



National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

NPS I&M Standard Operating Procedure: Processing TIGER Road Source Data for use with Landscape Dynamics

Version #1.0

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Summary

Internal SOP for processing TIGER road data from the U.S. Census Bureau.

Version History					
Previous Version No.	Date of Revision	Changes	Made by	Reason	Updated Version No.
DRAFT	20161209	Updated document	Michelle Kineth		1.0

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Overview

TIGER Line Road data comes from the United States Census Bureau. The data are continually updated, and updates are posted annually. Starting in 2007, US Census has released TIGER road data (in varying formats) annually. Beginning in 2015, TIGER road data will be obtained annually from the US Census Bureau and incorporated into the Landscape Dynamics Protocol. Previous versions of TIGER road data also used in Landscape Dynamics include 2010. There are currently no plans to incorporate other historic TIGER road data into the Landscape Dynamics Protocol.

From the source TIGER road data, roads are extracted and re-projected based on geographic extent (Alaska, Continental US (CONUS), Puerto Rico and the US Virgin Islands, Hawaii, Guam, Commonwealth of the Northern Mariana Islands, and American Samoa). No additional alteration to the source data occurs.

TIGER road data are used in Landscape Dynamics for calculating road density and area without roads summary statistics. See the respective SOPs for more information.

Requirements

- Internet connection, sufficient disc space for data download
- Zip file extract tool, sufficient storage for data extraction and processing
- ArcMap 10.2+
- Data Store permissions

NOTE: If processing of any new TIGER road data differs from the steps outlined here, move these processing steps to Appendix 2 before altering this published workflow to reflect the updated methods of processing TIGER road data.

Pre-Processing

Download locally the National Roads geodatabase from the U.S. Census Bureau,
<http://www.census.gov/geo/maps-data/data/tiger-geodatabases.html>

Download National TIGER Roads (tlgdb_YYYY_a_us_roads.gdb.zip) from
<ftp://ftp2.census.gov/geo/tiger/TGRGDB16/> (note this link will change each year)

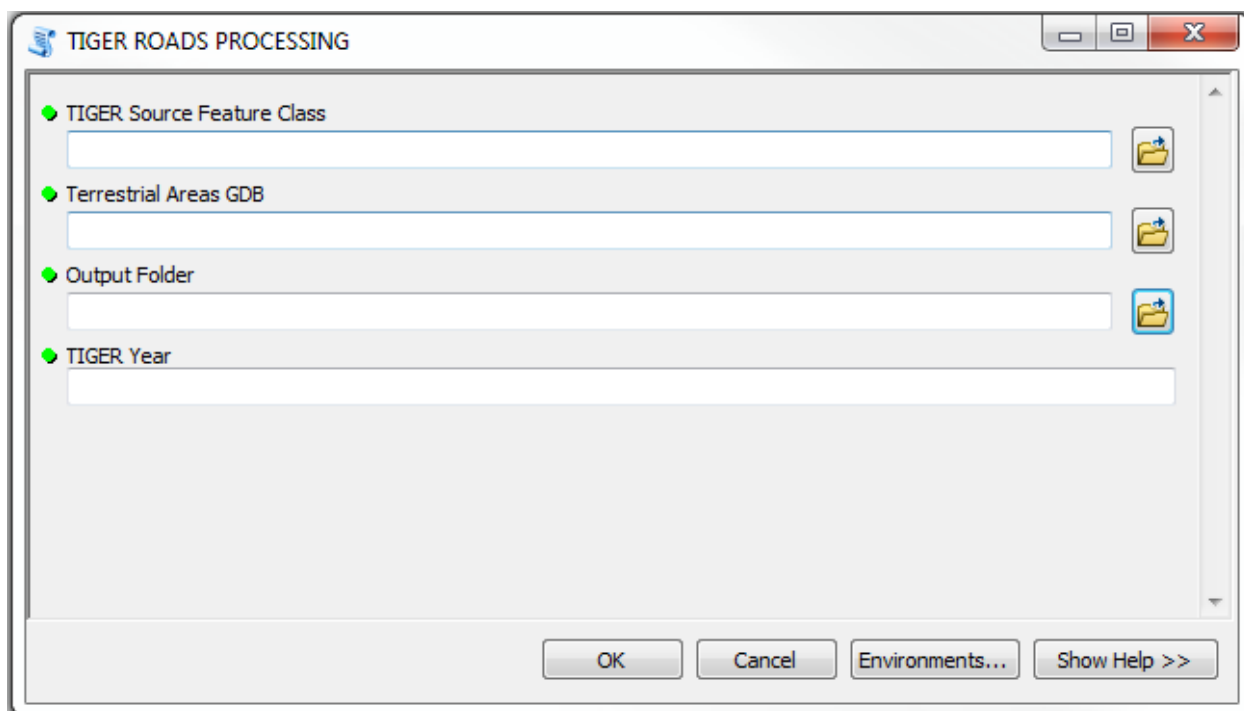
Additionally, download any Documentation posted on the TIGER website.

