Local Road Update Standards

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ACRONYMS

DGI – Kentucky's Division of Geographic Information

FGDC – Federal Geographic Data Committee

FHWA – Federal Highway Administration

GIS – Geographic Information System

GPS – Global Positioning System

HIS – Highway Information System, the Kentucky Transportation Cabinet's database of road centerlines, features, and attributes

HPMS – Highway Performance Monitoring System, an annual report submitted by each state to FHWA

KYAPED – Kentucky's Aerial Photography and Elevation Data Program

KYTC – Kentucky Transportation Cabinet

LRS – Linear Referencing System, a system in which feature locations are identified by a relative measure along a linear element

NGS – National Geodetic Survey

USPS – United States Postal Service

DEFINITIONS

Cardinal Direction

The direction a road is linear referenced in increasing milepoint order

Control Point

An accurately known reference point used for verifying field data collection

County Number

A three-digit identification number assigned to each County, from 001 – 120

Differential Correction

A technique for increasing the accuracy of GPS measurements by comparing the readings of a roving and fixed receiver to a known location

Digitizing

Manual process of tracing a mouse over features displayed on a computer monitor to vectorize raster data

Epoch

The measured interval of a GPS receiver

Local Road

A road maintained by a local government agency

Non-Cardinal Direction

The direction a road is linear referenced in decreasing milepoint order

Road Centerline

A graphic representation which follows the approximate center of a roadway section

Route Section

A portion of the route identifier that distinguishes mainline segments from non-mainline segments of road

Shapefile

A vector data storage format for storing the location, shape, and attributes of geographic features

Some definitions obtained from the Esri GIS Dictionary - http://support.esri.com/en/knowledgebase/Gisdictionary/

BACKGROUND

The Kentucky Transportation Cabinet (KYTC) Division of Planning has been responsible for road inventories and the preparation of highway maps since 1936 when the state first began collecting information about its highways. Since that time, the Division has been a key contributor of road inventory and mileage data for KYTC.

In the late 1990's, KYTC began incorporating the use of Global Positioning System (GPS) technology to reduce the cost and time involved in field data collection to acquire road alignments and over-the-road travel distances. When the project was completed in 2004, KYTC had built a geospatial, statewide road centerline network for all public roads.

The importance of this network has expanded tremendously since the initial GPS collection project. The network serves as KYTC's: Linear Referencing System (LRS) for County, Route, and Milepoint locations; map of official state road designations and lengths; and base network for multiple programs within many different business areas. The network is also Kentucky's official road centerline network to be consumed by public and private agencies and individuals. Additionally, the network is submitted to the Federal Highway Administration (FHWA) to support their Transportation for the Nation (TFTN) initiative that is creating one nationwide geospatial transportation network for mapping, reporting, and analysis.

KYTC continues to remain committed to the Local Road Update Program in order to maintain the accuracy and completeness of the geospatial, statewide road centerline network and to provide a product that best meets the needs of its users.

1. ROAD CENTERLINE PROCEDURES

KYTC employs two methodologies for acquiring road centerline graphics and attributes: GPS data collection and aerial imagery digitizing. Each method possesses its own set of advantages and disadvantages. For example, GPS data collection can provide highly accurate data, but it can also be a resource-intensive process; on the other hand, aerial imagery digitizing can improve efficiency, but it can also decrease the overall accuracy of collected data.

These advantages and disadvantages must be considered by the data collector in each unique situation. Ultimately, it is the responsibility of the data collector to assess which method best satisfies the requirements of these standards in the most appropriate and practical manner. Both methods are discussed in further detail later in this document.

KYTC has implemented the following road centerline procedures for all data submittals. These procedures should be followed whether collecting road centerlines using GPS data collection or aerial imagery digitizing.

Each data submittal needs to begin with the most recent version of KYTC's road centerline network. The "AllRds_ADDsEdit" file is updated every Monday and is available for download from KYTC's Sharepoint site at https://business.kytc.ky.gov/work/gpsmaintenance/SitePages/Home.aspx.

