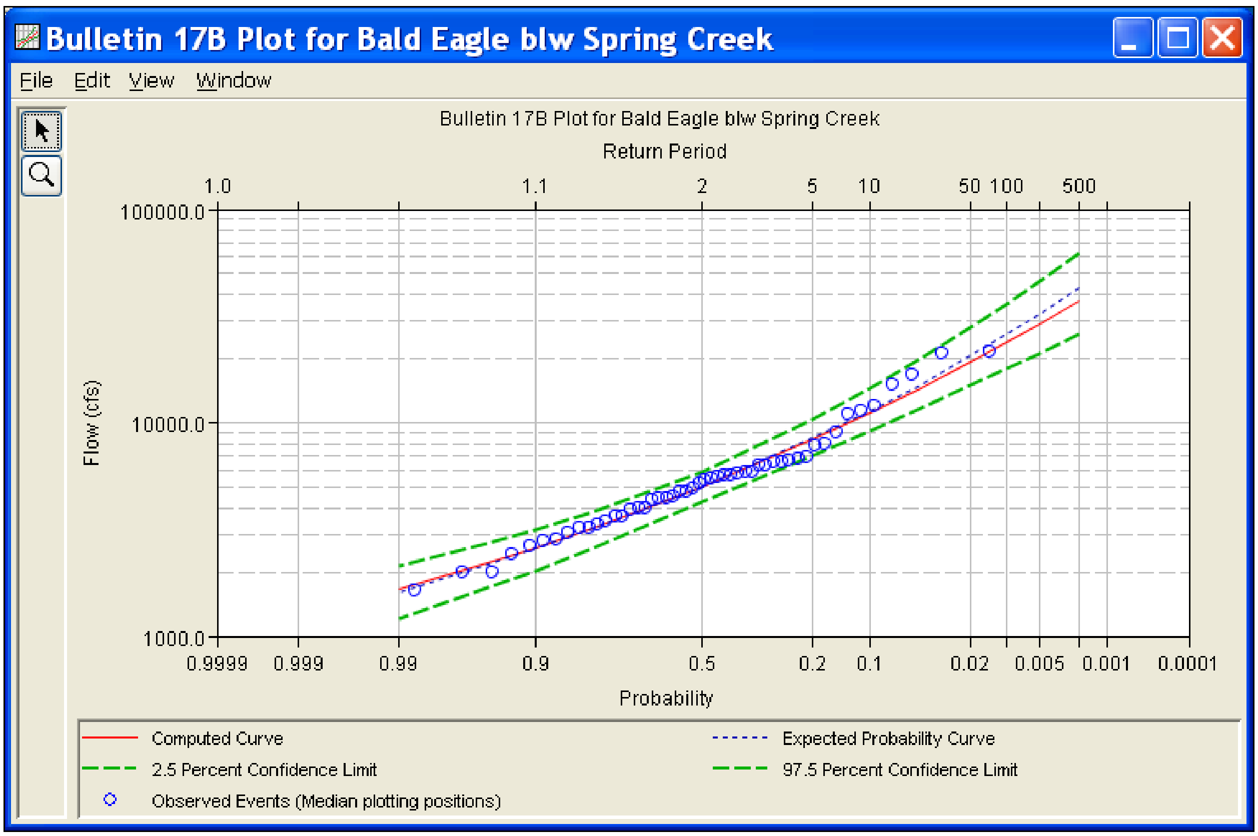
US Army Corps
of Engineers
Hydrologic Engineering Center

HEC-SSP
Statistical Software Package



User's Manual

Version 1.1
April 2009

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14. ABSTRACT
The Hydrologic Engineering Center's Statistical Software Package (HEC-SSP) allows the user to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flood flow frequency analysis based on Bulletin 17B, a generalized frequency analysis using any type of hydrologic data, and a volume-duration frequency analysis. Data storage and management is handled either through the use of text files (ASCII, XML), as well as the Hydrologic Engineering Center's Data Storage System (HEC-DSS).

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HEC-SSP, flood frequency, statistics, Bulletin 17B, flow, stage, computer program, hydrologic data, volume-duration, statistical analysis, data storage, reporting tools, frequency curves, confidence limits, low outliers, high outliers, regional skews

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US Army Corps of Engineers
Institute for Water Resources
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616

(530) 756-1104
(530) 756-8250 FAX
www.hec.usace.army.mil

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Statistical Software Package, HEC-SSP
Software Distribution and Availability Statement

The HEC-SSP executable code and documentation are public domain and were developed by the Hydrologic Engineering Center for the U.S. Army Corps of Engineers. The software was developed with United States Federal Government resources, and is therefore in the public domain. This software can be downloaded for free from the HEC internet site (www.hec.usace.army.mil). HEC does not provide technical support for this software to non-Corps users. However, we will respond to all documented instances of program errors. Documented errors are bugs in the software due to programming mistakes not model problems due to user-entered data.

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Foreword

The U.S. Army Corps of Engineers' Statistical Software Package (HEC-SSP) is software that allows you to perform statistical analyses of hydrologic data.

The first official version of HEC-SSP (version 1.0) was released in August of 2008. Version 1.1 was released in April, 2009 and included improvements to data entry, results visualization and reporting, and added capability to the volume-duration frequency analysis. These new features are discussed in the user's manual and in the release notes for Version 1.1.

The HEC-SSP software was designed by Mr. Gary Brunner, Mr. Jeff Harris, Dr. Beth Faber, and Mr. Matthew Fleming. The HEC-SSP user interface was programmed by Mr. Mark Ackerman, and the computational code was programmed by Mr. Paul Ely. This manual was written by Mr. Gary Brunner and Mr. Matthew Fleming.

CHAPTER 1

Introduction

Welcome to the U.S. Army Corps of Engineers Statistical Software Package (HEC-SSP) developed by the Hydrologic Engineering Center. This software allows you to perform statistical analyses of hydrologic data. The current version of HEC-SSP can perform flood flow frequency analysis based on Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (1982), a generalized frequency analysis on not only flow data but other hydrologic data as well, and a volume-duration frequency analysis on high and low flows.

The HEC-SSP software system was developed as a part of the Hydrologic Engineering Center's "Next Generation" (NexGen) development of hydrologic engineering software. The NexGen project encompasses several aspects of hydrologic engineering, including rainfall-runoff analysis, river hydraulics, reservoir system simulation, flood damage analysis, and real-time river forecasting for reservoir operations.

This chapter discusses the general philosophy of HEC-SSP and gives a brief overview of the capabilities of the software system. An overview of this manual is also provided.

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General Philosophy of the HEC-SSP

HEC-SSP is an integrated system of software, designed for interactive use in a multi-tasking environment. The system is comprised of a graphical user interface (GUI), separate statistical analysis components, data storage and management capabilities, mapping, graphics, and reporting tools.

Over a period of many years, the Hydrologic Engineering Center has supported a variety of statistical packages that perform frequency analysis and other statistical computations. Historically, the programs that received the most use within the Corps of Engineers were HEC-FFA (Flood Frequency Analysis) and STATS (Statistical Analysis of Time Series Data). FFA incorporates Bulletin 17B procedures that have been adopted by the Corps for flow frequency analysis. The STATS software package is used for statistical analysis of time series data. STATS can provide either analytical or graphical frequency analysis, specified by the user. STATS has the capability of computing monthly and annual maximum, minimum, and mean values along with computing a volume-duration analysis. Two other packages that used to receive a lot of use within the Corps of Engineers are REGFRQ (Regional Frequency Computation) and MLRP (Multiple Linear Regression Program). REGFRQ performs regional frequency analysis and MLRP is a multiple linear regression analysis tool.

The goal of HEC-SSP is to ultimately combine all of the statistical analyses capabilities of HEC-FFA, STATS, REGFRQ and MLRP. The current version of HEC-SSP supports performing flood flow frequency analyses based on Bulletin 17B Guidelines, generalized frequency analyses, and volume-duration frequency analyses. New features and additional capabilities will be added in future releases.

Overview of Program Capabilities

HEC-SSP is designed to perform statistical analyses of hydrologic data. The following is a description of the major capabilities of HEC-SSP.

User Interface

The user interacts with HEC-SSP through a graphical user interface (GUI). The main focus in the design of the interface was to make it easy to use the software, while still maintaining a high level of efficiency for the user. The interface provides for the following functions:

- File management
- Data entry, importing, and editing
- Statistical analyses
- Tabulation and graphical displays of results
- Reporting facilities

Statistical Analysis Components

Flow Frequency Analysis (Bulletin 17B) – This component of the software allows the user to perform annual peak flow frequency analyses. The software follows guidelines in Bulletin 17B, "Guidelines for Determining Flood Flow Frequency", by the Interagency Advisory Committee on Water Data.

Generalized Frequency Analysis – This component of the software allows the user to perform annual peak flow frequency analyses by various methods. Additionally the user can perform frequency analysis of variables other than peak flows, such as stage and precipitation data.

Volume-Duration Frequency Analysis – This component of the software allows the user to perform a volume-duration frequency analyses on daily flow data.

Data Storage and Management

Data storage is accomplished through the use of "text" files (ASCII and XML), as well as the HEC Data Storage System (HEC-DSS). User input data are stored in flat files under separate categories of study, analyses, and a data storage list. Gage data are stored in a project HEC-DSS file as time series data. Output data is predominantly stored in HEC-DSS, while a summary of the results is written to an XML file. Additionally, an analysis report file is generated whenever a computation is made. This report file is written to a standard ASCII text file.

Data management is accomplished through the user interface. The modeler is requested to enter a Name and Description for each study being developed. Once the study name is entered, a directory with that name is created, as well as a study file. Additionally a set of subdirectories is created with the following names: Bulletin17bResults, GeneralFrequencyResults, VolumeFrequencyAnalysisResults, Layouts, and Maps. As the user creates new analyses, an analysis file is created in the main project directory. The interface provides for renaming and deletion of files on a study-by-study basis.

Graphical and Tabular Output

Graphics include a map window, plots of the raw data, and frequency curve plots. The map window can be used to display background map layers. Locations of the data being analyzed can be displayed on top of the map layers. Once data are brought into HEC-SSP, they can be plotted for visual inspection. The frequency curve plots shows the results of the analyses, which include the analytically computed curve, the expected probability curve, confidence limits, and the raw data points plotted based on the selected plotting position method. Tabular output consists of tables showing the computed frequency curves, confidence limits, and summary statistics. All graphical and tabular output can be displayed on the screen, sent directly to a printer (or plotter), or passed through the Windows Clipboard to other software, such as a word-processor or spreadsheet.

A report file is available for each analysis. This report file includes the input data, preliminary results, all of the statistical tests (Low and High Outliers, Broken Record, Zero Flows Years, Incomplete Record, Regional Skews, and Historic Information), and final results. This report file is similar to the FFA output file.

Overview of This Manual

This user's manual is the primary documentation on how to use HEC-SSP. The manual is organized as follows:

- Chapters 1-2 provide an introduction and overview of HEC-SSP, as well as instructions on how to install the software.
- Chapter 3 provides an overview on how to use the HEC-SSP software in a step-by-step procedure, including a sample problem that the user can follow.
- Chapter 4 explains in detail how to enter and view data.
- Chapter 5 provides a detailed discussion on how to perform the Bulletin 17B flow frequency analysis. Additionally, this chapter describes all of the output capabilities available for displaying and printing the results.
- Chapter 6 provides a detailed discussion on how to use the generalized frequency analysis editor.
- Chapter 7 provides a detailed discussion on how to use the volume-duration frequency analysis editor.
- Appendix A contains a list of references.
- Appendix B has a series of example analyses that demonstrate the various capabilities of performing a Bulletin 17B flow frequency analysis, performing a general frequency analysis, and performing a volume-duration frequency analysis.

CHAPTER 2

Installing HEC-SSP

You install HEC-SSP using the program installation package available from HEC's web site. The setup program installs the software and the example applications. This chapter discusses the hardware and system requirements needed to use HEC-SSP, how to install the software, and how to uninstall the software.

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Hardware and Software Requirements

Before you install the HEC-SSP software, make sure that your computer has at least the minimum required hardware and software. In order to get the maximum performance from the HEC-SSP software, recommended hardware and software is shown in parentheses. This version of HEC-SSP will run on a microcomputer that has the following:

- Intel Based PC or compatible machine with Pentium processor or higher (a Pentium 4 or higher is recommended).
- A hard disk with at least 100 megabytes of free space
- A CD-Rom drive (or CD-R, CD-RW, DVD), if installing from a CD.
- A minimum of 512 megabytes of RAM (1 Gigabyte or more is recommended).
- A mouse.
- Color Video Display (Recommend running in 1280x1024 or higher, and as large a monitor as possible). Recommend at least a 17" monitor.
- Microsoft Windows NT 4.0, 2000, XP, or Vista (or later versions).

Installation Procedure

Installation of the HEC-SSP software is accomplished through the use of the Setup program.

To install the software onto your hard disk do the following:

1. Insert the HEC-SSP CD into your CD drive (or download the software from our web site: www.hec.usace.army.mil).
2. The setup program should run automatically if installing from a CD. When downloading from the web page you will need to save the setup file in a temporary directory and then execute the “HEC-SSP_11_Setup.exe” file to run the setup program.
3. If the setup program does not automatically run from the CD, use the windows explorer to start the HEC-SSP_11_Setup.exe program on the CD.
4. Follow the setup instructions on the screen.

The setup program automatically creates a program group called HEC. This program group will be listed under the Programs menu, which is under the Start menu. The HEC-SSP program icon will be contained within the HEC program group, within the HEC-SSP subdirectory. The user can request that a shortcut icon for HEC-SSP be created on the desktop. If installed in the default directory, the HEC-SSP executable can be found in the C:\Program Files\HEC\HEC-SSP\1.1 directory with the name "HEC-SSP.EXE".

The HEC-SSP User's Manual and example data sets are also installed with the software. The User's Manual can be viewed by selecting **User's Manual** from the **Help** menu. You must have Adobe Acrobat Reader to view the user's manual. This viewer can be obtained for free from the Adobe web page.

A zip file containing the example data sets described in Appendix B have been installed in the "**...\Examples**" folder within the program directory. You can install the example data sets by selecting the **Install Example Data** option from the **Help** menu. After selecting the Install Example Data menu option, a window will open for you to choose a location to install the example data sets. The program will create a subdirectory within your chosen folder called **SSP_Examples**. A project file called "SSP_EXAMPLES.ssp" will be contained in the SSP_Examples folder. You can load the test data sets by using the **Open Study** option from the File menu and then use the file chooser to select this file.

Uninstall Procedure

The HEC-SSP Setup program automatically registers the software with the Windows operating system. To uninstall the software, do the following:

- From the Start Menu select Control Panel.
- Select Add/Remove Programs from within the Control Panel folder.
- From the list of installed software, select the HEC-SSP program and press the Remove button.
- Follow the uninstall directions on the screen and the software will be removed from your hard disk.

CHAPTER 3

Working With HEC-SSP - An Overview

HEC-SSP is an integrated package of statistical analysis modules, in which the user interacts with the system through the use of a Graphical User Interface (GUI). The current version is capable of performing flow frequency analyses based on the Bulletin 17B "Guidelines for Determining Flood Flow Frequency", dated March 1982, generalized frequency analyses, and volume-duration frequency analyses. This chapter provides an overview of how a Bulletin 17B flow frequency analyses can be performed with the HEC-SSP software. General frequency and volume-duration frequency analyses can be developed in a similar manner as outlined for the Bulletin 17B analysis.

In HEC-SSP terminology, a **Study** is a set of files associated with a particular set of data and statistical analyses being performed. The files for a study are categorized as follows: study information, data list, and analysis data.

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Starting HEC-SSP

When you run the HEC-SSP Setup program, a new program group called **HEC** and program icon called **HEC-SSP** are created. They should appear in the start menu under the section called **All Programs**. The user also has the option of creating a shortcut on the desktop. If a shortcut is created, the icon for HEC-SSP will look like the following:

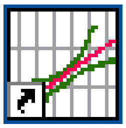


Figure 3-1. The HEC-SSP Icon.

To Start HEC-SSP from Windows:

- Double-click on the HEC-SSP Icon. If you do not have an HEC-SSP shortcut on the desktop, go to the **Start** menu and select **All Programs → HEC → HEC-SSP → HEC-SSP 1.1**.

Overview of the Software Layout

When you first start HEC-SSP, you will see the main window as shown in Figure 3-2, except you will not have any study data on your main window. As shown in Figure 3-2, the main window is laid out with a Menu Bar, a Tool Bar, and four window panes.

The upper right pane (which represents most of the window area) is the **Desktop Area** (Referred to as the "Desktop" from this point in the manual). This area is used for displaying maps, data editors, and analysis windows.

The upper left pane is called the **Study Explorer**. The Study Explorer acts like an explorer tree into the study. The top level of the tree is the study (Clarion River in this example). Below the study is an analyses branch, a data branch, and a map branch. Under the analyses branch, the first level is the types of analysis in the current study. Under each analysis type will be the current user-defined analyses for that type. The data branch lists all of the available data sets that have been brought into the current study. Generally, a data set represents a piece of data at a specific gage location. For example, all of the peak annual flows at a single gage would be stored as a single data set. When an analysis is created, the user selects a data set to be used for that particular analysis. The Map branch of the tree contains any maps the user has put together for the study. By default there is automatically a "Base Map" listed under the maps folder.

The lower left pane, and associated tabs, also belongs to the study explorer. This window is used to show additional information about items selected in the study explorer tree. The tabs are used to switch to different views within the study explorer window. The first tab, labeled Study, shows the explorer view of the study. The second tab, labeled Maps, lists the available maps and map layers associated with each map. The last tab, labeled Files, shows all of the files that make up the current study.

The lower right pane is called the **Message Window**. This window is used to display messages from the software as to what it is doing.

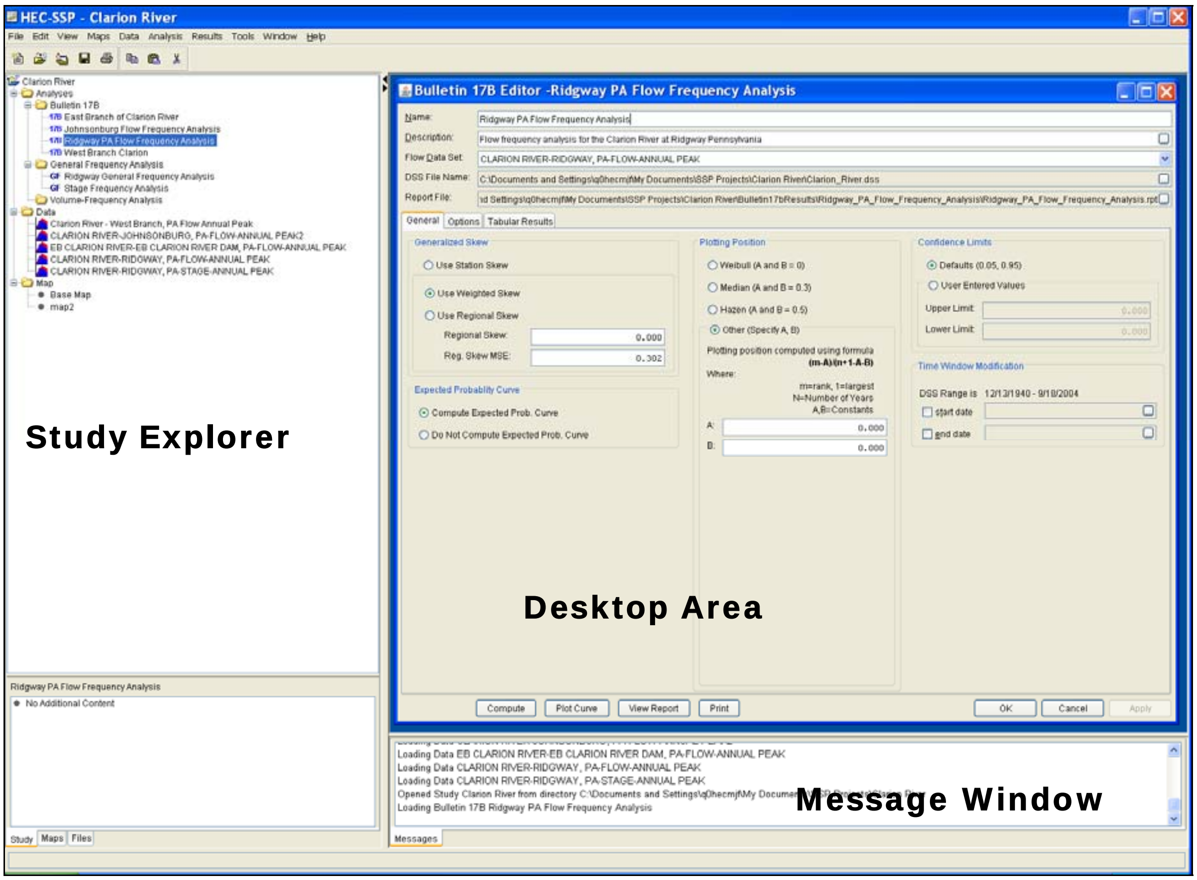
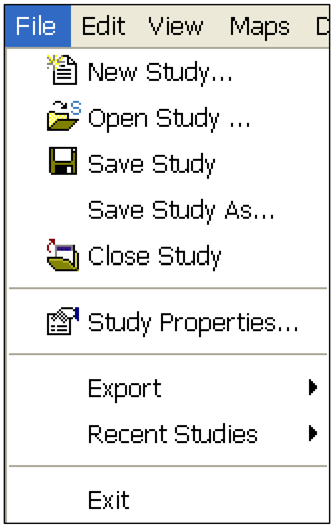


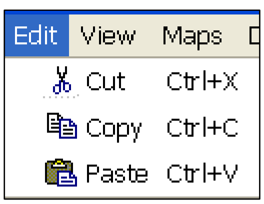
Figure 3-2. The HEC-SSP Main Window.

At the top of the HEC-SSP main window is a Menu bar with the following options:

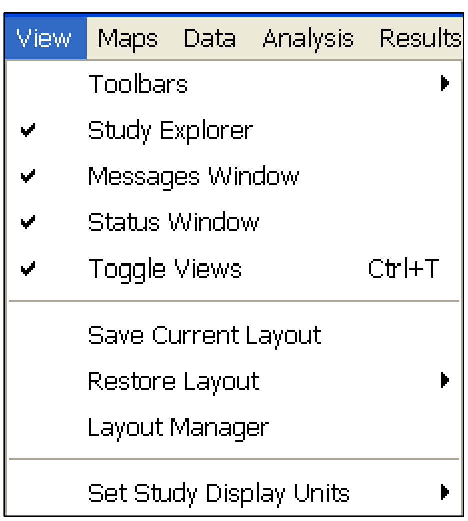
File: This menu is used for file management. Options available under the File menu include New Study, Open Study, Save Study, Save Study As, Close Study, Study Properties, Export, Recent Studies, and Exit. The Study Properties option is used to describe the study and to set the units system. The Export option is used to export HEC-SSP results, stored in the study DSS file, to another DSS file. The Recent Studies option lists the most recently opened studies, which allows the user to quickly open a study that was recently worked on.



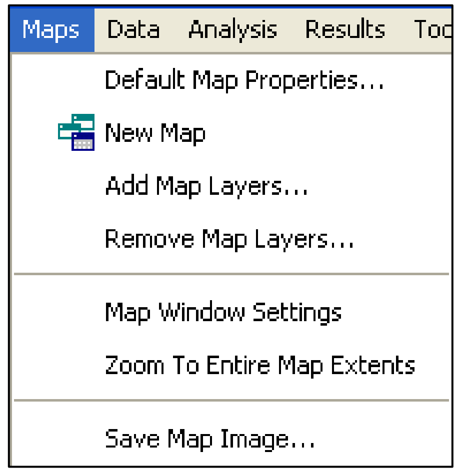
Edit: This menu is used for applying the Cut, Copy, and Paste clipboard features to data in editable fields and tables.



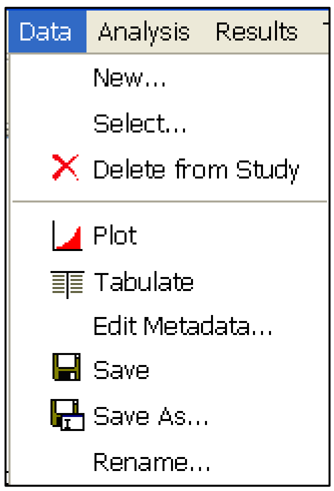
View: The View menu allows the user to control display of the toolbars and the study windows. The user can also toggle between viewing all of the panes or just the Main View Pane. The View menu also has options for saving the current layout (currently opened windows and their sizes and locations) and restoring a previous saved layout. The final option on the View menu is to set the study display units. This option allows the user to switch viewing output between English and metric units.



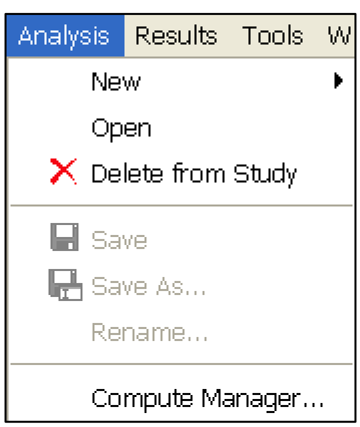
Maps: This menu is used to set the Default Map Properties (Coordinate system, extents, etc…), define a new map, add map layers to the study, and remove a map. Additionally, this menu has the following options available: Map Window Settings (allows the user to turn map layers on and off), Zoom To Entire Map Extents, Save Map Image, Import, and Export. The Zoom To Entire Map Extents option displays the entire set of map layers within the map window. The Save Map Image option can be used to save the current view of the map to a file.



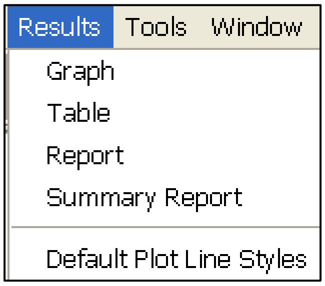
Data: This menu allows the user to define a new data set, open the metadata editor, and delete any existing data sets from the data list. Other options include opening a plot and table of the data.



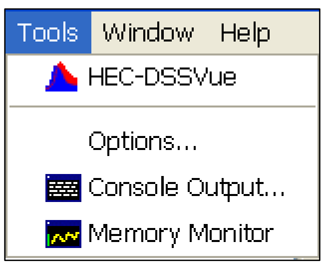
Analysis: This menu is used to create the various statistical analyses available in the software. Each statistical analysis is saved as a separate file containing the information that is pertinent to that specific analysis type. The current options under this menu item include New, Open, Delete from Study, Save, Save As, Rename, and Compute Manager. The compute manager allows the user to select one, several, or all of the analyses, and then have them all recomputed.



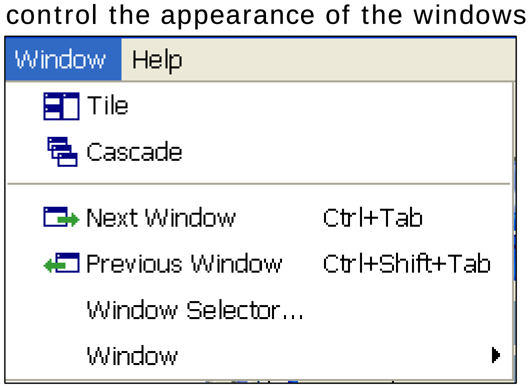
Results: This menu allows the user to graph and tabulate any of the existing analyses that have been computed. Additionally, the user can request to view the report file from a computed analysis. Users must select at least one analysis in the Study Tree before selecting Graph, Table, Report, or Summary Report. If more than one analysis of the same type are selected (this is accomplished by holding down the control key while clicking on the various analyses), the Graph and Summary Report options will include results from all analyses that are selected. However, when multiple analyses are selected, the Table and Report option bring up separate windows for each of the selected analyses. The Default Plot Line Styles menu option lets the user change the default line styles applied to different data types that are plotted in a graph. For example, the user can change the default line style for high outliers so that they are displayed as black triangular data points when a plot is opened.



Tools: This menu includes HEC-DSSVue, Options, Console Output, and Memory Monitor. The HEC-DSSVue option brings up the HEC-DSSVue program and automatically loads the current study DSS file. HEC-DSSVue is a DSS utility to tabulate, graph, edit, and enter data into DSS. The Options menu item brings up an options window that allows the user to set default HEC-SSP options.

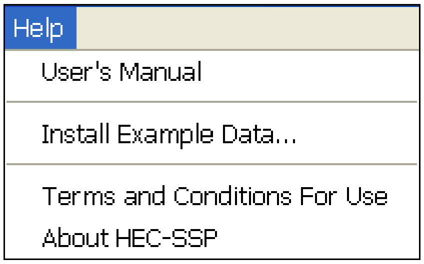


Window: This menu includes Tile, Cascade, Next Window, Previous Window, Window Selector, and Window. All these options are used to control the appearance of the windows in the Desktop area. When more than one window is open (such as a data importer, and various analysis windows), these menu items will help the user organize the windows, or quickly navigate to a specific window. The Tile option can be used to organize all of the currently opened windows in either a vertical or horizontal tile. The Cascade option puts one window on top of the next in a cascading fashion. The Next Window option brings the next window in the list of currently opened windows to the top. The Previous Window brings the last window that was on top back to the top. The Window Selector option brings up a pick list of the currently opened windows and allows you to select the



one you want. The Window option has a sub menu list of all the opened windows and allows you to select one.

Help: This menu allows the user to open the HEC-SSP User's Manual, install example data sets, read the terms and conditions of use statement, and display the current version information about HEC-SSP.



Also on the HEC-SSP main window is a Tool Bar. The buttons on the tool bar provide quick access to the most frequently used options under the HEC-SSP File and Edit menus.

Steps in Performing a Bulletin 17B Frequency Analysis

There are five main steps in performing a Bulletin 17B flow frequency analysis with HEC-SSP. Similar steps are required when performing a generalized frequency or volume-duration analysis.

- Starting a new study
- Adding a Background Map (Optional)
- Importing, Entering, and Editing Data
- Performing the Bulletin 17B Frequency Analysis
- Viewing and Printing Results

Starting a New Study

The first step in performing a Flow Frequency analysis with HEC-SSP is to establish which directory you wish to work in and to enter a title for the new study. To start a new study, go to the **File** menu and select **New Study**. This will bring up a New Study window as shown below.

