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Features in these lessons:

- **Step-by-Step Instructions** –an easy-to-follow format relevant for novice and experienced ArcGIS users.
- **“Scoping It Out” boxes** – boxes found in the margins that feature tools, tips and tricks to enhance the student’s ArcGIS experience.
- **Finished Layouts** –a self-assessment tool to ensure successful lesson completion.
- **Scenarios** –a process in each lesson used by professionals in the science, technology, engineering and mathematics industries letting users simulate an actual industry application.

About ESRI’s ArcGIS Desktop

ArcGIS is a software suite developed by Environmental Services Research Institute, Inc. (ESRI). It is designed to analyze and model geospatial data. This book will use three major components of the ArcGIS software suite: ArcMap, ArcToolbox and ArcCatalog. ArcMap is the primary part of the suite used in the book to display, create and analyze different types of geospatial data. ArcToolbox contains various geoprocessing tools used in the ArcGIS suite to complete tasks such as creating buffers, merging shapefiles and creating address locators. ArcCatalog is the “virtual filing cabinet” where users create, manipulate or preview data and metadata. ArcGIS is widely used among today’s GIS professionals and students. Students using this software transition more smoothly with their GIS skills from the classroom to the workplace or other academic pursuits.

How will I use this book?

These lessons are intended for use in preparation for the TSA National Geospatial Contest. The lessons provide a range of ArcGIS geospatial skills from geoprocessing to layout creation in the context of Green & Sustainability careers. The subsequent lessons each focus on one of three green and sustainable career directions using skills for the Science, Technology, Engineering and Mathematics career cluster.

Each lesson introduces a slightly different set of geospatial skills. The skills sets used are nonlinear in nature, meaning you do not have to complete Lesson 1 before you can cover begin Lesson 2 and so on, but it is recommended to complete all lessons to gain experience using ArcGIS.

Before beginning, ensure that you have downloaded and installed the required dataset from www.digitalquest.com/tsa.html.

These lessons are part of a larger course, aGIS in STEM, from Digital Quest. For more information or questions about working with these lessons contact or questions on the rest of the course contact Digital Quest via phone at 1-877-5Remote, extension 1 (877-573-6683, ext. 1), email at supportusers@digitalquest.com, or visit: www.digitalquest.com.

About the Authors

Eddie Hanebuth is founder and president of Digital Quest, a Mississippi-based development and training company that produces GIS instructional material for educational institutions. He chairs the U.S. Department of Labor's National Standard Geospatial Apprenticeship Program (STARS GeoAP) and the SkillsUSA Geospatial Competition Committee. He also oversees operations at Digital Quest's offices in Ridgeland, Miss. and at the Center of Geospatial Excellence at NASA's John C. Stennis Space Center.



Liz Rotzler has seven years of experience in geospatial technology education. After teaching GIS in the classroom using the STARS curriculum and certification, she has spent the past four years developing GIS/RS curriculum. She has co-authored and edited Digital Quest's aGIS series, *Introduction to Geospatial Technologies* and *aGIS in Agriculture, Food and Natural Resources*. She also has worked on the popular Digital Quest SPACESTARS series.



Austin Smith has been with Digital Quest for five years. He is Vice President of Development and Support and chair of the STARS Geospatial Certification Committee. He has experience in information technology development, implementation and training in a variety of public and private organizations. At Digital Quest he has co-authored or edited more than 30 titles. He serves in scenario planning, authoring and editing with Digital Quest's aGIS series.



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Digital Quest expresses our sincere appreciation to the individuals and organizations that contributed to this book. Their research benefits those who are, or will be, involved in STEM and Green and Sustainability Technologies. These experts are:

- **Marc Seelinger**, Professional Wetland Scientist, Proprietor of the Swamp School
Website: Swampschool.org **Twitter name:** [SwampSchool](https://twitter.com/SwampSchool)
Marc has taken the time out of his busy schedule in Wetland and Environmental education and services to assist Digital Quest in writing lessons pertaining to wetlands and land management (Lessons 6, Conservation Biology; Lesson 8, Watershed Management; and Lesson 9, Wetland Mitigation). His expertise truly enhanced our understanding of these important economic issues.
- **Don Meltz**, Principal Planner and Owner of Don Meltz Planning and GIS
Website: www.donmeltz.com **Twitter name:** [DonMeltz](https://twitter.com/DonMeltz)
Don's company provides high-quality GIS services to businesses and organizations without in-house service. Don graciously shared not only his planning expertise with Digital Quest but also various data files that made Lesson 4 (Green Space) possible. Don thanks Nan Stolzenburg, his partner with whom he teamed on their project emulated in our Lesson 4.



a Geospatial Industry Series in STEM

Using GIS to Support Sustainable/Green Technology

Lesson 1: Can We Preserve Green Space in our Community? Using Geospatial Technology to Find Green Space

Economic growth is almost always beneficial to a community. New buildings, parking facilities, streets, and sidewalks are all part of the growing process. Equally as important to a community are areas that preserve the natural assets of a community. Before all of the new places to eat, shop, and work are built, what can be done to preserve areas that community members and visitors could use to go to relax? Many communities want to create master plans that include both economic development and also protect the environment. Green spaces are not only an aesthetically pleasing “get away” in an urban area, but may also serve as a place where wildlife and certain species of plants can prosper. Added benefits such as improving the air quality as well as the reduction of both noise and water pollution can also come from having a green space in a community.

Where does a community planner begin in conserving green space? One plan of action could be to utilize natural features in the area such as a grove of trees or a natural stream or pond. The town of New Paltz, New York, already had a small public green space but they also had a heavily forested area complete with streams, wetlands, woods, plants, and animals. The idea was proposed to create a nature preserve, public park, and trail system to protect the area and to give the community an additional, much larger green space with multiple access points.

A plan was set forth to create this green space based on one of the area’s most popular residents, the beaver. Although numerous plants and other animals live in the area, why would the focus be directed solely at the beaver? Several reasons actually:







- Beavers change the ecosystem to suit their needs,
- Beavers provide habitat for other species that wouldn’t be found there otherwise,
- Beavers provide greater biodiversity, and
- Beavers change their behavior as the system changes.¹

The focus of the plan may be on the beaver, but the actual dimensions of the property are determined by those who live in that area and who own the property. The property owners around this proposed area were identified and then contacted. These owners were extremely receptive to the idea of a preserve and indicated of their willingness to participate in committing land to the preserve. The issue at this point was how to determine the core area within these property lines that should be designated for this Nature preserve. For the town of New Paltz, some considerations in concluding where the preserve should be are: giving the water and wetland areas a 100-foot buffer, allowing for adequate beaver forage area, and steep slopes.

¹Meltz, Don. (2010, February). *Mill Brook Preserve, Concept Development*. PowerPoint Presentation, Slide 9, New Paltz, New York.

Opening an ArcMap Document

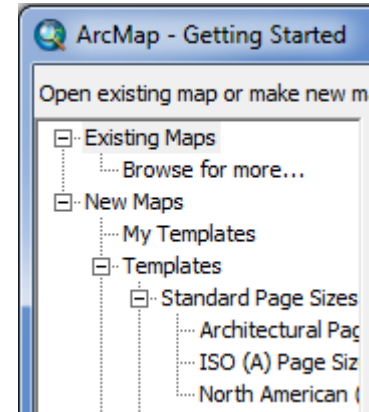
You will now use an existing **ArcMap** document to add, and then analyze different layers of data for the New Paltz Mill Brook Preserve. **ArcMap** is launched in the same manner as most Windows-based application programs.

1. **Start** ArcMap by **double-clicking** the  shortcut on your computer desktop (or by **clicking** the Windows Start button , **pointing** to  **All Programs** and then  **ArcGIS**  and **selecting**  .)

2. When the **ArcMap Getting Started** window appears, **Double click** **Browse for more...** and **navigate** to the **C:\DQI\AGIS\STEM\Lesson01** folder.

3. **Select** the **STEM_Lesson01.mxd** file.

4. **Click** .



The map document you opened contains a map of **Ulster County, New York**, and a file with places (cities, towns, and villages) in this county. Before working on this document, it is important to save a copy to your student folder.

5. **Select Save As...** from the **File** menu to **save** this **ArcMap** map document in your **student folder**.
6. **Name** the file **STEM_Lesson01_XX** (where XX is your initials).

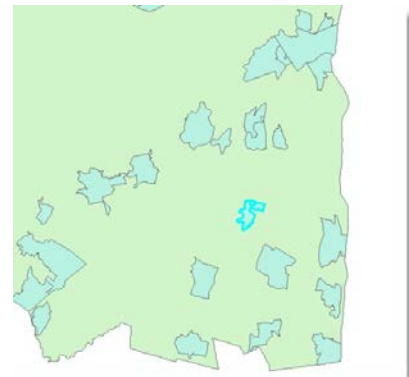
Selecting Tabular Data

The town, or village, that this study focuses on is New Paltz, New York. To begin we will locate New Paltz, and then zoom in to that area in ArcMap.


1. **Right click** on the **UlsterCountyPlaces** file and **select Open Attribute Table**.
2. Under the **NAME** column, **scroll** down until you see **New Paltz**.
3. **Single click** the attribute box to the left of this entry.

This will highlight the entire row in the table and it will highlight this town on the map.

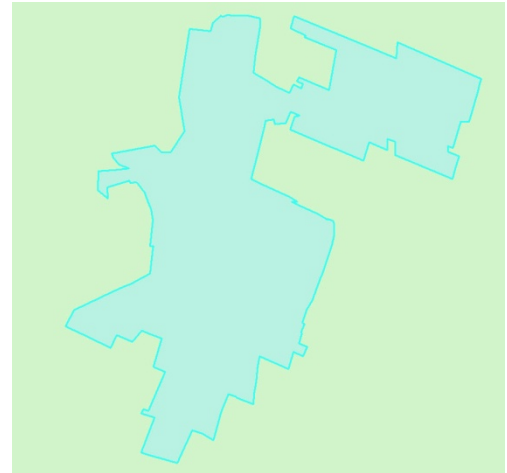
FID	Shape	ID	COUNTY	PLACE	NAME
10	Polygon	11	36111	37132	Hurley
11	Polygon	12	36111	39397	Kerhonkson
12	Polygon	13	36111	39727	Kingston
13	Polygon	14	36111	40585	Lake Katrine
14	Polygon	15	36111	42488	Lincoln Park
15	Polygon	16	36111	44654	Malden
16	Polygon	17	36111	45700	Marlboro
17	Polygon	18	36111	47554	Milton
18	Polygon	19	36111	49418	Napanoch
19	Polygon	20	36111	50551	New Paltz
20	Polygon	21	36111	57650	Phoenicia
21	Polygon	22	36111	58057	Pine Hill
22	Polygon	23	36111	58541	Plattekill
23	Polygon	24	36111	59311	Port Ewen




4. **Right click** on **UlsterCountyPlaces** again, this time go to **Selection, Zoom to Selected Features**.

5. On the **Tools** toolbar, **select** the **Clear Selected Features**  button.

The area that is being considered for this green space is located in the village of New Paltz. A group of land owners is willing to commit portions of their property to this project. The nature preserve will be built in this area. You will need to add the property owners file then zoom in even further to study this property.



6. **Click** the **Add Data**  button and **navigate** to the **C:\DQ\AGIS\STEM\Lesson01** folder.

7. **Double click** **PropertyOwnerBoundary.shp** to add it to the map display.


8. **Right click** on the **PropertyOwnerBoundary** and **select Zoom to Layer**.

Because this will now be the area of focus, you can turn off the other layers.

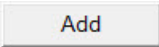
9. **Turn off** the **UlsterCountyPlaces** and the **UlsterCounty** layers by **unchecking** them in the **table of contents**.


Creating Buffers

When considering an area for a nature preserve, one major task is to make sure that the natural resources of the area are protected. If there are any endangered species, streams, wetlands, habitats, etc., efforts should be made to provide a protective barrier around these natural assets. Wetlands, for example, are federally protected. Many states also have laws or regulations to protect wetlands. For this study, you will first need to secure a 100 foot buffer area around the wetland and water areas.

1. **Click** the **Add Data**  button and **navigate** to the **C:\DQ\AGIS\STEM\Lesson01** folder.

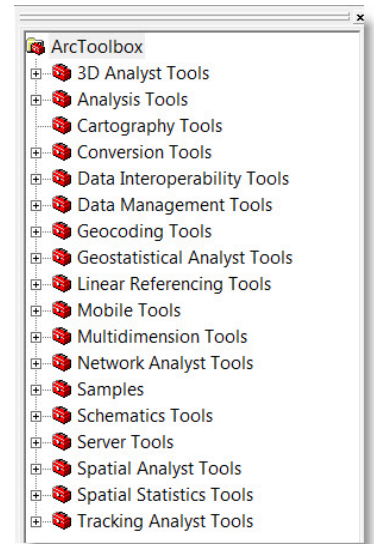
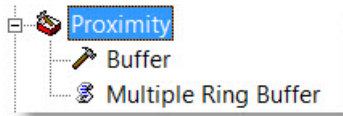
2. Use the **Ctrl** key to **select** the **Streams.shp**, **Water.shp**, and **Wetlands.shp** files.


3. **Click**  to add them to your map display.


4. **Open ArcToolbox** by clicking on the **ArcToolbox**  button on the **Standard** toolbar.

This will open the ArcToolbox pane in the ArcMap window.

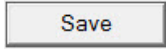
5. **Double click Analysis Tools** to expand its menu.
6. **Double click Proximity** to reveal its options.



7. In this case, you will need a 100 foot buffer. **Double click Buffer** to open the Buffer dialog box.
8. In the **Input Features** box, **click** the down arrow  and **select Wetlands** from the options listed.

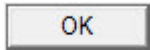
9. For the **Output Feature Class**, **click** the **Browse**  button and **navigate** to your **student folder**.

10. **Enter Wetlands_100ft_Buffer** and then **click**

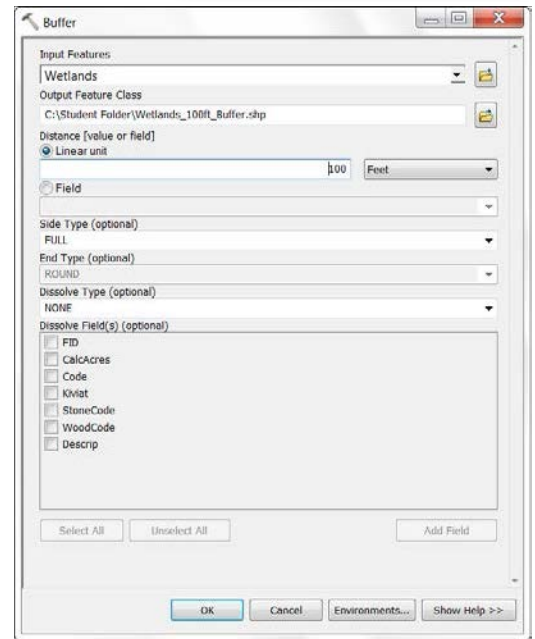


11. **Enter 100** in the **Linear unit** box and **verify** the units of measurement are in feet.

12. **Leave** all other fields to their defaults and **click**



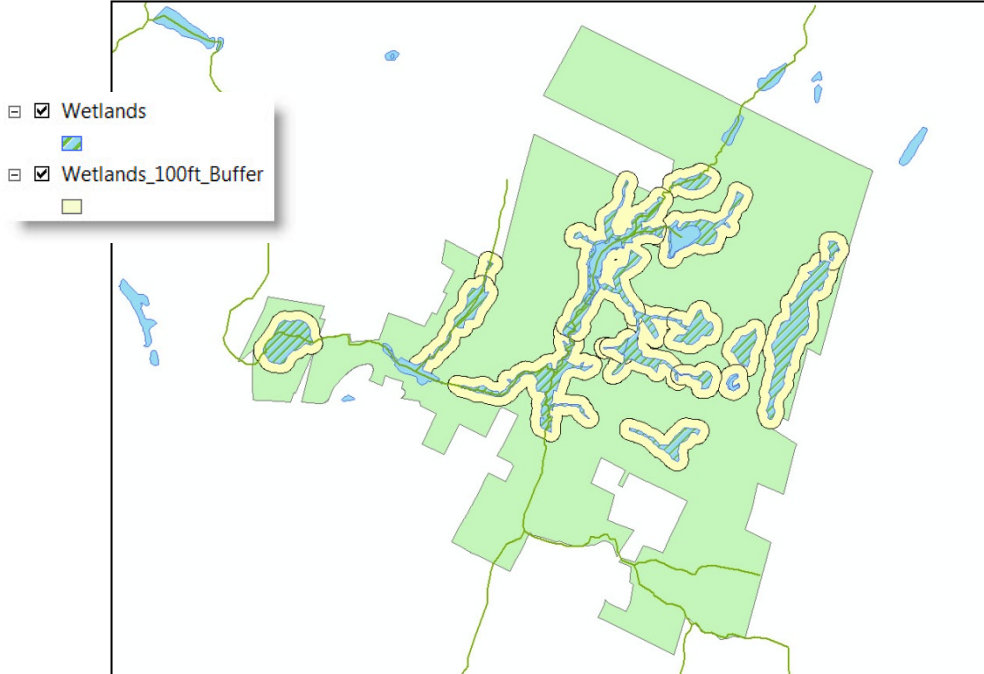
to run the buffer.



Scoping It Out...

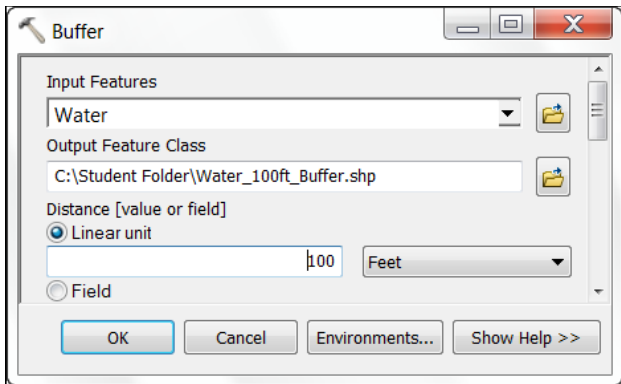
ArcMap automatically organizes layers as they are added in this order: points, lines, and polygons. The newest of each category will be placed at the top of that category when added. For this reason, the Wetlands buffer you just created was added on to the top of the polygons listed.

13. To be able to see the **Wetlands** layer, **click** on it in the **table of contents** and **drag** it above the **Wetlands 100ft Buffer** layer.



The buffer that was just created represents an area adjacent to the wetland areas that should be left in its natural state. This means that sidewalks or driving areas, for instance, should not be developed in the buffer zones. Like the wetlands, the other areas of water should also be given a 100 foot buffer.


14. **Create** a 100 foot buffer around the **Water** file using the same procedures as above.
15. **Save** the buffer as **Water_100ft_Buffer** in your **student folder**.
16. **Drag** the **Water** layer above the **Wetlands** layer in the **table of contents**.
17. **Create** a 100 foot buffer around the **Streams** file using the **Buffer** tool as you did above.
18. **Save** the buffer as **Streams_100ft_Buffer**.




Merging Shapefiles

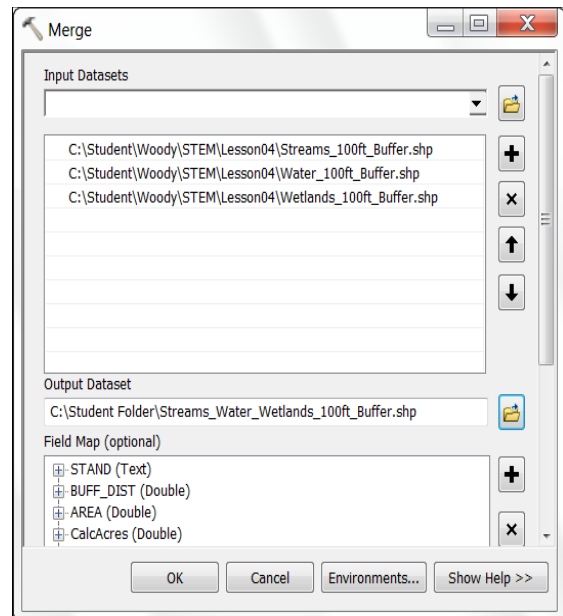
For easier file management, you will create one shapefile to display all of the buffer zones together. This will be done through a process called **Merging**.

1. In **ArcToolbox**, **double click Data Management Tools** to expand that toolset, then **General**, and then **Merge**.

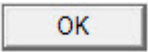
2. **Click** the down arrow  in the Input Datasets section and **select Streams_100ft_Buffer**, **Water_100ft_buffer**, and then **Wetlands_100ft_buffer**.

3. In the **Output Dataset** box, **click** the Browse  button and **navigate** to your **student folder**.

4. **Save** this dataset as **Streams_Water_Wetlands_100ft_Buffer**.



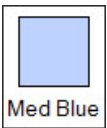
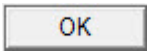
5. During the process, this trailer [fer...Multiple Rin](#) will appear at the bottom of your screen. It will disappear when the merge is complete.

6. **Click**  to begin the **Merge** process.

7. Because you will no longer need the initial buffers (**Streams_100ft_Buffer**, **Water_100ft_Buffer**, and **Wetlands_100ft_Buffer**) that you created, **right click** on each them and **select remove**.

8. In the table of contents, drag the **Streams_Water_Wetlands_100ft_Buffer** layer below the Water and Wetlands layers.

9. **Single click** on the symbol in the table of contents for the **Streams_Water_Wetlands_100ft_Buffer** to open the Symbol Selector box.