1.1 AUTHORITY FOR ROAD CENTERLINE CHANGES

KYTC recognizes the agency of ownership as the sole entity with permission to authorize changes to road centerlines within its respective road system. For all data submittals, the agency of ownership should indicate the necessary changes and/or fully agree with changes presented to it. KYTC will not accept road centerline changes that are not authorized by the owning agency. County Road changes must be accompanied by a resolution from the County's Fiscal Court and City Streets changes must be accompanied by a resolution from the City Council/Commission.

E911 offices, or other appropriate owning agencies, may be contacted to obtain input concerning the update and submittal of private road information.

HERE road centerline data is available as an additional resource on the GPS Maintenance SharePoint site to help identify discrepancies and/or gaps in KYTC road centerlines. Use of the HERE data is not required, but is strongly encouraged as it has proven to be a useful tool for identifying potential errors. HERE road centerlines are not an authoritative dataset and have not been closely inspected by KYTC. All potential changes generated from review of this data need to be thoroughly vetted with the agency of ownership and gain its official approval prior to submittal to KYTC. Changes are also subject to all other applicable requirements included in this document.

KYTC *requires* that the following types of roads be collected and included in submittals:

• All public roads that are not owned by KYTC, including, but not limited to: county roads, city streets, other local agency roads, other state agency roads, and federal roads.

• All drivable, non-mainline sections of road associated with the roads listed above, including, but not limited to: non-cardinal couplets, non-cardinal sides of a divided highway, "Y" intersections, crossovers, connectors, frontage roads, bays, cul-de-sacs, and spurs.

• Only new roads and existing roads that require a spatial and/or attribute change should be submitted. Existing roads that have not had any changes should not be submitted.

• Existing road segments that only require KYTC staff to perform a split or merge operation due to the addition or removal of an intersecting road should not be submitted.

KYTC *allows* for private roads to be collected and included in submittals, if <u>all</u> of the following conditions apply:

• A local agency desires for the road to be collected

• The private owning entity is not opposed to the road being collected

• The road is open to public travel

• The road is not a driveway

• The road possesses a uniquely-defined road name

1.3 ROAD CENTERLINE ATTRIBUTES

KYTC requires that the following attributes be properly populated for each road segment included in submittals. Attributes not listed here should not be modified or populated, including the LRS_ID field. KYTC will use the information submitted in the RT_PREFIX, RT_NUMBER, RT_SUFFIX, RT_SECTION, and COUNTY fields to build the RT_UNIQUE/LRS_ID.

TYPE_OP
Description: The operational characteristic of the road
Valid entries:
   1 – One-way
   2 – Two-way
   D – Divided by median (applied to both the cardinal and non-cardinal sides of the divided highway)

RD_NAME
Description: Full road name and suffix abbreviation
Guidance: The owning agency possesses road name authority for these submittals. The road name recognized by the owning agency should be used. Suffix abbreviations should be assigned using the United States Postal Service (USPS)

Street Suffix Abbreviations, found in Appendix C1 of USPS Publication 28 – Postal Addressing Standards (https://www.usps.com/business/address-management-pubs.htm).

SURFTYPE
Description: Road surface type
Valid entries:

       40 – Gravel, Soil, or Stone
       52 – Bituminous
       70 – Concrete
       80 – Brick, Block, or Other

GOV_LEVEL
Description: Road ownership indicator
Guidance: The GOV_LEVEL field must be in agreement with the RT_PREFIX field. (Valid RT_PREFIX codes listed below.)
Valid entries:

       02 – County Roads (CR)
       04 – City Streets (CS)
       11 – State Park and State Forest Roads (ST or IC)
       12 – Local Park and Local Forest Roads (LA)
       21 – Other State Agency Roads (ST or IC)
       25 – Other Local Agency Roads (LA)
       26 – Private Roads (PS or PR)
       60 – Other Federal Agency Roads (FD)
       64 – US Forest Service Roads (FD)
       66 – National Park Service Roads (FD)
       67 – Tennessee Valley Authority Roads (FD)
       70 – Army Corps of Engineers Roads (FD)
       72 – Air Force Roads (FD)
       73 – Navy/Marines Roads (FD)
       74 – Army Roads (FD)

STATUS
Description: Owning agency road adoption status
Guidance: ACCEPTED is now the only acceptable status
Valid entries:

       ACCEPTED – Road has been adopted by the owning agency

CHANGE_TYP
Description: Type of modification requested to the existing road centerline network
Valid entries:

       NR (New Road) – Add a completely new road segment that requires a new route number assignment
       DEL (Delete) – Completely remove an existing road segment
       R (Resolution/Documentation) – Modify only the STATUS attribute of an existing county or city owned road segment due to submittal of proper documentation to KYTC
       AT (Attribute Change) – Modify one or more non-spatial attributes of an existing road segment
       SP (Spatial Change) – Modify the graphic representation of an existing road segment

BOTH (Attribute / Spatial Change) – Modify a non-spatial attribute(s) AND the graphic representation of an existing road segment

RT_PREFIX

Description: Route Prefix, used in identifying unique routes

Guidance: The RT_PREFIX field must be in agreement with the GOV_LEVEL field. Refer to the GOV_LEVEL section for more information.

Valid entries:

> CR – County Road
>
> CS – City Street
>
> FD – Federal Agency
>
> IC – Inter-Agency Charge Account
>
> > + Owned by a state agency other than KYTC but maintained by KYTC
>
> LA – Local Agency
>
> PR – Private Road
>
> > + Owned by a private entity and not located within a development (subdivision, trailer park, etc.)
> >
> > + Refer to *Road Centerlines To Be Collected* for further guidance on collecting private roads
>
> PS – Private Subdivision/Development
>
> > + Owned by a private entity and located within a development (subdivision, trailer park, etc.)
> >
> > + Refer to *Road Centerlines To Be Collected* for further guidance on collecting private roads
>
> ST – Other State Agency
>
> > + Owned and maintained by a state agency other than KYTC

RT_NUMBER

Description: Route Number, used in identifying unique routes

Guidance: New roads and existing roads requiring a new route number should have that route number reserved in advance by contacting KYTC. The reserved number should be populated in the RT_NUMBER field. If a route number has not been reserved, the RT_NUMBER field should be left blank, and KYTC will assign a route number during processing.

RT_SUFFIX

Description: Route Suffix, used in identifying unique routes

Guidance: This field is optional. It may be populated for new roads and existing roads requiring a new route number when they are located very near existing roads with assigned suffixes. The RT_SUFFIX pattern should be continued. This field may also be populated for new roads and existing roads requiring a new route number when they are located in an area of the road network that is densely filled. The RT_SUFFIX pattern should begin with A, followed by B, C, and so on.

RT_SECTION

Description: Route Section, used in identifying unique routes

Valid entry ranges:

> 0 – Cardinal Direction Mainline
>
> 1-9 – Non-Cardinal Couplet
>
> 10 – Non-Cardinal Side of Divided Highway
>
> 20-29 – "Y" Intersection: A segment of road that splits from the mainline near an intersection
>
> 30-69 – Crossover: A short segment of road that connects both sides of a divided highway
>
> 70-79 – Connector: A short segment of road that provides access from one road to a separate road

80-89 – Frontage Road, Bay, Cul-de-sac, Spur, or Other

COMMENT

Description: Detailed and clear explanation of the requested modification. Codes should not be used.

Examples: Road has been extended; County has adopted this private road; Road is in error and does not exist; Road name has been changed by City

COUNTY

Description: Three-digit county number (with leading zero, if applicable)

2. GPS DATA COLLECTION

GPS data collectors are in motion while recording line features, and it is common for attribute values to change at different locations along the line feature. This requires the data collector to stop in place to make changes as the data is being collected. For this reason, it is important that safety be the number one priority for both the collection staff and the public.