Note: NHD data should be updated/downloaded concurrently with TIGER Roads, see [SOP_Download_Extract_NHDH_Data.docx](#).

Processing

Extract the data from the .zip.

In ArcMap or ArcCatalog, run **TIGER ROADS PROCESSING** from SourceProcessing.pyt Toolbox.



The tool will extract roads by defined geographic extents, and re-project roads into respective feature classes using the spatial references outlined below.

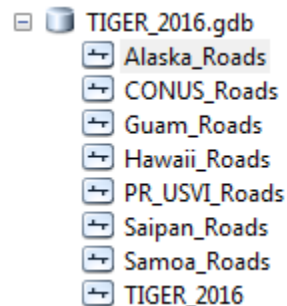
Based on geographical extent, the standard spatial reference for output data is as follows:

- North America (US, Canada, Mexico) = USA Contiguous Albers Equal Area Conic USGS (NAD83) (WKID: 102039)
- CONUS = USA Contiguous Albers Equal Area Conic USGS (NAD83) (WKID: 102039)
- Puerto Rico and USVI = USA Contiguous Albers Equal Area Conic USGS (NAD83) (WKID: 102039)
- Alaska = Alaska Albers Equal Area Conic (NAD83) (WKID: 3338)
- Hawaii = UTM Zone 5N NAD83 (WKID: 26905)
- American Samoa = NAD_1983_HARN_UTM_Zone_2S (WKID: 2195)
 - If necessary, when re-projecting use Transformation = WGS_1984_(ITRF00)_To_NAD_1983 + NAD_1983_HARN_To_WGS_1984_2
- Guam = WGS_1984_UTM_Zone_55N (WKID: 32655)
 - If necessary, when re-projecting use Transformation = "WGS_1984_(ITRF00)_To_NAD_1983"
- CN Mariana Islands = WGS_1984_UTM_Zone_55N (WKID: 32655)
 - If necessary, when re-projecting use Transformation = "WGS_1984_(ITRF00)_To_NAD_1983"

See Appendices for processing steps for previous versions of TIGER Roads (2010, 2015).

Post-Processing

Check the outputs for correct spatial reference and for features. Move final output geodatabase to final location (X drive...).



If needed, import/edit metadata from source file.

Post new TIGER Roads to Data Store, <https://irma.nps.gov/DataStore/Reference/Profile/2229418>.

If and edits or changes were made to this SOP with the new download of TIGER road data, be sure to version the data store record and re-post all files to the new reference.

