

Inventory & Monitoring Division

National Park Service



Standard Operating Procedure 3.11.13

Quality Assurance and Quality Control for Landscape Dynamics Metrics: Pattern Morphology

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Summary

This internal Landscape Dynamics SOP provides guidance on QA/QC process for area and percent area pattern morphology metric statistics.

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Overview

This SOP provides instruction on how to QA\QC final summary statistics for pattern morphology, derived from Morphology rasters created from the National Land Cover Dataset (NLCD), released by Multi-Resolution Land Characteristics Consortium (MRLC) (SOP 2.11.15; Nelson and Kinseth 2018).

Statistics can represent various areas of analysis (AOA). At a minimum, AOAs for statistics include a 30km buffer of park boundaries (SOP 2.11.6; Kinseth and Nelson 2018c). Other AOAs can include custom AOAs submitted by Networks or Cooperators for analysis such management areas, watershed boundaries, or other ecological boundaries of interest (SOP 2.11.8; Kinseth and Nelson 2018b). Pattern Morphology statistics are limited to those AOAs that are within the extent of the source data (NLCD).

Statistics for Landscape Pattern Morphology include total AOA area in square kilometers (km²), total area of each land cover category (in km²), and the percent total area of each land cover category within the AOA (SOP 3.11.2; Kinseth and Nelson 2018a).

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

Requirements

- Knowledge and ability to use SSMS 2014 (SQL Server Management Studio)
- Read/write database security privileges for StatsQA and LD_Stage
- Run pattern morphology summary statistics (SOP 3.11.2; Kinseth and Nelson 2018a).

QA Processing & Procedures

Note steps 1 to 3 can be accomplished by any IMD-GIS staff. Steps 4 to 6 can only be accomplished by select IMD-GIS staff with the proper, elevated permissions within the database.

Before you start:

- Connect to SSMS and view the tables within the StatsQA database. There may be multiple pattern morphology statistics tables, by AOA type.
- Repeats steps 1, 2 for each pattern morphology table present in StatsQA.

Naming convention for statistics tables:

NLCD<YYYYYYvYY>_<TargetType>_<Geography>_30KM_<Type><Edge_Width>_<Stat>

Where:

YYYYvYY = source data year

TargetType = Forest, Grassland, Shrubland, Wetland

Geography = CONUS, or, <Network> or <other> if a Custom AOA

Type = PFMORPH (Forest), PSMORPH (Shrubland), PGMORPH (Grassland), PWMORPH (Wetland)

Edge_Width = 1, 5 (*Exception: “_COVERTYPE_FREQ” has no EDGE_WIDTH, results are the same for both edge widths and there is only one table.*)

Stat = “_STATS”, or “_CORE_STATS”, or “_COVERTYPE_FREQ”

Step 1: Quality Assurance

ALL TABLES

1. View table and look for any NULL fields in DATE_CALC. If there are any, stop. Statistics may have to be rerun. If there are no NULLs, continue with QA.
2. Check all AOAs are represented in the table. The number of rows should match the number of features from the input AOA feature class list (if there is a discrepancy, stop immediately):

```
SELECT Count(  
    [COVER_TYPE])  
    , [AOA_NAME]  
FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]  
group by [AOA_NAME]  
order by [AOA_NAME]
```

FOR “_CORE_STATS”, “_COVERTYPE_FREQ” TABLES:

NOTE: QA of CORE_STATS and COVERTYPE_FREQ tables must take place before STATS table QA.

1. Sort by patch size; look for any ZERO or NEGATIVE values. If PATCHSIZE_SQKM is ZERO, FREQUENCY should also be ZERO. Add the following to the end of the select statement:


```
order by [PATCHSIZE_SQKM]
```
2. Sum the patch area, by AOA, and compare to the total area of the AOA ((TAREA_SQKM) - (SUM_PATCH) = (DIFF)). SUM_PATCH should always be less than or equal to TAREA_SQKM. Field DIFF should be ‘0.0000’ or greater. If any negative values exist, stop immediately.

```
with sums as  
  
(SELECT TOP 9999999 SUM([PATCHSIZE_SQKM]) AS [SUM_PATCH], [AOA_NAME]  
FROM [StatsQA].[dbo].[“COVERTYPE_FREQ” or “CORE_STATS” TABLE NAME HERE]
```

```

group by [AOA_NAME])

select [SUM_PATCH], [TAREA_SQKM], sums.[AOA_NAME], ([TAREA_SQKM] -

[SUM_PATCH]) AS [DIFF] from [StatsQA].[dbo].[“STATS” TABLE NAME HERE]

inner join sums on [“STATS” TABLE NAME HERE].[AOA_NAME] = [sums].[AOA_NAME]

order by [DIFF]

