Summarizing Landcover Lake County, MN

This document outlines the procedures to create four tables summarizing landcover in Lake County, MN: 1) Landcover percentages by elevation, 2) Landcover percentages across elevation categories, 3) Landcover percentages by areas near and far from railroad lines, and 4) Landcover percentages across areas near and far from railroad lines. Three data sources were used: landcover classification (NLCD) from USGS, DEM from Minnesota DNR, and a shapefile of railroad coverage from the Minnesota DOT. This was completed using ArcGIS Desktop 10.6.1 and Microsoft Excel.

Project DEM and Landcover Rasters

Step 1: Open ArcMap and connect the folder holding the three data sources described above. Pull the DEM raster (lkdem.tif) onto the map and create pyramids (Figure 1). Do the same for the landcover raster (lklu.tif). Building pyramids makes display-time for the raster files much faster.

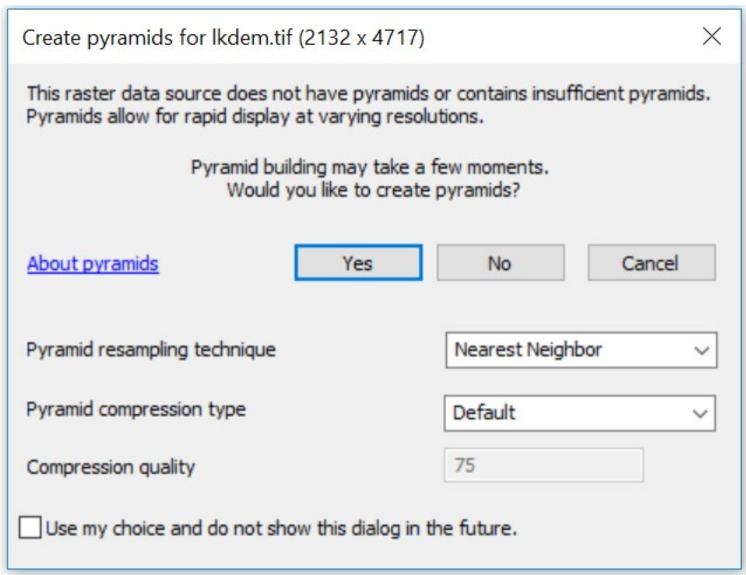


Figure 1. Pulled the DEM into ArcMap and created pyramids, repeat for landcover.

Step 2: Each raster data source has a .prj file which holds the projection information. Define the projection for each raster using the Define Projection tool found in Data Management Toolbox>Projections and Transformations>Define Projection. This step was completed for each raster (lkdem and lklu). Clicking the pointing hand next to Coordinate System pops-up the Spatial Reference Properties (Figure 2). In the XY Coordinate System tab under add coordinate system, choose “import.” Import the .prj file projection for lkdem.tif. In the Z Coordinate system tab choose NAVD88 (height) (ftUS). Click ok and run the tool. Repeat this step for lklu using it’s associated .prj file to import the projection. The lklu raster does not have a Z coordinate.

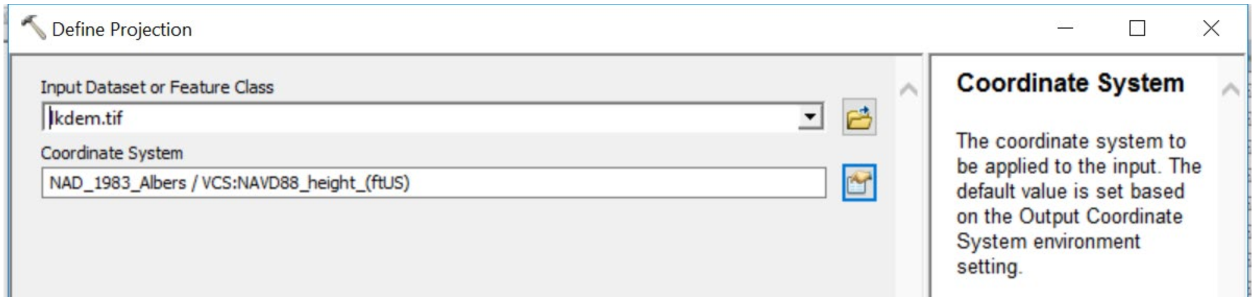


Figure 2. Define projection tool used for the dem and landcover rasters.

