

Exercise 2 – Introduction to Modelbuilder

Session Objectives: At the conclusion of this session, you will be able to:

- Understand how models affect workflow and transparency
- Create a new toolbox and model
- Load data and tools into a model, create outputs
- Use the Reclassify, Focal Statistics and Combine tools in a model
- Copy and modify pieces of existing models to increase efficiency

Material Created By: Gabe DeAlessio (Dec 2012), updated Paul Lang (Feb 2016)

Software: ArcGIS 10.2.2

Directory Path: D:\CSP7300\Exercise2

GDB: GWWA.gdb

Imagery:

MXDs: GWWA.mxd

SECTION 1 – Set Up (together with class)

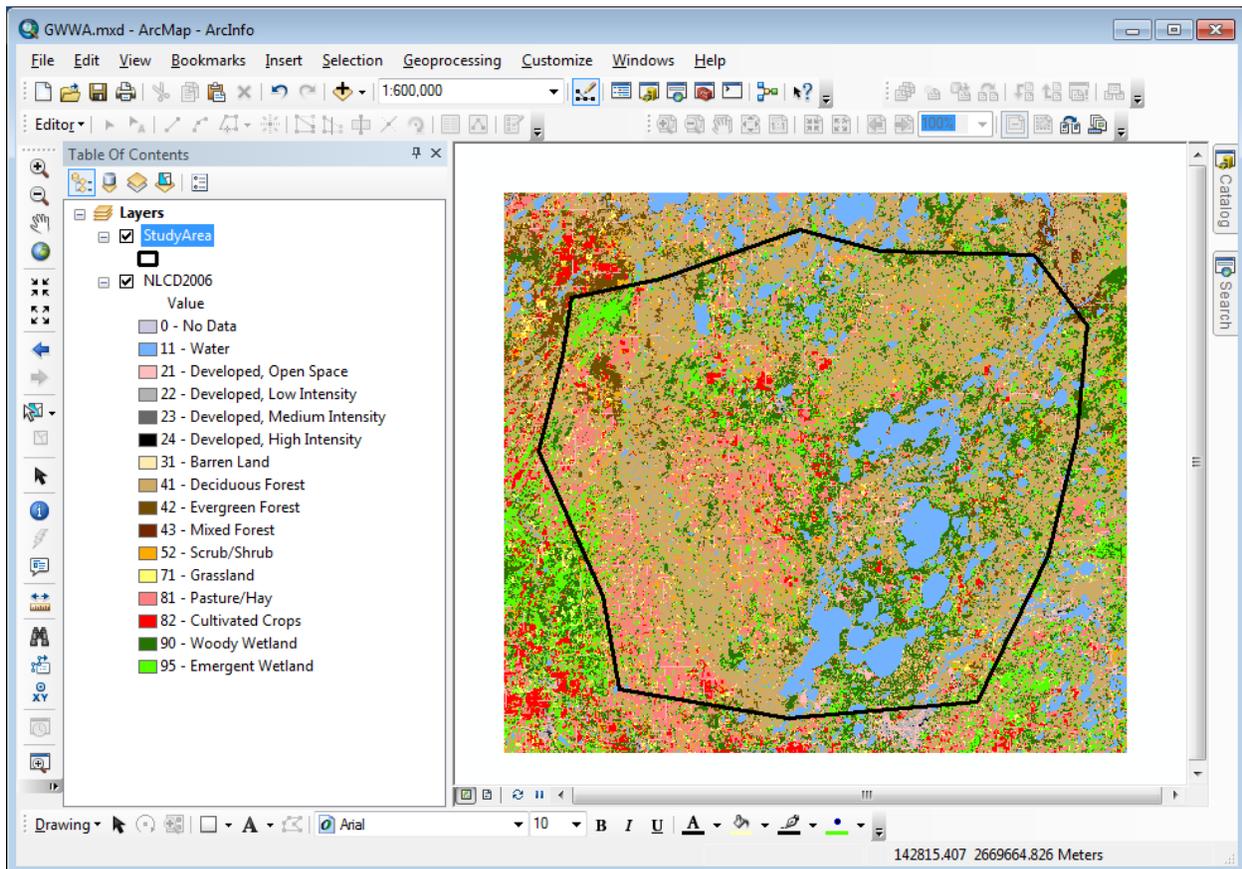
All data are located in D:\CSP7300\Exercise2 folder, unless otherwise stated.

The Golden winged Warbler is a species that lacks habitat across its nesting range. The Joint Venture recovery plan calls for another 200,000 acres of habitat in BCR 12 in Minnesota alone. We will look at the landscape and evaluate areas that currently meet the habitat requirements as a way to focus protection.

The Golden-winged Warbler Recovery Plan states the following: at the macro landscape context, **GWWA prefers 70% forest and 22% open, herbaceous landcover within 1.5 miles.**

Using these requirements, we will create a model that selects the macro-habitat landcover.

1. Open the GWWA.mxd.
2. Note the following 2 pieces of data are already added:
 1. Study area
 2. 2006 NLCD



3. If ArcToolbox isn't open, click on the button to open.

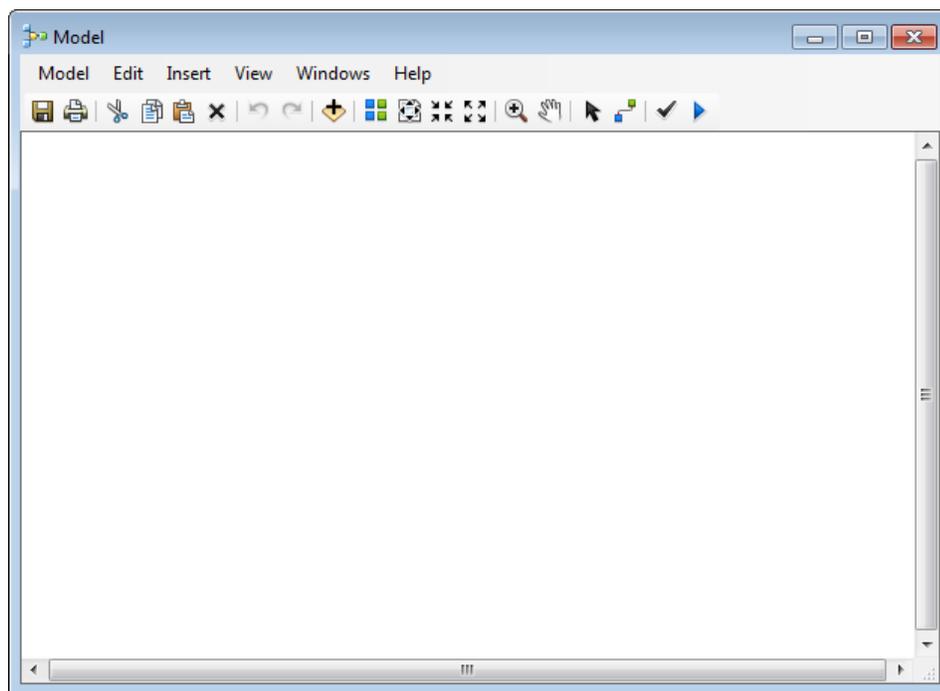
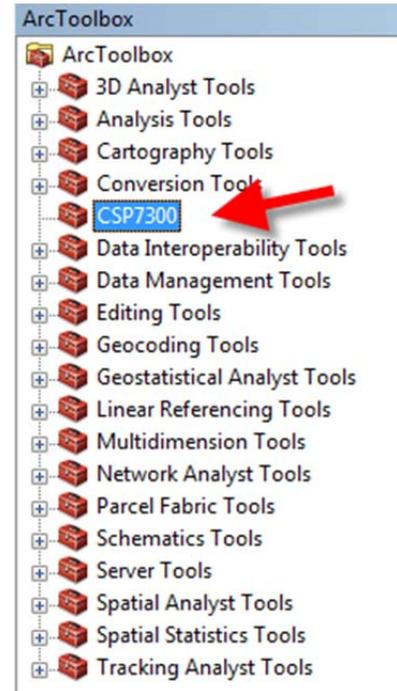


4. Right Click in ArcToolbox and select "Add Toolbox"
5. Browse to **Exercise2** and click on the "New Toolbox" icon . Name it "**CSP7300 Tools**", then highlight it and Click Open.