10. **Change** the color to  and then **click**  to close to apply the new color.



Creating a Multiple Ring Buffer


Now that the water and wetland sources have buffers, you will need to focus on the needs of the beaver. Beavers will typically settle along the banks of a water source such as a stream or river. When beavers build a dam, they not only are building a structure in which they will live, but they also change the surrounding ecosystem. This change usually happens when the stream backs up or at least slows, allowing other living organisms to thrive and survive in that area. In order to determine a good core preserve area, the beaver must be allowed area in which to forage. These animals will usually forage 350 feet (with some venturing up to 650 feet) from their dam. A multiple ring buffer will need to be created to represent these two ranges from the streams in the preserve area.

1. **Single click** the symbol for **Streams** in the **table of contents** to open the **Symbol Selector** box.



2. **Edit** the color to **River** and then **click**  to apply the change and **close** the **Symbol Selector** box.


3. In **ArcToolbox** (under Analysis Tools/Proximity, if ArcToolbox was closed), **double click** on **Multiple Ring Buffer** to open the **Multiple Ring Buffer** box.


4. In the **Input Features** box, **click** the down arrow  and **select Streams** from the options listed.

5. For the **Output Feature Class**, **click** the **Browse**  button and **navigate** to your **student folder**.

6. **Save** the file as **Beaver_Forage_350_650_Buffer**.

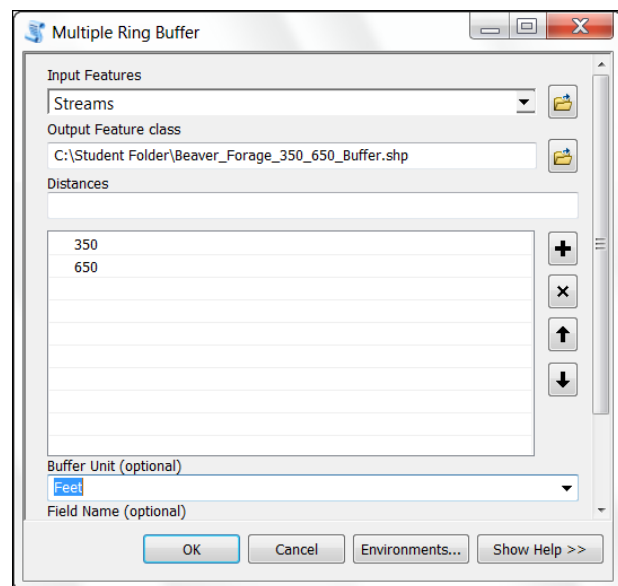
7. For the first distance, **enter 350** in the **Distances** box.

8. **Click**  **Add** button to send this number to the box below **Distances**.

9. **Enter 650** in the **Distances** box and **click**  again to add this total in the box below **Distances** also.

10. **Edit** the **Buffer Unit** to **Feet**.

11. **Leave** the other options as is and **click**  to run the multiple ring buffer.




12. During the process, this trailer [fer...Multiple Ring](#) will appear at the bottom of your screen. It will disappear when the multiple ring buffer is complete.
13. **Drag** the **Beaver_Forage_350_650_Buffer** below the **Streams_Water_Wetlands_100ft_Buffer**.
14. **Single click** on each of the colors for this layer in the **table of contents** to edit them to shades of brown as shown.

All of these buffer areas represent areas that should be included in the preserve and left as undisturbed as possible.



Land Cover and Food Sources

Upon inspection of the property, it was discovered that there was a slight variance in land cover. There were areas of woody vegetation, hemlock stands, areas with steep slopes, and several others. Beavers, being herbivores, forage on items such as leaves, twigs, woody plants, and aquatic vegetation. Aside from the steep slopes, the woody areas represent places that the beavers may visit to forage but not necessarily use for their habitat. Steep slopes, on the other hand, represent areas that are not necessarily suited for building human residences or beaver habitats but represent areas that naturally add to the nature preserve. You will now map these different types of areas.

1. **Click** the **Add Data**  button and **navigate** to the **C:\DQ\AGIS\STEM\Lesson01** folder.
2. **Double click** **PotentialBeaverFoodSource.shp** to add it to your map.
3. **Repeat Steps 1 and 2** to add **Hemlock_Stand.shp**, and **Steep_Slope_Area.shp**

You will now Merge these layers together into a single layer that represents food sources (in addition to their habitat) or natural features that are to be avoided during development.

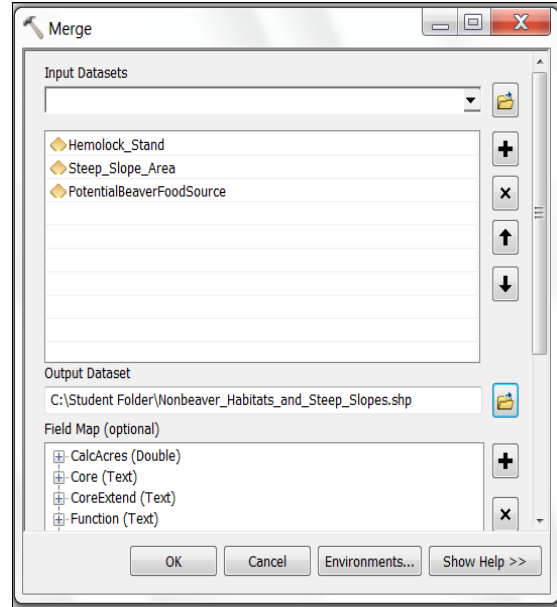
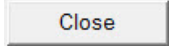
4. In **ArcToolbox**, open the **Data Management Toolbox** by *double clicking* on it.


5. *Double click* on the **General** tray icon and then the **Merge** tool to *open* the **Merge** box.

6. For the **Input Datasets**, *select* **Hemlock_Stand**, **Steep_Slope_Area**, and **Potential_Beaver_Food_Source**.

7. **Save** the **Output Dataset** in your **Student Folder** as **Nonbeaver_Habitats_and_Steep_Slopes**.

8. When the **Merge** is complete, *click*

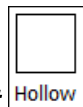


9. *Edit* the symbology of this layer to  **Green** by *single clicking* on the symbol for **Nonbeaver_Habitats_and_Steep_Slopes** in the **table of contents**.

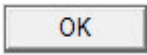
10. *Right click* and *remove* **Hemlock_Stand**, **Steep_Slope_Area**, and **Potential_Beaver_Food_Source** layers.

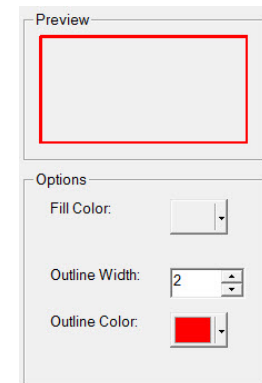
In order to be able to better view the **Property_Owners_Boundary**, you will need to edit and move it.

11. *Single click* on the symbology for **Property_Owners_Boundary** to open the Symbol Selector box.



12. *Select* **Hollow** and *change* the **Outline Color** to bright **Red**.

13. *Edit* the **Outline Width** to **2** and then *click* .

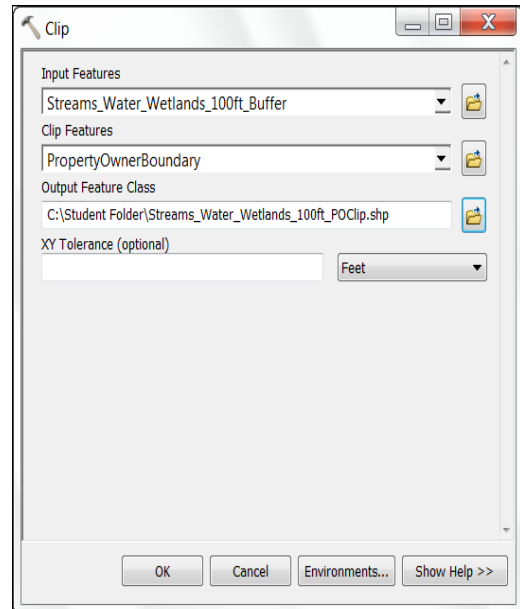
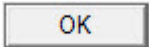


14. *Drag* the **Property_Owners_Boundary** above **Nonbeaver_Habitats_and_Steep_Slopes** layer in the **table of contents**.

Clipping & Merging Layers

In order to get a better idea of the area that will be the “core” of the nature preserve, the layers will have to be clipped to show only what is involved in the border of the Property Owner’s Boundary.

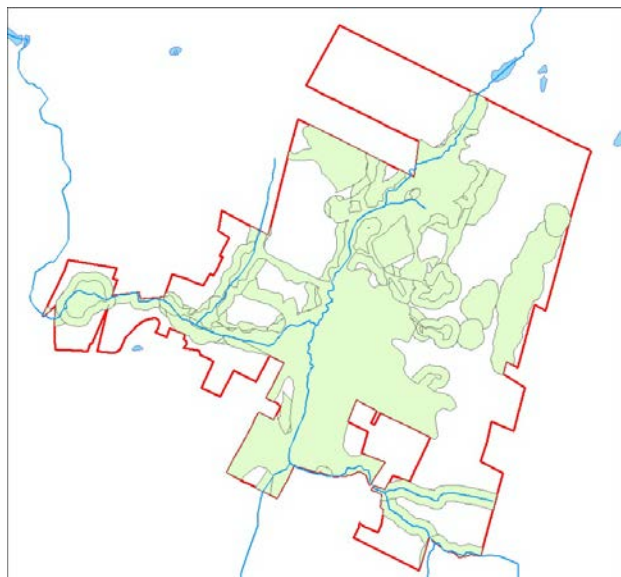
1. In **ArcToolbox**, **double click** the **Analysis** toolbox to open it.
2. **Double click** on the **Extract** toolset and then **double click** on the **Clip** tool.
3. For the **Input Features**, **select** **Streams_Water_Wetlands_100ft_Buffer**.
4. In **Clip Features**, **select** **Property_Owners_Boundary**.
5. For the **Output Features Class**, **navigate** to your **student folder** and **save** the file as **Streams_Water_Wetlands_100ft_POClip**.
6. **Leave XY Tolerance** as is and **click**



7. **Turn off** both the **Streams_Water_Wetlands_100ft_Buffer** and the **Beaver_Forage_350_to_650_Buffer** in the **table of contents**.
8. **Merge** the **Streams_Water_Wetlands_100ft_POClip** and the **Nonbeaver_Habitats_and_Steep_Slope** areas using the **Merge** tool.
9. **Save** the **Output Dataset** in your **student folder** as **Core_Preserve_Area**.

Now that the core area of the nature preserve has been mapped out, planners will have a visual aid to guide them in making the decision of the perimeter of the Mill Brook Preserve.

Can you think of other applications in your community in which these steps could be taken to make a decision?





A Geospatial Industry Series in STEM
Data Management Tools – Merge & Clip



Whenever data is acquired for a project, if it was not made specifically for your project, it may be too expansive for your needs. Too much data may be confusing and may seem to slow the performance of your computer. In this lesson you learned how to consolidate data by merging it and how to eliminate excess parts of the data files away via clipping. Neither of these acts permanently alters the original files. The original files can be added and analyzed in this or in other ArcMap documents. Being able to properly manage data is a valuable skill that many geospatial technicians must learn to be effective project managers.



a Geospatial Industry Series in STEM

Using GIS to Support Sustainable/Green Technology

**Lesson 2: Where Can A Biodiesel Fuel Company “Strike” Oil?
Using Geospatial Technology for Biodiesel Location**

Biodiesel is a fuel alternative that is made from renewable resources such as those found in vegetable oils or animal fats. The fuel is available as pure biodiesel or biodiesel blends that contain certain percentages of biodiesel along with petroleum diesel. Biodiesel is nontoxic and burns cleaner than petroleum fuel and is, therefore, more desirable for the environment.





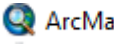
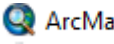
Soybeans are one of several sources that can be used for biodiesel production. After they no longer need the oil from their deep fryers, many restaurants have to dispose of their waste vegetable oils (WVO). These oils can be taken and refined into biodiesel. Biodiesel fuel can also be made from algae! Finding biodiesel can be a challenge. However, more retailers are starting to carry it. Some websites list biodiesel retailers, including maps for those nearest you or ones that can be found along a route of travel.

Scenario:

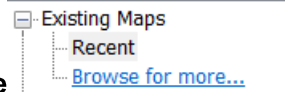
Tempe, Arizona, is located just west of Phoenix. It is a college town with many different things to see and do. The college students as well as the locals have a vast array of restaurants from which to choose when dining out. Knowing it has plentiful resources in this area, a new company, BioDFuels, has moved into town. This company offers restaurants a service for free for which, up until now, they have had to pay - collecting used cooking oils, also known as waste vegetable oil (WVO). One hundred percent of the products that BioDFuels gets from area restaurants will be recycled into biodiesel fuel that the company produces. The processing of the oil can take place in one day so literally the oil your fries were made in on Monday can be pumped into your car on Tuesday!

Along with producing a consumable product, restaurants are in the business of making money. BioDFuels, a biodiesel manufacturer, is in the process of building a biodiesel refinery in Tempe. This green company wants to contact local restaurants to see if it can set up schedules for picking up WVO. Your task will be to create a map and two reports showing the locations of these restaurants.

Opening and Saving an Existing Map Document

1. **Start** ArcMap by **double-clicking** the  shortcut on your computer desktop (or by **clicking** the Windows Start button , **pointing** to  **All Programs** and then  **ArcGIS**  and **selecting**  .)

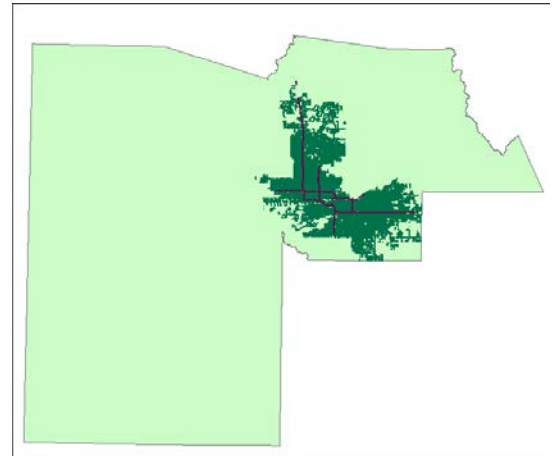
- In the **Opening** box, **select Browse for more Maps**, **navigate** to **C:\DQ\AGIS\STEM\Lesson02** folder.



- Double click** on **STEM_Lesson02.mxd** to open the map.

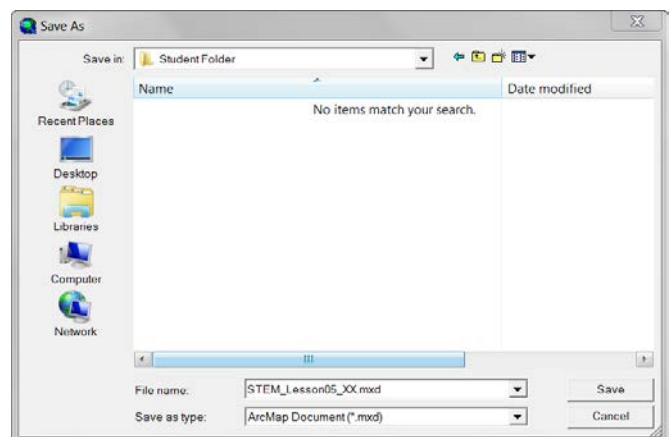
The map you are looking at is of Maricopa County, Arizona. This county has several well populated places, and our study area will work with a cluster of them including Phoenix, Tempe, Chandler, Mesa, and Gilbert.


This map will need to be saved to your student folder so that you may edit it as necessary.

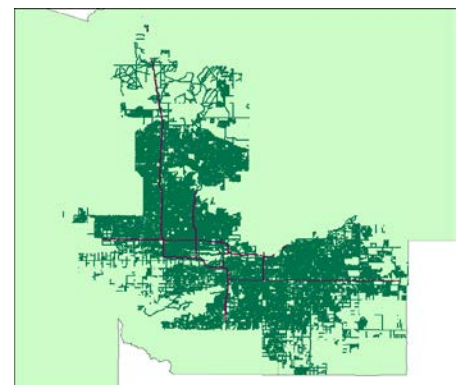


- From the **Main Menu**, **select File, Save As**.

- Navigate** to your **student folder** and **name** the file **STEM_Lesson02_XX** (where XX is your initials).



- To zoom in to the study area, **right click** on **Tempe_area_roads** and **select**  **Zoom To Layer**.



Adding and Editing Data Layers in ArcMap


The location of BioDFuels is in Tempe. You will now add it to your map.

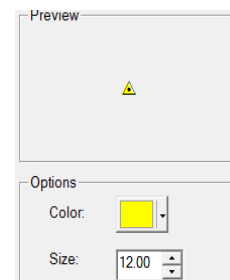
1. **Single click** the **Add Data**  button.
2. **Navigate** to the data folder **C:\DQ\AGIS\STEM\Lesson_05**.
3. **Double click** **BioDFuels_location** to add it to your map.
4. **Right click** **BioDFuels_location** to display its menu options and **select Properties**.
5. **Click** the **Symbololgy** tab.

6. **Single click** the **Symbol** box  to open the **Symbol Selector** box.

7. **Single click** **Triangle 3**  to select it.

8. **Edit** the color to **bright yellow** and **change** the **size** to **12**.

9. **Click**  to close the **Symbol Selector** box and to apply the change to the symbol.



The symbol for BioDFuels will appear in yellow on your map.





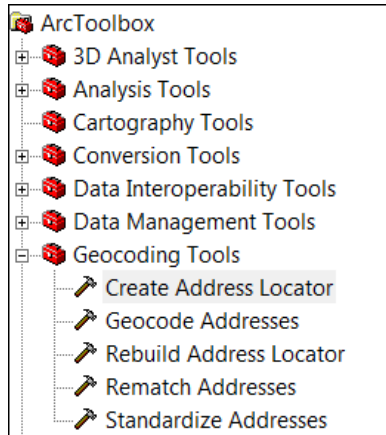

In order to establish a client base, BioDFuels would like to contact all restaurants near its facility. As part of your job, you will need to create a list and a map displaying the locations of these restaurants.

Creating an Address Locator

The names and addresses for all restaurants in Tempe have been given to you in the form of a spreadsheet. Before you can geocode this list so that it may be seen on a map, you must create an address locator. This address locator will enable the map to interpret the information contained in the spreadsheet.

1. **Click** the **Toolbox** button  on the **Standard Toolbar**. The **ArcToolbox** window will appear on your screen.

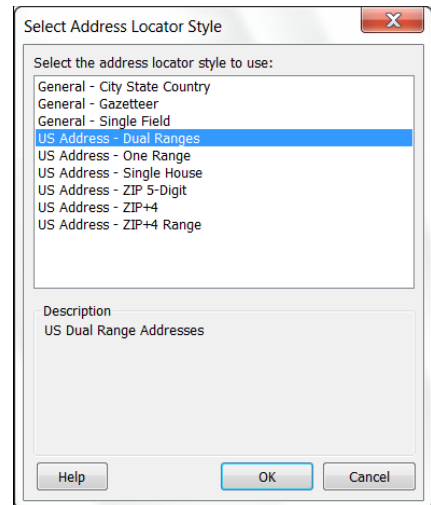
- In the **ArcToolbox** window, **expand** the  **Geocoding Tools** toolbox.
- Double click** the  **Create Address Locator** tool. The **Create Address Locator** dialog box will appear.

Scoping It Out...


Geocoding is the process of taking street addresses (nonspatial data) and converting them to spatial data so that they may be viewed in a map.


- Click the **Browse**  button to the right of the **Address Locator Style** box. The **Select Address Locator Style** dialog box will appear.

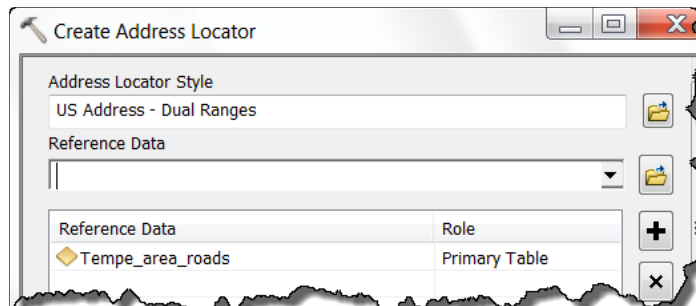


- Scroll** to find the **US Addresses - Dual Ranges** address locator style and **select** it.

- Click .


*Note: This will cause an error indicator(s) to show:  **Field Map**. This is only temporary and will be remedied in the next few steps.*

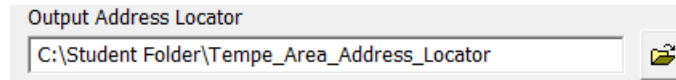
- Click the **down arrow**  to the right of the **Reference Data** box and **select** the **Tempe_Area_Roads** data layer as the reference data.

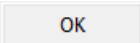


- Verify** in the **Role** cell to the right of the **Tempe_Area_Roads** data layer in the **Reference Data** list that **Primary Table** option is selected.

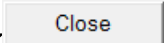

- Accept** the defaults under the **Field Map** options.

10. **Scroll down** (if necessary) and **click** the **Browse**  button to the right of the **Output Address Locator** box. The **Output Address Locator** dialog box will appear.
11. **Navigate** to your **student folder**.
12. **Name** and **save** the address locator as **Tempe_Area_Address_Locator** in your student folder.




