

# Population Estimation Tutorial

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## Total 2000 Population of Floodplains in San Juan, Puerto Rico



### 2000 Population



0 - 28  
29 - 79  
80 - 144  
145 - 266  
267 - 468  
469 - 823  
824 +

0 0.25 0.5 1 1.5 2 Miles



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## Introduction

The purpose of this document is to demonstrate a methodology for estimating the population living in a floodplain. This tutorial provides instruction for the process of collecting the necessary data, adjusting the Census blocks that are not completely contained within a floodplain, creating a population map, and the steps to produce the finished map. Following the steps in this document, the user will learn to:

- Upload files to ArcGIS.
- Use the Clip tool to edit layers.
- Change the properties of layers.
- Set up ArcGIS in a way that allows the user to effectively count houses within Census blocks.
- Create population maps using the symbology menu of ArcGIS.
- Export data from ArcGIS layers.
- Use the Select Features and Statistics tools to find populations of areas.
- Use Layout View to add a title, legend, scale bar, and north arrow to a map.
- Export a map.

Upon completion of this tutorial the user should have acquired an understanding of ArcGIS and Census data. The products that will result from this tutorial are a population map, and an estimate of the population within the floodplain(s).

## Getting Started

Before you get started, you will need a computer equipped with the proper software and data files.

### Necessary Software:

- ArcGIS 9.2 or higher
- Open Office 3.2 or higher
- Microsoft Excel 2007 or higher

### Necessary Files:

- Aerial photographs of the floodplain and surrounding area. These aerial photographs are obtained from a map database maintained by the Jacksonville District of the USACE.
- FIRM Map files of the floodplains under study. These are obtained from the Federal Emergency Management Agency (FEMA).
- Census Blocks containing U.S. Census population data. This data is obtained from a map database maintained by La Junta de Planificación. It can also be found in the U.S. Census Tiger Files Database at <http://www.census.gov/geo/www/tiger/>.

## Step 1: Uploading Files into ArcGIS 9.2

The first step towards a population estimate is uploading the correct files into ArcGIS 9.2. First, **open ArcGIS** and **select** the *A new empty map* option and **click OK**.

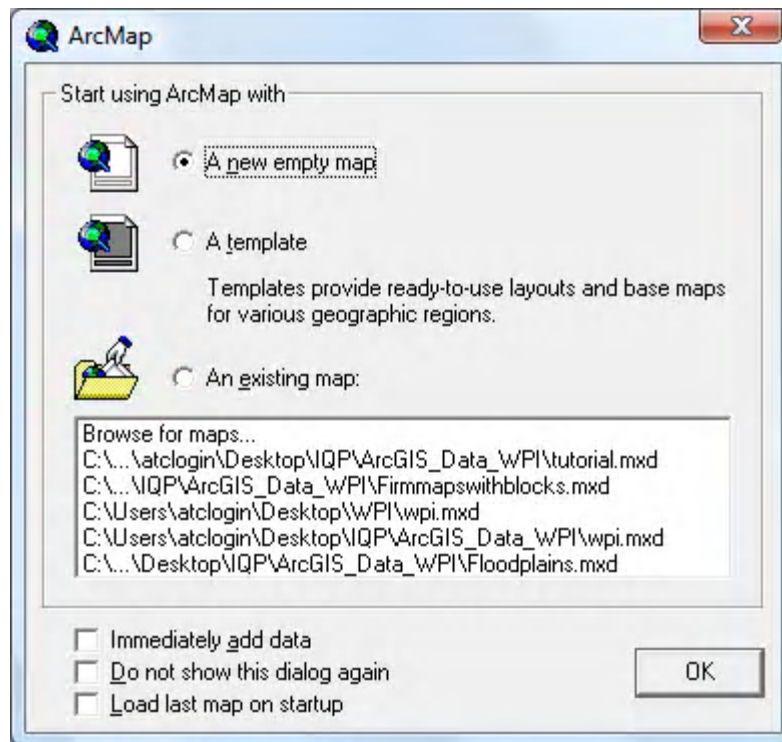


Figure 1: Opening Screen

## Adding FIRM Maps

Click the *Add Data* button on the toolbar. Find the folder where the FIRM map data is saved. These files will be called *firmmaps\_areas*. Select these files and click *Add*.

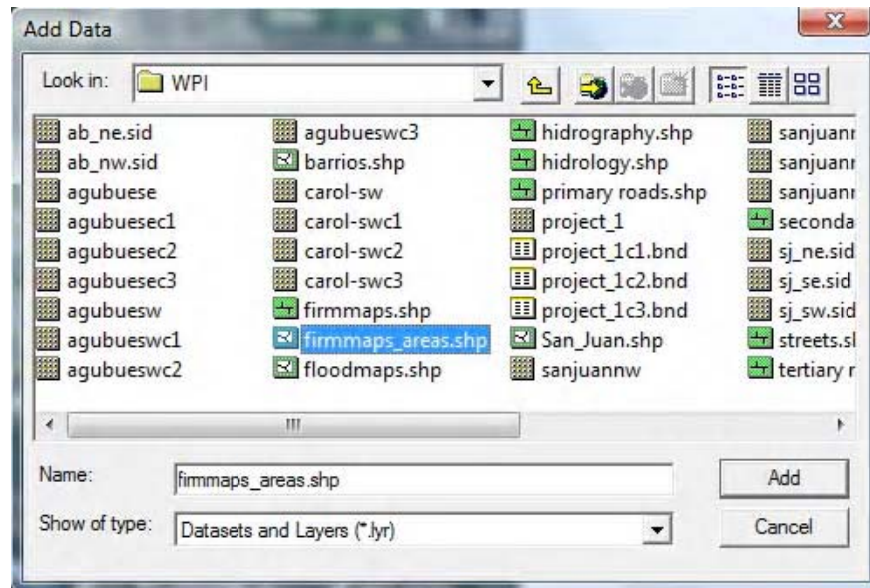


Figure 2: Adding FIRM Map Data

Right-click on *firmmaps\_areas*. Click on *Properties*, then click on the *Symbology* tab. Click *Categories*. Under *Value Field*, click *Flood\_Zone*, then *Add All Values*. Click *Apply*, then *OK*. In this example, FIRM map data has been uploaded for the entire municipality of San Juan. The resulting screen should look like Figure 3.

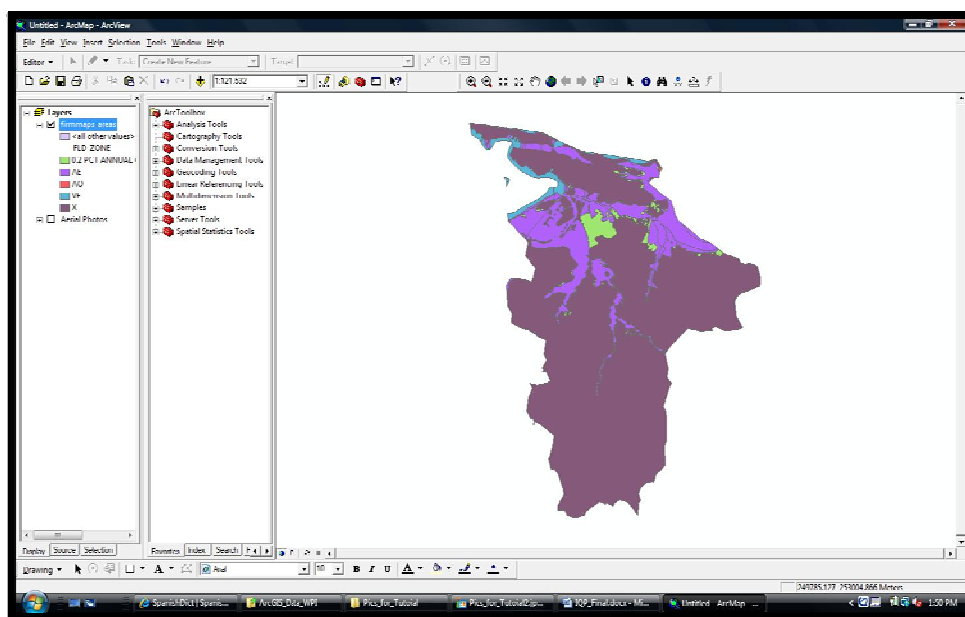


Figure 3: Uploaded FIRM Map Data

## Adding Aerial Photos:

Click the *Add Data* button on the toolbar. **Find** the folder where the aerial photograph files are saved, **select** them, and **click Add**.

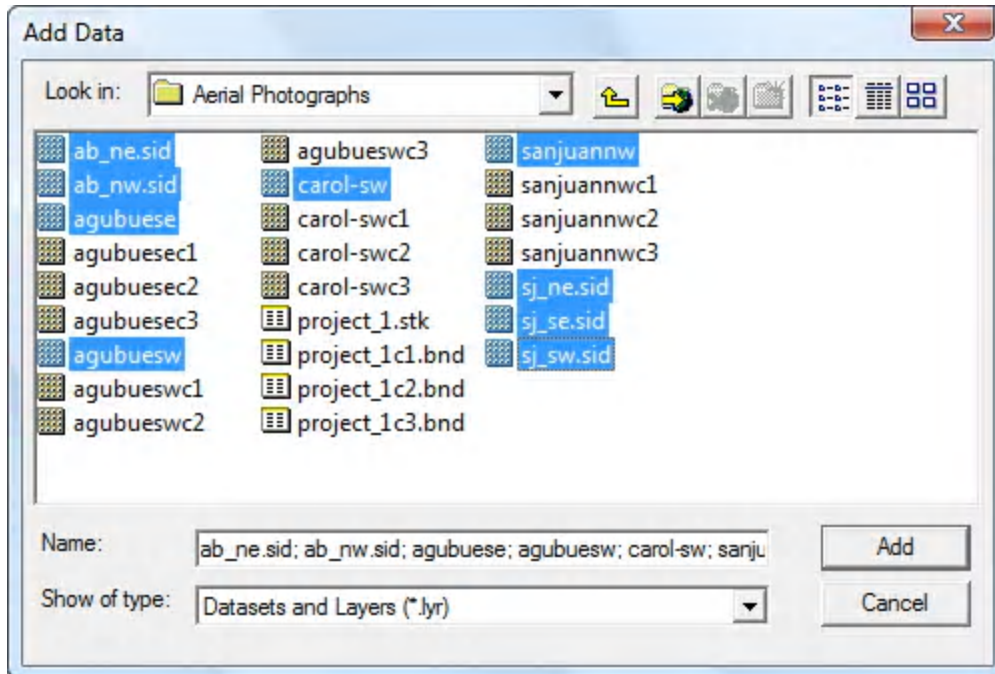


Figure 4: Adding Aerial Photos



The resulting screen should look like Figure 5. In this example, twenty-one files were uploaded to cover the entire Municipality of San Juan.

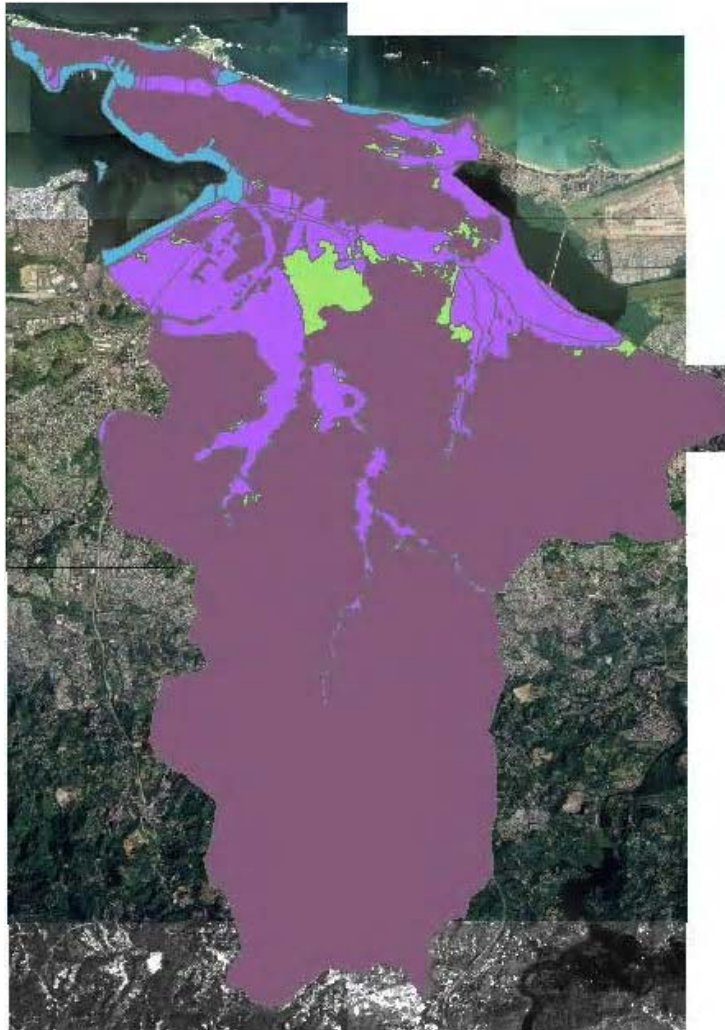


Figure 5: Uploaded Aerial Photos

The next step is to consolidate all aerial photos into one layer. **Right-click** on *Layers* and **select** *New Group Layer*. **Rename** this layer *Aerial Photos*. **Drag** and **drop** each aerial photo layer into *Aerial Photos*. Then **drag** and **drop** the *Aerial Photos* layer under the FIRM maps, so that the FIRM maps appear on top of the aerial photos.

