Lesson 5: Vector Data Analysis - Creating a Site Selection Model

## INTRODUCTION

In this lesson you will learn how to identify elements of vector data analysis needed to create a site selection model. This lesson will explain what proximity analysis is and the tools that use this information. You will learn about ModelBuilder, a tool in the ArcGIS desktop suite, and how to use it. Lastly, you will learn about site selection and the value based on its many uses.

## LESSON OBJECTIVES

By the end of this lesson, you will be able to:

1. Identify elements of vector data analysis used for creating a site selection model.

2. Apply the method of proximity analysis for buffering elements.

3. Develop a model that satisfies multiple location criteria.

## LEARNING SEQUENCE

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| Required Reading | Read the following:  Vector Data Analysis - Creating a Site Selection Model   * Proximity Analysis * ModelBuilder * Site Selection |
| Assignments | Complete the following:   * Lab: Vector Data Analysis – Creating a Site Selection Model * Quiz: Vector Data Analysis – Creating a Site Selection Model |

## INSTRUCTION

**Proximity Analysis**

## What is Proximity Analysis?

Proximity analysis is a set of tools used to analyze the relationship between a selected feature and its neighbors.

Consider the following questions:

* How close is the nearest gas station?
* What is the distance between your house and the candy store?
* What is the shortest route to get to Starbucks?
* Is there a mechanic a mile away?

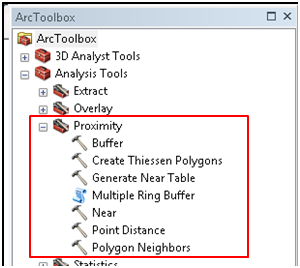
Questions like these can be answered with a GIS by using proximity analysis tools.

Typically, there are different proximity analysis tools for vector and raster data sets, as the algorithms may be quite different even though the desired result is the same. Proximity analysis tools output tables and or features and can take one or more inputs.

## Proximity Toolset

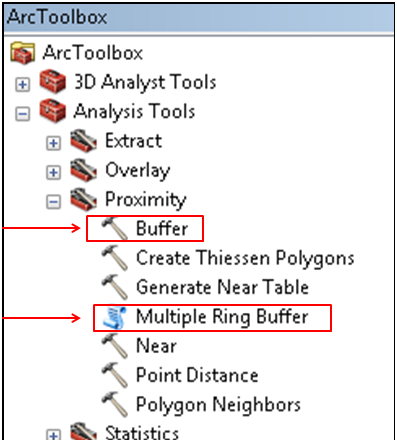
In an ArcGIS desktop, you will find the “*Proximity”* toolset within the “*Analysis Tools*” inside of “*ArcToolbox”.* The “*Proximity*” toolset contains several tools.

ArcToolbox -> Analysis Tools -> Proximity



## Buffers

The “*Proximity*” toolset includes the “*Buffer*” tool, and the “*Multiple Ring Buffer*” tool script. There are two types of buffers available: single buffers and multiple-ring buffers.



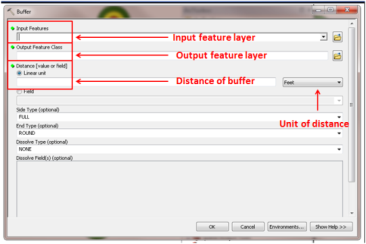
### Single Buffers

A single buffer creates an area feature at a single specified distance from the input feature. An example of a use for a buffer is if you wanted to specify a distance around a rocket test site to identify areas where sound levels will be disturbing to the residents.

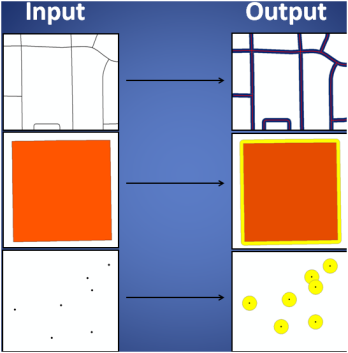
The single “*Buffer*” tool requires three parameters to be filled out before it can run.

* The first parameter is the input feature layer, which will be the center point of each buffer.
* The second parameter is the output feature layer which will contain all of the buffer areas.
* The third parameter is the linear distance in a distance unit, such as feet, miles, or kilometers, that determines the radius of the buffer around the input features. Another option for the third parameter is to select a field which contains numeric values that represent the radius of the buffer you wish to have around that individual feature.

