

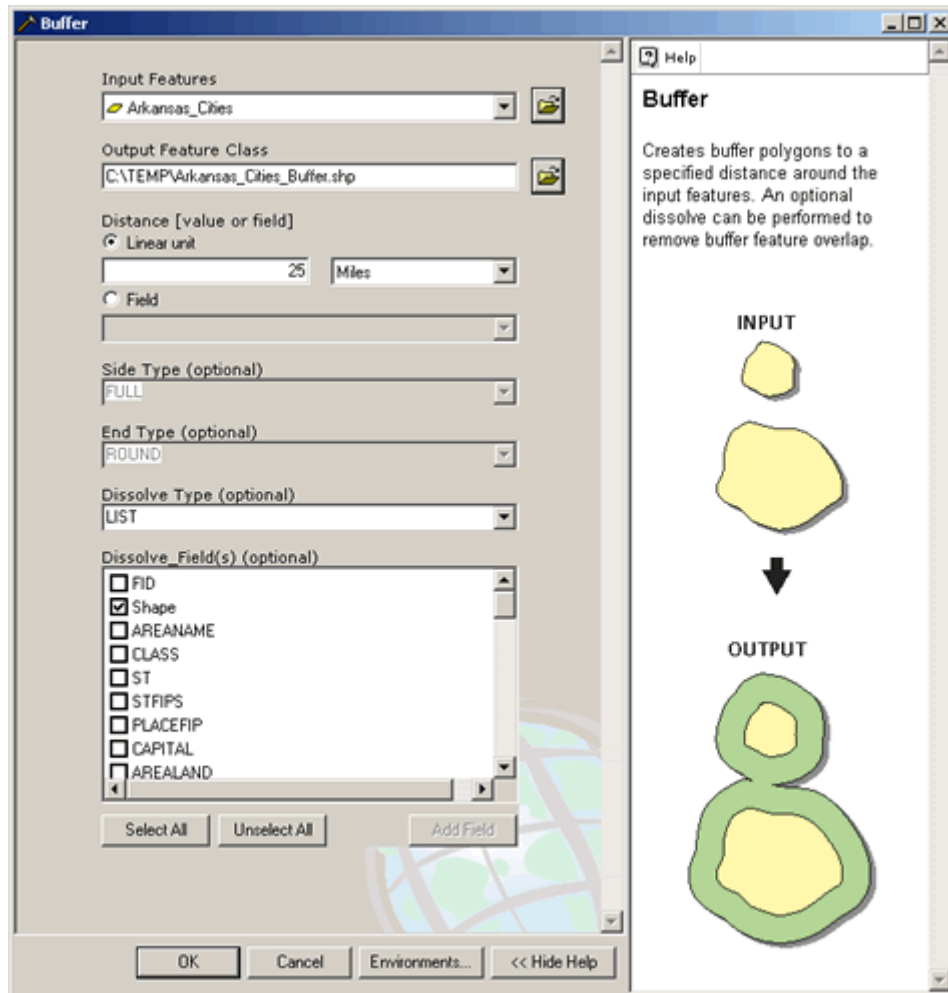
Section 5: Analyzing Spatial Data

Buffering Features:

A buffer operation is one of the most common spatial analysis tools. A buffer is a map feature that represents a uniform distance around a feature. When creating a buffer, the user selects the feature to buffer from, as well as the distance to be buffered.

The buffer operation creates a new polygon data set, where a specified distance is drawn around specific features within a layer. The distances can either be constant or can vary depending upon attribute values. When features are close together, their buffers may overlap. The user can choose to preserve the overlaps or remove them.

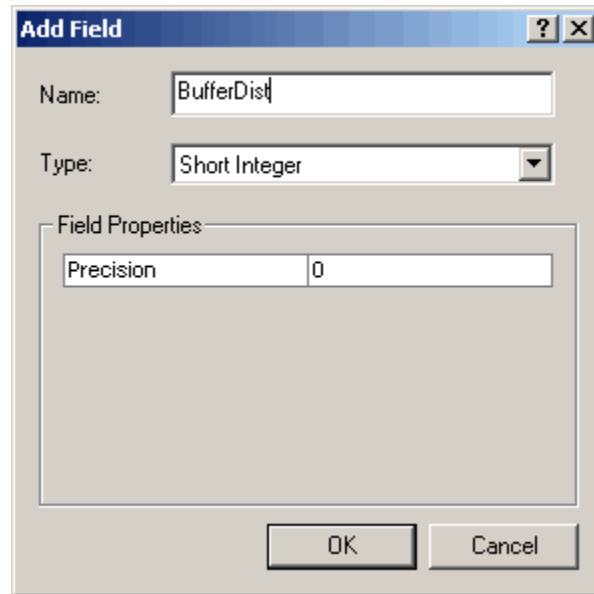
To use the ArcToolbox Buffer tool, the user must go to Analysis Tools and select Proximity. Buffer then appears in the list of tools. A double click on Buffer results in the appearance of the Buffer dialog box. The drop down arrow should be clicked, or the browse button used, to select the layer the user wishes to buffer. Then, the **Linear unit** radio button should be clicked and units and distance specified. If the user wishes to dissolve the barriers between any overlapping buffers he or she may do so by selecting LIST from the drop-down menu within **Dissolve Type**. Once the list of attribute fields appears with a white background the box next to Shape should be checked.



If the user wants to create a buffer around an input feature he or she may specify a value as illustrated above or a numeric field in the attribute table can be specified using the **Field** radio button.

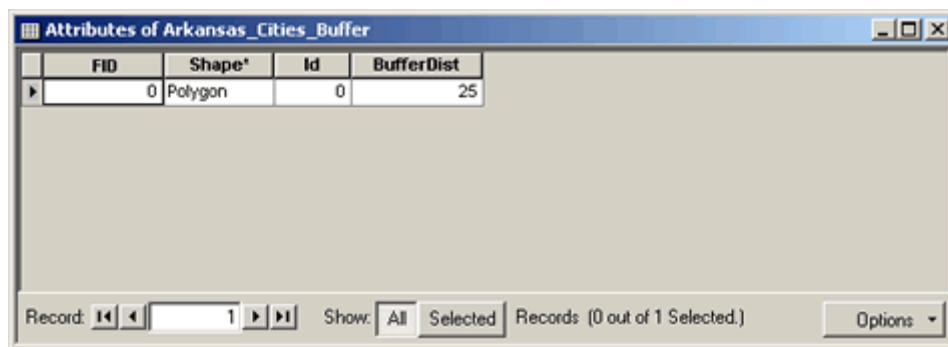
The **OK** button should be clicked once all parameters have been set. The buffer will be created and added to the ArcMap display if ArcToolbox was opened through ArcMap.

Once a buffer has been created the user may want to add the buffer distance to the new layer's attribute table. This can be done by right-clicking on the layer name in the table of contents and selecting **Open Attribute Table**. Once the attribute table opens, the **Options** button should be clicked. The user should then select the **Add Field** option.