## Adding Census Blocks

Click the *Add Data* button on the toolbar. Find the folder where the Census Block files are saved, select them, and click *Add*.

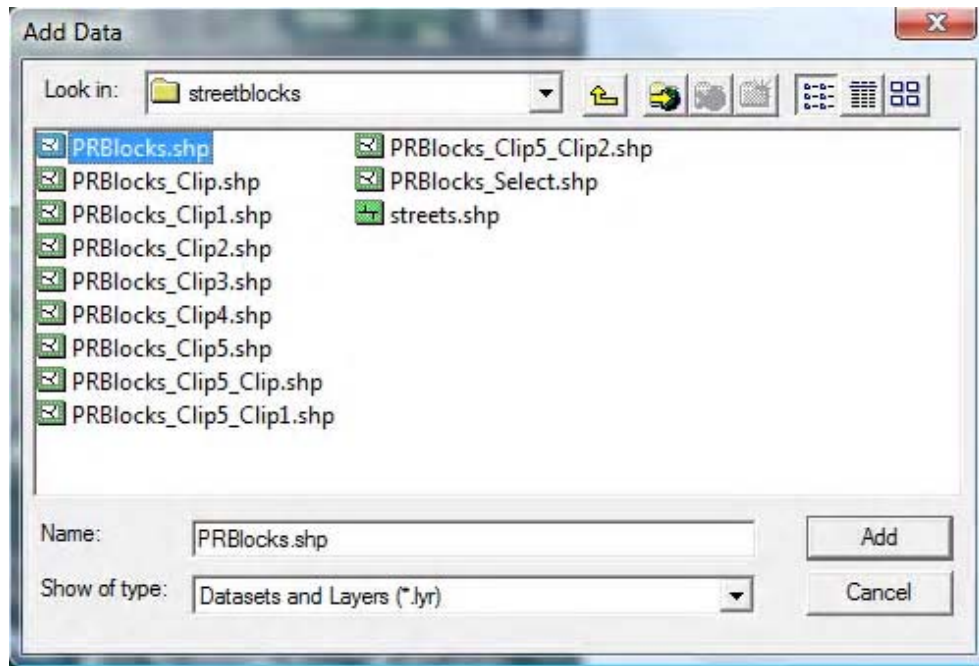


Figure 6: Adding Census Blocks

The resulting screen should look like Figure 7.

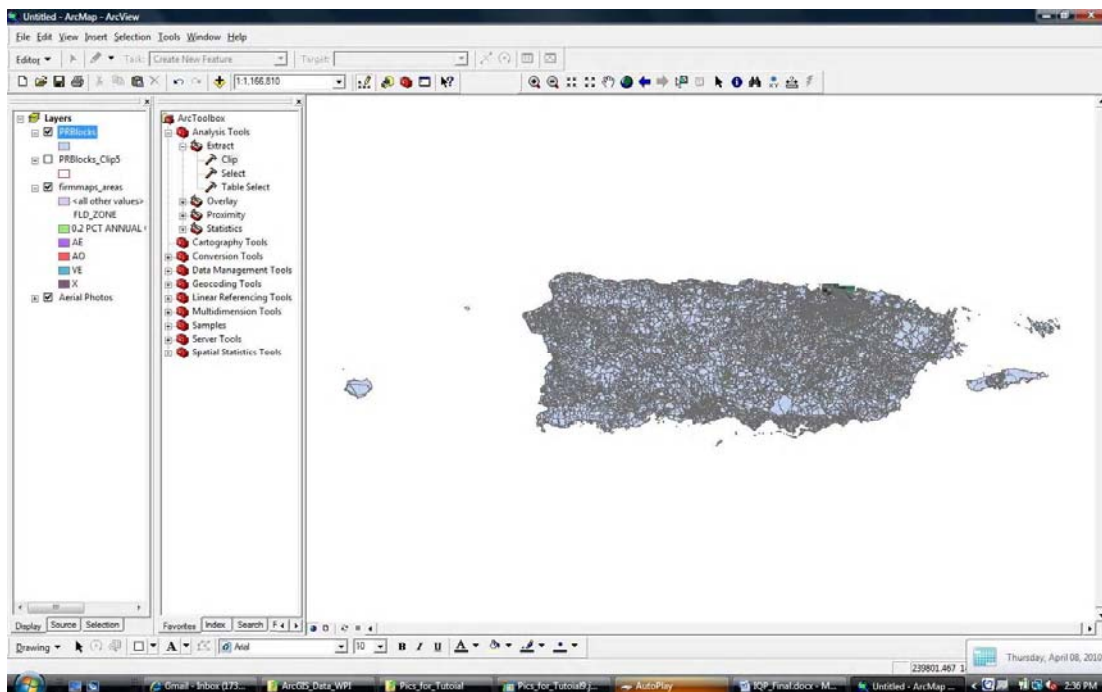


Figure 7: Uploaded Census Blocks

In this example, all of the Census blocks for Puerto Rico were added. It is not necessary to have any Census blocks outside of the areas of interest, so the next step is to **clip** the Census block layer within the area covered by the aerial photo. In the Arc Toolbox, **expand Analysis Tools**, **expand Extract**, and **double-click Clip**. The Clip Tool will open. For the *Input Features*, **select** the Census Blocks layer, called PRBlocks in this tutorial, from the drop-down menu. **Select** the FIRM map layer from the drop-down menu and **click OK**.

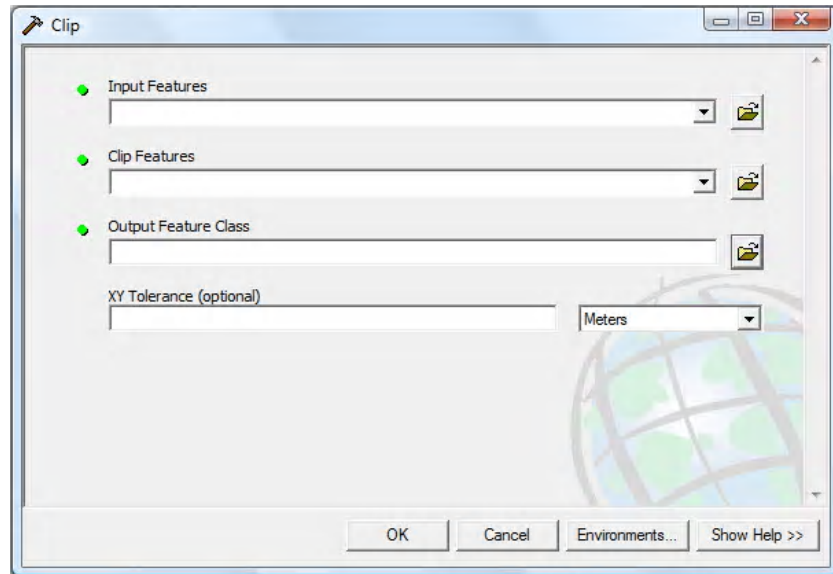


Figure 8: Clipping the Census Blocks

When the clip tool has finished, **click Close** on the clip window. This will create a new layer that will include all Census blocks within the desired area. In this example, the clipped layer includes all Census blocks within the Municipality of San Juan. To remove the original Census block layer, **right-click** on it and **click on Remove**. This should result in a screen like Figure 9.

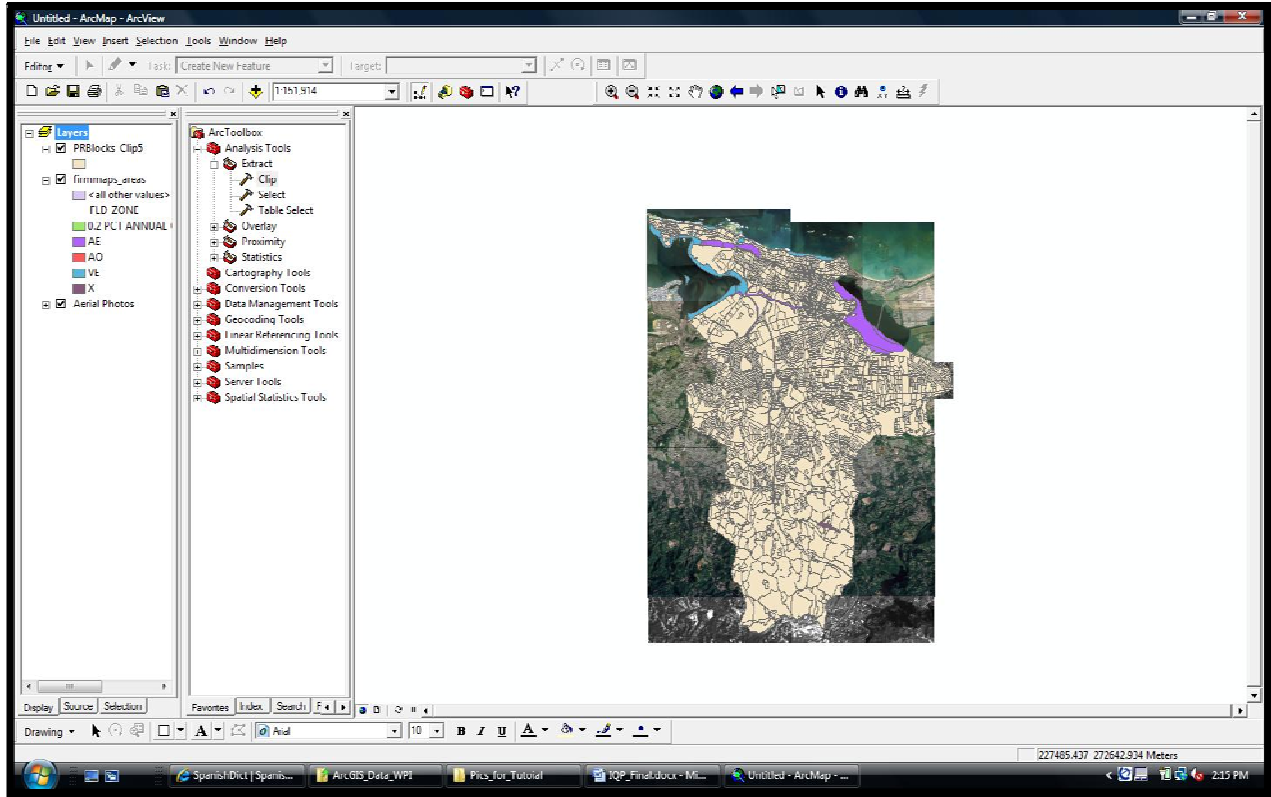


Figure 9: Clipped Census Blocks

All of the necessary files are now uploaded. Each layer can be turned off and on individually by **checking** and **un-checking** the boxes next to each layer. Next, **double-click** on the colored box under the name of the Census block layer. **Select *Hollow*** and **select 2.00** for the *Outline Width*. **Choose** a distinct color for *Outline Color* and **click OK**. In this example, red is used as the *Outline Color*.

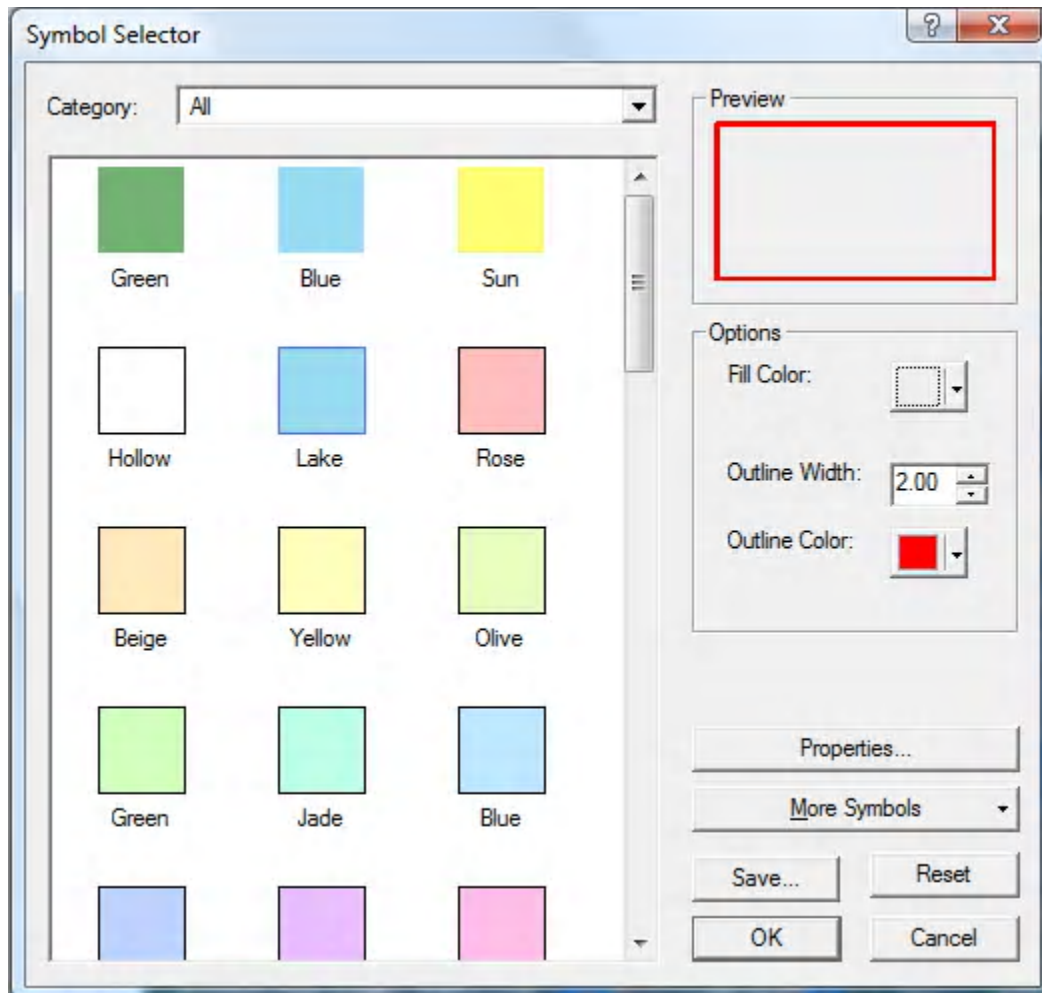


Figure 10: Changing Census Block Color

The resulting screen should look like Figure 11. This is the end of Step 1: Uploading Files into ArcGIS 9.2. All of the necessary files are uploaded and prepared for Step 2: Selecting a Floodplain.

