

ATtILA for ArcGIS Help

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Title Page

Analytical Tools Interface for Landscape Assessments for ArcGIS (ATtILA for ArcGIS)

version 1.1

User Manual

Lead Programmer: Donald W. Ebert

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Mention of trade names and commercial products does not constitute endorsement or recommendation for use.

U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
Environmental Sciences Division
Landscape Ecology Branch
P.O. Box 93478
Las Vegas, Nevada 89193

Notice

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The United States Environmental Protection Agency through its Office of Research and Development funded and managed the development of ATtILA for ArcGIS. It has been subjected to Agency and external scientific and administrative review and approved for distribution. Mention of trade names or commercial products does not constitute endorsement nor recommendation for use."

Acknowledgements

Programmers

Python code for ATtILA for ArcGIS was written by Don Ebert (EPA), Michael Jackson (EPA), and Torrin Hultgren (Innovate!, Inc.), with special assistance from Ellen D'Amico (Dynamac Corporation), BaoHong Ji (Innovate!, Inc.), and Doug Browning (EPA Student Services Contractor).

David Gottlieb (EPA Student Services Contractor) wrote the code for the Land Cover Coding Editor.

The original ATtILA for ArcView extension tool was written in Avenue code by Don Ebert and Tim Wade with assistance from Dennis Yankee (Tennessee Valley Authority, Public Power Institute) who wrote code for the PCTIA_RD metric.

The following programmers were not directly involved with the project, but gave permission for their code to be incorporated into the original ATtILA and we greatly appreciate their generosity:

- Laine, Jarko. 1998. Intersec Script, Novo.
- Eichenlaub, Bill. 1998. Profiler Script (Version 1.0), National Park Service (<http://arcscripts.esri.com/details.asp?dbid=11096>).
- O'Malley, Kevin. 1999. Two Theme Analyst Extension, <http://arcscripts.esri.com/details.asp?dbid=10653>
- DeLaune, Mike. 2003. XTools Extension, Oregon Department of Forestry (<http://arcscripts.esri.com/details.asp?dbid=11526>).
- Martin, Eugene. 1999. Spatial.AignedGridExtract Script, University of Washington. <http://arcscripts.esri.com/details.asp?dbid=10759>
- Fox, Timothy J. 1998. Nearest Feature Analysis Tool Script, USGS Upper Midwest Environmental Science Center. <http://arcscripts.esri.com/details.asp?dbid=11234>
- Cosmas, Tom. 1999. Table.RenameField Script, New Jersey Department of Environmental Protection. (<http://arcscripts.esri.com/details.asp?dbid=11402>)
- Schultz, Ron. 2003. Bearing extension (<http://arcscripts.esri.com/details.asp?dbid=10310>).
- Jenness, Jeff. 2005. Distance/Azimuth Tools (Version 1.4b), Jenness Enterprises (<http://arcscripts.esri.com/details.asp?dbid=13239>).

Help Files

Deborah Chaloud (EPA), Megan Culler (EPA Student Services Contractor), Steven Jett (Innovate!, Inc.), Caroline Erickson (EPA) and Bob Ohman (EPA Senior Environmental Employment Program) assisted with the help files.

Other Contributors

Rose Marie Moore (EPA) helped with coordination and planning of the project.

What is ATtILA?

ATtILA for ArcGIS is an Esri ArcGIS toolbox that allows users to easily calculate many common landscape metrics. GIS expertise is not required, but some experience with ArcGIS is recommended. Three metric groups (toolsets) are currently included in ATtILA for ArcGIS: Human Stressors, Landscape Characteristics, and Riparian Characteristics. ATtILA for ArcGIS is written using the Python programming language and is designed to accommodate spatial data from a variety of sources.

This guide provides basic information on installing and using ATtILA for ArcGIS. It is not, however, meant to provide background in landscape ecology. It is the user's responsibility to make appropriate use of ATtILA for ArcGIS output when conducting analyses or assessments. Users should also have some experience with spatial analysis and spatial data to ensure proper use of ATtILA for ArcGIS. New users should read through this manual at least once to familiarize themselves with potential pitfalls associated with spatial data, ArcGIS limitations, or ATtILA for ArcGIS processes. Important points are usually identified by *italics* in this document. A collection of appendices are included that contain a metric glossary, default land cover coding schemes, sample metadata, and more detailed information on some methods used in ATtILA for ArcGIS.

ATtILA for ArcGIS was developed specifically to aid landscape ecology research being conducted by the US EPA. Consequently, the tools are named for their original usage (e.g., roads near streams) and the examples given in this document are drawn from landscape ecology analyses. However, other applications are possible and encouraged as long as the input data meet the requirements of the tool and the output meets the needs of the user. Instead of a layer of watershed polygons as the summary layer as given in the examples, the base summary layer could be counties, zipcodes, school districts, etc, as long as the input layer contains non-overlapping polygons and a unique identifier variable. Instead of roads or streams, any line data layer could be substituted, such as existing or proposed routings for transmission lines, railroads, or pipelines. Any discrete grid can be substituted for land cover data, with the user-defined classification option. It is the responsibility of the user to determine if the output of the tools meets the needs of their particular analysis.

Please report bugs and forward comments to: LEBProjects@epa.gov and include "ATtILA" in the subject line.

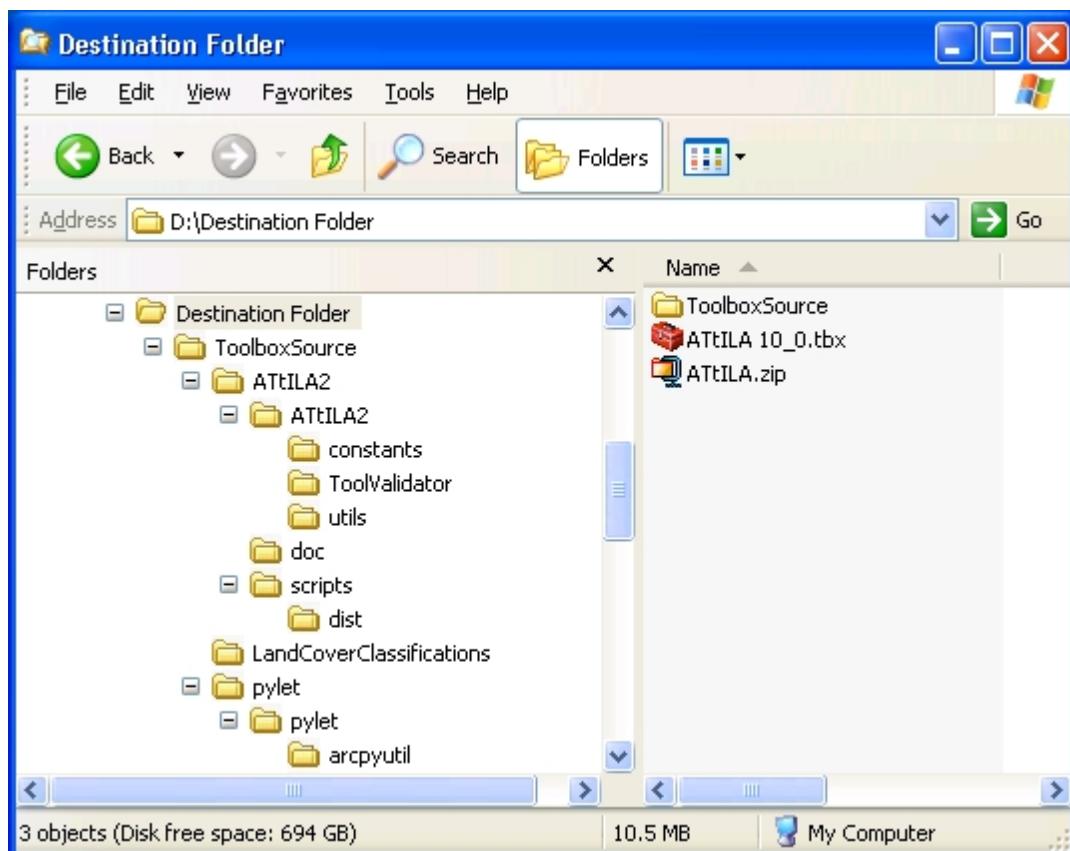
Installing ATtILA

Requirements

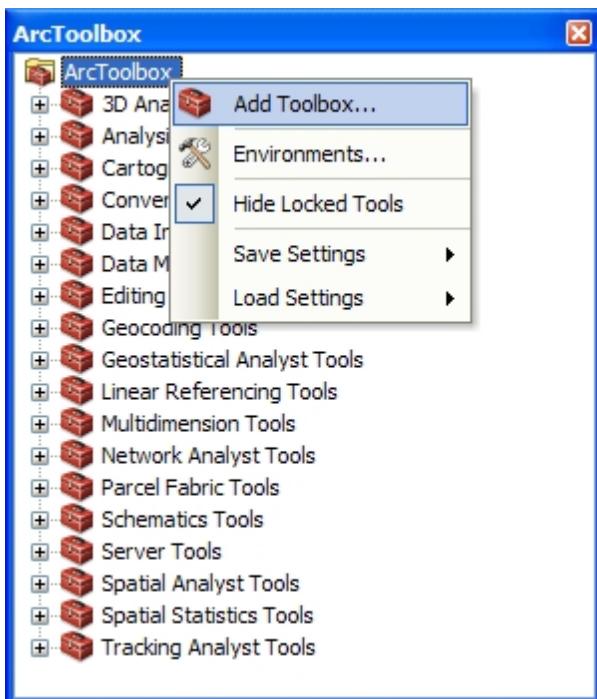
ATtILA for ArcGIS requires ArcGIS 10.0, service pack 4 or later and the Spatial Analyst extension. ATtILA for ArcGIS has not yet been tested on ArcGIS 10.1 or later versions.

Installation

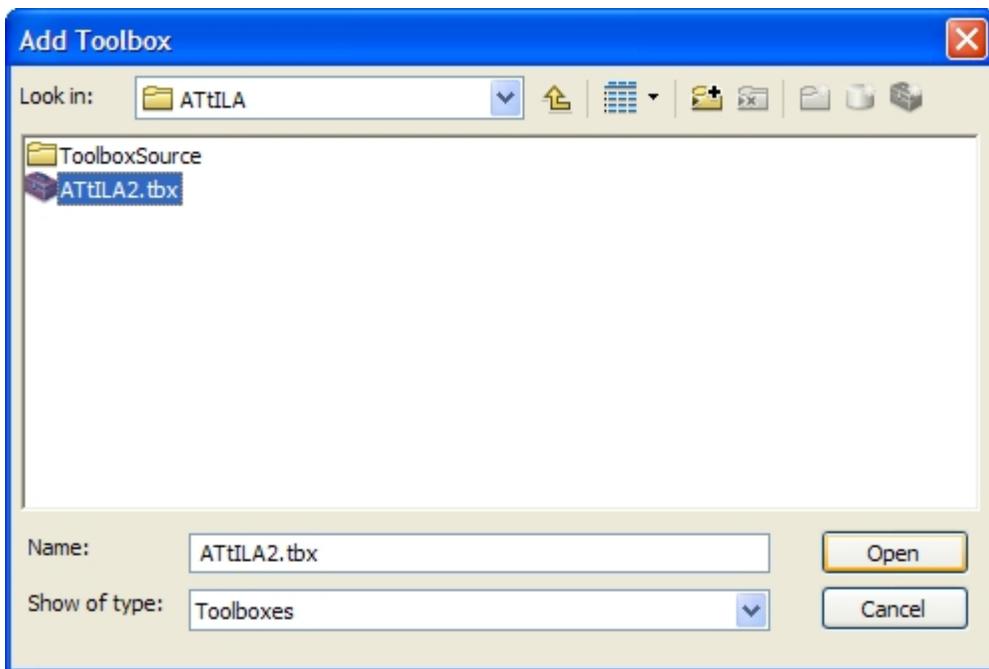
1. Download the ATtILA for ArcGIS distribution zip file to a safe location, such as a Downloads directory.
2. Extract the contents of the ATtILA.zip file to a location where you commonly store personal Toolboxes, such as your ArcGIS directory under MyDocuments. Ensure the ATtILA 10_0.tbx file and the ToolboxSource folder are at the same directory level. ATtILA for ArcGIS's directory structure is illustrated below.



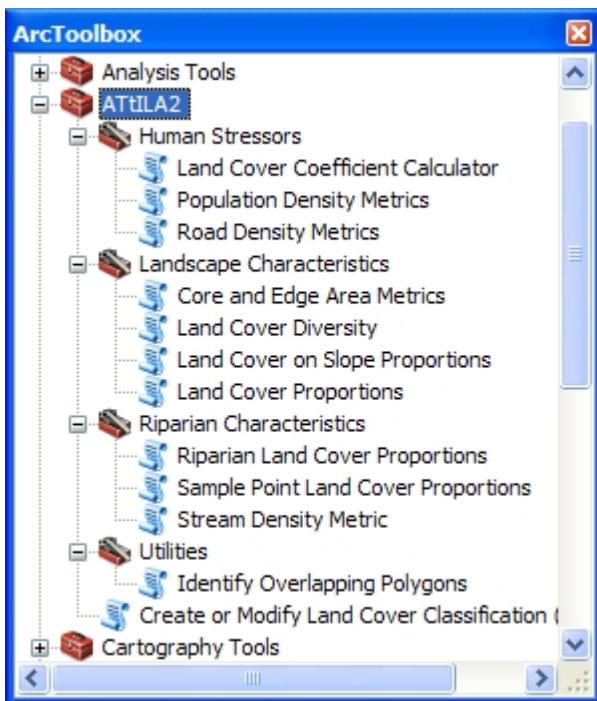
3. Start ArcGIS catalog or ArcMap. Open the ArcToolbox window, right click on ArcToolbox, and click on Add Toolbox.



4. Navigate to Attila 10_0.tbx, select it and click Open.



5. Check to see if the toolbox installed correctly, i.e., open Toolbox to see tools contained within.



NOTE: When installing ATtILA for ArcGIS using ArcCatalog, it may be necessary to restart ArcMap before the ATtILA for ArcGIS toolbox can be accessed from the ArcToolbox window within ArcMap.

NOTE: If installing ATtILA for ArcGIS to the ArcToolbox in ArcMap, you can either save the mxd to make the ATtILA for ArcGIS toolbox available for future sessions with the same map document, or right-click on ArcToolbox and select 'Save Settings' > 'To Default' to make the ATtILA for ArcGIS toolbox available from any ArcMap document. For more details on using ArcToolbox, search for "Using the ArcToolbox window" in ArcGIS's help documents.

Metrics

ATtILA for ArcGIS metrics are measurements of a component or components within the landscape, derived from combinations or overlays of data, which are used to characterize the composition and spatial configuration of those components in the landscape. A seminal work on metrics, which may be considered the genesis of ATtILA for ArcGIS, can be found in "*An Ecological Assessment of the United States Mid-Atlantic Region: A Landscape Atlas*" (Jones et al, 1997). Many of the metrics originally conceived and developed for the atlas are included in ATtILA for ArcGIS.

There are three toolsets in the ATtILA for ArcGIS toolbox: [Human Stressors](#), [Landscape Characteristics](#), and [Riparian Characteristics](#). Each toolset is comprised of several tools for calculating metrics. Input data varies depending on the tool being used, and the dialog box for each tool guides the user, step by step, through the acceptable input data types and formats. Help is available from within each tool's dialog box by clicking the Tool Help button. Additionally, each required dataset is described in detail in the tool-specific sections of this manual.

ATtILA for ArcGIS tools are extremely flexible and accept a wide range of data as input. Users are responsible for choosing data appropriate for their application or assessment. Spatial datasets are available from many sources, with a broad range of scales and spatial and thematic accuracy. There are numerous online clearinghouses that distribute many types of spatial data. Good places to start include the [Esri Data](#) Web site, the [Federal Geographic Data Committee's \(FGDC\) Geoplatform](#) or the United States Geological Survey's (USGS) [National Map Viewer](#). EPA's spatial data repository may be accessed through the [Geospatial Program](#) website. Datasets that cover the conterminous United States are available for download free of charge from these and other Internet sites. They are suitable for regional to national scale assessments. For local studies, higher resolution data is recommended, if available.

ATtILA for ArcGIS tools are not restricted to use of particular datasets, but can be run with any input dataset that matches the required dataset type as defined in the tool-specific sections of this manual. Again, ***it is the responsibility of the user to select datasets of the appropriate type, format, and resolution for the metric analysis being performed.***

Human Stressors

Human land uses and associated changes to land cover are one source of environmental stressors. For example, agriculture usually produces higher levels of nutrients like nitrogen and phosphorus than natural land cover. Excess export of nitrogen and phosphorus to streams leads to eutrophication of streams, lakes, bays, and other water bodies. Most of these nutrients come from non-point sources like animal waste from livestock operations and fertilizer applications on agricultural fields, golf courses, and residential lawns. Urban land uses increase the amount of impervious surfaces (roads, rooftops, parking lots, etc.), which increases the volume and force of precipitation runoff. Increased runoff leads to higher risk of flooding and also carries larger amounts of pollutants and sediment into surface waters.

Population density and change can be used to assess the potential magnitude of human impacts on the environment. Population growth can contribute to changes to land cover and

landscape patterns, such as forest fragmentation, loss of interior forest, and increased impervious surface, which can put pressures on ecosystems. Looking at population change can be helpful in identifying reporting units experiencing high rates of growth, making them vulnerable to adverse impacts, or to analyze the history of land use changes in a region.

Roads are another type of human-related stressor. Density of roads may be a surrogate for population density. Roads near streams or other water bodies increase the potential for pollution from runoff. Bridges or other stream crossing may alter the flow hydrology of streams as well as provide access points for dumping.

The Human Stressors toolset includes three metrics:

- [**Land Cover Coefficient Calculator**](#) encompasses the nutrient (nitrogen and phosphorus) loading and the impervious surface estimate metrics contained in an earlier release of ATtILA. For nitrogen (N), phosphorus (P), and impervious surface, coefficients for various land cover classes are applied (multiplied) to a grid of land cover. Coefficient values based on literature reviews are included as default values for the default land cover classification schemes, but the user is free to alter these values to suit his/her individual assessment needs. The user may also use a land cover classification other than the ones supplied with this release of ATtILA, which then requires the user to enter their own custom coefficients. The land cover coefficient calculator may also be used for other custom purposes beyond land cover. The only required input datasets are a grid with discrete values and a polygon theme of reporting units. Custom coefficient values are also required if the default values are not to be used.
- [**Population Density Metrics**](#) calculates the population count and density by reporting unit; it can also be used to calculate population change. Population density is reported as number of people per km². Population change is reported as percentage change in population by reporting unit. The population change tool is quite versatile, like many of the metrics in ATtILA, and can be used beyond its stated purpose. For example, instead of selecting population counts from different time periods, the user could select fields containing counts of male and female members of a population at a given time. The POPCHG metric could then be used to show the percentage difference between the number of males and females for the given reporting unit. Another possible application would be to use ATtILA for ArcGIS to calculate the total area of a land cover class in a reporting unit for two different time periods. Using these two themes as inputs into the POPCHG metric, the user could then calculate the percentage change in the land cover type over the given time period.
- [**Road Density Metrics**](#) includes road density, roads crossing streams, and roads near streams metrics. The road density metrics require only an input reporting unit polygon theme and a line theme of roads, although any other line theme could be substituted. To calculate roads near streams and roads crossing streams in addition to road density, a line theme of streams is also required as an input. Again, any line theme which makes sense for the analysis could be substituted. For example, this metric could be used to assess the density of power lines or to determine the frequency of railroad tracks crossing roads.

[**Land Cover Coefficient Calculator**](#)

[**Summary**](#)

Calculates metrics based on coefficient values (multipliers) associated with specific land cover classes within each reporting unit polygon and creates an output table.

Within the reporting unit polygons, the area of each land cover class present is multiplied by its supplied coefficient. The products for each land cover class are summed to produce a value for each coefficient type.

In this version of ATtILA for ArcGIS, this tool produces three metrics: percent impervious area, nitrogen loading (kg/ha/yr), and phosphorus loading (kg/ha/yr).

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- **NOTE:** To ensure desired results, the **Land cover grid** must be in a projected coordinate system with linear units of measure.
- Three coefficients for which metrics are calculated are included in this tool: IMPERVIOUS, NITROGEN, and PHOSPHORUS. Coefficient values are stored in the **Land cover classification file**. For more information on how coefficients are coded into the **Land cover classification file**, please refer to the [Coefficients Element](#) and [Values Element](#) sections of [ATtILA's LCC XML Document](#). To view specific coefficient values associated with supplied land cover schemes, refer to the particular scheme in [Supplied Land Cover Classification Schemas](#). To view and optionally edit coefficient values in a **Land cover classification file**, use either the [Create or Modify Land Cover Classification](#) tool or a text editor.
 - IMPERVIOUS coefficient - Represents an estimate of the percent impervious area for each land cover class. For example, many land cover classification schemes contain multiple "developed" land cover classes based on the intensity of development. Generally, high-intensity developed areas (e.g. city centers) contain a greater proportion of impervious surfaces per unit area than low-intensity developed areas (e.g. rural residential). Hence, a high-intensity developed land cover class should be assigned a higher coefficient value (perhaps 0.9 for 90% impervious) than that of a medium- or low-intensity developed land cover class (the coefficient values of which perhaps range from 0.7 to 0.25 for 70% to 25% impervious). Generally, percent impervious area in land cover classes other than developed is very low or zero.
 - NITROGEN coefficient - Represents an estimate of the amount of nitrogen output (stream loading) in kilograms per hectare per year for each land cover class. Nitrogen loading is generally found to be highest in land cover classes that are primarily human-use oriented (agricultural and developed land); hence ATtILA for ArcGIS assigns a higher nitrogen loading coefficient value to these classes as compared to natural land cover classes. Considering only the various natural land cover classes, nitrogen loading is generally found to be highest in classes with high vegetative biomass per unit area (forest) and ATtILA for ArcGIS assigns a higher nitrogen loading coefficient value than those of other natural land cover classes with lower biomass per unit area.
 - PHOSPHORUS coefficient - Represents an estimate of the amount of phosphorus output (stream loading) in kilograms per hectare per year for each land cover class. Phosphorus loading follows a similar pattern as nitrogen loading--it is found to be highest in human-use oriented land cover classes to which ATtILA for ArcGIS assigns higher phosphorus loading coefficient values versus natural land cover classes. Again, as with nitrogen loading, within the various natural land cover classes ATtILA for ArcGIS assigns the highest phosphorus loading coefficient values to classes with high vegetative biomass per unit area (forest), with coefficient values decreasing with diminishing biomass per unit area.
- Reporting unit metrics are based on the coefficient values as coded into the **Land cover**

classification file for each land cover class. These metrics are calculated in the following manner:

- IMPERVIOUS - The percent impervious metric uses a percent area method to calculate values. For each land cover class, the area within each reporting unit is multiplied by the impervious coefficient associated with that class, resulting in a product for each class. Products for all land cover classes are summed to produce the percent impervious area metric for each reporting unit.
 - **NOTE:** *The percent area method expects coefficient values to be expressed as decimal values between 1 and 0 (e.g., 0.9 for 90%).*
 - **NOTE:** *The output calculated value is supplied as a percentage.*
- NITROGEN - The nitrogen loading metric uses a per-unit-area method to calculate values. For each land cover class, the area within each reporting unit is converted to hectares then multiplied by the nitrogen coefficient associated with that class, resulting in a product for each class. Products for all land cover classes are summed, then divided by the total number of hectares within the reporting unit to provide an average nitrogen loading value across each reporting unit in kilograms per hectare per year.
- PHOSPHORUS - The phosphorus loading metric uses a per-unit-area method to calculate values. For each land cover class, the area within each reporting unit is converted to hectares then multiplied by the phosphorus coefficient associated with that class, resulting in a product for each class. Products for all land cover classes are summed, then divided by the total number of hectares within the reporting unit to provide an average phosphorus loading value across each reporting unit in kilograms per hectare per year.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If a disparity exists between the extents of the **Reporting unit feature** and the **Land cover grid**, the user may wish to set the Extent in Environment Settings > Processing Extent to the smaller of the two to avoid unnecessary processing.
- The **Land cover classification scheme** must correspond to the **Land cover grid**.

- Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).
- In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
- **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#), and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Field names in the **Output table** are as follows:
 - PCTIA - The percent impervious area metric for the reporting unit.
 - N_Load - The average annual nitrogen load per hectare for the reporting unit (kg/ha/yr).
 - P_Load - The average annual phosphorus load per hectare for the reporting unit (kg/ha/yr).
 - **NOTE:** Field names are obtained from the *fieldName* attribute in each coefficient element in the specified **Land cover classification file** (See the [Coefficients](#)

Element in ATtILA's LCC XML Document). Output field names can be changed by editing the Land cover classification file.

Syntax

LCCC (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid, Land_cover_classification_scheme, Land_cover_classification_file, Report_metrics_for_these_coefficients, Output_table, {Processing_cell_size}, {Snap_raster}, Select_options)

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes to be summarized within each Reporting unit feature. The grid input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_coefficients	A list of the coefficients available for processing. Check the box to calculate metrics for each coefficient desired within the reporting units.	String
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_cell_size(optional)	The Processing cell size for the zonal operation. The default Processing cell size is the cell size of the input raster land cover data. Optionally, the user may select a different cell size.	Analysis cell size
Snap_raster(optional)	The raster that the cell alignment of the Land cover grid and rasterized Reporting unit feature layer will be matched to during processing. The default Snap raster is the Land cover grid.	Raster Layer
Select_options	Two tool options are available to provide additional information: <ul style="list-style-type: none"> Add Quality Assurance Fields - Adds area fields to the Output table to facilitate quality assurance. 	Multiple Value

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Population Density Metrics

Summary

Calculates population count and density (people per km²) for each reporting unit polygon and creates an output table.

In addition to the default metrics, the tool optionally calculates population change over time.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- ***NOTE:*** To ensure desired results, the **Reporting unit feature**, **Census feature**, and **Census T2 feature** must be in projected coordinate systems with linear units of measure.
- The **Reporting unit feature** must be a polygon feature class or shapefile.
- This tool assumes that population is distributed evenly throughout each **Census feature** polygon. The tool apportions population by area weighting. For example, if 50% of a **Census feature** polygon is within a reporting unit, the tool will assign 50% of the value in the polygon's **Population field** to that reporting unit. Caution should be exercised when **Census feature** polygons do not have even population distributions as this could result in an overweighting or underweighting of population when the tool performs the apportionment. Generally, greater accuracy will be achieved if the **Census feature** polygons are smaller than the smallest **Reporting unit feature** polygons.
- When the optional **POPCHG** (population change) is checked, the tool allows the user to select a **Census T2 feature** and a corresponding **Population T2 field**.
 - For best results, the **Census T2 feature** should contain polygons at a similar scale to that of the **Census feature** (e.g. if **Census feature** represents census block groups, then **Census T2 feature** should also represent census block groups rather than census tracts or some other census geography).
 - **Census T2 feature** may be the same feature layer as used for **Census feature**.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - ***NOTE:*** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be

saved as an INFO Table if data sharing is important.

- The user may elect to [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Field names in the **Output table** follow this naming scheme:
 - For default tool settings (e.g. no optional settings selected):
 - AREAKM2 - The area of the reporting unit in km².
 - popCount (ALIAS: SUM_intPop) - The estimated total population within the reporting unit derived by area weighting the population values within each **Census feature** polygon that intersects with the reporting unit and summing the area-weighted values.
 - POPDENS - The estimated population density in persons per km² within the reporting unit derived by dividing popCount by AREAKM2.
 - When the **POPCHG** option is selected:
 - popCount_1 (ALIAS: SUM_intPop) - The estimated total population within the reporting unit derived by area weighting the population values within each **Census feature** polygon (Time 1) that intersects with the reporting unit and summing the area-weighted values.
 - POPDENS_1 - The estimated population density in persons per km² within the reporting unit derived by dividing popCount_1 by AREAKM2.
 - popCount_2 (ALIAS: SUM_intPop) - The estimated total population within the reporting unit derived by area weighting the population values within each **Census T2 feature** polygon (Time 2) that intersects with the reporting unit and summing the area-weighted values.
 - POPDENS_2 - The estimated population density in persons per km² within the reporting unit derived by dividing popCount_2 by AREAKM2.
 - POPCHG - The estimate percent change in population from Time 1 to Time 2.

Syntax

PDM (Reporting_unit_feature, Reporting_unit_ID_field, Census_feature, Population_field, Output_table, {POPCHG}, Census_T2_feature, Population_T2_field, {Select_options})

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Census_feature	The vector polygon dataset that contains population data.	Feature Layer
Population_field	The field in the Census feature layer that contains population data.	Field
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
POPCHG (optional)	Specifies whether population change over time (POPCHG) metrics will be included in the output table. <ul style="list-style-type: none"> • false - No POPCHG metrics will not be included. This is the default. • true - POPCHG metrics will be included. 	Boolean
Census_T2_feature	The optional vector polygon dataset (Census time 2) that contains population data for the comparison date. It may be the same feature layer as Census feature.	Feature Layer
Population_T2_field	The field in the Census feature layer that contains population data for the comparison date.	Field
Select_options (optional)	One tool option is available to provide additional information: <ul style="list-style-type: none"> • Retain Intermediate Layers Generated During Metric Calculation - Saves the intermediate table and/or raster that is normally deleted after processing is complete. 	Multiple Value

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Road Density Metrics

Summary

Calculates metrics based on input vector line dataset(s) for each reporting unit polygon and creates an output table.

Default metrics include total length (km) and line density (km/km²) by reporting unit. Also included in the default metrics is percent impervious surface within each reporting unit, the calculation of which assumes that the input vector line dataset represents roads.

In addition to the default metrics, the tool allows for several optional metrics to be calculated:

- Length and density metrics by Road feature class within each reporting unit. Classes are designated based on values in a specified field in the Road feature layer.
- Metrics that involve spatial relationships between the Road feature and a second linear feature (Stream feature). The user may select to calculate the following:
 - Metrics that measure the frequency of intersections between the Road feature lines and the Stream feature lines in each reporting unit. Measurements by Road feature class are also available.
 - Metrics that measure the length of the Road feature lines within a specified buffer distance from Stream feature lines within each reporting unit. Measurements by Road feature class are also available.
 - Both.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- This tool is designed to use vector line datasets that represent roads and streams, but any vector line dataset may be used. Caution should be exercised when interpreting results, particularly when using line datasets that do not represent roads and/or streams.
- ***NOTE: To ensure desired results, the Reporting unit feature, Road feature, and Stream feature must be in projected coordinate systems with linear units of measure.***
- The **Reporting unit feature** must be a polygon feature class or shapefile.
- The optional **Road class field** may be used to create metrics for different classes of **Road feature** lines. The **Road class field** may be any field that differentiates category of **Road feature** lines and does not necessarily need to represent road class.
- Values in the optional **Road class field** have restrictions. They may not contain spaces or special characters such as hyphens, parentheses, brackets, and symbols such as #, \$, %, and &. Essentially, the values in this field are acceptable if they consist only of alphanumeric characters or an underscore. The values in these fields are used to create class-specific metric fields for the three metrics (RDKM, RDDENS, and RDTIA) in the **Output table**. If any of the values in the **Road class field** violate these character restrictions, consider using a different class field or creating a new one that corresponds to the restrictions.
- If a **Road class field** is specified, the tool creates the new field names by appending the **Road class field** characters to the metric field names. Since field name length is dependent on the output table type (i.e., dBase, INFO, or geodatabase) care should be used so that the length of the final output field name does not exceed the maximum allowable field name limit for the desired output table. When the limit is exceeded, the **Road class field** characters

may replace the characters at the end of these field names.

- Example: Two road classes exist in the **Road feature** and a dBASE output table type is specified (maximum field length = 10 characters). The **Road class field** designates these as "A31" and "B45100". When the tool is run with default settings (e.g. no options are selected), six output fields are created in the **Output table**, which are named as follows (class characters underlined for emphasis):
 - A31: RDKMAA31 (7 characters), RDDENSAA31 (9 characters), RDTIAA31 (8 characters)
 - B45100: RDKMB45100 (10 characters), RDDEB45100 (10 characters), RDTIB45100 (10 characters)
- **NOTE:** If the **Road class field** characters replace too many of the characters in the metric field names, duplicate field names will be created.
- When the optional **STXRD** (stream-road crossing) and/or **RNS** (roads near streams) are checked, the tool allows the user to select a **Stream feature**. When **RNS** is checked, the user is also allowed to enter a **Buffer distance** from the **Stream feature** lines.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Field names in the **Output table** follow this naming scheme:
 - For default tool settings (e.g. no optional settings selected):
 - AREAKM2 - The area of the reporting unit in km².
 - RDKM - The total length of **Road feature** lines in km within the reporting unit.
 - RDDENS - The density of **Road feature** lines in km/km² within the reporting unit.
 - RDTIA - An estimate of percent impervious area within the reporting unit. This metric uses road density as the independent variable in a linear regression model to estimate percent impervious surface (see May, et al., 1997). Due to

the nature of the regression equation used, values below 1.8 km/km² are assigned a value of 0 for the percent impervious metric, while values above 11 km/km² are considered invalid and are reported as -1.

- When the **STXRD** option is selected:
 - STRMKM - The total length of **Stream feature** lines in km within the reporting unit.
 - STRMDENS - The density of **Stream feature** lines in km/km² within the reporting unit.
 - XCNT (Alias FREQUENCY) - The count of intersections (crossings) between the **Road feature** lines and the **Stream feature** lines within the reporting unit.
 - STXRD - The density of stream-road crossings per stream km within the reporting unit.
- When the **RNS** option is selected:
 - RNS[buffer distance] - The proportion of the total length of **Road feature** lines within the **Buffer distance** to the total length of **Stream feature** lines by reporting unit.
- When the option to report metrics by **Road class field** is selected, separate fields are generated for each metric/class combination. For example, if the **Road class field** contains five classes of roads, then five RDDENS metrics will appear in the **Output table**--one for each road class. Each of these fields appears in the **Output table** by the field aliases listed below. To view the field names with the appended classes rather than the aliases, open the table, select the Table Options dropdown, and uncheck Show Field Aliases:
 - RDKM - The total length of **Road feature** lines for each class in the **Road class field** within the reporting unit.
 - RDDENS - The density of **Road feature** lines for each class in the **Road class field** within the reporting unit.
 - RDTIA - An estimate of the percent impervious area within the reporting unit contributed by each class.
 - FREQUENCY - The count of intersections (crossings) between the **Road feature** lines and the **Stream feature** lines for each class within the reporting unit.
 - STXRD - The density of stream-road crossings for each class per stream km within the reporting unit.
 - RNS[buffer distance] - The proportion of the total length of **Road feature** lines within the **Buffer distance** to the total length of **Stream feature** lines in the reporting unit for each class.

Syntax

RDM (Reporting_unit_feature, Reporting_unit_ID_field, Road_feature, Output_table, {Road_class_field}, {STXRD}, {RNS}, Stream_feature, Buffer_distance, {Select_options})

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Road_feature	The vector line dataset representing roads or other linear features to be measured.	Feature Layer
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Road_class_field (optional)	The field in the Road feature layer that distinguishes classes of linear features in order to calculate separate metrics for each class. It may be an integer or a string data type. The values in this field must not contain spaces or special characters. As class code values are appended to output field names, care should be taken not to exceed the limit for field name size set by output table type.	Field
STXRD (optional)	Specifies whether stream-road crossing (STXRD) metrics will be included in the output table. <ul style="list-style-type: none"> • false - No STXRD metrics will not be included. This is the default. • true - STXRD metrics will be included. These include the total number of stream-road crossings (field name: FREQUENCY) and the density of stream-road crossings per stream kilometer (field name: STXRD) in the reporting unit. 	Boolean
RNS (optional)	Specifies whether the roads near streams (RNS) metric will be included in the output table. <ul style="list-style-type: none"> • false - RNS metric will not be included. This is the default. • true - RNS metric will be included. This metric is a measurement of the total length of roads within the buffer distance divided by the total length of stream in the reporting unit. 	Boolean
Stream_feature	The vector line dataset representing streams that is used to calculate the STXRD and/or RNS metrics. This dataset is required when the STXRD and/or RNS options are checked.	Feature Layer
Buffer_dist	The distance around the Stream features in which	Linear

Credits

May, C.W., Horner, R.R., Karr, J.R., Mar B.W., Welch, E.B. 1997. *Effects of urbanization on small streams in the Puget Sound Lowland Ecoregion*. Watershed Protection Techniques. 2:4. pp. 483–493.

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs

Landscape Characteristics

Natural land cover and anthropogenic land use have a profound effect on landscapes and environmental stressors. For example, cutting down forests reduces uptakes of nitrogen and other nutrients, disrupts habitats for various fauna, and exposes soils to increased runoff. Erosion may be further accelerated if the exposed area is on a slope. The proportions of various land cover/use types within a watershed can provide information about the expected condition of surface waters and aquatic habitats within that watershed.

