of uppercase and lowercase letters such as in “McKean”, “Avenue of the States”, “Cobbs Creek”), as deemed correct by the authoritative source.

3.5. Formatting Requirements for Provisioning NG911 GIS Data to GIS Data Hub

Data being provisioned to the GIS Data Hub Spatial Interface MUST adhere to the standards identified in this data model document, including rules for the field names used as well as the properties of each field, including specific guidance on the attribution to be placed within fields. Below are key requirements for submitting GIS layers to the GIS Data Hub:

- Data being provisioned to GIS Data Hub must be submitted as a zipped file geodatabase (.gdb) and each layer must be in the World Geodetic System of 1984 (WGS84) projection.

  Note: PEMA strongly encourages Provisioning Authorities to utilize the HubHelper tool, which can be downloaded directly from GIS Data Hub, to package and reproject their data automatically prior to provisioning it. For more information, see Appendix C.

- Currently, at the time of publication, all required NG911 GIS layers must be included whenever a file geodatabase is uploaded to GIS Data Hub. However, this requirement will be relaxed going forward. PEMA will communicate any changes to this rule.

- Prior to a jurisdiction’s migration, and up until the end of its dual provisioning period, ALI and MSAG tables must also be included with each upload to GIS Data Hub. Comtech provides these to Provisioning Authorities at no cost. The ALI data is also used for performing GIS to ALI synchronization checks.

  Note: ALI data provided to Provisioning Authorities early on in their migration is expected to go stale over time. Once a jurisdiction achieves zero critical errors, Comtech will obtain a fresh ALI pull from Originating Service Providers on behalf of the county, again at no cost to the county, and run an updated GIS to ALI synchronization check using the most current data available. Comtech will then assist the county in addressing any lingering ALI and MSAG related concerns.

- Feature class and field name names should remain consistent between uploads. If a Provisioning Authority decides to make a change to a feature class name or field name, they MUST first notify GeoComm via email at gcteampema@geo-comm.com prior to their upload, or unanticipated critical errors may result. Pre-notification allows GeoComm to update field mapping to accommodate any changes and will prevent false positive critical errors from being detected.

3.6. Data Availability

Recognizing the broad potential that this enterprise scale, high quality, well attributed data has for a constellation of secondary uses across all domains (e.g., federal, state, and local governments, the private and non-profit sectors, academia and research, and more), including the potential to lower GIS data development costs by reducing data duplication, opening access to this data for uses beyond NG911 purposes is a long-term objective. This aim was described in the 2019 RCL and SSAP Best Practices Document (see page 31 of that document) and is being carried over here. However, this objective MUST be weighed against GIS partner concerns for privacy, security, and other considerations.

To address these concerns, PEMA is actively engaging with our GIS stakeholders, including Provisioning Authorities, to ensure: (1) any Provisioning Authorities' concerns with providing open access to their NG911 GIS data are addressed. If any Provisioning Authorities decide to restrict open access outside of NG911 call delivery, processes will be established to prevent their data from being shared beyond the use of NG911; (2) the methodology for sharing data needs to be further defined; (3) depending on the selected method (or methods) for data sharing, PEMA may need to execute a Data Exchange Summary or similar agreement to establish the purpose, method, and any restrictions in sharing NG911 GIS data.

Additional concerns with federal partners, including those from the Department of Defense, will also need to be addressed prior to opening access to NG911 GIS data beyond use in NG911. Additionally, all Personally Identifiable Information (PII) and other information deemed sensitive will be removed from these layers prior to them being shared.

Notes:

- County 911 Authorities have access to the statewide NG911 GIS layers via GIS Data Hub. Currently, these layers are updated every weeknight and reflect the latest NG911-ready data provided by Provisioning Authorities. Typically, if a jurisdiction uploads NG911-ready data to Data Hub, it will be coalesced into the statewide dataset within 24 hours. Importantly, data containing critical errors *does not* get aggregated into the statewide dataset.

- GIS data may contain confidential, proprietary, and/or sensitive information which must not be introduced into the public domain. Such information may be considered confidential and/or proprietary when included in databases and on maps used by entities in the provision of emergency services. Confidential information must not be redistributed outside of 911. Sensitive information implies a loss of security when disclosed to others.

4. GIS Data Layer Descriptions and Usage in NG911 Systems

This section provides an overview of the required NG911 GIS data layers and describes their use in Pennsylvania's NG911 system. This is largely based on Part 4 of the NENA Standard for NG9-1-1 GIS Data Model, titled GIS Data Model Layers (NENA-STA-006.2-2022, see pages 22 – 50) [1]. This section also includes Pennsylvania-specific layer elements including descriptions and nomenclature (these instances are noted where they occur). For a full comparison of NENA and Pennsylvania specific data model elements, see Appendix B.

Note: several elements identified in the NENA Standard are not included in this document due to a lack of applicability or immediate relevance to the Commonwealth's NG911 system. Some of these

elements may be incorporated into Pennsylvania's NG911 system at a later date are identified in section 8, titled Items Pending Future Work.

4.1. Required NG911 GIS Layers

Pennsylvania's Act 17 of 2019 (Chapter 53 Title 35 of the PA Consolidated Statutes §5304 (a)(10)) [7] codifies the requirement for Pennsylvania 911 Authorities to make a reasonable effort in sharing all GIS data layers with PEMA necessary for supporting NG911 call delivery. These layers include the following:

- Road Centerlines
- Site/Structure Address Points
- Provisioning Boundary
- PSAP Boundary
- Fire Service Boundary
- Law Service Boundary
- EMS Service Boundary

4.2. Schema

This section defines the required data schema, or database structure of the data and associated fields, for the layers outlined above.

The fields listed in this standard, or corresponding fields using different nomenclature that have been shared with GeoComm for field mapping, MUST be carried in local data maintained by the Provisioning Authority, even if data does not exist for a field or a field is classified as "Optional (O)" or "Strongly Recommended (SR)". Compliance with this requirement facilitates the efficient aggregation of locally built and maintained GIS data layers into a corresponding set of standardized statewide data layers and will prevent future data downtime that would be required to add the "Optional" or "Strongly Recommended" fields later.

Notes:

- Decisions around naming MUST be communicated with PEMA and GeoComm to properly field map a Provisioning Authority's data and ensure alignment with the data model.

- To further clarify guidance regarding flexibility around field and layer nomenclature, a jurisdiction may maintain data outside of this document's recommended feature class and/or field naming conventions, but only if it has corresponding names or values that can be field mapped to GIS Data Hub. For example, the field **MSAG Community Name Left** is required for the Road Centerlines layer. According to this data model standard, the field should be named "**MSAGComm_L**" (see table 4-1 below). However, a jurisdiction does not necessarily need to name their **MSAG Community Name Left** field "MSAGComm_L" in their local Road Centerline layer's attribute table. If they have a field name that is different from but corresponds to the MSAGComm_L field in their local data, that field name can be field mapped into GIS Data Hub. For example, a Provisioning Authority may call its MSAG Community Name Left field "*MCL*" instead of "MSAGComm_L" in its local data. This is permitted to carry over into the GIS Data Hub, provided GeoComm has been requested to update their field mapping to accommodate this. With field mapping complete, it will be converted to MSAGComm_L automatically in GIS Data Hub and will appear that way in the statewide layer.

- Some required attribute table values can, in some circumstances, be automatically populated by GIS Data Hub (for example "State"). These fields, where the occur, are identified in required layer tables below. A Provisioning Authority may forgo this option and decide to populate these values locally. These options were discussed with all Provisioning Authorities prior to their onboarding to GIS Data Hub. Decisions on automated field population can be modified at any time.

4.3. Building and Maintaining *NG911-ready* GIS Data and Provisioning Schedule

4.3.1. Pre-migration Environment

A key GIS-related goal for counties to meet prior to migrating to NG911 service is getting their required set of GIS data NG911 ready. To be considered NG911 ready, a county's data MUST meet the following criteria:

- Be free of critical errors. These are errors that can either delay or prevent geospatial call routing and are therefore not ingested into Pennsylvania's NG911 system. They are flagged by GIS Data Hub, Pennsylvania's NG911 Spatial Interface solution.

- Boundaries are coincident, free of unintentional gaps or overlaps.

- GIS to ALI data synchronization rate meets or exceeds an acceptable rate (e.g., 98% or above).

As of the date of this publication, all counties in the Commonwealth have been onboarded to the GIS Data Hub Spatial Interface. The tool runs a robust set of Quality Control (QC) checks and flags critical and non-critical errors. A full list of all QC checks performed by GIS Data Hub, including all error types, can be found in Appendix B. Counties are provided with detailed trainings on how to get the most out of GIS Data Hub. These trainings are recorded and available via the Comtech Learning Passport accessible on the Comtech Insights page, which county 911 partners also have access to.

In addition to being provided with GIS Data Hub trainings, counties also have access to technical and customer support via PEMA, Comtech, and GeoComm.

GIS Data Hub allows counties to upload data as frequently as they like. **PEMA strongly encourages counties to upload every two weeks prior to migration.** This allows PEMA to monitor and flag potential issues early before they have the change to exponentially grow.

Note: after a county becomes critical error free, if it uploads new data containing critical errors this data does not get passed into the NG911 system. Instead, the provisioning county gets a QC fallout error report, and the last critical error free upload dataset is used by the system to support geospatial call routing for that particular jurisdiction.

4.3.2. Post-migration Environment

After a county migrates to NG911 service, they MUST maintain and regularly provision their GIS data to GIS Data Hub spatial interface solution. **PEMA recommends counties continue to provision data every two weeks and MUST provision a minimum of once per month**. As of the date of this publication, counties are required to submit all NG911 GIS data layers with each upload. However, in the near future, they will only need to submit datasets that have changed

within two weeks to one month after the change has been made in their local NG911 GIS data.

This data is critical for the ongoing operation of NG911, as it is used to derive two GIS based MSAGs, referred to as the Spatial MSAGs™. One is based on features within the Site/Structure Address Point layer and other, based on features within the Road Centerlines layer. In addition to maintaining critical error free GIS data via GIS Data Hub, around the time of migration counties are onboarded to Comtech's ALI Location Data Platform (ALI LDP).

The GIS-derived MSAG is utilized by Comtech's ALI LDP as part of the ALI Database Management System (DBMS). The GIS-derived MSAGs are updated after PSAPs submit their GIS data to GDH, but only after it passes QC. Automatic Location Information (ALI) data from the OSPs is then validated against the Spatial MSAGs™ within the ALI DBMS, first against the SSAP-sourced MSAG and then, if no matching records are found, the system looks for an RCL-sourced MSAG to validate against. **It is critical that counties regularly monitor and promptly respond to ALI and MSAG notifications via the Comtech ALI LDP system after they have migrated.**

It is important to note that this call routing process, while more accurate and efficient that the legacy call routing processes it is replacing, is not true end state NG911. The NENA i3 Standard for Next Generation 9-1-1, which Pennsylvania's NG911 system is built on, describes end state i3 call delivery as being one where "SRs (Selective Routers) and existing ALI systems are decommissioned, and all 9-1-1 calls are routed using the Emergency Call Routing Function (ECRF) and arrive at the ESInet/NGCS via Session Initiation Protocol (SIP)" (pages 2-3)[1]. At that point, the spatial MSAG and ALI components of the NG911 system will go away. These will be replaced by a Location Validation Function (LVF) that will query an Originating Service provider (OSP) - hosted Location Information Server (LIS), which replaces ALI, to validate 911 caller locations and route calls via SIP. GIS data will continue to drive the location validation and call routing processes, feeding directly into the LVF. As of this publication, the timeline for completing the transition to full i3 call delivery is unknown and difficult to estimate. A future update to this document should revisit this.

4.4. Spatial Attribution and PEMA Statewide Layers Formatting

After a Provisioning Authority has their required NG911 GIS layers free of critical errors, their data undergoes a spatial attribution process where it is used by Comtech to build two GIS-derived Master Street Address Guides (MSAGs), also known as Spatial MSAGs. These will become the jurisdiction's authoritative source for address verification, replacing the legacy tabular MSAG. During spatial attribution, a Provisioning Authority's Site/Structure Address Point and Road Centerline layers are attributed with attribute data from the service boundaries (PSAP and ESB boundaries) that the features fall within, including the display name, service URI and service URN fields. These layers are then aggregated with corresponding critical error free data layers uploaded by other Provisioning Authorities to create a regional dataset and GIS-derived Spatial MSAG. As more Provisioning Authorities become critical error free, this regional dataset will grow to include more jurisdictions until they provide complete statewide coverage. These aggregated layers will be continuously updated whenever a Provisioning Authority uploads critical error free data (typically, it takes 24 hours/1 business day for updated data to appear in the statewide dataset). It is important to note that if a Provisioning Authority submits data with new critical errors, this data does not get passed into the statewide GIS dataset.

[1] https://www.nena.org/resource/resmgr/standards/nena-sta-010.3d-2021_i3_stan.pdf

These regional/statewide layers will be accessible to all Provisioning Authorities in the Commonwealth for download via GIS Data Hub. The statewide layers are maintained in the WGS84 projection and will conform to the standardized naming convention and schema format defined in this document, regardless of how they appear locally. The layer names in the statewide dataset are as follows:

- PSAP = PSAP Boundary
- ESB_LAW = Law Service Boundary
- ESB_EMS = Emergency Medical Service Service Boundary
- ESB_FIRE = Fire Service Boundary
- PROV_BNDY = Provisioning Boundary
- RCL = Road Centerlines
- SSAP = Site/Structure Address Point

4.5. Data Layer Attributes

This section provides detailed attribute descriptions, required data domains, and example field values for each of the above identified required NG911 GIS data layers. 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:** Column gives the standardized GIS data field name for GIS data used in an NG911 system. The Pennsylvania statewide data layers MUST conform to this standard naming schema. Note: as mentioned above in section 4.2, a jurisdiction may maintain data outside of this document's recommended feature class and/or field naming conventions, but only if it has corresponding names or values that can be field mapped to GIS Data Hub and this has been communicated with GeoComm.

- **Field Width**: Column refers to the maximum number of characters a field may contain.

- **M/C/SR/O:** This column is used to indicate whether populating the attribute is Mandatory (M), Conditional (C), Strongly Recommended (SR) (Pennsylvania specific data model element), or Optional (O).

- **Mandatory**: An attribute value must be populated in the data field for each record. Mandatory data fields MUST not be blank.

- **Conditional:** 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.

- **Strongly Recommended:** Not required to be populated in the local data at this time, however population of this field will likely become mandatory in the coming years. Currently, it is a local decision to be made by the Provisioning Authority on whether to populate the field. This is a Pennsylvania specific data model element and does not appear in the NENA standard.

- **Optional:** Not required to be populated in the local data. It is a local decision to be made by the Provisioning Authority on whether to populate the data field.

- **Type:** indicates the type of data used within the data field and attributes, as defined in the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022) [1].

    - **P** – Printable UTF-8 [9] characters that display recognizable glyphs when printed, plus the space character, (U+0020). This explicitly supports accented characters and does not permit other blank characters such as non-breaking space or control characters such as carriage return, line feed, and escape. Indigenous characters are expressly allowed. It is up to the 911 Authority to verify with their 9-1-1 system vendors(s) that their systems support characters or pictographic glyphs for all of the indigenous languages within their service area, or for a service area from where they receive diverted or transferred emergency calls.

    - **U** – A Uniform Resource Identifier (URI) as described in Section 10, Terminology, and as defined in RFC 3986 [10], and also conforming to any rules specific to the scheme (e.g., sip:, https:, etc.) of the chosen URI.

    - **D** – Date and Time may be stored in the local database date/time format with the proviso that local time zone MUST be recorded, and time MUST be recorded to a precision of at least 1 second and MAY be recorded to a precision of .1 second. If the local database date/time format does not meet these specifications, the database SHOULD record the local date/time format in a string conforming to W3C dateTime format as described in XML Schema Part 2: Datatypes Second Edition [11].

    - **F** – Floating (numbers that have a decimal place). There is no defined field length of a floating number; it is system dependent. However, in Esri geodatabase feature classes and shapefiles, these shall be double fields.

    - **N** – Non-negative Integer. This field consists of whole numbers only. (e.g., In Esri geodatabase feature classes and shapefiles, these shall be short-integer or long-integer fields).

Additional GIS data layers and data fields may be used as needed to best meet local purposes and needs. However, only the required layers listed above, and the associated attribute data shown in the layers provided in this document, will be utilized for the loading and provisioning of GIS data for the Location Validation Function (LVF), Emergency Call Routing Function (ECRF), and MSAG Conversion Service (MCS) functions within NG9-1-1 as described in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4].

4.6. Road Centerlines – REQUIRED

Roads data is maintained as a line layer for representing the centerline of a real world roadway. This dataset is referred to as the RoadCenterline layer in the GIS Data Layers registry in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4]. In the previous version of the NENA Standard for NG9-1-1 GIS Data Model this layer was identified as the Road Centerlines layer. This recent name change will be carried forward in all future NENA documents. PEMA will review the layer name change and consider adopting it in a future update, but for the purposes of this update this document will continue to refer to this layer as Road Centerlines.

GIS road centerline arc-node topology is associated with attribute data containing information on street names, address ranges, jurisdictional boundaries, and other attributes. The Road Centerlines layer is an integral part of any public safety GIS due to its versatility and use for:

- Querying and geocoding of civic addresses based on dual (left/right) address ranges
- Tactical map displays
- Map and attribute viewing
- Map production
- Location and driving directions
- Integration of network topology to allow vehicle routing, drive time analysis
- Integration of spatially related attributes for advanced applications, including those focused on public safety, asset management, planning, utilities, and public works

Unnamed centerlines MUST have the Street Name field populated.

Table 4-1: Road Centerlines Layer

Descriptive Name	Field Name	M/C/SR/O	Type	Field Width	Notes
Discrepancy Agency ID	DiscrpAgID	M	P	100	This value can be auto populated via GIS Data Hub.
Date Updated	DateUpdate	M	D	-	
Effective Date	Effective	O	D	-	
Expiration Date	Expire	O	D	-	
NENA Globally Unique ID	NGUID	M	P	254	If only a unique number is available, GIS Data Hub will add the layer prefix and Discrepancy Agency ID.
Left Address Number Prefix	AdNumPre_L	C	P	15	
Right Address Number Prefix	AdNumPre_R	C	P	15	
Left FROM Address	FromAddr_L	M	N	6	
Left TO Address	ToAddr_L	M	N	6	
Right FROM Address	FromAddr_R	M	N	6	
Right TO Address	ToAddr_R	M	N	6	
Parity Left	Parity_L	M	P	1	
Parity Right	Parity_R	M	P	1	
Street Name Pre Modifier	St_PreMod	C	P	15	
Street Name Pre Directional	St_PreDir	C	P	9	
Street Name Pre Type	St_PreTyp	C	P	50	
Street Name Pre Type Separator	St_PreSep	C	P	20	
Street Name	St_Name	M	P	254	
Street Name Post Type	St_PosTyp	C	E	50	

Street Name Post Directional	St_PosDir	C	P	9	
Street Name Post Modifier	St_PosMod	C	E	25	
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2	
Legacy Street Name	LSt_Name	C	P	75	
Legacy Street Name Type	LSt_Typ	C	P	4	
Legacy Street Name Post Directional	LSt_PosDir	C	P	2	
ESN Left	ESN_L	C	P	5	
ESN Right	ESN_R	C	P	5	
MSAG Community Name Left	MSAGComm_L	C	P	30	
MSAG Community Name Right	MSAGComm_R	C	P	30	
Country Left	Country_L	M	P	2	GIS Data Hub can auto-populate these with "US" on behalf of the county when not populated locally.
Country Right	Country_R	M	P	2	GIS Data Hub can auto-populate these with "US" on behalf of the county when not populated locally.
State Left	State_L	M	P	2	GIS Data Hub can auto-populate these with "PA" on behalf of the county if the county is not on a state border and the value is not populated locally.
State Right	State_R	M	P	2	GIS Data Hub can auto-populate these with "PA" on behalf of the county if the county is not on a state border and the value is not populated locally.
County Left	County_L	M	P	100	GIS Data Hub can add "County" to the name of the county value when it is not populated locally.

County Right	County_R	M	P	100	GIS Data Hub can add "County" to the name of the county value when it is not populated locally.
Additional Code Left	AddCode_L	C	P	6	
Additional Code Right	AddCode_R	C	P	6	
Incorporated Municipality Left	IncMuni_L	M	P	100	
Incorporated Municipality Right	IncMuni_R	M	P	100	
Unincorporated Community Left	UnincCom_L	O	P	100	
Unincorporated Community Right	UnincCom_R	O	P	100	
Neighborhood Community Left	NbrhdCom_L	O	E	100	
Neighborhood Community Right	NbrhdCom_R	O	E	100	
Postal Code Left	PostCode_L	O	P	7	
Postal Code Right	PostCode_R	O	P	7	
Postal Community Name Left	PostComm_L	O	P	40	
Postal Community Name Right	PostComm_R	O	P	40	
Road Class	RoadClass	O	P	15	
One-Way	OneWay	SR	P	2	
Speed Limit	SpeedLimit	O	N	3	
Validation Left	Valid_L	O	P	1	
Validation Right	Valid_R	O	P	1	
Complete Alias Street Name	Alias	C	P	245	This element is specific to Pennsylvania.
ESN Left (Comtech)	ESN_L_Comtech	C	P	5	This element is specific to Pennsylvania and can be auto populated via GIS Data Hub.
ESN Right (Comtech)	ESN_R_Comtech	C	P	5	This element is specific to Pennsylvania and can be auto populated via GIS Data Hub.
Z Value	ZLevel	C	P	5	This element is specific to Pennsylvania.
GC QA/QC Exception Code	GC_Exception	C	P	75	This element is specific to GIS Data Hub. 999 is currently the only available exception code, though more are expected in the

					future.

4.7. Site/Structure Address Points – REQUIRED

Site/Structure Addresses data are maintained as a point layers for representing the location of a site, a structure, or access to a site or structure. Site/Structure Addresses data can also represent landmarks. This dataset is referred to as the SiteStructureAddressPoint layer in the GIS Data Layers Registry in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4]. In the previous version of the NENA Standard for NG9-1-1 GIS Data Model this layer was identified as the Site/Structure Address Points layer. This recent name change will be carried forward in all future NENA documents. PEMA will review the layer name change and consider adopting it in a future update, but for the purposes of this update, this document will continue to refer to this layer as Site/Structure Address Points.

While the Site/Structure Address Points layer is a required, there is no requirement for the completeness of the data. It is understood that it will take time and resources to fully develop complete and accurate Site/Structure Addresses data.

Site/Structure Addresses data can be used to locate sites that otherwise may not geocode correctly using the road centerlines data. It can also be used to locate areas of nonstandard addressing (i.e., odd addresses on even side of the road centerlines and vice versa), and other areas where the data is available.

The Address Number, Street Name, and place name attributes (e.g., Incorporated Municipality, Unincorporated Community, Neighborhood Community) in the Site/Structure Address Points layer SHOULD be consistent with the address number range, street name, and left/right place name attribute combinations found in the Road Centerlines layer.

While there may be address data available, it may not be in the standardized format of this structure. GIS Data Providers should be working toward developing and maintaining the site structure point described in this document.

Table 4-2: Site/Structure Address Point Layer

Descriptive Name	Field Name	M/C/SR/O	Type	Field Width	Notes
Discrepancy Agency ID	DiscrpAgID	M	P	100	This value can be auto populated via GIS Data Hub.
Date Updated	DateUpdate	M	D	-	
Effective Date	Effective	O	D	-	
Expiration Date	Expire	O	D	-	
NENA Globally Unique ID	NGUID	M	P	254	If only a unique number is available, GIS Data Hub will add the layer prefix

					and Discrepancy Agency ID.
Country	Country	M	P	2	GeoComm will auto-populate these with "US" on behalf of the county when not locally populated.
State	State	M	P	2	GeoComm will auto- populate these with "PA" on behalf of the county under the following situations: 1. County is not on a state border and 2. not locally populated.
County	County	M	P	40	GeoComm can add "County" to the name of the county value when it is not present locally.
Additional Code	AddCode	C	P	6	
Additional Data URI	AddDataURI	C	U	254	
Incorporated Municipality	Inc_Muni	M	P	100	
Unincorporated Community	Uninc_Comm	O	P	100	
Neighborhood Community	Nbrhd_Comm	O	P	100	
Address Number Prefix	AddNum_Pre	C	P	15	
Address Number	Add_Number	C	N	6	
Address Number Suffix	AddNum_Suf	C	P	15	
Street Name Pre Modifier	St_PreMod	C	P	15	
Street Name Pre Directional	St_PreDir	C	P	9	
Street Name Pre Type	St_PreTyp	C	P	50	
Street Name Pre Type Separator	St_PreSep	C	P	20	
Street Name	St_Name	C	P	254	
Street Name Post Type	St_PosTyp	C	P	50	
Street Name Post Directional	St_PosDir	C	P	9	
Street Name Post Modifier	St_PosMod	C	P	25	
Legacy Street Name Pre Directional	LSt_PreDir	C	P	2	Used in legacy systems and is not used in a

					full NG911 implementation.
Legacy Street Name	LSt_Name	C	P	75	Used in legacy systems and is not used in a full NG911 implementation.
Legacy Street Name Type	LSt_Type	C	P	4	Used in legacy systems and is not used in a full NG911 implementation.
Legacy Street Name Post Directional	LSt_PosDir	C	P	2	Used in legacy systems and is not used in a full NG911 implementation.
ESN	ESN	C	P	5	Used in legacy systems and is not used in a full NG911 implementation.
MSAG Community Name	MSAGComm	C	P	30	Used in legacy systems and is not used in a full NG911 implementation.
Postal Community Name	Post_Comm	O	P	40	
Postal Code	Post_Code	O	P	7	
Postal Code Extension	PostCodeEx	O	P	4	
Building	Building	SR	P	75	
Floor	Floor	SR	P	75	
Unit	Unit	SR	P	75	
Room	Room	SR	P	75	
Seat	Seat	O	P	75	
Additional Location Information	Addtl_Loc	O	P	225	
Complete Landmark Name	LandmkName	C	P	150	
Mile Marker/Milepost	Milepost	C	P	150	
Place Type	Place_Type	O	P	50	
Placement Method	Placement	O	P	25	
Longitude	Longitude	O	F	-	
Latitude	Latitude	O	F	-	
Elevation	Elevation	SR	N	6	
Taxing Authority	TaxAuth	O	P	50	This element is specific to

					Pennsylvania's NG911 implementation.
Parcel Identifier	UPI	O	P	50	This element is specific to Pennsylvania's NG911 implementation.
Comtech ESN	ESN_Comtech	C	P	5	This element is specific to Pennsylvania's NG911 implementation and can be auto populated via GIS Data Hub.
GC QA/QC Exception Code	GC_Exception	C	P	75	This element is specific to Pennsylvania's NG911 implementation. Only available exception code currently is 999. Additional exception codes will be added to GIS Data Hub soon.

4.8. Service Boundaries

Service Boundaries data are maintained as polygon layers for representing the geographic area for the providers or response services. Note: while many agencies could respond within a service boundary, the GIS layer represents the agency with primary responsibility.

These layers are collectively referred to as the service boundary layers in NENA documents and individually as the PsapPolygon layer, PolicePolygon layer, FirePolygon layer, and EMSPolygon layer in the GIS Data Layers Registry in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4] and in NENA documents going forward. All other service boundary layers (e.g., CoastGuardPolygon, PoisonControlPolygon) would follow the naming conventions found in the Data Layers Registry. PEMA will review the layer name changes and consider adopting them in a future update, but for the sake of continuity with PEMA's previous guidance, this document will continue to refer to these polygon layers as PSAP Boundary, Provisioning Boundary, Fire Service Boundary, Law Service Boundary, and EMS Service Boundary.

Within i3 architecture, all service boundary layers follow the same data structure. GIS Data Providers MAY locally maintain these layers as separate or combined. Within the Emergency Call Routing Function (ECRF), Location Validation Function (LVF), MSAG Conversion Service (MCS), Geocode Service (GCS), and Mapping Data Service (MDS), the PSAP Boundary layer is a service boundary.

It is listed as a separate layer here, although in every respect it is equivalent to a service boundary with urn:service:sos as its Service URN. It should be noted that the Policy Routing Function (PRF) of an Emergency Service Routing Proxy (ESRP) may override the predefined PSAP route provided by an ECRF based on certain policies established by the PSAP. The boundary that corresponds to the Service URN urn:service:sos depends on the architecture of the ESInet and deals with how unintentional gaps and overlaps of this layer are handled by the ECRF. How the ECRF determines what boundary it uses for urn:services:sos is beyond the scope of this document.

4.9. PSAP Boundary – REQUIRED

In an NG911 deployment, the initial routing of a 9-1-1 call cannot happen without Primary PSAP boundaries. It is the most critical layer and MUST be provided. Its data structure is the same as all service boundary layers defined in this section. All polygons in this layer MUST have a Service URN of urn:service:sos. Note that the Service URN field will be provided by Comtech and automatically populated via GIS Data Hub.

The PSAP Boundary layer may have one or many PSAP Boundaries contained in the layer. Each PSAP Boundary defines the geographic area of a PSAP that has primary responsibilities for an emergency request. This layer is used by the Emergency Call Routing Function (ECRF) to perform a geographic query to determine the PSAP to which an emergency request is routed. An emergency request is routed using the NG9-1-1 Core Services based upon the geographic location of the request, provided by either a civic address, geographic coordinate, or geodetic shapes as defined in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4]. The PSAP Boundary MUST align with data from all adjoining GIS Data Providers.

4.10. Provisioning Boundary – REQUIRED

Provisioning Boundary data is maintained as a polygon layer for representing the area of GIS data provisioning responsibility, with no unintentional gaps or overlaps. This dataset is commonly referred to as the ProvisioningPolygon layer in the GIS Data Layers Registry in the NENA i3 Standard for Next Generation 9-1-1 (NENA-STA-010.3b-2021) [4] and in NENA documents going forward. PEMA will review the layer name change and consider adopting it in a future update, but this document will continue to refer to this layer as the Provisioning Boundary.

When provisioning data for an Emergency Call Routing Function (ECRF) and Location Validation Function (LVF) through the GIS Data Hub SI, a GIS Data Provider MUST only include GIS data within their Provisioning Boundary and MUST ensure the data includes coverage for the entire extent of their Provisioning Boundary. The GIS Data Hub SI Operator, GeoComm, will utilize the Provisioning Boundary layer to ensure that these requirements are met.