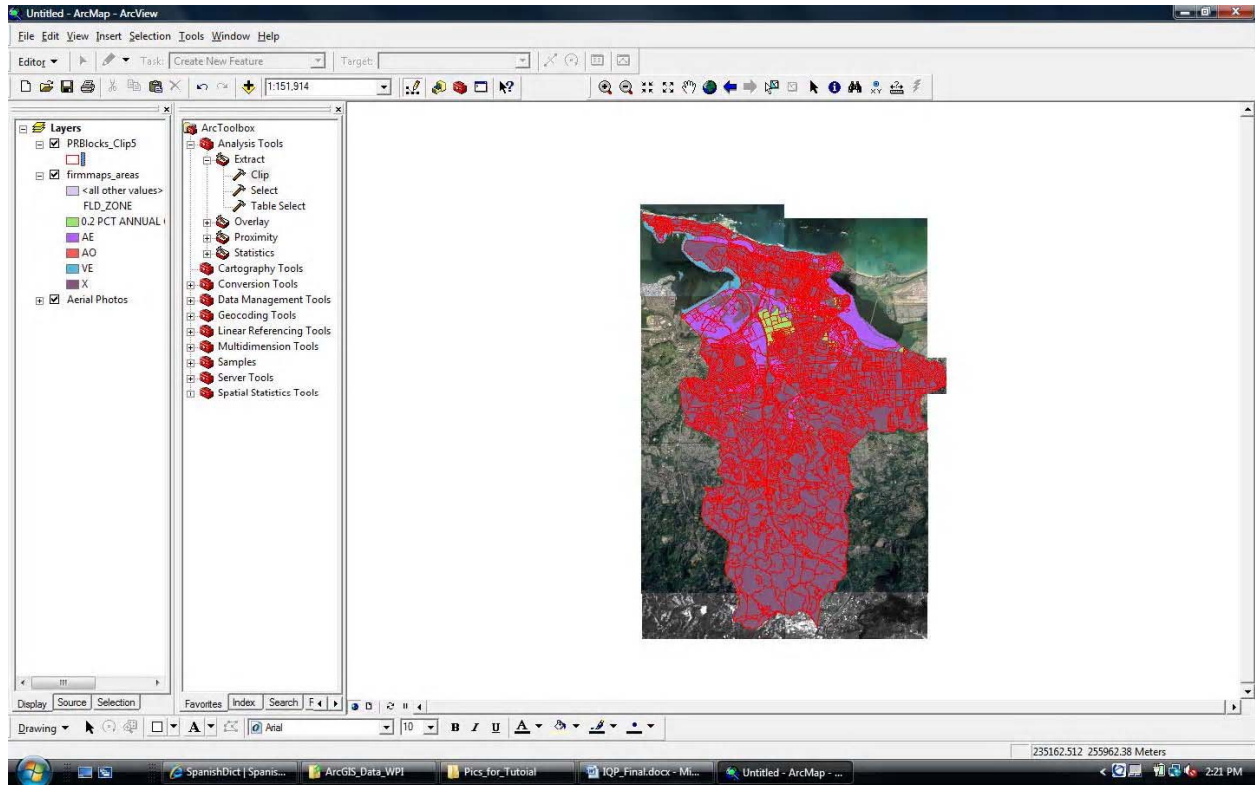


Figure 11: FIRM Map with Census Block Outline

## Step 2: Selecting a Floodplain

The FIRM map layer is broken up into 5 distinct floodplain designations. They are *0.2 Percent Annual Chance*, *AE*, *AO*, *VE*, and *X*. Each designation represents areas with different flood insurance rates. The *X* designation represents areas that where flood insurance is not required. The steps for calculating the population of each other designation are identical, so only one such procedure is detailed in this document. This example uses the *AE* designation.

In order to highlight the floodplain designation under immediate study, **right-click** on the FIRM Map layer, and **select Properties**. In the *Layer Properties* menu, **select** each floodplain designation not under study and **click Remove**. Figure 12 shows the *Layer Properties* menu after the removal of all but *AE* floodplains.

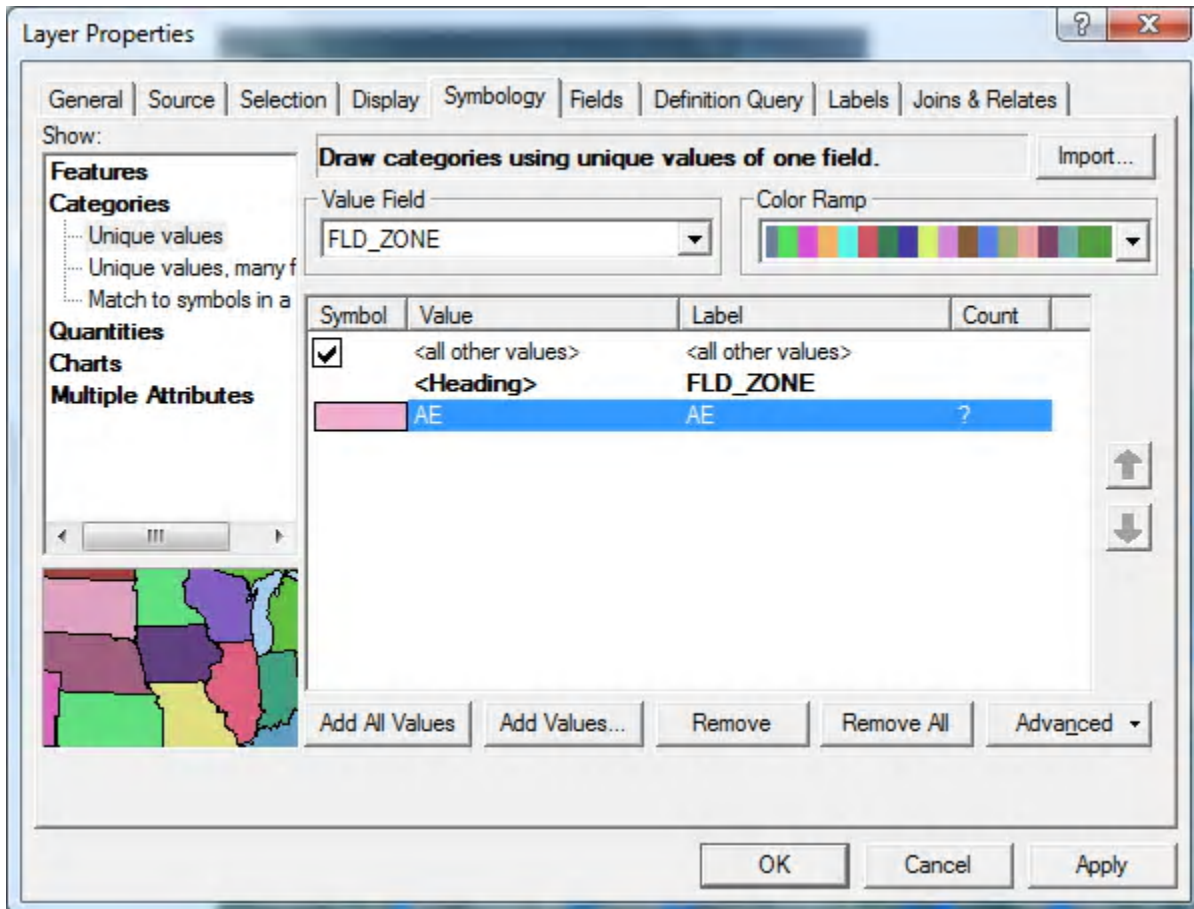


Figure 12: Final Layers Property Menu

**Click Apply** and then **OK**. **Double-click** the colored square next to *All Other Values* under the FIRM map layer. **Select Hollow** and **click OK**. **Double-click** the colored square next to the flood zone designation under the FIRM map layer. **Select** a color for the flood region. In this example, *10% Simple Hatch* is

used in order to allow the aerial photo to be seen beneath the hatch marks. **Select 2** for the *Outline Width* and distinct color for both *Fill Color* and *Outline Color* and **click OK**.

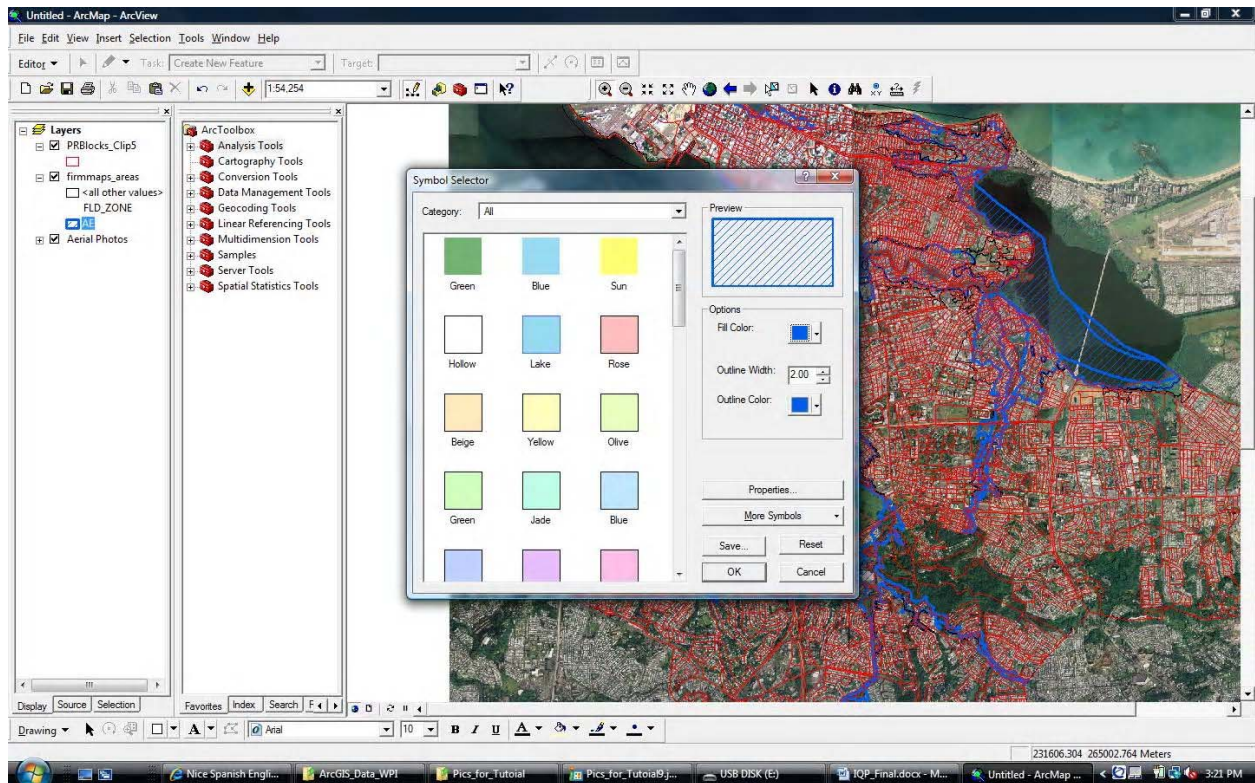


Figure 13: Selecting Floodplain Color



Figure 14 shows a magnified view of a community in San Juan within an AE floodplain. The blue hatch represents the area within the floodplain and the red lines represent the Census block boundaries. The buildings in the aerial photograph can be easily seen through the hatch. The map is now ready for Step 3: Counting and Population .