DEM Reclassification

Step 3: To reclassify the DEM (lkdem) we will use the Reclass by ASCII File tool. This tool is in the Spatial Analyst Tools (Spatial Analyst Tools>Reclass>Reclass by ASCII File). To use this toolbox the Spatial Analyst extension must be checked by clicking Customize>Extensions and checking Spatial Analyst (Figure 3).

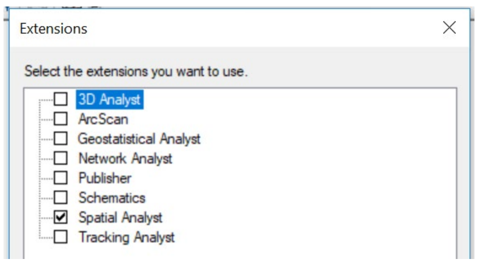


Figure 3. Click Customize from the top drop-down menus, click Extension, and check Spatial Analyst.

Step 4: To use Reclass by ASCII File we will create a text file that specifies how the DEM should be remapped. In your working folder, right-click and create a New>Text File. The remap values are shown below with the logic of how they will map in parentheses:

1 1000 : 1 (where 1 <= value <= 1000, values remapped to 1)
1000 1400 : 2 (where 1000 < value <= 1400, values remapped to 2)
1400 1800 : 3 (where 1400 < value <= 1800, values remapped to 3)
1800 2200 : 4 (where 1800 < value <= 2200, values remapped to 4)

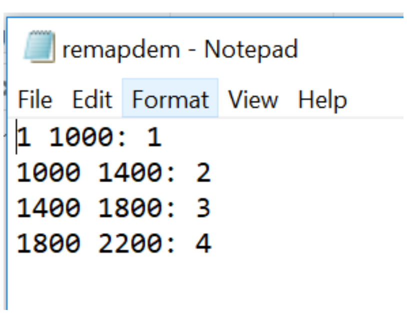


Figure 4. Remap text file used for Reclassification by ASCII File.

We don't want to lose the values between like 1400-1401, so it is important to make the top value of the above field match the bottom value of the below field. We can also consider 0 null values. Looking at the DEM in ArcMap, the black values on the edges are 0 and are not a part of the county boundary, therefore the reclassification starts at 1.

To use the Reclass by ASCII File tool, the input is lkdem. The input ASCII remap file is the text file just created. The output raster outputs to your geodatabase. I created a geodatabase for this project by right-clicking in the contents pane under my project folder and clicking New>File Geodatabase. Missing values are changed to NoData. Click Run.

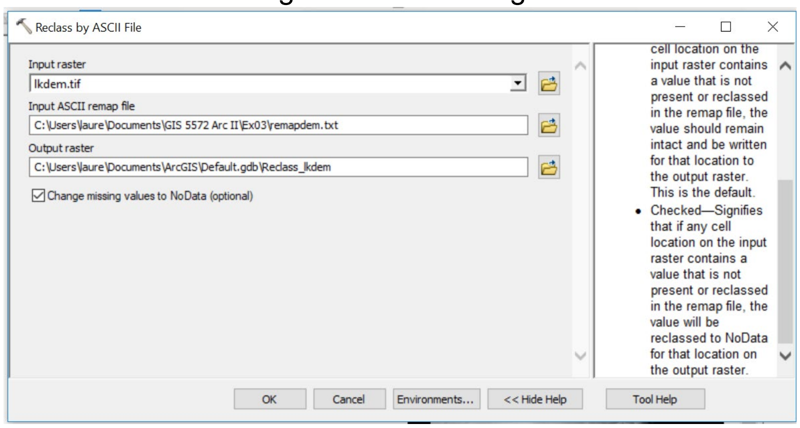
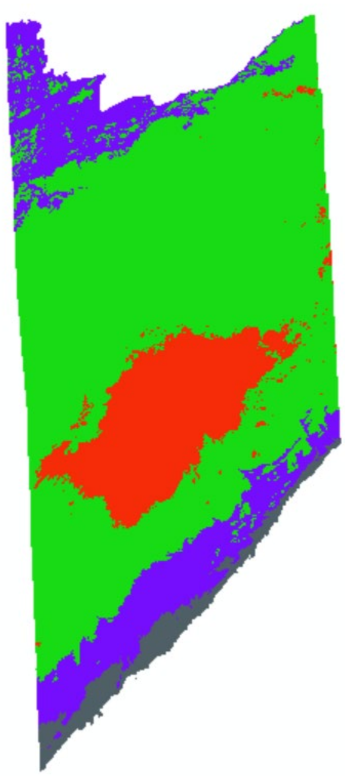


Figure 5. Reclass by ASCII File with inputs.



