

# Inventory & Monitoring Division

National Park Service



## Standard Operating Procedure 2.11.14

### *Processing Land Cover Seamless Data for Landscape Dynamics: Area without Roads*

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### **Summary**

This SOP details the processing used to produce seamless feature classes for two road measure metrics: distance from roads, and area without roads.

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## Overview

This SOP describes the preparation and processing steps to produce seamless distance from roads and area without roads for CONUS, Hawaii, Puerto Rico and the Virgin Islands, outlying Pacific territories, and Alaska.

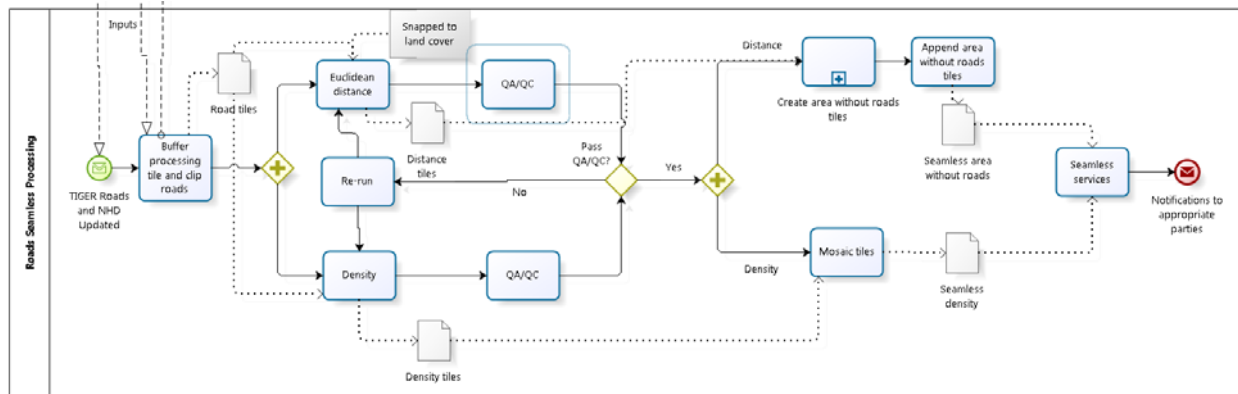


**Figure 1.** Summary of processing workflow

It is assumed users of this SOP have prior knowledge of data paths, file locations, and repositories referenced in this SOP.

## Requirements

ArcGIS software is required to generate the outputs. 64-bit Background Processing must be installed.

**All scripts should be run in 64 bit Python with either 64 bit PyScripter or 64 bit IDLE.**

All data should be on a local hard drive for processing performance and reliability.

The toolbox used is Roads.pyt in the Landscape Dynamics code repository.

Road Source Data Source data, located on the shared data drive, are the annual TIGER roads (all roads) datasets processed into geodatabase format (SOP 2.11.13, Kinseth and Nelson 2018a):

\\LandscapeDynamics\\Roads\\SourceData

Waterbodies NHD waterbody datasets for each geographic extent CONUS, Hawaii, Alaska, American Samoa, CNMI, Guam, Puerto Rico, and US Virgin Islands in geodatabase format (SOP 2.11.10, Kinseth and Nelson 2018b) matching the road data year:

\\LandscapeDynamics\\SourceData\\Hydrology\\NHDH\_Water

Note: These are used to erase water areas from the resulting area without roads polygons. Use the feature classes for the year matching the TIGER roads year (*EXCEPTION: 2015 NHD for 2010 TIGER processing*).

Terrestrial Area Boundaries For specific geographic areas, the terrestrial area feature class for the area is used to set the extent of the road tiles used in seamless processing. These feature classes are in geodatabase format: on the X: drive at

\\LandscapeDynamics\\SourceData\\Boundary\\LandscapeDynamics\_Geographical\_Boundaries.gdb

Road Tiles 300km tile polygons are generated for each geographic extent using the Create Tiles tool. See the pre-processing section for details.

