

# Assessing Clearcutting Activities

## *Calculating visible clearcut amounts*

—by Glen Jordan

## Introduction

---

### Problem

How does geographic information system (GIS) technology help you measure and monitor the aesthetics of clearcutting activity in a forest over time?

Clearcutting may have obvious economic benefits, but clearcuts are often ugly, especially when they are large and highly visible, and they remain that way until new trees regenerate and cover the site—usually within 5 to 10 years.

Most forestry operations are sensitive to the visual impact of clearcuts. In forest areas easily accessed by the public, foresters often attempt to lessen the impacts, typically by creating smaller clearcut openings, avoiding clearcutting in areas that are adjacent to well-traveled public or forest roads, and limiting or forgoing clearcuts on highly visible hillsides.

Solving this problem is not an easy task, but GIS provides the data and tools to help you succeed. How exactly does GIS do this?

### Location

A small, 1,400-hectare (ha) woodlot in the Acadian-New England forest region of North America

### Time to complete the lab

Three hours

*Keywords: clearcut visibility; characterizing by a single number; numerical distribution; selecting features by attribute and location; merging features; dissolving features; identifying polygon neighbors; creating rasters; using map algebra; calculating a viewshed*

## Prerequisites

A basic working knowledge of GIS data, including use of a geodatabase and ArcGIS® software in particular; some experience with rasters and the ArcGIS Spatial Analyst extension also beneficial (Familiarity with basic forest analysis techniques is important, while familiarity with forest inventory data and terminology is helpful but not essential.)

## Data used in this lab

- Feature classes and rasters for a small woodlot (personal geodatabase)
- Geographic coordinate system: NAD 1983 CSRS New Brunswick Stereographic
- Datum: NAD83
- Projection: New Brunswick Double Stereographic Grid (unless otherwise stated)

# Student activity

---

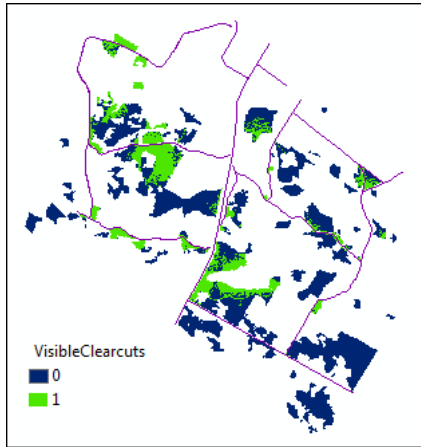
What is the visibility of clearcuts in the Woodlot, where extensive clearcut harvesting has occurred for many years and the public travels main roads frequently?

While the clearcut openings are relatively small in the Woodlot, has the Woodlot's forest manager attempted to limit their exposure and visibility?

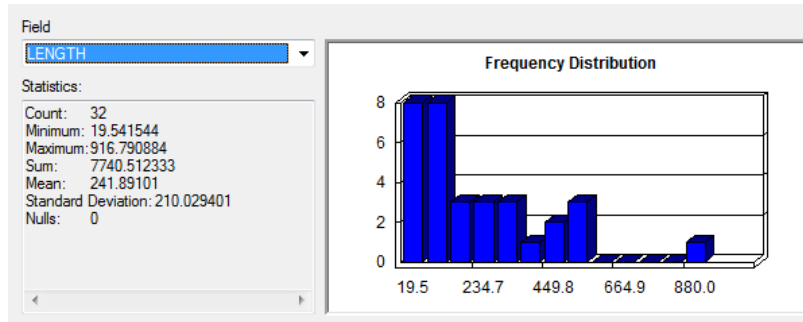
In this exercise, you'll find the answers by measuring the length of road shared with immediately adjacent clearcuts and calculating the amount of clearcut area visible in the distance.

## Results expected

A frequency distribution of shared lengths between main roads and clearcuts and a tally and map of clearcut visibility from main and public roads



OBJECTID *	Value	Count
1	0	21263
2	1	7305



## Data available

- Cover types feature class: *cover*
- Digital elevation model (DEM) raster: *DEM\_Woodlot*
- Main road centerlines: *clines*
- Public road centerlines: *proads*
- Public road rights-of-way: *publicrow*

## Solution steps

1. Identify recent clearcuts adjacent to main roads.
2. Identify boundaries shared by main roads and clearcuts.
3. Measure clearcut exposure.
4. Calculate a viewshed for all roads.
5. Determine the amount of visible clearcuts.

## IDENTIFY RECENT CLEARCUTS ADJACENT TO MAIN ROADS

Clearcuts are easily identified using cover type and stand age values stored in the cover types feature class (*cover*). In this case, they are stands, but not treed bogs, that are no older than five years ( $AGE \leq 5$ ). Clearcuts older than that would likely have greened up—that is, produced trees of 3 meters (m) or more in height. So, how many of these recent clearcuts border main roads in the Woodlot?

### RELATED CONCEPT: QUERY USING THEMATIC AND LOCATIONAL ATTRIBUTES

- 1 Start ArcMap™, and, if you haven't already done so, use *Environment Settings* to establish both your *Current Workspace* and *Scratch Workspace* as your *Woodlot* geodatabase.
- 2 Add the *cover* feature class as a layer.

Now you're ready to locate recent clearcuts that are adjacent to main roads.

This takes three steps involving selecting features by both thematic and locational attributes. You'll select main road rights-of-way ( $TYPE = 'RD'$ ) and then select all adjacent features. Finally, you'll limit the selection to just recent clearcuts.

- 3 Select main roads in *Cover Types* as  $[TYPE] = 'RD'$ .

This selects the 15 main road rights-of-way in the Woodlot.

Using locational attributes, you can now identify features—stands as well as nonforested features—that are immediately adjacent to these 15 main roads.

- 4 Use *Select By Location* to locate all features in *Cover Types* that are adjacent to, or intersect, the selected main roads.

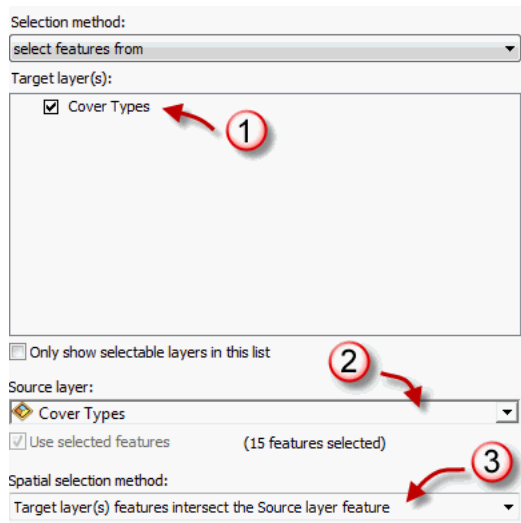


Figure 1. Selecting features in *Cover Types* that are adjacent to the Woodlot's 15 main roads.