The Landscape Characteristics toolset consists of five metric tools:

- **[Core and Edge Metrics](#)** requires a reporting unit polygon layer and a land cover raster with an accompanying land cover classification scheme. Core and edge area metrics are commonly generated for forest cover (providing an indication of forest health) and for habitat suitability studies, but may be calculated for any land cover class or group of classes.
- **[Land Cover Diversity](#)** requires a reporting unit polygon layer and a land cover raster. Diversity is an indicator of landscape composition and fragmentation. These indicators are influenced by two components – richness (number of different patch types present) and evenness (distribution of area among patch types). There are four diversity metrics available. H and H' are Shannon–Weiner diversity and Standardized Shannon–Weiner diversity, respectively, C is the Simpson index and S is simple diversity. More information on these, including the algorithms, is provided in the tool-specific section of this manual.
- **[Land Cover on Slope Proportions](#)** requires a reporting unit polygon layer, a land cover raster with an accompanying land cover classification scheme, and a slope raster. This tool produces a table of the percent of specified land cover types on slopes within each reporting unit. The slope raster may contain values in either percent or degrees. This tool is commonly used to calculate the amount of agriculture on steep slopes as an indicator of water quality. Steep slopes lead to higher runoff of water, soil and fertilizer and are susceptible to erosion.
- **[Land Cover Proportions](#)** requires a reporting unit polygon layer and a land cover raster with an accompanying land cover classification scheme. This tool produces a table of the percent of specified land cover types within each reporting unit. This metric is the foundation for many landscape analyses, including assessment of condition.
- **[Patch Metrics](#)** requires a reporting unit polygon layer and a land cover raster with an accompanying land cover classification scheme. This tool calculates number of patches, size of largest patch, average patch size, patch density, and proportion of largest patch area to total patch area. Optionally, Mean Distance to Closest Patch may also be reported. Patch metrics are commonly generated for forest cover for

fragmentation studies, but may be calculated for any land cover class or group of classes.

Core and Edge Metrics

Summary

Calculates the edge-to-area ratio within each reporting unit for selected land cover classes and creates an output table. Edge width is provided by the user.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- **NOTE:** *This tool is resource-intensive in terms of both processing time and disk space. Processing time varies depending on the extent and resolution of the input Land cover grid, the number of reporting units, and the number of classes selected for processing. To minimize processing time, consider creating a new Reporting unit feature layer that does not include unwanted reporting units. Also select only the land cover classes in the Report metrics for these classes parameter that are important for analysis. This tool creates multiple interim rasters during processing which may consume considerable disk space in the Scratch Workspace. If the Scratch Workspace resides on a disk with limited disk space, the tool may fail during processing. To prevent this, consider changing the Scratch Workspace in Environments > Workspace > Scratch Workspace to a location with sufficient available disk space, or free up disk space on the disk in which the current Scratch Workspace resides to accommodate the interim rasters.*
- **NOTE:** *To ensure desired results, the Land cover grid must be in a projected coordinate system with linear units of measure.*
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If the extent of the **Reporting unit feature** is smaller than that of the **Land cover**

grid, the user may wish to check the **Reduce land cover grid to smallest recommended size** option. This creates a temporary land cover raster with the processing extent equal to that of the **Reporting unit feature** to avoid unnecessary processing.

- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).
 - In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
 - **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- **Edge width** must be an integer value measuring the number of grid cells. For example, if the **Land cover grid** is at 30-meter cell resolution, an **Edge width** of five (5) would result in a width of (30 X 5) = 150 meters.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When ouput is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.

- Output field names are taken from the class element's caemField attribute in the specified **Land cover classification file**. If the caemField attribute is not provided, the following naming scheme applies (Refer to [Classes Element](#) in [ATtILA's LCC XML Document](#) for general information, or the individual **Land cover classification file** for details):
 - [class]_E2A[edge width] - The edge-to-area ratio for the land cover class within the reporting unit (e.g. "for_E2A5" is the name of the field for the edge-to-area ratio metric for the NLCD "Forest" class when a five-cell edge width is used).
 - **NOTE:** The output field name for each class is shown as the second item next to the class's check box in **Report metrics for these classes**.
 - **NOTE:** Output field names can be altered by [editing](#) the **Land cover classification file**.
- To describe the amounts of core and edge within each reporting unit for each selected land cover class, two ancillary fields are provided in the **Output table**. These field names follow a naming scheme which involves class abbreviations. Refer to the Classes section of [ATtILA's LCC XML Document](#) for general information, or the individual **Land cover classification file** for details. The ancillary field names in this **Output table** are as follows:
 - [class]_COR[edge width] - The percent of the reporting unit comprised of core cells for the land cover class (e.g. "nat_COR7" is the name of the field for the percent core metric for the NLCD "All natural land use" class when a seven-cell edge width is used).
 - [class]_EDG[edge width] - The percent of the reporting unit comprised of edge cells for the land cover class (e.g. "hrbt_EDG3" is the name of the field for the percent edge metric for the NLCD "All Herbaceous" class when a three-cell edge width is used).

Syntax

CAEM (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,
 Land_cover_classification_scheme, Land_cover_classification_file,
 Report_metrics_for_these_classes, Edge_width, Output_table, {Processing_cell_size},
 {Snap_raster}, Select_options, {Reduce_land_cover_grid_to_smallest_recommended_size})

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes upon which core and edge area metrics will be derived within each Reporting unit feature. The class input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	String
Edge_width	The width of the edge, measured in number of grid cells. The input must be an integer value.	Long
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_cell_size (optional)	The Processing cell size for the zonal operation. The default Processing cell size is the cell size of the input raster land cover data. Optionally, the user may select a different cell size.	Analysis cell size
Snap_raster (optional)	The raster that the cell alignment of the Land cover grid and rasterized Reporting unit feature layer will be matched to during processing. The default Snap raster is the Land cover grid.	Raster Layer

Credits

There are no credits for this item.

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Land Cover Diversity

Summary

Calculates land cover diversity within each reporting unit and creates an output table. Metrics include Shannon-Weiner index, standardized Shannon-Weiner index, Simpson's index, and simple diversity.

Diversity metrics quantify landscape composition. These metrics are influenced by two components – richness, the number of different patch types present, and evenness, the distribution of area among the patch types. The four diversity metrics calculated in this tool are:

- Shannon-Weiner index (H) - a measure of the diversity of land cover types throughout the reporting unit. The index value increases with the number of land cover types in the reporting unit.

$$H = - \sum_{i=1}^m P_i \times \ln P_i$$

- Standardized Shannon-Weiner index (H') - standardizes the Shannon-Weiner index to account for the variety of distinct land cover classes present in the reporting unit.

$$H' = (- \sum_{i=1}^m P_i \times \ln P_i) / \ln m$$

- Simpson's index (C) - a measure of the evenness of the distribution of land cover classes throughout the reporting unit. Simpson's index is most sensitive to the presence of common land cover types. Simpson's index values range from 0 to 1, with 1 representing perfect evenness of all land cover types.

$$C = 1 - \sum_{i=1}^m P_i^2$$

- Simple diversity (S) - a count of the number of distinct land cover classes present in the reporting unit.

$$S = m$$

- For all of the above,

- m = the number of different land cover types in the reporting unit
- P_i = the proportion of the reporting unit comprised of land cover type i

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If a disparity exists between the extents of the **Reporting unit feature** and the **Land cover grid**, the user may wish to set the Extent in Environment Settings > Processing Extent to the smaller of the two to avoid unnecessary processing.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** *For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.*
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to Add Quality Assurance Fields and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same

output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.

- Field names in the **Output table** are as follows:
 - H - The Shannon-Weiner index metric for the reporting unit.
 - H_Prime - The Standardized Shannon-Weiner index metric for the reporting unit.
 - C - The Simpson's index metric for the reporting unit.
 - S - The simple diversity metric for the reporting unit.

Syntax

LCD (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid, Output_table, {Processing_cell_size}, {Snap_raster}, Select_options)

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes upon which diversity metrics will be derived within each Reporting unit feature. The class input must be an integer raster layer.	Raster Layer
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_cell_size (optional)	The Processing cell size for the zonal operation. The default Processing cell size is the cell size of the input raster land cover data. Optionally, the user may select a different cell size.	Analysis Cell Size
Snap_raster (optional)	The raster that the cell alignment of the Land cover grid and rasterized Reporting unit feature layer will be matched to during processing. The default Snap raster is the Land cover grid.	Raster Layer
Select_options	Two tool options are available to provide additional information: <ul style="list-style-type: none"> • Add Quality Assurance Fields - Adds area fields to the Output table to facilitate quality assurance checking. • Retain Intermediate Layers Generated During Metric Calculation - Saves the intermediate table and/or raster that is normally deleted after processing is complete. 	Multiple Value

Credits

Shannon, C. E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, 27, 379-423.

Simpson, E. H. (1949). Measurement of diversity. *Nature*, 163, 688-688.

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent

min of inputs,

Land Cover on Slope Proportions

Summary

Calculates percentages of land cover types on slopes greater than a specified threshold value within reporting unit polygons and creates an output table.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- **NOTE:** To ensure desired results, the **Land cover grid** must be in a projected coordinate systems with linear units of measure.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If the extent of the **Reporting unit feature** is smaller than that of the **Land cover grid**, the user may wish to check the **Reduce land cover grid to smallest recommended size** option. This creates a temporary land cover raster with the processing extent equal to that of the **Reporting unit feature** to avoid unnecessary processing.
- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).

- In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
- **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- The **Slope grid** may contain slope values measured in either percent or degrees. Enter the **Slope threshold** value in the same units of measure as the **Slope grid** to analyze land cover proportions on slopes equal to or greater than the threshold value.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#), [Add Area Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Output field names are taken from the class element's lcspField attribute in the specified **Land cover classification file**. If the lcspField attribute is not provided, the following naming scheme applies (Refer to [Classes Element in ATtILA's LCC XML Document](#) for general information, or the individual **Land cover classification file** for details):
 - [class]SL[slope threshold] - The percent of the reporting unit occupied by the land cover class on slopes that are equal to or exceed the Slope threshold (e.g. "forSL9" is the name of the field for the metric representing the percent of NLCD "Forest" class on land at or above a threshold slope value of 9 within the reporting unit).
 - **NOTE:** The output field name for each class is shown as the second item next to the class's check box in **Report metrics for these classes**.
 - **NOTE:** Output field names can be altered by [editing](#) the **Land cover classification file**.

Syntax

```
LCOSP (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,  
Land_cover_classification_scheme, Land_cover_classification_file,  
Report_metrics_for_these_classes, Slope_grid, Slope_threshold, Output_table,  
{Processing_cell_size}, {Snap_raster}, Select_options,  
{Reduce_land_cover_grid_to_smallest_recommended_size})
```

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes to be summarized within each Reporting unit feature. The grid input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> • {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. • {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	String
Slope_grid	The raster dataset representing slope. The value units may be in either percent or degrees.	Raster layer
Slope_threshold	The slope value at or above which land cover proportion metrics are to be derived. Threshold value must be in the same units of measure as the Slope grid.	Double
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_cell_size (optional)	The Processing cell size for the zonal operation. The default Processing cell size is the cell size of the input raster land cover data. Optionally, the user may select a different cell size.	Analysis cell size

Credits

There are no credits for this item.

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Land Cover Proportions

Summary

Calculates percentages of selected land cover types within reporting unit polygons and creates an output table.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If a disparity exists between the extents of the **Reporting unit feature** and the **Land cover grid**, the user may wish to set the Extent in Environment Settings > Processing Extent to the smaller of the two to avoid unnecessary processing.
- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include

only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).

- In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
- **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#), [Add Area Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Output field names are taken from the class element's lcpField attribute in the specified **Land cover classification file**. If the lcpField attribute is not provided, the following naming scheme applies (Refer to [Classes Element](#) in [ATtILA's LCC XML Document](#) for general information, or the individual **Land cover classification file** for details):
 - 'p'+[class Id] - The percent of the non-excluded reporting unit occupied by the land cover class
 - **NOTE:** The output field name for each class is shown as the second item next to the class's check box in **Report metrics for these classes**.
 - **NOTE:** Output field names can be altered by [editing](#) the **Land cover classification file**.

Syntax

LCP (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,
Land_cover_classification_scheme, Land_cover_classification_file,
Report_metrics_for_these_classes, Output_table, {Processing_cell_size}, {Snap_raster},
Select_options)

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes to be summarized within each Reporting unit feature. The grid input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> • {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. • {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	String
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_cell_size (optional)	The Processing cell size for the zonal operation. The default Processing cell size is the cell size of the input raster land cover data. Optionally, the user may select a different cell size.	Analysis cell size
Snap_raster (optional)	The raster that the cell alignment of the Land cover grid and rasterized Reporting unit feature layer will be matched to during processing. The default Snap raster is the Land cover grid.	Raster Layer
Select_options	Three tool options are available to provide additional information: • Add Quality Assurance Fields - Adds area	Multiple Value

Credits

For additional information on the included classification schemes included in ATtILA for ArcGIS:

NLCD: <http://www.mrlc.gov/resources.php>

C-CAP: <http://www.csc.noaa.gov/digitalcoast/data/ccaphighres>

Corine: http://www.eea.europa.eu/publications/technical_report_2007_17

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Patch Metrics

Summary

Calculates the number of patches (NUM), largest patch size (LRG), average patch size (AVG), the number of patches per square kilometer (DENS), and proportion of largest patch area to total patch area (PLGP) within each reporting unit for selected land cover classes and creates an output table. Minimum patch size and maximum patch separation are provided by the user. Optionally, Mean Distance to Closest Patch (MDCP) within each reporting unit for selected land cover classes may also be calculated.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- **NOTE:** *This tool is resource-intensive in terms of both processing time and disk space. Processing time varies depending on the extent and resolution of the input Land cover grid, the number of reporting units, and the number of classes selected for processing. To minimize processing time, consider creating a new Reporting unit feature layer that does not include unwanted reporting units. Also select only the land cover classes in the Report metrics for these classes parameter that are important for analysis. This tool creates multiple interim rasters and other data layers during processing which may consume considerable disk space in the Scratch Workspace. If the Scratch Workspace resides on a disk with limited disk space, the tool may fail during processing. To prevent this, consider changing the Scratch Workspace in Environments > Workspace > Scratch Workspace to a location with sufficient available disk space, or free up disk space on the disk in which the current Scratch Workspace resides to accommodate the interim datasets.*
- **NOTE:** *To ensure desired results, the Land cover grid must be in a projected coordinate systems with linear units of measure.*
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output**

table.

- As the **Reporting unit feature** is a vector dataset, ArcGIS will perform a vector to raster conversion during processing.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If the extent of the **Reporting unit feature** is smaller than that of the **Land cover grid**, the user may wish to check the **Reduce land cover grid to smallest recommended size** option. This creates a temporary land cover raster with the processing extent equal to that of the **Reporting unit feature** to avoid unnecessary processing.
- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).
 - In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
 - **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- **Minimum patch size** sets the lower threshold of connected grid cells necessary to be considered a distinct patch. An eight-cell neighborhood is used to determine connectivity.
- The **Maximum separation** is the maximum distance in raster cells for disjunct patches to be considered continuous. The default is zero, requiring all cells in a patch to be continuous.
 - **NOTE:** Due to the nature of the algorithm, the number entered is half the amount used in processing. For example, entering a 1 will result in patches 2 cells apart to be considered continuous.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output**

- table** name. The output location must be a file geodatabase.
- When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
- When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Field names in the **Output table** follow this naming scheme:
 - For default tool settings (e.g. no optional settings selected):
 - [class]_PLGP - proportion of largest patch area to total patch area for the selected class within the reporting unit (e.g. "for_PLGP" is the name of the field for the proportion of largest forest patch area to all forest area within the reporting unit for the NLCD "Forest" class).
 - [class]_NUM - The number of distinct patches for the selected class within the reporting unit (e.g. "nat_NUM" is the name of the field for the patch number metric for the NLCD "All natural land use" class).
 - [class]_LRG - The size in squared map units of the largest class patch within the reporting unit (e.g. "agr_LRG" is the name of the field for the largest patch metric for the NLCD "All agriculture" class).
 - [class]_AVG - The average size in squared map units of all of the selected class patches within the reporting unit (e.g. "shb_AVG" is the name of the field for the average patch metric for the NLCD "Shrubland" class).
 - [class]_DENS - The density of the selected class patches within the reporting unit given as the number of patches per square kilometer (e.g. "wtl_DENS" is the name of the field for the patch density metric for the NLCD "All wetland" class).
 - **NOTE:** The output field name for each class is shown as the second item next to the class's check box in **Report metrics for these classes**.
 - **NOTE:** Only the [class]_PLGP field name is presented in the **Report metrics for these classes**.
 - **NOTE:** Output field names can be altered by [editing](#) the **Land cover classification file**.
 - When the **MDCP** option is selected:
 - [class]_MDCP - measures the shortest edge-to-edge distance between distinct patches and calculates the mean value in the reporting unit.
 - **NOTE:** The [class]_MDCP field will be populated with a value of -9999 when no

patches of [class] are located in the reporting unit.

Syntax

```
PM(Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,  
Land_cover_classification_scheme, Land_cover_classification_file,  
Report_metrics_for_these_classes, Minimum_Patch_Size, Maximum_Separation, Output_table,  
{MDCP}, {Processing_cell_size}, {Snap_raster}, Select_options,  
{Reduce_land_cover_grid_to_smallest_recommended_size})
```

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes upon which core and edge area metrics will be derived within each Reporting unit feature. The class input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	String
Minimum_patch_size	The minimum patch size, measured in number of grid cells, necessary to be considered a distinct patch. Connectivity is defined within the immediate eight-cell neighborhood. Cells of the same class to the right, left, above, below, or diagonal to each other are considered as part of the same patch. The input must be an integer value.	Long
Maximum_separation	The maximum distance separating non-adjoining cells before those cells are considered a distinct patch. The value entered is in number of cells. The processing cell size determines the actual linear distance. Non-adjoining cells are buffered by the maximum distance. If the buffers touch, the non-adjoining cells are considered to be one patch. The input must be an integer value.	Long

Credits

There are no credits for this item.

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs

Riparian Characteristics

Riparian zones, i.e., the areas adjacent to streams and associated waterbodies, provide critical habitat areas and play an important role in determining or preserving surface water quality. While all of the land area within a watershed may contribute pollutants via runoff, the effect of more distant (from stream) areas may be mitigated along the transport path. However, there is little or no mitigation of nutrient or soil runoff from stream side areas. Thus these buffer areas along streams may have a greater impact upon water quality. Conversely, conservation of riparian buffers may help to preserve good water quality.

The Riparian Characteristics toolset consists of three metrics. Two of the metrics in this toolset are directly related to riparian characteristics:

- **[Riparian Land Cover Proportions](#)** is similar to the Land Cover Proportions metric in the Landscape Characteristics toolset except that the results are calculated only for the buffer area around streams instead of over the whole reporting unit. Required inputs include a polygon reporting unit feature, a land cover grid, and one or more vector/polygon stream features. The width of the buffer is defined by the user; typical values include a distance equal to the land cover grid cell size (or a multiple thereof) or a value from a legal definition of riparian zone. A land cover classification scheme is also required; several popular classification schemes are supplied (see section Supplied Land Cover Classification Schemes) or, optionally, the user may define a custom classification scheme.
- **[Stream Density Metrics](#)** produces an output table, calculated as total stream length divided by total reporting unit area, with an option to calculate density separately by stream order. Required inputs are a polygon reporting unit feature and a vector stream feature.

The third metric contained in this toolset is not designed exclusively for riparian characteristics, but is included here as it uses the buffer concept employed in the Riparian Land Cover Proportions metric:

- **[Sample Point Land Cover Proportions](#)** produces an output table of the land cover proportions within a user-specified distance around a point or set of points. Required inputs include a polygon reporting unit feature, a land cover grid, and feature containing the point(s) of interest. Other required inputs include a buffer distance and a land cover classification scheme, as described above. One use of this metric is to determine the land cover proportions within the immediate area surrounding a sampling point. For example, using this metric on a set of water quality sampling station locations and a reporting unit consisting of the catchment areas to those sampling points will provide an output of land cover proportions within an upslope "wedge" of the sampling points; the downslope remainder of the buffer circle is eliminated because it falls outside the reporting unit.

Riparian Land Cover Proportions

Summary

Calculates the percentages of selected land cover types within the area adjacent to input features in each reporting unit and creates an output table. Input features may be lines or polygons. Adjacency is determined by a buffer distance specified by the user.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- This tool is designed to use a vector line or polygon dataset that represents streams, but any vector line or polygon dataset may be used. Caution should be exercised when interpreting results, particularly when using datasets that do not represent streams.
- **NOTE:** To ensure desired results, the **Reporting unit feature** and **Stream features** must be in projected coordinate systems with linear units of measure.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
 - **NOTE:** ArcGIS software has been improved over the years to analyze larger and larger datasets. However, limits do exist and large datasets can still cause problems. The Riparian Land Cover Proportions calculator can fail if an input **Reporting unit feature** contains a large number of reporting units and/or the reporting units cover a significantly large geographical area. Often this type of failure will manifest itself in a [Failed to execute \(Intersect\)](#) error. See [Failed to execute \(Intersect\)](#) for possible workarounds.
- The tool extracts the **Reporting unit feature** polygons that overlay the **Stream features** buffers using an Intersect and Query. This results in an intermediate polygon feature class containing multipart features of all buffer areas in each reporting unit. The tool then performs a vector to raster conversion of the multipart features to create zones for each reporting unit.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If a disparity exists between the extents of the **Reporting unit feature** and the **Land cover grid**, the user may wish to set the Extent in Environment Settings >

Processing Extent to the smaller of the two to avoid unnecessary processing.

- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in the metric calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).
 - In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
 - **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- **Stream features** may be one or more vector line or polygon datasets. The **Buffer distance** specifies the distance around the input features for which buffer zones are created.
 - When **Stream features** is a line dataset, the buffer occurs on both sides of each line.
 - When **Stream features** is a polygon dataset, the tool treats the polygon perimeters as lines. The buffer occurs on both sides of each polygon perimeter.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#), [Add Area Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.

- Output field names are taken from the class element's rlcpField attribute in the specified **Land cover classification file**. If the rlcpField attribute is not provided, the following naming scheme applies (Refer to [Classes Element](#) in [ATtILA's LCC XML Document](#) for general information, or the individual **Land cover classification file** for details):
 - r[class][buffer distance] - The percent of the total buffered area in the reporting unit occupied by the land cover class. For example, values in a field named "rfor100" would represent the percent of land occupied by the NLCD "Forest" class within all 100-meter buffers in the reporting unit.
 - **NOTE:** The output field name for each class is shown as the second item next to the class's check box in **Report metrics for these classes**.
 - **NOTE:** Output field names can be altered by [editing](#) the **Land cover classification file**.

Syntax

RLCP (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,
Land_cover_classification_scheme, Land_cover_classification_file,
Report_metrics_for_these_classes, Stream_features, Buffer_distance, Output_table,
{Processing_cell_size}, {Snap_raster}, Select_options)

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes to be summarized within each Reporting unit feature. The grid input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> • {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. • {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	Multiple Value
Stream_features	The vector line and/or polygon dataset(s) that provide the basis for the buffer zones. Land cover metrics are calculated for the area within the buffer zones.	Feature layer
Buffer_distance	The distance around the Stream features which comprises the buffer zones. The value must be an integer. If the distance linear units are not specified or are entered as Unknown, the linear unit of the input features' spatial reference is used.	Linear unit
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved within a file geodatabase.	Table
Processing_	The Processing cell size for the zonal operation.	Analy

Credits

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Sample Point Land Cover Proportions

Summary

Calculates the percentages of selected land cover types within the area adjacent to input point features in each reporting unit and creates an output table. Adjacency is determined by a buffer distance specified by the user.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- **NOTE:** To ensure desired results, the **Reporting unit feature** and **Sample point features** must be in projected coordinate systems with linear units of measure.
- The **Reporting unit feature** is a zone dataset.
 - A zone is defined as all areas in the input that have the same value. The areas do not have to be contiguous. The term "value" in this definition refers to the unique values in the **Reporting unit ID field**. Therefore, all polygons with the same reporting unit ID are treated as a single zone.
 - When more than one polygon has the same reporting unit ID, the areas for each polygon are combined and metrics are reported as a single record in the **Output table**.
- The tool extracts the **Reporting unit feature** polygons that overlay the **Sample point features** buffers using an Intersect and Query. This results in an intermediate polygon feature class containing multipart features of all buffer areas in each reporting unit. The tool then performs a vector to raster conversion of the multipart features to create zones for each reporting unit.
 - The **Reporting unit feature** must not contain overlapping polygons. When overlapping polygons exist, the vector to raster conversion assigns the value of the top-most polygon to any overlapping area, thereby erasing the areas of underlying zones and resulting in flawed metric calculations.
 - Use the [Identify Overlapping Polygons](#) utility to determine if overlapping polygons exist and parse the reporting unit feature layer into two or more feature classes or shapefiles in which no features overlap.
 - To better control the vector to raster conversion, the tool defaults the **Snap raster** and the **Processing cell size** to that of the **Land cover grid**. These may be changed from within the tool.
 - If a disparity exists between the extents of the **Reporting unit feature** and the **Land cover grid**, the user may wish to set the Extent in Environment Settings > Processing Extent to the smaller of the two to avoid unnecessary processing.

- The **Land cover classification scheme** must correspond to the **Land cover grid**.
 - Schemes for common land cover datasets are included with ATtILA for ArcGIS. Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in the metric calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded. More information about each of the classification schemes supplied with ATtILA for ArcGIS may be found in [Supplied Land Cover Classification Schemas](#).
 - In addition to the common land cover schemes, the tool permits a user-defined land cover classification scheme to be used by specifying a **Land cover classification file** (.xml). Refer to [Land Cover Classification](#) for more information.
 - **NOTE:** When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. For example, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit.
- **Sample point features** must contain an attribute that identifies the reporting unit in which each point lies. This attribute is entered in the **RU Link Field** parameter. If no such attribute exists in the **Sample point features** attribute table, it is recommended that the Identity tool be used. The Identity tool is located in the ArcToolbox under Analysis Tools > Overlay.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, it is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Add Quality Assurance Fields](#), [Add Area Fields](#) and/or [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When output is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Output field names are taken from the class element's splcpField attribute in the specified **Land cover classification file**. If the splcpField attribute is not provided, the following naming scheme applies (Refer to [Classes Element](#) in [ATtILA's LCC XML Document](#) for

general information, or the individual **Land cover classification file** for details):

- `s[class][buffer distance]` - The percent of the total buffered area in the reporting unit occupied by the land cover class. For example, values in a field named "sfor100" would represent the percent of land occupied by the NLCD "Forest" class within all 100-meter buffers in the reporting unit.
- **NOTE:** *The output field name for each class is shown as the second item next to the class's check box in Report metrics for these classes.*
- **NOTE:** *Output field names can be altered by [editing](#) the Land cover classification file.*

Syntax

`SPLCP (Reporting_unit_feature, Reporting_unit_ID_field, Land_cover_grid,
Land_cover_classification_scheme, Land_cover_classification_file,
Report_metrics_for_these_classes, Sample_point_features, RU_Link_Field, Buffer_distance,
Output_table, {Processing_cell_size}, {Snap_raster}, Select_options)`

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Land_cover_grid	The raster dataset representing land cover classes to be summarized within each Reporting unit feature. The grid input must be an integer raster layer.	Raster Layer
Land_cover_classification_scheme	The land cover classification schemes included in ATtILA and a User Defined option. The default schemes correspond to common input land cover datasets. Two schemes are supplied for each dataset included in ATtILA: <ul style="list-style-type: none"> • {DATASET NAME} ALL - includes all land cover types in the grid with no exclusions. • {DATASET NAME} LAND - excludes non-terrestrial land cover types. 	String
Land_cover_classification_file	The full pathname to the user-defined .xml file for custom or non-standard land cover classification schemes. Pathname is automatically filled when a default scheme is selected.	File
Report_metrics_for_these_classes	A list of the land cover classes and metric combinations for processing. Check the box to calculate metrics for each land cover class and/or combination class desired within the reporting units.	Multiple Value
Sample_point_features	The vector point dataset that provides the basis for the buffer zones. Land cover metrics are calculated for the area within the buffer zones.	Feature layer
RU_Link_Fld	The field in the Sample point features layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Buffer_distance	The distance around the Sample point features which comprises the buffer zones. The value must be an integer. If the distance linear units are not specified or are entered as Unknown, the linear unit of the input features' spatial reference is used.	Linear unit
Output_table	The output reporting unit metrics table to be created.	Table

Credits

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Stream Density Metrics

Summary

Calculates density metrics based on input vector line dataset(s) for each reporting unit polygon and creates an output table. Default metrics include area of the reporting unit (km^2), total length (km) and line density (km/km^2) within the reporting unit.

In addition to the default metrics, length and density metrics can be calculated by stream order. Stream order is designated based on values in a specified field in the Stream feature layer.

Usage

- This tool processes all polygons in the **Reporting unit feature** regardless of selections set. The ability to limit land cover calculations to only selected reporting unit polygons is not supported in this release.
- This tool is designed to use a vector line dataset that represent streams, but any vector line dataset may be used. Caution should be exercised when interpreting results, particularly when using line datasets that do not represent streams.
- **NOTE:** To ensure desired results, the **Reporting unit feature** and **Stream feature** must be in projected coordinate systems with linear units of measure.
- The **Reporting unit feature** must be a polygon feature class or shapefile.
- The optional **Stream order field** may be used to create density metrics for different classes of **Stream feature** lines. The **Stream order field** may be any field that differentiates classes of **Stream feature** lines and does not necessarily need to represent stream order.
- Values in the **Stream order field** have restrictions. They may not contain spaces or special characters such as hyphens, parentheses, brackets, and symbols such as #, \$, %, and &. Essentially, the values in this field are acceptable if they consist only of alphanumeric characters or an underscore. The values in these fields are used to create class-specific metric fields for the two metrics (aliases: STRMKM and STRMDENS) in the **Output table**. If any of the values in the **Stream order field** violate these character restrictions, consider using a different class field or creating a new one that corresponds to the restrictions.
- If a **Stream order field** is specified, the tool creates the new field names by appending the **Stream order field** characters to the metric field names. Since field name length is dependent on the output table type (i.e., dBase, INFO, or geodatabase) care should be used so that the length of the final output field name does not exceed the maximum allowable field name limit for the desired output table. When the limit is exceeded, the **Stream order field** characters may replace the characters at the end of these field names.
 - Example 1: The selected **Stream order field** uses an integer to designate the stream order, and contains only second- and third-order streams (field values "2" or "3"). When the tool is run, four output fields are created in the **Output table** which are named as follows (**Stream order field** characters underlined for emphasis):

- 2: STRM**KM2** (7 characters), STRMD**E**N**S2** (9 characters)
 - 3: STRM**KM3** (7 characters), STRMD**E**N**S3** (9 characters)
- Example 2: The selected **Stream order field** uses alphanumeric characters to designate stream feature types (field values "C6" or "F558"). When the tool is run, four output fields are created in the **Output table** which are named as follows (**Stream order field** characters underlined for emphasis):
 - C6: STRMK**M**C6 (10 characters), STRMD**E**NS**C**6 (10 characters)
 - F558: STRM**KM**F558 (10 characters), STRM**D**EF558 (10 characters)
- **NOTE:** If the **Stream order field** characters replace too many of the characters in the metric field names, duplicate field names will be created.

- **NOTE:** Do not use 'ORDER' as the **Stream order field** name as it is considered a reserved keyword in several database management systems, and its use may cause the Stream Density Metrics tool to fail.
- Final output is written to the location specified in the **Output table** parameter. The **Output table** may be saved as a File Geodatabase Table, a dBASE Table, or an INFO Table.
 - **NOTE:** For most consistent results, It is highly recommended that tool output be saved to a file geodatabase.
 - When saving as a File Geodatabase Table, no extension is necessary for the **Output table** name. The output location must be a file geodatabase.
 - When saving as a dBASE Table, include the .dbf extension in the **Output table** name. dBASE tables may not be saved in a file geodatabase.
 - When saving as an INFO Table, no extension is necessary for the **Output table** name. INFO tables may not be saved in a file geodatabase. A new directory in the output directory called "info" is automatically created in which the INFO tables are stored. INFO tables have limited portability, so it is recommended that output not be saved as an INFO Table if data sharing is important.
- The user may elect to [Retain Intermediate Layers Generated During Metric Processing](#).
 - Choosing to Retain Intermediate Layers saves the intermediate products to one of the following locations:
 - When output is saved as a File Geodatabase Table, intermediate products are placed in the same file geodatabase.
 - When ouput is saved as a dBASE Table or an INFO Table, a file geodatabase named "attilaScratchWorkspace" is automatically generated in the same output location specified for the **Output table**. Intermediate products are placed in the attilaScratchWorkspace file geodatabase.
- Field names in the **Output table** follow this naming scheme:
 - For default tool settings (e.g. no optional settings selected):
 - AREAKM2 - The area of the reporting unit in km².
 - STRM**KM** - The total length of **Stream feature** lines in km within the reporting unit.
 - STRMD**E**N**S** - The density of **Stream feature** lines in km/km² within the reporting unit.
 - When the option to report metrics by **Stream order field** is selected, separate fields are generated for each metric/class combination. For example, if the **Stream order**

field contains five classes of streams, then five STRMDENS metrics will appear in the **Output table**--one for each stream class. Each of these fields appears in the **Output table** by the field aliases listed below. To view the field names with the appended classes rather than the aliases, open the table, select the Table Options dropdown, and uncheck Show Field Aliases:

- STRMKM - The total length of **Stream feature** lines for each class in the **Stream order field** within the reporting unit.
- STRMDENS - The density of **Stream feature** lines for each class in the **Stream order field** within the reporting unit.

Syntax

SDM (Reporting_unit_feature, Reporting_unit_ID_field, Stream_feature, Output_table, {Stream_order_field}, {Select_options})

Parameter	Explanation	Data Type
Reporting_unit_feature	The vector polygon dataset that defines the reporting units.	Feature Layer
Reporting_unit_ID_field	The field in the Reporting unit feature layer that contains the unique ID for each reporting unit. It may be an integer or a string data type.	Field
Stream_feature	The vector line dataset representing streams.	Feature Layer
Output_table	The output reporting unit metrics table to be created. It is recommended that the Output table be saved either within a file geodatabase, or in a folder as a dBASE file with a .dbf extension.	Table
Stream_order_field (Optional)	The field in the Stream feature layer that contains the stream order for each feature. It may be an integer or a string data type. The values in this field must not contain spaces or special characters. As order code values are appended to output field names, care should be taken not to exceed the limit for field name size set by output table type.	Field
Select_options (Optional)	One tool option is available to provide additional information: <ul style="list-style-type: none"> • Retain Intermediate Layers Generated During Metric Calculation - Saves the intermediate table and/or raster that is normally deleted after processing is complete. 	Multiple Value

Credits

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs,

Land Cover Classification

Many ATtILA for ArcGIS tools require a Land Cover Classification (LCC) file as one of the input parameters. The LCC file dictates how the tools process the input Land cover grid based on properties of each land cover class. These properties are set within the LCC file:

- Defines the text description of land cover classes based on the raster integer value.
- Determines the inclusion or exclusion of specific land cover classes in metric calculations (e.g. limiting calculations to only terrestrial land cover types via the exclusion of water and ice/snow classes).
- Allows for the grouping of classes (e.g. deciduous, coniferous, and mixed forest classes may be grouped into a single "forest" class).
- Allows for the assignment of coefficients associated with specific land cover classes to calculate coefficient-based metrics (e.g. impervious percent, nitrogen loading, and phosphorous loading).

LCC files utilize XML formatting to define these properties for an associated Land cover grid. ATtILA for ArcGIS includes LCC files for some commonly-used Land cover datasets including the National Land Cover Database (NLCD) and the Coast Change Analysis Program (C-CAP). Descriptions of the LCC files that accompany ATtILA for ArcGIS are available in the [Supplied Land Cover Classification Schemas](#) section of this document. Details on the structure of the XML schema and its mandatory and optional elements may be found in [ATtILA's LCC XML Document](#).

LCC files may be created or edited to allow users to customize the properties of the land cover classes to meet their objectives. As XML files, LCC files may be edited using any standard text editing program. However, it is recommended that LCC file editing be performed using the LCC Editor that accompanies ATtILA for ArcGIS. See [Create or Modify Land Cover Classification](#) for more information on this tool. No previous experience editing XML files is necessary to edit the XML using the LCC Editor, which provides an easy-to-use interface.

NOTE: *It is recommended that the LCC file contain entries for all values in the input Land cover grid. However, if the LCC file does not define properties for a Land cover grid value, ATtILA for ArcGIS will alert the user by providing a warning message indicating that a value occurring in the Land cover grid was not defined in the LCC file.*

ATtILA's LCC XML Document

ATtILA for ArcGIS LCC XML Document

ATtILA for ArcGIS Land Cover Classification (LCC) schema documents require a precise XML

structure that consists of the following:

- [XML declaration statement](#)
- [Root element \(lccSchema\)](#)
- [Metadata element](#)
- [Coefficients element](#)
- [Values element](#)
- [Classes element](#)
- [Comments](#)

Detailed descriptions, applications, and possible restrictions for each element are provided their respective sections in this document.