Notes:

- PEMA acknowledges a problematic limitation stemming from NENA's current definition of the Provisioning Boundary layer and its underlying data structure. The existing NENA standards only permit one Provisioning Boundary layer per Provisioning Authority. The concern is that this limited structure may force a PSAP to allow portions of its boundary that extend beyond its Provisioning Boundary to be provisioned by another PSAP. We are investigating solutions to this concern. A resolution will be documented in a future release of this guide. For additional information, please see the following supplemental documents:

- Appendix D: Best Practices for Building, Maintaining, and Sharing GIS Data When a PSAP or Service Boundary Extends Beyond a Provisioning Boundary

- Appendix E: PSAP Boundary, Provisioning Boundary, and Service Boundary Layer Change Management Process Checklist

4.11. Service Boundaries (Fire, Law, and EMS) – REQUIRED

In an NG9-1-1 deployment, the selective transfer of 9-1-1 calls and Emergency Incident Data Objects (EIDOs) to another PSAP or downstream agency uses service boundary layers, all with the same data structure.

The following layers (formerly known as Emergency Service Boundaries), which may be maintained as separate or combined, are the next highest priority for NG9-1-1 deployment. Primary Emergency Services MUST include the following:

- Fire
- Law
- Emergency Medical Services (EMS)

Each of these layers is used by the Emergency Call Routing Function (ECRF) to perform a geographic query to determine which agencies are responsible for providing service to a location in the event a selective transfer is desired, or to direct an EIDO to an agency for dispatch, or to display the responsible agencies at the PSAP. In addition, service boundary layers are used by PSAPs to identify the appropriate entities/first responders to be dispatched. Each layer representing a primary emergency service may contain one or more polygon boundaries that define the primary emergency services for that geographic area.

Note: The service boundary layers described here are intended to represent the entirety of the service boundary of the agencies. In many agencies, the service boundary is broken into smaller areas served by a station/beat/platoon, with the service area of the agency being the union of the smaller areas. The layer can contain a polygon set (more than one polygon), which is intended to cover holes, and disconnected areas of service, which does occur. Because a polygon set is allowed, if this layer had the smaller polygons, if all of them have the same Service URI and Service URN (but not necessarily the same Display Name, for example), it would work correctly. It has the downside of increasing work on the ECRF since it has more polygons to consider. A future edition of this document will address the issue and specifically handle station/beat/platoon service areas directly.

4.12. Other Services – Strongly Recommended

Other service boundary layers, which may be maintained as separate or combined, MAY include, but are not limited to:

- Poison Control
- Forest Service
- U.S. Coast Guard
- Animal Control

The list above is not comprehensive. Other emergency service providers may have boundaries created for them, based on the unique needs within a geographical area. The local 911 authority MAY maintain the service boundary layer as a combined or single layer for each emergency service.

4.13. Road Centerlines and Site/Structure Address Points Address Validation Process

Within an NG911 system, the Road Centerlines and the Site/Structure Address Points GIS data layers are used by several NG911 Core Services (NGCS) functional elements. The Road Centerlines and the Site/Structure Address Points provide authoritative civic location address data that is used by the:

- Location Validation Function (LVF) to determine if a civic location is valid for call routing and dispatch before a 911 call is made.
- Emergency Call Routing Function (ECRF) to identify the location of a 911 call and then perform a geographic query to determine the appropriate PSAP to route the call to.
- Mapping Data Service (MDS) to display a map to the call taker showing the location of an out-of-area call.
- Geocode Service (GCS) to provide geocoding and reverse-geocoding services.
- MSAG Conversion Service (MCS) to create an MSAG record for backwards compatibility.
- Computer Aided Dispatch (CAD) system for map display and to support the dispatch of responders to the right location.

4.14. Data Structure for Each Service Boundary Layer

Table 4-3: PSAP Boundary Layer

Descriptive Name	Field Name	M/C/O	Type	Field Width	Notes
Discrepancy Agency ID	DiscrpAgID	M	P	100	This value can be auto populated via GIS Data Hub.
Date Updated	DateUpdate	M	D	-	
Effective Date	Effective	O	D	-	
Expiration Date	Expire	O	D	-	
NENA Globally Unique ID (Primary Key)	NGUID	M	P	254	If only a unique number is available, GIS Data Hub will add the layer prefix and Discrepancy Agency ID.
State	State	M	P	2	GeoComm will auto-populate these with "PA" on behalf of the county under the following situations:

					1. County is not on a state border and 2. not locally populated.
Agency ID	Agency_ID	M	P	100	
Service URI	ServiceURI	M	U	254	GeoComm will auto-populate these on behalf of the county once Comtech has supplied.
Service URN	ServiceURN	M	P	50	GeoComm will auto-populate these on behalf of the county once the NG9-1-1 Core Service Provider has Supplied.
Service Number	ServiceNum	O	P	15	
Agency vCard URI	AVcard_URI	M	U	254	
Display Name	DsplayName	M	P	60	
FCC PSAP ID	FCCID_PSAP	M	N	4	This element is specific to Pennsylvania's NG911 implementation and can be auto populated via GIS Data Hub.
GC QA/QC Exception Code	GC_Exception	C	A	75	This element is specific to Pennsylvania's NG911 implementation. Only available exception code currently is 999. Additional exception codes will be added to GIS Data Hub soon.

4.15. Service Boundary Layers – REQUIRED

Table 4-4: Service Boundary Layers

Descriptive Name	Field Name	M/C/O	Type	Field Width	Notes
Discrepancy Agency ID	DiscrpAgID	M	P	100	This value can be auto populated via GIS Data Hub.
Date Updated	DateUpdate	M	D	-	
Effective Date	Effective	O	D	-	
Expiration Date	Expire	O	D	-	
NENA Globally Unique ID (Primary Key)	NGUID	M	P	254	If only a unique number is available, GIS Data Hub will add the layer prefix and Discrepancy Agency ID.
State	State	M	P	2	GeoComm will auto- populate these with "PA" on behalf of the county under the following situations: 1. County is not on a state border and 2. not locally populated.
Agency ID	Agency_ID	M	P	100	
Service URI	ServiceURI	M	U	254	GeoComm will auto-populate these on behalf of the county once Comtech has supplied.
Service URN	ServiceURN	M	P	50	GeoComm will auto-populate these on behalf of the county once the NG9-1-1 Core Service Provider has supplied.
Service Number	ServiceNum	O	P	15	
Agency vCard URI	AVcard_URI	M	U	254	
Display Name	DsplayName	M	P	60	

GC QA/QC Exception Code	GC_Exception	C	A	75	This element is specific to Pennsylvania's NG911 implementation. Only available exception code currently is 999. Additional exception codes will be added to GIS Data Hub soon.

4.16. Provisioning Boundary – REQUIRED

Table 4-5: Provisioning Boundary

Descriptive Name	Field Name	M/C/O	Type	Field Width	Notes
Discrepancy Agency ID	DiscrpAgID	M	P	100	This value can be auto populated via GIS Data Hub.
Date Updated	DateUpdate	M	D	-	
Effective Date	Effective	O	D	-	
Expiration Date	Expire	O	D	-	
Provisioning Boundary NENA Globally Unique ID	NGUID	M	P	254	If only a unique number is available, GIS Data Hub will add the layer prefix and Discrepancy Agency ID.
GC QA/QC Exception Code	GC_Exception	C	A	75	This element is specific to Pennsylvania's NG911 implementation. Only available exception code currently is 999. Additional exception codes will be added to GIS Data Hub soon.

5. Detailed Description of Field Names and Associated Attribute Data

This section corresponds to information provided in Section 5 of the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022 (see pages 51 -85)) [1]. Each of the field names given in the tables provided throughout Section 4 are listed in alphabetical order below. Each field name has a description, attribute data domain, and an example. For details on case sensitivity, please refer to Section 3.4, Case Sensitivity, above.

An attribute data domain defines the set of all valid values that are allowed in the attribute data field. If the domain is none, then any value that matches the data type and description MAY be used for the attribute field. Those with a given data domain MUST use only those values with the domain given. Web links provided in the examples below are for illustrative purposes.

This section provides a description, attribute data domain, and an example for each field. All field values must be fully spelled out and utilize title case unless otherwise noted. An attribute data domain defines the set of all valid values that are allowed in the attribute data field. If the domain defines no values, then any value that matches the data type and description may be used for the attribute field. Those with given data value domain values must use only one of those values for the attribute field. All attribute Descriptive Names are grouped by data layer and listed alphabetically.

5.1. Additional Code

Description: A code that specifies a geographic area. Used in Canada to hold a Standard Geographical Classification code; it differentiates two municipalities with the same name in a province that does not have counties. Since this field is not applicable in the United States, it will not be populated in Pennsylvania NG911 GIS data layers.

Domain: Statistics Canada, Standard Geographical Classification 2011, Volume I, Statistical Area Classification by Province and Territory – Variant of SGC 2016 at https://www.statcan.gc.ca/eng/subjects/standard/sgc/2016/index

Example: 3318013; 5926005

5.2. Additional Code Left

Description: The Additional Code on the Left side of the road segment relative to the FROM Node. Since this field is not applicable in the United States, it will not be populated in Pennsylvania NG911 GIS data layers.

Domain: See Additional Code

Example: 4611040; 6106023

5.3. Additional Code Right

Description: The Additional Code on the Right side of the road segment relative to the FROM Node. Since this field is not applicable in the United States, it will not be populated in Pennsylvania NG911 GIS data layers.

Domain: See Additional Code

Example: 5926005; 4711066

5.4. Additional Data URI

Description: Uniform Resource Identifiers (URIs) for additional data associated with the address point. This attribute is contained in the Site/Structure Address Point layer and will define the Service URI of additional information about a location, including building information (blueprints, contact info, floor plans, etc.).

Domain: List of one or more URIs

Example: https://addl68603.example.com

5.5. Additional Location Information

Description: A part of a sub-address that is not a Building, Floor, Unit, Room, or Seat.

Domain: None

Example: Pediatric Wing; Loading Dock; Concourse B; Gate B27; Corridor 5

5.6. Address Number

Description: The numeric identifier of the structure or addressed site along a thoroughfare or within a defined community.

Domain: Whole numbers from 0 to 999999

Example: “10310” in “10310 Somerset Pike”; “100” in “100 East Union Street

Note: The Address Number MUST be a whole number. This element is a conditional element. For more details, please see CLDXF Standard, NENA-STA-004 [5].

5.7. Address Number Prefix

Description: An extension of the Address Number that precedes it and further identifies a location along a thoroughfare or within a defined area.

Domain: None

Example: “S” in “S877 Highway 88”; “N” in “N32774 Ferry Road

Note: The Address Number Prefix contains any alphanumeric characters, punctuation, and spaces preceding the Address Number. This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004 [5].

5.8. Address Number Suffix

Description: An extension of the Address Number that follows it and further identifies a location along a thoroughfare or within a defined area.

Domain: None

Example: "½" in "307 ½ Seventh Street", "Rear" in "408 Rear West Main Street", "B" in "8305B Algon Avenue"

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004 [5].

5.9. Agency Identifier

Description: A Domain Name System (DNS) domain name which is used to uniquely identify an agency. An agency is represented by a fully qualified domain name as defined in NENA-STA-010 [4]. In order to correlate actions across a wide range of calls and incidents, each agency MUST use one domain name consistently. Any domain name in the public DNS is acceptable so long as each distinct agency uses a different domain name. This ensures that each agency identifier is globally unique.

Domain: Fully qualified domain name

Example: psap.harriscounty.tx.us; police. allegheny.pa.us; newbrunswick.ca; flctnecd.gov

Note: The Agency Identifier is a field in service boundary layers which identifies the agency the boundary defines. It is also used in the Emergency Incident Data Object, the Service/Agency Locator, and MUST be used in constructing NGUIDs.

5.10. Agency VCard URI

Description: a vCard is a file format standard for electronic business cards. The Agency vCard URI is the internet address of JavaScript Objection Notation (JSON) data structure which contains contact information (Name of Agency, Contact phone numbers, etc.) in the form of a jCard (RFC 7095). The vCard URI is used in Agency Locator (see NENA-STA-010 [4]) provides these URIs for Agencies listed in it.

Domain: None

Example: https://vcard.psap.allegheny.pa.us; https://vcard.houstontx.gov/fire

Note: This field should be left blank at this time. The NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022) [1] notes that this field will be considered for deletion in a future version of its data model standard to align with future changes to that standard.

5.11. Complete Alias Street Name

Description: The primary complete alias street name (or "also known as" street name) associated with the road centerline segment.

Domain: None

Example: **"**Spring Road" as an alias for "Carlisle Springs Road"; "West Ward Line Alley" as an alias for "West Cedar Alley"; "T-0552" as an alias for "Snarrytown Road"

5.12. Building

Description: One among a group of buildings that have the same address number and complete street name.

Domain: None

Example: Building 8; East Tower

5.13. Complete Landmark Name

Description: The name by which a prominent site/structure is publicly known.

Domain: None

Example: Eastern State Penitentiary; Fairmount Park; Independence Hall; Wannamaker Building; Quemahoning Dam; Somerset County Courthouse; US Flight 93 National Memorial.

Note: Landmarks may or may not be associated with a civic address. There are two landmark name elements: Landmark Name Part and Complete Landmark Name. Within a record, Landmark Name Part MAY occur multiple times, while complete Landmark Name MAY occur only once. When a landmark is denoted by multiple names in a series (such as “University of South Florida” and “Sun Dome,” an arena on the university campus), the Landmark Name Part element holds the separate individual names, and the Complete Landmark Name holds the complete combination. The Landmark Name Part element also allows specification of the order in which the separate names SHOULD be combined into the complete name. This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004 [5].

5.14. Country

Description: The name of a country represented by its two-letter ISO 3166-1 [17] English country alpha-2 code elements in UPPER CASE letters. This value can be auto-populated by GIS data Hub.

Domain: Restricted to the two-letter designations provided in ISO 3166-1 [17]

Example: "US" for the United States of America; "CA" for Canada

5.15. Country Left

Description: The name of the Country on the Left side of the road segment relative to the FROM Node, represented by its two-letter ISO 3166-1 [17] English country alpha-2 code elements in UPPER CASE letters. This value can be auto-populated by GIS data Hub.

Domain: Restricted to the two-letter designations provided in ISO 3166-1 [17]

Example: "US" for the United States of America; "CA" for Canada

5.16. Country Right

Description: The name of the Country on the Right side of the road segment relative to the FROM Node, represented by its two-letter ISO 3166-1 [17] English country alpha-2 code elements in UPPER

CASE letters. This value can be auto-populated by GIS data Hub.

Domain: Restricted to the two-letter designations provided in ISO 3166-1 [17]

Example: "US" for the United States of America; "CA" for Canada

5.17. County

Description: The name of the county where the address point is located. The word "County" must be included.

Domain: Restricted to the exact listed values as published in ANSI INCITS 31:2009, including casing and use of abbreviations

Example: Berks County; Lycoming County; Somerset County

5.18. County Left

Description: The name of the County on the Left side of the road segment relative to the FROM Node. The word "County" must be included.

Domain: Restricted to the exact listed values as published in ANSI INCITS 31:2009, including casing and use of abbreviations

Example: Allegheny County; Centre County; Wyoming County

5.19. County Right

Description: The name of the County on the Right side of the road segment relative to the FROM Node. The word "County" must be included.

Domain: Restricted to the exact listed values as published in ANSI INCITS 31:2009, including casing and use of abbreviations

Example: Cambria County; Dauphin County; Elk County

5.20. Date Updated

Description: The date and time that the record was created or last modified. This value MUST be populated upon modifications to attributes, geometry, or both.

Domain: Date and time may be stored in the local database's date/time format with the condition that the local time zone MUST be recorded; also, time MUST be recorded to a precision of at least 1 second, but MAY be recorded to a precision of 0.1 second. If the local database date/time format does not meet these specifications, the database SHOULD record both the local date/time format and a string conforming to the W3C dateTime format as described in XML Schema Part 2: Datatypes Second Edition [11].

Example: (of a W3C dateTime with optional precision of 0.1 second)

- 2017-12-21T17:58.03.1-05:00 (representing a record updated on December 21, 2017 at 5:58 and 3.1 seconds PM US Eastern Standard Time);

- 2017-07-11T08:31:15.2-04:00 (representing a record updated on July 11, 2017 at 8:31 and 15.2 seconds AM US Eastern Daylight Time).

5.21. Discrepancy Agency ID

Description: Agency that receives a Discrepancy Report (DR), should a discrepancy be discovered, and will take responsibility for ensuring discrepancy resolution. This may or may not be the same as the 9-1-1 Authority. This MUST be represented by a domain name that is an Agency Identifier as defined in the NENA Master Glossary of 9-1-1 Terminology (NENA-ADM-000.24-2021) [6].

Domain: None

Example: luzerne911.pa.us.gov; LCWC911.pa.us

Note: The Discrepancy Agency ID and Agency ID values can be identical.

5.22. Display Name

Description: A description or "name" of the service provider that offers services within the area of a Service Boundary. This value MUST be suitable for display.

Domain: None

Example: Philadelphia Police Department; Med-Life Ambulance Services

5.23. Effective Date

Description: The date and time that the record is scheduled to take effect.

Domain: Date and time may be stored in the local database date/time format with the condition that the local time zone MUST be recorded; also, time MUST be recorded to a precision of at least 1 second but MAY be recorded to a precision of 0.1 second. If the local database's date/time format does not meet these specifications, the database SHOULD record both the local date/time format and a string conforming to the W3C dateTime format as described in XML Schema Part 2: Datatypes Second Edition [11].

Example: (of a W3C dateTime with optional precision of 0.1 second)

- 2017-02-18T02:30:00.1-05:00 (representing a record that will become active on February 18, 2017 at 2:30 and 0.1 seconds AM US Eastern Standard Time);

- 2017-10-09T13:01:35.2-04:00 (representing a record that will become active on October 9, 2017 at 1:01 and 35.2 seconds PM US Eastern Daylight Time).

Note: This field is used when time and date of a change is known. For example, the time and date an annexation takes effect.

5.24. Elevation

Description: The elevation, given in meters above a reference surface defined by the coordinate system, associated with the site/structure address.

Domain: Restricted to whole numbers.

Example: “68” representing the elevation (in meters) associated with the address “123 Main Street, Suite 401”

Note: WGS84 (GPS) elevation is measured as height above the ellipsoid, which varies significantly from height above the geoid (approximately Mean Sea Level).

5.25. ESN

Description: A 3-to-5-character numeric string that represents the Emergency Service Zones (ESZ).

Domain: Characters from 000 to 99999

Example: 359; 181; 57631

Note: An ESZ is not necessarily the same as a Service Boundary as outlined in this document. ESN is used for routing in Legacy Systems. This field may also provide backward compatibility with legacy map displays and Computer Aided Dispatch (CAD) systems.

5.26. ESN Left

Description: The Emergency Service Number (ESN) on the Left side of the road segment relative to the FROM Node.
Domain: Characters from 000 to 99999

Example: 005; 140; 5422

5.27. ESN Right

Description: The Emergency Service Number (ESN) on the Right side of the road segment relative to the FROM Node.

Domain: Characters from 000 to 99999

Example: 003; 130; 6314

5.28. Expiration Date

Description: The date and time when the information in the record is no longer considered valid.

Domain: Date and time may be stored in the local database’s date/time format with the condition that the local time zone MUST be recorded; also, time MUST be recorded to a precision of at least 1 second but MAY be recorded to a precision of 0.1 second. If the local database’s date/time format does not meet these specifications, the database SHOULD record both the local date/time format and a string conforming to the W3C dateTime format as described in XML Schema Part 2: Datatypes

Second Edition [11].

Example: (of a W3C dateTime with optional precision of 0.1 second)

- 2017-02-18T02:30:00-05:00.1 (representing a record that will expire and no longer be valid on February 18, 2017 at 2:30 and 0.1 seconds AM US Eastern Standard Time);

- 2017-10-09T13:01:35.2-04:00 (representing a record that will expire and no longer be valid on October 9, 2017 at 1:01 and 35.2 seconds PM US Eastern Daylight Time).

Note: This field is used when the time and date of a change is known. For example, the time and date an annexation takes effect, and the previous boundary is retired.

5.29. Floor

Description: a floor, story, or level within a building.

Domain: None

Example: Mezzanine; 1st Floor; Floor 8

5.30. Incorporated Municipality

Description: The name of the Incorporated Municipality or other general-purpose local governmental unit (if any), where the address is located.

Domain: None; however, use "Unincorporated" if the address is not within an incorporated local government.

Example: Harrisburg; Somerset Township; Cassandra Borough

5.31. Incorporated Municipality Left

Description: The name of the Incorporated Municipality or other general-purpose local governmental unit (if any), on the Left side of the road segment relative to the FROM Node.

Domain: None

Example: Indian Lake Borough; Philadelphia

5.32. Incorporated Municipality Right

Description: The name of the Incorporated Municipality or other general-purpose local governmental unit (if any), on the Right side of the road segment relative to the FROM Node.

Domain: None

Example: Wilkes-Barre; Callimont Borough

5.33. Latitude

Description: The angular distance of the address point location north or south of the equator as defined by the coordinate system, expressed in decimal degrees.

Domain: +90 degrees to -90 degrees

Example: 40.264385

5.34. Left Address Number Prefix

Description: An extension of the Address Number that precedes it and further identifies a location along a thoroughfare or within a defined area, on the Left side of the road segment relative to the FROM Node. It contains any alphanumeric characters, punctuation, and spaces preceding the Left FROM Address and Left TO Address.

Domain: None

Example: "201-" in “201-445 Meadow Drive”; “N” in “N32774 Ferry Road”

5.35. Left FROM Address

Description: in the Road Centerlines layer, each feature has a begin point and an endpoint. The FROM Node is the begin point while the TO Node is the endpoint. Each has a left side and a right side relative to a begin node and an end node. The Left FROM address is the address number on the Left side of the road segment relative to the FROM Node.

Domain: Whole numbers from 0 to 999999

Example: see Figure 5-1 below.

Note: This address can be higher than the Left TO Address

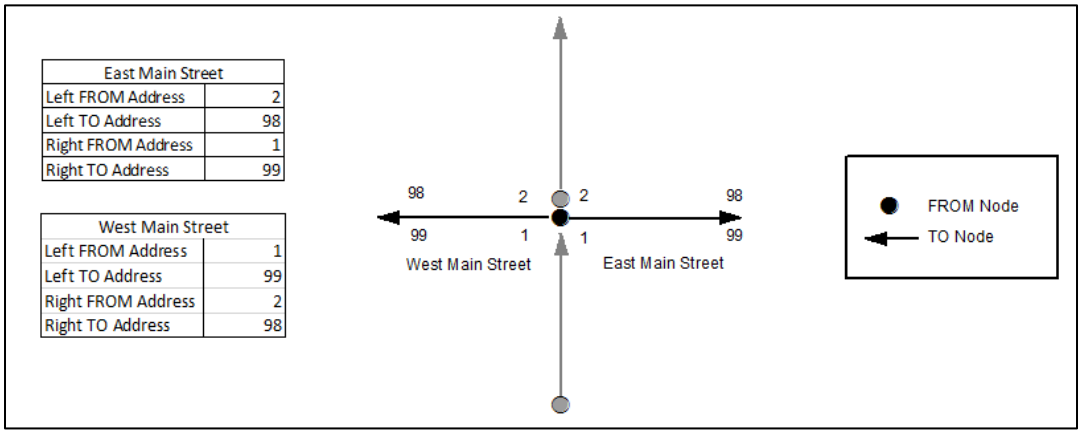

Figure 5-1: Example of Left FROM, Left TO, Right FROM, and Right TO Addresses

5.36. Left TO Address

Description: In the Road Centerlines layer, each feature has a begin point and an endpoint. The FROM Node is the begin point while the TO Node is the endpoint. Each has a left side and a right side

relative to a begin node and an end node. The Left TO address is the address number on the Left side of the road segment relative to the TO Node.

Domain: Whole numbers from 0 to 999999

Example: See Figure 5-1, above

Note: This address can be lower than the left FROM Address.

5.37. Legacy Street Name

Description: The street name as it currently exists in the MSAG. Ideally this is the name as assigned by the local addressing authority. However, it is imperative that the content of the "Legacy Street Name" field in the GIS data and the content of the "Street Name" field in the MSAG are identical. If there are discrepancies, one of these two databases (GIS and/or MSAG) MUST be updated to match the other.

Domain: None

Example: “MAIN” in “W MAIN ST”; “OLD LINCOLN” in “OLD LINCOLN HWY”

Note: This field is included in the GIS Data Model primarily for use with the MCS. Attributes in this field MUST match the corresponding field in the MSAG to ensure civic locations are accurately converted and stored as PIDF-LO for use in NG9-1-1 systems. This field may also provide backward compatibility with legacy map displays and Computer Aided Dispatch (CAD) systems.

5.38. Legacy Street Name Post Directional

Description: The trailing street direction suffix as it currently exists in the MSAG. Ideally this is the street name post directional as assigned by the local addressing authority. However, it is imperative that the content of the “Legacy Street Name Post Direction” field in the GIS data and the “Post Directional” field in the MSAG are identical. If there are discrepancies, one of these two databases (GIS and/or MSAG) MUST be updated to match the other.

Domain: N, S, E, W, NE, NW, SE, SW

Example: “W” in “MAIN ST W”; “S” in “MAPLE AVE S”

Note: This field is included in the GIS Data Model primarily for use with the MCS. Attributes in this field MUST match the corresponding field in the MSAG to ensure civic locations are accurately converted and stored as PIDF-LO for use in NG9-1-1 systems. This field map also provide backward compatibility with legacy map displays and Computer Aided Dispatch (CAD) systems.

5.39. Legacy Street Name Pre Directional

Description: The leading street direction prefix as it currently exists in the MSAG. Ideally this is the street name pre directional as assigned by the local addressing authority. However, it is imperative that the “Legacy Street Name Pre Directional” field in the GIS data and the “Prefix Directional” field in the MSAG are identical. If there are discrepancies, one of these two databases (GIS and/or MSAG) MUST be updated to match the other.

Domain: N, S, E, W, NE, NW, SE, SW

Example: “N” in “N CENTER AVE”; “W” in “W UNION ST”

Note: This field is included in the GIS Data Model primarily for use with the MCS. Attributes in this field MUST match the corresponding field in the MSAG to ensure civic locations are accurately converted and stored as PIDF-LO for use in NG9-1-1 systems. This field may also provide backward compatibility with legacy map displays and Computer Aided Dispatch (CAD) systems.

5.40. Legacy Street Name Type

Description: The valid street abbreviation as it currently exists in the MSAG. Ideally this is the street name type as assigned by the local addressing authority. However, it is imperative that the “Legacy Street Name Type” in the GIS data and the “Street Suffix” field in the MSAG are identical. If there are discrepancies, one of these two databases (GIS and/or MSAG) MUST be updated to match the other.

Domain: None

Example: “AVE” for “AVENUE”; “TRL” for “TRAIL”; “PKWY” for “PARKWAY”

Note: This field is included in the GIS Data Model primarily for use with the MCS. Attributes in this field MUST match the corresponding field in the MSAG to ensure civic locations are accurately converted and stored as PIDF-LO for use in NG9-1-1 systems. This field may also provide backward compatibility with legacy map displays and Computer Aided Dispatch (CAD) systems.

5.41. Longitude

Description: The angular distance of a location east or west of the prime meridian of the coordinate system, expressed in decimal degrees.

Domain: -180 to + 180 degrees
Example: -76.883829

5.42. Milepost

Description: A measured distance travelled along a route such as a road or highway, typically indicated by a milepost sign. There is typically a post or other marker indicating the distance in miles from or to a given point.

Domain: None

Example: “Milepost 101.3” on the Pennsylvania Turnpike “Mile Marker 42” on US 219”

Note: Milepost numbers, which may or may not be an actual milepost distance, are useful for specifying locations along interstate highways, recreational trails, navigable waterways and other unaddressed routes, as well as stretches of county, state, federal, and other routes where distance measurements are posted. Milepost numbers are a numeric measurement from a beginning point and MAY be used in place of, or in addition to, Address Numbers. This element is a conditional element. Including it as a conditional field within the Site/Structure Address Point layer allows for another means of location verification, particularly at the PSAP level. Including the field allows for matching an Address, assigned by an Addressing Authority using the local addressing interval, to the Mile

Marker. It should be noted that Mile Markers may not be placed at the exact mile intervals, due to post placement issues such as underground rock ledges or bridges. Tying an Address to the Mile Marker reduce potential ambiguity about location. For more details, please see the CLDXF Standard, NENA-STA-004 [5].

5.43. MSAG Community Name

Description: The Community Name associated with an address as given in the MSAG and may or may not be the same as the Community Name used by the postal service.

Domain: None

Example: PINE TOWNSHIP; JORDAN TOWNSHIP; NORTH HUNTINGDON TOWNSHIP

Note: Used in Legacy Systems and is not used in a full NG9-1-1 implementation.

5.44. MSAG Community Name Left

Description: The existing MSAG Community Name on the Left side of the road segment relative to the FROM Node.

Domain: None

Example: LISTIE; SAINT MICHAEL

Note: Used in Legacy Systems and is not used in a full NG9-1-1 Implementation.

5.45. MSAG Community Name Right

Description: The existing MSAG Community Name on the Right side of the road segment relative to the FROM Node.

Domain: None

Example: BLOUGH; DUNLO

Note: Used in Legacy Systems and is not used in a full NG9-1-1 implementation.

5.46. Neighborhood Community

Description: The name of an unincorporated neighborhood, subdivision, or area, either within an incorporated municipality or in an unincorporated portion of a county or both, where the address is located.

Domain: None

Example: Shadyside; Garden View; Copperfield Mobile Home Park

Note: Neighborhood communities are only used when they are known and have a clearly defined boundary. Neighborhood communities are usually not used for addressing purposes, but are often used as differentiators within an area that have the same or similar sounding street names.

5.47. Neighborhood Community Left

Description: The name of an unincorporated neighborhood, subdivision or area, either within an incorporated municipality or in an unincorporated portion of a county or both, on the Left side of the road segment relative to the FROM Node.

Domain: None

Example: Shawleytown; Garden View; Copperfield Mobile Home Park

5.48. Neighborhood Community Right

Description: The name of an unincorporated neighborhood, subdivision or area, either within an incorporated municipality or in an unincorporated portion of a county or both, on the Right side of the road segment relative to the FROM Node.

Domain: None

Example: Snob's Knob; East End

5.49. NENA Globally Unique ID

Description: The NENA Globally Unique ID (Primary Key) for each record in a GIS data layer. Each record in the GIS data layer MUST have a globally unique ID. When coalescing data from other local 9-1-1 Authorities into the ECRF and LVF, this unique ID MUST continue to have only one occurrence. The latest release of the NENA Standard for NG9-1-1 GIS Data Model [1] provides an update on how to develop NGUIDs, however more discussion is needed before Pennsylvania adopts NENA's updated methodology for building NGUIDs.

One approach to building NGUIDs is appending the 911 authority's domain to the end of the "locally unique ID." Examples are provided below. This method may be revisited in a future update of this guide.