You should have 211 features selected.

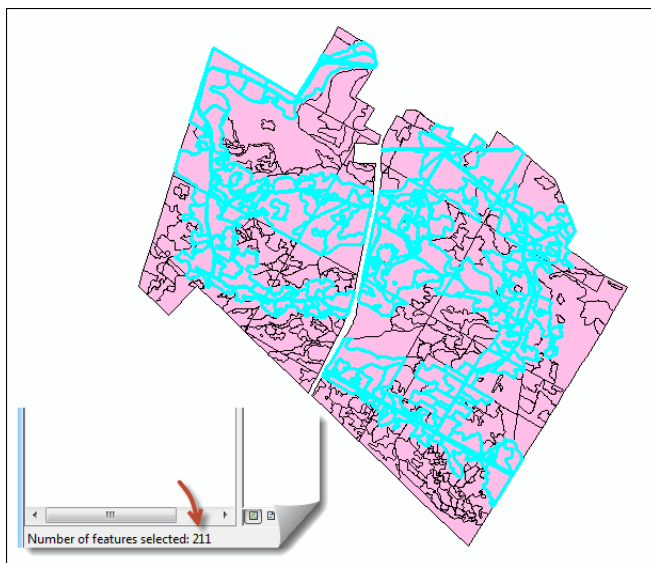


Figure 2. Woodlot main road rights-of-way and their adjacent features.

Now, remove all but clearcut stands, including treed bogs, from the currently selected set. Recall that in the Woodlot inventory, nonstand features are easily identified by their *AGE* value of -99.

- 5 Select from the current selection only young clearcuts using the following query expression:

```
[TYPE] <> 'BG' AND [AGE] >= 0 AND [AGE] <= 5
```

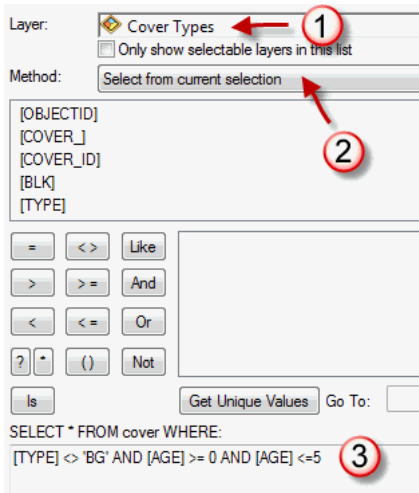


Figure 3. Zeroing in on clearcuts that are adjacent to main roads.

That leaves 43 recent clearcuts visible along main roads.

Their visual impact on travelers, however, depends on their size and exposure, that is, the length of road they border.

Determining clearcut sizes is straightforward using the *Shape\_Area* field in *Cover Types*, but calculating exposure is a bit more challenging. Check sizes first.

6 Open the attribute table and calculate statistics for the *Shape\_Area* field.

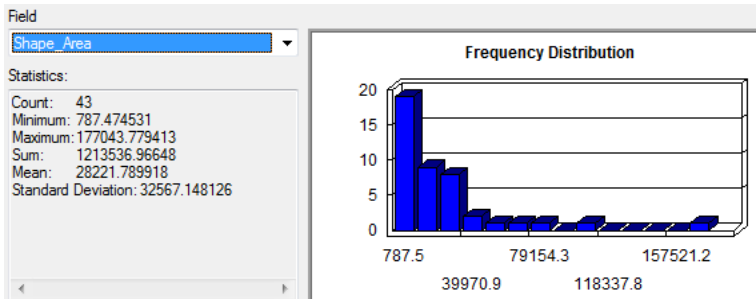


Figure 4. Summary area statistics (m<sup>2</sup>) and frequency distribution of clearcuts adjacent to main roads.

The 43 clearcuts adjacent to main roads occupy an area of about 121 ha in the Woodlot. The largest one is relatively small, at almost 18 ha (17.7), and most are much smaller than that. That might lead you to believe that the overall visual impact of the 43 clearcuts is small. But what about their exposure? Do the 43 clearcuts generally share a long length of border with main roads or a short length? Determining that is your next task.

**IDENTIFY BOUNDARIES SHARED BY MAIN ROADS AND CLEARCUTS**

Identifying boundaries shared by main roads and clearcuts is easier said than done.

However, at ArcGIS 10.1 a new tool, Polygon Neighbors, makes the task easier. The tool isolates boundaries (aka edges) shared by adjacent polygons in an input feature class, and then records the shared lengths in a summary table.

That provides a slick means of calculating the lengths of boundaries shared by the 43 clearcuts and their adjacent main road rights-of-way in the Woodlot.

Here’s how.

**RELATED CONCEPT: RECLASSIFY USING LOCATIONAL ATTRIBUTES TO LABEL**

First, you’ll need to uniquely label the 43 clearcuts so that in your polygon neighbors analysis they can be easily distinguished from main roads.

- 1 Add a new text field of length 3 in *Cover Types* named “CCut”, and then use Field Calculator to label clearcuts with “YES”, or something similar (CCut = “YES”).

You can’t run your polygon neighbors analysis just yet; you need to add main road features to the clearcuts currently selected in *Cover Types*.

- 2 Use *Select By Attributes* to add main road rights-of-way (TYPE = ‘RD’) to the 43 clearcuts selected in *Cover Types*.

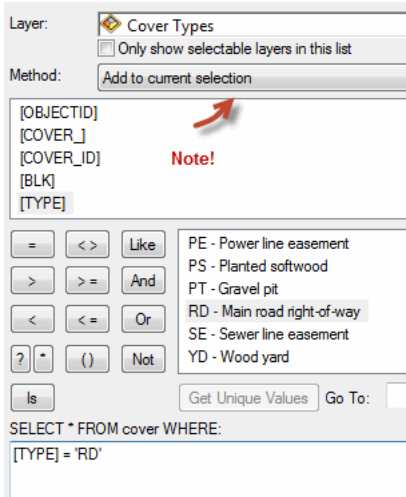


Figure 5. Adding main road rights-of-way polygons.

That will leave you with 58 polygons—43 clearcuts plus 15 main roads.

Okay, now you're ready to determine what's next to what, and how much boundary (edge) they share.

- Use the *Polygon Neighbors* tool (*Analysis Tools » Proximity*) to calculate a table that records the lengths of all shared polygon boundaries among selected features in the *Cover Types* layer. Report the *COVER\_ID*, *TYPE* and *CCut* fields in the output table, AND disable reporting of both sides of neighbors.

