# *Demo 06: Creating Vector Data*

In Lab 5, you will learn how to derive vector features from your growing raster dataset for your project area (by now including at minimum a georeferenced quad sheet, a Landsat MSS image, a Landsat ETM image, an aerial photograph and a SPOT image). The main output of this lab is a vector version of a raster soil map for your study area.

I. **First, prepare the demonstration data**
   a. Download and extract **Demo06_Data.zip**
   b. This contains a raster (jpg format) of soil map for each study area.
   c. The demo will use **Soils_NotreDame.jpg**.
   d. These jpeg maps should be georeferenced and display correctly, but if they do not, follow the process outlined in Lab 03.
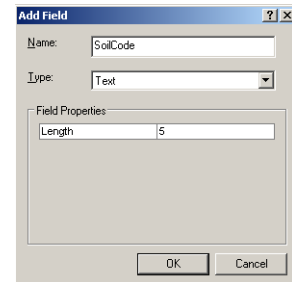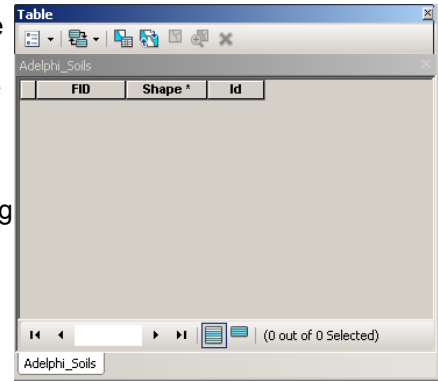II. **Creating Shapefiles**
   a. In order to digitize this soil map we must first create a shapefile to contain the new vector data.
   b. For this example, we also want to create a single feature representing the extent of this soil map. This will let us clip any features we make to the edges.
      1. This can be done either through the standalone program **ArcCatalog** or through the **Catalog** tab in ArcMap.
      2. The process is basically the same, so we will just use the easier **Catalog** Tab.
   c. First, open the Catalog Window either by clicking the catalog button (⬛) or going to **Windows → Catalog**
      1. This window can be docked or left floating just like Image Analysis
   d. The Catalog Window has the same basic choices as you have seen when adding or saving files.
   e. Go through **Folder Connections** to find your Lab 06 folder (on a drive for which you have write access)
   f. Once you have found the folder, right click on its name and choose **New → Shapefile**.
   g. This will bring up a new window in which you will select most of the important factors of your new shapefile.
      1. The **name** will be the file and layer name. Here, call it **NotreDame_Soils** This will be different for your study area, but make sure you include the soils part.
      2. For **Feature Type**, make sure you choose **Polygon.**
         i. Obviously, this would be different if you were making a point or polyline features.
      3. Click on the Edit button to set the Coordinate System.
         i. We will use our normal WGS 1984 UTM Zone 18N by going through **Select → Projected Coordinate Systems → UTM → WGS 1984 → Northern Hemisphere → WGS 1984 UTM Zone 16N.prj**
         ii. Alternatively, you could choose **Import** and navigate to a file that is already georeferenced to this system.
      4. Leave the res with the default values.
   h. Now repeat the process and make a shapefile called **NotreDame_Extent.**
   i. Both of these should have been automatically added to the Table of Contents. But because they are completely empty, there is nothing to see.
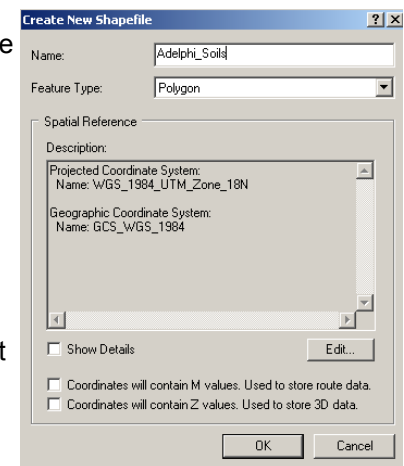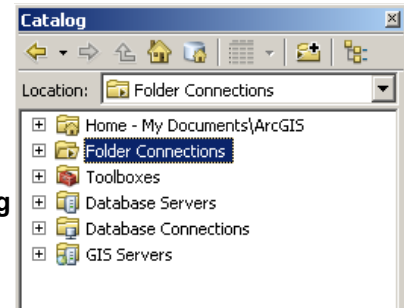
III. Adding Attribute Fields to Shapefiles
    a. One of the most important characteristics of vector files is the ability to store attribute data as well as the relationships between points
        1. For unique features, this field might include the name of a town, or a site designation;
        2. For features of varying classes, you can develop coding; for example, a track polyline shapefile might have a numeric field called "class" which could contain 0, 1, 2, or 3 for unclassified, dirt track, gravel track, or paved road, respectively.
    b. In this example, we want to create a field to represent the soil code displayed on the map (eg "W" or "CdP")
    c. You can also add more fields through ArcCatalog (right click on the shapefile name and choose properties), but we will do it in ArcMap only.
    d. In ArcMap, we add fields in the Attribute Table. Open this for **NotreDame_Soils** by right clicking on the layer name and choosing "**Open Attribute Table**"
        1. There are no features yet, but you can see the three system created fields (FID, Shape and ID) across the top.
        2. To add a new field click on the Table Options button (▤) and choose **Add Field.** This will bring up a new pop-up window
            i.   **NOTE**: If you are actively editing (see below) then it is impossible to add a new field, you will need to stop your editing session first. This is because of the way ArcGIS stores shapefiles and cannot be avoided.
           ii.   Give the new field a name. These have to be rather short and cannot contain spaces or special characters. It will warn you if there is a problem.
                a. Here call the field **SoilCode**
           iii. The Data Type field lets you select whether you want text, numeric or dates. The size of the numbers or text influences your choices as well.
                a. **Short Integer:** Numeric values without fractions (eg 1, 40, 23,098) between -32,768 and 32,767.
                b. **Long Integer:** Numeric values without fractions (eg 1, 40, 23,098) of almost any length. These take up more storage space and should only be used if necessary. Note that UTM coordinates would require a Long Integer.
                c. **Float:** Numeric values with fractions (eg 1.33, -1.09, 453, 222.122) with less than 7 digits
                d. **Double:** Numeric values with fractions (eg 1.33, -1.09, 453, 222.1232) of almost any length.
                e. **Text**: Names or other text.
                f. **Date**: Date stored in the format yyyy-mm-dd.
           iv. The choice of Data Type may then give you options about the size of the data
                a. **Short Integer** and **Long Integer**
                    1. **Precision** is the total the number of digits that can be stored in the field
                b. **Float** and **Double**
                    1. **Precision** is the total the number of digits that can be stored in the field
                    2. **Scale** is the number of decimal places
                        i. eg: Precision 5, Scale 3 = 23.654 or 123.32
                c. **Text**
                    1. **Length** is simply the number of characters possible
           v.   For our **SoilCode** field, choose **Text** with a length of **5** (3 would probably be OK, but a few extra characters are good just in case.
    e. Because **NotreDame_Extent** will just be one feature representing the extent we do not need to create any attribute field for this shapefile
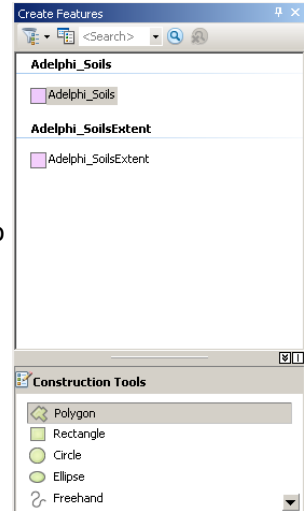
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IV. Creating Features
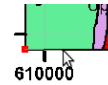   a.   In ArcMap you can only edit shapefiles in one folder at a time, thus occasionally you may be asked to choose which folder you want to activate.
   b.   To start editing a shapefile:
      1.   Right-click on the layer in the Table of Contents and choose **Edit Features → Start Editing**
      2.   Do this for **NotreDame_Extent** first.