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation="<!--
<metadata>
    <name></name>
    <description></description>
</metadata>
<coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
</coefficients>
<values>
    <value Id="" Name="" excluded="">
        <coefficient Id="" value="" />
    </value>
</values>
<classes>
    <class Id="" Name="" filter="">
        <value Id="" />
    </class>
</classes>
</lccSchema>
```

Basic structure of ATtILA's Land Cover Classification schema XML document.

It is recommended that users create or edit LCC schema XML documents using the [External LCC Editor](#) that accompanies ATtILA for ArcGIS to reduce the possibility of introducing errors. However, LCC XML documents may also be created or edited using any standard text editor and the syntax guidelines provided in each section.

Regardless of how a user chooses to create their LCC XML documents, it is strongly recommended that they first become acquainted with the details on LCC XML formatting that are provided in this section. This will give the user a better understanding of how ATtILA for ArcGIS interacts with the land cover grid and will provide a background for understanding how ATtILA for ArcGIS may be customized for user-specific needs.

XML Fundamentals, Well-Formed Document

An XML document is composed of text content marked up with tags describing the data. These tags look similar to HTML mark-up tags, but unlike HTML, the tags are customized to define what an item is (i.e., a book, a person, a telephone number, etc.) and particular attributes of each defined item (i.e. the book's title, a person's first and last name, whether the telephone number is

for a home, business, or mobile device, etc.). In order for an application to correctly parse an XML document into its various pieces, the XML document must be "well-formed"; in other words, it must follow certain rules.

When using the [External LCC Editor](#) in ATtILA for ArcGIS to modify or create an LCC XML document, the resulting output document will be well-formed with regard to the ATtILA for ArcGIS application. When editing the LCC XML document with a text editor, these general XML rules must be observed:

- Each start-tag must have a matching end-tag. The end-tag can be either a non-empty element, (e.g. "<tag> </tag>"), or an empty element (e.g. "<tag />").
- Attribute values must be quoted.
- Attribute names must be unique, and XML is case-sensitive: "**name**" is different from "**Name**" which is different from "**NAME**".
- Comments and processing commands cannot appear inside tags.

When editing an LCC XML document with a text editor, it is important to check the document for formatting errors and, more importantly, for any violations to the rules and restrictions ATtILA for ArcGIS places on document elements and attributes. The [XML Validation](#) section of this document provides instructions for performing these checks.

The [Supplied Land Cover Classification Schemas](#) that accompany ATtILA for ArcGIS may be useful to review while reading through the following sections. What may initially appear to be complex, hard to decipher documents will become easier to interpret with the background information provided herein.

LCC XML Document Storage

The [Supplied Land Cover Classification Schemas](#) that accompany ATtILA for ArcGIS are stored in the ToolboxSource > LandCoverClassifications folder in the ATtILA for ArcGIS toolbox destination folder (see [Installing ATtILA](#)). LCC XML documents stored here automatically populate the "Land cover classification scheme" dropdown in each ATtILA tool that requires a land cover classification file ([Core and Edge Metrics](#), [Land Cover on Slopes Proportions](#), [Land Cover Proportions](#), [Riparian Land Cover Proportions](#), and [Sample Point Land Cover Proportions](#)).

Customized LCC XML documents can exist anywhere on a local or network computer. Each tool that requires an LCC XML document includes a parameter for navigating to the local or network path at which the XML file is stored. However, users may find it more convenient to access their customized LCC XML documents from the "Land cover classification scheme" dropdown in the ATtILA tools, particularly for frequently-used customized LCC XML documents. To facilitate this, store the customized XML files in the ToolboxSource > LandCoverClassifications folder as indicated above.

XML Declaration

XML Declaration

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation=>
    <metadata>
        <name></name>
```

```

<description></description>
</metadata>
<coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
</coefficients>
<values>
    <value Id="" Name="" excluded="">
        <coefficient Id="" value="" />
    </value>
</values>
<classes>
    <class Id="" Name="" filter="">
        <value Id="" />
    </class>
</classes>
</lccSchema>

```

Basic structure of ATtILA's Land Cover Classification schema XML document with the XML declaration statement highlighted.

The first line of the LCC XML document is an XML declaration statement. It is not required, but if it is included, it must be the first line of the document. No other character or blank space can precede the declaration statement. The declaration statement allows an XML parser to obtain a basic understanding about how the text document is encoded.

Root Element: lccSchema

Root Element: lccSchema

```

<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation=">
<metadata>
    <name></name>
    <description></description>
</metadata>
<coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
</coefficients>
<values>
    <value Id="" Name="" excluded="">
        <coefficient Id="" value="" />
    </value>
</values>
<classes>
    <class Id="" Name="" filter="">
        <value Id="" />
    </class>
</classes>
</lccSchema>

```

Basic structure of ATtILA's Land Cover Classification schema XML document with the lccSchema root element highlighted.

The `<lccSchema>` tag is the root element of the LCC XML document. All other elements in the LCC XML document are contained within this element. XML documents are limited to one root element.

The XML root element can also contain information specific to the location and name of an XML Schema Document (XSD). The XSD document is used for validating the form and contents of the XML file. Information about the XSD document is optional.

The XSD information, if included, appears in the following form:

```
<root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation="XSD_
```

where XSD_FILE_PATH is the relative or absolute path of the XML schema file. When the XML file is located in the same folder as the designated XSD file, the XSD_FILE_PATH is simply the name of the XSD file.

The XSD file prepared for validating ATtILA's XML documents is named LCCSchema.xsd. It is located in the ToolboxSource > LandCoverClassifications folder in the ATtILA for ArcGIS toolbox destination folder ([see Installing ATtILA](#)).

You can include the following line as your root element if you place your custom XML document in the same folder as the XSD file:

```
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation=
```

Metadata Element

Metadata Element

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation="XSD_>
    <metadata>
        <name></name>
        <description></description>
    </metadata>
    <coefficients>
        <coefficient Id="" Name="" fieldName="" method="" />
    </coefficients>
    <values>
        <value Id="" Name="" excluded="">
            <coefficient Id="" value="" />
        </value>
    </values>
    <classes>
        <class Id="" Name="" filter="">
            <value Id="" />
        </class>
    </classes>
</lccSchema>
```

Basic structure of ATtILA's Land Cover Classification schema XML document with the Metadata element highlighted.

The Metadata element contains the name of the coding schema along with a brief description.

ATtILA for ArcGIS requires the Metadata element to be present when it parses the XML document, and it cannot be empty. The Metadata element must contain the following two elements:

- **name** - text, land cover coding schema name
- **description** - text, description of land cover coding schema

Example Metadata element:

```
<metadata>
  <name>NLCD 2001</name>
  <description>National Land Cover Database 2001</description>
</metadata>
```

The information contained in the Metadata element is for informational purposes only. It is displayed in the [External LCC Editor](#)'s Metadata window, and only there. The entries for the name and description attributes can be as long or as short as the user desires.

XML Note

XML is case-sensitive and care should be used when editing the LCC XML documents using a text editor. Wherever possible, element and attribute names for the document have been defined using lowercase characters. The only current exceptions are the attributes "**Id**" and "**Name**" in the Coefficients, Values, and Classes elements. If editing an LCC XML document outside of the [External LCC Editor](#), these attributes should be capitalized wherever they appear.

You may notice that in the Metadata element, the `<name>` element is lowercase. The distinction here is that "name" in the Metadata element pertains to an *element*, and that the capitalization rule only applies to an element's *attributes*.

Coefficients Element

Coefficients Element

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation=">
  <metadata>
    <name></name>
    <description></description>
  </metadata>
  <coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
  </coefficients>
  <values>
    <value Id="" Name="" excluded="">
      <coefficient Id="" value="" />
    </value>
  </values>
  <classes>
    <class Id="" Name="" filter="">
```

```

<value Id="" />
</class>
</classes>
</lccSchema>

```

Basic structure of ATtILA's Land Cover Classification schema XML document with the Coefficients element highlighted.

The Coefficients element is used to identify and to parameterize the coefficient-based metrics available in the [Land Cover Coefficient Calculator](#) tool. This element is required by ATtILA for ArcGIS to parse the LCC XML document, but it can be empty (i.e., it does not have to contain any <coefficient> elements).

NOTE: If no <coefficient> element is in the XML document when the user attempts to use the [Land Cover Coefficient Calculator](#) tool, the tool dialog will not populate the "Report metrics for these coefficients" input box when a "Land cover classification scheme" is selected. Despite the missing information, the user is still able to click the OK button to begin the calculation run, but the run will result in an error.

If any <coefficient> element is provided, it needs to contain the following attributes:

- **Id** - text, unique identifier
- **Name** - text, description of coefficient metric
- **fieldName** - text, name of field to be created for output
- **method** - text, either "P" or "A"

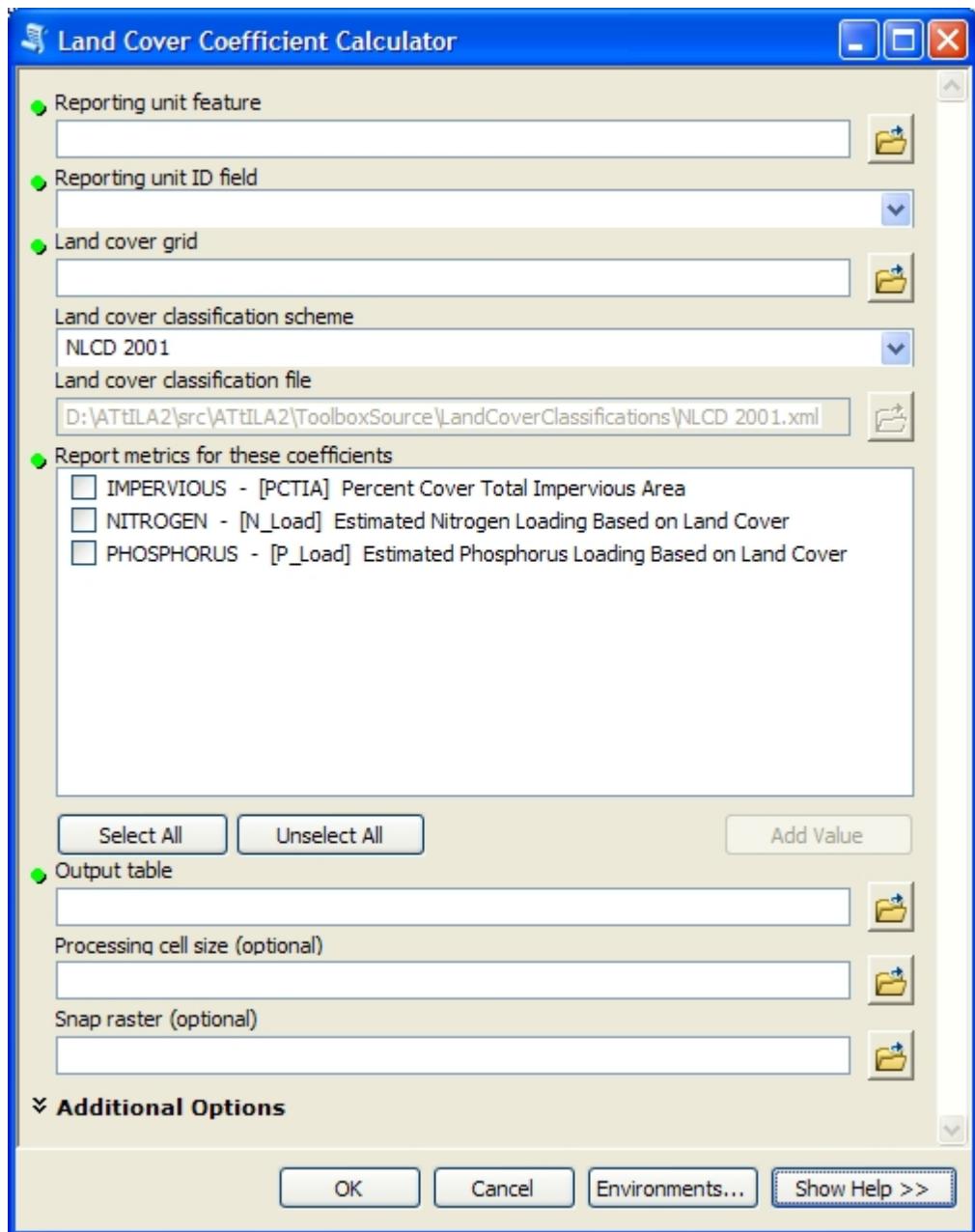
Example Coefficients element with three <coefficient> elements:

```

<coefficients>
  <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious Area" fieldName="PCTIA" method="P" />
  <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on Land Cover" fieldName="N_Load" method="P" />
  <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based on Land Cover" fieldName="P_Load" method="P" />
</coefficients>

```

Each coefficient represented by a <coefficient> element in the LCC XML document appears in the "Report metrics for these coefficients" parameter in the [Land Cover Coefficient Calculator](#) tool dialog and is individually selectable (see below). The element's attributes are listed next to the check box as follows: **Id - [fieldName] Name**



Id Attribute

Id is a text string of any length that supplies the short name for a coefficient. In this version of ATtILA for ArcGIS, the text string is restricted to 'NITROGEN', 'PHOSPHORUS', or 'IMPERVIOUS'. In a future release, the user will be able to use any string for the **Id** attribute. See the **method** attribute discussion below for more details.

Name Attribute

Name is a text string of any length used to supply a more detailed description of the coefficient and/or provide additional details regarding the metrics that result from tool calculations using the coefficient. It can also be an empty string (e.g., Name="").

fieldName Attribute

fieldName is a text string used to customize the name of the coefficient in the output table field.

The length of the text string is dependent on the output table type selected in the [Land Cover Coefficient Calculator](#) tool as follows:

- dBase table - field names are restricted to 10 characters in length.
- INFO table - field names are restricted to 16 characters in length.
- geodatabase table - field names are restricted to 64 characters in length.

ATtILA for ArcGIS will truncate field names that are longer than those allowed, and check to see if the truncated field name is already in the output table. If the truncated field name already exists, the text string is truncated further to allow a numerical value to be appended to the field name to create a unique field name. When this occurs, a warning message is added to the Geoprocessing > Results window informing the user of the changes to the fieldName's text string in the output table.

In addition to size limitations, the **fieldName** attribute string must conform to the field naming conventions dictated by the different database systems (dBASE, INFO, or geodatabase). In general, try to restrict field names to just alphanumeric characters and underscores. Use of spaces and special characters should be avoided, as well as beginning a field name with a number or an underscore. Also, avoid using field names that contain words that are considered reserved keywords, such as date, day, month, order, table, text, user, when, where, year, and zone. For more guidelines on the naming of fields, search on "Fundamentals of adding and deleting fields" in the ArcGIS help documentation.

method Attribute

CAUTION: In this version of ATtILA for ArcGIS, the **method** attribute is dummy attribute, and exists only as a placeholder.

In future releases, the **method** attribute will be used to pass an appropriate calculation routine for the coefficient to the [Land Cover Coefficient Calculator](#) tool. When implemented, the method element will be restricted to two choices:

- "A" - the tool will use a "Per Unit Area" calculation routine to calculate metrics associated with the coefficient.
- "P" - the tool will use a "Percent Area" calculation routine to calculate metrics associated with the coefficient.

More information on the different calculation routines can be found on the [Land Cover Coefficient Calculator](#) page.

XML Note

XML is case-sensitive and care should be used when editing the LCC XML documents using a text editor. Wherever possible, element and attribute names for the document have been defined using lowercase characters. The only current exceptions are the attributes "**Id**" and "**Name**" in the Coefficients, Values, and Classes elements. If editing an LCC XML document outside of the [External LCC Editor](#), these attributes should be capitalized wherever they appear.

You may notice that in the Metadata element, the `<name>` element is lowercase. The distinction

here is that "name" in the `Metadata` element pertains to an *element*, and that the capitalization rule only applies to an element's *attributes*.

Values Element

Values Element

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation="lcc.xsd">
  <metadata>
    <name></name>
    <description></description>
  </metadata>
  <coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
  </coefficients>
  <values>
    <value Id="" Name="" excluded="">
      <coefficient Id="" value="" />
    </value>
  </values>
  <classes>
    <class Id="" Name="" filter="">
      <value Id="" />
    </class>
  </classes>
</lccSchema>
```

Basic structure of ATtILA's Land Cover Classification schema XML document with the Values element highlighted.

The `Values` element defines the set of values that can exist in a land cover raster. This element is required by ATtILA for ArcGIS to parse the XML document, but it can be empty (i.e., it does not have to contain any `<value>` elements). Value elements are only necessary in two cases:

1. if the user wants to exclude the area occupied by a given grid value when determining a reporting unit's effective area (e.g., basing metric calculations on the land area in a reporting unit vs. the total area of the reporting unit), or
2. if the user is planning to calculate any metrics with the [Land Cover Coefficient Calculator](#). In this case `<value>` elements should be added where coefficient weights are known (e.g., the nitrogen loading coefficient for a particular agriculture type).

NOTE: Although values are not necessary in the XML document, if one is using the LCC Editor to construct an LCC XML document, you will be required to have value elements defined in order to assign values to a `class` element (see *Classes Element*).

If any `<value>` element is provided, it must have the **Id** attribute. The attributes, **Name** and **excluded**, are allowed, but are not necessary. Properties for the `<value>` element attributes are:

- **Id** - integer

- **Name** - text (optional, can be the empty string, "")
- **excluded** - boolean (optional, "true" or "false" or "1" or "0")

Example Values element with two <value> elements:

```
<values>
  <value Id="11" Name="Open Water" excluded="true" />
  <value Id="41" Name="Deciduous Forest" />
</values>
```

[Id Attribute](#)

Id is an integer value representing a grid code that may be found in a land cover raster. Values included in the LCC XML document can span the range of expected values of a particular land cover dataset (e.g., NLCD, CCAP, GAP), but all of the values provided in the document do not have to exist in the actual land cover layer. This is often the case when a national-level land cover coding schema is selected by the user, but the input land cover raster has been clipped to a regional study area.

A potentially more important issue is when all the values located in a land cover raster are not accounted for in the LCC XML document. ATtILA for ArcGIS will examine all of the values provided in the LCC XML document from both the Values section of the document and those provided in the [Classes Element](#) section and compare them to those found in the land cover raster. Any values in the grid not found in the LCC XML document will be reported to the user with a warning message in the Geoprocessing > Results window. The user can then determine if the reported values were accidentally omitted from the LCC XML document or incorrectly recorded. A report of missing values may also indicate that the wrong LCC Schema was selected for the input raster layer, or that the wrong raster layer was input for the selected LCC Schema.

[Name Attribute \(optional\)](#)

Name is a text string of any length used to supply a more detailed description of the grid code and/or provide other useful information regarding the value. The **Name** attribute may be an empty string (e.g., Name="").

[excluded Attribute \(optional\)](#)

The attribute, **excluded**, is used to identify grid codes whose area is to be excluded from the reporting unit's effective area calculation. Effective area can be thought of as the area of interest within a reporting unit that the user wishes to use for percentage based metric calculations. For example, the user may be interested in basing their metric calculations on just the land area in a reporting unit versus the overall total area of the reporting unit. To make the effective area equal to that of the land area, the user would set the **excluded** attribute of any water related grid value to "true".

The default setting for the **excluded** attribute is excluded="false" (i.e., if no **excluded** attribute is provided in the <value> element, the area associated with that grid value is not excluded from the reporting unit's effective area calculation). When all **excluded** attributes are tagged as 'false', the effective area is equal to the total overall area of the reporting unit.

CAUTION: any value tagged as **excluded = "true"**, should not be used in any `<class>` element definition within the LCC XML document. The `<class>` element is discussed in the [Classes Element](#) section.

Coefficient Elements within Value Elements

A Value element can also contain one or more Coefficient elements. These Coefficient elements are optional unless the user is planning on generating metrics using the [Land Cover Coefficient Calculator](#) tool. See the caution note below for more specifics on when `<coefficient>` elements must be supplied. If any `<coefficient>` element is provided, it needs to contain the following attributes:

- **Id** - text (Either 'NITROGEN', 'PHOSPHORUS', or 'IMPERVIOUS').
- **value** - decimal

Example Values element with one `<value>` element with two `<coefficient>` elements:

```
<coefficients>
  <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on Land Cover" apField="A" fieldName="NITROGEN">
    <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based on Land Cover" apField="" fieldName="PHOSPHORUS">
  </coefficients>

  <values>
    <value Id="41" Name="Deciduous Forest">
      <coefficient Id="NITROGEN" value="2.447" />
      <coefficient Id="PHOSPHORUS" value="0.089" />
    </value>
  </values>
```

Coefficient Element - Id Attribute

Id is a text string used to reference a `<coefficient>` element within the LCC XML document's [Coefficients Element](#) section. This text string needs to match the **Id** attribute for that `<coefficient>` element exactly. At present, the text string for this attribute is restricted to equal either 'NITROGEN', 'PHOSPHORUS', or 'IMPERVIOUS'. In future releases of ATtILA for ArcGIS, we plan to allow the user to use any string for the this element's **Id** attribute as long as it matches an **Id** attribute found in a corresponding `<coefficient>` element. See the discussion on the attribute, **method**, in [Coefficients Element](#) for more details on this.

Coefficient Element - value Attribute

The attribute **value** is a decimal number representing the coefficient weighting factor assigned to a land cover/land use type. Values for NITROGEN and PHOSPHOROUS should be given in kg per hectare per year. Values for IMPERVIOUS should represent percentages.

CAUTION: For any coefficient-based metric the user selects to calculate when running the [Land Cover Coefficient Calculator](#) tool, that coefficient `<element>` must be present in all of the `<value>` elements provided in the `<values>` element. Not all values in the input land cover raster need to be accounted for in the LCC XML document when using the [Land Cover Coefficient Calculator](#) tool, but if a value is included, its `<value>` element must contain the corresponding `<coefficient>` element for the desired metric.

XML Note

XML is case-sensitive and care should be used when editing the LCC XML documents using a text editor. Wherever possible, element and attribute names for the document have been defined using lowercase characters. The only current exceptions are the attributes "**Id**" and "**Name**" in the Coefficients, Values, and Classes elements. If editing an LCC XML document outside of the [External LCC Editor](#), these attributes should be capitalized wherever they appear.

You may notice that in the Metadata element, the `<name>` element is lowercase. The distinction here is that "name" in the Metadata element pertains to an *element*, and that the capitalization rule only applies to an element's *attributes*.

Classes Element

Classes Element

```
<?xml version='1.0' encoding='utf-8'?>
<lccSchema xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="lcc" xsi:noNamespaceSchemaLocation=">
  <metadata>
    <name></name>
    <description></description>
  </metadata>
  <coefficients>
    <coefficient Id="" Name="" fieldName="" method="" />
  </coefficients>
  <values>
    <value Id="" Name="" excluded="">
      <coefficient Id="" value="" />
    </value>
  </values>
  <classes>
    <class Id="" Name="" filter="">
      <value Id="" />
    </class>
  </classes>
</lccSchema>
```

Basic structure of ATtILA's Land Cover Classification schema XML document with the Classes element highlighted.

The `<classes>` element contains values from a land cover raster grouped into one or more `<class>` elements. The `<classes>` element is required by ATtILA for ArcGIS to parse the XML document, and it must contain at least one `<class>` element. Any provided `<class>` element needs to contain an **Id** attribute. The attributes, **Name**, **filter**, and **xxxxField** (where **xxxx** equals a tool name abbreviation), are allowed, but are not necessary. Properties for the `<class>` element attributes are:

- **Id** - text, unique identifier
- **Name** - text (optional, can be the empty string, "")
- **filter** - text, a string of one or more tool name abbreviations ([caem](#), [lcosp](#), [lcp](#), [pm](#), [rlcp](#), or [splcp](#)) separated by a ";" (optional, can be the empty string, "")

- **xxxxField** - text, where xxxx equals a tool name abbreviation ([lcosp](#), [lcp](#), [rlcp](#), or [splcp](#)). A separate xxxxField attribute can exist for each tool (optional, can be the empty string, "")

A <class> element can contain either <value> elements or additional <class> elements but not both types. A <class> element contained within another <class> element is known as a child class. The containing <class> element is the parent class. A <value> element within a <class> element has only one attribute:

- **Id** - integer, corresponds to a land cover/land use grid value

Example Classes element with one <class> element:

```
<classes>
  <class Id="nat" Name="All natural land use" filter="" lcpField="NINDEX">
    <value Id="41" />
    <value Id="42" />
    <value Id="43" />
    <value Id="51" />
    <value Id="52" />
  </class>
</classes>
```

Example Classes element with one parent <class> element and two child classes:

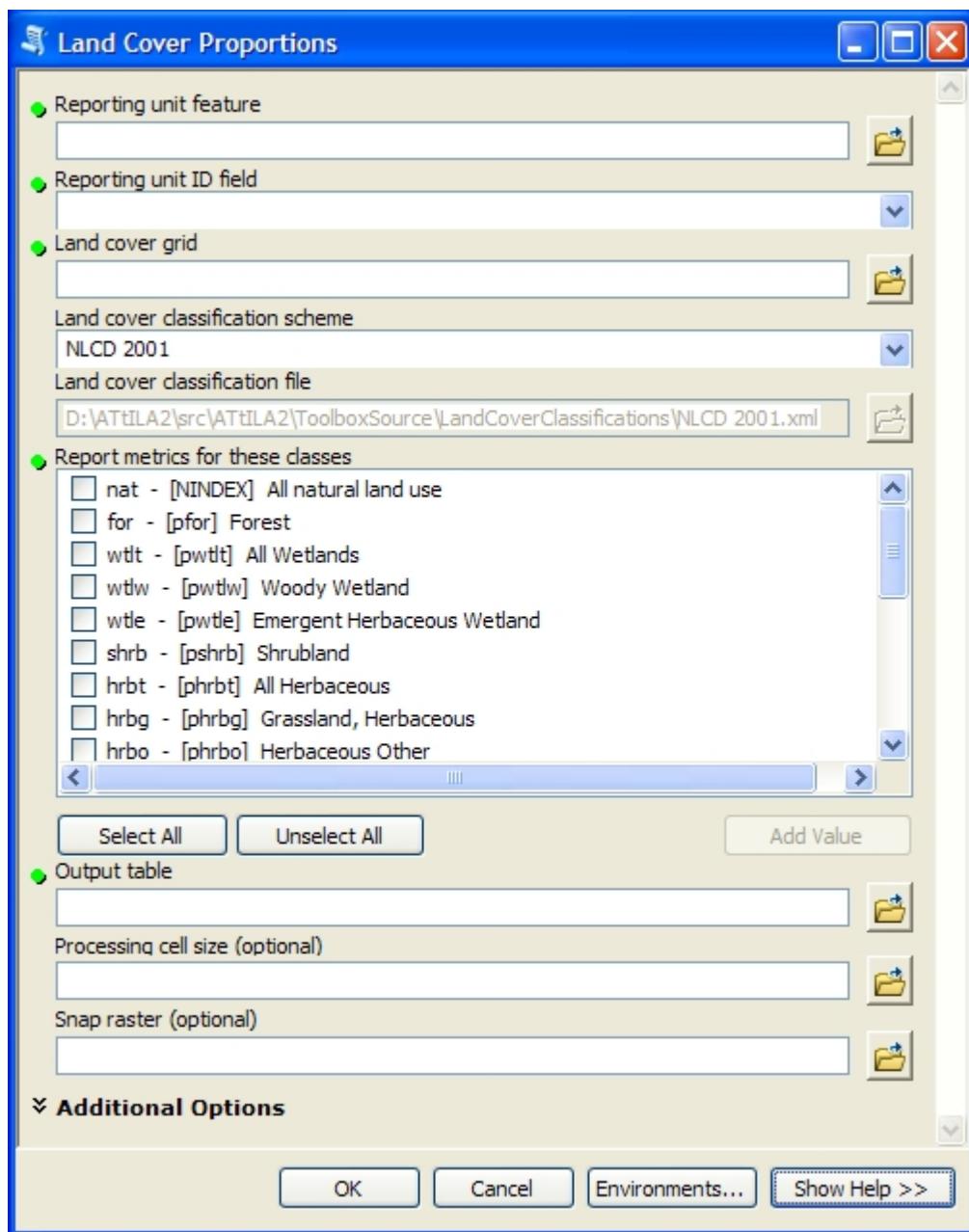
```
<classes>
  <class Id="nat" Name="All natural land use" lcpField="NINDEX">
    <class Id="for" Name="Forest">
      <value Id="41" />
      <value Id="42" />
      <value Id="43" />
    </class>
    <class Id="shrb" Name="Shrubland">
      <value Id="51" />
      <value Id="52" />
    </class>
  </class>
</classes>
```

NOTE: When a <class> element (parent class) has additional <class> elements nested within it (child classes), the <value> elements from all child classes are combined to define the parent class. For example, if a class, "nat", contains two classes, "for" and "shrb", and "for" is comprised of values 41, 42, and 43 and "shrb" is defined as values 51 and 52, "nat" would be defined as having values 41, 42, 43, 51, and 52.

NOTE: Empty <class> elements are ignored by ATtILA for ArcGIS.

NOTE: if a value is marked as excluded = "true" in the [Values Element](#) section, but is included in a class definition, ATtILA for ArcGIS will ignore the area of that excluded value when summing up the area of the selected class for metric calculations. If all values assigned to the class are tagged as excluded, the output metric is calculated as 0%.

Each <class> element in the LCC XML document will appear as a selectable metric in the "Report metrics for these classes" input parameter area for tools that utilize the LCC XML document (i.e., [caem](#), [lcosp](#), [lcp](#), [pm](#), [rlcp](#), and [splcp](#)). An example for [lcp](#) is shown below using the supplied land cover classification schema for the [NLCD 2001 dataset](#).



In the above example, the <class> element's attributes are listed next to its check box in the following order and format:

- **Id - [xxxxField or auto-generated field name] Name**

Id Attribute

Id is a text string used to identify the defined set of raster grid values as a group (i.e., class) for analysis. In addition, the class **Id** attribute is used as a base to auto-generate output metric field

names when no **xxxxField** class attribute is provided (see below) or if the **xxxxField** attribute is an empty string. Each ATtILA for ArcGIS tool has a predefined prefix and/or suffix which it will use in conjunction with the **Id** attribute string to auto-generate field names. See the help section for each individual tool ([caem](#), [lcosp](#), [lcp](#), [pm](#), [rlcp](#), and [splcp](#)) to learn more.

xxxxField Attribute (optional)

The attribute, **xxxxField**, where xxxx equals a tool name abbreviation, is a text string used as the default output field name. Only the tools [lcosp](#), [lcp](#), [rlcp](#), and [splcp](#) can make use of the **xxxxField** attribute. If no **xxxxField** attribute is provided or if the **xxxxField** attribute contains an empty string, ATtILA for ArcGIS will auto-generate an output field name using the class **Id** attribute as a base (see above). A separate **xxxxField** attribute can exist in the **<class>** element for each applicable tool (e.g., `<class Id="nat" Name="All natural land use" filter="" lcpField="NINDEX" rlcpField="RNatural">`).

CAUTION: The **Id** attribute, if used for output field naming, or the **xxxxField** attribute, if provided, must be unique among the different **<class>** elements or identical field names can be generated between classes. If duplicate field names are present, only one is added to the output table. During metric runs, all previous values calculated for that field will be overwritten by the last metric processed with the duplicate field name.

CAUTION: Field name size is limited by the Output table type: dBASE table field names can be 10 characters in length, INFO table field names can be 16 characters in length, and File Geodatabase table field names can be 64 characters in length.

- For **xxxxField** attribute strings: ATtILA for ArcGIS will truncate strings that are longer than those allowed, and check to see if the truncated field name is already in the output table. If the truncated field name already exists, the text string will be truncated further to allow a numerical value to be appended to the field name to create a unique entity. A warning message will then be added to the Geoprocessing > Results window informing the user of what the provided **xxxxField** attribute text string was changed to for the output table.
- For auto-generated field names: If the auto-generated field name is longer than what is allowed, ATtILA for ArcGIS will truncate the field name base (i.e., the class **Id** attribute string), keeping the metric's predefined prefix and/or suffix intact, to shorten the field name. If the truncated field name already exists in the output table, the base string will be truncated further to allow a numerical value to be appended to it to create a unique entity. A warning message will then be added to the Geoprocessing > Results window informing the user of what the auto-generated field name was changed to before adding it to the output table.

CAUTION: In addition to size limitations, the **Id** attribute, if used for output field naming, or the **xxxxField** attribute, if provided, must conform to the field naming conventions dictated by the different database systems (dBASE, INFO, or geodatabase). In general, try to restrict field names to just alphanumeric characters and underscores. Use of spaces and special characters should be avoided, as well as beginning a field name with a number or an underscore. Also, avoid using field names that contain words that are considered reserved keywords, such as date, day, month, order, table, text, user, when, where, year, and zone. For more guidelines on the naming of fields, search on "Fundamentals of adding and deleting fields" in the ArcGIS help documentation.

CAUTION: If an invalid field name is provided in the **xxxxField** attribute, such as a string of

spaces, the metric run will fail during execution, and an "Invalid field name" error message will appear in the Geoprocessing > Results window.

Name Attribute (optional)

Name, is a text string of any length used to supply a more detailed description of the class and/or provide other useful information regarding it. The **Name** attribute may be an empty string (e.g., Name=""). The **Name** attribute is not used in metric calculations or output field naming routines.

filter Attribute (optional)

The **filter** attribute is a string of one or more tool name abbreviations ([caem](#), [lcosp](#), [lcp](#), [pm](#), [rlcp](#), and [splcp](#)) separated by a semi-colon. It is used to exclude a class from a tool's list of selectable classes in the "Report metrics for these classes" input parameter area. This can be done to reduce clutter within a tool's GUI (e.g., dropping all classes except those related to agriculture for the Land Cover on Slopes Proportions tool) or to prevent classes incongruous for the analysis from being selected (e.g., <class Id="wetl" Name="All wetland land cover" filter="lcosp"> will eliminate the wetl class from the Land Cover on Slopes Proportions tool).

Value element - Id Attribute

The <value> element attribute, **Id**, is an integer value representing a grid code that may be found in a land cover raster. Groupings of <value> elements within a <class> element is dictated solely by the research needs of the user.

XML Note

XML is case-sensitive and care should be used when editing the LCC XML documents using a text editor. Wherever possible, element and attribute names for the document have been defined using lowercase characters. The only current exceptions are the attributes "**Id**" and "**Name**" in the Coefficients, Values, and Classes elements. If editing an LCC XML document outside of the [External LCC Editor](#), these attributes should be capitalized wherever they appear.

You may notice that in the Metadata element, the <name> element is lowercase. The distinction here is that "name" in the Metadata element pertains to an *element*, and that the capitalization rule only applies to an element's *attributes*.

Comments (optional)

Comments (optional)

XML documents can contain commented characters for notes and brief descriptions of sections. Comments are delimited by <!-- and end with the first occurrence of -->.

The [Supplied Land Cover Classification schemas](#) that come with ATtILA for ArcGIS come with a standardized set of comments (see below). They provide information to the user regarding the contents of the following elements: <coefficients>, <values>, and <classes>. These standardized comments are also inserted when LCC XML documents are created with the [External LCC Editor](#). Although comments are supplied by the program, they are unnecessary for the functioning of the XML document, and can be deleted. Any LCC XML document created by the user outside of the [External LCC Editor](#) can omit comments.

```
<!--
* The coefficients node contains coefficients to be assigned to values.

* REQUIRED ATTRIBUTES
* Id - text, unique identifier
* Name - text, word or phrase describing coefficient
* fieldName - text, name of field to be created for output
*           - must conform to the field naming conventions dictated by the output database system
* apMethod - text, "P" or "A", designates "P"ercentage or per unit "A"rea calculation routine
-->
```

```
<!--
* The values node defines the full set of values that can exist in a land cover raster.

* REQUIRED ATTRIBUTES
* Id - integer, raster code
*
* OPTIONAL ATTRIBUTES
* Name - text, word or phrase describing value
* excluded - boolean, "true" or "false" or "1" or "0"
*           - used to exclude values from effective area calculations
*           - excluded=false is the default

* A value element can optionally contain one or more coefficient elements

* REQUIRED COEFFICIENT ATTRIBUTES
* Id - text, must match an Id attribute from a coefficients node element
* value - decimal, weighting/calculation factor
-->
```

```
<!--
* The classes node contains values from a land cover raster grouped into one or more classes.

* REQUIRED ATTRIBUTES
* Id - text, unique identifier, also used for automated generation of output field name
*           - must conform to the field naming conventions dictated by the output database system

* OPTIONAL ATTRIBUTES
* Name - text, word or phrase describing class
* filter - text, a string of one or more tool name abbreviations separated by a ";"
*           - possible abbreviations are: lcp, rlcp, lcosp, splcp, caeam, and pm
*           - used to exclude the class from the selectable classes in the tool's GUI
* xxxxField - text, overrides ATtILA-generated field name for output
*           - where xxxx equals a tool name abbreviation
*           - possible abbreviations are: lcp, rlcp, lcosp, splcp, caeam, and pm
*           - a separate xxxxField attribute can exist for each tool
*           - must conform to the field naming conventions dictated by the output database system
```

- * A class can contain either values or classes but not both types.
 - * Value elements contain only an Id attribute which refers to a value in a raster.
 - * Values tagged as excluded="true" in the values node should not be included in any class.
- >

XML Validation

XML Validation

Validation ensures that any self-edited LCC XML document is both properly formatted as an XML document, and that all elements necessary for ATtILA for ArcGIS are present and correctly populated.

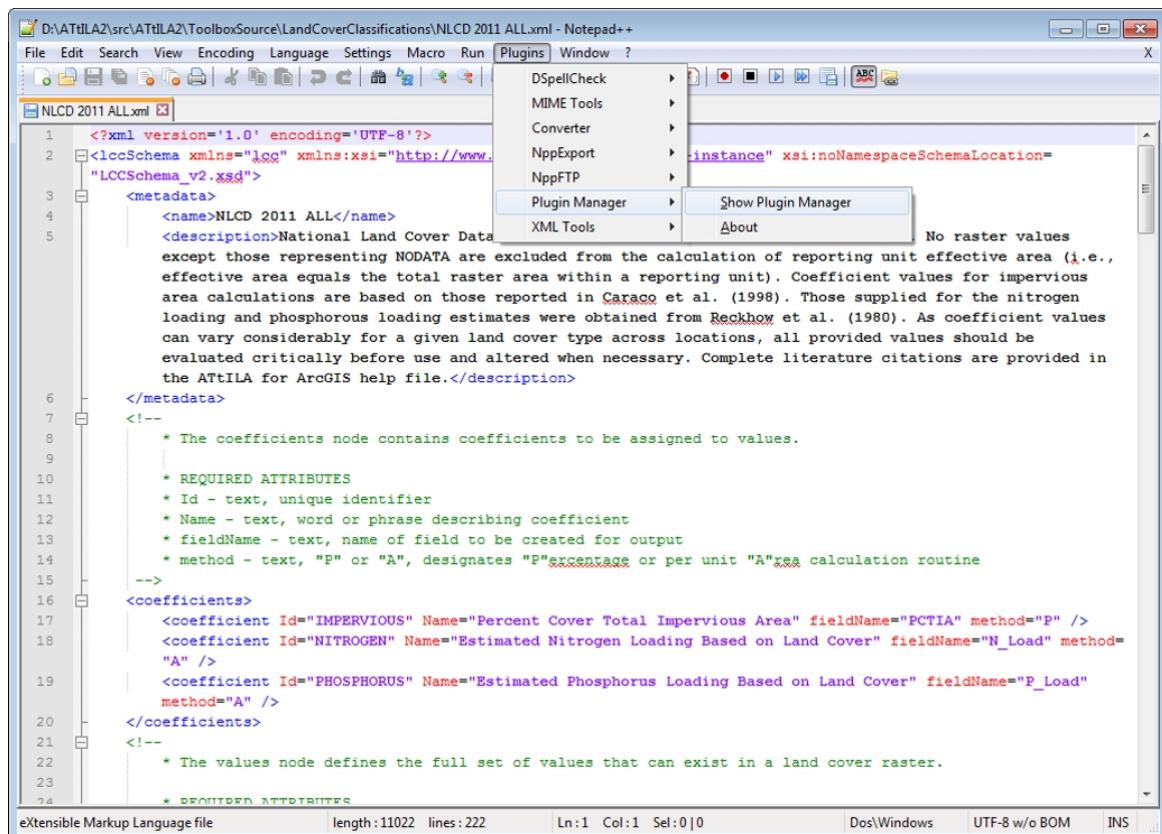
Validation is not necessary for any LCC XML documents created with the [External LCC Editor](#) or for any of the [Supplied Land Cover Classification Schemas](#) that came with ATtILA for ArcGIS. If you have used the [External LCC Editor](#) to create your LCC XML document, you may skip this section.

Validation is only recommended for LCC XML documents constructed outside of the External LCC Editor. If you have created a self-edited LCC XML file, please continue reading.

To perform validations, it is necessary to have either an XML editor/validator installed on your computer or by having access to the Internet and to one of several websites that provide validation service. If you do not currently have access to an XML program, an internet search using the phrase, "validation of XML", will locate several options.

While many programs/websites are available, the procedure for conducting syntax checks and validations are similar between them. We will describe the steps used within the Notepad++ v6.6.3 free source code editor. Notepad++ is available for download from <https://notepad-plus-plus.org>.

To use Notepad++ for validation, the XML plugin must be installed. To install the plugin, go to the Plugins dropdown menu and select Show Plugin Manager from the Plugin Manager menu item.