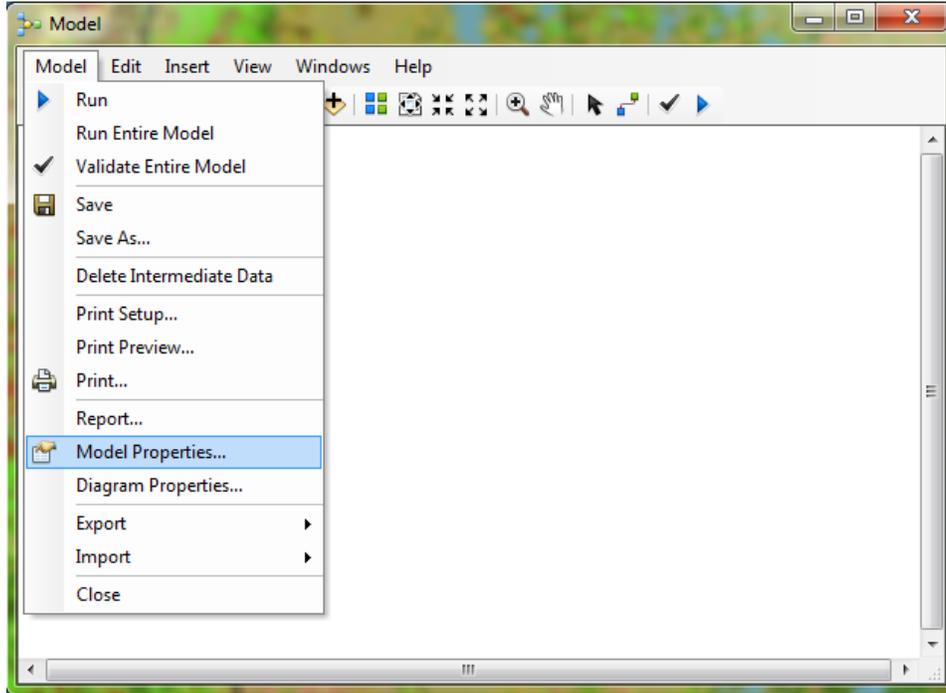
You now have an empty toolbox ready to add custom models and scripts into.

6. Right click on **CSP7300 Tools** and select New / Model.

An empty Model page will open.



7. Click on **Model** in the Model Builder window and select Model Properties

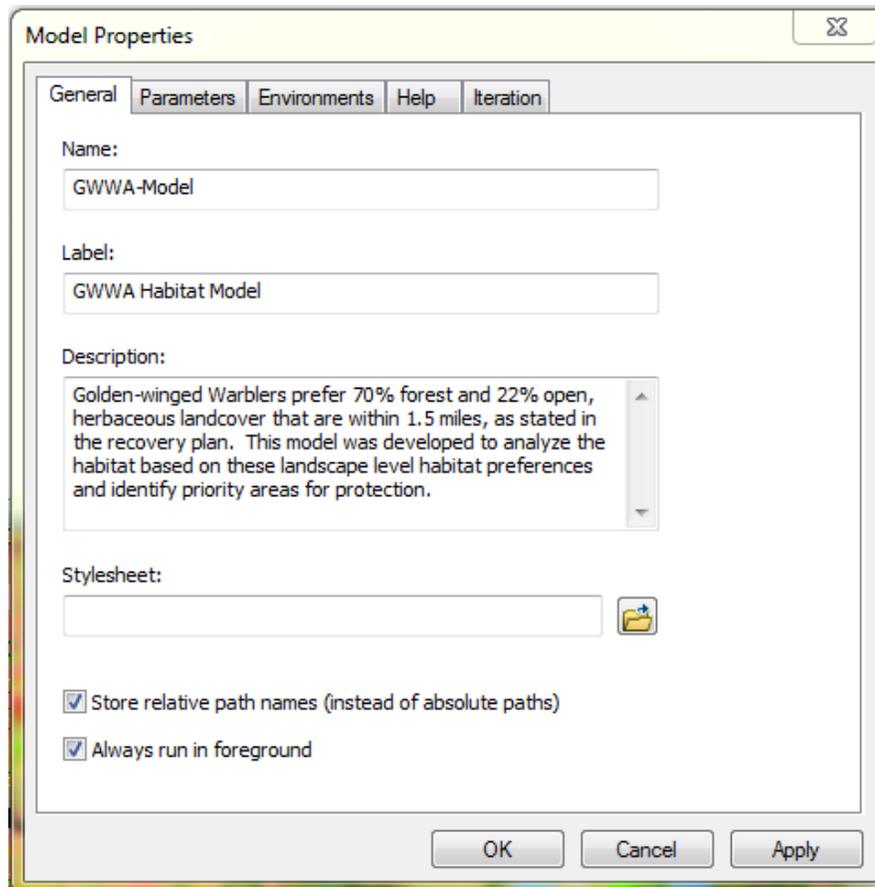


This will bring up a blank Model Properties window.

8. Click on the **General** tab in the Model Properties window (if not already selected)
9. You will now fill out most of the information in the General tab of the Model Properties window (see figure below for reference).
 - a. Type **GWWA-Model** into the *Name:* input box
 - b. Type **GWWA Habitat Model** into the *Label:* input box
 - c. Type a description for your model into the *Description:* input box.

Golden-winged Warblers prefer 70% forest and 22% open, herbaceous landcover that are within 1.5 miles, as stated in the recovery plan. This model was developed to analyze the habitat based on these landscape level habitat preferences and identify priority areas for protection.

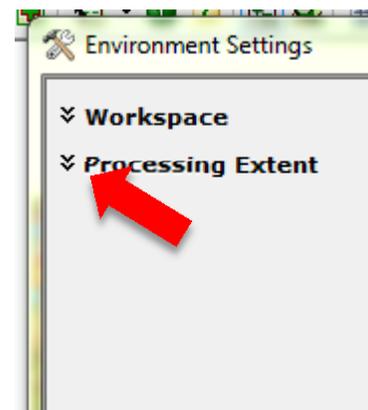
- d. Click on “**Store relative path names (instead of absolute paths)**”



10. Click on the Environments tab

We are now going to set up a couple environmental setting for our model.