**Single Buffer tool in ArcGIS Desktop**



**Single Buffer: Line, Polygon, and Point**



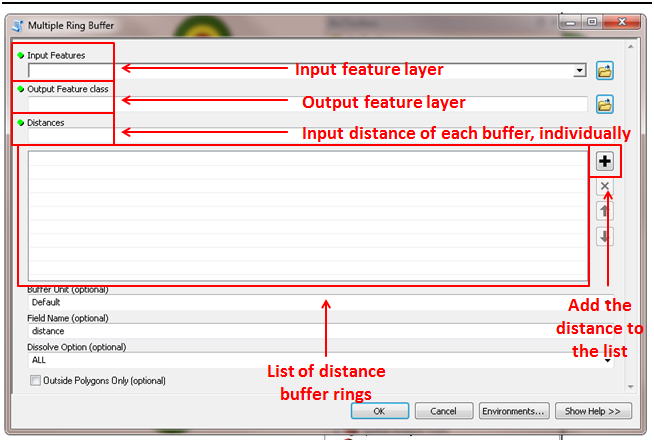
### Multiple-Ring Buffers

A multiple-ring buffer creates area features at multiple specified distances from the input feature. For example, we could use multiple-ring buffers to buffer multiple distances from a business to see how many customers live in each buffer range.

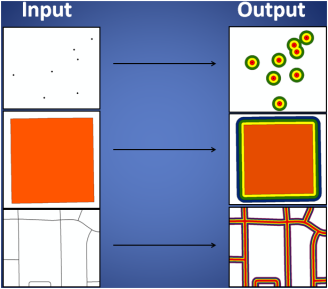
The “*Multiple-Ring Buffer*” tool requires three parameters to be filled out before it can run.

* The first parameter is the input feature layer, which will be the center point of each buffer.
* The second parameter is the output feature layer which will contain all of the buffer areas.
* The third parameter is the linear distance in a distance unit, such as feet, miles, or kilometers, that determines the radius of the buffer around the input features. You can add multiple distances by pressing the plus button in the tool to create a new entry in the list of distance buffer rings.

**Multiple-Ring Buffer tool in ArcGIS Desktop**



**Multiple-Ring Buffer: Point, Polygon, Line**



ModelBuilder

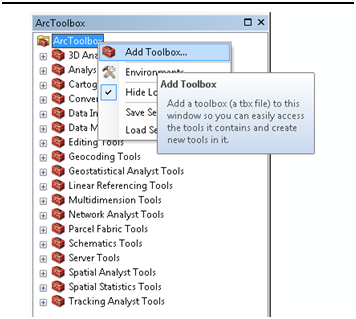
## What is ModelBuilder?

Modelbuilder is a tool in the ArcGIS desktop suite that allows you to create, edit, and manage Geoprocessing models. Modelbuilder preserves a workflow that you can execute multiple times. A model chains together multiple tools, allowing for the output of one tool to be the input of a subsequent tool. Building models provides the benefit of automating the process of running multiple tools in series, and easily saving, sharing, and rerunning the model.

## Custom Toolbox

In order to create a model, the model must first res'ide inside of a new, custom toolbox. To create a custom toolbox in “*ArcToolbox*”, open “*ArcToolbox”*, then right-click on “*ArcToolbox*”, and then click “*Add Toolbox*”.

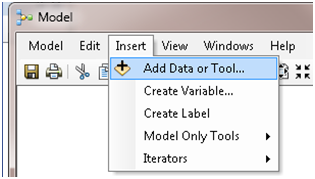
Right-click ArcToolbox -> Add Toolbox



## Inputting Tools

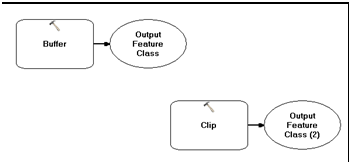
When you create a new model in your new toolbox, you can “*Add Data*” or “Tool” to Modelbuilder by simply dragging and dropping tools from “*ArcToolbox*”.

