Appendix A. APPLICATION EFFICIENCIES TUTORIAL

California Application Efficiencies: ArcGIS Tutorial for Hydrologic Regions Geo-database

Project:	Spatial Analysis of Irrigation Efficiencies for the State of California
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INTRODUCTION

Analyzing who is using the water, where, but most importantly, how efficiently, it is of substantial importance in order to identify potential places where improvements can be made. Application efficiency is defined as the ratio of beneficial water use for a determined crop and the applied water to that particular crop. The beneficial water use is the amount water beneficially transpired by plants, retained in the plant tissue and evaporated from adjacent soil surfaces, water for removal of salts or climate control, during a specific period of time. This value is highly dependent on the crop type. The applied water is the quantity of water applied to a specific crop per unit area, which depends on the irrigation method.

Understanding how irrigation methods and land use have changed over a time period is relevant to understanding what crops are being grown and how they are supplied with water throughout the state. Five irrigation surveys have been conducted in California (1972, 1980, 1991, 2001, and 2010); however they are compiled in an Excel format that has made the data less accessible for further water use analysis.

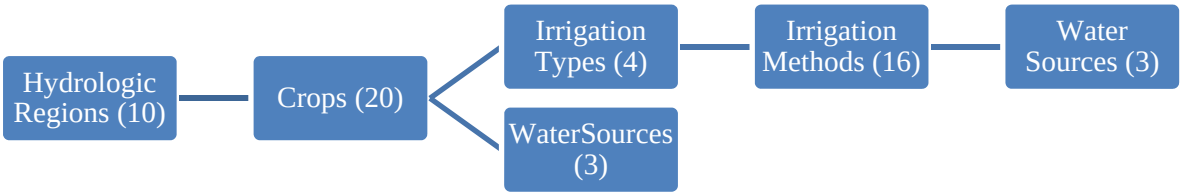
OBJECTIVES

The main objectives of the project are to introduce the Irrigation Survey data from 2001 and 2010 to a geographical information system (GIS) format called *California Irrigation Information System (CALIIS)*and perform a temporal and spatial analysis of water use efficiency for each crop and irrigation method. This will help to determine the variability and uncertainty of water use efficiency calculations. Irrigation survey data was collected by county for 20 crops, 4 irrigation types, and 16 irrigation methods. Composing the data into a GIS format provides easier access, use, and visualization of irrigation trends for each of the ten hydrologic regions in California.

This tutorial explains the data compilation and framework that was used in the creation of the database created for the hydrologic regions. It also will show how to manipulate data in the database from selecting by location and feature attributes. A in depth analysis discussion includes topics such as exporting selected data, construction of new feature classes, and construction of relationship classes.

DATA FRAMEWORK FOR GEODATABASE

The data framework for the geodatabase follows the pattern displayed below. Starting from ten hydrologic regions it is subdived into twenty crops. From twenty crops it is possible to find the water source (ground, surface, both) or continue to four irrigation type. From irrigation type we can then specify the irrigation method and lastly the water sources for each method present. Note that the figure below has the number of possible cateogories in parenthesis after the field name description. This is to indicate that there are multiple values associated with each box in the schema.



Below are the listed names for each subgroup for reference:

Hydrologic Regions:

1. North Coast
2. San Francisco Bay
3. San Joaquin River
4. Central Coast
5. Tulare Lake
6. South Coast
7. Sacramento River
8. North Lahontan
9. South Lahontan
10. Colorado River

Crops:

1. Corn
2. Cotton
3. Dry Beans
4. Grains (wheat, oats, barley, etc.)
5. Safflower
6. Sugarbeet
7. Other Field Crops (sorghum, sunflower, sudangrass, etc.)
8. Alfalfa
9. Pasture
10. Cucurbit (melons, squash, cucumber, etc.)
11. Onions and Garlic
12. Potato
13. Tomato (Fresh)
14. Tomato (Process)
15. Other Truck Crops (carrots, celery, cauliflower, broccoli strawberries, asparagus, etc.)
16. Almond and Pistachio
17. Other Deciduous (apples, peaches, prunes, pears, etc.)
18. Subtropical Trees (olives, avocado, citrus, dates, etc.)
19. Turfgrass and Landscape
20. Vineyard

Irrigation Types:

1. Gravity
2. Sprinkler
3. Low Volume
4. Other

Irrigation Methods:

1. Subsurface-Subsurface
2. Surface-Wildflood
3. Surface-Border
4. Surface-Basin
5. Surface-Furrow
6. Surface-Sprinkler-SideRoll
7. Surface-Sprinkler-Handmove
8. Sprinkler-Permanent
9. Sprinkler-Handmove
10. Sprinkler-Linearmove
11. Sprinkler-SideRoll
12. Sprinkler-MicroMini
13. Sprinkler-HosePull
14. Sprinkler-CenterPivot
15. Drip-AboveGround
16. Drip-Buried

Water Sources:

A) Surface
B) Groundwater
C) Both

DATA SOURCES

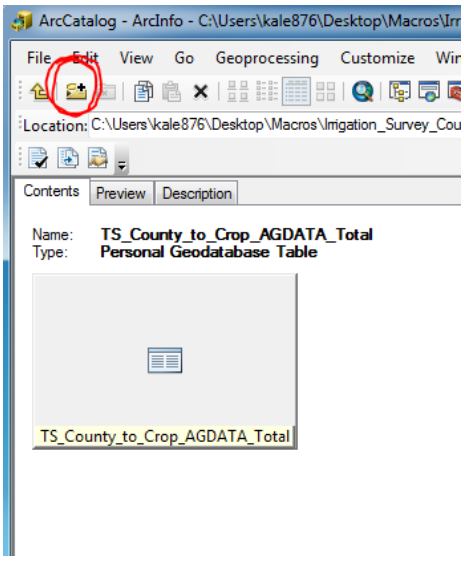
The data used to form the database was compiled from statewide irrigation surveys from 2001 (Orang et al 2008) and 2010 (DWR 2011). These data were compiled by county and surveys were sent to 10,000 randomized farmers from various counties within the state. Regional data was composed by the summation of county data within each region. Where regional and county boundaries overlapped, a distribution of the crops was composed based off of data from the DWR Land & Water Use Survey for various years. For these counties a percentage of crop values were added to each appropriate region. The limited sample size of returned surveys makes these data a sample set prone to skewed or inaccurate representations of crop and irrigation methods.

Data from the Agriculture Commissioner report for 2010 was delineated by county and distributed into regions similar as to that described above. This report covers a more comprehensive population based value that will be compared to the Irrigation Survey data within our analysis.

CONNECTING TO DATABASE

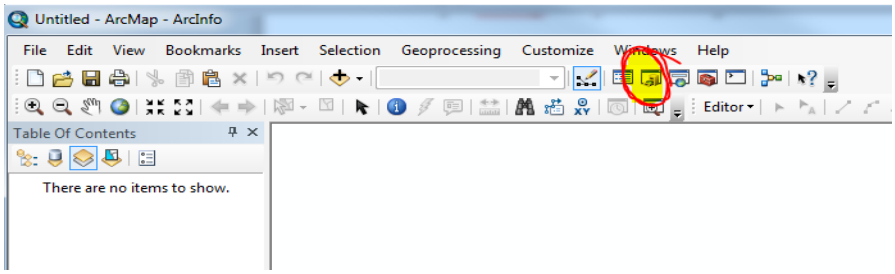
In order to connect to the database first download the database file from the website. If needed, unzip the file and save in an easily navigable folder on your computer.

Next, open ArcCatalog and select the ‘connect to folder’ in the second to upper toolbar. Navigate to the geo-database folder and Select.

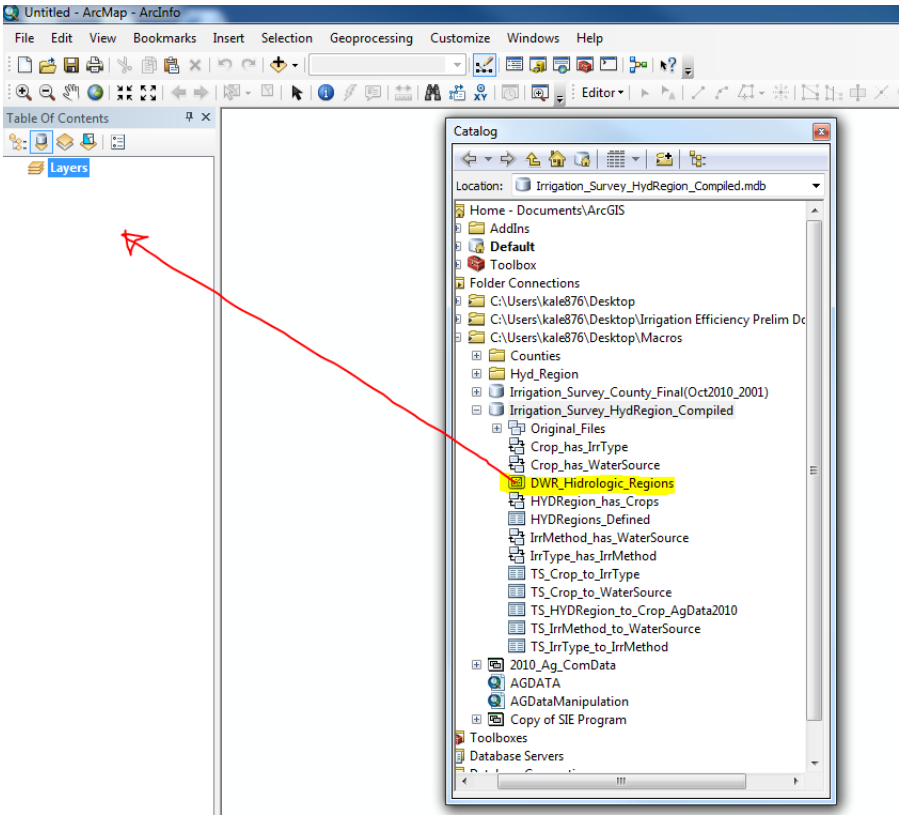


If the icon is not visible in the toolbar select File, then click on the 'Connect to Folder.'

After ArcCatalog is connected to the geo-database folder save and exit out of ArcCatalog. This is to trouble shoot possible errors that occur when both ArcCatalog and ArcMap are open. Now open ArcMap and open the Catalog Window located in the right side of the upper toolbar.



Now that ArcMap is connected to the Geo-database and the catalog window is open, right click the geo-database line and select 'Make Default Database'. In order to have a visual map appear, left-click the database to expand the list of feature and relationship classes. Highlight the shape file named "DWR_Hidrologic_Regions" and drag it into the Table of Contents of the ArcMap window.


Untitled - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Editor
Table Of Contents
Layers
Catalog
Location: Irrigation_Survey_HydRegion_Compiled.mdb
Home - Documents\ArcGIS
AddIns
Default
Toolbox
Folder Connections
C:\Users\kale876\Desktop
C:\Users\kale876\Desktop\Irrigation Efficiency Prelim Dc
C:\Users\kale876\Desktop\Macros
Counties
Hyd_Region
Irrigation_Survey_County_Final(Oct2010_2001)
Irrigation_Survey_HydRegion_Compiled
Original_Files
Crop_has_IrrType
Crop_has_WaterSource
DWR_Hidrologic_Regions
HYDRegion_has_Crops
HYDRegions_Defined
IrrMethod_has_WaterSource
IrrType_has_IrrMethod
TS_Crop_to_IrrType
TS_Crop_to_WaterSource
TS_HYDRegion_to_Crop_AgData2010
TS_IrrMethod_to_WaterSource
TS_IrrType_to_IrrMethod
2010_Ag_ComData
AGDATA
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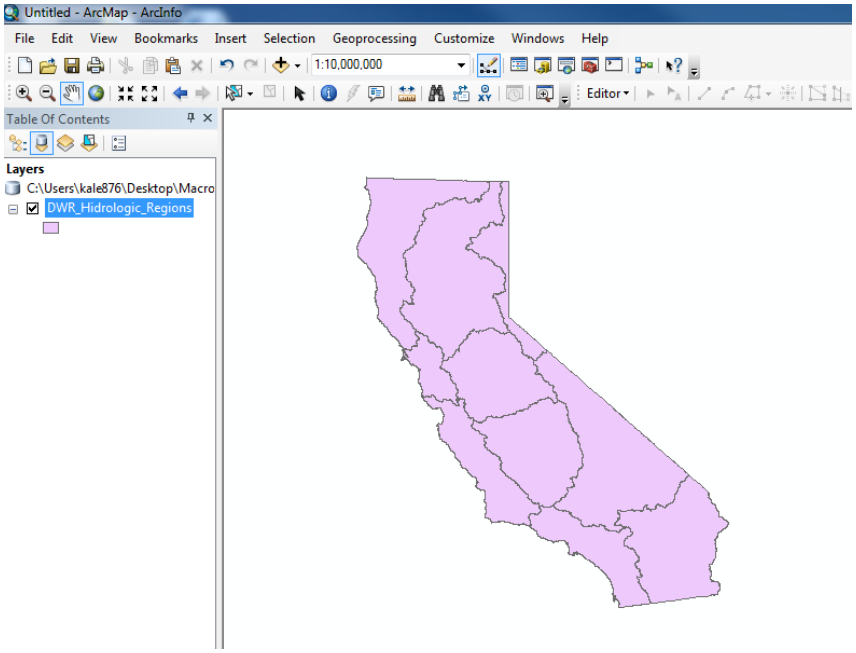
Copy of SIE Program
Toolboxes
Database Servers

The map of California's Hydrologic Regions should appear in the window as displayed below. From this view we are able to use ArcMap and the data in the geo-database in a visually integrative analysis.