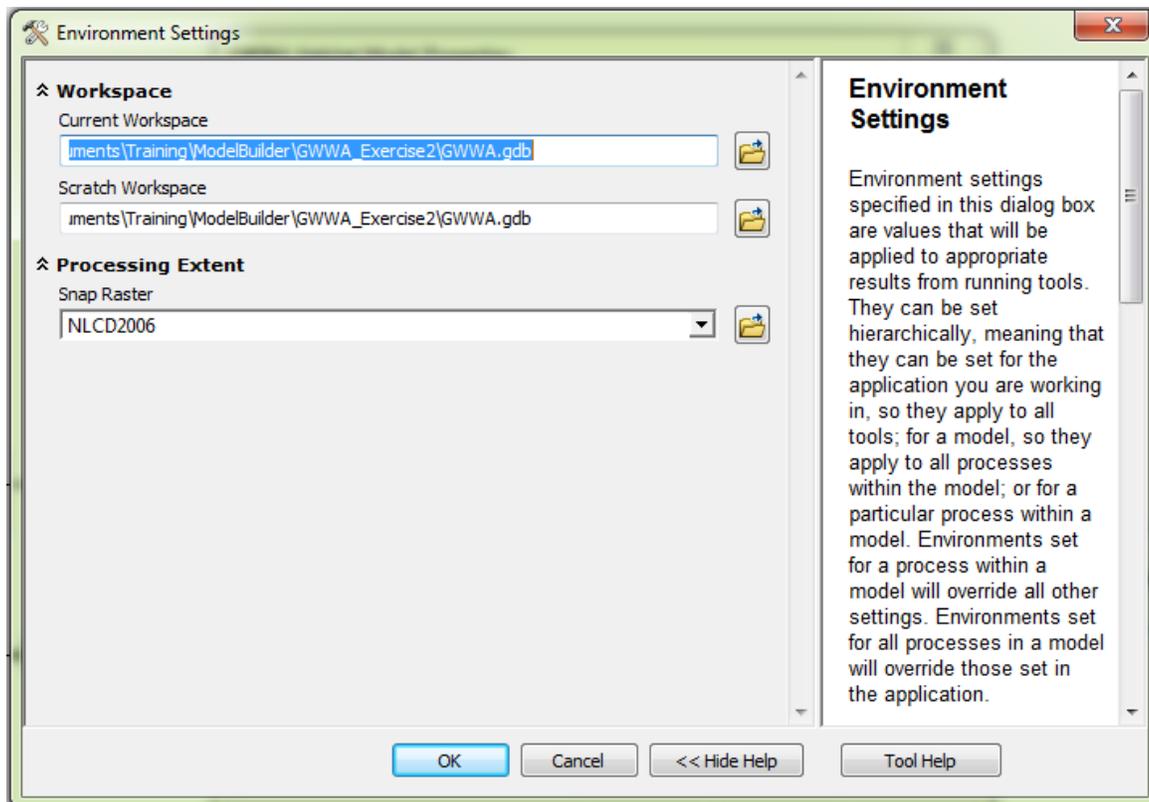
11. Scroll down the list and check the box next to **Processing Extent** and **Workspace**
 12. Click the + next to *Processing Extent* to expand the environmental parameters contained under *Processing Extent* and **uncheck Extent**.
 13. Click on **Values...** button in the Model Properties window
 14. Click on the two down arrows next to each of the entries (**Workspace** and **Processing Extent**) in the Environment Settings window
- This will expose the input boxes to set the values for these settings
15. Set the **Current Workspace** and the **Scratch**



Workspace to the path of your geodatabase
C:\CSP7300\Exercise2\GWWA_Exercise2\GWWA.gdb

16. Set **Snap Raster** to *NLCD2006*
17. Click **OK** for the Environment Settings window

Refer to the image below for guidance on setting values for the environmental settings



Side note: Other common environments you may set regularly are Mask, if you want to “clip” your results to some boundary (e.g. the Study Area); Extent if you want to set a common output extent for all the data you process; Cell Size if you want all your data to be the same cell size.

18. Click **OK** for the Model Properties window

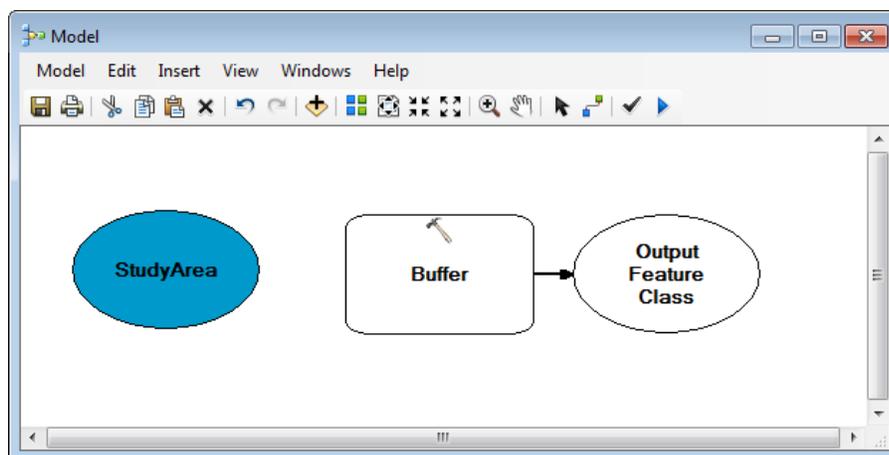
SECTION 2 – Simple Model Construction (instructor then student)

1. Position your ArcMap and Model Builder window so you can see both.

Drag the Study Area feature class from the table of contents into your model. Notice it turns to a blue oval, which by default represents a data input.

2. Next add the Buffer tool to the model. In ArcToolbox, find the Analysis Tools / Proximity / Buffer.

Drag the tool onto the model. Note the tool is rectangular and a connected oval is also added. They are uncolored as you have not specified how they will work yet. Your model should look like this:



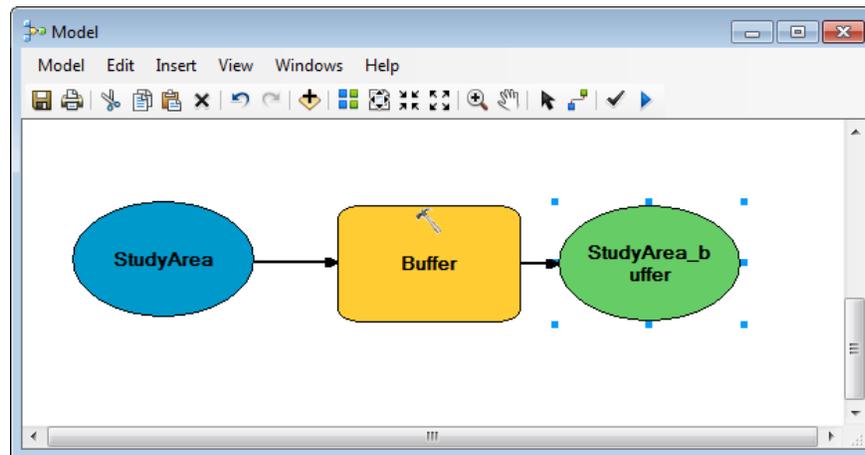
3. Connect the StudyArea to the Buffer Tool. First, select the Connect tool, then left mouse click inside the StudyArea, move the line into the Buffer tool and click again.



- Choose “Input Features” from the pop up to designate the StudyArea as the input for the tool to run.
4. Next, double click on the Buffer Tool. This opens the Tools dialog box. Set your output to the **GWVA geodatabase** and your buffer distance to 1.5 miles. Click OK.

Note: because our criteria looks at data within 1.5 miles, we need to expand our analysis area beyond the study area to yield accurate results.

5. Your model should now be colored in, indicating it's ready to run. Right Click on the green oval, StudyArea_buffer and make sure "Add to Display" is checked.



6. Under Model, choose Save.

Tip: Always Save BEFORE running a model or risk losing work should the model encounter an unexpected error!

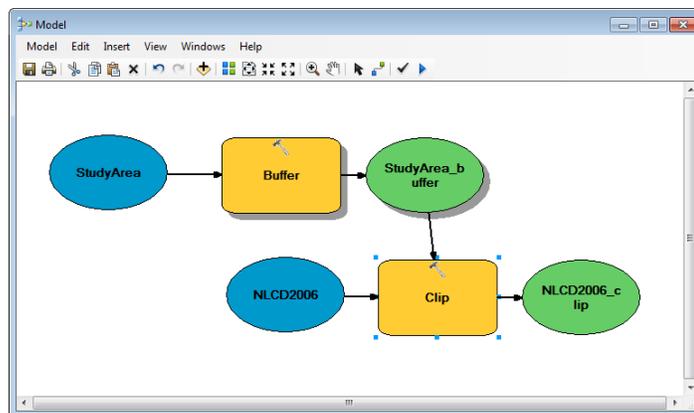
7. Finally, run the model by clicking on the Run icon  or going to the Model menu, and choosing Run.
8. Your model should run quickly and add to your map. Also notice the model elements have a shading behind them, indicating those processes have been run.
9. Change symbology of the Study Area Buffer to hollow out the outline.