```

FOR “_STATS” TABLE ONLY:

1. Right click → Select Top 1000 rows → Delete “TOP 1000” from query
 - a. Sort by area; look for any ZERO or NEGATIVE values. If AREA_SQKM, or TAREA_SQKM, is ZERO, Count_ should also be ZERO. Add the following to the end of the select statement, one at a time (hint: two dash marks before a line of SQL will comment it out):

```
order by [TAREA_SQKM]
```

```
order by [AREA_SQKM]
```

NOTE: the final step of the stats script is to insert any missing AOAs into the respective table, by cover type/edge width. These inserted rows will have a ‘Count_’ = 0, CLASSNAME = Background, and values of “0” in both [TAREA_SQKM], [AREA_SQKM]. These zero values are VALID and should not be counted as errors in QA tests. Visually check the AOA against the source morphology data in ArcGIS if there’s a question about a particular AOA returning “0” area.

2. Run a query to compare the raster calculated area of the AOA to the AOA source vector area ((TAREA_SQKM) – (SUM(AREA_SQKM)) = DIFF), by edge width. All DIFF values should range between 0.1 and -0.1, and any negative values outside this range should be representative of coastal and/or International border AOAs (if unsure, check AOA(s) in ArcGIS):

```

SELECT [EDGE_WIDTH], SUM([AREA_SQKM]) as [SUM_T], [AOA_NAME], [TAREA_SQKM],

([TAREA_SQKM] - SUM([AREA_SQKM])) AS [DIFF]

FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]

GROUP BY [AOA_NAME], [TAREA_SQKM], [EDGE_WIDTH]

order by [DIFF] desc

```

3. Check the SUM (PCT_AREA); it should be 100%. Acceptable range is 100 +/- 0.001.

Note: for any AOAs absent a specific cover type will have a sum PCT_AREA of 0.0000. This is acceptable. If unsure if a sum of 0.000 is correct, visually check AOAs with 0% against source morphology raster data in ArcGIS.

```

SELECT [EDGE_WIDTH], SUM([PCT_AREA]) AS [SUM_PCT], [AOA_NAME]

FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]

group by [EDGE_WIDTH], [AOA_NAME]

order by [SUM_PCT]

```

Step 2: Manage Data

“STATS” TABLE ONLY

Run the query below, to fill in any missing Pattern Morphology Classes, by AOA.

```

INSERT INTO [StatsQA].[dbo].[STATS TABLE NAME GOES HERE] ([VALUE], [COUNT_]
, [CLASSNAME] , [AOA_NAME], [EDGE_WIDTH], [AOA_AREA_SQKM] , [TAREA_SQKM] ,
[AREA_SQKM] , [PCT_AREA], [DATE_CALC], [PARK_CODE], [CreateDate],
[TOTAL_AOA_AREA_SQKM], [DATA_YEAR], [DATA_VERSION], [COVER_TYPE],
[AOA_DATE], [Code_Class_Area], [Code_Percent_Area])

SELECT DISTINCT X.[VALUE], 0, X.[CLASSNAME], X.[AOA_NAME], X.[EDGE_WIDTH],
X.[AOA_AREA_SQKM], X.[TAREA_SQKM], 0, 0, X.[DATE_CALC], X.[PARK_CODE],
X.[CreateDate], X.[TOTAL_AOA_AREA_SQKM], X.[DATA_YEAR], X.[DATA_VERSION],
X.[COVER_TYPE], X.[AOA_DATE], X.[Code_Class_Area], X.[Code_Percent_Area]
FROM [LD_Stage].[dbo].[tlu_PatternMorph_NoTransition_Grouped_Reclass]

LEFT OUTER JOIN

(SELECT

[LD_Stage].[dbo].[tlu_PatternMorph_NoTransition_Grouped_Reclass].[VALUE],
[LD_Stage].[dbo].[tlu_PatternMorph_NoTransition_Grouped_Reclass].[CLASSNAME]
],

[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_NAME],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[EDGE_WIDTH],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_AREA_SQKM],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[TAREA_SQKM],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[DATE_CALC],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[PARK_CODE],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[CreateDate],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[TOTAL_AOA_AREA_SQKM],

