

Inventory & Monitoring Division

National Park Service



Standard Operating Procedure 3.11.9

Quality Assurance and Quality Control for Landscape Dynamics Metrics: Total and Percent Area per National Land Cover Category

Please cite this as:

Kineth, M. and L. Nelson. 2018. Quality assurance and quality control for landscape dynamics metrics: Total and percent area per national land cover category. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.9. National Park Service, Fort Collins, Colorado.

Summary

This internal Landscape Dynamics SOP provides direction for QA for land cover area and percent area per category metric statistics.

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Overview

This SOP provides instruction on how to QA\QC final summary statistics for land cover area and percent area metrics, Anderson Level 1 (where applicable) and Anderson Level 2 (SOP 3.11.3; Kinseth and Nelson 2018a).

Statistics can represent various areas of analysis (AOA). At a minimum, AOAs include IMD park boundary, a 3km buffer of the park boundary, a 30km buffer of the park boundary, and HUC12 watersheds that intersect a park boundary (SOP 2.11.6; Kinseth and Nelson 2018c). Custom AOAs can be submitted by Networks or Cooperators for analysis, such as island boundaries, management areas, or other ecological boundaries of interest to a Network (SOP 2.11.8; Kinseth and Nelson 2018b).

For the CONUS and Alaska extents, land cover area and percent area per category metric statistics are derived from the Nation Land Cover Dataset (NLCD) released by Multi-Resolution Land Characteristics Consortium (MRLC); for island geographies, the source is Coastal Change Analysis Program (CCAP), produced through National Oceanic Atmospheric Agency (NOAA) (SOP 3.11.3; Kinseth and Nelson 2018a).

Statistics for land cover area and percent area per category include total area of each land cover class (in km²) and the percent total area of each land cover class, within an AOA.

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 (SQL Server Management Studio)
- Read/write database security privileges for StatsQA and LD_Stage
- Run land cover area and percent area per category statistics (SOP 3.11.3; Kinseth and Nelson 2018a).

QA Processing & Procedures

Steps 1 through 3 can be accomplished by any IMD-GIS staff. Steps 4, 5 can only be accomplished by select IMD-GIS staff with the proper, elevated permissions within the database.

- Connect to SSMS and view the tables within the StatsQA database. There may be multiple land cover statistics tables, by source, for various years, extents, and AOA types.
- Repeat steps 1, 2 for each Level 1 (LAC1) and/or Level 2 (LAC2) table in StatsQA.

Naming convention for land cover statistics tables:

<Source><YYYY>_Level_<Metric>_<Geography*>_<AOA>_STATS

Where:

Source = NLCD, CCAP

YYYY = Year of source data (NLCD includes vYY)

Metric = LAC1 (Level 1), LAC2 (Level 2)

Geography* = CONUS, ALASKA, HAWAII, USVI, PACIFIC_GUAM,
PACIFIC_SAIPAN, PACIFIC_AMSAM, (*applies to standard AOAs only)

AOA = AOA type (i.e. Park, 3km, 30km, HUC12, or defined type from Custom AOA feature class)

Step 1: Quality Assurance

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 of interest are represented in the table. The number of rows should match the number of features from the input AOA feature class (if there is a discrepancy, stop immediately):

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

3. 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]
```

4. Run a query to compare the raster calculated area of the AOA to the AOA source vector area ((AREA_SQKM) – (TOTAL_AOA_AREA_SQKM) = DIFF). All DIFF values should range between 0.1 and -0.1. All negative values outside this range should be representative of coastal and/or Canada or Mexico border AOAs (visually check AOAs in ArcGIS, if unsure).

```
SELECT SUM([AREA_SQKM]) as [SUM_T], [AOA_NAME], [TOTAL_AOA_AREA_SQKM],
```

```
(SUM([AREA_SQKM]) - [TOTAL_AOA_AREA_SQKM]) AS [DIFF]

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

GROUP BY [AOA_NAME], [TOTAL_AOA_AREA_SQKM]

order by [DIFF] desc
```

5. Verify PCT_AREA values in the results table. The values for fields [PCT_AREA] and [PCT_AREA_CHECK] should be equivalent up to three decimal places.

```
SELECT TOP .25 PERCENT [AOA_NAME], [CLASSNAME], [AREA_SQKM],
[TAREA_SQKM], [PCT_AREA], ([AREA_SQKM]/[TAREA_SQKM])*100 AS
[PCT_AREA_CHECK]

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

WHERE [TAREA_SQKM] <> 0

ORDER BY NEWID();
```

6. Calculate the SUM of PCT_AREA, by AOA. SUM_PCT should be 100%. Acceptable range of values is 100 +/- 0.001.

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

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

group by [AOA_NAME]

order by [SUM_PCT]
```

Step 2: Manage Data

Run the query below to fill in any missing Land Cover Classes, by AOA, by table. This assumes all AOAs have at least one landcover type represented – which should always be true.