As shown in Figure 3-3, the user is required to enter a name for the study, select a directory to work in (a default location is provided), and select the desired units system. Adding a description of the study is optional. Once you have entered all the information, press the **OK** button to have the information accepted. After the **OK** button is pressed, a subdirectory will be created under the user chosen directory. The subdirectory will be labeled the same name as the user-entered study name. This study directory is where the project file, as well as other study files and directories will be located.

Additionally, a default map window will appear in the Main View Pane. However, the map window will be blank when it first opens.

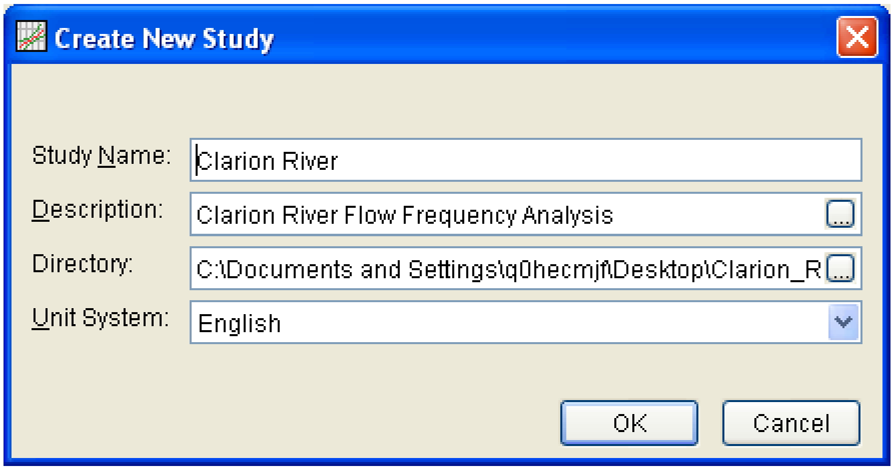


Figure 3-3. New Study Window.

Adding a Background Map

By default, when you start a new project in HEC-SSP a default map window (called Base Map) will open in the Desktop window. Having a background map is optional in HEC-SSP. Not having a map does not prevent the user from importing and entering data, or performing an analysis and viewing results. The map is mostly a visual aid of the study area. Additionally, when you bring in gage data you can enter the map coordinates of the gage and it will show up on the map. Once a gage is located on the map you can right click on it to open a shortcut menu for viewing the data, or graphing and tabulating the results.

To add a map layer to the default map, go to the **Maps** menu and select **Add Map Layers**. When this option is selected a file chooser window will appear, as shown in Figure 3-4, allowing the user to select map layers to bring into the map. The **Create Copy** option on the window will make a copy of the selected map and place it in the Maps subdirectory of the study folder.

Currently, the HEC-SSP software can load the following types of map layers: USGS DLG, AutoCAD DXF, shapefile, Raster Image, USGS DEM, Arc Info DEM, ASCII NetTIN, and Mr Sid.

An example map is shown in Figure 3-5. This map is an Arc Info DEM that was exported in the ASCII file format.

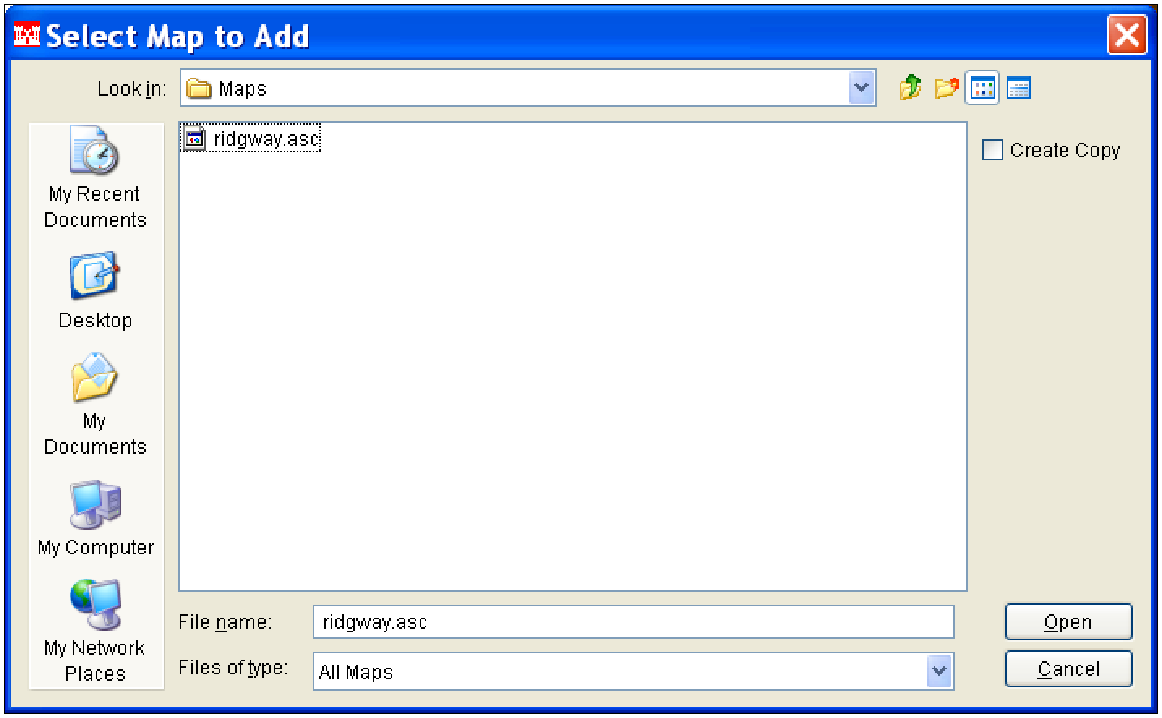


Figure 3-4. Add Map Layers File Chooser.

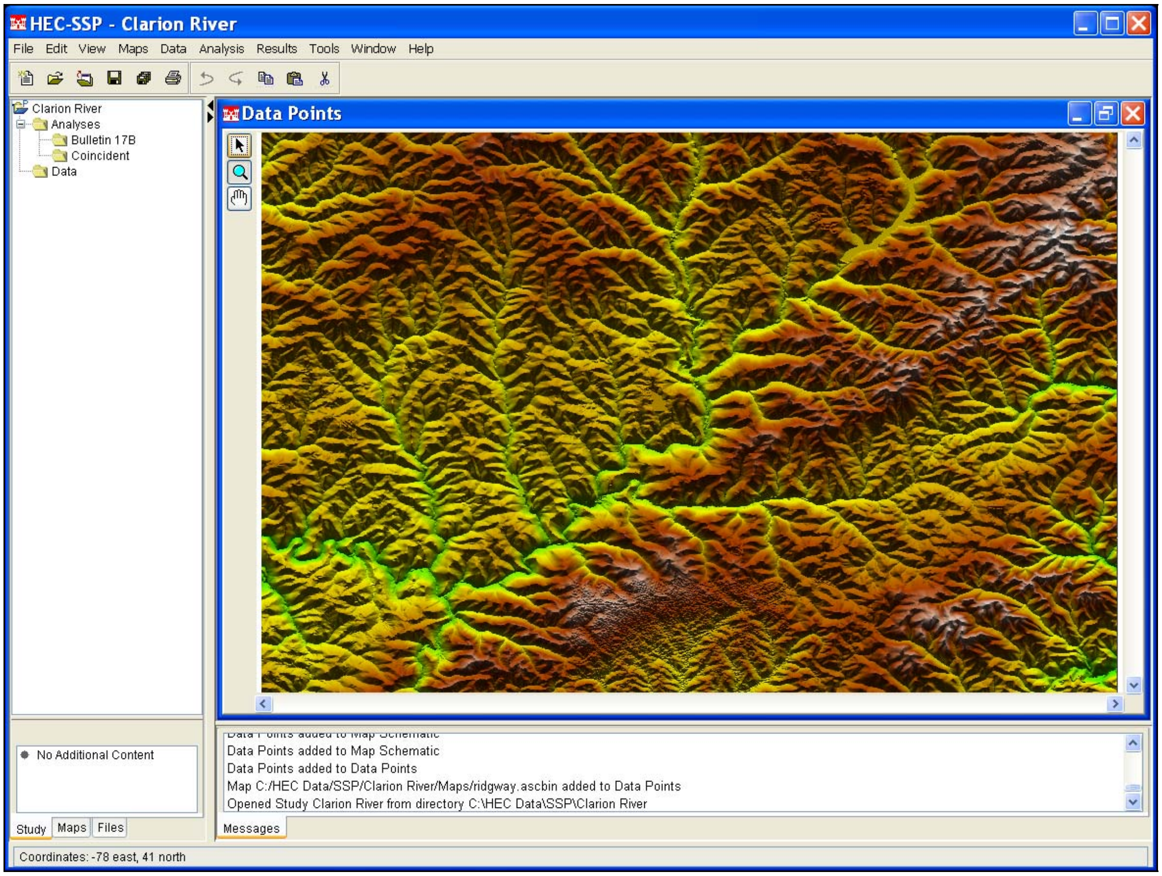


Figure 3-5. Example Background Map.

If more than one map layer is going to be used to make up a map, then it is up to the user to ensure that all map layers are in the same coordinate system. HEC-SSP does not perform coordinate system projections. Also, HEC-SSP can not always determine the coordinate system for all map layers entered. However, under the **Maps** menu is an option called **Default Map Properties**. This menu option can be used to set the default coordinate system for the map layers displayed in HEC-SSP. The user should set the default coordinate system first and then bring in map layers to the study.

Importing, Entering, and Editing Data

Before any analyses can be performed, the user must bring data into the HEC-SSP study. For a peak flow frequency analysis following guidelines in Bulletin 17B, the data must consists of peak annual flow data. To bring data into HEC-SSP go to the **Data** menu and select **New**. This will bring up the data importer as shown in Figure 3-6.

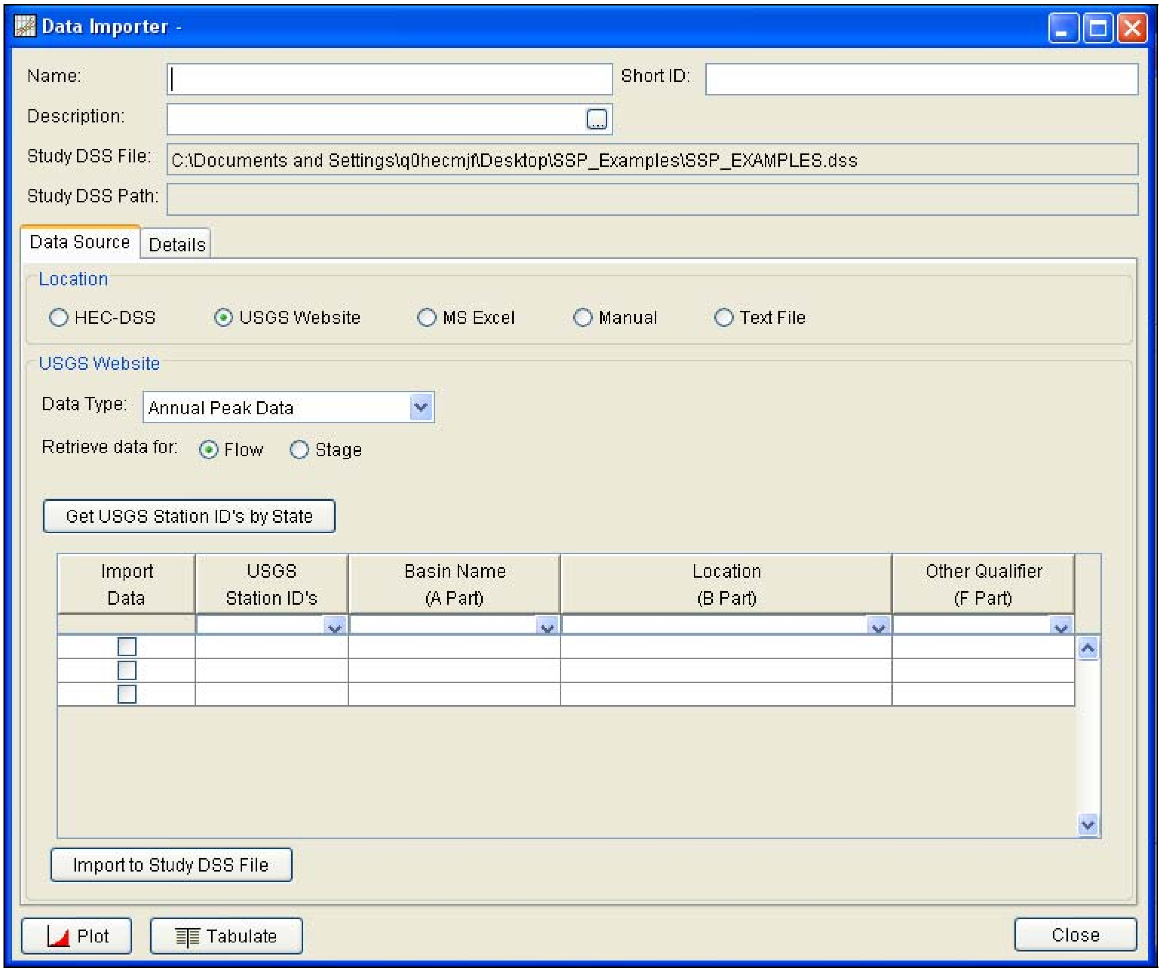


Figure 3-6. HEC-SSP Data Importer.

As shown in Figure 3-6, the Data Importer has fields for the Name, Short Identifier, and the Description of the data at the top of the window. Additionally, it lists the study DSS file name that the data will be stored in once it is brought into the study. The study DSS file is always labeled the same name as your study with the .DSS file extension.

The Data Importer contains two tabs, **Data Source** and **Details**. The **Data Source** tab is shown first. This tab is used for selecting and defining a source for bringing data into the HEC-SSP study. Currently, there are five ways to bring data into an HEC-SSP study: import from another HEC-DSS file, import data from the USGS web site, import from a Microsoft Excel spreadsheet, manually entering the data into a table, and import the data from a text file. All of these methods will import data into the study DSS file.

For this example, only importing data from the USGS website will be shown. For a complete description of the data importer see Chapter 4, using the Data Importer. To import data from the USGS website, first select the **USGS Website** option from the list of five options available in the Location panel. Next, select **Annual Peak Data** as the data type and make sure the **Flow** option is selected. The next step is to press the button labeled **Get USGS Station ID's by State**. When this button is pressed a shortcut window will appear (Figure 3-7) allowing the user to select a state from which to get data.

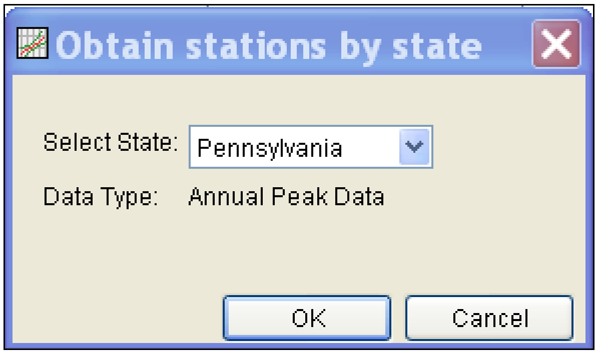


Figure 3-7. Window to Select a State for Downloading Data.

Once a state is selected, press the **OK** button and a list of the available gages from that state will appear in a pick list as shown in Figure 3-8. Check the boxes for all of the gages you would like to import and then press the **Import to Study DSS File** button. Once the import button is pressed, a process will begin in which the data will be downloaded from the USGS website and saved to the study DSS file. HEC-SSP will automatically name the data when importing multiple gages at one time. The USGS import process will download annual peak flow data, annual peak stage data, and the USGS data quality codes. The quality codes will be added as an addition object to the Data folder.

In addition to the data itself, any metadata that is available will be downloaded and stored with the data. The metadata can be viewed from the **Details** Tab on the Data Importer. Metadata can also be viewed or edited by opening the Metadata Editor. To open this editor, place the mouse on top of a data object in the Data folder and click the right mouse button. The shortcut menu contains an **Edit Metadata** option, as shown in Figure 3-9. The metadata editor is shown in Figure 3-10.

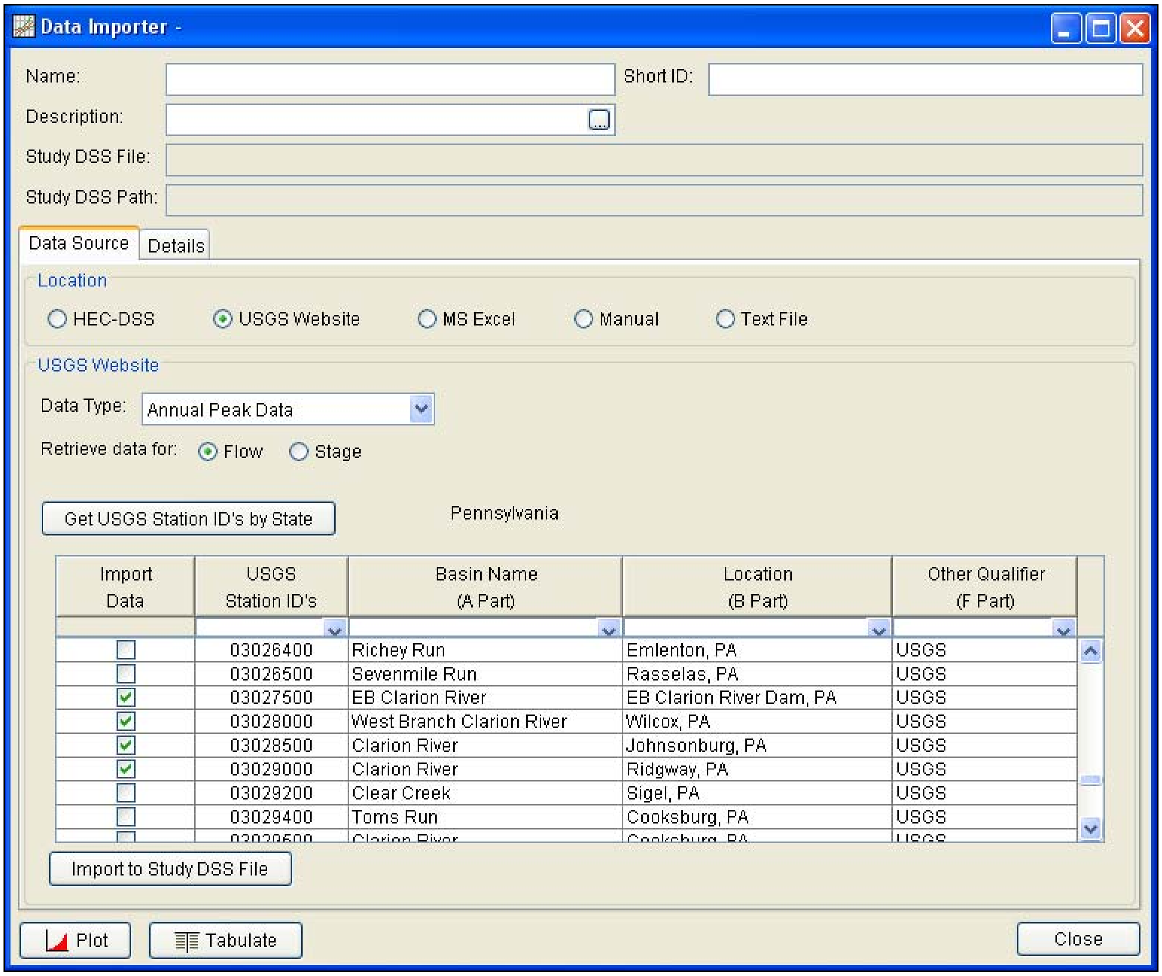


Figure 3-8. Example of Choosing Gages from a USGS State List to Import.

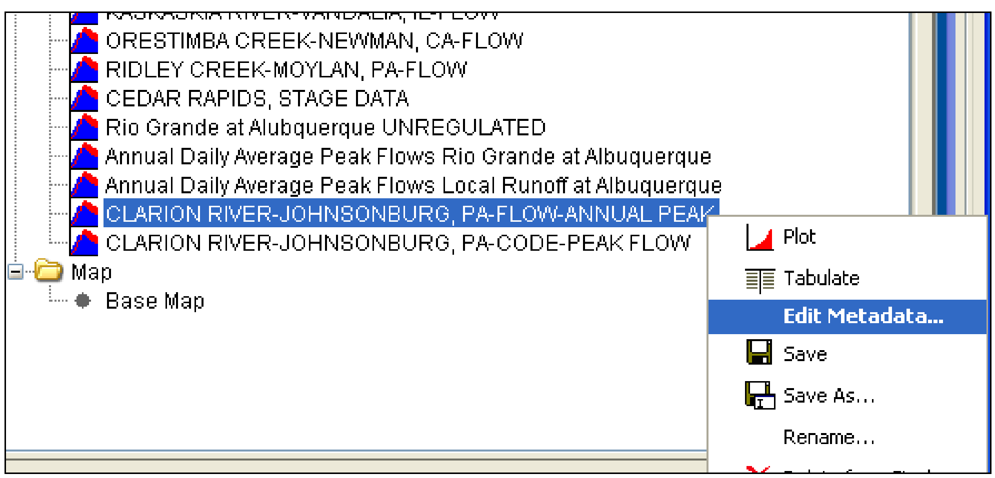


Figure 3-9. Open the Metadata Editor Using the Right Mouse Click Menu.

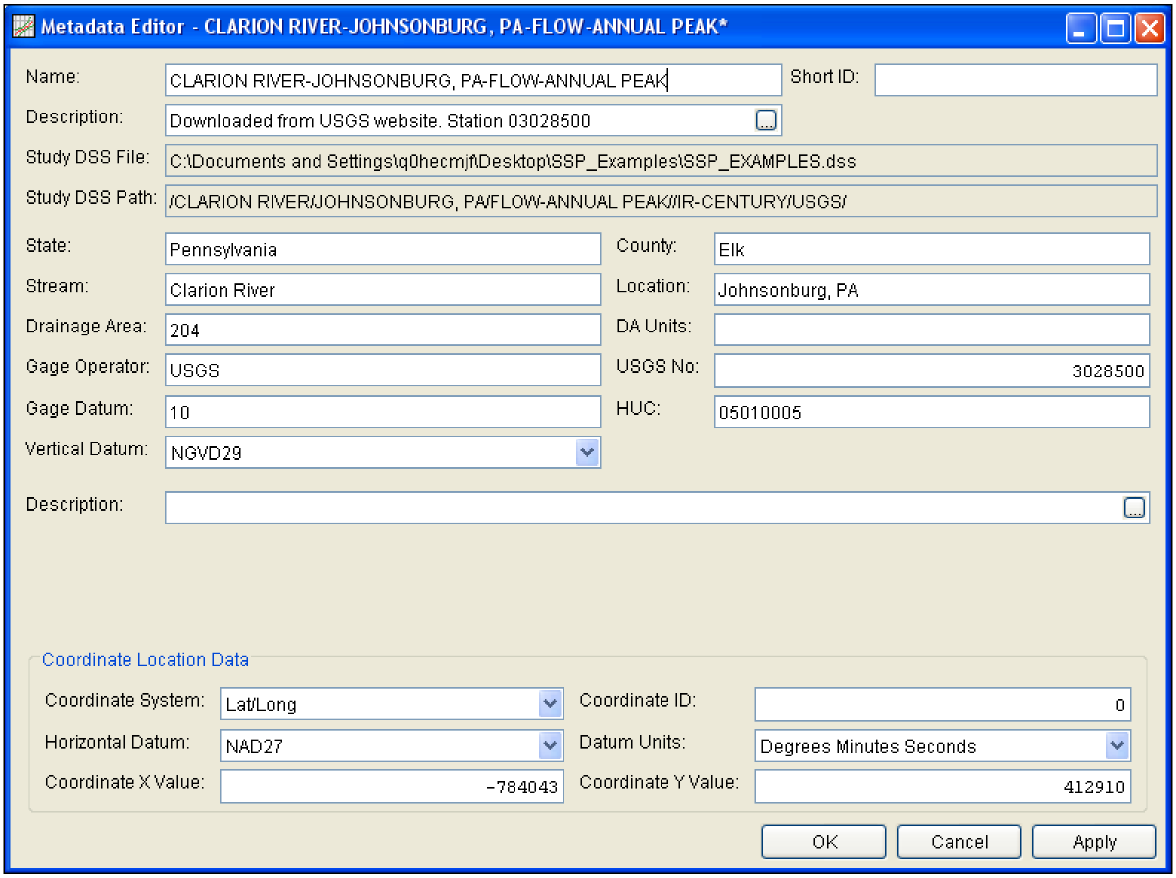


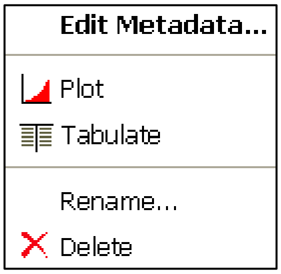
Figure 3-10. Metadata can be Viewed or Edited by Opening the Metadata Editor.

As shown in Figure 3-10, the metadata consists of the State, County, Stream, Location, Drainage Area, DA Units, Gage Operator, USGS Gage No., Gage Datum, HUC (Hydrologic Unit Code), Vertical Datum, and a description field. Additionally, the coordinate location of the data is shown. The coordinate location consists of Coordinate System, Coordinate ID, Horizontal Datum, Datum Units, Coordinate X Value, and Coordinate Y Value. Most of the USGS data is retrieved with the Latitude/Longitude coordinate system as shown in the example. In addition to editing the metadata, the Metadata Editor allows the user to change the name of the data, enter a short identifier, and enter a longer description.

If the metadata does not download automatically, the user has the option to enter any of the information by hand. Metadata is not generated automatically for any of the other four data sources. Therefore, entering the metadata is required if the user wants the data to be carried along with the study.

After the data is imported into the study, the user can select any one of the gages in the Data folder and **Plot** or **Tabulate** the data. The plot and tabulate options are available from the Data menu and from a shortcut menu that opens by clicking the right mouse button when the pointer is located on top of the gage object in the Data folder. If you press the **Plot** button you will get a plot of the peak flow data for that gage. If you press the **Tabulate** button you will get a table containing the data. Data values can be edited within the table; however, the editing mode must be turned on. To turn on editing, select the **Edit→Allow Editing** menu option. Use the **File→Save** or **File→Save As** menu option to save the data when you are satisfied with edits.

If the data has coordinate location information, it will then be plotted on top of the background maps. The software will convert the coordinates of the point data to the default coordinate system of the base map. The user can interact with the plotted points by right clicking on the gage icon in the map and a shortcut menu will appear as shown. The user has the option to edit the metadata, plot, tabulate, rename, or delete the data.



Performing the Bulletin 17B Flow Frequency Analysis

To perform a Bulletin 17B flow frequency analysis, go to the **Analysis** menu and select **New → Bulletin 17B Flow Frequency**. This will bring up a blank Bulletin 17B Analysis editor. As shown in Figure 3-11, the user must enter a name for the analysis, a description (optional), and select a flow data set (gage data stored in project DSS file). The DSS File Name and Report File are automatically filled in by the program. For now, the DSS File Name will be the study DSS file and the report file will have the same name as the analysis.

The analysis window contains three tabs: General, Options, and Tabular Results. The **General** tab contains settings for Generalized Skew, Expected Probability Curve, Plotting Positions, Confidence limits, and a Time Window Modification. Default settings are already established for each of the options on the General tab; however, the user can change the default settings.

The **Options** tab contains information on Low Outlier Threshold, Historic Period Data, and User-Specified Frequency Ordinates. These options are not required for most analyses but may be necessary depending upon the data.

A detailed description of each of the Bulletin 17B settings and options can be found in Chapter 5, performing a Bulletin 17B Flow Frequency Analysis. Once all of the settings and options have been selected, the user presses the **Compute** button to have the computations performed. When the computations have finished a message window will open stating **Compute Complete**. Press the **OK** button on the message window to close the window. Once the computations have finished the user can begin to look at output.

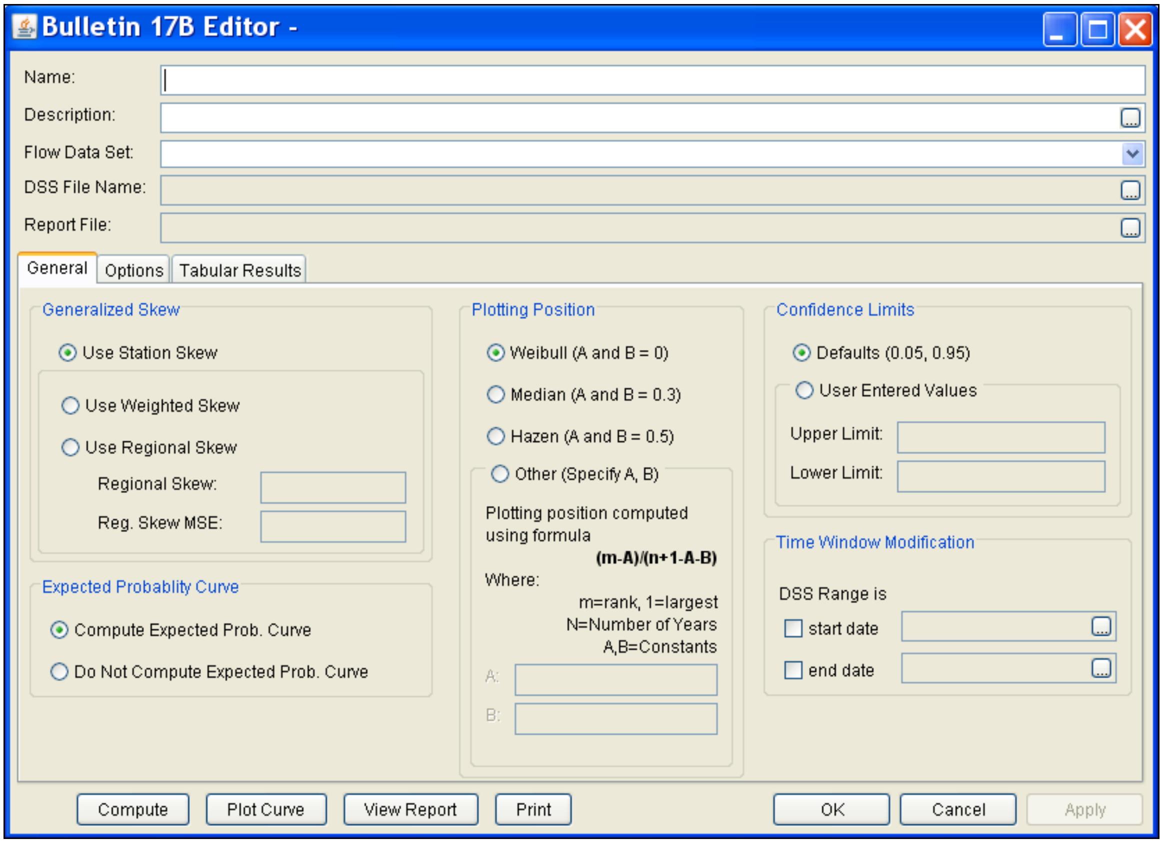


Figure 3-11. Bulletin 17B Flow Frequency Analysis Editor.