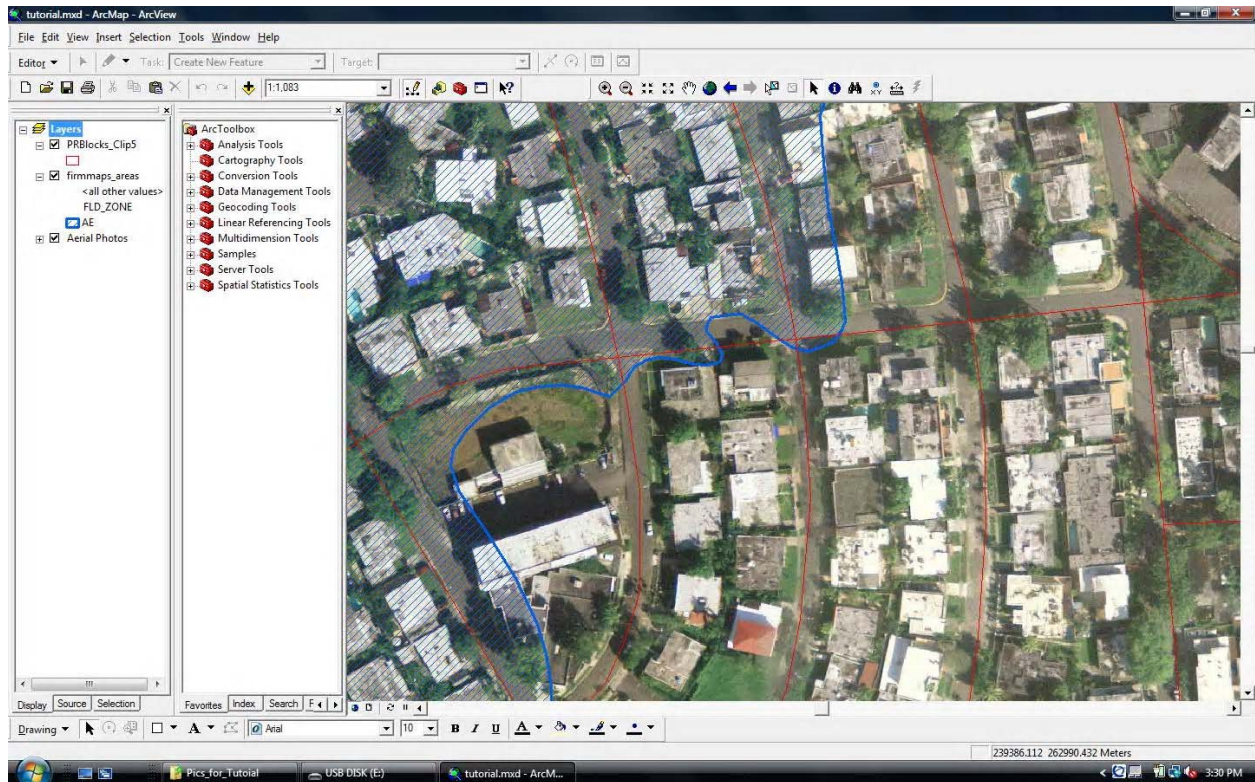


Figure 14: A Community in an AE Flood Region with Census Block Boundaries

### **Step 3: Counting and Population Estimation**

To determine how many people reside in the floodplain, it is necessary to estimate the population in each of the Census blocks that are also in the floodplain. By following the instructions in this section, a list of all of the Census blocks with the necessary information about each of these blocks needed to estimate the population will be created. Each step below explains how to obtain the following information: the ID number for each of the blocks, the population within each of the blocks, the number of households within each of the blocks, the number of buildings in that block which are in the floodplain, and the number of buildings in the block that are not in the floodplain.

## Setting up the Spreadsheet

To create a layer of Census blocks within a specific floodplain, decide the specific zone to set as the outline of the floodplain. **Click** the *Selection* tab, and then **select** *Select by Attributes...* which then displays the window shown in Figure 15.

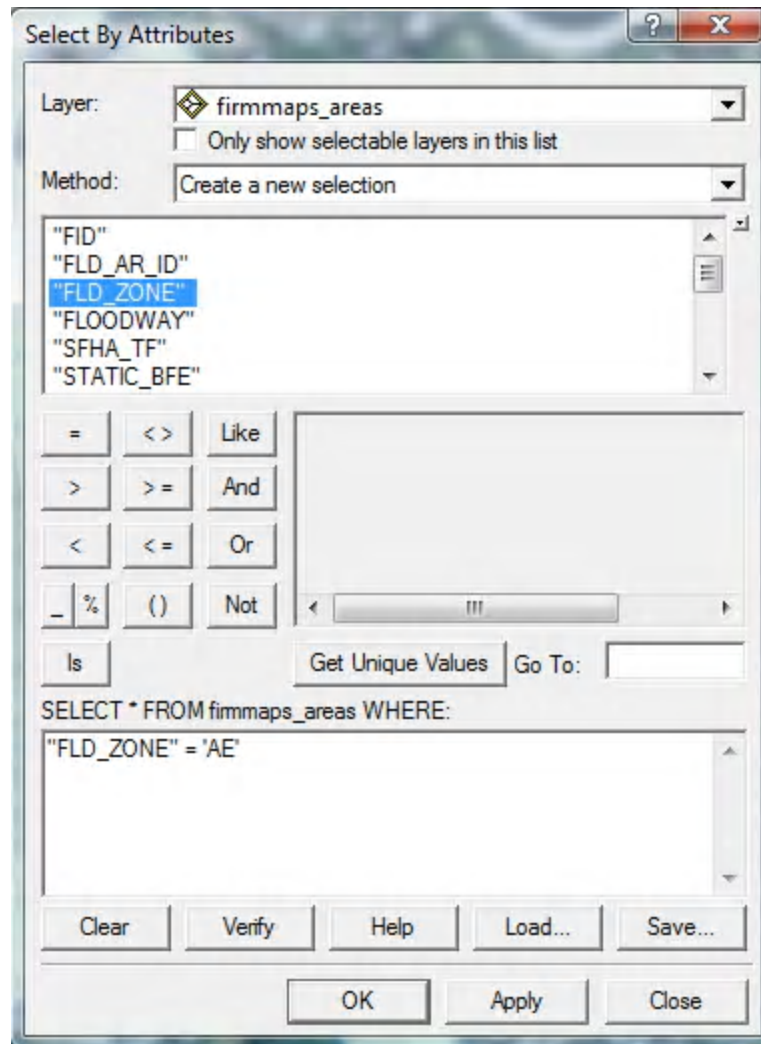


Figure 15: Select Attributes Window

Select `firmmaps_areas` as the *Layer*. In the field under *Methods*, **double Click** on “FLD\_ZONE”, then **click =** and then *Get Unique Values*. **Choose** the desired zone (in this example it is the AE Zone). The equation in the window should read “FLD\_ZONE”=‘AE’. **Click OK**. This selects the chosen floodplain region. Next **right click** on `firmmaps_areas`, **click Selection** and **Click Create Layer From Selected Features**, as shown in Figure 16.

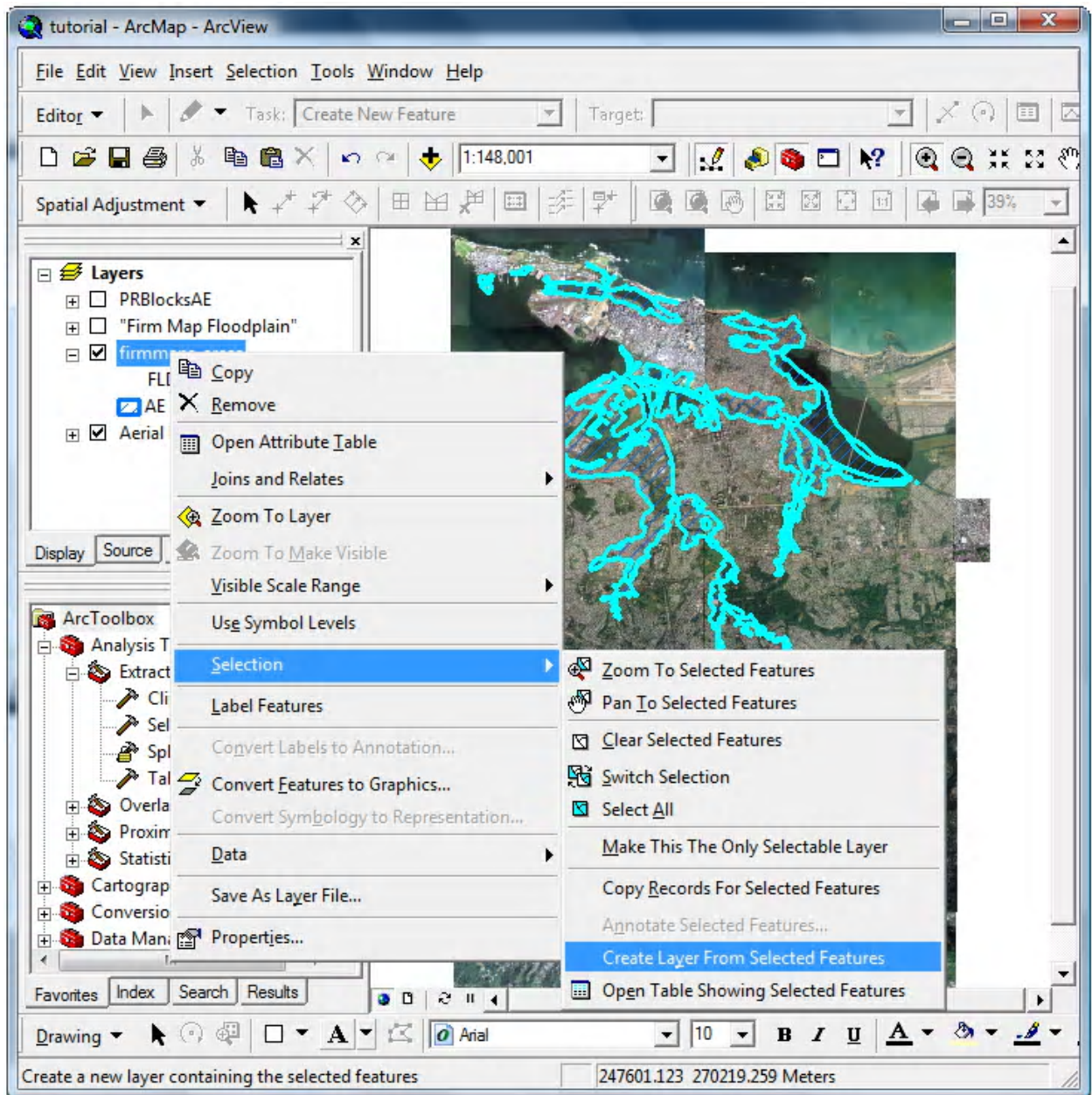


Figure 16: Creating a layer of a specific FIRM map floodplain region

This creates a new layer of a specific FIRM Map Floodplain. Next, it is necessary to create a layer of the Census blocks outlined by each of the floodplains using the *Clip* tool described in Step 1:

Uploading Files into ArcGIS 9.2. **Select** *Analysis Tools*, then *Extract*, then *Clip*, and the *Clip* tool is shown in Figure 8.

**Choose** *Census Blocks* as the input feature, and the *firmmaps\_areas* selection as the clip feature. **Type** *PRBlocksAE* in the highlighted part of *Output Feature Class* field displayed in Figure 17. This determines the name that the new layer will be saved as. **Click** *OK* to create a layer that allows visual inspection of the floodplains and the population inside of them.

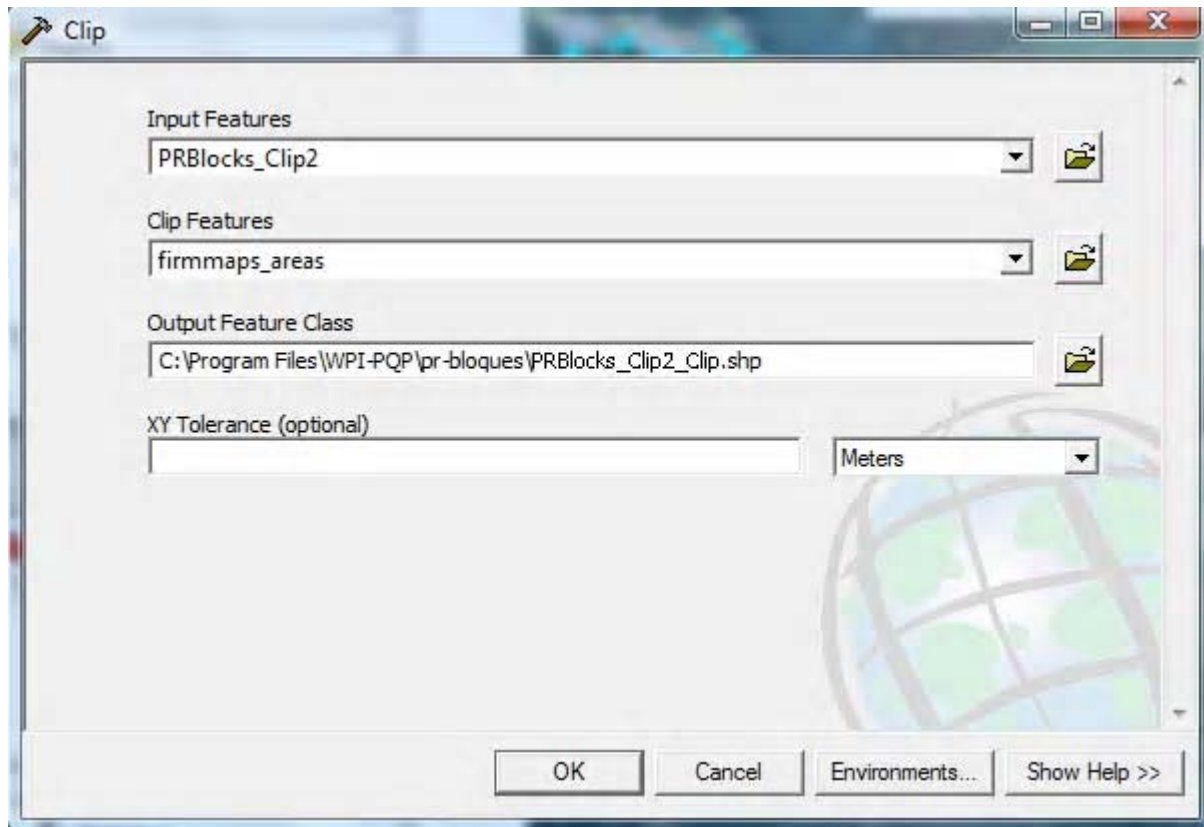


Figure 17: Changing the Output Feature file name

ArcGIS also automatically generates an attribute table associated with the layer which provides the Census blocks within the flood region, and Census data about each block. To open this attribute table, **right-click** on the *PRBlocksAE* layer and **select** *Open Attribute Table*, as displayed in Figure 18.

