Overview

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We have already explored the Buffer tool in ArcGIS. This tool is often used in conjunction with the Overlay toolset to determine features that are located within a certain distance of something else.

This works especially well with polygons, for example: which percentage of Greenfield is located within 10 miles of the Vermont Yankee nuclear power plant?

In addition, this cookbook includes information on how to determine the area of polygons and how we can use and visualize time in a GIS.

Good Practice!
GIS Tutorial 8-1 to 8-6 introduces you to a series of useful geoprocessing tools.
1) Buffer Analysis

The Buffer Tool is perfect example of GIS analysis!

Consider, for example, if you were asked to plot on a map a 100-meter-wide buffer zone surrounding a protected stream. If all you had to work with was a paper map, a ruler, and a pencil, you might have a lengthy job on your hands. You might draw lines scaled to represent 100 meters, perpendicular to the river on both sides, at intervals that vary in frequency with the sinuosity of the stream. Then you might plot a perimeter that connects the end points of the perpendicular lines.

The Buffer tool automates all this into one easy step!

You can buffer any type of spatial feature

- **Point**
  - Example: location of schools in a town
  - Buffer: Distance from schools where registered sex offenders are not allowed to live.

- **Lines**
  - Example: stream and rivers (= linear water bodies)
  - Buffer: The 100 foot non-disturb zone around water bodies

- **Polygons**
  - Example: The U.S. border
  - Buffer: the 12 mile territorial waters extending into the oceans

Which parcels are within 60m of the road?
1.1) The Buffer Tool

Using the Buffer Tool is easy!

1. Open the ArcToolbox – Analysis Tools – Proximity and double-click on Buffer.
   Or, open the Search window and enter Buffer.
   Or, select Geoprocessing, Buffer.

2. Make sure you click the Show Help >> button!

This opens a context-sensitive Help box on the right that explains every step of the tool and the settings.

Input Features
These are the spatial features that you want to buffer.

Output Feature Class
This is the file for your buffer, use a meaningful name!

Linear Unit
Here you specify the size and unit of the buffer.

Side Type and End Type
Optional settings – refer to the explanations on the right!

Dissolve Type
Here you have two main choices: NONE and ALL.

- NONE creates an individual buffer around each feature.
- ALL takes these individual buffers and combines them into one large buffer. The combination often makes sense, so you will use Dissolve Type = ALL in most cases.

More Information

- The Buffer Tool
- How Buffer Analysis works
- More on Buffer Analysis
1.2) Your Turn to Buffer!

How many certified vernal pools are located within 5 miles of Westfield? Create a map showing only these certified vernal pools.
2) **Area Determinations**

There are several ways to determine the area of a polygon feature in ArcGIS.

2.1) **Calculate Areas Tool**

The Spatial Statistics toolbox

Utilities toolset – Calculate Areas

This tool calculates the area for each polygon feature in a polygon feature class. The Output Feature Class is a copy of the Input Feature Class with the additional (or updated) F_AREA field containing polygon areas.

2.2) **Calculate Geometry Tool**

Calculating area, length, and other geometric properties

The Calculate Geometry tool allows you to access the geometry of the features in a layer. The tool can calculate coordinate values, lengths, and areas, depending on the geometry of the input layer.

You can only calculate the area, length, or perimeter of features if the coordinate system being used is projected.

1. Create a new attribute table field for your polygon area.
2. Start an Edit Session. You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.
3. Right-click the layer and click Open Attribute Table. You can only perform geometric calculations on attribute tables.
4. Right-click the field heading for which you want to make a calculation and click Calculate Geometry. Optionally, you can press CTRL+SHIFT+G to open the Calculate Geometry dialog box.
5. Click the geometric property you want to calculate. Different properties are available depending on the type of layer you're using.

6. Click to use either the coordinate system of the data source or the coordinate system of the data frame.

7. Click the units of the output calculations.

8. Optionally, if you have selected records in the table, choose whether to apply the calculations to all records or just the selected ones.