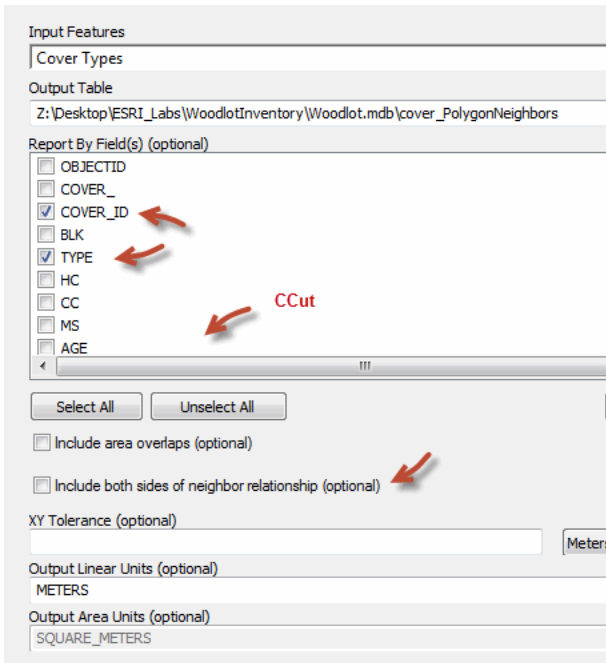


Figure 6. Calculating the length of edge shared by neighboring polygons.

What has that produced, exactly?

OBJECTID*	src_Stand#	nbr_Stand#	src_Cover Type	nbr_Cover Type	src_CCut	nbr_CCut	LENGTH	NOT
1	199	699	Main road right-of-way	Main road right-of-way	<Null>	<Null>	10.073887	
2	299	399	Main road right-of-way	Main road right-of-way	<Null>	<Null>	9.725054	
3	299	523	Main road right-of-way	Recent clearcut	<Null>	YES	0	
4	299	599	Main road right-of-way	Main road right-of-way	<Null>	<Null>	9.759022	
5	317	321	Planted softwood	Planted softwood	YES	YES	148.238206	
6	318	323	Planted softwood	Planted softwood	YES	YES	112.684404	
7	399	317	Main road right-of-way	Planted softwood	<Null>	YES	154.913383	
8	399	318	Main road right-of-way	Planted softwood	<Null>	YES	689.886264	
9	399	321	Main road right-of-way	Planted softwood	<Null>	YES	148.687642	
10	399	323	Main road right-of-way	Planted softwood	<Null>	YES	226.90462	
11	399	499	Main road right-of-way	Main road right-of-way	<Null>	<Null>	10.177746	
12	499	427	Main road right-of-way	Forested (untreated)	<Null>	YES	587.367551	
13	499	433	Main road right-of-way	Forested (untreated)	<Null>	YES	92.057395	
14	499	437	Main road right-of-way	Recent clearcut	<Null>	YES	22.528427	
15	499	439	Main road right-of-way	Forested (untreated)	<Null>	YES	355.59749	
16	499	441	Main road right-of-way	Forested (untreated)	<Null>	YES	72.560644	

Figure 7. Adjacent polygons in the *Cover Types* layer and their shared edge lengths (m).

Opening the table, you'll see that 71 shared boundaries (edges) were found among the 58 clearcut and main road polygons. And, since you requested recording of the *COVER\_ID*, *TYPE* and



CCut fields, you also know what’s next to what (src\_ and nbr\_), and the length (LENGTH) of boundary they share.

How can you use this information to measure clearcut exposure? That’s next.

## MEASURE CLEARCUT EXPOSURE

It’s now a matter of isolating the bounaries between clearcuts and main roads in the polygon neighbors table, and then calculating the total length of boundary shared. With that, you’d have a measure of clearcut exposure.

As you’ll see, this is where the CCut field you created earlier comes in handy.

### RELATED CONCEPT: CHARACTERIZE USING A SINGLE NUMBER

- 1 Use *Select By Attributes* to isolate neighboring clearcuts and main roads using the query expression: ( [src\_CCut] = 'YES' AND [nbr\_CCut] is Null ) OR ( [src\_CCut] is Null AND [nbr\_CCut] = 'YES' )

*Make sure Method is “Create a new selection”.*

OBJECTID *	src_Stand#	nbr_Stand#	src_Cover Type	nbr_Cover Type	src_CCut	nbr_CCut	LENGTH	II
13	499	433	Main road right-of-way	Forested (untreated)	<Null>	YES	92.057395	
14	499	437	Main road right-of-way	Recent clearcut	<Null>	YES	22.528427	
15	499	439	Main road right-of-way	Forested (untreated)	<Null>	YES	355.59749	
16	499	441	Main road right-of-way	Forested (untreated)	<Null>	YES	72.560644	
17	499	999	Main road right-of-way	Main road right-of-way	<Null>	<Null>	10.656317	
18	599	499	Main road right-of-way	Main road right-of-way	<Null>	<Null>	9.943502	
19	599	523	Main road right-of-way	Recent clearcut	<Null>	YES	20.704672	
20	599	540	Main road right-of-way	Forested (untreated)	<Null>	YES	101.732225	
21	599	550	Main road right-of-way	Forested (untreated)	<Null>	YES	115.895413	
22	599	561	Main road right-of-way	Recent clearcut	<Null>	YES	142.967856	
23	599	899	Main road right-of-way	Main road right-of-way	<Null>	<Null>	10.129742	
24	602	699	Forested (untreated)	Main road right-of-way	YES	<Null>	302.690992	
25	639	640	Forested (untreated)	Forested (untreated)	YES	YES	507.045121	
26	644	645	Partial cut	Forested (untreated)	YES	YES	384.462951	
27	644	647	Partial cut	Planted softwood	YES	YES	361.350959	
28	644	648	Partial cut	Planted softwood	YES	YES	203.016988	

Figure 7. Boundaries shared by clearcuts and main roads.

That selects 47 records (shared boundaries). If you examine the src\_ and nbr\_ field contents, you’ll see that only boundaries shared by clearcuts and main roads have been selected.

Calculating the total length of these shared boundaries is easy.

- 2 Calculate statistics on the LENGTH field.

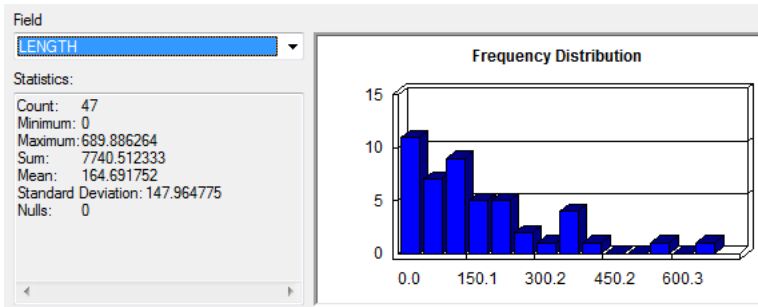


Figure 8. Statistics and frequency distribution of boundary lengths separating clearcuts and main roads.

