

# ***WRAP DISPLAY TOOL***

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## ***Users Manual and Operating Instructions***

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## ***Introduction***

This document is meant to be a handy reference guide to the WRAP Display Tool: a software tool used to harvest and display data from the Water Rights Analysis Package (WRAP) in a GIS environment, namely ArcMap. Details into the workings and usability of the features of this tool will be covered in varying degrees of detail in subsequent chapters. The structure of this manual will be informative-tutorial, meaning that the functions and features of the WRAP Display Tool will be presented both separately and as part of step-by-step instructions. This structure affords a hands-on introductory experience to the WRAP Display Tool as well as providing a reference for the experienced user.

The WRAP Display Tool was developed through research at the Center for Research in Water Resources (CRWR) for the Texas Commission on Environmental Quality (TCEQ). The WRAP Display Tool provides automated means of converting and digesting the output of the WRAP model, developed by Dr. Ralph Wurbs of Texas A&M University<sup>1</sup>, into usable GIS data. Additionally, the tool allows display of the WRAP output in both geographic map displays and time series graphs.

## 1.1 Tool Features

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This users' manual is divided into chapters and sections corresponding to different features of the WRAP Display Tool. These sections include:

- ◆ Getting Started: Covers requirements and installation of the WRAP Display Tool
- ◆ Geodatabase Management – Converting WRAP Output: Explains how to convert native WRAP output data into ArcGIS-friendly geodatabase format
- ◆ Linking to Geography – Map Display: Instructions on how to display WRAP data as a map display in an ArcMap document
- ◆ Linking to Geography – Time Series Graphs: Goes over procedures for showing WRAP data as time series graphs
- ◆ Customization: Introduction to customization steps to personalize the WRAP Display Tool
- ◆ Non-WRAP Data: Discusses how the WRAP Display Tool can be used for data from other sources

## 1.2 User Interface

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The WRAP Display Tool is a toolbar in ArcMap. As such, it inherits the basic properties of any toolbar in that it can:

- ◆ be docked on any side of the map display (Figure 1-1 shows the WRAP Display Tool docked next to the Tools and Standard toolbars),
- ◆ float freely as a separate tool (shown in Figure 1-1)
- ◆ be turned on/off from the toolbars listing found under **View | Toolbars**.



**Figure 1-1. Toolbar Docking Options**

In addition to standard toolbar handling, the WRAP Display Tool interacts with the layers and tables of the ArcMap document. Each of the many options presented by the WRAP Display Tool opens an interactive window where the layers and tables of interest are selected. The handling and management of these are discussed in great detail in subsequent sections.

## 1.3 Documentation Conventions

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This document uses various conventions to distinguish commands, actions, and so forth from the main text. These include:

- ◆ Commands are shown in **bold** with menus and submenus differentiated by as the following example shows: Select **File** | **Save** to save the document
- ◆ Actions such as clicking on a button are indicated in **bold**
- ◆ File names and file paths are shown in *italics*

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<sup>1</sup> Please see the official Water Rights Analysis Package website for further information, as well as a downloadable WRAP model and documentation, instructions, and reference manuals:  
<http://ceprofs.civil.tamu.edu/rwurbs/wrap.htm> Accessed 01 October 2007.





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## Getting Started

This chapter discusses the preliminary requirements for using the WRAP Display Tool. Included are instructions on installing the tool and a listing of necessary files or file types.

### 2.1 Required Files

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Before the WRAP Display Tool can be used, it must be installed. Therefore, if the tool is not installed, the WRAP Display Tool *setup.exe* file is needed. This is a self-extracting executable file which contains all of the necessary tools, templates, and libraries needed to use the WRAP Display Tool.

After installing the tool, appropriate GIS and WRAP files are needed. The GIS files contain the geometry of the study area, with a field that lists the WRAP identifier code, later called HydroCode. The WRAP data files include the output file produced as part of running the WRAP model (with an .OUT extension) and the reservoir storage-capacity file (with a .BES extension). These two WRAP files contain the information needed to produce GIS-friendly geodatabase tables used by the WRAP Display Tool.

### 2.2 ArcMap Requirements

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The WRAP Display Tool was created for use with ESRI's ArcGIS release version 9.2 with Service Pack 3. In order for the tool to function properly, this version of ArcMap and service pack are recommended. The release version and service pack information can easily be viewed by invoking the ArcGIS Desktop Administrator (e.g. by clicking **Start | All Programs | ArcGIS | Desktop Administrator**). Please see your systems administrator if your configuration does not match what is required.

## 2.3 Installation Process

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After checking that the proper ArcMap requirements are met (see section 2.2), the tool can be installed. The installation process is initiated by running the WRAP Display Tool *setup.exe* file as follows:

1. Locate and run *setup.exe*
2. The installer dialog shown in Figure 2-1 will appear

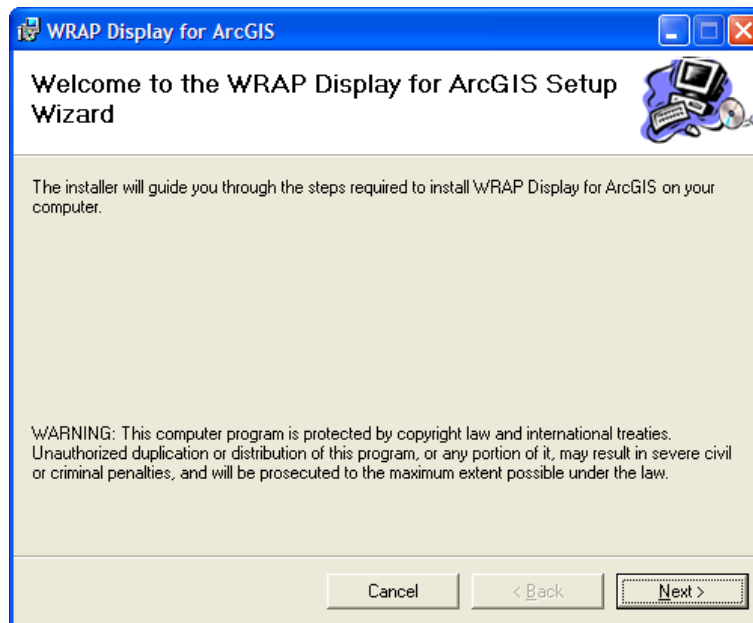


Figure 2-1. WRAP Display Tool Installer

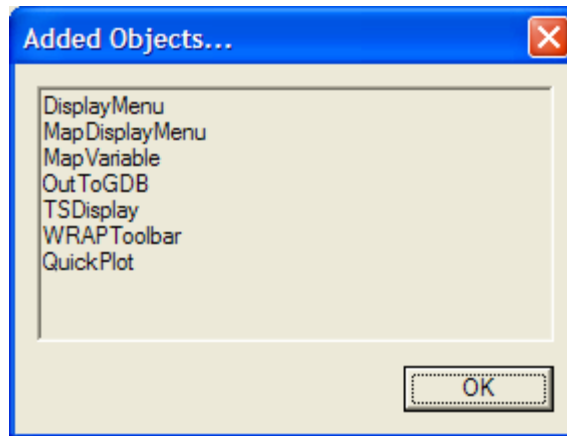
3. Select **Next** to navigate through the preliminary setup steps, paying attention to the installation location and other options
4. Click **Close** on the “Installation Complete” screen to finish installation
5. The WRAP Display Tool has successfully been installed on your machine in the directory specified in the preliminary setup steps (*Program Files\CRWR\WRAP Display for ArcGIS*, by default).

