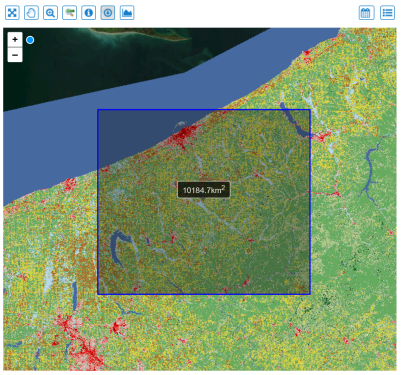
Landcover composition

Determining landcover composition (km2 and percent %) within both watersheds and riparian zones.

I. Download landcover data



1. Open a Web browser and go to - https://www.mrlc.gov/viewer/
2. Next, zoom into northwestern Pennsylvania (refer to figure)
3. On the toolbar, click on the Open Data Download Tool ( )
4. Click and drag a box around the area shown in the figure
5. On the right-hand side, find the Data Download panel
6. Select Rectangle for method and GeoTIFF for image type
7. Under Select categories, find the Annual NLCD
8. Next, check the box (☑) next to Land Cover
9. Under Select Years; adjust the slider for the preferred years
    a. If you want multiple years, define a range (1990-2000)
    b. If you want a single year, specify the same start and end (1995)
10. Under Lat&Long, enter your email address and click on Download
11. Click OK in popup window (depending on users, it may take seconds to hours)
12. Check your email for a message - MRLC Product Download is Ready
13. Click on the link to download the data to the computer
    a. Be sure to click on the URL link, not the attachment!

II. Unzip landcover data

1. When finished downloading, open File Explorer ( )
2. Next, browse to the Downloads folder
3. Right-click the NLCD_***.zip file and click Cut
4. Browse to your student folder
5. Next, paste the .zip file
6. Right-click on the .zip file > 7-zip > Extract All…
7. In the Extract Compressed window, click on Extract
    a. Folder will be created (NLCD_***)

**Note - In this exercise, you will be provided with example watershed and stream data. As you apply this workflow to your own project, you will need to provide your own map layers depicting the boundaries or zones of interest (for example, French Creek basin, Crawford County, West Mead Township, State Game Land #69, Bousson Experimental Forest, etc.) that you wish to calculate landcover composition.

Add landcover data

1. Launch ArcGIS Pro and create a new project file
2. On the Map tab, click on Add Data ( ) > Data
    a. M:\Gatormaps\Learn\Landcover\Examples.gdb\
    b. Streams and Watersheds
3. Change the watersheds to “hollow”, black outline and streams “blue”
4. Uncheck the background World Topographic and Hillshade basemaps
5. On the Map tab, click on Add Data ( ) > Data
6. Next, browse to the location of the downloaded landcover data
    a. e.g. M:\Students\<username>\NLCD_***
7. Select the file named Annual_NLCD_LndCov_****.tiff
8. Once selected, click on OK (do NOT double-click file!)
9. If asked to build pyramids or calculate statistics, click OK
10. Take a moment to examine the map and legend below

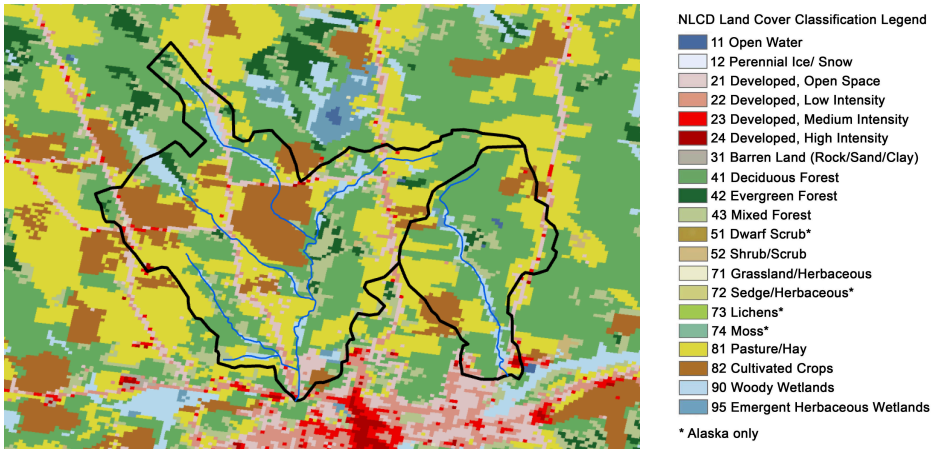


Figure 1: Example 2019 Land Cover data and associated legend.