UTILIZING GEODATABASE FEATURES

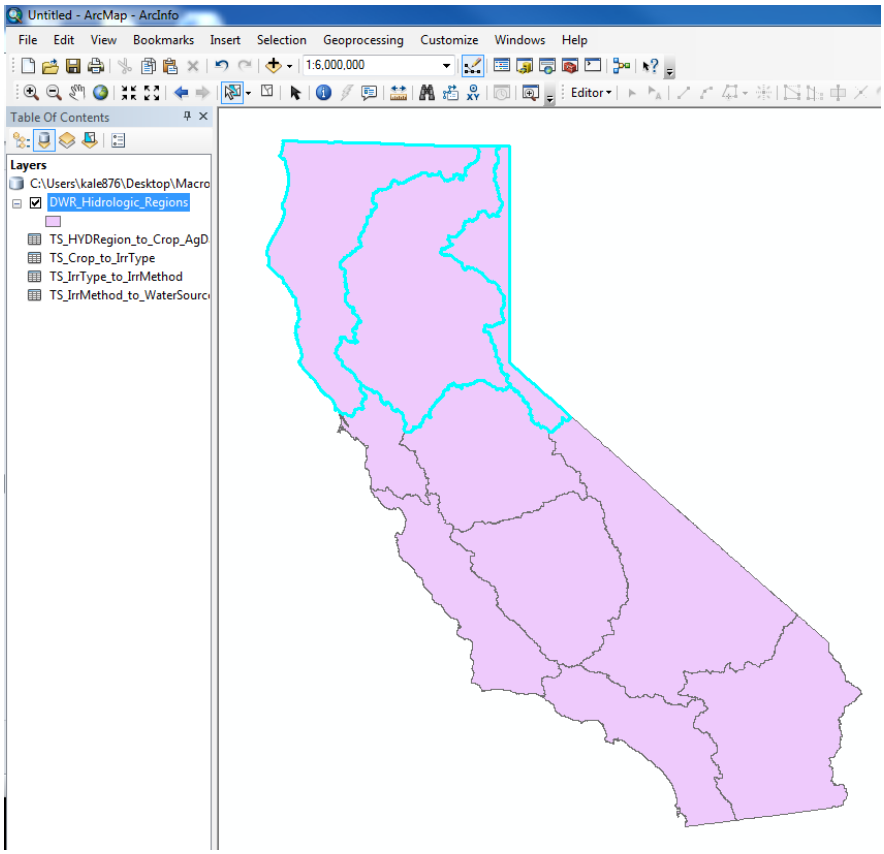
There are two ways to select data and features within ArcMap. This includes manual selection (i.e. dragging the cursor over the desired region or selection by attribute (i.e. specify region with more than 20,000 acres of corn). Below are two examples that show the inquiry interface of ArcMap and how this tool is useful for the spatial and temporal analysis of the Irrigation Survey and Agriculture Commissioner Data.

2. MANUAL SELECTION

Make sure that ArcMap is open and connected to the Hydrologic Regions database so that the shape file displays the regional map as seen in the last figure. In the lower toolbar, left click the  icon. A list of options will appear including: 'Select by Rectangle' and 'Select by Polygon'. After selecting an option, double-click the area on the map of the region (s) of particular interest. The borders of the regions touching the shape that is created will become highlighted showing that the features have been selected.

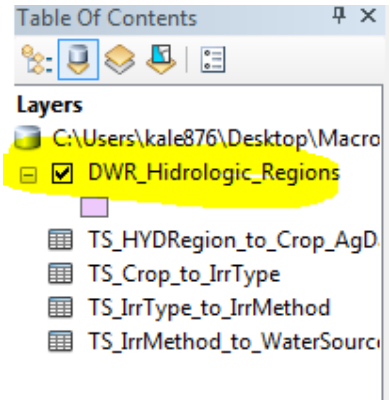
EXAMPLE

Select the three hydrologic regions that border the state of Oregon. First, double click the icon in the toolbar and select the option to ‘Select by Rectangle’. Click, hold, and drag to create a rectangle on the map that touches all three regions (North Coast, Sacramento River, and North Lahontan). Once the rectangle is in the desired area release your click and the desired regions should be outlined in a different color signifying that they have been selected.

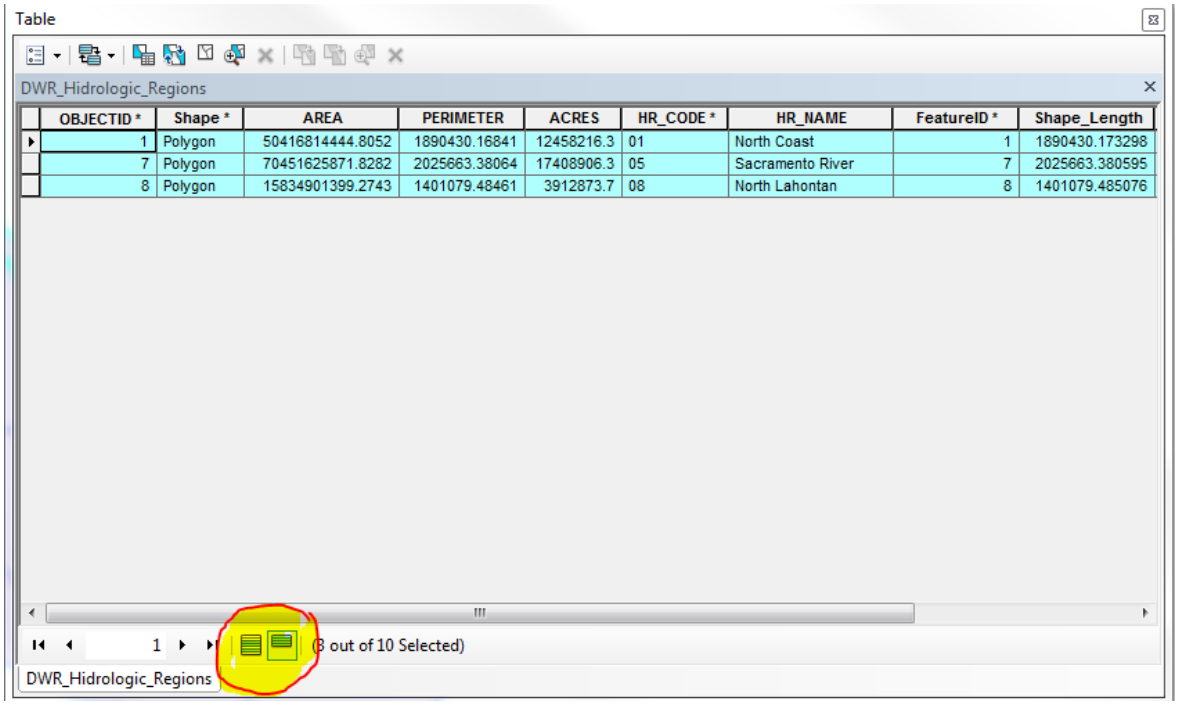


3. ACCESSING THE ATTRITUBE TABLE AND RELATED TABLES

After the selection has been made, then we can open the attributes tables in order to see more detailed data regarding our selection. To open the attributes table right-click the 'DWR_Hidrologic_Regions' line displayed in the layers.

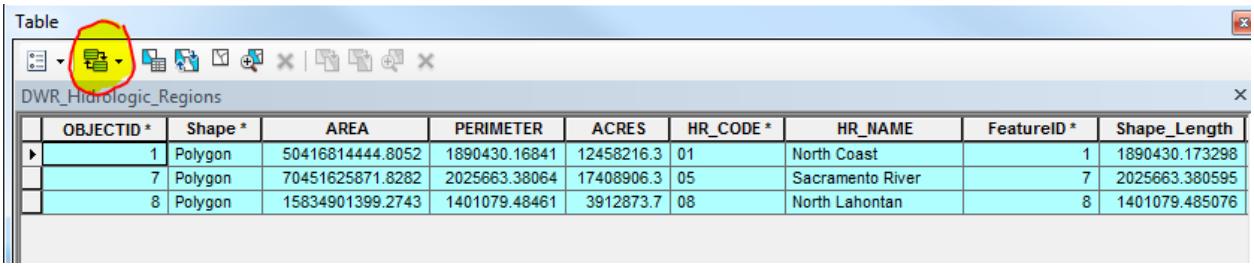


From the drop down menu select 'Open Attributes Table'. The titles in the attribute table are termed 'fields' and have different values for the properties of the regions. The tab at the bottom of the table enables the viewing of all of the data as well as only viewing the data of the selected features.



OBJECTID *	Shape *	AREA	PERIMETER	ACRES	HR_CODE *	HR_NAME	FeatureID *	Shape_Length
1	Polygon	50416814444.8052	1890430.16841	12458216.3	01	North Coast	1	1890430.173298
7	Polygon	70451625871.8282	2025663.38064	17408906.3	05	Sacramento River	7	2025663.380595
8	Polygon	15834901399.2743	1401079.48461	3912873.7	08	North Lahontan	8	1401079.485076

The creation of relationship classes within the database enables access to additional information pertaining to the hydrologic regions including: crops, irrigation methods, water source, etc. To access these data values from the attribute table click on the ‘Related Tables’ icon in the attributes table toolbar.