Viewing and Printing Results

Tabular output can be found by selecting the **Tabular Results** tab. When this tab is pressed, a set of tables will appear as shown in Figure 3-12. The primary table on the **Tabular Results** tab consists of percent chance exceedance, computed flow frequency curve, the expected probability adjusted curve, and the 5 and 95 percent confidence limits. The second table (bottom left) contains general statistics about the data, such as the mean, standard deviation, station skew, regional skew, weighted skew, and the adopted skew of the analysis. The third table (bottom right) contains the number of historic events, high outliers, low outliers, zero or missing values, systematic events in the data set, and the number of years in the historic period. The table can be sent to the printer by pressing the **Print** button at the bottom of the analysis window. The user can control the number of decimal digits shown in the result tables and in reports. Select **Options** from the **Tools** menu and then open the **Results** tab, as shown in Figure 3-13.

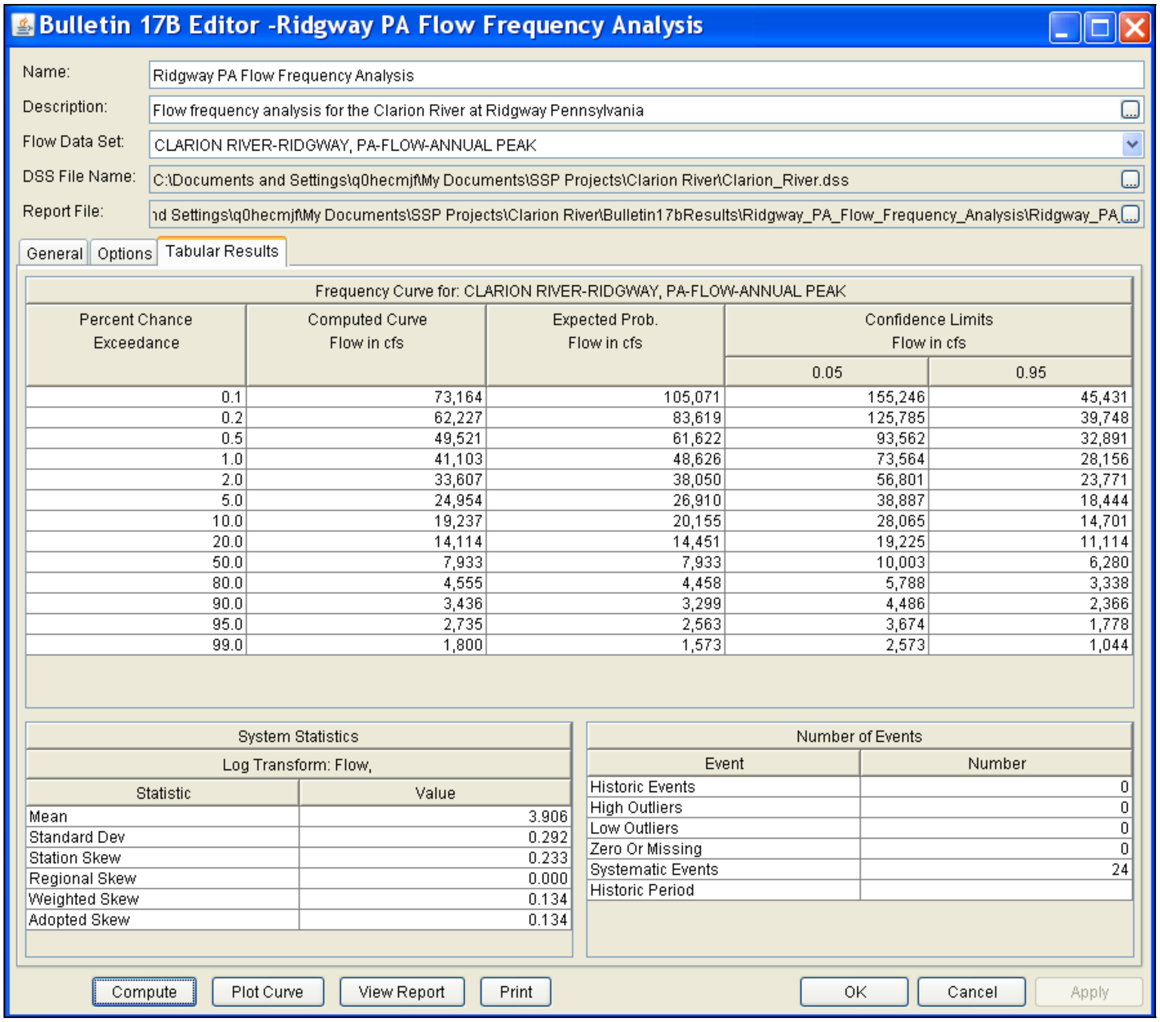


Figure 3-12. Tabular Results of Bulletin 17B Editor.

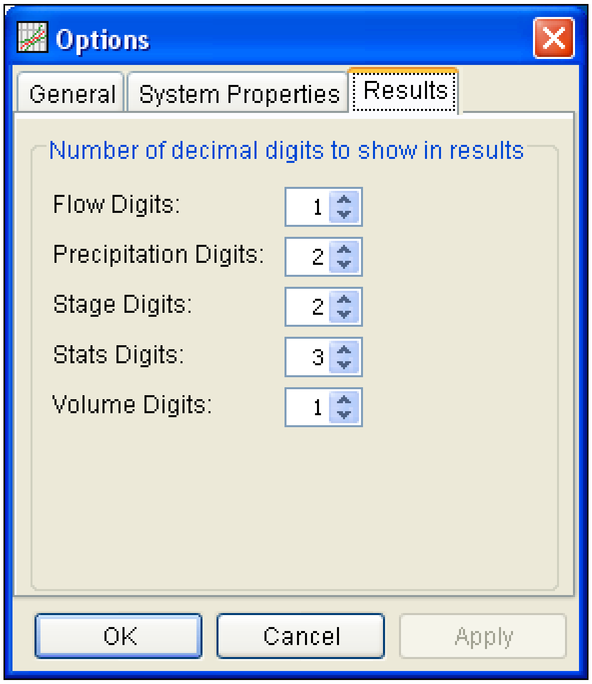


Figure 3-13. Dialog for Controlling the Number of Decimal Digits Shown in Result Tables and Reports.

Graphical output can be obtained by pressing the **Plot Curve** button at the bottom of the analysis editor. When this button is pressed, a plot will appear like the one in Figure 3-14. This plot contains the computed frequency curve, the expected probability adjusted curve, the confidence limits, and the data points plotted by the user-selected plotting position method. Additionally, a plot caption is listed at the top. The plot caption is by default the user-defined name of the analysis. The user can modify the plot properties by selecting the **Edit→Plot Properties** menu option. A plot properties window will open that lets the user change the line style for each data type, change the axis labels, modify the plot title, and edit other plot properties. The user can also edit line styles by placing the mouse on top of the line or data point in the plot or legend and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu. The plot can be printed or sent to the windows clipboard by using the **Print** and **Copy to Clipboard** options found under the **File** menu.

Additional points and lines can be added to a plot by placing the mouse anywhere in the plot area and clicking the right mouse button. Then select the **Add Marker** option to add a line or **Add Marker Point** to add a point. Draw properties can be edited for these user-defined lines and points by placing the mouse on top of the point or line and clicking the right mouse button. Then select the **Edit Properties** option in the shortcut menu.

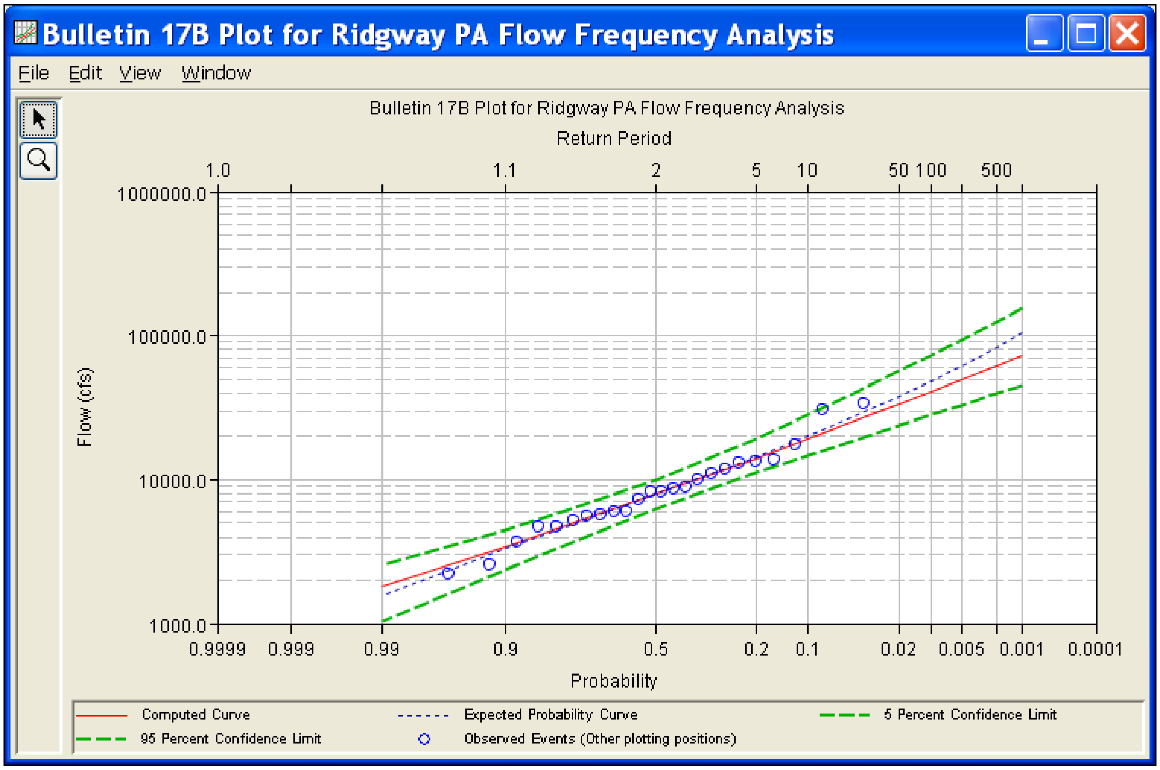
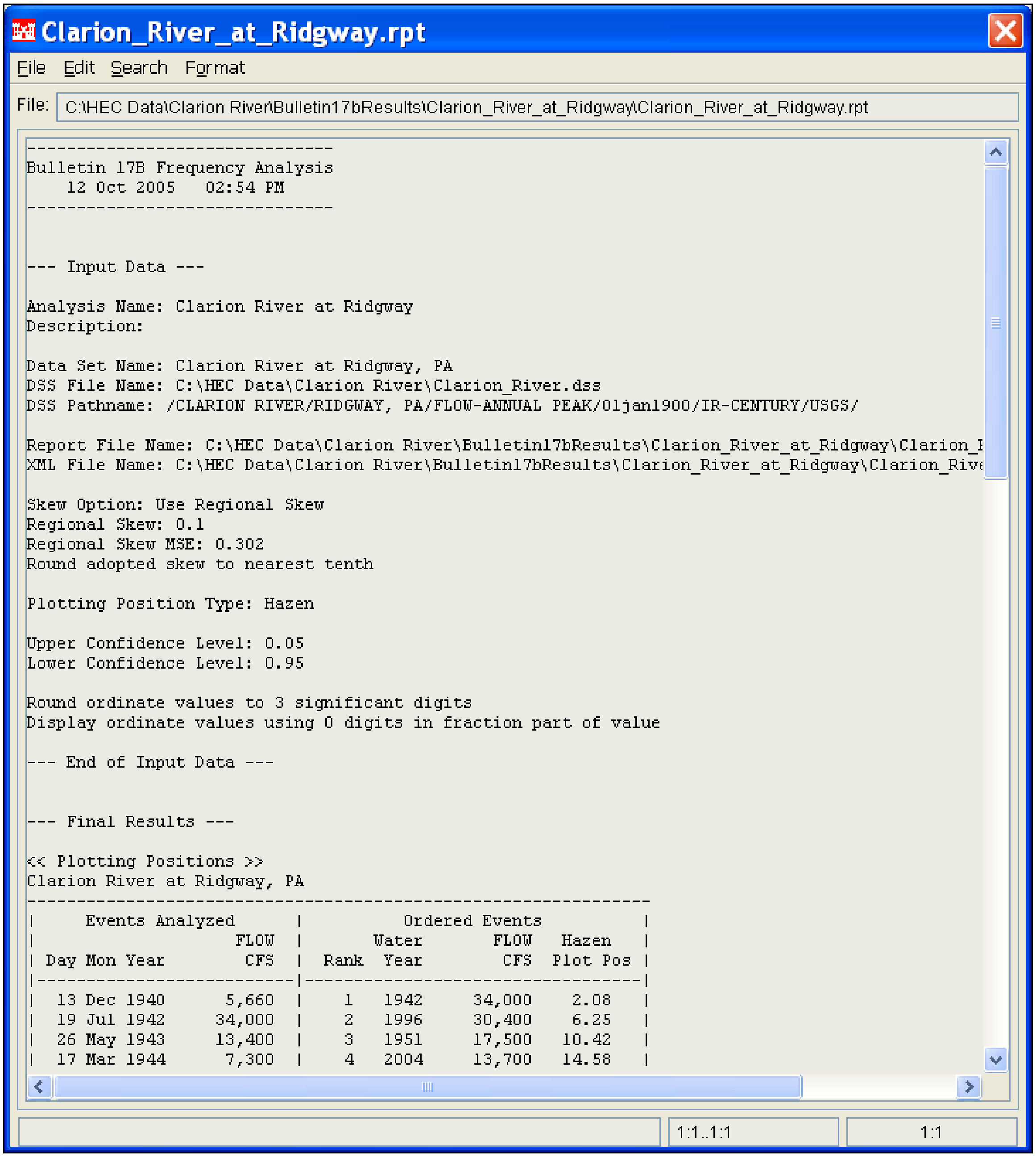


Figure 3-14. Flow Frequency Curve Plot.

The final piece of output available from a flow frequency analysis is a text report file. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc.), and the final results. This file is often useful for understanding how the software arrived at the final frequency curve. Press the **View Report** button at the bottom of the analysis editor to view the report file. When this button is pressed, a window will appear containing the text report as shown in Figure 3-15.



Clarion_River_at_Ridgway.rpt

File Edit Search Format

File: C:\HEC Data\Clarion River\Bulletin17bResults\Clarion_River_at_Ridgway\Clarion_River_at_Ridgway.rpt

```
------------------------------
Bulletin 17B Frequency Analysis
    12 Oct 2005   02:54 PM
------------------------------


--- Input Data ---

Analysis Name: Clarion River at Ridgway
Description:

Data Set Name: Clarion River at Ridgway, PA
DSS File Name: C:\HEC Data\Clarion River\Clarion_River.dss
DSS Pathname: /CLARION RIVER/RIDGWAY, PA/FLOW-ANNUAL PEAK/01jan1900/IR-CENTURY/USGS/

Report File Name: C:\HEC Data\Clarion River\Bulletin17bResults\Clarion_River_at_Ridgway\Clarion_I
XML File Name: C:\HEC Data\Clarion River\Bulletin17bResults\Clarion_River_at_Ridgway\Clarion_Rive

Skew Option: Use Regional Skew
Regional Skew: 0.1
Regional Skew MSE: 0.302
Round adopted skew to nearest tenth

Plotting Position Type: Hazen

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Round ordinate values to 3 significant digits
Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Final Results ---

<< Plotting Positions >>
Clarion River at Ridgway, PA
---------------------------------------------------------------
|     Events Analyzed       |          Ordered Events          |
|                    FLOW   |        Water       FLOW   Hazen  |
| Day Mon Year        CFS   |  Rank  Year         CFS  Plot Pos |
|---------------------------|----------------------------------|
|  13 Dec 1940       5,660  |    1   1942      34,000     2.08  |
|  19 Jul 1942      34,000  |    2   1996      30,400     6.25  |
|  26 May 1943      13,400  |    3   1951      17,500    10.42  |
|  17 Mar 1944       7,300  |    4   2004      13,700    14.58  |
```

1:1..1:1 1:1

Figure 3-15. Report File from Bulletin 17B Frequency Analysis.

CHAPTER 4

Using the HEC-SSP Data Importer

The HEC-SSP Data Importer is used to import, enter, and view data and the corresponding metadata used in an HEC-SSP study. The current version of HEC-SSP can be used to import annual peak data (flow and stage), daily data, hourly data, and real time data. Future versions of HEC-SSP will allow for other data types as other analyses are made available in the software.

Contents

Developing a New Data Set

Before any analyses can be performed in HEC-SSP, the user must import or enter data into the study. Importing, entering, and viewing data is accomplished in the **Data Importer**. To open the data importer, go to the **Data** menu and select **New** from the list of options. This will bring up a data importer as shown in Figure 4-1.

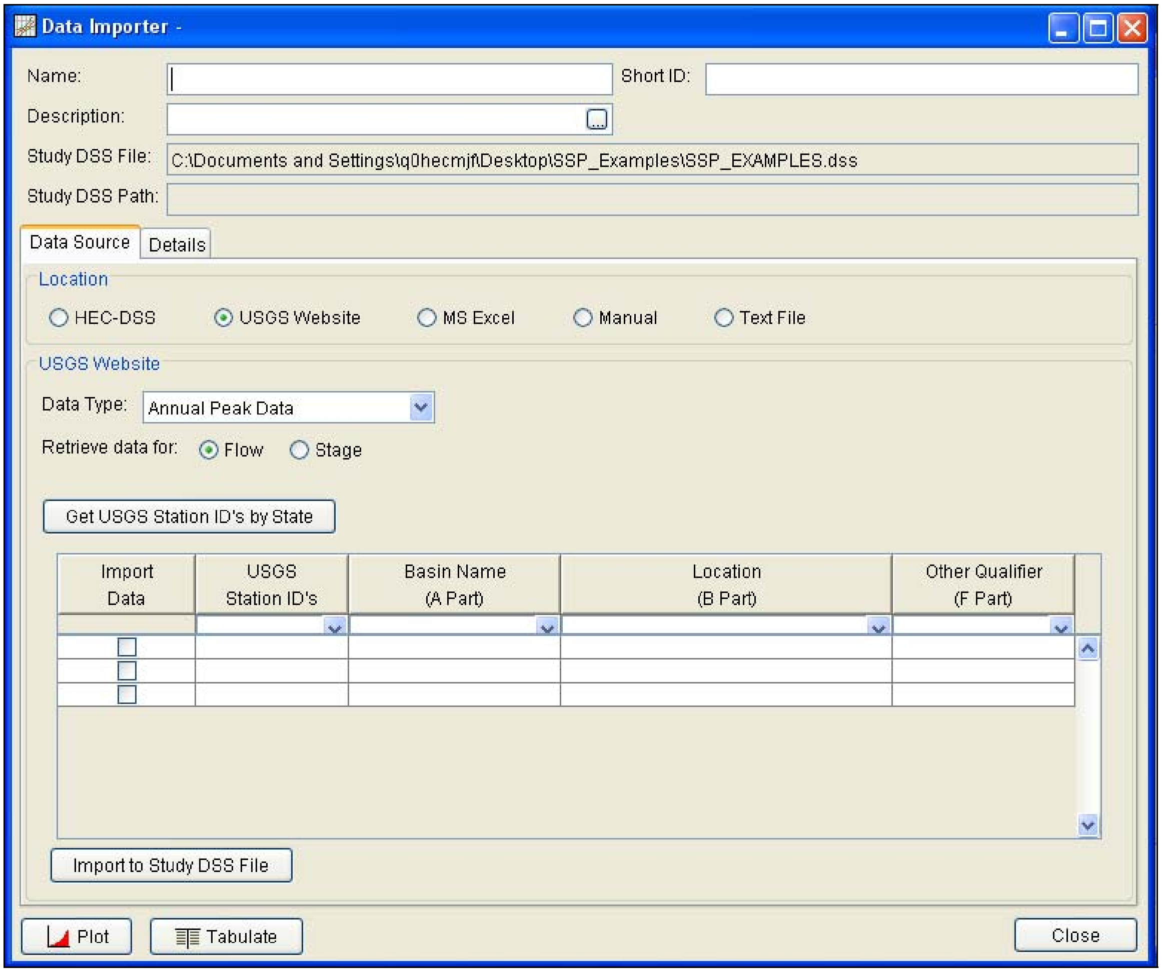


Figure 4-1. HEC-SSP Data Importer.

As shown in Figure 4-1, at the top of the editor, the user can enter a **Name** for the new data set. Optionally, the user can enter a short identifier (limited to 16 characters) and a **Description** of the data set. The study DSS file name is provided. The DSS file is used for storing the data for the study. The user does not have to enter a name when importing or manually entering data. The program will automatically name the data using USGS names or HEC-DSS pathname parts. If a **Name** is entered then it will be combined with the USGS gage name or HEC-DSS pathname parts to create a unique name. The user can rename a data set by selecting the data set in the study tree and clicking the right mouse button. A shortcut menu should open with a **Rename** menu option. The **Data** menu also contains a **Rename** menu option; however, the data set must be selected in the study tree before this menu option is active.

The Data Importer contains two main tabs, **Data Source** and **Details**. The **Data Source** tab is used for importing or entering data manually while the **Details** tab is used to describe the data (i.e. metadata). The **Data Source** tab contains five options for getting data into the study DSS file: Importing from an existing HEC-DSS file, importing from the USGS Website, importing from an Excel spreadsheet, entering the data manually, and importing from a text file.

Importing Data from an HEC-DSS File

To import data from an HEC-DSS file into the HEC-SSP study DSS file, first select the **HEC-DSS** radio button on the data importer. Selecting **HEC-DSS** will change the view of the Data Importer to look like Figure 4-2.

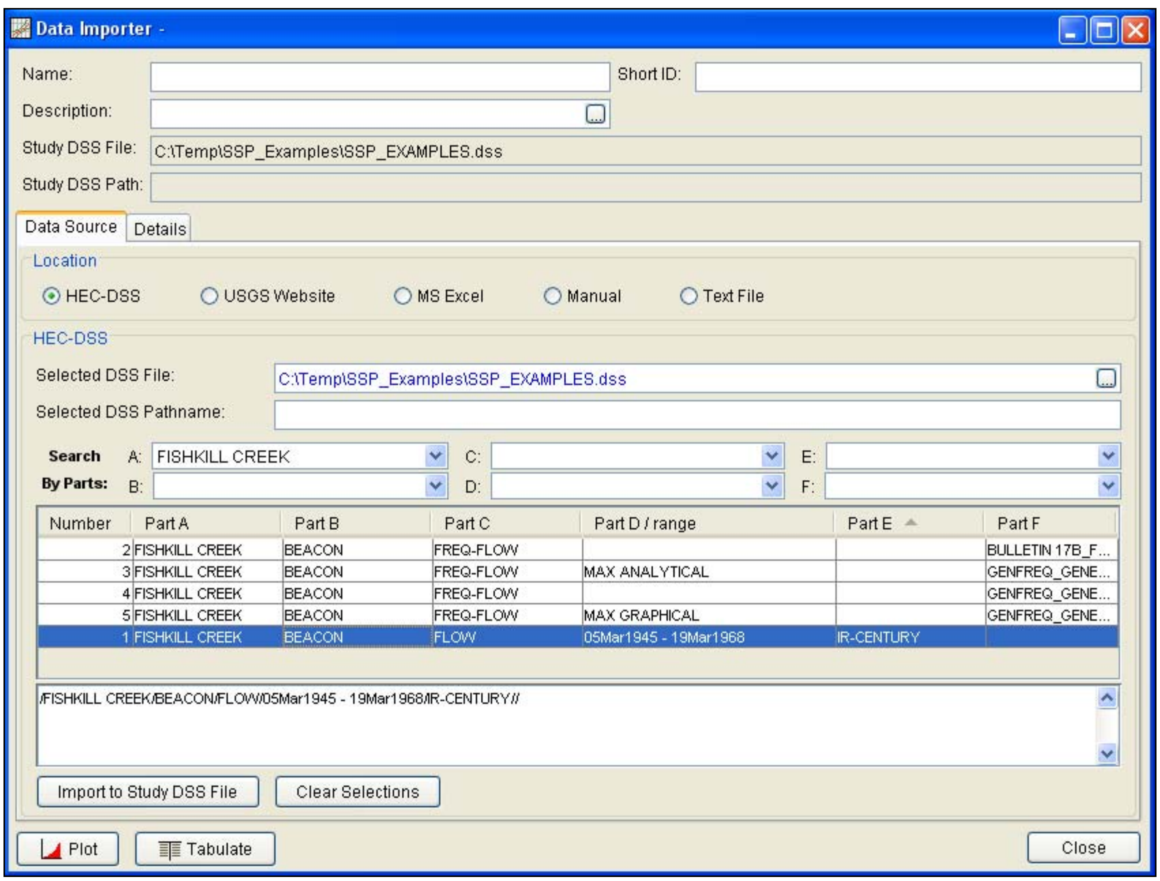


Figure 4-2. Data Importer with HEC-DSS Import Option.

As shown in Figure 4-2, the user first selects a DSS file to import from by typing the path and name or by choosing the file browser at the end of the input field. Once a DSS file is selected, the table of pathnames will be filled with the records that are contained in that DSS file. The user can reduce the number of listed pathnames by selecting pathname parts to filter in the pathname part selection area just above the table. Any pathname part can be used to filter the list down to a more manageable number of pathnames to select from. The user can then select pathnames to import by double clicking on one or more of the listed pathnames in the table. Each selected pathname will show up in the list below the table. Once the user has selected all of the pathnames that they want to import, pressing the **Import to Study DSS File** button enacts the import process. An HEC-SSP data set will be developed for each pathname that was selected.

Importing Data from the USGS Website

The second way to import data into HEC-SSP is to use the **USGS Website** option. When this option is selected, the data importer will look like Figure 4-3.

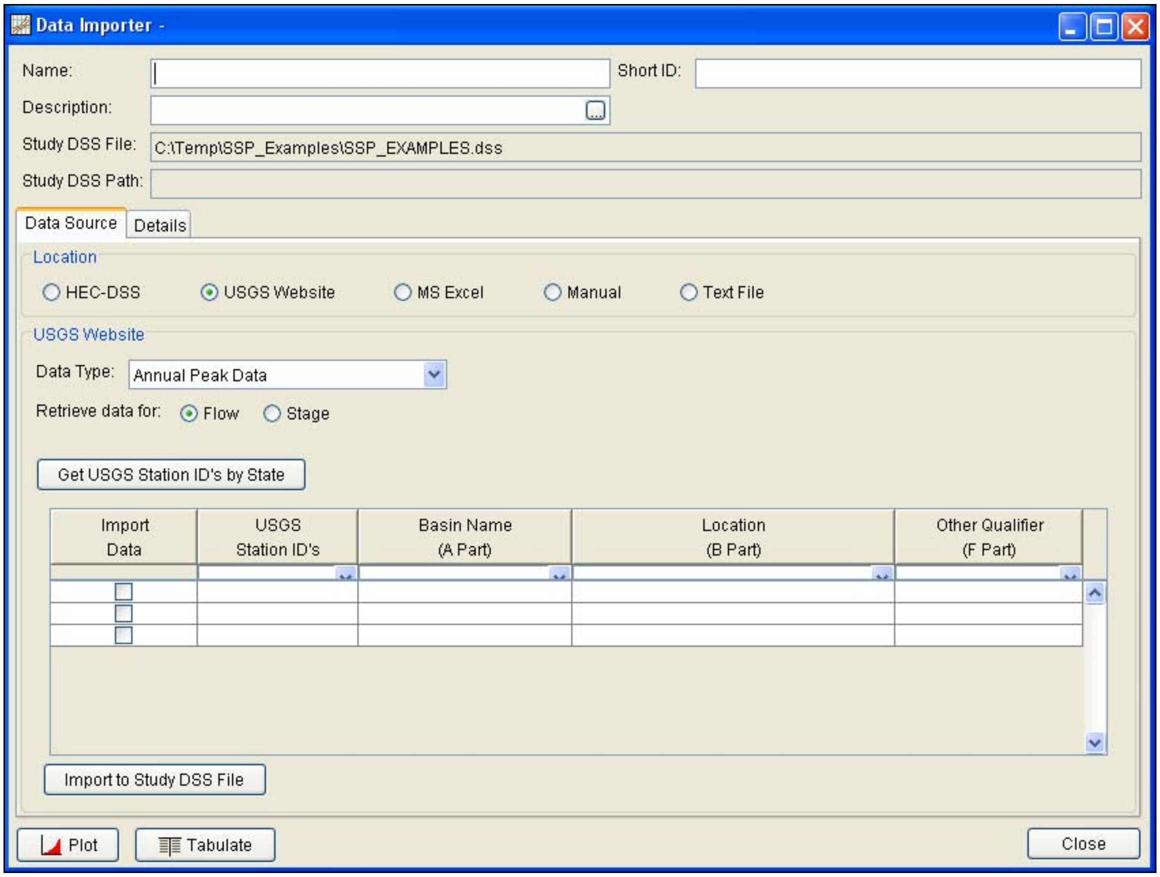


Figure 4-3. HEC-SSP Data Importer with USGS Website Import Option.

The first step in using the USGS import option is to select a data type to import (e.g. Annual Peak Data). Then choose to import **Flow** or **Stage** data. Next the user should select the **Get USGS Station ID's by State** button. Selecting this button will bring up a small window that allows the user to select a state in which to acquire data, as shown in Figure 4-4.