So, almost 8 km (7.74) of clearcuts are exposed to travelers of main roads in the Woodlot. That seems a substantial amount. But characteristic of single-number measures of forestwide condition, your total length measure hides some details. As the saying goes, "The devil is in the details." Fortunately, the statistics report also provides a frequency distribution of the 44 boundary lengths, indicating that most often, the length of clearcut bordering a main road is relatively short, 300 m or less.

This might cause you to conclude that clearcuts in the Woodlot shouldn't create a significant visual impact on any passerby. But how many of the clearcuts bordering main roads are adjacent to one another, creating longer exposure lengths than reflected in the frequency distribution? If you look back to the polygon neighbors table, you can see that several clearcuts are indeed adjacent. And, there are a few main road polygons that are also adjacent. How would you redo your calculations to reflect these adjacencies?

Simple. Aggregate adjacent clearcut and main road polygons in turn and then re-run your polygon neighbors analysis.

- 3 Aggregate clearcuts and main roads in *Cover Types* using the *Dissolve* tool (*Data Management » Generalization*) and the *CCut* field. Make sure you do not create multipart features.

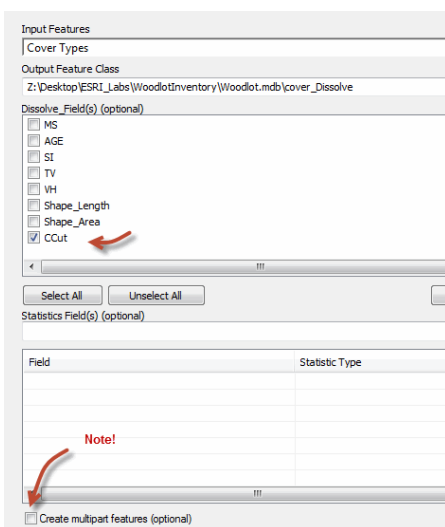


Figure 10. Dissolving edges separating adjacent clearcuts.

Opening the result table, you'll note there are now 36 features, down from 58. So, there must now be longer clearcut exposure lengths than was originally thought. How much longer?

- 4 Re-run the *Polygon Neighbors* tool with the aggregated feature class as input and *OBJECTID* and *CCut* as record fields. Again, do not record both sides of neighbors.

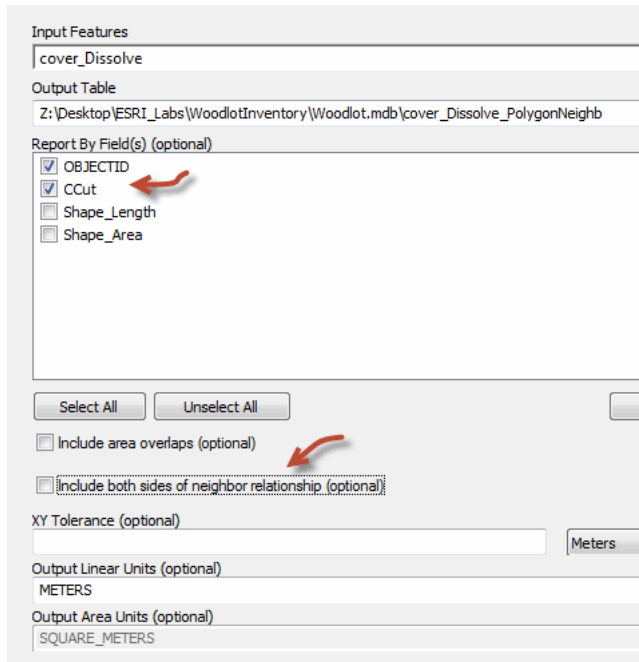


Figure 11. Polygon neighbors analysis using aggregated clearcuts and main roads.

Here again, the result table records boundaries that main road (Null) and clearcut (YES) polygons share. This time, however, the result reflects aggregated clearcuts and main roads. What effect has that had on clearcut exposure?

- 5 Calculate statistics on the *LENGTH* field.

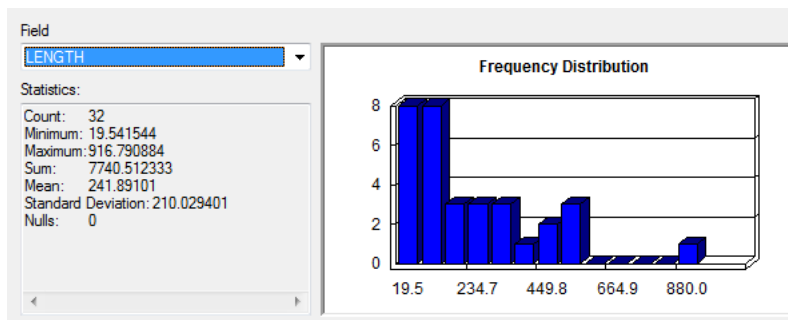


Figure 12. Statistics and frequency distribution of lengths of edges separating aggregated clearcuts and main roads..

While the total length has remained the same, of course, both the smallest and largest boundary lengths separating clearcuts and roads have increased. There is even one length approaching 1

km (916.8 m). That tells us that clearcut exposure in the Woodlot is greater than initially thought.

Additionally, even clearcuts that are not adjacent to roads may be visible in the distance, depending on topographic conditions and the heights of surrounding stands. How do you determine the extent to which this type of clearcut visibility exists in the Woodlot? Answering this question requires a classic viewshed analysis.

## CALCULATE A VIEWSHED FOR ALL ROADS

A viewshed is the area visible from one or more observers, considering topographic relief and the heights of any objects that block the line of sight. In this case, your observers are the main road centerlines in the Woodlot and the array of public roads near the Woodlot. You'll also need an elevation surface in the form of a DEM and stand height values across the Woodlot.

Main road and public road centerlines are found in the *clines* and *proads* feature classes, respectively. You have an elevation raster, *DEM\_Woodlot*, also located in the *Woodlot* geodatabase. Stand heights are recorded in the *Height Class* field of the *cover* feature class. Now you can build a viewshed.

## RELATED CONCEPT: RECLASSIFY SPATIALLY IN 3D

- 1 Start a new ArcMap document and then add the main road centerlines feature class, *clines*.
- 2 Use *Definition Query* (right click *clines* » *Layer Properties* » *Definition Query*) to drop the power and sewer line easements: `[CLASS] <> 'PE' AND [CLASS] <> 'SE'`. Name the layer *Main Roads*.
- 3 Use the *Merge* tool (*Data Management Tools* » *General*) to combine *Main Roads* and *proads* into a new feature class named *RoadViewers*.