Input data spatial references The landscape dynamics protocol uses the following spatial references for the geographic areas produced (Table 1):

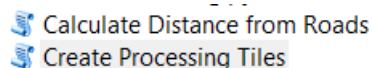
**Table 1.** Standard spatial references by processing extent

| Processing Extent                  | Spatial Reference Name (datum)                              | Well-known ID (WKID) |
|------------------------------------|-------------------------------------------------------------|----------------------|
| 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 (NAD83 HARN)                      | WKID: 2195           |
| <i>Transform (if needed):</i>      | WGS_1984_(ITRF00)_To_NAD_1983 + NAD_1983_HARN_To_WGS_1984_2 |                      |
| Guam                               | WGS_1984_UTM_Zone_55N (WGS84)                               | WKID: 32655          |
| <i>Transform (if needed):</i>      | WGS_1984_(ITRF00)_To_NAD_1983                               |                      |
| CN Mariana Islands                 | WGS_1984_UTM_Zone_55N (WGS84)                               | WKID: 32655          |
| <i>Transform (if needed):</i>      | WGS_1984_(ITRF00)_To_NAD_1983                               |                      |

## Pre-Processing

### Step 1: Create Tiles

To create or update the processing tile polygons used in this SOP, run the Create Processing Tiles tool in the Roads toolbox.



Create a file geodatabase for the tiles. Populate the Create Processing Tiles tool inputs, using the appropriate source feature class (use CONUS\_Roads for CONUS, and the respective terrestrial area feature class in the case of Hawaii, Alaska, Puerto Rico/Virgin Islands and the outlying Pacific territories). See Appendix 2 for details.