Literature Cited

- US Census Bureau. 2016. TIGER Products – TIGER Geodatabases.
<http://share.inside.nps.gov/sites/nrss/div/imd/co/irma/ldss/Version-1/LandscapeDynamicsStatisticsServicesFunctionalRequirements.docx> . Accessed 20161209.
- US Census Bureau. 2016. TIGER Products – FTP Data Download Site 1992-present.
<ftp://ftp2.census.gov/geo/tiger/>. Accessed 20161209.
- US Census Bureau. 2016. TIGER Products – Technical Documentation.
<https://www2.census.gov/geo/pdfs/maps-data/data/tiger/>. Accessed 20161209.
- US Census Bureau. 2016. Geography Reference – Functional Status Codes and Definitions.
<https://www.census.gov/geo/reference/funcstat.html>. Accessed 20161209.
- US Census Bureau. 2016. Geography Reference – MAF/TIGER Feature Class Codes and Definitions.
<https://www.census.gov/geo/reference/mtfcc.html> . Accessed 20161209.
- US Census Bureau. 2016. Geography Reference – Route Type Codes and Definitions.
<https://www.census.gov/geo/reference/rttp.html>. Accessed 20161209.

Appendices

Appendix 1: Known Issues

TIGER Roads:

Prior to 2013, TIGER road data was not available at a national level for download, and county level data had to be downloaded and manually mosaicked to create desired national, seamless layers. National level road products from 2015 and 2016 have been compared to county-level road data for those same years in multiple locations across the data extent and are found to be identical. This has removed the need for additional post-processing that existed with obtaining TIGER road data by County (2010, 2015) for all the United States and associated territories, as TIGER road data can now be obtained in a single file geodatabase download as a National product (2016).

When calculating Area without Roads summary statistics for Landscape Dynamics, areas of water of a certain size are erased. The source of this water data is the National Hydrography Dataset. This data is continually updated and updates are posted through the year. Because of this, it is important to also obtain NHD data as close to the day of the new TIGER road release/download date.

Additional Issues

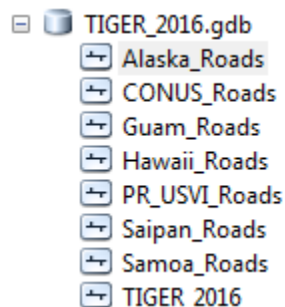
TIGER 2015 roads were downloaded in March 2016. NHD Data for use with the 2015 (and 2010) TIGER Roads were downloaded in April 2016.

Appendix 2: TIGER 2016

2016 Processing:

Source processing for TIGER 2016 road data occurred as described in this SOP.

Unlike previous versions, starting in 2016, only one output road layer (All Roads) is produced, by geography:



Appendix 3: TIGER 2015 Processing

2015 Pre-Processing:

1. FTP
 - a. By county:
 - i. <ftp://ftp2.census.gov/geo/tiger/TIGER2015/ROADS/>
 - b. National Level:
 - i. <ftp://ftp2.census.gov/geo/tiger/TIGRDB15/>
2. Steps to download data:
 - a. Locate FTP TIGER Roads most recent release. Data is released yearly, and updated throughout the year.
 - i. Click link and download in GDB format.
 - ii. ftp://ftp2.census.gov/geo/tiger/TIGRDB15/tlqdb_2015_a_us_roads.gdb.zip
 - b. Locate Primary Roads dataset (if desired)

- i. Primary roads data is a subset of the Roads dataset containing Interstates, Highways, and State Highways.
- ii. Primary roads dataset is released as a shapefile.
- iii. ftp://ftp2.census.gov/geo/tiger/TIGER2015/PRIMARYROADS/tl_2015_us_primaryroads.zip
- c. Locate Precise Roads (if desired)
 - i. Precise roads is a subset of the Roads dataset that includes primary roads as well as county highways, major highways, and other state roadways.
 - ii. State based dataset, commonly released as a shapefile.
 - iii. <ftp://ftp2.census.gov/geo/tiger/TIGER2015/PRISECROADS>

2015 Processing:

Data for 2015 was processed manually because there was no established work flow. After which such model was developed; therefore, 2010, and 2007 data processing was scripted, see **Appendix 2 and 3** for more information.