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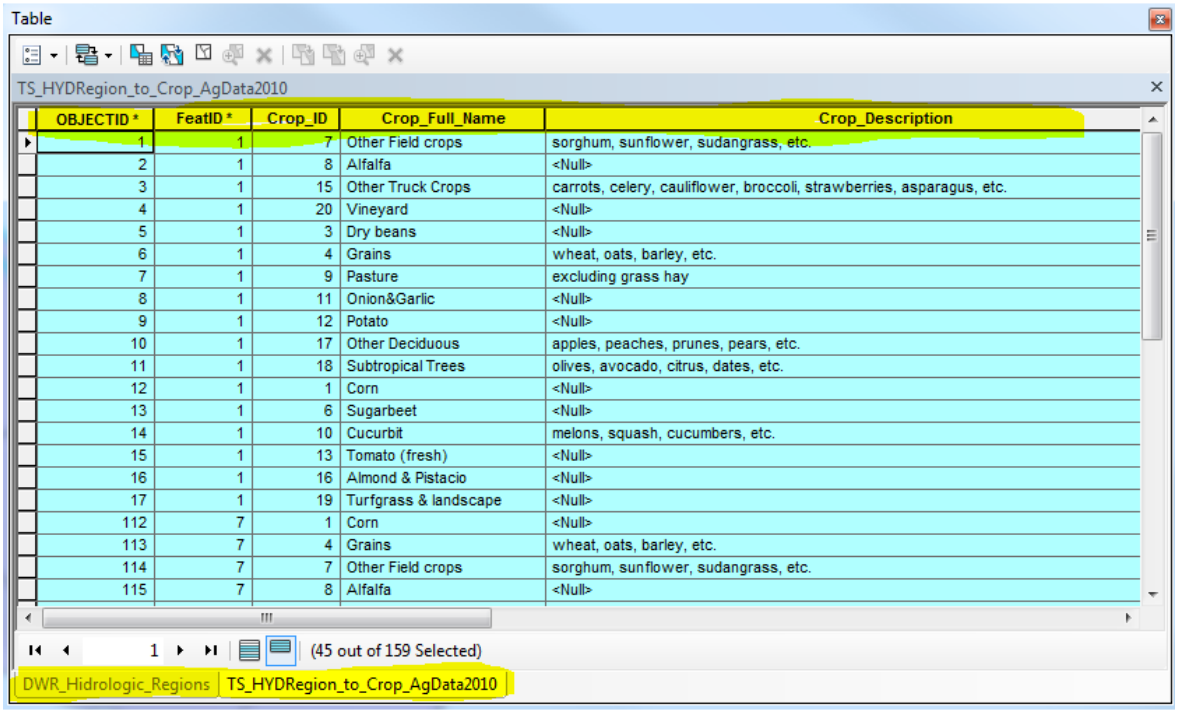
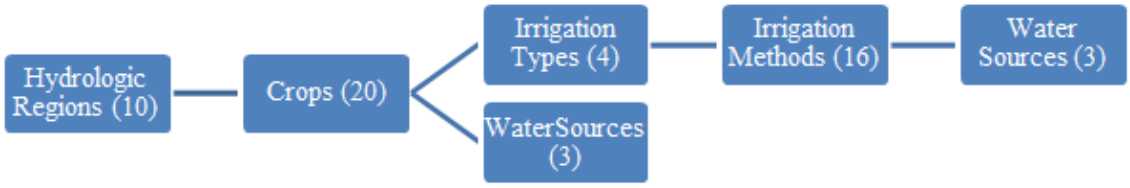
8	Polygon	15834901399.2743	1401079.48461	3912873.7	08	North Lahontan	8	1401079.485076

From the drop down menu we see that the hydrologic regions are connected to the data time series for the crops. This is labeled by the name of the relationship class and then the table for the time series of crops. Left-click and notice that the field names in the table have changed. The new table displays the crop time series data. Note that there are tabs at the bottom of the table to navigate back to the original hydrologic regions table.



OBJECTID *	FeatID *	Crop_ID	Crop_Full_Name	Crop_Description
1	1	7	Other Field crops	sorghum, sunflower, sudangrass, etc.
2	1	8	Alfalfa	<Null>
3	1	15	Other Truck Crops	carrots, celery, cauliflower, broccoli, strawberries, asparagus, etc.
4	1	20	Vineyard	<Null>
5	1	3	Dry beans	<Null>
6	1	4	Grains	wheat, oats, barley, etc.
7	1	9	Pasture	excluding grass hay
8	1	11	Onion&Garlic	<Null>
9	1	12	Potato	<Null>
10	1	17	Other Deciduous	apples, peaches, prunes, pears, etc.
11	1	18	Subtropical Trees	olives, avocado, citrus, dates, etc.
12	1	1	Corn	<Null>
13	1	6	Sugarbeet	<Null>
14	1	10	Cucurbit	melons, squash, cucumbers, etc.
15	1	13	Tomato (fresh)	<Null>
16	1	16	Almond & Pistacio	<Null>
17	1	19	Turfgrass & landscape	<Null>
112	7	1	Corn	<Null>
113	7	4	Grains	wheat, oats, barley, etc.
114	7	7	Other Field crops	sorghum, sunflower, sudangrass, etc.
115	7	8	Alfalfa	<Null>

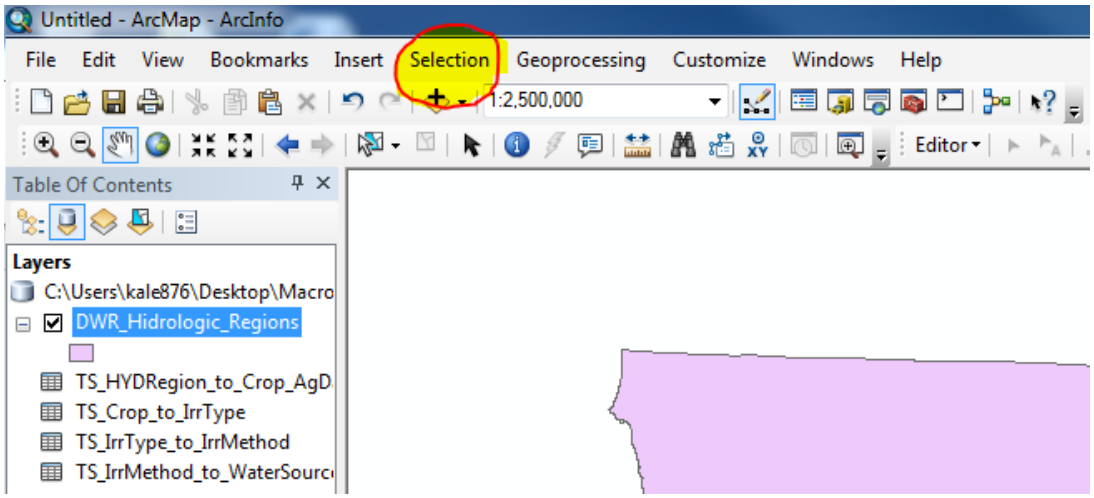
The data in the newer table pertains to the crops that are grown in the selected regions and their acreage and yield. By scrolling to the right, notice that there are fields for data from the Irrigation Survey for 2001, 2010, and Agriculture Commissioner for 2010. Click the 'Related Tables' icon while the crops table is open to see that the crops are connected to values for the water source and the irrigation type. To more easily visualize the connections between the data in the attributes table refer to the figure below.



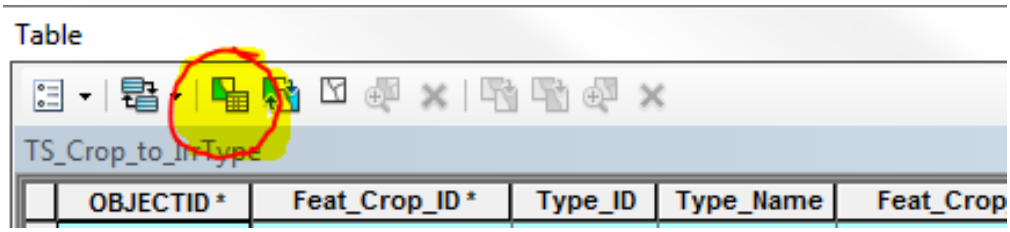
4.

5. SELECTION BY ATTRIBUTES

Selection by attributes is one of the most useful features obtained by transferring data from an excel file into a geo-database. In order to select by attribute, left-click the 'Selection' tab in the toolbar of ArcMap.



The ‘Select by Attributes’ dialogue allows us to make statements to refine the data selection. To visibly see the selections have the ‘DWR_Hidrologic_Regions’ attribute table open along with the ‘Select by Attributes’ dialogue box. The Attributes dialogue box can also be accessed through the Attributes table toolbar by clicking on the ‘Select by Attributes’ icon.

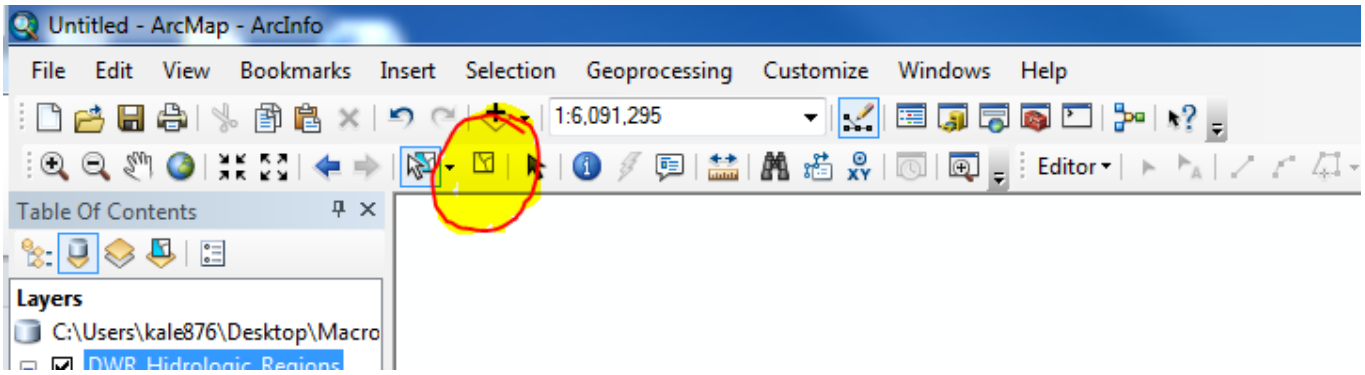


Attributes are selected in the dialogue box through the formation of statements, which will be further displayed in the example below. After the statement is form, Select Apply. The highlighted data displayed will adhere to the criteria of the statement.

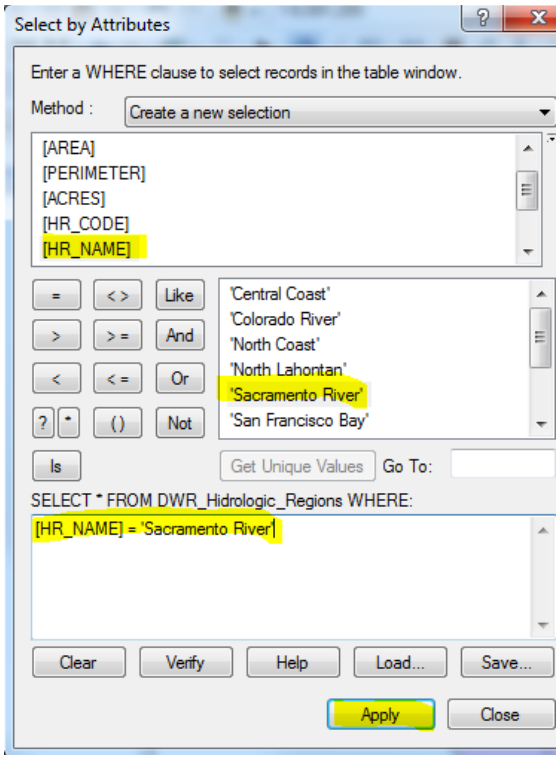
EXAMPLE:

Goal: Specify the Crops in the Sacramento River Hydrologic region that have greater than 150 acres of Gravity driven irrigation type for years of 2001 and 2010 of the Irrigation survey data.

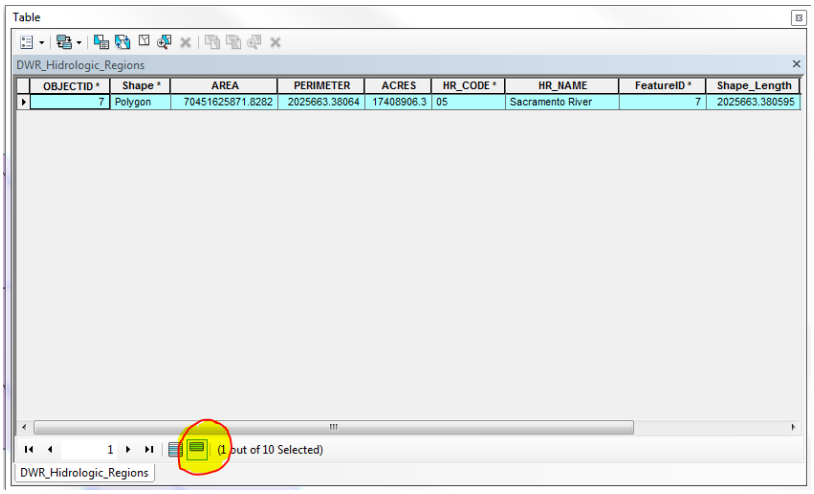
Clear any previous selections of the data by left-clicking the ‘Clear Selected Features’ icon in the toolbar.



Left click the ‘Select by Attributes’ icon in the Attribute table in order access the dialogue box. From here create the first statement: ‘[HR_NAME] = ‘Sacramento River’. Scroll down in the top box to find [HR_NAME] and then double click. Create a statement by selecting the equals sign, then ‘Get Unique Values’ and double clicking ‘Sacramento River’.