## 2.4 Enable the WRAP Display Tool in ArcMap

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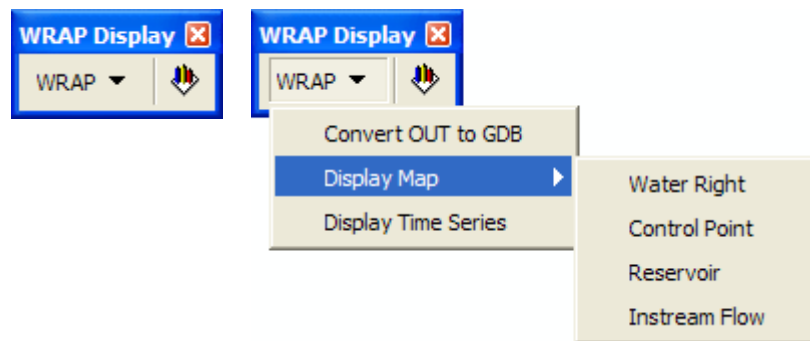
The previous steps should have automatically enabled the tool in ArcMap; further installation steps should be unnecessary. If, however, the tool is not shown as a toolbar option in ArcMap, please follow the steps below:

1. Open ArcMap
2. Select **Tools | Customize** to launch the Customize dialog
3. On the Toolbars tab, select the **Add from file** button in the lower right
4. Path to the installation location and open the *WRAP\_Display.tlb* file
5. Success is indicated by the results shown in Figure 2-2



**Figure 2-2. WRAP Display Tool Added Successfully**

1. Select **OK** from the Added Objects dialog to return to the Customize dialog
2. Ensure that WRAP Display is checked in the list of toolbars. The result is the WRAP Display Tool shown as a toolbar in Figure 2-3. This toolbar inherits ArcMap's toolbar properties and can be docked for convenience.



**Figure 2-3. WRAP Display Tool Toolbar**

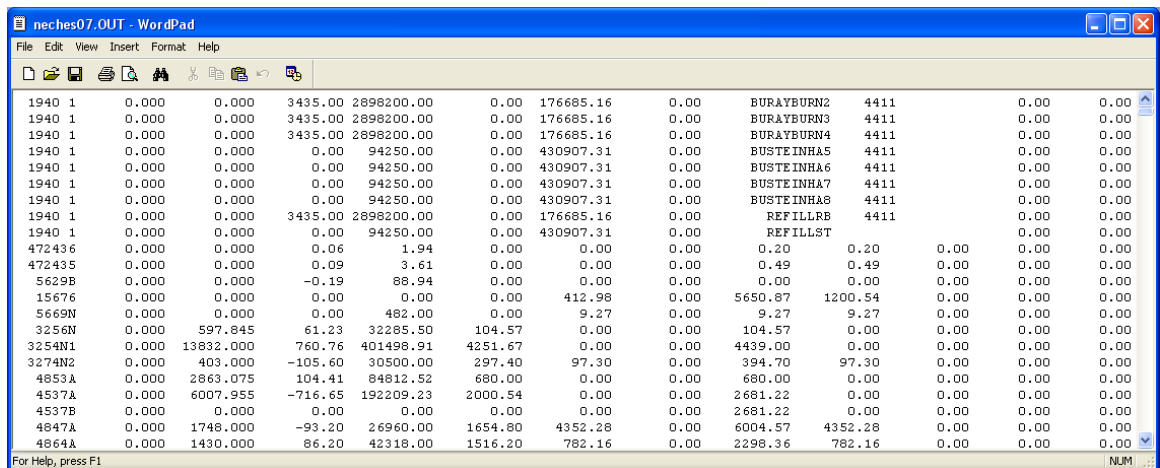
At left is the standard toolbar; at right is the toolbar with its options expanded

With the toolbar installed, WRAP output data can be processed.



## Geodatabase Management – Converting WRAP Output

Before the WRAP output data can be accessed by ArcMap it must be repackaged. The native output format of WRAP is ASCII text file. An example from a simulation of the Neches Basin is shown in Figure 3-1. This figure displays a small portion of the voluminous WRAP output file and shows the threshold between two data classes. The collection of variables represented is shown by the numerous columns; each column corresponding to an individual variable output. Notice the break in columnar styles midway. Each set of variables has its own unique column breaks, making standard data acquisition difficult. In other words, ArcMap cannot read the file due to the combination of formatting styles. Hence, a conversion is necessary. This chapter presents the conversion performed by the WRAP Display Tool.



1940 1	0.000	0.000	3435.00	2898200.00	0.00	176685.16	0.00	BURAYBURN2	4411	0.00	0.00
1940 1	0.000	0.000	3435.00	2898200.00	0.00	176685.16	0.00	BURAYBURN3	4411	0.00	0.00
1940 1	0.000	0.000	3435.00	2898200.00	0.00	176685.16	0.00	BURAYBURN4	4411	0.00	0.00
1940 1	0.000	0.000	0.00	94250.00	0.00	430907.31	0.00	BUSTEINHA5	4411	0.00	0.00
1940 1	0.000	0.000	0.00	94250.00	0.00	430907.31	0.00	BUSTEINHA6	4411	0.00	0.00
1940 1	0.000	0.000	0.00	94250.00	0.00	430907.31	0.00	BUSTEINHA7	4411	0.00	0.00
1940 1	0.000	0.000	0.00	94250.00	0.00	430907.31	0.00	BUSTEINHA8	4411	0.00	0.00
1940 1	0.000	0.000	3435.00	2898200.00	0.00	176685.16	0.00	REFILLRB	4411	0.00	0.00
1940 1	0.000	0.000	0.00	94250.00	0.00	430907.31	0.00	REFILLST		0.00	0.00
472436	0.000	0.000	0.06	1.94	0.00	0.00	0.00	0.20	0.20	0.00	0.00
472435	0.000	0.000	0.09	3.61	0.00	0.00	0.00	0.49	0.49	0.00	0.00
5629B	0.000	0.000	-0.19	88.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15676	0.000	0.000	0.00	0.00	0.00	412.98	0.00	5650.87	1200.54	0.00	0.00
5669N	0.000	0.000	0.00	482.00	0.00	9.27	0.00	9.27	9.27	0.00	0.00
3256N	0.000	597.845	61.23	32285.50	104.57	0.00	0.00	104.57	0.00	0.00	0.00
3254N1	0.000	13832.000	760.76	401498.91	4251.67	0.00	0.00	4439.00	0.00	0.00	0.00
3274N2	0.000	403.000	-105.60	30500.00	297.40	97.30	0.00	394.70	97.30	0.00	0.00
4853A	0.000	2863.075	104.41	84812.52	680.00	0.00	0.00	680.00	0.00	0.00	0.00
4537A	0.000	6007.955	-716.65	192209.23	2000.54	0.00	0.00	2681.22	0.00	0.00	0.00
4537B	0.000	0.000	0.00	0.00	0.00	0.00	0.00	2681.22	0.00	0.00	0.00
4847A	0.000	1748.000	-93.20	26960.00	1654.80	4352.28	0.00	6004.57	4352.28	0.00	0.00
4864A	0.000	1430.000	86.20	42318.00	1516.20	782.16	0.00	2298.36	782.16	0.00	0.00

