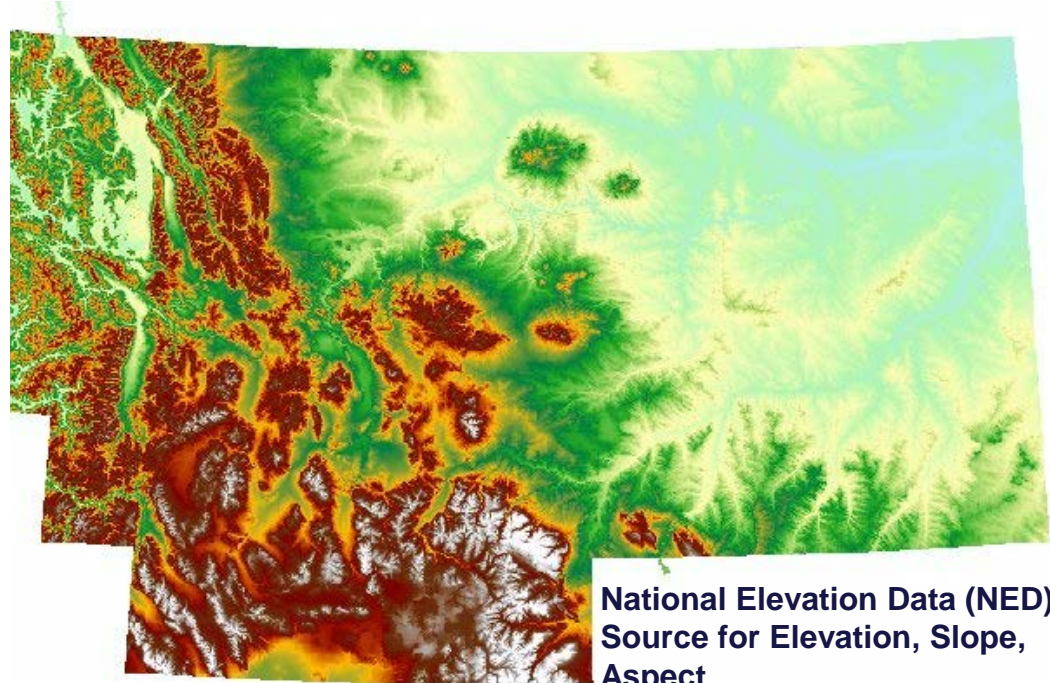# USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY

Elevation and Slopes Raster Data

The 10 meter National Elevation Dataset (NED) data is the highest resolution elevation data publicly available for the full state of Montana. It was digitally created from the contours of the last published USGS topographic quadrangle maps. This elevation data was used to create a slope raster for the State of Montana. The original elevation raster data and the slope raster data were subset for each of the four NRCS areas in Montana.

In consultation with NRCS rangeland specialists, the 10 meter slopes data were classified into 6 categories for rangeland inventory and planning purposes.

These raster datasets are provided in file geodatabases using the projected coordinate system of: NAD_1983_StatePlane_Montana_FIPS_2500

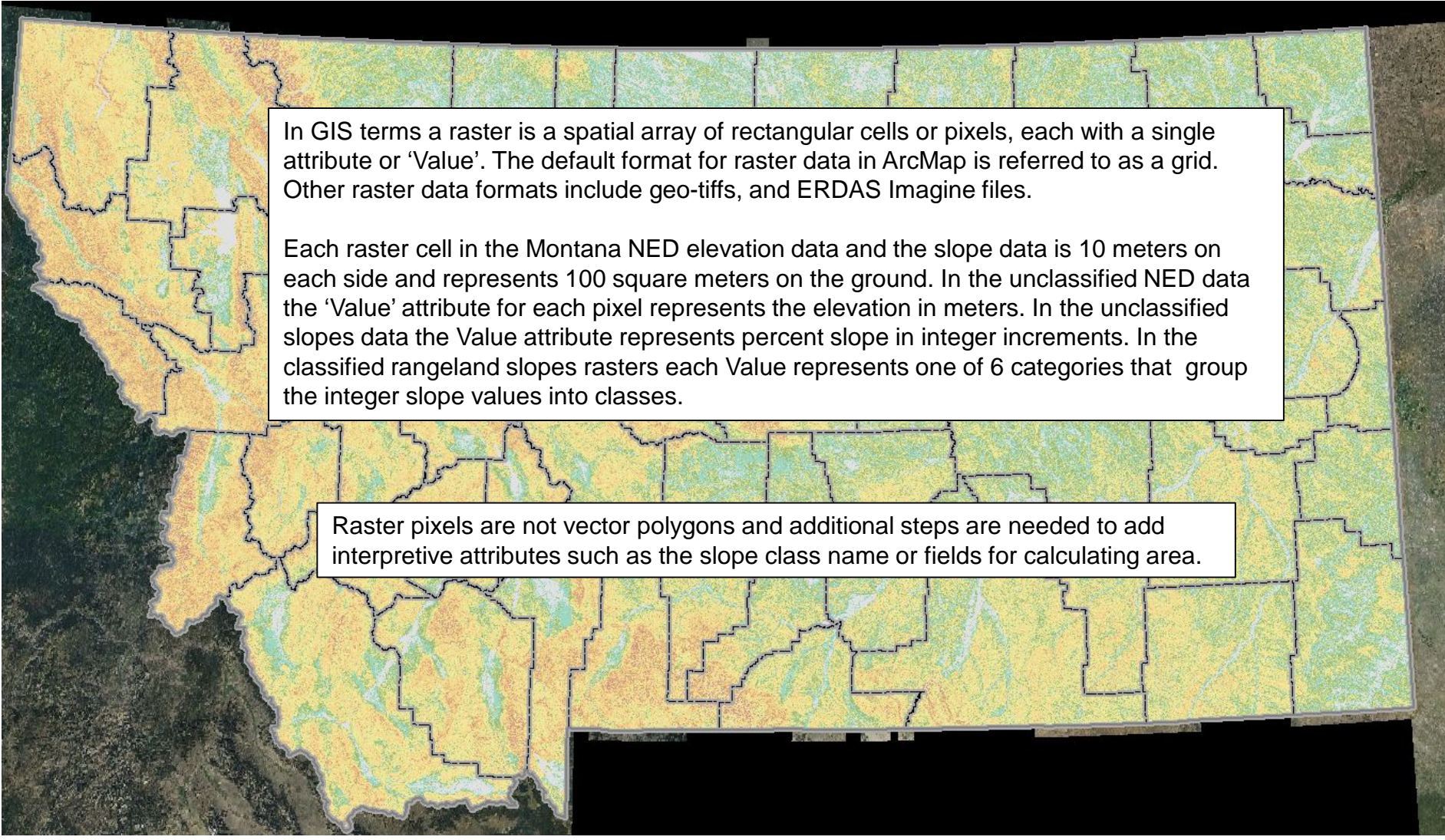**National Elevation Data (NED) Source for Elevation, Slope, Aspect**

Geodatabases containing the rasters of the statewide and NRCS areawide NED, slopes, and classified rangeland slopes are available for download through the MSL-NRCS Partnership landing page link: http://geoinfo.msl.mt.gov/nrcs_partnership or directly from the Elevation Data Products page link at: http://geoinfo.msl.mt.gov/nrcs_partnership/imagery_and_elevation A zipped file folder containing layer files for symbolizing the rangeland slopes is also available for download.

The following pages provide background information and instructions for creating subsets of the rangeland slopes data and using the data for project planning areas.

USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY

Raster Data Basics

In GIS terms a raster is a spatial array of rectangular cells or pixels, each with a single attribute or 'Value'. The default format for raster data in ArcMap is referred to as a grid. Other raster data formats include geo-tiffs, and ERDAS Imagine files.