Insert -> Add Data or Tool

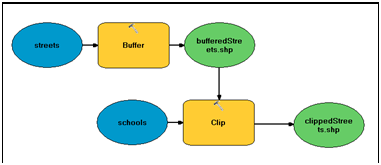


Another way to add tools or data is to click “*Insert*” from" the menu bar followed by “*Add Data*” or “*Tool*”.

ModelBuilder provides an easy to use and understand graphical user interface. Tools and data are represented by rectangles and ovals, respectively. After you initially drag a tool into ModelBuilder, the shapes will look hollow. They are hollow because the proper parameters have yet to be filled out.



Once you fill in the proper parameters, the shapes will be colored and the data names will be displayed.



## Flow Charts

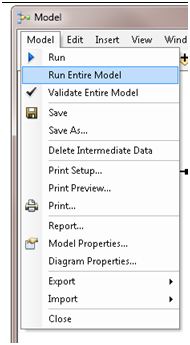
ModelBuilder represents the algorithm that you are designing as a flowchart. The boxes represent operations. Ovals represent the data that is inputted and outputted. Boxes and ovals are connected by arrows to set the order of execution and data flow. If you follow the arrows from the starting point or points of the flowchart, it will reveal the sequential order in which the operations must be executed.

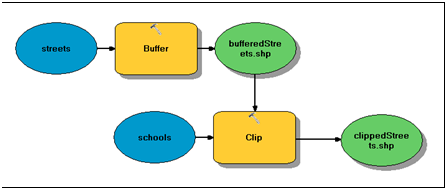
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| **Key Facts**  **Flow Charts**   * Represents an algorithm or process * Boxes represent operations * Ovals represent data input/output * Boxes and ovals are connected by arrows to set the order of execution and data flow * Follow the arrows to follow the sequential order |

## Running the Model

After you have designed your model, and all of the ovals and boxes are colored, you can run the model by choosing “*Model*” from the menu bar followed by “*Run Entire Model”*. The model run and the tools and output data will display a drop shadow showing that they have been run. Once all of the data and tools have a drop shadow, you can view the results. If there are any errors in execution, ModelBuilder will prompt you for more information.

Model -> Run Entire Model





## Saving and Accessing the Tool

Once you verify that your tool runs correctly, you can save the model by clicking the “Save” button. The model is saved inside of the custom toolbox that you created. If you wish to share your model with a colleague, simply provide your colleague with a copy of the toolbox file, and tell them to add it to their “*ArcToolbox*”. As a reminder, to add a toolbox to “*ArcToolbox*”, right-click “*ArcToolbox*”, then select “*Add Toolbox*”, and navigate to the toolbox and “select it”. The toolbox will then display in “*ArcToolbox*” and your model will be listed inside of it.

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| **Key Facts**  **Saving and Accessing the Tool**   * Save the model by clicking the save button. * Add to ArcToolbox   + - Same as before: Right-click ArcToolbox -> add toolbox and navigate to the toolbox to select it. * Toolbox will then display in the ArcToolbox |

**Site Selection**

## What is Site Selection?

Site selection is where you measure the needs of a project against the virtues of potential locations. There are many uses for site selection, such as finding an ideal location for a new facility, finding an existing facility for use, or identifying homes for sale within a certain neighborhood at a certain price range.

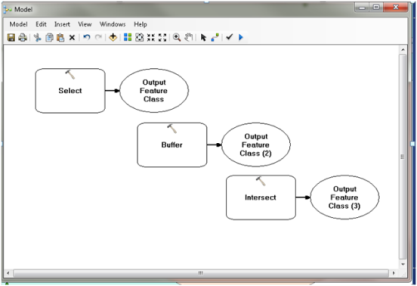
**Site Selection Example**

I want to fly to Corpus Christi, Texas and want to find an airport that is within 30 miles of Corpus Christi, so I do not have to drive too far once I arrive. My goal is to identify all the airports within 30 miles of Corpus Christi, Texas.

* The first thing I must determine is what data I require. For me to solve this problem, I need a data set containing cities in Texas, and the data set containing airports in Texas.
* The second thing to determine is which tools I should use to identify the airports within 30 miles of Corpus Christi. I have identified three tools that I will need to use: “*Select*”, “*Buffer*”, and “*Intersect*”. The “*Select*” tool will allow me to select Corpus Christi, Texas from all of the cities in Texas. The “*Buffer*” tool will create a 30 mile radius buffer around the selected city of Corpus Christi, Texas. Finally, the “*Intersect*” tool will collect the airports from the airport layer that intersects with the 30 mile radius buffer.