      3.   This will activate both the **Editing Toolbar** and the **Create Features** Window
      4.   Then select the layer you want to edit in the top section of the **Create Features** window. In this case **NotreDame_Extent**
      5.   There are a series of templates available for feature creation in the bottom section called **Construction Tools**
         i.   Usually one wants to use the default **Polygon**, but this extent file is to be a simple rectangle of the outer extent of the soil map, so change it to **Rectangle**
      6.   When you move the cursor into the viewer you should see a cross with a rectangle under it.
      7.   Click on the bottom right corner to place the first vertex.
      8.   This will pop up **Feature Construction** toolbar. For now, just ignore it.
      9.   Now pan or zoom over to the bottom right corner and click to place the second vertex.
      10. Pan or zoom up to the top right corner and click. This should make a large polygon covering the entirety of the map.
      11. To save this feature got to **Editor → Save Edits**
      12. You may want to change the symbology to hollow (transparent) and with an obvious color boundary.
   c.   Before proceeding with editing **NotreDame_Soils** we will set some of the variables for our editing environment.
   1.   Selectable Features:
         i.   When creating polygon features for the soil types you will occasionally need to select one feature for processing. Because we do not want to run these analyses on the **NotreDame_Extent** we need to tell the program not to let us select the features in the **NotreDame_Extent** layer
         ii. To do this, first change the Table of Contents view from "List by Drawing Order" to "List by Selection"
         iii. Then click on the ( ) button next to NotreDame_Extent to disable selection for this layer.
         iv. You should take care to disable selection in layers you are not actively editing.
         v.   When done return to the **List by Drawing Order** view (the first button)
      2.   Snapping: This will make the cursor jump to nearby features, making smooth boarders.
         i.   This is important here so we have edges that match the extent we just made.
         ii. ArcGIS 10 has a new **Snapping Toolbar**, representing a major overall of the system
            a.   Activate this toolbar by clicking on the word **Editor** and choosing Snapping → Snapping Toolbar
            b.   You have a series of buttons and a dropdown menu
               1.   In the dropdown menu
                  i.   A check next to **Use Snapping** indicates that snapping is enabled
                  ii. **Intersection, Midpoint** and **Tangent Snapping** are more complicated types that we will not be using
   iii. A check next to **Snap to Sketch** means that the cursor will
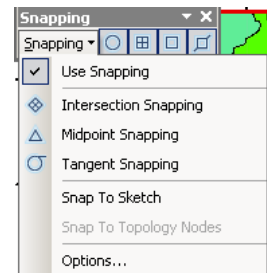
        snap to other vertices while you are drawing a feature. For now, leave this off, but we will experiment with it later.