Domain: None

Example: It is suggested that the NGUID start with concatenating the layer prefix (e.g., RCL, SSAP, EMS, LAW, FIRE, PSAP), the locally assigned unique ID, the "@" symbol, and the Agency Identifier (a registered domain name).

- Feature ID 243 in the EMS Service Boundary layer would be represented as EMS243@911Authority.domain.state.us
- Feature ID 44 in the law enforcement Service Boundary layer would be represented as LAW44@911Authority.domain.state.us
- Feature ID 18 in the fire Service Boundary layer would be represented as FIRE18@911Authority.domain.state.us
- Feature ID 7 in the PSAP Boundary layer would be represented as PSAP7@911Authority.domain.state.us

- Feature ID 652 in the SSAP layer would be represented as SSAP652@911Authoritiy.domain.state.us

- Feature ID 72 in the RCL layer would be represented as RCL72@911Authority.domain.state.us

5.50. One-Way

Description: The direction of traffic movement along a road in relation to the FROM node and TO node of the line segment representing the road in the GIS data. The one-way field has three possible designations: B (Both), FT (From-To), and TF (To-From).

- B – travel in both directions allowed
- FT – one-way traveling from the FROM node to the TO node
- TF – one way traveling from the TO node to the FROM node

Domain: B, FT, TF

Example: See Figure 5-2 below

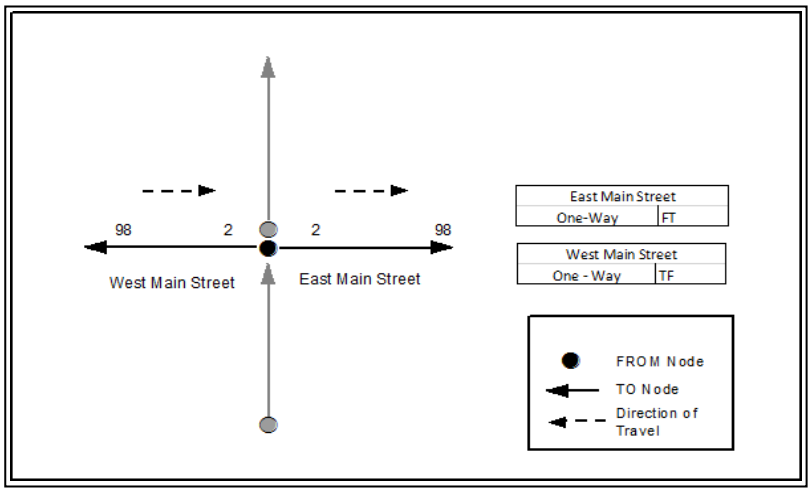

Figure 5-2: Example of One-Way

5.51. Parity Left

Description: The even or odd property of the address number range on the Left side of the road segment relative to the FROM Node.

Domain: O, E, B, Z

- O = Odd
- E = Even
- B = Both
- Z = Address Range 0-0

Example: O; E; B; Z

5.52. Parity Right

Description: The even or odd property of the address number range on the Right side of the road segment relative to the FROM Node.

Domain: O, E, B, Z

- O = Odd
- E = Even
- B = Both
- Z = Address Range 0-0

Example: O; E; B; Z

5.53. Place Type

Description: The type of feature identified by the address.

Domain: The Registry of Location Types proposed in RFC 4589 (https://tools.ietf.org/rfc/rfc4589.txt) is: https://www.iana.org/assignments/location-type-registry/location-type-registry.xml. A new value in the registry may be added by sending an email to iana@iana.org. Indicate you want to add a new value to the Location Types Registry as defined in Section 5.1 of RFC 4589.

Example: Airport; bank; hotel; office; residence; stadium; store

5.54. Placement Method

Description: The methodology used for placement of the address point.

Domain: Restricted to values found in the "NENA Site/Structure Address Point Placement Methodology Registry" at: http://technet.nena.org/nrs/registry/SiteStructureAddressPointPlacementMethod.xml

Example: Structure; Site; Parcel; Geocoding; Property Access; Unknown

5.55. Postal Code

Description: A 5-digit code that identifies the individual USPS Post Office or metropolitan area delivery station associated with the address point. Also known as a ZIP Code.

Domain: The domain of values comes from the USPS City State Product, which is a comprehensive list of Postal Codes with corresponding USPS city and county names.

Example: 15207; 17120; 18705

Note: Postal Codes in the US are the same as ZIP Codes. The USPS considers ZIP Codes to be delivery routes instead of areas. There may be differences between this depiction and actual ZIP Code mailing address. When Postal Code is used, it only includes the ZIP Code portion in the US and not the ZIP Plus 4 portion of a ZIP Code. The USPS City State Product only contains city and community names and their associated ZIP Codes. To perform complete 5-digit ZIP coding of address files, City State Product must be used in conjunction with Five-Digit ZIP Product, ZIP +4® Product, or Carrier Route Product.

5.56. Postal Code Extension

Description: The addition of the Postal Code Extension refines the mail delivery point down to a specific block or building, and may prove useful to validate locations. Postal Code Extensions change more often than US Postal Codes, and this additional data field should make maintaining these optional codes easier.

Domain: Defined by the USPS

Example: "0001" in "02109-0001" (The Postal Code Extension for Boston, MA)

5.57. Postal Code Left

Description: The Postal Code on the Left side of the road segment relative to the FROM Node.

Domain: See Postal Code

Example: 15217; 17101; 19106

5.58. Postal Code Right

Description: The Postal Code on the Right side of the road segment relative to the FROM Node.

Domain: See Postal Code

Example: 17102; 18702; 19107

5.59. Postal Community Name

Description: A city name for the Postal Code of an address.

Domain: Restricted to city names given in the USPS City State Product for a given ZIP Code. The USPS City State Product is a comprehensive list of ZIP Codes with corresponding USPS city and county names.

Example: Pittsburgh; Harrisburg; Wilkes-Barre

Note: The Postal Community Name is the name assigned to the post office that delivers mail to a given address, and may differ from the 9-1-1 city or community location. Only the "preferred" Postal Community Name as defined by the USPS City State Product is allowed. The Postal Community Name is also defined in the USPS ZIP Code lookup at https://tools.usps.com/go/ZipLookup Action_input. However, the USPS City State Product only contains city and community names and their associated ZIP Codes. To perform complete 5-digit ZIP coding of address files, the USPS City State Product must be used in conjunction with Five-Digit ZIP Product, ZIP +4® Product, or Carrier Route Product. The USPS Postal City name is the "preferred" name assigned to the post office from which the USPS delivers mail to the address, and may differ from the 9-1-1 city or community name.

5.60. Postal Community Name Left

Description: A city name for the Postal Code of an address, as given in the USPS City State Product on the Left side of the road segment relative to the FROM Node.

Domain: See Postal Community Name

Example: Pittsburgh; Harrisburg; Philadelphia

5.61. Postal Community Name Right

Description: A city name for the Postal Code of an address, as given in the USPS City State Product on the Right side of the road segment relative to the FROM Node.

Domain: See Postal Community Name

Example: Harrisburg; Philadelphia; Wilkes-Barre

5.62. Right Address Number Prefix

Description: An extension of the Address Number that precedes it and further identifies a location along a thoroughfare or within a defined area, on the Right side of the road segment relative to the FROM Node. It contains any alphanumeric characters, punctuation, and spaces preceding the Right FROM Address and Right TO Address.

Domain: None

Example: "S" in "S877 Highway 88"; "N" in "N32774 Ferry Road

5.63. Right FROM Address

Description: In the Road Centerlines layer, each feature has a begin point and an endpoint. The FROM Node is the begin point while the TO node is the endpoint. Each has a left side and a right side relative to a begin node and an end node. The Right FROM address number is the address number on the Right side of the road segment relative to the FROM Node.

Domain: Whole numbers from 0 to 999999

Example: See Figure 5-3, below.

Note: This address can be higher than the Right TO Address.

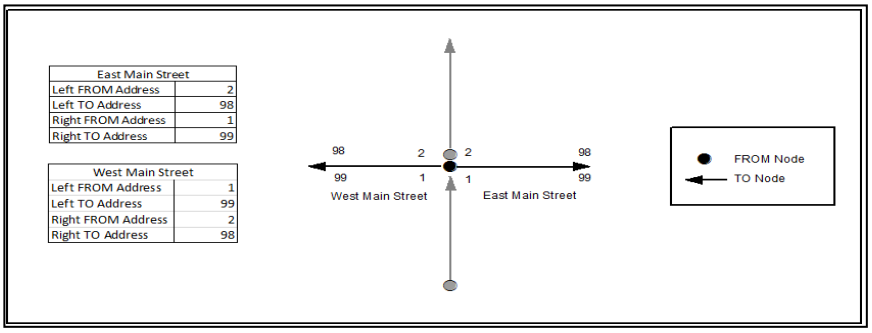

Figure 5-3: Example of Left FROM, Left TO, Right FROM, and Right TO Addresses

5.64. Right TO Address

Description: In the Road Centerlines layer, each feature has a begin point and an endpoint. The FROM Node is the begin point while the TO node is the endpoint. Each has a left side and a right side relative to a begin node and an end node. The Right TO address number is the address number on the Right side of the road segment relative to the TO Node.

Domain: Whole numbers from 0 to 999999

Example: See Figure 5-3, above.

Note: This address can be lower than the Right FROM Address.

5.65. Road Class

Description: The general description of the type of road. The Road Classifications used in this document are derived from the US Census MAF/TIGER Feature Classification Codes (MTFCC), which is an update to the now deprecated Census Feature Class Codes (CFCC).

Domain: Primary, Secondary, Local, Ramp, Service Drive, Vehicular Trail, Walkway/Pedestrian Trail, Stairway, Alley; Private, Parking Lot, Bike Path or Trail, Bridle Path, Other

Example: Ramp

Note: The Road Class is completed spelled out in the attribute fields. Road Classification is based on the Census road classification found in the 2019 MAF/TIGER Feature Class Codes (MTFCC) definitions [11]. The values are taken from the S series information in this document which provided the classification scheme for surface roads and can be found at: https://www2.census.gov/geo/pdfs/reference/mtfccs2019.pdf

- *Primary* roads are generally divided, limited-access highways within the interstate highway system or under state management, and are distinguished by the presence of interchanges. These highways are accessible by ramps and may include some toll highways.

- *Secondary* roads are main arteries, usually in the US Highway, State Highway, or County Highway system. These roads have one or more lanes of traffic in each direction, may or may not be divided, and usually have at-grade intersections with many other roads and driveways.

- *Local* roads are generally a paved non-arterial street, road, or byway that usually has a single lane of traffic in each direction. Roads in this classification include neighborhood, rural roads, and city streets.

- *Ramp* designates a road that allows controlled access from adjacent roads onto a limited access highway, often in the form of a cloverleaf interchange. Ramps typically do not have address ranges.

- *Service Drive* provides access to structures along the highway, usually parallel to a limited access highway. If these roads are named and addressed, they may be considered local roads.

- *Vehicular Trail* (4WD, snowmobile) is an unpaved trail or path where a four-wheel-drive

vehicle, snowmobile, or similar vehicle is required.

- *Walkway/Pedestrian Trail* is a path that is used for walking, being either too narrow for or legally restricted from vehicular traffic.

- *Stairway* is a pedestrian passageway from one level to another by a series of steps.

- *Alley* is generally a service road that does not generally have associated addressed structures and is usually unnamed. It is located at the rear of buildings and properties.

- *Private* (service vehicles, logging, oil fields, ranches, etc.) is a road within private property that is privately maintained for service, extractive, or other purposes. These roads are often unnamed.
- *Parking Lot* is the main travel route for vehicles through a paved parking area.

- *Bike Path or Trail* is a path that is used for manual or small, motorized bicycles, being either too narrow for or legally restricted from vehicular traffic.

- *Bridle Path* is a path that is used for horses, being either too narrow for or legally restricted from vehicular traffic.

- *Other* is any road or path type that does not fit into the above categories.

5.66. Room

Description: A single room within a building.

Domain: None

Example: Cypress Room; Classroom 213

5.67. Seat

Description: A place where a person might sit within a building.

Domain: None

Example: Seat K21; Metro Desk

Notes: From the CLDXF Standard, NENA-STA-004 [5]:

- The Seat element "designates a place where a person might sit, such as a seat in a stadium or theater, or a cubical in an open-plan office or a booth in a trade show" (IETF RFC 4776, section 3.4).

- Subaddress elements typically include both a "type" word (such as "seat" or "desk") and an identifier (a specific name or number). Include both the type word, the identifier in this element, and any separating characters or spaces.

- The type word may precede or follow the identifier ("Registration Desk" vs. "Desk 17"). Either order is acceptable; local usage should be followed. In some cases, no type word is used.

5.68. Service Number

Description: The numbers that would be dialed on a 12-digit keypad to reach the service appropriate for the location. This is not the same as an Emergency Service Number (ESN) in Legacy E9-1-1 systems. This field is used for all service boundary layers including the PSAP Boundary, Emergency Service Boundaries for Fire, Law, and EMS and other service boundaries that may be included (e.g., Poison Control). Within North America, the Service Number for most services is 9-1-1; however, there may be service boundaries that have a different number that may be associated with them such as Poison Control. Additionally, in some countries, different numbers may be used for Police, Fire, and EMS – this field would be used to denote those numbers.

Domain: A dialable number of dial string

Example: 911; 18002221212

5.69. Service URI

Description: The Uniform Resource Identifier (URI) for call routing. This attribute is contained in the service boundary layers and will define the Service URI of the service. The URI is usually a Session Initiation Protocol (e.g., SIP or SIPs) URI that defines the route to reach the service.

Domain: Registered domain name

Example: sips:sos.psap@eoc.houston.tx.us
sip:cambriaallianceems.com
sip:dispatch@harriscountyso.org
sip:22444032@ohiocountywv.gov:5061
sip:wexford-fire@psap.allegheny.pa.us

Note: The Service URI is provided by PEMA's NG911 service provider, Comtech, and *may* be auto-populated via the GIS Data Hub Spatial Interface. However, if your jurisdiction is served by two or more PSAPs, either for 9-1-1 call taking purposes or for dispatching of one or more emergency services, these values MUST be populated manually by the 911 Authority or their designee (e.g., their designated GIS data steward).

5.70. Service URN

Description: The uniform resource name (URN) used to select the service for which a route is desired. The ECRF is queried with a location and a service URN that returns the service URI.

Note: This value will be provided by Comtech and auto-populated by GIS Data Hub.

Domain: RFC 5031 defines the service URN; NENA-STA-010 [4] defines the domain of allowable values. PSAP boundaries SHOULD only contain features with service URN values of "urn:emergency:service:sos.psap." Values to be used for service boundaries for other responding agencies are found in the IANA urn:emergency:service:responder registry.

Example: urn:emergency:service:sos.psap
urn:emergency:service:responder.police
urn:emergency:service:responder.fire
urn:emergency:service:responder.ems

5.71. Speed Limit

Description: Posted speed limit in Miles Per Hour (MPH).

Domain: Whole numbers from 1 to 999

Example: 30; 45; 65

Note: in some jurisdictions, a Road Centerlines field with the name Speed Limit is sometimes used to reflect average observed speed, not posted speed. The intent of this standard is for this field to reflect the posted speed limit, not the observed speed limit.

5.72. State

Description: A state name, or state equivalent, represented by the two-letter abbreviation identified in USPS Publication 28 [13], Appendix B. A state is a primary governmental division of the United States.

Domain: ISO 3166-2 [14] contains the same abbreviations as USPS Publication 28 [13], Appendix B, plus additional abbreviations for the nine minor outlying islands owned by the U.S. These abbreviations are also freely available at https://www.census.gov/library/reference/code-lists/ansi/ansi-codes-for-states.html

Example: PA, MD, NY, OH, WV

5.73. State Left

Description: The name of a state on the Left side of the road segment relative to the FROM Node, represented by the two-letter UPPER CASE abbreviation given in USPS Publication 28 [13], Appendix B.

Domain: ISO 3166-2 [14] or USPS Publication 28 [13], Appendix B for the US

Example: PA, NY, WV

5.74. State Right

Description: The name of a state on the Right side of the road segment relative to the FROM Node, represented by the two-letter UPPER CASE abbreviation given in USPS Publication 28 [13], Appendix B.

Domain: ISO 3166-2 [14] or USPS Publication 28 [13], Appendix B for the US

Example: PA, DE, NJ

5.75. Street Name

Description: The official name of the road as defined by the local addressing authority. It does not include any street types, directionals, or modifiers.

Domain: None

Example: “Locust” in “Locust Street”; “219” in “Route 219”; “Fifth” in “Fifth Avenue”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.76. Street Name Post Modifier

Description: A word or phrase that follows and modifies the Street Name element but is separated from it by a Street Name Post Type or a Street Name Post Directional or both.

Domain: None

Example: “Extended” in “Main Street Extended”; “Fire Road 12” in “Lakeview Road Fire Road 12”; “southbound” in “Interstate 91 southbound”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.77. Street Name Post Type

Description: A word or phrase that follows the Street Name element and identifies a type of thoroughfare in a complete street name.

Domain: Restricted to the values found in the “NENA Street Name Pre Types and Street Name Post Types” or combinations thereof, at http://technet.nena.org/nrs/registry/StreetNamePreTypesAndStreetNamePostTypes.xml.

Example: “Highway” in “Mason Dixon Highway”; “Path” in “Iroquois Path”; “Bypass” in “Route 219 Bypass”; “Extension” in “Main Street Extension”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.78. Street Name Pre Directional

Description: A word preceding the Street Name element that indicates the direction taken by the road from an arbitrary starting point or line, or the sector where it is located.

Domain: North, South, East, West, Northeast, Northwest, Southeast, Southwest

Example: “North” in “North Center Avenue”; “East” in “East Bakersville-Edie Road”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.79. Street Name Pre Modifier

Description: A word or phrase that precedes and modifies the Street Name element but is separated from it by a Street Name Pre Type or a Street Name Pre Directional or both.

Domain: None

Example: “Old” in “Old Route 40”; “West” in “West South 4th Street”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.80. Street Name Pre Type

Description: A word or phrase that precedes the Street Name element and identifies the type of thoroughfare in a complete street name.

Domain: Restricted to the values found in the NENA Street Name Pre Types and Street Name Post Types Registry, or combinations thereof, at http://technet.nena.org/nrs/registry/StreetNamePreTypesAndStreetNamePostTypes.xml

Example: “Route” in “Old Route 40”, “Boulevard” in “Boulevard of the Allies”, Avenue in “Avenue A”

Note: Occasionally two or more type words occur together before the Street Name element (e.g., Bypass Highway 22). All of the words are placed in the Street Name Pre Type, unless the local address authority has included any of them in Street Name element. If the two type words are not part of the Street Name element and are not separated from each other by a directional word or other word, they are all placed in the Street Name Pre Type. This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.81. Street Name Pre Type Separator

Description: A preposition or prepositional phrase between the Street Name Pre Type and the Street Name. This element is defined in the CLDXF Standard, NENA-STA-004.1.1-2014 [5], as a US specific extension of PIDF-LO per RFC 6848 [15].

Domain: Restricted to values found in the “NENA Registry of Street Name Pre Type Separators” at: http://technet.nena.org/nrs/registry/StreetNamePreTypeSeparators.xml

Example: “of the” in “Boulevard of the Allies”

Note: This element is a conditional element. For more details, please see the CLDXF Standard, NENA-STA-004.1.1-2014 [5].

5.82. Unincorporated Community

Description: The name of an Unincorporated Community, either within an incorporated municipality or in an unincorporated portion of a county, or both, where the address is located.

Domain: None

Example: Wills; Mine 40; Vim

Note: An Unincorporated Community typically is a region of land that is not governed by its own local municipal corporation.

5.83. Unincorporated Community Left

Description: The Unincorporated Community, either within an incorporated municipality or in an unincorporated portion of a county, or both, on the Left side of the road segment relative to the FROM Node.

Domain: None

Example: Pennsdale; Opp

5.84. Unincorporated Community Right

Description: The Unincorporated Community, either within an incorporated municipality or in an unincorporated portion of a county, or both, on the Right side of the road segment relative to the FROM Node.

Domain: None

Example: Pump Station; Maggio Estates

5.85. Unit

Description: A group or suite of rooms within a building that are under common ownership or tenancy, typically having a common primary entrance.

Domain: None

Example: Apartment 201; Unit 13A; Suite 5100; Front; Rear

5.86. Validation Left

Description: Indicates if the address range on the left side of the road segment, relative to the FROM node, should be used for civic location validation. A value of "Y" MAY be entered if any Address Number within the address range on the left side of the road segment should be considered by the LVF to be valid. A value of "N" MAY be entered if the Address Number should only be validated using the Site/Structure Address Point layer. If not present, a value of "Y" is assumed.

Domain: Y, N

Example: Y; N

Note: This field does not affect routing of emergency calls, nor display of GIS data. It controls how the LVF determines its response when an address does not match an address point but is within a valid range of a Road Centerline.

5.87. Validation Right

Description: Indicates if the address range on the right side of the road segment, relative to the FROM node, should be used for civic location validation. A value of "Y" MAY be entered if any Address Number within the address range on the right side of the road segment should be considered by the LVF to be valid. A value of "N" MAY be entered if the Address Number should only be validated using the Site/Structure Address Point layer. If not present, a value of "Y" is assumed.

Domain: Y; N

Example: Y; N

Note: This field does not affect routing of emergency calls, nor display of GIS data. It controls how the LVF determines its response when an address does not match an address point but is within a valid range of a Road Centerline.

5.88. FCC PSAP ID

Description: The Federal Communications Commission (FCC) maintains a registry of PSAPs within the U.S. and its territories and assigns a unique 4-digit key to each. This field value should be the primary PSAP identifier from the *FCC Master PSAP Registry* assigned to the PSAP to which the ESN would default route.
Domain: The *FCC Master PSAP Registry* can be downloaded from https://www.fcc.gov/general/911-master- psap-registry. If you do not find your PSAP, or if a change has taken place, please advise the FCC using the contact information in the link provided and register.

Example: 5879 (Cumberland), 5906 (Lycoming), 5856 (Blair), 5887 (Erie)

Note: This field value will be provided by Comtech and auto-populated by GIS Data Hub.

5.89. GC QA/QC Exception Code

Description: Exception codes are used to notify the GIS Data Hub (GDH) Spatial Interface that a feature is an anomaly and that an identified error is a quality control check exception. As of this writing, only the 999 exception code, which is used to remove features outside the Provisioning Boundary, is available. Soon, GeoComm will distribute an updated list of exception codes and provide training and guidance on how to implement them.

Codes: 999

Example: 999

Notes:

- Exception codes cannot be used to mask NG911 critical errors, including overlapping road ranges, polygon overlaps, or missing mandatory attributes.

- This is a Pennsylvania NG911 GIS Data Model specific element and is driven by the GIS Data Hub Spatial Interface solution.

5.90. Comtech ESN

Description: A 3-5 character alphanumeric string that represents an Emergency Service Zone (ESZ) provided by Comtech. This element will be auto-populated by GIS Data Hub. It is also specific to the Pennsylvania NG911 GIS Data Model and is driven by the Comtech NG911 solution.

Example: 4152

5.91. Comtech ESN Left

Description: The Comtech Emergency Service Number (ESN) on the Left side of the road segment relative to the FROM Node.

Example: 4126

Notes:

- These ESNs will be provided by Comtech.
- This value will be auto-populated by GIS Data Hub.
- This element is specific to the Pennsylvania NG911 GIS Data Model and is driven by the Comtech NG911 solution.

5.92. Comtech ESN Right

Description: The Comtech Emergency Service Number (ESN) on the Right side of the road segment relative to the FROM Node.

Example: 4126

Notes:

- These ESNs will be provided by Comtech.
- This value will be auto-populated by GIS Data Hub.
- This element is specific to the Pennsylvania NG911 GIS Data Model and is driven by the Comtech NG911 solution.

5.93. Z Level

Description: Z fields (usually there are two one at start and one at the end for roads) are fields used to display Z axis or height of the feature. Often times it is not an actual height but a relative height (0 for ground level, 1 for above ground level). Used when roads are all snapped even at overpasses and underpasses to make sure that users are only routed down true intersections and not off of a ramp.

Domain: None

Example: 0, 1

5.94. Parcel Identifier

Description: A finite, punctuated sequence of numbers which identifies each separate tract, lot, land parcel or other interest of real estate in a county.

Domain: None

Example: 43+,005.0-0314.00-000+; 88534302788642

Note: This is a Pennsylvania NG911 GIS Data Model specific element.

5.95. Taxing Authority

Description: The primary local Incorporated Municipality to which property taxes are paid for the Site or Structure.

Note: This is a Pennsylvania NG911 GIS Data Model specific element.

Domain: None

Example: Nanty Glo Borough; Milford Township

5.96. Zip Plus-4

Description: A 4-digit code that when added to the Postal Code refines the mail delivery point down to a specific block or building and may prove useful to validate locations. ZIP Plus-4 codes change more often than US Postal codes because they are associated with delivery routes.

Domain: Restricted to the values provided in the USPS ZIP + 4® Product

Example: 0002; 1323; 2908

6. Impacts and Considerations

This section outlines how locally maintained GIS data is consumed by the NG911 system's functional elements and is based on Section 8 of the NENA Standard for NG9-1-1 GIS Data Model (see pages 87 – 89).

The Commonwealth of Pennsylvania's NG911 system relies on GIS data built, maintained, and shared by county 911 Authorities as the core database for civic location validation and 911 call routing. NG911 includes a new concept, the Emergency Services Internet Protocol network (ESInet) to facilitate communications among NG911 functional elements such as the Emergency Service Routing Proxy (ESRP), Emergency Call Routing Function (ECRF), Location Validation Function (LVF), and the PSAP. The ECRF is the primary location-based routing element. The LVF is the primary mechanism to determine that a civic address location is valid for routing and dispatch. Both ECRF and LVF use the same underlying GIS data.

The data format described in the document is expressly designed to facilitate conversion to NENA-STA-10 [4], Appendix B Spatial Interface (SI) data model. This allows a GIS system conforming to this data model, or capable of being automatically converted to this model, to be used to provision the ECRF and the LVF. The former is used to route emergency calls, and the latter is used to validate civic location prior to loading it into a Location Information Server (LIS). LVF validation is analogous to MSAG validation of an address prior to loading it into an ALI within an E911 system.

If both address points and road centerline ranges exist in the ECRF for the location of the caller, the address point route will be used. If there is no match of address points, but a road centerline or range segment matches, the route for that centerline segment will be used.

6.1. Operations Impact Summary

This NG911 GIS Data Model, based on NENA's Standard for NG911 GIS Data Model, requires higher levels of standardization and attribute detail than existing E911 GIS data standards contained in NENA Standard Data Formats for 911 Data Exchange & GIS Mapping, NENA-STA-015.10-2018 [16]. Existing GIS data may need to be manipulated and/or enhanced to conform to this standard structure.

County 911 Authorities are responsible for provisioning to GIS Data Hub, Pennsylvania's NG911 spatial interface solution, with local GIS data, which may require new procedures, processes, and training.

This GIS data model provides guidance on formatting of GIS data prior to use in NG911. This document defines the minimum GIS Data Model required for E911 and NG911. County 911 Authorities and other agencies must understand that a common baseline GIS data model must be established, recognized, and followed in order to participate in an interoperable NG911 environment. This document provides that baseline GIS data model.

This NG911 GIS Data Model represents not only the minimum set of GIS data which should be used for 911, but also recommended and in some cases locally required data for public safety. Non-standard field names and their associated attributes, as well as additional GIS data layers not discussed within this document, are allowed in order to meet individual entity needs. For example, additional data fields may be added to the road centerline data for number of lanes, maintaining entity, planning district, and so forth. Additional layers, data fields, and associated attributes are allowed and encouraged to meet local, regional, and other organization needs but are beyond the scope of this document.

Note: fields that are outside of this data model that are included in county 911 Authority's NG911 GIS data submissions are ignored by the GIS Data Hub spatial interface and not passed into the statewide set of NG911 GIS layers. This allows localities to potentially use their NG911 GIS data for other business and government functions.

6.2. Technical Impacts Summary

Hardware and software manufacturers may need to adapt their existing Customer Premise Equipment (CPE) or call handling software, Computer Aided Dispatch (CAD), map display, and related software to support this new format.

Service vendors may need to adapt their existing processes, procedures, and services to meet the new data needs.

Originating Service Providers (OSPs) may need to adapt existing software and systems to handle the new formats and use the PIDF-LO data structure.

6.3. Security Impact Summary

GIS data may contain confidential, proprietary, and/or sensitive information which must not be introduced into the public domain. For example, certain information that telephone companies, other data providers, and the Federal government (e.g., United States Postal Service, Department of Defense, Department of the Interior) furnish to local governmental entities, including those which provide 911 emergency services, are confidential or controlled under many laws and policies. Such information may be considered confidential and/or proprietary when included in databases and on maps used by entities in the provision of emergency services. Confidential information must not be redistributed outside of 911. Sensitive information implies a loss of security when disclosed to others.

7. Data Development and Maintenance Considerations

7.1. General Considerations

Use of orthoimagery versus GPS data collection devices – The availability of current, high resolution orthoimagery can provide a cost-effective way to create spatially accurate address points, add new road centerlines, or compile changes in existing road centerlines. Road centerline compilation and address point placement done in the office is much more efficient than sending staff into the field with GPS units to collect geospatial coordinates for addressed locations and road alignments. Consider limiting GPS use to collect locations for:

- Subaddresses
- Sites, structures and new roads not yet present in the existing imagery
- Sites, structures, and road centerlines that are not clearly discernible in the existing imagery
- More detailed guidance for developing Road Centerlines (RCL) data is discussed below in section 7.6 and Site/Structure Address Points (SSAP) data in section 7.8.

7.2. Quality Control of Next Generation 911 GIS Data

Quality Control (QC) 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 NG911 GIS data is categorized into two categories: critical and non-critical. Critical errors will cause issues with NG911 call routing and location validation functions and will not be accepted into the NG911 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. QC checks are automatically performed by the GIS Data Hub spatial interface whenever a dataset is provisioned. Counties can perform QC checks on demand and have access to QC fallout reports within a few hours of provisioning their data. For a full list of QC checks performed by GIS Data Hub, see Appendix B.

7.3. PSAP Boundary Delineation

The statewide Public Safety Answering Point (PSAP) layer consists of 61 PSAPs serving 67 counties. Each county is responsible for providing 911 service in their jurisdiction. Counties can accomplish this

by operating a countywide 911 system or by participating in a regional 911 system. County GIS data stewards must work with the appointed county 911 coordinators in their jurisdiction first and then with their counterparts in neighboring jurisdictions to define their respective PSAP boundary. The entire PSAP boundary should be seamless, without unintentional gaps or overlaps. In some cases, this may require coordination with a neighboring PSAP in an adjacent state. With 911 coordinator or designee approvals, GIS data stewards must take initiative to collaborate with neighboring PSAPs to submit identical boundaries. It is strongly recommended that PEMA, PSAPs, and GIS offices make every effort to coordinate all GIS boundary layer development (i.e., PSAP Boundaries, Emergency Service Boundaries, and Provisioning Boundaries). PEMA and Comtech review PSAP Boundary layers at the regional and statewide levels to ensure they are free of topology errors.