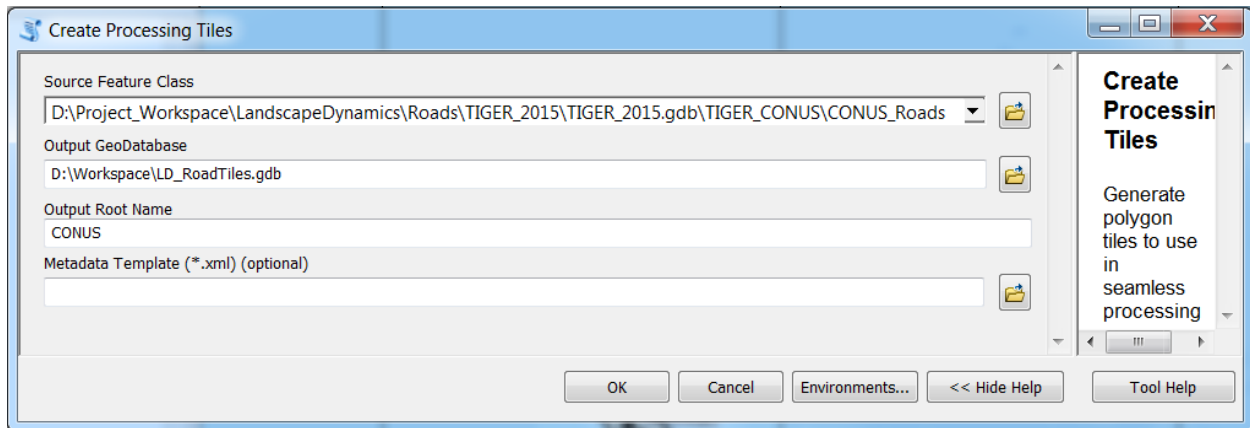


**Figure 2.** Create Processing Tiles tool

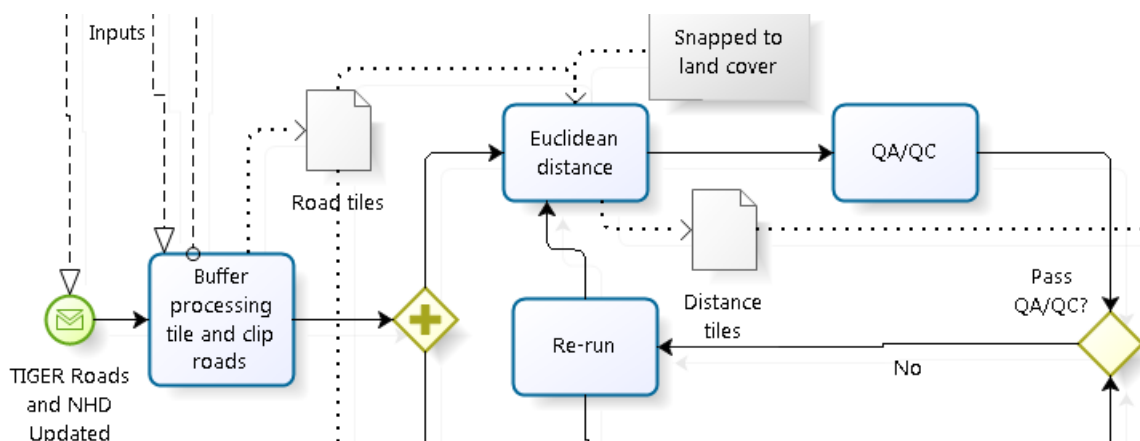
## Step 2: Tiles QA

Quality check the output feature class visually in ArcMap and overlay with the source roads and a basemap. Check tiles extend slightly beyond the extent of the source roads (or terrestrial area) feature class. Open the metadata and update the processing date and metadata date. Export metadata to XML format, storing in the same folder as the output geodatabase.

## Data Processing

Follow the steps outlined below for each geographic area, using the appropriate inputs specific to that area (see Appendix 3). Road distance rasters are snapped to land cover and inherit the cell size of that raster. The distance rasters are used as inputs for calculating area without roads polygons.

Note: distance from roads and area without roads is generated for 2010 even though matching time available waterbodies used when calculating area without roads are not available (2015 waterbodies are used as proxy).



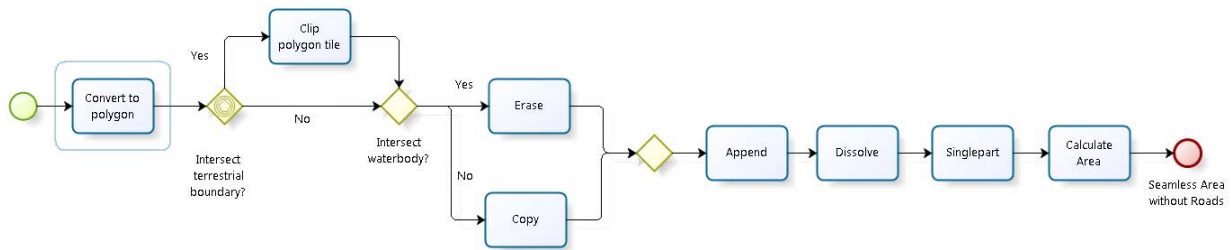


**Figure 3.** Workflow for distance from and area without roads

### Step 1: Run Calculate Distance from Roads Tool

Run this tool to generate tiled distance from roads rasters (snapped to NLCD land cover) that are converted into tiled area without roads polygons. **Script must be run with 64 bit Python because of high memory needs.** Run for each geographic area, selecting appropriate land cover snap raster (see Appendix 3).