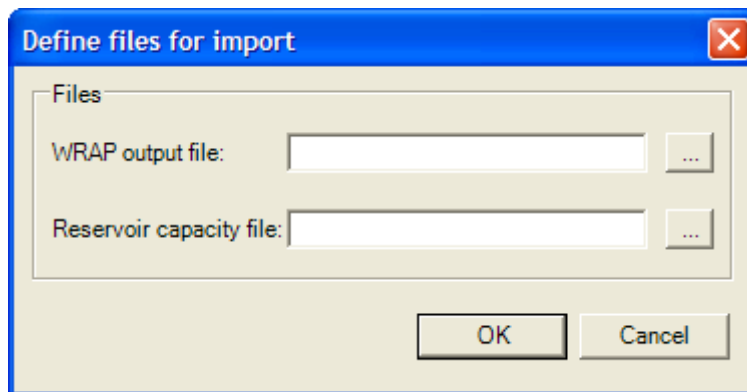
Figure 3-1. WRAP Native Output Format

### 3.1 Converting WRAP Output to Geodatabase Tables

The WRAP Display Tool converts the native output style into an ArcGIS-friendly geodatabase (GDB) format. This tool programmatically digests the ASCII file and

produces ordered, similar tables as geodatabases, thus enabling easier access to the data. The steps to produce this data transmogrification are as follows:

1. Ensure that WRAP output is available for the study of interest. This requires two files:
  - ◆ WRAP output file – with an .OUT extension, and
  - ◆ Beginning-ending storage (reservoir capacity) file – with a .BES extension.
2. On the WRAP Display Tool, select **WRAP | Convert OUT to GDB**
3. The dialog shown in Figure 3-2 appears allowing specification of the two files mentioned earlier. Either enter the files' paths or browse for the files using the buttons at the right and their resulting dialogs.



**Figure 3-2. Convert OUT to GDB Dialog**

4. Once the output file and reservoir file have been set, select **OK**
5. An ArcGIS file browser window appears from which the output name and location for the GDB is set. Specify this information and select OK
6. A progress dialog shows the conversion process and gives descriptors as to what is taking place behind-the-scenes. Upon completion, this dialog will close and the GDB will be added to the ArcMap document. To view this, select the Source tab of the ArcMap legend.

The geodatabase created in the preceding steps contains four tables, one for each type of WRAP output and its corresponding variables—water rights, control points, reservoirs, and instream flows. An example of the ReservoirTS table is shown in Figure 3-3. This figure shows the data organization of the WRAP data. The many variables are shown across the top of the table and the data corresponds to specific time and locations. Additionally, each table has metadata associated with it giving additional information for each variable, including descriptions and unit information.

ObjectID	HydroCode	TSDatTime	HydShort	Energy	Evap	EopSto	InfDep	InfRel	RelTurb	ReInTurb	AdjEvDepth	EvpDepth	ResWSE	PStor
1	472436	1/1/1940	0	0	0.06	1.94	0	0	0	0	2	0.03	0	97
2	472435	1/1/1940	0	0	0.09	3.61	0	0	0	0	3.7	0.03	0	97.567568
3	FLOR	1/1/1940	0	0	1.55	365.45	0	0	0	0	367	-0.04	0	99.577657
4	LMPRY	1/1/1940	0	0	0	482	0	0	0	0	482	0.03	0	100
5	WALLAC	1/1/1940	0	0	0.58	47	0.93	0	0.35	0	47	0	0	100
6	BEASLY	1/1/1940	0	0	0.74	69.16	0	0	0.1	0	70	0.04	0	98.8
7	MEVBERN	1/1/1940	0	0	0.6	49.38	0	0	0.02	0	50	0.03	0	98.76
8	COX1	1/1/1940	0	0	2.79	596.81	0	0	0.4	0	600	-0.08	0	99.468333
9	WMSE	1/1/1940	0	0	1.14	222.86	0	0	0	0	224	0.02	0	99.491071
10	PROJAM	1/1/1940	0	0	0.99	111.01	0	0	0	0	112	-0.07	0	99.116071
11	CALEND	1/1/1940	0	0	10.65	3403.35	0	0	0	0	3414	0	0	99.680049
12	ROBERT	1/1/1940	0	0	4.58	1337.42	0	0	2	0	1344	-0.04	0	99.510417
13	DUNCAN	1/1/1940	0	0	0.33	29.37	0	0	0.3	0	30	0.04	0	97.9
14	COLINS	1/1/1940	0	0	0.57	70.93	0	0	0.5	0	72	0.04	0	98.513689
15	HAND	1/1/1940	0	0	0.8	126.5	1.85	0	1.05	0	126.5	0.08	0	100

Figure 3-3. Geodatabase Representation of WRAP Data

In geodatabase format, the WRAP data is available for display and use by ArcMap.

## 3.2 WRAP Information as Metadata

As will be discussed and shown later, map and time series displays of WRAP data using the WRAP Display Tool have parameter specific labels. These include both variable units and expanded variable names (as opposed to the abbreviated variable names of the geodatabase tables, see field labels of Figure 3-3 for example).

Not only is metadata useful for maps and graphs, but the metadata also contains information about the original WRAP output files used. The following steps outline how to view and alter the metadata:

1. In the Source tab of ArcMap's legend, right-click on a WRAP geodatabase table and select **Data | View Metadata**
2. Ensure that the Stylesheet option at the top of the resulting dialog is set to *FGDC ESRI*

FGDC stands for *Federal Geographic Data Committee*. The options of the Stylesheet combo box change the way that metadata is viewed and accessed.

3. Click on the **Attributes** tab of the display

Shown in green are items that have metadata associated with them. These are in two main categories: the description and attributes.

4. Click on **Description**

The text that appears is the information that was in the original WRAP output file. It is shown with a pipe symbol “|” separating the lines of the original file. This data will likely contain the simulation method and date, along with the version of WRAP used.

5. Click on the attributes to reveal their metadata

All attributes below the *TSDatTime* attribute should have a Definition field that shows the expanded variable name and units (in parentheses). This is the metadata that is used in subsequent map and time-series displays.

The metadata for the WRAP variables is written when using the Convert OUT to GDB function of the WRAP Display Tool. While this is done automatically, metadata can still be changed or added to new fields (e.g. if additional fields are added to the table). The following steps outline how to change the metadata:

1. Open ArcCatalog
2. Path to the location of the geodatabase and click on the table to be changed
3. Choose the Metadata tab to see a similar display to before
4. On the Metadata toolbar, choose the **Edit Metadata** button (shown in Figure 3-4)

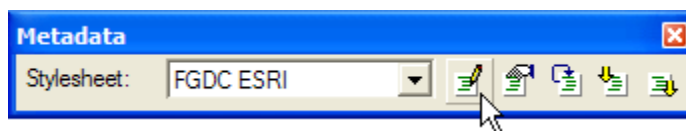


Figure 3-4. Metadata Toolbar

5. In the resulting dialog, click on **Entity Attribute** (near the top center of the window)
6. Choose the Attribute tab to view and change the metadata

Attributes are changed by clicking the small arrows near the bottom of the dialog.

7. In the Definition field, alter the metadata following the convention of:  
*Variable Name (Units)*

For example, the metadata for the PStor attribute of the ReservoirTS table is “Storage as a Percent of Capacity (Percent),” where the variable description is followed by the units in parenthesis. Any description and units combination can be entered here so long as it follows this simple standard. If followed, the Definition metadata will be available for subsequent data displays (maps or time-series).