Each raster cell in the Montana NED elevation data and the slope data is 10 meters on each side and represents 100 square meters on the ground. In the unclassified NED data the 'Value' attribute for each pixel represents the elevation in meters. In the unclassified slopes data the Value attribute represents percent slope in integer increments. In the classified rangeland slopes rasters each Value represents one of 6 categories that group the integer slope values into classes.

Raster pixels are not vector polygons and additional steps are needed to add interpretive attributes such as the slope class name or fields for calculating area.
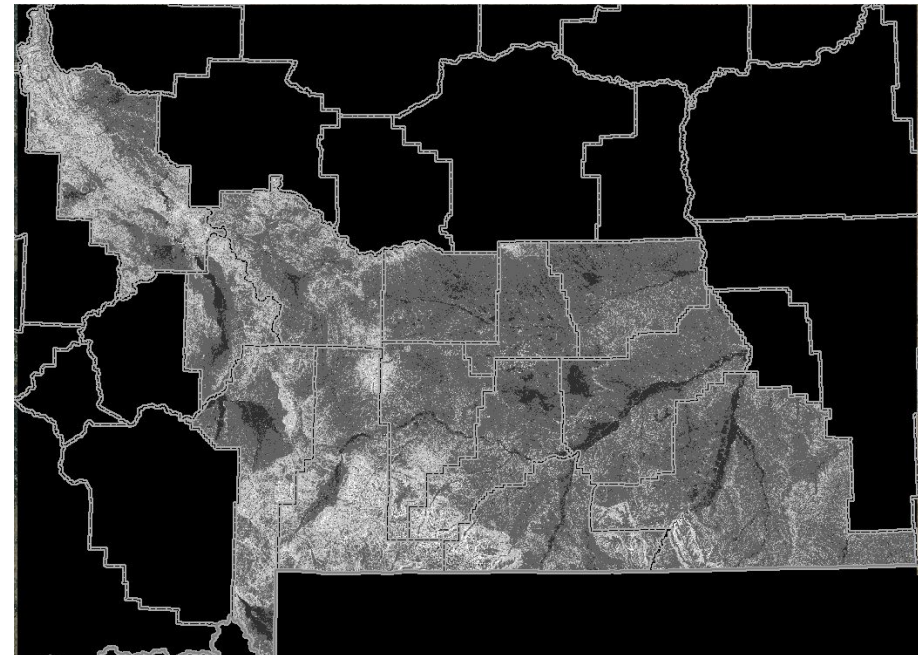
USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY
Adding and Displaying a rangeland slope raster to your ArcMap mxd

1. After downloading the zipped rangeland slopes geodatabase and layer files for your area make sure you have placed the files in a folder to which you have read/write permissions. Unzip the files into the new folder, make a separate folder that you can use for project purposes and place a copy the rangeland slopes geodatabase into it, while keeping the original as a backup. If you are familiar with ArcCatalog use it to make a copy of your geodatabase.

2. Open ArcMap using a previously created mxd for your project area. Use the add layer icon ✚ on the main ArcMap toolbar to add the rangeland slopes raster for your area. You will need to navigate to the folder where you have copied your rangeland slopes geodatabase.
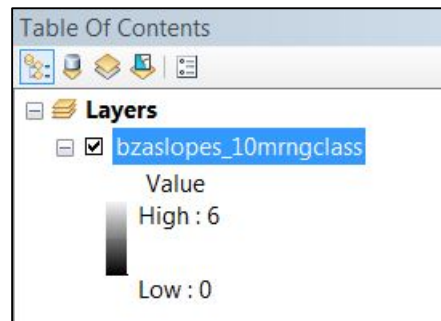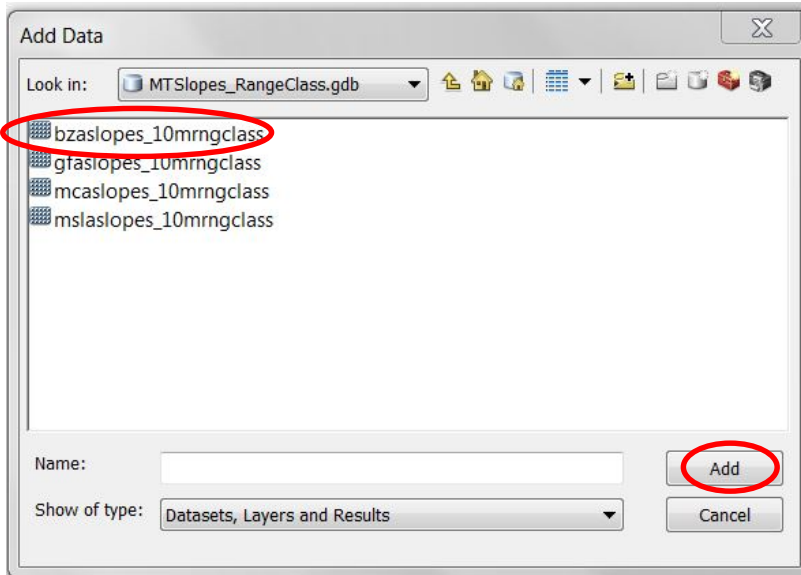

3. Highlight the rangeslopes raster you want to add, then click on the Add radio button. The rangeland slopes raster you have added will appear in your Table of Contents (TOC) and will be displayed with a black & white color ramp which is the default symbol for rasters. ArcMap defaults to displaying rasters using the Value attribute.
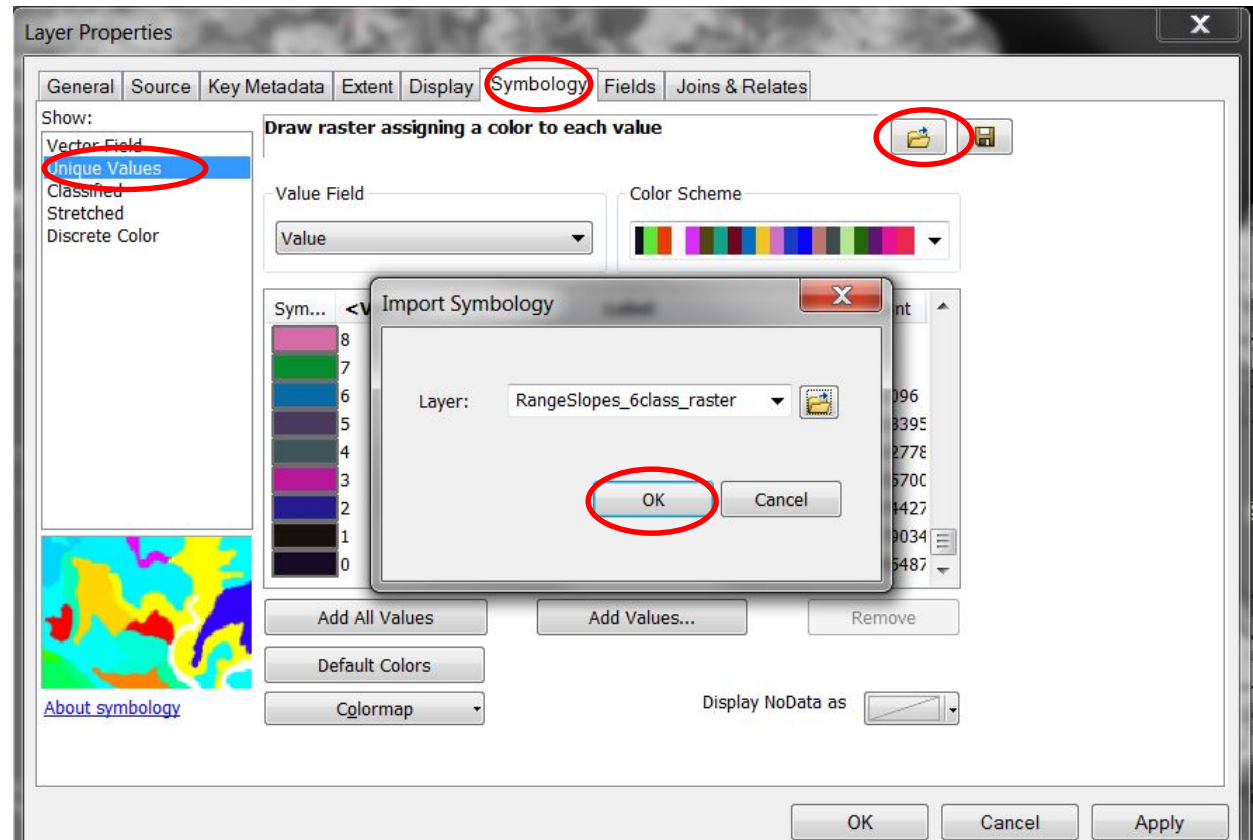
USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY
Adding and displaying a rangeland slope raster in your ArcMap mxd