Begin by selecting data by location based on geographic extents. Export selected features to a working GDB. Next project each result to match the projection with the relevant geographic extent. Next for each extent apply a definition query that separates out the relevant road types, primary, precise, and all roads. These queries are listed below in section titled Definition Query. Export each query result to a working directory. Lastly, create a feature dataset for each geographic extent and import each output into the relevant geographic extent name. Match the GDB layout and naming conventions listed, see **Example 1**, Standard naming conventions. Once a dataset has met the standards set for final QC, place this dataset in the scratch folder. 2015 was processed based on geographic extent name and the Boundary Dataset listed above. Geographic extent name as follows Alaska, CONUS, GuamSaipan, Hawaii, Samoa.

Below is the geographic extent name, followed by the associated states or territories.

- *Alaska* includes Alaska (AK) only
- *CONUS* includes the contiguous United States, Puerto Rico (PR) and the U.S. Virgin Islands (USVI)
- *GuamSaipan* includes Guam (GU) and the Commonwealth Northern Mariana Islands (CNMI)
- *Hawaii* includes Hawaii (HI) only
- *Samoa* includes American Samoa (AS) only

Definition Query:

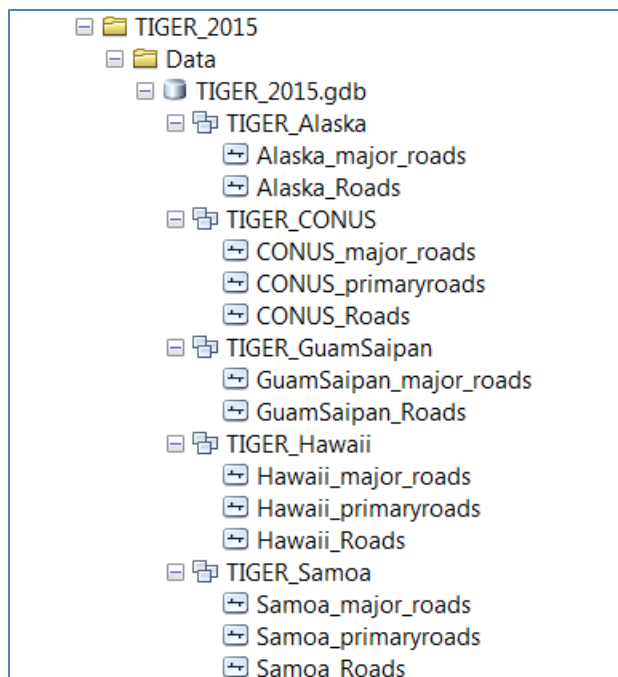
- MFTCC = 'S1100' (Query for primary roads)
- MFTCC = 'S1100' AND MFTCC = 'S1200' (Query for major roads or precise roads)
- MFTCC Like 'S%' (Query for all Roads, hint all features should be returned)

2015 STEPS:

1. Select roads based on geographic extent from boundary dataset listed above. Create Layer based on selected features, and export. Repeat this step for each geographic extent.
2. Run Project on each new file created and output to necessary SRS as referenced in the **Requirements** section. (see **Example 2**)
3. Run Definition Query on the output of the Project tool to create each subsequent dataset.
 - a. MFTCC = 'S1100' (Query for primary roads)
 - b. MFTCC = 'S1100' AND MFTCC = 'S1200' (Query for major roads or precise roads)
 - c. MFTCC Like 'S%' (Query for all Roads, hint all features should be returned)
4. Working directory/GDB should now contain 15 datasets.
 - a. Datasets only exist *IF* the query returns <true>
 - b. In 2015, 2 datasets returned <false>.
5. Begin building final GDB.
6. Create 5 Feature Datasets

- a. Table below has FeatureDataset names in **BOLD**. (see **Example 2**)
 - i. SET Projection to desired projection upon feature dataset creation.
 - b. Each item below the **BOLD** heading is the FeatureClass name.
7. Import each 3 geographic extent based, re-projected, query based, exported Feature Classes; into each Feature Dataset.

Example 1: Standard naming conventions as applied to TIGER Line 2015 GDB, Feature Datasets, Feature Classes as viewed in an ESRI file geodatabase structure.



Example 2: Standard naming conventions as applied to Feature Datasets, Feature Classes, and ESRI Projection string.