III. Isolate watershed of interest

You will isolate the watershed of interest and create a new dataset depicting only that watershed. The first step is to manually select the catchment you want to work with. Then, you will use analysis tools to create a “copy” of the polygon in a new file geodatabase named according to the site ID.

1. On the Map tab, click on the Select Features ( ) button
2. Next, left-click on the **LEFT** watershed of interest to select (highlight) it

3. On the ribbon toolbar, click on the Analysis tab > Tools ( )
4. In the Geoprocessing panel (right), search for “copy features”
5. In the list of results, click on Copy Features (Data Management Tools)
    a. Input features: Watersheds
    b. Output features: watershed_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!
    c. Back in the Copy Features tool, click Run ( )

You now have a layer that depicts only the watershed you are interested in. It is named according to the site ID so that you can keep track of and organize the data.

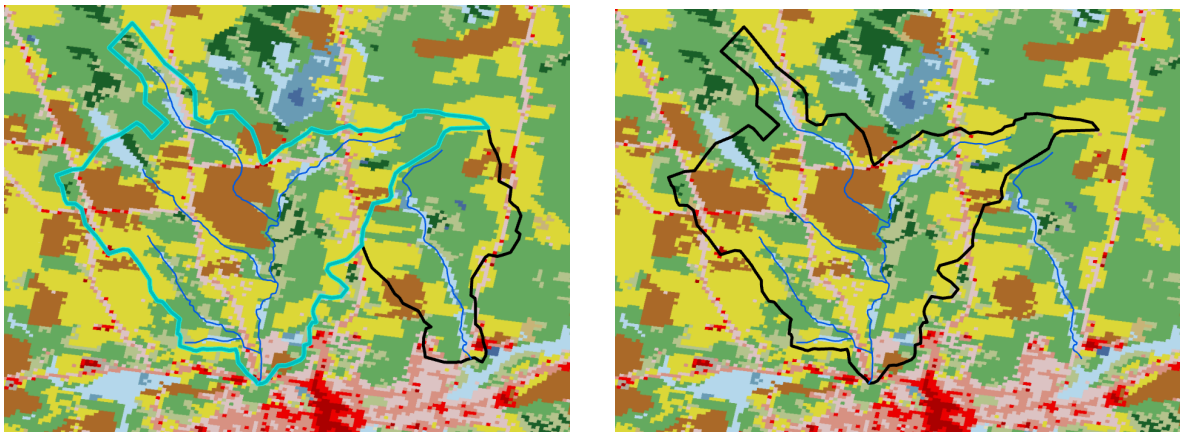


Figure 2: Watershed of interest highlighted (left) and new output layer depicting only the isolated watershed (right).

6. In the Contents panel, uncheck the original Watersheds layer

IV. Extract landcover in watershed

You will use analysis tools to extract the landcover grid cells that fall within the watershed boundary.

1. In the Geoprocessing panel, click the Back ( ) arrow
2. Next, search for the “extract by mask” geoprocessing tool
3. In the list of results, click on Extract by Mask (Spatial Analyst Tools)
    a. Input raster: Annual_NLCD_LndCov_****.tiff
    b. Input raster or feature mask data: watershed_380
    c. Output features: landcover_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!
    d. Extraction areas: Inside

e. Analysis extent: < default >

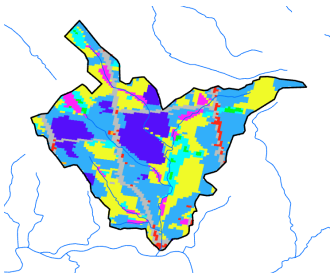
f. Back in the Extract by Mask tool, click Run ( )

You now have a layer that depicts only the landcover data within the watershed of interest.

