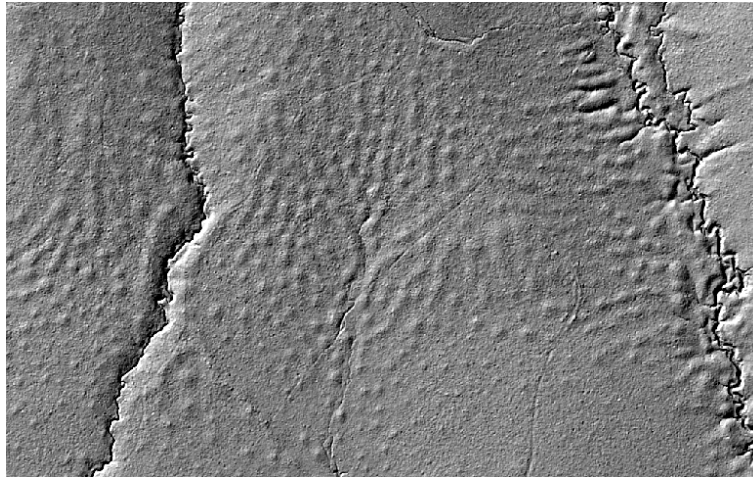


EXERCISE—optional

Delineating Cultural Features



Introduction

An increasingly common application of lidar derived DEMs is the identification of cultural or historical features on heavily vegetated landscapes. Due to the forest penetrating capability of lidar, we can map topographic features of historical or cultural significance that would otherwise be obscured by vegetation. In this exercise, you will be using the Land Facet Corridor tool in ArcMap and a lidar derived DEM to delineate human constructed mounds in eastern Texas.

Objectives

- Learn how to extract cultural features from lidar derived DEM
- Refine classification results in raster and vector formats

Required Data

- **DEM_1meter.tif**– elevation raster of the area of interest for this exercise
- **Hillshade_1meter.tif** – hillshade raster derived from DEM that highlights topographic features

Prerequisites

- Install Esri ArcMap on computer and have basic understanding of how to use the software.



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Part 1: Set up ArcMap

A. Download and Install Land Facet Corridor Tools

Note: If you already have the Land Facet Corridor Tools downloaded and installed to your version of ArcMap, move on to Part 1, Section B.

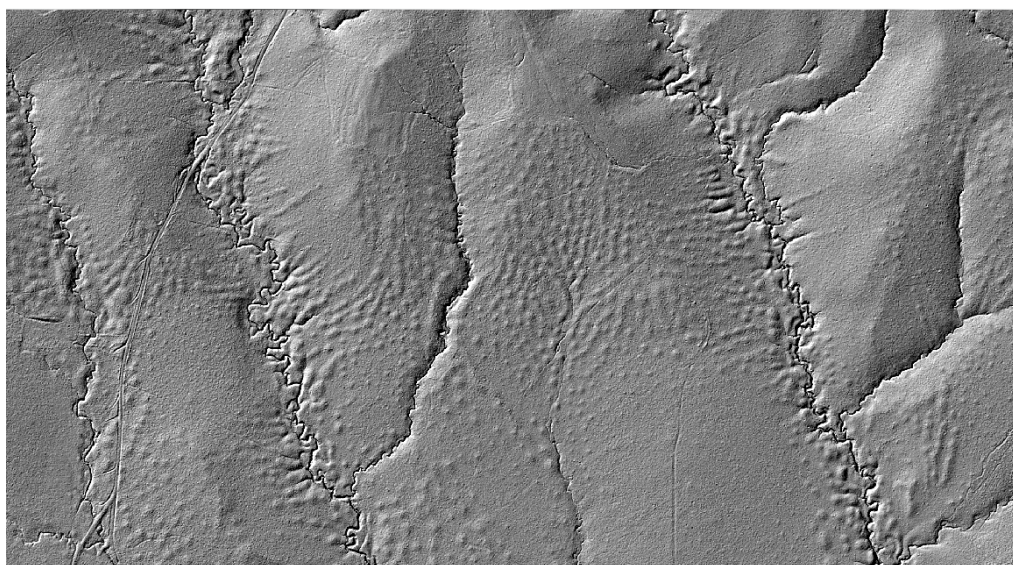
1. Visit http://www.jennessent.com/arcgis/land_facets.htm, scroll down to the Downloads section and click Land Faced Corridor Designer for ArcGIS 10. A .zip file with all of the pertinent download files and instructions automatically goes to your default download folder.
2. Copy the zipped folder to a desired local folder and use 7zip to unzip the folder.
3. Open up the ArcGIS_10_ReadMe.txt file and follow the specific instructions to download the Land Facet Corridor Tool and install it in ArcGIS.

