2021 – ArcGIS Pro

Coordinate Systems and Editing with ArcGIS Pro

Warthog Information Services

Created by Stefan Freelan

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Introduction

Editing of spatial data is a key function of a GIS, both the creation of new features and updating of existing features. Likewise, editing of the attribute data that goes with the spatial features is also a key function of a GIS. A common method of editing is to digitize (i.e., manually trace on-screen) the location and shape of features using an air photo or a scanned map as the source imagery. For this exercise we will digitize features on Shaw Island using a USGS topo map DRG (Digital Raster Graphic) and an air photo. Before we begin editing, however, we'll spend a little time reviewing coordinate systems.

All GIS data (raster or vector) must have coordinates to locate the features or cells in the data set. These coordinates must be based on a *coordinate system*. A coordinate system is a defined unit of measurement and a point of origin. Common coordinate systems include latitude-longitude, UTM (Universal Transverse Mercator), and the State Plane Coordinate System (SPCS).

Coordinate systems are based on a "*datum*," or model of the earth. Most GIS are capable of working with multiple data layers that use different coordinate systems and/or datums and can still display the data so that things line up geographically. This is because the GIS can "re-project" or "transform" the data from one coordinate system and/or datum into the coordinate system being used by the map.

Latitude-longitude is a *spherical* coordinate system (based on lines curving around the earth). Most of the coordinate systems used in a GIS are *orthogonal* (flat or 2-dimensional) coordinate systems. Spherical coordinate systems are sometimes referred to as "geographic" coordinate systems, as opposed to "projected," or flat, coordinate systems.

When you insert a new map view, it uses what is known as the *WGS-1984 Web Mercator Auxiliary Sphere* coordinate system by default. This is a global coordinate system, based on the WGS-1984 (World Geodetic Survey of 1984) datum and is the same coordinate system that is used for the ESRI basemaps as well as common online mapping applications such as Google Maps and Bing Maps. WGS-1984 Web Mercator is a projected (flat) coordinate system that uses decimal degrees as the measurement unit.

Another global coordinate system is UTM (Universal Transverse Mercator) which is composed of 60 north-south "zones." Washington State is in UTM Zones 10 and 11 North. UTM uses meters as the default measurement unit, and typically the North American Datum of 1927 or 1983 (NAD-27, NAD-83).

In the United States, it is also common to find data that uses the State Plane Coordinate System (SPCS), a series of zones customized for each state. Washington state uses the Wa North or Wa South zone. SPCS uses either feet or meters as the measurement unit, and typically uses NAD-27 or NAD-83.

In ArcGIS Pro, each data layer has *Spatial Reference* properties which include the Coordinate System, the datum, and the linear unit of measurement (typically decimal degrees, meters or feet). In order for ArcGIS Pro to do the mathematical calculations necessary to convert data from one coordinate system to the other, the Spatial Reference for each of the data layers needs to be properly defined. When it is, ArcGIS Pro can re-project the data so that all of the different data layers line regardless of the coordinate system. This is not, however, always the case. The coordinate information for both the individual data layers and the map view can be accessed via the *Properties* dialog boxes.

All of this is important to consider before we create a new data layer for editing, as we want to be sure that our new data is compatible with existing data layers.

Exercise Learning Objectives

- Creating new features (within a feature class)
- Editing of existing spatial features
- Editing of attribute data
- Creating new, blank feature classes (within a geodatabase)
- Creating Metadata

Step 1: Create a Project and Add Data

Overview

For this exercise we will create a new ArcGIS Pro project within the ***Editing*** data folder. In the **Editing** folder are both vector and raster data layers (stored in the **ShawVector** geodatabase and the **ShawRaster** sub-folder, respectively). By default, newly created map views use the WGS-84 Web Mercator coordinate system. When the first piece of new data is added to the map view the coordinate system of the map is changed to match the coordinate system of the new data. For this exercise we will be using data that is stored in three different coordinate systems:

- Vector data (**SPCS, Wa-N, NAD-83**)
    - Coordinate System: State Plane Coordinate System, Washington North Zone
    - Datum: North American Datum of 1983
    - Measurement units: Feet

- A scanned USGS topo map (**UTM, 10-N, NAD-27**)
    - Coordinate System: Universal Transverse Mercator, Zone 10 North
    - Datum: North American Datum of 1927
    - Measurement units: Meters

- Aerial imagery (Basemap) (**Web Mercator, WGS-84**)
    - Coordinate System: Web Mercator
    - Datum: World Geodetic Survey of 1984
    - Measurement units: Meters (displayed as Decimal Degrees)

When we create new vector features, we want them to be in the same coordinate system (and datum) as our existing vector data (in this case SPCS, Wa-N, NAD-83). But the source data (the topo map and the aerial imagery) are in different coordinate systems. Because of ArcGIS Pro's ability to re-project data on-the-fly, we can combine all of these data layers in a single map view. To improve the editing process, we'll make sure that our map view is in the same units as our vector data (SPCS, Wa-N).

Before we begin editing, we'll experiment a little with different map views using different coordinate systems. To do this we'll need to create a new project and add some data layers.

Instructions

- Open ArcGIS Pro (logging in to your ArcGIS user account if required).
- Under New/Blank Templates, click *Map* (in earlier versions, *Blank*).
- In the Create a New Project dialog box, specify:

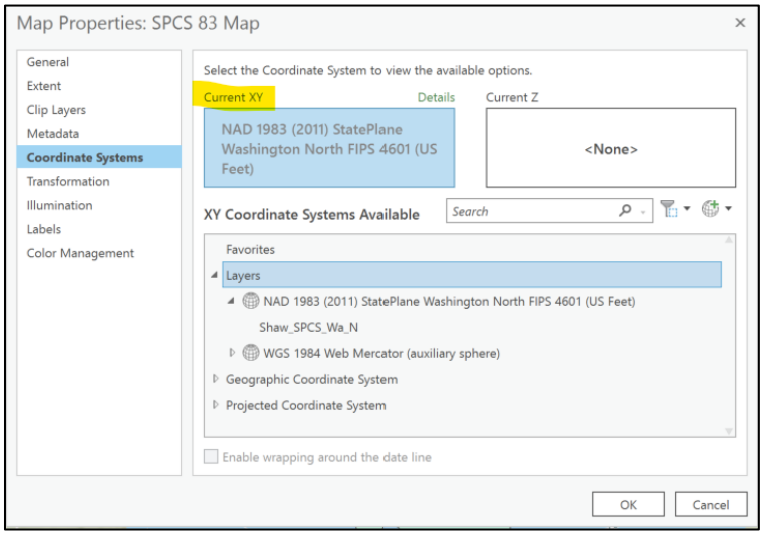
Name:	**Shaw_Island**	
Location:	<Browse to the **Editing** folder>	*(in the **Exercises** folder)*
Check the box:	**Create a new folder for this project**	

- Click *OK* to create a new project.

The file structure to your new project folder should look like this:

- <Course Data folder>
  - **Exercises**
    - **Editing** *(the exercise folder)*
      - **Shaw_Island** *(your new project folder)*
        - **Shaw_Island.gdb** *(the new project geodatabase)*
        - **Shaw_Island.aprx** *(the new project file)*
        - **Shaw_Island.tbx** *(the new project toolbox)*
      - **ShawRaster** *(a data folder with raster data)*
      - **ShawVector.gdb** *(a geodatabase w/vector data)*

- In the map Contents, right-click on the **Map** to open the map view *Properties*.
- Click the *General* tab and change the name of the map view: **SPCS 83 Map**.
- Click the *Coordinate Systems* tab to note that the *Current XY* coordinate system (as opposed to the Z or vertical coordinate system) is set to WGS 1984 Web Mercator (auxiliary sphere).



- Click *OK* to close the SPCS 83 Map Properties dialog box.

- In the Catalog pane, *Add a Folder Connection* to the **Editing** folder (in the **Exercises** folder).
- In the Catalog pane, expand the **Editing** folder and right-click on the **ShawVector.gdb** geodatabase to choose *+ Add to Project*.
- If you expand **Databases** (in the Catalog pane) you should now see two databases: the default project geodatabase (**Shaw_Island.gdb**) and the **ShawVector.gdb.**
- Add the **Shaw_SPCS** data layer to your **SPCS 83 Map** view by right-clicking on the **Shaw_SPCS** layer in the **ShawVector.gdb** and choosing *+Add to Current Map*.

  A polygon layer of Shaw Island should be added to the map view.

- In the map Contents, right-click on the **SPCS 83 Map** to re-open the map view *Properties.*

  Note that the Current XY Coordinate System should now be NAD 1983 (2011) StatePlane Washington North FIPS 4601 (US Feet). The first data layer that is added to a new map view establishes the coordinate system for the map view. (But you can always override this).

  The FIPS number is a federal ID for this particular State Plane Coordinate System.