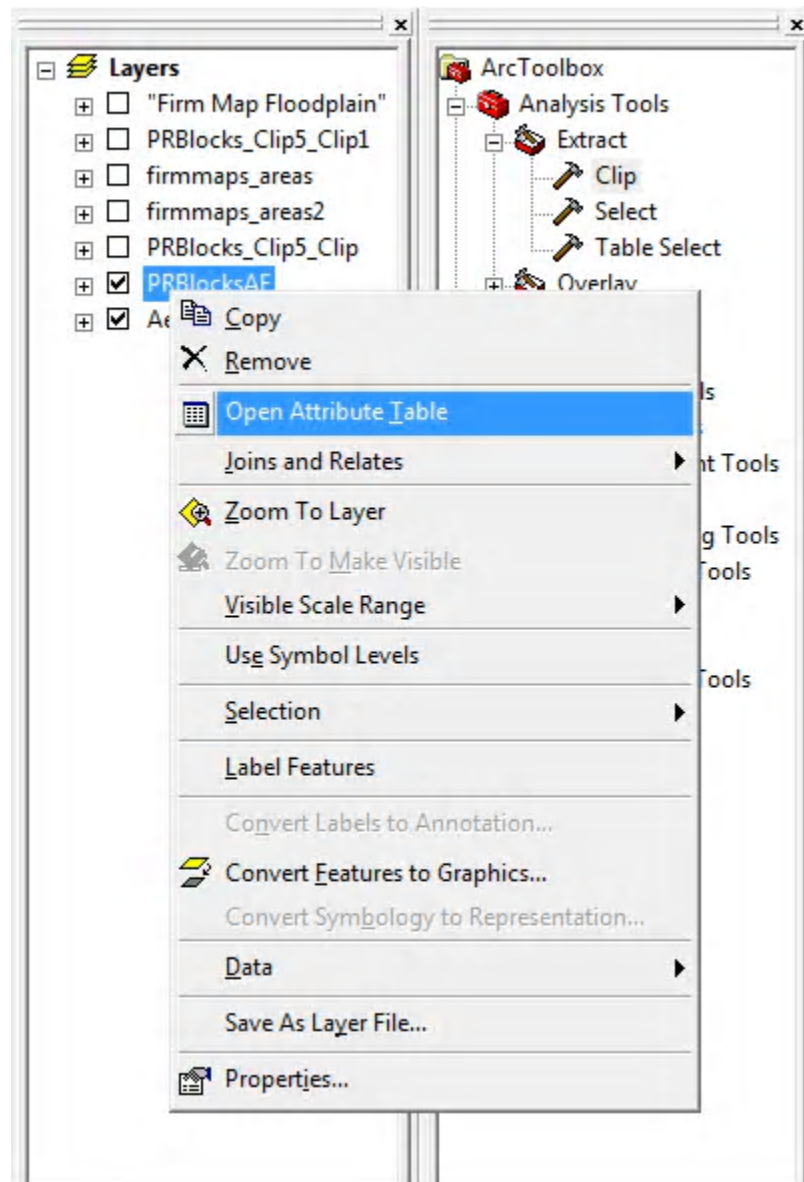


Figure 18: How to Open the Attribute Table

A table like the one in Figure 19 will appear.

FID	Shape*	ID	FIPSSTCO	TRACT2000	BLOCK2000	STFID	STATE	COUNTY	TRACT	BLOCK	POP2000	WHITE	BLACK	AMERI_ES	ASIAN	HAWN_PI	OTHER	MULT_RACE	HISPANIC
0	Polygon	288	72139	060222	1010	721390602221010	72	139	060222	1010	0	0	0	0	0	0	0	0	0
1	Polygon	96	72127	000600	2000	721270006002000	72	127	000600	2000	3	3	0	0	0	0	0	0	0
2	Polygon	97	72127	000600	2001	721270006002001	72	127	000600	2001	0	0	0	0	0	0	0	0	0
3	Polygon	98	72127	000600	2002	721270006002002	72	127	000600	2002	0	0	0	0	0	0	0	0	0
4	Polygon	99	72127	000600	2003	721270006002003	72	127	000600	2003	0	0	0	0	0	0	0	0	0
5	Polygon	100	72127	000600	2004	721270006002004	72	127	000600	2004	137	95	14	4	1	0	21	2	130
6	Polygon	105	72127	000600	2009	721270006002009	72	127	000600	2009	0	0	0	0	0	0	0	0	0
7	Polygon	106	72127	000600	2010	721270006002010	72	127	000600	2010	271	241	11	5	0	0	7	7	256
8	Polygon	107	72127	000600	2011	721270006002011	72	127	000600	2011	0	0	0	0	0	0	0	0	0
9	Polygon	110	72127	000600	2014	721270006002014	72	127	000600	2014	0	0	0	0	0	0	0	0	0
10	Polygon	111	72127	000600	2015	721270006002015	72	127	000600	2015	0	0	0	0	0	0	0	0	0
11	Polygon	112	72127	000600	2016	721270006002016	72	127	000600	2016	31	23	1	0	1	0	5	1	18
12	Polygon	115	72127	000600	3002	721270006003002	72	127	000600	3002	0	0	0	0	0	0	0	0	0
13	Polygon	137	72127	000700	2000	721270007002000	72	127	000700	2000	2	0	2	0	0	0	0	0	2
14	Polygon	139	72127	000700	2002	721270007002002	72	127	000700	2002	0	0	0	0	0	0	0	0	0
15	Polygon	140	72127	000700	2003	721270007002003	72	127	000700	2003	0	0	0	0	0	0	0	0	0
16	Polygon	141	72127	000700	2004	721270007002004	72	127	000700	2004	0	0	0	0	0	0	0	0	0
17	Polygon	154	72127	000700	2017	721270007002017	72	127	000700	2017	5	5	0	0	0	0	0	0	5
18	Polygon	157	72127	000700	2020	721270007002020	72	127	000700	2020	0	0	0	0	0	0	0	0	0
19	Polygon	160	72127	000700	2023	721270007002023	72	127	000700	2023	22	21	0	0	0	0	1	0	21
20	Polygon	161	72127	000700	2024	721270007002024	72	127	000700	2024	32	32	0	0	0	0	0	0	31
21	Polygon	162	72127	000700	2025	721270007002025	72	127	000700	2025	0	0	0	0	0	0	0	0	0
22	Polygon	163	72127	000700	2026	721270007002026	72	127	000700	2026	2	2	0	0	0	0	0	0	2
23	Polygon	164	72127	000700	2027	721270007002027	72	127	000700	2027	0	0	0	0	0	0	0	0	0
24	Polygon	165	72127	000700	2028	721270007002028	72	127	000700	2028	5	5	0	0	0	0	0	0	5
25	Polygon	166	72127	000700	2029	721270007002029	72	127	000700	2029	0	0	0	0	0	0	0	0	0
26	Polygon	168	72127	000900	1000	721270009001000	72	127	000900	1000	32	32	0	0	0	0	0	0	18
27	Polygon	169	72127	000900	1001	721270009001001	72	127	000900	1001	30	25	0	0	4	0	0	1	26
28	Polygon	170	72127	000900	1002	721270009001002	72	127	000900	1002	484	416	13	0	14	0	21	20	395
29	Polygon	171	72127	000900	1003	721270009001003	72	127	000900	1003	223	194	7	0	4	0	5	13	183
30	Polygon	173	72127	000900	2000	721270009002000	72	127	000900	2000	792	714	9	0	39	0	11	19	650
31	Polygon	174	72127	000900	2001	721270009002001	72	127	000900	2001	34	30	1	0	0	0	3	0	26
32	Polygon	175	72127	000900	3000	721270009003000	72	127	000900	3000	186	174	3	0	3	0	4	2	166
33	Polygon	176	72127	000900	3001	721270009003001	72	127	000900	3001	148	136	3	0	0	0	5	4	137

Figure 19: Attribute Table

Using the data in the Attribute table **create** an Excel spreadsheet to estimate the population for each Census block. To do this, **copy** the attribute table and **paste** it into Excel (individual columns in the attribute table cannot be copied so it is necessary to copy the entire table into Excel where it can be manipulated). **Copy** the attribute table by selecting all data (**press Ctrl-A**) **Right-click** on the left most column and **select Copy Selected**. Then **copy** the following columns: *ID* (the Block ID) and *POP2000* (the population of each block) from the recently created Excel sheet and **paste** them into another Excel spreadsheet. Then **create** columns for the number of buildings in the Census block and in the floodplain, the buildings in the Census block but not in the floodplain, and the estimated population living in both the Census block and the floodplain in the new Excel Spreadsheet. The columns of Table 1 show the columns of the spreadsheet with a description of the source of the information in that column.

ID	POP2000	Buildings Included	Buildings Excluded	Estimated Population
Given from Attribute table.	Given from Attribute table.	Found by counting buildings in aerial photos	Found by counting buildings in aerial photos	Equation 2

Table 1: Population Calculator Spreadsheet

## Estimating Population

The next step is filling the empty columns in the spreadsheet with data. The column detailing the average household size is calculated by dividing the population of the block by the number of households. To fill in the columns with the number of buildings in the Census block included and excluded from the floodplain, the team used the unclipped Census blocks and floodplain layers over the aerial photos. Figure 20 is an example of a section of the resulting map. The floodplain is shaded with a blue hatch so the aerial photo can still be seen, and the Census blocks are outlined in red.



Figure 20: Census Blocks near a Floodplain

If part of a building is in the floodplain then the entire building was considered to be within the floodplain because FEMA requires all buildings that are partially in a floodplain to have flood insurance. It was unnecessary to count the buildings in a Census block that is completely in or out of a floodplain. For adjusting the population of the Census block, only the ratio given in Equation 1 is important:



$$\frac{BUILDINGS\ INCLUDED}{BUILDINGS\ INCLUDED+BUILDINGS\ EXCLUDED} \quad (1)$$

If every building in the Census block is in the floodplain, Equation 1 is equal to one. Block 1 in Figure 20 is an example of a Census block with all buildings in the floodplain. For this block, **type** a one in the *Buildings Included* column and a zero in the *Buildings Excluded* column. If the floodplain area in a Census block does not include any buildings, the ratio detailed in Equation 1 is equal to zero. Block 2 in Figure 20 is an example of a Census block with no buildings in the floodplain. In this case, **type** a zero into the *Buildings Included* column and a one in the *Buildings Excluded* column.

If the floodplain area in a Census block includes houses in the flood region and houses that are outside the flood region, **determine** the estimated population by using the ratio in Equation 1. First, **count** the buildings inside the floodplain, and the buildings outside the floodplain for each Census block. **Type** the number of buildings inside the floodplain in the *Buildings Included* column and the number of buildings outside the floodplain in the *Buildings Excluded* column. Block 3 in Figure 20 contains 17 buildings within the floodplain and 4 buildings outside the floodplain. In this case, 17 would be typed into the *Buildings Included* column and 4 would be typed in the *Buildings Excluded* column. Equation 1 is then equal to 17/21, approximately 0.810. This ratio is used to determine the Estimated Population column. To determine the adjusted population of a Census block, Equation 2 was used, which multiplies with the population of the Census block to get Equation 2:

$$\frac{2000POP*BUILDINGS\ INCLUDED}{BUILDINGS\ INCLUDED+BUILDINGS\ EXCLUDED} \quad (2)$$

Table 2 below gives an example where data that was collected was entered into the Population Calculator Spreadsheet. It demonstrates how to determine the adjusted population in the three different cases; when no buildings in the block are in the floodplain, when a portion of the buildings in the block are in the floodplain, and when all of the buildings in the block are in the floodplain.

ID	POP2000	Buildings Included	Buildings Excluded	Adjusted Population
160	22	0	1	0
285	32	4	10	9
289	106	1	0	106

Table 2: Population Calculator Spreadsheet Example

After the population for all of the Census blocks is adjusted within the floodplain region, **sum** all adjusted Census block populations. **Repeat** this process for each flood risk designation, resulting in a total population estimate for all floodplains.

## Step 4: Creating the Population Map

The next step is to add the newly estimated populations to ArcGIS. In ArcGIS, **right click** on the *PRBlocksAE* and **click** on *Data*, then *Export Data*. **Click OK**, then a box will open up. If Yes is clicked it will add the exported data to the map as a layer, this is not necessary as *PRBlocksAE* is already a map layer, so **Click No**. This will create all the files associated with this layer, these files are the shapefile (.SHP), PRJ, SBN, SBX, SHX, XML, and the database file (.dbf). When layers are exported they are named Export\_Output. By default the files are exported to the Desktop. **Rename** the files *PRBlocksAE*. Make sure they are all named the same or they will not work properly. **Open** the database file (.dbf) with OpenOffice.

**Copy** the Estimated Population column into the *POP2000* column of the floodplain's database file and save it. The *PRBlocksAE* layer in ArcGIS now has the estimated population for the AE floodplain region. The next step is to configure it in ArcGIS. **Right-click** on the *PRBlocksAE* layer and **select Properties** **click** on the *Symbology* tab as shown in Figure 21.