B. Start ArcMap and Load Course Data

1. Launch ArcMap from the start menu by clicking **Start, Programs, ArcGIS, ArcMap 10.x**.
2. Turn on the Land Facet Corridor toolbar. From the top menu of ArcMap, go to Customize, Toolbars, and then select **Land Facet Analysis**. Dock the toolbar if you would like (see below).



3. Click the **Add Data** button and navigate to ...\\ProjectData\\Lidar\\CulturalFeatures.
4. Select **DEM_1meter.tif** and **Hillshade_1meter.tif** then click **Add**.
5. Right click on the **Hillshade_1meter.tif** in the table of contents and select Properties.
6. In the Layer Properties dialog box, select the **Symbology** tab and choose the **Stretched** option on the left side. Click **Ok**.
 - i. If you place the Hillshade layer above the DEM in the table of contents you should be able to clearly see the circular mounds we will be extracting.

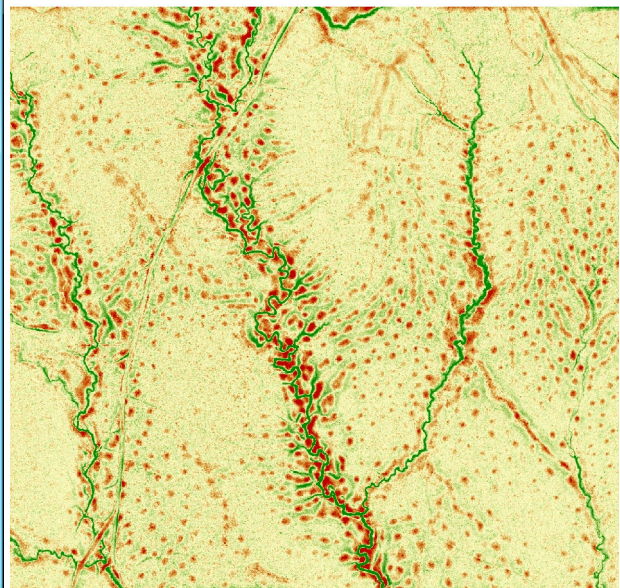
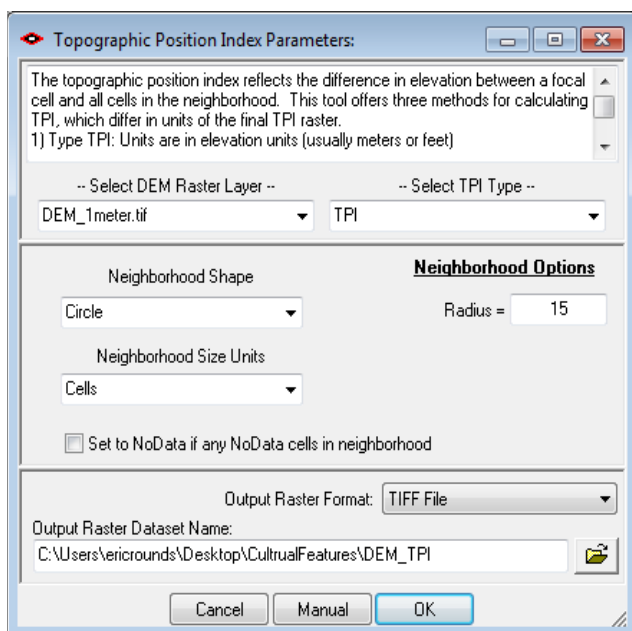


Part 2: Topographic Position Index

The first step to delineating the mounds is to use the TPI tool to perform a neighborhood analysis on elevation values. This will identify changes in elevation across the landscape that you can then categorize into three main groups: Canyons, Slopes, and Mounds.