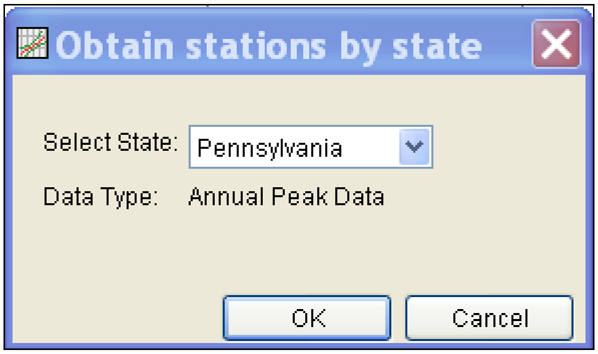


Figure 4-4. Window to Select a State for Importing USGS Data.

Once the user selects a state and presses the **OK** button, a process will begin in which all of the gage locations for that state will be downloaded from the USGS website. A listing of all the gages for that state will then show up in the table at the bottom of the data importer. An example of the data importer with a list of USGS gages is shown in Figure 4-5.

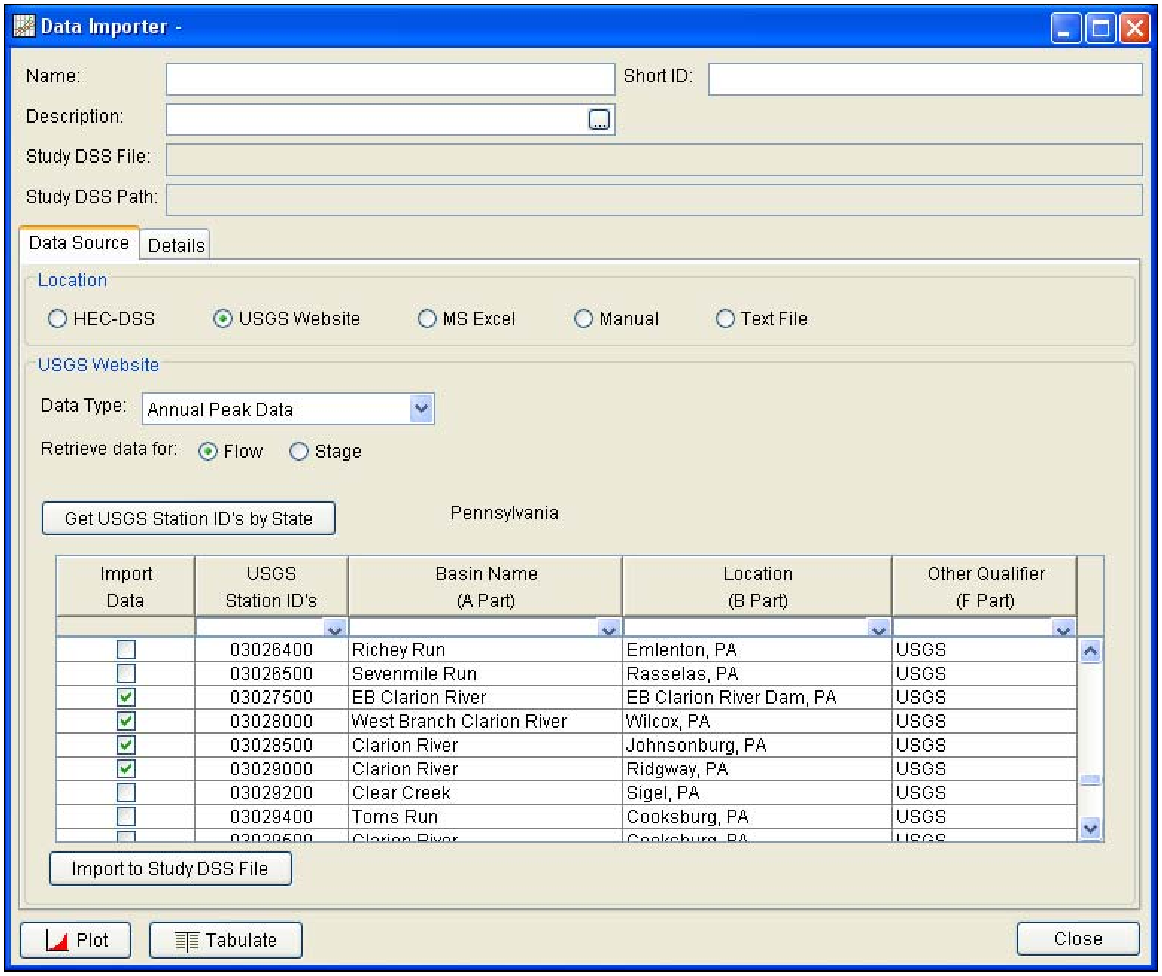


Figure 4-5. Data Importer with USGS Gages Listed in Table.

The next step is to select the desired gages for importing into the HEC-SSP study. The user can filter the list to a smaller number of gages by using the filter drop down boxes at the top of the table. To select a gage for importing, simply check the box in the left hand column for each gage location that is to be imported. After all of the desired locations are selected, press the **Import to DSS File** button to import the data into the study DSS file. Pressing this button will start a process of downloading data from the USGS website. For each selected location, the software will download the Data Quality Codes if they are available. The program issues a message that data quality codes are available and adds the codes as an additional data set to the Data folder. For an explanation of the codes, please visit the USGS website.

Warning: all data download from the USGS website should be reviewed to ensure it is appropriate before any analyses are performed on the data. Some data stored on the USGS website are estimated, not measured. The user should check the data on the USGS website and be aware of the quality of all the data before using it. HEC-SSP will import the annual peak flow and stage quality codes (the program does not import quality codes for daily, instantaneous, and real time data). A description of the quality codes for annual peak flows is contained in Table 4-1 and a description of the quality codes for annual peak stages is contained in Table 4-2.

Table 4-1. Quality Codes for USGS Annual Peak Flow Data.

Code	Description
1	Discharge is a Maximum Daily Average
2	Discharge is an Estimate
3	Discharge affected by Dam Failure
4	Discharge less than indicated value which is Minimum Recordable Discharge at this site
5	Discharge affected to unknown degree by Regulation or Diversion
6	Discharge affected by Regulation or Diversion
7	Discharge is an Historic Peak
8	Discharge actually greater than indicated value
9	Discharge due to Snowmelt, Hurricane, Ice-Jam or Debris Dam breakup
A	Year of occurrence is unknown or not exact
B	Month or Day of occurrence is unknown or not exact
C	All or part of the record affected by Urbanization, Mining, Agricultural changes, Channelization, or other
D	Base Discharge changed during this year
E	Only Annual Maximum Peak available for this year

Table 4-2. Quality Codes for USGS Annual Peak Stage Data.

Code	Description
1	Gage height affected by backwater
2	Gage height not the maximum for the year
3	Gage height at different site and(or) datum
4	Gage height below minimum recordable elevation
5	Gage height is an estimate
6	Gage datum changed during this year

Importing Data from an Excel Spreadsheet

The third option for importing data into HEC-SSP is **MS Excel**. When this option is selected, the data importer will change as shown in Figure 4-6. Use the HEC-DSS or USGS options if you need to import daily average flow data.

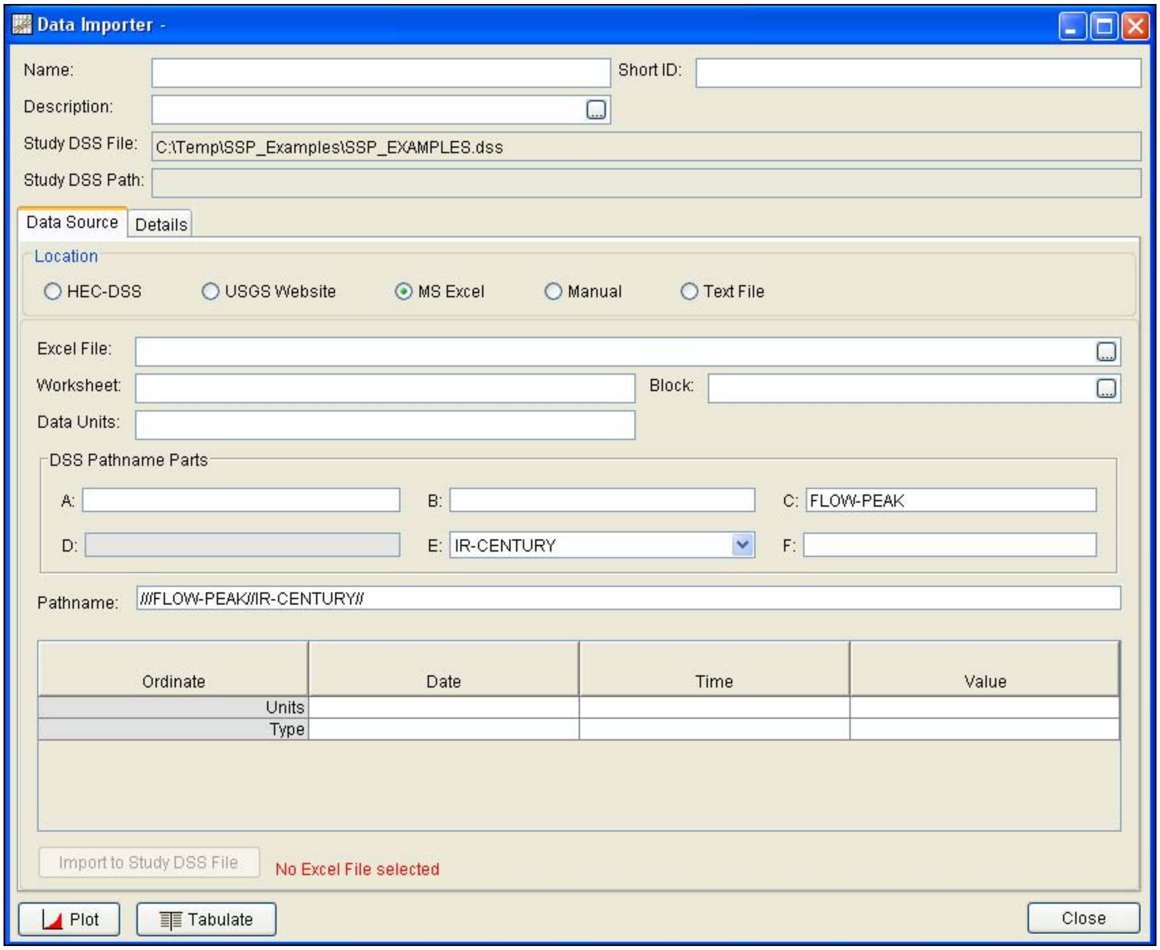


Figure 4-6. Data Importer with MS Excel Import Option Selected.

The first step in importing data from an Excel spreadsheet is to select browse the end of the **Excel File** field. Once an Excel file is selected, a data view window will open showing the data contained in the selected spreadsheet. An example Excel® Data viewer is shown in Figure 4-7.

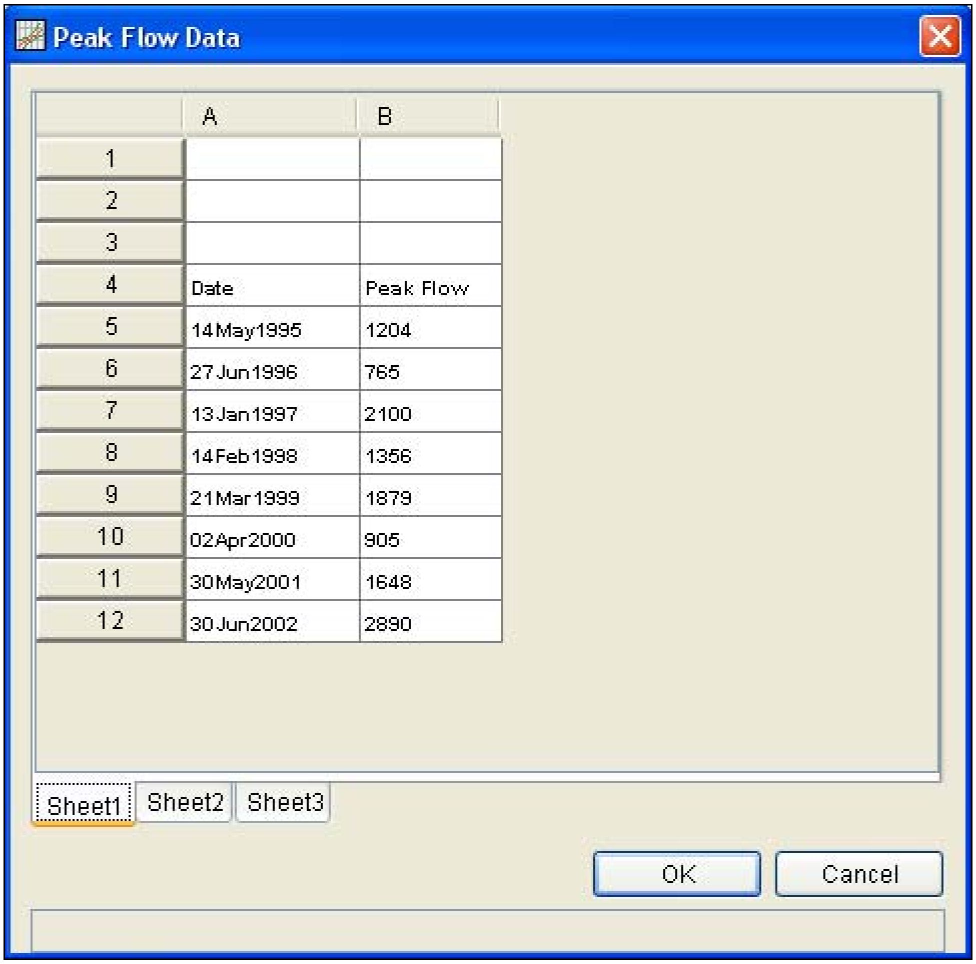


Figure 4-7. Example Excel Data Viewer.

The next step is to highlight the date and flow data values for each value to be imported into the study (only highlight the data, not the column headings). The data must be in a format of Date in the first column and Peak Annual Flow in the second column. The date must be in the Day, Month, Year format (ddmmyyyy) as shown in Figure 4-7. Next, press the **OK** button and the data will be placed in the table at the bottom of the editor. The last steps before importing the data is to specify the units of the data, and each of the pathname parts for storing the data in the study DSS file. Enter units of **cfs** for data in cubic feet per second or units of **cms** for data in cubic meters per second. The final step is to press the **Import to Study DSS File** button, and the data will be imported.

Entering Data Manually

Another option for getting data into the study is to enter the data manually. When the **Manual** option is selected, the window will change to what is shown in Figure 4-8.

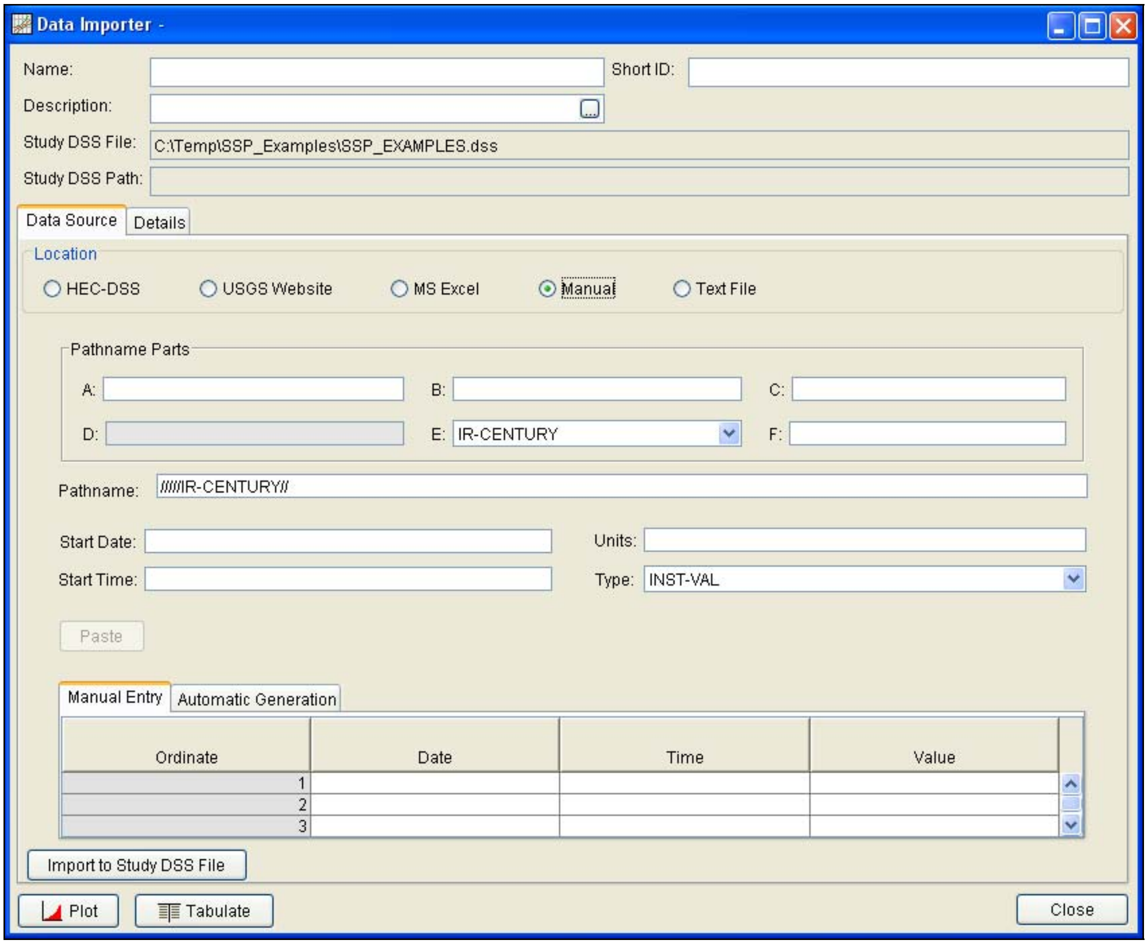


Figure 4-8. Data Importer with Manual Data Entry Option Selected.

To enter data manually, the user enters a name for the data set at the top, along with a short identifier and a description (optional). A starting date and time must be entered. The units of the data must also be defined as well as the data type. The last step before entering the data is to specify the pathname parts for how the data will be stored into the study DSS file. This requires the user to enter a label for the A, B, C, E, and F part of the DSS pathname. Once all of the data labeling is completed, the data can be entered into the table at the bottom of the editor. The user must enter the **Date**, **Time**, and data **Value** for each peak flow value to be entered. After a Date, Time, and Value are entered into a row, a new row will be generated in the table when the user leaves the Value field. The date must be in the Day, Month, Year format (ddmmyyyy). Another option for getting data into the table is to copy it to the clipboard and then paste it into the table. The table supports pasting data one column at a time or you can paste the date, time, and value information all at once. When all of the data are entered into the table, the user presses the **Import to Study DSS File** button and the data will be stored in the study DSS file.

Importing Data from a Text File

The fifth option for importing data into HEC-SSP is a comma delimited **Text File**. When this option is selected, the data importer will change as shown in Figure 4-9.

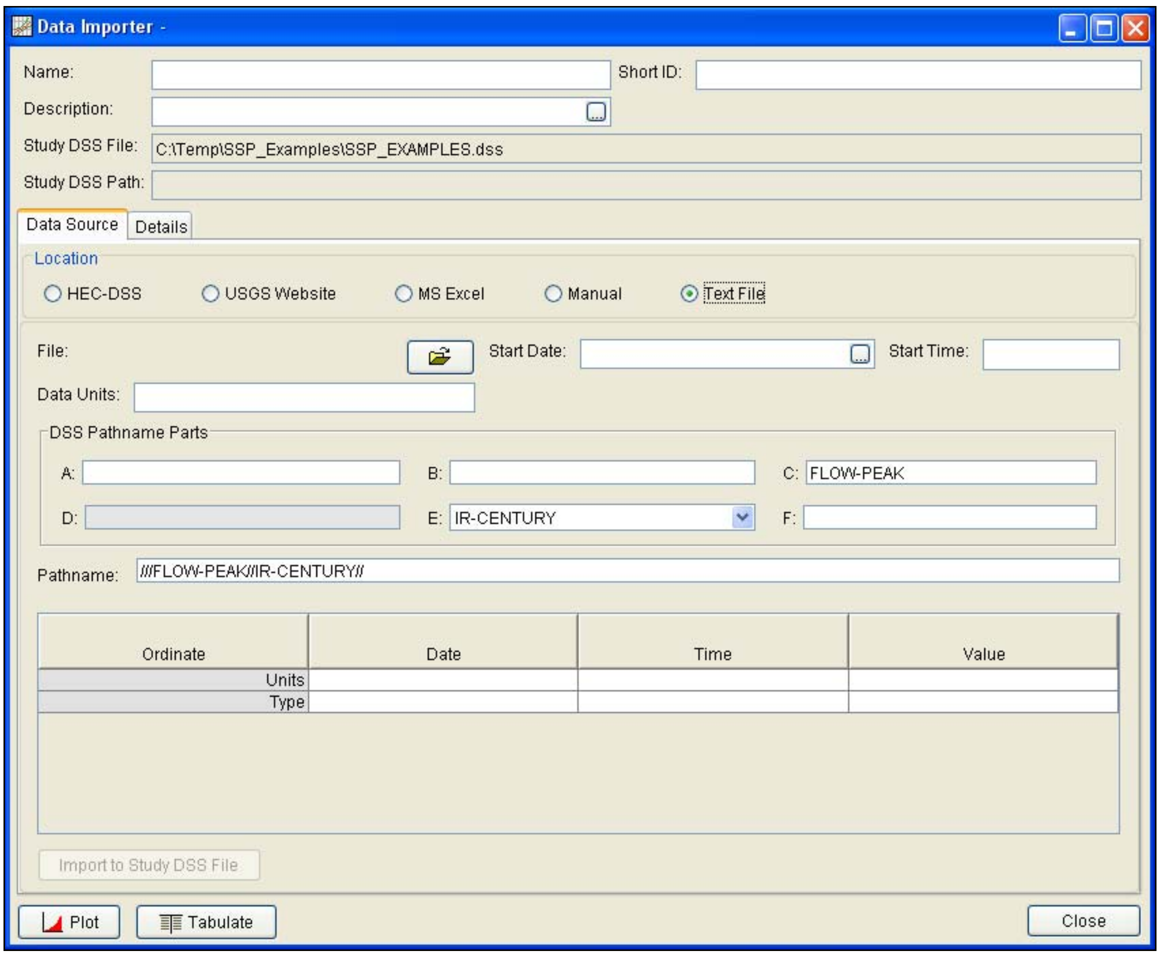
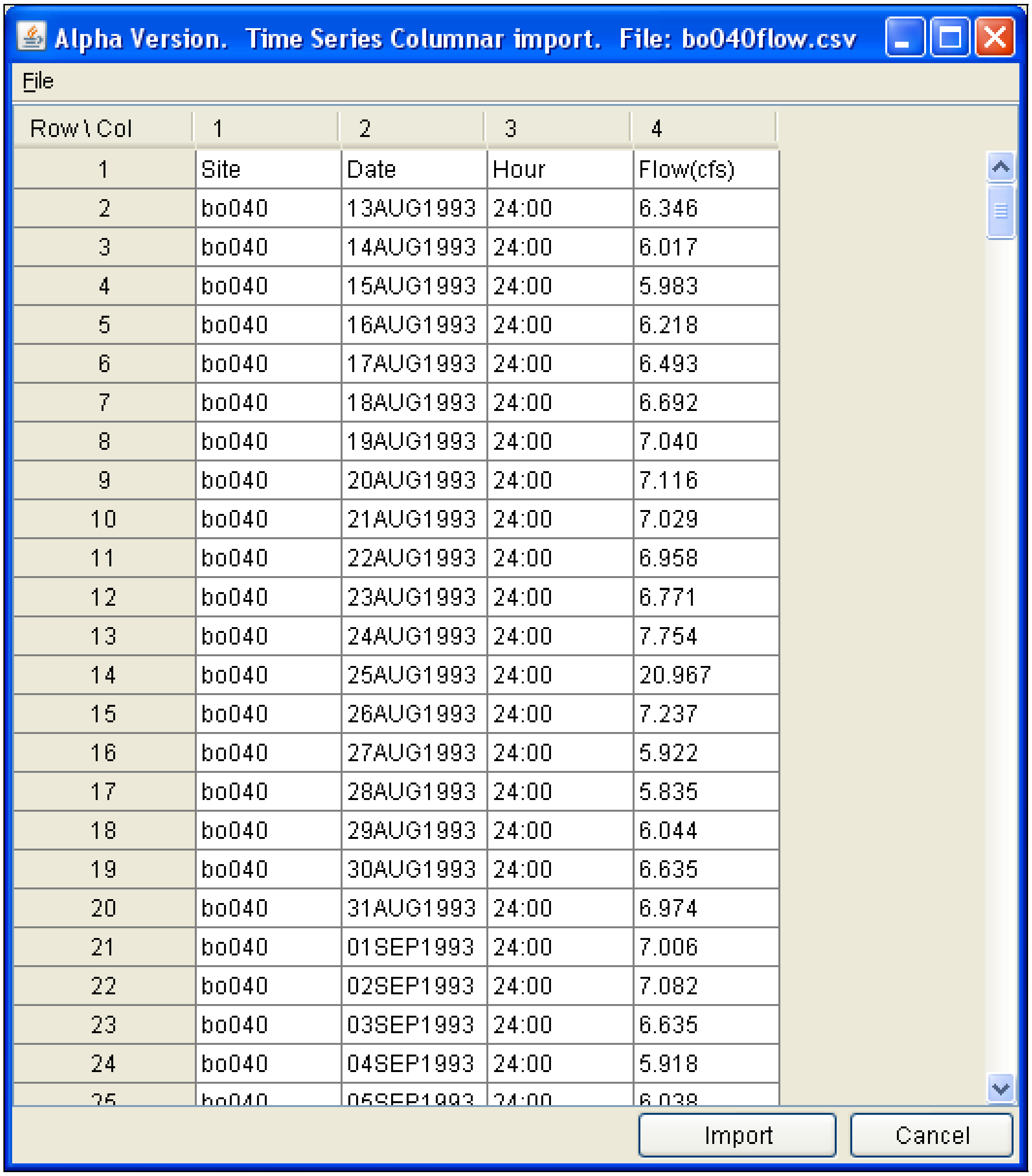


Figure 4-9. Data Importer with Text File Option Selected.

The first step in importing data from a comma delimited Text File is to press the Select File  button at the end of the **File** field. Once a comma delimited text file is selected, a data view window will open showing the data contained in the selected file. An example text file data viewer is shown in Figure 4-10.



Row \ Col	1	2	3	4
1	Site	Date	Hour	Flow(cfs)
2	bo040	13AUG1993	24:00	6.346
3	bo040	14AUG1993	24:00	6.017
4	bo040	15AUG1993	24:00	5.983
5	bo040	16AUG1993	24:00	6.218
6	bo040	17AUG1993	24:00	6.493
7	bo040	18AUG1993	24:00	6.692
8	bo040	19AUG1993	24:00	7.040
9	bo040	20AUG1993	24:00	7.116
10	bo040	21AUG1993	24:00	7.029
11	bo040	22AUG1993	24:00	6.958
12	bo040	23AUG1993	24:00	6.771
13	bo040	24AUG1993	24:00	7.754
14	bo040	25AUG1993	24:00	20.967
15	bo040	26AUG1993	24:00	7.237
16	bo040	27AUG1993	24:00	5.922
17	bo040	28AUG1993	24:00	5.835
18	bo040	29AUG1993	24:00	6.044
19	bo040	30AUG1993	24:00	6.635
20	bo040	31AUG1993	24:00	6.974
21	bo040	01SEP1993	24:00	7.006
22	bo040	02SEP1993	24:00	7.082
23	bo040	03SEP1993	24:00	6.635
24	bo040	04SEP1993	24:00	5.918
25	bo040	05SEP1993	24:00	6.038

Figure 4-10. Example Text File Data Viewer.

The next step is to highlight the date, time, and data columns. Only highlight the data that will be imported, not the column headings. If there are column heading then they need to be identified. To do this, select the row or rows that do not contain data to be imported. Then click the right mouse button and select the **Skip Row(s)** menu option, as shown in Figure 4-11.

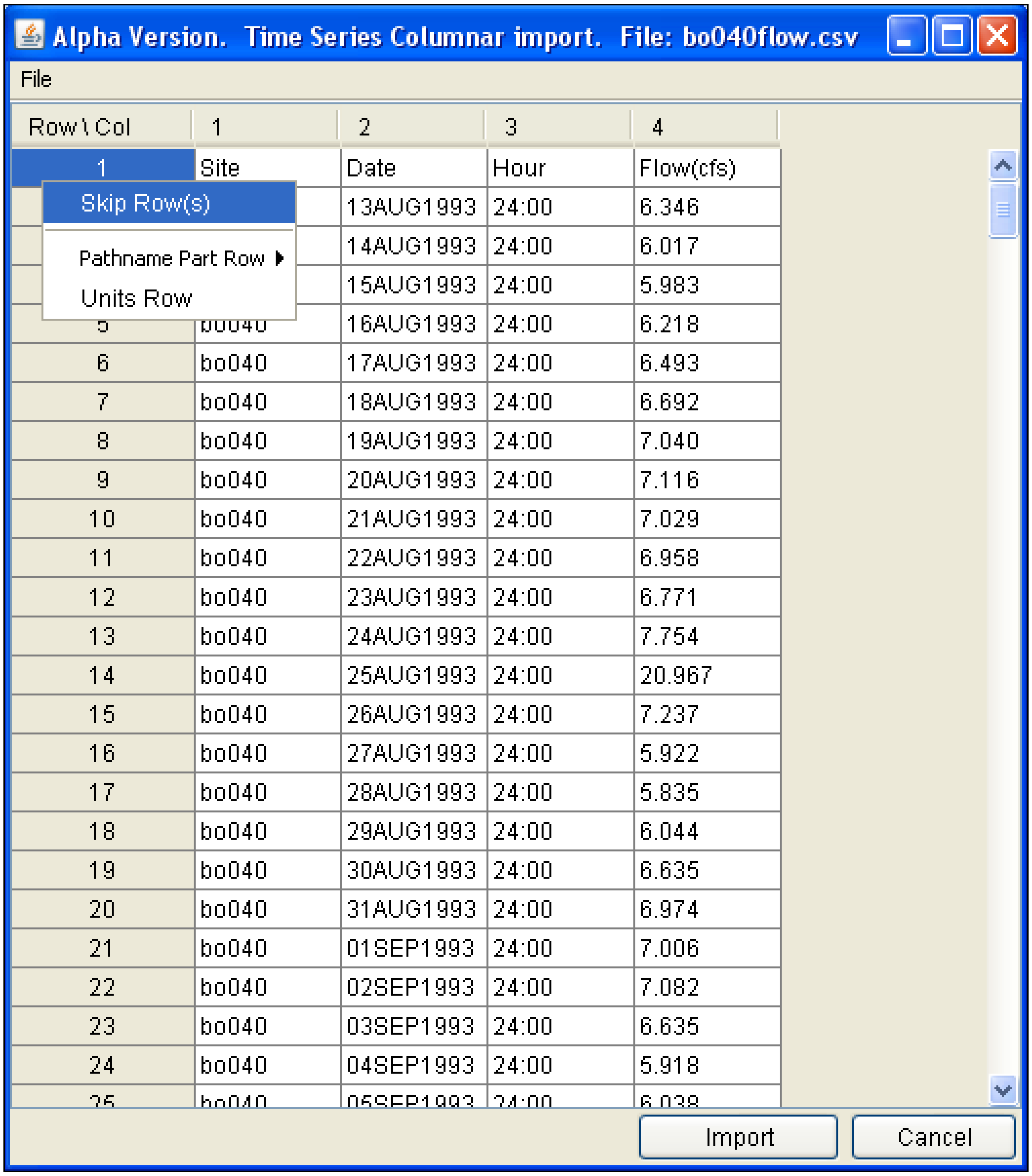


Figure 4-11. Identify Rows that do not Contain Data to be Imported.