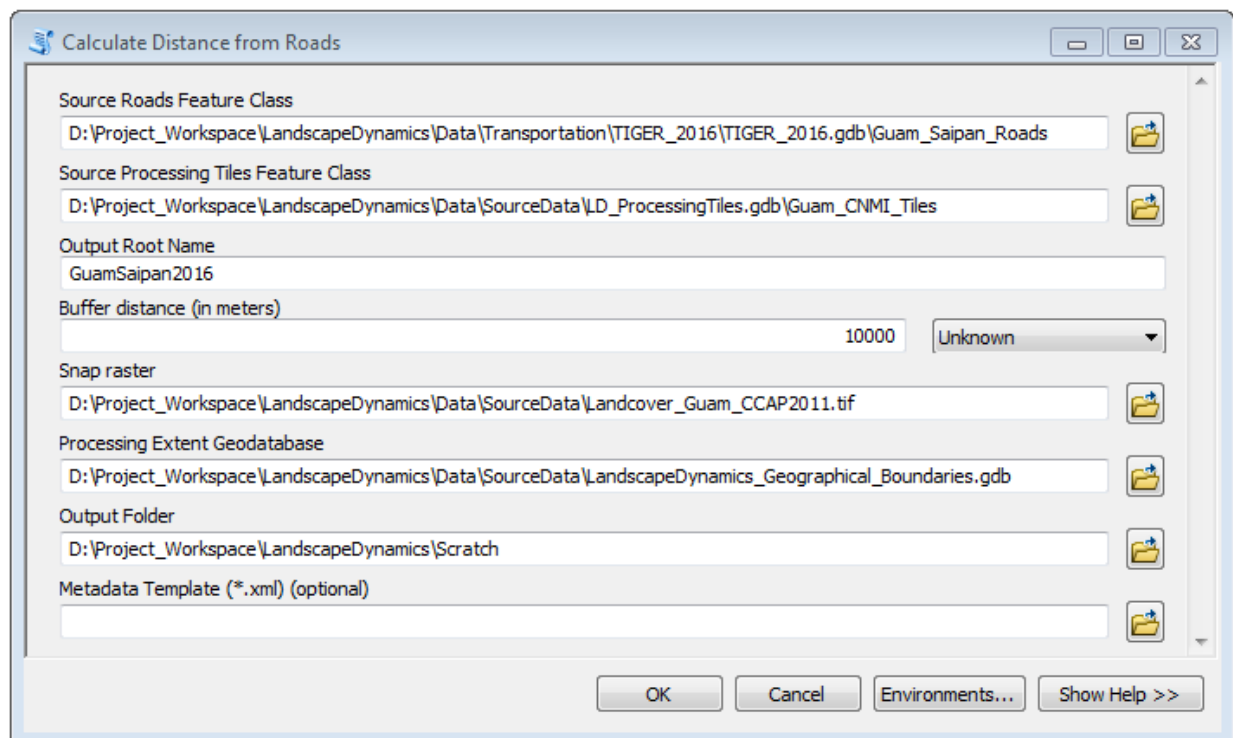


**Figure 4.** Calculate Distance from Roads tool

Quality check the output rasters by opening them in ArcMap and overlay with the source processing tiles and roads. Check alignment of roads and snap raster. Copy the output geodatabase(s) to \LandscapeDynamics\Roads\Products\Seamless\TIGER\_YYYY\DistanceRasters. Retain the output GeoTIFFs in their respective folders in the local workspace.

## Step 2: Run Calculate Area without Roads Tool

Using local copies of data, run this tool for each geographic area, selecting appropriate source geodatabase and template feature class. This tool will generate area without roads polygon feature classes (by processing tile) and append them into the seamless area without roads feature class for the geographic extent of interest.