KYTC has implemented the following GPS data collection requirements for all data submittals.

2.1 ACCURACY STANDARDS

KYTC accepts the Geospatial Positioning Accuracy Standards recommended by the Federal Geographic Data Committee (FGDC). KYTC has adopted a horizontal accuracy standard of .500 to 2.000 meter at the 95% accuracy level.

It is the responsibility of the data collector to assess which GPS technique or combination of GPS techniques are required to achieve the KYTC horizontal accuracy standard.

For a more complete description, please refer to the Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy, or its successor:

http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3

2.2 APPROVED EQUIPMENT & SOFTWARE

KYTC approves the use of the following GPS equipment and software to collect and process GPS data:

• Equipment: A GPS Receiver or Handheld that can obtain 2 meter or better horizontal accuracy after post-processing or real-time correction. If the horizontal accuracy of the GPS Receiver or Handheld is uncertain, contact the manufacturer or reference the manufacturer's website.

• Software: Any software that is compatible with your GPS hardware and can collect GPS points in a shapefile format. Post-processing is the preferred method for differential correction, however, you may use real-time correction techniques if the accuracy standards adopted by KYTC are met or exceeded. Regardless of whether post-processing or real-time correction techniques are used, the raw and corrected GPS files must be submitted proving the accuracy standard has been met.

2.3 EQUIPMENT VALIDATION

• At least two times per calendar year, the GPS system being utilized should be validated on the highest order National Geodetic Survey (NGS) control point that is easily reached. Visit http://www.ngs.noaa.gov/ for available control points.

• GPS observations totaling 1200 points at an epoch recording rate of 1 second should be made at the selected control point. This will result in approximately 20 minutes of collection time.

• The results should be reviewed to verify equipment accuracy. If repeated tests do not yield sub-meter results, seek advice from the equipment manufacturer. The results should be retained and provided to KYTC upon request.

2.4 COLLECTION TECHNIQUE

• Epoch recording rate should be 1 second for all roads.

• Elevation (vertical) data should be collected and retained in the GPS source files.

• Raw observational data (rover files) should be retained.

• GPS line features should be segmented at:

   ♦ At-grade intersections with other roads within the road centerline network
   ♦ Locations where a change in value of one or more attributes occurs
   ♦ Intersections with county line boundaries

• The line representing the center of the road is to be collected by placing the antenna on the driver's side of the vehicle and driving at normal traffic speeds. It is vitally important to maintain a constant distance from the centerline, especially around curves. To make it possible to determine the correct centerline location, use the appropriate offsetting method described below.

• Undivided and one-way roads should be driven as follows:

   ♦ Centerline defined as the center of all through lanes
   ♦ Driven in one direction
   ♦ Set offset as the distance from the receiver to the centerline
   ♦ Driven at a constant offset from the centerline

• Roads divided by a median should be driven as follows:

   ♦ Cardinal centerline defined as the center of through lanes on the cardinal side of the median
   ♦ Non-cardinal centerline defined as the center of through lanes on the non-cardinal side of the median
   ♦ Driven once on each side of the median
   ♦ Set offset as the distance from the receiver to each centerline
   ♦ Driven at a constant offset from the centerline

2.5 DATA PROCESSING

GPS data processing includes the review and storage of collected data files, performing post-processing or real-time differential correction on the collected positions, performing graphic adjustments to the corrected positions, and ensuring centerline features are correctly snapped to the existing road centerline network. Each step requires quality control analysis and prudent judgment to achieve the desired level of confidence.

The processed data should be contained in a shapefile with the Kentucky Single Zone projection (NAD_1983_StatePlane_Kentucky_FIPS_1600_Feet). The shapefile should include complete and proper road attribution as specified in Section 1.3 of this document.