To identify the date and time columns, place the mouse pointer on the column number at the top of the table and click the right mouse button. Then move the mouse pointer to the **Date – Time Column** option to see an addition menu of options, as shown in Figure 4-12. Figure 4-12 shows that column 2 will be defined as the date column. The date must be in the Day, Month, Year format (ddmmyyyy). The data viewer will highlight the date and time columns once they have been defined.

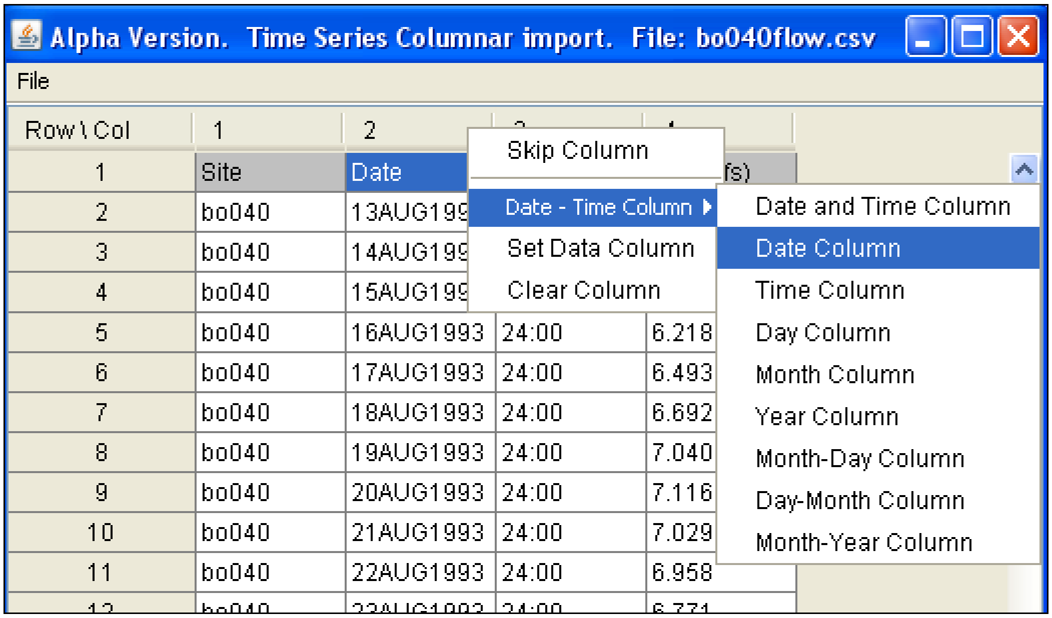


Figure 4-12. Identify Date and Time Columns.

To define the data column, place the mouse pointer on the column number at the top of the table and click the right mouse button. Then choose the **Set Data Column** menu option from the shortcut menu. Another editor will open, as shown in Figure 4-13, that allows the user to define the pathname parts, data units, and data type. After defining these data properties, click the **Import Now** button to import the data and data properties to the Data Importer. You can edit the data values or data properties in the data importer before importing the data to the study. The final step is to press the **Import to Study DSS File** button, and the data will be imported.

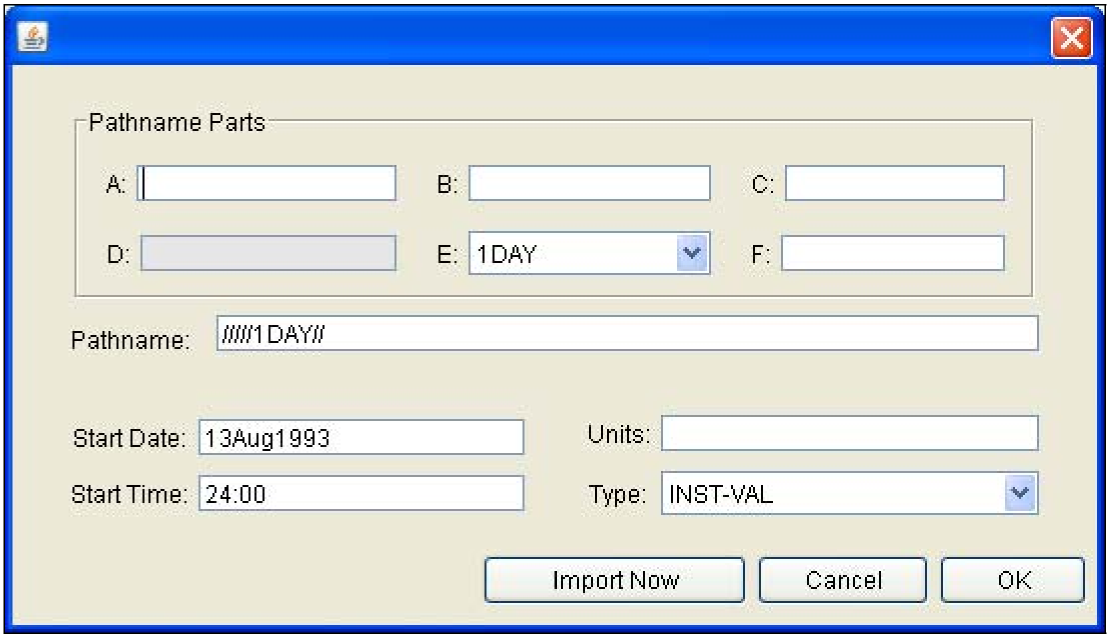


Figure 4-13. Editor for Defining the Data Properties.

Metadata

When downloading data from the USGS website, in addition to the raw data, the software will also attempt to download any metadata available for each gage location. When using one of the other four methods for importing data, the user can manually enter metadata by selecting the **Details** tab, as shown in Figure 4-14. The metadata consists of the State, County, Stream, Location, Drainage Area, DA Units, Gage Operator, USGS Gage No., Gage Datum, HUC (Hydrologic Unit Code), Vertical Datum, and a description field. Additionally, the coordinate location of the data is shown. The coordinate location consists of Coordinate System, Coordinate ID, Horizontal Datum, Datum Units, Coordinate X Value, and Coordinate Y Value. If coordinate system data are entered, data icons and text labels will show up on the background map at the specified locations.

Metadata can be viewed and edited any time after the data has been imported into the study by opening the **Metadata Editor**. To open the Metadata Editor, place the mouse pointer on top of a data set in the Data folder and then click the right mouse button. Choose the **Edit Metadata** option from the shortcut menu, as shown in Figure 4-15. The Metadata Editor will look exactly like the Details tab on the Data Importer. The Metadata Editor can also be opened from the Data menu and from a shortcut menu that opens by right clicking on a data icon in a background map.

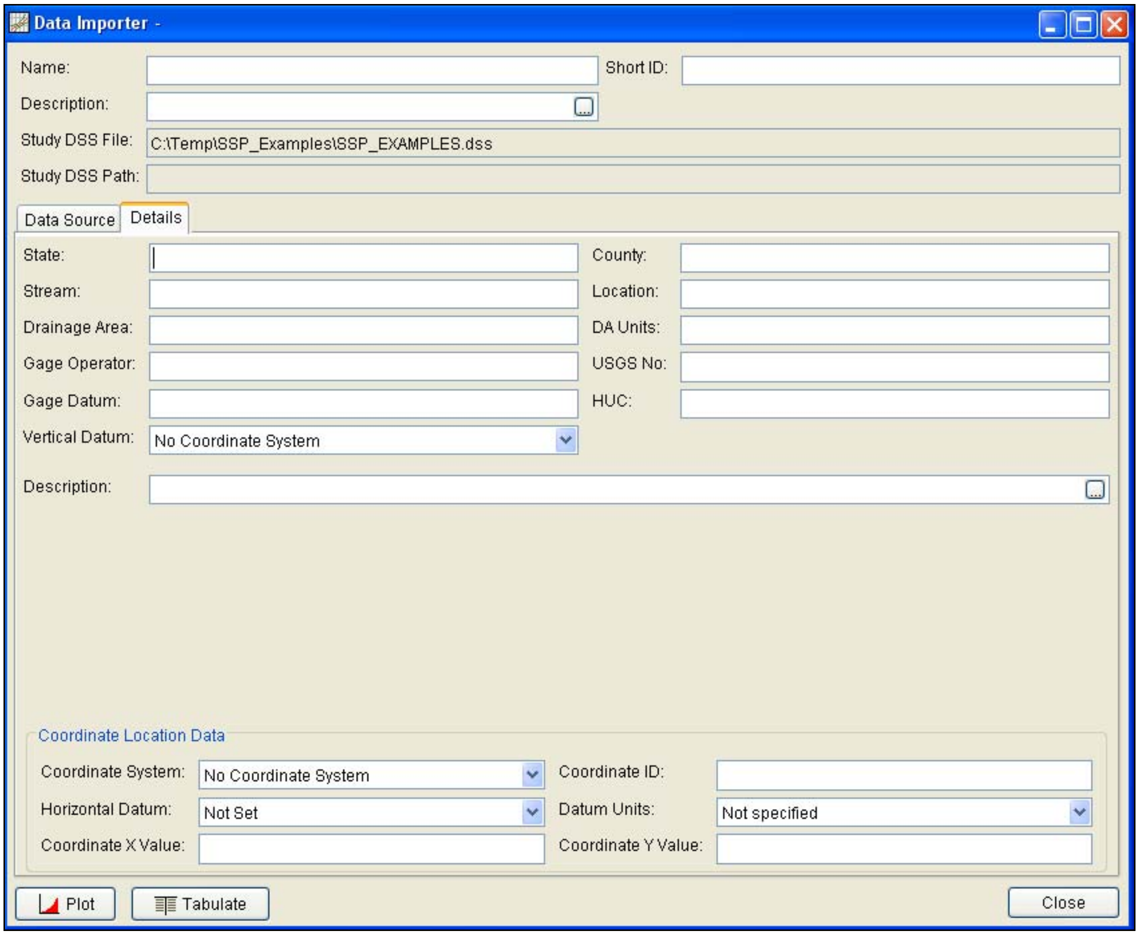


Figure 4-14. Details Tab on the HEC-SSP Data Importer.

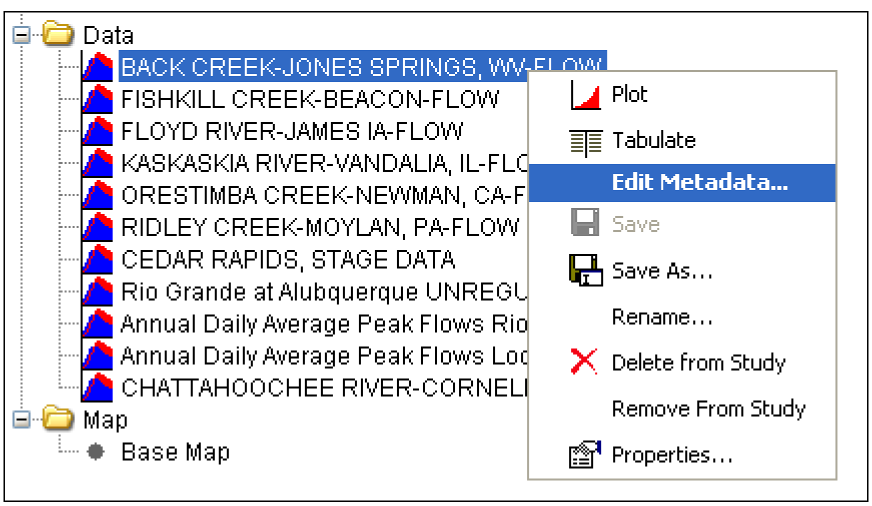


Figure 4-15. Menu Option for Opening the Metadata Editor.

Plotting and Tabulating the Data

After the data is imported into the study, the user can select any one of the data sets in the study tree. A shortcut menu will open when clicking the right mouse button while a data is selected. The shortcut menu contains options to change the name, plot, and tabulate the data. These options are also available from the Data menu; however, the data must be selected in the tree before these options are available. If you select the **Plot** option, you will get a plot similar to the one shown in Figure 4-16.

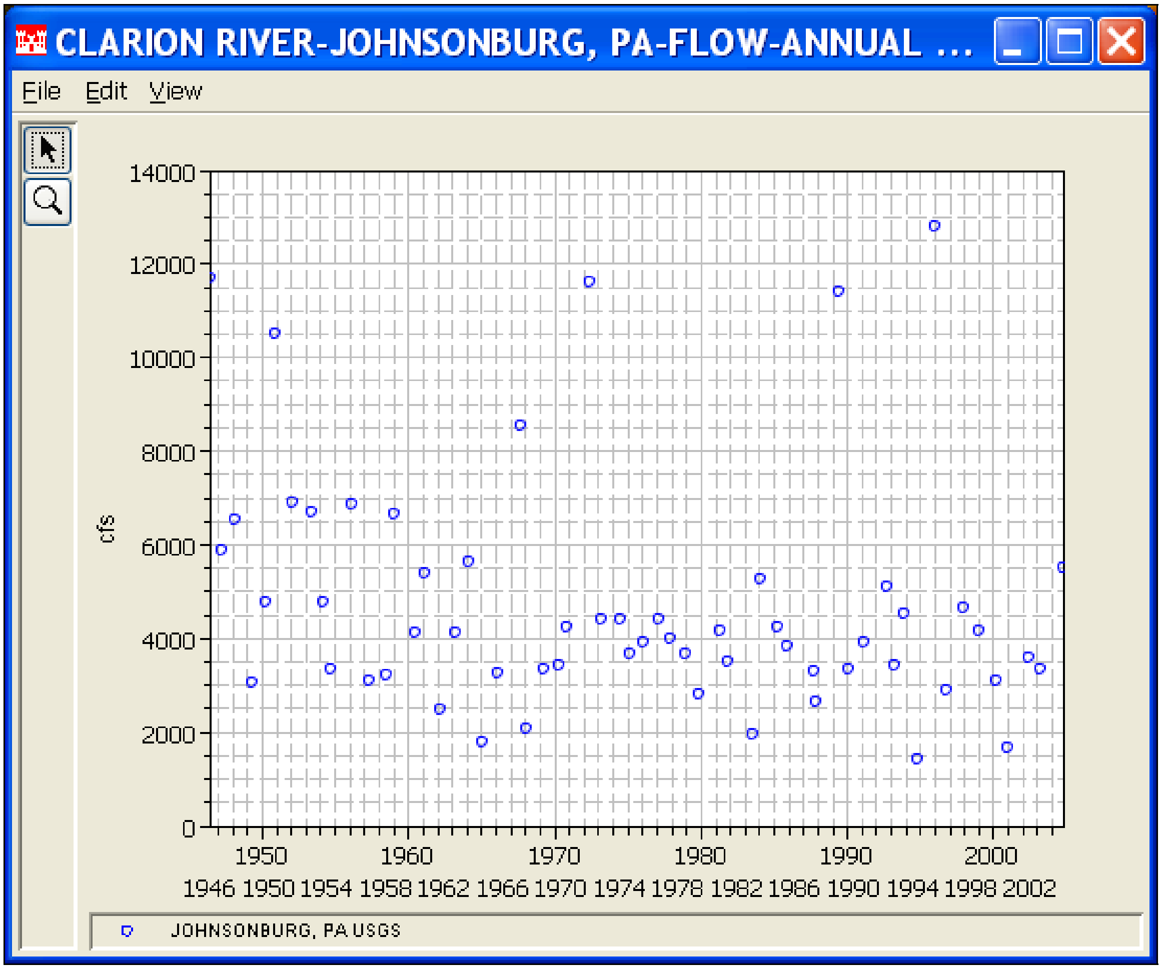


Figure 4-16. Plot of Peak Annual Flow Data Download from USGS Website.

If you select the **Tabulate** option, a table will open with the data listed as shown in Figure 4-17. Data values in the table can be edited after selected the **Edit→Allow Editing** menu option. To save any edits, select the **File→Save** menu option.

/Clarion River/Ridgway...

File Edit View

Ordinate	Date / Time	RIDGWAY, PA USGS
Units		CFS
Type		INST-VAL
1	13 Dec 40 24:00	5,660
2	19 Jul 42 24:00	34,000
3	26 May 43 24:00	13,400
4	17 Mar 44 24:00	7,300
5	03 Mar 45 24:00	10,000
6	28 May 46 24:00	13,100
7	05 Apr 47 24:00	8,280
8	12 Apr 48 24:00	8,680
9	22 May 49 24:00	3,710
10	29 Mar 50 24:00	8,280
11	25 Nov 50 24:00	17,500
12	18 Jan 52 24:00	10,900
13	23 May 53 24:00	8,900
14	14 Aug 94 24:00	11,700
15	20 Jan 95 24:00	2,530
16	19 Jan 96 24:00	30,400
17	08 Nov 96 24:00	4,630
18	08 Jan 98 24:00	5,510
19	24 Jan 99 24:00	6,030
20	04 Apr 00 24:00	5,220
21	17 Dec 00 24:00	2,190
22	13 May 02 24:00	4,660
23	01 Aug 03 24:00	5,920
24	18 Sep 04 24:00	13,700

Figure 4-17. Table Containing a Listing of Peak Annual Flow Data.

CHAPTER 5

Performing a Bulletin 17B Flow Frequency Analysis

The current version of HEC-SSP allows the user to perform flow frequency analyses based on Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (March 1982). This chapter discusses in detail how to perform a Bulletin 17B flow frequency analysis with HEC-SSP.

Contents

Starting a New Analysis

A flow frequency analysis can be started in two ways within the software, either by right clicking on the Bulletin 17B folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Bulletin 17B Flow Frequency**. When a new flow frequency analysis is selected, the Bulletin 17B Editor will appear as shown in Figure 5-1.

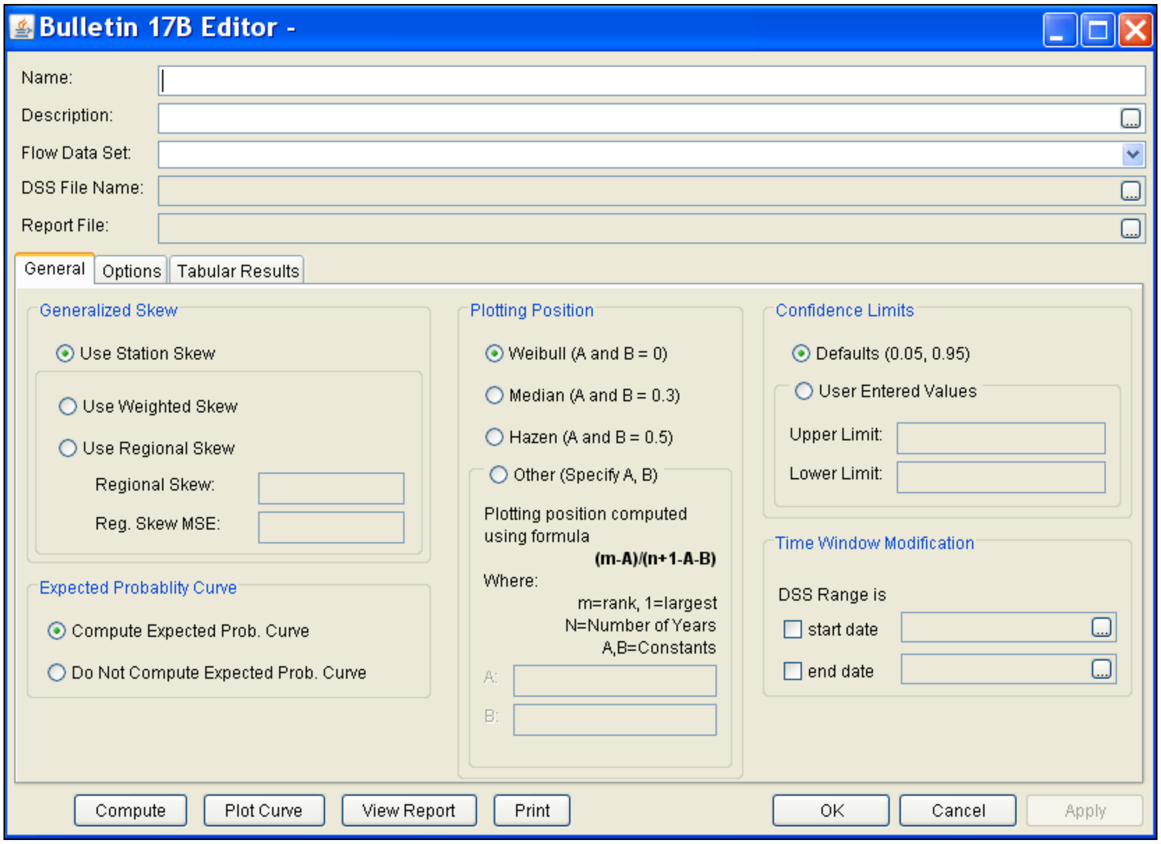


Figure 5-1. Bulletin 17B Flow Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. An annual peak flow data set must be selected from the available data sets stored in the current study DSS file (see chapter 4 for importing data into the study). Once a Name is entered, and a flow data set is selected, the **DSS File Name** and **Report File** will automatically be populated. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings, Options, and Computations

Once the analysis name and flow data set are selected, the user can begin setting up the analysis. Three tabs are contained on the Bulletin 17B editor. The tabs are labeled **General**, **Options**, and **Tabular Results**.

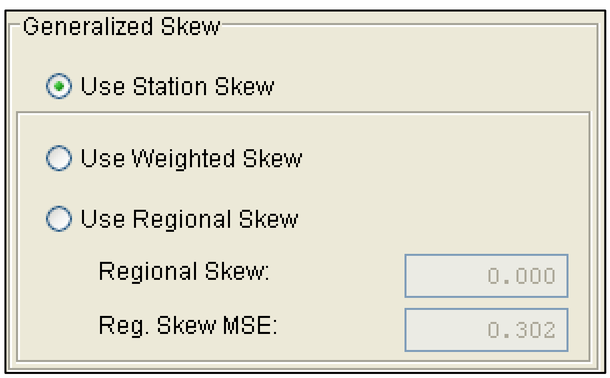
General Settings

The first tab contains general settings for performing the flow frequency analysis (Figure 5-1). These settings include:

- Generalized Skew
- Expected Probability Curve
- Plotting Positions
- Confidence Limits
- Time Window Modification

Generalized Skew

There are three options contained within the generalized skew setting: Use Station Skew, Use Weighted Skew, and Use Regional Skew. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points contained in the data set. No weighting will be performed to compute the final skew.

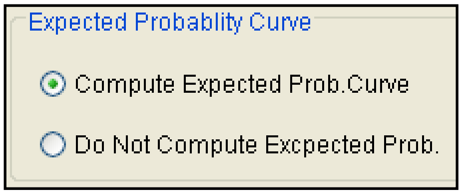


The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a Mean-Square Error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The last generalized skew option is **Use Regional Skew**. When this option is selected, the user must enter a generalized regional skew and an MSE for that skew. The program will ignore the computed station skew and use only the generalized regional skew.

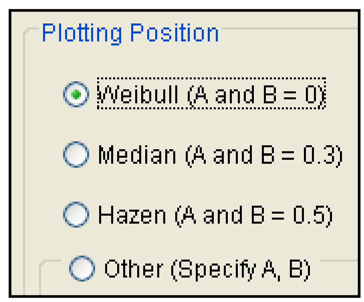
Expected Probability Curve

This setting has two options: compute the expected probability curve and do not compute the expected probability curve. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the result tables and the plots as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position methodologies within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Weibull plotting position formula. The generalized plotting position equation is:



$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

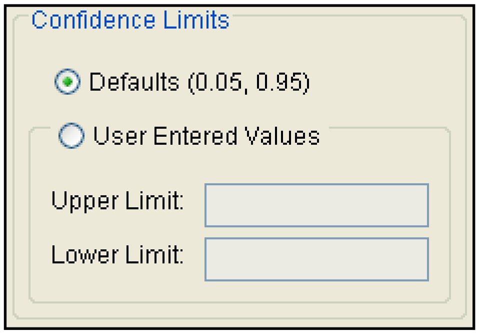
Where: m = rank of flood values with the largest equal to 1.

n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

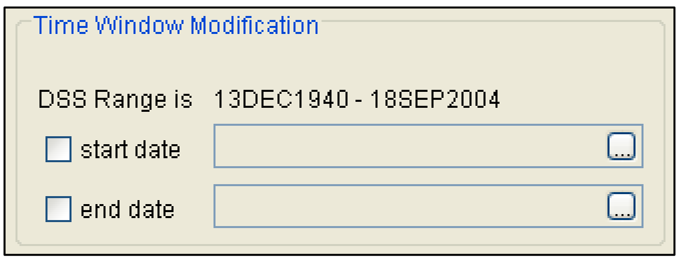
Plotting positions are estimates of the exceedance probability of each data point. Different methods can give very different values for the probabilities of the highest and lowest points in the data set. In the Bulletin 17B methodology, the plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

Confidence limits provide a measure of the uncertainty in the computed discharge for a given exceedance probability. The computation of confidence limits is outlined in Bulletin 17B appendix 9. By default, HEC-SSP calculates the 90 percent confidence interval (i.e. the 5% and 95% confidence limits). The confidence limits must be entered in decimal form (i.e. 95% = 0.95, and 5% = 0.05). The user has the option to override the default values and enter whatever values they would like for the confidence limits.



Time Window Modification

This option allows the user to narrow the time window used for the analysis. The default is to use all of the annual peak flow data contained in the selected data set. The user can enter either a start date for the analysis, and end date, or both a start and end date. If a start and/or end date are used, they must be dates that are encompassed within the data stored in the selected data set. The date range for the selected data set is shown in the editor just above the **Start Date** field.



Options

In addition to the general settings, there are also several options available to the user for modifying the computations of the frequency curves. These options include:

- Low Outlier Threshold
- Historic Period Data
- User-Specified Frequency Ordinates

When the Options tab is selected, the Bulletin 17B Editor will appear as shown in Figure 5-2.

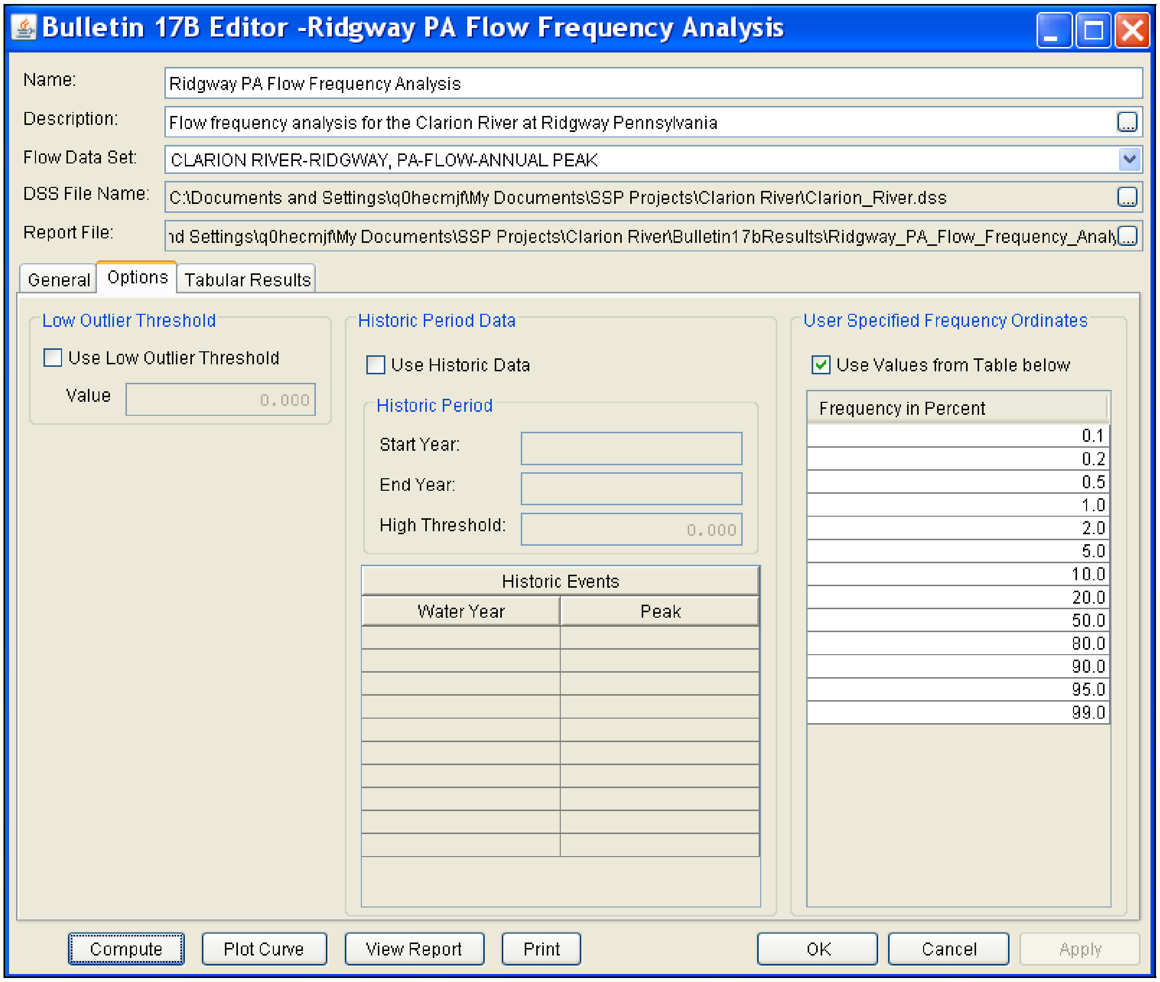
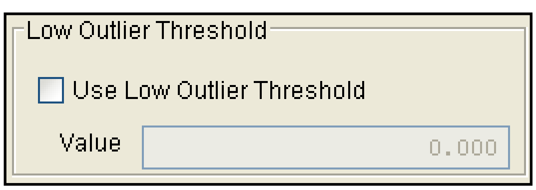


Figure 5-2. Bulletin 17B Editor with Options Tab Selected.