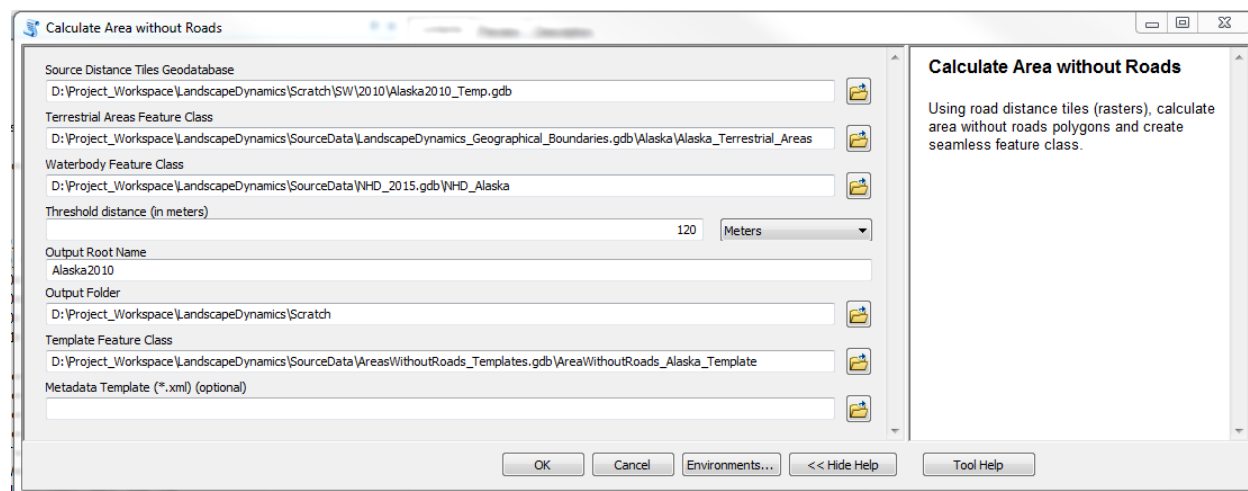


**Figure 5.** Calculate Area without Roads tool

Quality check the output feature class by opening it in ArcMap and overlaying source road features. Check threshold distance to verify it matches what was specified when running the tool. Update metadata with processing date and other relevant details. Copy the output geodatabase(s) to \LandscapeDynamics\Roads\Products\Seamless\TIGER\_YYYY\AreaWithoutRoads.

## Step 3: Create Mosaicked Distance Rasters

By geographic extent, use GDAL (<http://www.gdal.org/>, download/install if necessary) to mosaic GeoTIFF distance rasters into a seamless GeoTIFF.

Using a DOS command (cmd) window, change directory to folder where distance GeoTIFFs are located.

```
C:\Users\PubliDesktop>cd
D:\Project_Workspace\Landscape_Dynamics\Scratch
C:\Users\PubliDesktop>X:
D:\Project_Workspace\Landscape_Dynamics\Scratch
```

Run this DOS command to generate a file listing all GeoTIFFs (tiles). Example is CONUS 2016 distance rasters.

```
dir extentYYYY_*_dist.tif /b /s > Roads_extentYYYY_list.txt
dir CONUS2016_*_dist.tif /b /s > Roads_CONUS2016_list.txt
```

Then, use the output text file in a merge command.

```
gdal_merge -o new_CONUS2016_TIFFs\Roads_DistanceFromRoads_CONUS_TIGER2016.tif  
-of GTiff -co TFW=YES -init 0 --optfile Roads_CONUS2016_list.txt
```

## Dissemination

### Step 1: Move Processed Source Data

1. Move final, processed Area without Roads geodatabases to the respective folder on  
\\LandscapeDynamics\Roads\Products\Seamless\TIGER\_YYYY\AreaWithoutRoads.

### Step 2: Publish Services

See Environmental Settings Data Services SOP (SOP 4.1.2; Nelson and Kinseth 2018), and use the following information as a guide when creating and publishing services; see Publishing, Publish Map, Feature, or Image Services to ArcGIS Server or NPS ArcGIS Online, “Landscape Dynamics” section for guidance.

#### ***Area without Roads Seamless***

Publish Map Services for each TIGER year seamless output using categorical symbology on the AREA\_SQKM attribute. Build a Tile Cache for these map services. Publish all services to ArcGIS Server.

When complete, check REST endpoint for update of any new, published services.

<https://irmaservices.nps.gov/arcgis/rest/services/LandscapeDynamics>

See Landscape Dynamics Viewer Maintenance SOP (SOP 2.11.18; Kinseth 2018) to add the new data to the viewer.

### Step 3: Publish to Data Store

See Publishing to Data Store SOP (SOP 4.1.1; Kinseth and Nelson 2018) and use the following information (Table 1) as a guide when uploading Area without Roads Seamless data to Data Store.

1. From Environmental Settings Program,  
<https://irma.nps.gov/DataStore/Reference/Profile/2244060>, go to the Roads Project.
2. Compress all geodatabases into a .zip folder, by respective geography/year.