13. **Click**  to create the address locator.

The **Create Address Locator** ribbon at the bottom of the screen will display the status of the processing.

14. When processing is complete, **click** .
15. **Close ArcToolbox** by clicking on the .

Geocoding Addresses to ArcMap

Now that you have created the address locator, the geocoding process can take place.

1. **Click** the **Add data**  button.
2. **Navigate** to the **C:\DQI\AGIS\STEM\Lesson_05** folder and **select** the **Tempe_Restaurants.xlsx** data file.

3. **Click** .

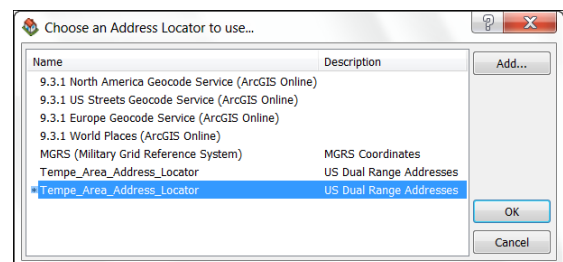
Workbooks typically come with more than one spreadsheet (i.e. Microsoft Excel gives three spreadsheets for every workbook opened). Because of this, you will have to designate the correct spreadsheet on the next screen.

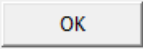
4. **Double click** on **Tempe_Restaurants\$** to add this table to your map.

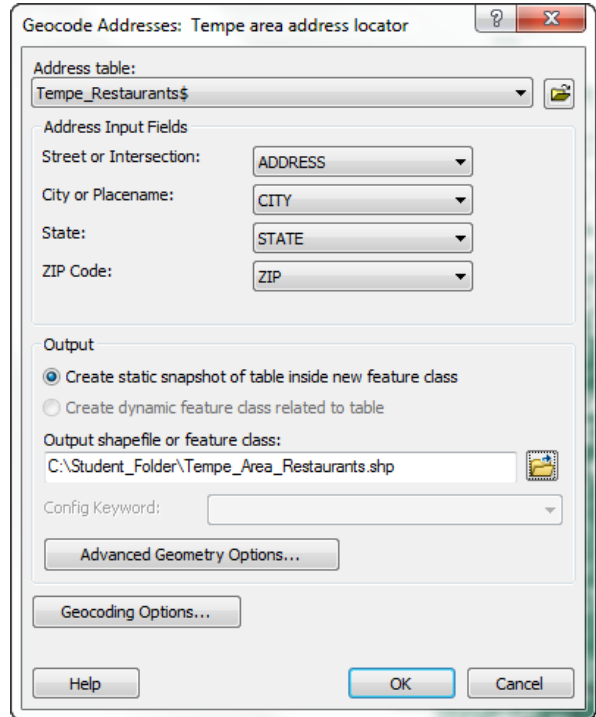
Because you have added a table, it will display as a layer on its own in the table of contents.

5. **Right click** on **Tempe_Restaurants\$** in your **table of contents** and **select Geocode Addresses**.

6. **Select** the **Tempe_Area_Address_Locator** and then .



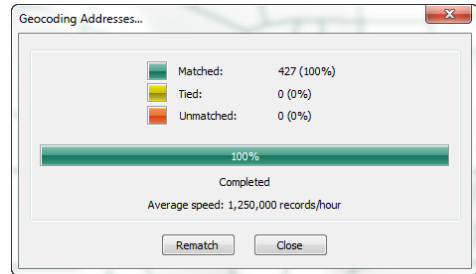
7. In the **Geocode Addresses** box, **verify** that **Tempe_Restaurants\$** is selected as the Address table.
8. **Leave** the **Address Input Fields** as is.
9. **Save** the **Output** in your **student folder** as **Tempe_Area_Restaurants**.
10. **Click**  to run the geocoding process.




When the process is complete, the completed box will appear:

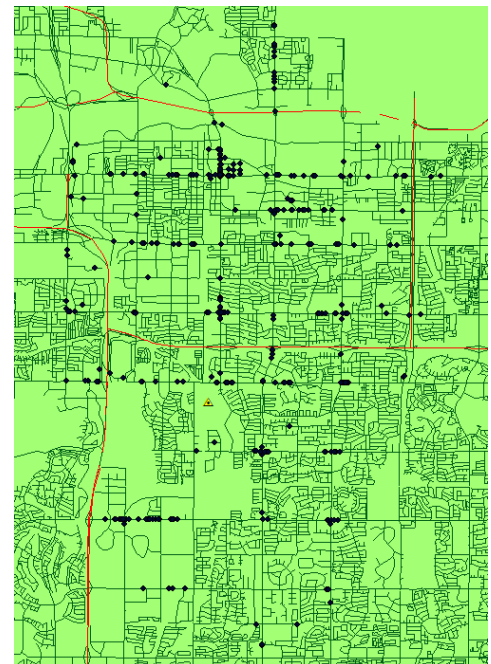
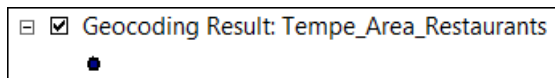
In this case, there are a total of 427 restaurants. All of these 427 (100%) were able to be placed in their approximate locations on the map.

Not all geocoding processes produce results where all addresses match and have a geospatial location on a map. When this is the case, selecting Rematch will allow you to either edit or further search the map for possible locations for those addresses that are unmatched or tied.

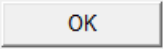


11. **Click**  to close the **Geocoding Addresses** box.

The new layer will be added to the table of contents and to the map.



The layer will need to be renamed so that it will make sense to those reading the map.


12. **Right click** on the new layer **Geocoding Result: Tempe_Area_Restaurants** and **open** its layer **Properties**.
13. In the **Layer Properties** box, **select** the **General** tab and **edit** the **Layer Name** to **Tempe Area Restaurants**.
14. **Click** .
15. **Right click** on **Tempe Area Restaurants** and **Zoom to Layer**.

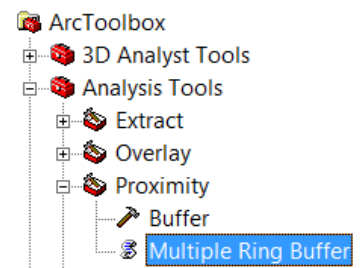
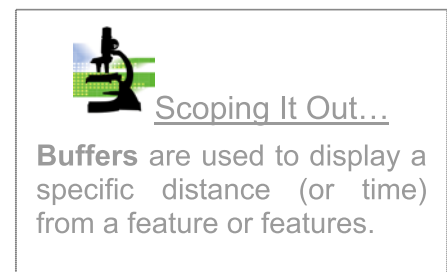
Because BioDFuels will be providing a free service to these restaurants, if it has to travel too far from its facility, the extra costs incurred to reach these restaurants may not be considered cost worthy. Ideally, within this first month of operation, BioDFuels would like to contact all restaurants within 3 miles of its business. As a secondary approach, to be done within the second month of operation, BioDFuels would like to contact all restaurants from just over 3 miles and up to 6 miles out.

BioDFuels now needs you to determine which of the local 427 restaurants fall into these categories.

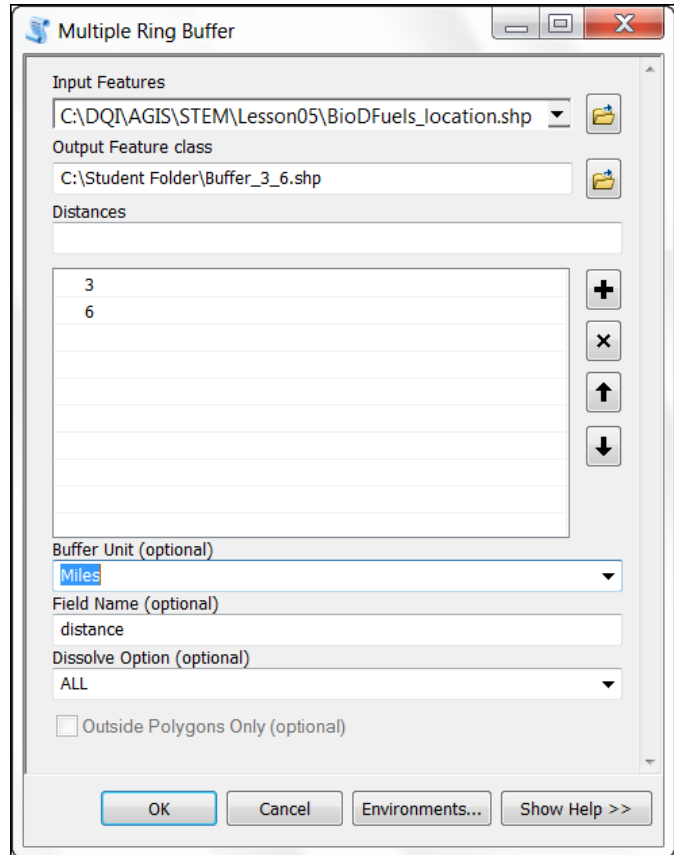
Creating a Multiple Ring Buffer

To determine which restaurants fall within 3 miles and 6 miles of the BioDFuels facility, you will create a multiple ring buffer. A buffer allows you to see how far something is from a specific point in every direction. A multiple ring buffer allows you to see more than one distance or time measurement from a given point.

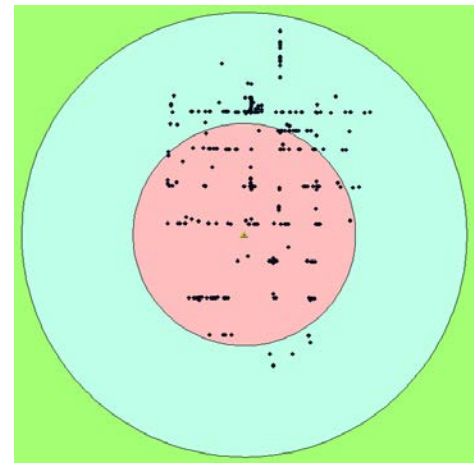
1. **Click Open Toolbox**  button to open **ArcToolbox**.
2. **Double click Analysis Tools** to expand its list.
3. **Double click Proximity** to display its list.
4. **Double click** on **Multiple Ring Buffer** to open the **Multiple Ring Buffer** box.



5. In the **Input Features** box, **select BioDFuels_location**.
6. **Save** the **Output Feature** class in your **student folder** as **Buffer_3_6**.
7. **Single click** in the **Distance** box and **enter 3**.
8. **Click** the **+** to accept the **3**.
9. **Single click** back in the **Distance** box and **enter 6**.
10. **Click** the **+** to accept the **6**.
11. **Edit** the **Buffer Unit** to **Miles**.
12. **Leave** all other fields as is.
13. **Click** **OK** to run the buffer.





14. **Right click** on **Buffer_3_6** and **select Zoom to Layer**.
15. **Turn off** both **roads** files by unchecking them in the **table of contents**.
16. **Close ArcToolbox** by clicking on the **X**.

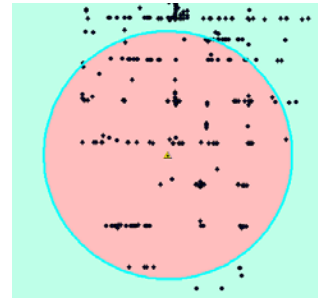




Setting Selectable Layers

Counting the number of restaurants in each buffer would require a large amount of time. After counting, you would still not have the names and addresses of these businesses. You will now need to split the buffer so that you can determine which businesses fall where.

1. On the **Tools** toolbar, **click** the down arrow beside the **Select Features by Rectangle**  button.
2. Because you will be selecting the buffers, **select**  **Select by Circle**.

3. In the map display window, **single click** inside of the first buffer (0 to 3 miles) to select it. The circle will have a highlight around it.
4. In the **table of contents**, **right click** on **Buffer_3_6** and **select Data, Export Data**.
5. **Save** the **Output shapefile** as **0_to_3_Miles_Buffer** in your **student folder**.

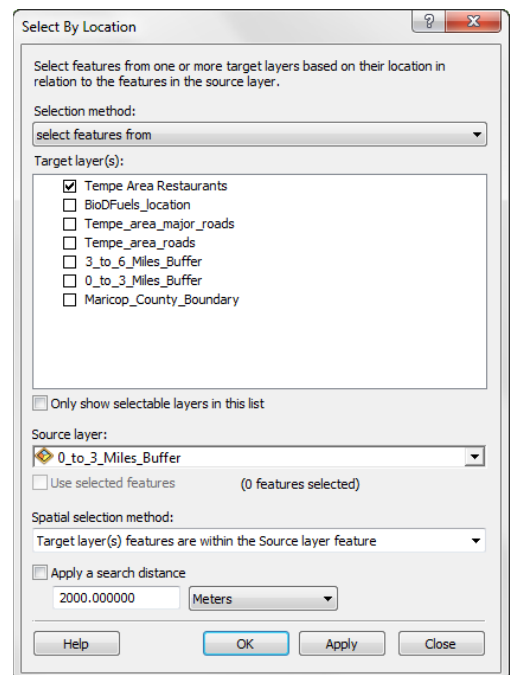


6. **Click** to add the exported data to the map.
7. **Click** the **Clear Selected Features**  button on the **Tools** toolbar to clear the selected buffer.
8. **Click** the **Select Features by Circle**  button and **click** the **outer buffer** to **select** it.
9. **Right click** **Buffer_3_6** in the **table of contents** and **select Data, Export Data**.
10. **Save** this **Output shapefile** as **3_to_6_Miles_Buffer** in your **student folder**.
11. **Click** to add the exported data to the map.
12. Because you no longer need the original buffer layer, **right click** **Buffer_3_6** and **select delete** from the options shown.

Using Select by Location in ArcMap

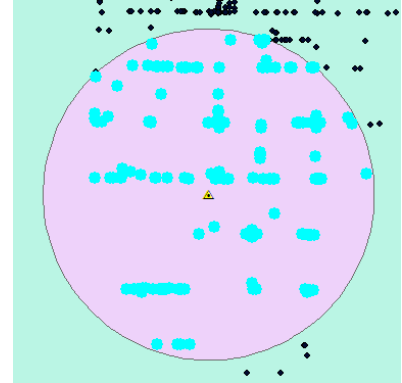
Now that you have two separate shapefiles to represent the two different distances from BioDFuels' location, you can create a list of restaurants for each. To do this, you will use Select by Location.

1. From the **Main Menu**, **click** **Selection**, then **Select By Location**.
2. In the **Select By Location** box, **verify** that **select features from** is selected in the first box.
3. **Click** the box beside **Tempe_Area_Restaurants**.
4. In the **Source layer**: **select** **0_to_3_Miles_Buffer**.
5. In the **Spatial selection method** box, **select** **Target layer(s) features are within the Source layer feature**.
6. **Click** to run the selection.



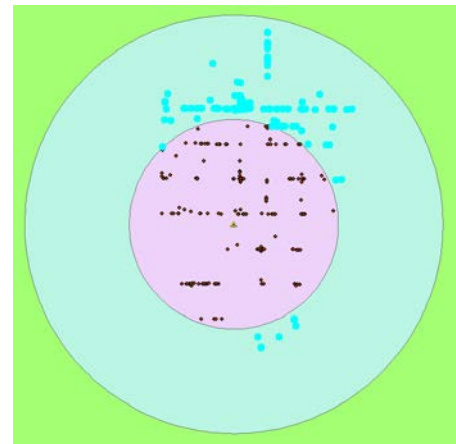
Now that you have these restaurants highlighted, you need to export them as their own shapefile to create your first list.

7. **Right click** on **Tempe_Area_Restaurants**, **select Data, Export data**.
8. **Save the Output shapefile** in your **student folder** as **0_to_3_Miles_Restaurants**.
9. **Click** to export the data.
10. **Click** to add the exported data to the map.
11. **Click** the **Clear Selected Features** button on the **Tools** toolbar to clear the selected restaurants.



You will follow the same procedures to designate those restaurants for BioDFuels second phase of marketing – those over 3 miles by less than 6 miles away.

12. From the **Main Menu**, **click Selection**, then **Select By Location**.
13. In the **Select By Location** box, **verify** that **select features from** is selected in the first box and that **Tempe_Area_Restaurants** is still selected in the center box.
14. In the **Source layer** box, **select 3_to_6 Miles_Buffer**.
15. **Verify** that **Target layer(s) features are within the Source layer feature** is selected as the **Spatial selection method**.
16. **Click** to run the selection.
17. **Right click** on **Tempe_Area_Restaurants** and **select Data, Export Data**.
18. **Save the Output shapefile** in your **student folder** as **3_to_6_Miles_Restaurants**.
19. **Click** the **Clear Selected Features** button on the **Tools** toolbar to clear the selected restaurants.
20. Because you already have restaurant data, you no longer need the **Tempe_Area_Restaurants** layer. **Right click** on **Tempe_Area_Restaurants** and **remove** this layer from the **table of contents**.

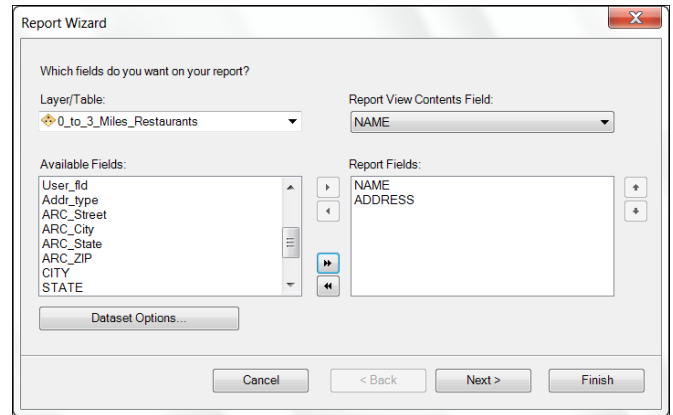


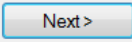
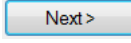
Creating Reports in ArcMap

Now you have created two shapefiles that contain the information about which area restaurants are within a 3 mile radius and which are more than 3 but fewer than 6 or fewer miles from the BioDFuels facility. With this information, you can now create not only a map showing this, but a report that will be able to be used for marketing purposes.

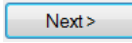
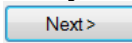
1. From the **Main Menu**, **click View, Reports**, and then **Create Reports** to open the **Report Wizard** box.
2. In the **Layer/Table** box, **select 0_to_3_Miles_Restaurants**.

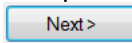
In the **Available Fields** window, all of the fields contained in the **0_to_3_Miles_Restaurants** table will be displayed. For this report, you will only need the name and addresses of the restaurants.

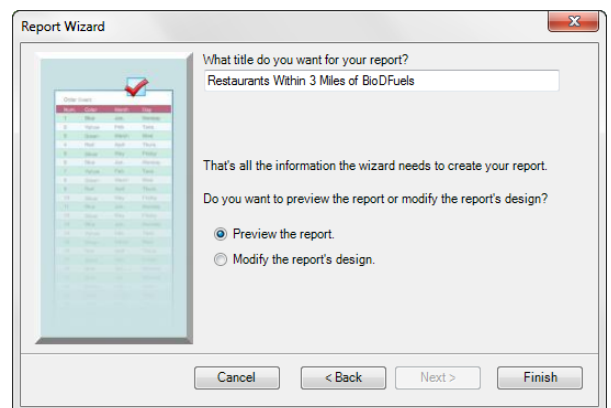


3. **Double click NAME** and **ADDRESS** to send them both to the **Report Fields** window.
4. **Click**  to view options for grouping levels. Leave the grouping levels as they are and **click** .



5. The third window of the Report Wizard allows you to determine how items are sorted. **Click** .
6. The fourth window offers a chance to determine the layout and its page orientation. **Verify** that **Adjust the field width so all fields fit on a page** is selected and then **click** .


7. Now you may choose a style for your report. **Select Stockholm**, and then **click** .
8. Now you may give your report a title. Name it **Restaurants Within 3 Miles of BioDFuels**.
9. After typing the title of your report, **select** the radio button next to **Preview the report**.



10. **Select** .

You can now see a preview of the report. In this preview, it shows that the Name and Address columns are too narrow and too far on the left side of the report. These fields need to be further edited.

NAME	ADDRESS
A & W ENTERPRISES	1801 S JENTILLY LN
DUCKS RESTAURANT & SPORTS BAR	915 E APACHE BLVD
TACO BELL	936 E APACHE BLVD
IHOP	225 E APACHE BLVD
KOREAN GARDEN	1324 S RURAL RD

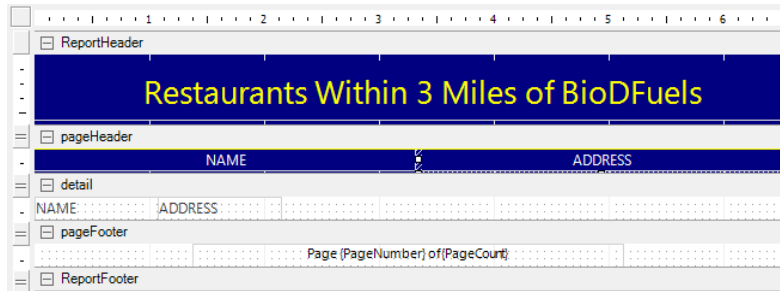
11. **Click**  to open the **Report Designer** box that will allow you to edit the individual properties of this report. This breaks the report up into its different elements. Many of these elements are represented within text boxes that can be resized and the text inside can be modified as well.

12. **Single click** in the box containing the report title to edit it.