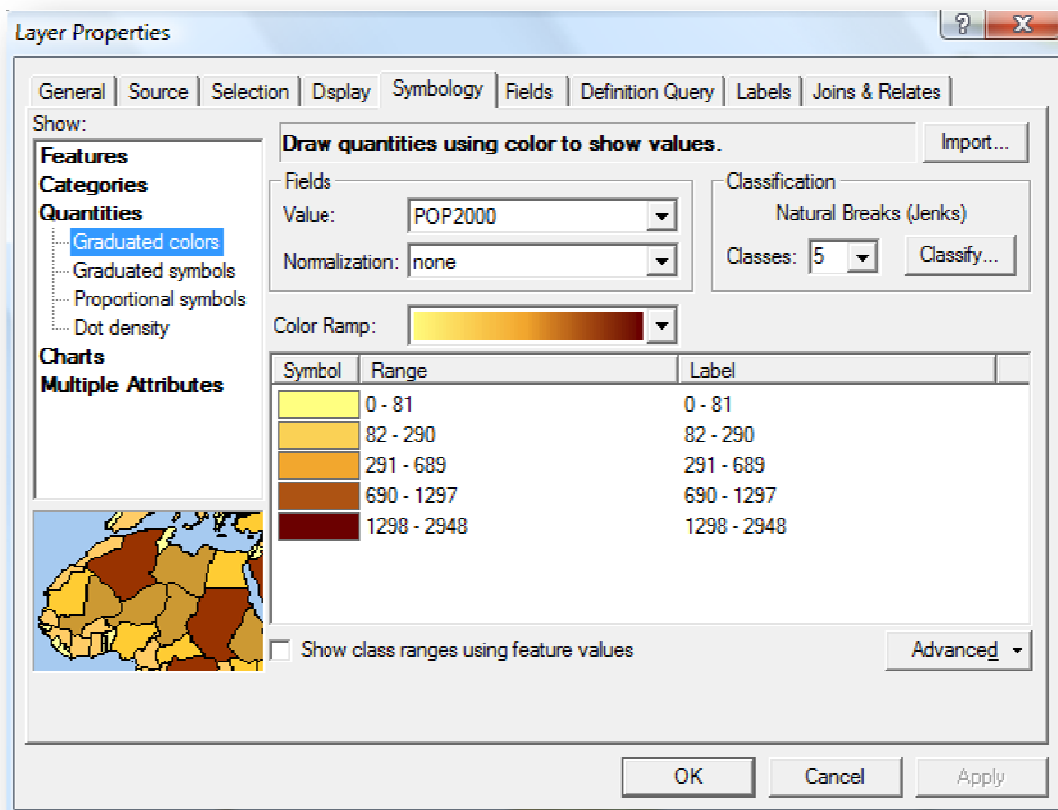


Figure 21: Symbology Menu

This menu is for determining the map's color ramp, number of classes, ranges, labels, value to display, and classification of classes. **Change** the *Fields Value* to *POP2000*. This configures ArcGIS to associate each block on the map with its *POP2000* value. The classification method chosen in this tutorial is Natural Breaks (Jenkins). Select the desired method and **Click OK**.

## Using ArcGIS to Find Population Sums

To calculate the population of any arbitrary floodplain or section of floodplain, ArcGIS can calculate the sum of the individual populations in a selected area. Before it is possible to select a specific floodplain region, it is necessary to turn off all the layers that do not wished to be included in the calculation. Then **Click** the *Select Features* utility in the *Tools* tool bar and **highlight** an area of blocks.

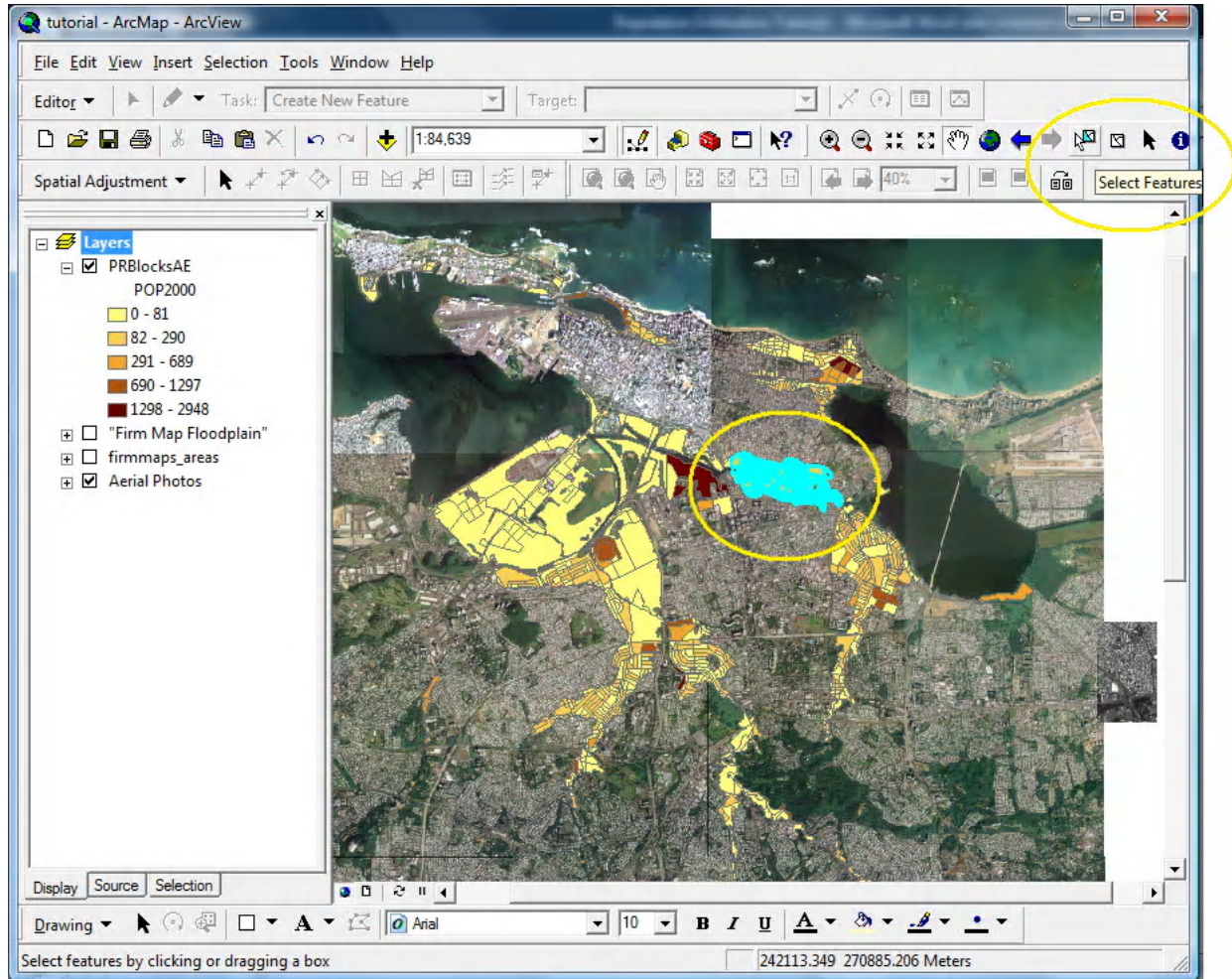


Figure 22 Select Features tool and a Selected Area

Next **pull down** the *Selection* menu and **click** *Statistics*. This opens the menu shown in Figure 23. The *Selection Statistics* tool displays statistics such as the count, minimum, maximum, mean, sum, and standard deviation of the selected blocks. The *count* refers to the number of Census blocks that are selected. The *minimum* is the lowest value that any of the selected blocks contain. The *maximum* refers to the highest value that any of the blocks contain. The *sum* is the sum of all the values of each

individual block. The *mean* is the calculated average of the population of all the selected blocks. Lastly, the *standard deviation* displays the standard deviation of the values. The *Selection Statistics* utility can calculate statistics of any layer that has been selected by the *select features* tool. The values that these statistics are using to determine each statistic are decided in the *Field* Pull Down menu. To find the estimated population of the selected area, **select POP2000** in the *Field* Pull Down menu. The *sum* is the estimated population of the selected area. The estimated population of the selected area in Figure 22 is determined to be 15369 for the AE flood region, as shown in Figure 23.

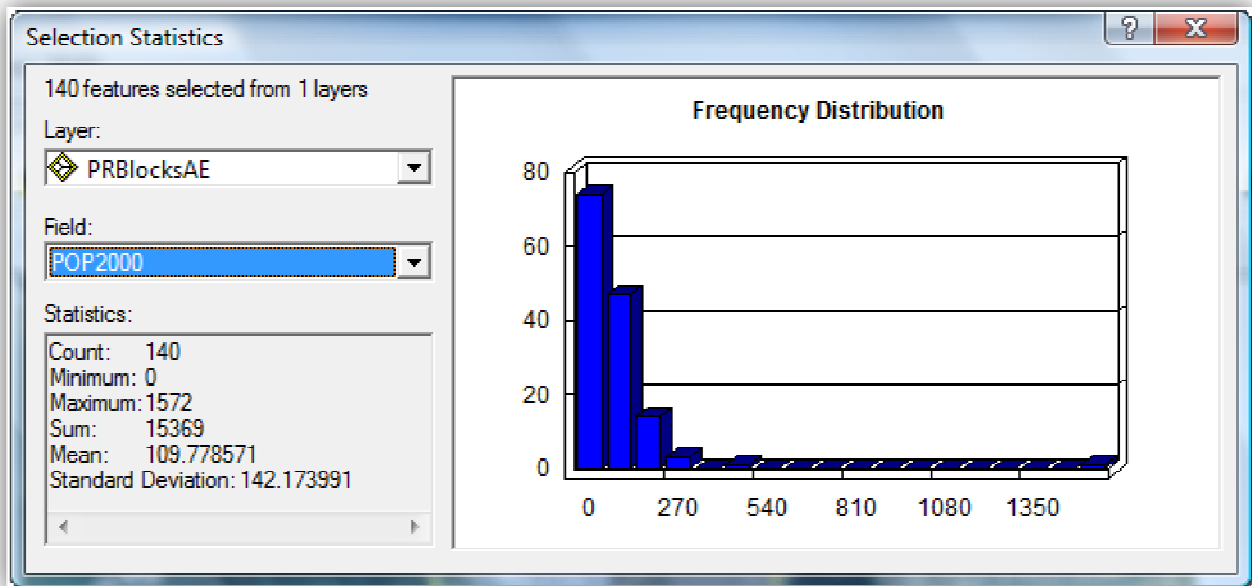


Figure 23 Selection Statistics Menu

## Step 5: Layout View

Once the map has been configured it is ready to be formatted using the Layout view. To use Layout view, **click** on *View* and select *Layout View*. This view is used to format the map for printing. This section will explain each step to add a legend, title, scale, and north arrow.

## Inserting the Legend

Legends explain the symbology used in a map. To insert a legend, **pull down** the *Insert* menu and **click** on *Legend*. This will bring up the *Legend Wizard*, shown in Figure 24. This wizard provides a step by step guide through the creation of the legend. The wizard automatically adds every item from the layers to the legend. To remove the unwanted items, **select** the item and **click** <. **Repeat** this step to remove all unwanted items. When all unwanted items are removed, **click** *Next*.

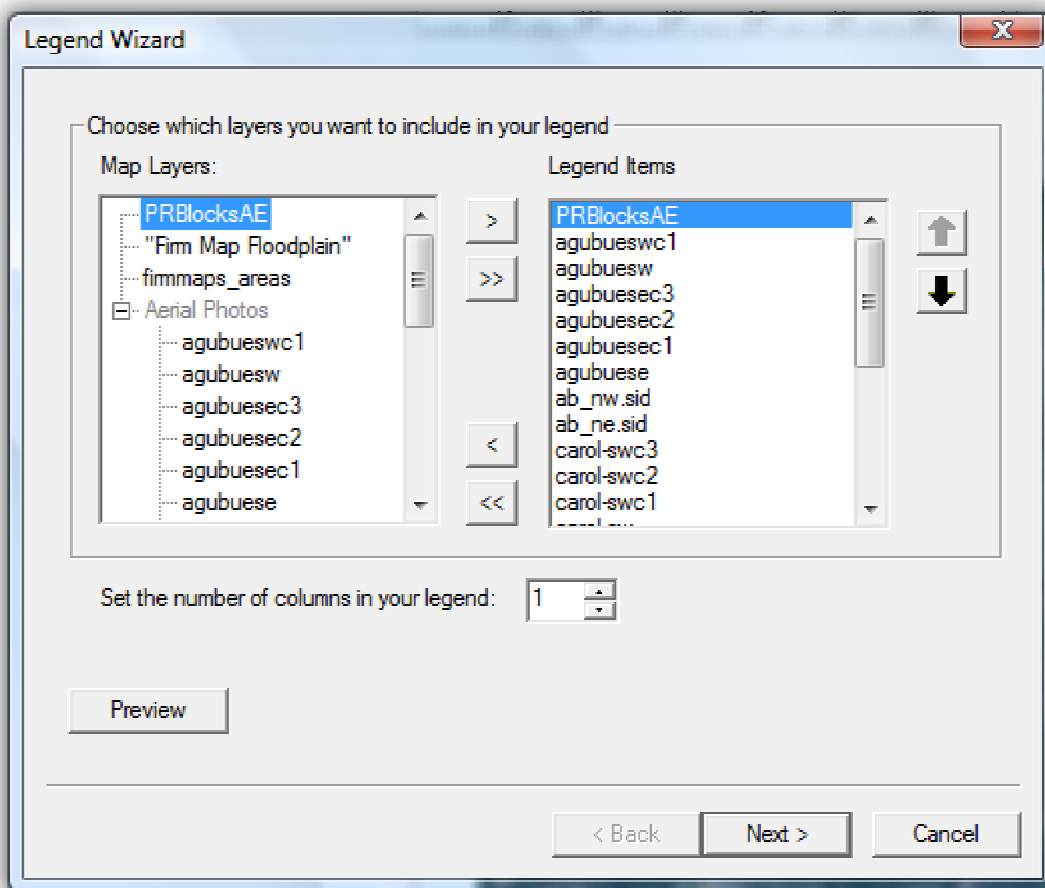


Figure 24 First Window of Legend Wizard

It is possible to change the font, size, and color of the title in this window. **Type** the desired name of the legend, and **click Next**.