- a. **TIGER_Alaska** = NAD_1983_Alaska_Albers (Alaska Albers Equal Area Conic).
 - i. Alaska_Roads
 - ii. Alaska_primaryroads
 - iii. Alaska_major_roads
- b. **TIGER_CONUS** = USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
 - i. CONUS_Roads
 - ii. CONUS_Primaryroads
 - iii. CONUS_major_roads
- c. **TIGER_GuamSaipan** = WGS_1984_UTM_Zone_55N
 1. Specific transformations listed below (most accurate NAD83 to WGS84)
 - i. GuamSaipan_Roads
 - ii. GuamSaipan_primaryroads
 - iii. GuamSaipan_major_roads
- d. **TIGER_Hawaii** = NAD_1983_UTM_Zone_5N
 - i. Hawaii_Roads
 - ii. Hawaii_primaryroads
 - iii. Hawaii_major_roads
- e. **TIGER_Samoa** = NAD_1983_HARN_UTM_Zone_2S
 1. Specific transformations listed below (specific to NAD83 to HARN)
 - ii. Samoa_Roads

- iii. Samoa_primaryroads
- iv. Samoa_major_roads

Transformations applied:

starting to ending projection

followed by the transformation name

NAD 1983 to NAD HARN

WGS_1984_(ITRF00)_To_NAD_1983 + WGS_1984_(ITRF00)_To_NAD1983_HARN

NAD 1983 to WGS 1984

WGS_1984_(ITRF00)_To_NAD_1983

Dataset Properties, 2015: (new datasets will match 2015 going forward)

1. Roads (Definition Query)(MTFCC LIKE 'S%')
 - a. Attributes available:
 - i. RTTYP - Route Type Code
 - ii. MTFCC - MAF/TIGER feature class code
 - iii. PREQUAL - Prefix qualifier
 - iv. PREDIR - Prefix direction description component
 - v. PRETYP - prefix type code description component of the feature name
 - vi. SUFTYP - suffix type code description component of the feature name
 - vii. SUFDIR - suffix direction code component of the feature name
 - viii. SUFQUAL - suffix qualifier code component of the feature name
 - b. Most useful attribute:
 - i. MTFCC (MAF/TIGER feature class code)
 - ii. Use this PDF to identify various codes that can be excluded from analysis.
 - iii. "X:\ProjectData\NPSCAPE\DATA\Scratch\TIGER_Roads\metadata\MAF_TIGER_CODES_mtfccs.pdf"
2. tl_2015_us_primaryroads (Definition Query) (MTFCC = 'S1100')
 - a. Dataset placed in national gdb
 - b. Subset of Roads that includes:
 - i. Interstates
 - ii. Highways
 - iii. Expressways
 - iv. State HWYs
 - c. Attributes available:
 - i. LINEARID - Linear feature identifier
 - ii. FULLNAME - Concatenation of expanded text for prefix qualifier, prefix direction, prefix type, base name, suffix type, suffix direction, and suffix qualifier (as available) with a space between each expanded text field; display name.
 - iii. RTTYP - Route type code
 - iv. MTFCC - MAF/TIGER feature class code
3. major_roads AKA precise_roads (Definition Query) (MTFCC = 'S1200' and MTFCC = 'S1100')
 - a. Dataset available depending on year.
 - b. If not available, process as MTFCC codes S1200 and S1100.
 - c. Combination of Primary and Secondary Road classifications.
 - d. Attributes available:
 - i. LINEARID - Linear feature identifier

- ii. FULLNAME - Concatenation of expanded text for prefix qualifier, prefix direction, prefix type, base name, suffix type, suffix direction, and suffix qualifier (as available) with a space between each expanded text field; display name.
- iii. RTTYP - Route type code
- iv. MTFCC - MAF/TIGER feature class code

Appendix 4: TIGER 2010 Processing

2010 Pre-Processing:

1. FTP
 - a. Data is available as FIPS based shapefile, zipped, with only "Roads" in the dataset
 - i. Roads implies [MTFCC] like 'S%'
 - b. <ftp://ftp2.census.gov/geo/tiger/TIGER2010/ROADS/>
 - i. Download shapes in efficient manner, ie one state at a time, alphabetical...etc
 - ii. Data must be downloaded on a per state, and per county basis.

