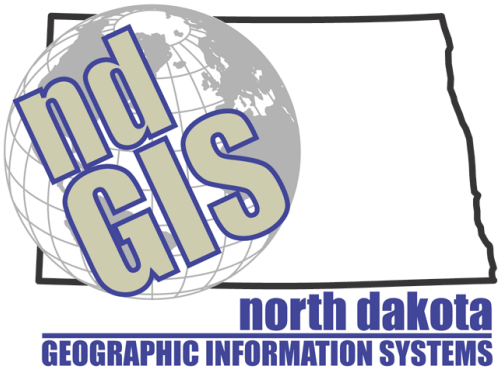
North Dakota Road Centerline Data Standards



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For: North Dakota GIS Technical Committee (GISTC)
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Introduction

Led by the North Dakota GIS Technical Committee, this document was developed to provide standards for the creation and maintenance of a road centerline dataset for the State of North Dakota. This data will be used for various applications including but not limited to 9-1-1, emergency management, routing services, geocoding services, tax assessing with each area of specialty requiring specific attributes and maintenance methodology.

Background

GOVERNANCE

The North Dakota GIS Technical Committee (GISTC) consists of eleven state agencies and was established by Executive Order 1995-05 and re-affirmed by 2001-06. The executive order list a number of GISTC priorities which include:

- coordinates and provides overview of GIS activities within the state
- acts as a clearinghouse of GIS activities
- provides orderly accumulation and dissemination of digital-spatial data

The GISTC leads the state's GIS Initiative, the core of which is the GIS Hub. The GIS Hub, consisting of a database and web infrastructure, is used for centralized storing and distribution of state agency GIS data.

ROAD CENTERLINES

The State of North Dakota, local and tribal government, and the private sector need a seamless, shareable, statewide road centerline data set that is maintainable, spatially accurate and containing the necessary attributes to be used by routing and geocoding applications. In particular, such a dataset is needed for emergency services and daily state agency activities.

The GISTC identified the need to conduct a study to determine the most feasible and cost-effective approach and an estimate of cost to meet the goal of developing and maintaining a statewide road centerline dataset using multiple sources and entities. The GISTC developed a scope of work and submitted a work order to the Business Analyst category of the GIS Professional Services Contract Pool. The Work Order Award was made to GeoComm of Saint Cloud, Minnesota. The project was begun in December 2006 with a kick-off meeting with GeoComm, the GISTC, the Department of Emergency Services, and the North Dakota Association of Counties.

Purpose

This document is designed to provide standards for the creation of a statewide road centerline file and to facilitate on-going maintenance practices. The plotting of 9-1-1 calls requires the interaction with outside databases such as the MSAG (Master Street Address Guide) and ALI (Automatic Location Information) database. These databases, along with professional organizations like NENA (National Emergency Number Association) play a key role defining the centerline standards.

These standards provide the necessary information to create a quality, uniform road centerline data set. Following the standards will allow data sharing across multiple entities and ensure consistent data development and maintenance.

Development Standards

Road centerlines will include all visually verifiable federal/state/county/township roads and trails. An example of the level of detail that needs to be captured is from the NDDOT county base maps.

Projection

Data to be used in the North Dakota Road Centerline Dataset must have associated and documented projection information that can be correctly interpreted by commercial GIS software. The systems in use on the GIS Hub will allow the uploading or downloading of road centerline data in other projections. The road centerline data stored on the GIS Hub will be stored in the Geographic Coordinate System using the North American Datum of 1983 (NAD83).

Data Format

Data to be used in the North Dakota Road Centerline Dataset must be in a format that is known and readable by commercial GIS software. The systems in use on the GIS Hub will allow the uploading or downloading of road centerline data in multiple data formats. The road centerline data stored on the GIS Hub will be stored in an enterprise geodatabase format.

Spatial Accuracy

Horizontal Accuracy

Data shall be collected an accuracy level of 1-3 meters or better at the 95% confidence level. When collecting data with mapping grade GPS equipment it is recommended to collect at 1 meter or better.

Vertical Accuracy

Elevation information is not required. Therefore, there is not a vertical accuracy requirement.

Accuracy Testing
The Federal Geographic Data Committee (FGDC) has adopted a nationally recognized standard for accuracy testing of GIS map data. The National Standard for Spatial Data Accuracy (NSSDA) outlines a methodology for measuring positional accuracy. If accuracy testing is desired, the NSSDA procedures outline the statistical processes.

Feature Type

Single lines will represent the road centerline features. A line represents the estimated center of a roadway not the legal right-of-way. Four address range fields represent the low to high on the odd and even side of the road segments for geocoding. The address range values shall represent actual or theoretical address ranges for the line segment and stored in the feature attribute table of the data set.