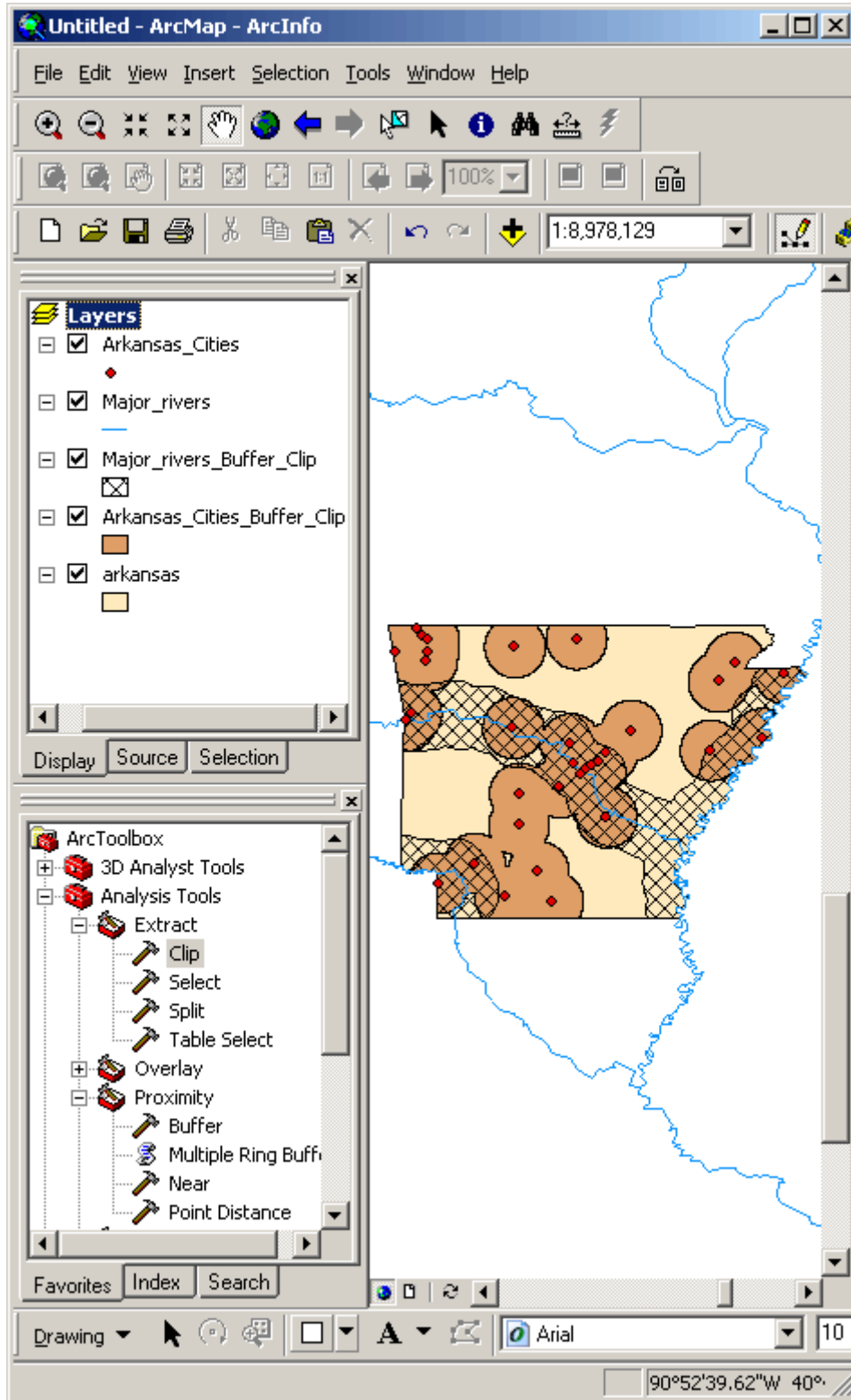
When the **Add Field** Dialog Box appears, the user must type in the name of the new field, select the type of attribute that will be added to the field, and click **OK**. In the above, a new field was created called "BufferDist" that will contain numeric data, in this case "25" for 25 miles buffer distance.

Once a new field has been created the user can place values in the cells under "BufferDist" by going to **Tools** on the main menu and selecting **Editor Toolbar** followed by **Editor** on the toolbar and then **Start Editing**. With this preparation the contents of cells in an attribute table may be edited simply by placing the cursor in the cell(s) and typing - in this case the cell underneath the newly created "BufferDist" field had "25" placed in it for 25 miles.



Closing the editing session is done by going back to **Editor**, selecting **Save Edits**, then **Stop Editing**.

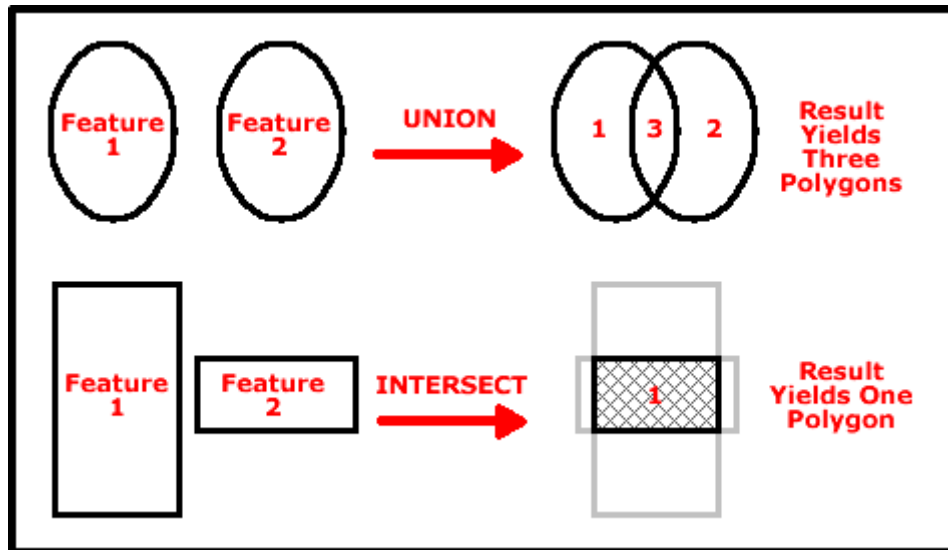
In the following illustrations a 25-mile buffer around cities in Arkansas is represented along with a 25-mile buffer around the major rivers. Note: the actual buffers extended beyond the boundary of Arkansas. The buffers shown below were clipped with the Arkansas layer in order to display only the areas within Arkansas that were within 25 miles of a city and all areas within 25 miles of a major river.



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Overlaying Data:

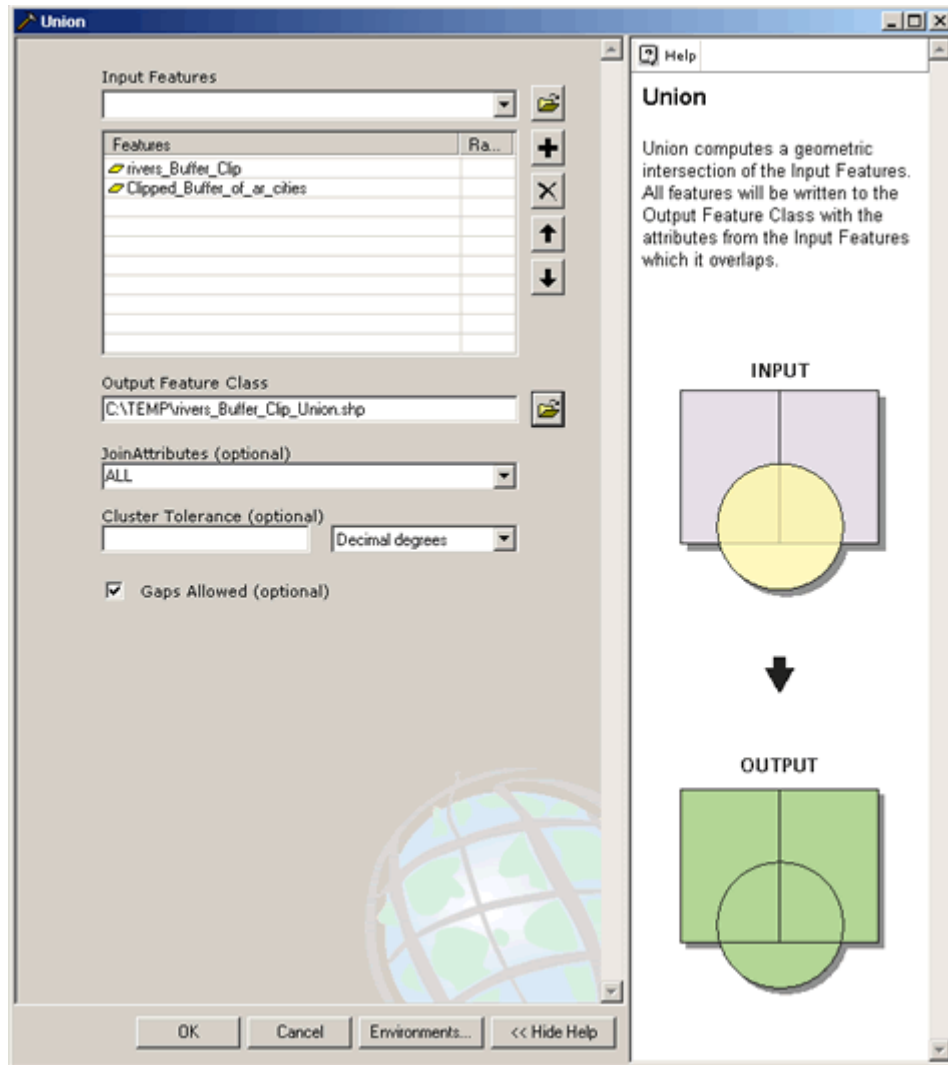
An overlay operation is also one of the most common spatial analysis tools. Overlays allow the user to identify areas where features in two layers overlap. A new data set is often created from these overlaps. In a **Union Overlay**, all features are included in the new data set but the features that overlap represent a new feature. In an intersect overlay, only the areas that overlap are contained in the new data set.