4. In the Contents panel, uncheck the Annual_NLCD_LndCov_****.tiff layer

**Note - If the colors don't match the original landcover layer, perform the following steps.

5. In the Contents panel, click on landcover_380
6. On the menu bar, click on Raster Layer > Symbology
7. In the Symbology panel, click on three lines ( ) > Import from Layer
    a. Input layer: landcover_380
    b. Symbology layer: Annual_NLCD_LndCov_****.tiff
    c. Accept the defaults for the other parameters
    d. Finally, click on Run



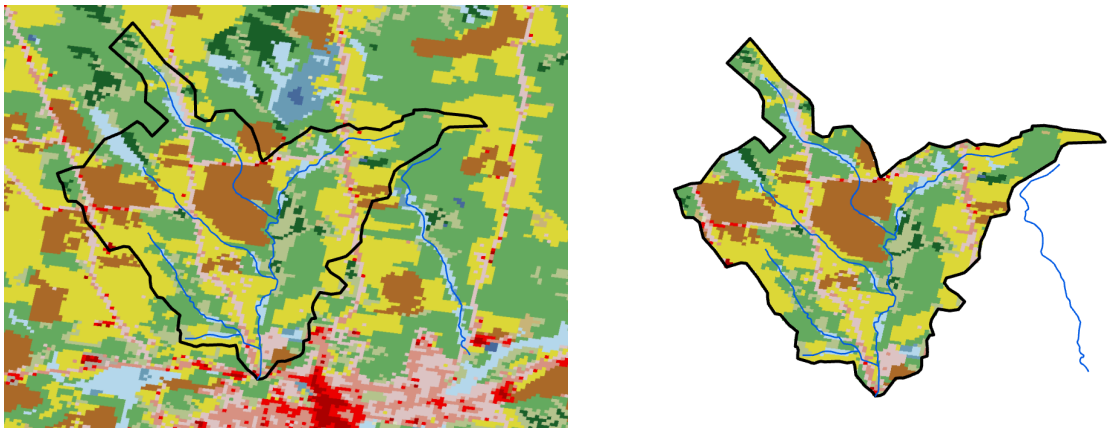


Figure 3: Land cover data for northwestern PA (left) and land cover data only for the watershed of interest (right).

V. Group similar landcover classes

You will use analysis tools to group similar classes of landcover together. Perform this step if you are only interested in knowing what percentage of the watershed is "forested", not the individual components of coniferous, deciduous, and mixed forest types.

1. In the Geoprocessing panel, click the Back ( ) arrow
2. Next, search for the "reclassify" geoprocessing tool
3. In the list of results, click on Reclassify (Spatial Analyst Tools)
    a. Input raster: landcover_380
    b. Reclass field: Value

Examine the table below. Notice how all of the developed classes (20's) are grouped into a new class with a value of "1". Same goes for forests (40's and 50's), agriculture (70's and 80's), and water/wetlands (11 and 90's). In the reclassification section of the geoprocessing tool, you will specify new values of either 1, 2, 3, or 4 depending on the current values listed in the table below.

4. Find the "Reclassification" section
    a. Click on the Unique button

Table 1: Land cover grid cell current values and new assigned values.

Classification	Current Value	New Value
Developed; Barren	21, 22, 23, 24, 31	1
Forested	41, 42, 43, 52	2
Agriculture	71, 81, 82	3
Water; Wetlands	11, 90, 95	4

    b. Assign New values based on the table above

All land cover classes may not be represented in the watershed of interest! For example, if "barren" is non-existent in the watershed, the value 31 will not be listed in the reclassification table.

    c. When finished, double-check your numbers!

Value	New
21	1
22	1
23	1
41	2
42	2
43	2
81	3
82	3
90	4
95	4
NODATA	NODATA

Figure 4: New value assignments to grid cells.

    d. Output features: lc_reclass_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!

    e. Check the box (☐) for "Change missing values to NoData"

    f. When finished, click Run ( )

You now have a layer that depicts grouped landcover classes within the watershed of interest. Output colors are randomly assigned, so your map may differ from the one below.

5. In the Contents panel, uncheck the landcover_380 layer

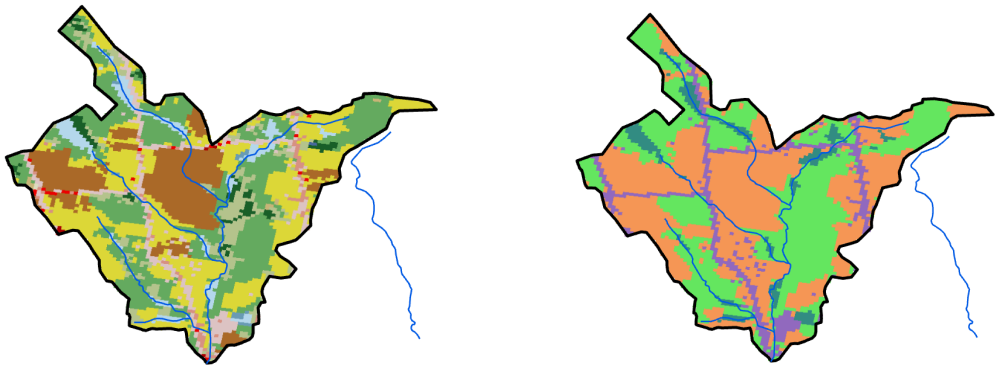


Figure 5: Original land cover values (left) and grouped cover data for the watershed of interest (right).