- Click *OK* to close the Map Properties dialog box.
- Open the Layer Properties for the **Shaw_SPCS** layer and choose the *Source* tab. Note that the Spatial Reference is NAD 1983 State Plane Washington North.
- Click *OK* to close the Layer Properties dialog box.

- From the Insert tab of the ribbon, insert a *New Map*.
- Rename your newly add map view: **UTM 27 Map**.

  By default, the current coordinate system will be Web Mercator (you can verify this if you wish).

- In the Catalog pane, expand the **ShawRaster** folder (in the **Editing** folder).
- Right-click on the **shaw_drg.tif** file and choose *+Add to the Current Map*.

  A "DRG" is a "Digital Raster Graphic" – which is a scanned USGS topo map.

- Open the Properties for the **UTM 27 Map** view.
- In the Map Properties dialog box, click the *Coordinate Systems* tab.
  The Current XY Coordinate system should be NAD 1927 UTM Zone 10N.

- Click *OK* to close the Map Properties dialog box.
- Open the Layer Properties for the **shaw_drg.tif** layer and choose the *Source* tab. Note that the Spatial Reference is NAD 1927 UTM Zone 10N.
- Click *OK* to close the Layer Properties dialog box.

- In your **UTM 27 Map** view, zoom to the northern-most tip of Shaw Island (Broken Point). Hover your mouse over the tip of Broken Point.
- In the coordinates box at the bottom of the map view you can see the coordinates (of your current cursor location).

  The coordinates of the northern tip of Broken Point should be approximately:

  502,550 E
  5,382,275 N

  These units are in meters (measured from the origin of the UTM zone).

- Activate the **SPCS 83 Map** view and zoom to Broken Point to again determine the coordinates of the northern tip of Shaw Island. They should be approximately:

  1,126,35 E
  580,810 N

  These units are in feet (measured from the origin of the State Plane Coordinate System zone).

  Note how the same location on the two different map views is radically different depending upon which coordinate system is being used. Obviously, this could create problems if you were attempting to enter coordinates using the wrong coordinate system.

Since we'll be editing and creating new vector features, it makes more sense for us to use the **SPCS 83 Map** view, as this map uses the same coordinate system as our vector data.

- Close the **UTM 27 Map** view.
- Add the **shaw_drg.tif** topo map to the **SPCS 83 Map** view.

  By default, raster layers are added below polygon layers in the map view List by Drawing Order in the Contents pane.

- Turn the **Shaw_SPCS** layer On and Off to verify that the two layers line up properly (i.e., Broken Pt. on the topo map should line up with Broken Pt. on the vector layer).

  *The fact that the two layers now line up is due to ArcGIS Pro's ability to re-project a data layer on-the-fly. The **shaw_drg.tif** layer still uses UTM NAD 27 (10-N), but it is now being displayed in SPCS 83 (Wa. N).*

- Open the **SPCS 83 Map** view *Properties* one more time.
- Click the *Coordinate Systems* tab.

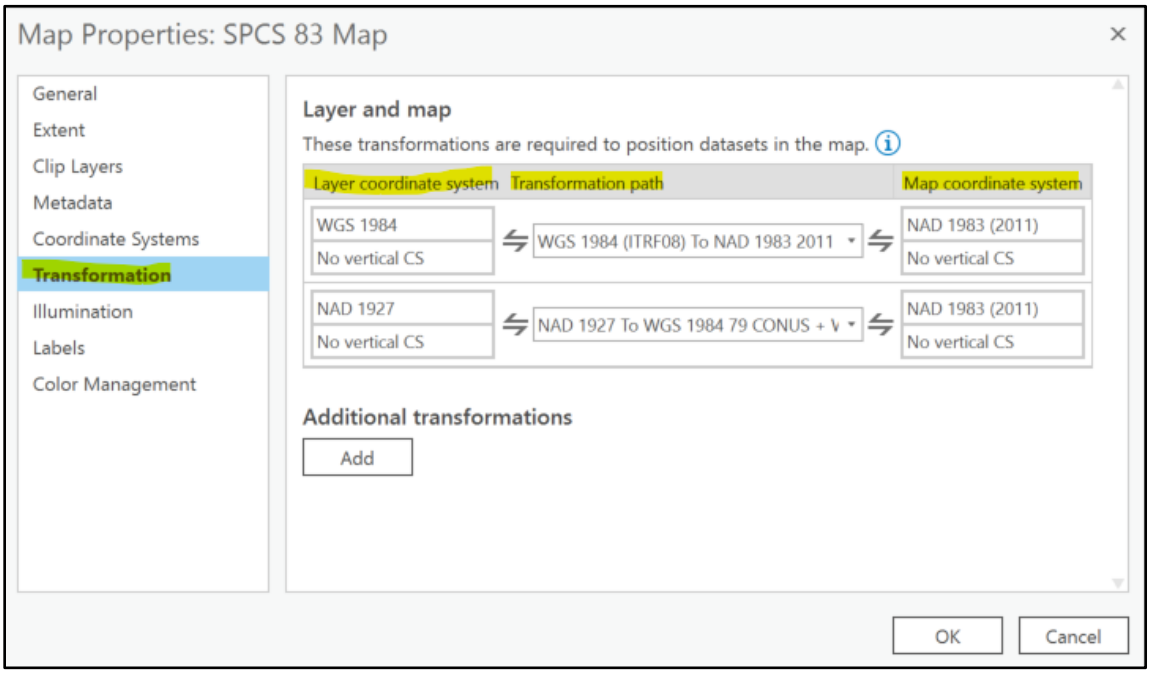
Note here that "Coordinate Systems" is plural, as there may be multiple coordinate systems used by different data layers in the map view.

In the *XY Coordinate Systems Available* box are listed the coordinates systems of the different data layers in the map (under Layers) as well as all of the available coordinate systems stored in ArcGIS Pro (listed under Geographic Coordinate Systems and Projected Coordinate Systems).

If you wanted to change the coordinate system for the Map you could select the coordinate system of one of the Layers in the map or from the list of available coordinate systems provided by ESRI.

- Still in the Map Properties dialog box, choose the *Transformation* tab.

Transformations are the mathematical calculations used to re-project data from one datum to another (which is a more complicated process than simply converting between two coordinate systems that use the same datum). The SPCS 83 Map view uses the NAD 1983 datum (listed on the right, under Map coordinate system). On the left (under Layer coordinate systems) are the WGS 1984 (the datum used by the ESSRI Basemaps, using Web Mercator) and NAD 1927 (the datum used by the topo map). In the middle section are the names of the Transformation paths being used. Note that the Transformation paths are drop-down menus allowing the choice of which transformation you wish to use. In this case, the default transformations being used are good choices.



Now that we have had a review of coordinate systems, let's begin the digitizing process.

- Click *OK* to close the Map Properties dialog box.

Step 2: Create (Digitize) New Features

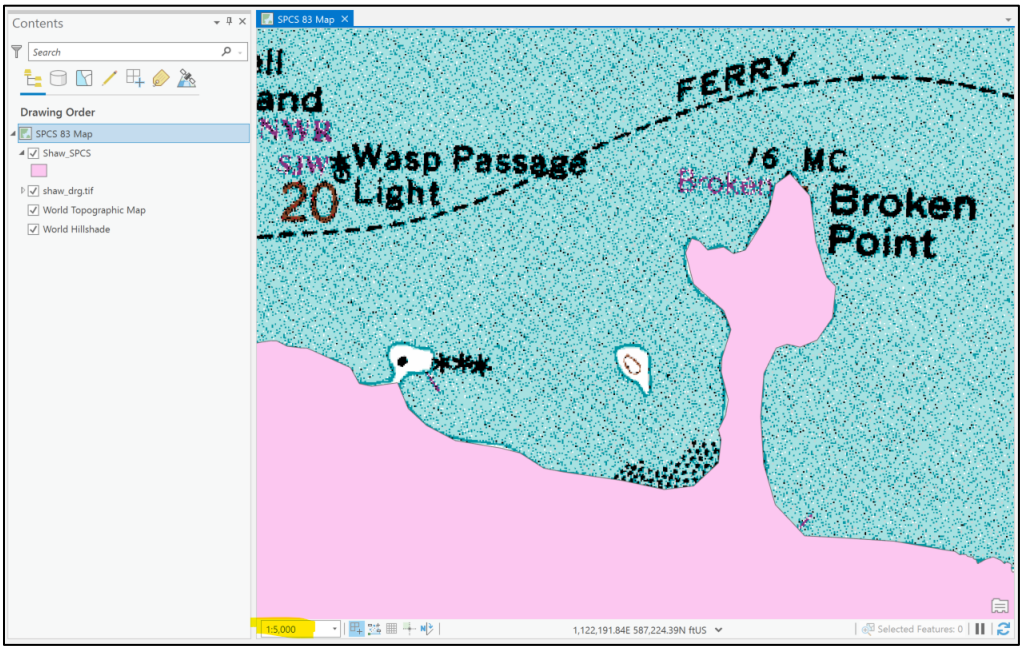
Overview

As an introduction to the editing tools in ArcGIS Pro we'll add a small rock / islet to the **Shaw_SPCS** data layer. We'll also modify the existing shoreline to include a small isthmus that is missing. We'll use the USGS topo map (**shaw_drg.tif**) as our reference data for these edits.