9. Click OK.

2.3) Field Calculator

Field calculator is a great tool for performing simple or complex mathematical operations on your attribute tables.

1. Create a new attribute table field for your calculation.

2. Start an Edit Session. You can make calculations without being in an editing session; however, in that case, there is no way to undo the results.

3. Right-click the layer and click Open Attribute Table.

4. Right-click the field heading for which you want to make a calculation and click Field Calculator…

Select your field, functions, and mathematical operators to create a function.

The example on the next page shows a simple unit conversion from square meters to acres. The attribute field area_1 contains polygon area in square meters. The function area_2 = area_1 / 4047 simply converts the areas into acres and puts them into the attribute field acres_2.
More Information

- Fundamentals of field calculations
- Making simple field calculations
3) The Overlay Toolset

One of the most basic questions asked of a GIS is "What's on top of what?" For example:

- What land use is on top of what soil type?
- What parcels are located within the 100-year floodplain? ("Within" is just another way of saying "on top of")
- What roads are within what counties?
- What wells are within abandoned military bases?

In GIS, these *What's on top of what?* questions are answered with the use of overlay tools.

The Overlay toolset contains tools to overlay multiple feature classes to combine, erase, modify, or update spatial features, resulting in a new feature class. New information is created when overlaying one set of features with another. There are six types of overlay operations; all involve joining two existing sets of features into a single set of features to identify spatial relationships between the input features.

![ArcToolbox](image)

All these tools are quite similar, but create different output – choose the tool matching your question(s)!

**More Information:**

- The Overlay Toolset  
4) The Intersect Tool

The Intersect tool computes a geometric intersection of the input features. Features or portions of features which overlap in all layers and/or feature classes will be written to the output feature class.

= You have 2 (or more) polygons that are intersecting = overlapping and you want that overlap as your new polygon!

Examples: Polygon inputs

Polygons can intersect in three ways:

- Overlap - Area of overlap can be produced by leaving the Output Type to its default value (LOWEST).
- Common boundary/touch at a line - This type of intersection can be produced by specifying LINE as the Output Type.
- Touch at a point - This type of intersection can be produced by specifying POINT as the Output Type.

More Information

- The Intersect Tool
- How Intersect Works
4.1) Your Turn to Intersect!

Two Questions

1. What percentage of Westfield city area is located within 3 miles of one of the existing 3 fire stations?
2. Assume that the fire station near the MassPike is closed…how does this percentage change?
5) Time-Aware GIS

Time values in your data can represent a point in time, sampled on a regular or irregular interval. These time values are stored in a single attribute field and can be used to visualize temporal data at particular times on the time line. For example, stream flow data is collected at different points in time at regular intervals. However, lightning or earthquake data is collected at irregular intervals depending on when a particular lightning storm or earthquake occurs.

Time values can also represent durations such as when a particular event occurs over a period of time. Time values in this case are stored in two fields, one representing the start time of the event, and the other representing the end time of the event. For example, polygon features representing a fire perimeter have a start and end time that depend on when the fire started and ended.

Temporal data can be visualized in ArcGIS after time enabling the layer. This can be done by setting the time properties of the layer using the Time tab on the Layer Properties dialog box. Once the time properties have been set on the temporal data, you can visualize it using the time slider. Also, you can serve the time-enabled layer as a map service.
More Information

What is temporal data?

A quick tour of temporal data management and visualization

Enabling time on your data

6) Homework Assignment #9

1. Buffer something!
   Perform a buffer analysis for something that you are interested in!

2. Is there any place in Massachusetts more than 20 miles from a community college?
   Visualize your answer using a map.

That’s it – two professional maps – no other instructions or report to write!

• Choose whatever map size and map layout makes sense for your first map.
• Create your second map in 8.5 by 11 inches in landscape orientation.
• Due Date: next class.