A. Calculate Topographic Position Index

1. Click the Land Facet Corridor Tools, hover over Topographic Position Index Tool, and then click **Calculate TPI Raster**.
2. Select **DEM_1meter.tif** as the Select DEM Raster Layer. Ensure that Neighborhood Shape is set to **Circle** and set the radius to **15**.
3. Click the folder symbol next to the Output Raster Dataset Name section and navigate to your workspace. Name the output file **DEM_TPI.tif** and change the format to TIFF File (see graphics below).
4. Click **OK**.

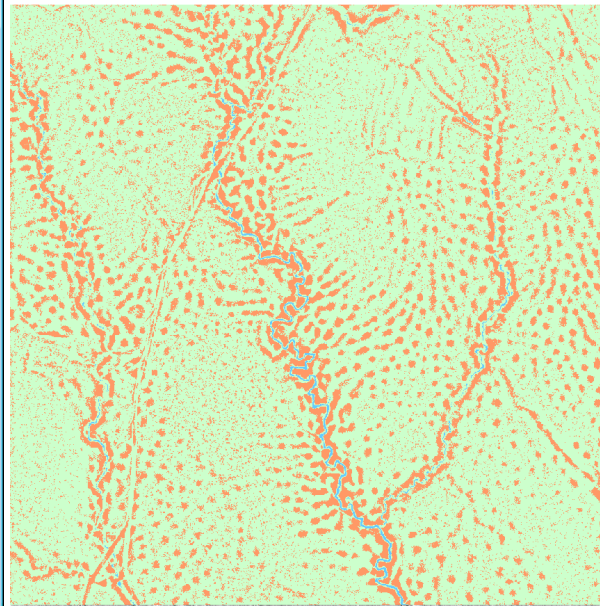
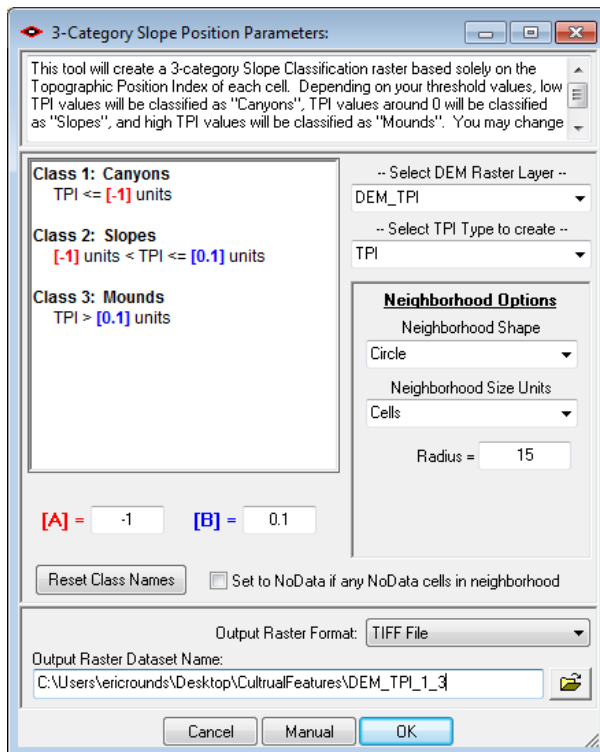


Note: Once the tool is done processing, a **Report** window will pop up that contains information about the parameters you set for that tool. If you would like, you can copy this information to a Word document to create a log of the processes you have employed and the parameters you have set.

B. Categorize Topography

1. Click the Land Facet Corridor Tools, hover over **Topographic Position Index Tool**, and then select **Topographic Position, 3-Category**.
 - i. This tool will reclassify your TPI output into three categories.
2. Select **DEM_TPI** as the Raster Layer and the Neighborhood Options will mirror those used to create that raster.