13. On the Formatting toolbar, **click** the **center align**  button to center align the title on the page.

14. Under **pageHeader**, **select** the NAME box. This text box that will need to be widened.

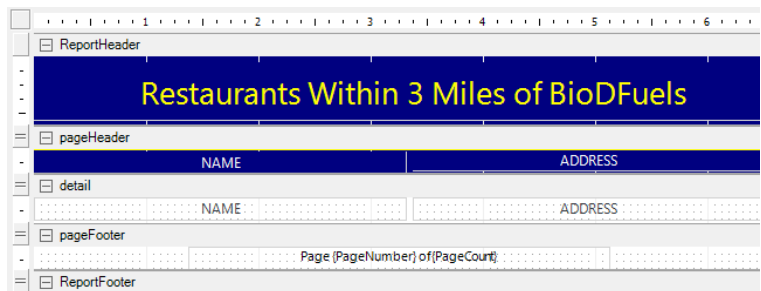
15. **Clicking** on the **right handle**, **resize** the box to be approximately **3.5” wide**.



16. **Select** the **ADDRESS** box and place it to the right of the **NAME** box.

17. **Resize** the **ADDRESS** box to approximately **3.5” wide**.


18. **Center align** both of the column names.



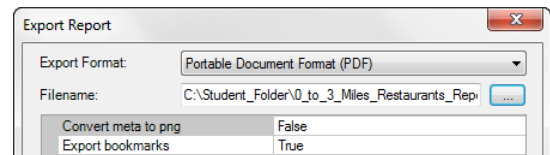
19. Under the **detail** section, follow the same procedures for **NAME** and **ADDRESS**.

20. **Click** on the **Run Report** button  at the top left of the **Report Designer** box.


Restaurants Within 3 Miles of BioDFuels	
NAME	ADDRESS
A & W ENTERPRISES	1801 S JENTILLY LN
DUCKS RESTAURANT & SPORTS BAR	915 E APACHE BLVD
TACO BELL	936 E APACHE BLVD
IHOP	225 E APACHE BLVD
KOREAN GARDEN	1324 S RURAL RD
WENDY'S	1314 S RURAL RD
WHATABURGER	1346 S RURAL RD
VINE TAVERN & EATERY	801 E APACHE BLVD
HAVANA BRO'S	1402 S PRIEST DR
TOP OF THE ROCK RESTAURANT	2000 W WESTCOURT WAY
J B'S RESTAURANT	2207 S 48TH ST #A
SWC CAFE	1600 W BROADWAY RD
FOOD TEAM	1438 W BROADWAY RD #8260
MC DONALD'S	1325 W BROADWAY RD
DENNY'S	1343 W BROADWAY RD
WENDY'S	790 W BROADWAY RD

21. To save a copy of this report as a portable file, **click** the **Export Report to file**  button from the top menu in the **Report Viewer** window. This will allow you to view and be able to print the report from outside of ArcMap.


22. In the **Export Report** box, under **Filename** **save** the document as **0_to_3_Restaurants_Report.pdf** in your **student folder**.



23. **Click**  to export the report.

24. In the **Report Viewer** window, **click**  to also save a copy of the report in an editable format within ArcMap.

25. **Navigate** to your **student folder** and **save** this as **0_to_3_Restaurants_Report.rdf**.

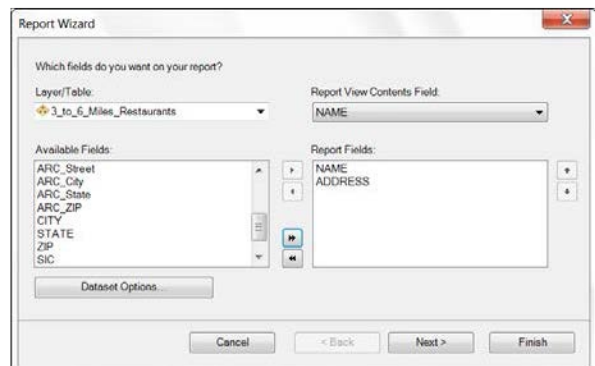
26. **Click**  to close the **Report Viewer** window.

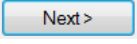
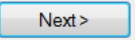
You will follow these same procedures to create a report for the restaurants 3 to 6 miles from the restaurant.

27. Under **View** on the **Main Menu**, **select Reports, Create Report**.

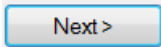
28. **Change** the **Layer/Table** to **3_to_6_Miles_Restaurants**.

29. **Double click** **NAME & ADDRESS** to make them move to the **Report Fields** window.

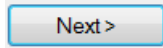


30. **Click**  to view options for grouping levels. Leave the grouping levels as they are and **click** .

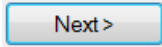
31. Because you only have two fields, you will not need to sort the fields. **Click**



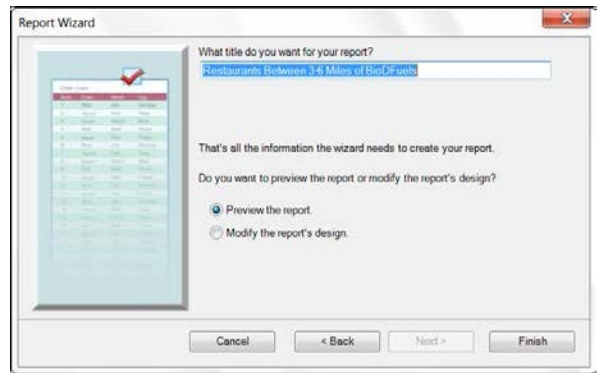
32. **Verify** that the layout is set for **Stepped** and **Portrait**, and then **click**



33. **Select Stockholm** once again for the style and then **click**



34. **Edit** the **Report Title** to read **Restaurants between 3 - 6 Miles of BioDFuels**.



35. After typing the title of your report, **select Preview the report** and **click**



From the Report Viewer window, you will notice that the same changes will need to be made to this report as was done in the previous report. You will also edit the color at top of the report.

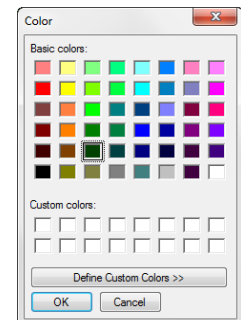
36. **Click** to open the **Report Designer** window.

37. Under the **Report Header** section, **single click** the title box to select it.

38. On the **Formatting** toolbar, **click** the **center align** button to center align the title on the page. *Note: if the title is cut off of the right side in the Report Designer window, manually click on it and drag it to until it is centered.*

39. On that same toolbar, **select** the **Back Color** button to open the color palate window.

40. **Select dark green** and then to **close** the color palate box.



41. Under the **pageHeader** section, **single click** the **Name** box to select it.

42. **Clicking** on the **right handle**, **resize** the box to be approximately **3.5" wide**.

43. **Select** the **ADDRESS** box and place it to the right of the **NAME** box.

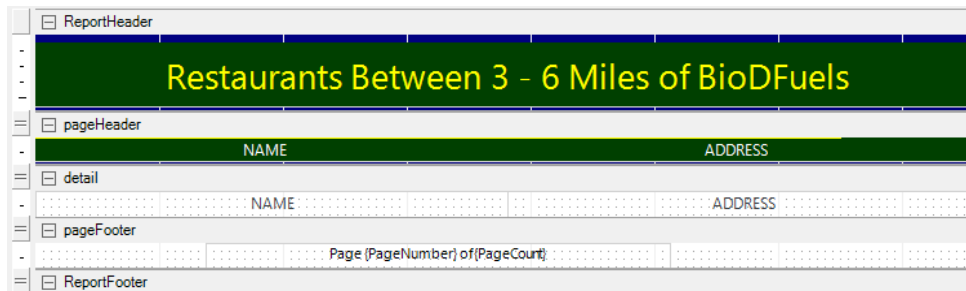
44. **Resize** the **ADDRESS** box to approximately **3.5" wide**.

45. **Center align** both of the column names.

46. **Edit** the back color of the **Name** and the **Address** boxes to **dark green** .


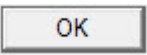



47. Under the **detail** section, **resize** the **NAME** and **ADDRESS** boxes.

48. **Center align** both the **NAME** and **ADDRESS** boxes.



49. **Click** the **Run Report** button  at the top left of the **Report Designer** box.

NAME	ADDRESS
VEGGIE FUN	2240 N SCOTTSDALE RD #8
LO CASCIO'S ITALIAN RESTAURANT	2210 N SCOTTSDALE RD
PICNIC CO GOURMET CAFE	1144 W WASHINGTON ST
JIM'S CONEY ISLAND CAFE	1750 N SCOTTSDALE RD
PHILLY'S SPORTS BAR & GRILL	1826 N SCOTTSDALE RD
BLUE IGUANA MEXICAN RESTAURANT	1849 N SCOTTSDALE RD
GRUMPY JOHN'S BBQ	1811 N SCOTTSDALE RD
JOAN'S KITCHEN	1857 N SCOTTSDALE RD
UDUPI CAFE	1639 N SCOTTSDALE RD
LA FONDA MEXICAN FOODS	1126 N SCOTTSDALE RD
LAYALENA	1290 N SCOTTSDALE RD #107
BURGER KING	1210 N SCOTTSDALE RD
SUBWAY SANDWICHES & SALADS	1380 N SCOTTSDALE RD
JACK IN THE BOX	901 E CURRY RD
DENNY'S	650 N SCOTTSDALE RD
PAPA JOHN'S PIZZA	735 E UNIVERSITY DR
CATERED BY CROSSON	525 S MCCLINTOCK DR
LUNCH BREAK	455 S 48TH ST #112
PERSONAL GOURMET	515 S 48TH ST #108

50. To save a copy of this report as a portable file, **click** the **Export Report to file**  button from the top menu in the **Report Viewer** window.
51. In the **Export Report** box, under **Filename** **save** the document as **3_to_6_Restaurants_Report.pdf** in your **student folder**.
52. **Click**  to export the report.
53. In the **Report Viewer** window, **click**  to also save a copy of the report in an editable format within ArcMap.
54. **Navigate** to your **student folder** and **save** this as **3_to_6_Restaurants_Report.rdf**.
55. **Click**  to close the **Report Viewer** window.
56. **Save**  the project.




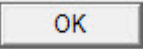
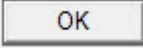
A Geospatial Industry Series in STEM Creating and Using Reports

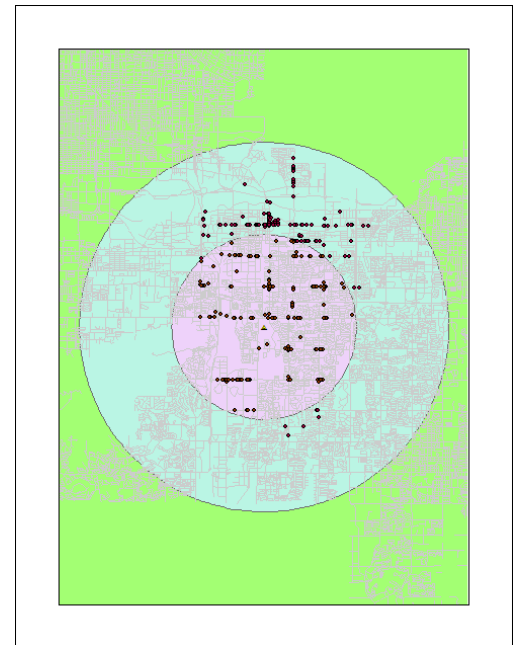


To be the most effective, a report like this should also include contact information. Additional fields might include phone numbers or email addresses. Because of the length of these reports (one was three pages and the second was eight pages), it is not useful to embed these reports in the map layout. They have been saved so that they can be printed and given to a company such as BioDFuels to develop its marketing plan. Can you think of any additional information that BioDFuels could benefit from having in its reports? Can you see how this would be beneficial from a marketing standpoint to a company?

Creating a Layout

The reports will supply BioDFuels with the list they desire however one additional task is to create a visual representation of that data in the form of a map layout.

1. **Switch** to **Layout View** by **clicking** on the **Layout View**  button at the bottom of the map display window.
2. **Right click** on **3_to_6_Mile_Buffer** layer in the **table of contents** and **select Zoom to Layer**.
3. **Turn on Tempe_area_roads** in the **table of contents** by checking it.
4. **Single click** the symbol below **Tempe_area_roads** to **open** the **Symbol Selector** box.
5. **Edit** the color of the roads to **Gray 20%** and **click**  to close the **Symbol Selector** box. This will allow the points for the restaurants to be easier to view.
6. From the **Insert** Menu, **select Title**.
7. **Double Click** the title to open the **Title Properties Box**. **Edit** the title to read **Restaurants Near BioDFuels**.
8. **Click** .
9. From the main menu, **click Insert >North Arrow** and select a North Arrow. **Drag** it to an area on the map in which it will not obstruct the view of any restaurants.



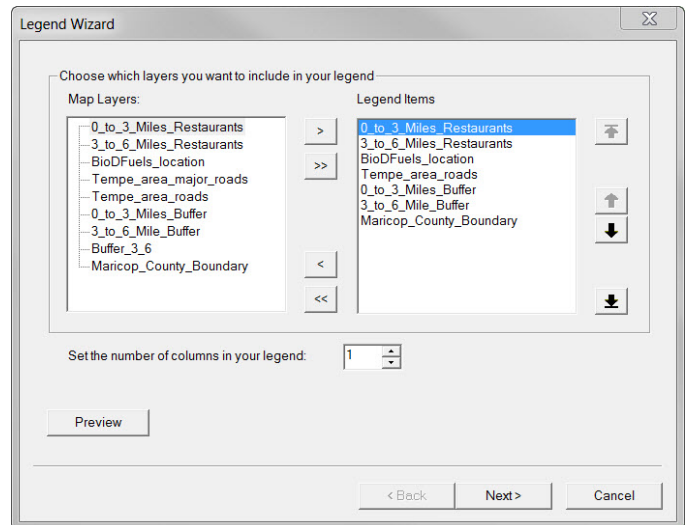
10. **Click Insert> Text.** *Type* your name and the **date**. **Drag** it to an area at the bottom of the map.

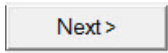
11. **Insert a Scale bar** and **position** it at the bottom of the map.

12. **Right click** on the **Scale bar** and **select Properties**.

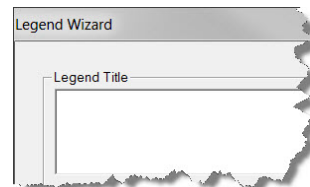
13. **Change the Units to Miles** and then **click** .

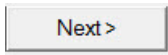
14. **Insert a Legend** to display all active layers in the map.



15. **Click**  to continue.

16. In the second window of the **Legend Wizard**, **delete** the word **“Legend”**.



17. **Click**  to continue.

18. In the third window of the Legend Wizard, **change** the **background to Grey 10%**.

19. **Click**  to continue three more times.

20. **Drag** the **legend** where it does not block any of the restaurants.

21. To **save** a copy of the map in a portable format, go to **File**, then **Export Map**.

22. **Navigate** to your **student folder** and **save** as **STEM_Lesson_05_XX.bmp** (where XX is your initials).

23. **Click**  to save the document.

Your map should look like this:



All three documents, the map and the two reports are now ready to be presented to BioDFuels.



A Geospatial Industry Series in STEM Creating and Using Reports



From geocoding to editing to creating reports, in completing this lesson, you have learned many important skills that professionals in the geospatial industry use. Although this lesson is centered on a company attempting to find clients by using these skills, many other scenarios could be implemented here as well. A company could use skills to map the locations of similar businesses (aka: its competitors) in the city or to locate possible complimentary businesses (like to map locations of gasoline stations that might be able to become biodiesel retailers). The next step up from this lesson would be to use a networking extension to determine the best route to and from these businesses.



a Geospatial Industry Series in STEM

Using GIS to Support Sustainable/Green Technology

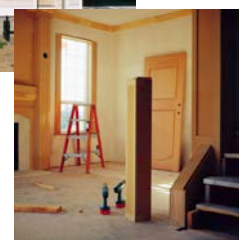
Lesson 3: How can Geospatial Technology be Beneficial to Conservation Biology?

Using Geospatial Technology in Habitat Preservation

Signs of progress are all around us. New homes. New roads. New buildings. Although these changes are usually good for us, these signs of progress may not be so accommodating to the animals that live in the areas being developed. As we expand the boundaries in which we live and work, most of the animals and plants that have inhabited the areas that we are taking over must relocate in order to survive.

A number of species are in an **endangered** (meaning that the species is like to become extinct) or **threatened** (meaning the species may become endangered if no corrective measures are taken) status. While not all of the problems in the animal and plant kingdom have humans to blame for their current status, our actions can directly affect the futures of plants and animals. One way to do this is to be environmentally responsible and investigate laws and regulations pertaining to any endangered or threatened species seen in or near your area.

Those involved in **Conservation Biology** want to perform actions that will keep plants and animals from becoming extinct. Without their efforts, many of the plants and animals that you see today would not be in existence. The following scenario will take you on a journey that might actually take place in the life of a developer with a keen sense for conservation biology.









Scenario:

XYZ Developers have been contracted to build a lodge in northeastern Chatham County, North Carolina. While surveying the land for the best potential site within the property boundary, a bald eagle is spotted. The bald eagle is considered “threatened” in the state of North Carolina. A “threatened” status means that the species is likely to become endangered. XYZ Developers knows that research must be done to ensure that the eagles and their habitats are not disturbed. The situation raises questions such as: Can we still build here? How far away from the eagle’s habitat must we build? These questions must be answered before work can proceed. At the time of the surveying, a small section of Harperella plants was also found. This species of plant life is considered “endangered” at both the state and national level. Endangered plants and animals are considered to be extremely rare and in danger of dying out.

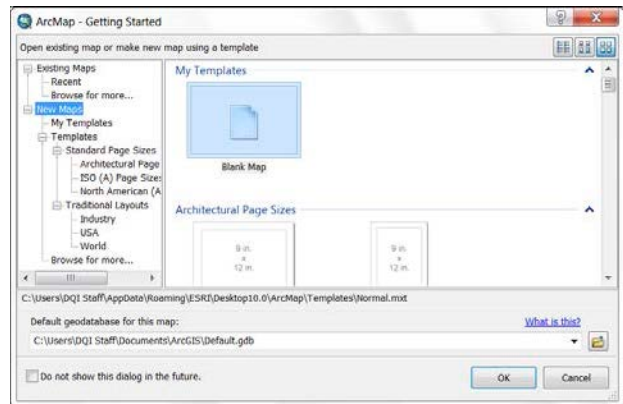
In this lesson, you, as an employee of XYZ Developers, will need to create a map displaying the known sightings of bald eagles and of the Harperella plants in the area. Further analysis will need to be done once this information is documented.

Launching ArcMap:

ArcMap is launched in the same manner as most Windows-based application programs.

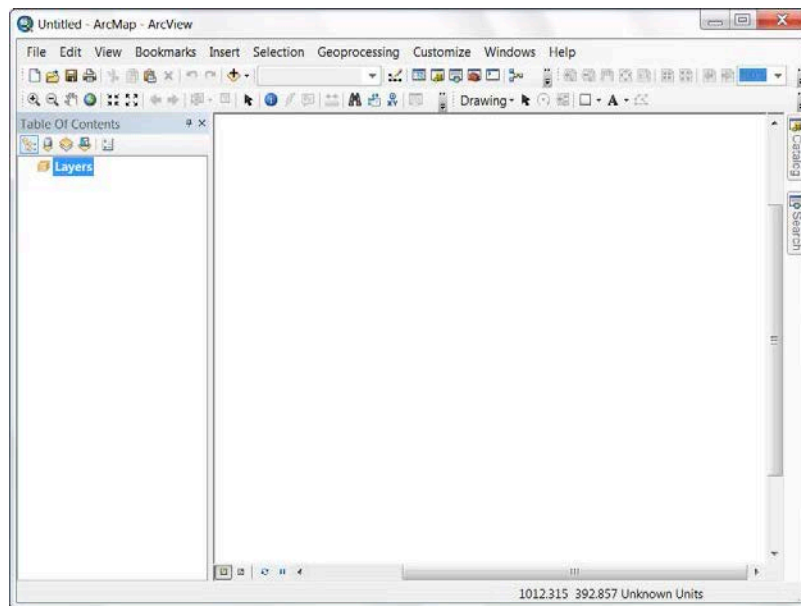
1. **Start** ArcMap by **double-clicking** the  shortcut on your computer desktop (or by **clicking** the Windows Start button , **pointing** to  **All Programs** and then  **ArcGIS**  and **selecting**  **ArcMap 10** .)

2. When the **ArcMap** window appears, **click** the box next to **New Maps**, and then **click Blank Map**.



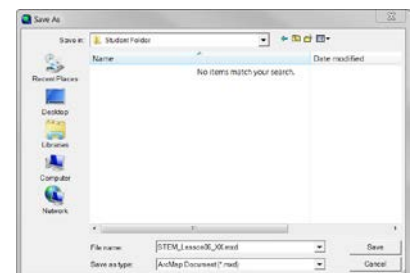
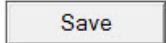
3. **Click**  .


A completely blank map document will open.