8. Click on **Save** when finished editing metadata

The WRAP Display Tool’s use of metadata provides for flexible labeling and display of variable data. Through available ArcGIS tools, metadata can be edited and/or added, thus allowing the possibility of additional uses of the WRAP Display Tool.



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## ***Linking to Geography – Map Display***

The geographic locations of the WRAP output are referenced through the *HydroCode* field of the geodatabase tables. In order to link the WRAP output with GIS data, a link must be made between the two. This is best accomplished through the *HydroCode*.

### **4.1 Preparing the Feature Class**

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In order for the WRAP Display Tool to function properly, the geographic feature class must contain a *HydroCode* field. This field can simply be added as demonstrated in the following steps:

1. Select the **Options | Add Field** command from the button in the lower right of an attribute table view
2. Specify the name *HydroCode* in the Name Field
3. Enter the Type of *HydroCode* as “Text” as set from the drop-down selection box
4. The *HydroCode* field must be populated with values corresponding to the *HydroCode*, which are the WRAP identifiers that link the GDB tables to the GIS features. This is done by right-clicking on the *HydroCode* field and selecting **Field Calculator**
5. In the resulting dialog, simply double-click on the field name in the Fields listing that corresponds to the *HydroCode*, *RES\_ID* in the example case (finished table shown in Figure 4-1).
6. Select **OK** to close the dialog and calculate the values. (NOTE: The WRAP Display Tool also uses a *MapValue* field. However, there is no need to create this field or calculate values because these steps are done automatically while running the WRAP Display Tool)

The result of these steps is shown in Figure 4-1 for a reservoirs feature class table.

OBJECTID *	Shape *	OID_	OID1	RES_ID	HydroCode
1	Point	26	44	WALLAC	WALLAC
2	Point	27	45	BEASLY	BEASLY
3	Point	29	47	MEWBRN	MEWBRN
4	Point	239	49	WISE	WISE
5	Point	237	50	PROJAM	PROJAM
6	Point	31	51	CALEND	CALEND
7	Point	30	48	COX1	COX1
8	Point	32	52	ROBERT	ROBERT
9	Point	33	53	DUNCAN	DUNCAN
10	Point	34	54	COLINS	COLINS
11	Point	10	80	SWANCL	SWANCL
12	Point	11	73	LENOX	LENOX
13	Point	12	74	KERSH1	KERSH1
14	Point	13	75	BELSND	BELSND
15	Point	15	77	BURKS	BURKS

Figure 4-1. Reservoir Feature Class

## 4.2 Displaying WRAP Data as Colors on a Map

With the geodatabase set and GIS features organized properly, we move to the realm of displaying data. Values corresponding to the WRAP output data are shown geographically by using the following steps:

1. The commands following **WRAP | Display Map** on the WRAP Display Tool include: Water Right, Control Point, Reservoir, and Instream Flow, as shown on the right figure of Figure 2-3. Select the option that best applies to the needs of the analysis (**Reservoir** is selected for this tutorial).
2. The same dialog appears, regardless of which of the four options is selected (shown in Figure 4-2). The options are to set descriptors on the form and automate table selection. This dialog allows selection of layer, time series table, and variable to display. Select these items as appropriate for the analysis.

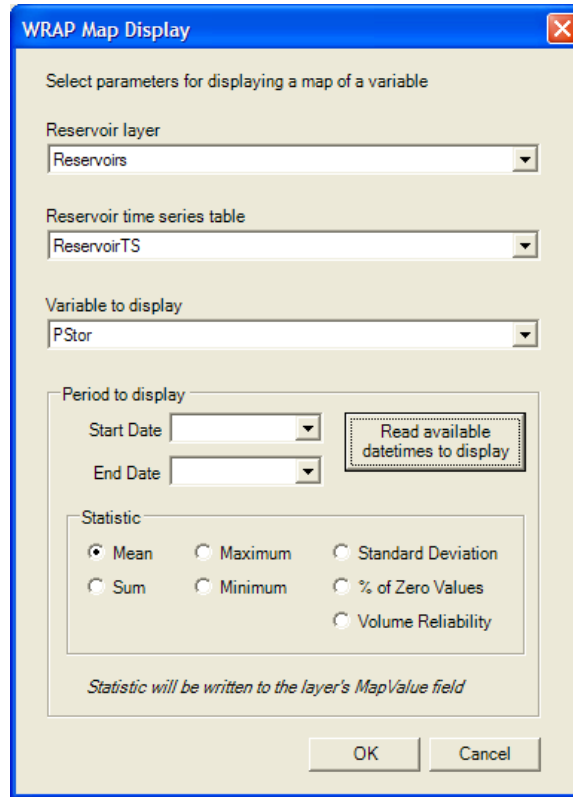


Figure 4-2. WRAP Map Display Dialog

3. The Period to display box has two drop-down boxes and a button. If these are left blank (default), the entire period of record is used for calculations. If a specific time step or time range are desired, click on the **Read available datetimes to display** button to populate the start and end dates.
4. Select the time period of interest
5. The Statistic box allows for specification of mathematical operations to apply to the data of a selected range. Select a statistical representation.

Two options are non-standard operations. These are:

- ♦ % of Zero Values – this option is a way of representing period reliability: the number of periods with zero shortages divided by the total number of periods, converted to a percentage. Period reliability gives an indication of how frequent the selected variable has zero values over the selected time range. This is represented mathematically as follows:

$$\frac{P_{zeros}}{P_{total}} \times 100\%$$

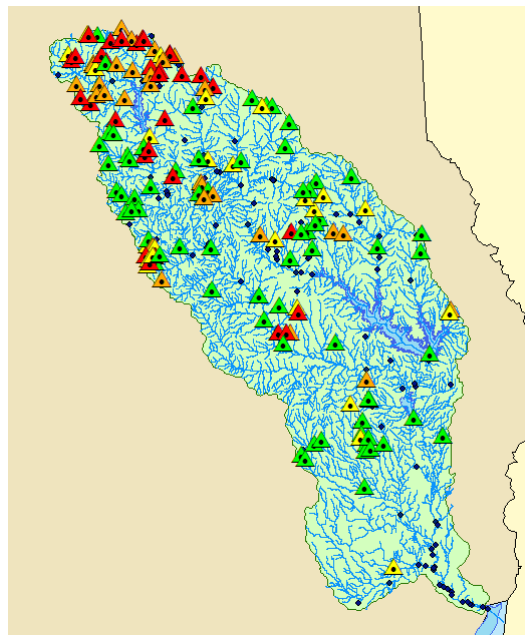
- ♦ Volume Reliability – this option is the percentage of total demand that is actually supplied; it is the mean target over the period of record minus the mean shortage over the period of record, all divided by the mean target over

the period of record, converted to a percentage. This is shown mathematically as follows:

$$\frac{\bar{T} \times \bar{S}}{\bar{T}} \times 100\%$$

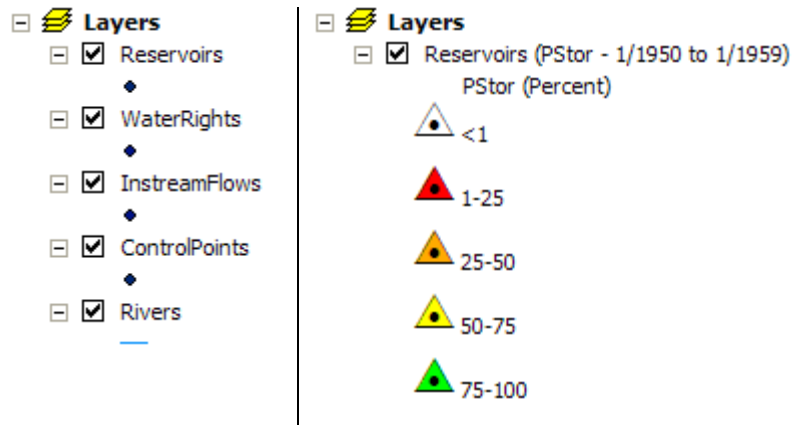
This option uses two variables, yet the form only allows the selection of one. For this option to be applied the selection is limited to either the shortage or target variables, as designated through the WRAP conversion process (see chapter 3). Therefore, to apply this option, select either the target or shortage variable (named Target, Shortage, ResTarget, or ResShort depending on the time series table selected) and the tool will automatically select its counterpart and perform the operation.

6. After setting all options, select **OK**
7. A progress dialog appears while appropriate data is retrieved from the specified geodatabase, calculations are performed, and results are written to the MapValue field. Upon completion, results are shown on the map, as indicated in Figure 4-3.
8. Repeat for other selections and/or layers.



**Figure 4-3. Percent of Storage in Reservoirs**

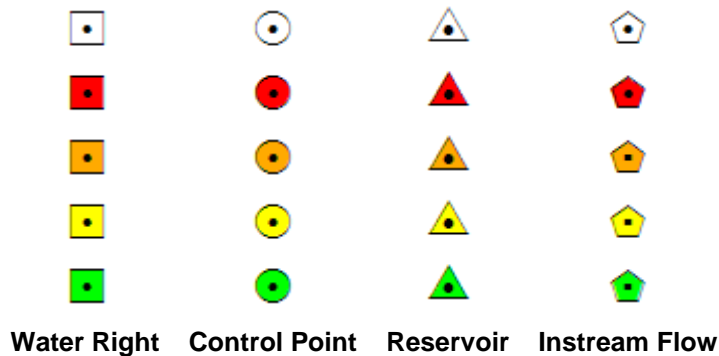
In addition to applying symbols and colors to the map, the legend is also updated to reflect the choices made in the form. In particular, the layer name is augmented to show both the variable and the date range, as shown as a progression in Figure 4-4. This figure shows the legend before invoking the **Display Map** tool (left), and after (right). In addition, the variable and its units are also displayed.



**Figure 4-4. Layer Changes**  
Legend before using Display Map tool (left) and after (right)

The distribution in Figure 4-4 is well suited for percentages. However, if another variable is selected, the class breaks are set according to breaks within the dataset itself.

Symbology was selected to display different symbols for each of the four tables. The symbols and color gradients are shown in Figure 4-5. The colors and shapes can be changed and applied universally thereafter by manipulating the layer files included in the *setup.exe* file (these procedures will be discussed further in chapter 6).



**Figure 4-5. Symbol Use for Layers**

NOTE: If the legend includes extremely small or large numbers such as 3.40e+038, this is an indication that the WRAP output file does not contain data for one or more points in the GIS feature class. Viewing the feature class attribute table and sorting the MapValue field will reveal which points are suspect.



---

## ***Linking to Geography – Time Series Graphs***

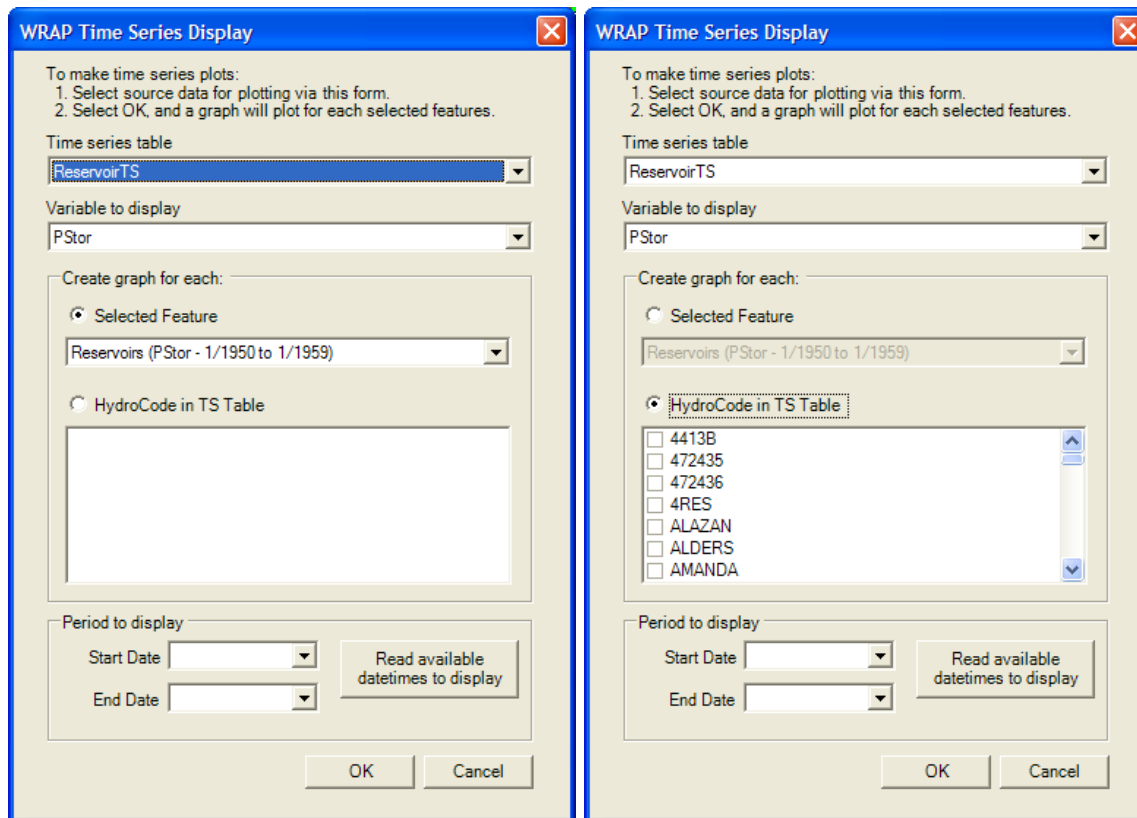
In addition to colored symbols on maps, the WRAP Display Tool also provides means for displaying WRAP output data as time series graphs. This can be achieved by using one of two options: the **Display Time Series** option and the **Quick Plot** option.

### **5.1 Time Series Graphs using Display Time Series**

---

A collection of time series graphs, one for each location, is produced through the following steps:

1. Select **WRAP | Display Time Series** from the WRAP Display Tool and the dialog shown in Figure 5-1 appears (NOTE: the Selected Feature option is only available if features are selected in the associated ArcMap document).