3. Set the **Radius** to 15
4. Set [A] = **-1** and [B] = **0.1**. This updates the parameters for Class 1, 2, and 3.
5. Change the names of the classes by clicking **Reset class Names**. Change “Ridges” to “Mounds” and click **OK**.
6. Set the output raster to your workspace and name the output **DEM_TPI_1_3.tif**. Change the format to TIFF File (see graphic below). Click **OK**.



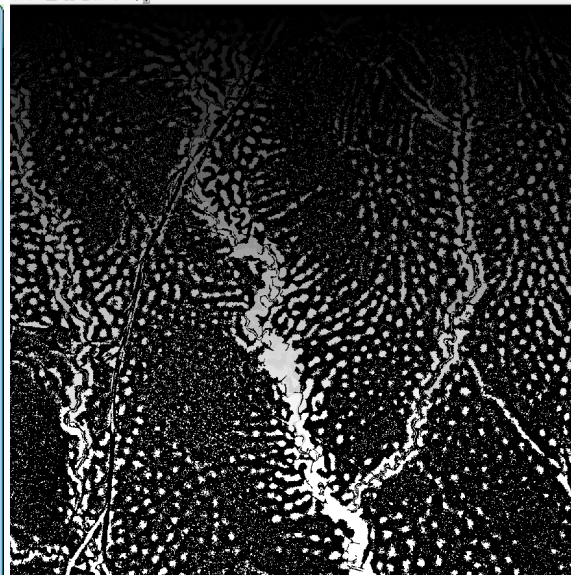
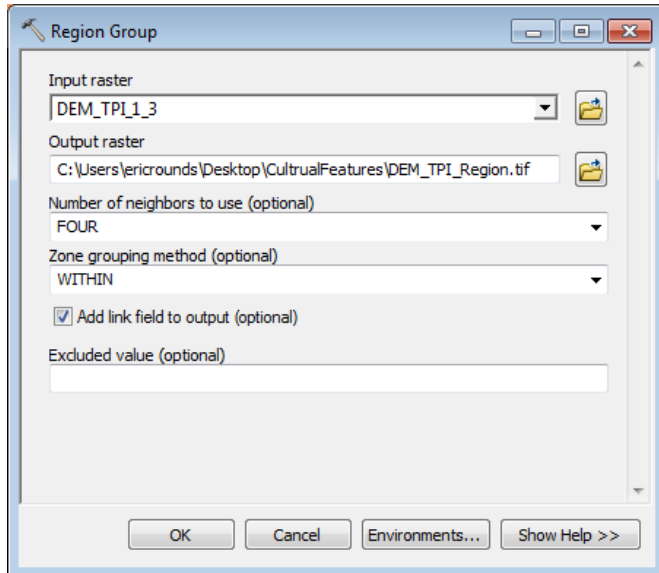
7. Look through the results and notice that although you have properly categorized most mounds there are still many areas within the “Mounds” class that are not accurate. You will refine those outputs in Part 3.