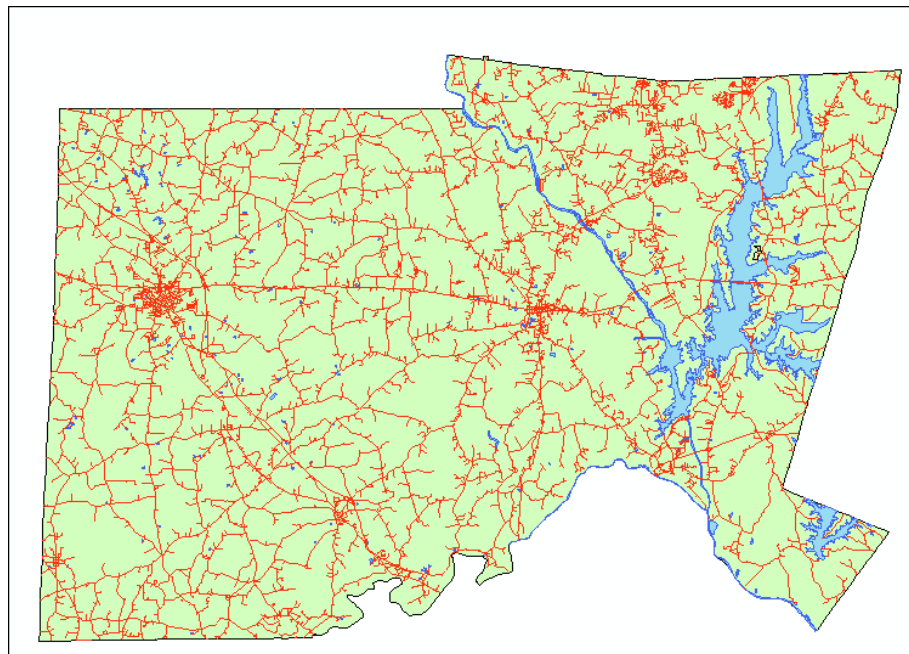
4. **Select Save As...** from the **File** menu to **save** this ArcMap map document in your student folder.

5. **Navigate** to a location specified for you to save your work on your computer hard drive. **Name** the new file **STEM_Lesson03_XX.mxd** (where **XX** is your initials) and **click**




6. **Click** the **Add Data** button  on the **Standard toolbar**. The **Add Data** dialog box will appear.
7. **Navigate** to the **C:\DQI\AGIS\STEM\Lesson03** folder.
8. **Select** the **Chatham_County**, **Chatham_Roads**, **Chatham_Water**, and **Woodlands_Lodge_Property** files.

Although ArcMap may have assigned different colors to your map, it should look like this; follow step 9 to organize your map like the one below:




9. **Place** the added layers in the order below in the **Table of Contents**. **Edit** the layers as indicated below:

(NOTE: You may have to click the **List by Drawing Order** button  in the above the **Table of Contents** window if you are unable to reorder the layers.)

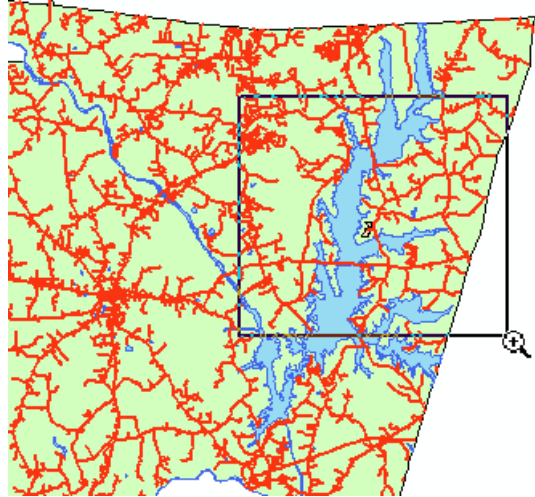
Feature	Color
Chatham Roads	Red, 1 point
Woodlands Lodge Property	Beige
Chatham Water	Lake
Chatham County	Light Green

Using the Zoom In Tool

The location of the Woodlands Lodge is located in the northeastern portion of the county. You will need to zoom in to this area to study it more closely.

1. On the **Tools** toolbar, **select** the **Zoom In** tool .
2. Use the **Zoom In** tool to **click, drag,** and **zoom** to the approximate area indicated in the image to the right.

As you can see from the map, the lodge will be built close to this lake.



Creating a Shapefile in ArcGIS

Upon inspecting the land for surveying, at least three sightings of one or more bald eagles near the property were recorded. The coordinates for the sightings were documented using a GPS unit and are noted below. This information will need to be set up in a spreadsheet so that you can add it as point data in ArcMap.

1. **Open** a new spreadsheet document in your computer's spreadsheet program (IE. Microsoft Excel).
2. **Enter Sighting, Latitude,** and **Longitude** on the top row of the spreadsheet.
3. **Enter** the data as shown below:

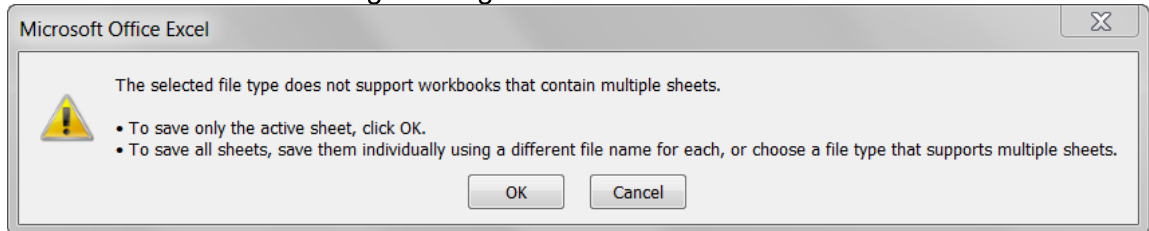
	A	B	C
1	Sighting	Latitude	Longitude
2	1st	35.764	-79.018
3	2nd	35.764	-79.036
4	3rd	35.729	-79.036
5			

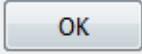
4. **Save** the file a as **Eagle_Sightings** in your **student folder** as a **Text (Tab delimited)(*.txt)**. This txt file is the one you will add to your ArcMap document.

File name:	Eagle_Sightings.txt
Save as type:	Text (Tab delimited) (*.txt)

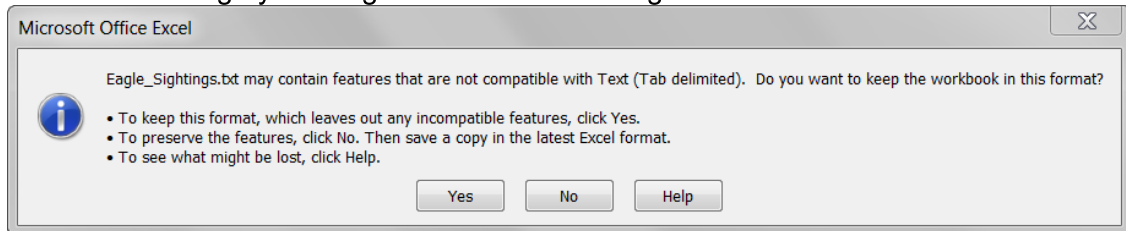
5. **Click** .

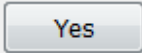
You will receive the following message:



6. **Click**  because there is no data on any other sheet than the first spreadsheet in the workbook.

The next message you will get will be the following:




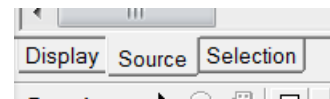
7. **Select**  to accept the text format.
8. **Close** the spreadsheet (click No if you are asked to save the changes).

Adding X, Y Data to ArcMap

You will now add the table you just created to ArcMap.

1. **Click** the **Add Data**  button on the **Standard toolbar**.
2. **Navigate** to your **student folder** and select **Eagle_Sightings.txt**.

This information is not yet ready to be displayed in ArcMap. You will notice when you add it, your table of contents shifts to the List By Source View . This will enable you to work with data that is not yet displayed in a spatial format.

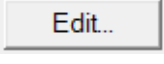
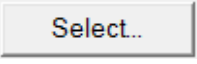



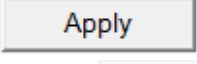
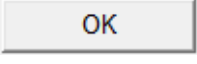
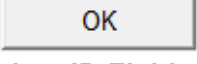


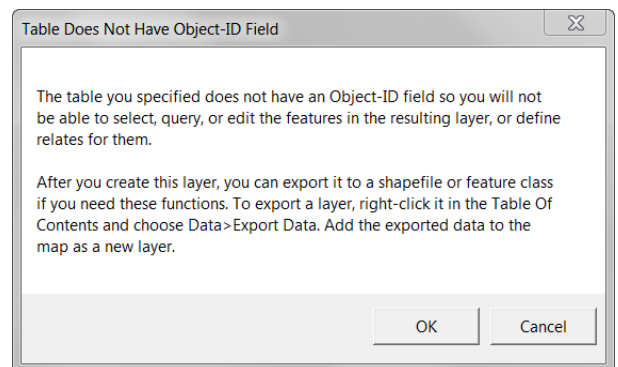
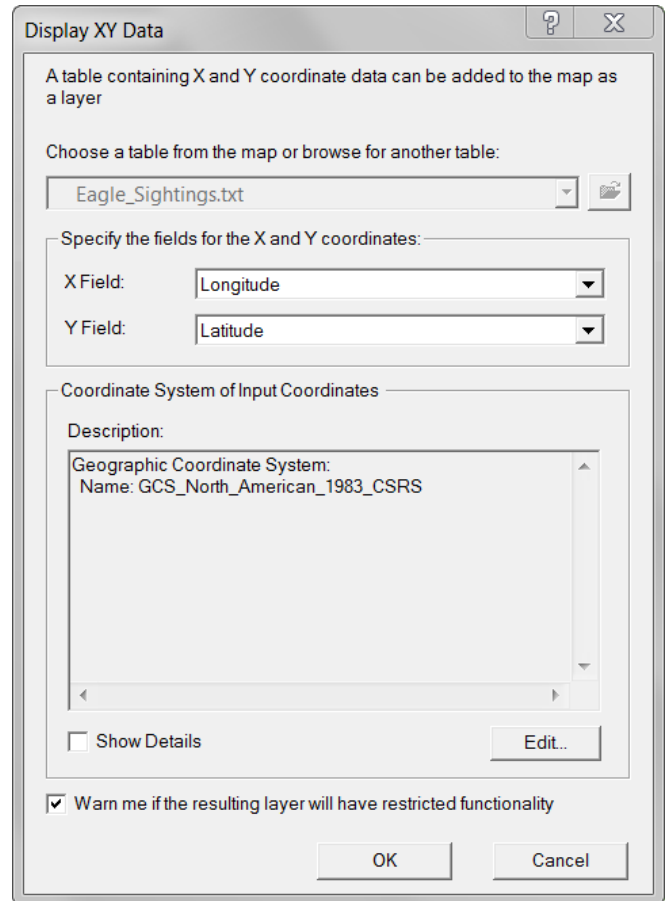
3. **Right click** on **Eagle_Sightings** and select  **Display XY Data ...**.

The Display XY Data dialog box will appear.

4. **Confirm** that **Longitude** and **Latitude** appear in the **X Field** and **Y Field** boxes respectively.

At this time, the spreadsheet that you added has XY coordinates. However, it will display a coordinate system identical to the data frame; you must specify the geographic coordinate system (Long, Lat) that the sightings are based on. There are several different ways to give it a coordinate system. The method you will use for this lesson will be to manually edit the coordinate system in the Display XY Data box.

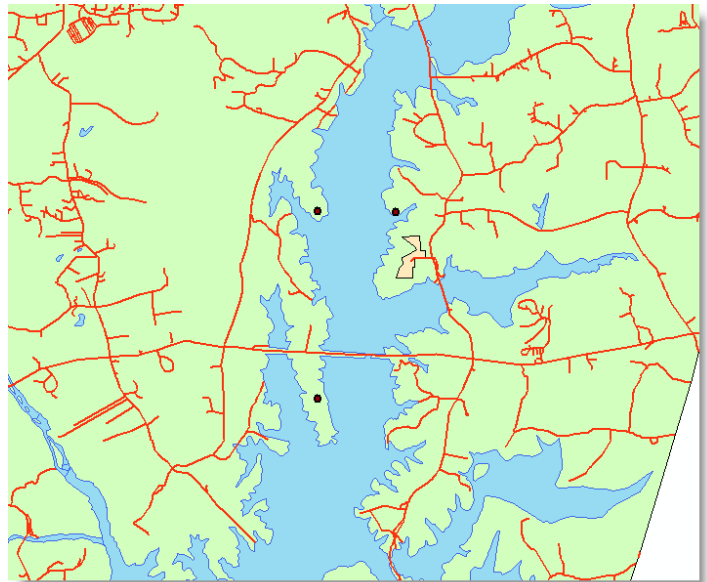
5. **Click**  to open the **Spatial Reference Properties** dialog box.
6. **Select**  to open the **Browse for Coordinate System** folder.
7. **Double click**  **Geographic Coordinate Systems** to select it.
8. **Double click**  **North America** to browse for coordinate systems.
9. **Double click**  **NAD 1983 (CSRS).prj**. This will allow the data contained in the table to know where to show on the Earth.
10. **Click**  to accept the changes and  twice to close the **Properties** and **Display XY Data** windows.
11. **Click**  if the message about the **Object ID Field** appears. You will follow these steps to create an object ID so that you will be able to select, query, or edit the features in this layer.


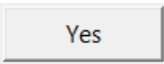


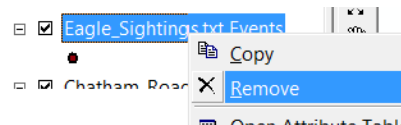
Complimentary for TSA Competitors

The points will show in the map display. However, without the object ID, you will not be able to conduct any analyses on these points.

If you look in the table of contents, you will notice that the filename associated with the eagle sightings ends in “Events”. This is another reminder that this is a temporary file and in order for it to be a true shapefile, you will need to export it and save it.



12. **Right click** on **Eagle_Sightings.txt Events** in the **table of contents**.
13. **Select Data, Export Data** from the options given.
14. In the **Export Data** dialog box, **select** **the data frame** so that the layer's coordinate system will match that of the Data Frame.
15. **Save** the **Output shapefile** as **Eagle_Sightings** in your **student folder**.
16. **Click**  to accept the changes.
17. **Click**  to add the exported data to the map as a layer.
18. Because you will no longer need it, **right click** and **remove** the **Eagle_Sightings.txt Events** file.



Although the bald eagle is now off the federal endangered species list, in North Carolina the bird is considered to be “threatened,” meaning it is likely to become endangered at some time in the near future if current conditions persist. In addition to their state and federal status, bald eagles are protected under the **Bald and Golden Eagle Protection Act**¹. This act was initiated in the 1940s and has undergone several amendments since, but it “prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their “parts, nests, or eggs.” This act expands on “taking” to mean, among other things, to disturb or agitate a bald or golden eagle to the point that it affects its “breeding, feeding, or sheltering behavior”. Violations of this act carry a stiff fine of \$100,000, imprisonment for one year, or both. All this can be the case for a first time offender!

With this in mind, XYZ Developers wants to make certain that it is not in danger of violating any rules with the bald eagles spotted near the building site of the lodge. Local wildlife officials were contacted to find if there were habitats, or nests, in the area near the lodge site. A few days later, it was reported back to XYZ Developers that only one habitat was found in the area. The

reported sightings most likely were from eagles using that one habitat. The location of that habitat was given to XYZ Developers in the format of an XY coordinate. You will follow the same procedures as for the sightings to create a shapefile for the eagle’s nest.

1. **Create** a spreadsheet with the following information:

	A	B	C
1	Nest	Latitude	Longitude
2	Location	35.774	-79.014
3			

2. **Save** the file as a **txt** file named **Eagles_Nest**.

3. **Close** the spreadsheet.

4. In **ArcMap**, **click** the **Add Data**  button on the **Standard toolbar**.


5. **Navigate** to your **student folder** and **select Eagles_Nest.txt**.


6. **Right click** on **Eagles_Nest** and **select**  **Display XY Data ...**.


7. **Confirm** that **Longitude** and **Latitude** appear in the **X Field** and **Y Field** boxes respectively.

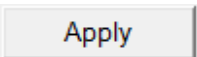
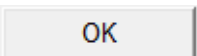
8. **Click**  to open the **Spatial Reference Properties** dialog box.

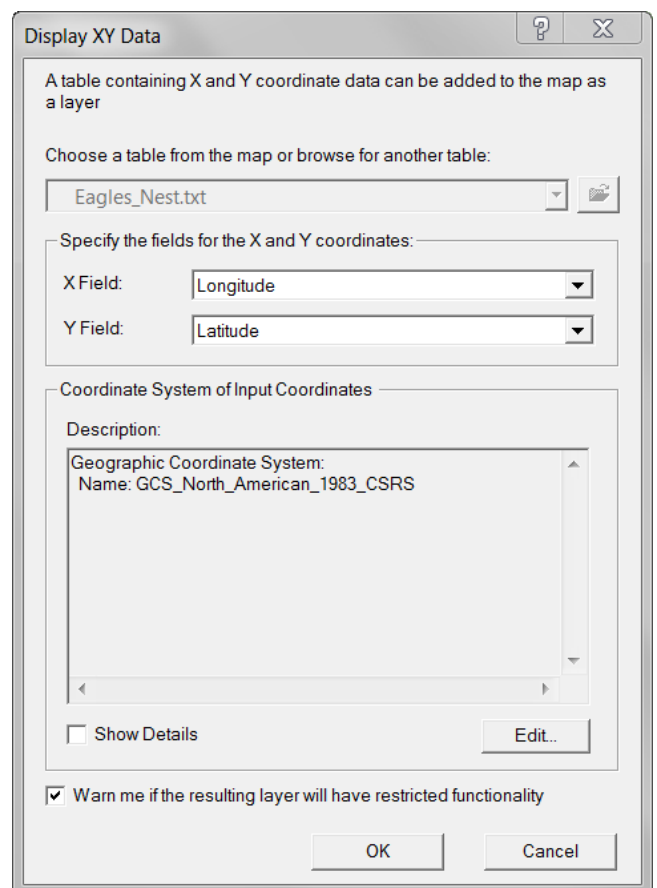
9. **Select** .

10. **Double click**  **Geographic Coordinate Systems** to select it.

11. **Double click**  **North America** to browse for coordinate systems.

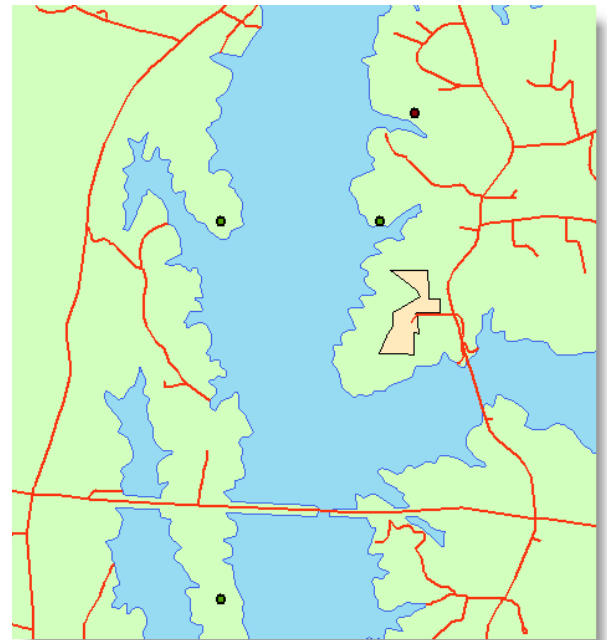
12. **Double click**  **NAD 1983 (CSRS).prj**. This will allow the data contained in the table to know where to show on the Earth.

13. **Click**  to accept the changes and  twice to close the **Properties** window.



Once the file is added as an events layer, it will need to be exported so that further analysis can be conducted on it and to make the Shapefile permanent.

14. **Right click** on **Eagles_Nest.txt Events** and **select Data, Export Data**.
15. In the **Export Data** dialog box, **select** **the data frame** so that the layer's coordinate system will match that of the Data Frame.
16. **Save** the **Output shapefile** as **Eagles_Nest** in your **student folder**.
17. **Click** to accept the changes.
18. **Click** to add the exported data to the map as a layer.
19. **Right click** and **remove** the **Eagles_Nest.txt Events** file.



Editing Symbology in ArcMap

Now there will be four points showing on your map. Editing the symbology of these will make your map easier to understand.

1. **Double click** on the current symbol for **Eagle_Sightings** to open up the **Symbol Selector** box.

The default symbols will be shown in the Symbol Selector window. Although there are many to select from, other symbols from different categories are available.

2. **Click** to view the other categories of symbols to select from.
3. From the list of options, **check Forestry**.

4. **Click** .

5. **Scroll** through the list until you find a pair of binoculars labeled **Viewing Area 1**.



6. **Single click** on **Viewing Area 1** to select it.


7. **Edit** the **size** to **15** and then **click** to close the **Symbol Selector** box.

8. **Double click** on the symbol for **Eagle's Nest**.

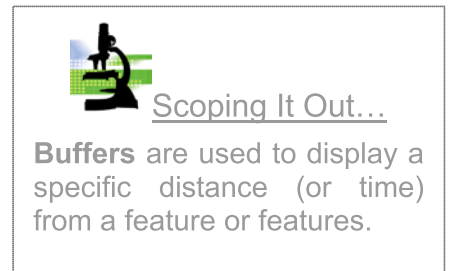
9. **Scroll** through the list to find **Raptors**  .
10. **Single click** to accept **Raptors** as the symbol.
11. **Edit** the **size** to **15** and then **click**  to close the **Symbol Selector** box.