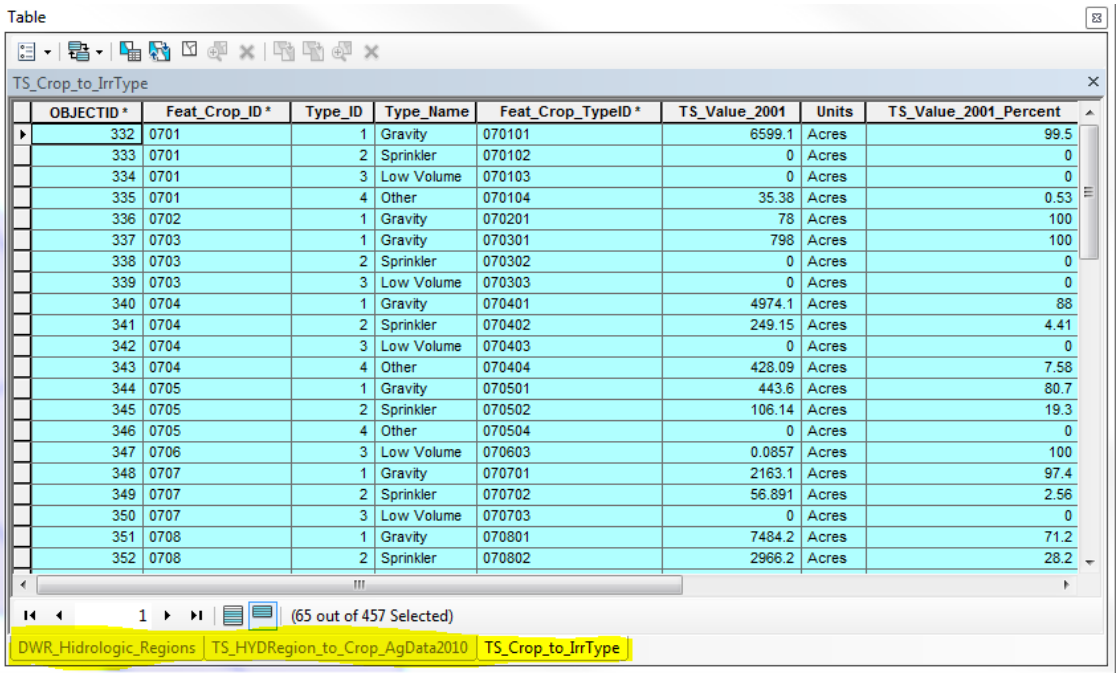


Once the statement is made, click ‘Apply’. This selects the Sacramento River Hydrologic region. Click ‘View Selected Records’ at the bottom of the attribute table window in order to ensure that the correct region is selected.



Now that the Sacramento River region is selected in order to refine the search further go to the related tables tab. Navigate from regions to crops by selecting the related table labeled

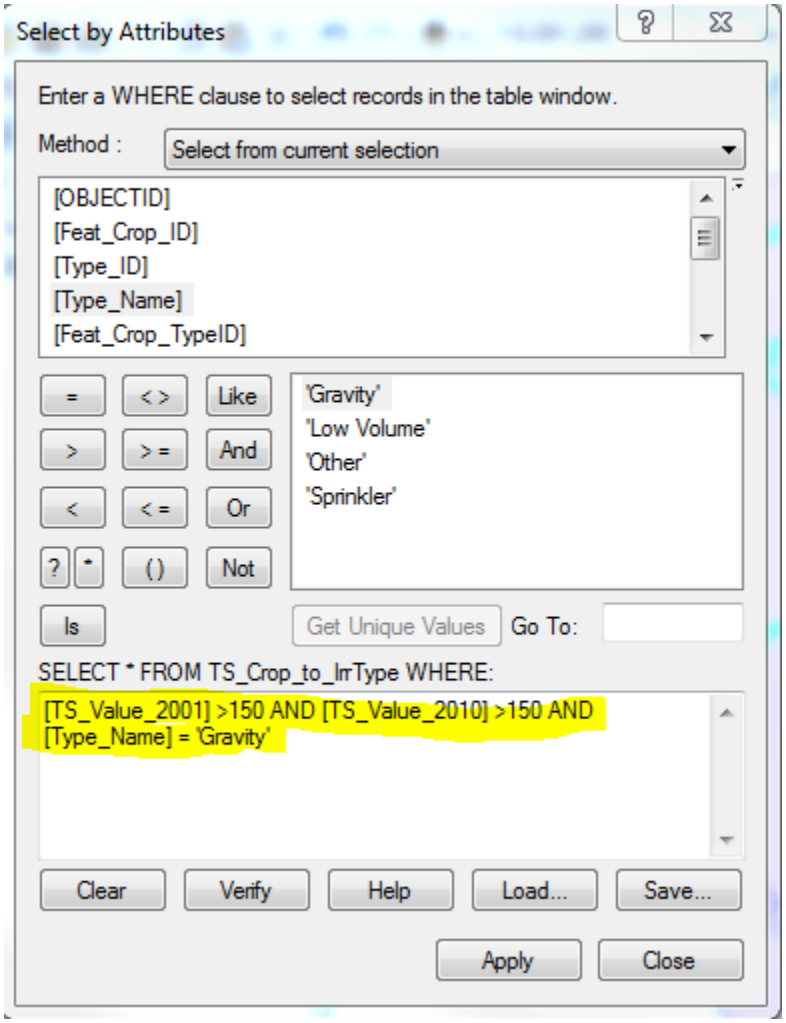
'TS_HYDRegion_to_Crop_AgData2010'. This opens the crop data. From here navigate to 'TS_Crop_to_IrrType'. There should now be three related opened in tabs in the attribute table window.



OBJECTID *	Feat_Crop_ID *	Type_ID	Type_Name	Feat_Crop_TypeID *	TS_Value_2001	Units	TS_Value_2001_Percent
332	0701	1	Gravity	070101	6599.1	Acres	99.5
333	0701	2	Sprinkler	070102	0	Acres	0
334	0701	3	Low Volume	070103	0	Acres	0
335	0701	4	Other	070104	35.38	Acres	0.53
336	0702	1	Gravity	070201	78	Acres	100
337	0703	1	Gravity	070301	798	Acres	100
338	0703	2	Sprinkler	070302	0	Acres	0
339	0703	3	Low Volume	070303	0	Acres	0
340	0704	1	Gravity	070401	4974.1	Acres	88
341	0704	2	Sprinkler	070402	249.15	Acres	4.41
342	0704	3	Low Volume	070403	0	Acres	0
343	0704	4	Other	070404	428.09	Acres	7.58
344	0705	1	Gravity	070501	443.6	Acres	80.7
345	0705	2	Sprinkler	070502	106.14	Acres	19.3
346	0705	4	Other	070504	0	Acres	0
347	0706	3	Low Volume	070603	0.0857	Acres	100
348	0707	1	Gravity	070701	2163.1	Acres	97.4
349	0707	2	Sprinkler	070702	56.891	Acres	2.56
350	0707	3	Low Volume	070703	0	Acres	0
351	0708	1	Gravity	070801	7484.2	Acres	71.2
352	0708	2	Sprinkler	070802	2966.2	Acres	28.2

Note that highlighted values are still values associated with the Sacramento River Hydrologic Region.

From The ‘TS_Crop_to_IrrType’ tab we refine the search to those values of our specifics. Those values include all of the crops with >150 acres for Gravity Type irrigation for both 2001 and 2010. From the ‘TS_Crop_to_IrrType’ tab click ‘Select by Attributes’ in the window toolbar. Make sure and change the ‘Method:’ to ‘Select from current selection’. Create the statement: [TS_Value_2001]>150 AND [TS_Value_2010]>150 AND [Type_Name]= ‘Gravity’.
Select ‘Apply’.

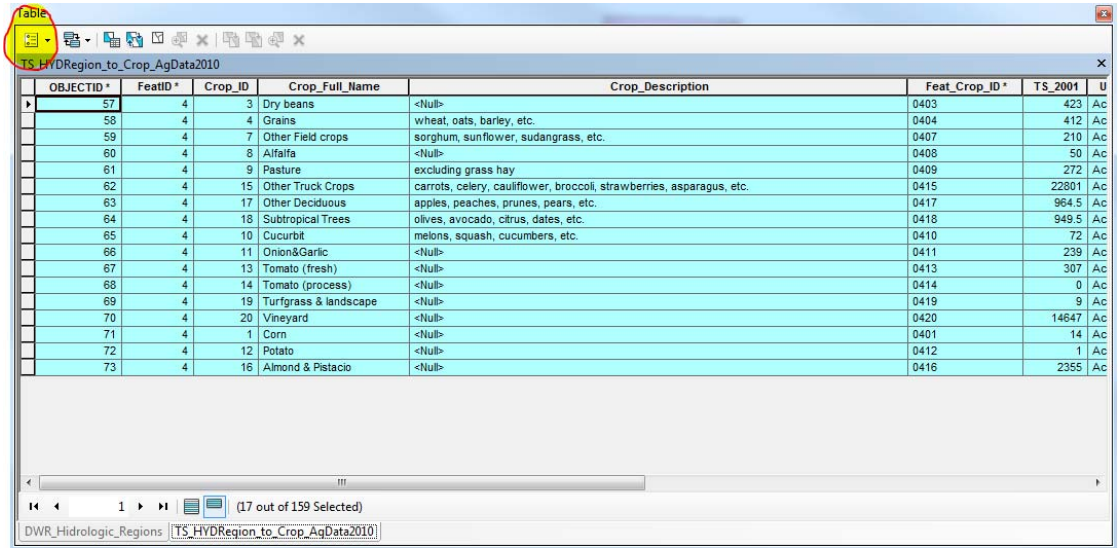


The final selection should have 12 out of 457 total values.

Note that there are many options and operators in order to form statements and refine the data, along with all of the different tabs for the related tables.

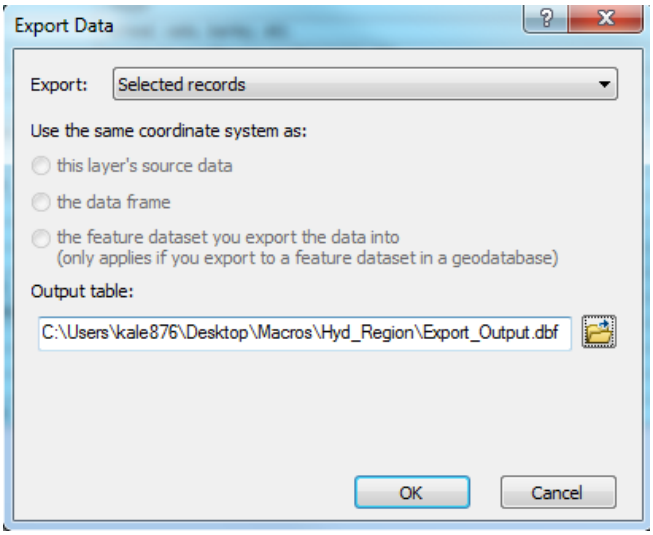
EXPORTING DATA

After manipulating data in the attributes table to specified values it is possible to export data as a table into Excel. First left click the ‘Table Options’ in the Toolbar. From here select the Export… option.