```

```

[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[DATA_YEAR],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[DATA_VERSION],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[COVER_TYPE],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_DATE],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[Code_Class_Area],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[Code_Percent_Area]
FROM [LD_Stage].[dbo].[tlu_PatternMorph_NoTransition_Grouped_Reclass]
CROSS JOIN
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE])
AS X ON X.[VALUE]=
[LD_Stage].[dbo].[tlu_PatternMorph_NoTransition_Grouped_Reclass].[VALUE]
WHERE X.[VALUE] NOT IN
(SELECT [StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[VALUE]
FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]
WHERE [StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_NAME] =
X.[AOA_NAME] AND [StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[EDGE_WIDTH]
= X.[EDGE_WIDTH]);

```

1. All absent morphology classes should have been inserted. Check the count again:

```

SELECT Count(
    [CLASSNAME])
    , [AOA_NAME]
FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]
group by [AOA_NAME], [EDGE_WIDTH]
order by [AOA_NAME]

```

- a. All rows should have the same count, **7/row**
 - b. The number of rows should match number of AOAs in the input feature class as above (Step 1.2).
2. Right click on table → Design. Edit field “Count_” to “Count” and save.
 3. Populate fields ‘Code_Class_Area’ and ‘Code_Percent_Area’.

- a. In SSMS, open PM_CodeJoins.sql; all .sql scripts can be found in the repository.
- b. Edit the table names, as needed.

sql Code Example::;

```
Update a set a.[Code_Class_Area] = b.Code
from [LD_Stage].[config].[LandscapeDynamicsMetrics] as b
FULL OUTER JOIN [StatsQA].[dbo].[nlcd2001v11_Forest_pm_stats_Custom] as a
on a.CLASSNAME = b.Classname and a.EDGE_WIDTH = b.ParameterSize
where b.MeasureType = 'Pattern Morphology' and b.ParameterType = 'Class
Area';
```

```
Update a set a.[Code_Percent_Area] = b.Code
from [LD_Stage].[config].[LandscapeDynamicsMetrics] as b
INNER JOIN [StatsQA].[dbo].[nlcd2001v11_Forest_pm_stats_Custom] as a
on a.CLASSNAME = b.Classname and a.EDGE_WIDTH = b.ParameterSize
where b.MeasureType = 'Pattern Morphology' and b.ParameterType = 'Percent
Area';
```

“CORE_STATS” TABLE ONLY

1. Populate fields ‘Code_Class_Area’ and ‘Code_Percent_Area’:
 - a. In SSMS, open PM_CoreFreq_CodeJoins.sql; all .sql scripts can be found in the repository.
 - b. for each Update statement listed, edit the join table to the appropriate QA table

sql Code Example

```
Update a set a.[Code_Core_Freq] = b.Code
from [LD_Stage].[config].[LandscapeDynamicsMetrics] as b
FULL OUTER JOIN [StatsQA].[dbo].[nlcd2001v11_Forest_pm_core_stats_Custom] as
a
on a.COVER_TYPE = b.Classname and a.EDGE_WIDTH = b.Size
where b.MeasureType = 'Pattern Morphology' and b.ParameterType = 'Frequency';
```

Step 3: Combine Statistics

Where applicable, combine data with matching source/year/metric/AOA to create one table of pattern morphology statistics.

Go to Step 4 if there are no tables to combine.