Creating Buffers Using ArcToolbox

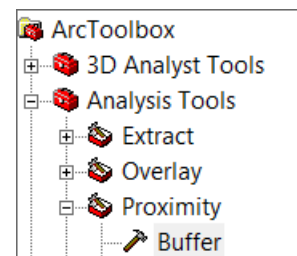
The United States Fish and Wildlife Service has created a National Bald Eagle Management Guideline in accordance with the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. This guide is to serve as a guide to anyone who shares public or private lands with these birds. In reading through this document, XYZ Developers has discovered that because its lodge will be four stories high, any building must be more than 660 feet from the nest site. How far is the eagle's nest from their construction site? You will create a 660-foot buffer around the eagle's nest using the buffer tool in ArcToolbox.

1. On the **Standard** toolbar, **click** the **ArcToolbox**  button to open **ArcToolbox**.

The ArcToolbox Window will open in your ArcMap window.



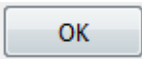
2. **Double click Analysis Tools** to view its contents.
3. **Double click Proximity** and then **double click Buffer** to open the **Buffer** dialog box.
4. **Click** the  on the right side of the **Input Features** box to display the list of shapefiles in the **Table of Contents** available for buffering.

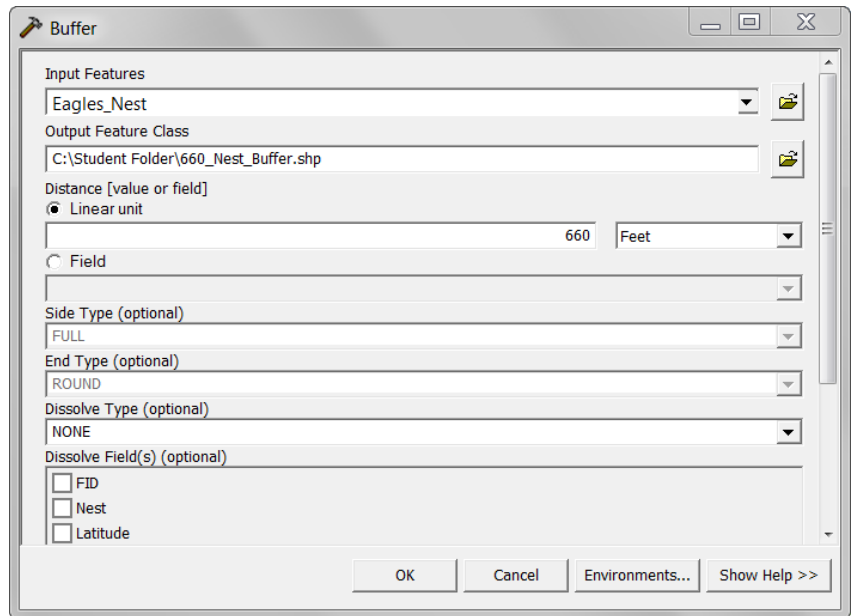


5. **Select Eagles_Nest** as the **Input Feature**.
6. For the **Output Feature Class**, **click** the  and **navigate** to your **student folder**.
7. **Save** the **Output Features Class** as **660ft_Eagle_Nest_Buffer**.


8. **Type 660** as the **Linear unit**. **Verify** that **Feet** is set in the pulldown menu.


9. **Leave** all other fields as they are.

10. **Click**  to start the buffer process. During the process, a scrolling marquee will appear at the bottom of the screen.

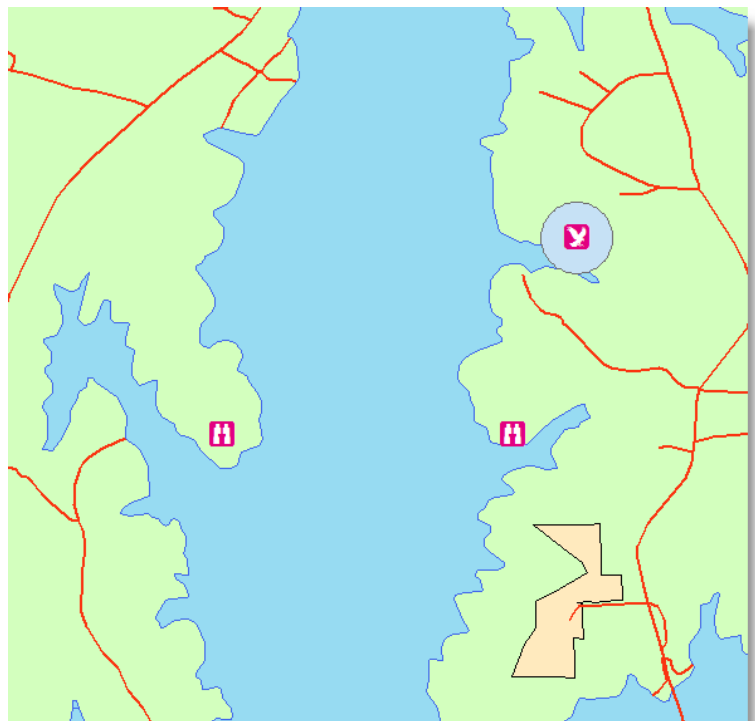


11. Once the process is complete, the ribbon at the bottom of the screen will disappear.

12. **Close ArcToolbox** by **clicking** on the  in the top right corner of the **ArcToolbox** pane.

13. Use the **Zoom In**  tool on the tools toolbar to zoom in to the area including the two closest sightings to the lodge area, the lodge area, and the nesting site to better view the buffer.

It appears from the buffer that the lodge site is well beyond the 660 feet required by the Bald and Golden Eagle Protection Act. This is one major item checked off XYZ Developer's list.





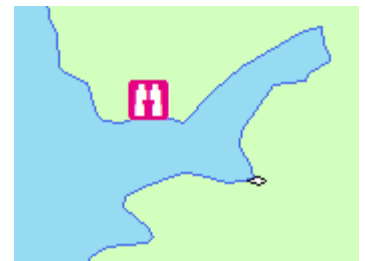
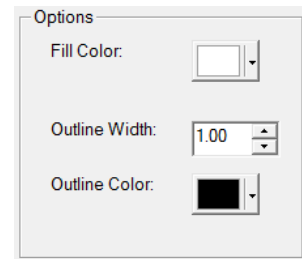


The Harperella is an endangered species that thrives in moist and rocky soil.
Source: US Fish & Wildlife Service

The new lodge is going to have two beach areas, a boat launching area, and several walking trails. Proposals sites for these items have been offered, but as of right now, no specific directions have been given to XYZ Developers. Something that might help with its decision was discovered when the eagle’s nest was found. The wildlife experts, who found the eagle’s nest, also discovered that the property contains a very rare and endangered plant, the Harperella. In the state of North Carolina, as well as the rest of the United States, the Harperella plant is considered endangered. Although no federal or state guidelines exist that specify a distance that must be kept from these plants, experts know these plants must not be disturbed. As a result of this information, XYZ Developers wants to establish a barrier around the area immediately around these plants as an environmentally conscious move. It will also supply the lodge owners with this information so that they may post signs on the property before guests arrive.


The location of the group of Harperella plants found on the property has been documented and a shapefile has been created. You will need to add this shapefile to your current map.

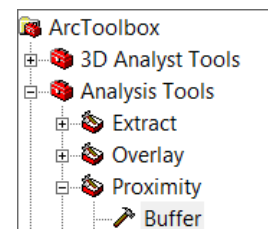
1. **Click** the **Add data** button  on the **Tools** toolbar.
2. **Navigate** to the **C:\DQI\AGIS\STEM\Lesson03** folder.
3. **Double click** to select and add the **Harperella_Location** file.
4. **Double click** the symbol for the **Harperella_Location** file to open the **Symbol Selector** box.
5. **Edit** the fill color to **White** and the **Outline** color to **Black** with a width of **1 point**.
6. **Use** the **Zoom In**  tool to zoom in to the territory where the Harperella is (South and East of the easternmost sighting).



Creating a Buffer Around a Polygon

These plants usually grow in rocky creek beds, on river banks, or in or near streams. They are extremely fragile and should be shielded from any development or human contact. For these reasons, XYZ Developers would like to create a 20 foot land buffer around these plants. It would also like to designate a 200 foot “no wake zone” in the water around these plants.

1. On the **Standard** toolbar, **click** the **ArcToolbox**  button to open **ArcToolbox**.
2. **Double click** **Analysis Tools** to view its contents.
3. **Double click** **Proximity** and then **double click** **Buffer** to open the **Buffer** dialog box.



4. **Click** the  on the right side of the **Input Features** box to display the list in the **table of contents**.

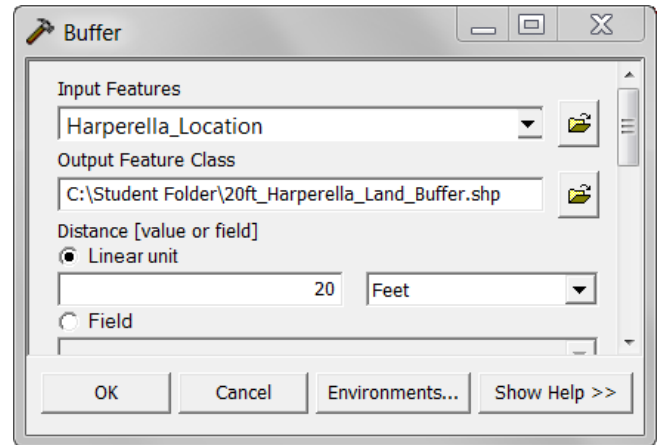
5. **Select Harperella_Location** as the **Input Feature**.

6. For the **Output Feature Class**, **click** the  and **navigate** to your **student folder**.

7. **Save** the **Output Features Class** as **20ft_Harperella_Land_Buffer**.

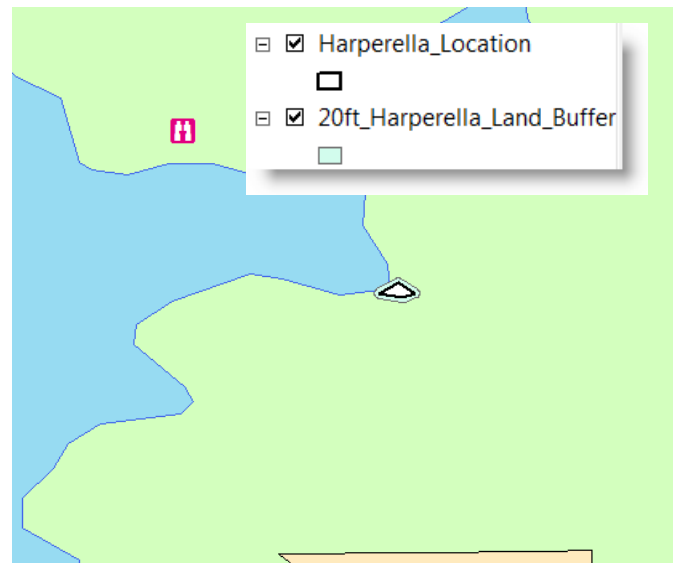
8. **Type 20** as the **Linear unit**. **Verify** that **Feet** is set in the pulldown menu.

9. **Click**  to run the buffer process.




10. When the process is complete, a buffer complete window at the bottom of the screen will appear briefly and then disappear.

In the table of contents, the newest polygon (20ft_Harperella_Land_Buffer) was added to the top of the polygons by default. You will need to move the Harperella Location file up to be able to view both at the same time.



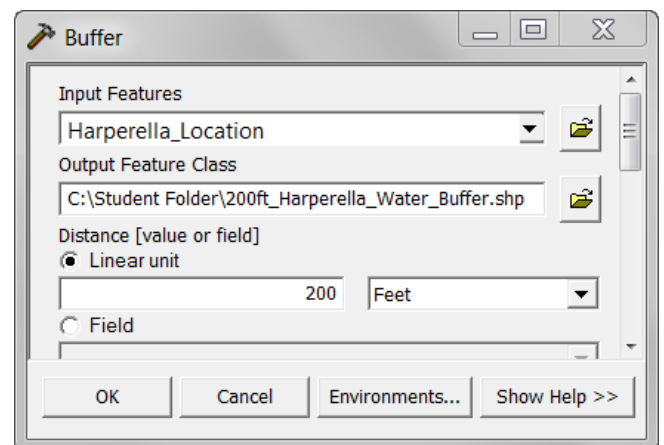
11. **Single click Harperella_Location** in the **table of contents** and **drag** it above the **20ft_Harperella_Land_Buffer**.

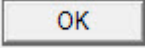

(NOTE: You may have to click the List by Drawing Order button  in the above the Table of Contents window if you are unable to reorder the layers.)

A second buffer will need to be created to designate the “No Wake Zone” in the water. There will need to be buoys placed out 200 feet in the water from the Harperella plants to keep boaters from creating waves that might disturb the Harperella population.

12. **Double click** again on the **Buffer** tool in **ArcToolbox**.


13. **Select Harperella_Location** as the **Input Feature**.

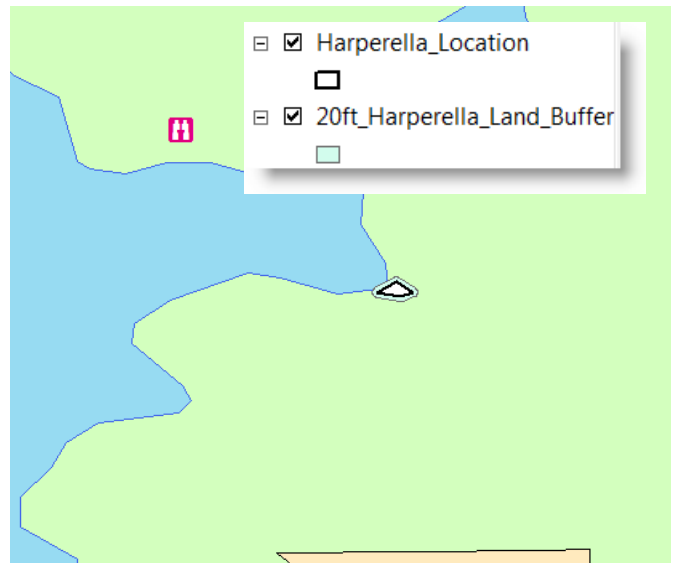


14. For the **Output Feature Class**, *navigate* to your **student folder**.
15. **Save** the **Output Features Class** as **200ft_Harperella_Water_Buffer**.
16. **Set** the **Linear unit** to **200 Feet**.
17. **Click**  to run the buffer process. During the process, a ribbon window will open at the bottom of the screen.
18. When the process is complete, a buffer complete window at the bottom of the screen will appear briefly and then disappear.
19. **Click** the **Save button**  to save your progress.

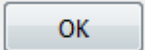
Using the Clip Tool

This buffer includes area both on land and in the water. Our concern with this buffer is to focus in on just the area in the water. You will use the Clip tool to show only the area that is in the water.

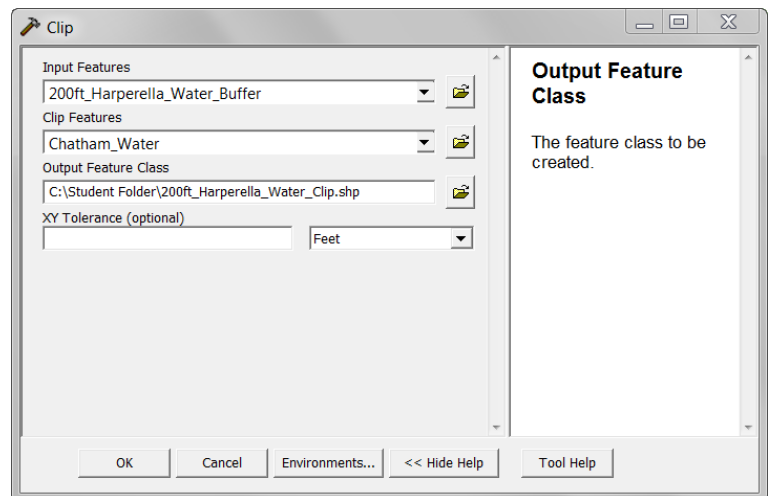
1. In **ArcToolbox**, **double click** on **Extract** under **Analysis Tools** to expand its list of options.
2. **Double click**  **Clip** to open up the **Clip** dialog box.
3. **Select 200ft_Harperella_Water_Buffer** as the **Input Feature**.
4. In the **Clip Features** box, **select Chatham_Water**.
5. **Save** the **Output Feature Class** in your **student folder** as **200ft_Harperella_Water_Clip.shp**.




6. **Leave XY Tolerance** blank.

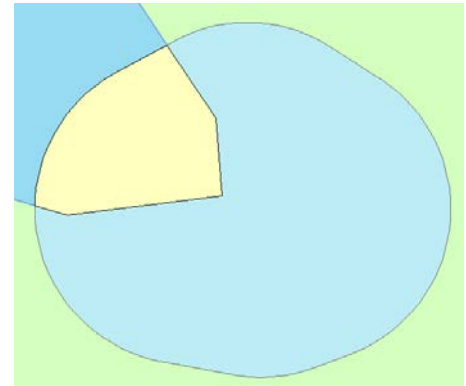
7. **Click**  to process this clip.

8. When the process is complete, a clip complete window at the bottom of the screen will appear briefly and then disappear.



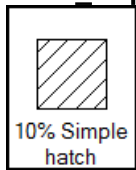
9. **Click**  to close the **ArcToolbox** pane.

You now have the area to be blocked off in the water as its own shapefile. This will allow you to edit the file to make this area stand out on a map.



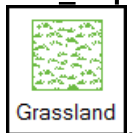
10. **Turn off** the **200ft_Haperella_Water_Buffer** shapefile in the **table of contents**.
11. **Drag** the **200ft_Haperella_Water_Clip** file beneath **20ft_Haperella_Land_Buffer** in the **table of contents**.

12. **Edit** the **symbology** of the **200ft_Haperella_Water_Clip** to

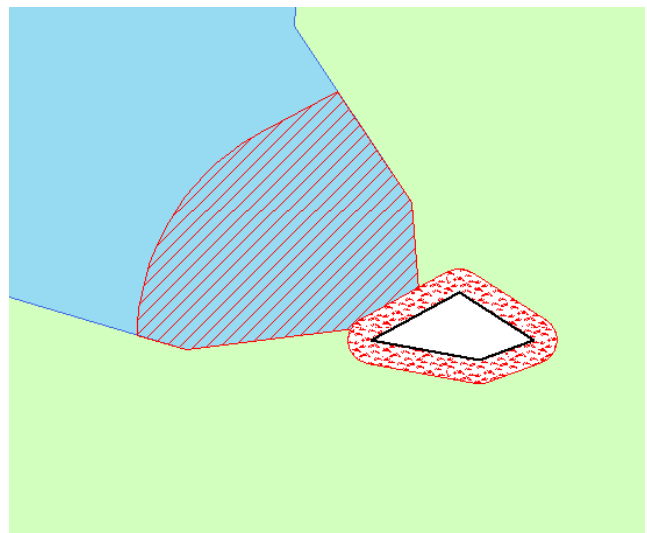


10% Simple hatch, **bright red fill color**, and the same **bright red** color for the **border** color.

13. Edit the symbology of the **20ft_Haperella_Land_Buffer** to




Grassland, **bright red fill color**, and the same **bright red** color for the **border** color.



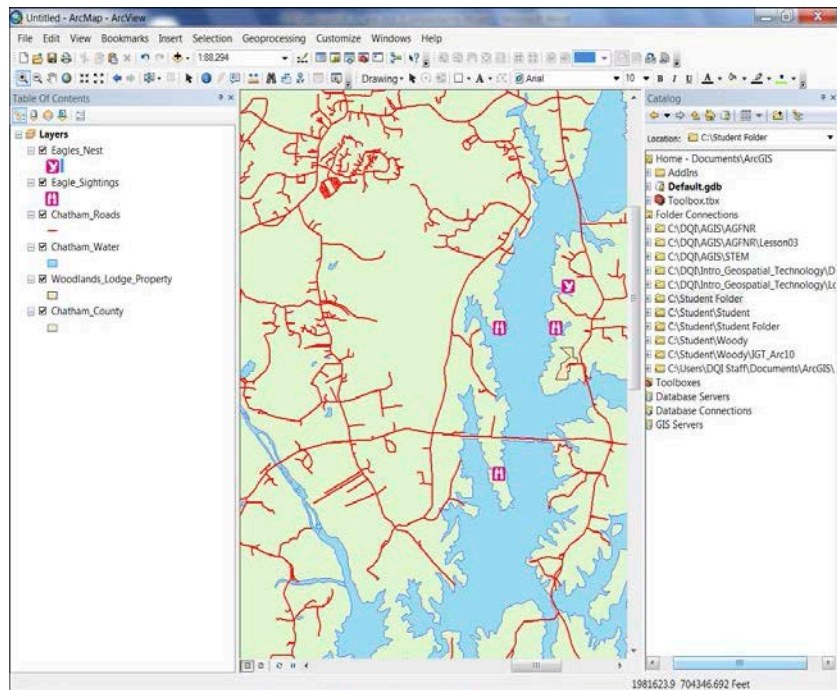
Creating Shapefiles using ArcCatalog

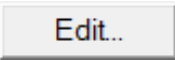
On land, signs need to be placed near the outer edges of the buffer to keep hikers from exploring the area in which the Harperella grows. In the water, markers, or buoys, need to be placed to slow boaters down. In order to do this, you will need to create two different shapefiles to show where these signs and markers should be placed.

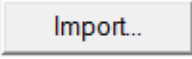
1. On the **Tools** toolbar, **click** the **ArcCatalog**  button to open **ArcCatalog**.
The **ArcCatalog** window will open on the right side of the map display.
2. In the **catalog tree**, **navigate** to your **student folder**.