In ArcGIS Pro you can edit features at any point (unlike in ArcMap where you had to start an 'Edit Session' before you could add or modify features). Edits are temporary until you Save your edits, allowing you to Undo or to Discard your edits if need be.

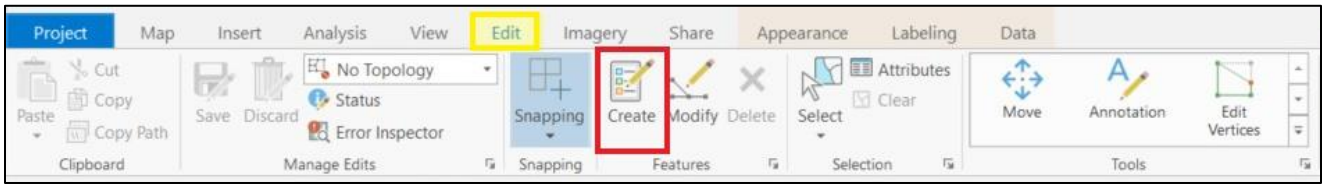
Instructions

- In the **SPCS 83 Map** view, zoom in to the area just west of Broken Point (to a map scale of approximately 1:5,000). You can view the map scale in the lower left corner of the map view.



Note that the small rock islet to the west of Broken point is missing from the **Shaw_SPCS** layer.

- From the Edit tab of the ribbon, click the *Create* tool.



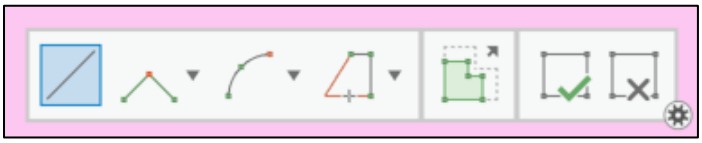
The Create Features pane should open.

- In the Create Features pane, click **Shaw_SPCS**

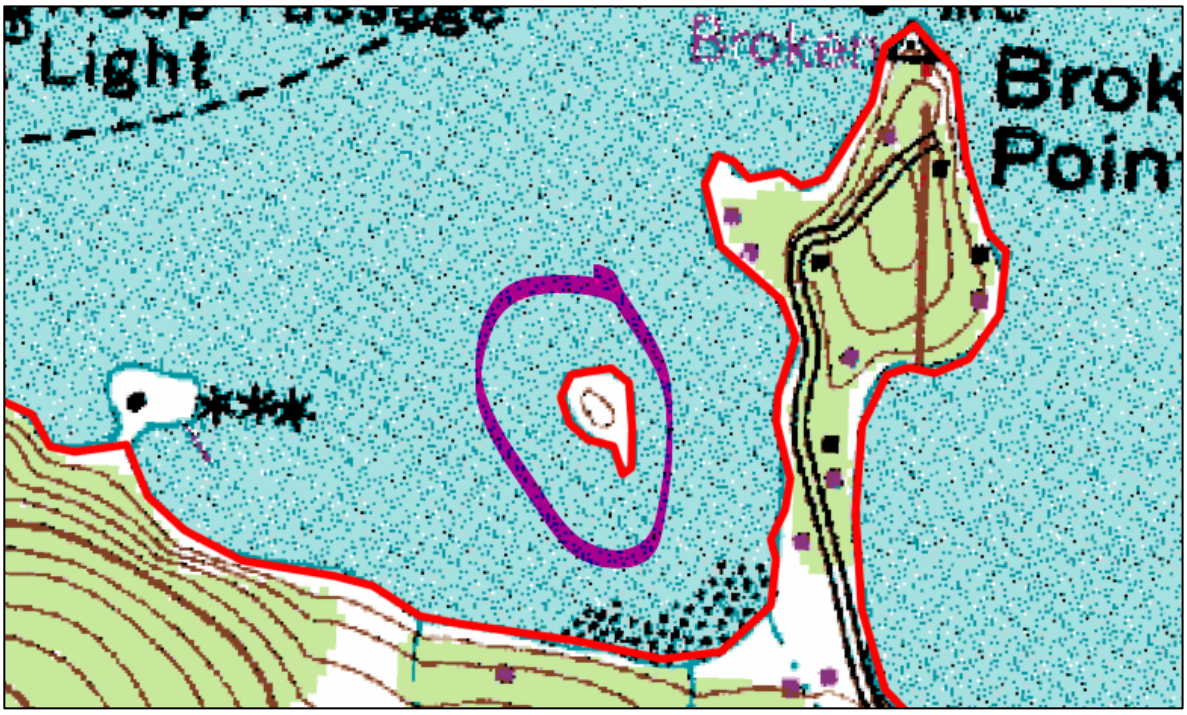
  If we had multiple vector data layers in the map view, we would need to specify which data layer we wanted to add a feature to. In this case, there is only one vector layer so there is only one choice.

- In the Create Features pane, below **Shaw_SPCS**, choose the *Polygon* tool.

  Note that when you select an editing tool (create Polygon in our case), a new editing toolbar appears on the map view.

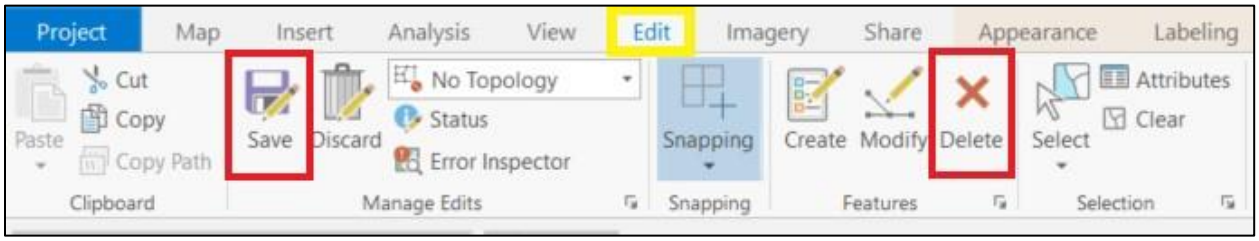


- With the create Polygon tool selected, click once on a point along the shoreline of the small islet to create the first vertex of a shore polygon (it does not matter where you start).
- Continue clicking along the shore to create more vertices creating an islet polygon. The more vertices you add, the more detailed your shoreline can be.
- Double click on the last shoreline vertex to create the polygon, closing the loop from the first vertex to the last vertex. The completed polygon will be selected once you finish it.
- Change the symbology for the **Shaw_SPCS** layer so that it uses a hollow/transparent (No Color) fill and a bold, red outline, allowing you to see the DRG below the land polygons.



- If you are not happy with the way your islet polygon turned out, you can delete it and start again. (You could also modify it, which we'll do in a moment.)

- To delete a feature, select it using the Select tool from the Edit tab of the ribbon.
- With the feature selected, click Delete from the Edit ribbon.



- When you are done editing the feature, click the *Finish* icon (the check mark icon) on the pop-up editing toolbar.
- Click the *Save* button in the ribbon to save your edits.

Step 3: Modify an Existing Feature

Overview

Using the Edit Vertices tool, we can modify the geometry of a feature. First, we'll adjust the shoreline of the islet we just created, then we'll add a missing isthmus to the shoreline of Shaw Island.