Symbol	<VALUE>	Label	Count
	<all other values>	<all other values>	
	<Heading>		
	1	1-1000	257300
	2	1001-1400	1085895
	3	14001-1800	4297908
	4	1801-2200	942073

Figure 6. Output reclassified DEM.

Landcover Reclassification

Step 5: Create another text file for using Reclass by ASCII File, shown in figure 7. We will again use range to classify landcover even though some of the classifications have only one value. For example, Herbaceous Upland has only one reclassification value, 71. There is no 70 value in the raster and the bottom value is taken as less than the remap value. Therefore, it should not be an issue to make the range for 71 70 – 71.

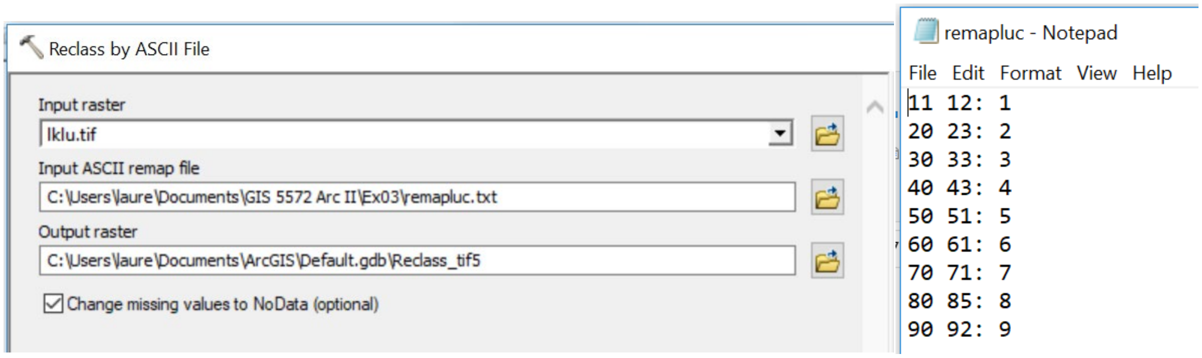


Figure 7. Reclass by ASCII File tool inputs and the text file remap.