**Figure 5-1. WRAP Time Series Display Dialog**

Graphs are based on selected features (left) or selections from a table (right)

2. Set the time series and variable of interest
3. Choose how the data to graph are determined: either selection or table
  - a. The Selected Feature option produces one graph for each selected feature in the layer selected. These are based on both the geodatabase table and layer.
  - b. The *HydroCode in TS Table* option produces one table for each HydroCode that is selected from the list. Please note that this option is based only on the geodatabase and no geographic data is required to produce these plots.
4. The Period to display box has two drop-down boxes and a button. If these are left blank (default), the entire period of record is used for calculations. If a specific time step or time range are desired, click on the **Read available datetimes to display** button to populate the start and end dates.
5. Select the time period of interest
6. Select **OK** to plot the time series graphs

An example of a time series graph is shown in Figure 5-2. Please note that the name of the graph reflects the table used, the variable plotted, and the location chosen. This graph is for the entire period of record and is, therefore, quite busy. However,



standard ArcMap operations can be executed to zoom and pan, etc. to a desired area within the graph. Furthermore, ArcMap graph properties can also be used to export the graph in many different forms

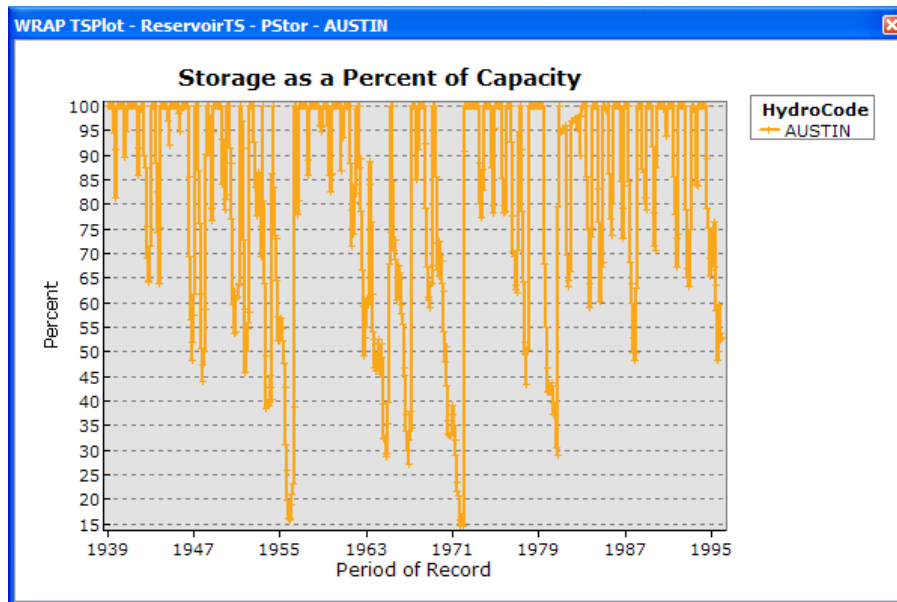


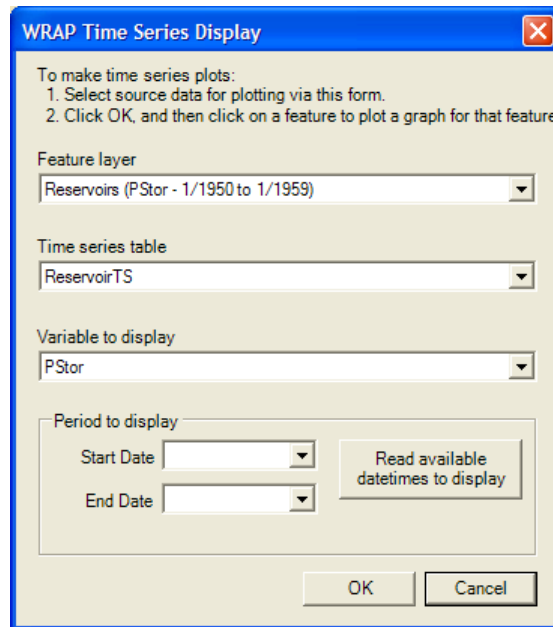


Figure 5-2. Time Series Graph


## 5.2 Time Series Graphs Using Quick Plot Tool

The **Quick Plot** tool  is similar to the **Display Time Series** tool in many respects. However, its purpose is to allow more rapid graphing of time series based on a selected table and layer. The following steps outline the use of this tool:

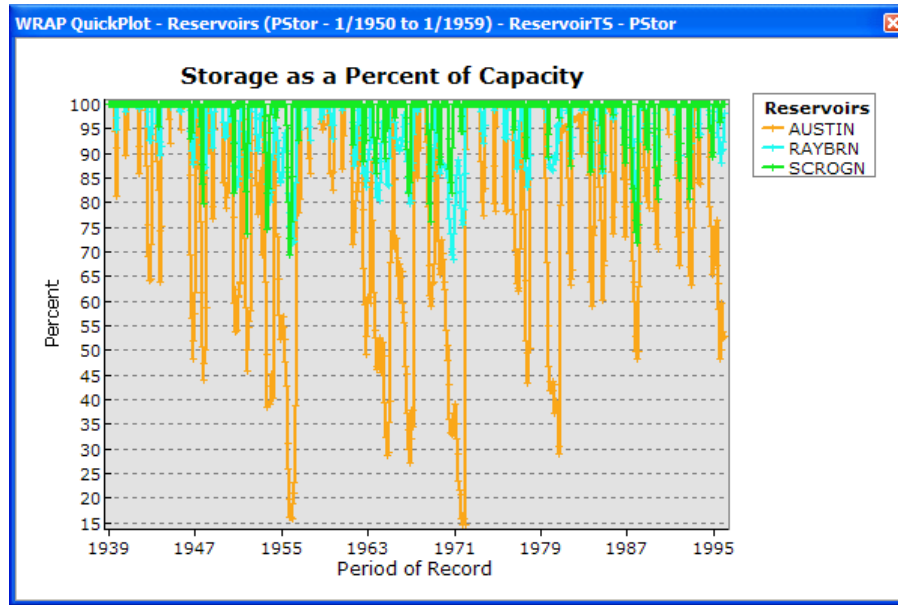
1. Click on the **Quick Plot** tool  and the dialog shown in Figure 5-3 appears



**Figure 5-3. Quick Plot Tool Interface**

2. Set the Feature layer, Time series table, and Variable to display using the drop-down boxes
3. The Period to display box has two drop-down boxes and a button. If these are left blank (default), the entire period of record is used for calculations. If a specific time step or time range are desired, click on the **Read available datetimes to display** button to populate the start and end dates.
4. Select the time period of interest
5. Select **OK** to activate the tool and the tool's icon changes slightly to indicate that the tool is active 

With the Quick Plot tool active, a time series graph is produced by clicking on a valid feature in the map. After the first click, a plot similar to that of Figure 5-2 appears. However, with the graph window active, additional clicks on features result in additional time series being added to the existing graph, as shown in Figure 5-4.



**Figure 5-4. Quick Plot Time Series**

Closing the resulting graph and subsequently clicking on a feature produces a new graph. Once closed, the graphs are not deleted, but remain in memory as part of the ArcMap document. Past graphs can be accessed and viewed by following **Tools | Graphs** and selecting the graph of interest. Alternately, one can follow **Tools | Graphs | Manage** for additional options.

To deactivate the tool, simply press the escape key (Esc). Thereafter, the parameters of the Quick Plot tool can be re-specified by invoking the tool again.