Note: As of publication, boundary data for all the Commonwealth's 61 PSAPs has been shared with PEMA. PEMA is working closely with our county 911 and GIS stakeholders to resolve remaining critical errors and obtain a critical error free PSAP layer that provides statewide coverage.

7.3.1. GIS Data Elements

It is important to note that a PSAP Boundary is not always identical with a county's established geopolitical boundary. An approximation of the extent of the PSAP coverage area is contained in tabular fashion in the legacy MSAG. The ESN values contained in the dataset can be correlated to an individual PSAP and are helpful in creating a PSAP Boundary dataset.

Emergency Service Zones (ESZs) should be compared with PSAP Boundaries because the extent of an ESZ may reveal a corresponding PSAP Boundary configuration. Geocoding the 911 authority's MSAG will generate a point layer of addresses assigned to that PSAP. Physical features, such as mountains and rivers, may have also been used to establish the current ESZs or PSAP boundaries, or may encourage local 911 authorities to consider adjustments to these layers for future efficiencies in emergency notification and response.

All county jurisdictions also have Service Boundary datasets depicting fire, emergency medical service (EMS), and law enforcement response areas. These boundaries are typically used by Computer Aided Dispatch (CAD) systems within the PSAP. The statewide boundary dataset can make use of these local response agency service boundaries.

7.3.2. PSAP Boundary Use Cases

In the NG911 system, the PSAP Boundary layer, which is built and maintained by a county's GIS data stewards, is used in lieu of the tabular MSAG to assist in routing 911 calls to the appropriate PSAP.

Developing an accurate and current PSAP Boundary layer that is aligned to the PSAP Boundaries of adjacent counties is a critical first step in providing potentially lifesaving public safety services. It is imperative that the county 911 coordinator and county GIS data stewards work together to develop their PSAP Boundary layer in collaboration with 911 coordinators and GIS data stewards in all neighboring counties to ensure alignment of their data and to help avoid any coverage gaps or overlaps, which will not be permitted within the NG911 system.

Once a PSAP has a boundary layer created, the next step is for the county 911 coordinators and GIS data stewards to further refine these boundaries to ensure there are no gaps or overlaps. Further adjustments to the boundary should be done to accommodate ground truthing of

emergency response, considering terrain and other physical features and existing mutual aid and first due agreements.

Additionally, geospatial call routing can accommodate mobile callers and route calls placed from anywhere (For example: the middle of a lake, swamps, or woods). This capability necessitates a PSAP boundary with no gaps or overlaps in order to quickly route the call to the correct PSAP. Great care is needed to ensure that GIS data used for NG911 meets rigorous standards.

Regional taskforces are encouraged to facilitate regional workshops involving all counties where they can work collectively to identify boundary issues and develop solutions for any discrepancies that are found. Indeed, since the original publication of PEMA's Best Practices Guides in 2019, we have seen examples of regional and interregional cooperation across the Commonwealth in delineating PSAP boundaries. Below are two examples that highlight instances where neighboring PSAPs coordinated the development of their respective PSAP Boundaries.

Use Case 1: Cumberland County and Franklin County

Figure 7-1: Final PSAP Boundary: Franklin and Cumberland

Cumberland County and Franklin County have gone through a PSAP Boundary delineation process with their GIS staff and 911 directors. The PSAP Boundary decisions they made are documented below.

Gunters Valley Example:

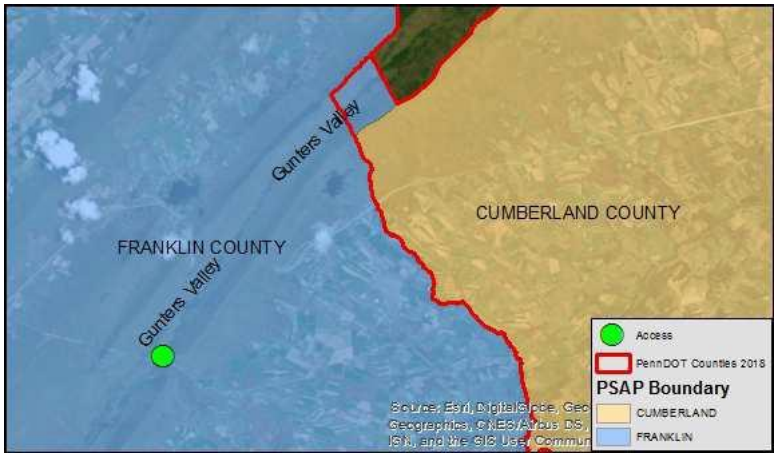

Figure 7-2: Gunters Valley

Gunters Valley runs along the border of Franklin, Cumberland, and Perry counties. Gunters Valley is long and narrow, with 1000 foot ridges on either end. There is only one road accessing the valley and it is only accessible from Franklin County. Because no direct access exists from Cumberland County, the section of Gunter Valley in Cumberland County has been assigned to the Franklin County PSAP.

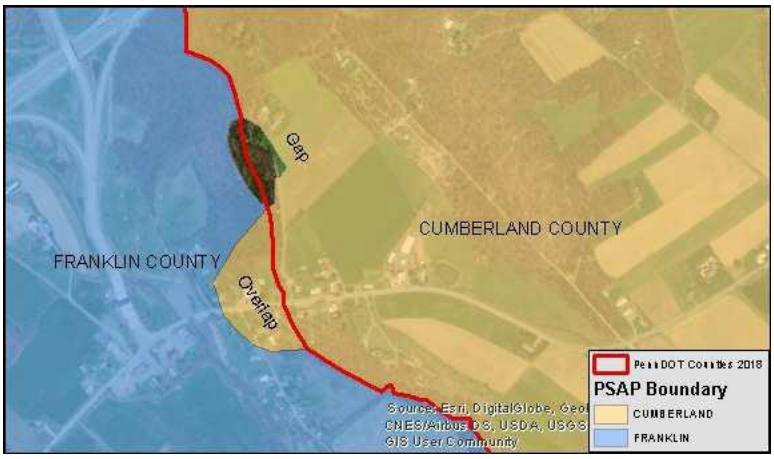

Figure 7-3: Coverage Issues

Great care is needed to ensure that GIS data used for NG911 meets public safety grade standards. PSAP Boundaries are required to be topologically clean with no gaps or overlaps.

Middle Springs Creek Example:

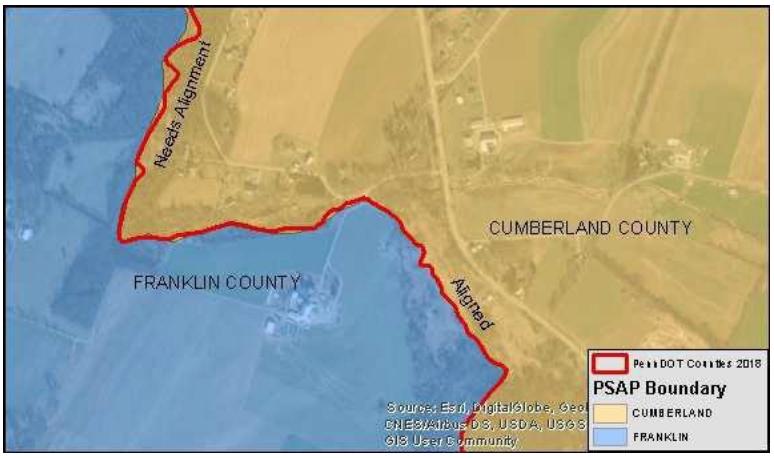

Figure 7-4: Conflicting Coverage Issues

County boundaries form the foundation of PSAP Boundaries in Pennsylvania, but in some instances a county boundary may not always maintain a one-to-one alignment with its respective PSAP Boundary. Middle Spring Creek illustrates this case in point. The creek forms a portion of the boundary between Franklin County and Cumberland County. The lower section of Figure 7-4 shows Franklin and Cumberland counties' PSAP Boundaries aligned with the 2018 PennDOT County Boundary GIS data layer. Between 2016, when this PSAP boundary was first created, and 2018, PennDOT updated this boundary to better reflect Middle Springs Creek geometry. The upper section of Figure 7-4 shows a section of Franklin and Cumberland Counties'PSAP

Boundaries that requires alignment.

Parcel Split Examples:

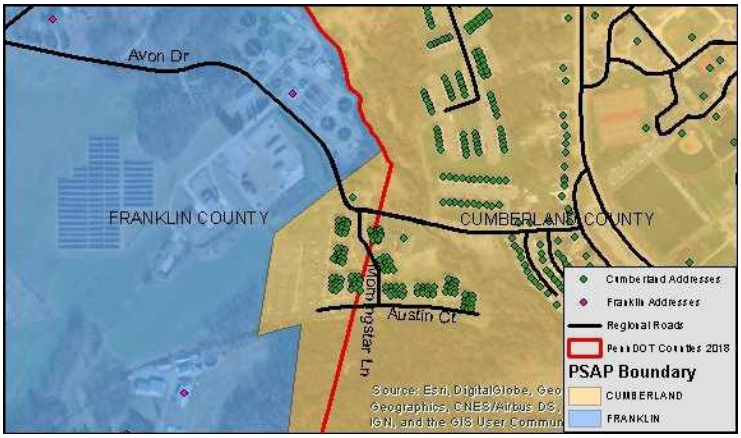

Figure 7-5: Parcel Splits by County Boundary

A thorough review of properties and their corresponding GIS data along county boundaries is necessary. Legacy 911 and the tabular MSAG and ALI records used the assigned addresses to route calls to the appropriate PSAP. Figure 7-5 shows a housing development that is bisected by the 2018 PennDOT County Boundary GIS layer. Cumberland County has first due responsibilities for fire and rescue services to this neighborhood. As such, the PSAP boundary was adjusted to route all 911 calls placed from within that neighborhood to Cumberland County's PSAP, even though the area is geographically within Franklin County.

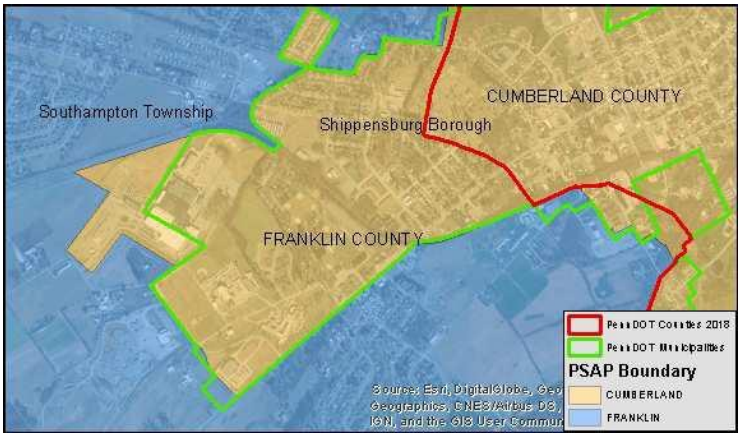

Figure 7-6: Jurisdiction Splits by County Boundary

Shippensburg Borough is split by the county boundary between Cumberland and Franklin counties. Many years ago, the Cumberland County PSAP accepted responsibility for receiving 911 calls from the entirety of Shippensburg Borough. As illustrated in Figure 7-6, the Cumberland County PSAP Boundary has been adjusted to cover all of Shippensburg Borough, including the portion in Franklin County. Also shown in the left section of Figure 7-6 is the Volvo plant that straddles Shippensburg Borough and Southampton Township. Since Shippensburg Borough is first due to the whole facility, the Cumberland County PSAP boundary was adjusted to cover the Volvo plant.

Use Case 2: Tioga County, Lycoming County, and Sullivan County

Tioga County GIS, along with Lycoming County GIS, took an initiative with the intent to establish and create logistically correct PSAP boundaries that will meet the topology rules necessary to function in the NG911 data model. In order to efficiently work out the discrepancies noticed between the two PSAP boundaries, Lycoming County and Tioga County staff focused on the primary objective, which is to route 911 calls to the proper PSAP. The first step in this process was to review the existing selective routing in order to establish the correct geographic area of the PSAP.

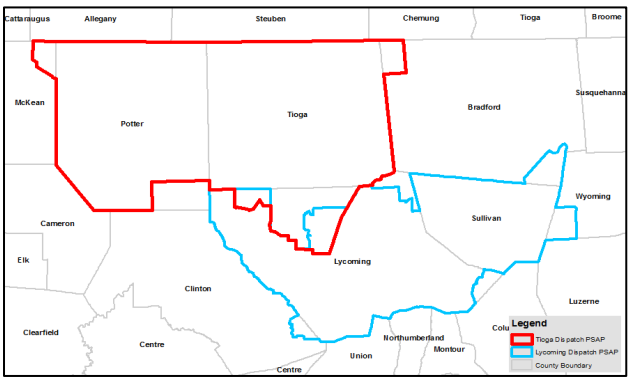

Figure 7-7: Tioga and Lycoming/Sullivan PSAP

A great deal of collaboration between GIS data stewards and 911 authorities and PSAP staff was required throughout this process. For example, the Tioga County PSAP is especially complicated because it is an answering point for not just all of Tioga and Potter counties, but also for portions of McKean, Lycoming, and Bradford counties.

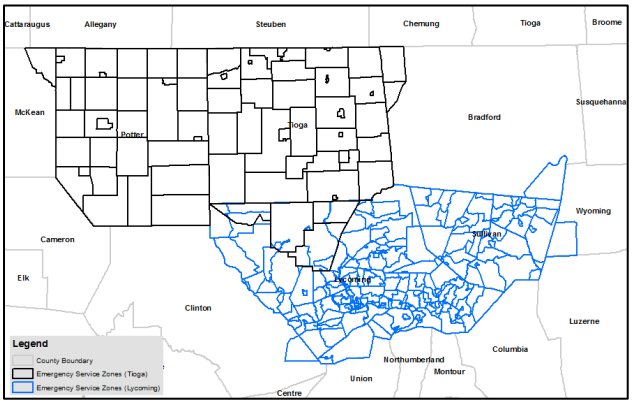

Figure 7-8: ESZ boundaries for Lycoming/Sullivan

They noticed a significant amount of overlap with PSAP layer and the ESZ (Emergency Service Zones) layers and realized that the ESZ layer could be a major component in refining the PSAP boundary.

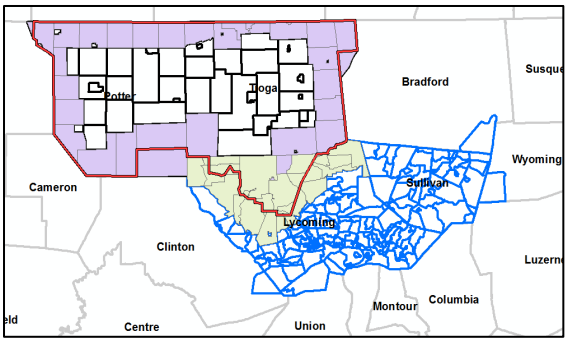

Figure 7-9: ESZ boundaries intersecting the PSAP

Both counties agreed to a perpetual data sharing cooperative to support NG911 feature compilation and Quality Control (QC). This sharing of datasets allowed for the GIS personnel of both organizations to overlay the data in ArcMap, which clearly revealed the discrepancies.

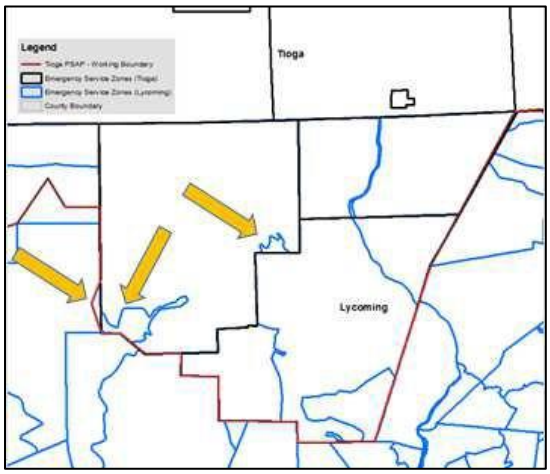

Figure 7-10: Boundaries overlap issues

Data from both counties showed discrepancies like overlapping ESZ boundaries. All the discrepancies that would affect the PSAP Boundaries were identified and documented. These discrepancies were discussed between the two counties, in sessions that involved all relevant 911 and GIS stakeholders.

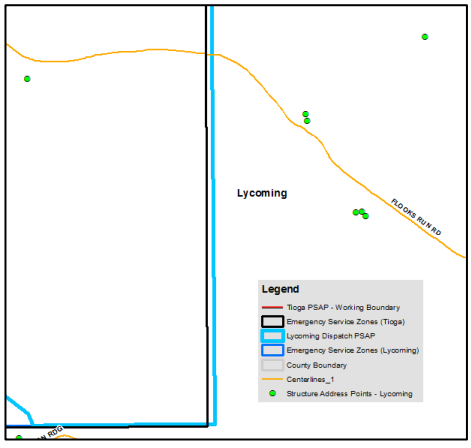

Figure 7-11: Example of changing PSAP boundary for access reasons

In order to determine the correct course of action, the supporting data layers utilized in the 911 dispatch systems from both counties were overlaid in ArcMap. The most critical layers utilized were Road Centerlines, Site/Structure Address Points, ESZ/ESN boundaries, and municipal boundaries.

With proper symbolization in ArcMap, the combined GIS datasets revealed discrepancies that managers from both organizations could easily identify. These uniformly displayed datasets allowed for consistent communication to occur back and forth between the organizations until solutions were decided upon. Final changes were then applied to the master datasets of both organizations.

Figure 7-11 shows why it was decided that Flooks Run Rd should be included in Tioga's PSAP as the properties on this road in Lycoming County cannot be accessed from Lycoming County.

To summarize, by sharing the entire datasets of these jurisdictions and then displaying them via a properly symbolized ArcMap document for all managers to utilize, complicated problems became much simpler to identify and solve. All solutions to the discrepancies were then communicated to all stakeholders for approval and applied to the master datasets.

Other recommended GIS layers for use in this process include:

- Hydro (water)
- Box Locations
- Phone Lines
- Data for Cellular (tower, coverage area, etc.)

7.4. Provisioning Boundary Delineation

The Provisioning Boundary layer defines jurisdictional areas for local GIS data stewards who are vested in the creation and maintenance of spatial data in their respective jurisdictions. Data updates and error corrections within the defined Provisioning Boundary must be approved by the 911 Coordinator or designee and submitted by the GIS data steward. Each Provisioning Boundary only has one individual or entity operating as the provisioning authority, and there can be no gaps or overlaps between adjacent boundaries.

The Provisioning Boundary must be agreed to by all adjoining data-provisioning providers. The associated polygon layer can be used for geoprocessing by the ECRF to identify and exclude erroneous features that lie beyond the boundary; it also can be used by the Forest Guide to determine coverage for a data-provisioning authority. (The Forest Guide is an element of the Location-to-Service Translation [LoST] protocol that helps to determine the correct emergency call routing based not only on the location of the caller, but also jurisdictional factors.) The Provisioning Boundary is a mandatory layer in the Commonwealth's schema structure.

When provisioning data for the ECRF and location validation function (LVF) through the GIS Data Hub spatial interface (SI)— both are NCGS functional elements—the locally appointed 911 authority must submit GIS data for its geographic area of jurisdiction only and must ensure that the data is inclusive of its geographic area of jurisdiction. For more information on building, maintaining, and provisioning data for areas that have a cross-jurisdictional responses where one or more service layers extend beyond the Provisioning Boundary, see Appendix D.

7.5. Emergency Service Boundaries for Fire, Law, and EMS Delineation

The set of Emergency Service Boundaries (ESBs) must include, at a minimum, the following:

- Law enforcement (ESB_LAW)
- Fire (ESB_FIRE)
- Emergency Medical Services (ESB_EMS)

Other Emergency Service Boundaries may include but are not limited to:

- Poison Control
- Forest Service
- U.S. Coast Guard
- Animal Control

The list above is not comprehensive. Other emergency service providers may have boundaries created for them, based on the unique needs within a geographical area. The local 911 authority MAY maintain the Service Boundary layer as a combined or single layer for each emergency service. However, when exchanging Service Boundary information in an NG911 environment, Emergency Service Boundaries MUST be exchanged as individual layers for each emergency service type, e.g., one for law enforcement, one for fire, and one for EMS.

7.6. Roads Centerlines Best Practices and Common Issues

7.6.1. Considerations for Road Centerlines

Accuracy of boundary data (for alignment/segmentation at boundaries)*:* accurate boundary data is essential to accurate NG911 data. Overlapping boundaries can create issues when segmenting data. When aligning Road Centerlines with any boundary, the local jurisdiction should always check with the GIS data steward for the entity responsible for maintaining that boundary alignment to ensure the correct boundary is being used. Note that Pennsylvania is currently working with its six adjacent states on developing an agreed upon boundary, which when finalized, will provide an additional resource for correctly aligning and segmenting Road Centerline data. In the meantime, jurisdictions that border adjacent states should collaborate with their counterparts in those states (typically county GIS and 911 staff) to ensure agreement on data alignment.

Additionally, counties are strongly encouraged to work together to edge match their road centerline data with neighboring jurisdictions. While this is not a requirement for NG911, it may support future NG911 applications and could support regional CAD projects.

Note: when aligning Road Centerlines to boundaries, it is Strongly Recommended that the Road Centerline be snapped to the polygon boundary by snapping its terminating vertices to the polygon. This may mitigate warping that can result from reprojecting data.

Limitations of Computer Aided Dispatch (CAD) software (0-0 ranges; breaking at over/underpasses): each CAD software has its own requirements when dealing with road centerline data. In some cases, CAD software may require 0-0 ranges,while others may not. Some CAD software may also allow for Z (height) values, which will affect how road centerlines are split at over/underpasses. These best practices may not account for each CAD software vendor's specific requirements and therefore the data developer should always refer to CAD software requirements whenever updating Road

Centerlines.

7.6.2. General Best Practices

Road alignments should be compiled from current orthoimagery or a high-quality data collection device and attributed using source data with reliable attribution. The accuracy of the Road Centerlines dataset is only as good as the least accurate data source or data collection device that was used to create it.

7.6.3. Road Centerline Segmentation

Road segmentation is an important part of the data development process for NG911 Road Centerlines data. There are different ways that segmentation may need to be done, and these may be based on the requirements of the local CAD vendor. In most cases, roads should not be split at driveways, unnamed roads, or parking lots. As a best practice, roads should always be split in the following cases:

- Road Intersections
- Boundaries: PSAP, Fire, Law and EMS Service Boundaries, ESN, MSAG Community, County, Incorporated Municipality
- Other boundaries: Unincorporated Community, Neighborhood Community, and Postal Boundaries (only if these are being maintained in the Road Centerlines dataset)

In cases of overpasses and underpasses, how the data is split may be dependent on your local CAD software. If the software handles Z values, the best practice would be not to split the roads at underpasses and overpasses. Always confirm with your CAD software vendor.

Limited access roads typically have two road centerlines representing each direction of travel. There should be a single road centerline when there is only yellow striping separating the travel directions. When there is a physical barrier, each side of the road should have its own centerline representation.

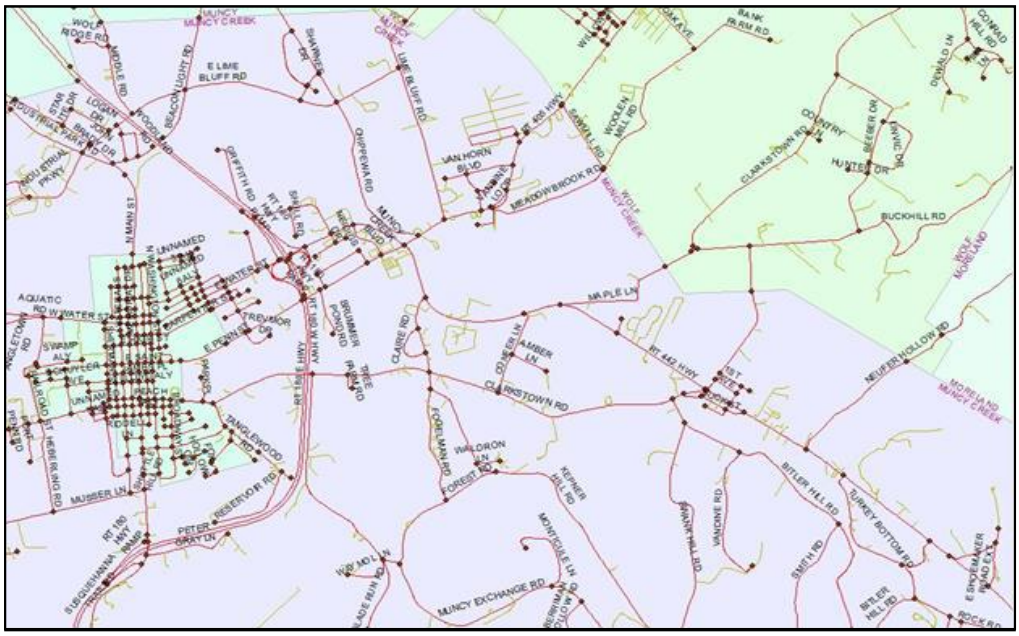

Figure 7-12: Example of Road Centerlines segmentation

Figure 7-12 from Lycoming County, above, shows road segments as lines with points representing road splits. Roads are split at municipal boundaries and (on rare occasions) at agreed upon landmarks such as the center or ends of bridges. Limited access highways are shown with dual lines representing both directions of travel.

Alignment at Borders

Aligning Road Centerlines at borders is essential to maintaining accurate NG911 location data. Road Centerlines must be aligned and snapped to the following borders:

- PSAP Boundary
- Provisioning Boundary

Figure 7-13 below shows Baun Lane split at the Provisioning Boundary line, even though the Somerset County PSAP Boundary includes the entire road. Note that no gaps or overlaps exist in the address ranges.

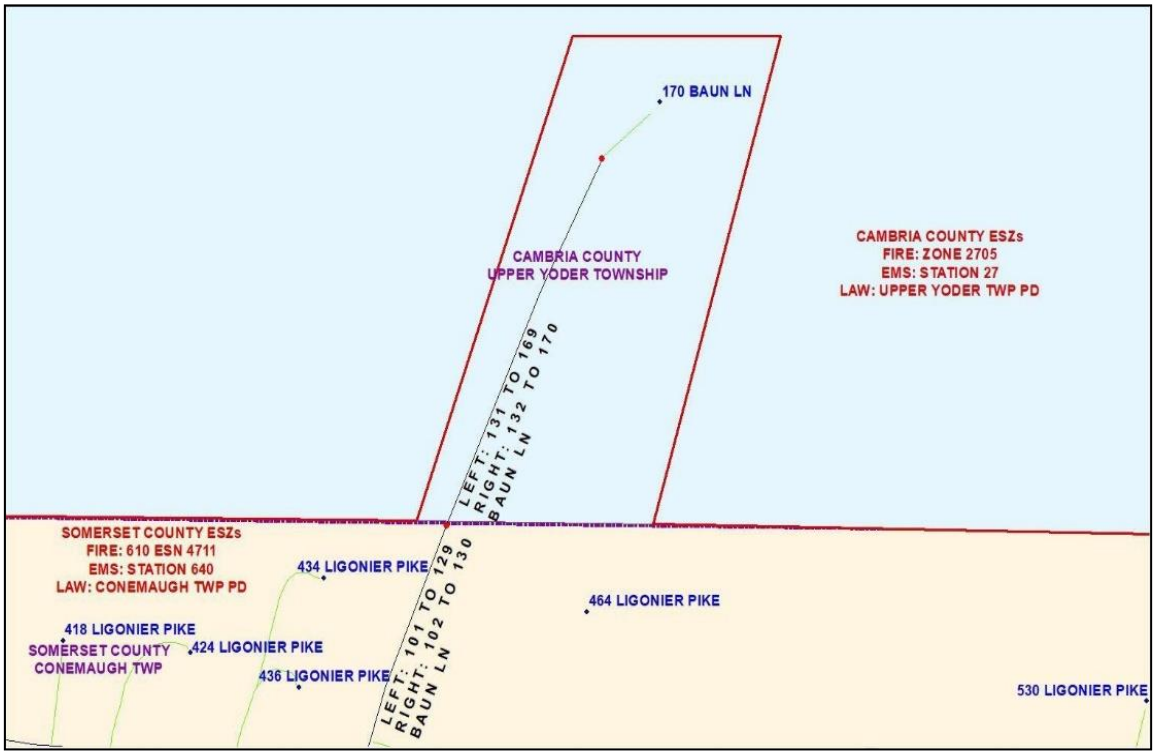

Figure 7-13: Example of Road Centerlines segmentation at Provisioning Boundary

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 incorporated municipality as they usually have responsibility for naming roads in their jurisdiction.

Road Centerlines topology should be checked against boundary datasets to ensure that Road Centerlines are snapped to the boundaries. Some Road Centerlines follow 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 Commonwealth of Pennsylvania

should already be topologically correct for NG911, border states are likely to have a conflict with boundary delineation. Pennsylvania borders the following states:

- New York
- New Jersey
- Delaware
- Maryland
- West Virginia
- Ohio

There are other ongoing discussions being held with these surrounding states on aligning borders. 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.

Additionally, as if the date of this publication, the Federal Highway Administration (FHWA) is conducting a National Road Network Pilot Project that includes the development of state match points. These identify roads that cross state borders and may prove useful in ensuring road networks are connected between Pennsylvania and its neighboring states.

Note: Erie County, Pennsylvania shares an international maritime border with Ontario, Canada. Erie County's PSAP boundary extends into Lake Erie to the United States – Canadian border.

7.6.4. Naming and Addressing

Interstate Highways

Interstates and highways should be named according to their jurisdiction. Traveling direction (e.g., northbound, southbound, eastbound, westbound) should be used and should be placed in the Post Modifier field in lowercase.

Example: I80 EB and I80 WB	
Street Name Pre Type:	Interstate
Street Name:	80
Street Name Post Modifier:	eastbound
Street Name Pre Type:	Interstate
Street Name:	80
Street Name Post Modifier:	westbound

Interchange Ramps

Ramp and interchange naming can be a particularly challenging. It is strongly recommended that as much information as possible is put into the ramp names, including the FROM road, TO road, traveling direction, and exit number as appropriate. Ramps should be single segments.

The following ramp naming convention is recommended, with everything placed in the Street Name field:

<Ramp/Exit #> <FROM Street> <travel direction> to <TO Street> <travel direction>

Where:

- Ramp/Exit #: The text “Ramp” or “Exit <#>”

Note: If there is no exit number for ramps between an undivided road and a divided road, then “On Ramp” and “Off Ramp” are preferred to the generic “Ramp” designation.