- Union Overlay:

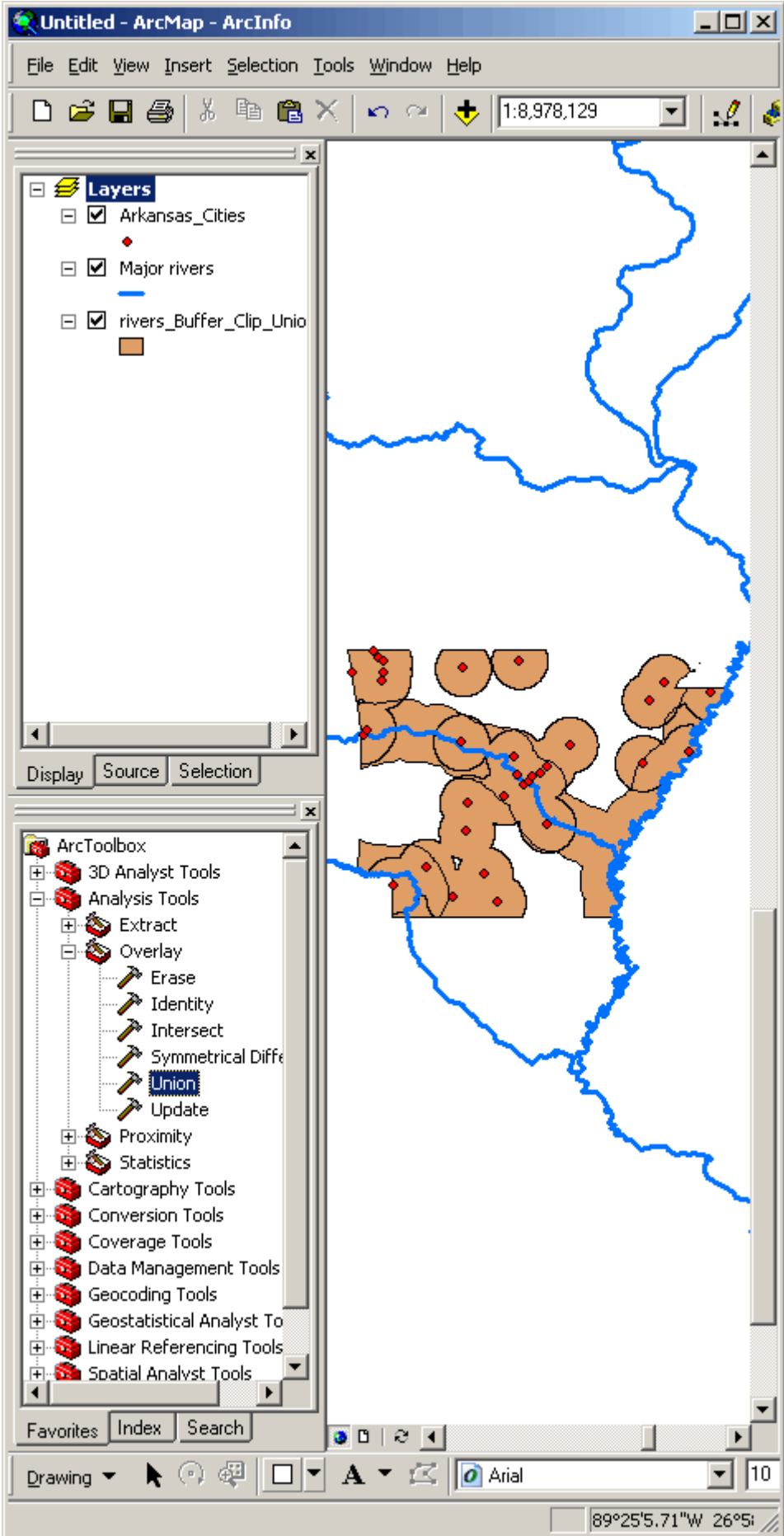
The union overlay option may be very useful if the user wishes to combine data layers into one layer. For example, if the user does not wish to build a house with close proximity to a stream or a railroad, the user could create a buffer area that represents close proximity to a stream. The user could do the same for the railroad layer. Last, the user could union the two buffers. The final result would represent all areas the user does NOT wish to build a house.

To perform a union overlay, the user must go to ArcToolbox's Analysis Tools, select Overlay, and then click **Union**. The user then specifies the input layers to union and a name for the output data set.



Again, once the **OK** button has been clicked, the result will be added to the ArcMap display should ArcToolbox have been used through ArcMap. The attribute table for the union layer will contain the attributes present in both input layers.

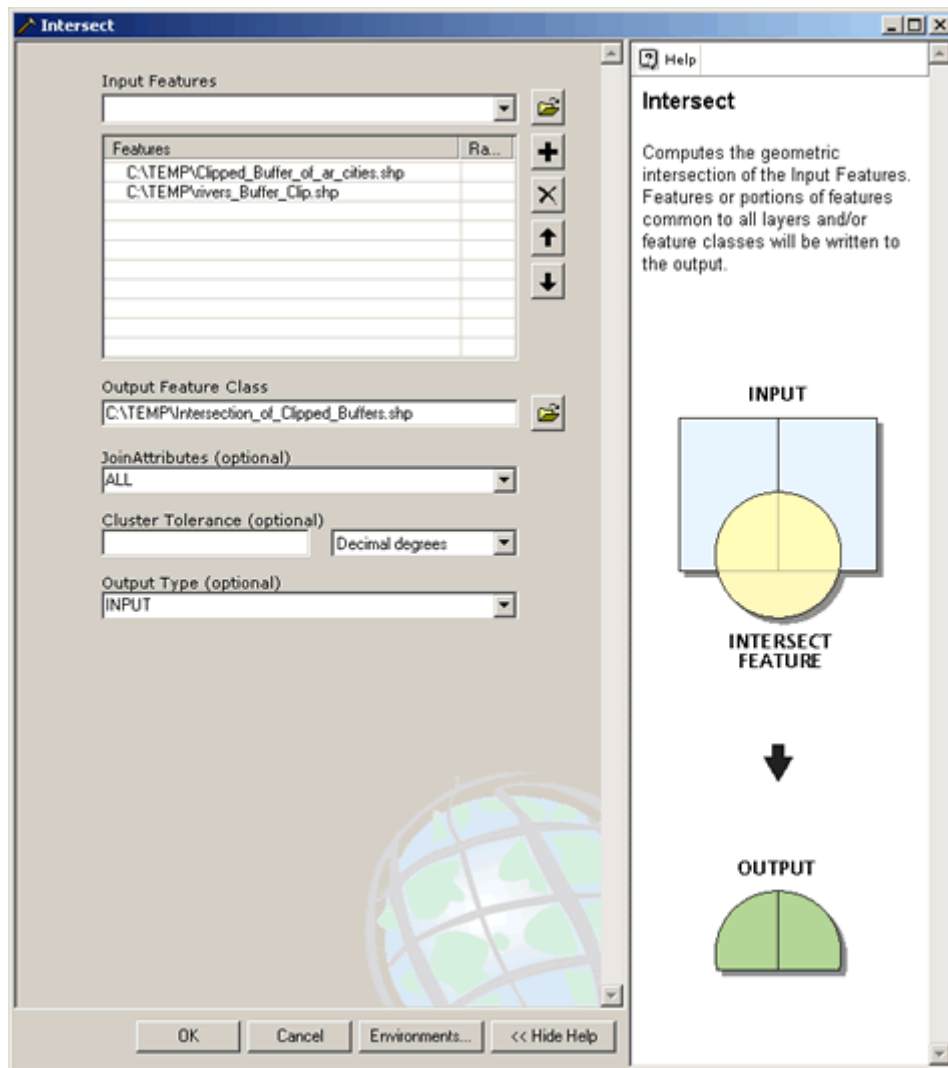
In the following example an Arkansas city buffer of 25 miles and an Arkansas' major rivers buffer of 25 miles were created to represent suitable areas in which to locate a transportation terminal. These two buffers were unioned in order to represent all areas that fall within either buffer. This operation represents the Boolean OR operation.