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## Customization

The WRAP Display Tool comes equipped to handle standard WRAP output data—this is what it was designed to do. However, the default functionality of WRAP can be augmented to meet needs that are more catered towards individual applications. These include adding data to existing geodatabase tables and changing the map or graph templates. This chapter walks through steps to make these changes.

---

### 6.1 Adding Data to Existing Geodatabase Tables

---

Through the process of converting WRAP output data to geodatabase tables (see chapter 3), WRAP data was set in distinct fields—one for each variable. The values in these fields can be shown as maps or graphs by using the WRAP Display Tool. However, additional data can be shown as well. For example, a new field can be added with values populated using mathematical combinations of existing data. This allows for manipulation and display of the standard WRAP output. To do this, simply:

1. Add a field in the ArcMap table view using **Options | Add Field**
2. Input a name for the field and set the type to **Double**

NOTE: the WRAP Display Tool will not recognize the field unless the type is Double.

3. Select **OK** to create the field
4. Invoke the Field Calculator by right-clicking the field and selecting **Field Calculator**
5. Set the value of this field by using standard ArcMap Field Calculator procedures
6. Select **OK** to apply the changes

With the new representation of data applied, the WRAP Display Tool can be used to display this data. This allows for further use of the WRAP Display Tool through creating additional fields in the geodatabase tables.

## 6.2 Customized Map Displays

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When the **WRAP | Display Map...** option is executed the result is a map display of selected variable values over a given time. This map display is a set of symbols of varying colors indicating breaks in the data. The WRAP Display Tool uses a collection of template layer files for each type of variable to assign the break type, symbol shape, and color gradient. To meet the needs of different users, these template layer files can be edited and/or saved under different names to produce distinct symbology for different variable classes or types.

### 6.2.1 Layer Files' Structure

Before discussing the procedures to change the map template layer files, an introduction to how the tool uses these files and how they are named is appropriate. When the Display Map option is chosen, after all options have been set and the **OK** is clicked, the tool looks in a layers directory (folder) to see if a layer for the chosen variable exists. For example, if **WRAP | Display Map | Reservoir** is chosen and the PStor (Percent of Storage) variable is selected, the tool looks for a file named: “*Reservoir - PStor.lyr*.” If this file exists, the symbology of the file is applied to the layer specified. However, if this file does not exist, the tool looks for a more generic “*Reservoir.lyr*” file and uses its symbology.

The naming structure is as follows: “*VariableType – Variable.lyr*.” This structure allows for the application of different symbologies to each variable and variable type possible. The WRAP Display Tool comes with default layer files for each type of variable (Water Right, Control Point, Reservoir, and Instream Flow), with a few specific others:

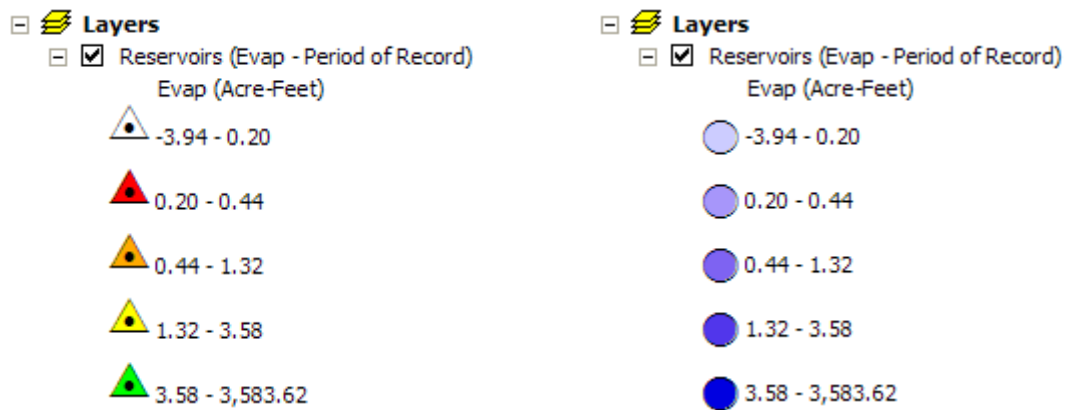
- ◆ *Reservoir - PStor.lyr* – this is included because the PStor variable has units of percent whereas the others do not.
- ◆ *Percent.lyr* – this is applied whenever the units are percent, as indicated in the metadata (see section 3.2).
- ◆ *Percent Zero.lyr* – This layer is applied when the statistic chosen is of type % of Zero Values (see section 4.2).
- ◆ *Volume Reliability.lyr* – This layer is applied when the statistic chosen is of type Volume Reliability (see section 4.2).
- ◆ *DemoLayer.lyr* – this is a fallback precautionary file that is applied only if all other conditions are not met—this should not ever be needed.

Each of the layer files can be seen in the following location (or one similar): *C:\Program Files\CRWR\WRAP Display for ArcGIS\Layers\*. This is also the location that will be used to save augmented layer files to, which process is discussed shortly.

### 6.2.2 Editing Layer Files

Perhaps the simplest way to edit a default layer file is to invoke the Map Display portion of the WRAP Display Tool, change the symbology, and save the resulting file. The following steps give specific instructions and guidance on how this is done. These steps will follow a specific variable choice, but similar steps can be used for any variable. The hypothetical situation is where the reservoir evaporation variable symbology is to be changed. Steps:

1. Produce a map display of the WRAP data desired—Reservoir – Evap in this case. Legend results may look like those on the left in Figure 6-1.
2. View the layers properties by either double-clicking on the layer or by right-clicking and selecting **Properties**
3. In the Symbology tab, change the display to suit the needs of the application. Change examples include: symbol shape, symbol size, symbol color, number of classes, classification type (Equal Interval, Natural Breaks, Quantile, etc).
4. Apply the changes by selecting **OK**



**Figure 6-1. Results of Map Display**

Default results are shown on the left, possible user-specified results on the right

With the changes applied, the layer properties can be saved to a variable-specific layer file.

5. Right-click on the layer and select **Save As Layer File**
6. Use the naming convention mentioned earlier on this layer file: “*Reservoir - Evap.lyr*” in this case
7. Set the location to match the layer file folder, typically *C:\Program Files\CRWR\WRAP Display for ArcGIS\Layers\*
8. Click on **Save** to complete the process

Similar steps could be used to change an existing layer file.

With this layer file created, each subsequent execution of a map display using this variable will result in the changes set above. The ability to change and create new

template layer files adds dynamic customization possibilities to the WRAP Display Tool. It is through these steps that organization-specific maps can be produced time-after-time with little effort, after first setting the template layer file.

## 6.3 Customized Time Series Graphs

---

The time series graphs produced as a result of using the **WRAP | Display Time Series** and **Quick Plot** commands are based on a time series template file. This file controls many properties of the graph. This section covers steps to change and re-save this template file in such a way that future time series graphs inherit a new style. Steps:

1. Create a graph using either the **WRAP | Display Time Series** or **Quick Plot** commands (the variable and time range do not matter here)
2. Right-click on the top window border of the graph and select **Advanced Properties**

Not all of the graph properties can be implemented by creating a template file. This is due to the behind-the-scenes programming of the tool. However, such parameters as date-time format and background color can be set with a template file.