- FROM Street: Route/Street Name that the ramp is coming off of
- TO Street: Route/Street Name that the ramp goes to
- Travel direction: *northbound, southbound, eastbound, westbound* traveling direction, in lower case

Due to the 60-character field width limitation of the Street Name field, the following abbreviations should be used with the numbered routes for ramp names ONLY:

- I – Interstate
- US – United States Highway, United States Route
- PA – State Highway, State Route
- CR – County Highway, County Route, County Road
- TWP – Township Road

Figure 7-14: Example of ramp names in Montgomery County

Example ramp names as shown in Figure 7-14 in the recommended ramp naming convention:

- **Street Name:** Exit 16A I476 northbound to I76 eastbound
- **Street Name:** Exit 16B I476 northbound to I76 westbound

- **Street Name:** Exit 331A I76 eastbound to I476 southbound
- **Street Name:** Exit 331B I76 eastbound to I476 northbound

Rest Areas/Service Plazas

Rest areas and service plazas can be isolated (entry only from a limited access highway) or accessible via a local road. The main service roads in and out of an isolated service plaza should be treated as driveways. Local roads which provide access to a rest area/service plaza should be treated as any other local road.

Divided Highway Connector Roads

Divided highways frequently include connector roads intended for use by emergency vehicles and maintenance vehicles to quickly get to the other side of the road without having to go to an exit or interchange. For the purposes of consistency, these roads should be named "Crossover".

7.6.5. Overlapping Routes and Multiple Street Names

Street names are an important part of any NG911 system. However, in many cases, roads can be known by several different names, especially by different agencies. Local jurisdictions may assign a local name for a road, while PennDOT may assign a specific state route number to that same road segment. To further complicate the street name issue, the road may also have a US route number, a second state route number, a county route number, or another name for that same road segment.

These multiple street names are all important in the NG911 system. However, they cannot currently all be captured in the PEMA NG911 GIS Data Model. In the future, it is expected that an Alias Street Name table will be built which will allow an unlimited number of alias street names to be cross referenced from the Road Centerline geometry to a related table which will allow storage of all the different street names.

Within the current PEMA NG911 GIS Data Model, the Complete Alias Street Name attribute field has been developed to allow for one additional alias street name. This is a conditional field that must be populated if an alias street name exists.

The official 911 street name for a road is always populated in the Street Name elements. Sometimes it maybe a local name (e.g., Main Street) and sometimes it may be a route number (e.g., United States Route 11). To utilize the Street Name and Complete Alias Street Name fields most effectively, one should use the following hierarchy to determine how the fields should be populated:

- Local 911 Street Name (highest priority)
- Interstate Name
- Interstate Business Route name
- US Route name
- US Business, Alternate, or Truck Route name
- State Route name
- State Business, Alternate, or Truck Route name
- County Route Name
- Other local or memorial street name (lowest priority)

In cases of concurrent routes with no local street name:

The highest jurisdiction route would be put into the Street Name elements, and the lower jurisdiction route would go into the Complete Alias Street Name.

Example: US Route 6 and PA 660 in Wellsboro, PA overlap but there is no local street name.	
Street Name Pre Type:	United States Route
Street Name:	**6**
Complete Alias Street Name	State/Route 660

When multiple routes with the same jurisdiction overlap but there is no local street name:

The lowest route number would go into the Street Name elements and the next higher route number would go into the Complete Alias Street Name. Any additional route numbers would not be represented in the data at this time. However, in the future all alias route numbers would be placed in the Complete Alias Street Name Table.

Example: PA 85, PA 210 & PA 954 in Beyer, PA all overlap but there is no local street name.	
Street Name Pre Type:	State Route
Street Name:	85
Complete Alias Street Name:	State Route 210

If routes overlap a local name:

The local street name would go into the Street Name elements, and the route number with the highest jurisdiction would go into the Complete Alias Street Name.

Example: US Route 30 in Gettysburg, PA has a local jurisdiction street name of York Street but it is also known locally as Lincoln Highway.	
Street Name:	York
Street Name Post Type:	Street
Complete Alias Street Name:	United States Route 30

7.6.6. Roundabouts and Traffic Circles/Squares

Naming of roundabouts, traffic circles, and traffic squares can be complicated, particularly when routes overlap the official 911 street names or when street names end or change at the circle. Many of the street naming concepts for overlapping routes, divided highway connector roads, and multiple street names that are discussed in the previous section, above. Overlapping Routes and Multiple Street Names can be applied to roundabouts and traffic circles.

If two roads intersect at a roundabout or traffic circle:

Populate the Street Name elements with the official 911 street name on those segments in the circle that one would traverse to get to the other side of the circle. In situations where a segment in the circle

would be traversed by both intersecting roads, populate the Street Name elements with the street name of the road with the higher jurisdiction, following the same hierarchy as established above in Section 8.6.5. Overlapping Routes and Multiple Street Names. Populate the Complete Alias Street name on segments in the circle traversed by both intersecting roads with the street name of the road with the lower jurisdiction.

The Complete Alias Street Name for segments in the circle traversed by only one intersecting road would be populated with the name of an overlapping route or other valid alias street name, following the same hierarchy as described above in Section 7.6.5. Overlapping Routes and Multiple Street Names. However, if there is no overlapping route or alias street name, populate the Complete Alias Street Name with the Street Name of the intersecting road, adding "Connector" as a Post Modifier on the segments that the intersecting road does not traverse through to get to the other side of the circle.

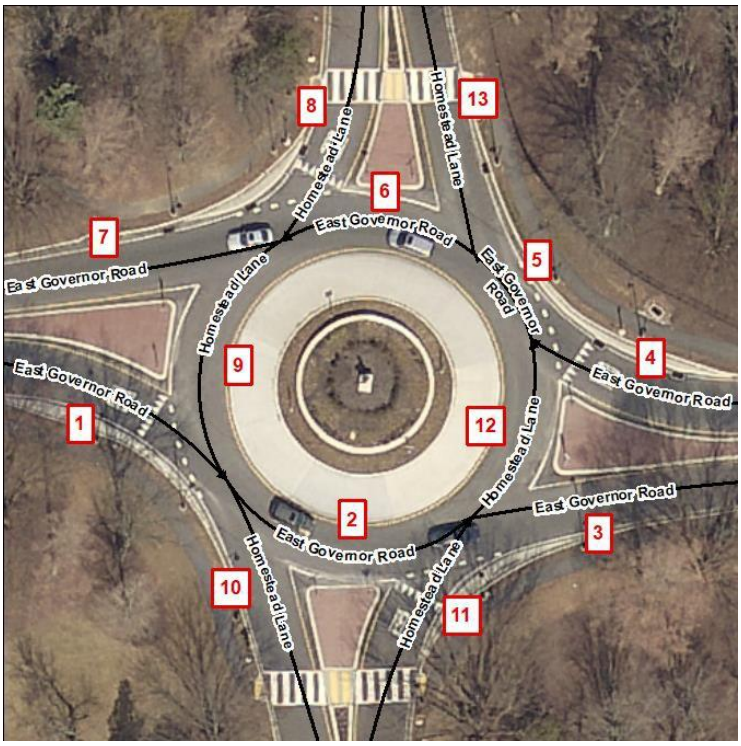

Figure 7-15: Example roundabout with two intersecting roads

For example, in Figure 7-15 above East Governor Road runs east-west through the roundabout on segments 2, 5, and 6 and Homestead Lane runs north-south through the roundabout on segments 9, 12, and 5. Since Governor Road is a higher jurisdiction (US Route) than Homestead Lane (local), the Street Name elements for segment 5 would be populated with Governor Road and Homestead Lane would be the Complete Alias Street Name.

The Complete Alias Street Name for segments 2 and 6 would be populated with United States Route 322, which overlaps East Governor Road. Since Homestead Lane has no alias street name, the Complete Alias Street Name for segments 9 and 12 would be populated with East Governor Road Connector. Table 7-1, below, provides the recommended population of the Street Name elements and the Complete Alias Street Name for all segments in Figure 7-15.

Segment #	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	Complete Alias Street Name
1		East			Governor	Road			United States Route 322
2		East			Governor	Road			United States Route 322
3		East			Governor	Road			United States Route 322
4		East			Governor	Road			United States Route 322
5		East			Governor	Road			Homestead Lane
6		East			Governor	Road			United States Route 322
7		East			Governor	Road			United States Route 322
8					Homestead	Lane			
9					Homestead	Lane			East Governor Road Connector
10					Homestead	Lane			
11					Homestead	Lane			
12					Homestead	Lane			East Governor Road Connector
13					Homestead	Lane			

Table 7-1: Population of Street Names in Figure 8-15

If a street name ends at a roundabout or traffic circle:

Do not populate the Street Name elements with the ending street name on any segments in the circle. Instead, populate the Street Name elements on all segments in the circle with the Street Name of the intersecting road, adding "Connector" as a Post Modifier on the segments that the intersecting road does not traverse through to get to the other side of the circle.

For routing purposes, populate the Complete Alias Street Name with the ending street name on those segments in the circle that one would traverse to get to the road on the other side of the circle. Do not populate the Complete Alias Street Name with the ending street name on any segments in the circle if there is no road on the other side of the circle.

For example, in Figure 7-16 below, Blue Mountain Parkway and Pennsylvania Avenue both end at the roundabout where they intersect with Linglestown Road. The Street Name elements for segments 2, 3, and 7 would be populated with Linglestown Road since it runs east-west through the circle and these are the primary segments one would traverse through the circle. The Street Name elements for segments 9 and 10 in the circle would be populated with Linglestown Road Connector.

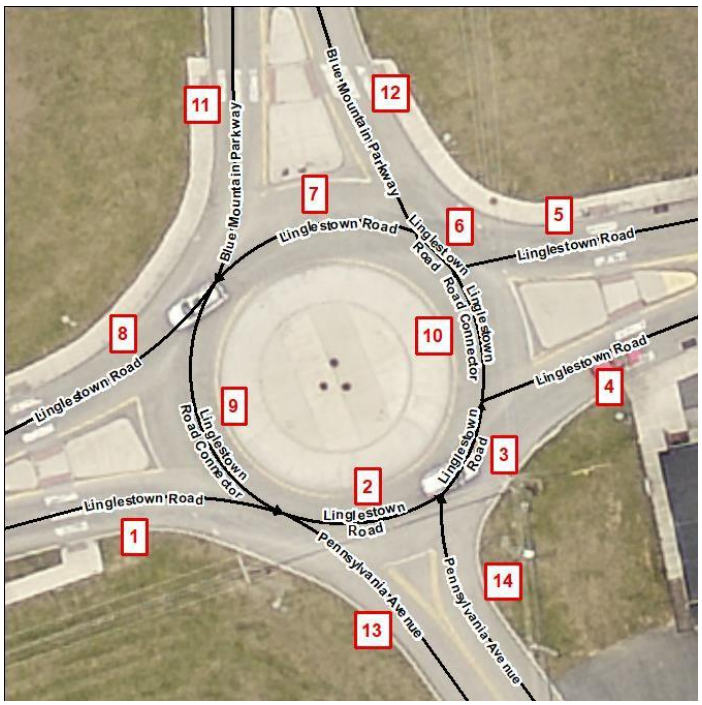

Figure 7-16: Example with street names ending at the roundabout

If a traffic circle has its own 911 street name, different than the intersecting roads:

Populate the Street Name elements with the traffic circle's 911 street name on all segments in the circle. If the intersecting roads continue through the traffic circle, populate the Complete Alias Street name with the street name of the road with the higher jurisdiction, following the same hierarchy as established above in Section 7.6.5. Overlapping Routes and Multiple Street Names.

Segment #	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	Complete Alias Street Name
1					Linglestown	Road			State Route 39
2					Linglestown	Road			State Route 39
3					Linglestown	Road			Pennsylvania Avenue
4					Linglestown	Road			State Route 39
5					Linglestown	Road			State Route 39
6					Linglestown	Road			Pennsylvania Avenue
7					Linglestown	Road			State Route 39
8					Linglestown	Road			State Route 39
9					Linglestown	Road		Connector	Blue Mountain Parkway
10					Linglestown	Road		Connector	Pennsylvania Avenue
11					Blue Mountain	Parkway			
12					Blue Mountain	Parkway			
13					Pennsylvania	Avenue			
14					Pennsylvania	Avenue			

Table 7-2: Population of Street Names

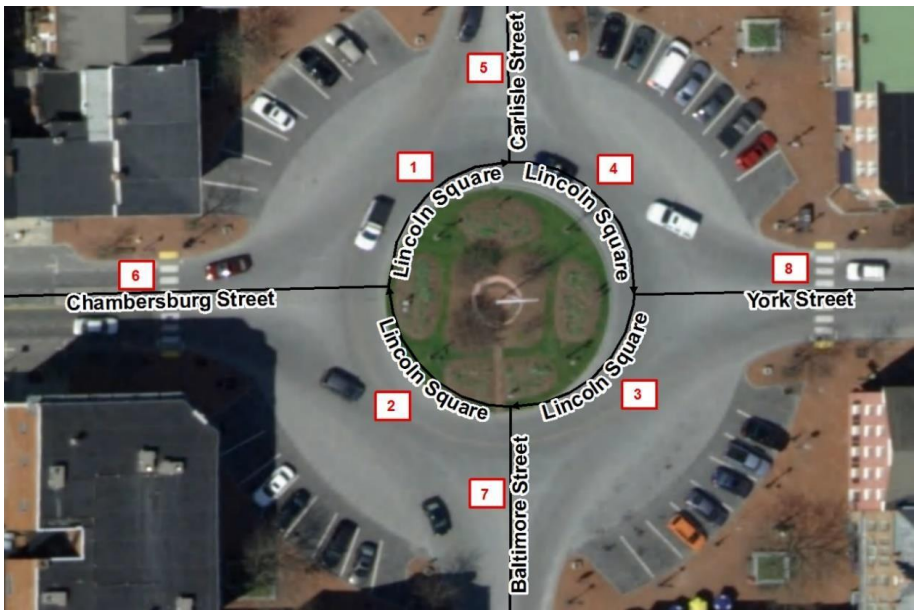

Figure 7-17: Example traffic circle with its own 911 street name

For example, in Figure 7-17 above the traffic circle has an official 911 street name of Lincoln Square. Therefore, the Street Name elements for segments 1, 2, 3, and 4 would be populated with Lincoln Square. The street names of all intersecting roads end at the traffic circle, so none are populated as the Complete Alias Street Name.

Since United States Route 30 overlaps the east-west roads, the Complete Alias Street Name for segments 1, 2, 3, and 4 would be populated with United States Route 30. Table 7-4 below provides the recommended population of the Street Name elements and the Complete Alias Street Name for all segments in Figure 7-17

Segment #	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	Complete Alias Street Name
1					Lincoln	Square			United States Route 30
2					Lincoln	Square			United States Route 30
3					Lincoln	Square			United States Route 30
4					Lincoln	Square			United States Route 30
5					Carlisle	Street			United States Route 15 Business
6					Chambersburg	Street			United States Route 30
7					Baltimore	Street			United States Route 15 Business
8					York	Street			United States Route 30

Table 7-4: Population of Street Names

7.6.7. Military Bases

Military bases may or may not have their own PSAP and responsibility for emergency services. In most cases, the military facility will share street name information but will not provide address specific information. It is recommended that the local 911 jurisdiction reach out to the military facility and work directly with them to obtain the most current information the facility is willing to provide.

7.6.8. Populating Validation Right/Validation Left

The intent of the Validation Right and Validation Left fields is to identify areas where only the Site/Structure Address Points should be used by the LVF for validation purposes and any address ranges on that side of the road segment should be ignored. Some locations have grandfathered addresses which are out of sequence with the Road Centerlines or may have parity issues (for example: odd address on the even side of the road).

Figure 7-18: Example where populating Validation Left is recommended

In Figure 7-18, the odd address of 715 is on the right side of 15th Street which has an address range of 700- 798, whereas odd addresses 705, 707, and 709 are on the left side of 15th Street which has an address range of 701-799. It is recommended that Validation Left on the segment associated with the odd addresses be populated with "N", indicating that the road segment on that side NOT be used for LVF validation since it would validate 715, but 715 does not exist on that side of the segment. As long as no even addresses in the 700-798 range exist elsewhere, Validation Right could be populated with "Y", indicating that side of the road segment CAN be used for LVF validation.

7.7. Parsing Street Names into the PEMA GIS Data Model

Parsing street names into their appropriate Street Name elements is usually straightforward. Most confusion arises when populating the new Pre Modifier, Pre Type, Pre Type Separator, and Post Modifier elements. The following table provides examples of how Street Names should be parsed. The NENA Next Generation 9-1-1 (NG9-1-1) United States Civic Location Data Exchange Format (CLDXF) Standard (NENA-STA-004.1.1-2014) [5] defines the detailed civic location data elements needed for address data exchange. Review of the document is strongly recommended as it provides an in-depth discussion of address parsing.

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
				Broadway			
				Mason Dixon	Highway		
				Cobbs Creek	Parkway		
	North			Center	Avenue		
				North	Avenue		
	North			Union	Street		
				North Union[1]	Street		
				South Carolina[1]	Avenue		
	South			West End[1]	Boulevard		
West[2]	South			4th	Street		
		United States Highway		22			
		State Route		301			
Old		County Road		40			
		Route		219	Bypass		
		Avenue		A			
Alternate	North	Avenue		B			
		Boulevard	of the	Allies			
		Avenue	of the	States			
		Lake	of the	Pines	Boulevard	South	
		Rue[3]	des[3]	Etoiles			
				Villa at the Woods[4]			
				Old Lane	Circle		
				Main Street[5]	Road		
				Main Street[5]	Extension		
				State	Street	East	
				Maple	Lane	South	Extension
				Main	Street		Extended[6]
				Lakeview	Drive		Fire Road 3
		Interstate		81			southbound[7]

Table 7-5: Street Name parsing examples

Notes:

- When the Street Name is a place name, the directional is included in the Street Name field and not parsed as a Street Name Pre Directional (requires local knowledge as to whether the directional is part of a place name).

- When two directional words occur together before the Street Name, the first occurrence is parsed as a Street Name Pre Modifier and the second is parsed as a Street Name Pre Directional.

- Foreign language (e.g., French, Spanish, Italian) equivalents of Street Name Pre Types and Street Name Pre Type Separators are parsed into these fields and not in the Street Name field.

- Since “Villa” is not a valid Street Name Pre Type and is not in USPS Publication 28 [13], Appendix C1, it is included in the Street Name field.

- When two Street Name Post Types occur after the Street Name, the first occurrence is included in the Street Name field and the second is parsed as a Street Name Post Type.

- Since “Extended” is not in USPS Publication 28 [13], Appendix C1, it is parsed as a Street Name Post Modifier.

- Traveling direction on divided roads is parsed as a Street Name Post Modifier (in lowercase).

- NENA maintains a Registry of known values for Street Name Pre Types and Street Name Post Types associated with a Street Name at http://technet.nena.org/nrs/registry/StreetNamePreTypesAndStreetNamePostTypes.xml. NENA also maintains a Registry of known values for Street Name Pre Type Separators associated with a Street Name at http://technet.nena.org/nrs/registry/StreetNamePreTypeSeparators.xml. When parsing addresses into these fields, confirm the parsed values already exist in the registries. Valid values that do not exist can be added to the NENA registries by request with appropriate supporting documentation. Contact the PEMA NG911 GIS Working Group who will coordinate all requests to add new valid values that exist in Pennsylvania to the NENA registries.

7.8. Site/Structure Address Points Best Practices and Common Issues

7.8.1. Considerations for Site/Structure Address Points

Programs developing Site/Structure Address Points need to carefully consider the level of positional accuracy desired and the resources available not just for initial data development but long-term data maintenance. In general, address point placement methodologies that result in more spatially accurate points require more resources to create and maintain them. Not all attribute fields are required for the ECRF and LVF to function. Having a strategy to populate these fields over time will help keep costs in check while making efficient use of available resources.

A detailed data development and maintenance plan should be created at the earliest stages to ensure the best use of available resources and address data. Considerations when developing such a plan include, but are not limited to, the following:

- **Placement Method (e.g., Structure, Site, Property Access, Parcel, Geocoding)**: Some address point placement methodologies require minimal resources while others are very resource intensive. Consider starting with a less spatially accurate placement method and over time gradually improve the spatial accuracy of the address points as resources allow. For example, use available parcel data to generate address points from parcel centroids and then, as resources permit, use orthoimagery to move the address points onto the sites and structures. This allows for quick creation of a Site/Structure Address Points layer that can be used immediately in 911 applications. Similarly, if using orthoimagery to place address points but field research is required for an address that cannot be clearly discerned on the imagery, create a temporary address point using the parcel centroid location if the parcel upon which it is located is known. Population of the Placement Method attribute is recommended in these situations to provide data users with information on the address point’s positional accuracy

- **Amount of subaddress detail needed:** Costs increase directly with the amount of subaddress detail that is collected. When determining the amount of subaddress detail needed, consider how 911 applications will use the data and how precise the address point location needs to be. At a minimum, enough subaddress detail should be provided to route 911 calls to the appropriate PSAP and get first responders to the correct location. Consider beginning with a low level of subaddress information and increase in granularity as time and resources permit. For example,

collect subaddress information that will correctly get responders to a specific building. Additional subaddress detail may be needed where a large site or building is split by an Service Boundary and subaddresses at that location are served by different responding agencies.

- **Limitations of CAD software**: It is important to understand the limitations and requirements of your CAD software as, currently, not all CAD software programs can natively ingest GIS data that has been formatted in NENA's NG911 GIS Data Model Standard, which the PEMA NG911 GIS Data Model is based on. Some optional fields may not be recognized and therefore population of those fields could be postponed. Consider the CAD software's ability to use stacked points, subaddress data in a related table structure, or even recognize subaddresses as unique addresses. Also consider if the CAD software can differentiate between the Placement Methods or requires a specific Placement Method (e.g., Property Access versus Structure). For example, a structure located far from the road it is addressed off of may benefit from having two address points: one address point at the driveway entrance (Placement Method = Property Access) and a second address point on the structure (Placement Method = Structure). If the CAD software cannot differentiate between the points, it may be preferred to only show one point.

7.8.2. Site/Structure Address Points General Best Practices

Address point placement should be based on an authoritative list of addresses, current orthoimagery, and source data with reliable attribution. The accuracy of the Site/Structure Address Points dataset is only as good as the least accurate data source or data collection device that was used to create it.

7.8.3. Address Point Placement

NENA's Development of Site/Structure Address Point GIS Data for 9-1-1 (NENA-INF-014.1-2015) [14] document provides detailed guidelines on address point placement and sub-address data development. Review of the document is strongly recommended as it provides an in-depth discussion of five address point placement methodologies that meet NG911 call routing and location validation requirements. These include:

- Placement of an Address Point Based on Geocoding off of Road Centerlines
- Placement of an Address Point Based on a Parcel
- Placement of an Address Point Based on a Site
- Placement of an Address Point Based on a Structure(s)
- Placement of an Address Point Based on Property Access

The above referenced NENA document also includes a section on Address Point Placement for Sub-addresses (specific locations within structures, sites, or within a group of structures and/or sites). As such, NENA-INF-014 should be considered a companion document to this Best Practices document.

Address point placement is especially critical for NG911 call routing and dispatch. During NG911 call routing, an address point is spatially compared to the PSAP Boundary to determine which PSAP to send the call. It is also spatially compared to corresponding Service Boundaries to provide the call taker with the recommended Law, Fire and EMS providers that should respond to the call. All address points must fall within the correct PSAP Boundary or valuable time will be lost in transferring calls to the correct PSAP.

Note: some addressable locations may be problematic near boundaries.

7.8.4. Address Point vs. Access Point

Address points are typically placed on the addressed feature (e.g., structure, site). However, there are some situations where an access point may be preferred. An access point is the point of access to an addressed feature and may represent a driveway, gate, an entrance to a building containing multiple addresses, or other entrance. The access point can be useful for directing emergency responders to a structure that may be located far from the road it is addressed off of, an addressed location that has multiple entrances to the property, or a building with multiple entrances where each entrance serves multiple different addresses. In such cases, it may be useful to include an address point and an access point.

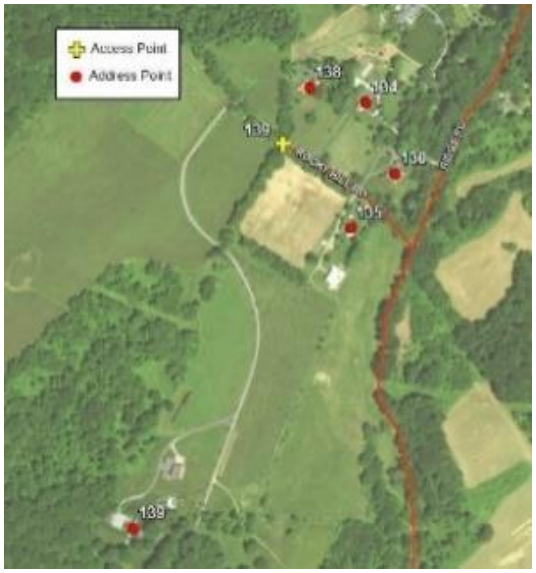

Figure 7-19: Example of when including both an Access Point and Address

If both an access point and address point are shown, population of the Placement Method attribute field is strongly recommended to clearly differentiate the two points. It also provides a means to easily remove one or the other if a 911 application is unable to differentiate between them. See NENA-INF-014, Section 3.4.5 Placement of an Address Point Based on Property Access for more information.

7.8.5. Address Point Placement for Special Cases

In most cases, address point placement is straightforward, with points placed on the center of a structure or site. Large structures or sites, particularly those with multiple entry points, may benefit by having the address point placed at the primary entrance to the structure or site. However, there are some situations that may require a little more research or even field visits to determine the correct placement location.

Multiple Addresses or Units within a Single Structure

Shopping centers, commercial buildings, condominiums, and duplexes contain multiple businesses or residences that are located within the same structure. In some cases, the individual units have been addressed with their own individual address number, but in many situations, they share the same address number and are only differentiated by sub-address information (e.g., apartment, unit, suite, etc.). In both situations, address point placement is usually based on whether the units share an entrance to the building or have their own separate entrance.

Generally, address points should be placed at or near each addressed unit's building entrance. When addressed units share a common entrance, typical practice is to stack the address points at the shared building entrance. Additionally address points should fall within a building's footprint.

Figure 7-20: Example showing multiple addresses within a single structure, all with separate entrances

Large buildings may sometimes have multiple entrances with elevators located nearby that only serve specific floors. In these situations, it is important to make sure that address points are stacked at the building entrance associated with the elevator that serves their floor so that responders are directed to the correct entrance.

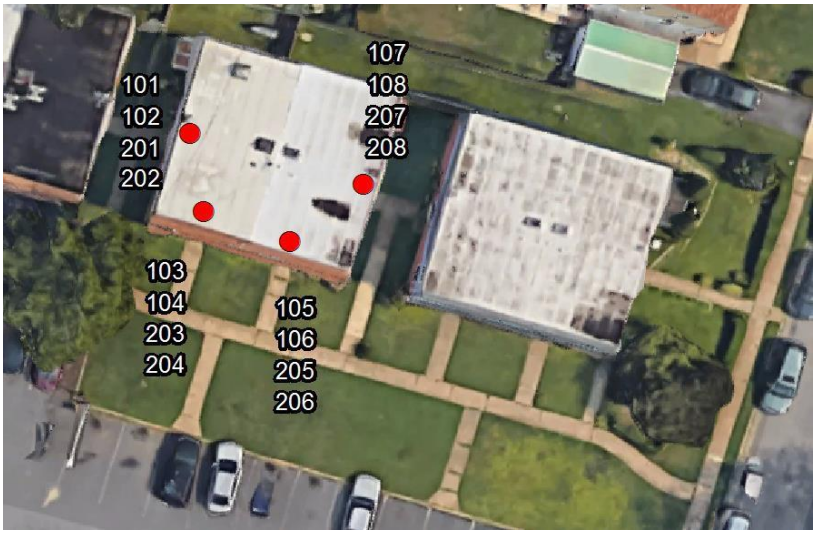

Figure 7-21: Example showing multiple addresses within a single structure, sharing a common entrance

Some 911 applications and CAD software have difficulty with subaddresses. To alleviate this issue, an address point that has only the structure address and no subaddress information can be created and placed at the structure's primary entrance. The address points with subaddress information can then be stacked on it. If subaddresses are not usable in an application, address points with populated subaddress fields can then be easily extracted from the file while still allowing other applications full use of the

address points with subaddress information.

In rare situations, a structure may be split by a PSAP Boundary or Service Boundary. In these situations, it is critical that the address points are placed within the corresponding PSAP and Service Boundaries that services the address. This may not be at the structure entrance.

Multiple Structures and/or Sites that Share the Same Address

Some properties contain multiple structures and/or sites that share the same address and are only differentiated by a number, name, or other unique identifier (e.g., medical campus, mobile home park, correctional facility, university campus, campground).

At a minimum, each structure and/or site should have its own address point with subaddress fields populated so that responders can be sent to the correct location. This is especially critical when the property is spilt by a PSAP Boundary or Service Boundary. Points must be placed so that calls can be routed to the correct PSAP and the appropriate emergency service providers can be identified.

Figure 7-22: Example where structures share same address but are differentiated by building number

To assist responders, it is often helpful to create an address point that contains only the property address (no sub address information) and place the address point at the primary access to the property, particularly if the property is very large. If sub address information is known but one is not able to identify the specific structure and/or site it is associated with, the address points with sub address information can be stacked on this access point.

Transient Structures

Mobile home parks, seasonal camps, and other addressed locations often have temporary structures that can be moved to a different location on the addressed property or be removed entirely from the property. For large properties where the temporary structure is moved frequently, the address point should be placed at the access to the property.

For small areas or areas where the temporary structure is usually located when it is on the property, the address point can be placed where the transient structure would normally be located. To minimize maintenance of the Placement Method attribute field for such situations, populate Placement Method as "Site" if the address contains sub address information (e.g., Lot #, Unit #, etc.) and "Parcel" if there is only one address for the property. This avoids having to constantly update the record when the temporary structure is removed from the property.

7.8.6. Named Sites and Structures

Currently, named locations in some 911 systems are stored in a common places or landmarks layer rather than in an address points GIS dataset, even if the location is assigned an address. In NG911, these locations should all be represented as address points in the Site/Structure Address Points dataset with the Complete Landmark Name attribute field populated with the feature's name.

The Address Number and Street Name fields in the Site/Structure Address Points are conditional Elements, meaning if an address number or street name exists for a location, it must be populated. That is why landmarks that do not have a civic address can still be represented as an address point in the Site/StructureAddress Points dataset. They just need to have their Complete Landmark Name field populated.