Topology

The topology shall be consistent and developed in accordance with ESRI methodology whereby all arcs shall connect to adjacent arcs via from-nodes (FN) or to-nodes (TN), unless it is a dead end street.

The road segments shall be broken and snapped where at grade intersections exist as well as changes in the emergency service zones (ESN) and political boundary changes (e.g., county, city, or tribal boundaries). All lines must have correct origin and end points that coincide with address flow and must be segmented at every intersection with no topological errors (overshoots, undershoots, etc). The topology quality control follows three main feature characteristics explained in the table below.

Roads MUST NOT INTERSECT OR TOUCH INTERIOR	An error is returned when two segments overlap and do not create a true intersection.
Roads MUST BE SINGLE PART	This rule identifies road segments which are multi-part (select one segment, two are highlighted).
Roads MUST NOT HAVE DANGLES	An error is returned when the end of a line segment is not snapped to another.

Data Development

Digitizing:

Digitizing is an acceptable method for the creation of spatial centerline features to be incorporated into the statewide road centerline dataset. However, digitizing can produce varying degrees of accuracy if data capture standards are not followed. When using aerial imagery obscured streets may need field verification with a map grade GPS unit. To ensure accuracy levels are maintained, digitizing procedures should be completed using the following minimum standards:

Capture Scale for digitizing: 1:1200
Projection: UTM Zone 13 or Zone 14[1]
Datum: North American Datum of 1983 (NAD83)
Units: Meters
Source – Available aerial imagery that meets the accuracy levels established in this document[2]

[1]Or approved projection of aerial imagery

[2]Note that 1m NAIP imagery has a horizontal accuracy of within +/- 3 meters relative to referenced USGS digital ortho quarter quadrangles. The NAIP imagery therefore does not meet the accuracy standards of this document.

Global Positioning Systems (GPS):

Development of spatial centerline features may be created utilizing GPS technology. The GPS equipment and techniques must provide output that meets the accuracy levels established in this document. Post processing of the data may be required to obtain desired accuracy levels.

Attributes

The local Master Street Address Guide (MSAG) shall be used as a guide for the development of street name and address range attributes. The incorporation of attributes into the defined fields may be through manual or automated processes.

Table Structure

Attributes for the North Dakota road centerlines shall follow the defined table structure. The table structure represents the minimum fields. Local applications may require additional fields. Additional fields listed in the table below represent fields maintained by the North Dakota Department of Transportation.

BASEFIELDS			
FIELD	**TYPE**	**WIDTH**	**DESCRIPTION**
STR_NAME	Text	50	Combined street name
L_LOW	Long Integer		Left address low
L_HIGH	Long Integer		Left address high
R_LOW	Long Integer		Right address low
R_HIGH	Long Integer		Right address high
PREFIX	Text	4	Street prefix directional
STREET	Text	30	Street name, parsed
SUFFIX	Text	4	Street suffix, NENA std
POSTDIR	Text	4	Street post directional
RDCODE	Text	10	Road hierarchy
A_PREFIX	Text	4	Alternate street prefix directional
A_STREET	Text	30	Alternate street name parsed
A_SUFFIX	Text	4	Alternate street suffix, NENA std
A_POST	Text	4	Alternate street post directional
SURFACE	Text	20	Description of road surface
ONEWAY	Text	4	1=one way street, 2=two way
L_ESN	Long Integer		ESN left side of street
R_ESN	Long Integer		ESN right side of street
UPDATED	Date		Date of last change to segment
SOURCE	Text	10	Original source of centerline data
SCALE	Text	10	Original scale of centerline data
ACCURACY	Text	10	Original accuracy of centerline data
UNIQUEID	Long Integer		State Unique ID given to every segment
LOCALID	Long Integer		Local unique ID can be used for linking local data back into the data
ADDITIONALFIELDS			
FIELD	**TYPE**	**WIDTH**	**DESCRIPTION**
ROUTE_ID	Long Integer		NDDOT field
F_MILE	Double		NDDOT field
T_MILE	Double		NDDOT field
ZIP_LEFT	Double		Zip left side of road
ZIP_RIGHT	Double		Zip right side of road
LENGTH_FT	Double		Length of segment (feet)
LENGTH_MI	Double		Length of segment (miles)
SPEEDLIMIT	Short Integer		Speed limit for road

MINUTES	Double		Determined by dividing the speed limit by 60 and then dividing that by the length in miles = time to drive segment (at speed limit)
NOTES	Text	50	Additional notes added

Street Names

Named

The MSAG valid street names should be used in the main street name fields in the above table structure. Additional fields are provided for Alternative or local street names. In the case of variation in street name spellings for the same road in the MSAG, a standard should be applied across the statewide data attributes.