- Intersect Overlay:

To perform an intersect overlay, the user must go to Analysis Tools in ArcToolbox and click on Overlay. From the list of Overlay tools double-click on **Intersect**. The user is prompted to select the input features for intersection and the output feature class.

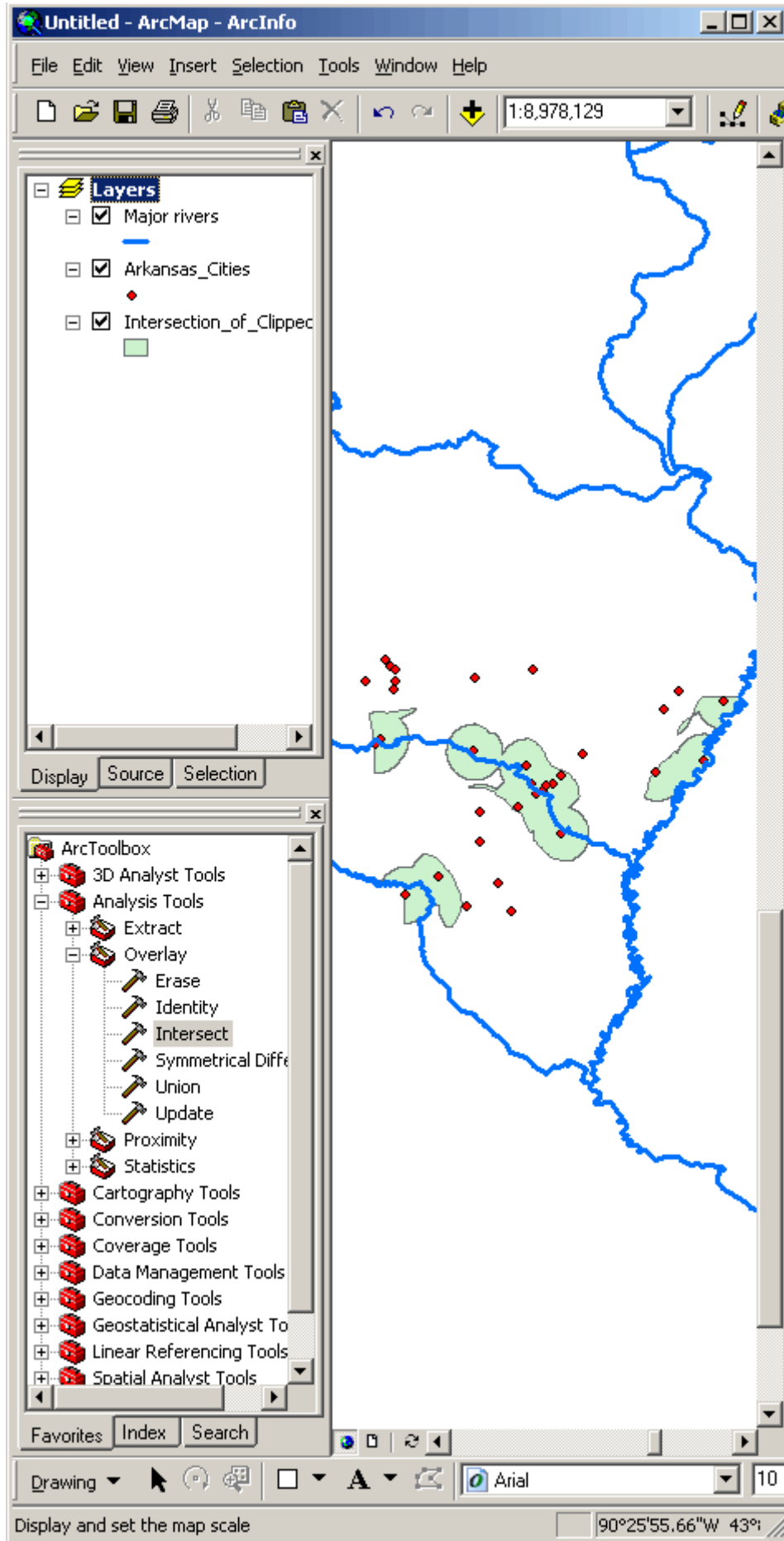
In the above union overlay example, the output shows where at least one of the buffer criteria have been met. A more restrictive overlay is to find the places where BOTH criteria occur in the same place. This is otherwise known as the Boolean AND operation. The following shows the process to determine the places that are within 25 miles of an Arkansas city AND within 25 miles of a major Arkansas river.



The **OK** button should be clicked. The result is automatically displayed in ArcMap if ArcMap was used to access ArcToolbox. In the above union overlay example, the output shows where at least one of the buffer criteria have been met. A more restrictive overlay is to find the places where BOTH criteria occur