7.8.7. Military Bases

Military bases may or may not have their own PSAP and responsibility for emergency services. In most cases, the military facility will share street name information with the local 911 jurisdiction but will not provide address specific information. It is recommended that the local 911 jurisdiction reach out to the military facility and work directly with them to obtain the most current information the facility is willing to provide. Some facilities may share their address information but restrict usage for 911 operations only, not allowing the data to be publicly shared. Local 911 entities having difficulties obtaining address information should reach out to PEMA for assistance.

7.8.8. Populating Address Number Suffix

When creating new addresses, use of the Address Number Suffix field should be avoided. Instead, it is recommended that the Unit field be populated with "Apartment #" or "Unit #" (for residences) and "Suite #" (for businesses). Existing addresses with a valid Address Number Suffix must still populate this field.

7.8.9. Populating Parcel Identifier

This is a new, optional field that does not exist in the NENA Standard for NG911 GIS Data Model but was added to the PEMA GIS Data Model to be able to link to local parcel databases for data analysis purposes. Population of the Parcel Identifier field is generally straightforward with the parcel ID, Uniform Parcel Identifier (UPI), or another unique parcel identifier based on the parcel it is located within. Users should note the following:

- Multiple address points on the same parcel will carry the same Parcel Identifier value. Counties that have a "point card" for each structure could concatenate the point card and parcel ID to generate a unique Parcel Identifier. However, subaddresses within the same structure would still carry the same Parcel Identifier.

- Addressed structures on leaseholds (e.g., privately-owned cabins on state land, wind turbines, etc.) can be populated with the parcel ID of the parcel they are located on. This could be useful for future damage assessment purposes.

- Some buildings may fall into two (or more) separate parcels. The PEMA NG911 GIS Working Group will provide guidance for this in a future version of this document.

8. Items Pending Future Work

The PEMA NG911 GIS Working Group has identified the following items that require additional research and development:

- At the time of publication, an updated version of the NENA GIS Data Stewardship for NG9-1-1 Document is anticipated to be released, but a publication data is not yet known. As soon as it is published, the GIS Working Group should convene to review the updated NENA document and compare against this guide. A decision should then be made on whether it is prudent to make immediate updates to this document, including but not limited to a reference to review the NENA GIS Data Stewardship for NG9-1-1 document, or table this until this guide undergoes its next regular update.

- Implement regular reoccurring statewide trainings on the GIS Data Hub and the Comtech ALI Location Database Platform (ALI LDP) Systems.

- Identify a Broad Data Sharing/Open Access Approach for statewide Site/Structure Address Points and Road Centerlines.

- Define minimum metadata requirement for local data submissions and statewide NG911 GIS data layers.

- Review the impacts that replacing the North American Vertical Datum of 1988 (NAVD 88) may have on NG911 GIS data (previously slated for 2022 but delayed due to COVID-19 pandemic) and plan for the change.

- Prepare for the Federal Communications Commission (FCC) anticipated rule regarding dispatchable location or z-axis technology requirements and its potential impact in GIS data development and develop guidance to help counties prepare. Particularly in populating z-values.

- Working Group to define an approach that assists counties and addressing authority partners in targeting areas or structures that need sub-address fields populated (e.g., unit, floor, building…etc).

    - PEMA can conduct outreach to counties and promote the development of such plans, including potentially hosting workshops and sharing examples of published plans.

- Develop guidance for populating the Parcel Identifier field.

- Develop guidance for creating Address Points representing Mile Markers/Mile Posts for navigable waterways and river miles.

- Review the need for additional Pennsylvania-specific fields for the PEMA NG911 GIS Data Model.

- Begin populating the Strong Recommended (SR) attribute fields, taking into consideration that some of these fields are marked as potentially changing in a future update of another NENA standard or may be impacted by the pending vertical datum change. An area to start may include prioritization of sub-addressing and z-axis fields.

- Begin populating the Optional attribute fields, taking into consideration that some of these fields are also marked as potentially changing in a future update of another NENA standard.

- Review the development of any new national policy guidance related to Computer Aided Dispatch (CAD) systems adopting the NENA Standard for NG-9-1-1 GIS Data Model and assess its implications in the Commonwealth.

- Revisit discussion in section 4.3 on transition versus end state i3 call delivery.

- Review updates from the Federal Highway Administration's (FHWA) National Road Network Pilot Project regarding the development and use of match points to support interstate road network alignment and connectivity work.

9. Items Previously Identified for Future Work That Have Been Addressed

Below is a summary of issues that were identified by the GIS Working Group in 2019 but have since been addressed.

- **List of QC Exception codes and descriptions**: with the deployment of GIS Data Hub, GeoComm has released a 999 GC Exception Code, which essentially tells GIS Data Hub to ignore a feature. Additional exception codes are being developed and expected in 2023. When these become available, PEMA will coordinate with GeoComm and Comtech to provide additional guidance.

- **NGUID prefix values for other Service Boundary layers**: NGUID prefix values for all required NG911 GIS data layers are identified in this document.

- **Identify existing ETL scripts and facilitate additional development and sharing of scripts to transform local GIS data into the PEMA GIS Data Model**: this issue has been resolved by GeoComm's Field Mapping process.

- **Transformation from local reference systems to WGS84**: this is no longer necessary, as GIS Data Hub's HubHelper tool automatically transforms data into WGS84. One caveat to this is that the data being provisioned must be in a valid reference system, as HubHelper cannot accommodate custom coordinate reference systems.

10. Terminology and Abbreviations

The following terms are a subset of terms as defined in the NENA Knowledge Base and in the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022) [1].

Term or Abbreviation	Definition / Description
Agency Identifier	A domain name for an agency used as a globally unique Identifier.
ALI (Automatic Location Identification)	The automatic display at the PSAP of the caller's telephone number, the address/location of the telephone, and supplementary emergency services information of the location from which a call originates.
Associated Location	A location (civic, geodetic, or polygon) within the designated PSAP jurisdiction that may be used in wireless call scenarios to route the call toward the designated PSAP.
CAD (Computer Aided Dispatch)	A computer-based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities.
CLDXF (Civic Location Data Exchange Format)	A United States profile of PIDF-LO that defines a set of standard data elements that describe detailed street address information.
Data Domain	An enumerated listing or range of valid values that may be used as an attribute. If no Data Domain is provided, then any value that meets the format criteria may be used.
E911 (Enhanced 911)	A telephone system which includes network switching, database, and Public Safety Answering Point premise elements capable of providing automatic location identification data, selective routing, selective transfer, fixed transfer, and a callback number. The term also includes any enhanced 911 service so designated by the Federal Communications Commission in its Report and Order in WC Docket Nos. 04-36 and 05-196, or any successor proceeding.
ECRF (Emergency Call Routing Function)	A functional element in NGCS (Next Generation Core Services) which is a Location-to-Service Translation (LoST) protocol server where

	location information (either civic address or geo-coordinates) and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller's location or towards a responder agency. **<u>Related Terms:</u>** **External ECRF** An ECRF instance that resides outside of an NGCS instance. **Internal ECRF** An ECRF instance that resides within and is only accessible from an NGCS instance.
EMS (Emergency Medical Service)	A service providing out-of-hospital acute care and transport to definitive care, to patients with illnesses and injuries which the patient believes constitute a medical emergency.
ESInet (Emergency Services IP Network)	A managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG911 Services. ESInets maybe constructed from a mix of dedicated and shared facilities. ESInets may be interconnected at local, regional, state, federal, national, and international levels to form an IP-based inter-network (network of networks). The term ESInet designates the network, not the services that ride on the network. See NG911 Core Services.
ESN (Emergency Service Number)	A 3-5 digit number that represents one or more ESZs (Emergency Service Zone), stored as a 3-5 character numeric string in a GIS database. An ESN is defined as one of two types: Administrative ESN and Routing ESN.
ESRP (Emergency Services Routing Proxy)	An i3 functional element which is a SIP proxy server that selects the next hop routing within the ESInet based on location and policy. There is an ESRP on the edge of the ESInet. There is

	usually an ESRP at the entrance to an NG911 PSAP. There may be one or more intermediate ESRPs between them.
EIDD (Emergency Incident Data Document)	A National Information Exchange Model (NIEM) conformant, object that is used to share emergency incident information between an among authorized entities and systems.
FGDC (Federal Geographic Data Committee)	An interagency coordinating body responsible for facilitating cooperation among federal agencies whose missions include producing and using geospatial data. **External References:** https://www.fgdc.gov
Forest Guide	A special instance of a LoST server. It is part of the Location to Service Translation (LoST) protocol (RFC 5222) query process and allows client functional elements to discover call routing information outside of its domain (typically their ESInet or state level ECRF/LVF).
Geocoding	Interpolation-based computational techniques to derive estimates of geographic locations.
Geospatial Call Routing	The use of an ECRF (Emergency Call Routing Function) and GIS (Geographic Information System) data to route an emergency call to the appropriate PSAP or emergency service provider based on the civic location or geographic coordinates provided with the call.
GIS (Geographic Information System)	A system for capturing, storing, displaying, analyzing, and managing data and associated attributes which are spatially referenced.
GIS Attributes	Tabular information about features contained in GIS data.
GIS Data Layer	A spatial dataset containing a common feature type.
GIS Data Stewards	Data stewards are GIS professionals who are vested in the creation and maintenance of spatial data in their respective jurisdictions, and as such are the logical source for authoritative

	foundational data for NG911 from all jurisdictions in the Commonwealth.
IANA (Internet Assigned Numbers Authority)	The departmental entity within ICANN (Internet Corporation for Assigned Names and Numbers) that oversees coordination of global IP address allocation, DNS root zone management, protocol name and number registries, and other internet protocol assignments. Some NENA documents may use IANA Protocol Registries following the processes described in RFC 8126. **Related Term:** ***IANA Registry*** A place where globally coordinated account records reflecting internet codes and numbers used in technical standards are centrally maintained by the Internet Assigned Numbers Authority, usually at the behest of the IETF. **Relevant NENA Documents:** NENA-STA-010, Detailed Functional and Interface Standards for the NENA i3 Solution **External References:** • IANA website • RFC 8126, Guidelines for Writing an IANA Considerations Section in RFCs
IETF (Internet Engineering Task Force)	Lead standard setting authority for internet protocols.
ISO (International Organization for Standardization)	An independent, non-governmental international organization of national standards bodies. **External References:** www.iso.org
LoST (Location-to-Service Translation) Protocol	A protocol that takes location information and a Service URN and returns a URI. Used generally for location-based call routing. In NG9-1-1, used as the protocol for the ECRF and LVF.
LVF (Location Validation Function)	A functional element in an NGCS that is a LoST protocol server where civic location information

	is validated against the authoritative GIS database information. A civic address is considered valid if it can be located within the database uniquely, is suitable to provide an accurate route for an emergency call, and adequate and specific enough to direct responders to the right location.
MCS (MSAG Conversion Service)	A web service providing conversion between PIDF-LO (Presence Information Data Format – Location Object) and MSAG (Master Street Address Guide) data.
Metadata	A record or information, usually presented as an eXtensible Markup Language (XML) document, which captures the basic characteristics of a data or information resource. Metadata records include core library catalog elements such as Title, Abstract, and Publication Data; geographic elements such as Geographic Extent and Projection Information; and database elements such as attribute label definitions and attribute domain values.
MDS (Mapping Data Service)	Provides a PSAP call taker with information showing the location of an out-of-area caller.
MSAG (Master Street Address Guide)	A database of street names and house number ranges within their associated communities defining Emergency Service Zones (ESZs) and their associated Emergency Service Numbers (ESNs) to enable proper routing of 9-1-1 calls.
NENA (National Emergency Number Association)	NENA is also referred to as The 9-1-1 Association, which is fully dedicated to the continued improvement and modernization of the 9-1-1 emergency communication system. NENA's approach includes research, standards development, training, education, certification, outreach, and advocacy through communication with stakeholders. As an ANSI-accredited Standards Developer, NENA works with 9-1-1 professionals, public policy leaders, emergency services and telecommunications industry partners, like-minded public safety associations, and more. Current NENA activities center on awareness, documentation, and implementation for Next Generation 9-1-1 (NG911) and international three-digit emergency communication systems. NENA's worldwide

	members join with the emergency response community in striving to protect human life, preserve property, and maintain the security of all communities. www.nena.org
NENA i3	Refers to the NG9-1-1 system architecture defined by NENA, which standardizes the structure and design of Functional Elements making up the set of software services, databases, network elements and interfaces needed to process multi-media emergency calls and data for NG9-1-1.
NGCS (Next Generation 911 (NG911) Cores Services)	The set of services needed to process a 9-1-1 call on an ESInet. It includes, but is not limited to, the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services, and typical IP services such as DNS and DHCP. The terms NG9-1-1 Core Services includes the services and not the network on which they operate. See Emergency Services IP Network.
NGUID (NENA Globally Unique ID)	A globally unique ID generated and maintained within a GIS database as defined in NENA-STA-0006. Each NGUID MUST be unique.
PIDF-LO (Presence Information Data Format – Location Object)	Provides a flexible and versatile means to represent location information in a SIP header using XML schema.
PSAP (Public Safety Answering Point)	A physical or virtual entity where 9-1-1 calls are delivered by the 9-1-1 Service Provider. Primary PSAP: A PSAP to which 9-1-1 calls are routed directly from the 9-1-1 Control Office. Secondary PSAP: A PSAP to which 9-1-1 calls are transferred from a Primary PSAP. Alternate PSAP: A PSAP designated to receive calls when the primary PSAP is unable to do so. Consolidated PSAP: A facility where multiple Public Safety Agencies choose to operate as a single 9-1-1 entity. Legacy PSAP: A PSAP that cannot process calls received via i-3-defined call interfaces (IP-based calls) and still requires the use of CAMA or

	ISDN trunk technology for delivery of 9-1-1 emergency calls. Serving PSAP: The PSAP to which a call would normally be routed. NG9-1-1 PSAP: This term is used to denote a PSAP capable of processing calls and accessing data services as defined in NENA's i3 specification, NENA-STA-001, and referred to therein as an "i3 PSAP". Virtual PSAP: An operational model directly enabled through NG9-1-1 features and/or network hosted PSAP equipment in which telecommunicators are geographically dispersed, rather than working from the same physical location. Remote access to the PSAP applications by the dispersed telecommunicators requires the appropriate network connections, security, and work station equipment at the remote location. The virtual work place be a logical combination of physical PSAPs, or an alternate work environment such as a satellite facility, or any combination of the above. Works are connected and interoperate via IP connectivity.
Registry	A registry is a single place for keeping valid data values associated with a specific XML data element.
RFC (Request for Comment)	A document published by the Internet Engineering Task Force (IETF). Note that the name is a historic artifact – An RFC is finalized. RFCs are never revised; updates are published as new RFCs. Errata are noted separately. (Documents for which input and comments are requested are called Internet Drafts. Most RFCs are originally published as an Internet Draft).
SI (Spatial Interface)	A standardized interface between the GIS data and the functional elements that consume GIS data, such as the ECRF, LVF, Map Database Services, etc.
Spatial Data	Information stored as coordinates and topology that identifies the geographic location of features and boundaries on Earth.

	Also known as: Geospatial Data Geographic Information
Spatial MSAG	MSAG data that the Location Database Platform (LDP) converts from your GIS data, then stores in its Database Management System (DBMS). SPATIAL MSAG is used the same as MSAG data was previously — the only difference is that it is derived from a Provisioning Authority's GIS data.
URI (Uniform Resource Identifier)	A URI is an identifier consisting of a sequence of characters matching the syntax rule that is named <URI> if RFC 3986. It enables uniform identification of resources via a set of naming schemes. A URI can be further classified as a locator, a name, or both. The term "Uniform Resource Locator" (URL) refers to the subset of URIs that, in addition to identifying a resource, provides a means of locating the resource by describing its primary access mechanism (e.g., its network "location"). The term "Uniform Resource Name" (URN) has been used historically to refer to both URIs under the "urn" scheme [RFC2141], which are required to remain globally unique and persistent even when the resource ceases to exist or becomes unavailable, and to any other URI with the properties of a name. An example of a URI that is neither a URL nor a URN is sip:psap@example.com
URN (Uniform Resource Name)	A type of URI. Uniform Resource Names (URNs) are intended to serve as persistent, location-independent, resource identifiers and are designed to make it easy to map other namespaces (which share the properties of URNs) intro URN-space. An example of a URN is urn:service:sos. **External References:** RFC, 8141, Uniform Resource Names (URNs)
USPS (United States Postal Service)	An independent agency of the United States government responsible for providing mail service in the United States.

WGS 84 (World Geodetic System of 1984)	The World Geodetic System reference coordinate systems used by the Globally Positioning Systems and in cartography and navigation.
XML (eXtensible Markup Language)	An internet specification for web documents that enables tags to be used that provide functionality beyond that in Hyper Text Markup Language (HTML). In contrast to HTML, XML has the ability to allow information of indeterminate length to allow information of indeterminate length to be transmitted to a PSAP call taker or dispatcher versus the current restriction that requirements that requires information to fit that parameters of pre-defined fields.

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APPENDIX A:

PENNSYLVANIA AND NENA NG911 GIS DATA MODEL KEY DIFFERENCES

This document outlines the differences between the PEMA and NENA NG911 GIS Data Models. Though minor, these differences may impact how a Pennsylvania jurisdiction approaches NG911 GIS data development and maintenance. Each of the five required NG911 GIS layers are impacted. These are outlined below for reference:

1. PSAP Boundary
2. Provisioning Boundary
3. Services Boundaries for Fire, Law and EMS;
4. Road Centerlines
5. Site/Structure Address Points

Field Categories: within each layer's attribute table, each field name is identified by one of four categories, defined below. *While this format appears in both the PEMA and NENA data models, the PEMA Data Model contains a Pennsylvania-specific element.*

M – Mandatory: An attribute value must be populated in the data field for each record and must not be blank, unless otherwise noted. *This category appears in both the PEMA and NENA data models.*

C – Conditional: 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. *This category appears in both the PEMA and NENA data models.*

SR – Strongly Recommended: Not required to be populated in local data at this time, however population of fields identified with this category type may be mandatory in the coming years. Currently it is a local decision on whether to populate the data field. *This field is unique to the PEMA Data Model and does not appear in the NENA data model.*

O – Optional: Not required to be populated in the local data. It is a local decision on whether to populate the data field. *This category appears in both the PEMA and NENA data models.*

PSAP BOUNDARY

Agency VCard URI: this field's category is coded by both the PEMA and NENA GIS Data Models as "M" for Mandatory. However, this value is not being populated at this time. While the field should be present in a jurisdiction's data, it should not be populated.

FCC PSAP ID: this field is present in the PEMA GIS Data Model, but not the NENA Data Model. This value is identified in the Federal Communications Commission's (FCC) 911 Master PSAP Registry and is auto-populated by PEMA's NG911 service provider, Comtech, in consultation with the PSAP. It does not need to be present in a Provisioning Authority's local GIS data prior to uploading it to the GIS Data Hub Spatial Interface but may be if the jurisdiction prefers.

GC QA/QC Exception Code: this field is present in the PEMA Data Model, but not in the NENA Data Model. This field is used by GIS Data Hub to remove values that have an exception code entered from being passed into the NG911 system. As an example, if a local jurisdiction's PSAP Boundary

extends beyond its Provisioning Boundary, the sliver of the PSAP Boundary that extends beyond the Provisioning Boundary border (and thus are of provisioning authority), should have a GC Exception Code included to be ignore by GIS Data Hub. If this is not identified with an exception code, a Critical Error will be flagged, and the data will not be passed into Next Generation Cores Services (NGCS).

SERVICE BOUNDARIES FOR FIRE, LAW, AND EMS

Agency VCard URI: this field's category is coded by both the PEMA and NENA GIS Data Models as "M" for Mandatory. However, this value is not being populated at this time. While the field needs to be present, it should not be populated.

GC QA/QC Exception Code: this field is present in the PEMA Data Model, but not in the NENA Data Model. This field is used by GIS Data Hub to remove values that have an exception code from being passed into the NG911 system. For example, if a local jurisdiction's ESB LAW boundary extends beyond its Provisioning Boundary, the sliver of the ESB Boundary extending beyond the jurisdiction's Provisioning Boundary (and thus provisioning authority), should have a GC Exception Code. If this is not identified with an exception code, a Critical Error will be flagged, and the data will not be passed into Next Generation Cores Services (NGCS).

PROVISIONING BOUNDARY:

GC QA/QC Exception Code: this field is present in the PEMA Data Model, but not in the NENA Data Model. This field is used by GIS Data Hub to remove values that have an exception code from being passed into the NG911 system. For the time being, this functionality is limited within the Provisioning Boundary layer. Unlike the other NG911 layers that may cross into adjacent jurisdictions (for example, a PSAP boundary may cover all of County A and portions of County B – without any gaps or overlaps), a Provisioning Boundary cannot overlap with another Provisioning Boundary. It is anticipated that new GC Exception Codes will be released in the future.

ROAD CENTERLINES

The **Additional Code Left** and **Additional Code Right** fields appear in both the PEMA and NENA data models but are specific to Canada and therefore should not be populated. The fields can be present but should not be empty.

One-Way: within the PEMA Data Model, this value is categorized as "SR" for Strongly Recommended. In the NENA Data Model, this value is categorized as "O" for Optional. For the time being, this remains optional.

Complete Alias Street Name: this field is present within the PEMA Data Model, but not the NENA Data Model. This is categorized as "C" for Conditional value.

Description: The primary complete alias street name (or "also known as" street name) associated with the road centerline segment.

Example: "Spring Road" as an alias for "Carlisle Springs Road"

The ESN Left (Comtech) and **ESN Right (Comtech)** fields are in addition to and distinct from the ESN Left and ESN Right fields. These will be automatically populated by Comtech.

GC QA/QC Exception Code: this field is present in the PEMA Data Model, but not in the NENA Data Model. This field is used by GIS Data Hub to remove values that have an exception code from

being passed into the NG911 system. For example, if a local jurisdiction wishes to maintain a road segment that extends beyond its Provisioning Boundary, they may do so by adding a GC Exception Code. If this is not identified with an exception code, a Critical Error will be flagged, and the data will not be passed into Next Generation Cores Services (NGCS).

SITE/STRUCTURE ADDRESS POINTS

Within the PEMA NG911 GIS Data Model, the following fields are categorized as "SR", or Strongly Recommended, while the NENA Data Model categorizes these values as "O", or Optional:

- Building
- Floor
- Unit
- Room
- Elevation

For the time being, SR and O fields can be understood to both be optional fields.

The Comtech ESN field is separate and distinct from the ESN field. Values for this field will be provided by Comtech and can be automatically populated.

GC QA/QC Exception Code: this field is present in the PEMA Data Model, but not in the NENA Data Model. This field is used by GIS Data Hub to remove values that have an exception code from being passed into the NG911 system. For example, if a local jurisdiction wishes to maintain a Site/Structure Address Point that extends beyond its Provisioning Boundary, they may do so by adding a GC Exception Code. If this is not identified with an exception code, a Critical Error will be flagged, and the data will not be passed into Next Generation Cores Services (NGCS).

Taxing Authority: this field is present within the PEMA Data Model, but not the NENA Data Model. This is categorized as "O" for Optional value.

Description: The primary local Incorporated Municipality to which property taxes are paid for the Site or Structure.

Example: Nanty Glo Borough; Milford Township

Parcel Identifier: this field is present within the PEMA Data Model, but not the NENA Data Model. This is categorized as "O" for Optional value.

Description: A finite, punctuated sequence of numbers which identifies each separate tract, lot, land parcel or other interest of real estate in a county.

Example: 43+,005.0-0314.00-000+; 88534302788642

APPENDIX B:

GIS DATA HUB QUALITY CONTROL CHECKS OVERVIEW

Ingestion Errors and Critical Errors: these types of errors will cause issues with NG911 call routing and location validation functions and will not be accepted in the NG911 Core Services components. They are found under the red heading.

Other Errors: these types of errors have the potential to cause delays in the call routing and location validation functions, however additional features within the system will ensure that calls are routed correctly. Non-critical errors will not prevent data from being provisioned from the GIS Data Hub Spatial Interface into Next Generation Core Services, but they may cause delays in responses times. These are found under orange headings.

***Note**: New QC checks may be added in the future. Additional, current information on Quality Control checks is available in GIS Data Hub via the Help tab.*

GEOCOMM GIS DATA HUB SPATIAL INTERFACE QUALITY CONTROL CHECKS SUMMARY, ORGANIZED BY ERROR TYPE			
INGESTION ERRORS | PROVISIONING HALTED			
	Issue	**Testing Method**	**Effect**
1	**Corrupt data in a file geodatabase**	Upon ingest, GIS Data Hub verifies that the file geodatabase can be opened, and its contents can be read for processing.	Causes ingestion failure and no GIS data will proceed to quality control process or provisioning to ECRF and LVF.
2	**Invalid geometry in any layers**	Empty Geometry and Invalid Geometry QC Checks.	Causes ingestion failure and no GIS data for the affected layer will proceed to quality control process or provisioning to ECRF and LVF.
3	**Features containing a vertex count higher than 1,000,000 per feature**	Invalid Geometry QC Check.	Causes ingestion failure and no GIS data for the affected layer will proceed to quality control process or provisioning to ECRF and LVF.
4	**Data schema changes without prior notification**	Upon ingest, GIS Data Hub compares layer names and fields names to ensure they match	Causes ingestion failure and no GIS data for the affected layer will proceed to quality control process or

		existing layer mappings.	provisioning to ECRF and LVF. Schema changes require a “Pause” of processing and a notification to the GeoComm team to make needed schema changes.
5	**Stacked address points with the exact same attributes**	Duplicate Values QC Check	Causes ingestion failure and no address point features will proceed to quality control process or provisioning to ECRF and LVF. NGUIDs are included when evaluating features with the exact same attributes.
6	**NG9-1-1 Unique ID (NGUID) population in every layer**	Globally Unique ID QC Check	Unique IDs should be unique throughout entire dataset. This allows for a full reporting feedback loop using unique ID for reference back to the GIS data submitter.
7	**Missing projection of GIS Data**	Verify Projection (Precheck)	Causes ingestion failure and no GIS data for the affected layer will proceed to quality control process or provisioning to ECRF and LVF. A known projection is required upon upload of the GIS data.
8	**Multi part geometry**	Multi Part Geometry (Road Centerlines & Polygons)	The check identifies multipart features that may lead to unexpected behavior in the consuming application.
CRITICAL ERRORS (9-1-1 CALL ROUTING) | PROVISIONING HALTED			
9	**Invalid or missing ServiceURN attribute in PSAP Boundary layer polygons**	Unacceptable Values and Null	Area covered by this feature cannot be identified as a service

		Value in a Field QC Checks	boundary to which a 9-1-1 call can be routed.
10	**Invalid or missing ServiceURI attribute in PSAP boundary layer polygons**	Unacceptable Values and Null Value in a Field QC Checks	Area covered by this feature cannot be used to route a call to a PSAP, and the call will be routed based on default policy routing rules.
11	**Gaps in the Provisioning Boundary layer polygons**	Polygon Compare (Gaps) QC Check	The Provisioning boundary submitted by each entity must create a seamless coverage of the Commonwealth's NG9-1-1 coverage area. Quality control check confirms no features in the road centerline and Site/Structure address point layers fall outside the individual GIS data submitter's Provisioning Boundary.
12	**Unintentional gaps/overlaps in PSAP Boundary and Provisioning Boundary layer polygons**	Single Layer Polygon Gap and Polygon Overlaps QC Checks	Overlaps and gaps in the PSAP and Provisioning boundary layer will cause any call located within that gap/overlap to default route to a PSAP specified in the policy routing rules.
13	**Road centerlines not broken at PSAP boundary polygon**	Features Broken at Polygon QC Check	Addresses found in road centerline ranges at the beginning or end of a road segment that crosses the PSAP boundary may route to the incorrect PSAP.
14	**Complex geometry on road centerlines layer features**	Complex Geometry QC Check	Nonstandard geometry (self-intersecting, curve, surface, multicurve, multi-

			surface) is simplified during the ingest process, which may introduce alignment issues between boundaries and road centerlines that are not visible in the source data.
15	**Address range overlaps on features in the road centerline layer**	Address Range Overlaps QC Check.	Road centerline address range overlaps can cause an address to be found in more than one location. This can affect a call transfer if the locations found fall within different emergency service boundaries.
16	**Duplicate address attributes on features in the Site/Structure address point layer**	Duplicate Values QC Check	Duplicate address attributes on different point features found in the same community (Incorporated Municipality) causes ambiguity in exact location of an address. This can affect a call transfer if the addresses fall within different emergency service boundaries.
17	**Missing CLDXF compliant attributes in the road centerlines layer and Site/Structure address point layer**	Unacceptable Values and Null Value in a Field QC Checks	CLDXF compliant attribute population is 100% mandatory in the road centerline and the Site/Structure address point layers. All fields identified as mandatory in the CLDXF standard are required to be populated. Fully spelled out CLDXF fields to be checked; street name Null only; acceptable values Pre/Post

			Directional; Pre/Post Type; Pre Type Separator
18	**Missing attributes in the legacy street name component field of the road centerline layer and Site/Structure address point layer**	Unacceptable Values and Null Value in a Field QC Checks	Legacy street names must be 100% populated in the road centerline and the Site/Structure address point layers. Legacy street name Null only; acceptable USPS Pub 28, Appendix C values Legacy Pre/Post Directional; Legacy Post Type.
WARNINGS – CALL TRANSFERS | PROVISIONING CONTINUED			
19	**Invalid or missing ServiceURN attribute in service boundary layer polygons**	Unacceptable Values and Null Value in a Field QC Checks	Area covered by this feature cannot be identified as a service boundary for a specific response type.
20	**Invalid or missing ServiceURI attribute in service boundary layer polygons**	Unacceptable Values and Null Value in a Field QC Checks	Area covered by this feature cannot be used to determine a transfer route of a call to a specific responder, and the call will be routed based on responder default policy routing rules.
21	**Road centerline features not broken at service boundary layer polygons**	Features Broken at Polygon QC Check	Addresses found in road centerline ranges at the beginning or end of a road segment where it crosses an service boundary may cause a call transfer to the incorrect emergency service responder or secondary PSAP.
WARNINGS – PSAP MAPPING & CAD SYSTEMS | PROVISIONING CONTINUED			
22	**Unacceptable Values**	Identifies records containing forbidden values identified within a domain value list.	