Part 3: Refine Raster Outputs

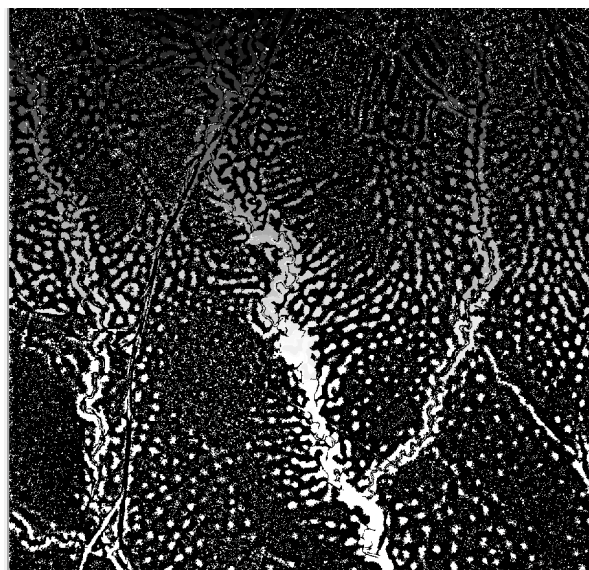
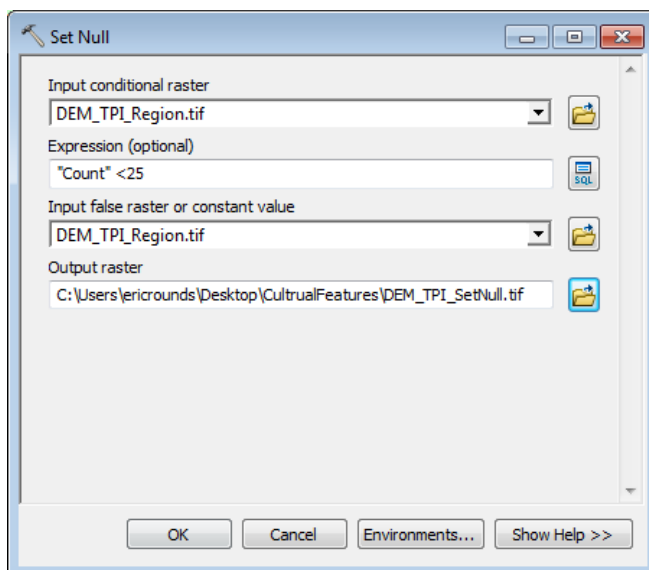
Now that you have separated the elevation data into 3 main categories, you will follow a workflow that eliminates spurious features from the raster that are too small to be classified as mounds.

A. Region Groups, Set Null, and Nibble workflow

1. Turn on the Spatial Analyst Extension if not already activated. From the top menu of ArcMap, go to Customize, Extensions, and click the box next to Spatial Analyst to activate it.
2. Navigate to the **Region Group** tool (Spatial Analyst Tools>Generalization).
3. Select **DEM_TPI_1_3** as your input. Leave the optional parameters to their defaults.
4. Save the output as **DEM_TPI_Region.tif** in your workspace (see graphic below).
5. Click **Ok**.

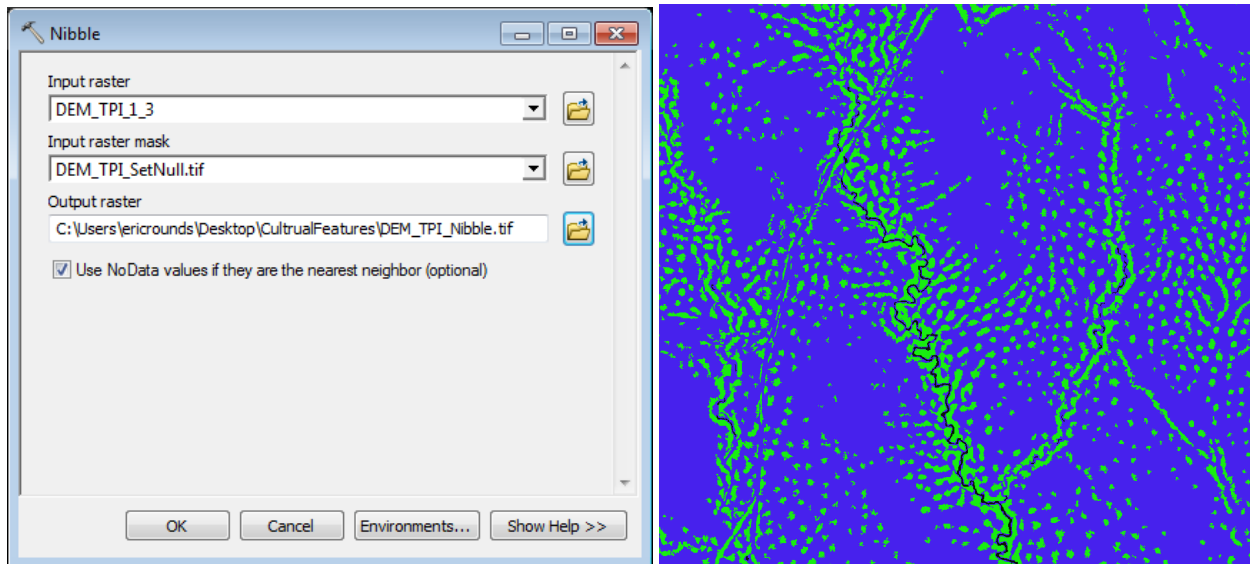


6. Next, open the **Set Null** tool (Spatial Analyst>Conditional).
7. Set the both Input conditional raster and the Input false raster or constant value fields as **DEM_TPI_Region.tif**.
8. Click the **SQL** button next to the Expression field and insert the following expression using the attribute names at the top and the mathematical operators.
"Count" <25
9. In the Output raster field, save the raster at **DEM_TPI_SetNull.tif** in the outputs folder (see graphic below).
10. Click **OK**.