STOP HERE

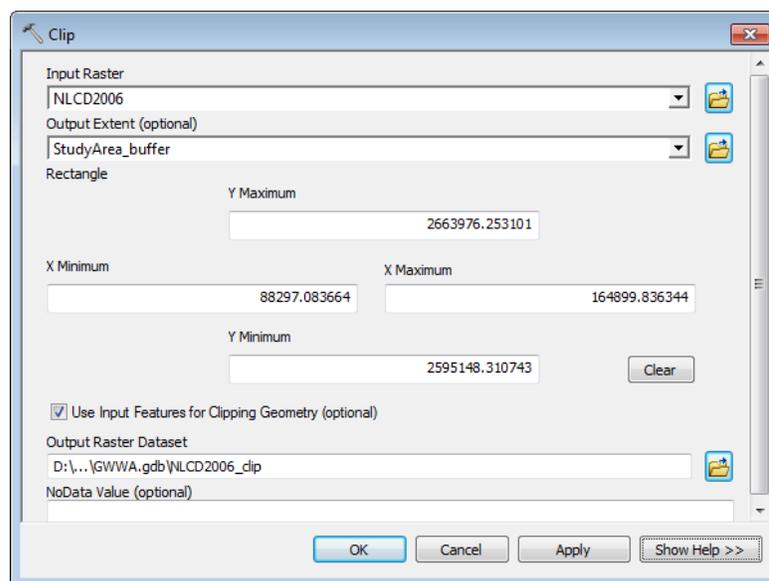
SECTION 3 – Additional Model Construction (instructor then student)

In this section we will fully develop our model based on the landcover requirements for the Golden Winged Warbler. Because the warbler requirements use 2 different habitats, our model will split into 2 courses and combine them at the end.

1. With your model open, Drag the NLCD2006 data onto it.
2. Find the Clip Tool in ArcToolbox / Data Management / Raster /Raster Processing. Drag and drop it into your model.
3. Use the Connect tool to add the Study Area Buffer as the 'output extent' and the NLCD 2006 as the 'input raster.



4. Double click on the Clip tool and verify your settings. Check on the “Use Input Features for Clipping Geometry”. Set the output to go into the GWWA.gdb and name it NLCD2006_Clip.



5. Run the model so far. This will create the data that we will use in the next step. *Without running the model, the Reclassify wouldn't have data to drive on!*
6. Add the Reclassify tool to the model. It can be found in ArcToolbox / Spatial Analyst Tools / Reclass

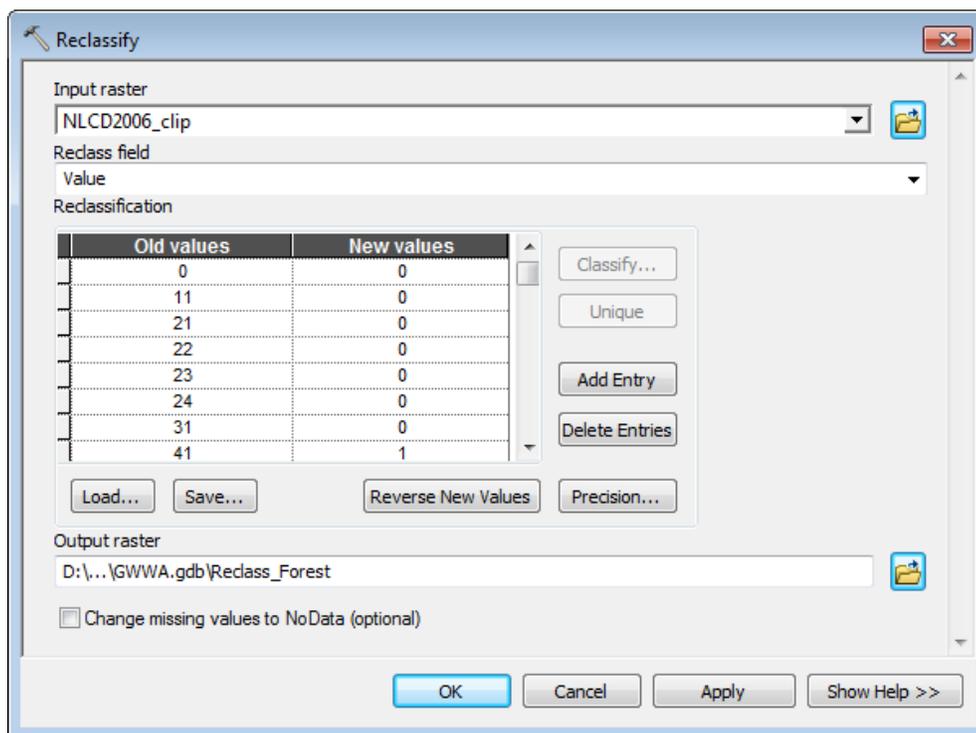
Tip: Expand your model window as needed.

We will use the Reclassify to “flag” the appropriate forest habitats from the NLCD.

7. Connect the NLCD 2006 Clip to the Reclassify tool, specifying it as the ‘input raster’.
8. Double click on the Reclassify to open the tool dialog box. In the dialog box, click on “Unique” to get the list of NLCD values.
9. In the “New values” column, make the following values 1 and all others 0:

41 – Deciduous Forest, 42 – Mixed Forest, 90 – Woody Wetlands

Specify the output into the GWWA.gdb, named Reclass_Forest



10. Add the Focal Statistics Tool to the model. It can be found in ArcToolbox at Spatial Analyst Tools / Neighborhood

Focal Statistics is a powerful analytical tool that looks at each pixel and quantifies the pixels around it based on your criteria. We will use it to determine the amount of “Forest” within 1.5 miles of each pixel.

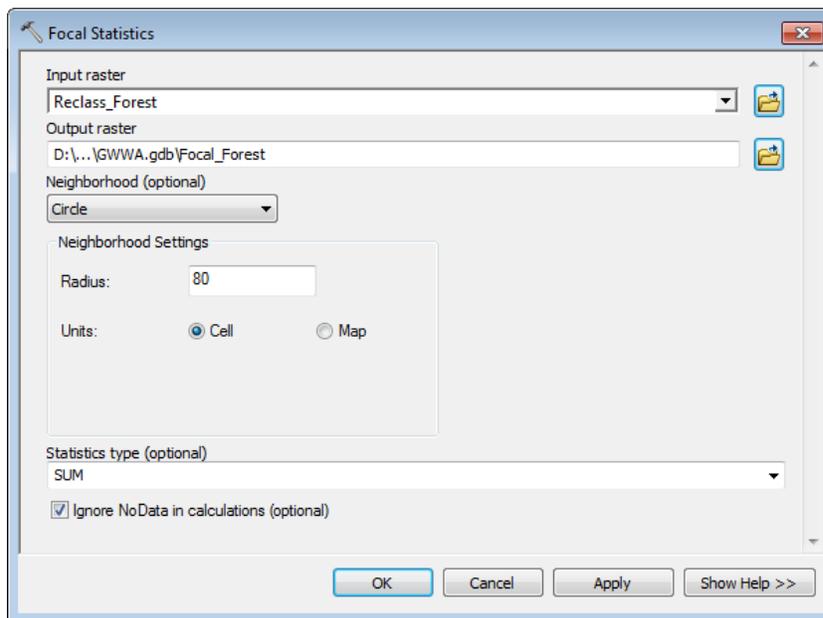
11. Connect the Relass_Forest to the Focal Statistics Tool. Set the output to the GWWA.gdb named Focal_Forest

Set the Neighborhood to Circle with a Radius of 80.

Set the Statistics type to “Sum”. Since all values are 0 or 1, we will get a count of all Forest pixels.

Check on Ignore NoData.