2.6 GPS DATA COLLECTED BY ANOTHER AGENCY

GPS data collected by another agency may be a beneficial resource for improving efficiency in the Local Road Update Program. However, to ensure that data collection techniques meet the GPS Data Collection requirements of these Standards, advance approval from KYTC must be obtained prior to the use of GPS data collected by another agency. Adhere to the following process to obtain KYTC approval:

• Evaluate and verify that the GPS data collected meets the GPS Data Collection requirements of these Standards and is appropriate for the Local Road Update Program

• Prepare an approval request to KYTC that includes:

  ♦ Name of the collecting agency
  ♦ A brief summary of the agency's GPS data collection activities, including equipment and software used
  ♦ A brief summary of the methodology used to verify that the data collected meets the GPS Data Collection requirements of these Standards and is appropriate for the Local Road Update Program

KYTC will review the approval request and determine its acceptance or denial. Approval must be received prior to beginning work with GPS data collected by another agency.

The submitting agency is still responsible for the processing, attribution, and preparation of the GPS data in order to meet the requirements of contract documents and these Local Road Update Standards.

3. AERIAL IMAGERY DIGITIZING

The availability, accuracy, and clarity of aerial imagery is continually improving. For these reasons, aerial imagery digitizing has become a potential data collection alternative when it is not appropriate or practical to perform GPS data collection in the field.

KYTC has implemented the following aerial imagery digitizing requirements for all data submittals.

3.1 PROVISIONS

KYTC requires that the following provisions are satisfied when using aerial imagery to digitize road centerline features. If all of these provisions cannot be met, contact KYTC for further guidance.

• Road centerlines can be digitized while using aerial imagery datasets published by Kentucky's Division of Geographic Information (DGI). These datasets are available for public download at http://kygeonet.ky.gov/.

> ♦ The preferred DGI datasets are those included in Kentucky's Aerial Photography & Elevation Data Program (KYAPED). Since new datasets in this program are being released in stages, these datasets may not be available in all areas of the state.
> ♦ If a KYAPED dataset is not available in the area of interest, the most recently collected DGI dataset available should be used. Datasets prior to 2014 should not be used.

• If the necessary information cannot be obtained from the DGI datasets, road centerlines can be digitized while using the World Imagery dataset published by ESRI. This dataset is available for public download at http://services.arcgisonline.com/ArcGIS/rest/services/World_Imagery/MapServer.

• Advance approval from KYTC is required prior to using any other aerial imagery dataset.

• The entire road that is to be collected should be present and easily visible on the selected aerial dataset.

• To ensure relative accuracy, existing road centerlines near the road that is to be collected should be reviewed to confirm that they are spatially located within their respective roadbeds as viewed on the selected aerial dataset. State roads owned by KYTC are preferred for this review. If possible, at least one perpendicular road and at least one parallel road to the road of interest should be reviewed.

3.2 DATA PROCESSING

Data processing includes ensuring centerline features are correctly snapped to the existing road centerline network.

The processed data should be contained in a shapefile with the Kentucky Single Zone projection (NAD_1983_StatePlane_Kentucky_FIPS_1600_Feet). The shapefile should include complete and proper road attribution as specified in Section 1.3 of this document.

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RESOURCES

Sharepoint Website for Local Road Updates:
https://business.kytc.ky.gov/work/gpsmaintenance/SitePages/Home.aspx

Local Roads Spatial Application Website:
http://maps.kytc.ky.gov/photolog/?config=LocalRoads

Highway Information System (HIS) Website:
http://transportation.ky.gov/Planning/Pages/Roadway-Information-and-Data.aspx

United States Postal Service (USPS) Publication 28 – Postal Addressing Standards:
https://www.usps.com/business/address-management-pubs.htm

Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy:
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3

National Geodetic Survey (NGS):
http://www.ngs.noaa.gov/

Division of Geographic Information (DGI) Kentucky Geography Network:
http://kygeonet.ky.gov/