- i. If you turn off other layers in the table of contents, you will see that many of the very small features have now been eliminated from the raster.

- ii. Use the identify tool to check the values of the white areas in the raster. They should read as NoData because they were features that had fewer than 25 pixels.
11. Finally you will use the Nibble tool to further refine the raster.
12. Navigate to the **Nibble** tool (Spatial Analyst>Generalization).
13. Set the input raster to **DEM_TPI_1_3.tif**.
14. Set the Input raster mask to **DEM_TPI_SetNull.tif**.
15. Save the output raster to your outputs folder and name it **DEM_TPI_Nibble.tif** (see graphic below). Click **OK**.

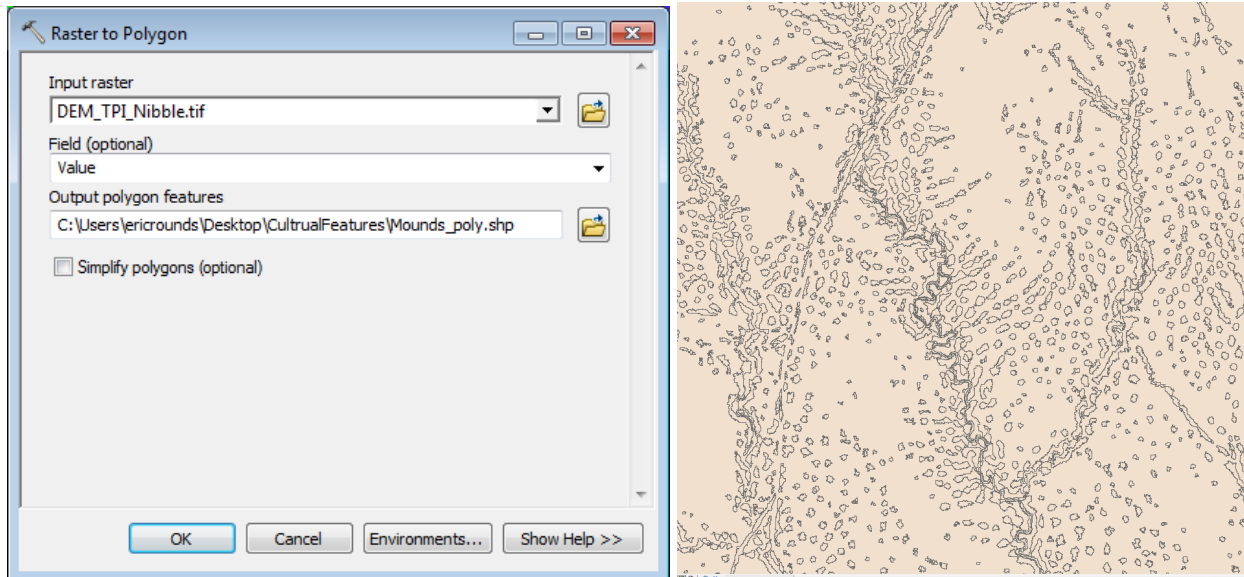


Part 4: Refine Mounds Polygons

Having generalized the raster results to a sufficient degree, it is now time to manually eliminate non-mounds features from a polygon shapefile using the Editor toolbar and Select By Attributes.