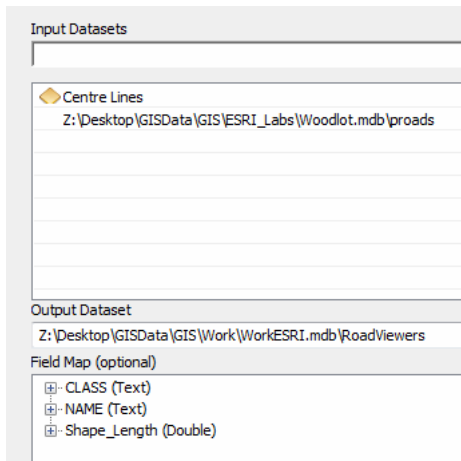


Figure 13. Merging main road and public road centerlines.

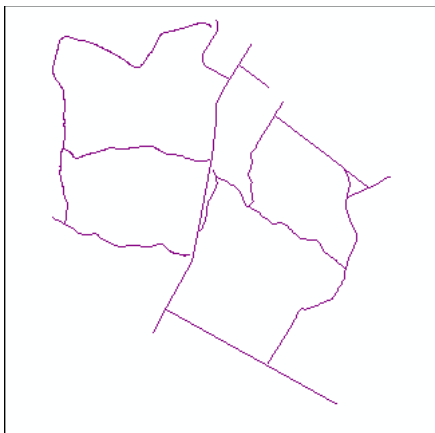


Figure 14. The Woodlot main road and public road centerlines are combined.

*RoadViewers* features are your observers in your viewshed analysis. Next, you need to construct a viewing surface.

- 4 Start by adding the *DEM\_Woodlot* elevation raster as a layer.

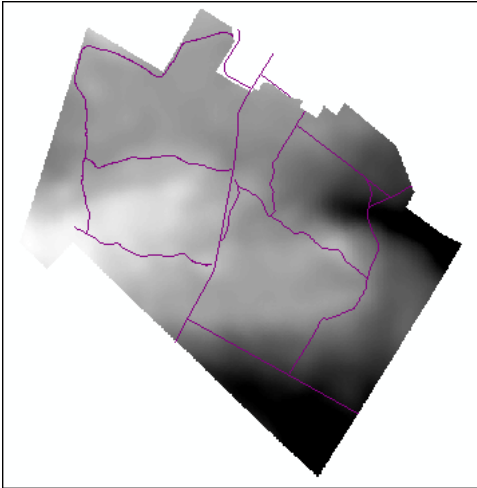


Figure 15. Main road and public road centerlines superimposed on a DEM.

Although you could use just the elevation surface to identify visible areas across the Woodlot, you would be ignoring the visual block that trees create. So add stand heights to the DEM to create a realistic viewing surface. Stand heights are recorded for each Woodlot stand in the *Height Class* field (3 m classes) of the *Cover Types* feature class.

But, how do you add these stand heights to the DEM?

To add stand heights to the DEM, create a stand height raster from the *Height Class* field in the *Cover Types* layer. Then you can add the raster, on a cell-by-cell basis, to the DEM raster. You can use that new surface to create a viewshed that incorporates the influence of both elevation relief and vegetation height on visibility.

- 5 Use the *Feature to Raster* tool (*Conversion Tools » To Raster*) to create a 10 x 10 m *HeightClass* raster from the *Height Class* field in *Cover Types* (make sure you clear selection before conversion).

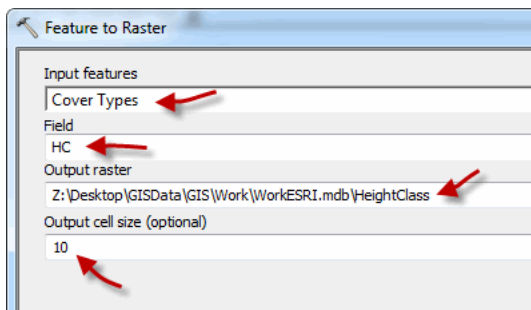


Figure 16. Making a raster of the cover types *Height Class* (HC) field.

**Question 1:** *Why use a 10 m cell size for Height Class?*

This produces a very colorful raster of 3 m stand height classes, ranging from 0 to 24 m.

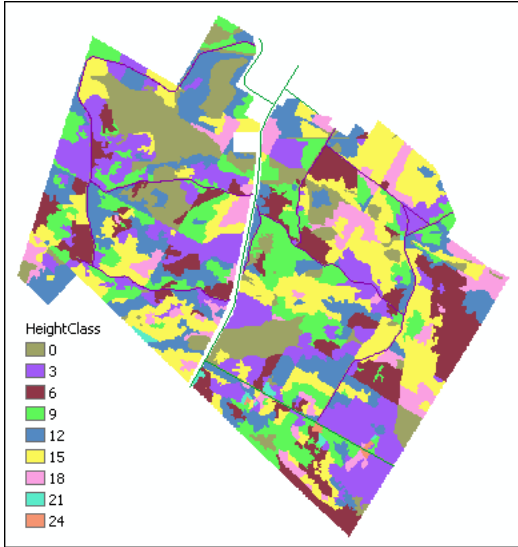


Figure 17. Raster of 3 m height classes (10 m cell size).

Can you see the problem here?

Turn off *DEM\_Woodlot* for a moment, and you'll see a white band of no data running south to north through the center of the Woodlot. This is a right-of-way for a major public highway. This missing data creates a problem in constructing your viewing surface. You need to build a *HeightClass* raster that incorporates the right-of-way before adding it to the DEM for the final viewing surface.

Fortunately, the Woodlot inventory includes a feature class of public road rights-of-way, *publicrow*. You can merge that with the *Cover Types* feature class, assign the rights-of-way *Height Class* values of zero, and build a new *HeightClass* raster.

6 Use the *Merge* tool again to combine *publicrow* with *Cover Types*.

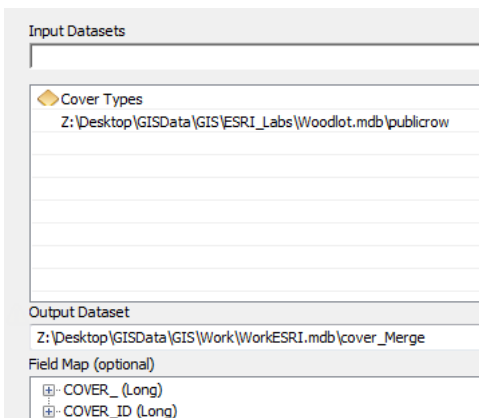


Figure 18. Merging public road rights-of-way with cover types.