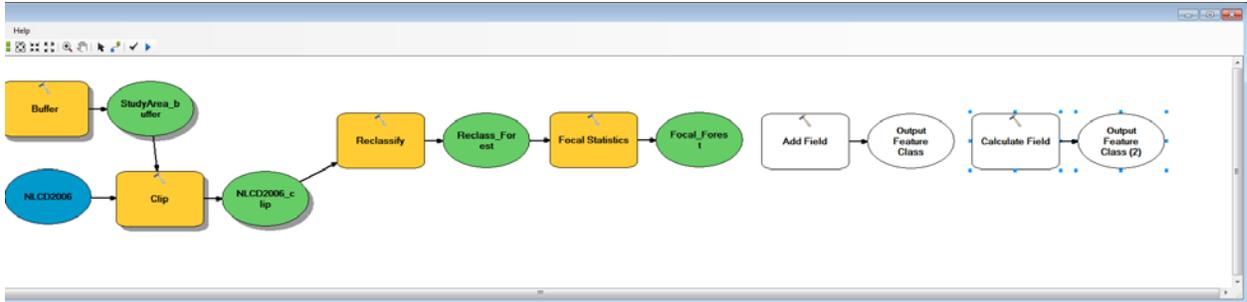
Why 80? A 30 meter pixel equates to ~98.4 feet. Since 1.5 miles is 7920 feet, we need to examine 80 pixels in all directions.



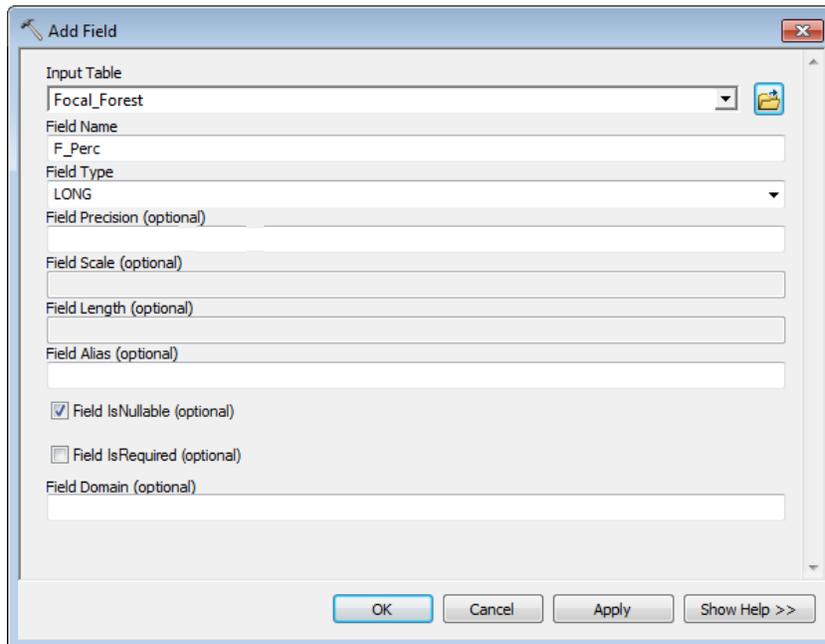
12. The next two steps we will take our Focal Stats value and convert it to a percentage.

Drag the Add Field tool to the model. It can be found in ArcToolbox \ Data Management \ Fields

Drag the Calculate Field tool to follow the Add Field tool.



13. Connect the Focal Forest to the Add Field. Double click on the tool and set the Field Name to “F_Perc”. Leave Field Type as Long and all other settings as is.

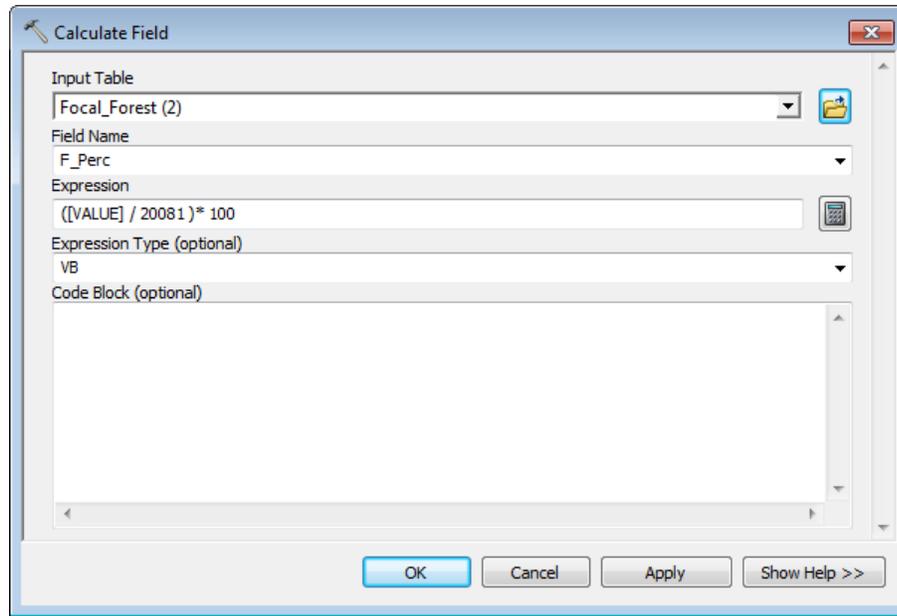


14. Connect the Focal_Forest(2) to the Calculate Field tool.

Double click the tool and set the Field Name to the newly created F_Perc.

Using the calculator button, input the expression: $([VALUE] / 20081) * 100$

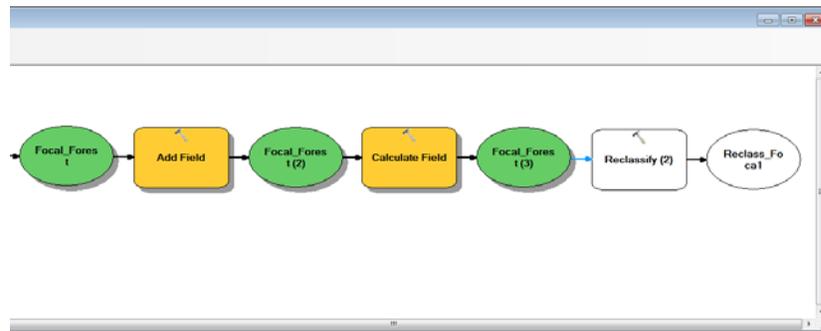
Why 20081? This is the amount of 30 meter pixels contained within a 1.5 mile buffered area.



15. Save your model.
16. Click Run Model. This should take a minute to complete. Be sure your model completes without errors. If you get errors, review the error and correct.
17. After running, we have to add an additional Reclassify step. We have to convert the Forest Percent (F_Perc) field to VALUE. This is because many of the raster tools run solely on the value field rather than additional table fields.

Drag and drop the Reclassify tool into the model. (see step 5 is you forgot where it is.)

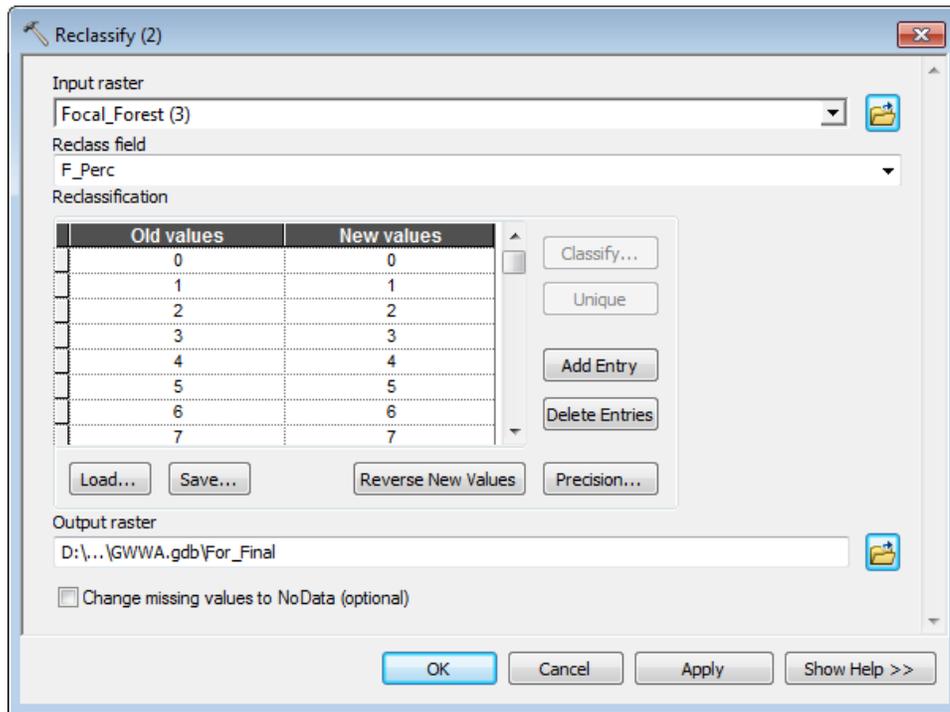
Connect the Focal_Forest(3) to the Reclassify.