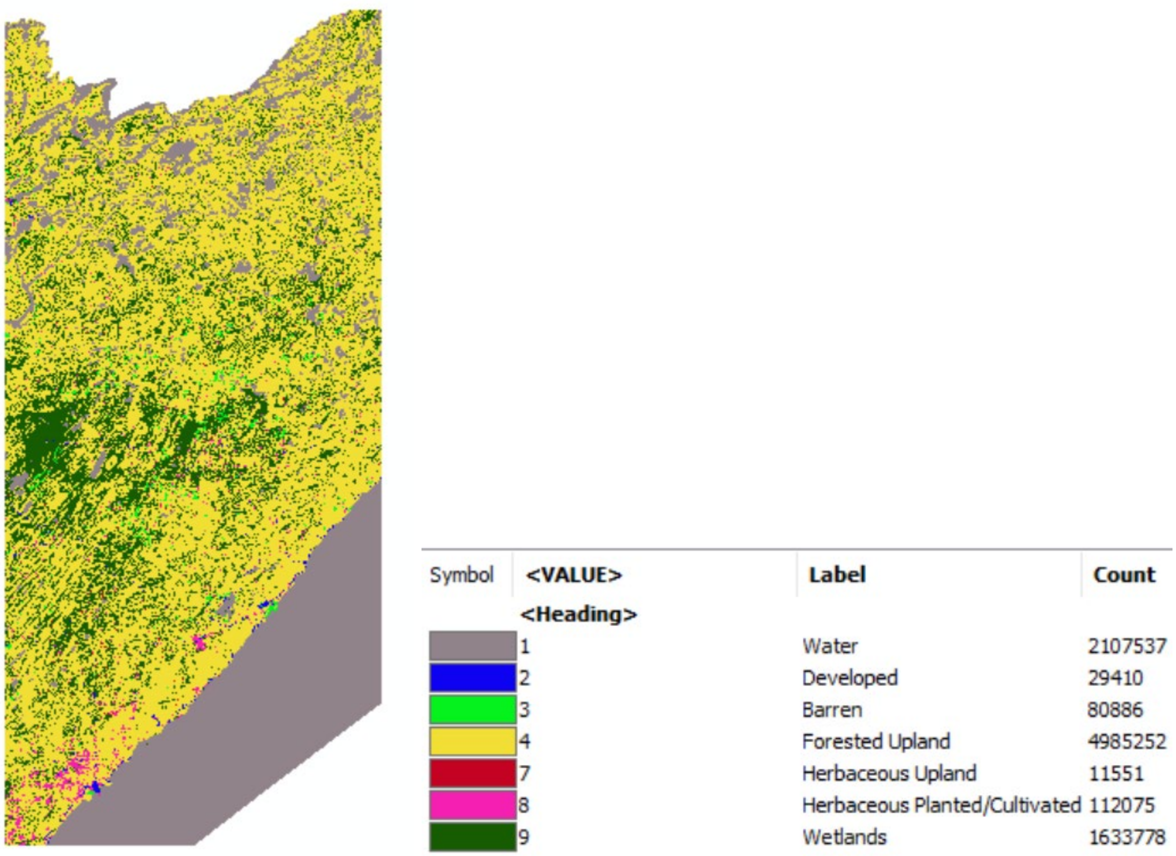


Figure 8. Output results of landcover reclassification by ASCII file.

Combine Rasters

Step 6: The combine tool is found in Spatial Analyst Tools>Local>Combine tools. It is used to combine Reclass_lkdem and Reclass_lklu. The output (Combine_Recl1) is a raster where a new value is created for each unique combination of the values from the two input rasters. I verified that these numbers are correct by summing the pixel counts for the classes of the Reclass_lkdem (Figure 9) and checking against the pixel counts from the original Reclass_lkdem. This works because the boundary of the DEM stays the same throughout combine raster whereas the landcover raster is clipped to the dem and therefore has less pixels.

Table

Combine_Recl1

OBJECTID *	Value	Count	Reclass_lkdem	Reclass_lklu
22	22	11145	1	9
23	23	208386	1	4
24	24	18119	1	8
25	25	4861	1	3
26	26	13121	1	2
27	27	841	1	7
28	28	827	1	1
6	6	197193	2	1
7	7	155796	2	9
8	8	684523	2	4
9	9	32131	2	8
10	10	2491	2	7
11	11	7298	2	3
12	12	6463	2	2
1	1	321045	3	1
2	2	2915762	3	4
3	3	25868	3	8
4	4	6026	3	7
5	5	992398	3	9
13	13	31589	3	3
19	19	5220	3	2
14	14	591076	4	4
15	15	288466	4	9
16	16	15399	4	8
17	17	11543	4	1
18	18	1403	4	7
20	20	32052	4	3
21	21	2134	4	2

Figure 9. Attribute table for Combine_Recl1 from the Combine tool using the inputs of the reclassified DEM and landcover raster data.

Simplify Railroad

Step 7: The railroad data from the DOT shapefile of railroads in Lake County, Minnesota is detailed. To get a smoother buffer, it is necessary to highly generalize the railroads before buffering. To do this we will use the Simplify Line tool found in Cartography tools>Generalization>Simplify Line. Simplify Line removes extraneous bends while preserving essential shape. This inputs for the tool can be seen in Figure 10.

The simplification algorithm used is POINT_REMOVE. This retains critical points that preserve the essential shape of a line and removes all other points. I thought bend simplify would be more appropriate for lakes or streams and weighted area didn't make sense for just trying to simplify the line.

The railroads are simplified with a 1000-meter tolerance. After measuring the railroad lines with the measure tool in ArcMap it seemed appropriate to use roughly 1000 m tolerance to make the lines highly generalized. The output of the tool is shown in figure 11.