Instructions

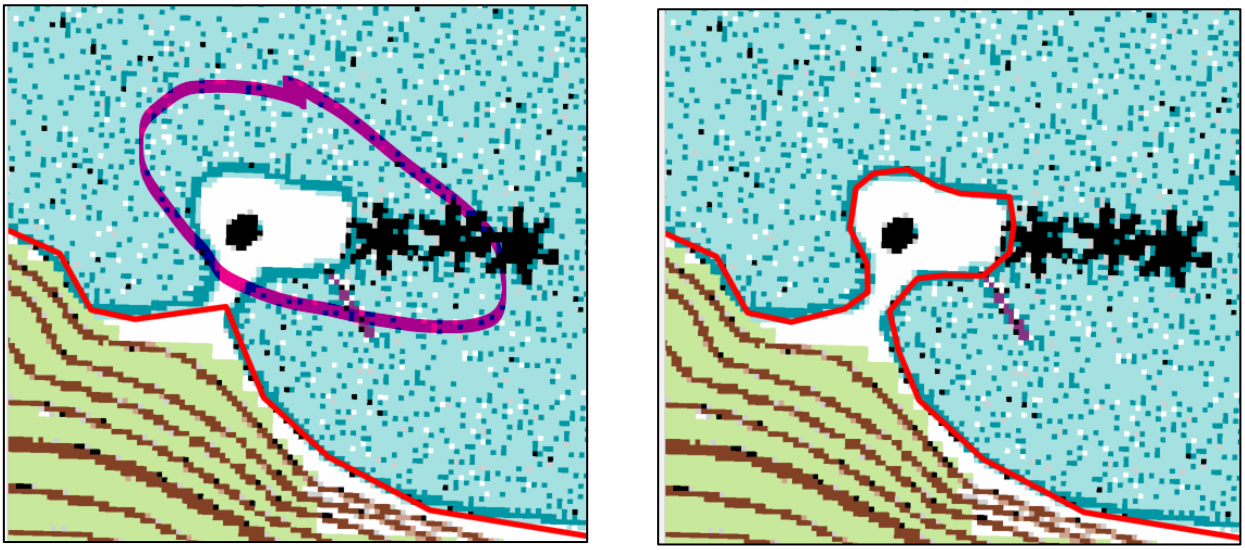
- Using the Select tool from the Edit tab of the ribbon, select your newly created Islet feature.
- Zoom in further so you can see the individual vertices. The more vertices that are used in creating a curved polygon the smoother the line will appear when zoomed out.
- With the feature selected click the *Edit Vertices* tool from the Edit ribbon.

    - The vertices of the polygons should be shown as boxes along the line.
    - The last vertex of the polygon is shown in red.
    - The coordinates of the vertices are listed in the Modify Features pane.
    - Click and drag a vertex to reposition it. (You may want to zoom in even more for this)
    - Right-click on the line to Add Vertex.
    - Reposition newly added vertices as needed.
    - Right-click on a vertex to Delete Vertex.

    There are also Add and Delete vertex buttons on the pop-up editing toolbar.

- Add, Delete or Move vertices to reshape the polygon as desired...
- You can also move a feature, using the Move tool from the Edit tab of the ribbon…

Once you have the shoreline of the new islet adjusted to your liking, zoom out a bit again so you can see the small isthmus to the west of our new islet. We'll modify the shoreline of Shaw Island so that it includes this small peninsula. You may want to zoom it to just the area of the isthmus.



The Shaw Island shoreline before editing. And after editing.

- Using the Select tool from the Edit tab of the ribbon, click on Shaw Island to select the feature.
- With the Shaw Island feature selected click the *Edit Vertices* tool from the Edit ribbon.
    - Click and drag the northern vertex to reposition it further out on the peninsula.
    - Right-click along the shoreline line to choose Add Vertex.
    - Reposition your newly added vertex to an appropriate location along the shoreline.
    - Continue adding and positioning vertices to create the isthmus geography.

    There are also Add and Delete vertex buttons on the pop-up editing toolbar.

- When you are done editing the feature, click the *Finish* icon (the check mark icon) on the pop-up editing toolbar.

- Click the *Save* button on the Edit tab of the ribbon.

Step 4: Edit Attributes

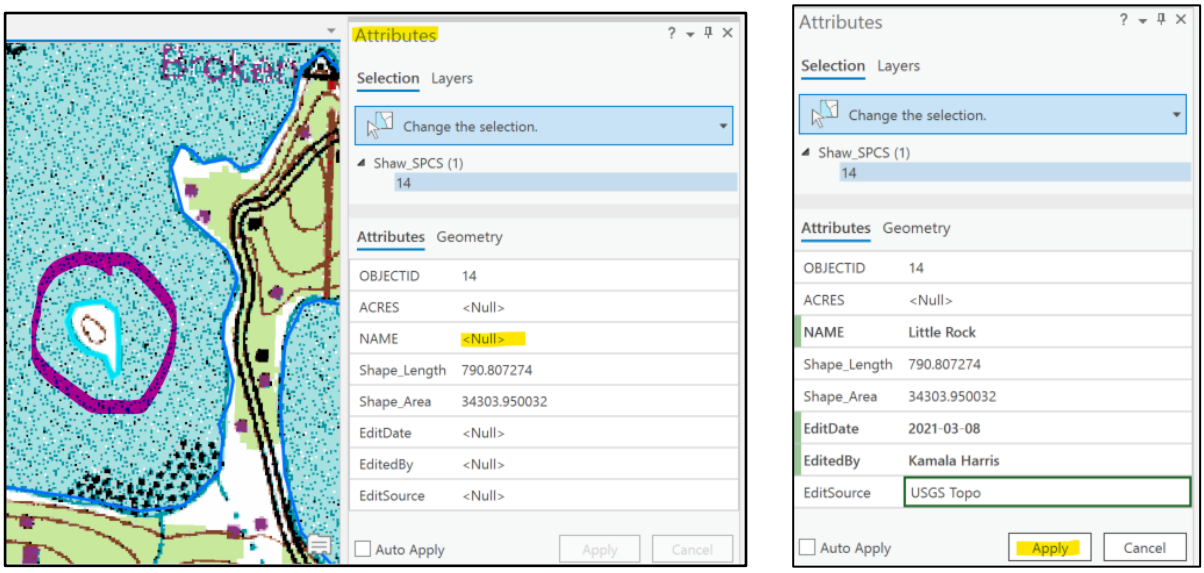
Overview

Having created a new feature, we also need to enter any attribute data for the new feature. We can do this from the Attribute Table or via the Attributes pane.

Instructions

- Using the Select tool from the Edit tab of the ribbon, select your newly created Islet feature.
- With the feature selected, click the *Attributes* button on the Edit tab of the ribbon to open the Attributes pane.

  The attributes pane displays a subset of the attribute table, with just the attributes for the selected feature shown.



The Attribute Pane before editing. And after Editing.

Note that the OBJECTID, Shape_Length and Shape_Area fields already have values. The OBJECTID is an auto-generated ID number for each feature. The Shape_Length and Shape_Area fields are automatically updated each time a new feature is added or modified. The units for the Shape_Length and Shape_Area fields are in the units of the data layer's coordinate system (which are feet in this case since the **Shaw_SPCS** layer uses SPCS Wa-N Feet).

- In the Attributes pane, click in the box beside the NAME field and make up a name for your new little islet (we don't know if it actually has a name or not, so you can use your imagination).
- Likewise enter today's date for the EditDate field, your name for the EditedBy field and "USGS Topo" for the EditSource field.
- Click the *Apply* button.
- Click the *Save* button from the Edit tab of the ribbon.

There is also a field for ACRES, but it did not get automatically calculated. This is because geodatabase feature classes only update the Shape_Length and Shape_Area fields. One option for adding the acreage would be to convert the number of square feet (from the Shape_Area field) to acres and manually enter this number. A better option is to use the Calculate Geometry tool. To use this tool we'll open the attribute table.

- In the map Contents, right-click on the **Shaw_SPCS** layer to click Attribute Table.
- In the **Shaw_SPCS** table view, verify that your new feature is still selected and that your name and edit information attributes were saved.
- At the top of the table view, right-click on the ACRES column header to click *Calculate Geometry*.
- In the Calculate Geometry dialog:

Input Features:	**Shaw_SPCS**
Target Field:	**ACRES**
Property:	**Area** *(from drop-down menu)*
Area Unit:	**Acres** *(from drop-down menu)*
Coordinate System:	**<**Choose **Shaw_SPCS** from the drop-down menu to enter the details for **NAD_1983_2011_StatePlane_Washington_North**>

- Click *OK*.

  Attribute edits can also be made by typing directly into the attribute table.

  If you have a number of features that all need to have the same value (such as the EditDate for a batch of edits that have been made) you could select multiple records in the table and then right-click on a field header to choose Calculate Field. The Calculate Field tool will enter data into the specified field for all of the selected records.

- From either the attribute table or the Attribute pane you can also update the attribute data for the Shaw Island polygon, again entering your name, the date and "USGS Topo" for the source.

- Click *Save* from the Edit tab of the ribbon.

  Data edits made via a tool (i.e., Calculate Geometry or Calculate Field) are automatically saved. Edits that are made manually to the attribute table or via the Attribute pane need to be saved, similar to spatial edits.

Step 5: Create New Feature Class

Overview

Sometimes we need to create a new feature class prior to adding new features. This might be because the feature class does not exist at all, or because we want to keep the newly created data separate for some reason (such as awaiting approval or because we don't have edit rights to the existing layer).