6. Right-click on each color to change it based on the following:
    a. 1 - Developed - purple
    b. 2 - Forested - green
    c. 3 - Agriculture - brown
    d. 4 - Water/wetlands - blue

VI. Calculate watershed land cover percentages

Next, you will copy values from the landcover attribute table into an Excel spreadsheet and use formulas to calculate the percentage of each generalized land cover class in the watershed.

1. In the Contents panel, right-click on lc_reclass_380 > Attribute Table

The values in the “Value” column represent the generalized land cover classes. The values in the “Count” column correspond to the number of grid cells for each land cover class. In this example, there were 505 grid cells classified as developed, 1706 of forest, 2375 of agriculture, and 221 of water/wetlands.

	OBJECTID *	Value	Count
1	1	1	505
2	2	2	1706
3	3	3	2375
4	4	4	221

	OBJECTID *	Value	Count
1	1	1	505
2	2	2	1706
3	3	3	2375
4	4	4	221

Figure 6: Watershed land cover attribute table.

2. Hold down the CTRL key and select each row
3. At the top-right of the table, click on Copy ()

You will paste the copied rows into Microsoft Excel to help with the calculations.

4. Launch Microsoft Excel and open a new, black worksheet

5. Next, click in cell A1 and right-click > Paste
6. Rename the tab from Sheet1 to Watershed 380
7. Save the Excel spreadsheet in your project folder!

You will enter formulas to calculate percent (%) landcover and total area in km2.

8. Rename cell D1 to Percent (%) and cell E1 to Area (km2)
9. Sum the values of the C column to find the total grid cells
10. Enter the following formula into cell D2
    a. =C2/4807*100
11. Copy and paste the formula into cells D3-D6

**Note - The landcover grid cells are 30x30m or 900 m2 in size. Therefore, you can multiply the number of grid cells times 900 to find the total area in m2, and then multiply by 0.000001 to find the area in km2.

12. Enter the following formula into cell E2
    a. =C2*900*0.000001
13. Copy and paste the formula into cells E3-E6

Formulas were used to calculate the sum of the Count field and to divide the counts for each land cover class by the total to get a percentage. The percentages were then summed to ensure they equal 100%.

14. Click on cells C6 and D2-5 to view the formulas

	A	B	C	D	E
1	OBJECTID	Value	Count	Percent (%)	Area (km2)
2	1	1	505	10.50551279	0.4545
3	2	2	1706	35.48991055	1.5354
4	3	3	2375	49.40711462	2.1375
5	4	4	221	4.597462035	0.1989
6			4807	100	4.3263
7					

Figure 7: Landcover statistics for watershed 380.

VII. Clip streams to watershed

You will use analysis tools to discard or remove the streams outside the watershed of interest. This is necessary because eventually you want to calculate the percentage of forest within the riparian zone of streams for each individual watershed.

1. In the lc_reclass_380 table, click on Clear ( )
2. Next, close the layer attribute table window
3. In the Geoprocessing panel, click the Back ( ) arrow

4. Next, search for the “clip” geoprocessing tool
5. In the list of results, click on Clip (Analysis Tools)
    a. Input features: Streams
    b. Clip features: watershed_380
    c. Output features: streams_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!
6. When finished, click Run ( )

You now have a layer that depicts only streams within the watershed of interest.

7. In the Contents panel, uncheck the original Streams layer

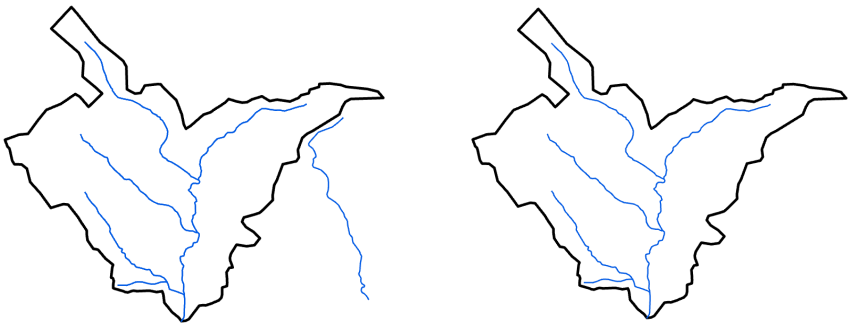


Figure 8: Streams within northwestern PA (left) and streams only within the watershed of interest (right).