1. To change the symbology of the rangeland slopes raster to display the rangeland slope class categories right-click on the raster name and select Properties from the drop-down menu. Go to the 'Symbology' tab, and in the Layer Properties window highlight 'Unique Values'.
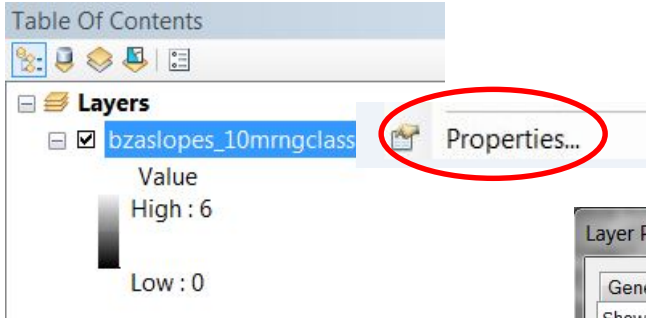
2. Use the folder icon to open the Import Symbology dialogue box. Then navigate to the folder where you have copied the RangeSlopes_6class_raster layer file and when it is selected click on the OK button. This layer file was created to symbolize the rangeland slopes raster using the 6 unique values associated with the slope classes shown below.
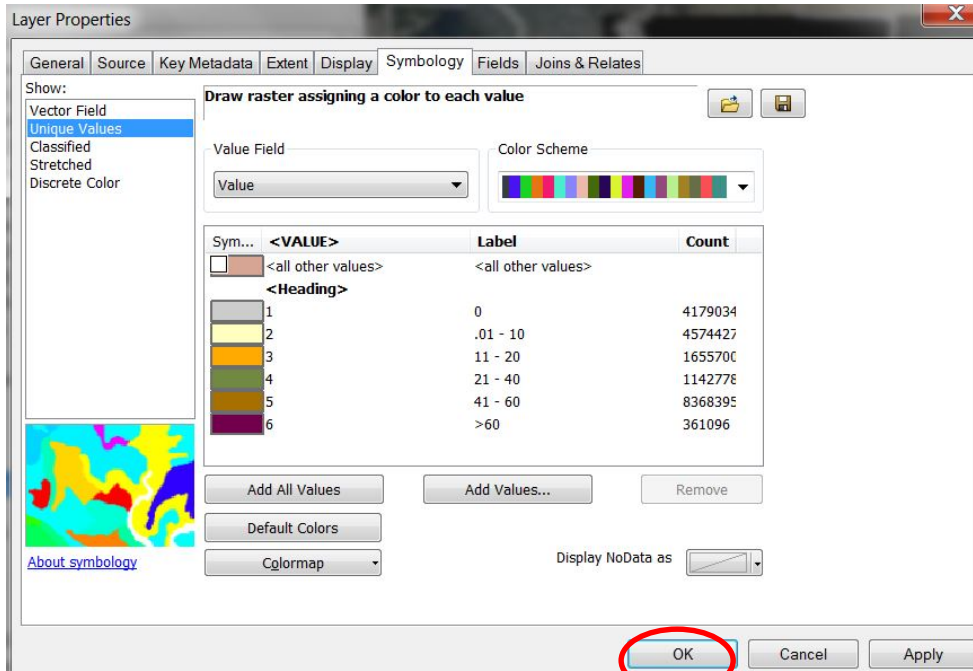
Classified Rangeland Slopes

Class	Percent Slopes
1	0
2	0 .01 – 10%
3	11 – 20%
4	21 – 40%
5	41 – 60%
6	>60%

USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY
## Adding and displaying a slope raster in your ArcMap mxd

3. Your Layer Properties will now show the rangeland slopes raster data symbolized by the Values representing the 6 rangeland slope classes. Click on the 'OK" Button.

Classified Rangeland Slopes

Class	Percent Slopes
1	0
2	0 .01 – 10%
3	11 – 20%
4	21 – 40%
5	41 – 60%
6	>60%

4. The rangeland slope raster will also be shown in your display window symbolized by the slope classes shown in your TOC. These classes will be used when creating a map legend. If you change the colors associated with the slope classes be sure to save your selections as a new layer file for future use.
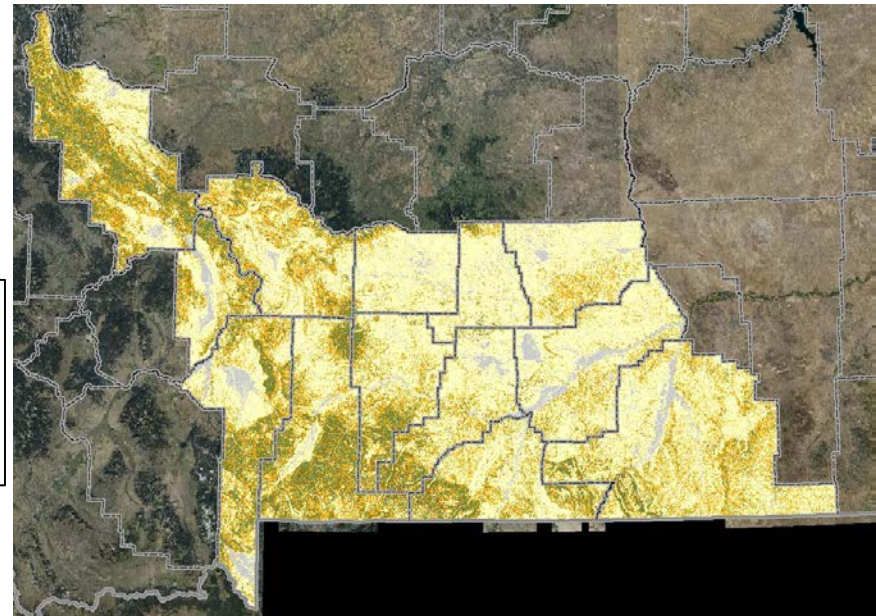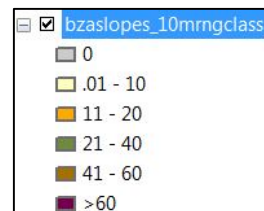
USING CLASSIFIED SLOPE RASTERS FOR RANGELAND INVENTORY
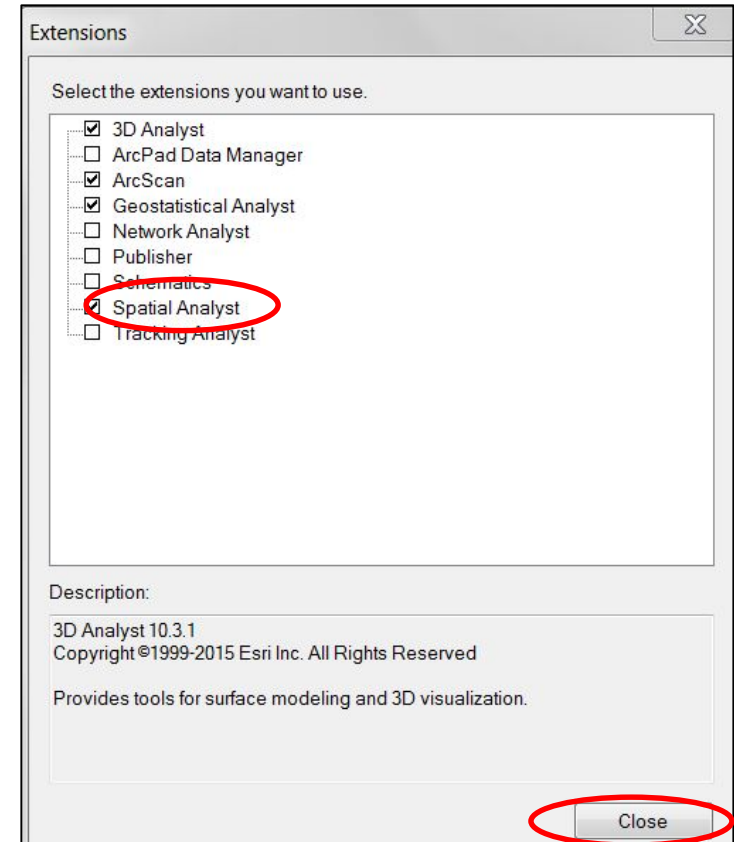## Subsetting the slope raster to your project area