Now you can assign zero height values to all the public road rights-of-way. Open the *cover\_Merge* attribute table, and you'll see that they're easily identified by their null *Height Class* field values.

Cover Type	Height Class	Crown Closure	Material Size	AG
Forested area	18	fully stocked	sawlog	6
Treed bog	0	treed bog	non-forested	
Forested area	12	understocked	sawlog	5
Forested area	6	understocked	non-merchantable	
Dept. of Transport	<Null>	<Null>	<Null>	<Nu
Highway	<Null>	<Null>	<Null>	<Nu
Main road right-of-way	<Null>	<Null>	<Null>	<Nu
RCMP HQ	<Null>	<Null>	<Null>	<Nu

Figure 19. Merger of main and public road rights-of-way showing null *Height Class* values for public roads.

- 7 Select all four rights-of-way in *cover\_Merge* manually or use the query expression `[HC] Is Null`. Then, use *Field Calculator* to assign `HC = 0`.
- 8 Clear all selected features in *cover\_Merge* and compute a new *HeightClass* raster.

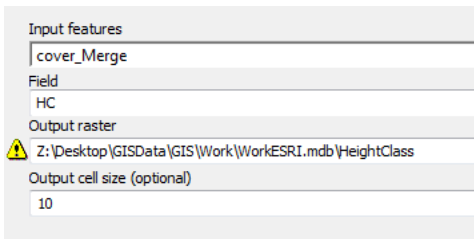
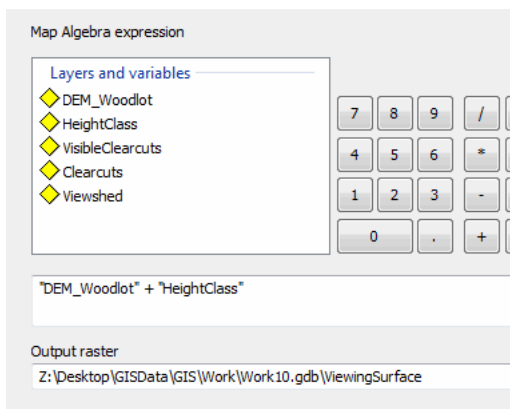


Figure 20. Making a new *HeightClass* raster.

**Question 2:** How do you tell ArcGIS it's OK to replace existing files when error messages appear?

With that, you have public road rights-of-way incorporated and assigned zero heights. You can now create a viewing surface that incorporates stand heights in your viewshed analysis by adding *HeightClass* and *DEM\_Woodlot*.

- 9 Using the *Raster Calculator* (*Spatial Analyst* » *Map Algebra*), create a new surface by adding *DEM\_Woodlot* and *HeightClass*. Name the result *ViewingSurface*.



You could also use the Plus tool here (*Spatial Analyst* » *Math*).

Figure 21. Adding *HeightClass* and *DEM\_Woodlot* rasters.



You'll see a surface that incorporates both elevation and stand heights. Low values are darker in shade, while higher values are lighter.

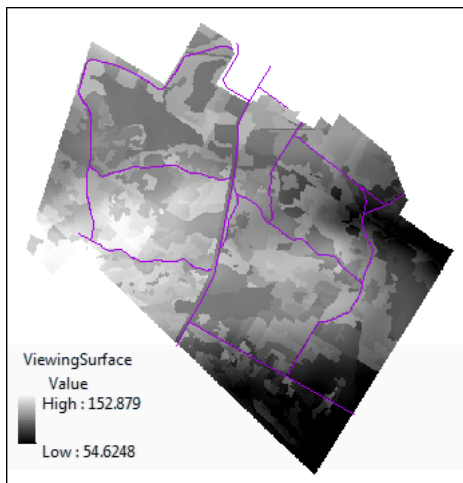


Figure 22. A viewing surface produced by adding stand heights to DEM values.

- 10 Use the *Viewshed* tool (*Spatial Analyst* » *Surface*) to create a viewshed using *RoadViewers* features as observers and *ViewingSurface* as the viewing surface. Name the result *Viewshed*.

The viewshed calculation may take several minutes to complete. The *Viewshed* tool uses each vertex in each line feature as an observer. In originally digitizing the main road centerlines for the Woodlot, numerous vertices were typically collected. This is desirable for creating a viewshed that reflects what can be seen from a road that is traveled, but it increases processing time considerably.

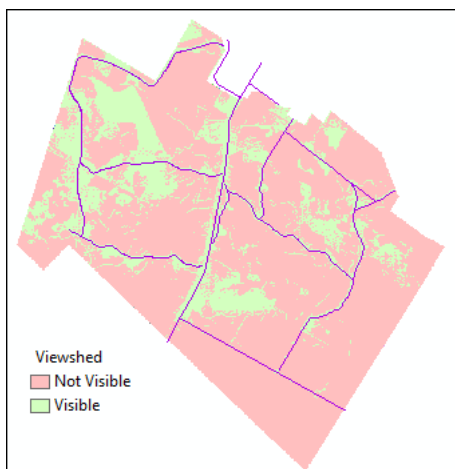


Figure 23. Viewshed for main and public roads with stand heights and elevation factored in.

At a glance, it seems that a significant area of the Woodlot is visible from main roads or public roads, even with stand heights factored in.

**Question 3:** Why isn't more visible area seen around the public roads, especially Flanagan Road, which runs east–west in the bottom corner of the Woodlot?

If you open the *Viewshed* attribute table, you can determine how much Woodlot area is visible or not.

OBJECTID*	Value	Count
1	0	111456
2	1	9532
3	2	7444
4	3	4682
5	4	3527
6	5	2843
7	6	1760
8	7	1043
9	8	620
10	9	471
11	10	487
12	11	334
13	12	188
14	13	135
15	14	104
16	15	116
17	16	112

Figure 24. A portion of the *Viewshed* raster table, showing not visible cells (Value = 0) and visible cells (Value >= 1).

Observe the cell *Count* for value 0—that is, not visible—and cell *Count* for values greater than 0—that is, visible by at least one observer. Keep in mind that each cell in the viewshed raster is 10 x 10 m, or 100 m<sup>2</sup>. A little arithmetic reveals that almost 1,115 ha (1,114.56) are not visible. Select for *Value* >= 1 and calculate *Count* statistics, and you'll see that 355 ha are visible. But you really want to know what portion of that 355 ha is occupied by recent clearcuts.

## DETERMINE THE AMOUNT OF VISIBLE CLEARCUTS

Now that you finally have your Woodlot viewshed calculated, it should be relatively straightforward to determine how much of it contains recent clearcuts.

### RELATED CONCEPT: CHARACTERIZE USING A SINGLE NUMBER

First, you'll have to identify recent clearcuts in the Woodlot. In this case, you're looking for recent clearcuts that have not likely greened up, meaning clearcuts within the last five years.