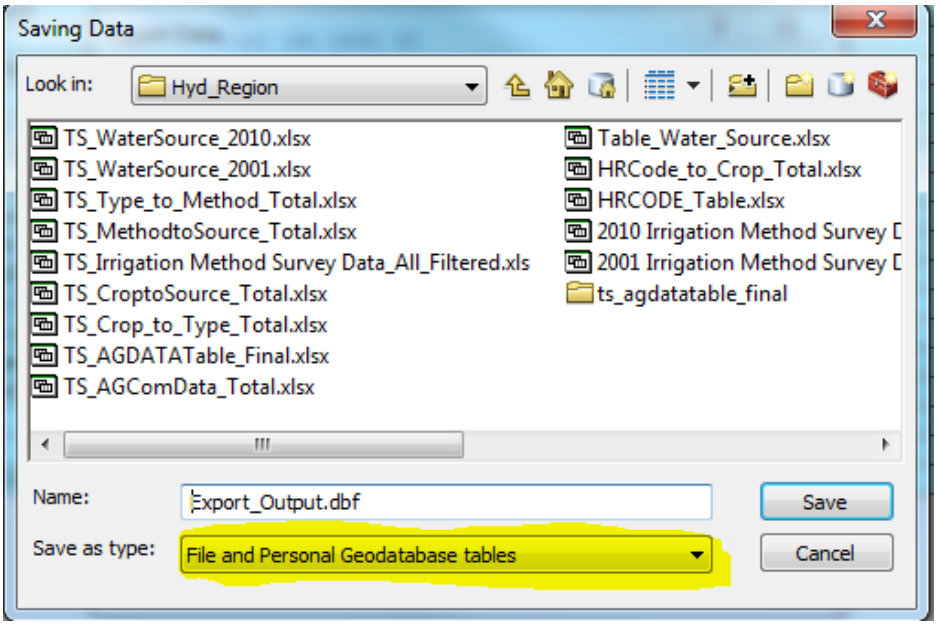


OBJECTID *	FeatID *	Crop_ID	Crop_Full_Name	Crop_Description	Feat_Crop_ID *	TS_2001	U
57	4	3	Dry beans	<Null>	0403	423	Ac
58	4	4	Grains	wheat, oats, barley, etc.	0404	412	Ac
59	4	7	Other Field crops	sorghum, sunflower, sudangrass, etc.	0407	210	Ac
60	4	8	Alfalfa	<Null>	0408	50	Ac
61	4	9	Pasture	excluding grass hay	0409	272	Ac
62	4	15	Other Truck Crops	carrots, celery, cauliflower, broccoli, strawberries, asparagus, etc.	0415	22801	Ac
63	4	17	Other Deciduous	apples, peaches, prunes, pears, etc.	0417	964.5	Ac
64	4	18	Subtropical Trees	olives, avocado, citrus, dates, etc.	0418	949.5	Ac
65	4	10	Cucurbit	melons, squash, cucumbers, etc.	0410	72	Ac
66	4	11	Onion&Garlic	<Null>	0411	239	Ac
67	4	13	Tomato (fresh)	<Null>	0413	307	Ac
68	4	14	Tomato (process)	<Null>	0414	0	Ac
69	4	19	Turfgrass & landscape	<Null>	0419	9	Ac
70	4	20	Vineyard	<Null>	0420	14647	Ac
71	4	1	Corn	<Null>	0401	14	Ac
72	4	12	Potato	<Null>	0412	1	Ac
73	4	16	Almond & Pistacio	<Null>	0416	2355	Ac

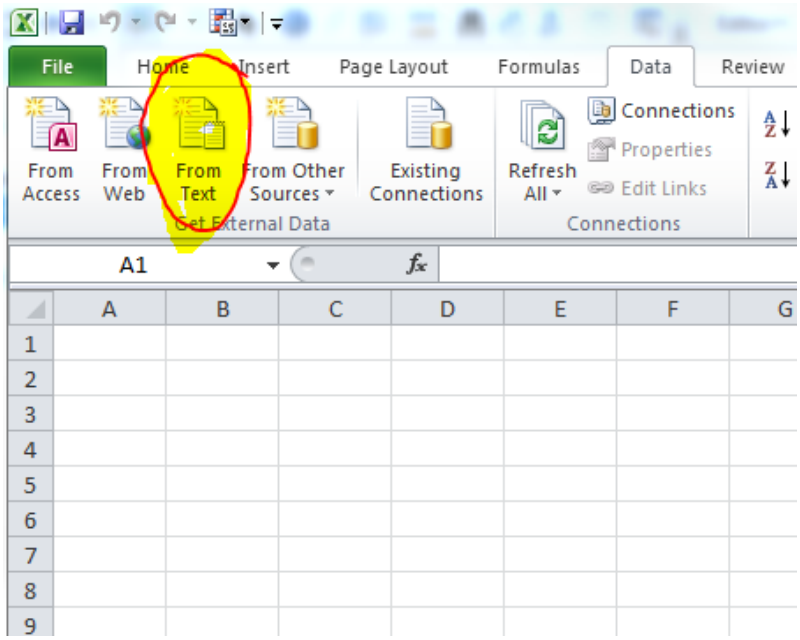
The ‘Export Data’ pop up window will have a top drop- down menu. From here either export the entirety of the attribute table or only the selected features. From the Export table: left-click the folder at the end of the ‘Output table:’ line to open the ‘Saving Data’ pop up window.



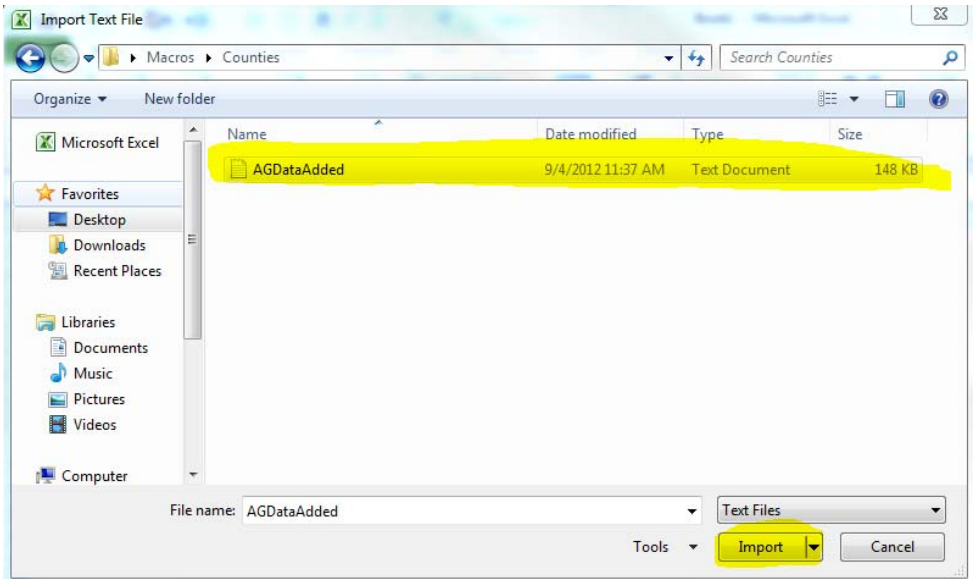
In the Saving Data pop up window create a recognizable name for the exported data. In the “Save as type:” Select “Text File” and then ‘Save’.



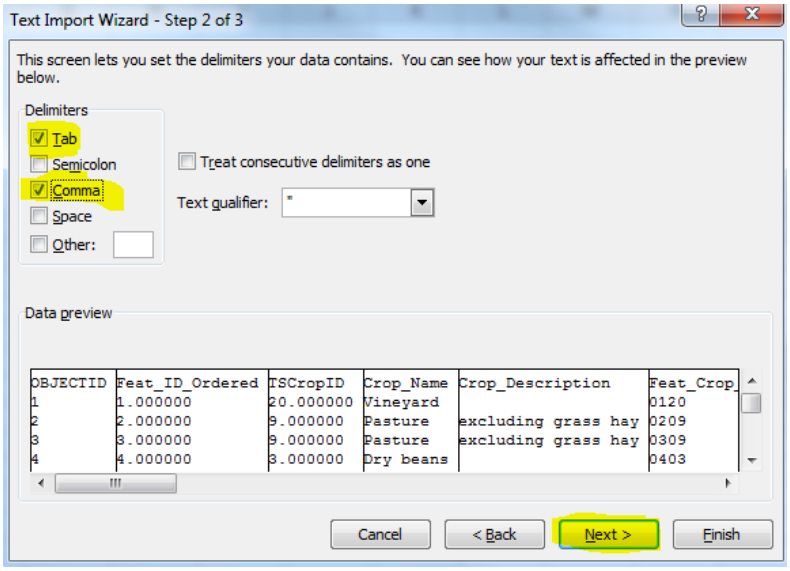
In order to retrieve the data, open Microsoft Excel and create a new workbook. In the data tab of the toolbar select ‘Get External Data From Text’.



In the ‘Import Text File’ dialog box navigate to the folder with the previously exported text file and select the name and ‘Import’.



The ‘Text Import Wizard’ pop up window should appear. The data exported from ArcMap is delimited, which should be the default option. Click Next. In Step 2 of the Import Wizard make checks next to the ‘Tab’ and ‘Comma’ then click Next.

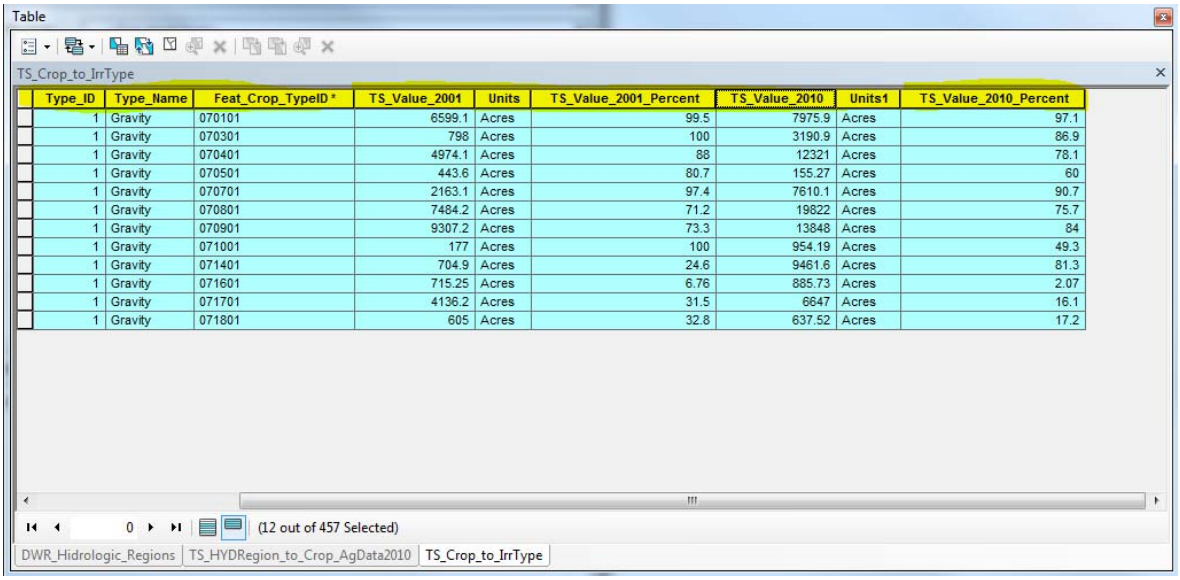


Default settings for Step 3 are sufficient, click Finish. A small import data window appears and unless the data must be put in a specific area of the workbook the settings should be appropriate, so click ‘OK’. The data along with the headings should now appear in the columns of the workbook page. From excel it is possible to further filter the data (also located in the Data tab of the toolbar). If the workbook is saved in this format with titles in Line 1 and data in the

preceding columns it is easy to add this data as a table to the existing or to a new database. This is further explained below in the ‘Creating a Feature Classes’ section.

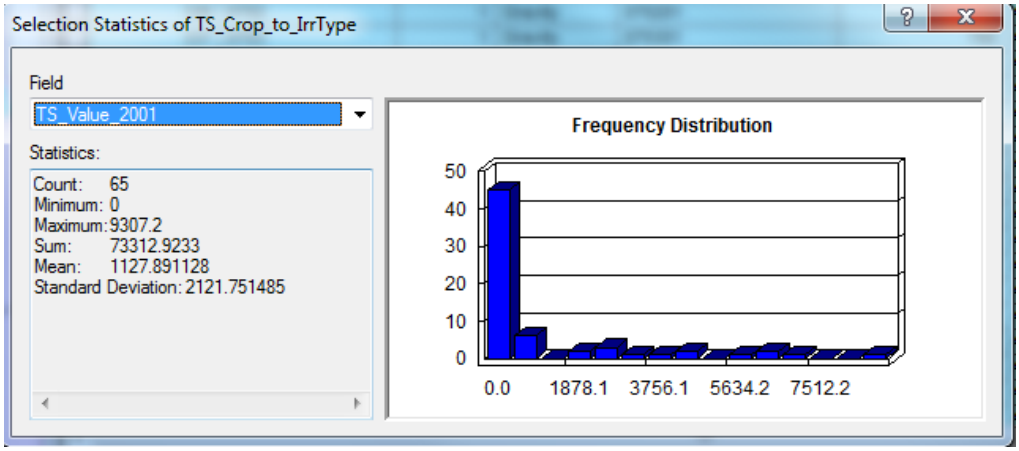
STATISTICAL ANALYSIS FEATURES OF ARCMAP

There are built in statistical analysis features within ArcMap that can be accessed through the attributes table. Right click the field title (highlighted below) and select ‘Statistic…’ from the drop down menu.