<GEOGRAPHY>\_<Year>\_AreaWithoutRoads.zip (geodatabase)

DistanceFromRoads\_<GEOGRAPHY>\_TIGER<YYYY>.zip (GeoTIFF)

GEOGRAPHY = CONUS, Alaska, American Samoa, Hawaii, PR\_USVI, GuamSaipan

Year = YYYY

**Table 2.** Required upload parameters for holdings: Landscape Dynamics Seamless Data – Roads.

| Parameter                         | Value                                                                                                                                                 |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Date of Issue/Publication         | Reference Level; Date of upload                                                                                                                       |
| Description, Notes, Purpose       | Reference Level; Make necessary edits to text in the reference for these two fields. Update years of data, reasons for new reference, etc, as needed. |
| Permissions                       | Reference/Holding Level; Public, all                                                                                                                  |
| Description (Area without Roads)  | Holding Level; "Area without Roads file geodatabase – TIGER <YYYY> <GEOGRAPHY>"                                                                       |
| Description (Distance from Roads) | Holding Level; "Distance from roads GeoTIFF – TIGER <YYYY> <GEOGRAPHY>"                                                                               |

## Literature Cited

- Environmental Systems Research Institute (ESRI). 2017. How To: Redirect where ArcInfo Workstation and/or ArcGIS writes temporary or scratch files during processing website. <http://support.esri.com/en/technical-article/000001418> (accessed 12/19/2017).
- Kineth, M. 2018. Maintenance and management of the landscape dynamics data viewer for use as part of the IMD Environmental Settings Protocol. Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—2.11.18. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018. Publishing to Data Store. Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—4.1.1. National Park Service, Fort Collins, Colorado.
- Nelson, L. and M. Kineth. 2018. Creating and maintaining data services for the IMD Environmental Settings Monitoring Protocol. Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—4.1.2. National Park Service, Fort Collins, Colorado.

# Appendix 1: Memory Failures

Several vector geoprocessing steps (Dissolve and Erase) needed to create the Area without Roads datasets are memory intensive and time consuming. If the scripts provided are run with 32 bit Python it is highly likely they will crash or produce erroneous results. If possible these scripts should be run on an idle workstation so the machine's maximum available memory can be utilized. For Area without Roads, the template feature classes used to create the merged outputs have a reduced resolution of 1.0m and tolerance of 2.0m

## Memory Issues

If an ArcGIS tool fails due to an issue with memory, see ESRI (2017).

The following is extracted and modified slightly from the above-referenced article. User must have Admin privileges to accomplish these steps.

Use the following procedure to set an ARCTMPDIR system environment variable:

1. Navigate to Start > Control Panel > System and Security > System.
2. Select Advanced system settings, and click the Environment Variables button.
3. Under System variables, click the New button and enter the following:  
variable name: ARCTMPDIR  
variable value: \*new drive location here\* (for example, D:\temp)
4. Click OK on the New System Variable dialog box and click OK on the System Properties dialog box.
5. Restart ArcInfo or ArcGIS Desktop for this change to take effect.

## Appendix 2: Geographic Areas for Processing

The source datasets for geographic area extents are the terrestrial area of the geographic region. In the case of Alaska, Hawaii, Guam/Saipan, and American Samoa, processing tiles used are defined by an intersect selection with the source indicator features. This step maximizes the processing efficiency for the various indicators.