```

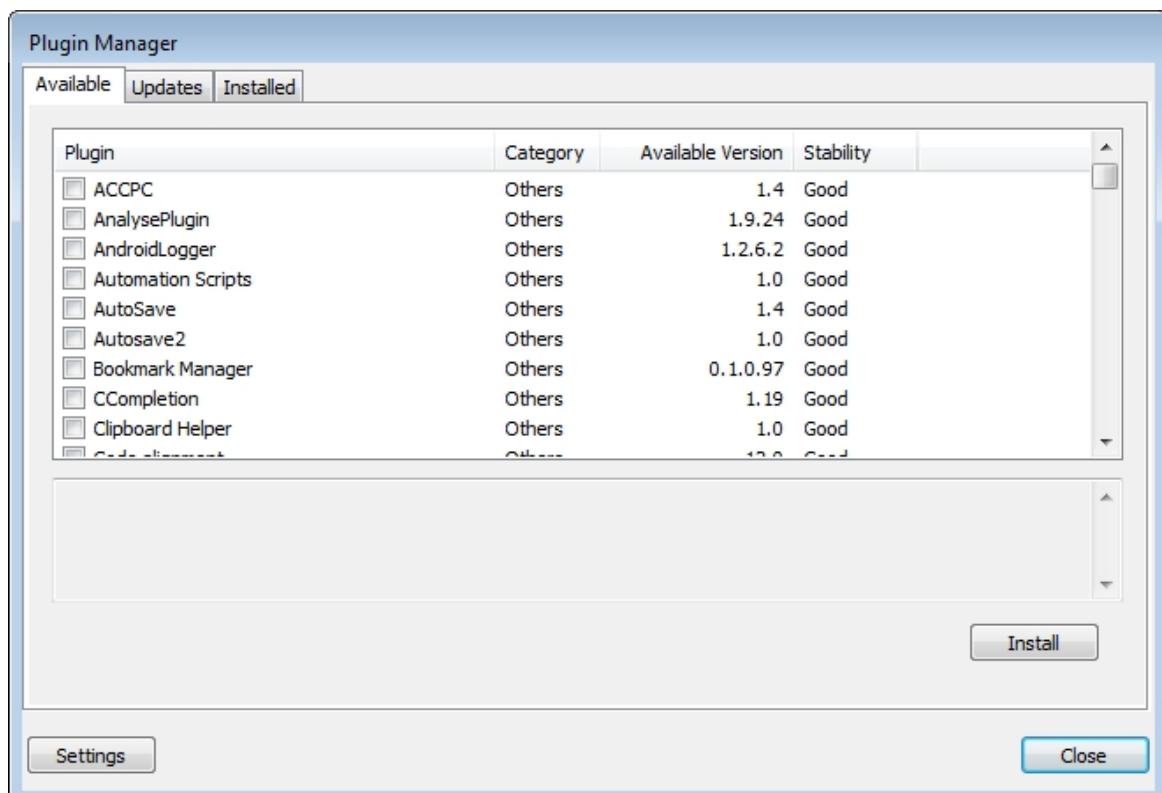
<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="loc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="LCCSchema_v2.xsd">
<metadata>
  <name>NLCD 2011 ALL</name>
  <description>National Land Cover Data</description>
  <!--
    * The coefficients node contains coefficients to be assigned to values.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier
    * Name - text, word or phrase describing coefficient
    * fieldName - text, name of field to be created for output
    * method - text, "P" or "A", designates "P"ercentage or per unit "A"rea calculation routine
  -->
<coefficients>
  <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious Area" fieldName="PCTIA" method="P" />
  <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on Land Cover" fieldName="N_Load" method="A" />
  <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based on Land Cover" fieldName="P_Load" method="A" />
</coefficients>
<!--
  * The values node defines the full set of values that can exist in a land cover raster.

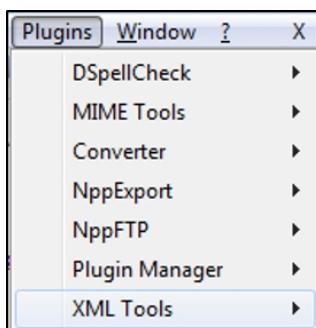
  * DEPRECATED ATTRIBUTES
-->
```

eXtensible Markup Language file length : 11022 lines : 222 Ln:1 Col:1 Sel:0|0 Dos\Windows UTF-8 w/o BOM INS

Once the Plugin Manager dialog box opens, select the Available tab and then click on XML Tools. Select Install. After installation is complete, close the Plugin Manager dialog.



The XML Tools item will now be available from the Plugins dropdown menu.

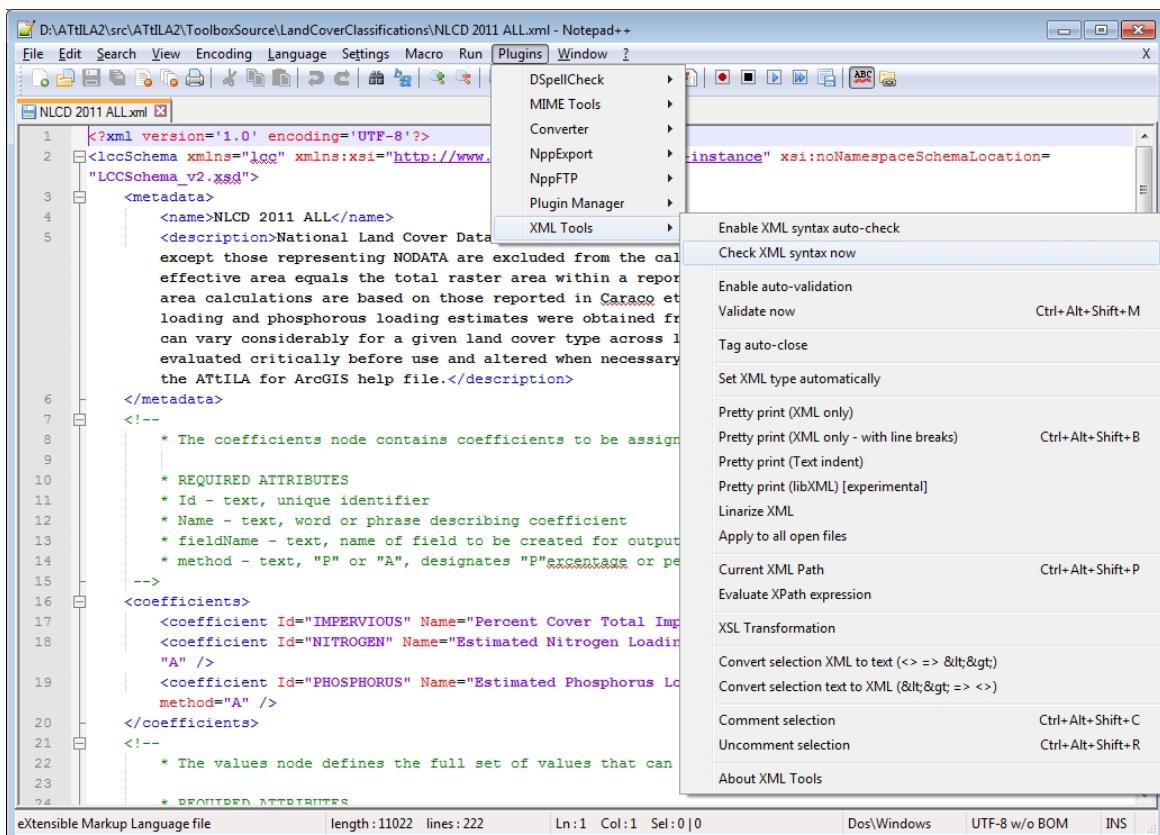


XML Validation - Step One

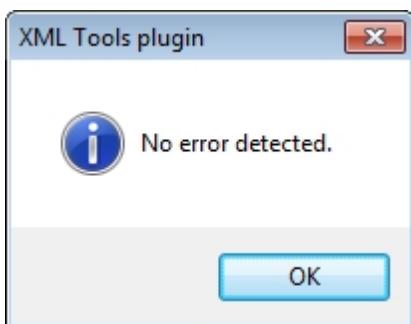
Validation is typically a two step process. The first step ensures that the XML document follows standard formatting rules. Some standard rules include:

- each start-tag must have a matching end-tag. The end-tag can be either a non-empty element, "<tag> </tag>", or an empty element, "<tag />"
- attribute values must be quoted
- attribute names must be unique, but XML is case-sensitive so "name" is different from "Name" which is different from "NAME"
- comments and processing commands cannot appear inside tags

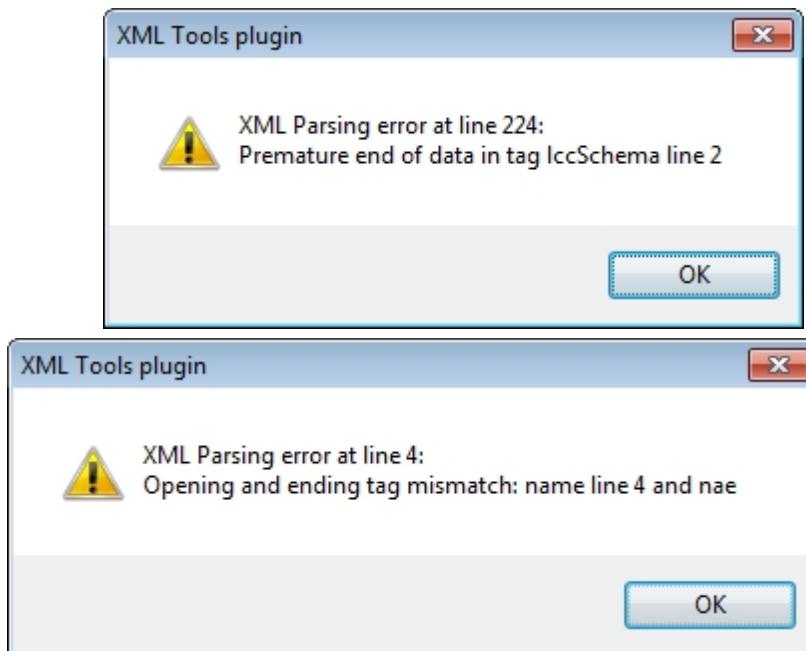
Checking of XML syntax rules is rather straightforward. Once your XML LCC documented is loaded into Notepad++, select "Check XML syntax now" from the XML Tools plugin menu.



If all is correct, a message similar to the one below should appear indicating that no errors were detected, and you can proceed to step two.



If an error does exist, an error dialog will appear, and the error must be located and corrected before continuing. A couple examples of error messages are provided below.



Using the information from the error message will often quickly lead to the problem area in the text, but in certain cases, such as in our first example error message, locating and correcting the cause of the error requires a careful examination of the entire XML document. If the errors are not readily apparent, forgo manually editing your LCC XML document, and perform your final edits in the [External LCC Editor](#).

Once all syntax errors have been corrected, you can proceed to step two.

XML Validation - Step Two

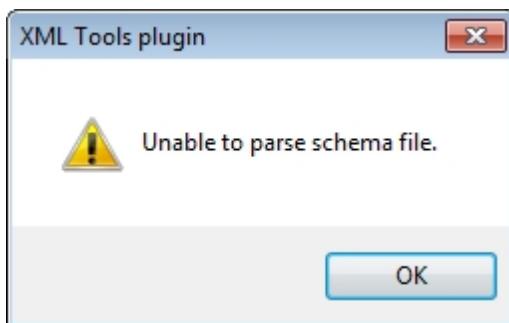
The second step of the validation process is ensuring that all XML elements necessary for ATtILA for ArcGIS are present and correctly populated. ATtILA for ArcGIS requires several customized elements and attributes to also be in the XML document (see [ATtILA's LCC XML Document](#)). If these items are missing or their content rules are not followed, ATtILA for ArcGIS may fail to operate or, worse yet, produce incorrect results.

To assist with this step of the validation, an XML Schema Definition (XSD) file has been provided for the ATtILA for ArcGIS user. An XSD is a type of file that is used to formally describe the elements of an XML document, and to constrain and verify their contents. The XSD provided for ATtILA for ArcGIS specifically controls which elements and attributes are permitted in the LCC XML document, the contents of those items, their order, and whether or not the items are required or optional.

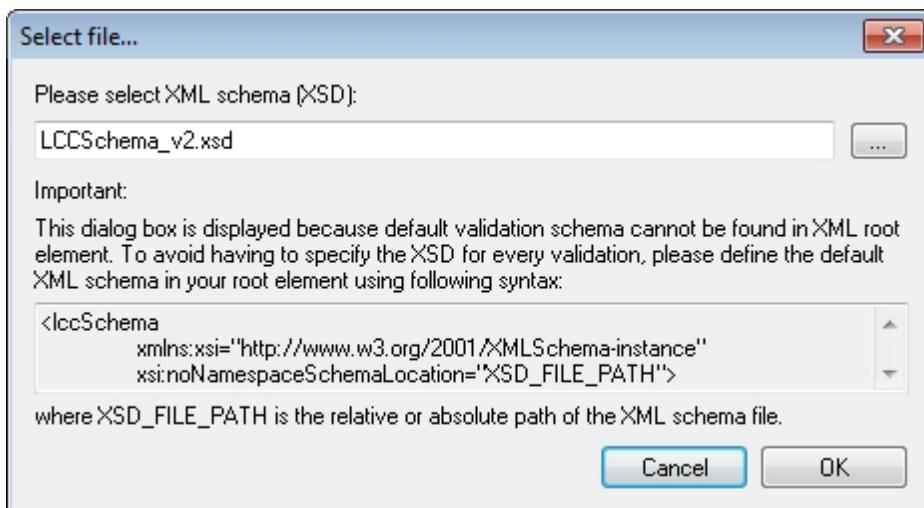
ATtILA for ArcGIS's XSD file is located in the ToolboxSource > LandCoverClassifications folder in the ATtILA 10_0 toolbox destination folder ([see Installing ATtILA](#)). It is named, "LCCSchema_v3.xsd". A copy of its contents can be found in the appendix ([LCCSchema_v3.xsd](#)).

You perform the validation step in much the same way as checking the XML's syntax, but you select "Validate now" from the XML Tools plugin menu instead.

If you have placed a reference to the XSD file in the [root element of the LCC XML document](#), the XML editor should be able to locate the XSD file and perform the validation checks. If the XSD file is not found in the referenced location or if there is an error in the [root element](#), the following error message may appear:



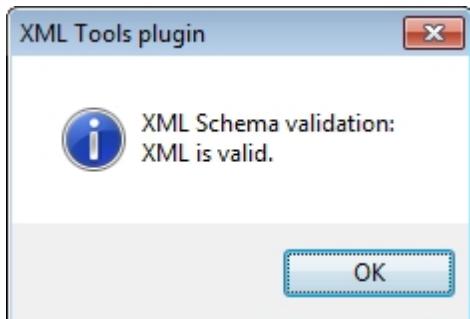
If the LCC XML document does not contain a reference to an XSD file in its [root element](#), Notepad++ will open a "Select file..." dialog allowing you to locate the XSD file yourself.



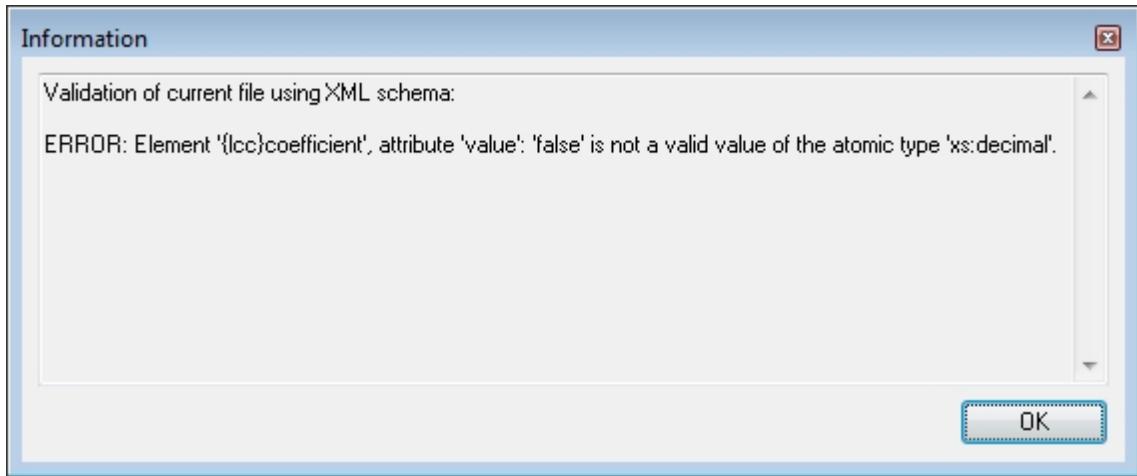
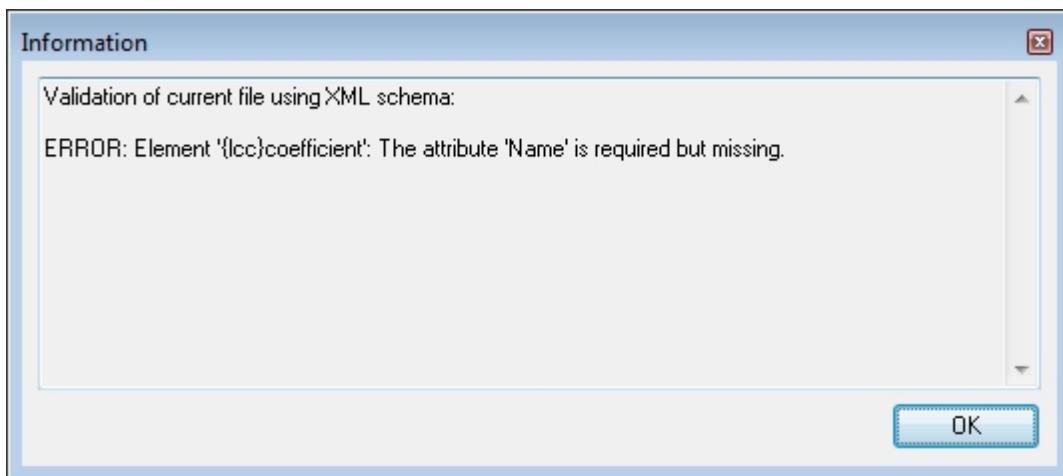
Again, the ATtILA for ArcGIS XSD file is located in the ToolboxSource >

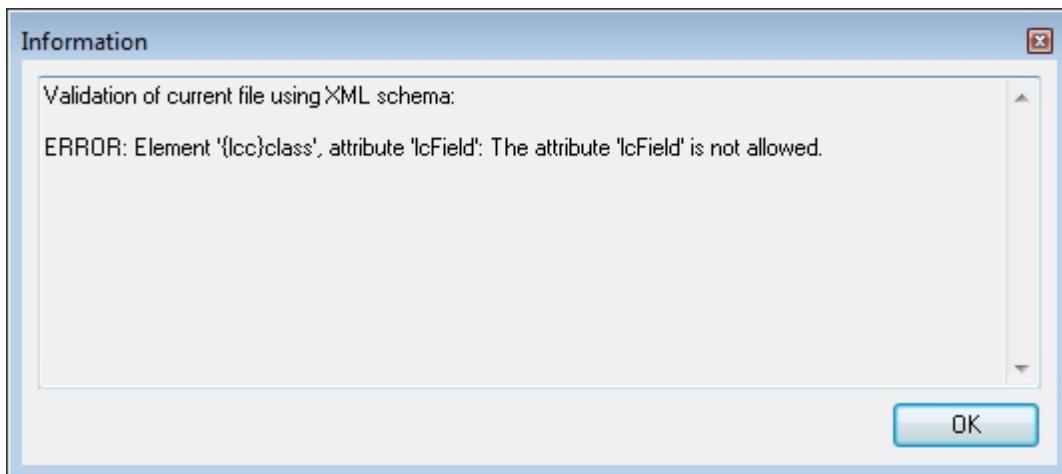
LandCoverClassifications folder in the ATtILA 10_0 toolbox destination folder ([see Installing ATtILA](#)). It is named, "LCCSchema_v3.xsd", and a copy of its contents can be found in the appendix ([LCCSchema_v3.xsd](#)).

If all goes well, an "XML is valid" statement will appear.



If any problems are encountered, Notepad++ will alert you with an Information dialog describing the problem. The descriptions tend to be detailed, but the exact location of the troublesome element in the LCC XML document may be difficult to locate (see example errors below).





Once validation steps one and two are performed without error reports, your LCC XML document should be ready for use with ATtILA for ArcGIS. If any problems do occur during tool execution, please reread the section, [ATtILA's LCC XML Document](#), and amend your file as necessary. As mentioned above, if the errors are not readily apparent, forgo manually editing your LCC XML document, and perform your final edits in the [External LCC Editor](#).

Create or Modify Land Cover Classification

Summary

Create custom Land Cover Classification (LCC) files or modify existing files.

The [External LCC Editor](#) will be launched separately from ArcGIS. You may close ArcGIS without disrupting the editor. A LCC file defines the classification scheme and is a required input for some tools.

Illustration



Usage

- Allows users to modify an existing LCC XML file to suit their specific needs. For example, the user may define a new grouped class by combining multiple individual classes (e.g., deciduous, conifer, and mixed forest into a single forest class).
- Allows users to create a new LCC XML file for a land cover grid other than the standard datasets already included in ATtILA for ArcGIS (e.g. a local Land cover grid with a unique classification scheme).

Syntax

LaunchLccEditor ()

This tool has no parameters.

Credits

Environments

Use limitations

There are no access and use limitations for this item.

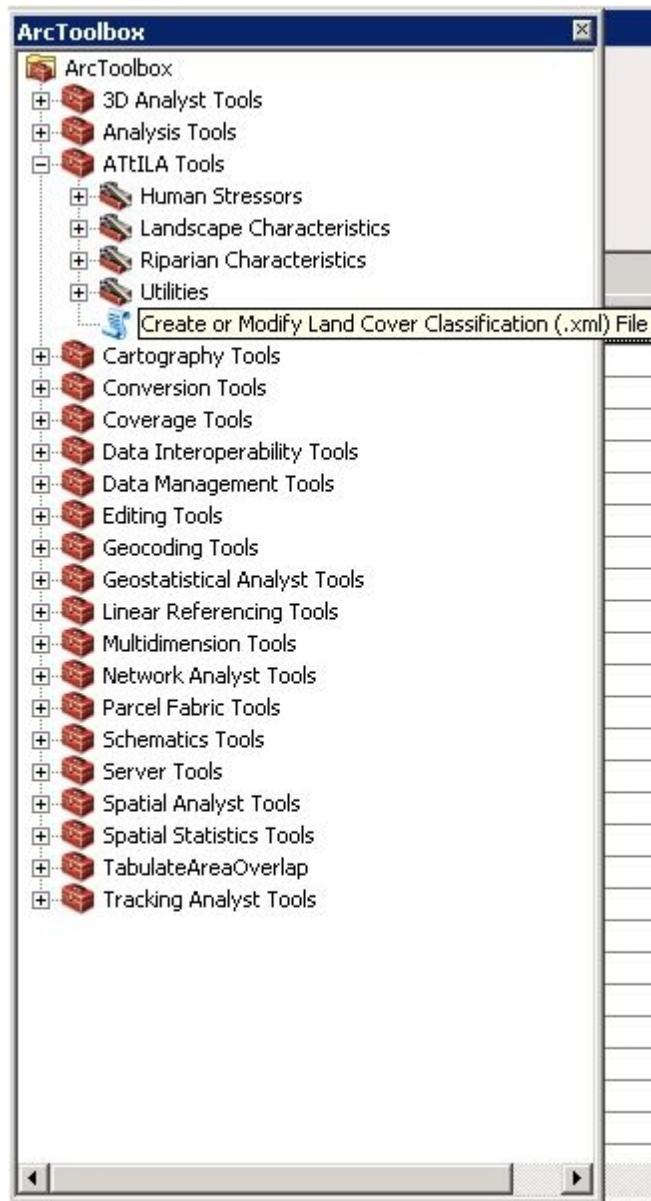
External LCC Editor

Summary

The Land Cover Classification Editor provides a user-friendly interface to create or edit a Land Cover Classification XML file for use in ATtILA for ArcGIS.

Land Cover Classification Editor

To start editing, click the Create or Modify Land Cover Classification (.xml) File tool in the ATtILA Toolbox.

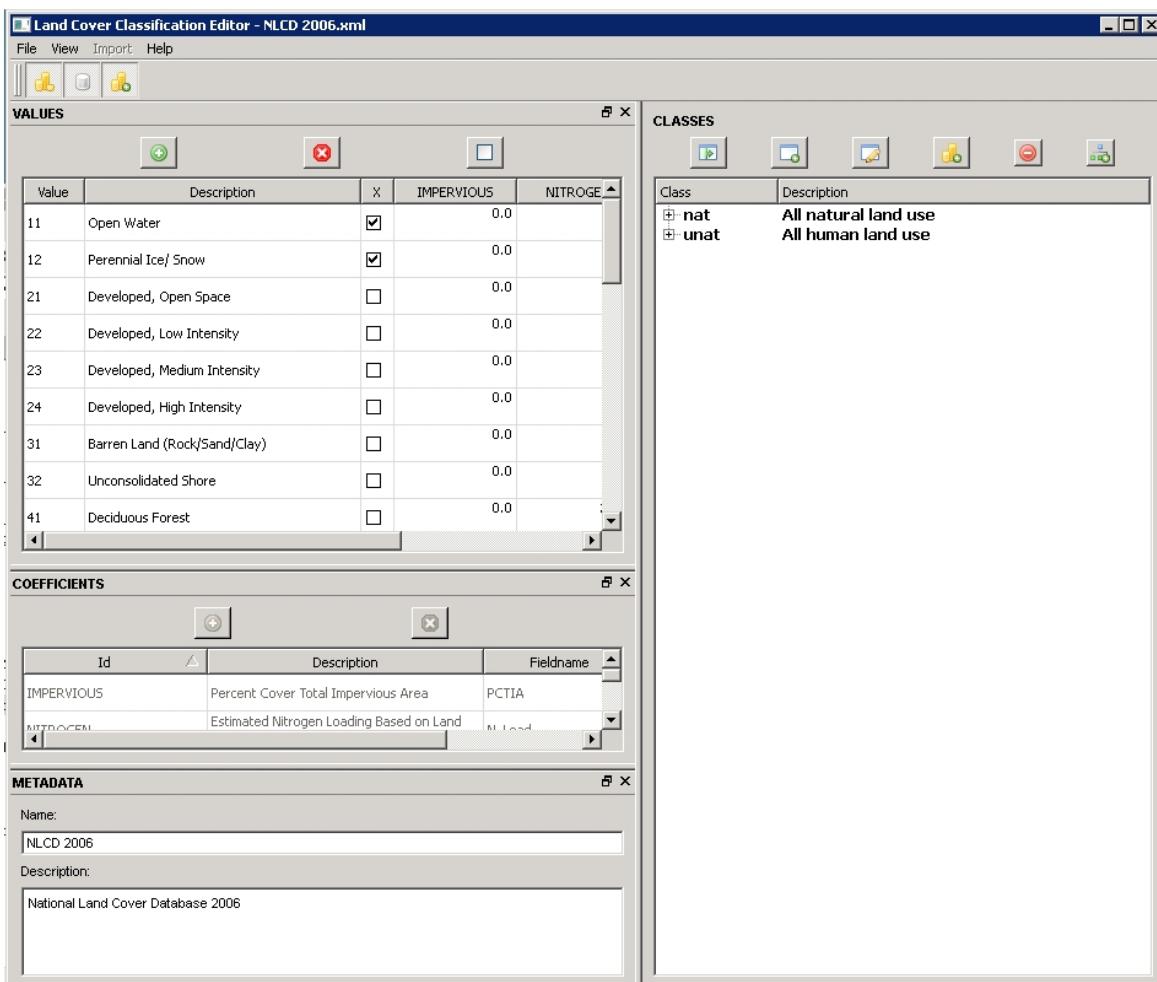


The tool will open with the message "This tool has no parameters." Simply click OK to open the LCC Editor graphical user interface.



Land Cover Classification Editor Sections

The LCC Editor consists of four windows ([VALUES](#), [COEFFICIENTS](#), [METADATA](#), and [CLASSES](#)), with buttons to edit information within the windows. In addition, the Editor contains menu dropdowns with commands to manipulate the LCC XML file and the appearance of the LCC Editor, and an icon toolbar below the menu dropdowns that also controls the Editor's appearance.



Menu Items

File

The File menu contains file utilities necessary for manipulation of the XML files:

- New - Clears the Editor for a new file or for a clean start.
- Open - Opens an existing XML file.
- Open Recent - Allows for quick navigation to the five most recent XML files viewed.
- Restore AutoSave - Restores an auto-saved version of the current work. AutoSave occurs every five seconds; select to restore the last saved version of the file.
- Save - Saves the existing work in the LCC editor to a new XML file if none exists, or to the opened file name.
- Save As - Saves the existing work in the LCC editor with a new file name.
- Quit - Closes the Editor

View

The View menu allows the user to turn on or off the three dockable windows on the left side of the tool: Values, Coefficients, and Metadata.

- Show/Hide Values Window Dock - Toggles the Values Window on or off.
- Show/Hide Coefficients Window Dock - Toggles the Coefficients Window on or off.
- Show/Hide Metadata Window Dock - Toggles the Metadata Window on or off.

The Icon Toolbar provides the same functionality.

The windows may also be viewed as tabs by clicking on the title bar of a window, holding the mouse button and dragging the window onto another window, then releasing the mouse button. To untab, click the title bar of the window and drag to an open location (the other windows will "move" out of the way).

Double-clicking on the title bar of a window will pop it out from the editor.

Import

Reserved for future use.

Help

The Help menu provides access to the ATtILA for ArcGIS help document and provides information about the editor.

- LCCEditor Help - Opens the ATtILA for ArcGIS help document.
- About LCCEditor - Provides system information about the editor.

Icon Toolbar



The Icon Toolbar provides the same functionality as View.

- Show/Hide Values - Toggles the [Values Window](#) on or off.
- Show/Hide Metadata - Toggles the [Metadata Window](#) on or off.
- Show/Hide Coefficients - Toggles the [Coefficients Window](#) on or off.

Entering and Editing Data

Information is entered into the [Values window](#), the [Metadata window](#) and the [Classes window](#). In this version of ATtILA for ArcGIS, the [Coefficients window](#) is uneditable. Future versions will allow for editing within the Coefficients window.

The general workflow is as follows with additional detail in the specific table sections:

1. Raster values, their descriptions, and their properties (exclusion and coefficient values) are entered in the Values table.
2. Classes are created in the Classes tree. Classes may be comprised of a single land cover type, multiple land cover types grouped together, or groups of groups.
3. Items from the Values table are added to the appropriate section(s) in the Classes tree.
4. Metadata containing the name and description of the Land Cover Classification are added to the Metadata section.

Values Window

Values Window

The Values Window consists of three buttons and a table:

1. Add Value - Enter new values into the table
2. Remove Value - Remove values from the table
3. Remove Exclusion - Remove all exclusions set

The screenshot shows the 'VALUES' window with a title bar and a close button. Below the title bar are three buttons numbered 1, 2, and 3, each with a circled number and a corresponding icon: a green plus sign for 'Add Value', a red minus sign for 'Remove Value', and a blue square with a diagonal line for 'Remove Exclusion'. The main area is a table with the following structure:

Value	Description	X	IMPERVIOUS	NITROGEN

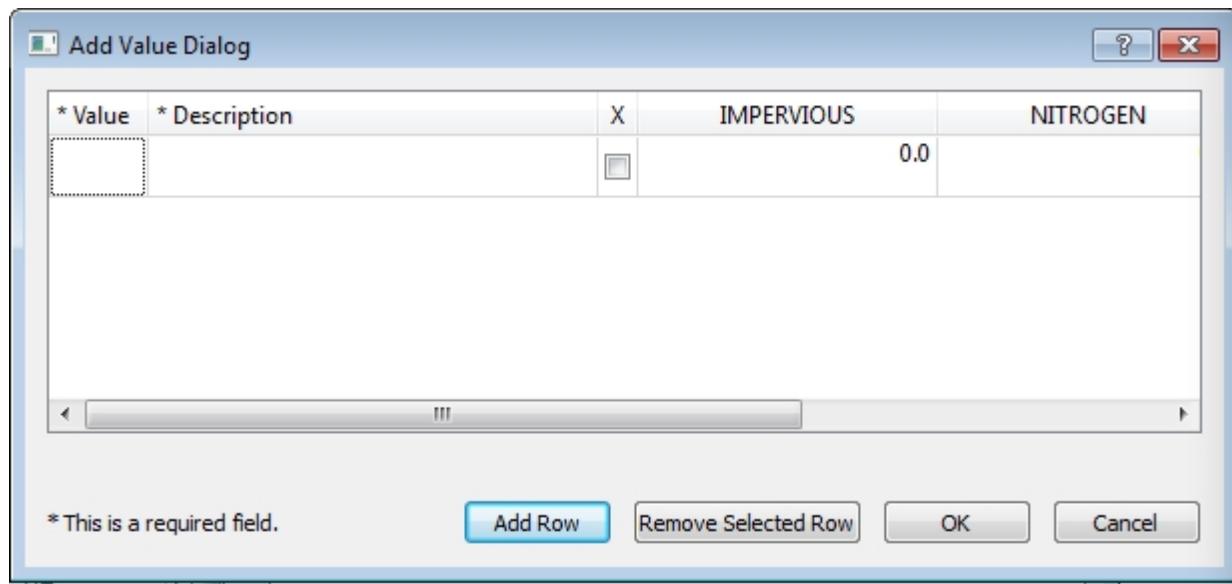
Add Value

Values are entered into the Values Table by pressing the Add Value button. Here, the user may then enter the following:

- Value (required) - The integer value of the land cover class in the Land cover grid.
- Description (required) - A text description of the land cover value.
- X - A checkbox that determines whether the land cover value will be excluded from ATtILA for ArcGIS metric calculations. This is frequently checked when the user elects to exclude open water and perennial snow/ice values out of calculations, but may be used on any value.
- IMPERVIOUS - Numerical coefficient that estimates the percent of impervious surfaces that is generally found within the land cover type. This coefficient is frequently used with developed land cover types. **NOTE:** *The coefficient should be entered as a decimal value rather than a percentage.*
- NITROGEN - Numerical coefficient that estimates the amount of nitrogen output (stream loading) in kilograms per hectare per year that is generally found within the land cover type. This coefficient is frequently used with developed and agricultural land cover types.
- PHOSPHORUS - Numerical coefficient that estimates the amount of phosphorus output (stream loading) in kilograms per hectare per year that is generally found within the land cover type. This coefficient is frequently used with developed and agricultural land cover types.

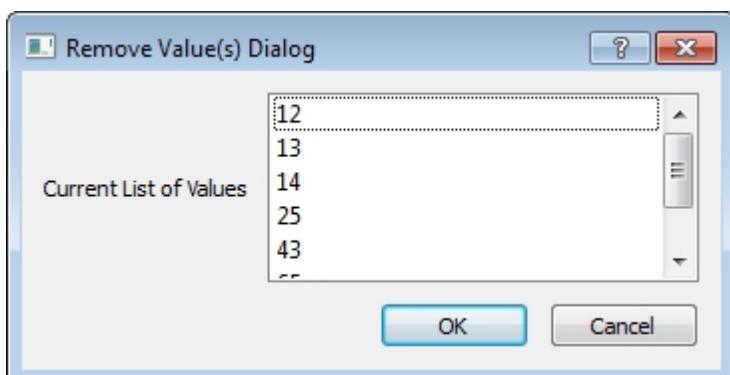
The Add Row button may be clicked to add one or more additional values, if needed. Once the desired number of values have been added, they should be reviewed for accuracy. Edits may be made directly in the fields, or entire values may be deleted by clicking on the value to be deleted, then clicking the Remove Selected Row button. Once satisfied with the entries, click the OK button to add the new values to the Values table.

NOTE: *Once in the Values table, the Value cannot be modified. However, the Description, eXclusion or Coefficients may be modified from the table.*



Remove Value

To delete a single value from the Values table, click on the value to be deleted in the table, then click the Remove Value button. To remove multiple values, click the Remove Value button *without* selecting a value. The Remove Value dialog will appear. Select multiple values by holding the Shift key while selecting the values with the mouse, and then click OK to delete.



Deselect Exclusion

To remove all exclusions set on the values in the Values table, click the Deselect Exclusions button. To reset exclusions, simply click the X checkbox for each value to be excluded.

Coefficients Window

Coefficients Window

The Coefficients Window lists the three coefficients that are utilized in this version of ATtILA for ArcGIS. These are not editable. Future versions of ATtILA for ArcGIS will provide users the opportunity to add coefficients.

COEFFICIENTS		
Id	Description	Fieldname
IMPERVIOUS	Percent Cover Total Impervious Area	PCTIA
NITROGEN	Estimated Nitrogen Loading Based on L...	N_Load
PHOSPHORUS	Estimated Phosphorus Loading Based o...	P_Load

Metadata Window

Metadata Window

The Land Cover Classification name and description are entered in these fields. To minimize errors, it is recommended that the Name be consistent with the name of the LCC XML file.

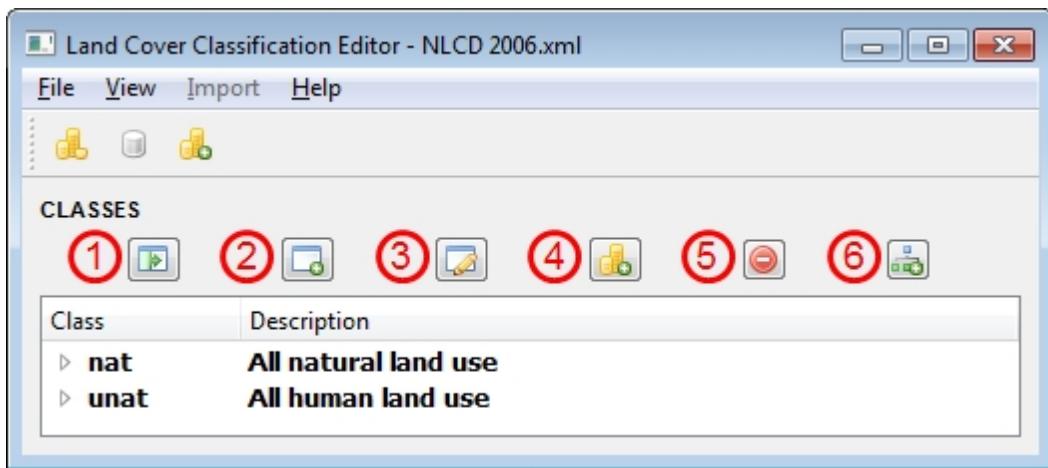
METADATA	
Name:	<input type="text"/>
Description:	<input type="text"/>

Classes Window

Classes Window

The Classes Window provides an expandable and collapsible view of the classes, class groups, and the land cover values that belong to the classes. This window is used to start, edit, and view the Classes tree with the following buttons:

1. Start Tree/Add Sibling Class - Start a Classes tree or add a sibling class to the Classes tree
2. Add Child Class - Add a child class to the Classes tree
3. Edit Class - Edit a class
4. Insert Values - Insert values into the Classes tree
5. Remove Class/Value - Remove class or value from Classes tree
6. Expand/Collapse - Expand or collapse the entire Classes tree



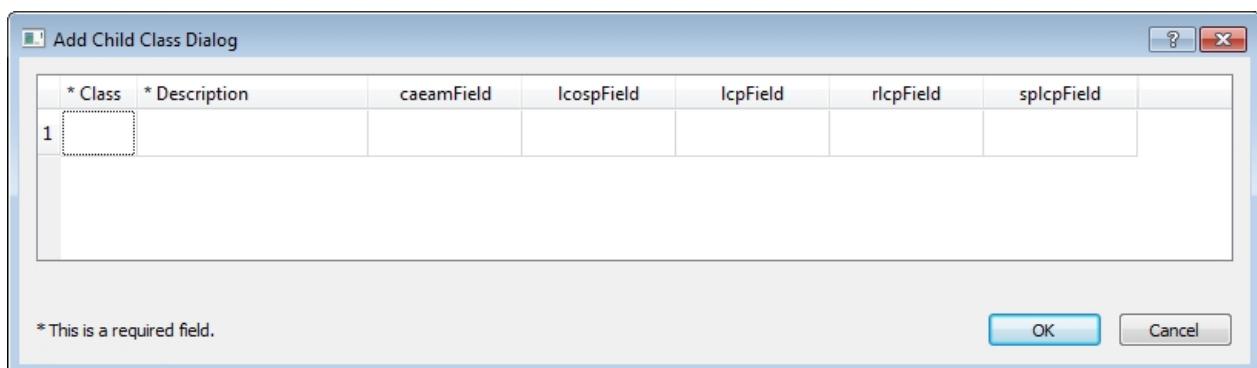
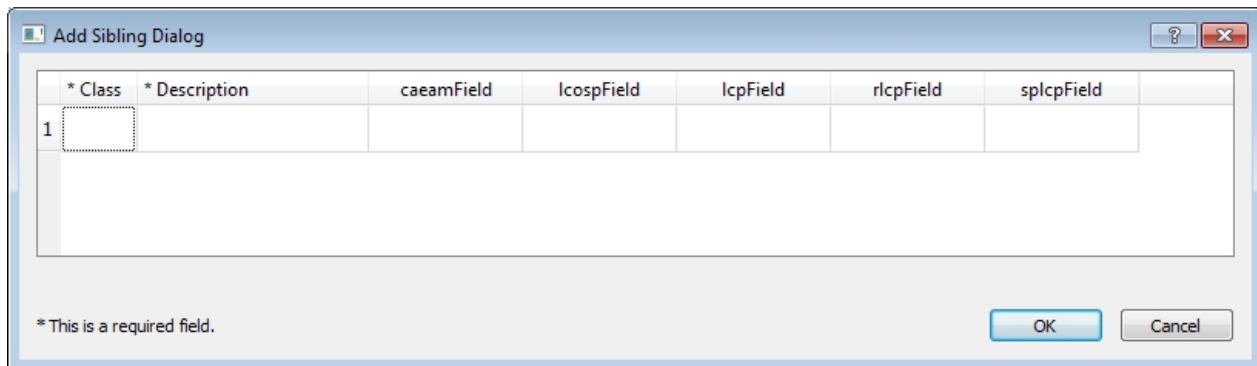
Entering a Class

The first step to creating a land classification scheme is to start the Classes tree. Click the Start Tree/Add Sibling Class button. If there are no entries in the Classes Window, this will be the only button active. The Add Sibling Dialog opens. Here, the user may enter the following:

- Class (required) - The alphanumeric value to assign to the class. It is recommended that this be a recognizable short (three to five characters) abbreviation of the class description.
- Description (required) - A text description of the class.
- caemField - The abbreviation assigned to the field(s) that represent metrics for the class in the Core and Edge Metrics output table. If left blank, the same abbreviation entered in the Class field is used.
- lcospField - The abbreviation assigned to the field(s) that represent metrics for the class in the Land Cover on Slope Proportions output table. If left blank, the same abbreviation entered in the Class field is used.
- lcpField - The abbreviation assigned to the field(s) that represent metrics for the class in the Land Cover Proportions output table. If left blank, the same abbreviation entered in the Class field is used.
- pmField - The abbreviation assigned to the field(s) that represent metrics for the class in the Patch Metrics output table. If left blank, the same abbreviation entered in the Class field is used.
- rlcpField - The abbreviation assigned to the field(s) that represent metrics for the class in the Riparian Land Cover Proportions output table. If left blank, the same abbreviation entered in the Class field is used.
- splcpField - The abbreviation assigned to the field(s) that represent metrics for the class in the Sample Point Land Cover Proportions output table. If left blank, the same abbreviation entered in the Class field is used.

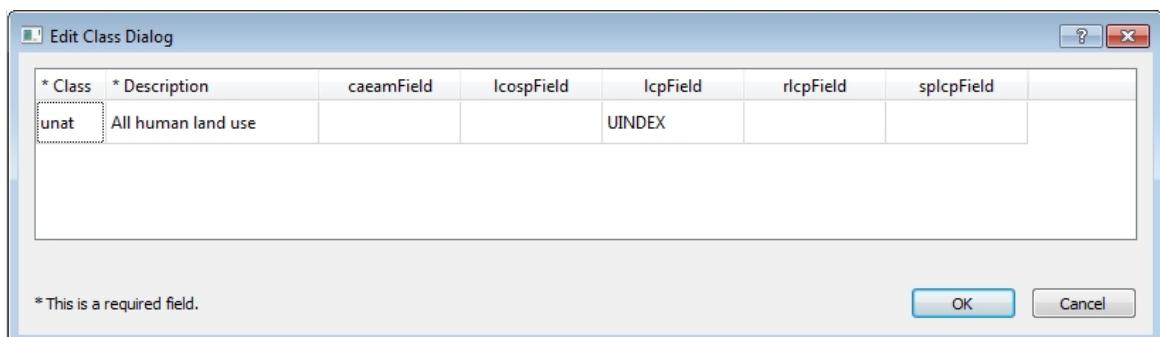
Once a class is entered into the Classes tree, a new class may be added by selecting a class and clicking either the Start Tree/Add Sibling Class or Add Child Class buttons. A "sibling" is a class at the same level as the selected class, while a "child" is a subclass that has membership within the upper-level class. The fields for entry are the same as described above. Once the

entry is complete, click OK to accept the class. The class will now be visible in the Classes tree.



Editing a Class

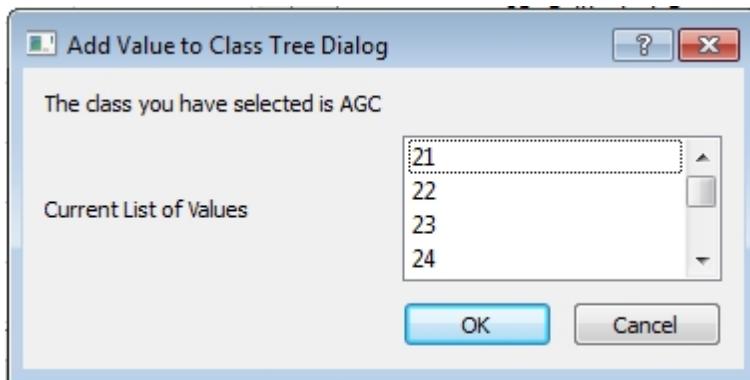
To edit a class, click the Edit Class button. The Edit Class Dialog pop-up will appear, allowing modifications in each of the fields. Press OK to accept the modifications.



Inserting Values into the Classes Tree

The Classes tree is populated with items from the Values table in one of three ways:

- Drag a value from the Values table - Click and hold the mouse cursor on the desired value and drag it to the appropriate class in the Classes Table.
- Insert a value using the Insert Values button - Select the class in the Classes Table in which the value is to be inserted. Click Insert Values, which will display the Add Value to Class Tree Dialog. Select the value or values to be inserted and click OK.
- Right click on the class and select Insert Value - Right-click on the class in which the value is to be inserted. Click Insert Values, which will display the Add Value to Class Tree Dialog. Select the value or values to be inserted and click OK.



Removing a Class or a Value from the Classes Tree

Classes or values may be removed from the classes tree in one of two ways:

- Remove Class/Value button - Select the class or value to be removed and click the Remove Class/Value button.
- Right click on the class and select Remove - Right-click on the class or value to be removed and click Remove.

CAUTION: This action will erase all child classes and values in the tree below the selected class. This action cannot be undone.

NOTE: An alternative way to exclude classes from ATtILA for ArcGIS metric calculations is to utilize the exclusion checkboxes in the Values table. This removes all occurrences of the selected values from the Classes tree and therefore should be used with caution. The values may be restored in the Classes tree by unchecking the checkboxes.

Expanding or Collapsing the Class Tree

To expand or collapse the Classes tree, click the Expand/Collapse Tree button. This will expand or collapse the entire tree. To expand or collapse an individual group, click the plus or minus sign next to the class name or double-click the class description.

Shortcut Keys

Shortcut Keys

Action	Ctrl	Function	Alt
Menu Items:			
New	Ctrl+N		
Open	Ctrl+O		
Restore AutoSave	Ctrl+R		
Save	Ctrl+S		
SaveAs		F12	
Quit	Ctrl+Q		
Help		F1	
Buttons:			
Value Table			
Add Value	Ctrl+A		
Remove Values(s)	Ctrl+D		
Remove Exclusion	Ctrl+I		
Class Tree			
Start Tree/Add Sibling			Alt+S
Add Child			Alt+C
Edit Class			Alt+E
Insert Value			Alt+I
Remove Value			Alt+D
Expend/Collapse Tree			Alt+T

Supplied Land Cover Classification Schemas

An attempt has been made to standardize the land cover classification compiled metric fields among the NLCD1992, NLCD2001 and C-CAP data sets. Slightly different land cover classification schemes were used for each of these, although in some cases the only real difference is in the nomenclature. For example, NLCD1992 describes three urban classes as low density residential, high density residential, and commercial/industrial. Later NLCD outputs and C-CAP describe the three urban classes as low intensity developed, medium intensity developed, and high intensity developed. In the standard land cover classifications provided here, the latter terminology was adopted, primarily to aid the user in making comparisons among these data sets. The Developed metric for each consists of these three urban descriptions plus urban grasslands.

In a few cases, it was not possible to complete standardization. The NLCD1992 data contains separate descriptions of natural and man-made barren lands, while the later NLCD and C-CAP data do not make this distinction. Therefore, the user must be cautious in making comparisons or drawing conclusions based on the barren metric.

Supplied schemes may be designated as either "ALL" or "LAND" (e.g. NLCD 2001 ALL vs. NLCD 2001 LAND). Schemes designated as "ALL" include all land cover classes in reporting unit area calculations, while those designated as "LAND" include only terrestrial land cover classes, with non-terrestrial land cover classes such as water and snow/ice excluded.

When a classification scheme with excluded land cover classes is selected, the areas of the excluded classes are disregarded in metric calculations. This means, when selecting a "LAND" classification scheme, the tool will process individual land cover classes and calculate metrics based on the total terrestrial area they occupy within the reporting unit, rather than the percent of the total area within the reporting unit. Thus, when using a "LAND" classification scheme, a calculated output value of 70% forest in say the Land Cover Proportions tool means that 70% of the land area in the reporting unit is covered by forest.

C-CAP ALL

C-CAP ALL

No raster values except those representing NODATA are excluded from the calculation of reporting unit effective area (i.e., effective area equals the total raster area within a reporting unit).

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the C-CAP dataset go to: <http://www.csc.noaa.gov/digitalcoast/data/ccapregional>

For the data go to: <http://www.csc.noaa.gov/ccapatlas/>

C-Cap ALL - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
0	Background	yes				
1	Unclassified					UC
2	High Intensity Developed		5.5	1.2	0.9	Ul,dev, devh
3	Medium Intensity Developed		5.5	1.2	0.6	Ul,dev, devm
4	Low Intensity Developed		5.5	1.2	0.4	Ul,dev, devl
5	Open Spaces Developed				0.1	Ul,dev, devo
6	Cultivated Crop		5.0	0.9		Ul,agr, agrc
7	Pasture/Hay		5.0	0.9		Ul,agr, agrp
8	Grassland		0.3	0.06	0.02	NI,hrb
9	Deciduous Forest		2.5	0.25	0.02	NI,for
10	Evergreen Forest		2.5	0.25	0.02	NI,for
11	Mixed Forest		2.5	0.25	0.02	NI,for
12	Scrub/Shrub		0.4	0.04	0.02	NI,shb
13	Palustrine Forested Wetland		2.5	0.25	0.02	NI, wtl, wtlw
14	Palustrine Scrub/Shrub Wetland		0.4	0.04	0.02	NI, wtl, wtlw
15	Palustrine Emergent Wetland		0.3	0.06	0.02	NI, wtl, wtle
16	Estuarine Forested Wetland		2.5	0.25	0.02	NI, wtl, wtlw
17	Estuarine Scrub/Shrub Wetland		0.4	0.04	0.02	NI, wtl, wtlw
18	Estuarine Emergent Wetland		0.3	0.06	0.02	NI, wtl, wtle
19	Unconsolidated Shore					NI,bar
20	Barren Land					NI,bar
21	Open Water					NI,wtr
22	Palustrine Aquatic Bed					NI,wtr
23	Estuarine Aquatic Bed					NI,wtr
24	Tundra		0.3	0.06	0.02	NI,tun
25	Perennial Ice/Snow					NI,wtr

C-CAP ALL - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25
Herbaceous	hrb	8
Forest	for	9,10,11
Shrubland	shb	12
Wetland	wtl	13,14,15,16,17,18
Woody Wetland	wtlw	13,14,16,17
Emergent Wetland	wtle	15,18
Barren	bar	19,20
Water	wtr	21,22,23,25
Tundra	tun	24
All Human Land Use	UI	2,3,4,5,6,7
Developed	dev	2,3,4,5
High Intensity Developed	devh	2
Medium Intensity Developed	devm	3
Low Intensity Developed	devl	4
Open Space Developed	devo	5
Agriculture	agr	6,7
Cultivated Crop	agrc	6
Pasture/Hay	agrp	7
Unclassified	UC	1

XML

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<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>C-CAP ALL</name>
        <description>C-CAP ALL Land Cover Classification Schema. No raster
values except those representing NODATA are excluded from the calculation of
reporting unit effective area (i.e., effective area equals the total raster
area within a reporting unit). Coefficient values for impervious area
calculations are based on those reported in Caraco et al. (1998). Those
supplied for the nitrogen loading and phosphorous loading estimates were
obtained from Reckhow et al. (1980). As coefficient values can vary
considerably for a given land cover type across locations, all provided values
should be evaluated critically before use and altered when necessary. Complete
literature citations are provided in the ATtILA for ArcGIS help file.</
description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *                 - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *                 - used to exclude values from effective area calculations
        *                 - excluded=false is the default

        * A value element can optionally contain one or more coefficient
elements

        * REQUIRED COEFFICIENT ATTRIBUTES
        * Id - text, must match an Id attribute from a coefficients node
    -->