    iv. **Options** opens a new window that lets you set the Tolerance (how close the cursor must be to snap) and the color and presence of pop up tips.

2. Each of the buttons on the toolbar enables/disables a different type of snapping

    i. **Point**: Ⓞ Snapping to point feature

    ii. **End**: ⊞ Snapping to the end of polyline features

    iii. **Vertex**: ☐ Snapping to any vertex, be it part of point, polyline or polygon.

    iv. **Edge**: ▱ Snapping to any edge, be it part of a polyline or polygon

    v. Here, we need to verify that Vertex and Edge are turned on. The other two do not matter as we have no point or polyline layers.

  c. I find this new system overly complicated and impossible to use for map documents with many layers.

iii. Fortunately, the old system, which lets you simply choose which layers to snap to, is still available

  a. You can enable it by choosing **Editor → Options** and enabling **Use Classic Snapping** on the General tab

  b. Now when you choose **Editor → Snapping** you have the option to display the **Snapping Window** where you can choose which layers will be snapped to.

  c. If you choose this option, enable both Vertex and Edge Snapping for **NotreDame_Extent**

d. We are now ready to digitize all of the features in the soil map

1. Verify that the Create Features window is visible and that NotreDame_Soils is selected in the top part and Polygon is selected in the bottom part.

2. Now, identify a feature from your soil map and create vectors outlining it. For these polygon features (also for polylines), double-click on the last point to indicate that the feature is completed.

    i. The completed feature will be selected (highlighted with cyan).

    ii. You may want to turn the layer transparent (Layer Properties → Display Tab) or Adjust its symbology to be hollow. This will let you see the underlying soil code.

    iii. Note that once the new feature is created, you may not be able to see the underlying soil types. To solve this problem, turn the soil feature layer partially transparent.

      a. Open the **Layer Properties** window for the soil layer and select the Display tab.

      b. In the **Transparent** box, type 50 (%).

      c. On the **Symbology** tab, it may be useful to increase the outline thickness to 2 or greater and change the outline color to something (such as primary red) which will stand out.

      d. Click OK to close the **Layer Properties** window.

      e. Alternatively you can give it a transparent Fill Color (as for **NotreDame_Extent**).