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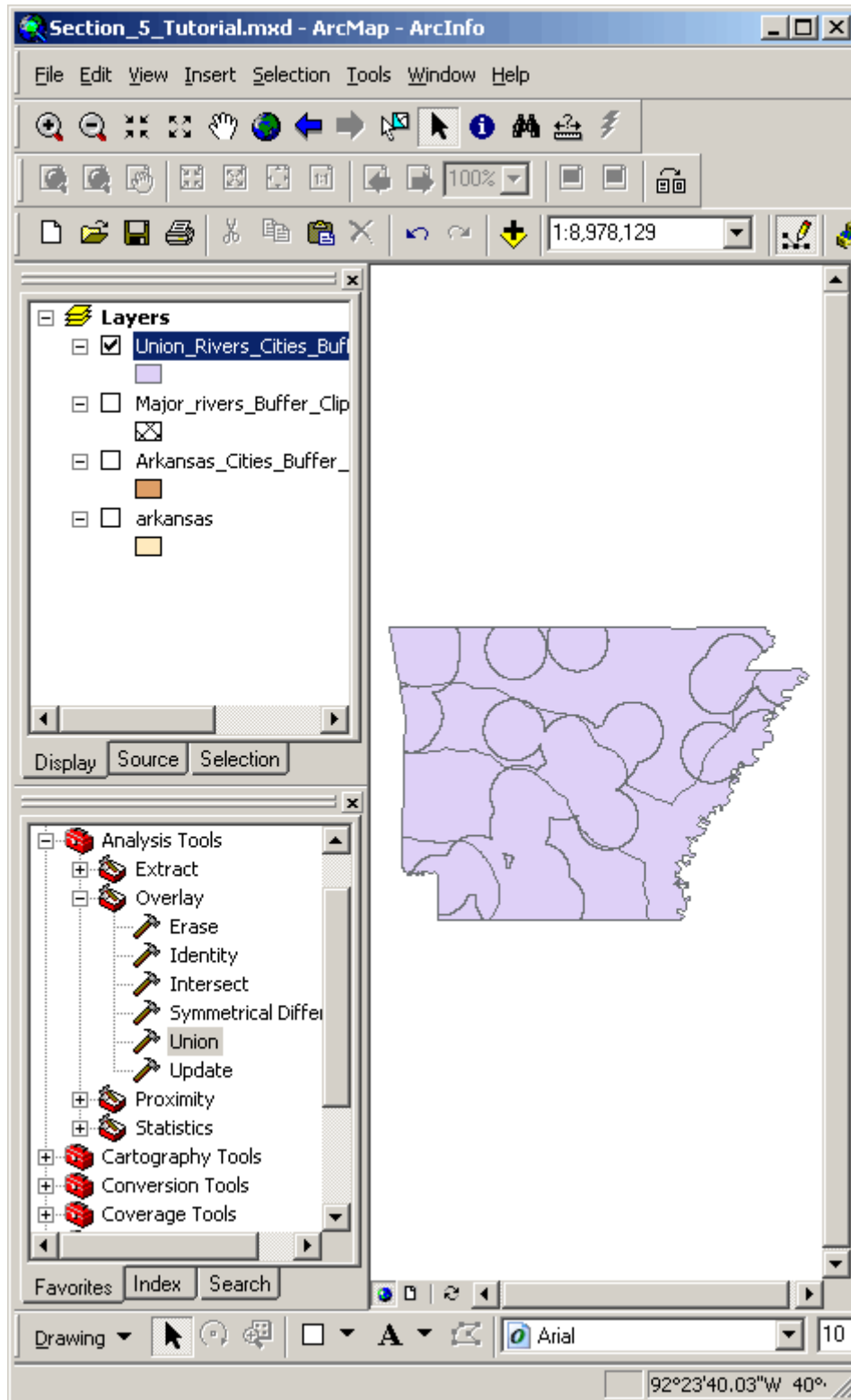
in the same place. This is otherwise known as the Boolean AND operation. The following shows the places that are within 25 miles of an Arkansas city AND within 25 miles of a major Arkansas river.



Calculating Attribute Values:

Using ArcMap, the user is capable of calculating new values within a layer's attribute table. The calculation can be performed on all records in a table or selected records only. The calculated values can either be text or numeric.

Using a Union Overlay of the above city buffer, river buffer, and the Arkansas State boundary, the following section will explain how to perform attribute queries within the unioned layer. More specifically, the areas that fall within BOTH buffers will be named "suitable" in the attribute table. The features that only contain one or none of the buffer criteria, will be named "unsuitable."



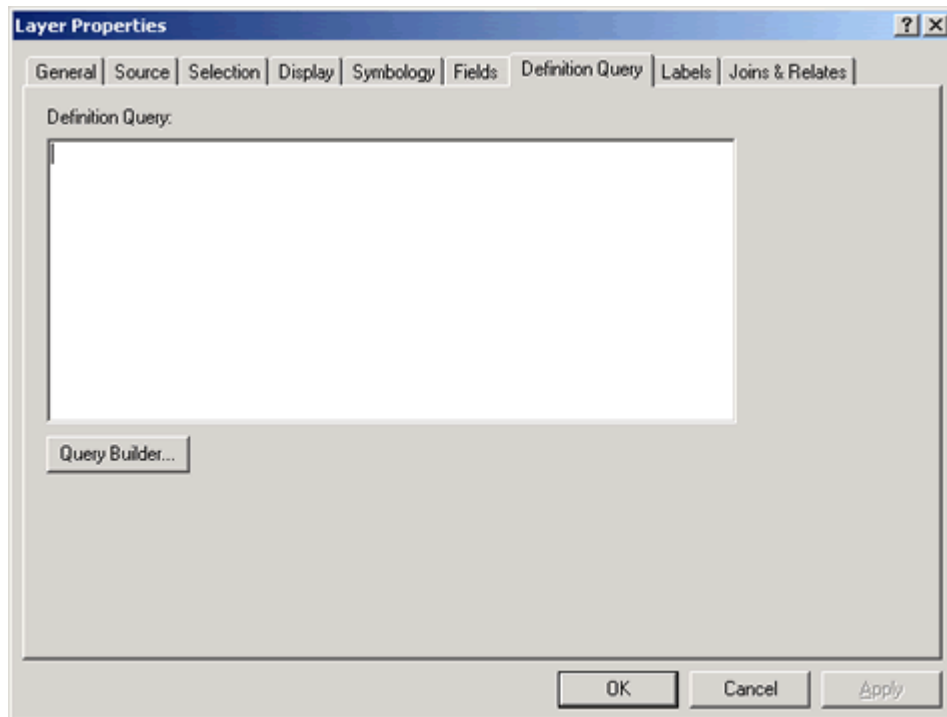
To begin, a new field should be created in the "union" layer's attribute table using the procedure described earlier in this section. In this case, a new field was created called "Suitability" (since it will

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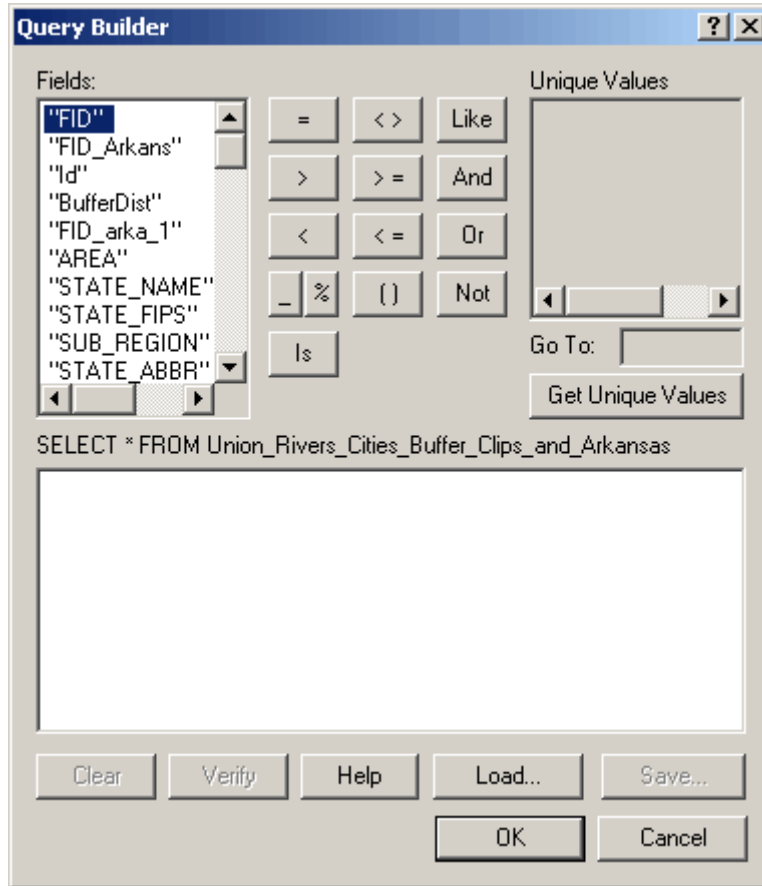
describe whether or not the feature is suitable, or falls within BOTH buffers). The type of field was text, since the user will either enter in the words "suitable" or "unsuitable". The following shows the field after it was added to the attribute table.

FID_Major	Id	BufferDist	Id_1	BufferDi_1	Suitabilit
-1	0	0	0	0	
-1	0	25	0	0	
0	0	0	0	25	
0	0	25	0	25	

Now that a new field has been created, the user must perform queries so that attributes can be calculated based on those queries. To do this, the user must double-click on the layer name in the table of contents. When the **Layer Properties** dialog box appears, the user should click the **Definition Query** tab.