Before proceeding to the next section be sure that the Spatial Analyst extension is activated, then open ArcToolbox.

1. To activate the Spatial Analyst extension, from the main ArcMap toolbar right-click on the **Customize** button and select **Extensions** from the drop-down menu. From the list of available extensions make sure Spatial Analyst is checked, then close the Extensions window.
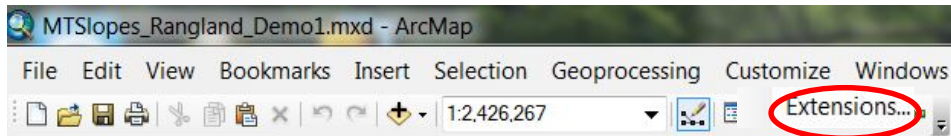
!! IMPORTANT TO NOTE !!

You will need to have READ WRITE PERMISSIONS to the folders and files you are using. Before proceeding to the next steps make sure you have these file permissions so you are able to run the processes, save and use the files you will be creating. ArcMap will generate error messages if you attempt to perform processing steps using files for which you do not have full permissions.
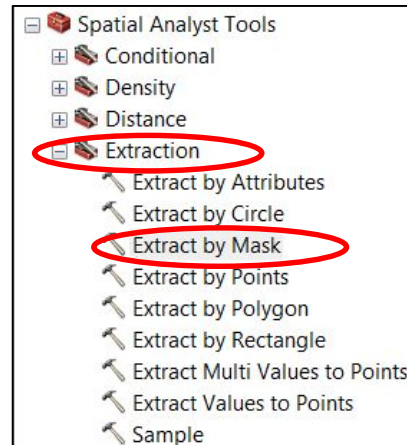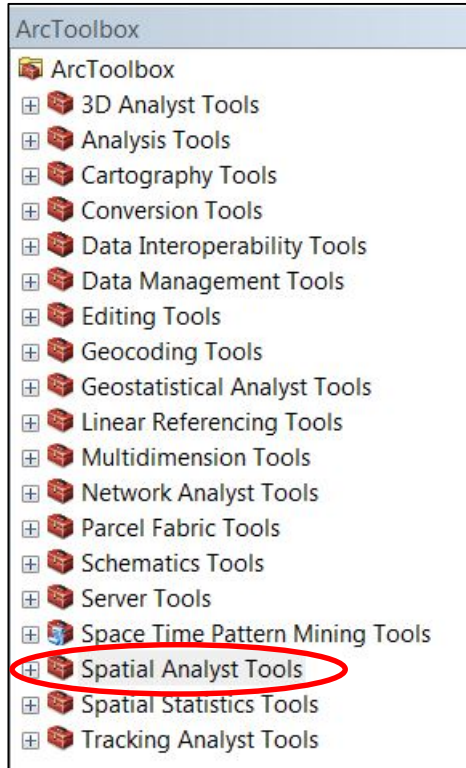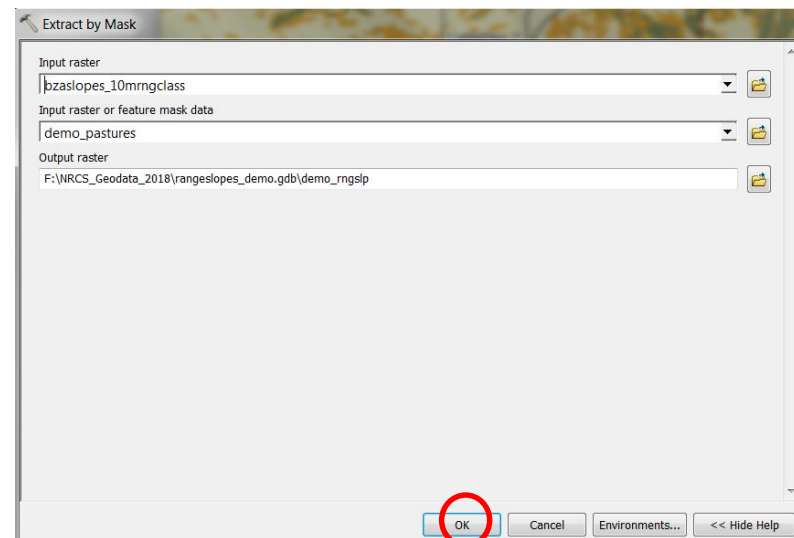
SUBSETTING THE RANGELAND SLOPES DATA
To create a raster of the rangeland slopes data for your project area apply the following steps:

1. Open ArcToolbox using the Toolbox icon on the main menu bar.

2. In ArcToolbox expand the Spatial Analysis Tools, open the Extraction Toolbox, and select the Extract by Mask Tool.

3. In the Extract by Mask dialogue box select the rangeland slopes raster as the 'Input raster'. Select the shapefile for your project area as the 'Input raster or feature mask data'. This must be in the same coordinate system as the range slopes raster. If your project area is in UTM coordinates you will first need to re-project it to Montana State Plane coordinates. In the 'Output raster' dialogue box use the folder icon to navigate to your rangeland slopes geodatabase. Attempting to save the subset rangeland slopes raster outside of the geodatabase may cause the process to fail. Assign a name to your output raster that will be the rangeland slopes subset to your project area and select OK. ESRI raster files names cannot exceed 12 characters.

When processing is completed the rangeland slopes raster subset to your project area will be added to your project Table of Contents (TOC).

SUBSETTING THE RANGELAND SLOPES DATA
Displaying the rangeland slopes for your project area

When the extract by mask processing is completed and the subset rangeland slopes raster has been added to your project Table of Contents (TOC) you will need to repeat the steps on Page 4 to symbolize the new raster with the range slope class layer file or the layer file you have created. Not all slope classes may occur in your project area. The legend will reflect only the classes present in your project area.