Lookup tables (tlu) are located in the LD_Stage database.

****Make sure the correct lookup table is referenced!****

NLCD:

tlu_NLCD_LAC1_Colormap (Level 1 – CONUS and ALASKA, all available years)

tlu_NLCD_LAC2_Colormap (Level 2 – CONUS ONLY, all available years)

tlu_NLCD_LAC2_ALASKA_Colormap (Level 2 – ALASKA ONLY, all available years)

CCAP:

tlu_CCAP2010_LAC2_AmSamoa_Colormap

tlu_CCAP2005_LAC2_SaipanCNMI_Colormap

tlu_CCAP2011_LAC2_Guam_Colormap

tl_u_CCAP2010_2011_LAC2_Hawaii_Colormap

tl_u_CCAP2007_2012_LAC2_USVI_Colormap

1. Paste this into the Query screen and make edits to appropriate tables where noted:

```
INSERT INTO [StatsQA].[dbo].[STATS TABLE NAME GOES HERE] ([Count_] ,
[CLASSNAME] , [TOTAL_AOA_AREA_SQKM] , [AOA_FEATURE_AREA_SQKM] ,
[TAREA_SQKM] , [AREA_SQKM] , [PCT_AREA], [AOA_NAME] , [PARK_CODE],
[CreateDate], [DATE_CALC], [DATA_YEAR], [DATA_VERSION], [AOA_DATE],
[Code_Class_Area], [Code_Percent_Area])
SELECT DISTINCT 0, X.[CLASSNAME], X.[TOTAL_AOA_AREA_SQKM],
X.[AOA_FEATURE_AREA_SQKM], X.[TAREA_SQKM], 0, 0, X.[AOA_NAME],
X.[PARK_CODE], X.[CreateDate], X.[DATE_CALC], X.[DATA_YEAR],
X.[DATA_VERSION], X.[AOA_DATE], X.[Code_Class_Area],
X.[Code_Percent_Area]
FROM [LD_Stage].[dbo].[TLU GOES HERE]
LEFT OUTER JOIN (SELECT [LD_Stage].[dbo].[TLU GOES HERE].[CLASSNAME],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[TOTAL_AOA_AREA_SQKM],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_FEATURE_AREA_SQKM],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[TAREA_SQKM],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_NAME],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[PARK_CODE],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[CreateDate],
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[DATE_CALC],
[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].[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 GOES HERE]
CROSS JOIN
[StatsQA].[dbo].[STATS TABLE NAME GOES HERE])
AS X ON X.[CLASSNAME]= [LD_Stage].[dbo].[TLU GOES HERE].[CLASSNAME]
WHERE X.[CLASSNAME] NOT IN
(SELECT [StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[CLASSNAME]
FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]
WHERE [StatsQA].[dbo].[STATS TABLE NAME GOES HERE].[AOA_NAME] =
X.[AOA_NAME]);
```

2. Any absent land cover classes should have been inserted, by AOA. Check the AOA count again. Each AOA should have the same number of classes (Count), the actual number varying whether Level 1 or Level 2 statistics.

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

- a. Check the following:
 - i. All rows should have the same count.
 - ii. The number of rows should match the number of features from the input AOA feature class list, as above (Step 1.2).
3. Right click on table → Design. Edit field “Count_” to “Count” and save.
4. Populate fields ‘Code_Class_Area’ and ‘Code_Percent_Area’.
 - a. In SSMS, open *_CodeJoins.sql. *selecting the one that is appropriate for the data (NLCD, CCAP, LAC1/2, etc). All .sql scripts can be found in the repository.
 - b. Edit the script as needed, changing target stats tables and other parameters where appropriate.

sql Code Example:

```
Update a set a.[Code_Class_Area] = b.Code
from [LD_Stage].[config].[LandscapeDynamicsMetrics] as b
INNER JOIN [StatsQA].[dbo].[nlcd2001v11_lac1_stats_Park] as a
on a.CLASSNAME = b.Classname
where b.MeasureType = 'Level 1' and b.ParameterExtent = 'CONUS' 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_lac1_stats_Park] as a
on a.CLASSNAME = b.Classname
where b.MeasureType = 'Level 1' and b.ParameterExtent = 'CONUS' and
b.ParameterType = 'Percent Area';
```

Step 3: Combine Statistics

Where applicable, combine like data with matching: source/year/metric/AOA (i.e. CCAP/2011/LAC2/30km, NLCD/2011v11/LAC1/30km).