3. **Right click** on your student folder, **select New** and then **Shapefile**.


The **Create New Shapefile** window will appear.

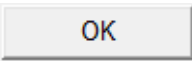


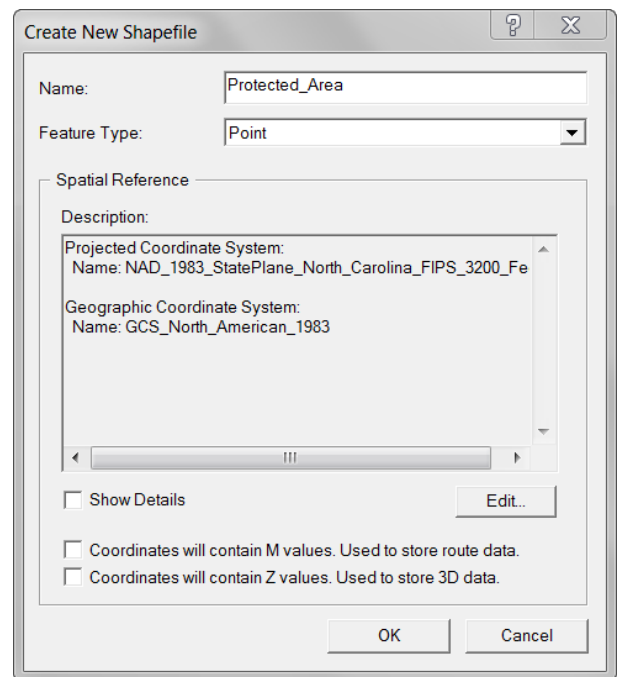
4. **Name** the file **Protected_Area**.
5. **Leave** the **Feature Type** as **Point**.
6. Because there is no **Spatial Reference**, **click**  to open the **Spatial Reference Properties** box.

7. **Click**  to **Browse for Dataset**.


8. **Navigate** to your **student folder** and **single click** on a file you already established, **660_Eagle_Nest_Buffer.shp** to set it as the coordinate system for this shapefile.

9. **Click**  to accept this coordinate system.

10. **Click**  twice to close the **Spatial Reference Properties** and **Create New Shapefile** boxes and to create a new shapefile.

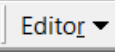
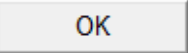


Buoys will also need to be placed in the water to indicate to boaters a “no wake zone”. This type of zone means that boaters must be going slow enough not to cause waves that might be harmful to the tender vegetation of the Harperella plant.

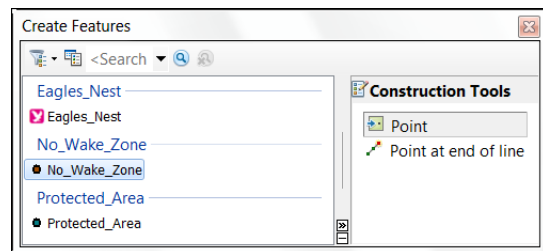
11. **Follow** these same procedures to **create** a second shapefile naming it **No_Wake_Zone**.
12. The shapefiles are automatically added to your **Table of Contents**.
13. **Click** the  to close **ArcCatalog**.

Using Heads Up Digitizing in Creating Shapefiles

The basic shapefiles you just created are projected, but contain no data. You will now add data (points) to these shapefiles.

1. **Open** the **Editor** toolbar by going to **Customize> Toolbars> Editor**.
2. On the **Editor** toolbar, **select**  and **Start Editing**.
3. From the source area of the list provided, **select** your **student folder, Type :Shapefiles** and then .

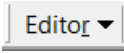
4. The **Create Features** box will appear. **Select No_Wake_Zone**. In **Construction Tools** at the bottom of the Create Features Window, **Click on Point**.

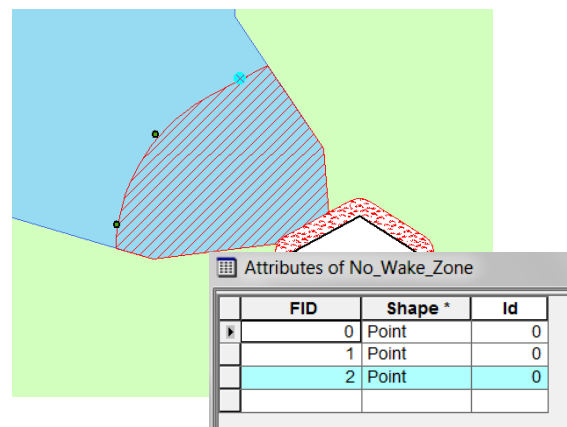


You are going to place three buoys in the water to designate the No Wake Zone.

5. **Right click** on the **No_Wake_Zone** file in the **table of contents** and **Open Attribute Table**.
6. **Move** the **Attribute table** aside where you can see it, but it will not obstruct your view of the water buffer zone.
7. **Single left click** to place three “buoys” just on the edge of the buffer zone as shown in the image to the right.

You will notice as you create these that the points will also be represented in your table.

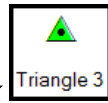
8. To **save** these points, **click**  **>Save Edits**, then



> Stop Editing.

9. **Close** the **Attributes of No_Wake_Zone** table.

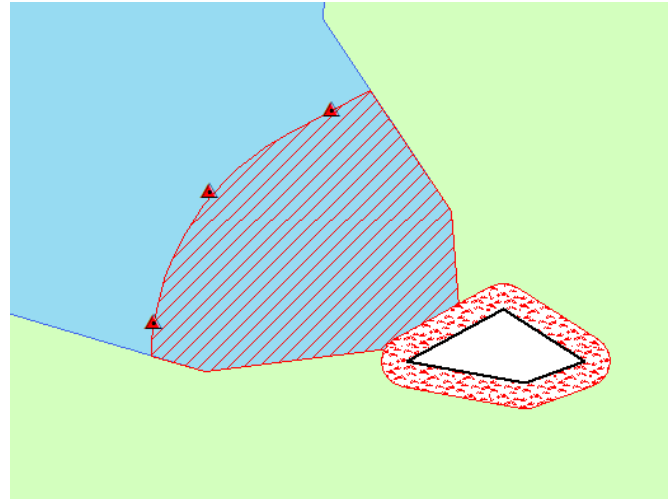
10. **Double click** the symbol for **No_Wake_Zone** to open the **Symbol Selector** box.



11. **Single click** **Triangle 3** to select it.

12. **Change** the color to **red** and the **size** to **15** point.

13. **Click** to close the **Symbol Selector** box.



You will now follow the same procedures to create places for warning signs for those on land.

14. **Right click** on **Protected_Area** and **select Open Attribute Table**.

15. **Move** the **Attribute table** aside where you can see it, but it will not obstruct your view of the buffer zone.

16. From the **Editor** toolbar, **select Start Editing**.

17. **Select** your **student folder** as the **source** file.

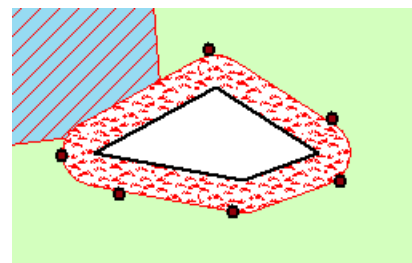
18. On the **Create Features** toolbar, **verify** that the **Protected Shapefiles layer** is selected.

19. In **Construction Tools** at the bottom of the Create Features Window, **Click** on **Point**

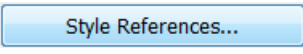
20. **Place six** points where signs will be posted around the land side of the buffer.


21. To **save** these points, **click** > **Save Edits**, then > **Stop Editing**.


22. **Close** the **Attributes of Protected_Area** table.

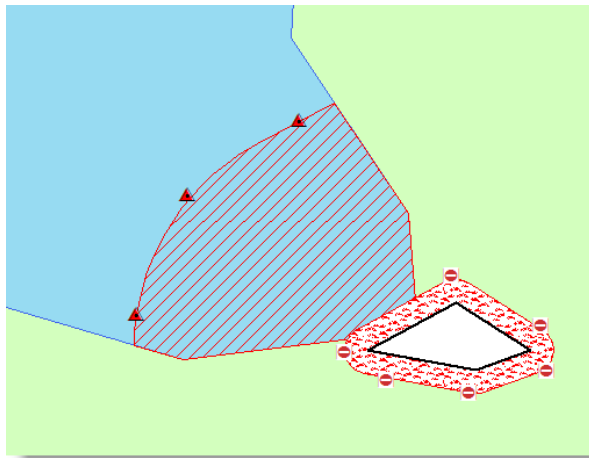


23. **Double click** the symbol for **Protected_Area** to open the **Symbol Selector** box.

24. **Click**  and **select Public Signs**.

25. **Scroll** through the opens and **find** .

26. **Edit** the **size** to **15** and **click**  to close the **Symbol Selector** box.



You are now able to view your boundaries established to protect these endangered plants.

Creating a Layout in ArcMap

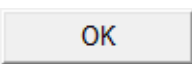
Now that you have all of the data that you need to prove that neither XYZ Developers nor the lodge owners are in violation of any rules or regulations regarding endangered or threatened species, you can create a map to show that information.

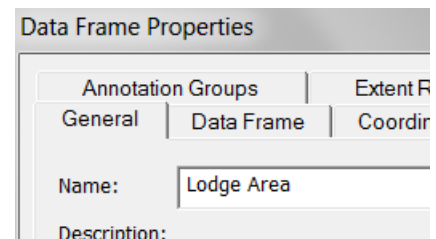
Adding a Second Data Frame to the Layout


You will now create a layout that contains two maps; one showing the “big picture” and one that is zoomed in to the lodge property. In order to accomplish this task, you will need a second data frame.

1. **Right click** on  and **select Properties**.

2. Under the **General** tab, **Name** the data frame **Lodge Area**.


3. **Click**  to close the **Data Frame Properties** box.





4. **Right click**  **Lodge Area** and **select Copy**.

5. From the **Main Menu**, **click Edit** and **select Paste**.

All of the layers included in the original Lodge Area data frame are now copied into a second data frame.

6. **Right click** on the second  **Lodge Area** , **select Properties** and **name** it **Harperella Zoom**.

You are now ready to go to Layout view to set up your map.

7. **Switch** to **Layout View** by clicking on the **Layout** button   in the bottom left corner of your map display window.

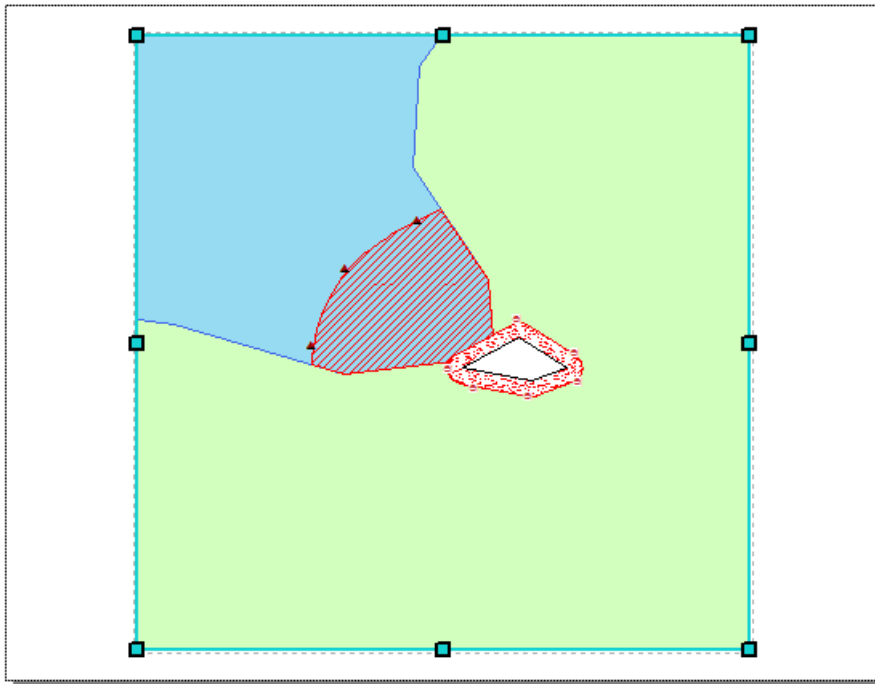
It has been decided that the layout would be best viewed from a Landscape view as opposed to Portrait.

8. From the **Main Menu**, **select File, Page and Print Setup**.

9. **Change** the **Orientation** to **Landscape**.

10. **Select** the box to **Scale Map Elements proportionally to changes in Page Size**.

11. **Click**  to apply these changes.




At this point, you do have two data frames displaying information for two identical maps. You will need leave the extent of the Lodge Area map large and make Harperella Zoom a zoomed-in inset of the Harperella plants near the lodge.

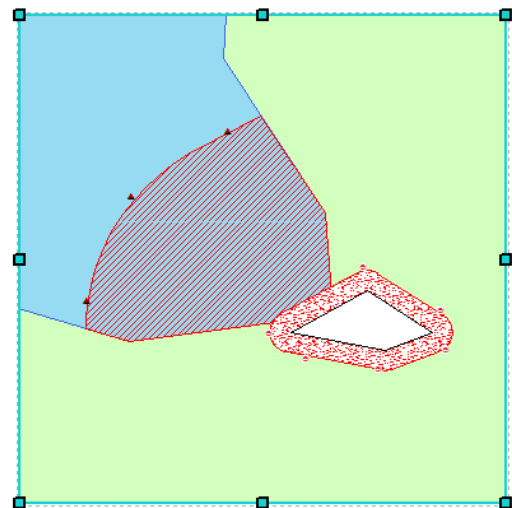
Differentiating Between Data Frames

When you have two or more data frames, one is always “active”. There are two ways to tell which data frame is active: (1) the data frame title in the table of contents is bold, and (2) the map that is active will have teal handles on it. Any changes made in the table of contents of the active data frame will be shown in the active map that corresponds with it. To switch to another data frame, simply click on the appropriate map in the layout or right click on its title in the table of contents and select Activate.

1. If it is not already active, **select** the **Harperella Zoom** data frame.

2. Use the **Zoom In**  tool on the **Tools** toolbar and **zoom in** as close to the Harperella site as you can to include all buffered areas.

3. **Resize** this map by grabbing one of the corner **handles** making it about one fifth of its current size. (This map will be an inset when your layout is complete.)



You will notice that the other map is below the first map.

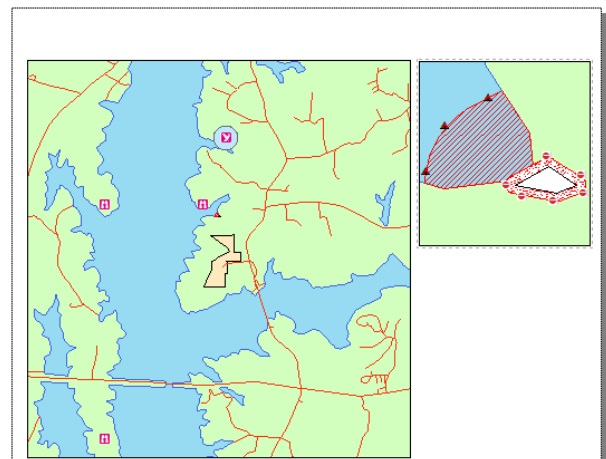
4. **Activate** the **Lodge Area** data frame and map by **clicking** on the bottom most map. This map will need to show a greater area.

5. On the **Tools** toolbar, **click** the **Fixed Zoom Out**  button until the **Scale** (found on the Standard toolbar) is approximately **1:35,000**.



6. Using the **handles**, **stretch** the map to cover almost two thirds of the page.

7. Because the Lodge Area map is a small scale map, the Harperella plant area will appear “cluttered”. To avoid this, **turn off** both the **Protected_Area** and **No_Wake_Zone** shapefiles in the Lodge Area Data Frame in the **table of contents**.



8. **Drag** the smaller map of the **Harperella Zoom** to a position on the right side of the map towards the top. You will add information about this data frame under it in a few steps.

Inserting a Title in a Map Layout

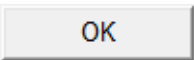
1. From the **Main Menu**, **click Insert**, and **select Title**.
2. For the title, type **Threatened and Endangered Species Near Lodge Site**.

3. **Click** .

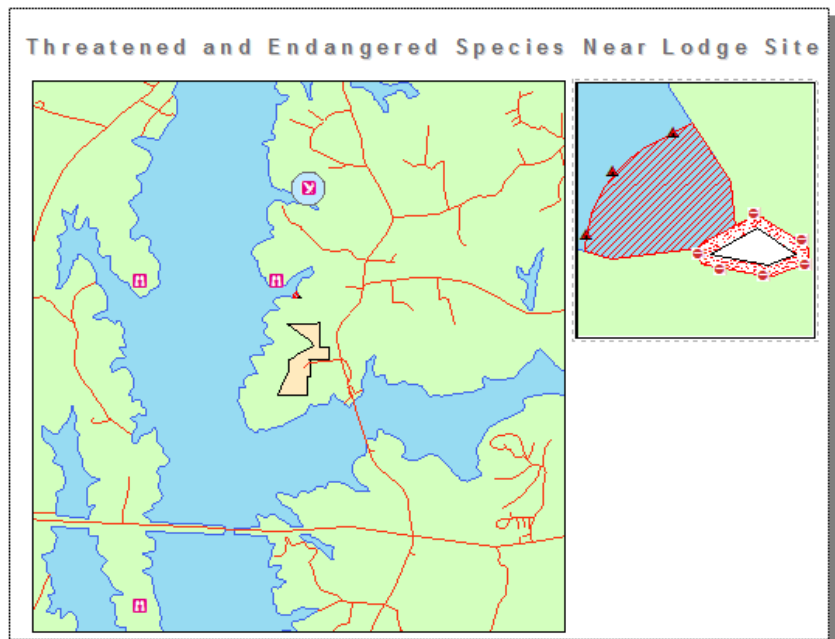
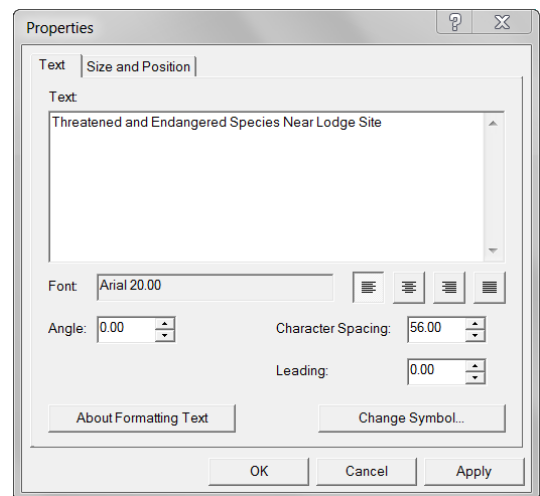
4. To enhance the title, **double click** it to open the **Properties** box.

5. **Select** .

6. **Click** on **Country 2**, **set** the **size** to **20** and **bold**.

7. **Click**  **twice** to close **Symbol** and **Properties** boxes.

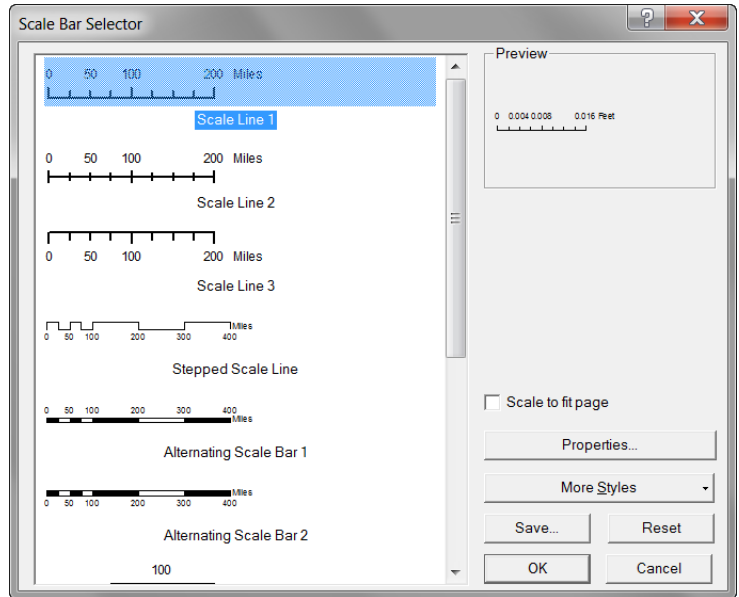
8. **Position** the **title** at the top of the map layout window.




Inserting a Scale Line in a Map Layout

In order to add a scale bar, the proper data frame must be active.

1. **Activate** the **Lodge Area data frame**, by **single clicking the date frame** in the Map Display.
2. From the **Main Menu**, **click Insert**, then **Scale Bar**.
3. **Single click Scale Line 1** from the options provided.




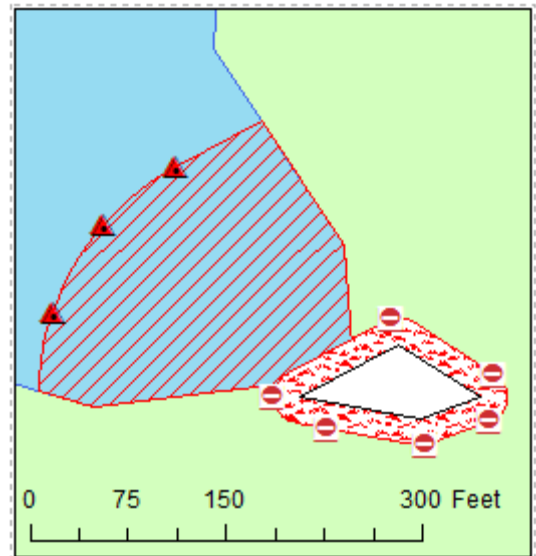
4. **Click**  to close the **Scale Bar Selector Window** and return to the map layout.
5. **Drag** the **scale bar** to a location below the Lodge Area Data Frame.
6. **Activate** the **Harperella Zoom** data frame.