2010 STEPS:

1. Run script as noted below.
 - a. Script 1 extracts shapefiles from .zip, imports into a feature class for efficiency, builds a single road dataset per state FIPS code.
 - i. "X:\ProjectData\NPSCape\DATA\Scratch\TIGER_Roads\TIGER_2010\Products\Scripts\extract_from_shape_roads_2010.py"
 - b. Script 2 projects FIPS based roads to standardized SRS, builds 3 new road datasets based on road type, appends final products to 2010 Tiger GDB road datasets.
 - i. "X:\ProjectData\NPSCape\DATA\Scratch\TIGER_Roads\TIGER_2010\Products\Scripts\build_roads_2010_GDB.py"
 - c. Follow steps to match 2015 data projection, separation, names, format, etc for further processing. (Script based)

2010 Processing:

Run script:

"X:\ProjectData\NPSCape\DATA\Scratch\TIGER_Roads\TIGER_2010\Products\Scripts\extract_from_shape_roads_2010.py" builds road dataset based on state from shapefiles.

Inputs as follows:

- a. FIPS number (per state)
- b. Shapes (per state)
- c. Working directory

Run script:

"X:\ProjectData\NPSCape\DATA\Scratch\TIGER_Roads\TIGER_2010\Products\Scripts\build_roads_2010_GDB.py" run project, final merge, and standardize naming properties to match TIGER2015.

Inputs as follows:

- a. Working directory
- b. Region (ProcessRegion OR Geography), number explained in description.
- c. Text file as input for feature datasets based on Region

2010 Script Logic as follows:

Download roads by state, first, manually, and in some organizational structure.

1. Import each road by state dataset into a working GDB in source projection (Script 1)
 - a. Import shape into FeatureClass GDB, this was scripted for ease and efficiency but is not necessary. Space is saved by doing this per state, then deleting the .zip files, and repeat.
 - b. Output based on FIPS code.
2. Build working GDBs (Script 2)
 - a. data_wrk
 - b. data_prj
 - c. data_primary
 - d. data_precise

3. Re-project roads by state to new projection and export (Project tool)
4. Separate out primary roads and export
5. Add precise roads to primary roads and export
6. Build final GDB, and append files based on ProcessRegions
 - a. Create new product *Region*_roads
 - b. Create new product *Region*_primaryroads
 - c. Create new product *Region*_major_roads
 - d. Append all.

Appendix 5: U.S. Census Bureau Geographic Codes and Terms

FIPS – Federal Information Processing Standards, a set of standards related to federal, state, and local government agencies and Information Technology. Related to TIGER data, the data is classified according to county and state FIPS codes.

LSAD – Legal/Statistical Area Description codes related to the U.S. Census bureau, the data they release, and collect related to census demographics.

MTFCC – MAF/TIGER Feature Class Codes used to classify items physical, man-made or other, across years, and decades by the U.S. Census Bureau. Codes are standardized, and were adopted in 2002. The U.S. Census Bureau continues to use this code system. (Item1)

- MAF – Master Address File
- TIGER – Topologically Integrated Geographic Encoding and Referencing

Functional Status Code	Functional Status Code Description	Associated Geographic Entity
A	Active government providing primary general-purpose functions	Consolidated City, County or Equivalent Feature, County Subdivision, Economic Census Place, Incorporated Place, Nation, State or Equivalent Feature, Tribal Subdivision
A	Active entity (federally recognized entities only)	American Indian/Alaska Native/Native Hawaiian Area
B	Active government that is partially consolidated with another government but with separate officials providing primary general-	County or Equivalent Feature, County Subdivision, Economic Census Place, Incorporated Place
C	Active government consolidated with another government with a single set of officials	County or Equivalent Feature, County Subdivision, Economic Census Place
E	Active government providing special- purpose functions	Elementary School District, Secondary School District, Special School Administrative Area, Special-Purpose District, Unified School District