Numbered

US Postal and NENA standards should be followed for numbered streets. No numbered streets will be spelled out. In addition, all number streets will include the appropriate “th”, “rd”, “st” or “nd”. The table below displays examples of the appropriate format.

Street Number	Abbreviation	Street Number	Abbreviation
First	1st	Thirteenth	13th
Second	2nd	Twentieth	20th
Third	3rd	Thirtieth	30th
Fourth	4th	Fortieth	40th
Fifth	5th	Fiftieth	50th
Sixth	6th	Sixtieth	60th

Punctuation

Punctuation and characters such as &, #, /, -,etc. shall not be included in any fields within the road file.

Directionals

US Postal and NENA standards should be followed for street directionals. The table below displays the corresponding abbreviation.

Directional	Abbreviation	Directional	Abbreviation
North	N	Northeast	NE
South	S	Northwest	NW
East	E	Southeast	NE
West	W	Southwest	SE

Street Types

US Postal and NENA standards should be followed for street types. The table below displays the corresponding abbreviation.

Type	Abbreviation	Type	Abbreviation
Street	ST	Way	WAY
Avenue	AVE	Road	RD
Boulevard	BLVD	Highway	HWY
Lane	LN	Parkway	PKWY
Circle	CIR	Terrace	TER
Loop	LOOP	Trail	TRL
Drive	DR		

*The above is a sample of street designators for the region. Add designators will follow Postal Addressing Standards Pub. 28.

Address Ranges

- There are typically two different ranging methods:
  - Theoretical Address Ranges - this is very broad ranging and typically starts with zero and ends with 99. An example would be the 100 block ranged from 100/101 to 198/199.
  - Actual Address Ranges - ranging of individual segments is tighter. Typically starts with zero/one and ends with a number that more closely represents what exists. An example would be the 100 block ranged from 100/101 to 134/135.

Theoretical address ranging for the state centerline data is acceptable. However actual address ranging is recommend whenever possible based on funding, available resources, and application specifications.

Metadata

Metadata means data about data. Metadata shall be provided and updated on all GISTC data layers. This information is critical in today's data-sharing world. The primary purpose of metadata is to provide a complete answer to *who, what, when, why* and *how* on the individual layer, to aid in the distribution of the spatial data set.

The metadata shall be developed and maintained following the FGDC metadata standards. Up to date metadata shall be provided for any information to be included in the statewide centerline file. Metadata shall accompany any state centerline information when distributed or transferred between entities. Metadata should be successfully passed through an FGDC compliant parser such as the U.S. Geological Survey Metadata Parser (mp).

Feature level metadata will be included with each road segment. This will include but not be limited to source, scale, estimated accuracy, and date.

Distribution

The North Dakota road centerline data shall be distributed via the North Dakota GIS Hub at no cost to private or public users. The data will be distributed as downloadable data and as web services.

Glossary

ALI database- Automatic Location Identification - the street address associated with the telephone number (ANI), which is displayed at the dispatcher's position in a PSAP (Public Safety Answering Point).

Dangles- A starting or end point of a polyline which is not connected to another polyline feature. Feature such as dead ends or cul de sacs are examples of acceptable segment dangles since they are not intended to connect to another polyline feature.

ESN- Emergency Service Number - a 3 to 5 digit number representing a unique combination of emergency service agencies (Police, Fire, and Medical) designated to service a specific range of addresses within a particular geographic area (ESZ). The ESN facilitates the selective routing of calls to the appropriate PSAP.

FGDC – Federal Geographic Data Committee. An interagency committee that promotes data sharing and standards on a national scale.

Metadata- refers to detailed information about a spatial data set. Content focuses on content, quality, origin, contact information, and any other characteristics important to the data.

MSAG-Master Street Address Guide - a listing of all the streets and house number ranges within a 911-service area. The streets and address ranges are assigned ESNs to enable the proper routing of 911 calls.

NENA- National Emergency Number Association - a professional association comprised of emergency number agencies and telephone company personnel responsible for the planning, implementation, management, and administration of emergency number systems.

Nodes- In regards to a geodatabase, a node is the point representing the beginning or ending point of an edge, topologically linked to all the edges that meet there.

Snapping- A function/procedure in GIS software that takes two nodes and connects them together.

Topology- Topology stores the relationships of one spatial element with respect to another. In terms of GIS data, topology is a spatial data structure used primarily to ensure that the associated data forms a consistent and clean topological fabric. Traditionally, this would mean that by building topology into a dataset, intersections would be created whenever lines crossed, dangling nodes could be identified as an error, polygons of certain areas could be identified as

slivers, and small gaps in polygons could be identified as errors. With advances in technology, topology can now be thought of as a collection of rules and relationships that, coupled with a set of editing tools and techniques, enables the geodatabase to more accurately model geometric relationships found in the world (ESRI help).

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