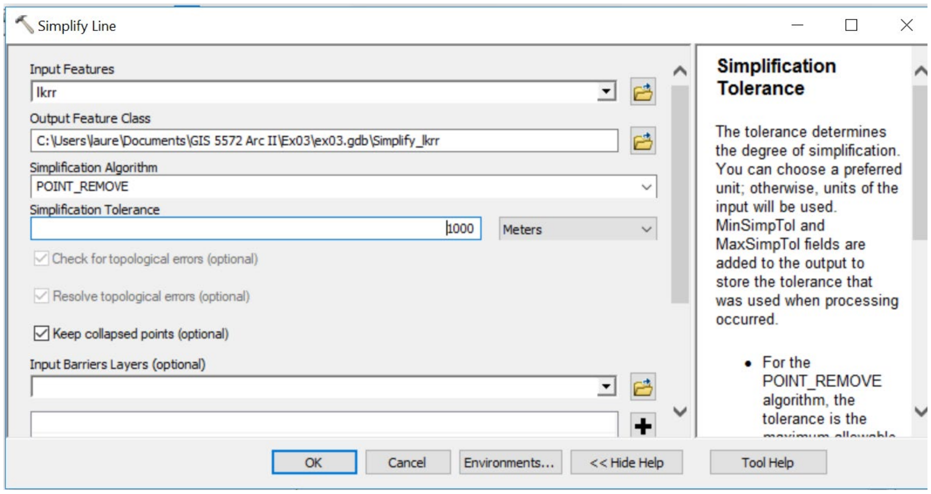


Figure 10. Tool inputs for Simplify Line to simplify the railroads using POINT_REMOVE and a 1000-m tolerance.

Figure 11. Output of tool comparing a portion of the railroad line before Simplify Line (Left) and after (Right).

Buffer RR

Step 8: Buffer the simplified railroads using python. First, open the python window in ArcMap and input Python Script:

```
>>> import arcpy
>>> arcpy.Buffer_analysis("Simplify_lkrr",
"Buffer_lkrr",9656.06,"FULL","FLAT","ALL")
```

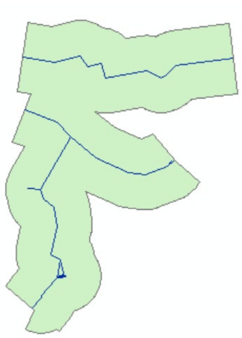


Figure 11. Output Buffer from Simplified Railroads.

Clip Combined Raster to RR Buffer

Step 9: To clip the combined raster to the railroad buffer polygon feature, use the clip tool specified for raster data found in Data Management Tools>Raster>Raster Processing>Clip. Remember that the combined raster took the two reclassified rasters for landcover and dem and created a raster that classified unique value pairs.

The input of the tool was the combined raster (Combine_Recl1). The output extent takes the railroad buffer created above and uses the input features for clipping geometry.

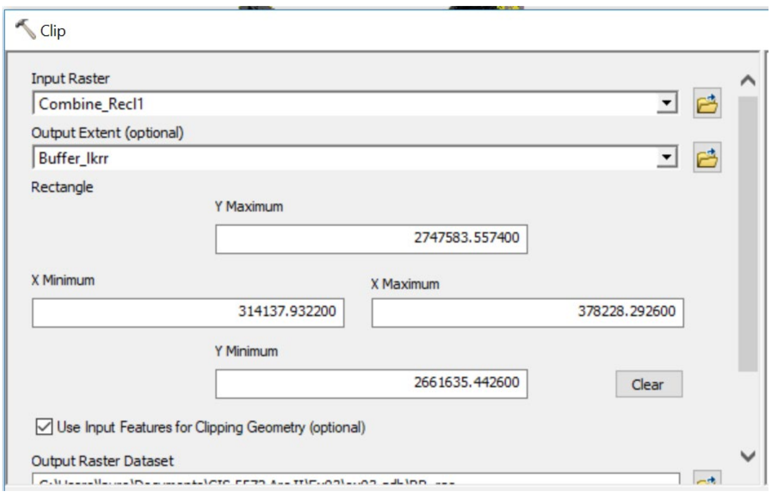


Figure 12. Clip tool with inputs used to clip the combined raster (from the reclassified landcover and DEM) to the railroad buffer polygon feature.