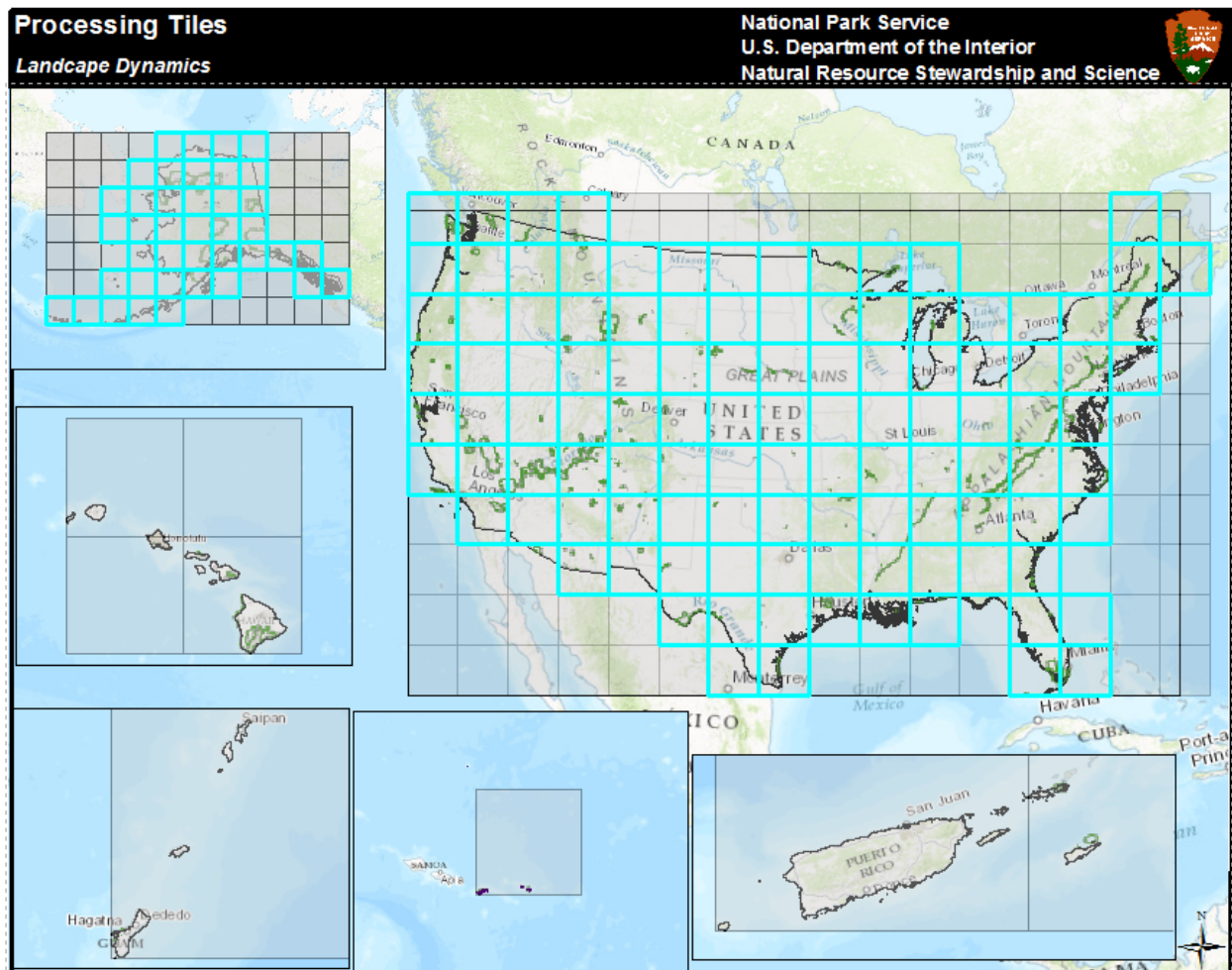


**Figure 6.** Processing extents

## Appendix 3: Processing Parameters

For distance from roads processing, see the table below for processing parameters by geographic area.