## Solving the Site Selection Example: Setting Parameters

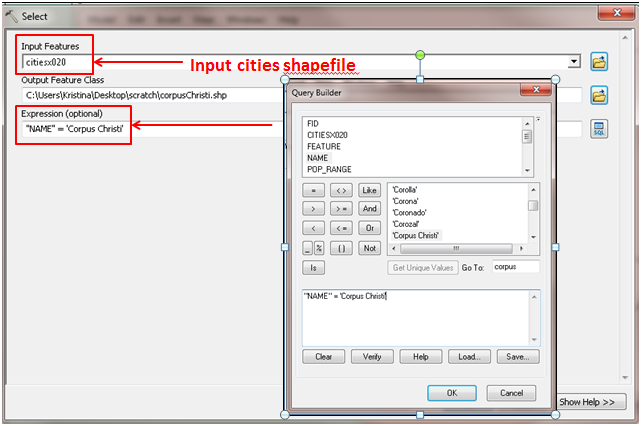
Now that I have all of my tools identified, I drag them one by one from “*ArcToolbox”* into an empty model. I will then review how to set the parameters for each of the three tools: “*Input*”, “*Buffer*”, and “*Intersect*”. Remember, all the tools and data outputs are not filled in because the tools do not have all the required parameters to run yet.



Tools Added to ModelBuilder

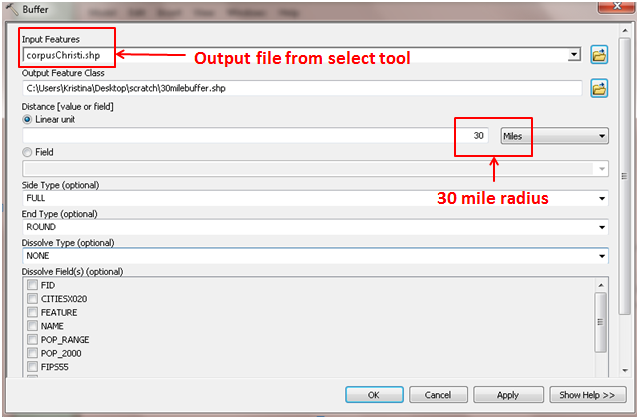
## Select Input Parameters

For the “*Select*” tool, I set the “*Input Features*” as my city’s feature class. I set my “*Output Feature Class*” to the location I want to save it at with the feature class name I wish to use. Last, I use “*Query Builder”* to form the input features.



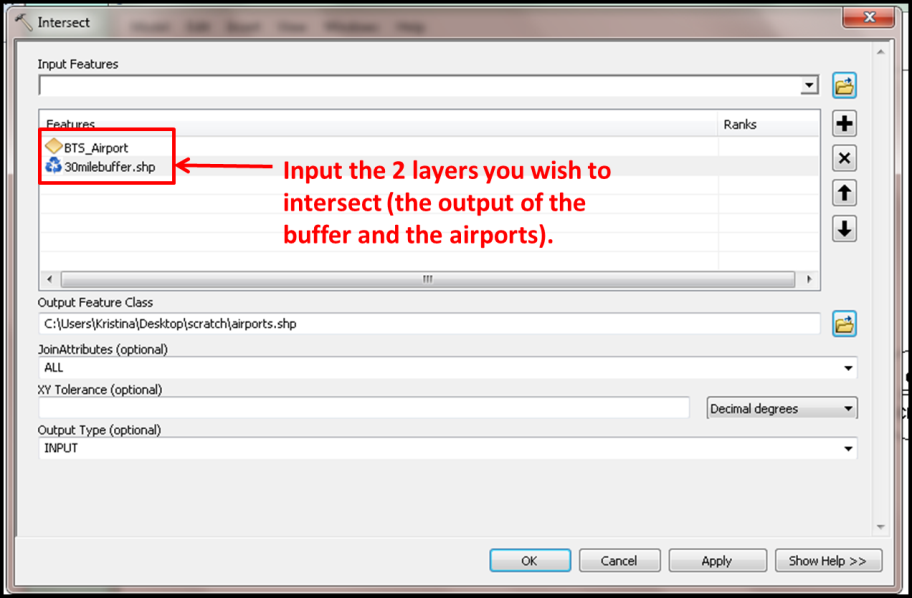
## Buffer Input Parameters

For the “*Buffer*” tool, the “*Input Features*” are the output file from the “*Select*” tool that I just set the parameters for. I set the “*Output Feature Class”* name, and also set the “*Linear unit*” for the “*Buffer*”, which is 30 miles.