Type_ID	Type_Name	Feat_Crop_TypeID *	TS_Value_2001	Units	TS_Value_2001_Percent	TS_Value_2010	Units1	TS_Value_2010_Percent
1	Gravity	070101	6599.1	Acres	99.5	7975.9	Acres	97.1
1	Gravity	070301	798	Acres	100	3190.9	Acres	86.9
1	Gravity	070401	4974.1	Acres	88	12321	Acres	78.1
1	Gravity	070501	443.6	Acres	80.7	155.27	Acres	60
1	Gravity	070701	2163.1	Acres	97.4	7610.1	Acres	90.7
1	Gravity	070801	7484.2	Acres	71.2	19822	Acres	75.7
1	Gravity	070901	9307.2	Acres	73.3	13848	Acres	84
1	Gravity	071001	177	Acres	100	954.19	Acres	49.3
1	Gravity	071401	704.9	Acres	24.6	9461.6	Acres	81.3
1	Gravity	071601	715.25	Acres	6.76	885.73	Acres	2.07
1	Gravity	071701	4136.2	Acres	31.5	6647	Acres	16.1
1	Gravity	071801	605	Acres	32.8	637.52	Acres	17.2

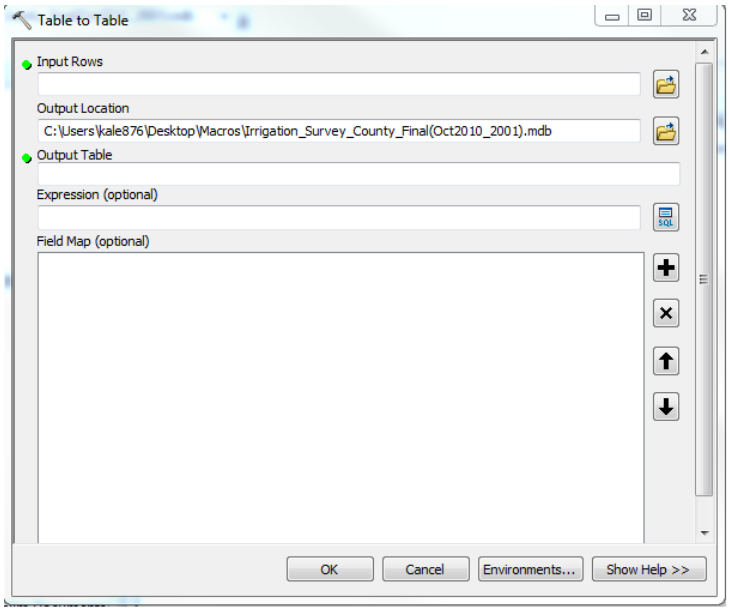
The new pop up window shows standard statistical analysis features including: frequency distribution, count, minimum vales, maximum vales, sum, mean, and standard deviation.



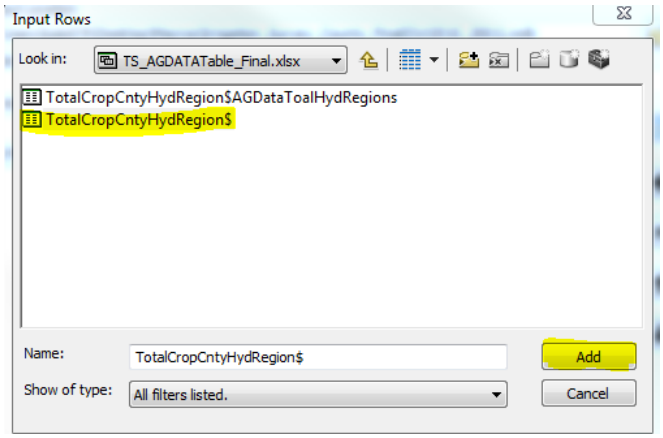
ADVANCED: REDEFINING THE DATABASE

IMPORT A TABLE TO DATABASE

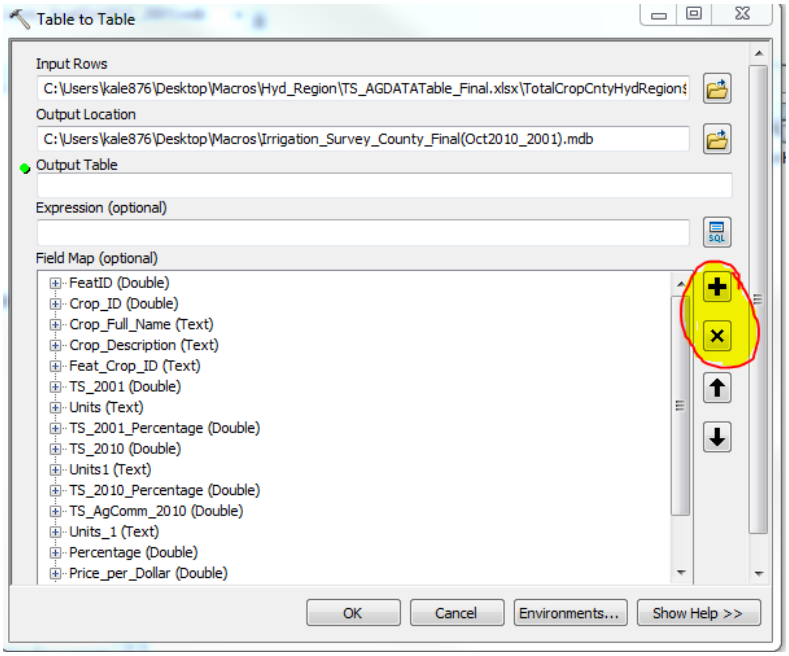
First, format data in Microsoft Excel so that row A are desired field titles and columns are the data values. Save the file in an easily retrievable place and with a descriptive title. Open ArcCatalog and navigate to the database. Right click the database and select ‘Import’ from the drop-down menu. From the expansion of the ‘Import’ select ‘Table (Single)’. The Table to Table pop up window should appear.



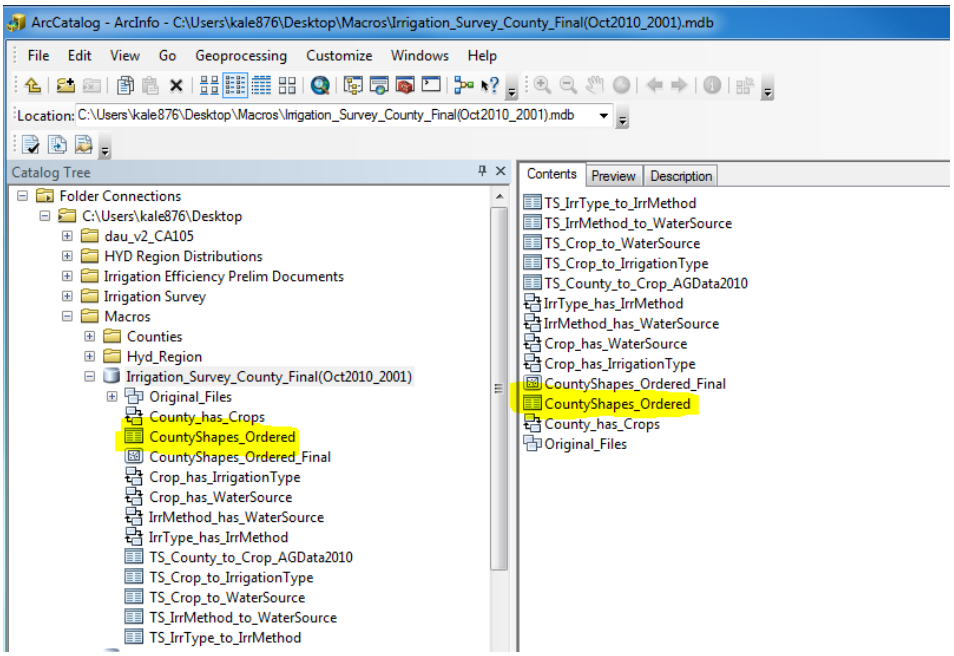
In the “Input Rows” line select the folder at the end of the line and navigate to the Microsoft Excel file where the data is saved. Once the correct workbook sheet is selected, click ‘Add’ in the bottom right hand corner.



Next, in the ‘Output Table’ line create a name for the table that will appear in the database. Within the ‘Field Map’ make sure that the desired fields of data are present. Use the “+” and ‘X’ to add and delete necessary fields.



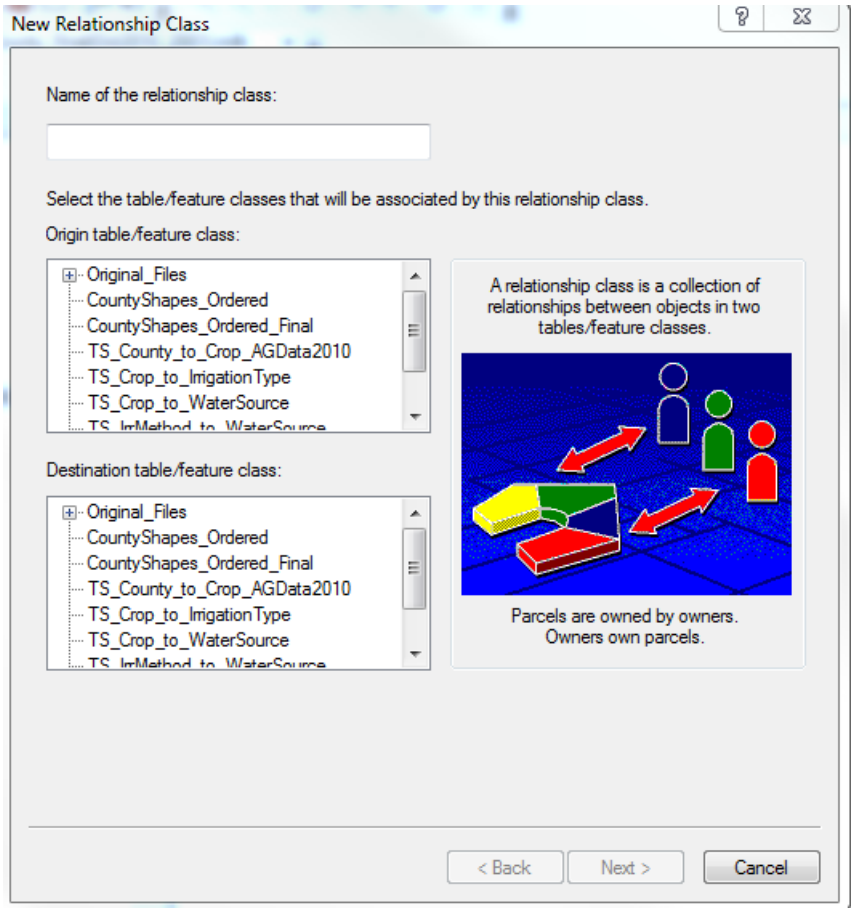
Select OK. The newly created table should appear under the geo-database title when expanded in the Catalog Tree or in the ‘Contents’ when the database is selected in the Catalog Tree window.