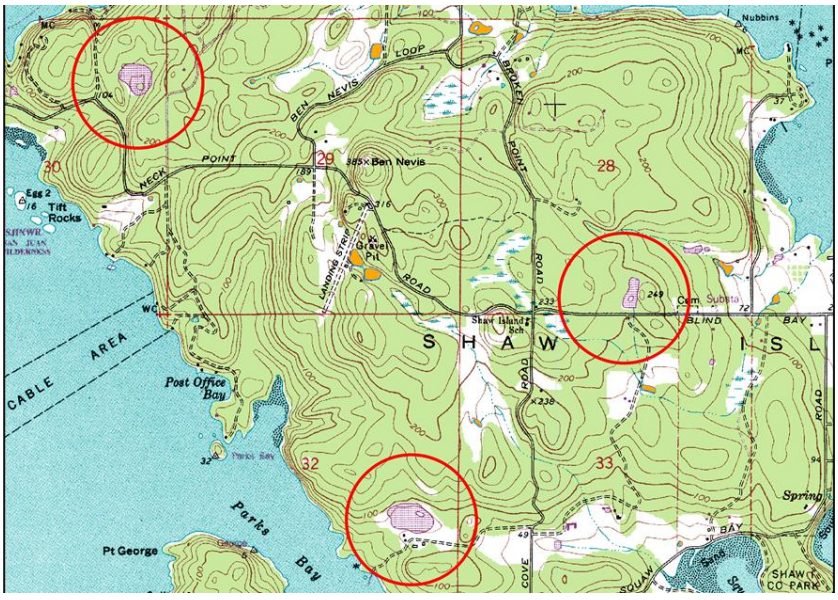
For this portion of the exercise, we'll be creating a series of new lake features that are missing from the existing lakes layer. We'll digitize these new features in a newly created feature class using the USGS topo as our reference source. First, we need to determine what we want to digitize by comparing the **shaw_drg.tif** layer the **Shaw_Lakes_SPCS** layer to see which lakes are missing.

When creating a new feature class, we will need specify the type of data (point, line, or polygon) and the coordinate system to be used. One way of selecting a coordinate system is to import the system from a dataset that already exists. This ensures that the coordinate system of our new data will match our existing data.

Instructions

- Add the **Shaw_Lakes_SPCS** layer from the **ShawVector.gdb** (in the **Editing** folder).
- **Shaw_Lakes_SPCS** also uses State Plane, Wa-North, matching the **Shaw_SPCS** layer.
- Turn Off the **Shaw_SPCS** layer.
- Adjust the symbology of **Shaw_Lakes_SPCS** to something that will show up well on top of the .drg (in the graphic below the lakes are orange).

You will note that some of the lakes shown on the .drg are not included in the **Shaw_Lakes_SPCS** layer. In the example below, some of the missing lakes are circled.



If you turn Off the **Shaw_Lakes_SPCS** layer you will see that some of the lakes on the topo map are blue while others are purple. The color purple on a USGS topo map indicates a feature that has been recently updated or added to the map. Some of these lakes are likewise missing from our lakes layer. Rather than adding these missing lakes to the existing **Shaw_Lakes_SPCS** layer we will create a new layer for just the new lakes.

- From the Analysis tab of the ribbon click the *Tools* button to open the Geoprocessing pane.
- From the Geoprocessing pane, search for and open the *Create Feature Class* tool (Data Management Tools).
- In the Create Feature Class pane, specify the following parameters:

Feature Class Location:	**Shaw_Island.gdb**	*(the default project geodatabase)*
Feature Class Name:	**New_Lakes**	
Geometry Type:	**Polygon**	
Template Dataset:	**(blank)**	
Has M:	**No**	*(we are not using Linear measurements)*
Has Z:	**No**	*(we will not be using Z or elevation units)*
Coordinate System:	<From the drop-down list, choose **Shaw_SPCS,** which will input **NAD_1983_StatePlane_Washington**>	
Feature Class Alias:	**(leave blank)**	

- Click *Run*.

  Note that you can also create a new feature class by right-clicking on a geodatabase in the Catalog pane and clicking New/Feature Class, which opens a dialog box for the same process, but where the parameters are instead a series of steps.

Step 6: Add Attribute Fields to New Feature Class

Overview

In the map view Contents you will note that the newly created **New_Lakes** layer is added to the map view. There are no polygons in the new layer, so nothing is added to the map itself, but the feature class is now available for editing. Before we begin, however, we will add some attribute fields. When creating a new field in a table you need to specify the type of field (text, numerical, etc.) and the size of the field (number of characters or digits).

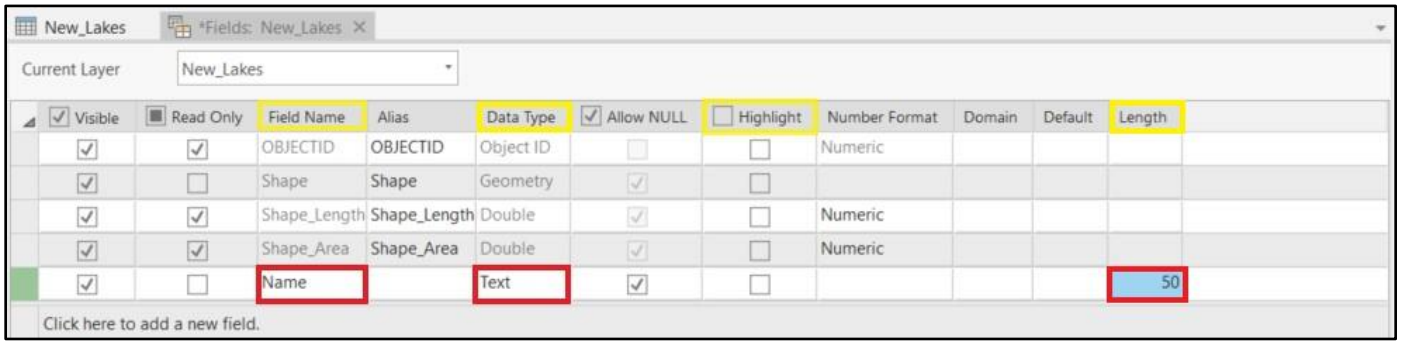
Instructions

- In the Contents pane, open the attribute table for the **New_Lakes** layer.
  At this point there are no features in the layer so the table should be empty (no records).
- At the top of the table pane, click the *Add* button.

  A second table / view, labeled *Fields: New_Lakes* should open.

- In the Fields view, click into the bottom box under the Field Name column.
- Enter *Name* for the Field Name of the new field.
- Under Data Type, choose *Text* from the drop-down menu.
- For Length, change the value to *50* (50 characters should be big enough for lake names and smaller fields require less storage space).

Optional: check the Highlight box to highlight the new field in the attribute table view.



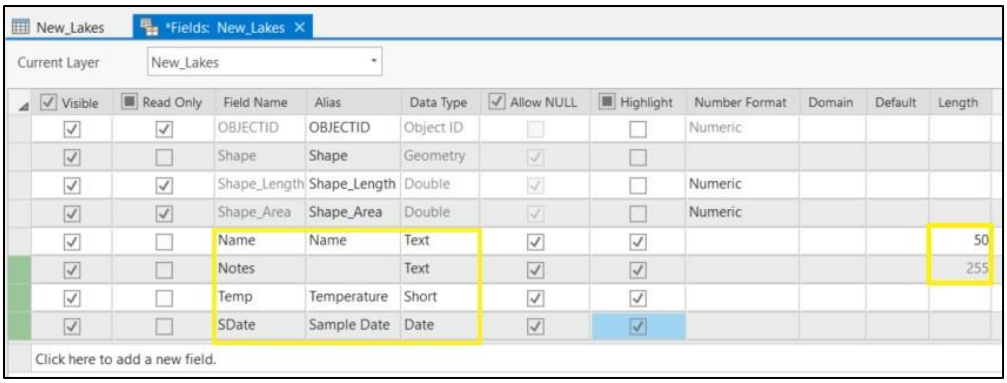
- Click the "Click here to add a new field" option at the bottom of the Fields table.
- Repeat the process of defining a new field to create three more new fields:

Field Name: **Notes**
Data Type: **Text**
Length: **255**

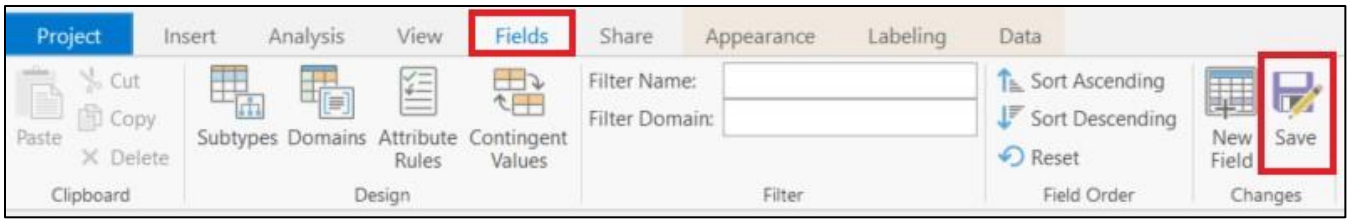
Field Name: **Temp**
Alias: **Temperature**
Data Type: **Short** *(for Short Integers)*

Field Name: **SDate**
Alias: **Sample Date**
Data Type: **Date**

As with the names of data sets (and data folders), there are reasons to keep field names short and to not use spaces in the field names. Add an Alias for a more descriptive display name.