18. Double click to open the tool. Change the Reclass Field to F_Perc.

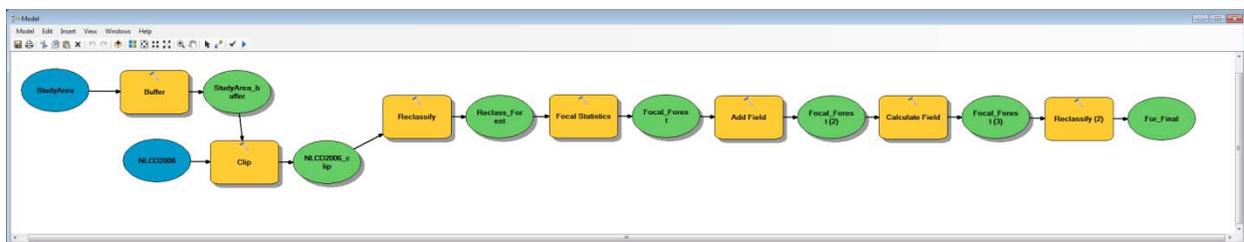
Now click Unique. Because we already converted the values to an integer, all the values line up, 0 to 0, 1 to 1, etc.

Change the output to GWWA.gdb and name it For_Final



The result is converting the F_Perc field INTO the Value field, so it can be properly processed later.

19. Make sure to Save your model. It should look like a long flowchart:

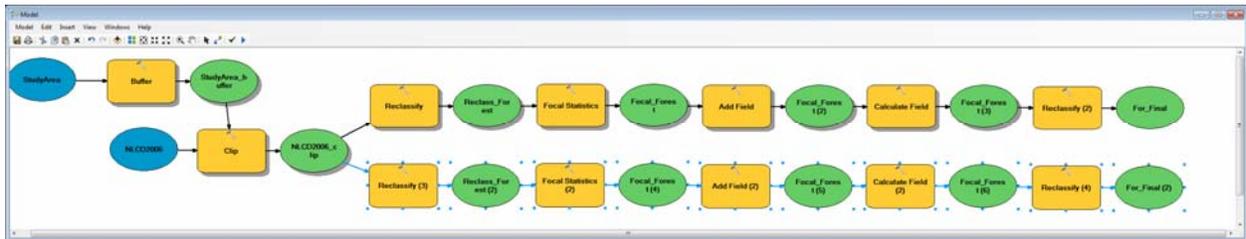


SECTION 4 – Additional Model Construction – Repeat for Open Land (instructor then student)

1. We will now effectively repeat steps 4 – 18, this time focusing our reclassification on Open Lands rather than Forest. This can be done by either individually adding each element again OR using a simple copy/paste of all the elements.

Using the Select tool, highlight the everything to the right of the NLCD 2006 Clip.

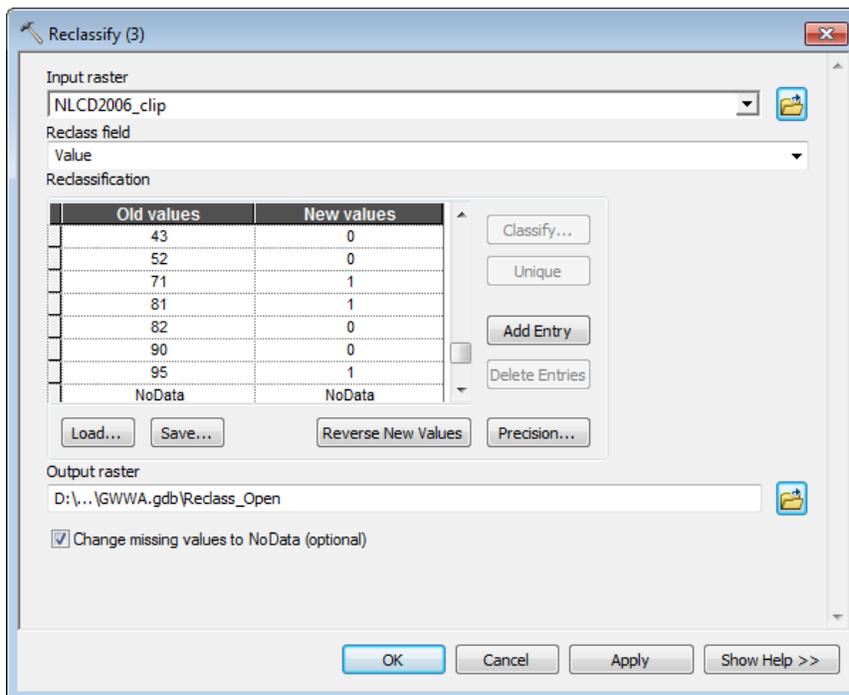
Copy and paste, moving the elements underneath the originals.



2. Starting with the newly copied Reclassify(3), double click the tool and modify the Unique Values to reset all Values to 0, except the following:

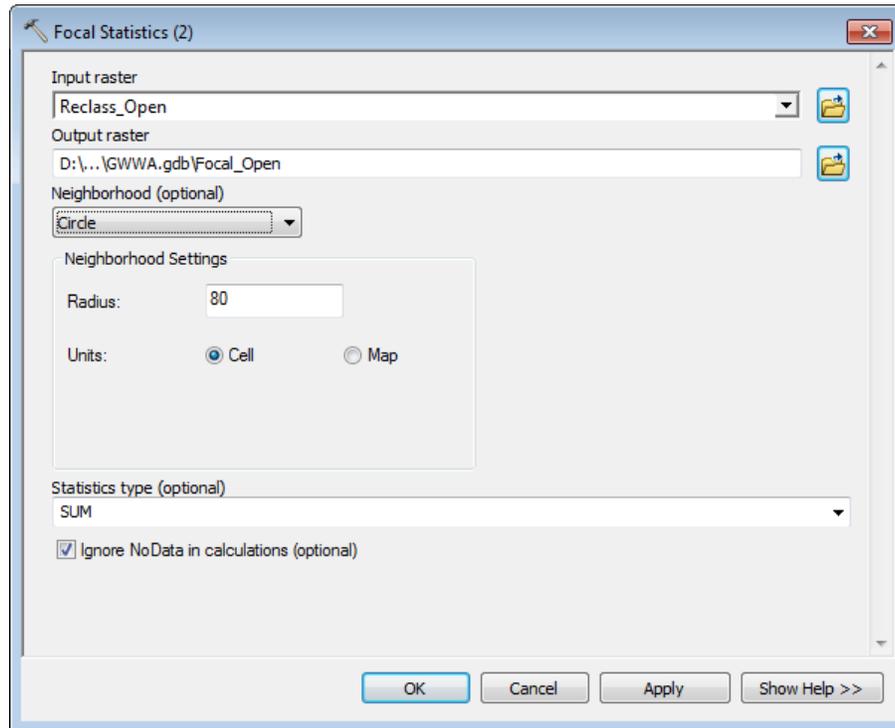
71 – Grassland, 81 – Pasture/Hay, 95 – Emergent Herbaceous Wetland