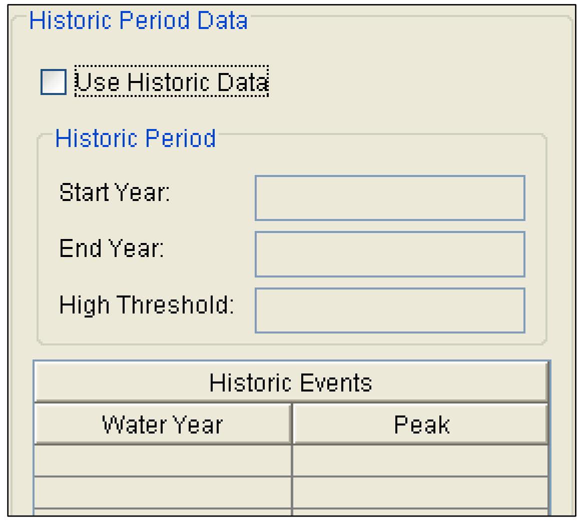
Low Outlier Threshold

High and low outlier tests are based on the procedures outlined in Bulletin 17B. The calculated outlier magnitudes, by the Bulletin 17B



procedures, are used as default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different value for the low outlier threshold. If a value is entered for the low outlier threshold, then this value will override the computed value from Bulletin 17B procedure. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analysts should try to incorporate historical period information to extend the time period for which the high outlier(s) is considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide. To use the low outlier threshold, simply check the box and enter the value.

Historic Period Data

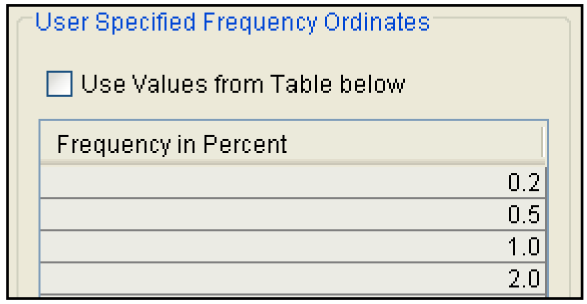


Any historic data that provides reliable estimates of flood peaks outside the systematic record should be used in order to modify and improve the frequency computations. Flood information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. To use historic data in HEC-SSP, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period, and a high threshold value. If the user enters a high threshold value, then any value in the systematic record greater than that value will also be treated as a historical flood peak. The user can also enter historic flood peaks that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Flood Peaks**. All years must be entered as water year values (October 1 through September 30). If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide.

Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record). Please see test example 6 in Appendix B for an example of using the historic data adjustment.

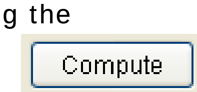
User Specified Frequency Ordinates

This option allows the user to change the frequency ordinates used in computing the resulting frequency curves and confidence limits. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.



Compute

Once the new analysis has been defined, and the user has all of the settings and options the way they want them, performing the computations is simply a matter of pressing the **Compute** button at the bottom of the Bulletin 17B Editor.



Once the compute button is pressed, the flow frequency computations are performed. If the computations are successful, the user will receive a message that says **Compute Complete**. At this point, the user can begin to review the results of the flow frequency analysis.

Multiple Bulletin 17B analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Viewing and Printing Results

The user can view output from the flow frequency analysis directly from the Bulletin 17B Editor. The output consists of tabular results, a frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the flow frequency analysis are completed, the user can view tabular output by opening the **Tabular Results** tab. When this tab is pressed, the results will be displayed as shown in Figure 5-3.

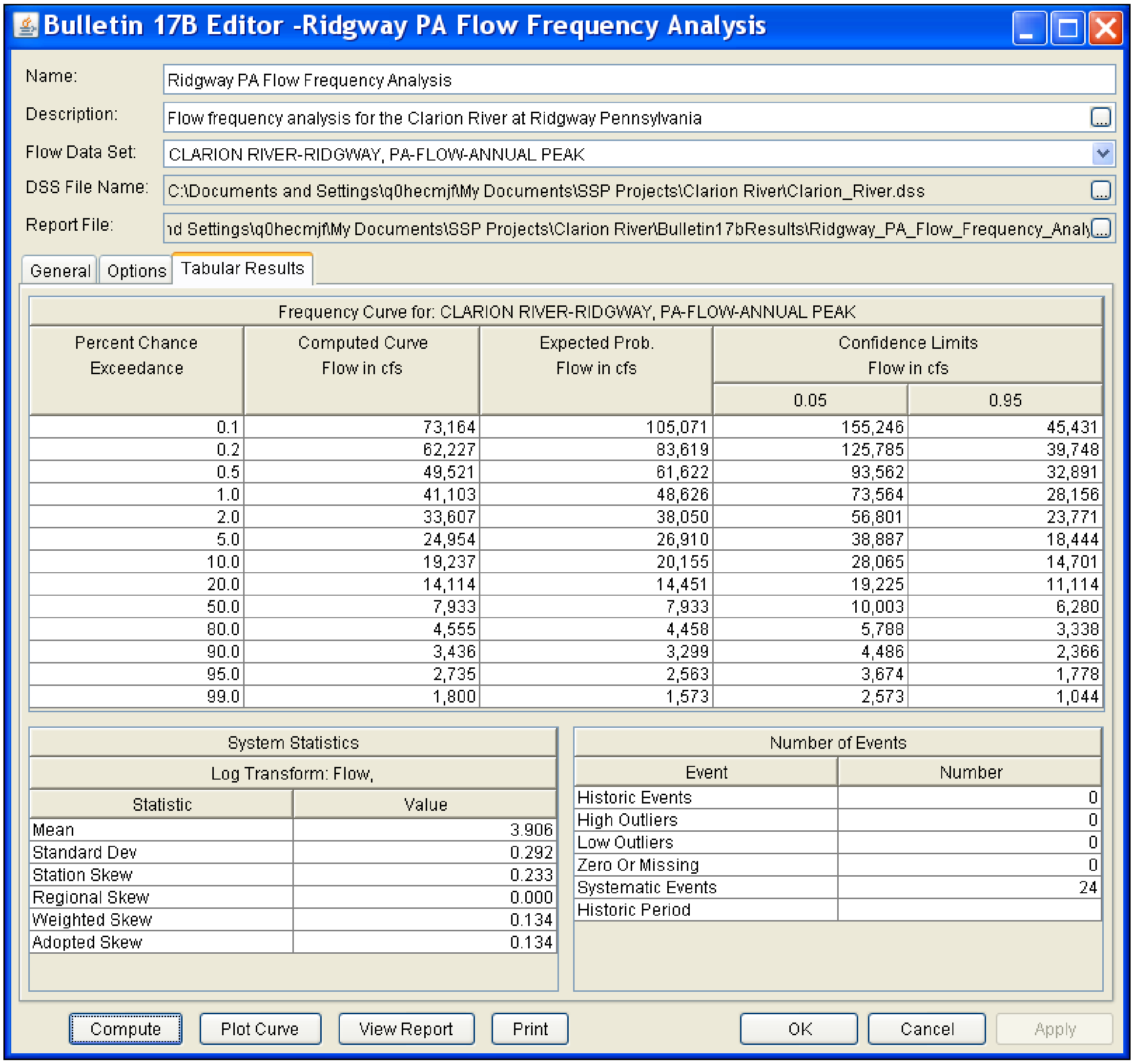


Figure 5-3. Bulletin 17B Editor with Tabular Results Tab Active.

Output on the results tab consists of three tables: Frequency Curves, System Statistics, and Number of Events. The **Frequency Curve** output table contains the percent chance of exceedance ordinates, the computed Log Pearson III frequency curve, the expected probability adjusted frequency curve, the 5% chance of exceedance confidence limit, and the 95% chance of exceedance confidence limit. The **System Statistics** table contains the mean of the data in log space, standard deviation in log space, station skew, user entered regional skew, weighted skew (weighted between station skew and regional skew), and the adopted skew for the analysis. The **Number of Events** table tabulates the number of historic events, high outliers, low outliers, zero or missing values, systematic events, and the number of years in the historic period (this value only comes into play if the user entered historic data).

The tabular results can be printed by using the **Print** button at the bottom of the Bulletin 17B Editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed.

Graphical Output

Graphical output of the frequency curves can be obtained by pressing the **Plot Curve** button. When the Plot Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 5-4. The user can modify the plot properties by selecting the **Edit→Plot Properties** menu option. A plot properties window will open that lets the user change the line style for each data type, change the axis labels, modify the plot title, and edit other plot properties. The user can also edit line styles by placing the mouse on top of the line or data point in the plot or legend and clicking the right mouse button. Then select the **Edit Properties** menu option in the shortcut menu.

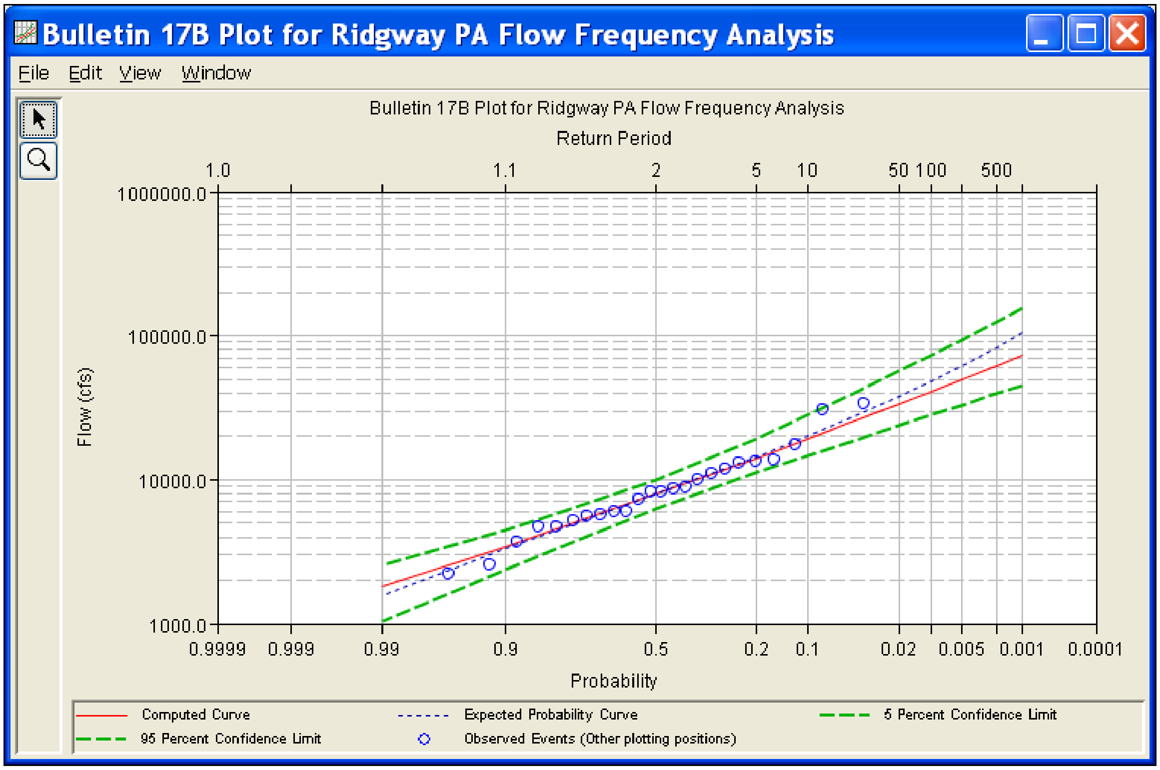


Figure 5-4. Example Frequency Curve Plot.

The frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently, four file formats are available for saving the graphic to disk, windows metafile, postscript, JPEG, and portable network graphic.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the **File** menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the graphics options as a template (**Save Template)** and applying previously saved templates to the current graphic (**Apply Template**).

The **Edit** menu on the graphic window contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties.

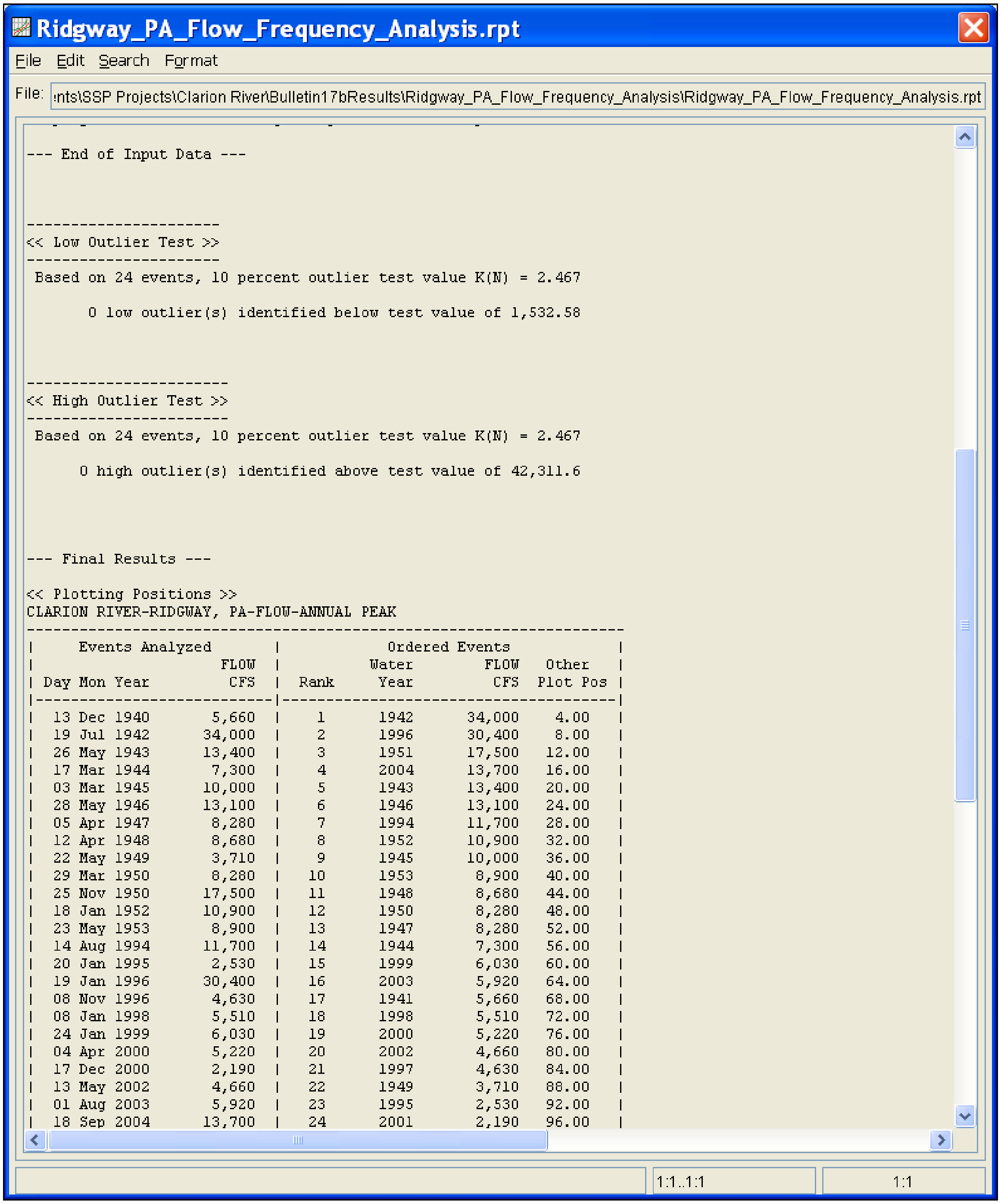
Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend.

The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing graphics in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

When the Bulletin 17B computations are performed, the computations module writes a report file of the statistical computations. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding how the software arrived at the final frequency curve.

Press the **View Report** button at the bottom of the Bulletin 17B Analysis window to view the report file. When this button is pressed a window will appear containing the text report as shown in Figure 5-5.


Ridgway_PA_Flow_Frequency_Analysis.rpt

File Edit Search Format

File: :nts\SSP Projects\Clarion River\Bulletin17bResults\Ridgway_PA_Flow_Frequency_Analysis\Ridgway_PA_Flow_Frequency_Analysis.rpt

--- End of Input Data ---

<< Low Outlier Test >>

Based on 24 events, 10 percent outlier test value K(N) = 2.467

0 low outlier(s) identified below test value of 1,532.58

<< High Outlier Test >>

Based on 24 events, 10 percent outlier test value K(N) = 2.467

0 high outlier(s) identified above test value of 42,311.6

--- Final Results ---

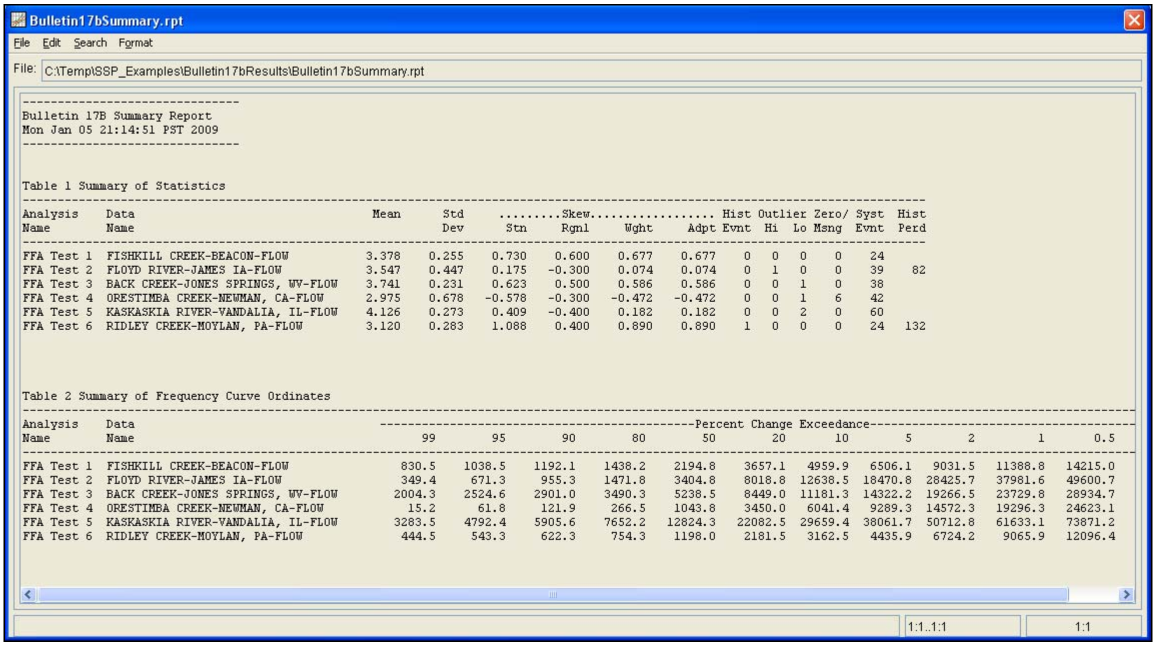
<< Plotting Positions >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK

Events Analyzed				Ordered Events			
Day	Mon	Year	FLOW CFS	Rank	Water Year	FLOW CFS	Other Plot Pos
13	Dec	1940	5,660	1	1942	34,000	4.00
19	Jul	1942	34,000	2	1996	30,400	8.00
26	May	1943	13,400	3	1951	17,500	12.00
17	Mar	1944	7,300	4	2004	13,700	16.00
03	Mar	1945	10,000	5	1943	13,400	20.00
28	May	1946	13,100	6	1946	13,100	24.00
05	Apr	1947	8,280	7	1994	11,700	28.00
12	Apr	1948	8,680	8	1952	10,900	32.00
22	May	1949	3,710	9	1945	10,000	36.00
29	Mar	1950	8,280	10	1953	8,900	40.00
25	Nov	1950	17,500	11	1948	8,680	44.00
18	Jan	1952	10,900	12	1950	8,280	48.00
23	May	1953	8,900	13	1947	8,280	52.00
14	Aug	1994	11,700	14	1944	7,300	56.00
20	Jan	1995	2,530	15	1999	6,030	60.00
19	Jan	1996	30,400	16	2003	5,920	64.00
08	Nov	1996	4,630	17	1941	5,660	68.00
08	Jan	1998	5,510	18	1998	5,510	72.00
24	Jan	1999	6,030	19	2000	5,220	76.00
04	Apr	2000	5,220	20	2002	4,660	80.00
17	Dec	2000	2,190	21	1997	4,630	84.00
13	May	2002	4,660	22	1949	3,710	88.00
01	Aug	2003	5,920	23	1995	2,530	92.00
18	Sep	2004	13,700	24	2001	2,190	96.00

1:1..1:1 1:1

Figure 5-5. Example of the Bulletin 17B Report File.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one Bulletin 17B analysis must be selected in the tree before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study tree when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 5-6.


Bulletin17bSummary.rpt

File Edit Search Format

File: C:\Temp\SSP_Examples\Bulletin17bResults\Bulletin17bSummary.rpt

Bulletin 17B Summary Report
Mon Jan 05 21:14:51 PST 2009

Table 1 Summary of Statistics

Analysis Name	Data Name	Mean	Std Dev	Skew Stn	Skew Rgnl	Skew Wght	Skew Adpt	Hist Evnt	Outlier Hi	Outlier Lo	Zero/ Msng	Syst Evnt	Hist Perd
FFA Test 1	FISHKILL CREEK-BEACON-FLOW	3.378	0.255	0.730	0.600	0.677	0.677	0	0	0	0	24	
FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	3.547	0.447	0.175	-0.300	0.074	0.074	0	1	0	0	39	82
FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	3.741	0.231	0.623	0.500	0.586	0.586	0	0	1	0	38	
FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	2.975	0.678	-0.578	-0.300	-0.472	-0.472	0	0	1	6	42	
FFA Test 5	KASKASKIA RIVER-VANDALIA, IL-FLOW	4.126	0.273	0.409	-0.400	0.182	0.182	0	0	2	0	60	
FFA Test 6	RIDLEY CREEK-MOYLAN, PA-FLOW	3.120	0.283	1.088	0.400	0.890	0.890	1	0	0	0	24	132

Table 2 Summary of Frequency Curve Ordinates

Analysis Name	Data Name	Percent Change Exceedance 99	95	90	80	50	20	10	5	2	1	0.5
FFA Test 1	FISHKILL CREEK-BEACON-FLOW	830.5	1038.5	1192.1	1438.2	2194.8	3657.1	4959.9	6506.1	9031.5	11388.8	14215.0
FFA Test 2	FLOYD RIVER-JAMES IA-FLOW	349.4	671.3	955.3	1471.8	3404.8	8018.8	12638.5	18470.8	28425.7	37981.6	49600.7
FFA Test 3	BACK CREEK-JONES SPRINGS, WV-FLOW	2004.3	2524.6	2901.0	3490.3	5238.5	8449.0	11181.3	14322.2	19266.5	23729.8	28934.7
FFA Test 4	ORESTIMBA CREEK-NEWMAN, CA-FLOW	15.2	61.8	121.9	266.5	1043.8	3450.0	6041.4	9289.3	14572.3	19296.3	24623.1
FFA Test 5	KASKASKIA RIVER-VANDALIA, IL-FLOW	3283.5	4792.4	5905.6	7652.2	12824.3	22082.5	29659.4	38061.7	50712.8	61633.1	73871.2
FFA Test 6	RIDLEY CREEK-MOYLAN, PA-FLOW	444.5	543.3	622.3	754.3	1198.0	2181.5	3162.5	4435.9	6724.2	9065.9	12096.4

1:1..1:1 1:1

Figure 5-6. Summary Table for Selected Bulletin 17B Analyses.

CHAPTER 6

Performing a Generalized Frequency Analysis

The current version of HEC-SSP allows the user to perform generalized frequency analyses of flow and stage data, as well as other data types. The user can choose between different analytical distributions as well as perform a graphical fit to the data. This chapter discusses in detail how to use the Generalized Frequency analysis editor with HEC-SSP.

Contents

Starting a New Analysis

A generalized frequency analysis can be started in two ways, either by right clicking on the Generalized Frequency Analysis folder in the study tree and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Generalized Frequency Analysis**. When a new generalized frequency analysis is selected, the Generalized Frequency editor will appear as shown in Figure 6-1.

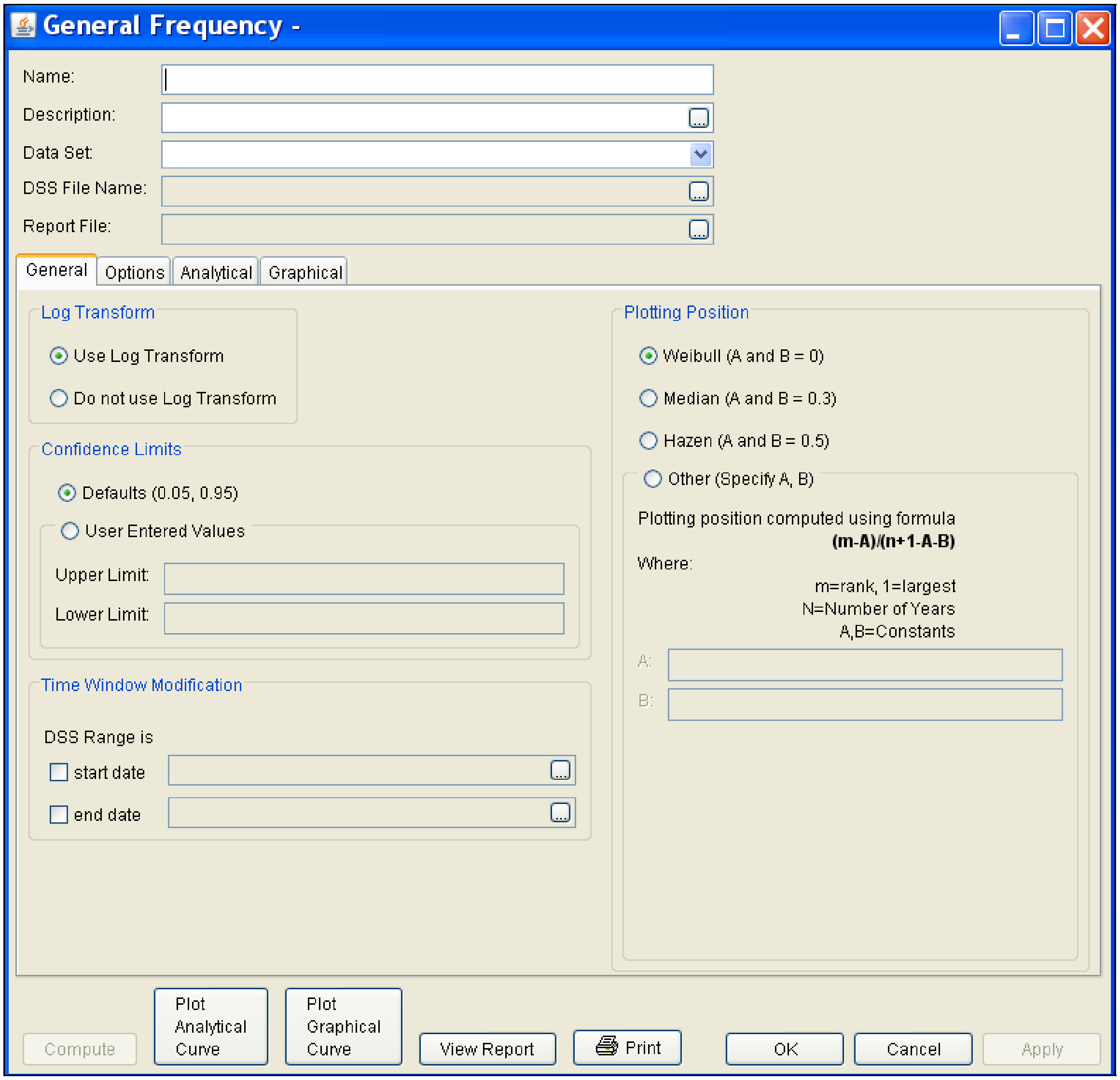


Figure 6-1. Generalized Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis, while a **Description** is optional. A data set (flow, stage, or other) must be selected from the available data sets stored in the current study DSS file (see Chapter 4 for importing data into the study). Once a Name is entered and a data set is selected, the **DSS File Name** and **Report**

File will automatically be filled out. The DSS filename is by default the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings and Options

Once the analysis name and data set are selected, the user can begin to perform the computations. Contained on the Generalized Frequency editor are four tabs. The tabs are labeled **General**, **Options**, **Analytical**, and **Graphical**. This section of the manual explains the use of the General and Options tabs.

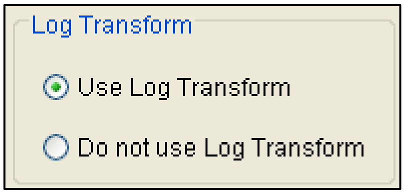
General Settings

The first tab contains general settings for performing the frequency analysis (Figure 6-1). These settings include:

- Log Transforms
- Plotting Positions
- Confidence Limits
- Time Window Modification

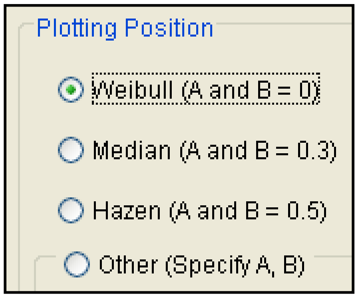
Log Transform

There are two options contained within the Log Transform setting: Use Log Transform and Do not use Log Transform. If the user selects **Use Log Transform** then the logs of the data will be taken first. The frequency analysis will be performed on the logs of the data. If the user selects **Do not use Log Transform**, then the frequency analysis will be performed on the raw data values without taking the logs of the data. The default setting is **Use Log Transform**.



Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position methodologies within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Weibull plotting position formula. The generalized plotting position equation is:



$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

Where: m = rank of flood values with the largest equal to 1.

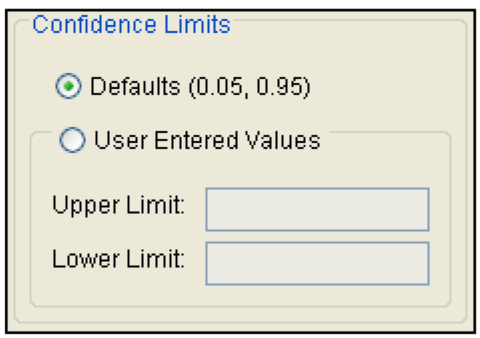
n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

Plotting positions are estimates of the exceedance probability of each data point. Different methods can give very different values for the probabilities of the highest and lowest points in the data set. In the Generalized Frequency methodology, the plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

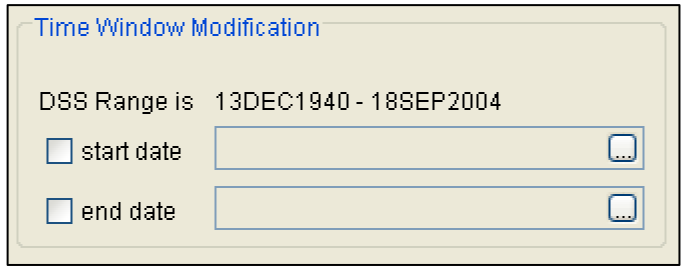
Confidence Limits

Confidence limits provide a measure of the uncertainty in the computed value for a given exceedance probability. The computation of confidence limits is outlined in Bulletin 17B Appendix 9, and is applied in the same manner here in the generalized frequency analysis. By default, HEC-SSP calculates the 90 percent confidence interval (i.e. the 5% and 95% confidence limits). The confidence limits must be entered in decimal form (i.e. 95% = 0.95, and 5% = 0.05). The user has the option to override the default values.



Time Window Modification

This option allows the user to narrow the time window used for the analysis. The default is to use all of the data contained in the selected data set. The user can enter either a start date and end date or both a start and end date. If a start and/or end date are used, they must be dates that are encompassed within the data stored in the selected data set. The date range for the selected data set is shown in the editor just above the **Start Date** field.



Options

In addition to the general settings, there are also several options available to the user for modifying the computations of the frequency curves. These options include:

- Low Outlier Threshold
- Historic Period Data
- User-Specified Frequency Ordinates
- Output Labeling

When the Options tab is selected, the Generalized Frequency editor will appear as shown in Figure 6-2.

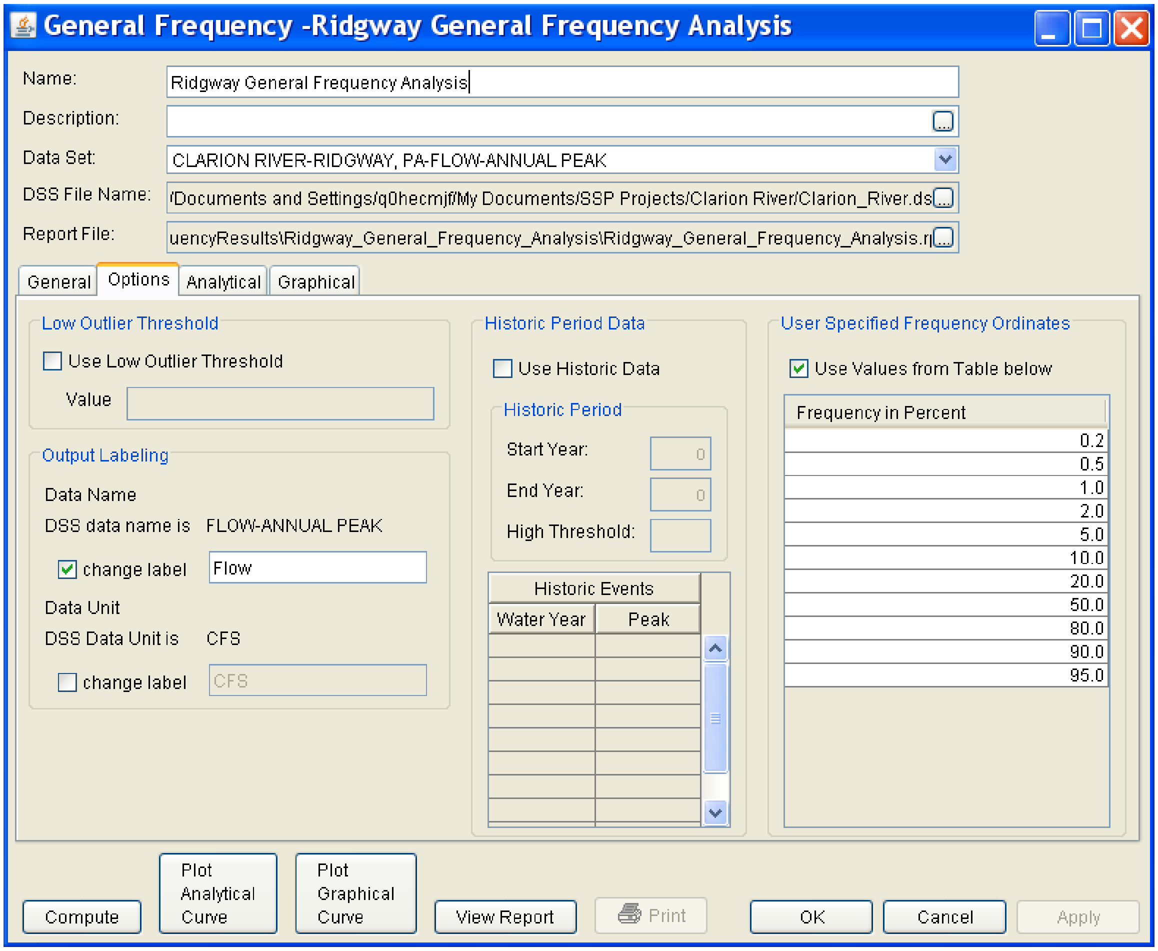
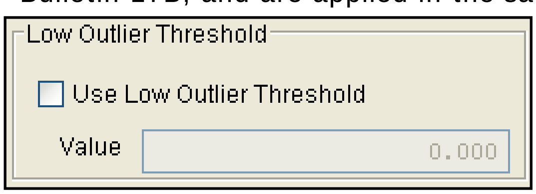


Figure 6-2. General Frequency Editor with Options Tab Selected.

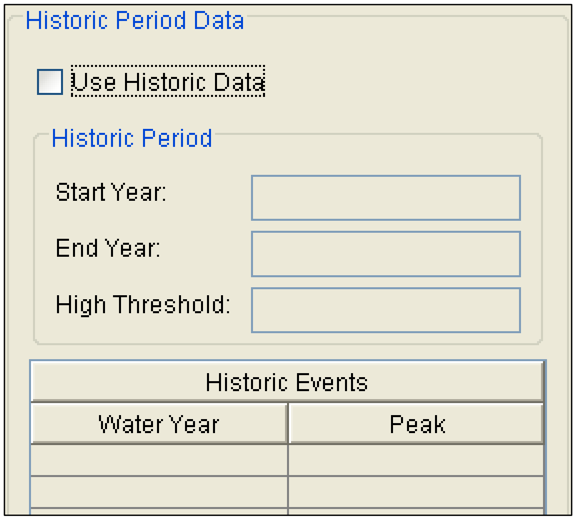
Low Outlier Threshold



High and low outlier tests are based on the procedures outlined in Bulletin 17B, and are applied in the same manner in the Generalized Frequency Analysis. The calculated outlier magnitudes, by the Bulletin 17B procedure, are used as default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different value for the low outlier threshold. If a value is entered for the low outlier threshold, then this value will override the computed value from the Bulletin 17B methodology. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analysts should try to incorporate historical period information to extend the time period for which the high outlier(s) is considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide. To use the low outlier threshold, simply check the box and enter the value.

Historic Period Data

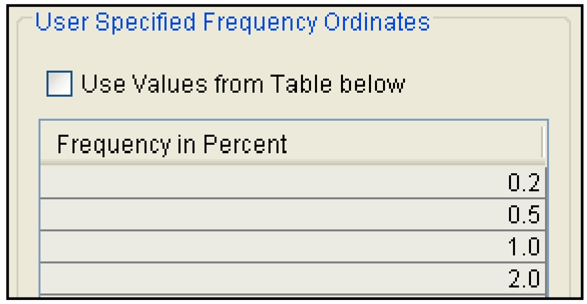
Any historic data that provides reliable estimates outside the systematic record should be used in order to modify and improve the frequency computations. Information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. This calculation is applied in the same manner in the Generalized Frequency Analysis. To use historic data, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period, and a High Threshold value. If the user enters a high threshold value, then any data in the systematic record greater than that value will also be treated as a historical annual maximum. The user can also enter historic data that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Events**. All years must be entered as water year values (October 1 through September 30). If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide.



Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record). Please see test example 6 in Appendix B for an example of using the historic data adjustment.

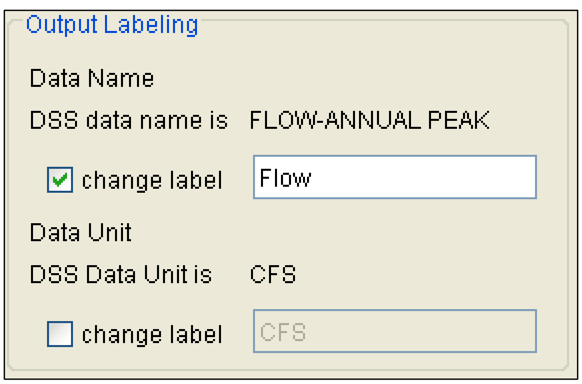
User Specified Frequency Ordinates

This option allows the user to change the frequency ordinates used in computing the resulting frequency curves and confidence limits. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option are not checked. Finally, all values in the table must be between 0 and 100.



Output Labeling

This option allows the user to change the default labels for data contained in the output tables and plots. The user can change both the name of the data as well as how the units of the data are labeled.



Analytical Frequency Analysis

Once the new analysis has been defined and the user has all of the general settings and options the way they want them, the user can choose between performing an Analytical Frequency analysis or a Graphical Frequency analysis. This section of the manual describes how to use the Analytical Frequency analysis option.

When the user selects the **Analytical** tab on the Generalized Frequency Analysis editor, the window will appear as shown in Figure 6-3. As shown, three additional tabs will appear on the screen: Settings, Tabular Results, and Plot.

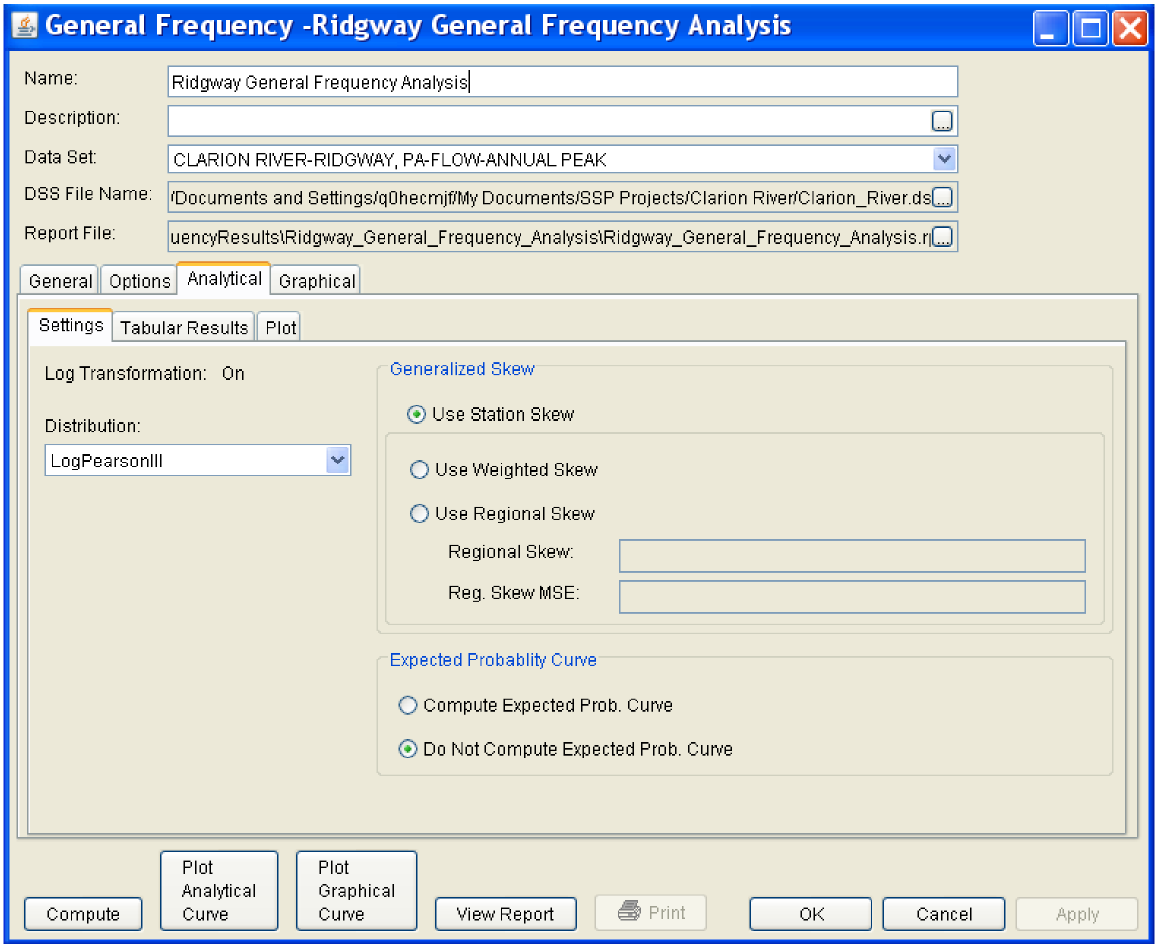


Figure 6-3. Analytical Analysis Tab of the Generalized Frequency Editor.

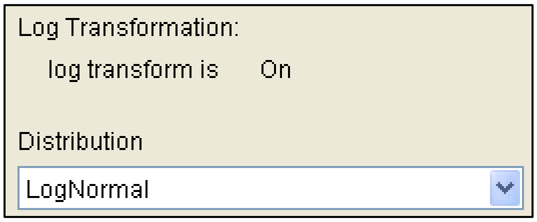
Settings

The **Settings** tab contains additional settings for the analytical frequency analysis. These settings include:

- Distribution
- Generalized Skew
- Expected Probability Curve

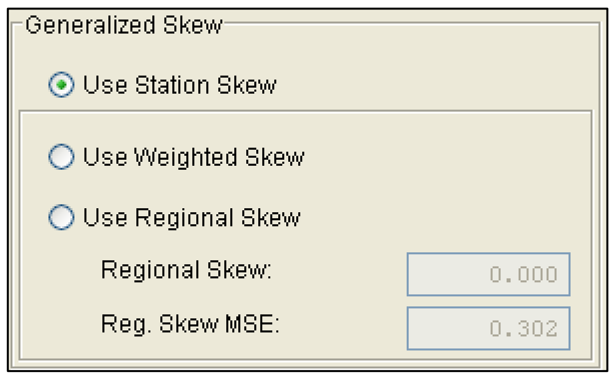
Distribution

This option allows the user to select from available analytical distributions to perform the frequency analysis. The current version of HEC-SSP contains five distribution choices: None, Normal, LogNormal, Pearson III, and LogPearson III. If the user has selected to transform the data to log space (General tab), then the only available choices for distribution will be None, LogNormal, and LogPearson III. If the user did not select the option to transform the data to log space (General tab), then the only available choices for distribution will be None, Normal and Pearson III.



Generalized Skew

There are three options contained within the generalized skew setting: Use Station Skew, Use Weighted Skew, and Use Regional Skew. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points.

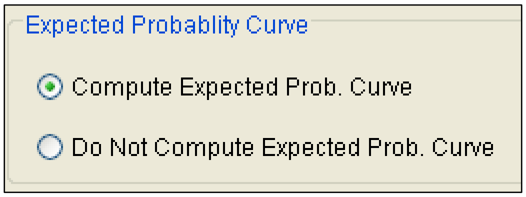


The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a Mean-Square Error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (Equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The last generalized skew option is **Use Regional Skew**. When this option is selected, the user must enter a generalized regional skew and an MSE for that skew. The program will ignore the computed station skew and use only the generalized regional skew.

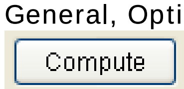
Expected Probability Curve

This setting has two options: Compute the expected probability curve and do not compute the expected probability curve. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the tables and the plots as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Compute

Once the new analysis has been defined, and the user has all of the General, Options, and Settings information selected the way they want, performing the computations is simply a matter of pressing the **Compute** button at the bottom of the Generalized Frequency editor.



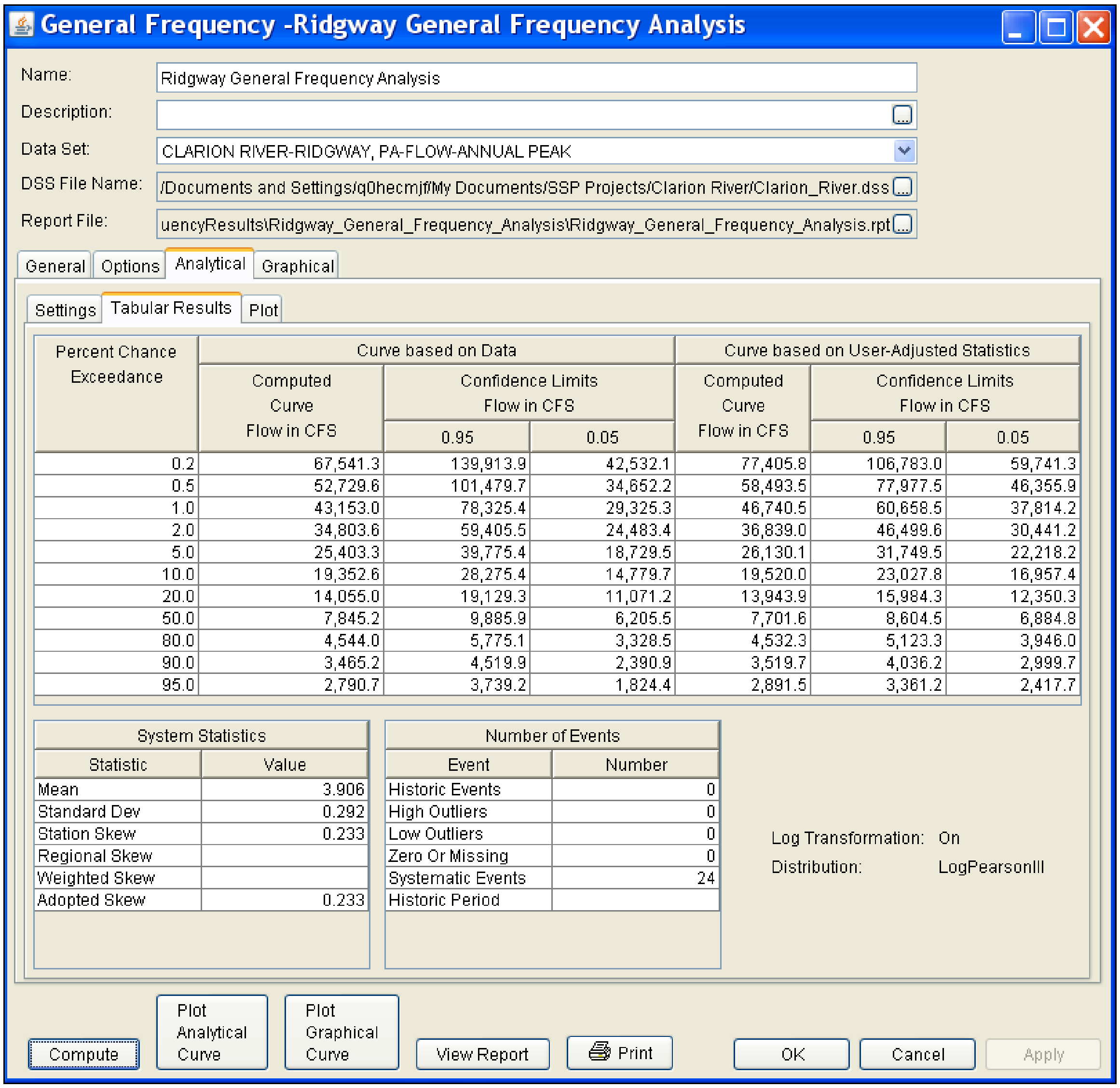
Once the compute button is pressed, the frequency computations are performed. If the computations are successful, the user will receive a message that says “Compute Complete”. At this point, the user can begin to review the results of the Analytical Frequency computations.

Multiple General Frequency analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Tabular Results

The **Tabular Results** tab will bring up a table of results for the Analytical Frequency analysis. An example of the results tab is shown in Figure 6-4.

As shown in Figure 6-4, the window contains three tables. The top table contains results of the computed frequency curve. The very left column of the top table is the Percent Chance Exceedance for all the computed values. The next three columns in the top table contain the computed frequency curve and the 95% and 5% confidence limits that correspond to that computed curve. The last three columns of the top table contain a computed frequency curve and confidence limits for an analysis based on user-adjusted statistics for the mean, standard deviation, adopted skew, and equivalent years of record. User entered adjusted statistics are an option that the user can set on the **Plot** tab, which is discussed in detail in the next section of this manual. If the user has not entered adjusted statistics, then these columns will be empty.



Percent Chance Exceedance	Curve based on Data: Computed Curve Flow in CFS	Curve based on Data: Confidence Limits Flow in CFS 0.95	Curve based on Data: Confidence Limits Flow in CFS 0.05	Curve based on User-Adjusted Statistics: Computed Curve Flow in CFS	Curve based on User-Adjusted Statistics: Confidence Limits Flow in CFS 0.95	Curve based on User-Adjusted Statistics: Confidence Limits Flow in CFS 0.05
0.2	67,541.3	139,913.9	42,532.1	77,405.8	106,783.0	59,741.3
0.5	52,729.6	101,479.7	34,652.2	58,493.5	77,977.5	46,355.9
1.0	43,153.0	78,325.4	29,325.3	46,740.5	60,658.5	37,814.2
2.0	34,803.6	59,405.5	24,483.4	36,839.0	46,499.6	30,441.2
5.0	25,403.3	39,775.4	18,729.5	26,130.1	31,749.5	22,218.2
10.0	19,352.6	28,275.4	14,779.7	19,520.0	23,027.8	16,957.4
20.0	14,055.0	19,129.3	11,071.2	13,943.9	15,984.3	12,350.3
50.0	7,845.2	9,885.9	6,205.5	7,701.6	8,604.5	6,884.8
80.0	4,544.0	5,775.1	3,328.5	4,532.3	5,123.3	3,946.0
90.0	3,465.2	4,519.9	2,390.9	3,519.7	4,036.2	2,999.7
95.0	2,790.7	3,739.2	1,824.4	2,891.5	3,361.2	2,417.7

System Statistics: Statistic	Value
Mean	3.906
Standard Dev	0.292
Station Skew	0.233
Regional Skew	
Weighted Skew	
Adopted Skew	0.233

Number of Events: Event	Number
Historic Events	0
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	24
Historic Period	

Figure 6-4. Tabular Results Tab for Analytical Analysis.

Two additional tables are shown at the bottom of the window: System Statistics and Number of Events. The **System Statistics** table consists of the mean, standard deviation, station skew, user entered regional skew, weighted skew (weighted between station skew and regional skew), and the adopted skew for the analysis. The **Number of Events** table contains the number of historic events, high outliers, low outliers, zero or missing values, systematic events, and the number of years in the historic period (this value only comes into play if the user entered historic data).

Additionally, the lower right portion of the table will show if Log Transform is On or Off, and which analytical distribution was selected for the analysis.

Plot

In addition to tabular results, a **Plot** tab is available for viewing a graphical plot of both the computed frequency curve, as well as a computed curve based on any user-adjusted statistics. When the Plot tab is selected the window will change to what is shown in Figure 6-5.

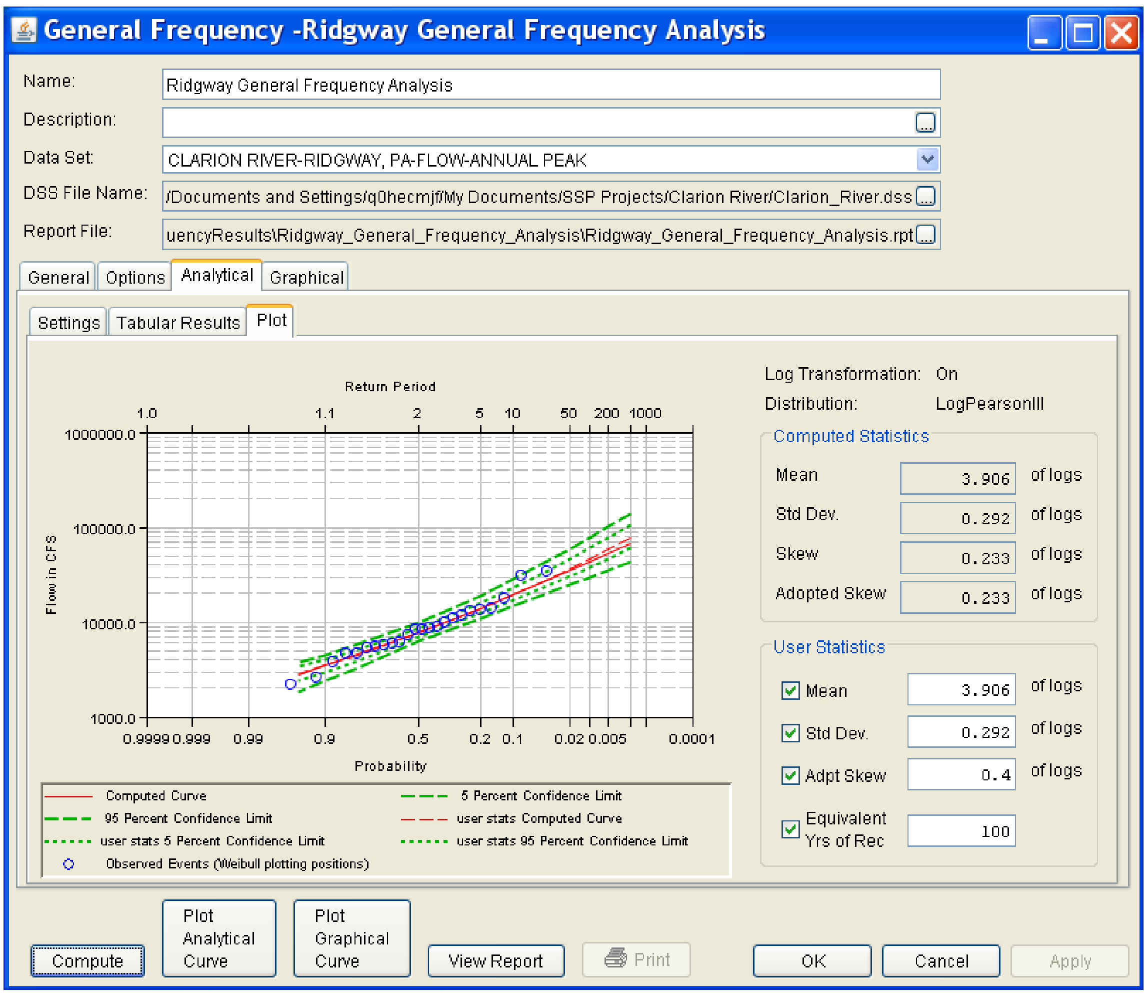


Figure 6-5. Plot Tab of the Generalized Frequency Analytical Analysis.

As shown in Figure 6-5, the plot contains the computed frequency curve, 95 and 5% confidence limits, and raw data points plotted by the user selected plotting position method. The computed statistics for the frequency curve are shown in a table on the right side of the window. Below the computed statistics is a table labeled "User Statistics". There is a check box and a data entry field for the Mean, Standard Deviation, Adopted Skew, and Equivalent Years of Record. The user can enter values into any or all of these fields. Turning on the check box then enacts that field to be used in computing a curve with the user entered statistic overriding the computed value from the raw data. The user statistics option allows the user to see how the curve would change if any or all of the statistics were different. When data is entered into the user statistics fields, and the check boxes are turned on, the user must press the compute button again in order for the computations to be performed with the user entered statistics. After the compute button is pressed, both the plot and the table on the Tabular Results tab will be updated to reflect any user entered statistics.

Graphical Frequency Analysis

In addition to an analytical frequency analysis which uses a statistical distribution fit to the data, the user has the option to graphically fit a curve to the data. A graphical fit can be very useful when the available analytical distributions do not provide a good fit to the data. One example of when a graphical frequency analysis is most appropriate is when plotting a frequency curve for flow data that is downstream of a flood control reservoir. Analytical frequency distributions are often not appropriate for fitting flow data that is significantly regulated by upstream reservoirs. In general, a portion of the flow frequency data for a highly regulated stream will be very flat in the zone in which upstream regulation can control the flows for a range of frequencies. This type of data lends itself to a graphical fit analysis over the use of an analytical equation. Another example of using a graphical fitting technique over an analytical curve is when trying to compute a frequency curve to annual peak stage data at a point on a river. Often the stages will flatten out with decreased frequencies when flows go out into the overbank and floodplain area. Again, this type of data is fitted much better using a graphical fit curve instead of an analytical distribution.

When the **Graphical** tab is selected, the editor will display a plot and table as shown in Figure 6-6. In the plot, the data will be plotted using the user selected plotting position method. The table to the right of the plot allows the user to enter data values for the frequency ordinates defined on the Options tab. When the user enters values in this table, those values will be plotted as a line on the plot after the **Compute** button is pressed. The idea is to enter values in the table that will create a best fit line of the data, based on the user's judgment.