Format Tables using Excel

Step 10:

I formatted the tables in excel by copying the records in the attribute tables and pasting into the table formats provided in the exercise directions. I completed the calculations using excel. The tables are attached below and represent the following: 1) Landcover percentages by elevation, 2) Landcover percentages across elevation categories, 3) Landcover percentages by areas near and far from railroad lines, and 4) Landcover percentages across areas near and far from railroad lines.

Key Table 1:

Land Use	1000 ft and less		1001-1400		1401-1800		1801-2200		TOTALS	
Water	827	0.321%	197193	18.159%	321045	7.470%	11543	1.225%	530608	8.060%
Developed	13121	5.099%	6463	0.595%	5220	0.121%	2134	0.227%	26938	0.409%
Barren	4861	1.889%	7298	0.672%	31589	0.735%	32052	3.402%	75800	1.151%
Forested Upland	208386	80.990%	684523	63.038%	2915762	67.841%	591076	62.742%	4399747	66.833%
Herbaceous Upland	841	0.327%	2491	0.229%	6026	0.140%	1403	0.149%	10761	0.163%
Herbaceous Upland/Cultivated	18119	7.042%	32131	2.959%	25868	0.602%	15399	1.635%	91517	1.390%
Wetlands	11145	4.332%	155796	14.347%	992398	23.090%	288466	30.620%	1447805	21.993%
TOTALS	257300	100.000%	1085895	100.000%	4297908	100.000%	942073	100.000%	6583176	100.000%

Key Table 2:

Land Use	1000 ft and less		1001-1400		1401-1800		1801-2200		TOTALS	
Water	827	0.156%	197193	37.164%	321045	60.505%	11543	2.175%	530608	100.000%
Developed	13121	48.708%	6463	23.992%	5220	19.378%	2134	7.922%	26938	100.000%
Barren	4861	6.413%	7298	9.628%	31589	41.674%	32052	42.285%	75800	100.000%
Forested Upland	208386	4.736%	684523	15.558%	2915762	66.271%	591076	13.434%	4399747	100.000%
Herbaceous Upland	841	7.815%	2491	23.148%	6026	55.999%	1403	13.038%	10761	100.000%
Herbaceous Upland/Cultivated	18119	19.799%	32131	35.109%	25868	28.266%	15399	16.826%	91517	100.000%
Wetlands	11145	0.770%	155796	10.761%	992398	68.545%	288466	19.924%	1447805	100.000%
TOTALS	257300	3.908%	1085895	16.495%	4297908	65.286%	942073	14.310%	6583176	100.000%

Key Table 3:

Land Use	Close to RR		Far From RR		TOTALS	
Water	48375	1.777%	482233	12.491%	530608	8.060%
Developed	21116	0.776%	5822	0.151%	26938	0.409%
Barren	44731	1.643%	31069	0.805%	75800	1.151%
Forested Upland	1720255	63.184%	2679492	69.407%	4399747	66.833%
Herbaceous Upland	6701	0.246%	4060	0.105%	10761	0.163%
Herbaceous Upland/Cultivated	67925	2.495%	23592	0.611%	91517	1.390%
Wetlands	813511	29.880%	634294	16.430%	1447805	21.993%
TOTALS	2722614	100.000%	3860562	100.000%	6583176	100.000%

Key Table 4:

Land Use	Close to RR		Far From RR		TOTALS	
Water	48375	9.117%	482233	90.883%	530608	100.000%
Developed	21116	78.387%	5822	21.613%	26938	100.000%
Barren	44731	59.012%	31069	40.988%	75800	100.000%
Forested Upland	1720255	39.099%	2679492	60.901%	4399747	100.000%
Herbaceous Upland	6701	62.271%	4060	37.729%	10761	100.000%
Herbaceous Upland/Cultivated	67925	74.221%	23592	25.779%	91517	100.000%
Wetlands	813511	56.189%	634294	43.811%	1447805	100.000%
TOTALS	2722614	41.357%	3860562	58.643%	6583176	100.000%

Time Spent

Time working in ArcMap was roughly 4 hours, I got stuck at different points especially finding a way to combine the rasters and get an output that give pixel counts for each land cover type within each elevation category. I then spent another two hours creating the tables and finishing the write-up document. 6 hours total.