- Once you have typed in all the field settings, click Save from the Fields tab of the ribbon.

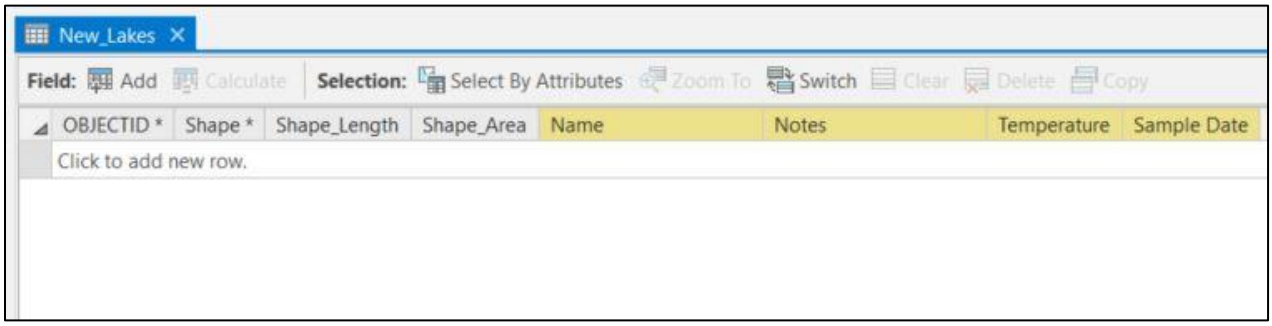


Until the changes to the Fields table are Saved, they cannot be used.

Note that there is also a New Field tool in the Fields tab of the ribbon as well. This will also open the Fields view.

- Close the Fields: New_Lakes view.

- In the **New_Lakes** layer attribute table, you will note that the table now has 4 new fields (still empty, but now available to be "filled").



The common choices for types of field are:

- *Text*
- *Short Integers (whole numbers +/- 32,000)*
- *Long Integers (whole numbers +/- 2,000,000)*
- *Float (big decimals numbers: 4 bit, single precision)*
- *Double (bigger decimal numbers: 8 bit, double precision)*
- *Date (the default format is mm/dd/yyyy hh:mm:ss)*

With number fields, you can also open the numeric field properties to specify the type of number (percent vs. currency, etc.) as well as the number of decimal places, the optional use of commas, etc.

Part of the decision regarding different types of number field is the storage size. Short Integers require the least storage, Double's the most. But that is rarely a big concern anymore and the typical recommendation is to use Long Integers (if you don't need decimals) or Doubles (if you do).

Step 7: Digitize New Lake Features Using Aerial Imagery

Overview

Now that we have prepared our new feature class, we will use the same editing tools that we used for island shorelines to create some of the missing lakes. To start with we will use the .drg layer as a reference, then we will digitize more lakes using aerial imagery (i.e., an air photo or satellite image).

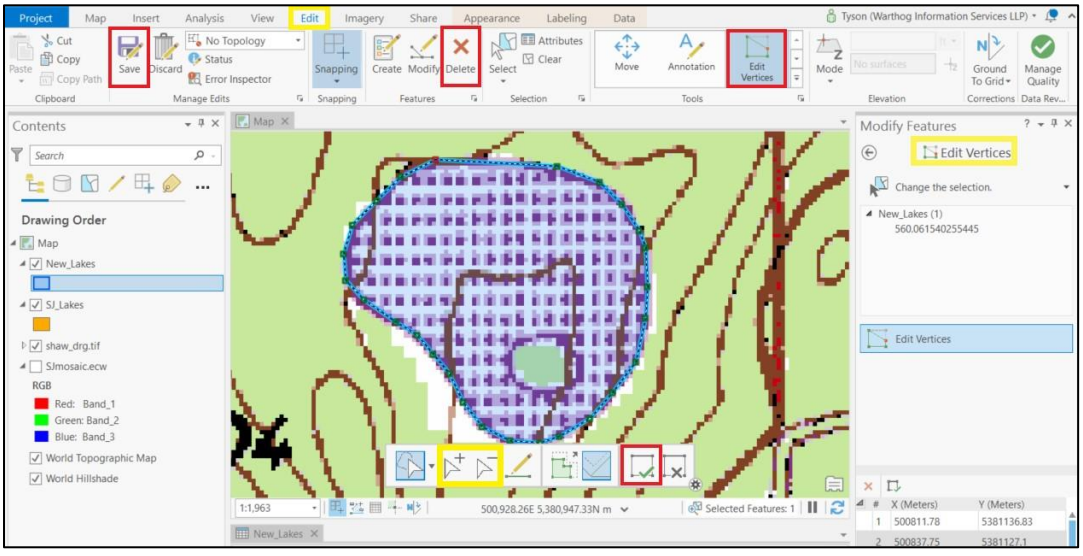
Instructions

- In the map view, zoom in to one of the lakes on the DRG image that is missing from the **SJ_Lakes** layer (the graphic below uses the western-most lake, south of Crane Island).
- From the Edit tab in the ribbon, click the *Create* tool.
- In the Create Features pane, click **New_Lakes**.
  Now that there are multiple vector data layers in the map view you need to specify which one.

- In the Create Features pane, below **New_Lakes**, choose the *Polygon* tool.
- With the create Polygon tool selected, click once on a point along the shoreline of the lake to create the first vertex of a lake polygon and continue clicking along the shore.
  If your chosen lake has an island, ignore the island for now.

- Double click on the last shoreline vertex to finish the lake, closing and selecting the polygon.
- You can also click the *Finish* icon (the check mark icon) on the pop-up editing toolbar.
- Change the symbology for the **New_Lakes** layer so that it uses a semi-transparent fill and a bold, blue outline, allowing you to see the DRG below the lake.
  Use a semi-transparent fill, not a hollow fill, so that we can still see the lake itself.

- If want to you can modify your lake or you can delete it and start again.
- Click the *Save* button from the Edit tab of the ribbon.



- If it is not still open, open the attribute table for the **New_Lakes** layer via the Contents pane.
- While the lake is selected, click the *Name* field in the attribute *table* to add a name for your lake. You can name it anything you want.
- Likewise, add any Notes. Perhaps your name as the person who digitized the feature.
- We do not know the temperature of the lake, but we have a Temperature and Sample Date field available for the next time we visit Shaw Island for water quality sampling. For now, you can make up a temperature and use today's date. Adding a date will give you an idea of how a Date field varies from a regular text field (the **Shaw_SPCS** layer used a text field for the EditDate).

  What happens if you try to type letters into the Temperature field?

- Close the **New_Lakes** attribute table.

Now we'll digitize another lake using aerial imagery instead of the topo map.

- In the Contents pane, turn the **shaw_drg.tif** Off.
- From the Map tab of the ribbon, click the drop-down menu below *Basemap* and choose the Imagery basemap.

  ESRI Basemaps are served online. The Imagery basemap is a mosaic of air photos and satellite images.

Your lake polygon probably does not match the air photo. This is because the DRG was created using a different data source than this air photo – and from a different time. The lake may have changed, or one of the data sources may be better than the other. Which do you think is better?

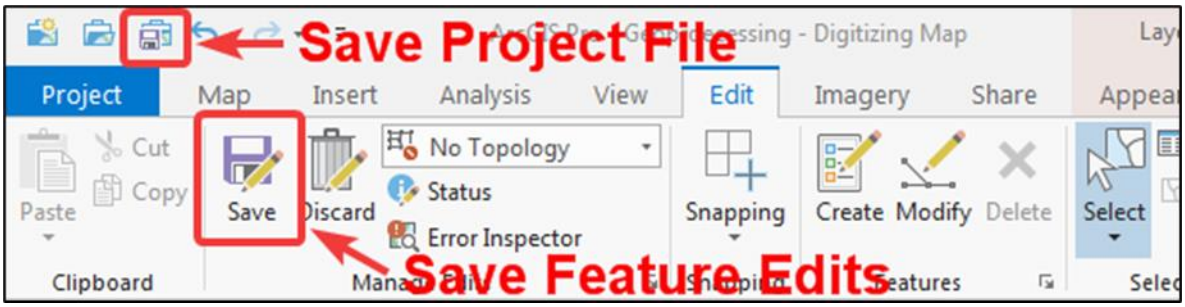
An example of the lake, with newly created polygon compared to the Imagery basemap.