F	Fictitious Entity created to fill the Census Bureau's geographic hierarchy	American Indian/Alaska Native/Native Hawaiian Area, County or Equivalent Feature, County Subdivision, Economic Census Place, Elementary School District, Incorporated Place, Secondary School District, State Legislative District (Lower Chamber), State Legislative District (Upper Chamber), Unified School District, Voting District
G	Active government that is subordinate to another unit of govt.	County Subdivision
I	Inactive governmental unit that has the power to provide primary special-purpose functions	County Subdivision, Elementary School District, Incorporated Place, Secondary School District, Special School Administrative Area, Unified School District
L	Inactive, nonfunctioning legal real property entity with potential quasi-legal administrative functions	Military Installation, Park
M	Active legal real property entity with quasi-legal functions	Military Installation
N	Nonfunctioning legal entity	Alaska Native Regional Corporation, American Indian/Alaska Native/Native Hawaiian Area, Congressional District, County or Equivalent Feature, County Subdivision, Economic Census Place, Elementary School District, Incorporated Place, Local/Tribal Legislative District, Secondary School District, Special School Administrative Area, Special- Purpose District, State Legislative District (Lower Chamber), State

MTFCC	Feature Class	Superclass	Point	Linear	Areal	Feature Class Description
C3022	Mountain Peak or Summit	Miscellaneous Topographic Features	Y	N	N	A prominent elevation rising above the surrounding level of the Earth's surface.
C3023	Island	Miscellaneous Topographic Features	Y	Y	Y	An area of dry or relatively dry land surrounded by water or low wetland. [including archipelago, atoll, cay, hammock, hummock, isla, isle, key, moku and rock]
C3024	Levee	Miscellaneous Topographic Features	N	Y	Y	An embankment flanking a stream or other flowing water feature to prevent overflow.

C3026	Quarry (not water-filled), Open Pit Mine or Mine	Miscellaneous Topographic Features	Y	N	Y	An area from which commercial minerals are or were removed from the Earth; not including an oilfield or gas field.
C3027	Dam	Miscellaneous Topographic Features	Y	Y	Y	A barrier built across the course of a stream to impound water and/or control water flow.
C3061	Cul-de-sac	Miscellaneous Topographic Features	Y	N	N	An expanded paved area at the end of a street used by vehicles for turning around. For mapping purposes, the U.S. Census Bureau maps it only as a point feature.
C3062	Traffic Circle	Miscellaneous Topographic Features	Y	N	N	A circular intersection allowing for continuous movement of traffic at the meeting of roadways.
C3066	Gate	Miscellaneous Topographic Features	Y	N	N	A movable barrier across a road.
C3067	Toll Booth	Miscellaneous Topographic Features	Y	N	N	A structure or barrier where a fee is collected for using a road.

Route Type Code	Route Type Code Description
C	County
I	Interstate
M	Common Name
O	Other
S	State recognized
U	U.S.

Appendix 6: Additional Information

Census Data Organization – 2010 and 2015

Census products are named based on FIPS codes at the time of collection, boundary datasets are thus useful to isolate changes, and file counts. Overview files are used for quality control, and can be referenced throughout data collection. For example the state FIPS code is used as entry into the 2010 TIGER extract script to create a set of ~56 feature classes. They can be referenced for quality control

when processing and collecting data across ~3000+ counties and territories. They are available on the U.S. Census Bureau FTP site. All items are organized on the FTP site according to year released.

Files used to organize data based on specific geographic extents geographic extent are listed below. See literature cited for FTP and website links.

1. 2015
 - a. tl_2015_us_state
 - b. cb_2014_us_state_500k
2. 2010
 - a. tl_2010_us_county10
 - b. tl_2010_us_state10
3. 2007
 - a. fe_2007_us_county
 - b. fe_2007_us_state