3. Adding attribute data

    i. Your newly created feature now has a shape but no underlying attribute data.

    ii. While the new feature is still selected, click the Feature Property Editor button (▤) on the Editor toolbar.

    iii. The Attributes of the selected feature will be shown as a new tab in the Create Features window

      a. I find it most useful to separate these two by dragging the tab out and leaving the Attributes window floating

    iv. The first two fields (FID and ID) are automatically set, but any other user-defined ones will be blank.

    v. Enter the relevant text into the blank area next to Soil Code.

    vi. You can leave the Attribute window open to the side as you create new features. The attributes of the selected feature(s) will always be visible in this window.

4. Saving your edit

    i. The new feature must be saved. To do this, select Save Edits from the Editor menu. It is not necessary to do this after creating each feature, but it is useful to get into the habit of saving your edits periodically.

    ii. Note that by selecting **Save Edits**, you are writing to the shapefile itself, rather than just making

changes to the layer's display or the map document. To save changes to the layer properties, save the entire map (**File → Save**).

V. **Tricks for Creating Polygon features**: There are several tricks or tips for creating polygon features that might save you time, especially if your polygon layer is continuous (e.g., soils, land use, vegetation classification, etc.).

   a. **Autocompleting a polygon**
      1. To create a feature which shares an edge with an existing feature, it is not necessary to duplicate the shared edge; the software can automatically do this, guaranteeing that the two features will abut each other precisely.
      2. Select **Auto-Complete Polygon** in the **Construction Tools** Section of the **Create Features** Window.
      3. Begin to draw the new feature from its intersection (edge or vertex) with the existing feature, then create vertices along the new feature. You can snap to that point, or you can overlap (see example to right).
      4. The final point of the polygon should be on or beyond the edge of the existing feature, and should be double-clicked.
      5. ArcMap should automatically close the polygon.
      6. For a layer such as a soils layer, where features are continuous, you will probably create the majority of the features using polygon auto-completion.
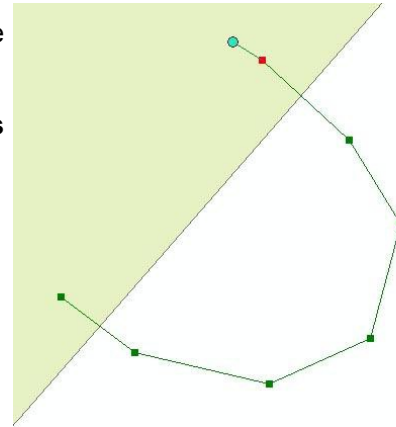
   b. **Cutting polygon features**
      1. Occasionally it is easier and more accurate to create a feature that encompasses several map features (soil areas) and then divide (cut) that feature into the discrete soil areas.
      2. Create (or Autocomplete) a polygon feature which includes several features (e.g., several soil zones, several contiguous fields).
      3. Select the feature to be cut
      4. Click on the **Cut Polygons Tool** ( ) in the Editing Toolbar.
      5. Draw a line across the feature to be cut. Your first and last point should be outside the selected feature. Double-click to finish.
      6. The feature will be cut, and the two new features will be selected. If the Attributes window is visible, note that both new features are listed, and can have their attributes updated at this time.
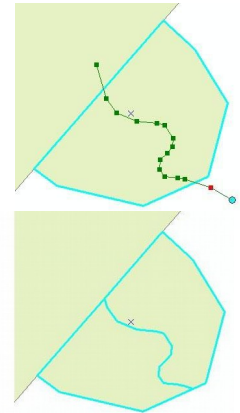
   c. **"Island" Polygons**
      1. Occasionally one feature will exist entirely within another. To deal with this:
         i.   Vectorize the larger (encompassing) area into a feature;
         ii.   Turn on **Snap to Sketch** in the Snapping menu of the Snapping Toolbar (see Section IV.C.2).
         iii. With the feature selected, again, click on the Cut Polygons Tool ( ) in the Editing Toolbar.
         iv.   Now vectorize the "island" feature (i.e., the donut hole);
         v.   Your final (double-clicked) vertex should be snapped to your first vertex to close the polygon; this is possible because Edit Sketch Vertices was checked in the Snapping Environment window
      2. As with cutting polygons, the two new features are selected and ready to have attribute data added.