Change the Output raster to: Reclass_Open

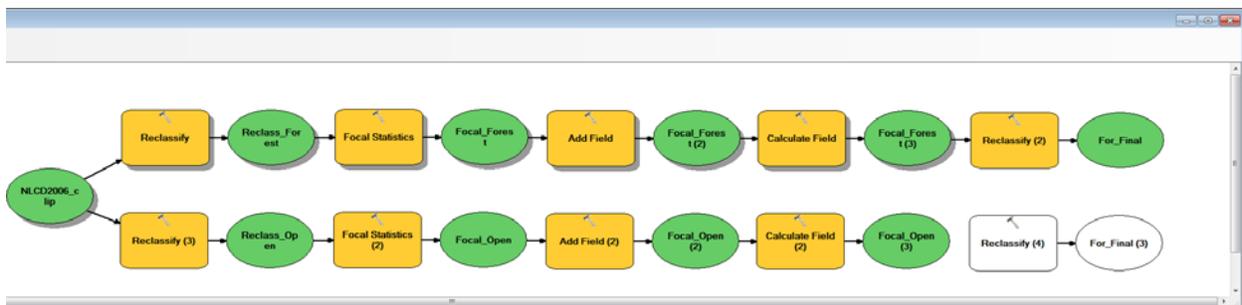


3. When you click OK, notice the green oval Output is renamed.

4. Double Click the Focal Stastics (2). Here we only need to modify the Output rater Name to Focal_Open.



5. Double click the Add Field(2) tool, and adjust the field Name to O_Perc (open percentage)
6. Double click the Calculate Field tool, and adjust the Field Name to O_Perc. The formula remains the same.
7. Use your Select tool to delete the connection between the Focal_Open(3) and the Reclassify(4) tool. Because we have not yet run this model to this point, we cannot get the values or reclassify them.



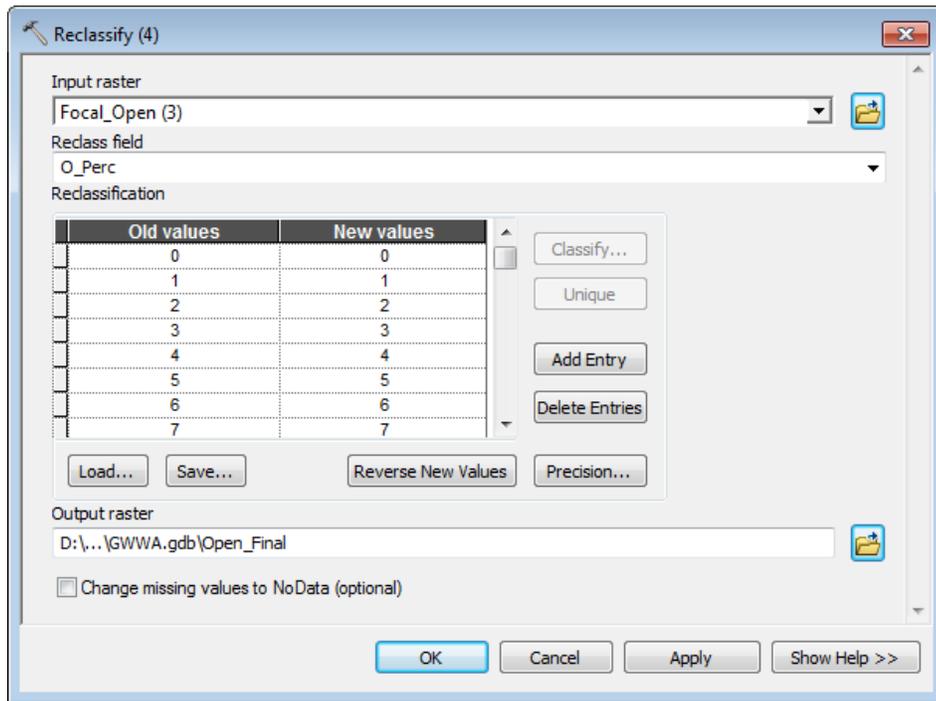
8. With the connection disabled, Save the model and Run.

If you get any errors, review them and fix as necessary.

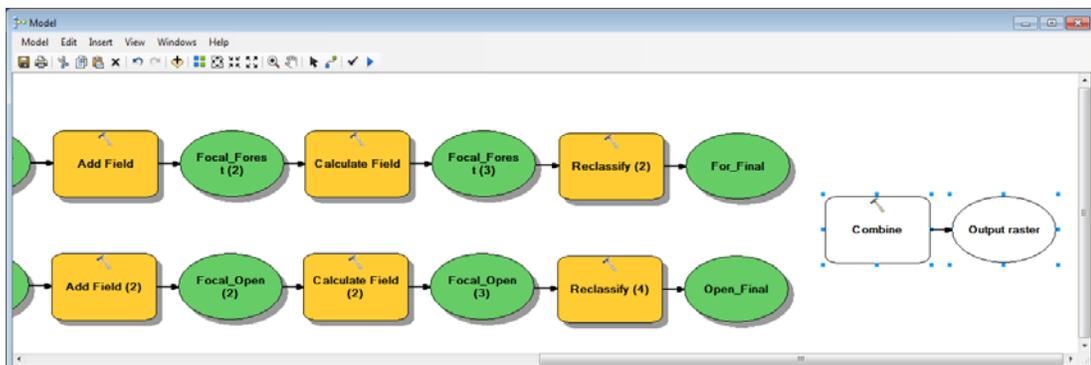
- Next, reconnect the final Reclassify using the Connect tool. Be sure to specify the Reclass field as the O_Perc field (not Value!).

Change the output name to Open_Final.

Click the Unique button.

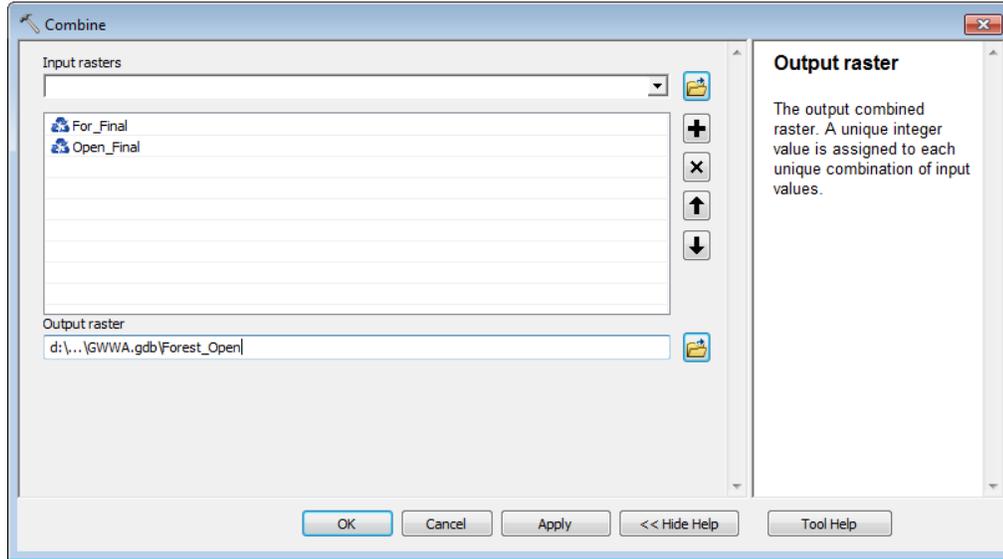


- Run the the model again to finish the last reclassify. At this point, all the model should be run.
- In order to easily analyze the data, we will add one final tool to the model called Combine. Find the Combine tool in Spatial Analyst Tools / Local and drag it to the end of the model.

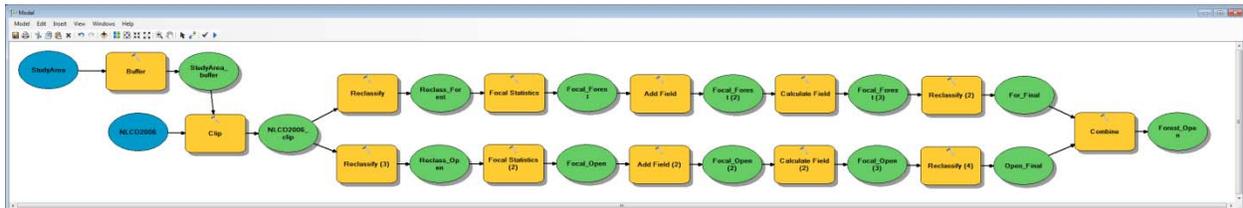


- Use the Connect tool to add the For_Final and Open_Final to the Combine.