- 1 Remove the *cover\_arcs*, *cover\_arcs\_Dissolve*, *cover\_Merge*, *DEM\_Woodlot*, *ViewingSurface*, and *HeightClass* layers.
- 2 Use *Definition Query* to isolate young clearcuts in the *Cover Types* layer using the following query expression. Rename the layer *Recent Clearcuts*.

```
[AGE] >= 0 AND [AGE] <= 5 AND [TYPE] <> 'BG'
```

This selects 121 stands.

- 3 For a visual clue, turn on the *Recent Clearcuts* layer and symbolize the polygons with a hollow fill and black outline. (Make sure any selected features in *Viewshed* are cleared.)

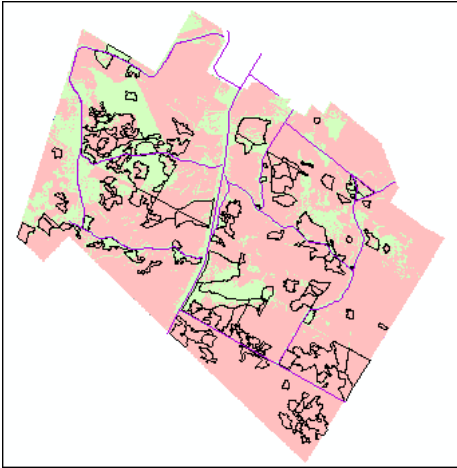


Figure 25. Woodlot clearcuts (dark outlines) superimposed on the viewshed (green: visible; pink: not visible).

There are many visible clearcuts in the western side of the Woodlot. How, though, do you determine exactly how much area is affected across the entire Woodlot? You can answer this question using a bit of map algebra and *Raster Calculator*.

- 4 Convert *Recent Clearcuts* to a 10 m cell-size raster using the *Feature to Raster* tool. Name it *Clearcuts*.

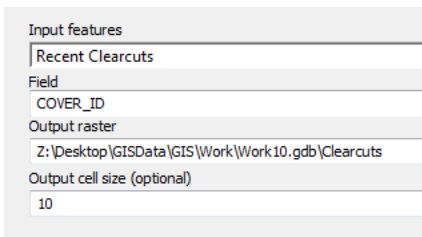


Figure 26. Rasterizing the recent clearcut features.

If you turn off *Recent Clearcuts*, you'll see the raster equivalent.

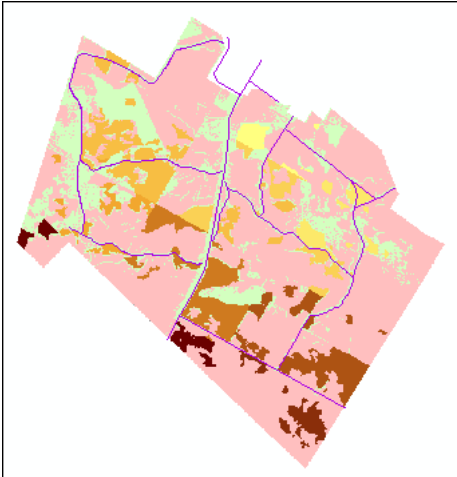
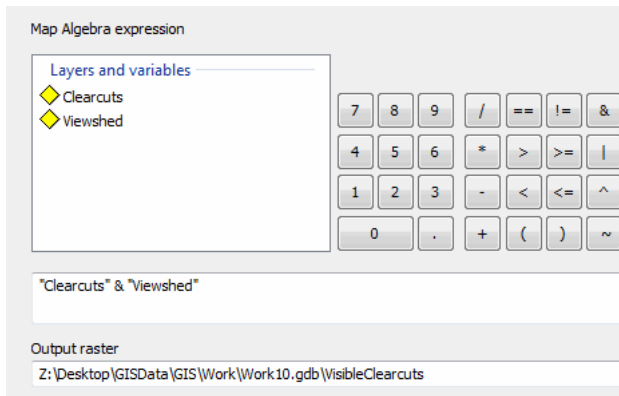


Figure 27. A raster of the Woodlot's 121 clearcuts.

It's a simple matter now of logically overlaying the *Clearcuts* and *Viewshed* rasters, cell by cell, to locate areas where both conditions are present—that is, where they intersect.

- 5 Use *Raster Calculator* to enter the following expression. Name the output raster *VisibleClearcuts*.

"Clearcuts" & "Viewshed"



*You could also use the Boolean And tool here (Spatial Analyst » Math » Logical).*

Figure 28. Overlaying *Clearcuts* and *Viewshed* rasters using a map algebra *And* operator: &.

This *And* overlay of the two rasters produces a binary raster with cells containing a value of 1, where both *Clearcuts* and *Viewshed* exist—that is, they have nonzero values or, otherwise, a value of 0.

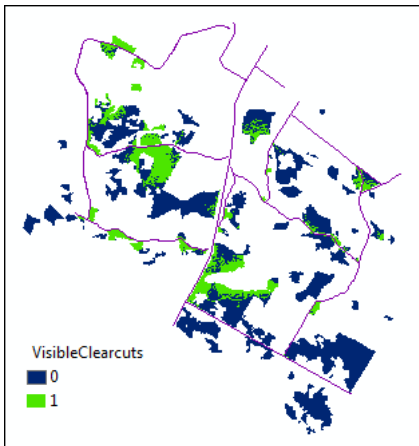


Figure 29. Clearcut visibility in the Woodlot (0: not visible; 1: visible).

If you open the *VisibleClearcuts* table, you can determine the amount of visible clearcuts in the Woodlot.

	OBJECTID *	Value	Count
▶	1	0	21263
	2	1	7305

Figure 30. Clearcut visibility amounts (0: not visible; 1: visible).

This tells you that about 73 ha (73.05) of recent clearcuts are visible from main and public roads in the Woodlot.

## Conclusion

Your numbers, tables, and maps tell the clearcutting story in the Woodlot. They tell us that almost 8 km of clearcuts lie adjacent to main roads, with at least one clearcut stretching for about 1 km. You also determined that a large area of the Woodlot, 355 ha, is visible from main and public roads. Of that area, some 73 ha contains clearcuts. Is this good news or bad, from economic, ecological, and aesthetic perspectives?