Project Example Rangeland Slopes
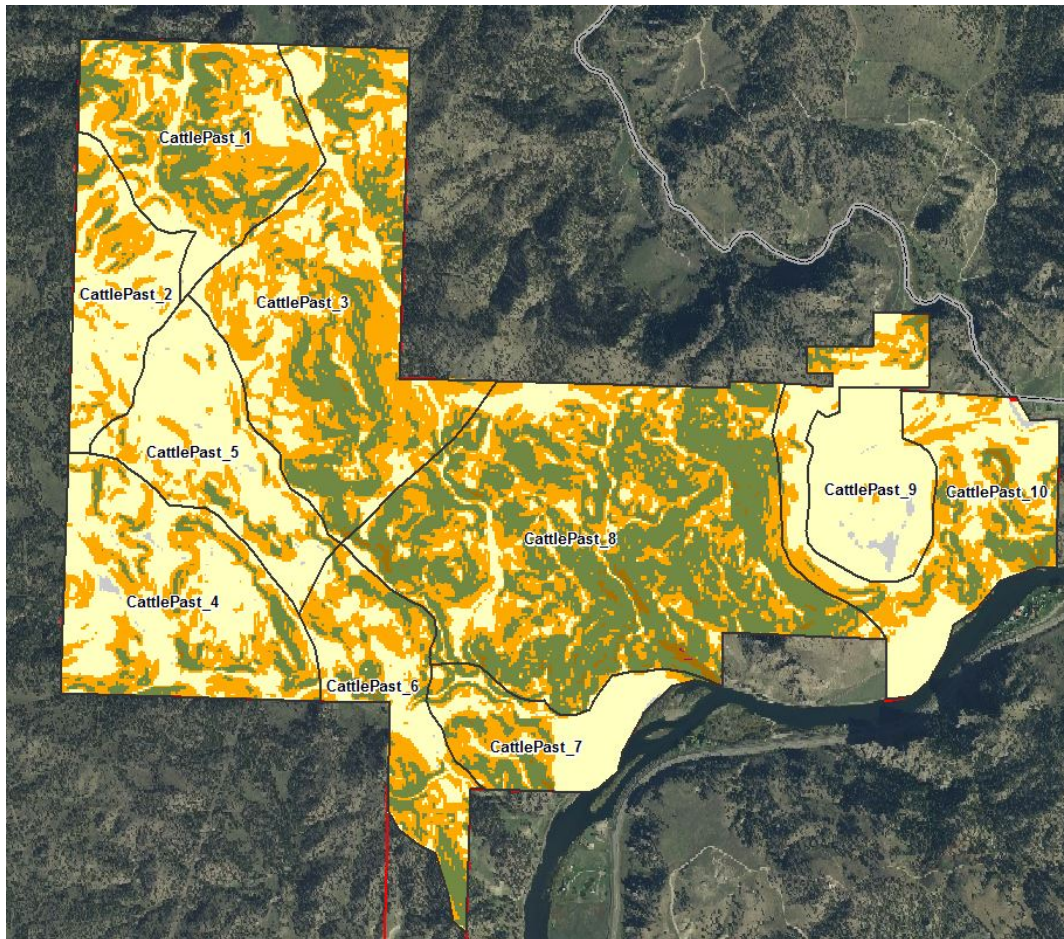
The instructions on Page 9 will explain how to update the area fields in the subset rangeland class raster.

Pages 10 – 16 will explain how to convert the rangeland slopes raster to polygons, combine the rangeland slopes with the pastures or other management units in your project area, and create a summary table for reporting purposes.

CALCULATING AREA FOR THE SUBSET RANGELAND SLOPES RASTER

Attributes representing area in square meters and acres have been created for the rangeland slopes raster. To view the attributes table, in the TOC left click on the rangeland slopes raster for your project area and select 'Open Attribute Table' from the drop-down menu.

Table Of Contents

bzaslopes_10mrngclass   Open Attribute Table
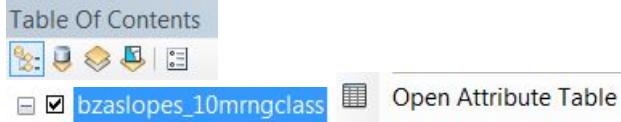
1. With the attribute table open, hover the mouse over the field named SqMeters and right-click to open the drop-down menu and select the 'Field Calculator option.

Field Calculator...

2. The attribute table will open in a separate window and you will be see that in addition to the standard raster attributes of Value and Count (number of pixels), attributes for area in square meters and acres have been added, along with the Slope Class field. The values in these area fields will be incorrect because you have subset the raster to a smaller area. These area fields do not automatically update when the raster is subset to a project area and will need to be re-calculated. You will first need to re-calculate the area in square meters and then in acres.

Table

bzaslopes_10mrngclass

OBJECTID *	Value	Count	SqMeters	Acres	SlopeClass
1	0	1285487588	128548758800	31765041.0433	No Data
2	1	41790342	4179034200	1032660.24599	0
3	2	457442760	45744276000	11303639.321	.01 – 10
4	3	165570057	16557005700	4091318.8935	11 – 20
5	4	114277894	11427789400	2823863.89969	21 – 40
6	5	8368395	836839500	206787.224648	41 – 60
7	6	361096	36109600	8922.862708	>60

3. In the Field Calculator window calculate the SqMeters field to be equal to Count * 100. The Count represents the number of pixels and each pixel has an area of 100 sq. meters.
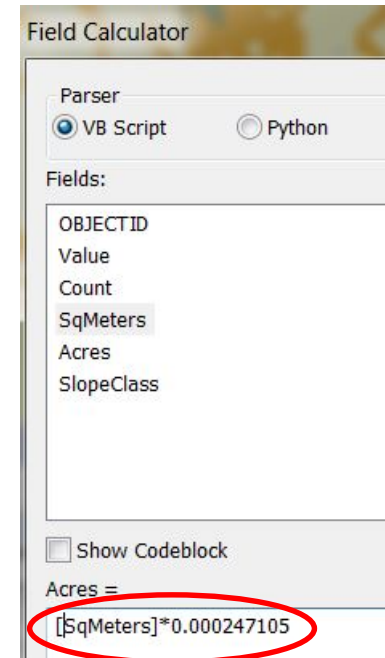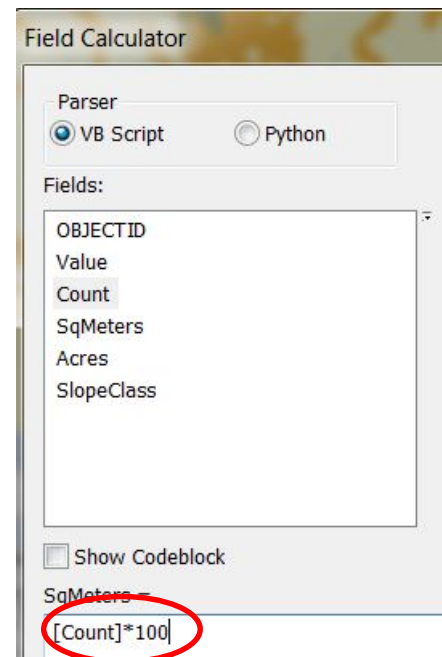
4. Repeat the process, opening the Field Calculator window for the Acres attribute. Calculate the Acres field to be equal to SqMeters * 0.0002471054.