VIII. Generate riparian zone buffers

You will use analysis tools to generate 30 meter riparian zone buffers around the streams in the watershed of interest. These will be used to help calculate the percentage of forest near streams.

7. In the Geoprocessing panel, click the Back ( ) arrow
8. Next, search for the “buffer” geoprocessing tool
9. In the list of results, click on Buffer (Analysis Tools)
    a. Input features: streams_380
    b. Output features: streams_buff_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!
    c. Distance [value or field]: 30 meters
    d. Side type: Full
    e. End type: Round

f. Method: Planar
g. Dissolve type: Dissolve all output features into a single feature

10. When finished, click Run ( )

You now have a layer that depicts a 30 meter riparian zone around streams.

8. In the Contents panel, change the buffer symbol to “hollow”

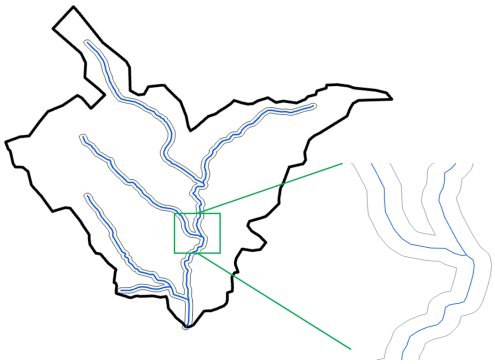


Figure 9: Riparian zone (30m) buffer of streams.

IX. Extract landcover in riparian zone

You will use analysis tools to extract the landcover that falls within the boundary of the 30m riparian zone.

1. In the Geoprocessing panel, click the Back ( ) arrow
2. Next, search for the “extract by mask” geoprocessing tool
3. In the list of results, click on Extract by Mask (Spatial Analyst Tools)
    a. Input raster: lc_reclass_380
    b. Input raster or feature mask data: streams_buff_380
    c. Output features: lc_buffer_380
        i. Output will be stored in project geodatabase
        ii. Replace with some unique name or ID!
    d. Extraction areas: Inside
    e. Analysis extent: < default >
    f. Back in the Extract by Mask tool, click Run ( )

You now have a layer that depicts only the landcover data within the 30 meter riparian zone buffer.

4. In the Contents panel, uncheck the lc_reclass_380 layer

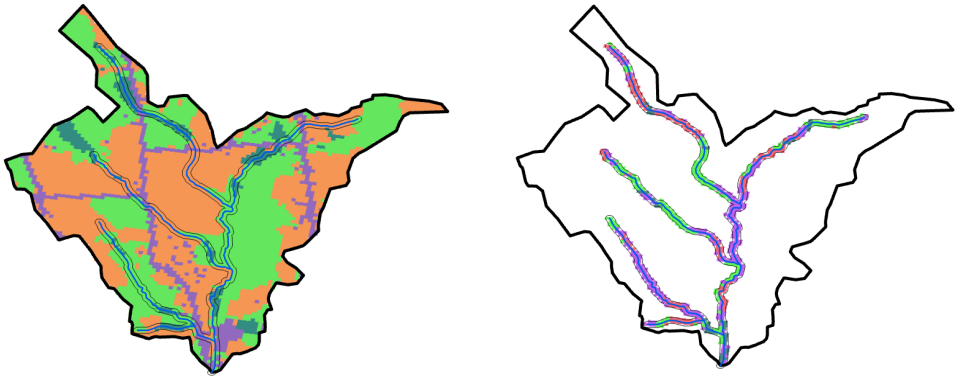


Figure 10: Landcover for the watershed of interest (left) and data only for the 30 meter riparian zone (right).

X. Calculate riparian zone land cover percentages

**Note - Leverage the knowledge and skills you learned earlier in the exercise to a) import the symbology [page 4] and b) calculate percent and area [pages 6-7] of the riparian zone landcover.

	OBJECTID *	Value	Count
1	1	1	51
2	2	2	230
3	3	3	181
4	4	4	123

Figure 11: Riparian zone landcover attribute table.