“COVERTYPE_FREQ” TABLE ONLY

1. Create a new “covertime_stats” table for combined morphology cover type frequency stats (by cover type, year, AOA). Add the following to the select statement, on the line above ‘From’:

```
INTO [StatsQA].[dbo].[NEW TABLE HERE]
```

Naming convention for **new** tables should match table names in LD_Stage, for the same metric (if any):

Example New Table =
[StatsQA].[dbo].[nlcd2011v11_Forest_pm_covertime_freq_30km]

2. Refresh StatsQA and look for the new table.
3. Insert additional morphology covertime frequency stats as needed:

```
INSERT INTO [StatsQA].[dbo].[NEW TABLE HERE]
    ([FREQUENCY]
    , [PatchSize_SQKM]
    , [AOA_NAME]
    , etc. with remaining fields)

SELECT [FREQUENCY]
    , [PatchSize_SQKM]
    , [AOA_NAME]
    , etc. with remaining fields

FROM [StatsQA].[dbo].[ADDITIONAL SOURCE TABLE(S)]
```

4. When done, check combined table:

```
SELECT Count(
    [AOA_NAME])

    , [AOA_NAME]

FROM [StatsQA].[dbo].[NEW/DESTINATION TABLE NAME GOES HERE]

GROUP BY [AOA_NAME]
```

The number of rows should equal the total of all AOAs from the individual tables that were merged.

“CORE_STATS” TABLE ONLY

1. Create a new “core_stats” table (by cover type, year, AOA). Add the following to the select statement, on line above ‘From’:

```
INTO [StatsQA].[dbo].[NEW/DESTINATION TABLE HERE]
```

Naming convention for **new** tables should match table names in LD_Stage, for the same metric (if any):

Example New Table = [StatsQA].[dbo].[nlcd2011v11_Forest_pm_core_stats_30km]

2. Refresh StatsQA and look for the new table.
3. Insert additional morphology core frequency stats to the new destination table:

```
INSERT INTO [StatsQA].[dbo].[NEW/DESTINATION TABLE HERE]

    ([FREQUENCY]

    , [PATCHSIZE_SQKM]

    , [AOA_NAME]

    , [EDGE_WIDTH]

    , etc. for remaining fields)

SELECT [FREQUENCY]

    , [PATCHSIZE_SQKM]

    , [AOA_NAME]

    , [EDGE_WIDTH]

    , etc. for remaining fields

FROM [StatsQA].[dbo].[ADDITIONAL SOURCE TABLE(S)]
```

4. Check counts on combined table:

```
SELECT Count(

    [EDGE_WIDTH]), [AOA_NAME], [EDGE_WIDTH]

FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]

GROUP BY [AOA_NAME], [EDGE_WIDTH]

ORDER BY [AOA_NAME]
```

The number of rows should equal the total of all AOAs from the individual tables that were merged.

“STATS” TABLE ONLY

1. Create a new “stats” table (by cover type, year, AOA) for combined morphology stats. Add the following to the select statement, on line above ‘From’:

```
INTO [StatsQA].[dbo].[NEW TABLE HERE]
```

Naming convention for **new** tables should match table names in LD_Stage, for the same metric (if any):

Example New Table = [StatsQA].[dbo].[nlcd2011v11_Forest_pm_stats_30km]

2. Refresh StatsQA and look for the new table.
3. Insert additional morphology stats to the new table:

```
INSERT INTO [StatsQA].[dbo].[NEW TABLE HERE]

    ([Value]

    , [Count]

    , [CLASSNAME]

    , etc. for remaining fields)

SELECT [Value]

    , [Count]

    , [CLASSNAME]

    , etc. for remaining fields

FROM [StatsQA].[dbo].[ADDITIONAL SOURCE TABLE(S)]
```

4. When done, check counts on new table:

```
SELECT Count(

    [CLASSNAME] )

    , [AOA_NAME]

    , [EDGE_WIDTH]

FROM [StatsQA].[dbo].[NEW TABLE GOES HERE]

GROUP BY [AOA_NAME], [EDGE_WIDTH]

ORDER BY [AOA_NAME]
```

Each AOA should have 7 CLASSNAME Count, the number of rows should equal the total of all AOAs from the individual tables that were merged.

- a. If combined tables have the proper count (as noted above), delete individual tables leaving only the combined/new tables in the database.