Field Calculator

Parser: ● VB Script   ○ Python

Fields:
OBJECTID
Value
Count
SqMeters
Acres
SlopeClass

☐ Show Codeblock

SqMeters =

[Count]*100

Field Calculator

Parser: ● VB Script   ○ Python

Fields:
OBJECTID
Value
Count
SqMeters
Acres
SlopeClass

☐ Show Codeblock

Acres =

[SqMeters]*0.000247105

COMBINING THE RANGELAND SLOPES DATA WITH PROJECT AREA MANAGEMENT UNITS
## Raster to Polygon Conversion

1. Open ArcToolbox using the Toolbox icon on the main menu bar.

2. In ArcToolbox expand the **Conversion Tools - From Raster** toolbox and select the **Raster to Polygon t**ool.
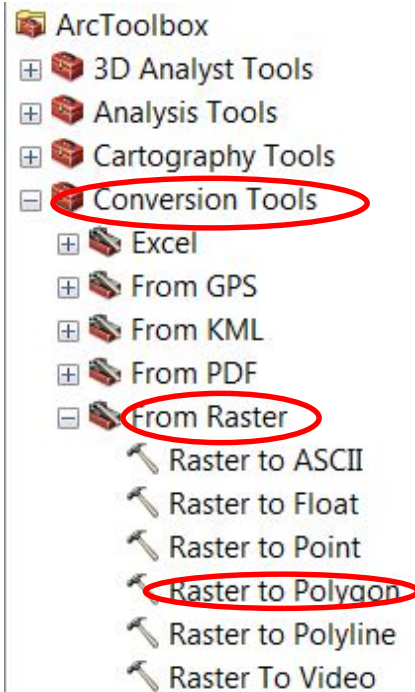
3. The Raster to Polygon dialogue box will open and you will notice that the Simplify polygons option is automatically checked. **Make sure to uncheck this box.**

4. Select the rangeland slopes raster that you have subset to your project area as the 'Input raster'. Use the dropdown arrow to selection SlopeClass as the attribute Field you want to be included with your rangeslopes polygons. Use the folder icon to navigate to the location where you want to store the output data. The rangeslopes polygons can be saved as a feature class in your project geodatabase or separately as a shapefile. Assign a name to your 'Output polygon features' and select OK.
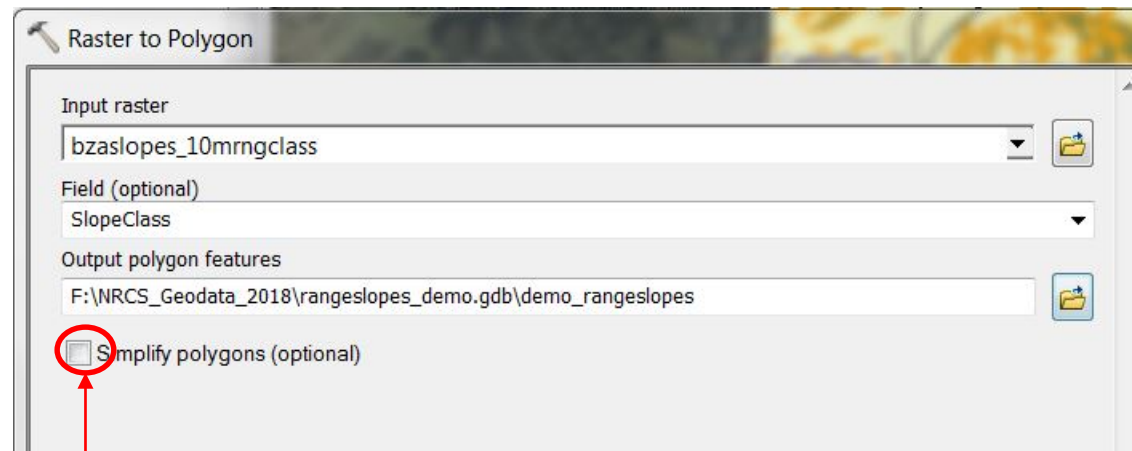
Uncheck this box.

When processing is completed the polygon shapefile or feature class of rangeland slopes for your project area will be added to your project Table of Contents (TOC).

COMBINING THE RANGELAND SLOPES DATA WITH PROJECT AREA MANAGEMENT UNITS
Raster to Polygon Conversion

When the conversion of the rangeland slopes to polygons has completed and the rangeland slopes polygons shapefile or feature class has been added to your TOC it will automatically display with a solid color and the polygons, which were derived from the 10 meter raster pixels, outlined. To associate the symbology representing the rangeslope classes use the following steps.
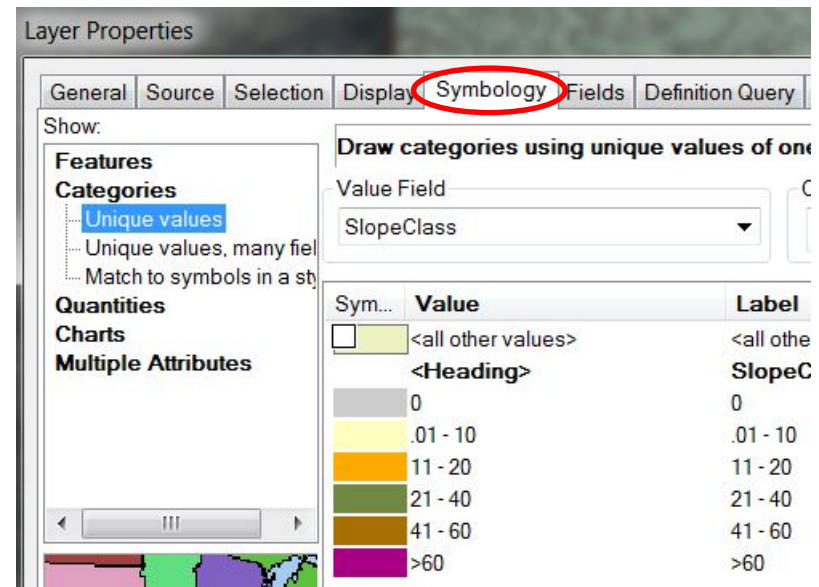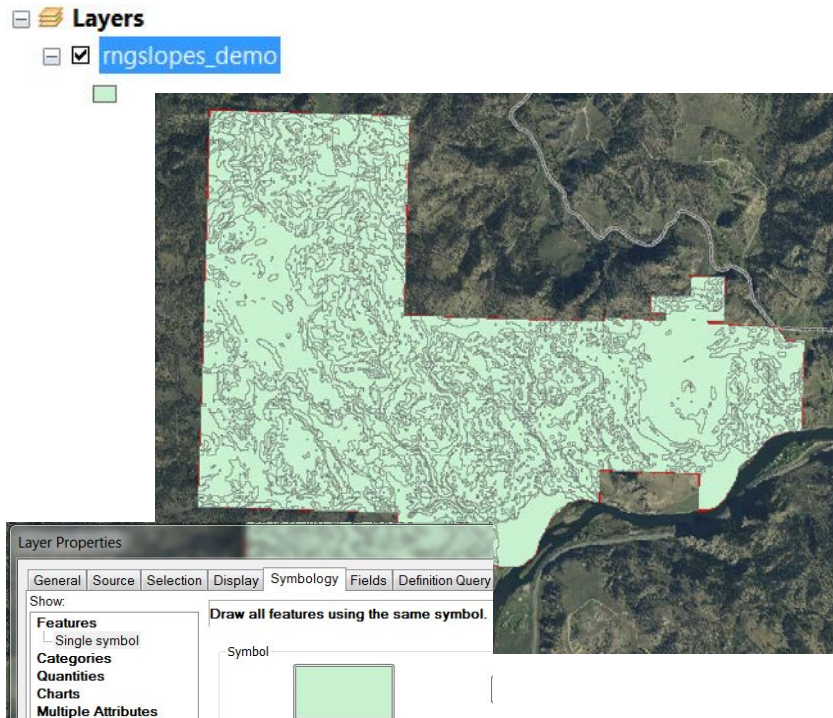
1. To change the symbology of the rangeland slopes raster to display the rangeland slope class categories right-click on the raster name and select Properties from the drop-down menu. Go to the 'Symbology' tab, and in the Layer Properties window highlight 'Unique Values'.

2. Use the folder icon to open the Import Symbology dialogue box. Then navigate to the folder where you have copied the **RangeSlopes_6class_poly** layer file and when it is selected click on the OK button. This layer file was created to symbolize the rangeland slopes polygons using the 6 unique values associated with the six slope classes.