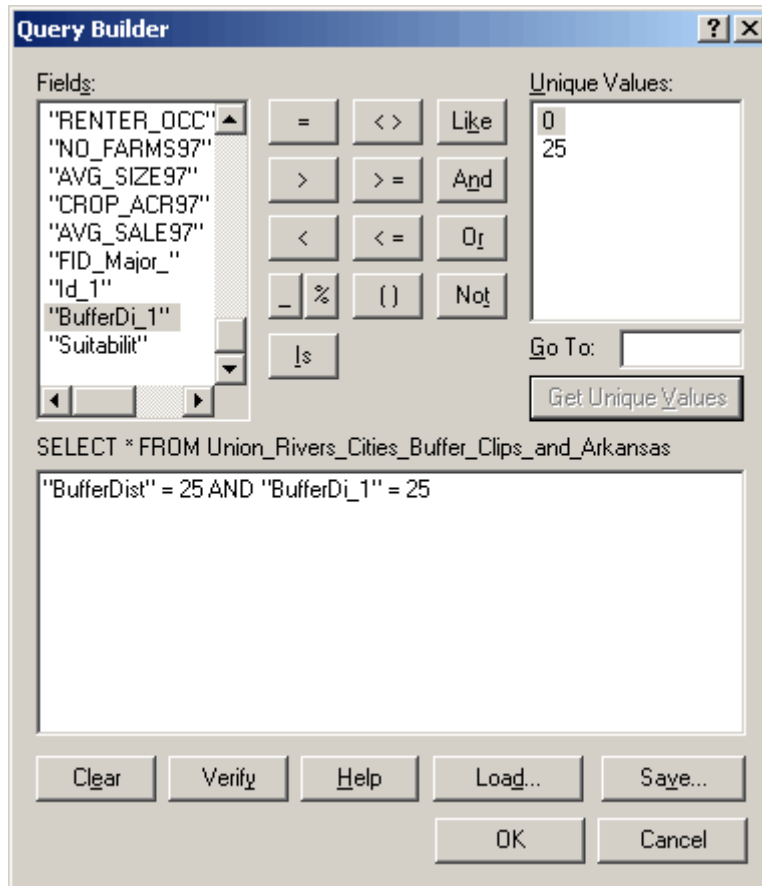


Next, the **Query Builder...** button should be clicked. The **Query Builder** dialog box will appear.

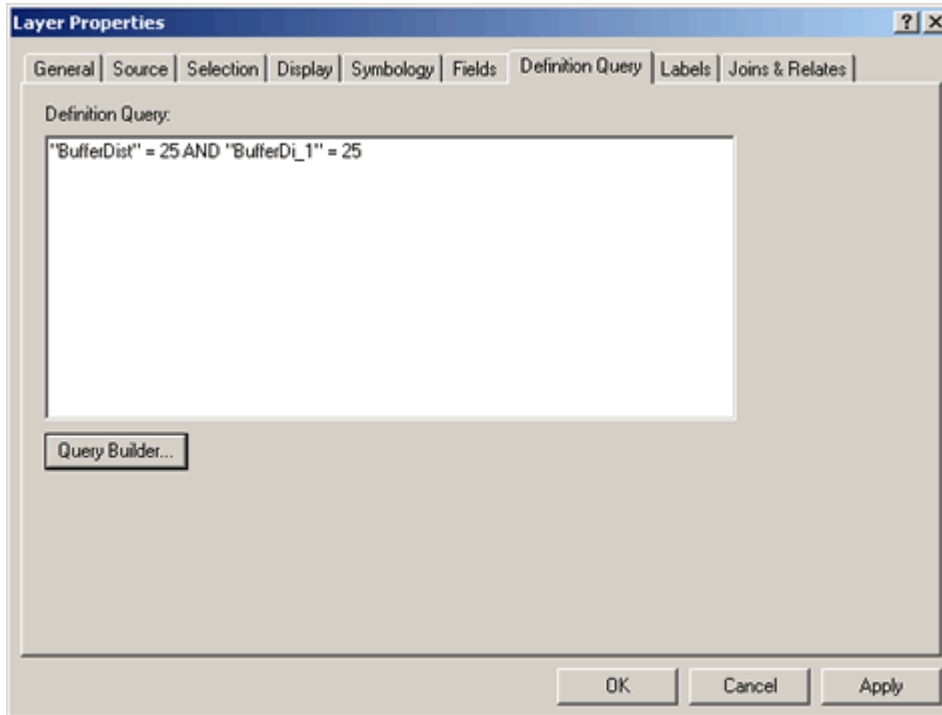


Using this dialog the user can build a query that will display only the areas contained within BOTH buffers. This can be found by querying out the features where BufferDist = 30 AND BufferDi_1= 30. These are the fields that contain the city and the river buffer information. The value of 0 in either field means that the feature is NOT within 30 miles of a city or stream. The value of 30 means that the feature IS within 30 miles of the city or stream.

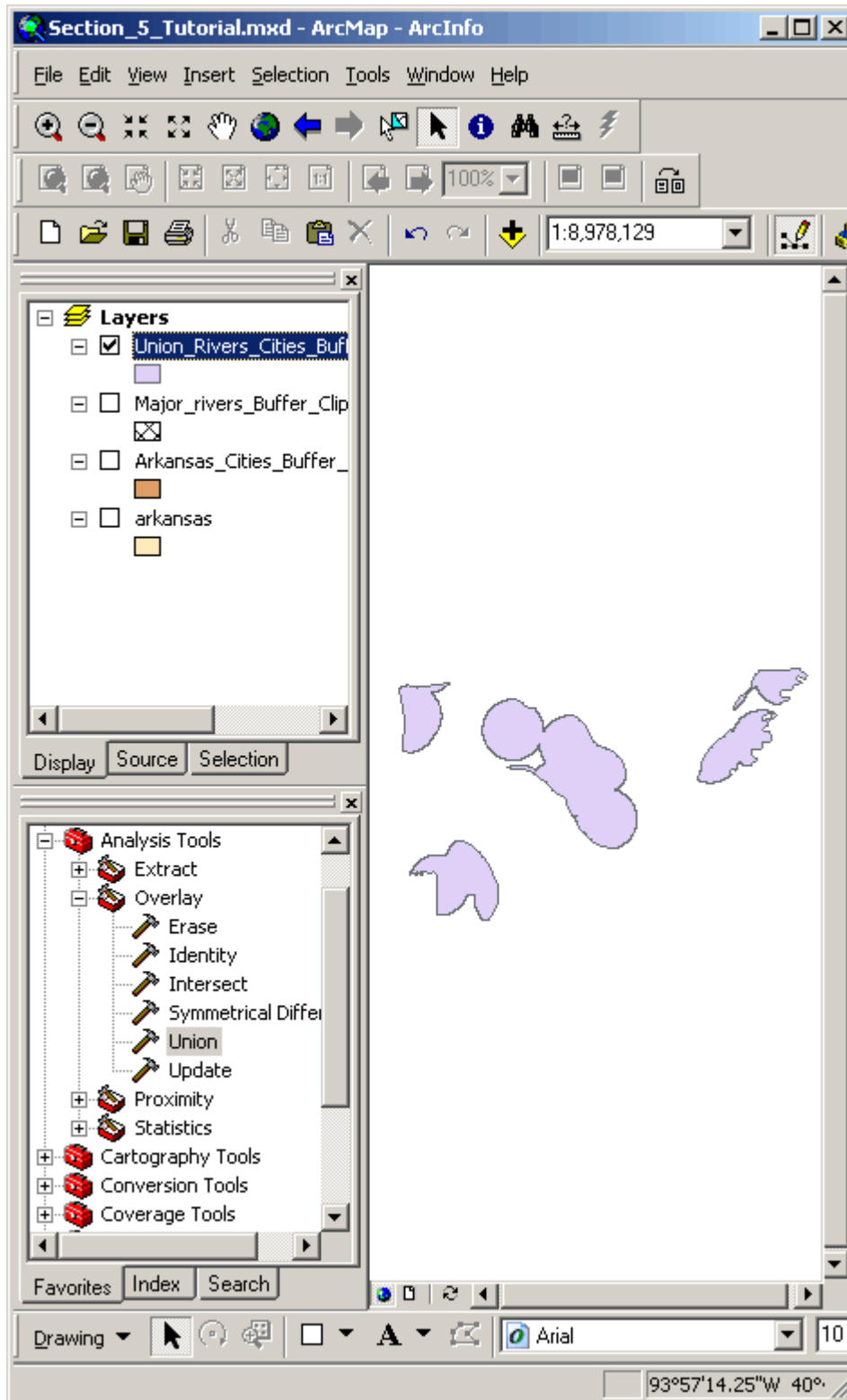
In the *Fields* box, the "BufferDist" field should be double-clicked in order for it to be added to the expression box. Next, the equals (=) button should be clicked. In the **Unique Values** box, 30 should be double clicked. Next, the AND button should be clicked and the "BufferDi_1" field should be added to the expression box. The equals (=) button should once again be pressed, and the value of 30 should again be double-clicked. The dialog box should look like the following graphic.