```

```

element
    * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="0" Name="Background" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="1" Name="Unclassified">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="2" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="3" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="4" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="5" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="6" Name="Cultivated Crop">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="7" Name="Pasture/Hay">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="8" Name="Grassland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="9" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="10" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="11" Name="Mixed Forest">

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```
<coefficient Id="IMPERVIOUS" value="0.02" />
<coefficient Id="NITROGEN" value="2.5" />
<coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="12" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="13" Name="Palustrine Forested Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="14" Name="Palustrine Scrub/Shrub Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="15" Name="Palustrine Emergent Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="16" Name="Estuarine Forested Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="17" Name="Estuarine Scrub/Shrub Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="18" Name="Estuarine Emergent Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="19" Name="Unconsolidated Shore">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="20" Name="Barren Land">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="21" Name="Open Water">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="22" Name="Palustrine Aquatic Bed">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="23" Name="Estuarine Aquatic Bed">
```

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<coefficient Id="IMPERVIOUS" value="0.0" />
<coefficient Id="NITROGEN" value="0.0" />
<coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="24" Name="Tundra">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="25" Name="Perennial Ice/Snow">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
into one or more classes.

    * REQUIRED ATTRIBUTES
        * Id - text, unique identifier, also used for automated generation of
output field name
            * - must conform to the field naming conventions dictated by the
output database system

    * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing class
        * filter - text, a string of one or more tool name abbreviations
separated by a ";"
            * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
and pm
            * - used to exclude the class from the selectable classes in
the tool's GUI
        * xxxxField - text, overrides ATtILA-generated field name for output
            * - where xxxx equals a tool name abbreviation
            * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
            * - a separate xxxxField attribute can exist for each tool
            * - must conform to the field naming conventions dictated by
the output database system

        * A class can contain either values or classes but not both types.
        * Value elements contain only an Id attribute which refers to a value
in a raster.
            * Values tagged as excluded="true" in the values node should not be
included in any class.
-->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
        <class Id="hrb" Name="Herbaceous" filter="">
            <value Id="8" />
        </class>
        <class Id="for" Name="Forest" filter="">
            <value Id="9" />
            <value Id="10" />
            <value Id="11" />
        </class>
        <class Id="shb" Name="Shrubland" filter="">
            <value Id="12" />
        </class>
    </class>
</classes>

```

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<class Id="wtl" Name="Wetland" filter="">
    <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="13" />
        <value Id="14" />
        <value Id="16" />
        <value Id="17" />
    </class>
    <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="15" />
        <value Id="18" />
    </class>
</class>
<class Id="bar" Name="Barren" filter="">
    <value Id="19" />
    <value Id="20" />
</class>
<class Id="wtr" Name="Water" filter="">
    <value Id="21" />
    <value Id="22" />
    <value Id="23" />
    <value Id="25" />
</class>
<class Id="tun" Name="Tundra" filter="">
    <value Id="24" />
</class>
</class>
<class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
        <class Id="devh" Name="High Intensity Developed" filter="">
            <value Id="2" />
        </class>
        <class Id="devm" Name="Medium Intensity Developed" filter="">
            <value Id="3" />
        </class>
        <class Id="devl" Name="Low Intensity Developed" filter="">
            <value Id="4" />
        </class>
        <class Id="devo" Name="Open Space Developed" filter="">
            <value Id="5" />
        </class>
    </class>
    <class Id="agr" Name="Agriculture" filter="">
        <class Id="agrc" Name="Cultivated Crop" filter="">
            <value Id="6" />
        </class>
        <class Id="agrp" Name="Pasture/Hay" filter="">
            <value Id="7" />
        </class>
    </class>
</class>
<class Id="UC" Name="Unclassified" filter="">
    <value Id="1" />
</class>
</classes>
</lccSchema>

```

C-CAP LAND

C-CAP LAND

Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area.

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the C-CAP dataset go to: <http://www.csc.noaa.gov/digitalcoast/data/ccapregional>

For the data go to: <http://www.csc.noaa.gov/ccapatlas/>

C-Cap LAND - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
0	Background	yes				
1	Unclassified	yes				
2	High Intensity Developed		5.5	1.2	0.9	Ul,dev, devh
3	Medium Intensity Developed		5.5	1.2	0.6	Ul,dev, devm
4	Low Intensity Developed		5.5	1.2	0.4	Ul,dev, devl
5	Open Spaces Developed				0.1	Ul,dev, devo
6	Cultivated Crop		5.0	0.9		Ul,agr, agrc
7	Pasture/Hay		5.0	0.9		Ul,agr, agrp
8	Grassland		0.3	0.06	0.02	NI,hrb
9	Deciduous Forest		2.5	0.25	0.02	NI,for
10	Evergreen Forest		2.5	0.25	0.02	NI,for
11	Mixed Forest		2.5	0.25	0.02	NI,for
12	Scrub/Shrub		0.4	0.04	0.02	NI,shb
13	Palustrine Forested Wetland		2.5	0.25	0.02	NI, wtl, wtlw
14	Palustrine Scrub/Shrub Wetland		0.4	0.04	0.02	NI, wtl, wtlw
15	Palustrine Emergent Wetland		0.3	0.06	0.02	NI, wtl, wtle
16	Estuarine Forested Wetland		2.5	0.25	0.02	NI, wtl, wtlw
17	Estuarine Scrub/Shrub Wetland		0.4	0.04	0.02	NI, wtl, wtlw
18	Estuarine Emergent Wetland		0.3	0.06	0.02	NI, wtl, wtle
19	Unconsolidated Shore					NI,bar
20	Barren Land					NI,bar
21	Open Water	yes				
22	Palustrine Aquatic Bed	yes				
23	Estuarine Aquatic Bed	yes				
24	Tundra		0.3	0.06	0.02	NI,tun
25	Perennial Ice/Snow	yes				

C-CAP LAND - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	8,9,10,11,12,13,14,15,16,17,18,19,20,24
Herbaceous	hrb	8
Forest	for	9,10,11
Shrubland	shb	12
Wetland	wtl	13,14,15,16,17,18
Woody Wetland	wtlw	13,14,16,17
Emergent Wetland	wtle	15,18
Barren	bar	19,20
Tundra	tun	24
All Human Land Use	UI	2,3,4,5,6,7
Developed	dev	2,3,4,5
High Intensity Developed	devh	2
Medium Intensity Developed	devm	3
Low Intensity Developed	devl	4
Open Space Developed	devo	5
Agriculture	agr	6,7
Cultivated Crop	agrc	6
Pasture/Hay	agrp	7
Unclassified	UC	1

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>C-CAP LAND</name>
        <description>C-CAP LAND Land Cover Classification Schema. Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area. Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary. Complete literature citations are provided in the ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *                 - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *                 - used to exclude values from effective area calculations
        *                 - excluded=false is the default

        * A value element can optionally contain one or more coefficient
elements

        * REQUIRED COEFFICIENT ATTRIBUTES
        * Id - text, must match an Id attribute from a coefficients node
    -->

```

```

element
    * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="0" Name="Background" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="1" Name="Unclassified" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="2" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="3" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="4" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="5" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="6" Name="Cultivated Crop">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="7" Name="Pasture/Hay">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="8" Name="Grassland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="9" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="10" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="11" Name="Mixed Forest">

```

```

<coefficient Id="IMPERVIOUS" value="0.02" />
<coefficient Id="NITROGEN" value="2.5" />
<coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="12" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="13" Name="Palustrine Forested Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="14" Name="Palustrine Scrub/Shrub Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="15" Name="Palustrine Emergent Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="16" Name="Estuarine Forested Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="17" Name="Estuarine Scrub/Shrub Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="18" Name="Estuarine Emergent Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="19" Name="Unconsolidated Shore">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="20" Name="Barren Land">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="21" Name="Open Water" excluded="true">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="22" Name="Palustrine Aquatic Bed" excluded="true">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="23" Name="Estuarine Aquatic Bed" excluded="true">

```

```

<coefficient Id="IMPERVIOUS" value="0.0" />
<coefficient Id="NITROGEN" value="0.0" />
<coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="24" Name="Tundra">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="25" Name="Perennial Ice/Snow" excluded="true">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
into one or more classes.

    * REQUIRED ATTRIBUTES
        * Id - text, unique identifier, also used for automated generation of
output field name
            * - must conform to the field naming conventions dictated by the
output database system

    * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing class
        * filter - text, a string of one or more tool name abbreviations
separated by a ";"
            * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
and pm
            * - used to exclude the class from the selectable classes in
the tool's GUI
        * xxxxField - text, overrides ATtILA-generated field name for output
            * - where xxxx equals a tool name abbreviation
            * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
            * - a separate xxxxField attribute can exist for each tool
            * - must conform to the field naming conventions dictated by
the output database system

        * A class can contain either values or classes but not both types.
        * Value elements contain only an Id attribute which refers to a value
in a raster.
            * Values tagged as excluded="true" in the values node should not be
included in any class.
-->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="">
        <lcpField="NINDEX">
            <class Id="hrb" Name="Herbaceous" filter="">
                <value Id="8" />
            </class>
            <class Id="for" Name="Forest" filter="">
                <value Id="9" />
                <value Id="10" />
                <value Id="11" />
            </class>
            <class Id="shb" Name="Shrubland" filter="">
                <value Id="12" />
            </class>
        </lcpField>
    </class>
</classes>
```

```
<class Id="wtl" Name="Wetland" filter="">
    <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="13" />
        <value Id="14" />
        <value Id="16" />
        <value Id="17" />
    </class>
    <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="15" />
        <value Id="18" />
    </class>
</class>
<class Id="bar" Name="Barren" filter="">
    <value Id="19" />
    <value Id="20" />
</class>
<class Id="tun" Name="Tundra" filter="">
    <value Id="24" />
</class>
</class>
<class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
        <class Id="devh" Name="High Intensity Developed" filter="">
            <value Id="2" />
        </class>
        <class Id="devm" Name="Medium Intensity Developed" filter="">
            <value Id="3" />
        </class>
        <class Id="devl" Name="Low Intensity Developed" filter="">
            <value Id="4" />
        </class>
        <class Id="devo" Name="Open Space Developed" filter="">
            <value Id="5" />
        </class>
    </class>
    <class Id="agr" Name="Agriculture" filter="">
        <class Id="agrc" Name="Cultivated Crop" filter="">
            <value Id="6" />
        </class>
        <class Id="agrp" Name="Pasture/Hay" filter="">
            <value Id="7" />
        </class>
    </class>
</class>
<class Id="UC" Name="Unclassified" filter="">
    <value Id="1" />
</class>
</classes>
</lccSchema>
```

NLCD 2011 ALL

National Land Cover Database 2011 ALL

No raster values except those representing NODATA are excluded from the calculation of reporting unit effective area (i.e., effective area equals the total raster area within a reporting unit).

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2011 go to: <http://www.mrlc.gov/nlcd2011.php>

NLCD 2011 ALL - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water					NI
12	Perennial Ice/Snow					NI
21	Open Space Developed				0.1	UI, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	UI, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	UI, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	UI, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for
51	Dwarf Scrub		0.4	0.04	0.02	NI, tun
52	Scrub/Shrub		0.4	0.04	0.02	NI, shb
71	Grassland		0.3	0.06	0.02	NI, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	NI, tun
73	Lichen		0.3	0.06	0.02	NI, tun
74	Moss		0.3	0.06	0.02	NI, tun
81	Pasture/Hay		5.0	0.9		UI, agr, agrp
82	Cultivated Crop		5.0	0.9		UI, agr, agrc
90	Woody Wetland				0.02	NI, wtl, wtlw
95	Emergent Herbaceous Wetland				0.02	NI, wtl, wtle

NLCD 2011 ALL - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	11,12,31,41,42,43,51,52,71,72,73,74,90,95
Water	wtr	11,12
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95

Woody Wetland	wlw	90
Emergent Wetland	wle	95
All Human Land Use	UI	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23
High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 2011 ALL</name>
        <description>National Land Cover Database 2011 ALL Land Cover
Classification Schema. No raster values except those representing NODATA are
excluded from the calculation of reporting unit effective area (i.e.,
effective area equals the total raster area within a reporting unit).
Coefficient values for impervious area calculations are based on those
reported in Caraco et al. (1998). Those supplied for the nitrogen loading and
phosphorous loading estimates were obtained from Reckhow et al. (1980). As
coefficient values can vary considerably for a given land cover type across
locations, all provided values should be evaluated critically before use and
altered when necessary. Complete literature citations are provided in the
ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *                 - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *                 - used to exclude values from effective area calculations
        *                 - excluded=false is the default

        * A value element can optionally contain one or more coefficient
elements

        * REQUIRED COEFFICIENT ATTRIBUTES
        * Id - text, must match an Id attribute from a coefficients node
    -->

```

```

element
    * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="22" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="24" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="31" Name="Barren Land (Rock/Sand/Clay)">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="41" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="42" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="43" Name="Mixed Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="51" Name="Dwarf Scrub">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.4" />
        <coefficient Id="PHOSPHORUS" value="0.04" />
    </value>
    <value Id="52" Name="Scrub/Shrub">

```

```

<coefficient Id="IMPERVIOUS" value="0.02" />
<coefficient Id="NITROGEN" value="0.4" />
<coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="72" Name="Sedge/Herbaceous">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="73" Name="Lichen">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="74" Name="Moss">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pasture/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="90" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="95" Name="Emergent Herbaceous Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
 * The classes node contains values from a land cover raster grouped
 into one or more classes.

 * REQUIRED ATTRIBUTES
 * Id - text, unique identifier, also used for automated generation of
 output field name
 *      - must conform to the field naming conventions dictated by the
 output database system

 * OPTIONAL ATTRIBUTES
 * Name - text, word or phrase describing class
 * filter - text, a string of one or more tool name abbreviations
 separated by a ";"
 *          - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,

```

and pm

- * - used to exclude the class from the selectable classes in the tool's GUI
- * xxxxField - text, overrides ATtILA-generated field name for output
- * - where xxxx equals a tool name abbreviation
- * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
- * - a separate xxxxField attribute can exist for each tool
- * - must conform to the field naming conventions dictated by the output database system

* A class can contain either values or classes but not both types.

* Value elements contain only an Id attribute which refers to a value in a raster.

* Values tagged as excluded="true" in the values node should not be included in any class.

-->

```

<classes>
    <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
        <class Id="wtr" Name="Water" filter="">
            <value Id="11" />
            <value Id="12" />
        </class>
        <class Id="bar" Name="Barren" filter="">
            <value Id="31" />
        </class>
        <class Id="for" Name="Forest" filter="">
            <value Id="41" />
            <value Id="42" />
            <value Id="43" />
        </class>
        <class Id="tun" Name="Tundra" filter="">
            <value Id="51" />
            <value Id="72" />
            <value Id="73" />
            <value Id="74" />
        </class>
        <class Id="shb" Name="Shrubland" filter="">
            <value Id="52" />
        </class>
        <class Id="hrb" Name="Herbaceous" filter="">
            <value Id="71" />
        </class>
        <class Id="wtl" Name="Wetland" filter="">
            <class Id="wtlw" Name="Woody Wetland" filter="">
                <value Id="90" />
            </class>
            <class Id="wtle" Name="Emergent Wetland" filter="">
                <value Id="95" />
            </class>
        </class>
    </class>
    <class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
        <class Id="dev" Name="Developed" filter="">
            <class Id="devo" Name="Open Space Developed" filter="">
                <value Id="21" />
            </class>
            <class Id="devl" Name="Low Intensity Developed" filter="">
                <value Id="22" />
            </class>
        </class>
    </class>

```

```
<class Id="devm" Name="Medium Intensity Developed" filter="">
    <value Id="23" />
</class>
<class Id="devh" Name="High Intensity Developed" filter="">
    <value Id="24" />
</class>
</class>
<class Id="agr" Name="Agriculture" filter="">
    <class Id="agrp" Name="Pasture/Hay" filter="">
        <value Id="81" />
    </class>
    <class Id="agrc" Name="Cultivated Crop" filter="">
        <value Id="82" />
    </class>
</class>
</classes>
</lccSchema>
```

NLCD 2011 LAND

National Land Cover Database 2011 LAND

Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area.