Figure 25 Second Window of Legend Wizard



This window configures the legend frame. **Click Next.**

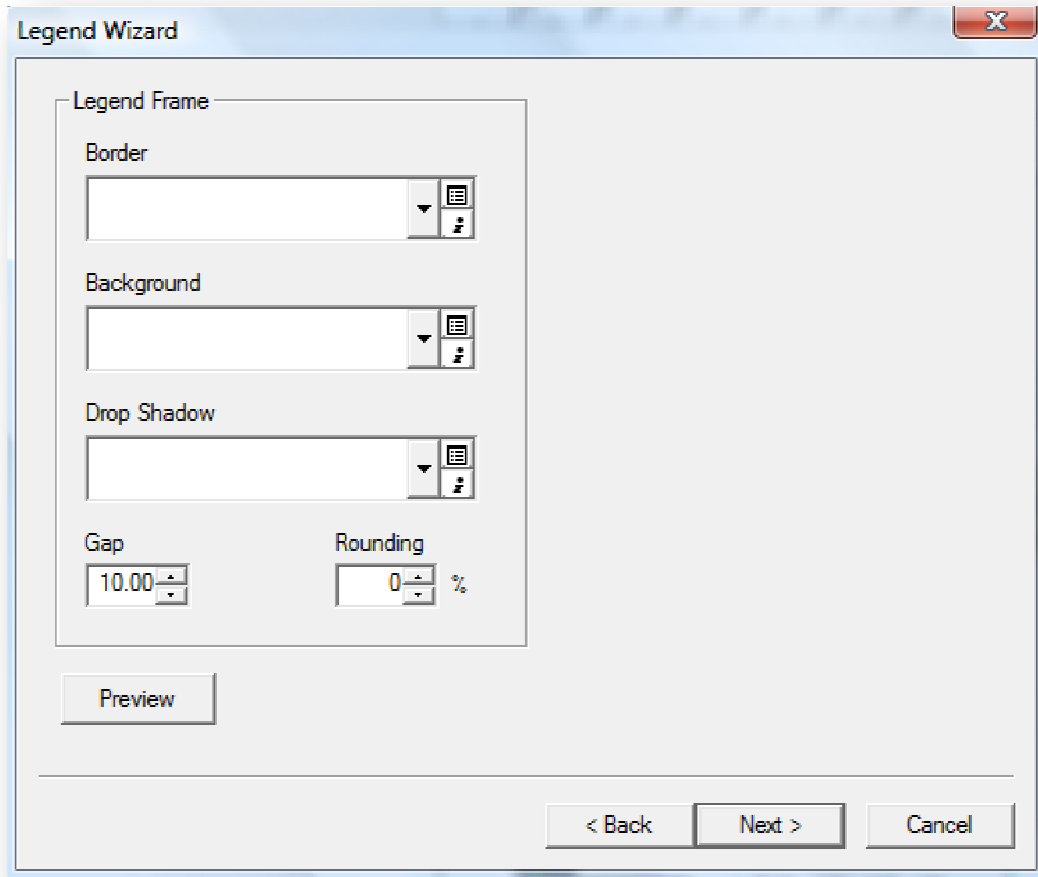


Figure 26 Third Window of Legend Wizard

In this window, the size and shape of the symbol patch used to represent line and polygon features in the legend can be changed. When done, **click Next**.

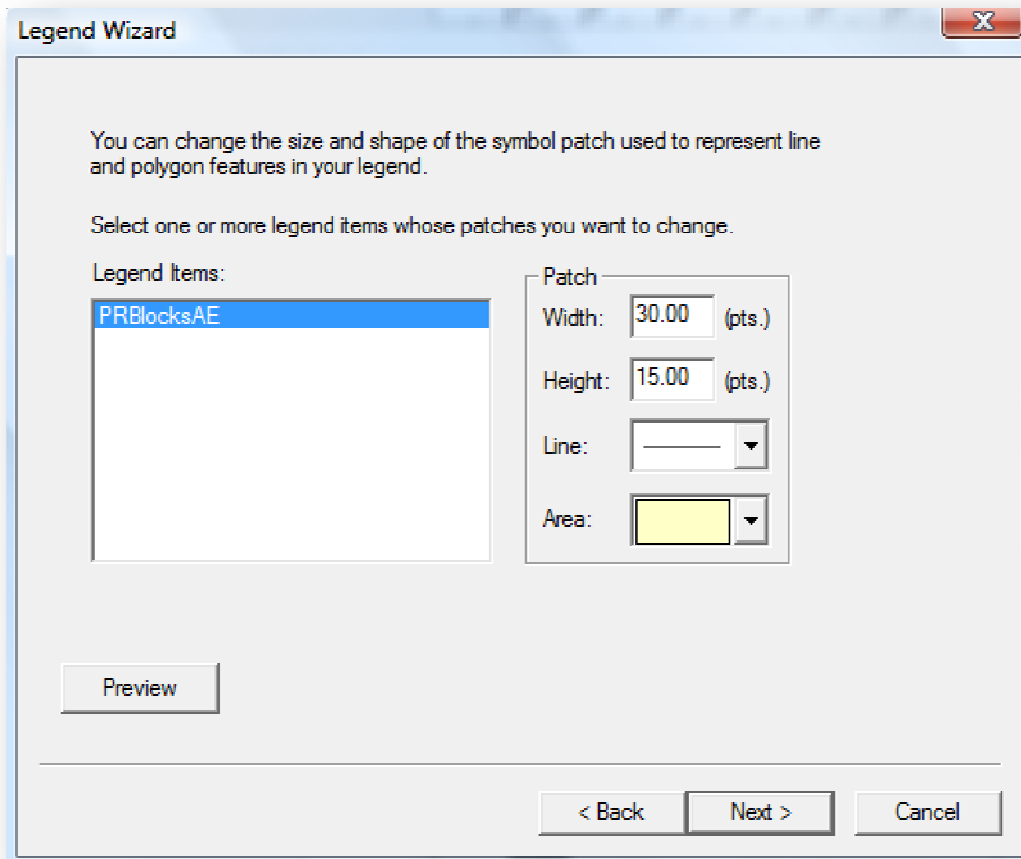


Figure 27 Fourth Window of Legend Wizard

This window sets the spacing between the numbers, symbols, and letters of the legend. **Click Finish** after choosing appropriate spacing. To configure the style of the legend, **double click** on the legend object box. This will bring up the *Legend Properties* window. **Click** on the *Items* tab.

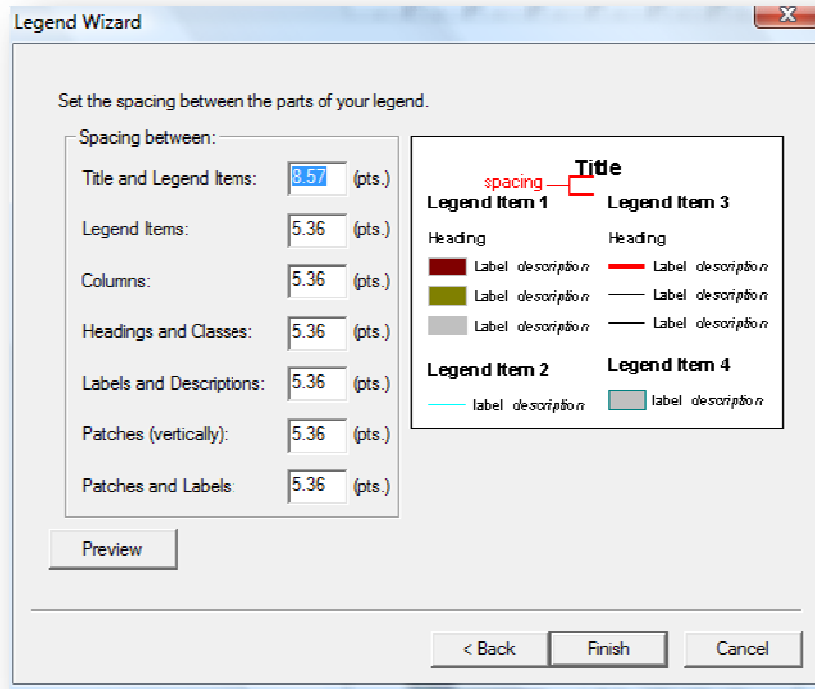


Figure 28 Fifth Window of Legend Wizard

Double click on the legend item in the right column, in this case AE.

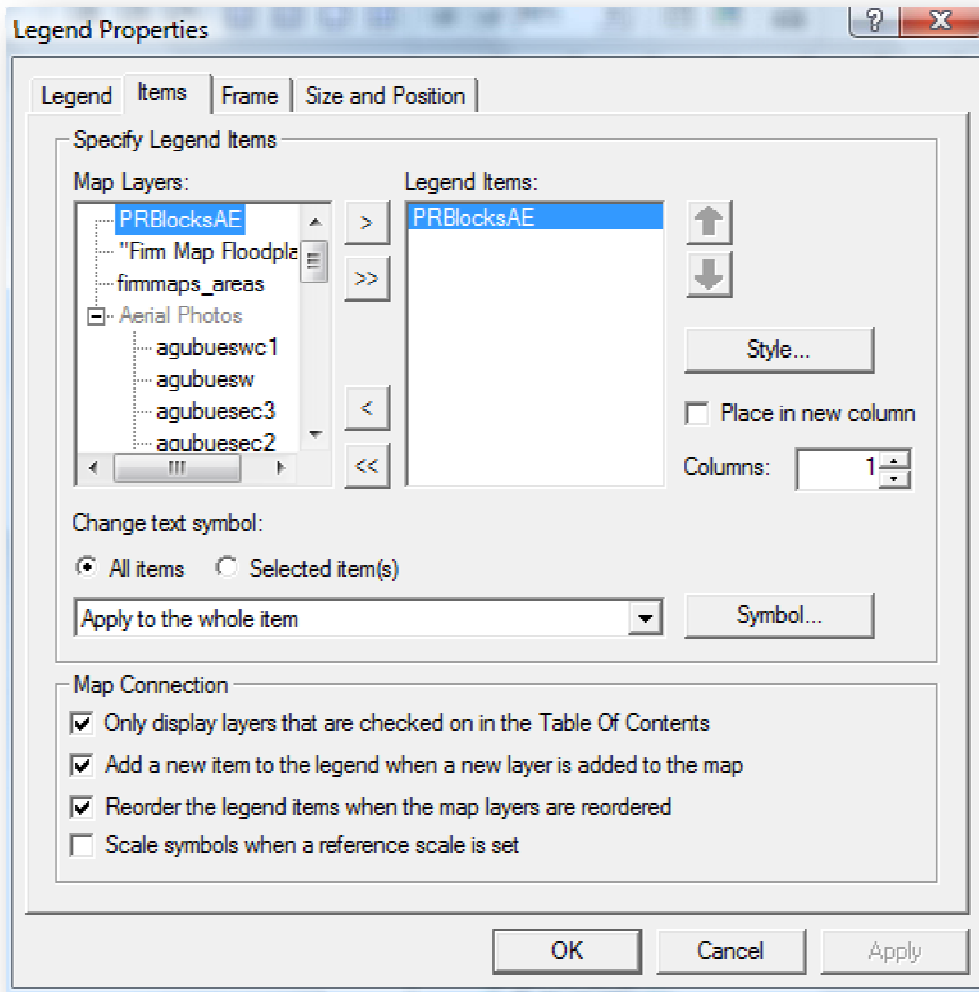


Figure 29 Legend Properties Window

From here it is possible to select many different styles for the legend. This tutorial uses the horizontal bar with heading, labels, and description. Pick the desired style and **click OK**.

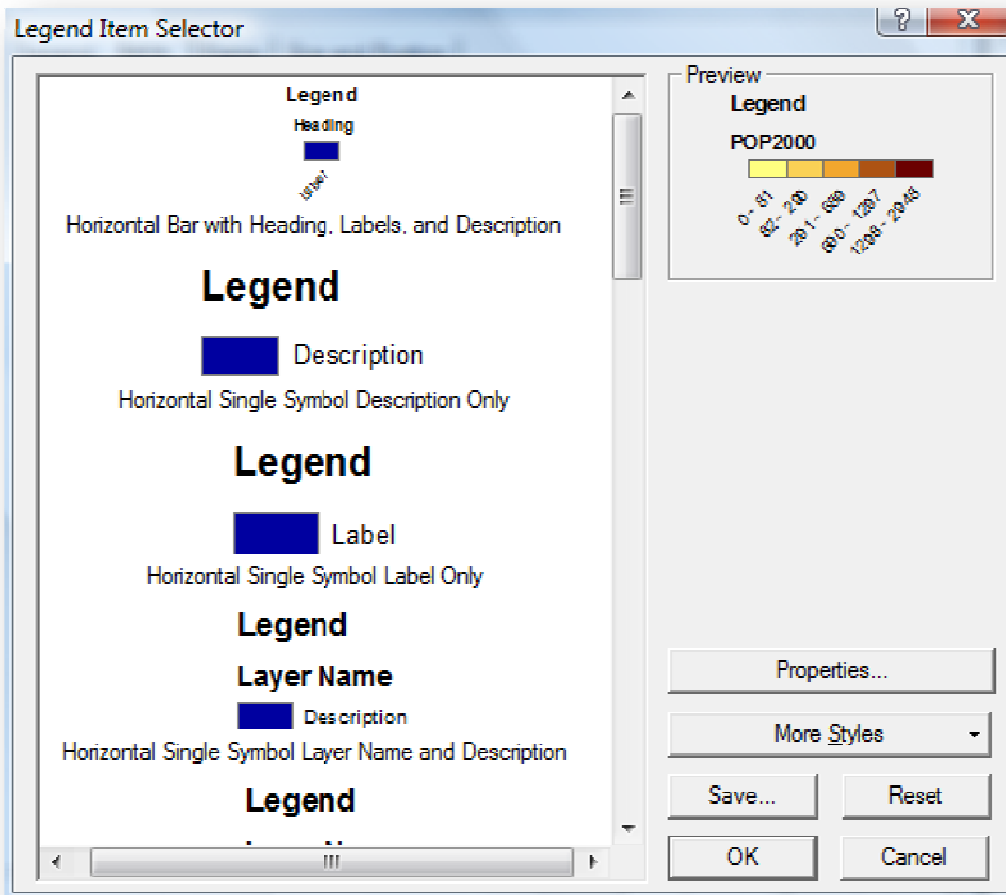


Figure 30: Legend Item Selector

At this point the map should look similar to Figure 31.