- Turn the DRG back On and pan/zoom to another one of the missing lakes.
- Repeat the same process of digitizing to create polygons for another missing lake or two, this time using the aerial imagery as the reference source.
- In the Attribute table, enter the values for Name, Notes, Temperature, and Date fields (or you can leave them blank). Remember that you can also access the Attributes pane from the Attributes button on the Edit tab of the ribbon.

  Optionally, you can compare the vertices of your lake polygons with the topo map.

- Once you have completed the digitizing process and filled in all the attribute fields, click the **Save** button on the Edit tab of ribbon to save your edits (spatial and tabular).

- Then click *Save* from the Quick Access Toolbar to save your .aprx project file.



Step 8: Cutting a Hole from a Polygon

Overview

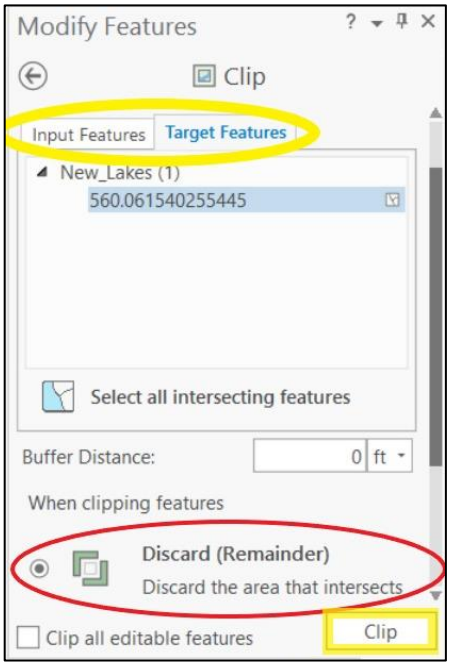
As you may have noticed, many of these lakes have small islands within them. Since the feature layer is "Lakes" (and not "Islands"), we need to remove the areas that are islands from the lakes. We can remove these islands from the lake polygons using additional editing tools.

Instructions

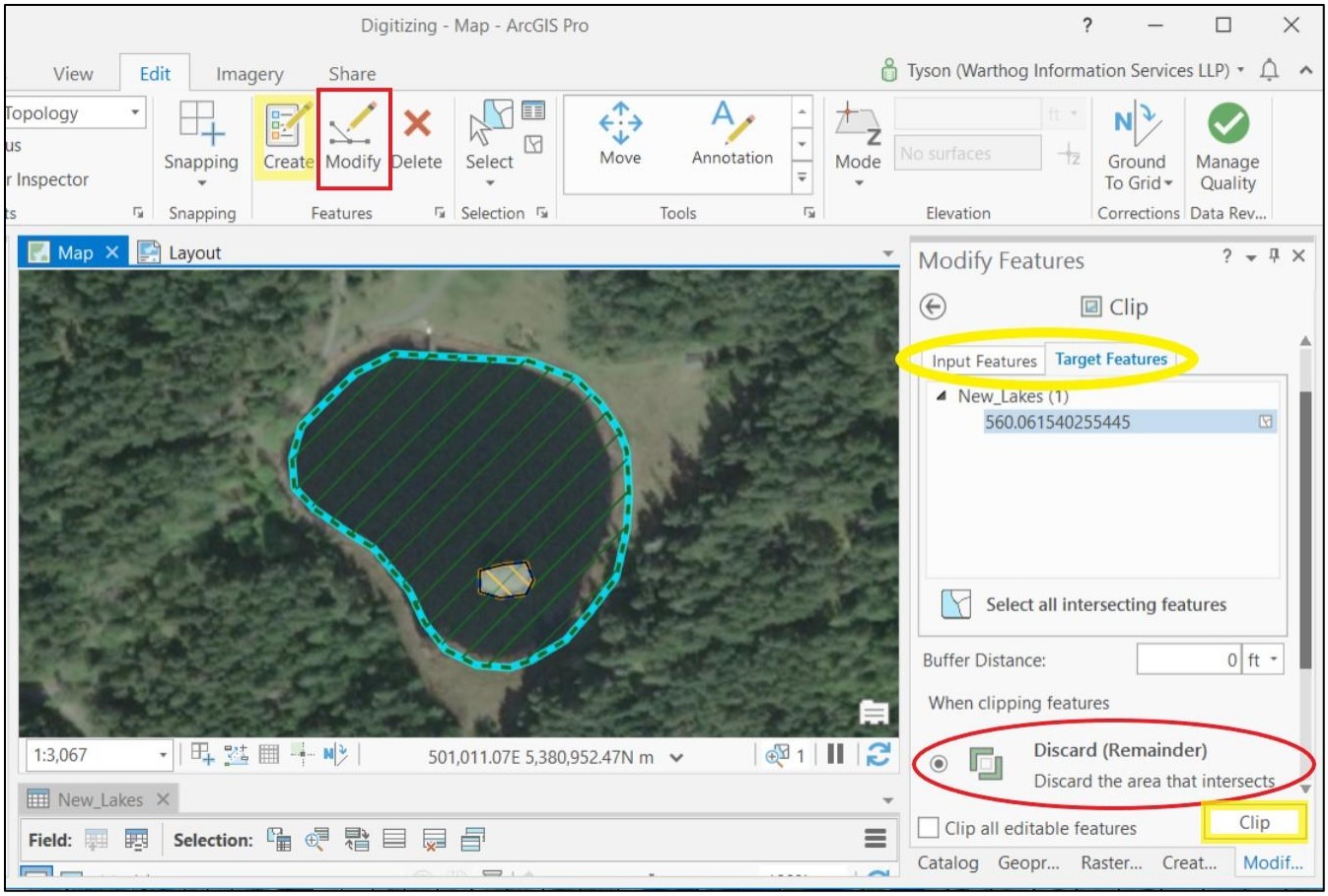
- Zoom to a lake you created that has an island within it (or create a new one if need be).
- Make sure that your **New_Lakes** layer has a solid fill that is semi-transparent.
- Turn the **shaw_drg.tif** layer Off.
- Turn the World Imagery basemap layer On.
- From the Create Features pane, choose the polygon tool to digitize a polygon in the **New_Lakes** layer (just as you did with the lakes) – but this time follow the shore of the *island*.

  This will create a new "lake" polygon on top of the existing polygon.

- With the newly created polygon selected, click *Modify* from the Edit tab of the ribbon.
- Choose *Clip* (under Divide) from the Modify Features pane.
  - The island feature should be automatically selected as the Input Feature
  - Buffer Distance: **0 ft.**
  - Select ***Discard (Remainder)* option**
  - Then, click the *Target Features* tab (beside Input Features)
  - Click anywhere in the main, original lake polygon to select it as the Target Feature



(continued on next page)



*The **Input** feature should be shown with an orange hatch.*
*The **Target** feature should be shown with a green hatch.*

- Click the *Clip* button (from the bottom of the Modify Features pane).

The Input Feature (the island polygon) is clipped from the Target Feature (the lake polygon). However, even though the overlapping area was removed from the main lake polygon it still exists as its own feature. Now that the island feature has served its purpose for clipping It will need to be deleted.

- If it is not already selected, use the Select tool from the Edit ribbon to select the island polygon.

  Note that if you select the main lake it is now what is referred to as a donut polygon.

- With the island feature selected, click *Delete* from the Edit tab of the Ribbon (or you can right-click on the selected island polygon and choose *Delete*).

  This should leave just the lake polygon with the island removed.

- Save your Edits and your .aprx project file.