23	**Road Centerline Topology**	Identifies roads not broken or snapped where they intersect with other roads, which may affect vehicle routing or intersection look-ups.	
24	**NULL Value in a Field**	Verifies that a target field does not have <null> values present in fields required for specific software functionality.	
25	**Acceptable Values**	Identifies data entry errors in features that contain values outside of a domain value list.	
26	**Duplicate Values**	Identifies where data records occur multiple times in the dataset. Duplicate values occur when two or more records contain the same information.	
27	**Field Comparison**	Compares two or more fields in a single layer to test concatenated column values.	
28	**Line to Polygon Attribute Compare**	Identifies disparity between a line feature that intersects with a polygon feature to locate attribute discrepancies between a line segment and its corresponding polygon.	
29	**Point to Polygon Attribute Compare**	Identifies disparity between a point feature that intersects with a polygon feature to	

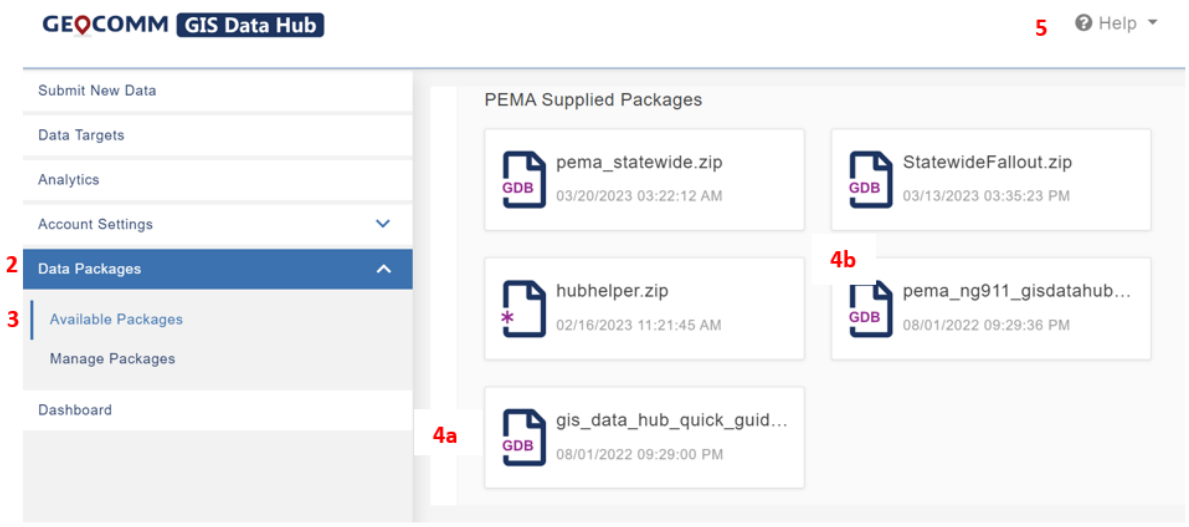
		identify attribute discrepancies between a point and its corresponding polygon.	
30	**Polygon Overlaps**	Identifies areas where overlaps exist in a polygon layer. Can be used on municipal boundaries, neighborhood boundaries, etc.	
31	**Single Layer Polygon Gap**	Identifies areas where gaps exist in a polygon layer. Can be used on municipal boundaries, neighborhood boundaries, etc.	
32	**Polygon Compare (Gaps)**	Identifies gaps in coverage between two polygon layers.	
33	**Polygon Compare (Overhangs)**	Identities where one polygon layer extends past the outer limits of another polygon layer.	
34	**Features Broken at Polygon**	Identifies road centerlines not broken where NG9-1-1 GIS Data Model attributes change, causing incorrect boundary values to be referenced.	
35	**Features Outside of Polygon**	Identifies where lines and points are outside of a polygon layer such as provisioning boundary.	
36	**Address Points to Road Centerlines**	Identifies where the address points data is inconsistent with the road centerlines address data.	

APPENDIX C:

ACCESSING EDUCATIONAL RESOURCES IN GIS DATA HUB

GIS Data Hub, the Commonwealth's spatial interface solution, includes a library of additional supplemental resources to assist in learning the tools features and capabilities. To access these resources, take the following steps:

1. Log into GIS Data Hub via your Comtech Insights account.
2. Navigate to the Data Packages menu on the left-hand side of your screen.
3. Select the Available Packages option.
4. Download file the following files:
    a. "pema_ng911_gisdatahub": This includes the most recent slide deck of GIS Data Hub trainings provided to regions within the Commonwealth. It includes a section on the Pennsylvania NG911 GIS Data Model and gets into how to utilize GIS Data Hub to provision data to the statewide NG911 system and run quality control on your data.
    b. "gis_data_hub_quick_guide": this is a pdf document that outlines to proper procedure for preparing your GIS data using GIS Data Hub's HubHelper tool. It also describes how to use the tool to access and interpret quality control fallout reports.
5. For additional questions about GIS Data Hub, including detailed information on critical or warning errors, select Help. This provides an up-to-date knowledge base about Data Hub.



APPENDIX D

BEST PRACTICES FOR BUILDING, MAINTAINING, AND SHARING GIS DATA WHEN A PSAP OR SERVICE BOUNDARY EXTENDS BEYOND A PROVISIONING BOUNDARY

In Pennsylvania 911 response is a county-government responsibility, but there are instances throughout the Commonwealth where a cross-county response is deemed necessary and appropriate by local 911 Authorities. This can include 911 call taking responsibilities and/or fire, law, and EMS response areas extending beyond a county's geopolitical boundary. For example, a county may participate in a regional 911 system and as a result its PSAP boundary layer extends into one or potentially more counties. As another example, a municipality located along a county boundary may request its first due fire response to come from a fire company based in the neighboring county because they are able to access the municipality faster than a company based in the same county as the municipality in question. This may be due to physical geography providing the company from the neighboring county with more direct access to the community. There are numerous other context specific examples illustrating the need for cross-county emergency response. These situations are accommodated for in the NG911 system, but it is important to consider GIS data needs to support cross-jurisdictional responses.

This document identifies best practices for GIS data stewards to follow on recommended approaches for building, maintaining, and sharing NG911 polygon boundary data for supporting cross-county responses. These recommendations are based on the NENA Standard for NG9-1-1 GIS Data Model (NENA-STA-006.2-2022) [1], which provide the basis for Pennsylvania's NG911 GIS data standards. This document further identifies constraints and limitations with the existing NENA standards and identifies opportunities for future work to address and mitigate these.

Implications of Cross-Provisioning Boundary Responses for GIS Data

In jurisdictions where a cross-county response agreement between county 911 authorities exists, there are several GIS data design and maintenance considerations that potentially impact one or more of a county's NG911 polygon layers to be aware of. With regards to hierarchy, the Provisioning Boundary should be delineated first, as its geometry impacts that of a jurisdiction's other NG911 polygon service layers. To be successful, NG911 requires a high level of coordination, collaboration, and communication between neighboring counties in building and maintaining GIS datasets.

911 Authorities and NG911 GIS data stewards within a county must work with neighboring counties and agree to all neighboring county Provisioning Boundary geometries to ensure they are aligned with their own. This is because there can be no unintentional gaps or overlaps between neighboring Provisioning Boundaries, not duplicate datasets within the NG911 system. If gaps or overlaps were present in a Provisioning Boundary or duplicates NG911 datasets were permitted into the NG911 system, geospatial call routing could be negatively impacted or altogether fail, causing calls to default to secondary routing measures. The next section outlines an approach for designing the Provisioning Boundary to meet NG911 requirements. However, before proceeding, it is helpful to further define what the Provisioning Boundary is by discussing its role and limitations as outlined by the current NENA Standard for NG9-1-1 GIS Data Model [1].

Provisioning Boundary: this boundary represents a 911 Authority's geographic area of responsibility for maintaining and sharing GIS data for. In Pennsylvania, this is typically a county government responsibility, though this responsibility may be contracted out to a neighboring county for the entirety

of a county or for portions of it. As noted above, a county's Provisioning Boundary must align with the Provisioning Boundaries of all adjoining counties and be free of any unintentional gaps or overlaps. Additionally, the NENA standard maintains that a GIS Data Provider MUST only include GIS data within their Provisioning Boundary and MUST ensure the data includes coverage for the entire extent of their Provisioning Boundary. These rules exist to prevent duplicate data submissions, which are not allowed in the system because they could delay or prevent geospatial call routing.

For example, if there were duplicate datasets being submitted along a border area between two counties, where County A and County B are both submitting a Site/Structure Address Point (SSAP) feature for the same address, the system cannot know which SSAP feature is authoritative, and it would cause a critical error. There can be no areas of gap or overlap between the required polygon boundaries and only one submission per feature. The Provisioning Boundary assists counties in meeting this requirement. Ideally, there would not be a need for the Provisioning Boundary because all boundary data between counties would be aligned, but in practice this is not the case.

Limitations

The current NENA Standard for NG9-1-1 GIS Data Model [1] maintain that a jurisdiction's Provisioning Boundary applies to all NG911 GIS layers within a particular geographic area and a jurisdiction may not use multiple Provisioning Boundaries for different NG911 GIS datasets. For example, a county cannot use one Provisioning Boundary layer for their PSAP and Service Boundary layers and a separate Provisioning Boundary layer for their Road Centerline and Site/Structure Address Point layers. This may be addressed in a future version of the NENA data model, but currently presents a gap between the standards and existing data building and maintenance practices.

This raises a dilemma when a PSAP and/or one or more Service Boundary layer or layers extend beyond a jurisdiction's Provisioning Boundary. This document provides guidance to mitigate these concerns. Additional items are marked for future work at the end of this document. It should be further clarified that the PSAP boundary layer is used for NG911 call routing purposes (both the layer's geometry and Service URI field impact where a call is geospatially routed), while the Service Boundary layers exist to provide supplemental information to 911 call takers but are not used for routing calls or dispatching emergency services.

We strongly recommend raising this issue as a target for discussion in future updates of the NENA NG911 GIS data model standard with the recommendation that the layer be modified to allow for multiple Provisioning Boundaries per jurisdiction. Permitting multiple Provisioning Boundaries would mitigate concerns with this approach.

With regards to how the existing NENA standards impact how a Provisioning Boundary is drawn, there are three approaches a county may take. The Commonwealth's NG911 system is agnostic as to what approach is taken as long as it complies with the current NENA standards. Details and considerations on each of three approaches are provided below.

1. **Provisioning Boundary Designed to Follow a County's Geopolitical Boundary**

A common approach for Pennsylvania counties in defining their Provisioning Boundary's geometry is to trace their county's geopolitical boundary. This approach is viable; however, it is important to recognize that a county's authoritative boundary may differ from that of its neighboring counties. In PEMA's previous version of its Best Practices Guides published in 2019, it was recommended that counties utilize PennDOT's county boundary layers as a starting point for drawing PSAP boundaries due to the PennDOT boundaries being topologically clean (free of gaps and overlaps). The PennDOT boundary layers were

also used by counties as a starting point for drawing Provisioning Boundaries. Importantly, PEMA cannot mandate the use of the PennDOT layers, or any layer, and there are instances where a county's local geopolitical boundary, or boundary data from another source, is considered by local 911 Authorities and GIS data stewards to be more accurate than what may be depicted in the PennDOT County Boundary dataset.

The lack of pre-existing standardized, authoritative county geopolitical boundaries that all neighbors agreed to meant that a county's geopolitical boundary layer did not always align to those of neighboring counties. For the purposes of building topologically clean Provisioning Boundaries (and other NG911 service polygon layers), in addition to recommending the use of the PennDOT County Boundaries as a jumping off point, PEMA's original Best Practices Guides, and the Commonwealth of Pennsylvania Statewide NG911 GIS Strategic Plan [19] of March 2019 strongly recommended counties work together to establish topologically clean NG911 service boundaries. Cross-county collaboration, cooperation, and communication was recognized as an essential element for success early on.

Act 17 of 2019 formally codified the need for collaboration between counties as a requirement for ensuring GIS data can support geospatial call routing. Additionally, PEMA made it top priority to provide financial assistance via its 15% Fund grant awards to counties and regions to support inter and intra-regional GIS edge matching initiatives, among other GIS-related projects. Between calendar years 2017 through 2022, PEMA awarded over 12 million dollars in GIS-related projects to further support this work. Overall, at the time that this update is being published, there is a high degree of topological accuracy between Provisioning Boundaries observed across the Commonwealth, indicating that these early efforts in collaboration and financial investments in edge matching and related GIS data development projects paid off.

Going forward, as we transition from a pre-NG911 migration environment to a post-migration environment, it will be critical for county 911 Authorities and GIS data stewards to maintain an integrated view of NG911 GIS data development, maintenance and sharing with their neighboring counties and with the statewide NG911 system. Ongoing cross-county collaboration in GIS will need to continue in perpetuity.

For counties not yet migrated to NG911 service, your data will be audited for topological accuracy as part of the pre-migration process. If gaps or overlaps are detected, PEMA will facilitate discussions between your county and any impacted neighbors. The sooner these discussions occur the better prepared your county will be for migration. To further assist in proactively detecting topology errors, please see Appendix F, which details how to perform a topology check on your own using out of the box Esri tools that are available with an Esri Advanced License, should you wish to initiate this process earlier.

Counties are strongly encouraged to review their boundary topologies early to mitigate or altogether eliminate the need for potential duplicate work. For example, if you build out your NG911 Road Centerlines to snap to your Provisioning Boundary, but later need to edit the Provisioning Boundary's geometry because of a previously unacknowledged dispute with a neighboring county, you will then need to edit the road centerline layer again to snap to the updated Provisioning Boundary. Pre-empting this as early possible by checking and agreeing to boundaries with your neighboring counties will help reduce this risk.

Example of a Provisioning Boundary that Follows its Geopolitical Boundary

Potter County's Provisioning Boundary follows the Potter County geopolitical border. Potter County is responsible for provisioning all NG911 GIS data within its Provisioning Boundary, including the PSAP

Boundaries, Emergency Service Boundaries for Fire, Law, and EMS, Site and Structure Address Points (SSAPs), and Road Centerlines (RCLs).

Of particular interest here are the PSAP and ESB layers in how they are built and get provisioned into the spatial interface (GIS Data Hub). The Tioga County PSAP covers most of Potter County and dispatches fire, law, and EMS services for the area that its PSAP covers, while Clinton County provides PSAP coverage and dispatches fire, law, and EMS emergency services for the southeastern corner of Potter County that is not covered by Tioga County's PSAP. Tioga and Clinton counties are responsible for drawing and attributing their respective PSAP and Service Boundary layers for Fire, Law and EMS for the jurisdictions that they cover, including those within Potter County.

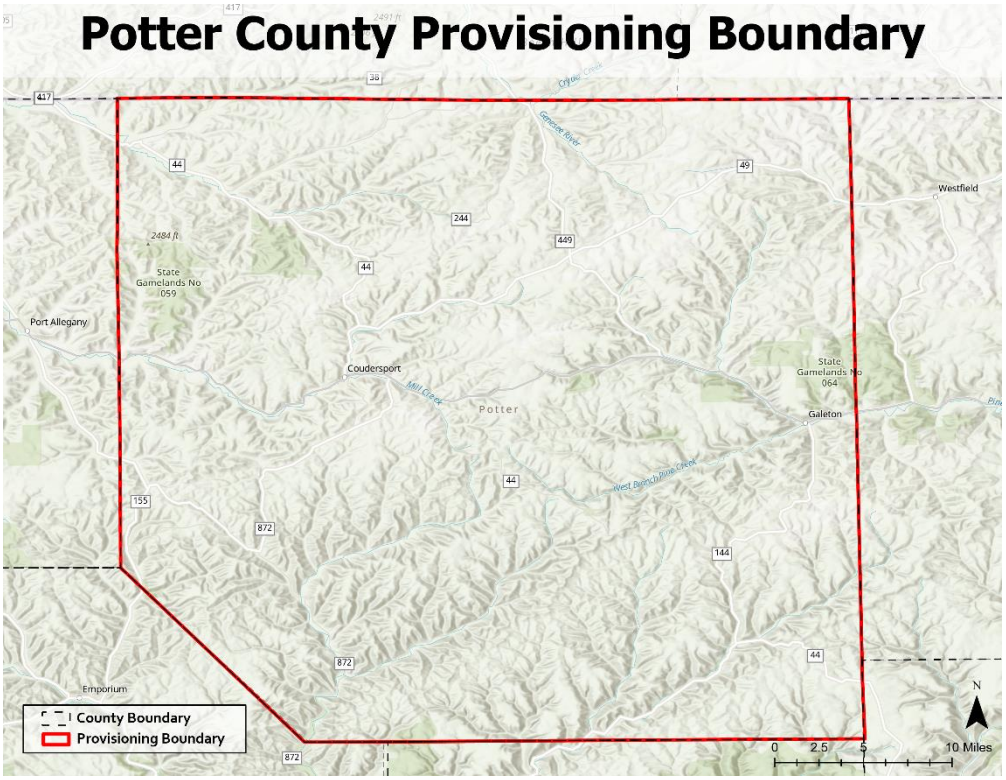
Even though Potter County is the provisioner of the PSAP and ESB layers, the 911 Authorities from Tioga and Clinton counties have sole jurisdiction on how their respective PSAP and ESB layers are drawn and attributed. Any changes to these layers need to be authorized by Tioga and Clinton counties for their respective layers. Potter County cannot make any unilateral changes to these layers without being directed to do so by Tioga or Clinton counties. Due to the limitations in the existing NENA standards on the Provisioning Boundary layer, Potter County is responsible for uploading the portions of these service boundary layers that fall within Potter County's Provisioning Boundary on behalf of Tioga and Clinton counties to the spatial interface (GIS Data Hub).

Additionally, while Tioga and Clinton counties have sole authority over how their respective PSAP and ESB boundaries are drawn and attributed, only Potter County can make edits to the RCL and SSAP data representatives of features within Potter County, even though they fall with the Tioga or Clinton county PSAP coverage areas. One benefit with this approach is that Tioga and Clinton counties do not need to monitor building activities or update their GIS datasets for communities outside of their respective counties. A downside is that Potter County must provision data that it does not have authority to edit on its own.

For the time being, due to the limitations of the existing NENA standards, Potter County is solely responsible for building, maintaining, and provisioning its SSAP and RCL layers, and also in provisioning clipped versions of the Tioga and Clinton county PSAP and ESB Fire, Law and EMS service boundary layers into the spatial interface (GIS Data Hub) because the NENA standards currently only permit one Provisioning Boundary for all NG911 GIS data layers. Any changes that need to be made to the Tioga or Clinton county PSAP or ESB layers can only be made if Tioga or Clinton county notifies Potter County of these changes and authorizes Potter County to make these edits for their next upload to GIS Data Hub, or sends an updated PSAP and or ESB boundary layer to Potter County's GIS Data Steward.

Note: for any county that has countywide PSAP and ESB layers that do not cross it's Provisioning Boundary, that county has sole responsibility for building, maintaining, and provisioning all its required NG911 GIS layers, including its PSAP, ESB, SSAP and RCL layers, to the spatial interface (GIS Data Hub).

In reviewing the next two approaches, we will explore use cases where 911 Authorities take over part or all the GIS data building, maintenance, and provisioning responsibilities for areas outside of their county's geopolitical boundary. This approach is permitted under the existing NENA standard but requires a high degree of coordination between the participants.



Map 1: Potter County Provisioning Boundary

2. The Provisioning Boundary *Mostly* Follows a County's Geopolitical Boundary, but Includes One or More Areas that Extend into a Neighboring County

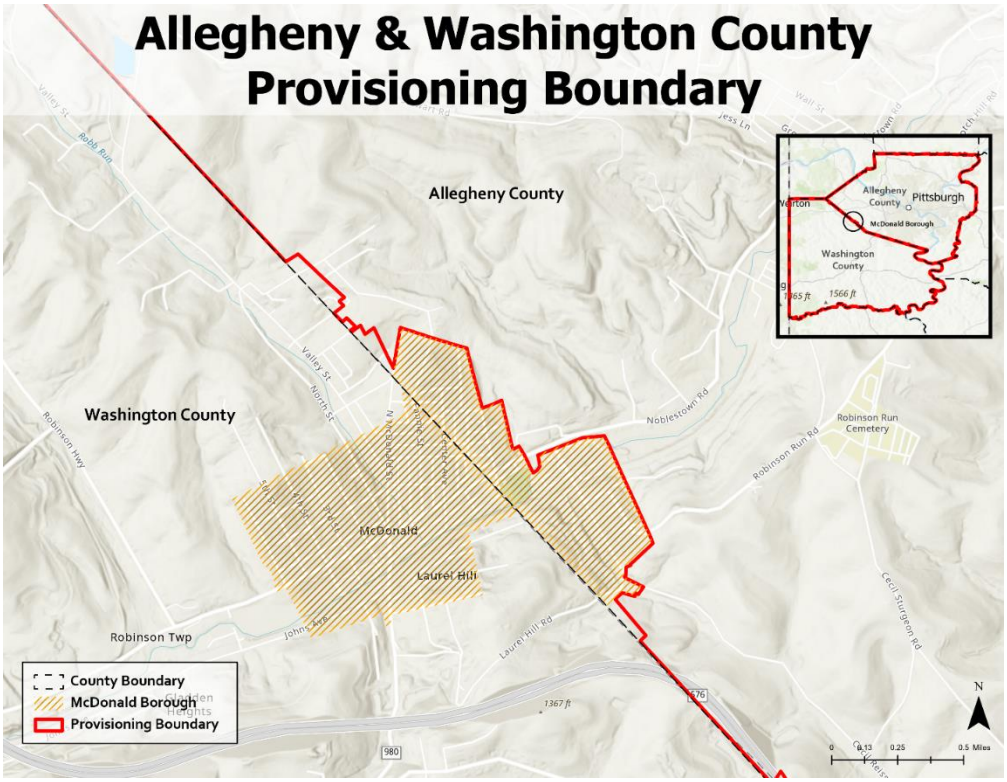
Another approach for delineating Provisioning Boundaries is one where the boundary mostly aligns to a county's geopolitical boundary, but also includes areas that extend into portions of neighboring counties. It is important to note that for the purposes of NG911 a Provisioning Boundary, like the other required NG9111 polygon layers, is not required to align to tax maps, legal surveys, or other officially recognized boundaries. It does need to be agreed to by 911 Authorities from the county and its neighboring counties and should reflect a logical approach for building, maintaining, and sharing NG911 GIS data for a geographic area to support efficient 911 service delivery.

Example of a Provisioning Boundary that *Mostly* Follows its Geopolitical Boundary, but Includes Areas That Extend into Neighboring Counties

Allegheny County and Washington County adjusted their respective Provisioning Boundaries in the area of McDonald Borough to accommodate a geopolitical anomaly. McDonald Borough is a municipality that has the somewhat unique distinction of being situated in two counties, with most of the municipality located in Washington County, and some of it landing in Allegheny County. In this situation, Washington County's Provisioning Boundary was updated to include all of McDonald Borough. Washington County took the responsibility for building, maintaining, and sharing all NG911 GIS data for the entirety of McDonald Borough for NG911 purposes. It should be noted that Washington County's PSAP and ESB boundaries also include the entirety of McDonald Borough.

This decision was based largely on historical precedent. Prior to migrating to NG911 service, Washington County had provided 911 call taking and dispatching services to the entirety of McDonald Borough. By both Washington and Allegheny counties agreeing to update their respective Provisioning, and also PSAP

and ESB layers, they were able to maintain continuity with their pre-NG911 agreement for Washington County to serve the residents of McDonald Borough with 911 and emergency dispatching services.



Map 2: Allegheny & Washington Counties Provisioning Boundaries

3. A Provisioning Boundary Covers Two or More Counties/Regional Provisioning Boundary

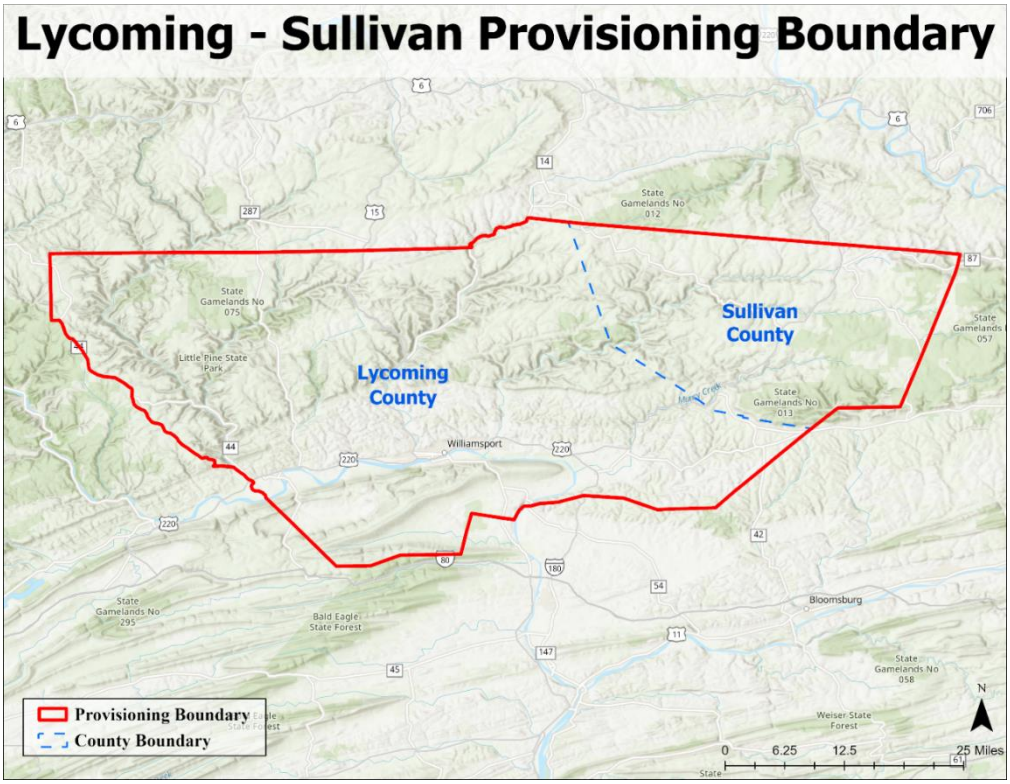
A third approach for drawing a Provisioning Boundary is building it to cover two or more counties. As previously stated, the Commonwealth's NG911 solution is agnostic to a Provisioning Boundary's geometry if it complies with the NENA standards. A regional approach where one county maintains and provisions NG911 GIS data for two or more counties is permitted by the standards. While a regional approach is possible, there are important considerations to consider before pursuing this approach. First, this approach requires the county that will be provisioning the data to perform additional administrative duties, including aggregating all required NG911 data from participating counties to then upload to GIS data Hub on their behalf and share Quality Control (QC) fallout reports with those counties, and ensuring critical errors are being addressed and that data remains current.

These additional administrative duties may be supported by deploying new tools (e.g., scripting solutions for regional data sharing) and may make sense for a region to pursue, but it is important to consider that additional work will be needed to stand up a regional data provisioning system. It should further be noted that it would be logistically difficult to break up a regional data provisioning enterprise, should the counties involved go their separate ways and decide to reclaim provisioning authority.

Example of a Regional Provisioning Boundary

Lycoming County has an agreement in place with Sullivan County to maintain and upload their data for NG911. Due to this arrangement, they have a regional Provisioning Boundary that includes both counties.

Lycoming County builds, maintains, and provisions NG911 GIS data for its county, and maintains and uploads NG911 data to the spatial interface (GIS Data Hub) on behalf of Sullivan County.



Map 3: Lycoming – Sullivan Counties Shared Provisioning Boundary

How to Build, Maintain and Provision PSAP and Emergency Service Boundaries That Extend Beyond a Provisioning Boundary

The three approaches for building out a Provisioning Boundary described above meet the existing NENA standards and are compatible with the Commonwealth's NG911 system. As of the date of this document's publication, the most common approaches are the first and second, where a Provisioning Boundary either fully or largely corresponds to a county's geopolitical boundary, but some counties are taking a regional approach. Regardless of how a Provisioning Boundary is designed, PSAP and Emergency Service Boundaries occasional cross a county's Provisioning Boundary. Examples of how these situations can be addressed were include above. This section further outlines recommendations and best practices for maintaining and submitting data for PSAP and ESB boundaries when they extend beyond a county or region's respective Provisioning Boundary.

When a PSAP and/or an Service Boundary crosses a Provisioning Boundary, any portions of these polygons that cross the Provisioning Boundary need to be split and broken at the Provisioning Boundary. This will result in two or more polygons, depending on the number of adjacent counties a PSAP or Service Boundary extends into. **For all intents and purposes, even though these boundaries are split at the Provisioning Boundary, they remain under the originating county's 911 Authority's purview and control.** However, this creates an issue where real-world boundaries, which are the result of a constellation of locally contingent considerations and agreements, diverge from the framework established by the current NENA NG911 GIS data model standards.

Under NENA's current standards, because there can only be one Provisioning Boundary used for all GIS data in a particular geographic location, any portions of a PSAP or Service Boundary that crosses over a Provisioning Boundary and into another jurisdiction's Provisioning Boundary MUST BE uploaded by the jurisdiction hosting the feature. This requires a high level of collaboration between county 911 authorities and GIS data stewards where cross-county 911 call taking and/or emergency response agreements are in place. This is to ensure that spatial and attribution differences in PSAP and 911 Service Boundaries do not occur.

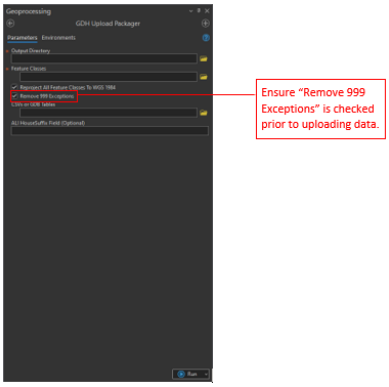
Use of Exception Codes to Maintain Full Extent Boundaries Locally

For counties that have data extending beyond their Provisioning Boundary, they have a few options for approaching data management. They may decide to maintain polygons that display their full extent, rather than removing them. To do this, they can utilize the GC Exception Code field. The steps for using this field are outlined below:

1. split your impacted service layer polygon (or polygons) at your Provisioning Boundary. This will produce two or more polygons, with features within and outside of your Provisioning Boundary.

2. For the newly created polygons falling outside of your Provisioning Boundary, add the code 999 to the GC Exception Code field, without any preceding or leading spaces.

3. Package your data for submission to GIS Data Hub using the HubHelper tool and ensure the checkmark next to the "remove 999 Exceptions" line is checked. The 999 exception code tells GIS Data Hub to ignore any features that are coded with it. This will prevent PSAP or Service Boundary polygons that fall outside of your Provisioning Boundary from getting passed into GIS Data Hub and throwing a critical error while still allowing you to maintain these features in your data locally.



Note: any additional fields contained within your GIS layers that are not in the NG911 GIS Data Model or field mapped to GIS Data Hub are ignored. There is no need to remove them locally prior to upload.