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2011 go to: <http://www.mrlc.gov/nlcd2011.php>

NLCD 2011 LAND - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water	yes				
12	Perennial Ice/Snow	yes				
21	Open Space Developed				0.1	Ul, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	Ul, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	Ul, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for
51	Dwarf Scrub		0.4	0.04	0.02	NI, tun
52	Scrub/Shrub		0.4	0.04	0.02	NI, shb
71	Grassland		0.3	0.06	0.02	NI, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	NI, tun
73	Lichen		0.3	0.06	0.02	NI, tun
74	Moss		0.3	0.06	0.02	NI, tun
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Cultivated Crop		5.0	0.9		Ul, agr, agrc
90	Woody Wetland				0.02	NI, wtl, wtlw
95	Emergent Herbaceous Wetland				0.02	NI, wtl, wtle

NLCD 2011 LAND - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	31,41,42,43,51,52,71,72,73,74,90,95
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95

Woody Wetland	wlw	90
Emergent Wetland	wle	95
All Human Land Use	ui	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23
High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 2011 LAND</name>
        <description>National Land Cover Database 2011 LAND Land Cover
Classification Schema. Water-related raster values are tagged as EXCLUDED.
Excluded values are ignored when calculating the effective area of a reporting
unit. Percentage metrics are based on the effective area of a reporting unit,
not the total area. Coefficient values for impervious area calculations are
based on those reported in Caraco et al. (1998). Those supplied for the
nitrogen loading and phosphorous loading estimates were obtained from Reckhow
et al. (1980). As coefficient values can vary considerably for a given land
cover type across locations, all provided values should be evaluated
critically before use and altered when necessary. Complete literature
citations are provided in the ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *             - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
        -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
    -->

```

```

* OPTIONAL ATTRIBUTES
* Name - text, word or phrase describing value
* excluded - boolean, "true" or "false" or "1" or "0"
*           - used to exclude values from effective area calculations
*           - excluded=false is the default

* A value element can optionally contain one or more coefficient
elements

* REQUIRED COEFFICIENT ATTRIBUTES
* Id - text, must match an Id attribute from a coefficients node
element
* value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="22" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="24" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="31" Name="Barren Land (Rock/Sand/Clay)">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="41" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="42" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>

```

```

<value Id="43" Name="Mixed Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="51" Name="Dwarf Scrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="52" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="72" Name="Sedge/Herbaceous">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="73" Name="Lichen">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="74" Name="Moss">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pasture/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="90" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="95" Name="Emergent Herbaceous Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
 * The classes node contains values from a land cover raster grouped
 into one or more classes.

```

```

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier, also used for automated generation of
output field name
            * - must conform to the field naming conventions dictated by the
output database system

        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing class
        * filter - text, a string of one or more tool name abbreviations
separated by a ";"
            * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
and pm
            * - used to exclude the class from the selectable classes in
the tool's GUI
            * xxxxField - text, overrides ATtILA-generated field name for output
            * - where xxxx equals a tool name abbreviation
            * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
            * - a separate xxxxField attribute can exist for each tool
            * - must conform to the field naming conventions dictated by
the output database system

        * A class can contain either values or classes but not both types.
        * Value elements contain only an Id attribute which refers to a value
in a raster.
        * Values tagged as excluded="true" in the values node should not be
included in any class.
-->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
        <class Id="bar" Name="Barren" filter="">
            <value Id="31" />
        </class>
        <class Id="for" Name="Forest" filter="">
            <value Id="41" />
            <value Id="42" />
            <value Id="43" />
        </class>
        <class Id="tun" Name="Tundra" filter="">
            <value Id="51" />
            <value Id="72" />
            <value Id="73" />
            <value Id="74" />
        </class>
        <class Id="shb" Name="Shrubland" filter="">
            <value Id="52" />
        </class>
        <class Id="hrb" Name="Herbaceous" filter="">
            <value Id="71" />
        </class>
        <class Id="wtl" Name="Wetland" filter="">
            <class Id="wtlw" Name="Woody Wetland" filter="">
                <value Id="90" />
            </class>
            <class Id="wtle" Name="Emergent Wetland" filter="">
                <value Id="95" />
            </class>
        </class>
    </class>
    <class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">

```

```

<class Id="dev" Name="Developed" filter="">
    <class Id="devo" Name="Open Space Developed" filter="">
        <value Id="21" />
    </class>
    <class Id="devl" Name="Low Intensity Developed" filter="">
        <value Id="22" />
    </class>
    <class Id="devm" Name="Medium Intensity Developed" filter="">
        <value Id="23" />
    </class>
    <class Id="devh" Name="High Intensity Developed" filter="">
        <value Id="24" />
    </class>
</class>
<class Id="agr" Name="Agriculture" filter="">
    <class Id="agrp" Name="Pasture/Hay" filter="">
        <value Id="81" />
    </class>
    <class Id="agrc" Name="Cultivated Crop" filter="">
        <value Id="82" />
    </class>
</class>
</classes>
</lccSchema>

```

NLCD 2006 ALL

National Land Cover Database 2006 ALL

No raster values except those representing NODATA are excluded from the calculation of reporting unit effective area (i.e., effective area equals the total raster area within a reporting unit).

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2006 go to: <http://www.mrlc.gov/nlcd2006.php>

NLCD 2006 ALL - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water					NI
12	Perennial Ice/Snow					NI
21	Open Space Developed				0.1	Ul, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	Ul, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	Ul, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for

51	Dwarf Scrub		0.4	0.04	0.02	NI, tun
52	Scrub/Shrub		0.4	0.04	0.02	NI, shb
71	Grassland		0.3	0.06	0.02	NI, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	NI, tun
73	Lichen		0.3	0.06	0.02	NI, tun
74	Moss		0.3	0.06	0.02	NI, tun
81	Pasture/Hay		5.0	0.9		UI, agr, agrp
82	Cultivated Crop		5.0	0.9		UI, agr, agrc
90	Woody Wetland				0.02	NI, wtl, wtlw
95	Emergent Herbaceous Wetland				0.02	NI, wtl, wtle

NLCD 2006 ALL - Class Table		
Class Name	abbr	Value
All Natural Land Use	NI	11,12,31,41,42,43,51,52,71,72,73,74,90,95
Water	wtr	11,12
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95
Woody Wetland	wtlw	90
Emergent Wetland	wtle	95
All Human Land Use	UI	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23
High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 2006 ALL</name>
        <description>National Land Cover Database 2006 ALL Land Cover
Classification Schema. No raster values except those representing NODATA are
excluded from the calculation of reporting unit effective area (i.e.,
effective area equals the total raster area within a reporting unit).
Coefficient values for impervious area calculations are based on those
reported in Caraco et al. (1998). Those supplied for the nitrogen loading and
phosphorous loading estimates were obtained from Reckhow et al. (1980). As
coefficient values can vary considerably for a given land cover type across
locations, all provided values should be evaluated critically before use and
altered when necessary. Complete literature citations are provided in the
ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.
    -->

```

```

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *           - must conform to the field naming conventions dictated by
the output database system
            * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
-->
<coefficients>
    <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
    <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
    <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
</coefficients>
<!--
    * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *           - used to exclude values from effective area calculations
        *           - excluded=false is the default

    * A value element can optionally contain one or more coefficient
elements

        * REQUIRED COEFFICIENT ATTRIBUTES
        * Id - text, must match an Id attribute from a coefficients node
element
            * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="22" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>

```

```
<value Id="23" Name="Medium Intensity Developed">
    <coefficient Id="IMPERVIOUS" value="0.6" />
    <coefficient Id="NITROGEN" value="5.5" />
    <coefficient Id="PHOSPHORUS" value="1.2" />
</value>
<value Id="24" Name="High Intensity Developed">
    <coefficient Id="IMPERVIOUS" value="0.9" />
    <coefficient Id="NITROGEN" value="5.5" />
    <coefficient Id="PHOSPHORUS" value="1.2" />
</value>
<value Id="31" Name="Barren Land (Rock/Sand/Clay)">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="41" Name="Deciduous Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="42" Name="Evergreen Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="43" Name="Mixed Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="51" Name="Dwarf Scrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="52" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="72" Name="Sedge/Herbaceous">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="73" Name="Lichen">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="74" Name="Moss">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
```

```

<value Id="81" Name="Pasture/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="90" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="95" Name="Emergent Herbaceous Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
    into one or more classes.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier, also used for automated generation of
    output field name
        * - must conform to the field naming conventions dictated by the
    output database system

    * OPTIONAL ATTRIBUTES
    * Name - text, word or phrase describing class
    * filter - text, a string of one or more tool name abbreviations
    separated by a ";"
        * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
    and pm
        * - used to exclude the class from the selectable classes in
    the tool's GUI
        * xxxxField - text, overrides ATtILA-generated field name for output
        * - where xxxx equals a tool name abbreviation
        * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
        * - a separate xxxxField attribute can exist for each tool
        * - must conform to the field naming conventions dictated by
    the output database system

    * A class can contain either values or classes but not both types.
    * Value elements contain only an Id attribute which refers to a value
    in a raster.
        * Values tagged as excluded="true" in the values node should not be
    included in any class.
-->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
        <class Id="wtr" Name="Water" filter="">
            <value Id="11" />
            <value Id="12" />
        </class>
        <class Id="bar" Name="Barren" filter="">

```

```

        <value Id="31" />
    </class>
    <class Id="for" Name="Forest" filter="">
        <value Id="41" />
        <value Id="42" />
        <value Id="43" />
    </class>
    <class Id="tun" Name="Tundra" filter="">
        <value Id="51" />
        <value Id="72" />
        <value Id="73" />
        <value Id="74" />
    </class>
    <class Id="shb" Name="Shrubland" filter="">
        <value Id="52" />
    </class>
    <class Id="hrb" Name="Herbaceous" filter="">
        <value Id="71" />
    </class>
    <class Id="wtl" Name="Wetland" filter="">
        <class Id="wtlw" Name="Woody Wetland" filter="">
            <value Id="90" />
        </class>
        <class Id="wtle" Name="Emergent Wetland" filter="">
            <value Id="95" />
        </class>
    </class>
</class>
<class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
        <class Id="devo" Name="Open Space Developed" filter="">
            <value Id="21" />
        </class>
        <class Id="devl" Name="Low Intensity Developed" filter="">
            <value Id="22" />
        </class>
        <class Id="devm" Name="Medium Intensity Developed" filter="">
            <value Id="23" />
        </class>
        <class Id="devh" Name="High Intensity Developed" filter="">
            <value Id="24" />
        </class>
    </class>
    <class Id="agr" Name="Agriculture" filter="">
        <class Id="agrp" Name="Pasture/Hay" filter="">
            <value Id="81" />
        </class>
        <class Id="agrc" Name="Cultivated Crop" filter="">
            <value Id="82" />
        </class>
    </class>
</classes>
</lccSchema>

```

NLCD 2006 LAND

National Land Cover Database 2006 LAND

Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when

calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area.

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2006 go to: <http://www.mrlc.gov/nlcd2006.php>

NLCD 2006 LAND - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water	yes				
12	Perennial Ice/Snow	yes				
21	Open Space Developed				0.1	Ul, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	Ul, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	Ul, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					Nl, bar
41	Deciduous Forest		2.5	0.25	0.02	Nl, for
42	Evergreen Forest		2.5	0.25	0.02	Nl, for
43	Mixed Forest		2.5	0.25	0.02	Nl, for
51	Dwarf Scrub		0.4	0.04	0.02	Nl, tun
52	Scrub/Shrub		0.4	0.04	0.02	Nl, shb
71	Grassland		0.3	0.06	0.02	Nl, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	Nl, tun
73	Lichen		0.3	0.06	0.02	Nl, tun
74	Moss		0.3	0.06	0.02	Nl, tun
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Cultivated Crop		5.0	0.9		Ul, agr, agrc
90	Woody Wetland				0.02	Nl, wtl, wtlw
95	Emergent Herbaceous Wetland				0.02	Nl, wtl, wtle

NLCD 2006 LAND - Class Table		
Class Name	abbv	Value
All Natural Land Use	Nl	31,41,42,43,51,52,71,72,73,74,90,95
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95
Woody Wetland	wtlw	90
Emergent Wetland	wtle	95
All Human Land Use	Ul	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23

High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 2006 LAND</name>
        <description>National Land Cover Database 2006 LAND Land Cover
Classification Schema. Water-related raster values are tagged as EXCLUDED.
Excluded values are ignored when calculating the effective area of a reporting
unit. Percentage metrics are based on the effective area of a reporting unit,
not the total area. Coefficient values for impervious area calculations are
based on those reported in Caraco et al. (1998). Those supplied for the
nitrogen loading and phosphorous loading estimates were obtained from Reckhow
et al. (1980). As coefficient values can vary considerably for a given land
cover type across locations, all provided values should be evaluated
critically before use and altered when necessary. Complete literature
citations are provided in the ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *
            - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *
            - used to exclude values from effective area calculations
        *
            - excluded=false is the default

        * A value element can optionally contain one or more coefficient
elements
    -->

```

```

        * REQUIRED COEFFICIENT ATTRIBUTES
        * Id - text, must match an Id attribute from a coefficients node
element
        * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="22" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="24" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="31" Name="Barren Land (Rock/Sand/Clay)">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="41" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="42" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="43" Name="Mixed Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="51" Name="Dwarf Scrub">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.4" />
    </value>

```

```

        <coefficient Id="PHOSPHORUS" value="0.04" />
    </value>
    <value Id="52" Name="Scrub/Shrub">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.4" />
        <coefficient Id="PHOSPHORUS" value="0.04" />
    </value>
    <value Id="71" Name="Grassland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="72" Name="Sedge/Herbaceous">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="73" Name="Lichen">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="74" Name="Moss">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.3" />
        <coefficient Id="PHOSPHORUS" value="0.06" />
    </value>
    <value Id="81" Name="Pasture/Hay">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="82" Name="Cultivated Crop">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="5.0" />
        <coefficient Id="PHOSPHORUS" value="0.9" />
    </value>
    <value Id="90" Name="Woody Wetland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="95" Name="Emergent Herbaceous Wetland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
</values>
<!--
 * The classes node contains values from a land cover raster grouped
 into one or more classes.

 * REQUIRED ATTRIBUTES
 * Id - text, unique identifier, also used for automated generation of
 output field name
 *      - must conform to the field naming conventions dictated by the
 output database system

 * OPTIONAL ATTRIBUTES
 * Name - text, word or phrase describing class

```

```

        * filter - text, a string of one or more tool name abbreviations
separated by a ";"  

        * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,  

and pm  

        * - used to exclude the class from the selectable classes in  

the tool's GUI  

        * xxxxField - text, overrides ATtILA-generated field name for output  

        * - where xxxx equals a tool name abbreviation  

        * - possible abbreviations are: lcp, rlcp, lcosp, and splcp  

        * - a separate xxxxField attribute can exist for each tool  

        * - must conform to the field naming conventions dictated by  

the output database system

        * A class can contain either values or classes but not both types.  

        * Value elements contain only an Id attribute which refers to a value  

in a raster.  

        * Values tagged as excluded="true" in the values node should not be  

included in any class.  

-->  

<classes>  

    <class Id="NI" Name="All Natural Land Use" filter=""  

lcpField="NINDEX">  

        <class Id="bar" Name="Barren" filter="">  

            <value Id="31" />  

        </class>  

        <class Id="for" Name="Forest" filter="">  

            <value Id="41" />  

            <value Id="42" />  

            <value Id="43" />  

        </class>  

        <class Id="tun" Name="Tundra" filter="">  

            <value Id="51" />  

            <value Id="72" />  

            <value Id="73" />  

            <value Id="74" />  

        </class>  

        <class Id="shb" Name="Shrubland" filter="">  

            <value Id="52" />  

        </class>  

        <class Id="hrb" Name="Herbaceous" filter="">  

            <value Id="71" />  

        </class>  

        <class Id="wtl" Name="Wetland" filter="">  

            <class Id="wtlw" Name="Woody Wetland" filter="">  

                <value Id="90" />  

            </class>  

            <class Id="wtle" Name="Emergent Wetland" filter="">  

                <value Id="95" />  

            </class>  

        </class>  

    </class>  

    <class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">  

        <class Id="dev" Name="Developed" filter="">  

            <class Id="devo" Name="Open Space Developed" filter="">  

                <value Id="21" />  

            </class>  

            <class Id="devl" Name="Low Intensity Developed" filter="">  

                <value Id="22" />  

            </class>  

            <class Id="devm" Name="Medium Intensity Developed" filter="">
```

```

        <value Id="23" />
    </class>
    <class Id="devh" Name="High Intensity Developed" filter="">
        <value Id="24" />
    </class>
</class>
<class Id="agr" Name="Agriculture" filter="">
    <class Id="agrp" Name="Pasture/Hay" filter="">
        <value Id="81" />
    </class>
    <class Id="agrc" Name="Cultivated Crop" filter="">
        <value Id="82" />
    </class>
</class>
</class>
</classes>
</lccSchema>

```

NLCD 2001 ALL

National Land Cover Database 2001 ALL

No raster values except those representing NODATA are excluded from the calculation of reporting unit effective area (i.e., effective area equals the total raster area within a reporting unit).

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2001 go to: <http://www.mrlc.gov/nlcd2001.php>

NLCD 2001 ALL - Value Table

Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water					NI
12	Perennial Ice/Snow					NI
21	Open Space Developed				0.1	Ul, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	Ul, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	Ul, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for
51	Dwarf Scrub		0.4	0.04	0.02	NI, tun
52	Scrub/Shrub		0.4	0.04	0.02	NI, shb
71	Grassland		0.3	0.06	0.02	NI, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	NI, tun
73	Lichen		0.3	0.06	0.02	NI, tun
74	Moss		0.3	0.06	0.02	NI, tun
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Cultivated Crop		5.0	0.9		Ul, agr, agrc
90	Woody Wetland				0.02	NI, wtl, wtlw

95	Emergent Herbaceous Wetland				0.02	NI, wtl, wtle
----	-----------------------------	--	--	--	------	---------------

NLCD 2001 ALL - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	11,12,31,41,42,43,51,52,71,72,73,74,90,95
Water	wtr	11,12
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95
Woody Wetland	wtlw	90
Emergent Wetland	wtle	95
All Human Land Use	UI	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23
High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
  <metadata>
    <name>NLCD 2001 ALL</name>
    <description>National Land Cover Database 2001 ALL Land Cover
Classification Schema. No raster values except those representing NODATA are
excluded from the calculation of reporting unit effective area (i.e.,
effective area equals the total raster area within a reporting unit).
Coefficient values for impervious area calculations are based on those
reported in Caraco et al. (1998). Those supplied for the nitrogen loading and
phosphorous loading estimates were obtained from Reckhow et al. (1980). As
coefficient values can vary considerably for a given land cover type across
locations, all provided values should be evaluated critically before use and
altered when necessary. Complete literature citations are provided in the
ATtILA for ArcGIS help file.</description>
  </metadata>
  <!--
    * The coefficients node contains coefficients to be assigned to
values.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier
    * Name - text, word or phrase describing coefficient
    * fieldName - text, name of field to be created for output
    *             - must conform to the field naming conventions dictated by
the output database system
    * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
  -->

```

```

-->
<coefficients>
    <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
    <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
    <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
</coefficients>
<!--
    * The values node defines the full set of values that can exist in a
land cover raster.

    * REQUIRED ATTRIBUTES
    * Id - integer, raster code
    *
    * OPTIONAL ATTRIBUTES
    * Name - text, word or phrase describing value
    * excluded - boolean, "true" or "false" or "1" or "0"
    *           - used to exclude values from effective area calculations
    *           - excluded=false is the default

    * A value element can optionally contain one or more coefficient
elements

    * REQUIRED COEFFICIENT ATTRIBUTES
    * Id - text, must match an Id attribute from a coefficients node
element
        * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Open Space Developed">
        <coefficient Id="IMPERVIOUS" value="0.1" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="22" Name="Low Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="Medium Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="24" Name="High Intensity Developed">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>

```

```
</value>
<value Id="31" Name="Barren Land (Rock/Sand/Clay)">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="41" Name="Deciduous Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="42" Name="Evergreen Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="43" Name="Mixed Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="51" Name="Dwarf Scrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="52" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="72" Name="Sedge/Herbaceous">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="73" Name="Lichen">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="74" Name="Moss">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pasture/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
```

```

    </value>
<value Id="90" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="95" Name="Emergent Herbaceous Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
    into one or more classes.

    * REQUIRED ATTRIBUTES
        * Id - text, unique identifier, also used for automated generation of
        output field name
            * - must conform to the field naming conventions dictated by the
        output database system

    * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing class
        * filter - text, a string of one or more tool name abbreviations
        separated by a ";"
            * - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
        and pm
            * - used to exclude the class from the selectable classes in
        the tool's GUI
        * xxxxField - text, overrides ATtILA-generated field name for output
            * - where xxxx equals a tool name abbreviation
            * - possible abbreviations are: lcp, rlcp, lcosp, and splcp
            * - a separate xxxxField attribute can exist for each tool
            * - must conform to the field naming conventions dictated by
        the output database system

    * A class can contain either values or classes but not both types.
    * Value elements contain only an Id attribute which refers to a value
    in a raster.
        * Values tagged as excluded="true" in the values node should not be
    included in any class.
    -->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="">
        <lcpField=NINDEX>
            <class Id="wtr" Name="Water" filter="">
                <value Id="11" />
                <value Id="12" />
            </class>
            <class Id="bar" Name="Barren" filter="">
                <value Id="31" />
            </class>
            <class Id="for" Name="Forest" filter="">
                <value Id="41" />
                <value Id="42" />
                <value Id="43" />
            </class>
            <class Id="tun" Name="Tundra" filter="">
                <value Id="51" />

```

```

<value Id="72" />
<value Id="73" />
<value Id="74" />
</class>
<class Id="shb" Name="Shrubland" filter="">
    <value Id="52" />
</class>
<class Id="hrb" Name="Herbaceous" filter="">
    <value Id="71" />
</class>
<class Id="wtl" Name="Wetland" filter="">
    <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="90" />
    </class>
    <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="95" />
    </class>
</class>
</class>
<class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
        <class Id="devo" Name="Open Space Developed" filter="">
            <value Id="21" />
        </class>
        <class Id="devl" Name="Low Intensity Developed" filter="">
            <value Id="22" />
        </class>
        <class Id="devm" Name="Medium Intensity Developed" filter="">
            <value Id="23" />
        </class>
        <class Id="devh" Name="High Intensity Developed" filter="">
            <value Id="24" />
        </class>
    </class>
    <class Id="agr" Name="Agriculture" filter="">
        <class Id="agrp" Name="Pasture/Hay" filter="">
            <value Id="81" />
        </class>
        <class Id="agrc" Name="Cultivated Crop" filter="">
            <value Id="82" />
        </class>
    </class>
</class>
</classes>
</lccSchema>

```

NLCD 2001 LAND

National Land Cover Database 2001 LAND

Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area.

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 2001 go to: <http://www.mrlc.gov/nlcd2001.php>

NLCD 2001 LAND - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water	yes				
12	Perennial Ice/Snow	yes				
21	Open Space Developed				0.1	Ul, dev, devo
22	Low Intensity Developed		5.5	1.2	0.4	Ul, dev, devl
23	Medium Intensity Developed		5.5	1.2	0.6	Ul, dev, devm
24	High Intensity Developed		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					Nl, bar
41	Deciduous Forest		2.5	0.25	0.02	Nl, for
42	Evergreen Forest		2.5	0.25	0.02	Nl, for
43	Mixed Forest		2.5	0.25	0.02	Nl, for
51	Dwarf Scrub		0.4	0.04	0.02	Nl, tun
52	Scrub/Shrub		0.4	0.04	0.02	Nl, shb
71	Grassland		0.3	0.06	0.02	Nl, hrb
72	Sedge/Herbaceous		0.3	0.06	0.02	Nl, tun
73	Lichen		0.3	0.06	0.02	Nl, tun
74	Moss		0.3	0.06	0.02	Nl, tun
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Cultivated Crop		5.0	0.9		Ul, agr, agrc
90	Woody Wetland				0.02	Nl, wtl, wtlw
95	Emergent Herbaceous Wetland				0.02	Nl, wtl, wtle

NLCD 2001 LAND - Class Table		
Class Name	abbv	Value
All Natural Land Use	Nl	31,41,42,43,51,52,71,72,73,74,90,95
Barren	bar	31
Forest	for	41,42,43
Tundra	tun	51,72,73,74
Shrubland	shb	52
Herbaceous	hrb	71
Wetland	wtl	90,95
Woody Wetland	wtlw	90
Emergent Wetland	wtle	95
All Human Land Use	Ul	21,22,23,24,81,82
Developed	dev	21,22,23,24
Open Space Developed	devo	21
Low Intensity Developed	devl	22
Medium Intensity Developed	devm	23
High Intensity Developed	devh	24
Agriculture	agr	81,82
Pasture/Hay	agrp	81
Cultivated Crop	agrc	82

XML

```
<?xml version='1.0' encoding='UTF-8'?>
```

```

<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
  <metadata>
    <name>NLCD 2001 LAND</name>
    <description>National Land Cover Database 2001 LAND Land Cover
Classification Schema. Water-related raster values are tagged as EXCLUDED.
Excluded values are ignored when calculating the effective area of a reporting
unit. Percentage metrics are based on the effective area of a reporting unit,
not the total area. Coefficient values for impervious area calculations are
based on those reported in Caraco et al. (1998). Those supplied for the
nitrogen loading and phosphorous loading estimates were obtained from Reckhow
et al. (1980). As coefficient values can vary considerably for a given land
cover type across locations, all provided values should be evaluated
critically before use and altered when necessary. Complete literature
citations are provided in the ATtILA for ArcGIS help file.</description>
  </metadata>
  <!--
    * The coefficients node contains coefficients to be assigned to
values.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier
    * Name - text, word or phrase describing coefficient
    * fieldName - text, name of field to be created for output
      *           - must conform to the field naming conventions dictated by
the output database system
    * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
  <coefficients>
    <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
    <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
    <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
  </coefficients>
  <!--
    * The values node defines the full set of values that can exist in a
land cover raster.

    * REQUIRED ATTRIBUTES
    * Id - integer, raster code
    *
    * OPTIONAL ATTRIBUTES
    * Name - text, word or phrase describing value
    * excluded - boolean, "true" or "false" or "1" or "0"
      *           - used to exclude values from effective area calculations
      *           - excluded=false is the default

    * A value element can optionally contain one or more coefficient
elements

    * REQUIRED COEFFICIENT ATTRIBUTES
    * Id - text, must match an Id attribute from a coefficients node
element
      * value - decimal, weighting/calculation factor
    -->
  <values>
    <value Id="11" Name="Open Water" excluded="true">

```

```
<coefficient Id="IMPERVIOUS" value="0.0" />
<coefficient Id="NITROGEN" value="0.0" />
<coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="12" Name="Perennial Ice/Snow" excluded="true">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="21" Name="Open Space Developed">
    <coefficient Id="IMPERVIOUS" value="0.1" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="22" Name="Low Intensity Developed">
    <coefficient Id="IMPERVIOUS" value="0.4" />
    <coefficient Id="NITROGEN" value="5.5" />
    <coefficient Id="PHOSPHORUS" value="1.2" />
</value>
<value Id="23" Name="Medium Intensity Developed">
    <coefficient Id="IMPERVIOUS" value="0.6" />
    <coefficient Id="NITROGEN" value="5.5" />
    <coefficient Id="PHOSPHORUS" value="1.2" />
</value>
<value Id="24" Name="High Intensity Developed">
    <coefficient Id="IMPERVIOUS" value="0.9" />
    <coefficient Id="NITROGEN" value="5.5" />
    <coefficient Id="PHOSPHORUS" value="1.2" />
</value>
<value Id="31" Name="Barren Land (Rock/Sand/Clay)">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="41" Name="Deciduous Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="42" Name="Evergreen Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="43" Name="Mixed Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="51" Name="Dwarf Scrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="52" Name="Scrub/Shrub">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="71" Name="Grassland">
```

```

<coefficient Id="IMPERVIOUS" value="0.02" />
<coefficient Id="NITROGEN" value="0.3" />
<coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="72" Name="Sedge/Herbaceous">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="73" Name="Lichen">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="74" Name="Moss">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pasture/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="90" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="95" Name="Emergent Herbaceous Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
    into one or more classes.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier, also used for automated generation of
    output field name
    *      - must conform to the field naming conventions dictated by the
    output database system

    * OPTIONAL ATTRIBUTES
    * Name - text, word or phrase describing class
    * filter - text, a string of one or more tool name abbreviations
    separated by a ";"
    *      - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
    and pm
    *      - used to exclude the class from the selectable classes in
    the tool's GUI
    * xxxxField - text, overrides ATtILA-generated field name for output
    *              - where xxxx equals a tool name abbreviation
-->
```

```

*
*      - possible abbreviations are: lcp, rlcp, lcosp, and splcp
*      - a separate xxxxField attribute can exist for each tool
*      - must conform to the field naming conventions dictated by
the output database system

* A class can contain either values or classes but not both types.
* Value elements contain only an Id attribute which refers to a value
in a raster.
* Values tagged as excluded="true" in the values node should not be
included in any class.

-->
<classes>
  <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
    <class Id="bar" Name="Barren" filter="">
      <value Id="31" />
    </class>
    <class Id="for" Name="Forest" filter="">
      <value Id="41" />
      <value Id="42" />
      <value Id="43" />
    </class>
    <class Id="tun" Name="Tundra" filter="">
      <value Id="51" />
      <value Id="72" />
      <value Id="73" />
      <value Id="74" />
    </class>
    <class Id="shb" Name="Shrubland" filter="">
      <value Id="52" />
    </class>
    <class Id="hrb" Name="Herbaceous" filter="">
      <value Id="71" />
    </class>
    <class Id="wtl" Name="Wetland" filter="">
      <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="90" />
      </class>
      <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="95" />
      </class>
    </class>
  </class>
  <class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
      <class Id="devo" Name="Open Space Developed" filter="">
        <value Id="21" />
      </class>
      <class Id="devl" Name="Low Intensity Developed" filter="">
        <value Id="22" />
      </class>
      <class Id="devm" Name="Medium Intensity Developed" filter="">
        <value Id="23" />
      </class>
      <class Id="devh" Name="High Intensity Developed" filter="">
        <value Id="24" />
      </class>
    </class>
    <class Id="agr" Name="Agriculture" filter="">
      <class Id="agrp" Name="Pasture/Hay" filter="">

```

```

        <value Id="81" />
    </class>
    <class Id="agrc" Name="Cultivated Crop" filter="">
        <value Id="82" />
    </class>
</class>
</classes>
</lccSchema>

```

NLCD 1992 ALL

National Land Cover Database 1992 ALL

No raster values except those representing NODATA are excluded from the calculation of reporting unit effective area (i.e., effective area equals the total raster area within a reporting unit).

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 1992 go to: <http://www.mrlc.gov/nlcd1992.php>

NLCD 1992 ALL - Value Table

Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water					NI
12	Perennial Ice/Snow					NI
21	Low Intensity Developed (Residential)		5.5	1.2	0.4	Ul, dev, devl
22	Medium Intensity Developed (Residential)		5.5	1.2	0.6	Ul, dev, devm
23	High Intensity Developed (Commercial/Industrial/Transportation)		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
32	Quarry/Strip Mine/Gravel Pit					Ul, mmb
33	Transitional					Ul, mmb
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for
51	Shrubland		0.4	0.04	0.02	NI, shb
61	Orchard/Vineyard/Other Cultivated Crop		6.0	0.8		Ul, agr, agrc
71	Grassland		0.3	0.06	0.02	NI, hrb
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Row Crop		8.5	2.3		Ul, agr, agrc
83	Small Grain		6.0	0.8		Ul, agr, agrc
84	Fallow					Ul, agr, agrc
85	Open Space Developed (Urban Grass/Recreational Grass)				0.1	Ul, dev, devo
91	Woody Wetland				0.02	NI, wtl, wtlw

NLCD 1992 ALL - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	11,12,31,41,42,43,51,71,91,92
Water	wtr	11,12
Barren	bar	31
Forest	for	41,42,43
Shrubland	shb	51
Herbaceous	hrb	71
Wetland	wtl	91,92
Woody Wetland	wtlw	91
Emergent Wetland	wtle	92
All Human Land Use	UI	21,22,23,32,33,61,81,82,83,84,85
Developed	dev	21,22,23,85
Man-Made Barren	mmb	32,33
Agriculture	agr	61,81,82,83,84
Pasture/Hay	agrp	81
Cultivated Crop	agrc	61,82,83,84

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 1992 ALL</name>
        <description>National Land Cover Database 1992 ALL Land Cover
Classification Schema. No raster values except those representing NODATA are
excluded from the calculation of reporting unit effective area (i.e.,
effective area equals the total raster area within a reporting unit).
Coefficient values for impervious area calculations are based on those
reported in Caraco et al. (1998). Those supplied for the nitrogen loading and
phosphorous loading estimates were obtained from Reckhow et al. (1980). As
coefficient values can vary considerably for a given land cover type across
locations, all provided values should be evaluated critically before use and
altered when necessary. Complete literature citations are provided in the
ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *             - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
        -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on

```

```

Land Cover" fieldName="N_Load" method="A" />
    <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
</coefficients>
<!--
    * The values node defines the full set of values that can exist in a
land cover raster.

    * REQUIRED ATTRIBUTES
    * Id - integer, raster code
    *
    * OPTIONAL ATTRIBUTES
    * Name - text, word or phrase describing value
    * excluded - boolean, "true" or "false" or "1" or "0"
    *           - used to exclude values from effective area calculations
    *           - excluded=false is the default

    * A value element can optionally contain one or more coefficient
elements

    * REQUIRED COEFFICIENT ATTRIBUTES
    * Id - text, must match an Id attribute from a coefficients node
element
        * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Low Intensity Developed (Residential)">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="22" Name="Medium Intensity Developed (Residential)">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="High Intensity Developed (Commercial/Industrial/
Transportation)">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="31" Name="Barren Land (Rock/Sand/Clay)">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="32" Name="Quarry/Strip Mine/Gravel Pit">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />

```

```
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
<value Id="33" Name="Transitional">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="41" Name="Deciduous Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="42" Name="Evergreen Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="43" Name="Mixed Forest">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="2.5" />
    <coefficient Id="PHOSPHORUS" value="0.25" />
</value>
<value Id="51" Name="Shrubland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="61" Name="Orchard/Vineyard/Other Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="6.0" />
    <coefficient Id="PHOSPHORUS" value="0.8" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pature/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Row Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="8.5" />
    <coefficient Id="PHOSPHORUS" value="2.3" />
</value>
<value Id="83" Name="Small Grain">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="6.0" />
    <coefficient Id="PHOSPHORUS" value="0.8" />
</value>
<value Id="84" Name="Fallow">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="85" Name="Open Space Developed (Urban Grass/Recreational Grass)">
    <coefficient Id="IMPERVIOUS" value="0.1" />
```

```

        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="91" Name="Woody Wetland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="92" Name="Emergent Wetland">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
</values>
<!--
     * The classes node contains values from a land cover raster grouped
into one or more classes.

     * REQUIRED ATTRIBUTES
     * Id - text, unique identifier, also used for automated generation of
output field name
         *      - must conform to the field naming conventions dictated by the
output database system

     * OPTIONAL ATTRIBUTES
     * Name - text, word or phrase describing class
     * filter - text, a string of one or more tool name abbreviations
separated by a ";"
         *      - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
and pm
         *      - used to exclude the class from the selectable classes in
the tool's GUI
         * xxxxField - text, overrides ATtILA-generated field name for output
         *      - where xxxx equals a tool name abbreviation
         *      - possible abbreviations are: lcp, rlcp, lcosp, and splcp
         *      - a separate xxxxField attribute can exist for each tool
         *      - must conform to the field naming conventions dictated by
the output database system

     * A class can contain either values or classes but not both types.
     * Value elements contain only an Id attribute which refers to a value
in a raster.
         * Values tagged as excluded="true" in the values node should not be
included in any class.
-->
<classes>
    <class Id="NI" Name="All Natural Land Use" filter="">
        <lcpField="NINDEX">
            <class Id="wtr" Name="Water" filter="">
                <value Id="11" />
                <value Id="12" />
            </class>
            <class Id="bar" Name="Barren" filter="">
                <value Id="31" />
            </class>
            <class Id="for" Name="Forest" filter="">
                <value Id="41" />
                <value Id="42" />
                <value Id="43" />
            </class>

```

```

<class Id="shb" Name="Shrubland" filter="">
    <value Id="51" />
</class>
<class Id="hrb" Name="Herbaceous" filter="">
    <value Id="71" />
</class>
<class Id="wtl" Name="Wetland" filter="">
    <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="91" />
    </class>
    <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="92" />
    </class>
</class>
<class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
        <class Id="devl" Name="Low Intensity Developed" filter="">
            <value Id="21" />
        </class>
        <class Id="devm" Name="Medium Intensity Developed" filter="">
            <value Id="22" />
        </class>
        <class Id="devh" Name="High Intensity Developed" filter="">
            <value Id="23" />
        </class>
        <class Id="devo" Name="Open Space Developed" filter="">
            <value Id="85" />
        </class>
    </class>
    <class Id="mmrb" Name="Man-Made Barren" filter="">
        <value Id="32" />
        <value Id="33" />
    </class>
    <class Id="agr" Name="Agriculture" filter="">
        <class Id="agrp" Name="Pasture/Hay" filter="">
            <value Id="81" />
        </class>
        <class Id="agrc" Name="Cultivated Crop" filter="">
            <value Id="61" />
            <value Id="82" />
            <value Id="83" />
            <value Id="84" />
        </class>
    </class>
</classes>
</lccSchema>

```

NLCD 1992 LAND

National Land Cover Database 1992 LAND

Water-related raster values are tagged as EXCLUDED. Excluded values are ignored when calculating the effective area of a reporting unit. Percentage metrics are based on the effective area of a reporting unit, not the total area.

Coefficient values for impervious area calculations are based on those reported in Caraco et al. (1998). Those supplied for the nitrogen loading and phosphorous loading estimates were

obtained from Reckhow et al. (1980). As coefficient values can vary considerably for a given land cover type across locations, all provided values should be evaluated critically before use and altered when necessary.

For more information about the National Land Cover Dataset 1992 go to: <http://www.mrlc.gov/nlcd1992.php>

NLCD 1992 LAND - Value Table						
Value	Description	Excluded	Nitrogen	Phosphorus	Impervious	Class(es)
11	Open Water	yes				
12	Perennial Ice/Snow	yes				
21	Low Intensity Developed (Residential)		5.5	1.2	0.4	Ul, dev, devl
22	Medium Intensity Developed (Residential)		5.5	1.2	0.6	Ul, dev, devm
23	High Intensity Developed (Commercial/Industrial/Transportation)		5.5	1.2	0.9	Ul, dev, devh
31	Barren Land (Rock/Sand/Clay)					NI, bar
32	Quarry/Strip Mine/Gravel Pit					Ul, mmb
33	Transitional					Ul, mmb
41	Deciduous Forest		2.5	0.25	0.02	NI, for
42	Evergreen Forest		2.5	0.25	0.02	NI, for
43	Mixed Forest		2.5	0.25	0.02	NI, for
51	Shrubland		0.4	0.04	0.02	NI, shb
61	Orchard/Vineyard/Other Cultivated Crop		6.0	0.8		Ul, agr, agrc
71	Grassland		0.3	0.06	0.02	NI, hrb
81	Pasture/Hay		5.0	0.9		Ul, agr, agrp
82	Row Crop		8.5	2.3		Ul, agr, agrc
83	Small Grain		6.0	0.8		Ul, agr, agrc
84	Fallow					Ul, agr, agrc
85	Open Space Developed (Urban Grass/Recreational Grass)				0.1	Ul, dev, devo
91	Woody Wetland				0.02	NI, wtl, wtlw
92	Emergent Wetland				0.02	NI, wtl, wtle

NLCD 1992 LAND - Class Table		
Class Name	abbv	Value
All Natural Land Use	NI	31,41,42,43,51,71,91,92
Barren	bar	31
Forest	for	41,42,43
Shrubland	shb	51
Herbaceous	hrb	71
Wetland	wtl	91,92
Woody Wetland	wtlw	91
Emergent Wetland	wtle	92
All Human Land Use	Ul	21,22,23,32,33,61,81,82,83,84,85
Developed	dev	21,22,23,85
Man-Made Barren	mmb	32,33
Agriculture	agr	61,81,82,83,84

Pasture/Hay	agrp	81
Cultivated Crop	agrc	61,82,83,84

XML

```

<?xml version='1.0' encoding='UTF-8'?>
<lccSchema xmlns="lcc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="LCCSchema_v3.xsd">
    <metadata>
        <name>NLCD 1992 LAND</name>
        <description>National Land Cover Database 1992 LAND Land Cover
Classification Schema. Water-related raster values are tagged as EXCLUDED.
Excluded values are ignored when calculating the effective area of a reporting
unit. Percentage metrics are based on the effective area of a reporting unit,
not the total area. Coefficient values for impervious area calculations are
based on those reported in Caraco et al. (1998). Those supplied for the
nitrogen loading and phosphorous loading estimates were obtained from Reckhow
et al. (1980). As coefficient values can vary considerably for a given land
cover type across locations, all provided values should be evaluated
critically before use and altered when necessary. Complete literature
citations are provided in the ATtILA for ArcGIS help file.</description>
    </metadata>
    <!--
        * The coefficients node contains coefficients to be assigned to
values.