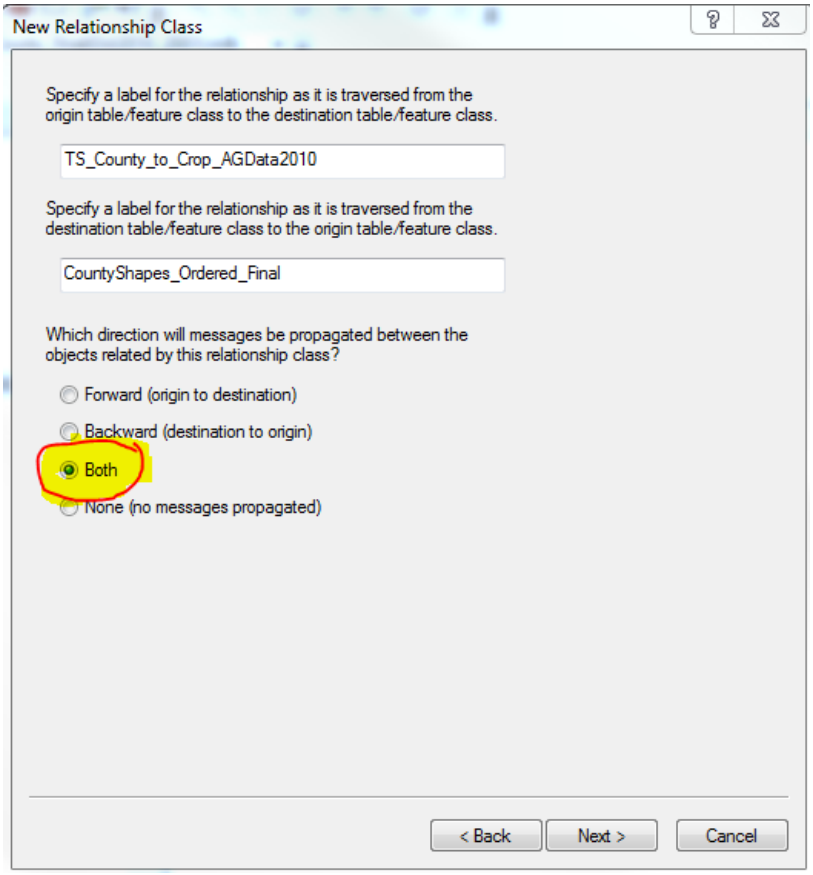
CREATING RELATIONSHIP CLASSES

A relationship class connects two tables within a database based on one overlapping field index in each table, while still keeping the tables separate. This enables the connection of one feature in a table to many related features in another table. For example, to connect from one hydrologic region to twenty crops. This organizes data in a branching network that can be easily accessed in ArcMap.

In order to create a relationship class open ArcCatalog and make sure that the geo-database has the two tables present, with one shared field between the two tables. Right-click the geo-database title in the ‘Catalog Tree’. From the drop down menu select ‘New’ and from the expansion select ‘Relationship Class…’ The following ‘New Relationship Class’ pop-up window should appear.

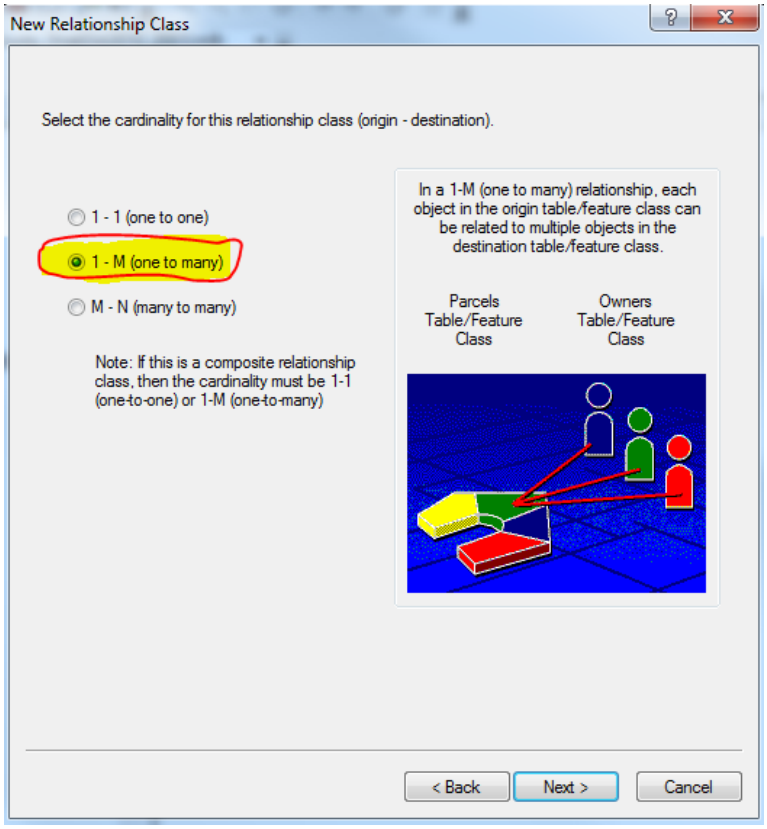


First create a name for the relationship class. Select one line in the ‘Origin table/feature class:’ and one from the ‘Destination table/feature class:’. These are the two titles of the existing tables that are being related to one another. Then select Next. For the construction of the Hydrologic Regions database a simple (peer to peer) relationship class has been made. This is the default setting so select ‘Next’. On the next screen select ‘Both’. This allows for navigation both forwards and backwards within the attribute table selections in ArcMap.



Select Next.

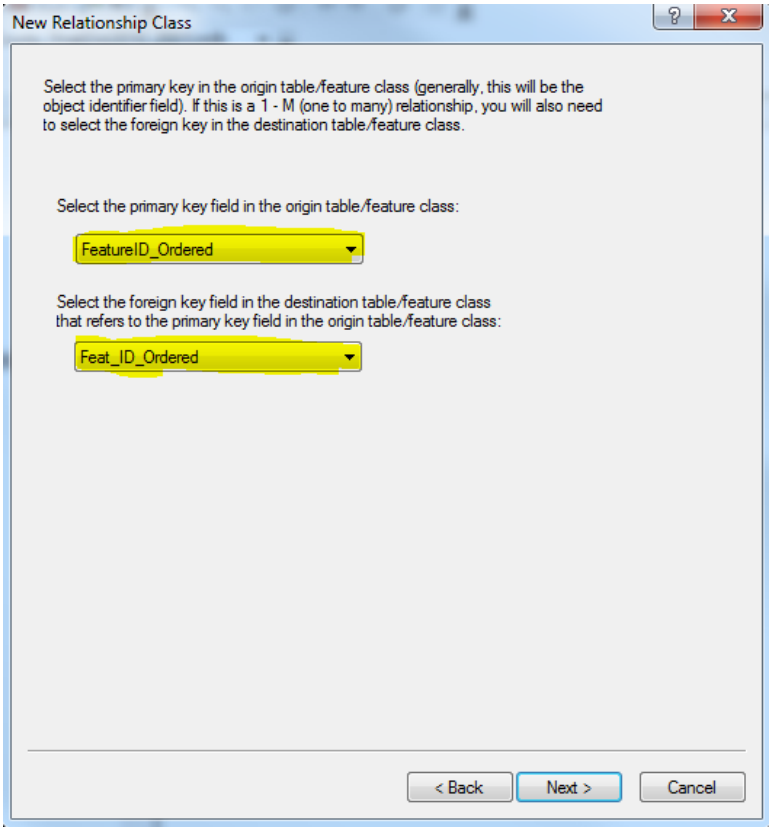
Based on the type of data that is being added the relationship between values in one table to the other may have one to one relationship, a one to many relationship, or many to many relationship. The Hydrologic Regions database uses a one to many relationship class.



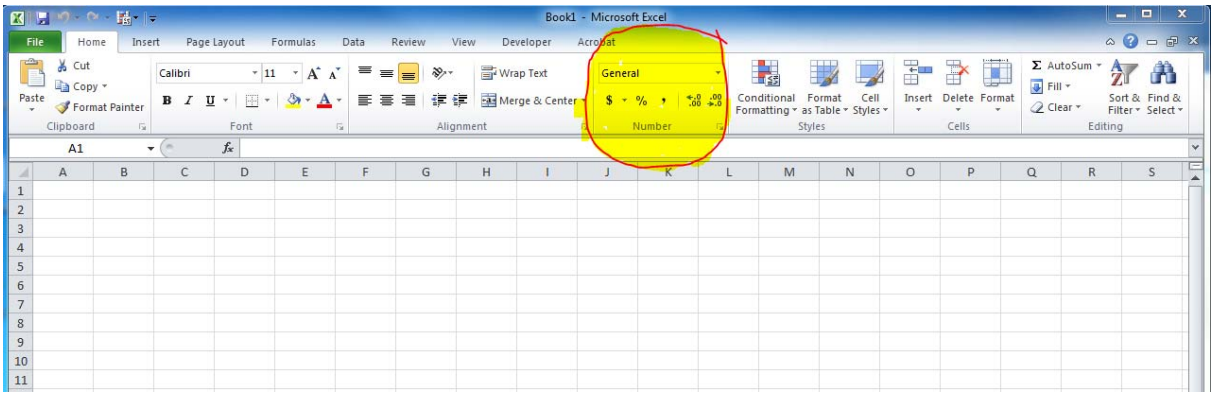
Select the appropriate and ‘Next’.

The next prompt asks if the data should have attributes, default settings are most typically used so select ‘Next’.

The next prompt indicates the specific fields that relate the data in the two tables. From the drop down lists select the desired fields. When formatting data in Excel it is convenient to have the same title for the related field for clarity.



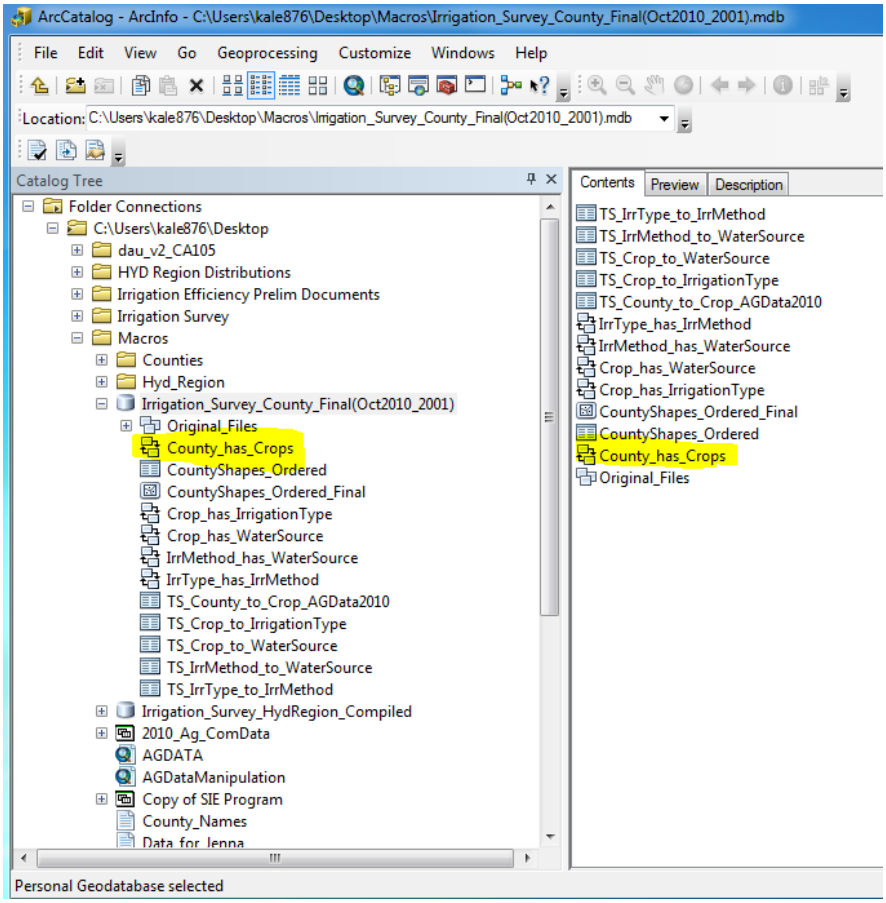
**Trouble-shooting: If the fields that are desired to be connected do not appear in the crop down menu then, open up the properties of the tables and make sure that the fields desired to be joined are of the same type (i.e. text, double). To fix this go back to Excel and change the ‘Number’ type to the appropriate type. The two most common types include ‘Number’ and ‘Text’.