When the **OK** button is clicked, the expression will be added to the **Definition Query** box.

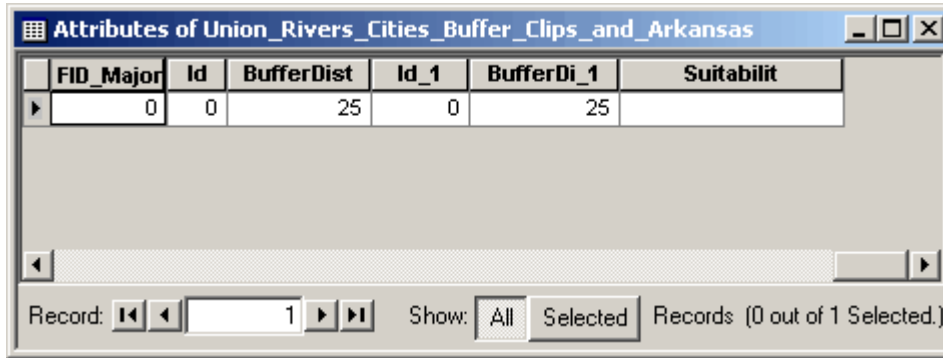


Next, the **OK** button should be clicked. Only the features that meet both buffer criteria will be displayed in the Map Display.

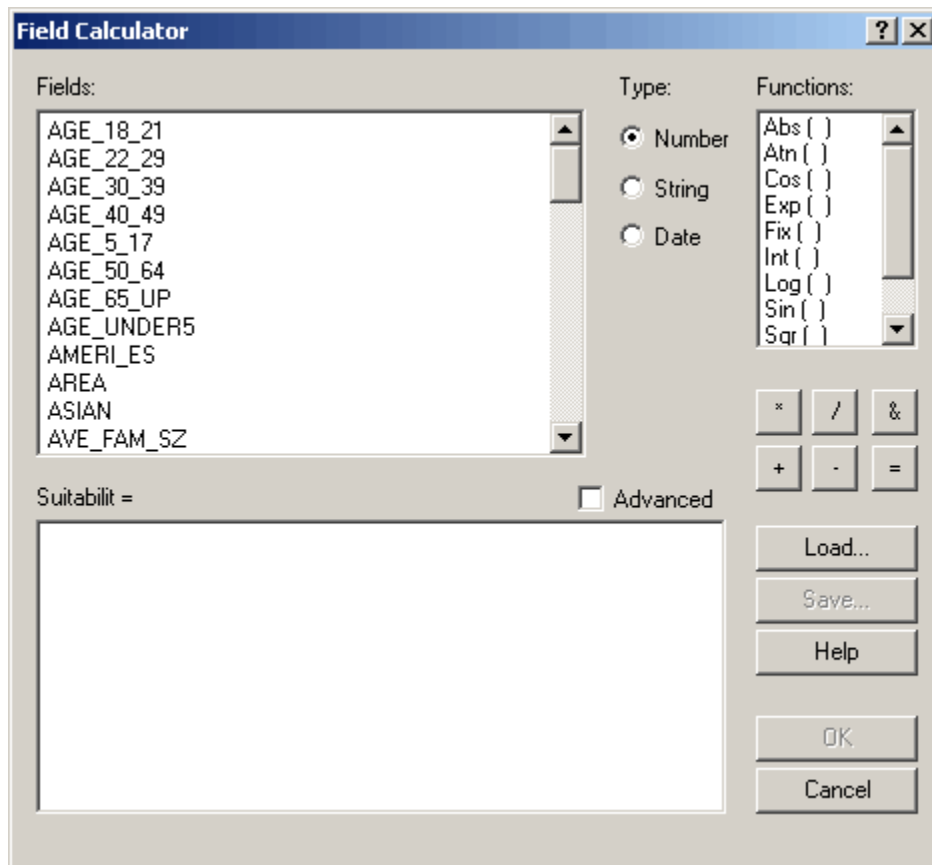


Next, the user should right-click on the layer name and click **Open Attribute Table**. The table will only contain those fields that meet the query criteria.

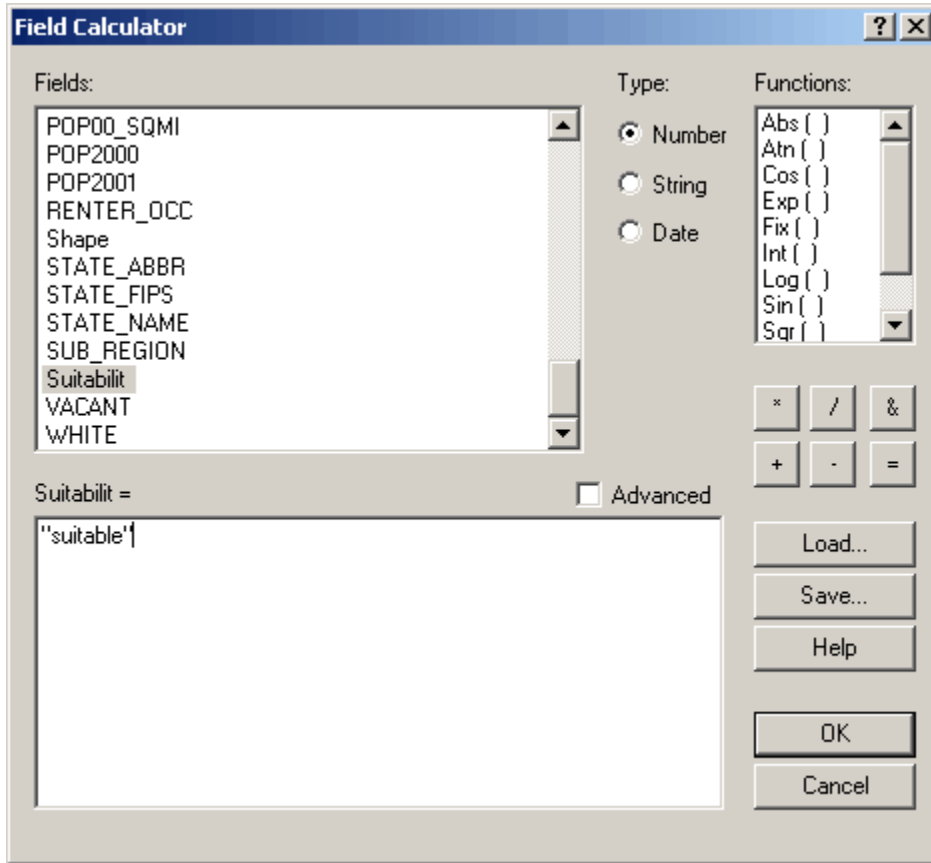
(<http://libinfo.uark.edu/gis/tutorial.asp>)



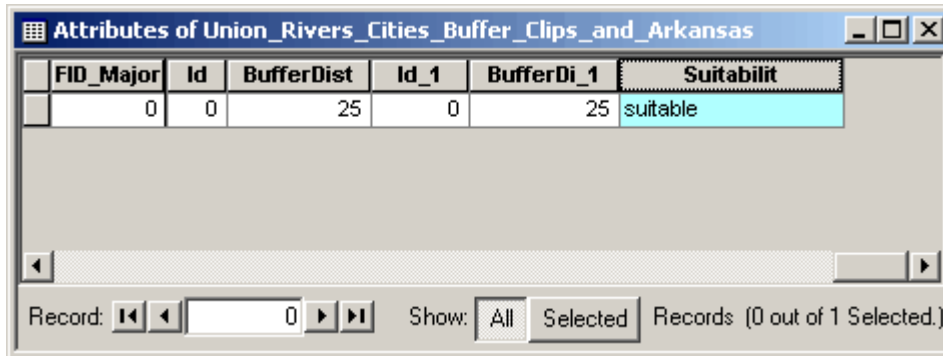
The value "suitable" can now be added to all the records within the Suitability field (since only the "suitable" records are displayed). This can be done by right-clicking on the field name "Suitability" and clicking the **Calculate Values** option. NOTE: A message box will appear that informs the user they are about to make changes to a table outside an editing session. When the user clicks **Yes**, the **Field Calculator** dialog opens.