3. To change the data-time format, select the **Bottom Axis** option under Chart | Axis on the left-hand side navigation panel
4. Navigate to the Labels tab and the Format sub-tab
5. Set the desired format using the drop-down selection box
6. To change the background color, choose the **Walls** option under Chart on the left-hand side navigation panel
7. Navigate to the **Back** tab
8. Change the color by clicking on the Color button, selecting the desired color, and clicking **OK**
9. Select **Close** to close the Advanced Properties dialog

With the graph appearance as desired, the template file can be created.

10. Right-click on the top window border of the graph and select **Export**
11. Navigate to the Native tab
12. Ensure that the Include Series data option is not checked
13. Change the Format to **Text**
14. Click on the **Save** button
15. In the Save As dialog, navigate to *C:\Program Files\CRWR\WRAP Display for ArcGIS\* and save the file as *timeseries.tee* (select Yes if asked to replace existing file)
16. Click **Close** on the Export Dialog



The exported version of the file needs to have a portion of its data manually deleted in order for it to be used properly by the WRAP Display Tool. This requires opening the template file and editing it with Notepad or a similar program:

17. Navigate to the location where the template file was saved: *C:\Program Files\CRWR\WRAP Display for ArcGIS\*
18. Open the template file *timeseries.tee* with Notepad or some other text editing software
19. Scroll to the bottom of the file and locate the section that looks similar to that of Figure 6-2
20. Manually delete only the section shown in the box in Figure 6-2

```

BevelOuter = bvNone
Color = clWhite
ColorPaletteIndex = 1
object Series0: TLineSeries
  Marks.Callout.Brush.Color = clBlack
  Marks.Font.Charset = ANSI_CHARSET
  Marks.Style = smsLegend
  Marks.Visible = False
  SeriesColor = 35235834
  Title = '4167R1'
  LinePen.Width = 2
  Pointer.Brush.Color = clWhite
  Pointer.Brush.Style = bsClear
  Pointer.HorizSize = 2
  Pointer.InflateMargins = True
  Pointer.Pen.Color = clDefault
  Pointer.Style = psCross
  Pointer.VertSize = 2
  Pointer.Visible = True
  XValues.DateTime = True
  XValues.Name = 'X'
  XValues.Order = loNone
  YValues.Name = 'Y'
  YValues.Order = loNone
end
end

```

**Figure 6-2. Time Series Template File Editing**

21. Save the file

Now, when time series graphs are created with the WRAP Display Tool they will have the properties set in the above process.



---

## ***Non-WRAP Data***

As has been alluded to elsewhere in this manual, the WRAP Display Tool can be used to display maps and time-series graphs for non-WRAP data. Due to the usefulness of the WRAP Display Tool, this section presents techniques and protocols for successfully accessing non-WRAP data using the WRAP Display Tool.

---

### **7.1 Data Structure and Format**

The WRAP Display Tool can be used for non-WRAP data providing the data is in a structure similar to WRAP output data. This section describes this format.

As was discussed in Chapter 3, and is shown in Figure 3-3, the WRAP data in geodatabase format has a specific structure. The WRAP Display Tool looks for this structure and certain formats of data and only works when both structure and format specifications are correct.

General data structure requires that a shapefile and data file exist that have a linking identification field in each. This field must be named *HydroCode* for the WRAP Display Tool to link these files. This field must be of type *String*. In addition to *HydroCode*, the data must have a field named *TSDatetime* that is of type *Date*. These two fields are the only fields that are mandatory.

Once a dataset has *HydroCode* and *TSDatetime* fields, any additional data fields (variables) are allowable providing they are of type *Double*. In organizing the data, ensure that the structure shown in Figure 3-3 is followed, namely that *HydroCode* entries are repeated for each time step. For example, if one year of monthly data is available, each location (*HydroCode*) will have twelve entries or rows of data. These rows will contain the location (*HydroCode*), the time step (*TSDatetime*), and as many variables as needed.

In organizing this data, it may be helpful to use a spreadsheet program such as Microsoft Excel. In this case, the data can be organized with header rows indicating the field names. This data will be exported and used in ArcMap by the WRAP Display Tool.

## 7.2 Using Non-WRAP Data

---

The standard means of exporting Excel data into ArcMap involves using a comma separated variable (csv) file. A csv file does not retain data format information, so any information imported into ArcMap will not meet the WRAP Display Tool's format requirements, even though it may meet the structure requirements. There are at least two options for importing the non-WRAP data into ArcMap in such a way as to edit and properly reflect the correct formatting requirements for using the WRAP Display Tool.

### 7.2.1 Option 1: Database File

#### ***Save the file as a database file***

In order to input data fields and values, save the csv file's data to a database using the following steps:

1. Open the csv in Microsoft Excel
2. Ensure that the field names contain *HydroCode* for the identifier and *TSDatetime* for the date
3. In Excel, select **File | Save As...**
4. Name the outgoing file and save it as type *DBF 4 (dBASE IV) (\*.dbf)*

#### ***Create a viable working environment for the WRAP Display tool***

Due to the programming specifics of the tool, the data used for mapping and time series plotting has to have specific formatting. The following steps establish such:

1. Open ArcCatalog and create a new file geodatabase by right-clicking in the desired file location and choosing **New | File Geodatabase**
2. Right-click on the geodatabase and select **Import | Table (single)...**
3. In the *Table to Table* dialog, set the database file created above in the *Input Rows* option
4. Ensure that the *Output Location* is within the geodatabase created above
5. Set a name for the table in the *Output Table* field
6. Use the *Field Map (optional)* window of the dialog to set field types as follows:
  - a. Using successive right-click and Properties selections, set the following field and types for all fields to be used (for example, check that each field is of the proper format, or Type):

Field	Type
TSDatetime	Date
HydroCode	Text
All other data fields	Double

7. Select **OK** to finalize

***Load data in ArcMap***

The above steps created a table in a geodatabase with formatting required for the WRAP Display Tool. The following steps are used to load the data into the table:

1. Establish a GIS environment that has the geographic data (shapefile) and geodatabase table created above added to an ArcMap document
2. Invoke the desired WRAP Display Tool features, following the tool's steps

***7.2.2 Option 2: Copy and Paste******Create a viable working environment for the WRAP Display tool***

Due to the programming specifics of the tool, the data used for mapping and time series plotting has to have specific formatting. The following steps establish such:

1. Ensure that the csv field names contain *HydroCode* for the identifier and *TSDatetime* for the date
2. Open ArcCatalog and create a new file geodatabase by right-clicking in the desired file location and choosing **New | File Geodatabase**
3. Right-click on the geodatabase and select **New | Table...**
4. Specify a name for this table and click **Next**
5. Use the Default option and then click **Next**
6. Click on the **Import...** button to load the csv data
7. Add the csv file
8. Change the name of the identifier field to *HydroCode* and set the type as Text
9. Change all data fields to type *Double*
10. Click **Finish**

***Load data in ArcMap***

The above steps created a table in a geodatabase with formatting required for the WRAP Display Tool. Unfortunately, the table created did not inherit the values from the csv file, only the field names. Therefore, the following steps can be used to load the data into the table:

1. Establish a GIS environment that has the geographic data (shapefile) and geodatabase table created above added to an ArcMap document
2. Open the table created above
3. Start an editing session using the Editor toolbar
4. With the csv file open for view in Excel, select a single field's data and copy it to the clipboard (Ctrl + C)
5. Right-click on the top cell of the appropriate field of the table in ArcMap and select **Paste**

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6. Repeat this until all the desired data is loaded
7. Invoke the desired WRAP Display Tool features, following the tool's steps