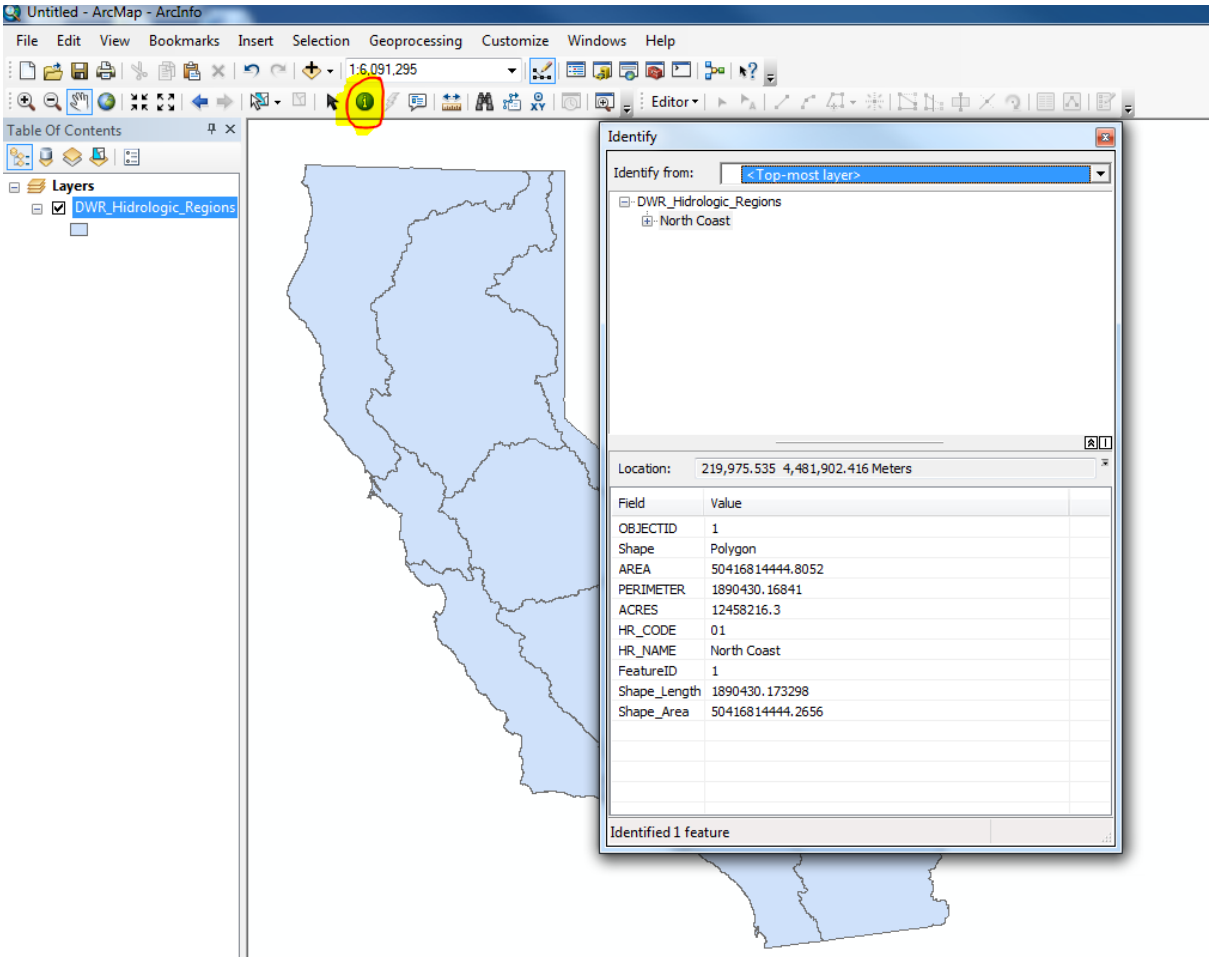
Select Next.

Select Finish.

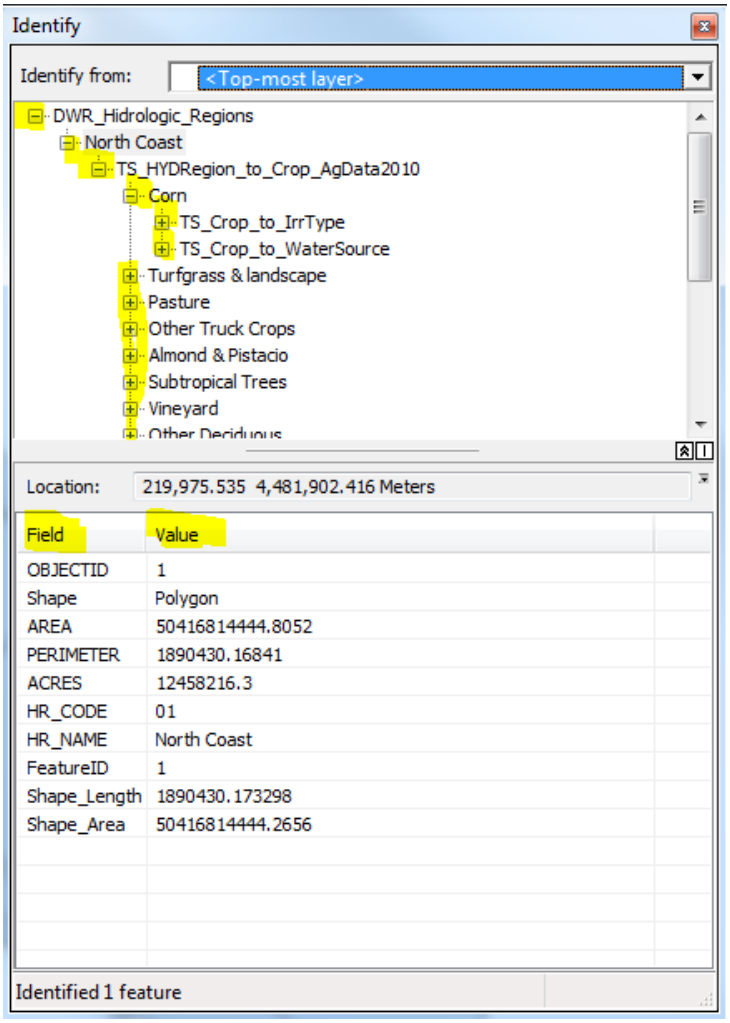
The new relationship class should appear in the Catalog Tree underneath the geo-database title as well as in the ‘Contents’.



The relationship class is now created, however, to ensure that it functions correctly exit ArcCatalog and open ArcMap. Navigate to the database and drag the shape file into the Table of Contents so that the map appears and a layer is created. Open the attribute table and select the 'Related Tables'. The new relationship class should appear. Another way to visualize the branching network created by Relationship classes is to select 'Identify' in the toolbar. Then select the region of interest. The region will change color to denote that it is selected and an 'Identify' pop up window will appear.

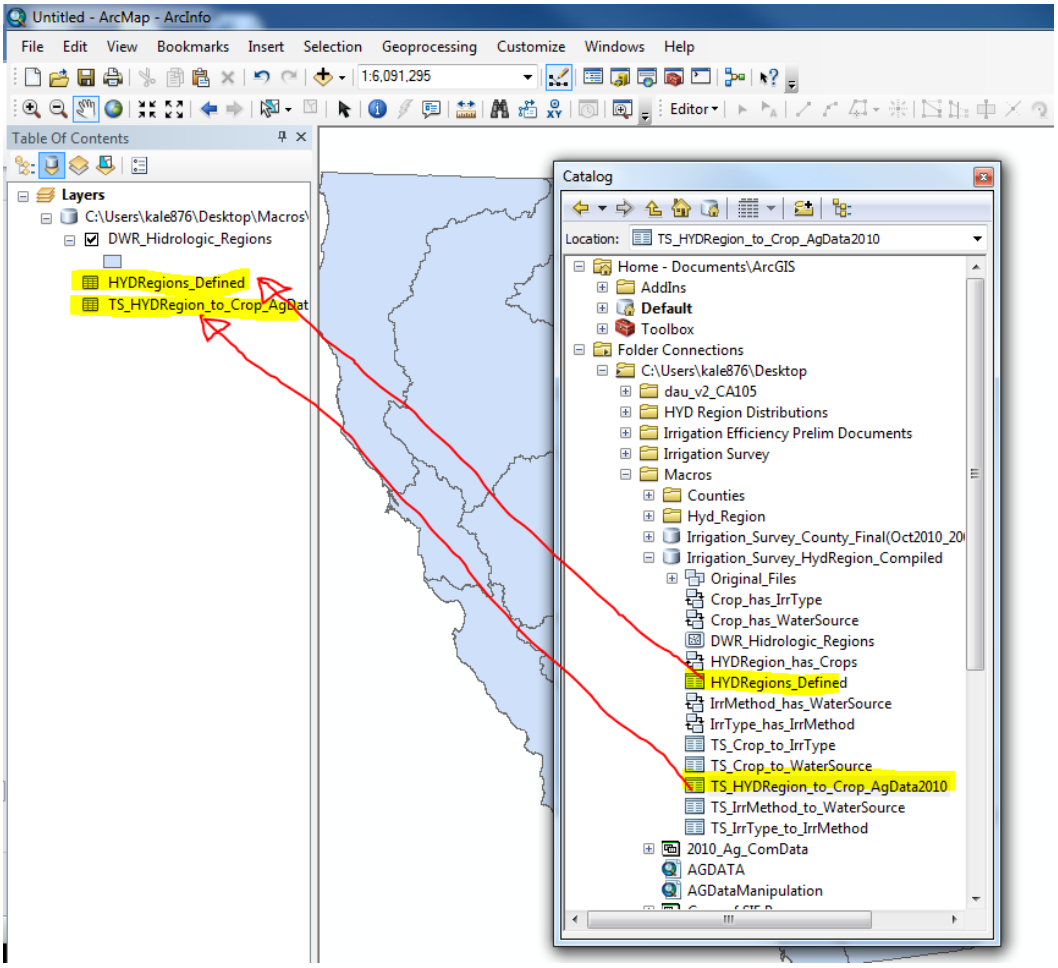


From the Identify window it is we are able to navigate through expanding the plus and minus signs. Information retaining data is displayed in the ‘Field’ and ‘Value’ areas below.

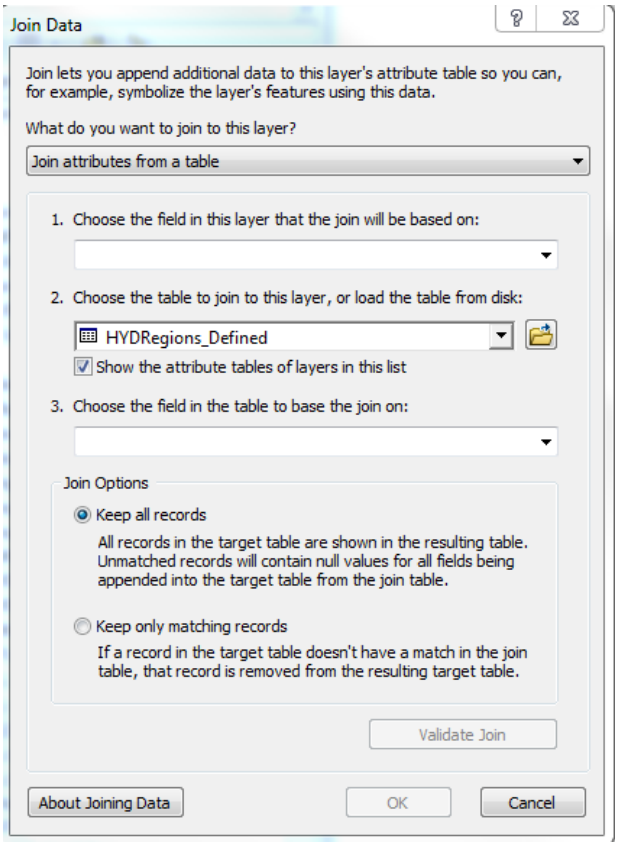


JOIN FEATURES IN ARCMAP

If there is data in two tables that are related by an index or specific field the data can be joined into one table within ArcMap. In order to join tables make sure that both tables are imported to the geo-database in ArcCatalog. Connect to the database in ArcMap. Click and drag the two tables from the database in the Catalog Window into the Table of Contents window in ArcMap.



Right-click the destination table and from the drop down menu select ‘Joins and Relates’. From the expansion select ‘Join’. The Join Data pop up window should appear as below.



In the ‘Join Data’ window, fill in the desired information as prompted including: choosing the field in the layer to be joined, choose the table to join to this layer, and choose the field in the table to bas the join on. There are options to keep all records or keep only matching records. Note that if all records are kept, it is possible to delete unwanted fields in a later editing process of the table.

Click ‘OK’.

Open the attributes table of the already highlighted destination table. Scroll to the right in order to see that all of the features of both tables are present. This data can now be exported, saved as a text file, imported into ArcCatalog for storage in a geo-database.