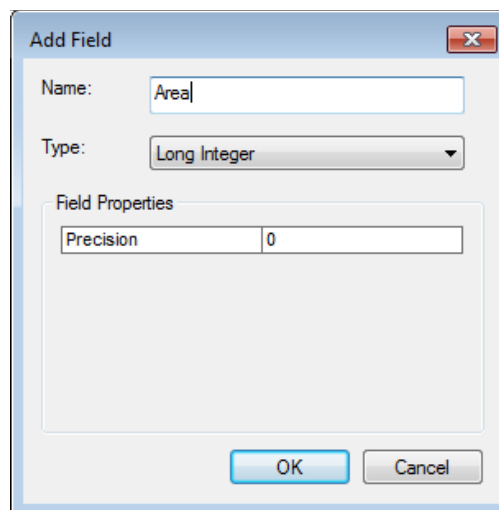
A. Raster to Polygon

1. Next you will convert the raster to polygons and eliminate select areas above and below a given threshold.
2. Navigate to the **Raster to Polygon** tool (Conversion Tools> From Raster).
3. Set the input raster to **DEM_TPI_Nibble.tif**.
4. Uncheck **Simplify polygons**. If you don't uncheck this box, the output will be "smoothed" in a way that does not preserve the cell edges of the input raster.
5. Save the output raster to the outputs folder and name it **Mounds_poly.shp** (see graphic below).



B. Add and Calculate Geometry for New Attribute Field

1. Before eliminating features, you need to create an attribute field that captures the area of polygons in your data.
2. In the Table of Contents, right click **Mounds_poly** and select **Open Attribute Table**
3. Click the **Table Options** dropdown at the top left of the window and click **Add Field**.
4. Name the field Area and change the Type to Long Integer (see graphic below). Click OK.



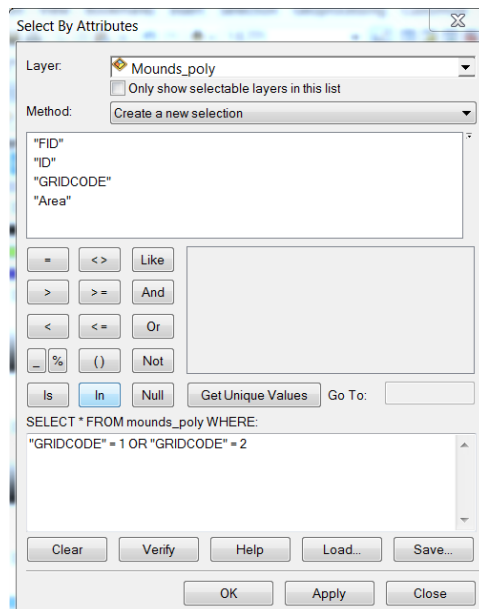
- i. Notice that an **Area** column is added to the right side of the Attribute Table.
5. Right click the **Area** column and click **Calculate Geometry**.
 - i. Click yes if prompted with a warning.
6. When the **Calculate Geometry** dialog box appears, select **Area** in the Property dropdown and **Square Meters [sq m]** in the Units dropdown.
7. Click **OK**. This will populate the Area field for every individual polygon.

8. Close the Attribute Table.

C. Eliminate Canyons and Slopes

Note: You are about to begin permanently changing the Mounds_poly shapefile. You can preserve the current state of this shapefile by exporting an additional copy of it (right-click, data, and export data). If you make any mistakes when deleting features, you can simply stop editing and not save the edits.

1. In the table of contents, right click **Mounds_poly** and select **Edit Feature** and **Start Editing**.
2. From the top menu of ArcMap, go to Selection and click **Select By Attributes**.
3. Ensure that the Layer is set to Mounds_poly.
4. Enter the expression below in the expression window:
 - i. "GRIDCODE" = 1 OR "GRIDCODE" = 2
 - ii. Note that if you used AND instead of OR in the expression, you would be searching for polygons that meet both parameters.