7. **Follow** the same procedures to **insert a Scale Line** in this small map.
8. **Drag** the **scale bar** to a location at the bottom of the Harperella Zoom Data Frame. **NOTE:** You may have to resize the scale bar horizontally to make it fit under the Harperella Zoom Data Frame.

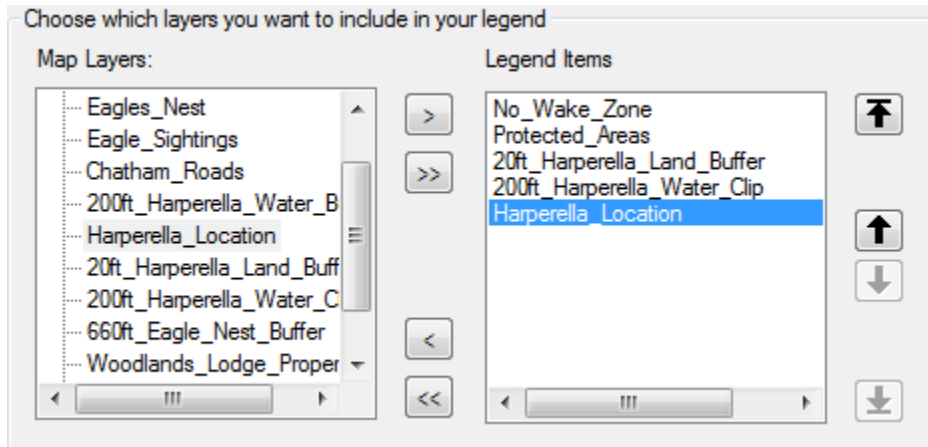
Inserting a Legend in a Map Layout

Because this map is zoomed in to show the detail around the Harperella, you will only need the five layers.

1. With the **Harperella Zoom** data frame **active**, **go** to **Insert** then **Legend**.
2. In the **Legend Wizard**, first **select**  to clear the current list of **Legend Items** listed on the right.



3. **Double click** on the following layers to move them to the **Legend Items** box:
 - Protected_Area
 - No_Wake_Zone
 - 20ft_Harperella_Land_Buffer
 - 200ft_Harperella_Water_Clip
 - Harperella_Location



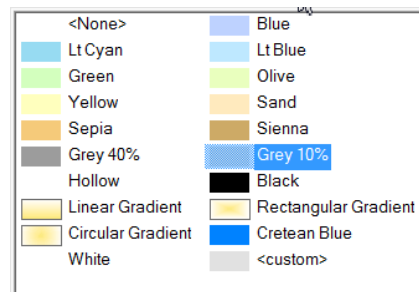
4. **Click** to take you to the **Legend Title** page.

5. **Delete** the default title of **Legend** from the box and leave it blank.

6. **Click** to take you to the **Legend Frame** page.

7. **Change** the background to **Grey 10%**.

8. **Click** to take you to the **Symbol Patch** page.



9. **Leave** this page as is and **click** to go to the **Spacing Page**.

10. **Leave** this page as is and **click** .

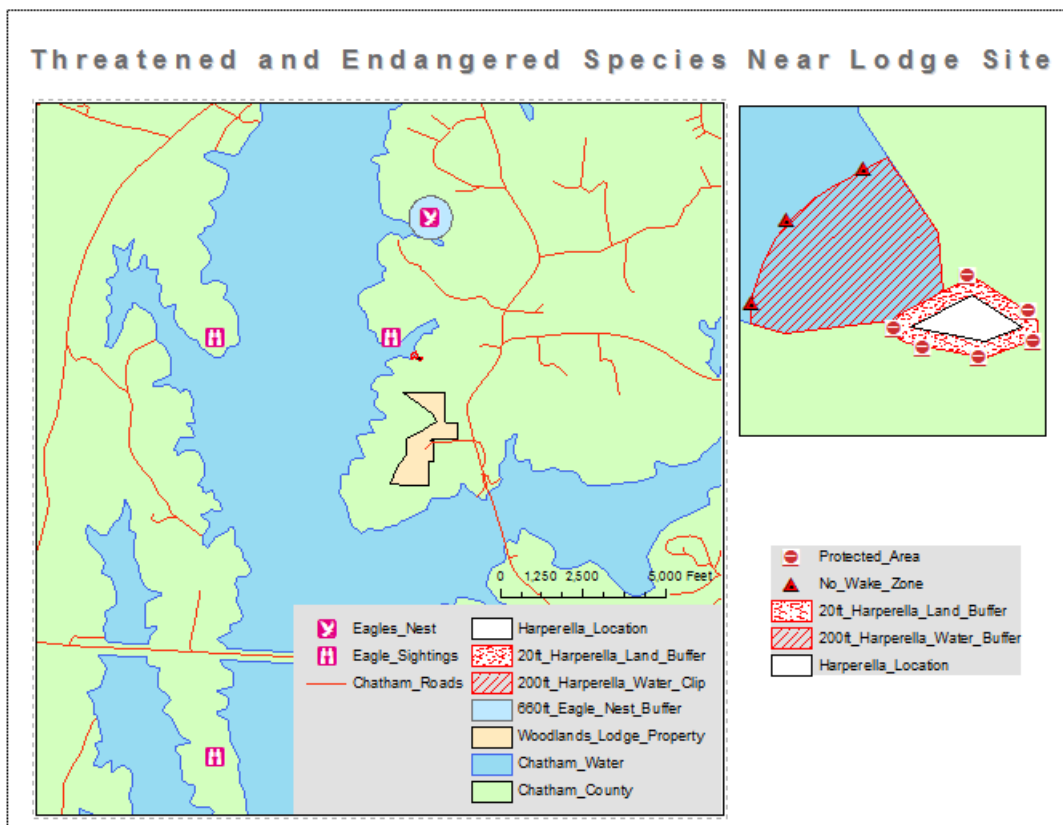
11. **Position** the legend below the **Harperella Zoom** map.

12. **Activate** the **Lodge Area** data frame.

13. **Select** **Insert>Legend** from the **Main Menu**.

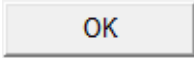
14. **Leave** all layers to be included under **Legend Items**.

15. After clicking , **delete** the title “**Legend**” from the next page of the **Legend Wizard**.
16. **Click** and **change** the background to **Grey 10%**.
17. **Click** once more, then .
18. **Position** the **Legend** in the bottom right corner of the **Lodge Area** map.
19. To split it into **two columns**, **double click** on the **legend**.
20. **Single click** on **Harperella Location** on the **Legend Items** side to select it.
21. **Click** in the box next to **Place in new column** to select it.
22. **Click** to apply the change.
23. **Move** the **scale bar** to be placed just above the legend.



Adding a Directional Arrow

Each map layout created needs a directional arrow included so that the reader always knows which direction is north.

1. From the **Main Menu**, **select Insert**, then **North Arrow**.
2. From the list provided, **select ESRI North 3**.
3. **Click**  to add it to your map display.
4. **Drag** it below the **Harperella Zoom legend**.

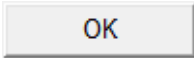
Adding Text to a Map Layout

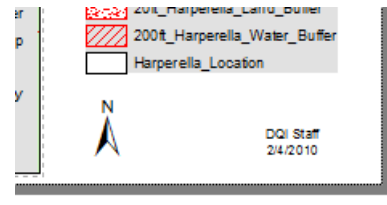
A few more pieces of information are needed to complete this layout. These will include informational text boxes to display the author and date, as well as information about the two maps.

1. From **Main Menu**, **select Insert**, then **Text**.
2. **Enter** your name, and then **strike** the **Enter** key.
3. **Drag** this **text box** to the **bottom right corner** of the map display window.

4. **Double click** on the **text box** to open the **Properties** box.

5. **Add** the **date** below your name.

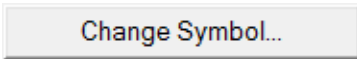
6. **Click**  to accept the changes to the text box.

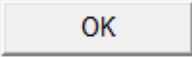

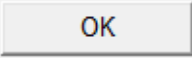


7. **Insert** a second **text box**.
8. **Enter** the following text into the **text box**, returning at the ends of each of these lines:



Inset Above: A group of Harperella plants were discovered near the lodge property. "No Wake Zone" buoys were set up in the water supplying a 200 foot buffer and signs warning of a "Protected Area" were placed on the land around these endangered plants supplying a 20 foot buffer.

9. **Double click** on the **text box** to open the **Properties** box.


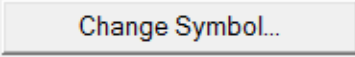
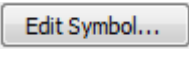
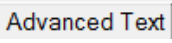
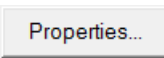
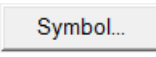
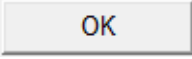
10. **Click**  and **edit** the **font size** to **11**.

11. **Click**  to **return** to the Text Properties box
12. **Click the Left Align button**  and **click**  to return to the **map layout**.
13. **Drag** this text box just below the **Harperella Zoom** map layout.

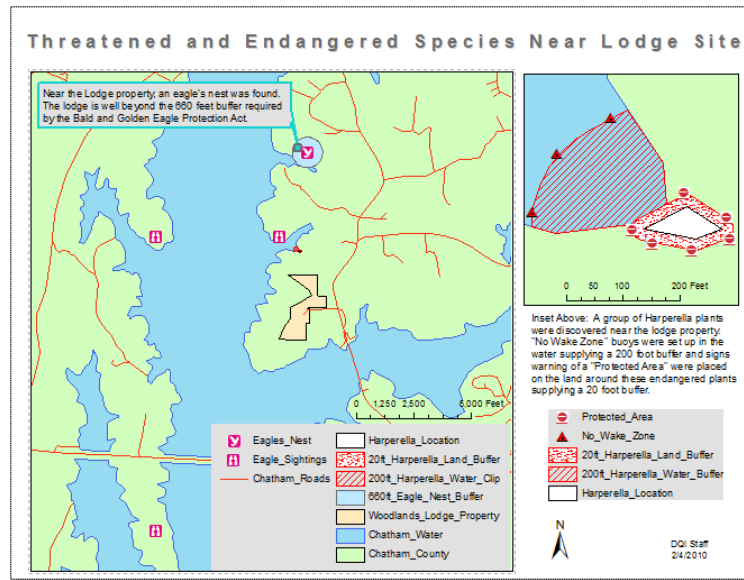
Adding Features from the Draw toolbar to the Map Layout

1. From the **Draw toolbar**, **click** the pull down arrow next to the  and **select Callout** .
2. **Click the Eagles Nest** to add a callout to be attached to the **Eagle's Nest point** in the **Lodge Area map layout**.
3. **Enter** the following text into the callout, **returning** at the ends of each of these lines:

Near the Lodge property, an eagle's nest was found.
The lodge is well beyond the 660 feet buffer required
by the Bald and Golden Eagle Protection Act.

4. **Double click** on the **text box** to open the **Properties** box.
5. **Click** the **Center Align**  button.
6. **Click**  and **edit** the **font size** to **11**.
7. To change the background of the callout to grey, **click** on  and then **select** the  tab.
8. **Click**  under the **Text Background** section.
9. **Click**  and then **Grey** from the selection provided.
10. **Click**  **five** times to **close** all editing boxes and **return** to the **map layout**.
11. **Drag** this callout to the **top left corner** of the **Lodge Area map layout**.

Your layout should currently look like this; you may need to drag and reposition the elements in the bottom right corner until they appear similar to the layout below:

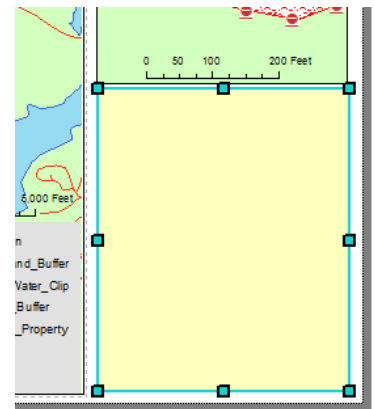


A gray box will be added to the bottom right corner of the map layout to provide consistent background to the text, legend, and compass elements.

- From the **Draw toolbar**, **select** the **New Rectangle** button.

- Draw** a **rectangle** as shown:

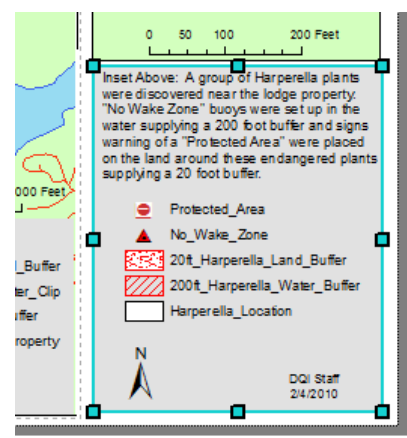
NOTE: Do not be alarmed if the rectangle covers the existing elements, we will reorder the elements in the next steps.



- Double click** on the **rectangle** to open its properties box.

- Click** the **Symbol tab** and **Edit** the Fill Color to Gray 10%.

- Click** to apply the new color.



- Right click** on the **text box** and **select Order**, then **Send to Back**.

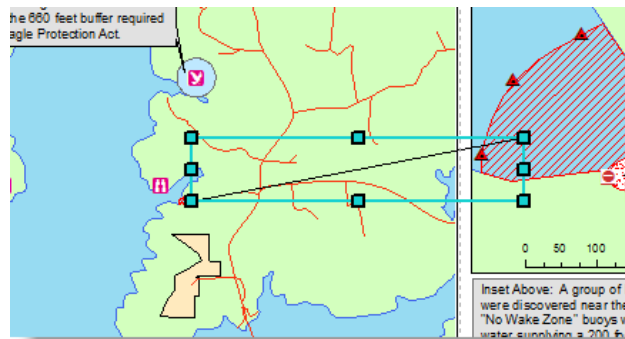
One last item to add is an arrow to allow the reader to know where the Harperella Location is located on the small scale map.

18. **Click** the down arrow beside the **New Rectangle** tool to display your drawing options.

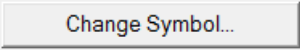


19. **Select** the New Line tool.

20. To draw a line, **single click** near the Harperella Location in **small scale/large extent map**. The line will follow your movements; **double click** on the **Harperella Zoom (large scale) inset map** to finish the line.

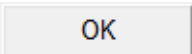


21. **Double click** on the line to open the **Properties** box.

22. **Click**  to open the **Symbol Selector**.


23. **Scroll down** the list to find .

24. **Change** the **width** to **2.00**.

25. **Click**  twice to accept and close the **Symbol Selector** and **Line Properties** windows.

Saving and Exporting Map Layouts

Once your map is complete, you will need to save it and then export a copy of it as a picture so that it may be able to be used in other applications or just simply to be printed.

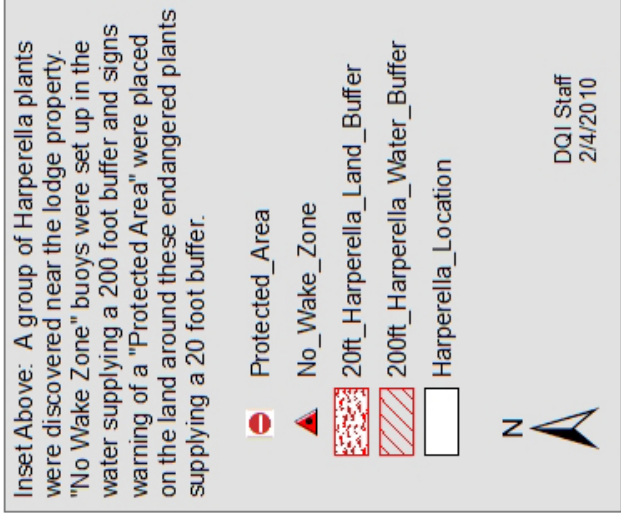
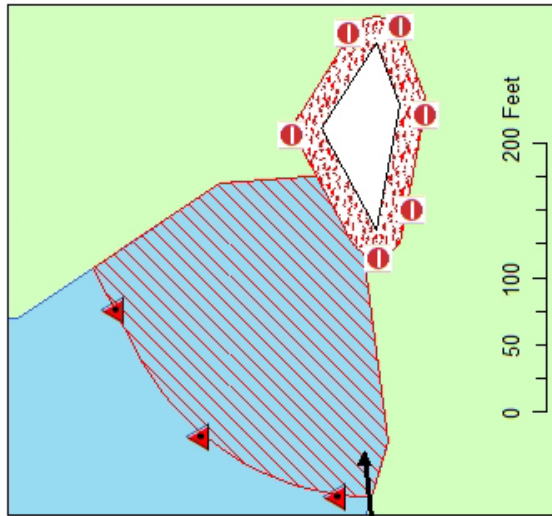
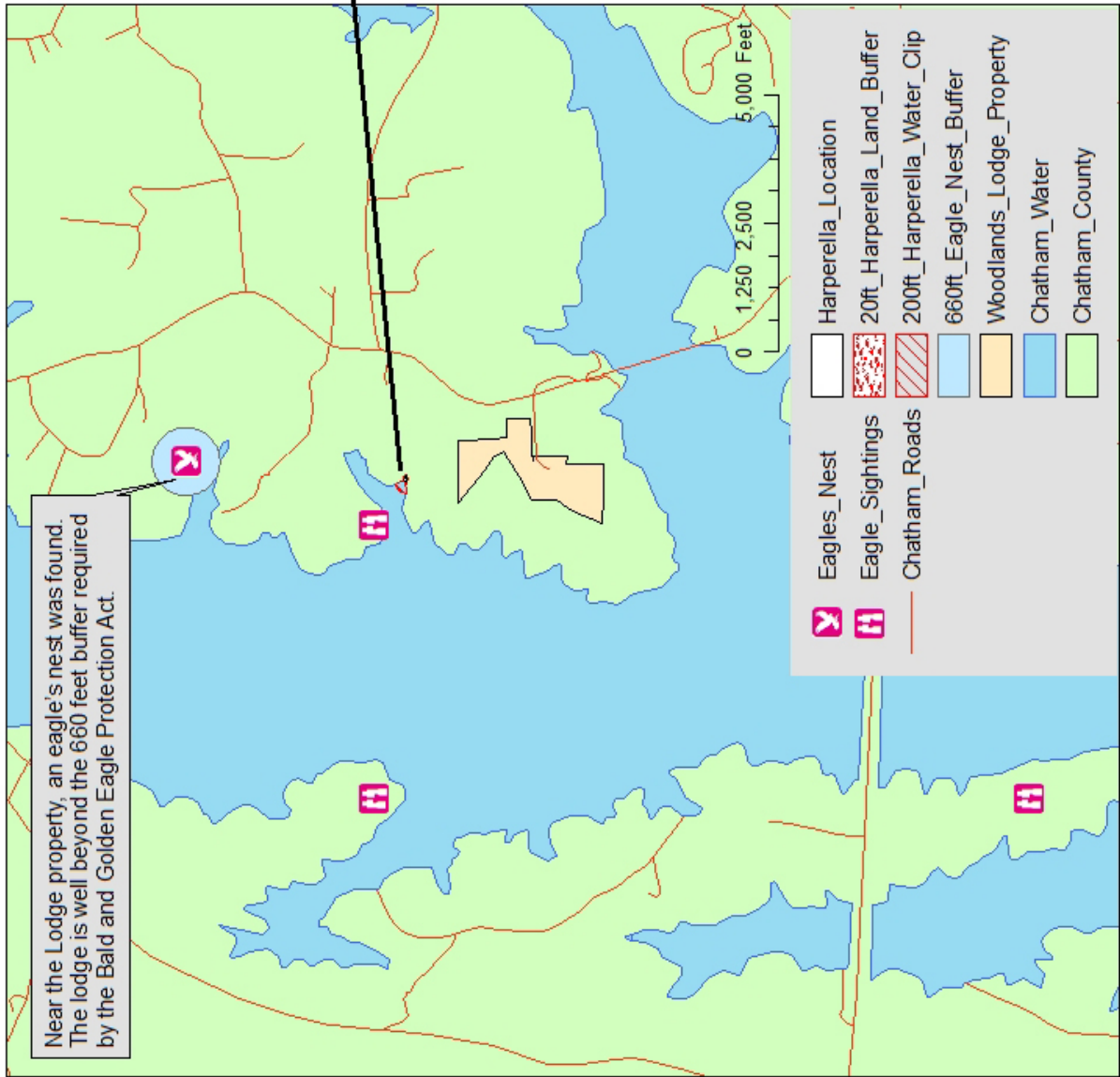
1. **Click**  to **save** the map.
2. **Double click** on the **text box** to open the **Properties** box.
3. **Export Map**.
4. **Navigate** to your **student folder** and **save** the map as **STEM_Lesson03_XX**.
5. **Verify** that the **Save** as type is **JPEG (*.jpg)**.

6. **Click** 

7. **Double click** on the **text box** to open the **Properties** box, then **Print**. Print one copy.

8. **Close ArcMap**.

Threatened and Endangered Species Near Lodge Site



DOI Staff
2/4/2010