Within this dialog, the user must enter the desired attribute to be added to all of the suitable records. In this case, the user must type "suitable", and press **OK**.

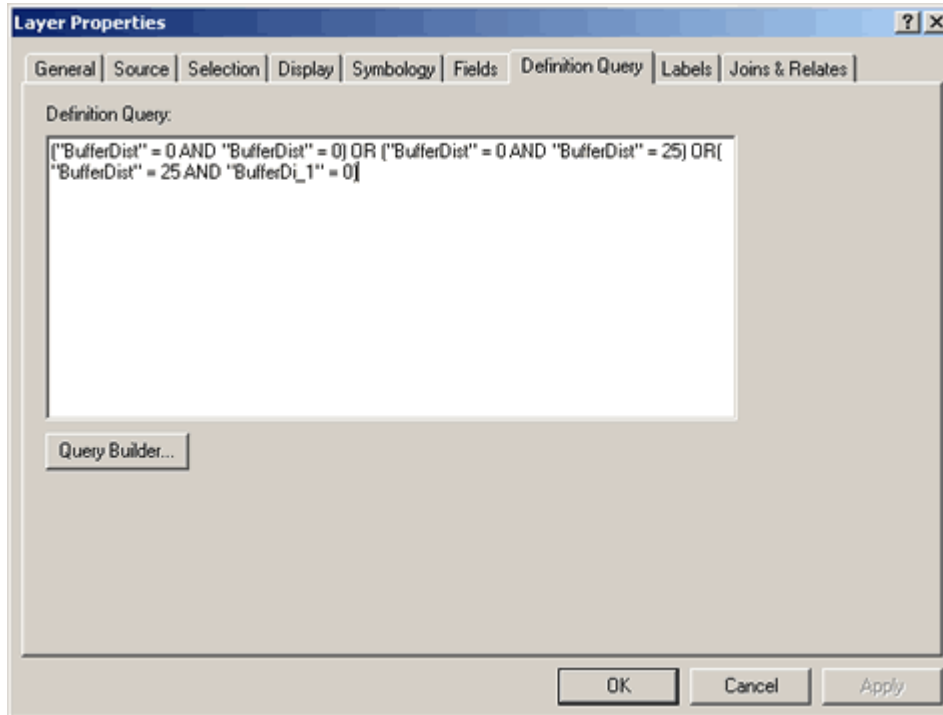


The attribute table will be automatically updated.

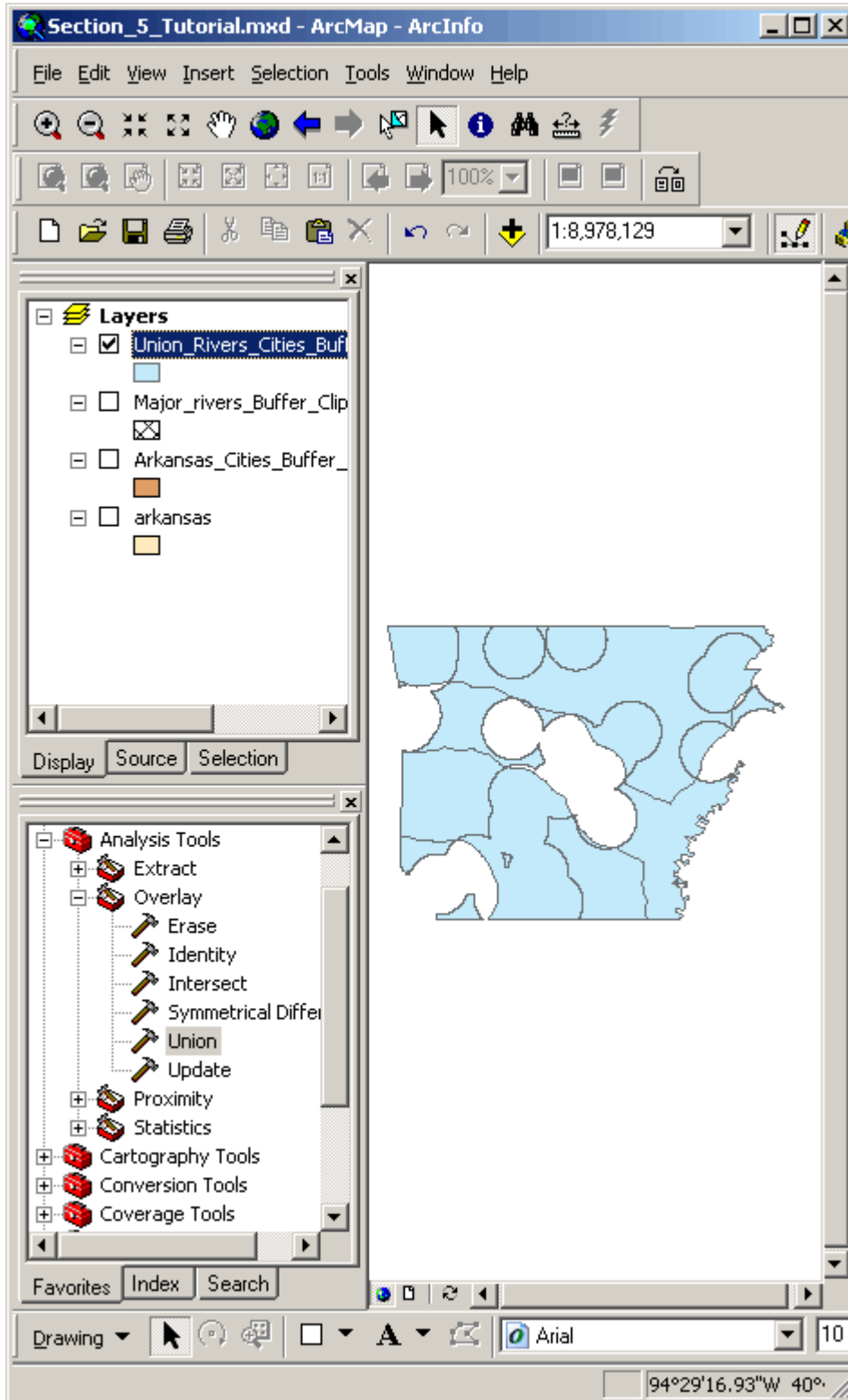


In order to label all of the other attribute fields "unsuitable", a new query must be built. The following query was built.

(<http://libinfo.uark.edu/gis/tutorial.asp>)



When the **OK** button was clicked, the following result was displayed.



(<http://libinfo.uark.edu/gis/tutorial.asp>)

Once the attributes for the above selection were labeled "unsuitable" in the Suitability Field, all queries were cleared. The attribute table for the entire layer was displayed, and both suitability values appeared.

AVG_SALE97	FID_Major_	Id_1	BufferDi_1	Suitabilit
121.39	-1	0	0	unsuitable
121.39	-1	0	0	unsuitable
121.39	0	0	25	unsuitable
121.39	0	0	25	suitable

Record: 1 Show: All Selected Records (0 out of 4 Selected.)