COMBINING THE RANGELAND SLOPES DATA WITH PROJECT AREA MANAGEMENT UNITS
Displaying rangeland slopes polygons

Your Table of Contents will now show the rangeland slopes polygon data symbolized by the 6 rangeland slope classes. Turn on the layer of the pastures or other management units that you want to associate with the rangeslopes.
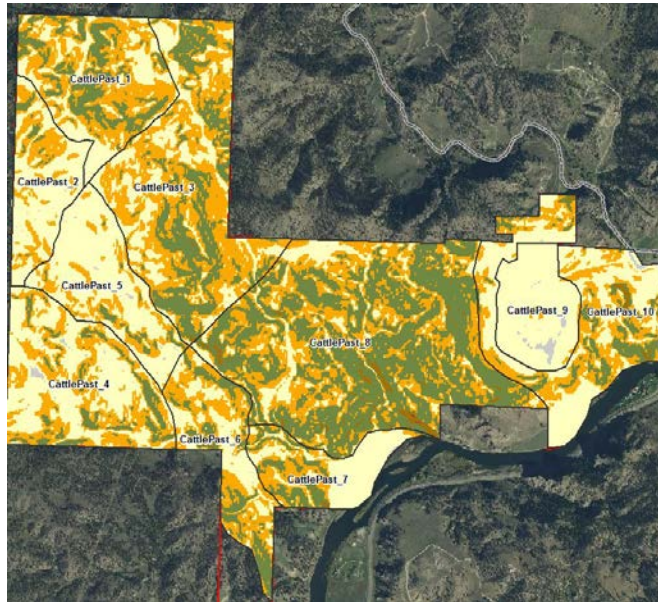

1. Open the attribute table for the pastures or management units shapefile that you will be combining with the slopes data. Make sure that each unit has a name or number that corresponds with how you will want to summarize and report the acreages of rangeland slopes.

2. If the attribute table does not have a field for the pasture or management unit name, use the drop-down menu from the Table window to open the Add Field dialogue box. Assign a field name and Type. Using a Text field type will ensure you can use numbers or characters in your pasture names. Click Ok and the field will be added to your attribute table. You will then need to select the record for each pasture and enter the pasture name for that polygon.
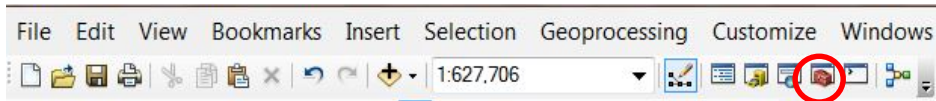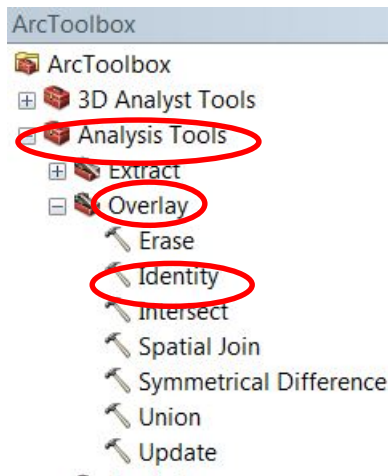
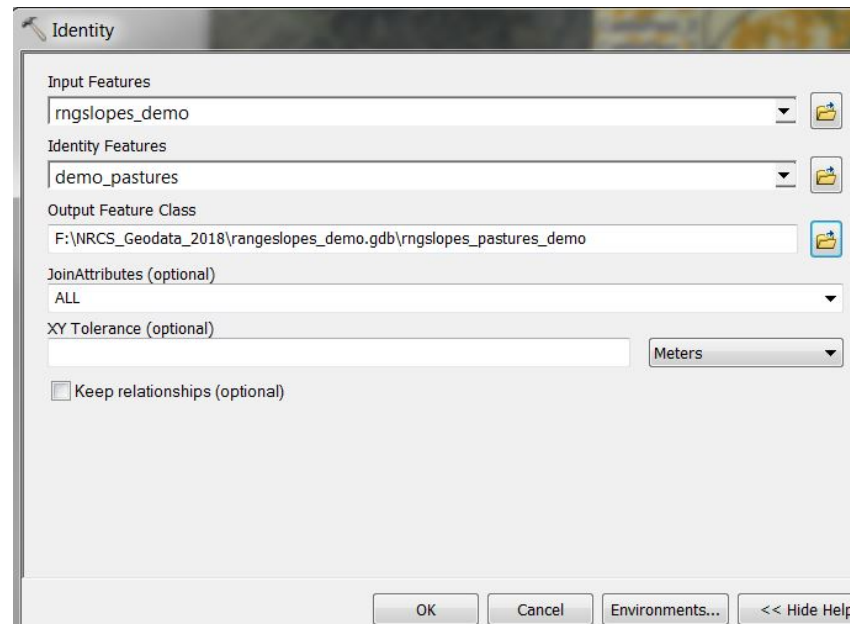# COMBINING THE RANGELAND SLOPES DATA WITH PROJECT AREA MANAGEMENT UNITS

1. Open ArcToolbox using the Toolbox icon on the main menu bar.

2. Expand the **Analysis Tools toolbox,** then expand the '**Overlay**' toolset and select the **Identity t**ool.

3. In the **Identity** dialogue box set the rangeland slopes polygon shapefile or feature class that was created using the raster to poly process for your project area as the 'Input Features'. Set the 'Identity Features' to be the shapefile for your project area. Navigate to the folder that contains your project files and assign a filename for the 'Output Feature Class' that will be created. This can be saved as a shapefile or a feature class within your project geodatabase. Make sure to leave the JoinAttributes set as ALL. Select OK.
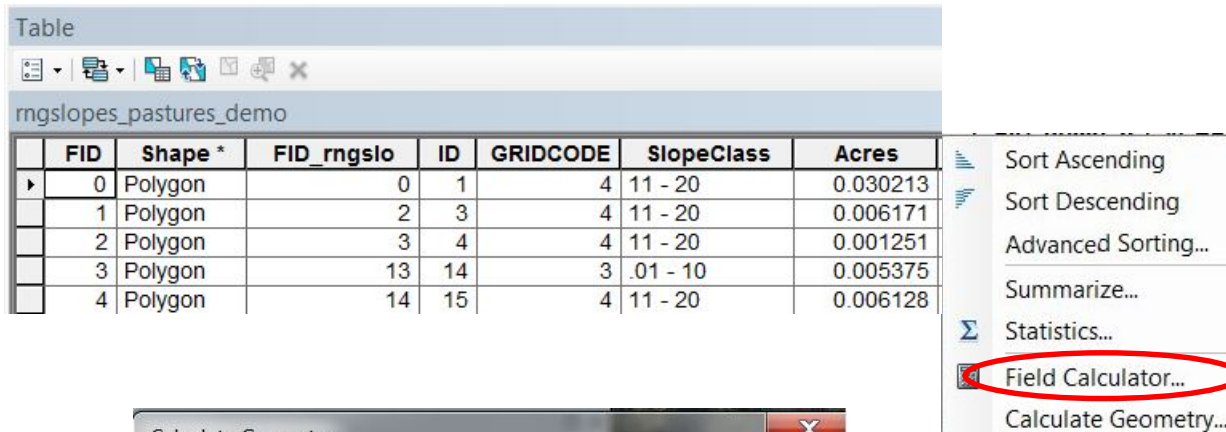
When processing is completed a feature class or polygon of the rangeland slopes combined with the pastures or management units of your project area will be added to your project Table of Contents (TOC).

USING THE COMBINED RANGELAND SLOPES DATA TO REPORT ACREAGES

When the combined rangeland slopes and pastures has been created and added to your TOC it will automatically display with a solid color and the polygons will include the attributes and topology of the rangeland slopes and the pastures boundaries. To associate the symbology representing the rangeslope classes use the steps outlined on Page 11. To calculate the acreages of rangeland slope class for each of the pastures in your project area you will first need to update the acres field in your attribute table.