**Table 1.** Sources used for processing distance from roads and area without roads

| Geographic extent | Source roads feature class                          | Source processing tiles feature class      | Buffer distance (meters) | Snap raster                             |
|-------------------|-----------------------------------------------------|--------------------------------------------|--------------------------|-----------------------------------------|
| CONUS             | TIGER_2017\TIGER_2017.gdb\CONUS_Roads               |                                            |                          | Landcover_Level2_NLCD2011v11.tif        |
|                   | TIGER_2016\TIGER_2016.gdb\CONUS_Roads               | LD_ProcessingTiles.gdb\CONUS_Tiles         | 10000                    | Landcover_Level2_NLCD2011v11.tif        |
|                   | TIGER_2015\TIGER_2015.gdb\TIGER_CONUS\CONUS_Roads   | LD_ProcessingTiles.gdb\CONUS_Tiles         | 10000                    | Landcover_Level2_NLCD2011v11.tif        |
|                   | TIGER_2010\TIGER_2010.gdb\TIGER_CONUS\CONUS_Roads   | LD_ProcessingTiles.gdb\CONUS_Tiles         | 10000                    | Landcover_Level2_NLCD2011v11.tif        |
| Alaska            | TIGER_2017\TIGER_2017.gdb\Alaska_Roads              | LD_ProcessingTiles.gdb\Alaska_Tiles        | 10000                    | Landcover_Alaska_Level2_NLCD2011v11.tif |
|                   | TIGER_2016\TIGER_2016.gdb\Alaska_Roads              | LD_ProcessingTiles.gdb\Alaska_Tiles        | 10000                    | NLCD2011_Alaska.tif                     |
|                   | TIGER_2015\TIGER_2015.gdb\TIGER_Alaska\Alaska_Roads | LD_ProcessingTiles.gdb\Alaska_Tiles        | 10000                    |                                         |
|                   | TIGER_2010\TIGER_2010.gdb\TIGER_Alaska\Alaska_Roads | LD_ProcessingTiles.gdb\Alaska_Tiles        | 10000                    |                                         |
| Hawaii            | TIGER_2017\TIGER_2017.gdb\Hawaii_Roads              | LD_ProcessingTiles.gdb\Hawaii_Tiles        | 10000                    | Landcover_Hawaii_CCAP2010_2011.tif      |
|                   | TIGER_2016\TIGER_2016.gdb\Hawaii_Roads              | LD_ProcessingTiles.gdb\Hawaii_Tiles        | 10000                    | Landcover_Hawaii_CCAP2010_2011.tif      |
|                   | TIGER_2015\TIGER_2015.gdb\TIGER_Hawaii\Hawaii_Roads | LD_ProcessingTiles.gdb\Hawaii_Tiles        | 10000                    |                                         |
|                   | TIGER_2010\TIGER_2010.gdb\TIGER_Hawaii\Hawaii_Roads | LD_ProcessingTiles.gdb\Hawaii_Tiles        | 10000                    |                                         |
| Guam/Saipan       | TIGER_2017\TIGER_2017.gdb\Guam_Saipan               | LD_ProcessingTiles.gdb\Guam_CNMI_Tiles     | 10000                    | Landcover_Guam_CCAP2011.tif             |
|                   | TIGER_2016\TIGER_2016.gdb\Guam_Saipan_Roads         | LD_ProcessingTiles.gdb\Guam_CNMI_Tiles     | 10000                    |                                         |
|                   | TIGER_2015.gdb\TIGER_GuamSaipan\GuamSaipan_Roads    |                                            |                          |                                         |
|                   | TIGER_2010.gdb\TIGER_GuamSaipan\GuamSaipan_Roads    | LD_ProcessingTiles.gdb\Guam_CNMI_Tiles     | 10000                    |                                         |
| American Samoa    | TIGER_2017\TIGER_2017.gdb\Samoa_Roads               | LD_ProcessingTiles.gdb\AmericanSamoa_Tiles | 10000                    | Landcover_AmericanSamoa_CCAP2010.tif    |
|                   | TIGER_2016\TIGER_2016.gdb\Samoa_Roads               |                                            |                          |                                         |
|                   | TIGER_2015.gdb\TIGER_Samoa\Samoa_Roads              |                                            |                          |                                         |
|                   | TIGER_2010.gdb\TIGER_Samoa                          | LD_ProcessingTiles.gdb                     | 10000                    | Landcover_AmericanSamoa_CC              |

| Geographic extent          | Source roads feature class              | Source processing tiles feature class                 | Buffer distance (meters) | Snap raster                             |
|----------------------------|-----------------------------------------|-------------------------------------------------------|--------------------------|-----------------------------------------|
|                            | a\Samoa_Roads                           | \AmericanSamoa_Tiles                                  |                          | AP2010.tif                              |
| Puerto Rico/Virgin Islands | TIGER_2017\TIGER_2017.gdb\PR_USVI_Roads | LD_ProcessingTiles.gdb\PuertoRico_VirginIslands_Tiles | 10000                    | Landcover_USVirginIslands_CCA_P2012.tif |
|                            | TIGER_2016\TIGER_2016.gdb\PR_USVI_Roads |                                                       |                          |                                         |
|                            | TIGER_2015\TIGER_2015.gdb\TIGER_USVI    | LD_ProcessingTiles.gdb\PuertoRico_VirginIslands_Tiles | 10000                    |                                         |
|                            | TIGER_2010\TIGER_2010.gdb\PR_USVI_Roads | LD_ProcessingTiles.gdb\PuertoRico_VirginIslands_Tiles | 10000                    |                                         |