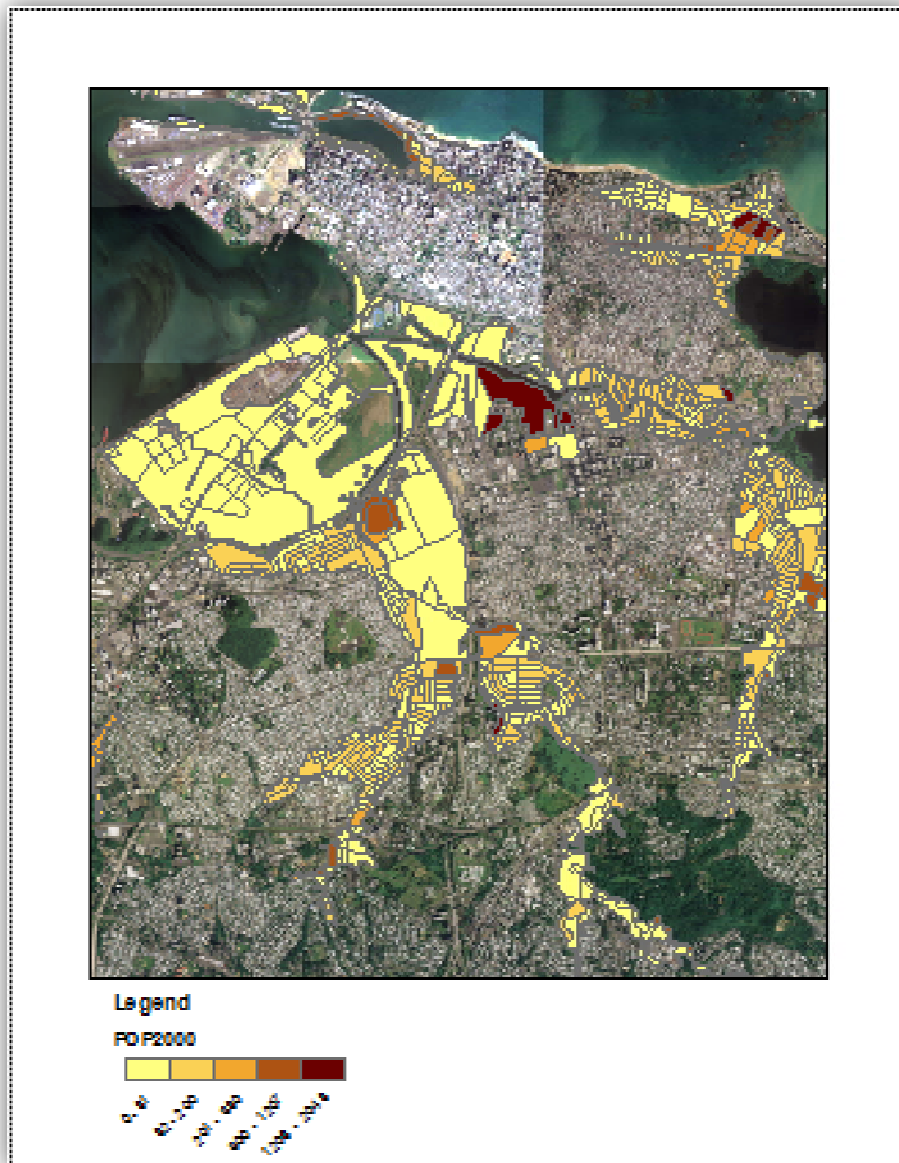


Figure 31: Population Map with Legend

## Inserting the Title

Titles are used to describe the region and contents of a map. To add a title **pull down** the *Insert* menu and **click** on the *Title* option, as shown in Figure 32.

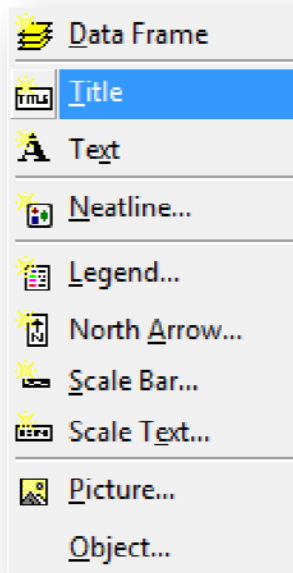


Figure 32: Insert Title

A text box will appear with the project name in it. **Double click** on the *text box* to open up the text properties menu.

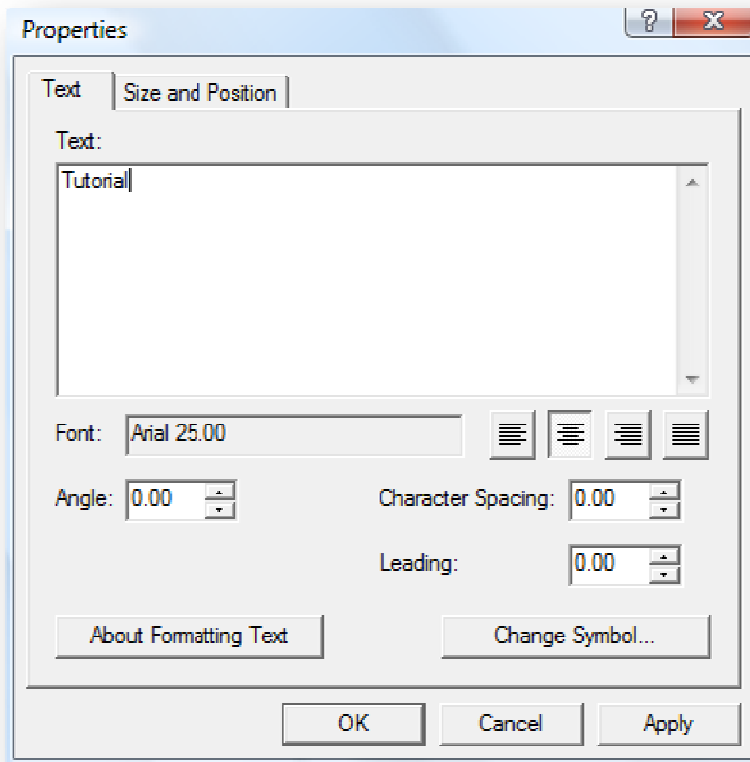


Figure 33 Text Properties Menu

In this menu, text, font, color, and other attributes can be adjusted. After choosing an appropriate title and its attributes, **click OK**.



## Inserting the Scale Bar

Scale bars are used to relate the distance on the map to the actual distance on the ground. To insert a scale bar **pull down** the *Insert* menu and **click** on *Scale Bar*.

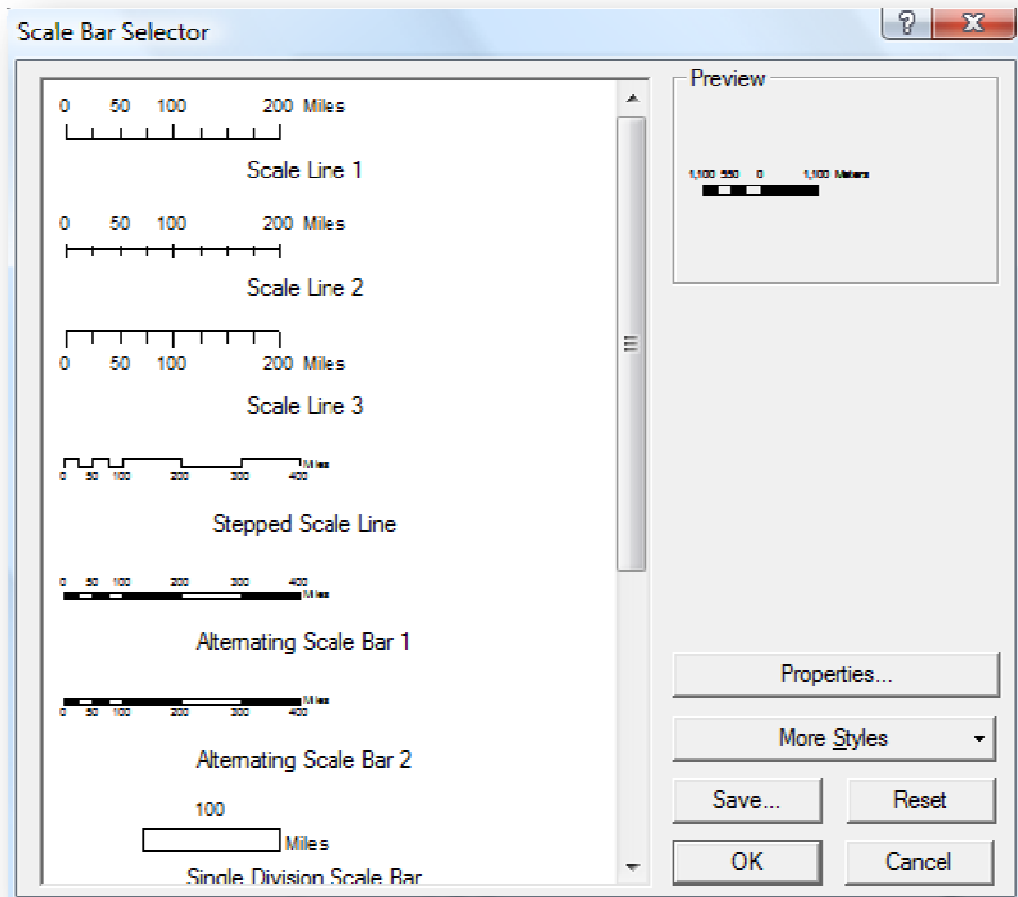


Figure 34: Scale Bar Selector Menu

There are many different styles of scales available in the *Scale Bar Selector* window, shown in Figure 34.

**Select** a scale and **click** *OK*.

## Inserting the North Arrow

A north arrow identifies the north direction. Although it seems very simple it is crucial to be aware of the orientation of the map. To insert a north arrow, go to **pull down Insert** and **click North Arrow**. The *North Arrow Selector* menu is displayed in Figure 35. This menu provides a list of different styled north arrows to choose from. Select a north arrow and click **OK**.

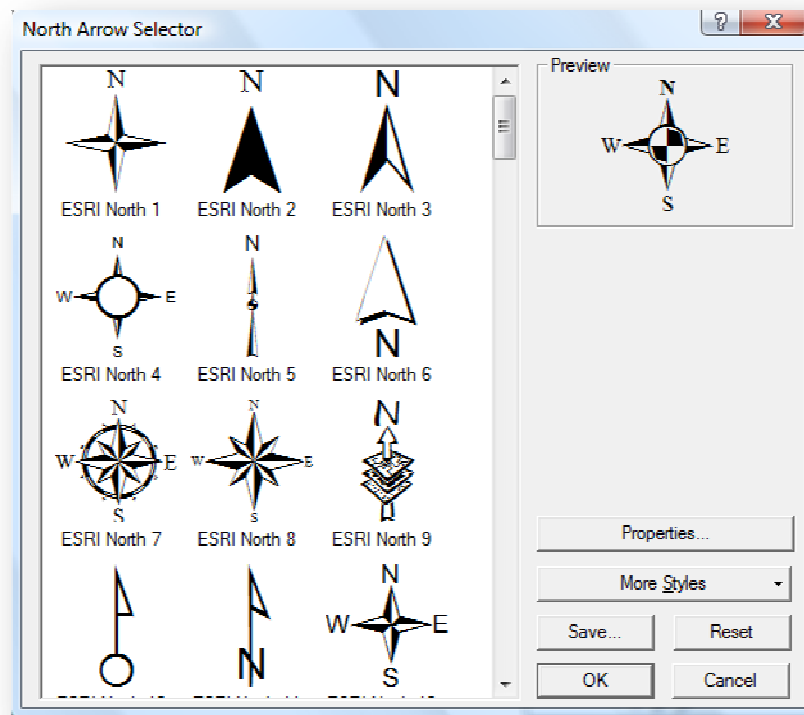


Figure 35: North Arrow Selector Menu

## Step 6: Finished Population Map

The last step is to export the map image. **Pull down** the *File* menu and **Select** *Export Map*. **Choose** a file name and a file type. **Click** *Save*. The exported map is shown in Figure 36.



Figure 36: Completed and Exported Map

Figure 36 displays the finalized Population Map of all of the floodplains in San Juan, Puerto Rico.

## **Conclusion**

This tutorial has covered the essentials of creating a population map using ArcGIS. By the end of Step 6 of this tutorial, the user should have attained an estimation of the population residing in the floodplain and a population map illustrating the distribution of population throughout the floodplain.