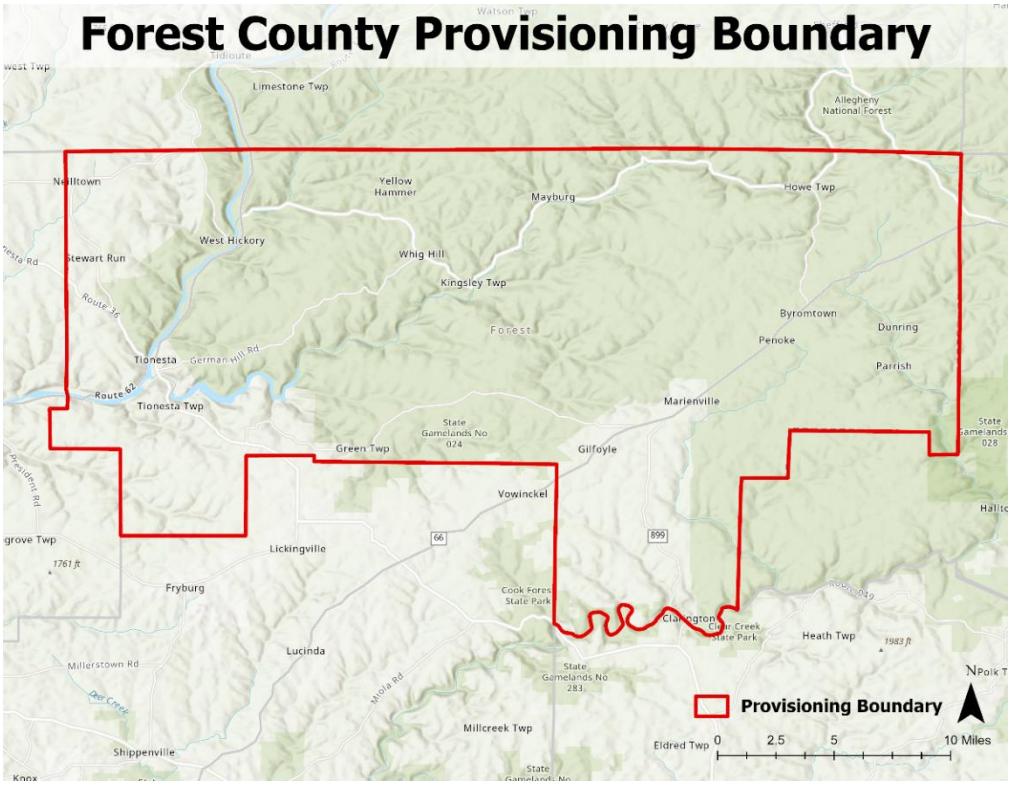
Some counties take this approach so that they can use the same dataset for NG911 and other county government/business functions. Alternatively, a county may completely remove features that fall outside of their Provisioning Boundary. In either case, the county MUST coordinate with any other county covered by their respective PSAP or ESB Boundaries and ensure they have the most current and accurate versions of the PSAP and ESB layers.

Cross-County Response Uses Case: Forest County, PA

This section outlines a use case that illustrates the above recommended best practices for preparing and sharing PSAP and Service Boundary layers when they extend beyond a county's Provisioning Boundary, by focusing on Forest County.

Forest County does not have a countywide PSAP, and instead partners with the Clarion County and Warren County to provide 911 service. However, Forest County retains responsibility for building, maintain and provisioning its NG911 GIS data, and is the data steward for the NG911 GIS data that falls within its countywide Provisioning Boundary. This data is used to geospatially route calls to the correct PSAP based on its coverage area and is used to direct calls to the Clarion and Warren County PSAPs based on where in the county a 911 call is placed. It is therefore especially important that the PSAP boundaries provisioned by Forest County are complete, accurate and current and free of critical errors.

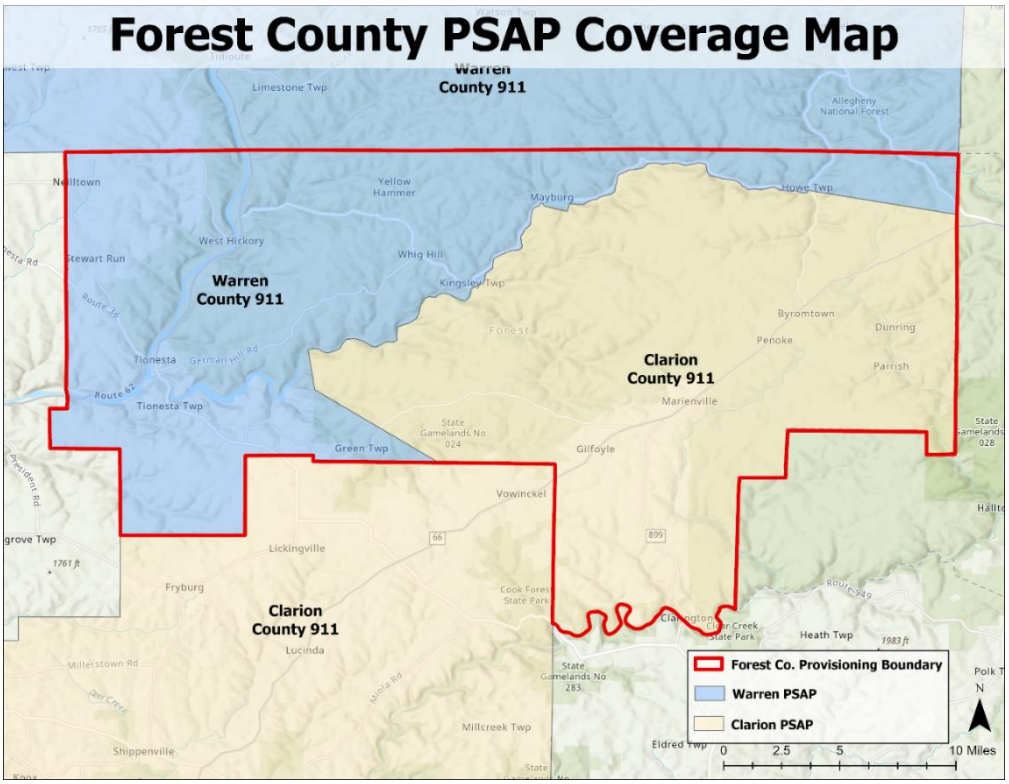
Since Forest County maintains responsibility for stewarding its NG911 GIS data, it is responsible for providing all NG911 GIS data layers for the entire county, including the portions of the Warren and Clarion county PSAP and Emergency Service Boundaries that fall within the Forest County's Provisioning Boundary. Importantly, even though Forest County provisions these polygons, they still *belong* to Warren and Clarion counties, and they remain under their respective 911 Authority's purview and control. Forest County cannot arbitrarily make edits to the PSAP or ESB boundary geometries or attribution without authorization from Warren or Clarion counties. All three counties must maintain a high-level collaboration to ensure and maintain long-term integrity of these boundaries.



Map 4: Forest County Provisioning Boundary

Map 4, above, shows Forest County's Provisioning Boundary (red border), which defines the area that the county, as the Provisioning Authority, is responsible for maintaining, and submitting all required NG911

GIS layers to GIS Data Hub. This data is used to support geospatial call routing, routing 911 calls to the proper PSAP. If there are any edits that need to be made to the GIS data within Forest County, the county is responsible for making those updates and provisioning updated layers to GIS Data Hub in a timely manner. For example, if a housing sub-division is built in the community of Gilfoyle, Forest County's GIS data steward would need to update its Road Centerlines and Site/Structure Address Points to include any new road centerline and site/structure address point features.



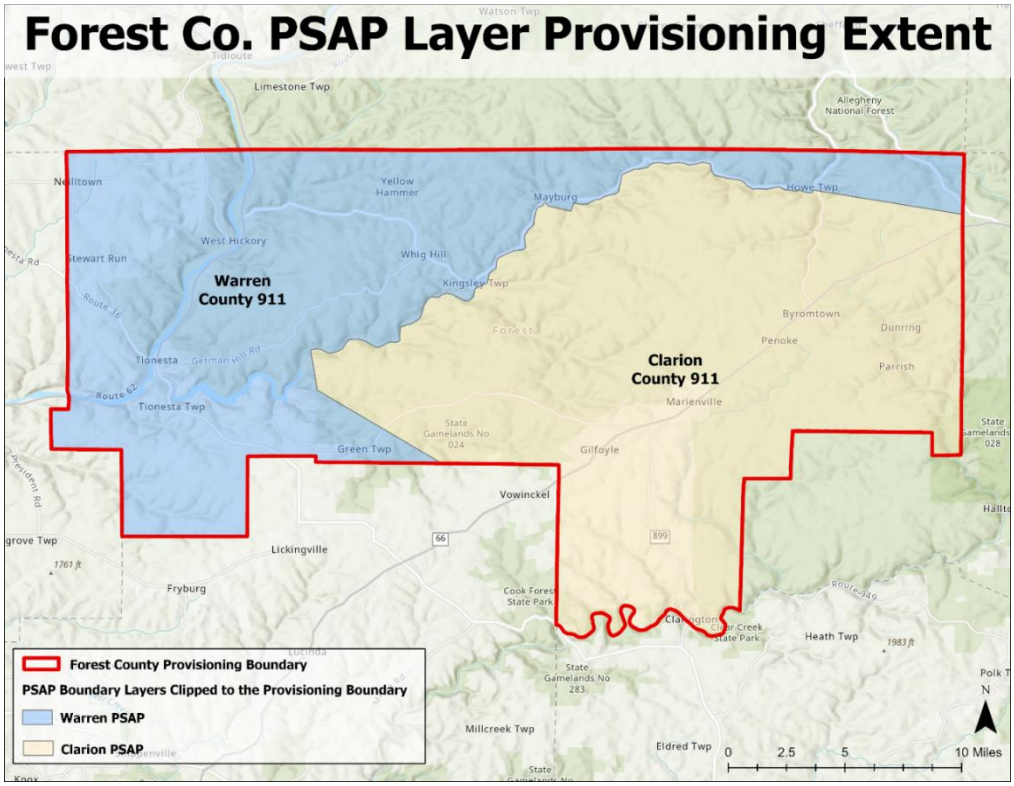
Map 5: Forest County PSAP Coverage Map

Map 5, above, shows where the Warren County and Clarion County PSAPs respond within Forest County. Keeping with the example of a new housing development being built in Gilfoyle, we see that this town falls squarely within the Clarion County PSAP boundary. However, since Forest County retains countywide NG911 GIS data stewardship responsibility, it, not Clarion County, would need to make the necessary changes in its GIS data to include the new housing development.

Due to the current limitation in the NENA Standard around Provisioning Boundaries, Forest County MUST submit all required NG911 layer features that fall within its Provisioning Boundary. This includes PSAP, Emergency Service Boundaries for Fire, Law and EMS, Road Centerlines, and Site/Structure Address Points. They are unable to defer provisioning of the PSAP and ESB boundaries to Clarion County at this time.

As an alternative, Forest County and Clarion County could establish an agreement where Clarion County takes on all responsibility for maintaining and submitting all GIS data for the area of Forest County that is serve by its PSAP (they could also pursue this with Warren County) but this requires additional administration. This would be the regional provisioning model described earlier. If this were to occur, Clarion County would need to regularly obtain data for the area that is covers in Forest County, or agree to build and maintain that data, and follow up on any Quality Control issues in a timely manner. Failure to

keep accurate and current data in the statewide system could contribute to less accurate call routing in the future. It is therefore important that counties remain diligent about regularly updating their data.



Map 6: Forest County PSAP Boundary Provisioning Extent

Map 6, above, shows the Warren and Clarion county PSAP boundaries clipped to the Forest County Provisioning Boundary. Due to the limitations and role of the Provisioning Boundary, Forest County will need to obtain Warren and Clarion county's PSAP boundary layers and then include it as part of its upload package to GIS Data Hub.

To prepare the PSAP and ESB boundary data, Forest County's GIS Data Steward would take the following steps:

1. Warren County and Clarion counties to provide their respect portions of their PSAP and Emergency Service Boundaries that fall within Forest County. *Note: only Warren and Clarion counties can edit or authorize edits to their respective PSAP and ESB layer geometries and attribution.*

2. Forest County's GIS data steward, and their counterparts in Warren and Clarion counties must ensure the **Agency ID, Discrepancy Agency ID, Service URI, and Display Name** fields in the respective PSAP Boundary and Service Boundary attribute tables are correctly populated. The PSAP layer's Service URI field is critical for call routing, while the other fields listed provide supplemental secondary information. Note: The Service Boundary layer exists solely to provide 911 call takers with supplemental data but is not used by the NG911 system for call routing or dispatching.

Agency ID	Valid domain name for the county that owns the data. For example: **warrencopa.com**
Discrepancy Agency ID	Valid domain name for the county provisioning the data. For example: **forest.state.pa.us**
Service URI	Provided to the PSAP by Comtech. This MUST reflect the Service URI assigned to the PSAP.
Display Name	A description or "name" of the service provider that offers services within the area of a Service Boundary. For example: Clarion County 911

3. After confirming attribution and geometry with Warren and Clarion counties, Forest County includes the PSAP and service boundary layers as part of its upload package and submits the to GIS Data Hub. If no critical errors are present, the data gets aggerated into the statewide layers and is used for Geospatial call routing. If critical errors are present in these layers, the data does not get passed into the statewide GIS layers and instead Forest County receives a quality control fallout report.

Note: Prior to a PSAP's migration to NG911 service, part of the go/no-go discussion includes a final review by the migrating PSAP of the geometry and attribution of their PSAP and Service Boundary layers to validate accuracy. If any PSAP or Service Boundary features are provided by a neighboring county, that county will be included on the layer geometry and attribution review.

Future Work

A primary concern with the above-described limitations with the existing NENA standards as they relate to Provisioning Boundaries is a scenario where an accidental change is made to the attribution or geometry of a PSAP or Service Boundary polygon that a neighboring county is responsible for provisioning to the spatial interface (GIS Data Hub). Of greatest concern is the potential for a data steward in a county served by a neighboring county's PSAP to unintentionally modify the geometry or Service URI field in that county's PSAP Boundary layer. This field is populated with a sip code that is used to point a call to the proper PSAP and an accidental change to the Service URI field has the potential to cause a 911 call to be routed to the incorrect PSAP and delaying an emergency response.

In the immediate, as of time of publication of this document, PEMA is working with Comtech to identify approaches that seek to mitigate this concern and are acceptable to our county GIS stakeholders.

A long-term goal is to update the NENA NG911 GIS Data Model standard and NENA i3 Standard to provide more flexibility in how the Provisioning Boundary can be drawn and attributed. More specifically, it would be beneficial to update the layer's data structure to allow for multiple Provisioning Boundaries per 911 Authority to organize and submit different layers with. The timeline for implementing this is dictated by the NENA GIS Working Group and will take time to implement.

It should be noted that counties in Pennsylvania can download the statewide NG911 GIS dataset and review data submitted by neighboring jurisdictions via GIS Data Hub anytime, but this can be a time intensive process. The statewide datasets are updated every weeknight and reflect the latest critical error free NG911 GIS data from counties across the Commonwealth.

In the meantime, while the PSAP Boundary is not expected to require frequent changes, it is imperative that counties rigorously review their GIS data for accuracy and completeness prior to each upload. Counties are the first line of defense in ensuring their data is complete and accurate.

APPENDIX E

PSAP BOUNDARY, PROVISIONING BOUNDARY, AND SERVICE BOUNDARY LAYER CHANGE MANAGEMENT PROCESS CHECKLIST

County 911 Authorities will, on occasion, need to update their PSAP, Provisioning, and Service Boundary GIS layers. This guide outlines a step-by-step process for guiding county 911 Authorities and GIS data stewards in updating these layers. This guide is intended to help counties prevent erroneous or otherwise conflicting GIS data from being passed into the statewide NG911 system and includes a template checklist that PEMA strongly recommends counties use.

For awareness, the PSAP Boundary layer impacts NG911 call routing and the Provisioning Boundary layer impacts what NG911 data gets loaded for a geographic area. **Therefore, additional caution should be exercised when updating your PSAP Boundary or Provisioning Boundary layers.** The Service Boundary layers for Fire, Law, and EMS are also required for NG911. However, these layers only provide supplemental information to 911 call takers and are not used directly to route 911 calls or dispatch emergency services. Caution is still warranted when updating these layers, but it is important to note that they are not used by the Pennsylvania NG911 system for routing 911 call traffic or dispatching first responders. *Note, if your county or region uses NG911 Service Boundary layers for other systems, such as Computer Aided Dispatch (CAD), please take appropriate measures to ensure your layers are complete and ensure they are accurately drawn and attributed.*

When making updates to a boundary layer that neighbors another county, cooperation with the neighboring county or counties is essential, especially with their 911 Coordinator and GIS data steward(s). GIS data is a critical component of the Commonwealth's NG911 system and changes to one counties data are reflected in the statewide dataset. It is imperative that counties work closely in updating any layers that have the potential to impact their neighbors. To support this effort, PEMA developed the checklist below (see next page) for counties to follow when managing boundary changes that may impact neighboring counties. For now, these recommendations are limited to counties inside the Commonwealth. A future work item will be extending these recommendations to include boundaries with counties in neighboring states.

Note: the process detailed below will likely take time for counties to complete. For expedited or emergency updates, please contact PEMA.

Boundary Change Management Checklist Template:

Briefly describe what layer (or layers) needs to be updated and why (PSAP, Provisioning, and Service Boundaries for Fire, Law, and EMS):

_____
_____
_____
_____
_____
_____

Describe the changes to geometry and/or attribution that will be needed:

_____
_____
_____
_____
_____
_____

Please list all impacted counties and provide contact information for their respective 911 Coordinator(s) and their GIS data steward(s). For a current list of county 911 coordinators, please visit PEMA's 911 Coordinator List

County Name	911 Coordinator and Contact	GIS Data Steward and Contact

Provide a deadline for when these changes need to take effect: __/__/____
An estimate is ok but try to be as precise as possible

Next Steps:

- Draft an updated GIS boundary layer (or layers), updating geometry and attribution as needed.
- Share copies of the updated GIS data layer (or layers) with your GIS counterparts in impacted neighboring counties for their review. *Ensure their county IT department does not block links or zip files.* Also, agree to a deadline for the neighboring county or counties to finish their review.
- *A virtual or in-person meeting may be useful once data has been shared and reviewed for addressing questions or concerns. If you have multiple counties that you are working with, it is recommended that you schedule one-on-one sessions with each impacted county rather than trying to meet counterparts from all impacted counties at once. This will allow you to narrow*

your focus to one geographic area at a time. Depending on the changes needed, a meeting may not be necessary at this stage.

- If the updated boundary or boundaries crosses your county's Provisioning Boundary, coordinate with your GIS counterparts in jurisdictions served by the boundary layer or layers being updated and ensure they provision the most current version of the data that falls within their county's Provisioning Boundary to GIS Data Hub. **Note**: **they cannot edit your PSAP, Provisioning, or Service Boundary layers, even if these layers fall within their Provisioning Boundary. Their role is limited to provisioning the data and working with you in ensuring that it is current and accurate. You need to authorize any changes to a PSAP or Service Boundary layer that fall outside of your Provisioning Boundary.** For more information on how to build, maintain, and provision boundary layers that cross a Provisioning Boundary, please see Appendix D.

- If no issues are identified by the reviewing county (or counties), or after issues have been addressed, request that they update their own boundaries to ensure alignment with your data and set a mutually agreeable deadline for them to complete their updates and share back their data with you to then compare against. Also, agree to a go live date for provisioning the updated layer (or layers) to GIS Data Hub.

- Next, merge the edited layers and set up a topology check on the updated boundaries. See Appendix F for an overview on how to perform a topology analysis, if needed. When building your topology rules, please set the XY Cluster Tolerance to <= 0.862105 meters. Execute the topology check and confirm the updated layers are free of any unintentional gaps or overlaps.

- Once boundaries are finalized, schedule a final one-on-one review session with each impacted county and re-confirm that 911 Authorities from affected counties agree to the updated geometry and attribution. It is strongly recommended that participants view updated maps (PDF, web maps, printouts – whichever media works best to support this review task) to confirm geometry and examine the corresponding attribute table or tables to confirm agreement to attribution.

- PEMA strongly recommends any decisions between counties on updated layers are memorialized via written notification and dated, with the notification being provided by the jurisdiction initiating the changes. This can be done via email, PDF, or printed copy letter summarizing the decision behind the edits and their effective dates.

- After coordinating changes with all impacted counties, notify GeoComm and PEMA of a pending upload. They will monitor for any anomalies.

- Package your updated data using the HubHelper tool and submit to GIS Data Hub. Provided no critical errors are found, your data should typically appear in the NG911 system within one business day. If critical errors are detected, your data will not be passed into the NG911 system, and a quality control fallout report will be compiled in GIS Data Hub and made available under the analytics tab.

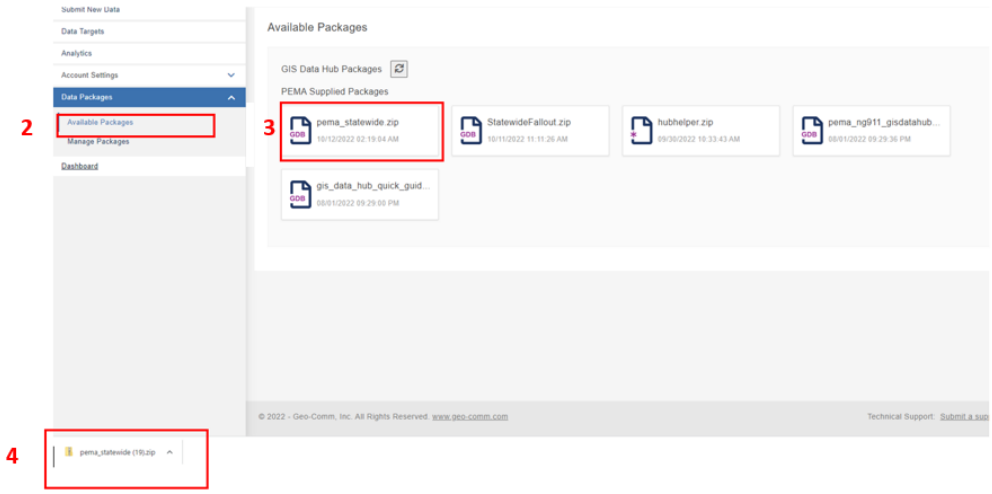
APPENDIX F:

HOW TO RUN TOPOLOGY CHECKS ON THE STATEWIDE PSAP, PROVISIONING, AND SERVICE BOUNDARY LAYERS

Downloading the aggregated data from GIS Data Hub

1. Log into GIS Data Hub
2. Navigate to Data Packages and select Available Packages
3. Select the card labeled "pema_statewide.zip"
4. Within a few seconds to a few minutes, a zipped file download will initiate. Please be patient if it does not kick off right away.

Figure 1: Where to Download Statewide NG911 Datasets within GIS Data Hub (access is restricted)



Setting Up Your Topology Analysis in ArcGIS Pro (the workflow is very similar in ArcMap)

5. Open your recently downloaded data in ArcGIS Pro.
6. Create a new File Geodatabase (FGDB) and add the features you are looking to run a topology analysis on into your new FGDB. For example, import the statewide PSAP layer**.**

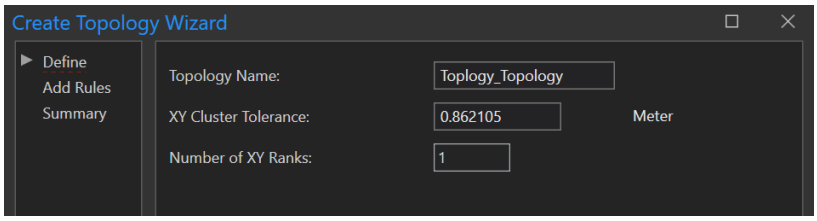
Once your data is pre-loaded into a FGDB feature dataset, you can set topology rules.

7. To do this, right click on your FGDB in the Catalog window, and select New > Topology.

Define an XY Cluster Tolerance

8. This defines your acceptable margin of error. Esri's default value is 0.001 meters, however this setting will likely be too precise for your analysis. We recommend using an XY cluster tolerance less than or equal to .862105 meters (2.828427 feet)

Figure 2: Setting the XY Cluster Tolerance to 0.862105 meters (2.828427 feet)



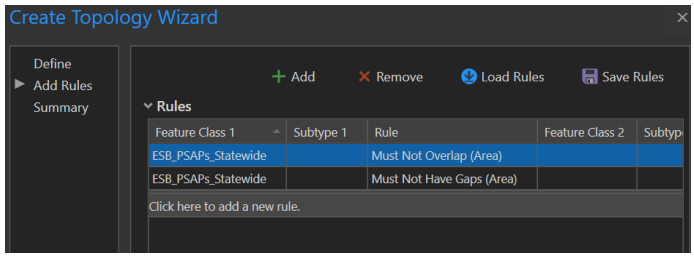
Define Topology Rules

9. You will need to define rules for your analysis. You can do this by selecting "Add Rules" on the left-hand side of the Create Topology Wizard window and choose the following rules from the dropdown menu:

    a. **Must Not Overlap (Area):** Polygons of the first feature class or subtype must not overlap with polygons of the second feature class or subtype**.** Polygon errors are created where polygons from the two feature classes or subtypes overlap. Use this rule when polygons from one feature class or subtype should not overlap polygons of another feature class or subtype. **Applying this rule will you us to detect overlaps between PSAPs.**

    b. **Must Not Have Gaps (Area):** Polygons must not have a void between them within a feature class or subtype. Line errors are created from the outlines of void areas in a single polygon or between polygons. Polygon boundaries that are not coincident with neighboring boundaries are errors. Use this rule when all of your polygons should form a continuous surface with no voids or gaps. **Applying this rule will allow you to detect gaps within and between PSAP layers.**

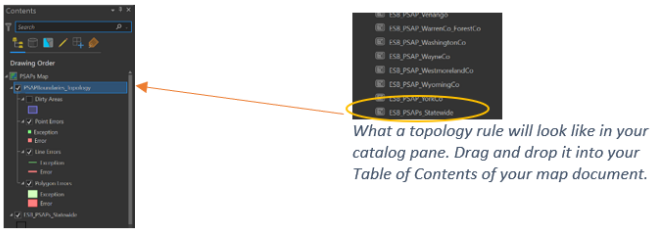
Figure 3: Configuring the topology rules



Validating Your Topology Analysis

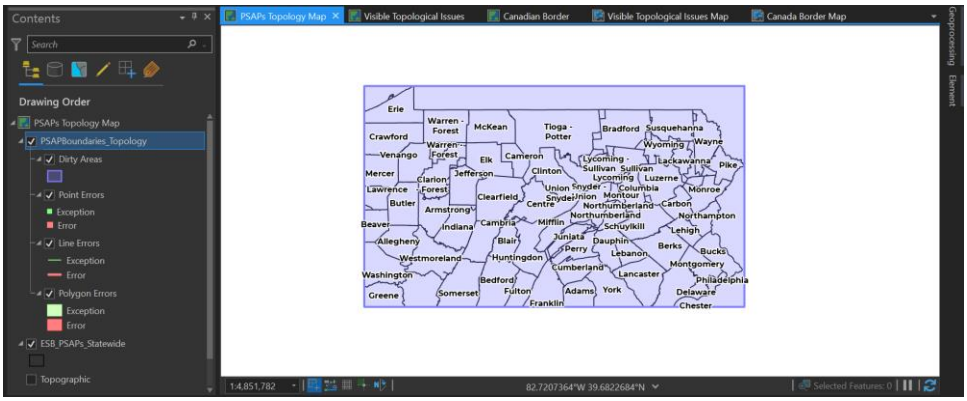
10. With your data imported and the above topology rules defined, you are now ready to run you topology analysis. To do this, drag and drop the topology rules from the feature dataset in the FGDB into the map's table of contents.

Figure 4: The topology rules in the Table of Contents of our map



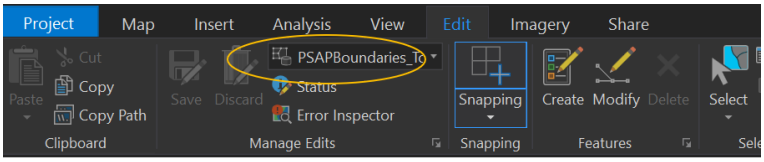
11. Next, zoom out to the full extent of your area of interest. This will ensure that all areas on your map are included in the topological analysis. If an area of your map is not included in the topology check, it will show up on the resulting map in purple as a "Dirty Area", meaning it has not been vetted yet. To correct this, zoom to that area or zoom out to include your entire region of interest and re-validate your topology.

Figure 5: Zoom out to your region of interest's full extent



12. In the Edit tab, under the Manage Edits group, click on Topology and select the rules we just created from the dropdown list

Figure 6: Select and enable the topology rule

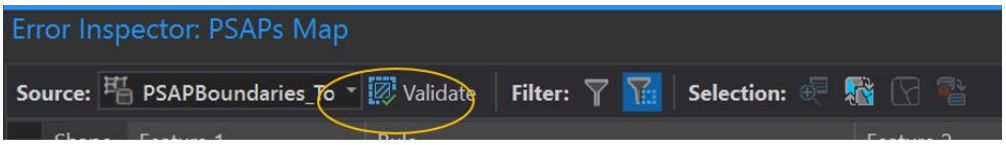


13. Next, select Error Inspector, found in the Manage Edits group. Click **Validate**. This process may take a few moments to complete.

Validate Your Topology

14. **Select the Validate Button.** This will enable ArcGIS to validate your data and will identify and flag all gaps and voids. Note that this may take a few moments.

Figure 7: Select validate



View and Correct

15. You can view your errors both on the map and in an attribute table. To veiw the attribute table, select the Error Inspector. This will pull up a data table that allows you to highlight specific errors, zoom to them, and either correct them or mark them as exceptions if there is a reason for them to be present.

Figure 8: Error inspector

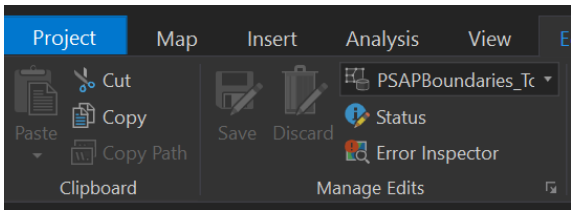
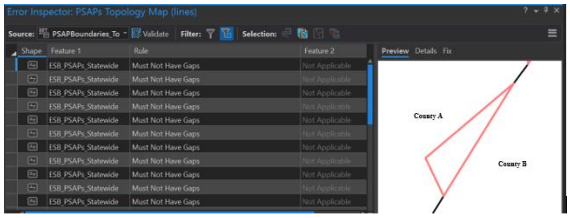


Figure 9: Error inspector results table



Note: the results in the error inspection table will adjust to areas that you zoom to on your map. For example, if you were to zoom into County A, as shown in figure 9 above, you would no longer see errors for other counties if the data table.