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

1. Create a new table for combined LAC Stats (one each Level 1, Level 2). 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 existing table names in LD_Stage, for the same metric (if any):

Example New/Destination Table =
[StatsQA].[dbo].[nlcd2011v11_lac2_stats_30km]

2. Refresh StatsQA and look for the new table.
3. Insert additional land cover stats data to the new table using the following code:

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

    ([Count]

    , [CLASSNAME]

    , etc. with all fields listed)

SELECT [Count]

    , [CLASSNAME]

    , etc. with all fields listed

FROM [StatsQA].[dbo].[ADDITIONAL SOURCE TABLE HERE]
```

4. When done inserting all tables, check merged table(s):

```
SELECT Count(

    [CLASSNAME] )

    , [AOA_NAME]

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

group by [AOA_NAME]
```

Classname count per row should be the same for ALL rows, and should match the Classname count that was noted in Step 2, number 2.

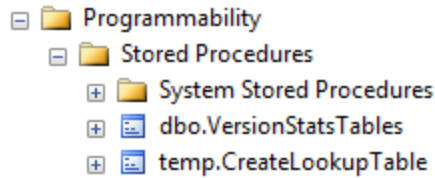
Confirm all AOAs are present; the number of rows should equal the total of all AOAs from the tables that were merged.

Step 4: Replace Statistics Data – All AOAs

Go to Step 5 if updating/adding a partial list of AOAs

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

1. Version previous LAC1/2 LD_Stage table(s) (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):

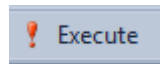
```

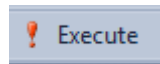
DECLARE @RC int
DECLARE @fromTable varchar(60)

-- TODO: Set parameter values here.

EXECUTE @RC = [dbo].[VersionStatsTables]
        'nlcd2001v11_lac1_stats_30km'
GO

```



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

  dbo.nlcd2011_lac1_stats_30km_2015-11-25

2. Copy the new statistics table into LD_Stage.

- a. Right click on table → Script Table As → Select To → New Query Editor Window

```

SELECT [OBJECTID]
      , CONVERT(int, [Count]) Count
      , [CLASSNAME]
      , [TOTAL_AOA_AREA_SQKM]
      , [[. . . make sure all fields are listed]]

INTO [LD_Stage].[dbo].[NEW STATS TABLE NAME GOES HERE]
FROM [StatsQA].[dbo].[STATS TABLE NAME GOES HERE]
GO

```

Name NEW LD_Stage tables as follows:

[SourceYYYYvYY_metric_stats_AOA] → [nlcd2011v11_lac1_stats_30km] (see existing tables in LD_Stage for additional examples)

- b. EXECUTE the Query
- c. REFRESH LD_Stage and look for the new table. It should be adjacent to the date-stamped table (if applicable).

```
+ dbo.nlcd2011_lac1_stats_30km
+ dbo.nlcd2011_lac1_stats_30km_2015-11-25
```

3. If applicable, change schema of date-stamped table(s) from dbo to zArchive in LD_Stage:

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

4. Refresh LD_Stage and check all date-stamp tables are moved from dbo to zArchive. Only tables without a date-stamp should be listed under the dbo schema.

Tables example, zArchive:

```
+ zArchive.nlcd2001v11_lac2_stats_Park_2016-01-08
+ zArchive.nlcd2001v11_lac2_stats_Park_2017-01-26
+ zArchive.nlcd2001v11_lac2_stats_Park_2017-05-04
+ zArchive.nlcd2001v11_inc_stats_30km_2016-01-13
+ zArchive.nlcd2001v11_inc_stats_30km_2017-01-26
+ zArchive.nlcd2001v11_inc_stats_30km_2017-05-04
```

5. Delete the moved table from the StatsQA database.

6. Go to Step 6 – Manage Data Views

Step 5: Replace Statistics Data – Select AOA's

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

1. Append updated statistics or add new AOA statistics to existing statistics tables:
 - a. Copy the table to be updated from LD_Stage into 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 AOA's:

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

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

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

1. 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 more 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] )

, [AOA_NAME]

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

group by [AOA_NAME]
```

4. Insert new/updated statistics from the newly created base 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 MATCHING FIELD LIST HERE

FROM [StatsQA].[dbo].[NEW BASE 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] )  
    , [AOA_NAME]  
FROM [StatsQA].[dbo].[STATS TABLE NAME_copy]  
group by [AOA_NAME]
```

6. Visually check “_copy” 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: Total and percent area per national land cover category. Inventory & Monitoring Program Standard Operating Procedure NPS/NRSS/IMD/SOP—3.11.3. 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.

Appendix 1: Known 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.