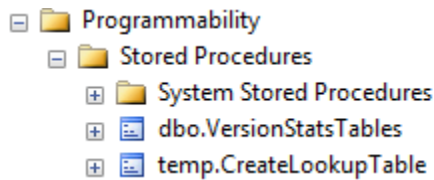
Step 4: Replace Statistics Data – All AOAs

Skip to Step 5 if updating/adding a partial list of AOA statistics

Move the final tables from StatsQA to the LD_Stage database when all QA checks are done and all data values are as they should be (requires elevated privileges). If adding new YYYY data/statistics, go to #2.

1. Version previous morphology tables (if applicable)

- a. In LD_Stage expand Programmability → Stored Procedures:

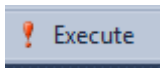


- b. Right click on dbo.VersionStatsTables → “Script Stored Procedure As” → EXECUTE TO → New Query Window.
- c. Replace @fromTable with the name of the table to be versioned, in single quotes (example below in red):

```
DECLARE @RC int
DECLARE @fromTable varchar(60)

-- TODO: Set parameter values here.

EXECUTE @RC = [dbo].[VersionStatsTables]
'nlcd2011_Forest_pm_core_stats_30km'
GO
```

- d. Click  to date-stamp existing table
- e. Refresh to see table with date stamp appended:

 zArchive.nlcd2011_Forest_pm_stats_30km_2016-03-09

2. Copy each new statistics table into LD_Stage, repeat for all new tables.

- a. Right click on table → Script Table As → Select To → New Query Editor Window
- b. Run the following, as appropriate:

- i. For “_COVERTYPE_FREQ”:

```
SELECT **all table fields here**
INTO [LD_Stage].[dbo].[NEW TABLE HERE]
FROM [StatsQA].[dbo].[STATS TABLE NAME HERE]
```

- ii. For “_CORE_STATS”:

```

SELECT **all table fields here**
INTO [LD_Stage].[dbo].[NEW TABLE HERE]
FROM [StatsQA].[dbo].[STATS TABLE NAME HERE]

```

iii. For “_STATS”:

```

SELECT [OBJECTID]
, CONVERT(int, [Count]) Count
, **all remaining fields here**
INTO [LD_Stage].[dbo].[NEW TABLE HERE]
FROM [StatsQA].[dbo].[STATS TABLE NAME HERE]

```

Name NEW LD_Stage tables as follows:

**[SourceYYYY_TargetType_pm_<stat>_AOA] →
[nlcd2011v11_Forest_pm_<core_stats>_30km]**

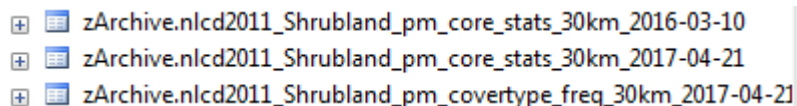
(see existing tables in LD_Stage for additional examples)

- c. Refresh LD_Stage and look for the new table. It should be adjacent to the date-stamped table (if any).
3. In LD_Stage, change schema of date-stamped table(s) from dbo to zArchive:

```
ALTER SCHEMA zArchive TRANSFER dbo.[DATE STAMP TABLE NAME HERE] ;
```

- a. Refresh LD_Stage and check all date-stamp tables are moved from dbo to zArchive.

Tables example, zArchive:



```

+ zArchive.nlcd2011_Shrubland_pm_core_stats_30km_2016-03-10
+ zArchive.nlcd2011_Shrubland_pm_core_stats_30km_2017-04-21
+ zArchive.nlcd2011_Shrubland_pm_covertime_freq_30km_2017-04-21

```

4. Delete the moved tables from StatsQA.

5. Go to Step 6 – Manage Data Views

Step 5: Replace Statistics Data – Select AOAs

Move stats table of interest from LD_Stage to StatsQA and replace data for AOAs that have been updated, or add data for new AOAs to the table.