1. Open the attribute table for your combined rangeland slopes and pastures shapefile or feature class. Right-click in the Acres field label box and select 'Calculate Geometry' from the drop-down menu.
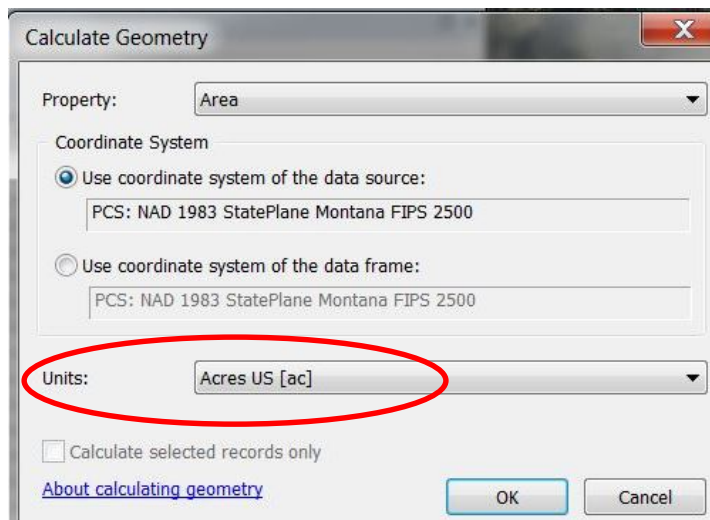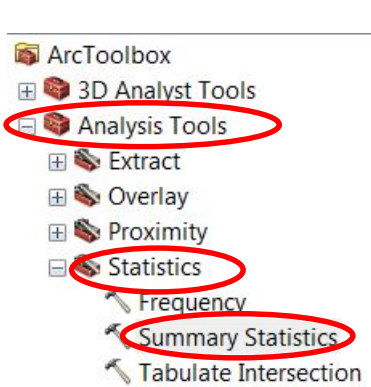

2. In the Calculate Geometry dialogue box make sure that Area is selected as the Property. Then select Acres US (ac) from the Units drop-down menu and click OK. The acres field in the attribute table will be updated.

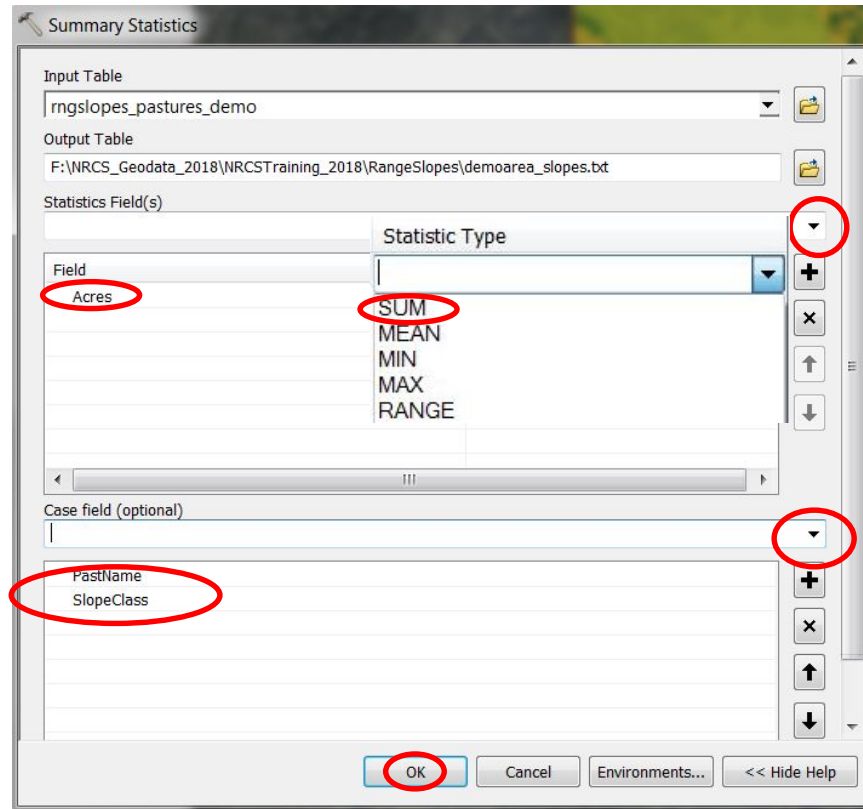## USING THE COMBINED RANGELAND SLOPES DATA TO REPORT ACREAGES
Creating a Table of Summary Statistics

For project planning a report of slope acreages by pasture or management unit is usually needed. Whether you are using an MS Access database, MS Excel spreadsheets, or just MS Word the following steps will enable you to export a table you can use for reporting purposes.

1. To create a table of the rangeland slopes acreages summarized by each of the pastures or management units in your project area open ArcToolbox and select the Summary Statistics tool from the Analysis Tools toolbox.

3. Use the drop-down menu for the 'Statistics Field' to select Acres from the list of attributes. Then use the drop-down for 'Statistics Type' to select 'SUM'.

4. Use the drop-down menu for the 'Case field' to select both the field containing your pasture names and the SlopeClass field from the list of attributes. Then click OK to create the table.

2. In the Summary Statistics dialogue box select your combined rangeslopes/pastures polygon layer as the 'Input Table'. Navigate to a folder where you want to store the output table and assign it a name. Be sure to include the .txt extension to your file name or it will not be accessible outside of your ArcMap mxd.

## USING THE COMBINED RANGELAND SLOPES DATA TO REPORT ACREAGES
Importing the Table of Summary Statistics into Excel

The summary statistics table will automatically be added to your project Table of Contents and the TOC will switch from List by Drawing Order to List by Source. To view the table contents, left-click on the table name and select the Open option from the drop-down menu. You will see the summary acreages reported for each slope class within each pasture or management unit of your project area. The frequency column refers to the number of polygons (pixels) for each combination. When you have finished reviewing the table you can switch the TOC back to List by Drawing Order.

1. To import your table into an MS Excel spreadsheet, open Excel to a blank worksheet and from the Data tab select the 'From Text/CVS option.
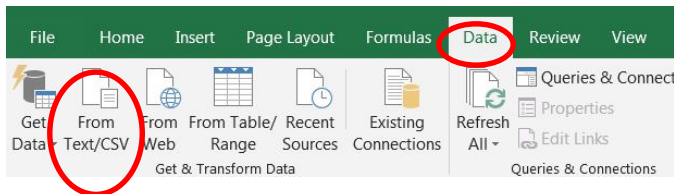
2. Once the table has been imported delete the columns you do not need (Columns 1 and 4 in this example) and rename the remaining columns for your report. You may also want to reformat the Acres column and truncate the number of decimal places.

OID	PastName	SlopeClass	FREQUENCY	SUM_Acres
6	CattlePast_1	.01 – 10	74	68.512221
7	CattlePast_1	0	6	0.168882
8	CattlePast_1	11 – 20	105	100.150493
9	CattlePast_1	21 – 40	46	58.67192
10	CattlePast_1	41 – 60	3	0.44479
11	CattlePast_10	.01 – 10	72	139.198823
12	CattlePast_10	0	5	1.66774
13	CattlePast_10	11 – 20	110	94.782341
14	CattlePast_10	21 – 40	61	37.332371
15	CattlePast_10	41 – 60	7	2.58711
16	CattlePast_10	No Data	1	0.167878
17	CattlePast_2	.01 – 10	20	86.402847
18	CattlePast_2	0	14	0.300619
19	CattlePast_2	11 – 20	40	38.477439
20	CattlePast_2	21 – 40	22	5.110859
21	CattlePast_2	41 – 60	1	0.024711
22	CattlePast_3	.01 – 10	143	110.021268
23	CattlePast_3	0	1	0.024711
24	CattlePast_3	11 – 20	196	194.699029
25	CattlePast_3	21 – 40	61	107.882421
26	CattlePast_3	41 – 60	11	0.699519

MONTANA SPATIAL ANALYSIS SUPPORT

If you have questions or need further assistance contact
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