Step 6: Creating Metadata

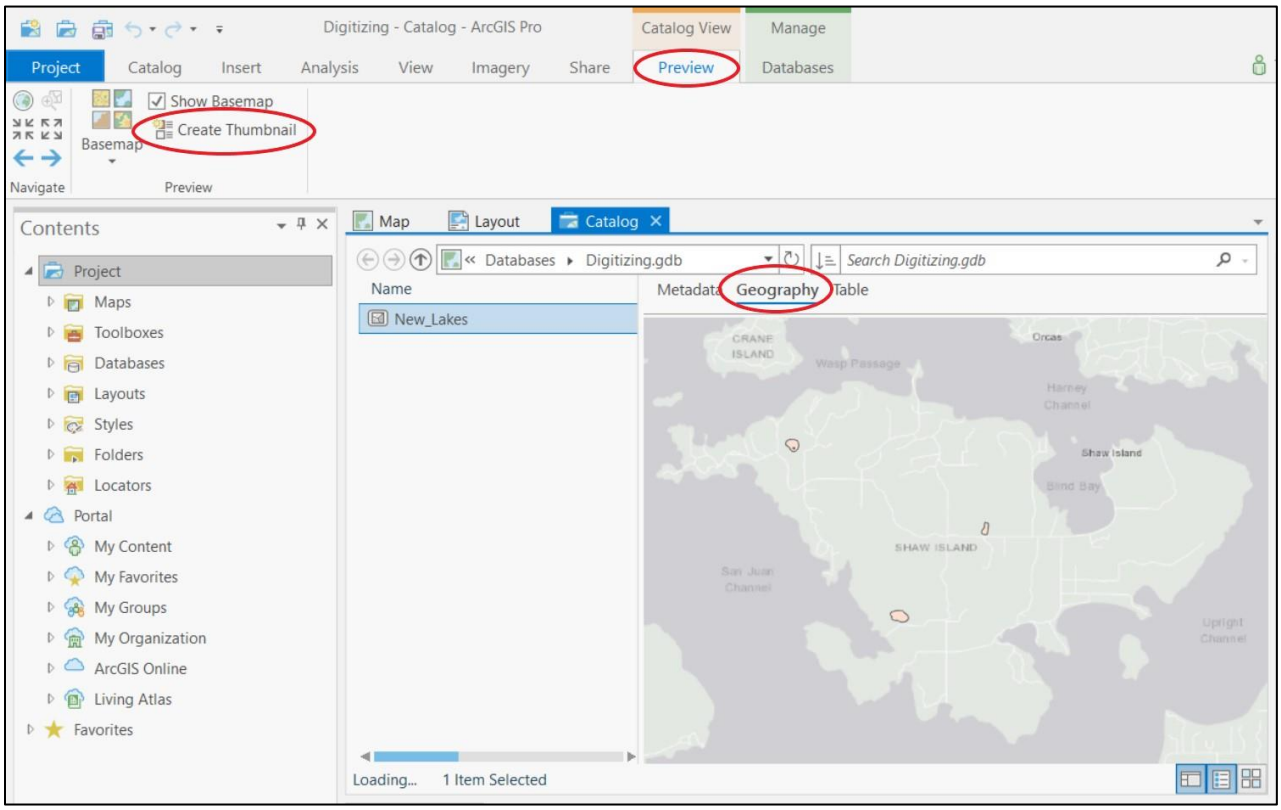
Overview

Having created a new feature class, we need to create metadata for it to document our work. Metadata is data about data. When we leave our data and come back to it, post it online or share it with someone else, the metadata will inform the person using our data the who, what, where, when, and why of the dataset along with any other important details (such as use limitation).

Instructions

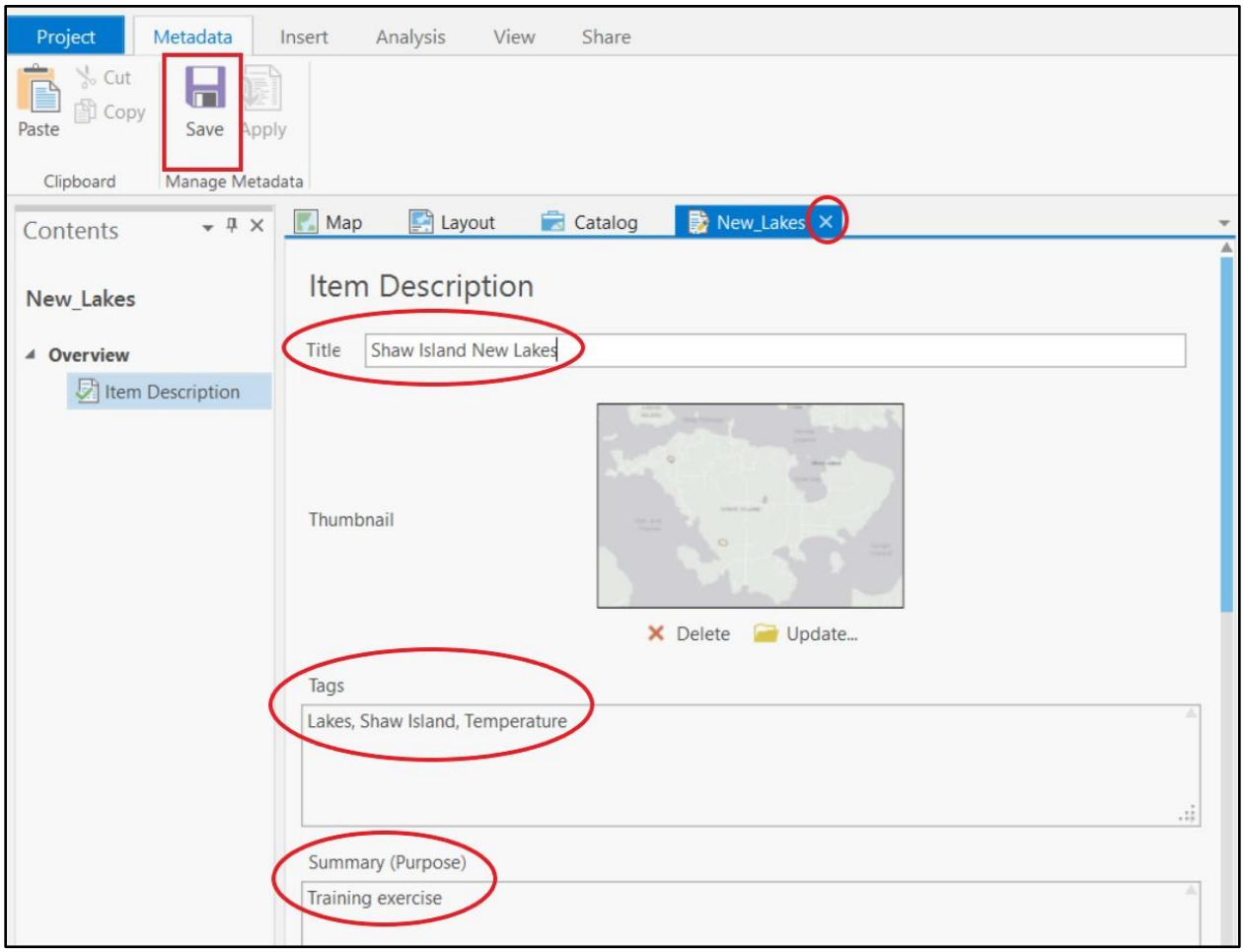
- Open the Catalog pane and browse to your project geodatabase (**Shaw_Islad.gdb**).
- Right-click the **New_Lakes** polygon feature class and choose *View Metadata*.
  You will notice that there is no metadata for this layer, yet.

- At the top of the Catalog view, click *Geography* to display the **New_Lakes** features.
- Zoom out in the Geography display to show most of Shaw Island (the theoretical extent of our **New_Lakes** layer).
- Click the *Preview* tab in the ribbon.
- Click the *Create Thumbnail* button on the Preview tab.



- At the top of the Catalog view, click *Metadata* to return to the metadata details display.
  The thumbnail you just created should now be shown.

- From the Catalog tab of the ribbon, click *Edit* in the Metadata group to open the metadata editor view.
    - Enter Title, Tags, Summary, Description and Credits (see example below or make up your own wording).
- Click *Save* from the Metadata tab of the ribbon and close the metadata editor view by clicking the *X* on the **New_Lakes** metadata editing tab.



- Save your project.

Optional: Editing Options

There are many editing tools available in ArcGIS Pro that you can experiment with. Refer to the Help for more information. A few of the more commonly used tools (via the Create Features pane) are:

- The *Autocomplete Polygon* tool, which allows the creation of a polygon directly adjacent to an existing polygon (with a shared or common line segment between them).
- The *Right Angle Polygon* tool for creating polygons with right angles (i.e., buildings, etc.).
- The *Circle, Rectangle* and *Ellipse* polygon tools.
- The *Freehand* polygon tool, which allows for creating lines without entering individual vertices.
- The *Trace* tool, used for tracing existing features (without having to manually create vertices).

You can also use the right-click context menu while creating a new feature to create:

- Lines that are parallel or perpendicular to another line.
- Vertices at a particular X-Y location
- Lines of a specified distance or direction
- Etc.

From the Modify Features pane (opened via the Modify command on the Edit tab of the ribbon):

- Split (an existing feature into multiple features).
- Merge (two existing features into a single feature).
- Move (to reposition an entire feature).
- Buffer (creates a buffer feature around an existing feature, similar to the Buffer tool).

Snapping is a setting that allows you to "snap" a new vertex to the exact location of another feature or vertex. In the Edit tab of the ribbon is the Snapping tool and its options in the drop-down menu (there is also a smaller snapping button at the bottom of the map view). Use the button to turn Snapping On or off and the drop-down menu to control what aspects of an existing feature are 'snapable':

- Snap to Vertex.
- Snap to Endpoint.
- Snap to Midpoint.
- Etc.

Optional: Digitizing Point or Line Features

In this exercise, we digitized polygons. You can also digitize point or line features. Create a new line feature class in your default geodatabase named Trails and digitize any trails you can find (or place where you would like to see a trail) on the DRG. Create a new point feature class in your default geodatabase named Buildings and digitize building centroids using the DRG or aerial imagery.

End of Exercise

Coordinate Systems and Editing with ArcGIS Pro

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