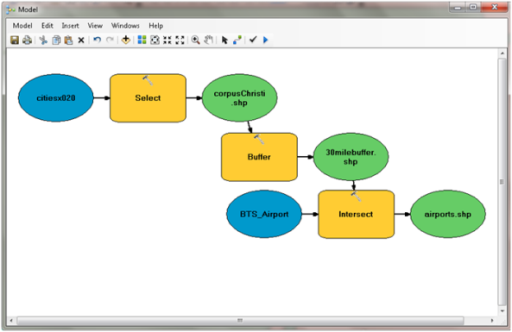


## Intersect Parameters

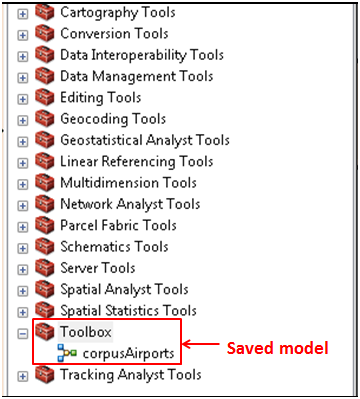
Lastly, for the input tool, I set the “*Input Features*” to the output of the “*Buffer*” tool that I just set, and the airports feature class. I then set the “*Output Feature Class*” name which will represent all the airports within 30 miles of Corpus Christi.

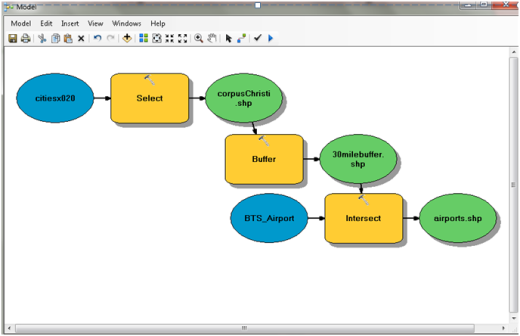


## Ready to Run

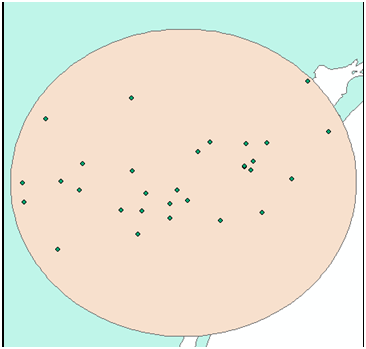


This is what the model looks like with all the parameters set. The blue ovals represent data that is only used as input. The green ovals represent data that is the output of tools that may or may not be used as input to other tools. This model is now ready to run.

Before I run the model, I will “*Save*” the model inside of my custom toolbox. Now it is time to run the model by choosing “Model” from the menu bar followed by “Run Entire Model”.



This image shows what a model looks like after it has completely executed. All the toolsand outputs have drop shadows indicating that they have successfully executed. Now that the model has completed, we can look at the results in ArcMap.

Here are the results of the model. The green dots represent all the airports within 30 miles of Corpus Christi, Texas. The tan oval represents the 30 mile radius around Corpus Christi, Texas. The green background represents the coastal bend of Texas.

## SUMMARY

## In this lesson you gained an understanding of vector data analysis and the process required to create a site selection model. You learned what proximity analysis tools are such as the proximity toolkit and buffers in the ArcGIS desktop. You learned about different buffer types used in vector data analysis and how to use ModelBuilder to create a site selection model.

## ASSIGNMENTS

1. Lab: Vector Data Analysis – Creating a Site Selection Model

2. Quiz: Vector Data Analysis – Creating a Site Selection Model