1. To append updated AOA statistics, or to add new AOA statistics to existing statistics tables:
 - a. COPY the table to be updated FROM LD_Stage TO StatsQA:
Right click LD_Stage table → Script Table As → Select To → New Query Window

```
INTO [StatsQA].[dbo].[STATS TABLE NAME_copy]
```

```
FROM [LD_Stage].[dbo].[STATS TABLE NAME]
```

- b. Get an initial count of AOAs:

```
SELECT Count(  
    [CLASSNAME]/[FREQUENCY])  
    , [AOA_NAME]  
FROM [StatsQA].[dbo].[STATS TABLE NAME_copy]  
group by [AOA_NAME]
```

2. Delete from the “_copy” table all AOAs/rows to be updated/replaced

- a. Right click → Edit Top 200 Rows → click white sql button and edit query as needed

- i. Select and delete AOAs/rows that are updated.
Edits are immediate and cannot be undone – make sure you are editing the appropriate table.

- b. Or, edit sql statement as needed. Run.

```
DELETE FROM [StatsQA].[dbo].[STATS TABLE NAME_copy]  
where AOA_NAME like 'APIS%'  
OR AOA_NAME like 'AZRU%'  
OR AOA_NAME like 'BIBE%'  
OR AOA_NAME like 'BITH%'  
OR AOA_NAME like 'BLCA%'  
OR AOA_NAME like 'CARL%'  
,...add/edit as needed
```

- i. Deleted rows cannot be undone. Make sure to delete from the appropriate table.

3. Query for new count on edited table:

```
SELECT Count(  
    [CLASSNAME]/[FREQUENCY])  
    , [AOA_NAME]  
FROM [StatsQA].[dbo].[STATS TABLE NAME_copy]  
group by [AOA_NAME]
```

4. Insert new/updated statistics from the newly created table into the ‘_copy’ of the table (make sure to match fields based on table being updated; exclude field ‘OBJECTID’):

```
INSERT INTO [StatsQA].[dbo].[STATS TABLE NAME_copy]
    ([FIELD LIST HERE])

SELECT
    FIELD LIST HERE

FROM [StatsQA].[dbo].[NEW TABLE HERE]
```

5. Check Count. The number of rows should have increased by the number of AOAs added in the previous step and should now reflect required total for AOA type.

```
SELECT Count(
    [CLASSNAME]/[FREQUENCY])
    , [AOA_NAME]

FROM [StatsQA].[dbo].[STATS TABLE NAME_copy]

group by [AOA_NAME]
```

6. Visually check table for the applied updates.
 - a. Right click → “Select Top 1000 rows”
 - i. Order by AOA_Name
 - ii. Order by OBJECTID
 - iii. Other queries
7. **Go to STEP 4 – Replace Statistics Data – All AOAs** and follow steps to replace/update table in LD_Stage

Step 6: Manage Data Views

If required, go to Inventory and monitoring database documentation: Environmental Setting Protocol SOP (SOP 7.1.1; Kinseth et al. 2018) and check the Landscape Dynamics portion.

Literature Cited

- Kineth, M. and L. Nelson. 2018a. Calculating statistics for national landscape dynamics metrics: Pattern morphology. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.2. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018b. Creating custom areas of analysis for use as a part of the IMD Environmental Settings Protocol. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—2.11.8. National Park Service, Fort Collins, Colorado.
- Kineth, M. and L. Nelson. 2018c. NPS unit boundary processing: Boundary-derived areas of analysis for use as a Part of the IMD Environmental Settings Protocol Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—2.11.6. National Park Service, Fort Collins, Colorado.
- Kineth, M., L. Nelson, and S. Schupbach. 2018. Inventory and monitoring database documentation: Environmental Setting Protocol. Inventory & Monitoring Division Standard Operating Procedure NPS/NRSS/IMD/SOP—7.1.1. National Park Service, Fort Collins, Colorado.
- Nelson, L. and M. Kineth. 2018. Processing land cover source data to derive landscape dynamics metrics: Pattern. Inventory & Monitoring Division Standard Operating Procedure NPS/IMD/SOP—2.11.15. National Park Service, Fort Collins, Colorado.

Appendix 1: Data Availability and Known issues

Data availability

Pattern Morphology source data is dependent on available NLCD data, and is only available for those AOAs within the extent of source NLCD. Not all geographies/AOAs will have data available to calculate Pattern Density summary statistics.

Additional issues

PARK_CODE is valid for AOAs derived specifically from individual parks. Some Custom AOAs are not park-based and therefore will not have a PARK_CODE value.