## Submit your work

---

- A frequency distribution of boundary lengths shared by clearcuts and main roads
- A tally and map of clearcut visibility
- Answers to the questions posed in the exercise:
  1. Why use a 10 m cell size for *Height Class*?
  2. How do you tell ArcGIS that it is OK to replace existing files when error messages appear?
  3. Why wasn't there more visible area seen around the public roads, especially Flanagan Road, which runs east–west in the bottom corner of the Woodlot?
- A summary of the exercise, indicating where and how related reclassifying and characterizing concepts, as well as analysis techniques, are used (It could take the form of a table that checks off each of these elements.)
- A written assessment of clearcutting in the Woodlot, from aesthetic, economic, and ecological perspectives
- Clearcut exposure and visibility statistics for a different forest, compiled using techniques similar to those encountered in the exercise

## Credits

---

### Sources of supplied data

#### *Course Data*

Data\cover, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\highway, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\newprop, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\tn, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Woodlot.mdb, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Codes\Woodlot\_Codes.xls, courtesy of University of New Brunswick UNB Faculty of Forestry and Environmental Management

Data\Coordinate Systems\ATS 1977 New Brunswick Stereographic.prj, courtesy of ESRI  
Data\Coordinate Systems\NAD 1983 CSRS New Brunswick Stereographic.prj, courtesy of ESRI

Data\GPS\Knowledge.shp, courtesy of University of New Brunswick  
Data\GPS\towers.xls, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management

Data\Layer Files\Age Classes.lyr, courtesy of Glen Jordan  
Data\Layer Files\Air Photo Centre Points.lyr, courtesy of Glen Jordan  
Data\Layer Files\Main Roads.lyr, courtesy of Glen Jordan  
Data\Layer Files\Mgt Compartments.lyr, courtesy of Glen Jordan  
Data\Layer Files\Non-forested.lyr, courtesy of Glen Jordan  
Data\Layer Files\Secondary Roads.lyr, courtesy of Glen Jordan  
Data\Layer Files\Streams.lyr, courtesy of Glen Jordan

Data\Mass Points\DTM.txt, courtesy of Service New Brunswick

Data\Models\Clearcutting.tbx, courtesy of Glen Jordan  
Data\Models\Forest Analysis.tbx, courtesy of Glen Jordan  
Data\Models\Forest Values.tbx, courtesy of Glen Jordan

Data\Orthophotos\Z45856650.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45856660.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45856670.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45906650.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45906660.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45906670.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45956650.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45956660.tif, courtesy of Service New Brunswick  
Data\Orthophotos\Z45956670.tif, courtesy of Service New Brunswick

Data\Photos\118\_178.TIFF, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management  
Data\Photos\118\_178.tiffw, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management  
Data\Photos\118\_178r.tif, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management  
Data\Photos\118\_180.TIFF, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management

Data\Photos\118\_180.tiffw, courtesy of University of New Brunswick Faculty of Forestry and  
Environmental Management

Data\Photos\118\_180r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_182.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_182.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_182r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_184.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_184.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\118\_184r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_61.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_61.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_61r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_65.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_65.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_65r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_67.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_67.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_67r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_69.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_69.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\119\_69r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\120\_112.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\120\_112.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\120\_112r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\120\_114r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management



Data\Photos\l21\_30.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_30.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_30r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_32.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_32.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_32r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_34.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_34.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_34r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_36.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_36.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_36r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_38.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_38.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l21\_38r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l22\_77.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l22\_77.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l22\_77r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l23\_16.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l23\_16.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l23\_16r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l23\_18.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management  
Data\Photos\l23\_18.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_18r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_20.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_20.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_20r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_22.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_22.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l23\_22r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_129.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_129.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_129r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_131.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_131.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l24\_131r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l26\_175.TIFF, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l26\_175.tiffw, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\l26\_175r.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\image2345, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\image2345c1, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\image2345c2, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Photos\image2345c3, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Rasters\accessibility, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Rasters\dollarvalue, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Rasters\elevation, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\basemap.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\clines.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\compart.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\cover.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\cpoints.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\outline.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\proads.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\publicrow.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\roads.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\s4551.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\s4552.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\streams.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\towers.shp, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Shapes\volumes.dbf, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Updates\l20\_112u.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Updates\l20\_114u.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Updates\l23\_16u.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Updates\l23\_18u.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\Updates\l24\_129u.tif, courtesy of University of New Brunswick Faculty of Forestry and Environmental Management

Data\WatershedDelineation\Watershed Delineation Tools.tbx – ESRI

### **Lesson 3: Clearcutting data**

Data\Openings\DiagStep2a.gif, courtesy of Glen Jordan  
Data\Openings\DiagStep3a.gif, courtesy of Glen Jordan  
Data\Openings\DiagStep3b.gif, courtesy of Glen Jordan  
Data\Openings\DiagStep4a.gif, courtesy of Glen Jordan  
Data\Openings\DiagStep5a.gif, courtesy of Glen Jordan  
Data\Openings\ResStep1a.gif, courtesy of Glen Jordan  
Data\Openings\ResStep2a.gif, courtesy of Glen Jordan  
Data\Openings\ResStep2b.gif, courtesy of Glen Jordan  
Data\Openings\ResStep4a.gif, courtesy of Glen Jordan  
Data\Openings\ResStep4b.gif, courtesy of Glen Jordan  
Data\Openings\ResStep5a.gif, courtesy of Glen Jordan

Data\Visible\DiagStep1a.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep1b.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep1c.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep2a1.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep2a2.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep2b.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep3a.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4a.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4b.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4c.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4d.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4e.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4f.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4g.gif, courtesy of Glen Jordan  
Data\Visible\DiagStep4h.gif, courtesy of Glen Jordan  
Data\Visible\ResStep1a.gif, courtesy of Glen Jordan  
Data\Visible\ResStep2a.gif, courtesy of Glen Jordan  
Data\Visible\ResStep2b.gif, courtesy of Glen Jordan  
Data\Visible\ResStep2c.gif, courtesy of Glen Jordan  
Data\Visible\ResStep3a.gif, courtesy of Glen Jordan  
Data\Visible\ResStep3b.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4a.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4b.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4c.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4d.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4e.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4f.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4g.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4h.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4i.gif, courtesy of Glen Jordan

Data\Visible\ResStep4j.gif, courtesy of Glen Jordan  
Data\Visible\ResStep4k.gif, courtesy of Glen Jordan

Data\Watershed\DiagStep2a.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep2b.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep3a.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep3b.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4a.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4b.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4c1.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4c2.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4d.gif, courtesy of Glen Jordan  
Data\Watershed\DiagStep4e.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep1a.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep1b.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2a.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2b.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2c.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2d.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2e.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep2f.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep3a.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep3b.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep3c.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4a.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4b.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4c.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4d.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4e.gif, courtesy of Glen Jordan  
Data\Watershed\ResStep4f.gif, courtesy of Glen Jordan  
Data\Watershed\Result3D.gif, courtesy of Glen Jordan  
Data\Watershed\ResultTable1.gif, courtesy of Glen Jordan  
Data\Watershed\ResultTable2.gif, courtesy of Glen Jordan