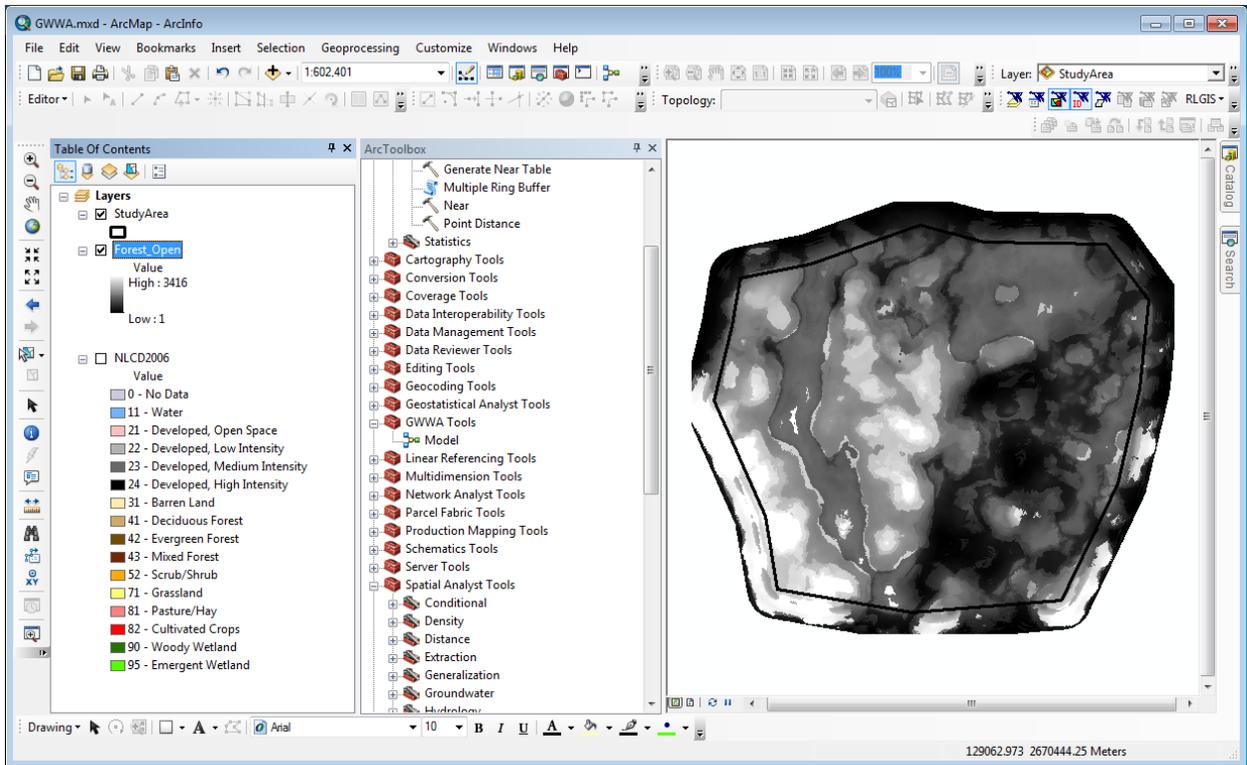
13. Set the Output to Forest_Open, and click OK when complete.



14. Right Click on the Forest_Open green oval. Check “Add to Display” on.
15. Save and Run the model.



16. At this point, the model is complete and has been run, and you should have a Forest_Open raster in ArcMap.



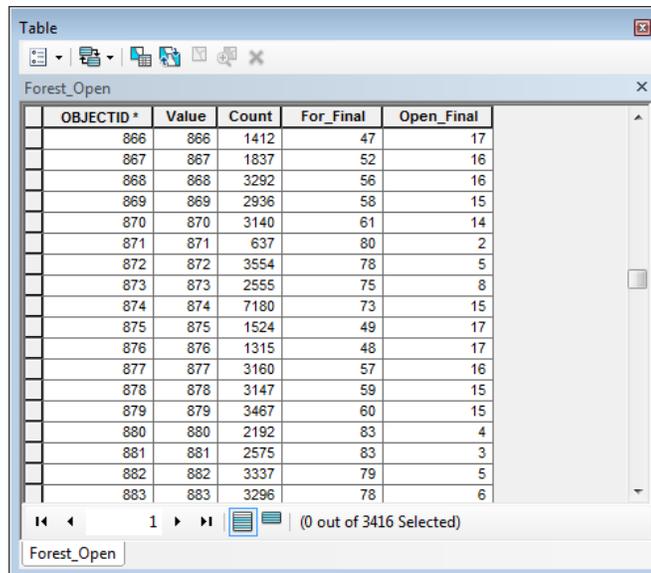
What does the raster as-is show?

SECTION 5 – Evaluating the Output

Because the Value field is nothing more than a counter for unique combinations of percent forested and percent open, you have to dig a little deeper to get useful information out of the output.

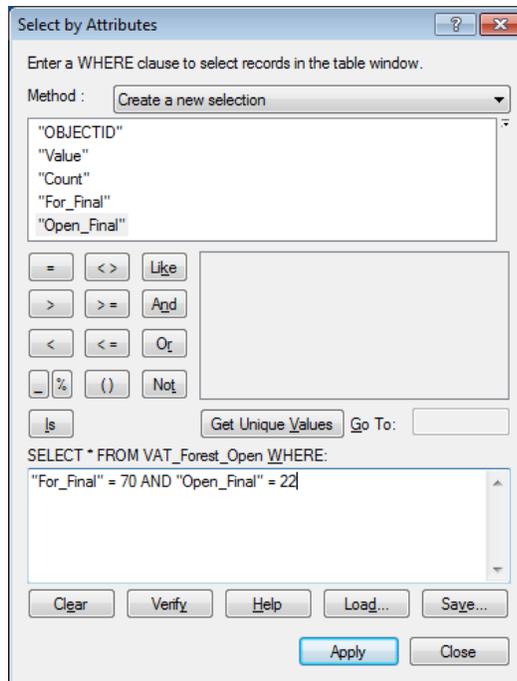
1. In the ArcMap Table of Contents, Right click on the Forest_Open and Open Attribute Table.
2. Note that in addition to the Value and Count columns, the Combine tool also returned the For_Final and Open_Final columns.

These values hold the key to our analysis!



OBJECTID*	Value	Count	For_Final	Open_Final
866	866	1412	47	17
867	867	1837	52	16
868	868	3292	56	16
869	869	2936	58	15
870	870	3140	61	14
871	871	637	80	2
872	872	3554	78	5
873	873	2555	75	8
874	874	7180	73	15
875	875	1524	49	17
876	876	1315	48	17
877	877	3160	57	16
878	878	3147	59	15
879	879	3467	60	15
880	880	2192	83	4
881	881	2575	83	3
882	882	3337	79	5
883	883	3296	78	6

3. Use the Select by Attribute in the table menu and start a selection query.
Remember the GWWA habitat requirements: 70% of Forest and 22% of Open land.
4. Construct a query based on the exact requirements.



How many pixels are selected? _____

Our model yielded a pretty small amount of area using the exact specifications. Since we're modeling, and using coarse data, and nature tends to have a bit of wiggle room anyway; let's increase the amount of forest and open space to give a bit of a range.

5. Change the Select by Attributes to query plus or minus 5% for both forest and open land.

("For_Final" > 65 AND "For_Final" < 75) AND ("Open_Final" > 17 AND "Open_Final" < 27)

Now how many pixels are selected? _____

Hint: Right click on Count and use Statistics

How many acres does that equate to? _____

Try an online site like <http://www.onlineconversion.com/> if you're stuck.

6. Congrats, you have identified the areas which may be priorities for protection!