        * REQUIRED ATTRIBUTES
        * Id - text, unique identifier
        * Name - text, word or phrase describing coefficient
        * fieldName - text, name of field to be created for output
        *             - must conform to the field naming conventions dictated by
the output database system
        * method - text, "P" or "A", designates "P"ercentage or per unit
"A"rea calculation routine
    -->
    <coefficients>
        <coefficient Id="IMPERVIOUS" Name="Percent Cover Total Impervious
Area" fieldName="PCTIA" method="P" />
        <coefficient Id="NITROGEN" Name="Estimated Nitrogen Loading Based on
Land Cover" fieldName="N_Load" method="A" />
        <coefficient Id="PHOSPHORUS" Name="Estimated Phosphorus Loading Based
on Land Cover" fieldName="P_Load" method="A" />
    </coefficients>
    <!--
        * The values node defines the full set of values that can exist in a
land cover raster.

        * REQUIRED ATTRIBUTES
        * Id - integer, raster code
        *
        * OPTIONAL ATTRIBUTES
        * Name - text, word or phrase describing value
        * excluded - boolean, "true" or "false" or "1" or "0"
        *             - used to exclude values from effective area calculations
        *             - excluded=false is the default

        * A value element can optionally contain one or more coefficient
elements

        * REQUIRED COEFFICIENT ATTRIBUTES
    -->

```

```

    * Id - text, must match an Id attribute from a coefficients node
element
    * value - decimal, weighting/calculation factor
-->
<values>
    <value Id="11" Name="Open Water" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="12" Name="Perennial Ice/Snow" excluded="true">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="21" Name="Low Intensity Developed (Residential)">
        <coefficient Id="IMPERVIOUS" value="0.4" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="22" Name="Medium Intensity Developed (Residential)">
        <coefficient Id="IMPERVIOUS" value="0.6" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="23" Name="High Intensity Developed (Commercial/Industrial/
Transportation)">
        <coefficient Id="IMPERVIOUS" value="0.9" />
        <coefficient Id="NITROGEN" value="5.5" />
        <coefficient Id="PHOSPHORUS" value="1.2" />
    </value>
    <value Id="31" Name="Barren Land (Rock/Sand/Clay)">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="32" Name="Quarry/Strip Mine/Gravel Pit">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="33" Name="Transitional">
        <coefficient Id="IMPERVIOUS" value="0.0" />
        <coefficient Id="NITROGEN" value="0.0" />
        <coefficient Id="PHOSPHORUS" value="0.0" />
    </value>
    <value Id="41" Name="Deciduous Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="42" Name="Evergreen Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>
    <value Id="43" Name="Mixed Forest">
        <coefficient Id="IMPERVIOUS" value="0.02" />
        <coefficient Id="NITROGEN" value="2.5" />
        <coefficient Id="PHOSPHORUS" value="0.25" />
    </value>

```

```

</value>
<value Id="51" Name="Shrubland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.4" />
    <coefficient Id="PHOSPHORUS" value="0.04" />
</value>
<value Id="61" Name="Orchard/Vineyard/Other Cultivated Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="6.0" />
    <coefficient Id="PHOSPHORUS" value="0.8" />
</value>
<value Id="71" Name="Grassland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.3" />
    <coefficient Id="PHOSPHORUS" value="0.06" />
</value>
<value Id="81" Name="Pature/Hay">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="5.0" />
    <coefficient Id="PHOSPHORUS" value="0.9" />
</value>
<value Id="82" Name="Row Crop">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="8.5" />
    <coefficient Id="PHOSPHORUS" value="2.3" />
</value>
<value Id="83" Name="Small Grain">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="6.0" />
    <coefficient Id="PHOSPHORUS" value="0.8" />
</value>
<value Id="84" Name="Fallow">
    <coefficient Id="IMPERVIOUS" value="0.0" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="85" Name="Open Space Developed (Urban Grass/Recreational
Grass)">
    <coefficient Id="IMPERVIOUS" value="0.1" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="91" Name="Woody Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
<value Id="92" Name="Emergent Wetland">
    <coefficient Id="IMPERVIOUS" value="0.02" />
    <coefficient Id="NITROGEN" value="0.0" />
    <coefficient Id="PHOSPHORUS" value="0.0" />
</value>
</values>
<!--
    * The classes node contains values from a land cover raster grouped
    into one or more classes.

    * REQUIRED ATTRIBUTES
    * Id - text, unique identifier, also used for automated generation of
    output field name

```

```

*      - must conform to the field naming conventions dictated by the
output database system

* OPTIONAL ATTRIBUTES
* Name - text, word or phrase describing class
* filter - text, a string of one or more tool name abbreviations
separated by a ";"
*          - possible abbreviations are: lcp, rlcp, lcosp, splcp, caem,
and pm
*          - used to exclude the class from the selectable classes in
the tool's GUI
* xxxxField - text, overrides ATtILA-generated field name for output
*          - where xxxx equals a tool name abbreviation
*          - possible abbreviations are: lcp, rlcp, lcosp, and splcp
*          - a separate xxxxField attribute can exist for each tool
*          - must conform to the field naming conventions dictated by
the output database system

* A class can contain either values or classes but not both types.
* Value elements contain only an Id attribute which refers to a value
in a raster.
* Values tagged as excluded="true" in the values node should not be
included in any class.
-->
<classes>
  <class Id="NI" Name="All Natural Land Use" filter="" lcpField="NINDEX">
    <class Id="bar" Name="Barren" filter="">
      <value Id="31" />
    </class>
    <class Id="for" Name="Forest" filter="">
      <value Id="41" />
      <value Id="42" />
      <value Id="43" />
    </class>
    <class Id="shb" Name="Shrubland" filter="">
      <value Id="51" />
    </class>
    <class Id="hrb" Name="Herbaceous" filter="">
      <value Id="71" />
    </class>
    <class Id="wtl" Name="Wetland" filter="">
      <class Id="wtlw" Name="Woody Wetland" filter="">
        <value Id="91" />
      </class>
      <class Id="wtle" Name="Emergent Wetland" filter="">
        <value Id="92" />
      </class>
    </class>
  </class>
  <class Id="UI" Name="All Human Land Use" filter="" lcpField="UINDEX">
    <class Id="dev" Name="Developed" filter="">
      <class Id="devl" Name="Low Intensity Developed" filter="">
        <value Id="21" />
      </class>
      <class Id="devm" Name="Medium Intensity Developed" filter="">
        <value Id="22" />
      </class>
      <class Id="devh" Name="High Intensity Developed" filter="">
        <value Id="23" />
      </class>
    </class>
  </class>

```

```

    </class>
    <class Id="devo" Name="Open Space Developed" filter="">
        <value Id="85" />
    </class>
</class>
<class Id="mmrb" Name="Man-Made Barren" filter="">
    <value Id="32" />
    <value Id="33" />
</class>
<class Id="agr" Name="Agriculture" filter="">
    <class Id="agrp" Name="Pasture/Hay" filter="">
        <value Id="81" />
    </class>
    <class Id="agrc" Name="Cultivated Crop" filter="">
        <value Id="61" />
        <value Id="82" />
        <value Id="83" />
        <value Id="84" />
    </class>
</class>
</classes>
</lccSchema>

```

Additional Options

Retain Intermediate Layers Generated

The intermediate output are the metrics that are required to calculate the final metrics for the tool. Many metrics produce other map or tables from the initial data inputs necessary for the calculation of selected metrics. By default, these map products are discarded at the end of the ATtILA for ArcGIS metric runs. Several of them, however, can be retained by selecting the 'intermediates' box under additional options in the tool. By default the intermediate files are saved in a geodatabase in the project working directory which can be found (or changed) by selecting 'geoprocessing' on the selection bar, then environments, and workspace. By creating and examining the intermediate layers for the various ATtILA for ArcGIS metrics the user can gain a better understanding how the metric is calculated and what the metric is measuring.

Land Cover Coefficient Calculator

Intermediate File Retained

- **lccc_TabArea* table** - A table of areas corresponding to the values in the Land cover raster within each reporting unit. The name of the intermediate table has the prefix "lccc_TabArea" followed by a number (e.g. lccc_TabArea0, lccc_TabArea1, lccc_TabArea2, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Population Density Metrics

Intermediate Files Retained

- **pdm_[Reporting unit feature]* vector** - A polygon feature class containing reporting units with a new area field in km². The name of the intermediate feature class has the prefix "pdm_" followed by a the name of the Reporting unit feature, then followed by a number (e.g. pdm_WI_Counties0, pdm_HUC120, pdm_HUC121, etc.). The number is appended when the

feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.

- **pdm_[Census feature]* vector** - A polygon feature class of all census polygons with fields containing population, polygon area, and population density within the census polygons. The name of the intermediate feature class has the prefix "pdm_" followed by the name of the Census feature, then followed by a number (e.g. pdm_AK_2000_tracts0, pdm_census2010, pdm_census 2010_10, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **pdm_intersectOutput* vector** - A polygon feature class with Census features intersected with reporting units. The name of the intermediate feature class has the prefix "pdm_intersectOutput" followed by a number (e.g. pdm_intersectOutput0, pdm_intersectOutput_10, pdm_intersectOutput_20, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **pdm_summaryTable* table** - A table of the number of intersected Census feature polygons and the sums of the area-weighted population counts within each reporting unit. The name of the intermediate table has the prefix "pdm_summaryTable" followed by a number (e.g. pdm_summaryTable0, pdm_summaryTable_10, pdm_summaryTable_20, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Road Density Metrics

Intermediate Files Retained

- **rdm_[Reporting unit feature]* vector** - A polygon feature class containing reporting units with a new area field in km². The name of the intermediate feature class has the prefix "rdm_" followed by a the name of the Reporting unit feature, then followed by a number (e.g. rdm_WI_Counties0, rdm_HUC120, rdm_HUC121, etc.). The number is appended when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **rdm_[Road feature]* vector** - A line feature class containing road features. The name of the intermediate feature class has the prefix "rdm_" followed by a the name of the Road feature, then followed by a number (e.g. rdm_WI_Roads0, rdm_Interstates0, rdm_Interstates1, etc.). The number is appended when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location. This intermediate vector is only generated if the geometry coordinates for the input Road feature include M or Z values. These values are stripped off in the intermediate file.
- **rdm_RdsByRU* vector** - A line feature class with Road features intersected with reporting units. The name of the intermediate feature class has the prefix "rdm_RdsByRU" followed by a number (e.g. rdm_RdsByRU0, rdm_RdsByRU1, rdm_RdsByRU2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **rdm_[Stream feature]* vector** - A line feature class containing stream features. The name of the intermediate feature class has the prefix "rdm_" followed by a the name of the Stream feature, then followed by a number (e.g. rdm_WI_Streams0, rdm_HUC12streams0, rdm_HUC12streams1, etc.). The number is appended when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location. This intermediate vector is only

generated if the geometry coordinates for the input Stream feature include M or Z values. These values are stripped off in the intermediate file.

- **rdm_StrByRU* vector** - A line feature class with Stream features intersected with reporting units. The name of the intermediate feature class has the prefix "rdm_StrByRU" followed by a number (e.g. rdm_StrByRU0, rdm_StrByRU1, rdm_StrByRU2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **rdm_PtsOfXing* vector** - A point feature class depicting locations where Road feature lines intersect Stream feature lines. The name of the intermediate feature class has the prefix "rdm_PtsOfXing" followed by a number (e.g. rdm_PtsOfXing0, rdm_PtsOfXing1, rdm_PtsOfXing2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **rdm_RdsXStrMP* vector** - A multipoint feature class in which all stream-road crossing points from the PtsOfXing feature class are assembled by reporting unit. The name of the intermediate feature class has the prefix "rdm_RdsXStrMP" followed by a number (e.g. rdm_RdsXStrMP0, rdm_RdsXStrMP1, rdm_RdsXStrMP2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **rdm_RdsXStrTbl* table** - A table of stream lengths and stream-road crossing density within each reporting unit. The name of the intermediate table has the prefix "rdm_RdsXStrTbl" followed by a number (e.g. rdm_RdsXStrTbl0, rdm_RdsXStrTbl1, rdm_RdsXStrTbl2, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.
- **rdm_StrBuffers* vector** - A polygon feature class containing Stream features from the StrByRU intermediate feature class buffered by the selected buffer distance. The name of the intermediate feature class has the prefix "rdm_StrBuffers" followed by a number (e.g. rdm_StrBuffers0, rdm_StrBuffers1, rdm_StrBuffers2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and results saved to the same output location.
- **rdm_RdsNrStrms* vector** - A line feature class containing Road features contained within the StrBuffers intermediate feature class. The name of the intermediate feature class has the prefix "rdm_RdsNrStrms" followed by a number (e.g. RdsNrStrms0, rdm_RdsNrStrms1, rdm_RdsNrStrms2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and results saved to the same output location.

Core and Edge Metrics

Intermediate Files Retained

- **caem_Raster[class name][edge width]* raster** - Rasters created for each class selected in the "Report metrics for these classes" parameter of the tool, with reclassified values corresponding to the following scheme: 1 - Excluded, 2 - Other, 3 - Edge, 4 - Core. The names of the intermediate rasters have the prefix "caem_Raster" followed by the land cover class abbreviation, the edge width, and another number (e.g. caem_Rasterfor30, caem_Rasterw1t30, caem_Rasterfor31, etc.). The final number in the file name is added when the raster is saved in order to give each raster a unique name when the tool is executed more than once with results saved to the same output location.

- **caem_TabArea[class name][edge width]* table** - A table of areas corresponding to the values in the caem_Raster* within each reporting unit. The name of the intermediate table has the prefix "caem_TabArea" followed by the land cover class abbreviation, the edge width, and another number (e.g. caem_TabAreafor30, caem_TabAreawtlt30, caem_TabAreafor31, etc.). The suffix corresponds to the suffix in the caem_Raster*, and, like the raster suffix, is added to give each table a unique name when multiple classes are selected in the tool and when the tool is executed more than once with results saved to the same output location.

Land Cover Diversity

Intermediate File Retained

- **lcd_TabArea* table** - A table of areas corresponding to the values in the Land cover raster within each reporting unit. The name of the intermediate table has the prefix "lcd_TabArea" followed by a number (e.g. lcd_TabArea0, lcd_TabArea1, lcd_TabArea2, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Land Cover on Slope Proportions

Intermediate Files Retained

- **lcosp_[Land cover grid name]* raster** - A land cover raster that is the result of checking the "Reduce land cover grid to smallest recommended size" optional checkbox in the tool dialog. This raster is created by limiting the Land cover grid to the extent of the Reporting unit feature layer. The name of the intermediate raster has the prefix "lcosp_" followed by the name of the Land cover grid, then appended with a number (e.g. lcosp_NLCD060, lcosp_FLAGAP0, lcosp_CCAP1, etc.). The number at the end of the intermediate raster name is added when the raster is saved in order to give each successive raster a unique name when the tool is executed more than once and the results are saved to the same output location.
- **lcosp_RasterSL[slope threshold]* raster** - A land cover raster resulting from the overlay between all Land cover grid cells and Slope grid cells that do not meet the Slope threshold. Land cover cells in overlay areas are reclassified with a new value that is outside of the range of valid class values as recognized by the Land cover classification file. The processes involved in creating this raster are as follows:
 1. Examine the values in both the Land cover grid and the Land cover classification file to determine which has the highest high value.
 2. Calculate a new value by adding one (1) to the higher of the two high values. For example, if the high value in the input grid is 95 and the high value in the classification file is 99, the calculated value for cells meeting the Slope threshold is $(99+1) = \underline{100}$ in the new intermediate raster.
 3. Create a new raster that assigns this new value to all cells that are below the slope threshold. Retain all other land cover cell values.
 4. Name the intermediate raster "lcosp_RasterSL[slope threshold]*" where "[slope threshold]" is the input slope threshold and "*" is a sequential number added when the raster is saved in order to give each successive raster a unique name when the tool is executed more than once and results saved to the same output location (e.g. lcospRaster0SL7, lcospRaster1SL7, lcospRaster0SL9, etc.).

The purpose of this intermediate raster product in the Land Cover on Slope Proportions tool is to exclude land cover cells that do not meet the threshold slope from metric calculations. The tool uses this raster to calculate the proportion of each reporting unit that is covered by each valid land cover type on slopes that meet or exceed the threshold slope.

- **IcospTabArea* table** - A table of areas corresponding to the values in the intermediate raster within each reporting unit. Areas with reclassified values that do not meet the Slope threshold are included. The name of the intermediate table has the prefix "IcospTabArea" followed by a number (e.g. IcospTabArea0, IcospTabArea1, IcospTabArea2, etc.). As with the intermediate raster, the number at the end of the intermediate table name is added when saving to create a unique name.

Land Cover Proportions

Intermediate File Retained

- **IcpTabArea* table** - A table of areas corresponding to the values in the Land cover raster within each reporting unit. The name of the intermediate table has the prefix "IcpTabArea" followed by a number (e.g. IcpTabArea0, IcpTabArea1, IcpTabArea2, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Patch Metrics

Intermediate Files Retained

- **pm_[class name]_PatchRast* raster** - Rasters created for each class selected in the **Report metrics for these classes** parameter of the tool, with values corresponding to the following scheme:
 - -9999 - Excluded
 - 0 - Other
 - 1 - n, a unique number assigned to each distinct patch of the selected class

The names of the intermediate rasters have the prefix "pm_" followed by the land cover class abbreviation, the suffix "_PatchRast", and another number (e.g. pm_wtl_PatchRast0, pm_wtl_PatchRast1, pm_wtl_PatchRast2, etc.). The final number in the file name is added when the raster is saved in order to give each raster a unique name when the tool is executed more than once with results saved to the same output location.

The processes involved in creating this raster are as follows:

1. Reclass the input land cover grid so that cells representing the selected class = 3), cells with values marked as excluded = -9999, and all other land cover cells = 0.
2. If a **Maximum separation** value is NOT provided:
 1. Assign unique values to each distinct clump of class cells by use of the regiongroup command. Use the eight neighbor rule to determine connectivity.
3. If a **Maximum separation** value is provided:
 1. Create a single value class raster by setting to NULL cells in the reclassified raster with values less than 3.
 2. Use a euclidean distance operation on the class patch and NULL raster to buffer the classes out by the supplied maximum separation distance.
 3. Assign unique values to each distinct clump of class cells by use of the regiongroup command. Use the eight neighbor rule to determine connectivity.
 4. Trim the buffered regiongroup patches to the original boundaries of the patch clumps by use of the con statement and the reclass grid (if it's a patch in the reclass grid (value = 3) assign it the regiongroup number, else leave the other values (-9999, 0) alone).
4. If a **Minimum patch size** value is provided:

1. Eliminate all patches below the **Minimum patch size** (any regongroup value with a value in the COUNT field less than the **Minimum patch size**, set its value to 0).
5. Add the excluded class areas back to the raster if any are indicated.

The purpose of this intermediate raster product is to identify individual patches, non-patch areas, and excluded land cover cells for metric calculations.

- **pm_[class name]_PatchPoly* vector** - A polygon feature class of all patches of [class name] derived from the pm_[class name]_PatchRast using the Raster to Polygon conversion operation. The Simplify polygons option was unchecked to force the polygon edges to conform to the cell boundaries of the input raster. The gridcode field contains the unique identifier for each distinct patch. The name of the intermediate feature class has the prefix "pm_" followed by the land cover class abbreviation, the suffix "_PatchPoly", and another number (e.g. pm_wtl_PatchPoly0, pm_wtl_PatchPoly1, pm_wtl_PatchPoly2, etc.). The final number in the file name is added when the feature class is saved in order to give each feature class a unique name when the tool is executed more than once with results saved to the same output location.
- **pm_[class name]_PatchPoly_Diss* vector** - A polygon feature class of all patches of [class name] after performing a Dissolve on the pm_[class name]_PatchPoly feature class using gridcode as the dissolve field. Gridcode is the unique identifier for each distinct patch. The name of the intermediate feature class has the prefix "pm_" followed by the land cover class abbreviation, the suffix "_PatchPoly_Diss", and another number (e.g. pm_wtl_PatchPoly_Diss0, pm_wtl_PatchPoly_Diss1, pm_wtl_PatchPoly_Diss2, etc.). The final number in the file name is added when the feature class is saved in order to give each feature class a unique name when the tool is executed more than once with results saved to the same output location.
 - ***NOTE:*** Due to the complex pattern of some patches, the dissolve function may not create a single multipart polygon for each distinct patch. A quick check to see if duplicate values are found in the gridcode field by using either the Frequency tool or by the field Summarize... option.
- **pm_[class name]_PatchCentroids* vector** - A point feature class depicting the cell centroids of cells delimiting patches in the pm_[class name]_PatchRast* raster with the unique patch identifier found in the grid_code field. The name of the intermediate feature class has the prefix "pm_" followed by the land cover class abbreviation, the suffix "_PatchCentroids", and another number (e.g. pm_wtl_PatchCentroids0, pm_wtl_PatchCentroids1, pm_wtl_PatchCentroids2, etc.). The final number in the file name is added when the feature class is saved in order to give each feature class a unique name when the tool is executed more than once with results saved to the same output location.

Riparian Land Cover Proportions

Intermediate Files Retained

- **rlcp_Buffer[buffer distance]* vector** - A polygon feature class containing all Stream features buffered by the selected buffer distance within each reporting unit. The name of the intermediate feature class has the prefix "rlcp_Buffer" followed by the buffer distance, then a number (e.g. rlcp_Buffer1000, rlcp_Buffer1001, rlcp_Buffer500, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and results saved to the same output location.
- **rlcpTabArea* table** - A table of areas corresponding to the values in the Land cover raster within each reporting unit. The name of the intermediate table has the prefix "rlcpTabArea" followed by a number (e.g. rlcpTabArea0, rlcpTabArea1, rlcpTabArea2, etc.). The number

suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Sample Point Land Cover Proportions

Intermediate Files Retained

- **splcp_Buffer[buffer distance]* vector** - A polygon feature class containing all Sample point features buffered by the selected buffer distance within each reporting unit. The name of the intermediate feature class has the prefix "splcp_Buffer" followed by the buffer distance, then a number (e.g. splcp_Buffer1000, splcp_Buffer1001, splcp_Buffer500, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and results saved to the same output location.
- **splcpTabArea* table** - A table of areas corresponding to the values in the Land cover raster within each reporting unit. The name of the intermediate table has the prefix "splcpTabArea" followed by a number (e.g. splcpTabArea0, splcpTabArea1, splcpTabArea2, etc.). The number suffix is added when the table is saved in order to give each successive table a unique name when the tool is executed more than once and results saved to the same output location.

Stream Density Metrics

Intermediate Files Retained

- **tempReportingUnitFeature* vector** - A polygon feature class containing reporting units with a new area field in km². The name of the intermediate feature class has the prefix "tempReportingUnitFeature" followed by a number (e.g. tempReportingUnitFeature0, tempReportingUnitFeature1, tempReportingUnitFeature2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.
- **StrByRU* vector** - A line feature class with Stream features intersected with reporting units. The name of the intermediate feature class has the prefix "StrByRU" followed by a number (e.g. StrByRU0, StrByRU1, StrByRU2, etc.). The number suffix is added when the feature class is saved in order to give each successive feature class a unique name when the tool is executed more than once and the results saved to the same output location.

Add Quality Assurance Fields

*_OVER - percent raster overlap between the rasterized Reporting unit feature layer and the Land cover grid within each reporting unit when both are in the same coordinate system.

*_TOTA - total raster area of each reporting unit after the polygon-to-raster conversion.

Land Cover Coefficient Calculator

Fields Added

- **LCCC_OVER** - The percent overlap between the Reporting unit feature layer and the Land cover grid for each reporting unit.

Core and Edge Metrics

Fields Added

- **CAEM_OVER** - The percent raster overlap between the rasterized Reporting unit feature

layer and the Land cover grid for each reporting unit when both are in the same coordinate system.

- **CAEM_TOTA** - The total raster zonal area for each reporting unit (zone) after the Reporting unit feature layer has been rasterized.
- **CAEM_EFFA** - The effective raster area of each reporting unit (zone) after excluded classes have been removed.
- **CAEM_EXCA** - The raster area of the excluded classes within each reporting unit (zone) based on exclusions in the Land cover classification scheme.

Land Cover Diversity

Fields Added

- **LCD_OVER** - The percent overlap between the Reporting unit feature layer and the Land cover grid for each reporting unit.

Land Cover on Slope Proportions

Fields Added

- **LCOSP_OVER** - The percent overlap between the Reporting unit feature layer and the Land cover grid for each reporting unit.
- **LCOSP_TOTA** - The total raster zonal area for each reporting unit (zone) after the Reporting unit feature layer has been rasterized.
- **LCOSP_EFFA** - The effective raster area of each reporting unit (zone) after excluded classes have been removed.
- **LCOSP_EXCA** - The raster area of the excluded classes within each reporting unit (zone) based on exclusions in the Land cover classification scheme.

Land Cover Proportions

Fields Added

- **LCP_OVER** - The percent overlap between the Reporting unit feature layer and the Land cover grid for each reporting unit.
- **LCP_TOTA** - The total raster zonal area for each reporting unit (zone) after the Reporting unit feature layer has been rasterized.
- **LCP_EFFA** - The effective raster area of each reporting unit (zone) after excluded classes have been removed.
- **LCP_EXCA** - The raster area of the excluded classes within each reporting unit (zone) based on exclusions in the Land cover classification scheme.

Patch Metrics

Fields Added

- **PM_OVER** - The percent overlap between the Reporting unit feature layer and the Land cover grid for each reporting unit.
- **PM_TOTA** - The total raster zonal area for each reporting unit (zone) after the Reporting unit feature layer has been rasterized.
- **PM_EFFA** - The effective raster area of each reporting unit (zone) after excluded classes

have been removed.

- **PM_EXCA** - The raster area of the excluded classes within each reporting unit (zone) based on exclusions in the Land cover classification scheme.
- **[class]_PWN** - The number of patches of the selected class **with** a neighboring patch within the reporting unit (e.g. "for_PWN" is the number of patches of the "Forest" class in the NLCD **with** at least one neighboring patch).
 - **NOTE:** This value should equal the number of patches recorded in the [class]_NUM field except for reporting units where the number of patches = 1 or 0. Reporting units with only one patch will have a zero value recorded in this field. Those with no patches will have a value of -9999.
- **[class]_PWON** - The number of patches of the selected class **without** a neighboring patch within the reporting unit (e.g. "for_PWON" is the number of patches of the "Forest" class in the NLCD **without** a neighboring patch).
 - **NOTE:** This value should be 0 for all reporting units with two or more patches recorded in the [class]_NUM field, 1 where only a single patch is reported, and -9999 for reporting units with no patches.

Riparian Land Cover Proportions

Fields Added

- **RLCP_OVER** - The percent overlap between the Stream features buffer areas in each reporting unit and the Land cover grid.
- **RLCP_TOTA** - The total raster zonal area for all Stream features buffers in each reporting unit (zone) after the buffer areas have been rasterized.
- **RLCP_EFFA** - The effective raster area of all Stream features buffers in each reporting unit (zone) after excluded classes have been removed.
- **RLCP_EXCA** - The raster area of the excluded classes within the Stream features buffers in each reporting unit (zone) based on exclusions in the Land cover classification scheme.

Sample Point Land Cover Proportions

Fields Added

- **SPLCP_OVER** - The percent overlap between the Sample point features buffer areas in each reporting unit and the Land cover grid.
- **SPLCP_TOTA** - The total raster zonal area for all Sample point features buffers in each reporting unit (zone) after the buffer areas have been rasterized.
- **SPLCP_EFFA** - The effective raster area of all Sample point features buffers in each reporting unit (zone) after excluded classes have been removed.
- **SPLCP_EXCA** - The raster area of the excluded classes within the Sample point features buffers in each reporting unit (zone) based on exclusions in the Land cover classification scheme.

Add Area Fields

Land Cover on Slope Proportions

Fields Added

- **[class]SL[slope threshold]_A** - The area of the rasterized reporting unit occupied by the land cover class on slopes that are equal to or exceed the Slope threshold (e.g. "forSL9_A" is the name of the field for the metric representing the area of NLCD "Forest" class on land at or above a threshold slope value of 9 within the reporting unit).

Land Cover Proportions

Fields Added

- **p[class]_A** - The area of the rasterized reporting unit occupied by the land cover class (e.g. "pfor_A" is the name of the field for the metric representing the area of NLCD "Forest" class within the reporting unit).
- **NINDEX_A** - The area of the rasterized reporting unit occupied by all "natural" land use classes.
- **UINDEX_A** - The area of the rasterized reporting unit occupied by all "human" land use classes.

Riparian Land Cover Proportions

Fields Added

- **r[class][buffer distance]_A** - The area of the rasterized Stream features buffer, by reporting unit, occupied by the land cover class (e.g. "rfor100_A" is the name of the field for the metric representing the area of NLCD "Forest" class within the rasterized buffer area in each reporting unit).

Sample Point Land Cover Proportions

Fields Added

- **s[class][buffer distance]_A** - The area of the rasterized Sample point features buffer, by reporting unit, occupied by the land cover class (e.g. "sfor100_A" is the name of the field for the metric representing the area of NLCD "Forest" class within the rasterized buffer area in each reporting unit).

Utilities

Identify Overlapping Polygons

Summary

Determines whether an input polygon feature layer contains overlapping polygons, and creates new non-overlapping feature layers.

Usage

- ***NOTE:*** Processing time for this tool varies depending on the number of polygons in the **Input polygon features** layer. To minimize processing time, consider creating a new **Input polygon features** layer that does not include unwanted polygons. This tool may create multiple polygon layers which will consume disk space in the **Output workspace**. If the **Output workspace** resides on a disk with limited disk space, the tool may fail during processing. To prevent this, consider changing the **Output workspace** to a location with sufficient available disk space, or free up disk space on the disk in which the current **Output workspace** resides to accommodate the new polygon layers.

- This tool processes all polygons in the **Input polygon features** layer regardless of selections set. The ability to limit discovery of overlaps to only selected polygons is not supported in this release.
- When overlapping polygons are discovered in the **Input polygon features** layer, the tool creates new polygon layers. The number of new layers is based on the maximum number of overlaps for any individual polygon. For example, when one or more polygons in the **Input polygon features** layer are overlapped by, at most, one other polygon, the tool produces two new non-overlapping polygon layers. When one or more polygons are overlapped by two other polygons, the tool produces three new non-overlapping polygons layers, etc.
- When the **Check for overlaps only** option is enabled, no new layers are created. Therefore, the **Output workspace** is grayed out.

Syntax

IOP (Input_polygon_features, Output_workspace, Check_for_overlaps_only)

Parameter	Explanation	Data Type
Input_polygon_features	The vector polygon dataset upon which the overlapping polygon check will be performed.	Feature Layer
Output_workspace	The output location in which new polygon layers will be saved if overlapping polygons are present in the Input polygon features. If the Output workspace is a file folder, new layers will be saved as shapefiles. If the Output workspace is a geodatabase, new layers will be saved as geodatabase feature classes.	Work space
Check_for_overlaps_only (optional)	Specifies whether the process will result in new non-overlapping polygon layers. <ul style="list-style-type: none"> • false - Non-overlapping polygon layers will be produced. This is the default. • true - Non-overlapping polygon layers will not be produced. Instead, the tool will simply determine whether overlapping polygons exist in the Input polygon features layer, and, if so, the number of overlaps present. These results are reported in the tool results box. 	Boolean

Credits

Environments

Current Workspace, Scratch Workspace, Output Coordinates same as input, Processing extent min of inputs

References

Caraco, D., Claytor, R., Hinkel, P., Kwon, H.Y., Schueler, T., Swann, C., Vysotsky, S. and Zielinske, J. 1998. *Rapid Watershed Planning Handbook*. Center for Watershed Protection. Ellicott City, Maryland.

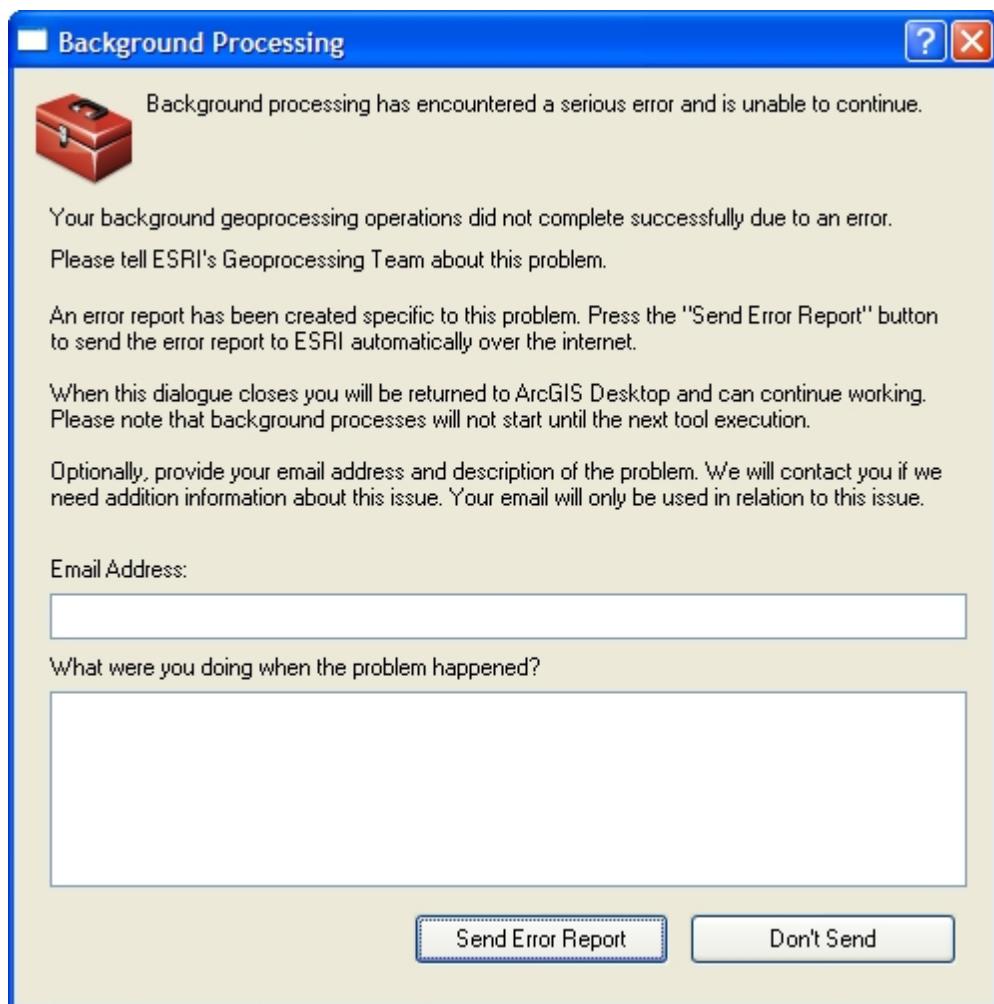
Jones, K. B., K. H. Riitters, J. D. Wickham, R. D. Tankersley, Jr., R. V. O'Neill, D. J. Chaloud, E. R. Smith, and A. C. Neale. 1997. An Ecological Assessment of the United States Mid-Atlantic Region: A Landscape Atlas. EPA/600/R-97/130.

Reckhow, K.H., Beaulac, M.N., and Simpson, J.T. 1980. *Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients*. USEPA 4405-80-011. Washington, DC: Office of Water Regulations and Standards, U.S. Environmental Protection Agency. Washington, DC, USA.

Troubleshooting

Background Processing error

When running a tool in which the output and intermediate files are directed to be saved to a file geodatabase, the following Background Processing error may occur:



This error may be due to an incompletely deleted file geodatabase, such as the attilaScratchWorkspace.gdb. This occurs periodically when the attilaScratchWorkspace.gdb is deleted using ArcCatalog. While the geodatabase may be successfully deleted and no longer appear in the ArcCatalog interface, some folders and files may linger.

To correct this, simply open Windows Explorer, navigate to the disk location where the file geodatabase formerly resided, and delete the lingering geodatabase folder and its contents.

Excluded Values in Class Definitions

Excluded Values in Class Definitions

This warning message is triggered when a value is marked as excluded = "true" in the [Values Element](#) section of the LCC XML document, but is also included in one or more class definitions in the [Classes Element](#) section. The warning message will also provide the class name that contains the value tagged as excluded.

The value attribute, **excluded**, (see [Values Element](#) in [ATtILA's LCC XML Document](#)) is used to identify grid codes whose area is to be excluded from the reporting unit's effective area calculation. Effective area can be thought of as the area of interest within a reporting unit that the user wishes to use for percentage based metric calculations. For example, the user may be interested in basing their metric calculations on just the land area in a reporting unit versus the overall total area of the reporting unit. To make the effective area equal to that of the land area, the user would set the **excluded** attribute of any water related grid value to "true".

Values attributed as excluded = "true" included in any class definition in the [Classes Element](#) section of the LCC XML document create an ambiguous situation for ATtILA for ArcGIS. When this occurs, ATtILA for ArcGIS will ignore the area of that excluded value when summing up the area of the selected class for metric calculations, as well as ignoring its area in the calculation of the effective area.

The following example illustrates the point.

Assume a land cover raster layer contains four land cover types, values 1, 2, 3, and 4 with value 1 attributed as excluded = "true". Only one class has been defined named "Forest", and consists of values 1 and 2. For our example, the different land cover types have the following areas within a reporting unit:

value 1 = 100 square meters
 value 2 = 200 square meters
 value 3 = 300 square meters
 value 4 = 400 square meters

If the [Land Cover Proportions](#) tool is run, the output for pForest will be calculated as follows:

$pForest = (\text{Area of Forest} / \text{Effective Area of Reporting Unit}) * 100$

If value 1 was not attributed as excluded = "true", then the calculations would be as follows:

```
pForest = ((Area of value 1 + Area of value 2) / (Area of value 1 +Area of value 2 + Area of value 3 + Area of value 4))  
pForest = ((100 sq m + 200 sq m) / (100 sq m + 200 sq m + 300 sq m + 400 sq m)) * 100  
pForest = (300 sq m / 1000 sq m) * 100  
pForest = 30
```

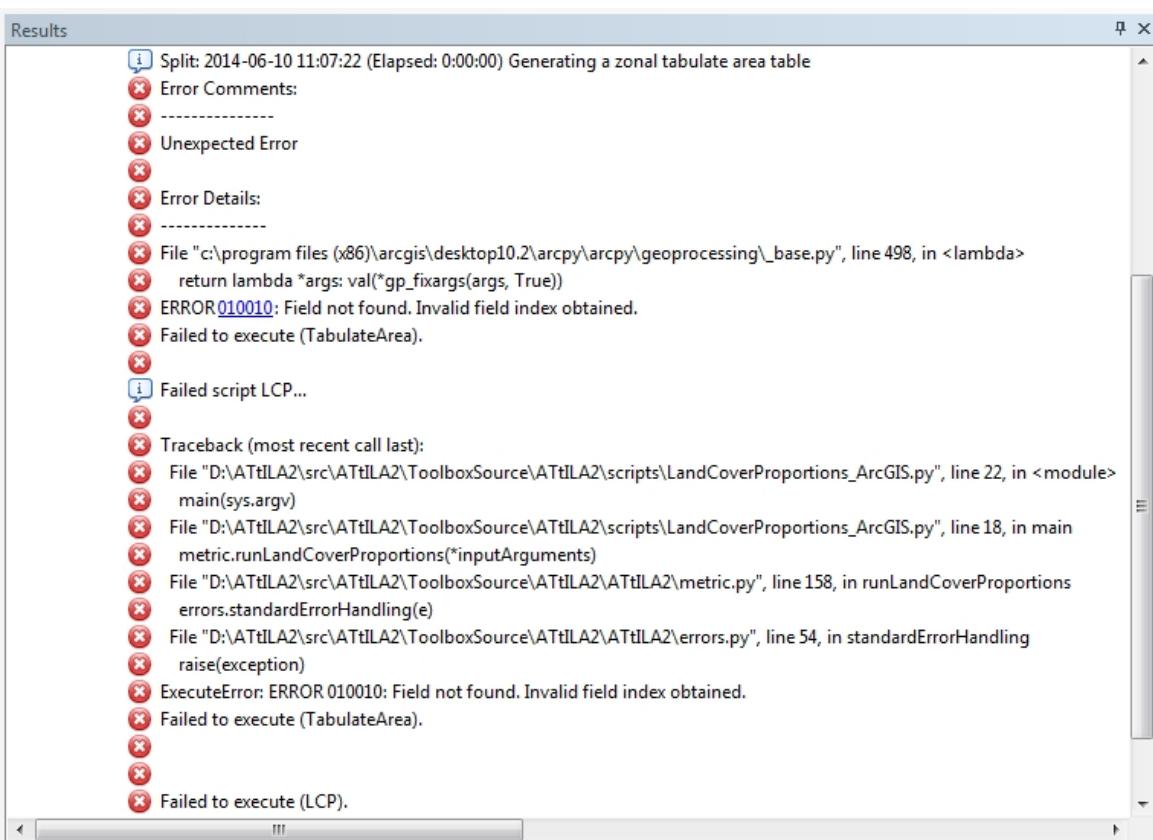
But if value 1 is attributed as excluded = "true", then the calculations will adjust to the following:

```
pForest = ((Area of value 2) / (Area of value 2 + Area of value 3 + Area of value 4))  
pForest = ((200 sq m) / (200 sq m + 300 sq m + 400 sq m)) * 100  
pForest = (200 sq m / 900 sq m) * 100  
pForest = 22.22
```

NOTE: If all values assigned to the class are tagged as excluded, the output metric is calculated as 0%.

Failed to execute (TabulateArea)

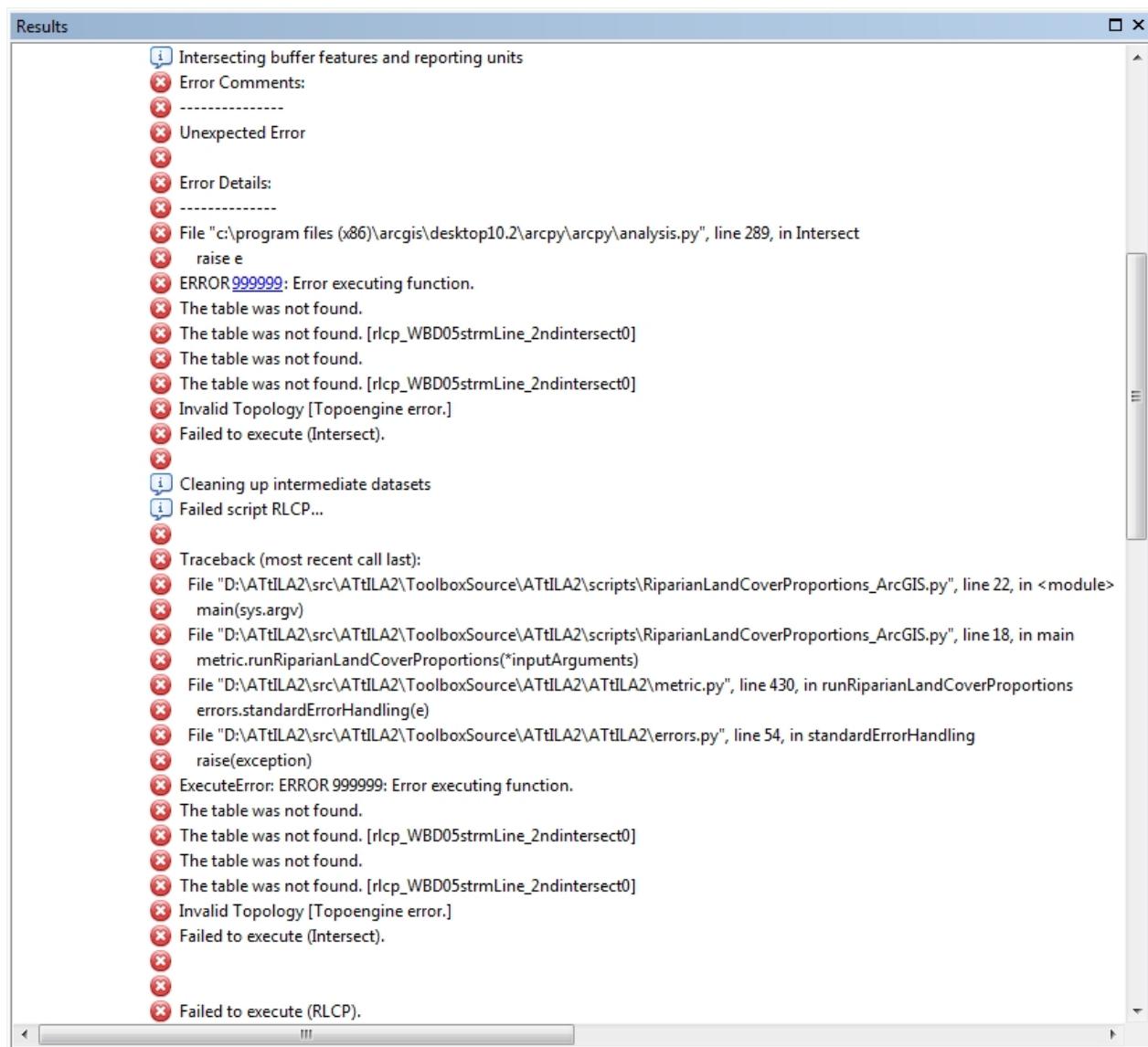
When running a tool that uses a Land cover grid (Land Cover Coefficient Calculator, Core and Edge Metrics, Land Cover Diversity, Land Cover on Slope Proportions, Land Cover Proportions, Riparian Land Cover Proportions, and Sample Point Land Cover Proportions), an error may occur indicating that TabulateArea failed to execute:



The issue is that raster geoprocessing tools convert other formats to GRID format internally, then perform the analysis, then re-convert the GRID back out to the desired format. The limit is reached at the conversion to the GRID format; GRID's have an upper limit of 2.1 billion cells in their INFO table. The only workaround for this is breaking your data down into smaller chunks before running the tabulate area tool or by selecting a larger processing cell size. The larger processing cell size may allow the process to finish, but the output results will be of a more generalized nature.

Failed to execute (Intersect)

This error been detected when executing the [Riparian Land Cover Proportions](#) tool. Please report any additional instances of this error to: LEBProjects@epa.gov and include "ATtILA" in the subject line.



This problem appears to occur when the input reporting unit feature consists of a large number of reporting units and/or covers a large geographic area. When the ArcGIS software tries to tile the data to process the dataset, the tiling process appears to fail, usually during the reassembly stage. This is an inconsistent error. Sometimes when the metric run is reattempted, using the exact same inputs, the metric run will finish.

If the metric run fails a second or third time, we recommend using the selection tool and selecting approximately half of the input reporting unit features, exporting the selected reporting units into a new dataset, and reattempting the metric run with the new dataset as the input reporting unit theme.

Continue the reduction process until the metric run runs to completion or until a single reporting unit remains.

If the metric run fails with only one reporting unit feature as the input reporting unit theme, it is likely that there is an error in one of the other input datasets within the confines of the recalcitrant reporting unit. Close inspection of the other input datasets in this area may reveal the problem (e.g. poor digitization of input data as in nodes not being used at line intersections).

{FIELD} already exists error

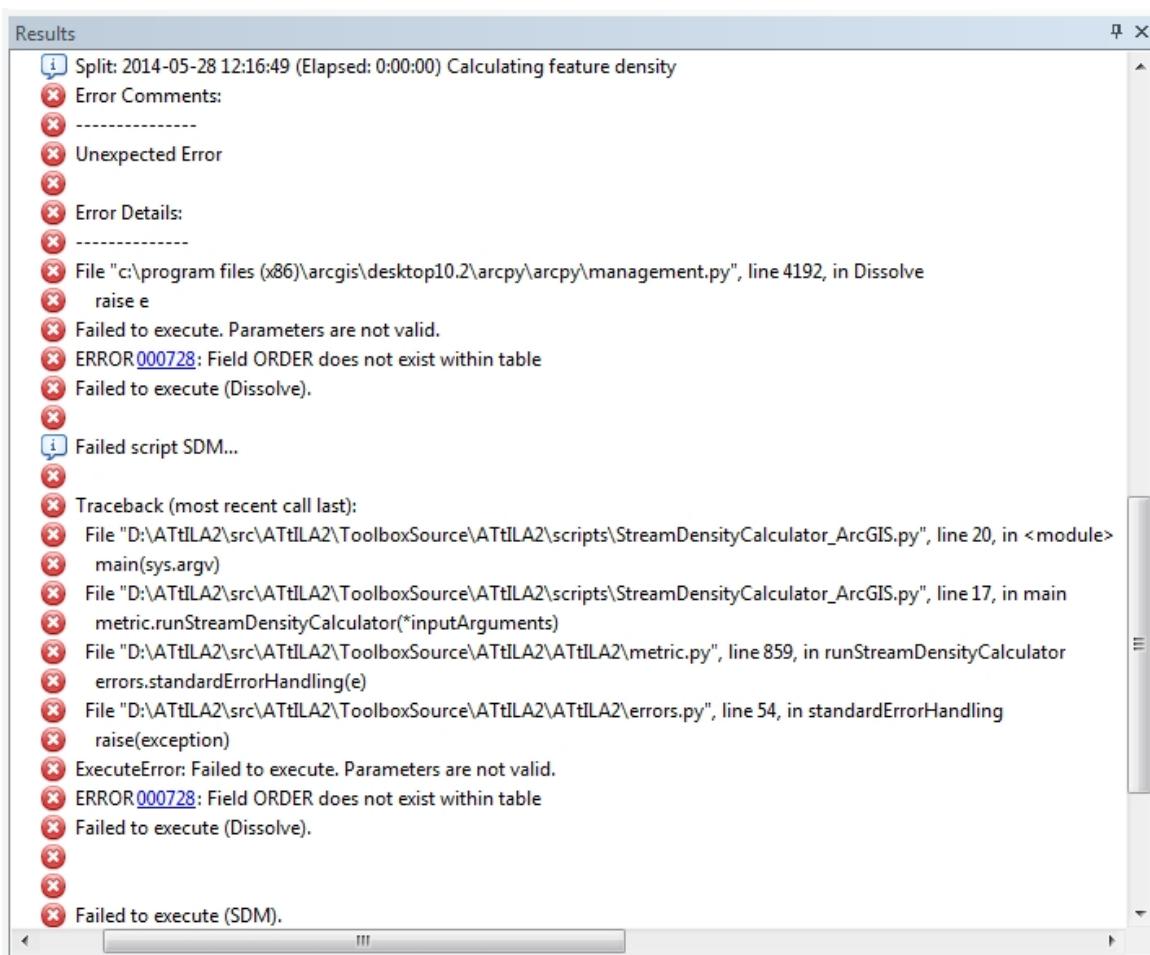
When running the Road Density Metrics or the Stream Density Metrics tool, an error may occur indicating that a field already exists:

The screenshot shows a 'Results' window with a dark blue header bar. Below the header, the log content is displayed in a white area with black text. The log starts with informational messages like 'Start Time: Fri Jan 24 15:55:47 2014' and 'Running script RDM...'. It then moves into a series of error messages, each preceded by a red circular icon with a white 'X'. The errors are categorized under 'Error Comments:' and include details such as file paths ('d:\public\server\apps\arcgis\desktop10.0\arcpy\arcpy\management.py'), specific error codes ('raise e', 'ERROR 000012'), and failed operations ('Failed to execute (AddField)'). One particular error, 'ERROR 000012: STXMAX_LRT already exists', is highlighted with a yellow background. The log concludes with a final informational message about cleaning up intermediate datasets and ends with the total execution time ('Failed at Fri Jan 24 15:59:58 2014 (Elapsed Time: 4 minutes 11 seconds)').

This error may be caused by problems with the field used to classify the different road or stream features (Road class field or Stream order field, respectively). Specific rules for the length of the fields and the characters contained within the fields are found in each tool's help section.

{FIELD} does not exist within table error

When running the Road Density Metrics or the Stream Density Metrics tool, an error may occur indicating that a field does not exist:

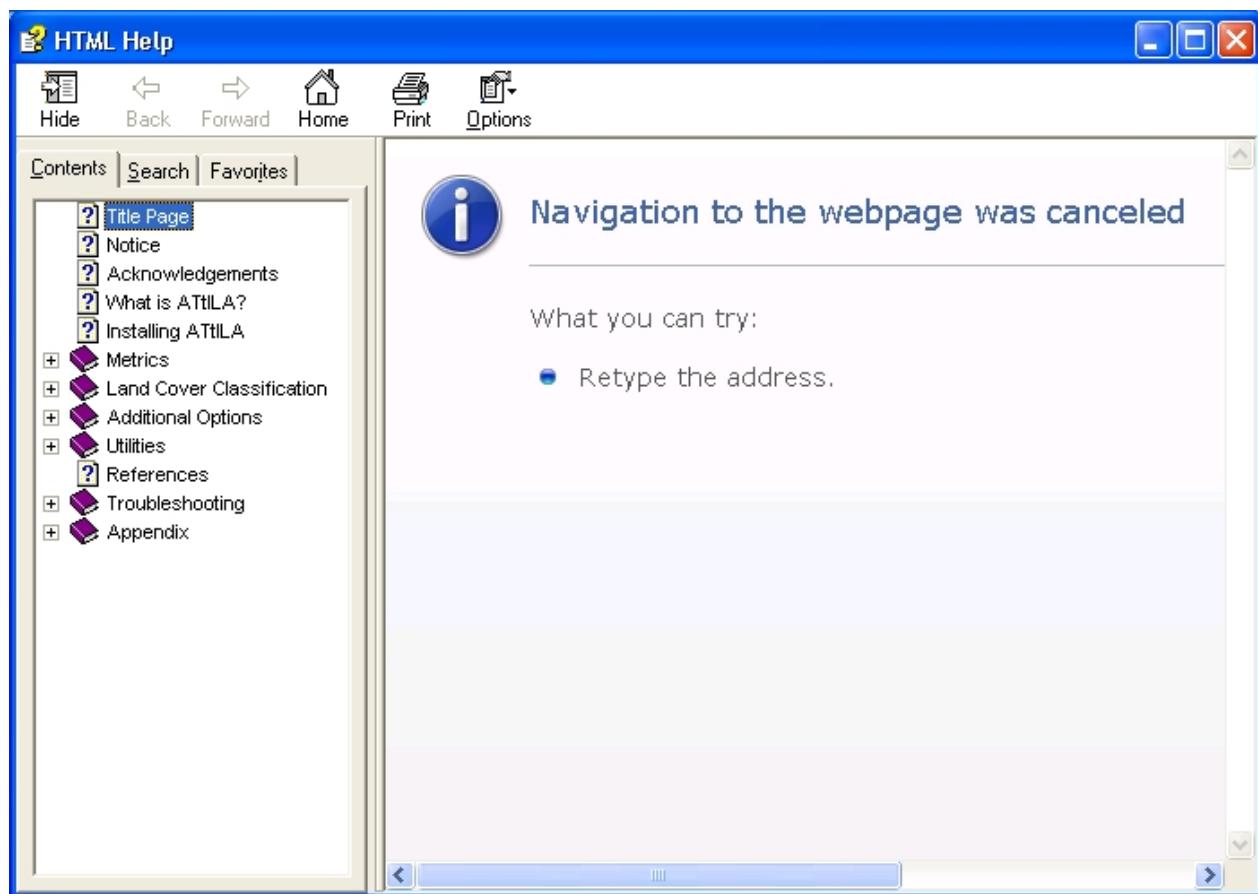


This error may be caused by problems with the field used to classify the different road or stream features (Road class field or Stream order field, respectively).

If an input feature layer contains a reserved keyword such as ORDER as a field name, that field name is altered slightly by ArcGIS when the input feature layer is copied. ATtILA for ArcGIS copies several of the input feature layers while processing selected metrics. This can result in ATtILA for ArcGIS being unable to locate the specified field in the copied dataset. For more guidelines on the naming of fields, search on "Fundamentals of adding and deleting fields" in the ArcGIS help documentation.

Navigation to the webpage was canceled

When opening ATtILA for ArcGIS's CHM Help file, the following message is displayed:

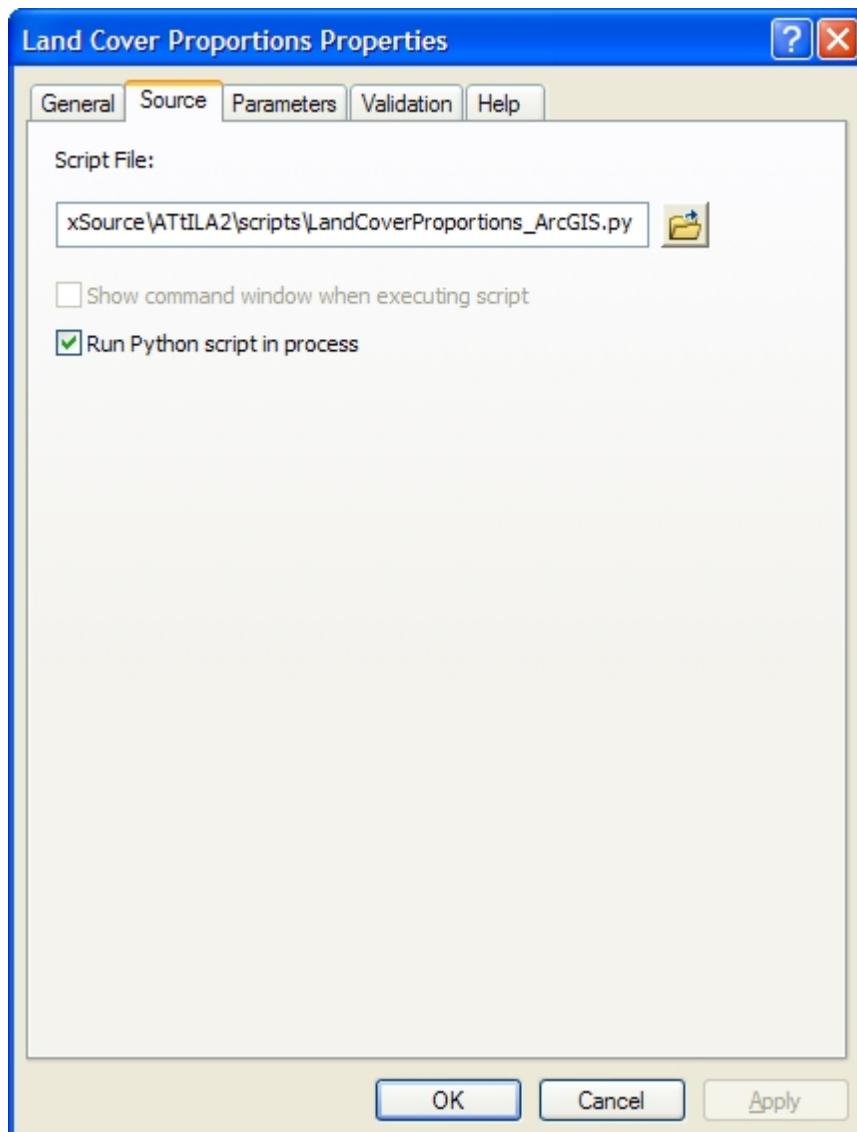


This error often occurs when the CHM Help file is located on a network drive. To resolve, copy the file onto a local drive and reopen.

Tool appears to run but does not finish

If one of ATtILA for ArcGIS's tools 'hangs' (i.e., you enter all the necessary tool inputs and click OK, but the tool never finishes):

- Open Windows Task Manager and select the hung ArcGIS application in the Applications Tab - Click End Task
- Reopen the ArcGIS application where the problem occurred
- Right-click on the tool and open its properties
- Check under the source tab to be sure that the 'Run Python script in process' box is checked



That should solve the problem.

To relaunch the tool with all it's previously set parameters, checkboxes, and options, do the following:

- Open the 'Not Run' shortcut menu in the Geoprocessing > [Results Window](#)
- Right-click on the tool execution that failed
- Select 'Re-Run'

Unable to Determine Conversion Factor

Unable to Determine Conversion Factor

This error is triggered when ATtILA for ArcGIS is unable to determine the conversion factor necessary to convert output linear units to metric units. The following two possible scenario's

have been identified when this may occur.

1) Output Coordinates are not set to a system defined with angular units of Decimal Degrees.

Please be sure that the Environment Settings > Output Coordinates are not set to a system defined with angular units of Decimal Degrees. If an Environment Settings > Output Coordinates is not set, please be sure to select an 'Input reporting unit feature' that does not have a spatial reference defined with angular units of decimal degrees.

2) Output Coordinates unit name is not found in the look up tables used by ATtILA for ArcGIS for metric conversions

It is also possible for this error to occur if the linear units name defined in the Output Coordinates, if one is set, or the linear units property of the 'Input reporting unit feature', if an Output Coordinates is not set, is not found in ATtILA for ArcGIS's look up table for metric conversion factors. Please compare your linear units with those found in the list of [Conversion Factors](#) located in the appendix. If the linear units name is not found, it will be necessary to change the Output Coordinates in the Environment Settings to one found in the look table or to project the 'Input reporting unit feature' to a projection with a linear units property known to ATtILA for ArcGIS.

Undefined Values in LCC XML Document

Undefined Values in the LCC XML Document

For tools in ATtILA for ArcGIS that utilize an [LCC XML document](#), (i.e., tools that utilize a land cover raster input) ATtILA for ArcGIS will examine all of the values found in that tool's selected land cover raster and compare them to those values supplied in the LCC XML document. The values in the LCC XML document are gathered from both the [Values Element](#) section of the document and the [Classes Element](#) section. Any values found in the grid but not found in the LCC XML document will be reported to the user with a warning message in the Geoprocessing > Results window. The user can then determine if the reported values were either accidentally or purposely omitted from the LCC XML document or were possibly incorrectly transcribed. A report of missing values may also indicate that the wrong LCC Schema was selected for the input raster layer, or that the wrong raster layer was input for the selected LCC Schema.

NOTE: Not all values found in the land cover grid need to be included in the LCC XML document. Only land cover values that are of interest to the user (e.g., values for forest or agriculture land cover types) need to be accounted for. If this is the case, and the LCC XML document was constructed to analyze only a subset of land cover classes from the land cover raster, then the warning message from ATtILA from ArcGIS is superfluous and can be ignored.

Warning Messages

When ATtILA for ArcGIS encounters a potential problem or an unexpected occurrence during the execution of one of its tools, it will attempt to relay that information to the user via ArcGIS's Results window. Depending on the situation, ATtILA for ArcGIS may provide potential solutions, possible consequences, or some other piece of information deigned useful to the user. In most cases, the message provided in the Results window will be sufficient to inform the user fully of the situation. In other cases, a more detailed explanation than what can be readily expressed in the Results window is necessary and a referral to the ATtILA for ArcGIS Help document is provided.

Current warning messages that refer the user to the user manual are:

- [Excluded Values in Class Definitions](#)
- [Unable to Determine Conversion Factor](#)
- [Undefined Values in LCC XML Document](#)

NOTE: For more information on examining and understanding the contents of the Results window, search on "Using the Results window" in the ArcGIS help documentation.

Appendix

Conversion Factors

Conversion factors to convert to **square meters**

```
'150_Kilometers': 22500000000.0,
'50_Kilometers': 2500000000.0,
'Centimeter': 0.0001,
'Chain': 404.68564224,
'Chain_Benoit_1895_A': 404.68493412895,
'Chain_Benoit_1895_B': 404.684937926029,
'Chain_Clarke': 404.678379705448,
'Chain_Sears': 404.684238955715,
'Chain_US': 404.687260987426,
'Decimeter': 0.01,
'Fathom': 3.34450944,
'Foot': 0.09290304,
'Foot_1865': 0.092903548000694,
'Foot_Benoit_1895_A': 0.092902877440071,
'Foot_Benoit_1895_B': 0.09290287831176,
'Foot_British_1936': 0.092903496651921,
'Foot_Clarke': 0.09290137275148,
'Foot_Gold_Coast': 0.092902863326732,
'Foot_Indian': 0.09290274144751,
'Foot_Indian_1937': 0.092902070738528,
'Foot_Indian_1962': 0.09290279616016,
'Foot_Indian_1975': 0.09290273520025,
'Foot_Sears': 0.092902717850256,
'Foot_US': 0.092903411613275,
'Inch': 0.00064516,
'Inch_US': 0.000645162580648,
'Kilometer': 1000000.0,
'Link': 0.040468564224,
'Link_Benoit_1895_A': 0.040468493412895,
'Link_Benoit_1895_B': 0.040468493792603,
'Link_Clarke': 0.040467837970545,
'Link_Sears': 0.040468423895572,
'Link_US': 0.040468726098743,
```

```
'Meter': 1.0,
'Meter_German': 1.00002719318486,
'Mile_US': 2589998.47031953,
'Millimeter': 0.000001,
'Nautical_Mile': 3429904.0,
'Nautical_Mile_UK': 3434290.937856,
'Nautical_Mile_US': 3434528.149504,
'Rod': 25.29285264,
'Rod_US': 25.2929538117141,
'Statute_Mile': 2589988.110336,
'Yard': 0.83612736,
'Yard_Benoit_1895_A': 0.83612589696064,
'Yard_Benoit_1895_B': 0.836125904805841,
'Yard_Clarke': 0.836112354763322,
'Yard_Indian': 0.836124673027593,
'Yard_Indian_1937': 0.836118636646753,
'Yard_Indian_1962': 0.83612516544144,
'Yard_Indian_1975': 0.83612461680225,
'Yard_Sears': 0.836124460652307,
'Yard_Sears_1922_Truncated': 0.836123702404,
'Yard_US': 0.836130704519474
```

Conversion factors to convert to **meters**

```
'150_Kilometers': 150000.0,
'50_Kilometers': 50000.0,
'Centimeter': 0.01,
'Chain': 20.1168,
'Chain_Benoit_1895_A': 20.1167824,
'Chain_Benoit_1895_B': 20.1167824943759,
'Chain_Clarke': 20.11661949,
'Chain_Sears': 20.1167651215526,
'Chain_US': 20.1168402336805,
'Decimeter': 0.1,
'Fathom': 1.8288,
'Foot': 0.3048,
'Foot_1865': 0.304800833333333,
'Foot_Benoit_1895_A': 0.304799733333333,
'Foot_Benoit_1895_B': 0.304799734763271,
'Foot_British_1936': 0.3048007491,
'Foot_Clarke': 0.304797265,
'Foot_Gold_Coast': 0.304799710181509,
'Foot_Indian': 0.304799510248147,
'Foot_Indian_1937': 0.30479841,
'Foot_Indian_1962': 0.3047996,
'Foot_Indian_1975': 0.3047995,
'Foot_Sears': 0.304799471538676,
'Foot_US': 0.304800609601219,
'Inch': 0.0254,
'Inch_US': 0.0254000508001016,
'Kilometer': 1000.0,
'Link': 0.201168,
```

```
'Link_Benoit_1895_A': 0.201167824,
'Link_Benoit_1895_B': 0.201167824943759,
'Link_Clarke': 0.2011661949,
'Link_Sears': 0.201167651215526,
'Link_US': 0.201168402336805,
'Meter': 1.0,
'Meter_German': 1.0000135965,
'Mile_US': 1609.34721869444,
'Millimeter': 0.001,
'Nautical_Mile': 1852.0,
'Nautical_Mile_UK': 1853.184,
'Nautical_Mile_US': 1853.248,
'Rod': 5.0292,
'Rod_US': 5.02921005842012,
'Statute_Mile': 1609.344,
'Yard': 0.9144,
'Yard_Benoit_1895_A': 0.9143992,
'Yard_Benoit_1895_B': 0.914399204289812,
'Yard_Clarke': 0.914391795,
'Yard_Indian': 0.914398530744441,
'Yard_Indian_1937': 0.91439523,
'Yard_Indian_1962': 0.9143988,
'Yard_Indian_1975': 0.9143985,
'Yard_Sears': 0.914398414616029,
'Yard_Sears_1922_Truncated': 0.914398,
'Yard_US': 0.914401828803658
```

LCCSchema_v3.xsd

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema attributeFormDefault="unqualified" elementFormDefault="qualified"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
    targetNamespace="lcc" xmlns="lcc" xmlns:k="lcc">
    <xs:element name="lccSchema">
        <xs:complexType>
            <xs:sequence>
                <xs:element name="metadata">
                    <xs:complexType>
                        <xs:sequence>
                            <xs:element type="xs:string" name="name"/>
                            <xs:element type="xs:string" name="description"/>
                        </xs:sequence>
                    </xs:complexType>
                </xs:element>
                <xs:element name="coefficients">
                    <xs:annotation>
                        <xs:documentation>
                            * The coefficients node contains coefficients to be
assigned to values.

                            * REQUIRED ATTRIBUTES
                            * Id - text, unique identifier
                            * Name - text, word or phrase describing coefficient
                            * fieldName - text, name of field to be created for output
                            * - must conform to the field naming conventions
dictated by the output database system
                            * method - text, "P" or "A", designates "P"ercentage or
```

```

per unit "A"rea calculation routine
    </xs:documentation>
</xs:annotation>
<xs:complexType>
    <xs:sequence>
        <xs:element name="coefficient" maxOccurs="unbounded"
minOccurs="0">
            <xs:complexType>
                <xs:attribute name="Id" use="required">
                    <xs:simpleType>
                        <xs:restriction base="xs:string">
                            <xs:enumeration value="NITROGEN"/>
                            <xs:enumeration value="PHOSPHORUS"/>
                            <xs:enumeration value="IMPERVIOUS"/>
                        </xs:restriction>
                    </xs:simpleType>
                </xs:attribute>
                <xs:attribute type="xs:string" name="Name"
use="required"/>
                <xs:attribute name="method" use="required">
                    <xs:simpleType>
                        <xs:restriction base="xs:string">
                            <xs:enumeration value="A"/>
                            <xs:enumeration value="P"/>
                        </xs:restriction>
                    </xs:simpleType>
                </xs:attribute>
                <xs:attribute name="fieldName" use="required">
                    <xs:simpleType>
                        <xs:restriction base="xs:string">
                            <xs:minLength value="1"/>
                        </xs:restriction>
                    </xs:simpleType>
                </xs:attribute>
            </xs:complexType>
        </xs:element>
    </xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="values">
    <xs:annotation>
        <xs:documentation>
            * The values node defines the full set of values that can
exist in a land cover raster.

            * REQUIRED ATTRIBUTES
            * Id - integer, raster code
            *
            * OPTIONAL ATTRIBUTES
            * Name - text, word or phrase describing value
            * excluded - boolean, "true" or "false" or "1" or "0"
            *           - used to exclude values from effective area
calculations
            *
            *           - excluded=false is the default

            * A value element can optionally contain one or more
coefficient elements

            * REQUIRED COEFFICIENT ATTRIBUTES
            * Id - text, must match an Id attribute from a
        </xs:documentation>
    </xs:annotation>

```

```

coefficients node element
    * value - decimal, weighting/calculation factor
    </xs:documentation>
    </xs:annotation>
    <xs:complexType>
        <xs:sequence>
            <xs:element name="value" maxOccurs="unbounded" minOccurs="0">
                <xs:complexType>
                    <xs:sequence>
                        <xs:element name="coefficient" maxOccurs="unbounded"
minOccurs="0">
                            <xs:complexType>
                                <xs:simpleContent>
                                    <xs:extension base="xs:string">
                                        <xs:attribute name="Id" use="required"/>
                                        <xs:attribute type="xs:decimal" name="value"
use="required"/>
                                    </xs:extension>
                                </xs:simpleContent>
                            </xs:complexType>
                        </xs:element>
                    </xs:sequence>
                    <xs:attribute type="xs:int" name="Id" use="required"/>
                    <xs:attribute type="xs:string" name="Name" use="optional"/>
                    <xs:attribute type="xs:boolean" name="excluded"
use="optional"/>
                </xs:complexType>
                <xs:unique name="uniqueCoefficient">
                    <xs:selector xpath="coefficient"/>
                    <xs:field xpath="@Id"/>
                </xs:unique>
            </xs:element>
        </xs:sequence>
    </xs:complexType>
</xs:element>
<xs:element name="classes">
    <xs:annotation>
        <xs:documentation>
            * The classes node contains values from a land cover
raster grouped into one or more classes.

            * REQUIRED ATTRIBUTES
            * Id - text, unique identifier, also used for automated
generation of output field name
                * - must conform to the field naming conventions
dictated by the output database system

            * OPTIONAL ATTRIBUTES
            * Name - text, word or phrase describing class
            * filter - text, a string of one or more tool name
abbreviations separated by a ";"
                * - possible abbreviations are: lcp, rlcsp, lcosp,
splcp, caem, and pm
                * - used to exclude the class from the selectable
classes in the tool's GUI
                * xxxxField - text, overrides ATtILA-generated field name
for output
                * - where xxxx equals a tool name abbreviation
                * - possible abbreviations are: lcp, rlcsp,
lcosp, and splcp
        </xs:documentation>
    </xs:annotation>

```

* - a separate xxxxField attribute can exist for each tool

* - must conform to the field naming conventions dictated by the output database system

* A class can contain either values or classes but not both types.

* Value elements contain only an Id attribute which refers to a value in a raster.

* Values tagged as excluded="true" in the values node should not be included in any class.

```

</xs:documentation>
</xs:annotation>
<xs:complexType>
  <xs:sequence>
    <xs:element name="class" maxOccurs="unbounded" minOccurs="1"
type="classType"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
<!--<xs:key name="coefficientKey">
  <xs:selector xpath="k:coefficients/k:coefficient"/>
  <xs:field xpath="@Id"/>
</xs:key>
<xs:keyref name="coefficientKeyRef" refer="k:coefficientKey">
  <xs:selector xpath="k:values/k:value/k:coefficient"/>
  <xs:field xpath="@Id"/>
</xs:keyref>-->
</xs:element>
<xs:complexType name="classType">
  <xs:sequence>
    <xs:choice minOccurs="1" maxOccurs="1">
      <xs:element name="class" maxOccurs="unbounded" minOccurs="0"
type="classType"/>
      <xs:element name="value" maxOccurs="unbounded" minOccurs="0">
        <xs:complexType>
          <xs:simpleContent>
            <xs:extension base="xs:string">
              <xs:attribute type="xs:int" name="Id" use="required"/>
            </xs:extension>
          </xs:simpleContent>
        </xs:complexType>
      </xs:element>
    </xs:choice>
  </xs:sequence>
<xs:attribute name="Id" use="required">
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:pattern value="([a-zA-Z0-9_])*/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
<xs:attribute type="xs:string" name="Name" use="optional"/>
<xs:attribute type="xs:string" name="lcpField" use="optional"/>
<xs:attribute type="xs:string" name="rlcpField" use="optional"/>
<xs:attribute type="xs:string" name="lcospField" use="optional"/>
<xs:attribute type="xs:string" name="splcpField" use="optional"/>
<xs:attribute type="xs:string" name="filter" use="optional"/>
```

```
</xs:complexType>  
</xs:schema>
```