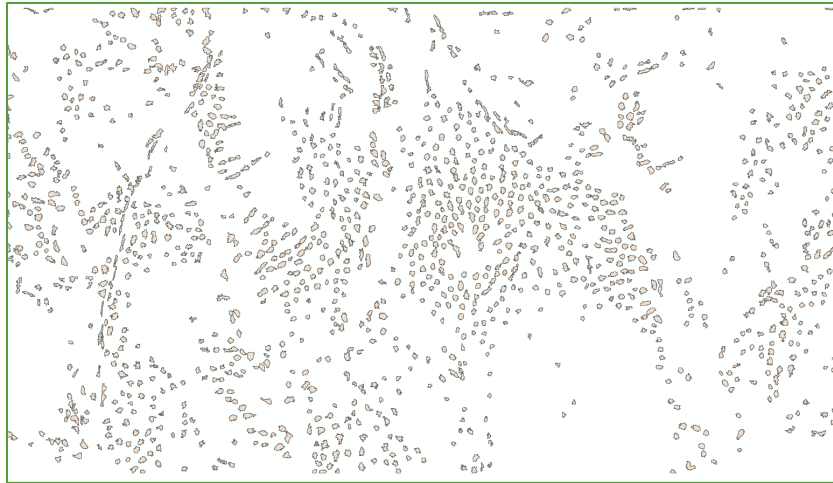


5. Click **OK** and notice that many features have been highlighted.
6. Press the **Delete** key on your keyboard.
 - i. This deletes the polygons that you earlier classified as Canyons and Slopes, thus leaving you with only the Mounds category. Turn off other layers in your TOC so that you are only displaying Mounds_poly.

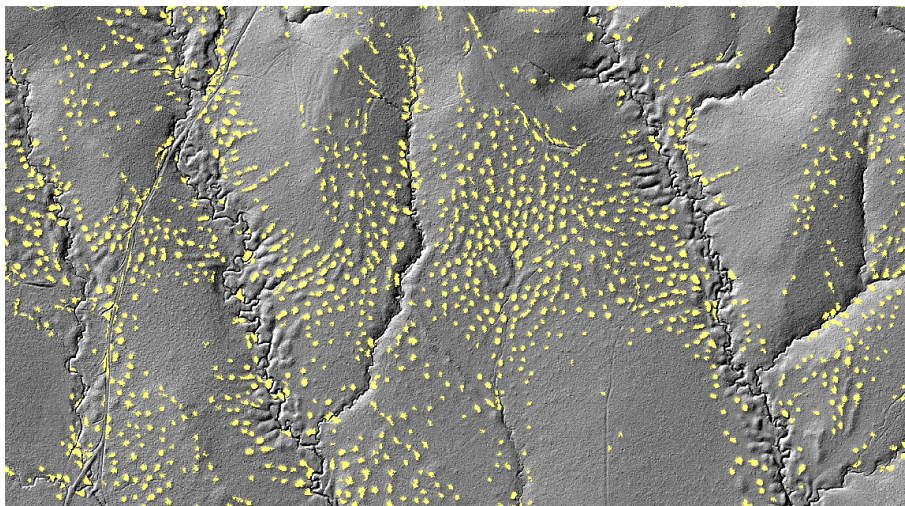
D. Set Maximum and Minimum Thresholds for Mounds

1. Click the **Select By Attributes** tool again and ensure that the Layer is set to Mounds_poly.
2. Clear the previous expression and enter the following expression:
 - i. "Area" >300 OR "Area" <60
 - ii. This selects areas greater than 300 square meters and areas less than 60 meters.
3. Press the **Delete** key on your keyboard.

4. Your results should look similar to the graphic below.



5. To save the edits you have made, click the **Editor** dropdown in the Editor Toolbar, click **Save Edits** and then **Stop Editing**. If you don't see the Editor toolbar, right click anywhere above the graphical interface and select Editor to turn on the toolbar.
6. In order to check how well this process has delineated mounds, turn on the **Hillshade_1meter.tif** in your table of contents and place the **Mounds_poly.shp** above it.
7. Click the Mounds layer on and off in order to see how the polygons line up with the mounds on the hillshade.
8. The majority of the mounds have been properly identified, but some polygons are still incorrect.
9. To further refine these results, you can apply the skills you just learned to identify different parameters that might exclude these longer, non-round polygons.



Congratulations! You have successfully completed this exercise. You are now acquainted with the Land Facet Corridor Tool and how it can be used to identify certain topographic features. You have also become adept at refining both raster and vector files to suit a specific objective.