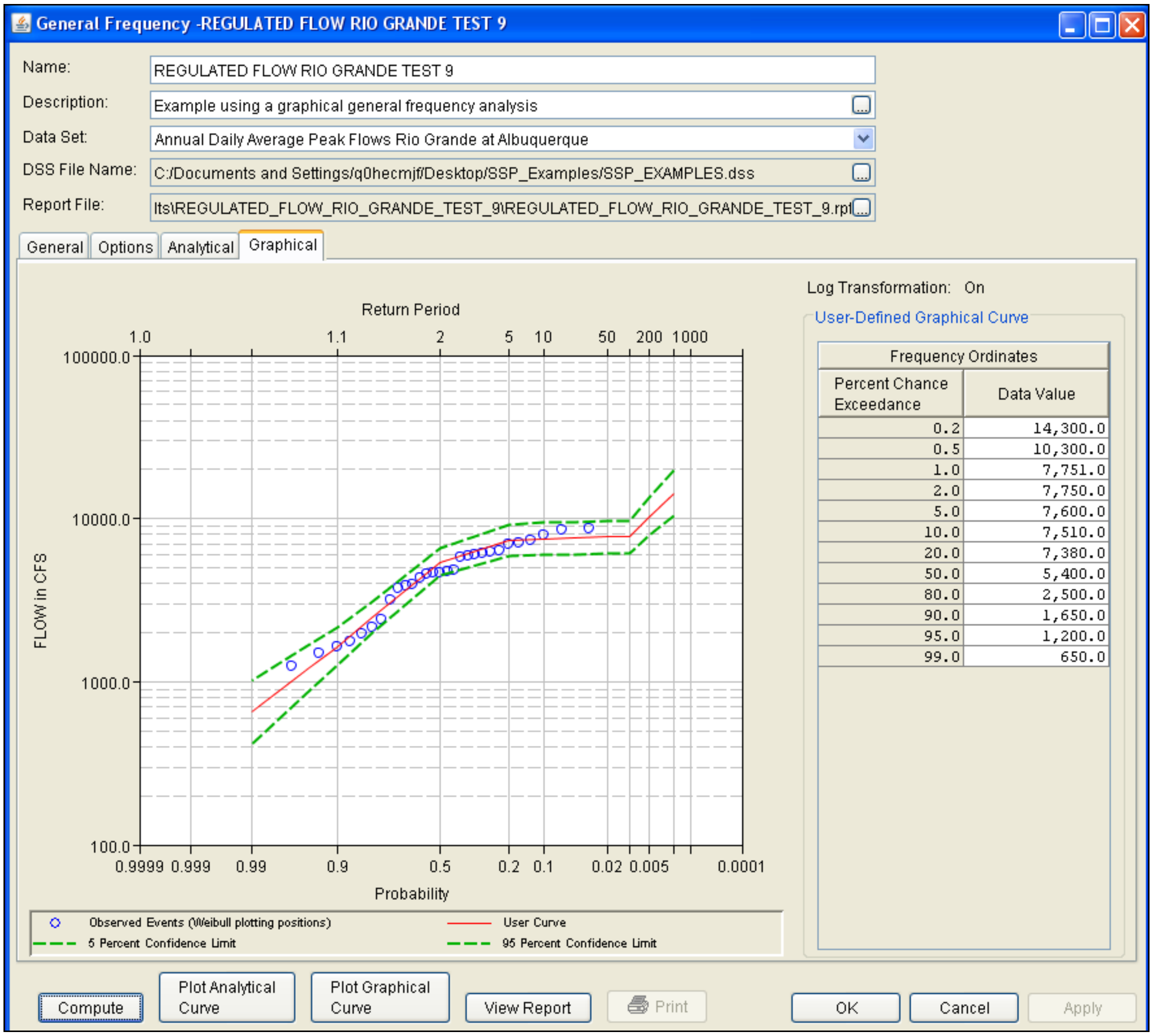


Figure 6-6. Graphical Analysis Tab of the Generalized Frequency Editor.

Viewing and Printing Results

The user can view output for the frequency analysis directly from the Generalized Frequency editor (Tabular and Graphical output) or by using the plot and view buttons at the bottom of the editor. The output consists of tabular results, an analytical frequency curve plot, a graphical frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the analytical frequency analysis are completed, the user can view tabular output by selecting the **Tabular**

Results tab under the **Analytical** analysis tab. The details of this table were discussed under the analytical analysis option above.

The tabular results can be printed by using the **Print** button at the bottom of the Generalized Frequency editor. When the print button is pressed, a window will appear giving the user options for how they would like the table to be printed.

Graphical Output

Graphical output of the analytical frequency curve can be obtained by selecting either the **Plot** tab under the analytical analysis tab, or by pressing the button labeled **Plot Analytical Curve** at the bottom of the general frequency editor. When the Plot Analytical Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 6-7.

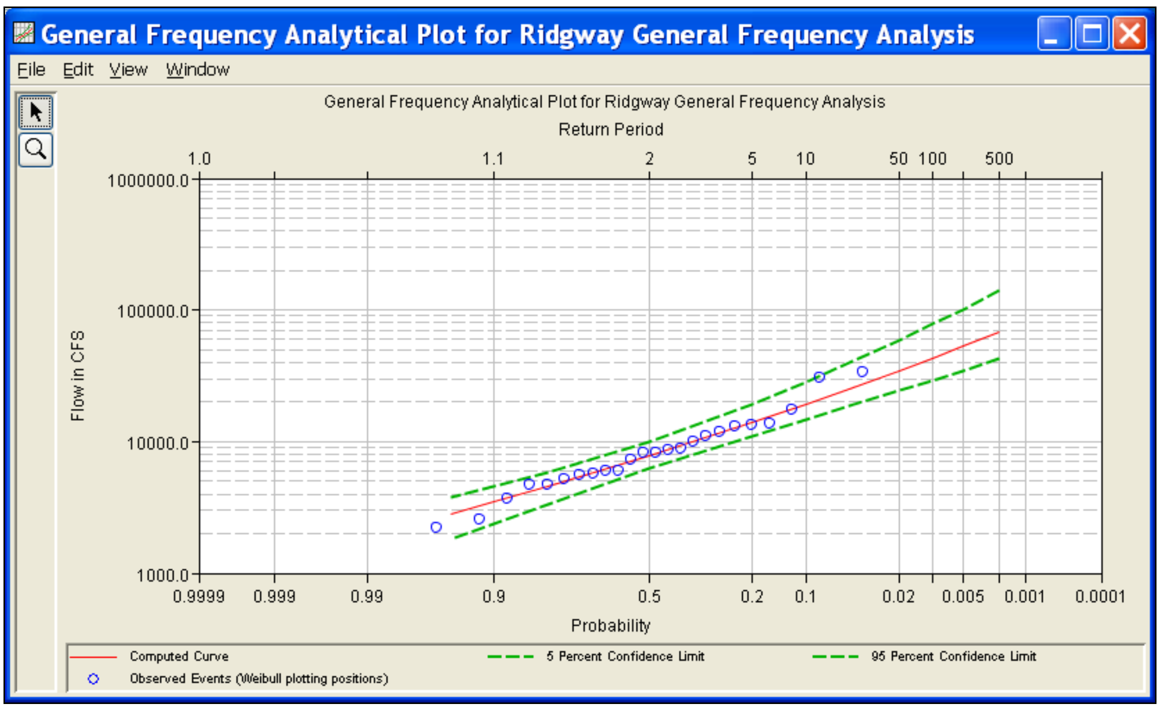


Figure 6-7. Analytical Analysis Frequency Curve Plot.

The analytical frequency curve plot can be sent to the printer by selecting the **Print** option from the **File** menu at the top of the window. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The graphic can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the graphic to disk: windows metafile, postscript, JPEG, and portable network graphic.

The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot options as a template (**Save Template)** and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the graphic. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, a shortcut menu will appear with further customizing options when the user right-clicks on a line on the graph or the legend. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

A plot of the graphical frequency curve can be obtained by pressing either the **Graphical** tab, or by pressing the button labeled **Plot Graphical Curve** at the bottom of the general frequency editor. When the Plot Graphical Curve button is pressed, a frequency curve plot will appear in a separate window as shown in Figure 6-8. All of the same options for tabulating, printing, and sending results to the windows clipboard are available for this plot as they are for the analytical frequency curve plot.

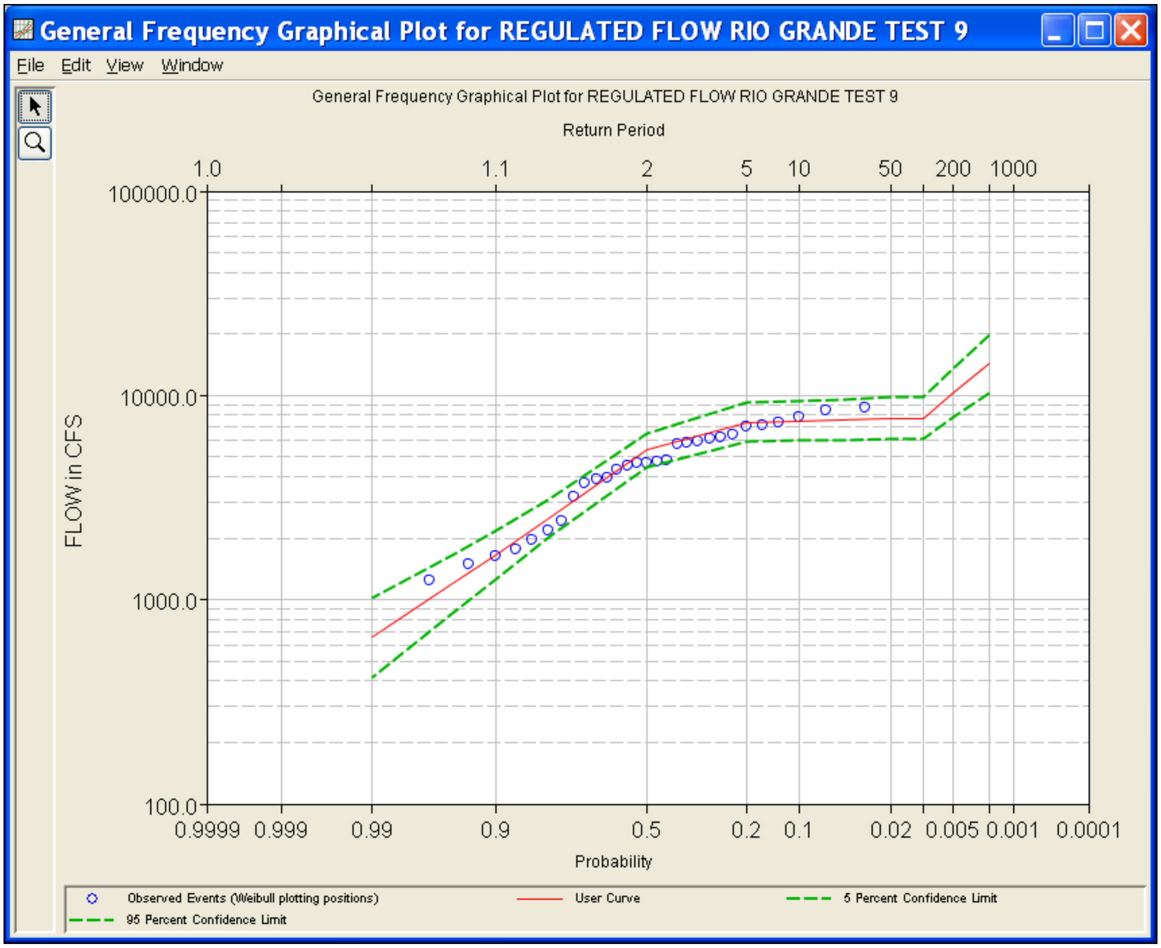


Figure 6-8. Graphical Analysis Frequency Curve Plot.

Viewing the Report File

When the General Frequency analysis computations are performed, the computations module writes a report file. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding how the software arrived at the final frequency curve.

To view the report file press the **View Report** button at the bottom of the General Frequency analysis window. When this button is pressed, a window will appear containing the text report as shown in Figure 6-9.

Ridgway_General_Frequency_Analysis.rpt

File Edit Search Format

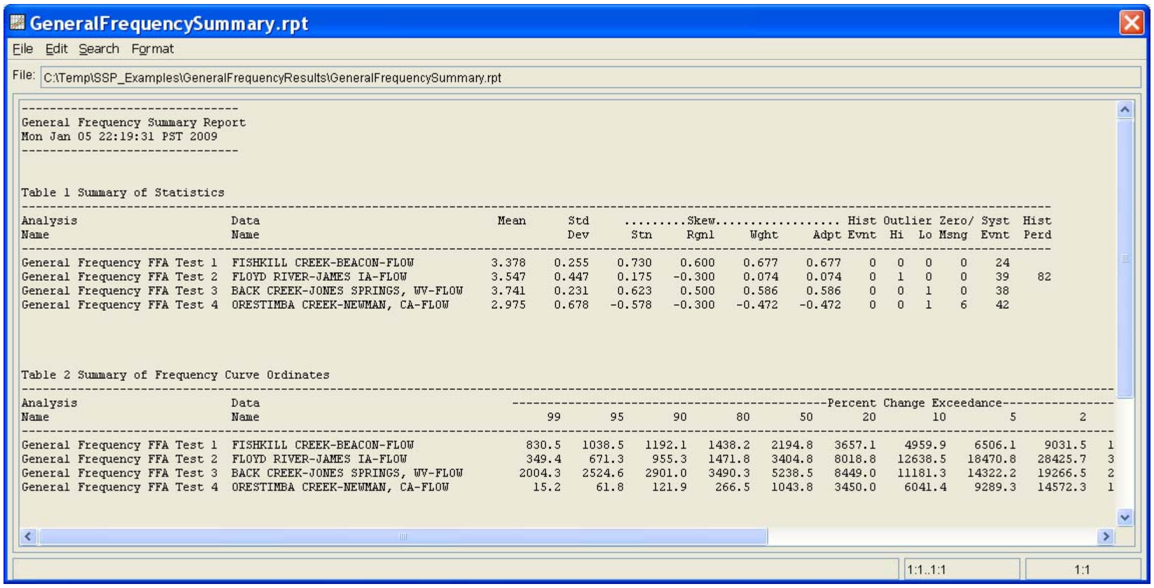
File: ırion River\GeneralFrequencyResults\Ridgway_General_Frequency_Analysis\Ridgway_General_Frequency_Analysis.rpt

```
 Based on 24 events, 10 percent outlier test value K(N) = 2.467

      0 high outlier(s) identified above test value of 42,311.6




--- Final Results ---

<< Plotting Positions >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK
--------------------------------------------------------------------
|     Events Analyzed        |            Ordered Events            |
|                      FLOW  |           Water         FLOW  Weibull |
| Day Mon Year          CFS  |  Rank     Year           CFS  Plot Pos |
|----------------------------|---------------------------------------|
|  13 Dec 1940     5,660.0   |    1      1942     34,000.0     4.00  |
|  19 Jul 1942    34,000.0   |    2      1996     30,400.0     8.00  |
|  26 May 1943    13,400.0   |    3      1951     17,500.0    12.00  |
|  17 Mar 1944     7,300.0   |    4      2004     13,700.0    16.00  |
|  03 Mar 1945    10,000.0   |    5      1943     13,400.0    20.00  |
|  28 May 1946    13,100.0   |    6      1946     13,100.0    24.00  |
|  05 Apr 1947     8,280.0   |    7      1994     11,700.0    28.00  |
|  12 Apr 1948     8,680.0   |    8      1952     10,900.0    32.00  |
|  22 May 1949     3,710.0   |    9      1945     10,000.0    36.00  |
|  29 Mar 1950     8,280.0   |   10      1953      8,900.0    40.00  |
|  25 Nov 1950    17,500.0   |   11      1948      8,680.0    44.00  |
|  18 Jan 1952    10,900.0   |   12      1950      8,280.0    48.00  |
|  23 May 1953     8,900.0   |   13      1947      8,280.0    52.00  |
|  14 Aug 1994    11,700.0   |   14      1944      7,300.0    56.00  |
|  20 Jan 1995     2,530.0   |   15      1999      6,030.0    60.00  |
|  19 Jan 1996    30,400.0   |   16      2003      5,920.0    64.00  |
|  08 Nov 1996     4,630.0   |   17      1941      5,660.0    68.00  |
|  08 Jan 1998     5,510.0   |   18      1998      5,510.0    72.00  |
|  24 Jan 1999     6,030.0   |   19      2000      5,220.0    76.00  |
|  04 Apr 2000     5,220.0   |   20      2002      4,660.0    80.00  |
|  17 Dec 2000     2,190.0   |   21      1997      4,630.0    84.00  |
|  13 May 2002     4,660.0   |   22      1949      3,710.0    88.00  |
|  01 Aug 2003     5,920.0   |   23      1995      2,530.0    92.00  |
|  18 Sep 2004    13,700.0   |   24      2001      2,190.0    96.00  |
|----------------------------|---------------------------------------|



<< Skew Weighting >>
---------------------------------------------------------------
Based on 24 events, mean-square error of station skew =   0.226
Mean-square error of regional skew is undefined.
---------------------------------------------------------------


<< Frequency Curve >>
CLARION RIVER-RIDGWAY, PA-FLOW-ANNUAL PEAK
-------------------------------------------------------------------
|  Computed     Expected   |  Percent     |    Confidence Limits    |
|    Curve    Probability  |  Chance      |       0.05        0.95  |
|        Flow, CFS         | Exceedance   |       Flow, CFS         |
|--------------------------|--------------|-------------------------|
|    67,541.3         ---  |      0.2     |   139,913.9    42,532.1 |
```

1:1..1:1 1:1

Figure 6-9. General Frequency Analysis Report File.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one General Frequency analysis must be selected in the study tree before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study tree when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 6-10.




```
------------------------------
General Frequency Summary Report
Mon Jan 05 22:19:31 PST 2009
------------------------------


Table 1 Summary of Statistics
-----------------------------------------------------------------------------------------------------------------------------
Analysis                      Data                                 Mean     Std     .........Skew................. Hist Outlier Zero/ Syst  Hist
Name                          Name                                          Dev      Stn     Rgnl     Wght     Adpt Evnt  Hi  Lo Msng  Evnt  Perd
-----------------------------------------------------------------------------------------------------------------------------
General Frequency FFA Test 1  FISHKILL CREEK-BEACON-FLOW          3.378    0.255    0.730    0.600    0.677    0.677    0   0   0    0    24
General Frequency FFA Test 2  FLOYD RIVER-JAMES IA-FLOW           3.547    0.447    0.175   -0.300    0.074    0.074    0   1   0    0    39    82
General Frequency FFA Test 3  BACK CREEK-JONES SPRINGS, WV-FLOW   3.741    0.231    0.623    0.500    0.586    0.586    0   0   1    0    38
General Frequency FFA Test 4  ORESTIMBA CREEK-NEWMAN, CA-FLOW     2.975    0.678   -0.578   -0.300   -0.472   -0.472    0   0   1    6    42



Table 2 Summary of Frequency Curve Ordinates
------------------------------------------------------------------------------------------------------------------------------------
Analysis                      Data                                  ---------------------------------------------Percent Change Exceedance---------------
Name                          Name                                       99       95       90       80       50       20       10        5        2
------------------------------------------------------------------------------------------------------------------------------------
General Frequency FFA Test 1  FISHKILL CREEK-BEACON-FLOW              830.5   1038.5   1192.1   1438.2   2194.8   3657.1   4959.9   6506.1   9031.5  1
General Frequency FFA Test 2  FLOYD RIVER-JAMES IA-FLOW               349.4    671.3    955.3   1471.8   3404.8   8018.8  12638.5  18470.8  28425.7  3
General Frequency FFA Test 3  BACK CREEK-JONES SPRINGS, WV-FLOW      2004.3   2524.6   2901.0   3490.3   5238.5   8449.0  11181.3  14322.2  19266.5  2
General Frequency FFA Test 4  ORESTIMBA CREEK-NEWMAN, CA-FLOW          15.2     61.8    121.9    266.5   1043.8   3450.0   6041.4   9289.3  14572.3  1
```

Figure 6-10. Summary Table for Selected General Frequency Analyses.

CHAPTER 7

Performing a Volume-Duration Frequency Analysis

The current version of HEC-SSP allows the user to perform a volume-duration frequency analysis of flow data. The user can choose between different analytical distributions as well as perform a graphical fit to the data. This chapter discusses in detail how to use the volume-duration frequency analysis editor with HEC-SSP.

Contents

Starting a New Volume-Duration Frequency Analysis

A volume-duration frequency analysis can be started in two ways within the software, either by right clicking on the Volume-Frequency Analysis folder in the study explorer and selecting **New**, or by going to the **Analysis** menu and selecting **New** and then **Volume-Frequency Analysis**. When a new volume-frequency analysis is selected, the Volume-Duration Frequency editor will appear as shown in Figure 7-1.

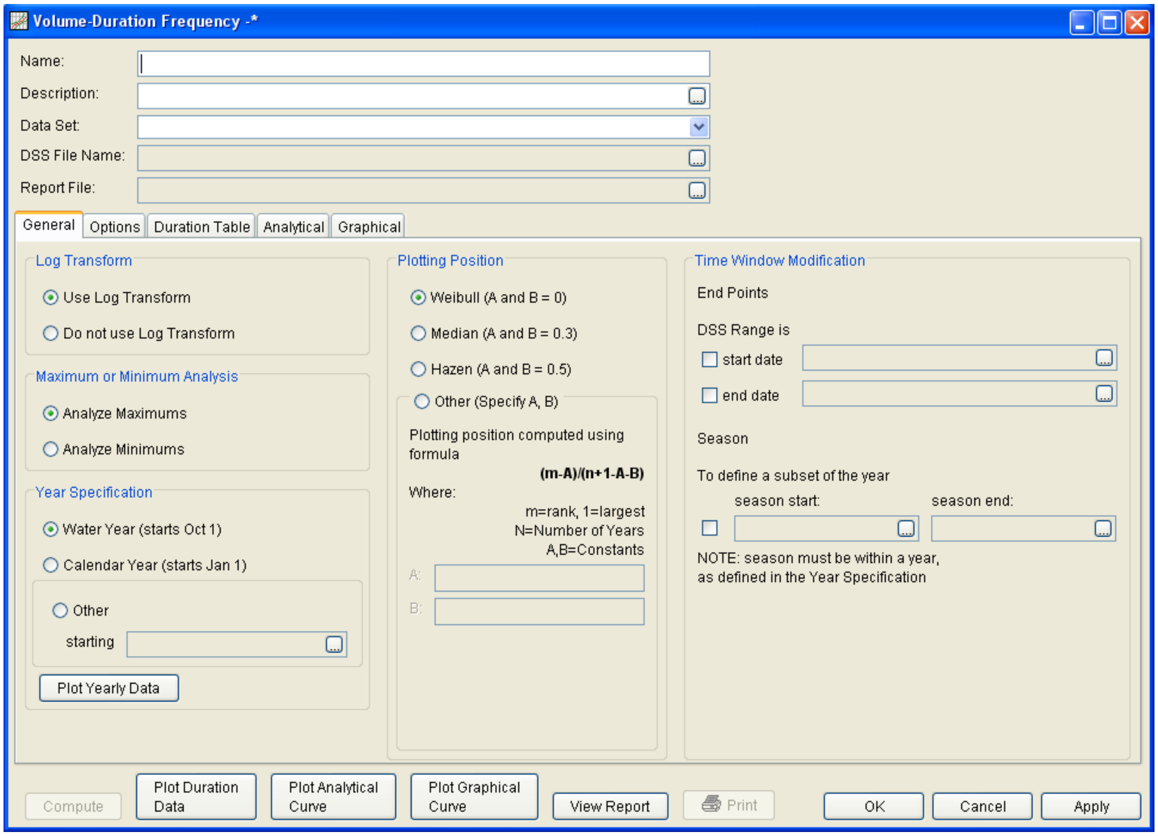


Figure 7-1. Volume-Duration Frequency Analysis Editor.

The user is required to enter a **Name** for the analysis; while a **Description** is optional. A data set (daily average flow) must be selected from the available data sets stored in the current study DSS file (see Chapter 4 for importing daily flow data into the study). Once a **Name** is entered and a data set is selected, the **DSS File Name** and **Report File** will automatically be filled out. The DSS filename is by default the same name as the study DSS file. The report file is given the same name as the analysis with the extension ".rpt".

General Settings and Options

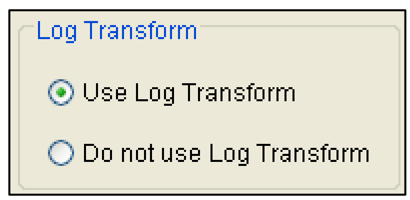
Once the analysis name and data set are selected, the user can begin defining the analysis. Five tabs are contained on the Volume-Duration Frequency editor. The tabs are labeled **General**, **Options**, **Duration Table**, **Analytical**, and **Graphical**. This section of the manual explains the use of the General and Options tabs.

General Settings

The first tab contains general settings for performing the frequency analysis (Figure 7-1). These settings include:

- Log Transforms
- Plotting Positions
- Maximum or Minimum Analysis
- Year Specification
- Time Window Modification

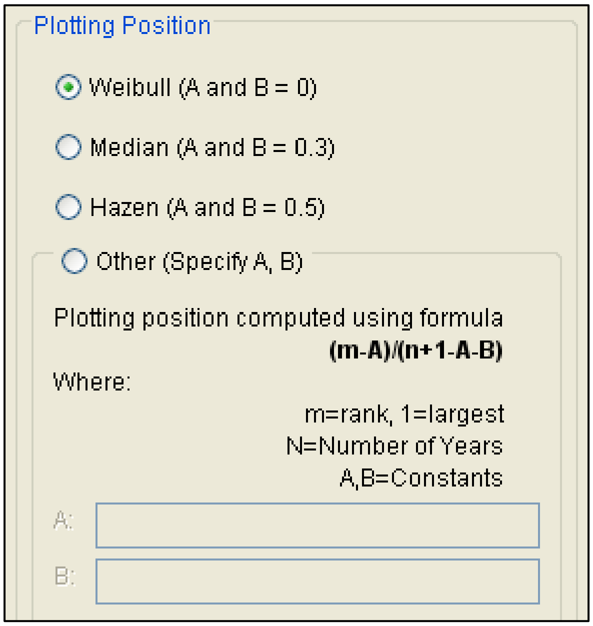
Log Transform



There are two options contained within the Log Transform setting: **Use Log Transform** and **Do not use Log Transform**. If the user selects **Use Log Transform**, then the logs of the data will be computed first, and the frequency analysis will be performed on the logs of the data. If the user selects **Do not use Log Transform**, then the frequency analysis will be performed on the raw data values without taking the logs of the data. The default setting is **Use Log Transform**.

Plotting Positions

Plotting positions are used for plotting the raw data points on the graph. There are four options for plotting position within HEC-SSP: Weibull, Median, Hazen, and user entered coefficients. The default method is the Weibull plotting position method.



The generalized plotting position equation is:

$$P = \frac{(m - A)}{(n + 1 - A - B)}$$

Where: m = rank of flood values with the largest equal to 1.

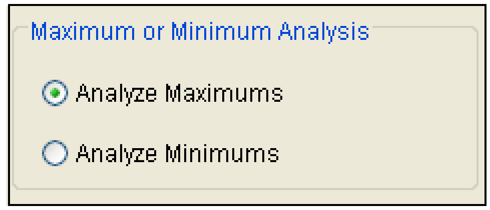
n = number of flood peaks in the data set.

A & B = constants dependent on which equation is used (Weibull A and B=0; Median A and B = 0.3; and Hazen A and B=0.5).

Plotting positions are estimates of the exceedance probability for each data point. Different methods can give different values for the probabilities of the highest and lowest points in the data set. The plotting of data on the graph by a plotting position method is only done as a guide to assist in evaluating the computed curve. The plotting position method selected does not have any impact on the computed curve.

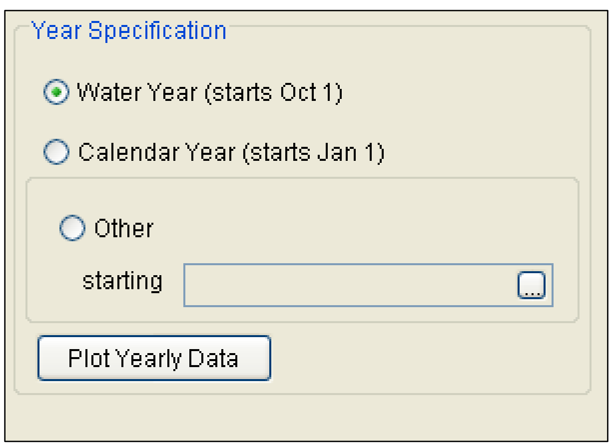
Maximum or Minimum Analysis

A volume-frequency analysis can be performed using annual maximum or minimum flows. A maximum flow analysis could be used for determining the amount of reservoir storage required for a flood of specific frequency. A minimum flow, or low flow analysis, could be used determine if a river could supply a given demand. A low flow analysis could also be beneficial for water quality and reservoir storage projects. There are two options contained in the Maximum or Minimum Analysis section. If **Analyze Maximums** is selected, then the program will extract annual maximum volumes for all durations. The program will extract annual minimum volumes for all durations if **Analyze Minimums** is selected.



Year Specification

This option allows the user to define the beginning and ending date for what will be considered as the analysis year for extracting the data. These dates are used for extracting the annual maximum or minimum flows, in order to get one value for each analysis year. It is important to choose a start date that captures all flood events from a certain hydrologic regime. If high flows generally occur between November and May, then the year should not start between theses months. This will minimize the possibility that the same flood event is used for consecutive years. There are three options contained in the Year Specification section. If **Water Year** is selected, the program uses a starting date of October 1 and an ending date of September 30. If **Calendar Year** is selected, the program uses a starting date of January 1 and an ending date of December 31. The **Other** option lets the user define the starting date. One way to determine when the year should begin is to plot each year of record on top of one another, as shown in Figure 7-2. The program will create a graph like the one shown in Figure 7-2 when the **Plot Yearly Data** button is pressed. This data set is from an area that experiences both snowmelt floods and summer/fall rain floods. Starting the year on January 1 would be more appropriate for this data set because a few large flood events occurred around October 1.



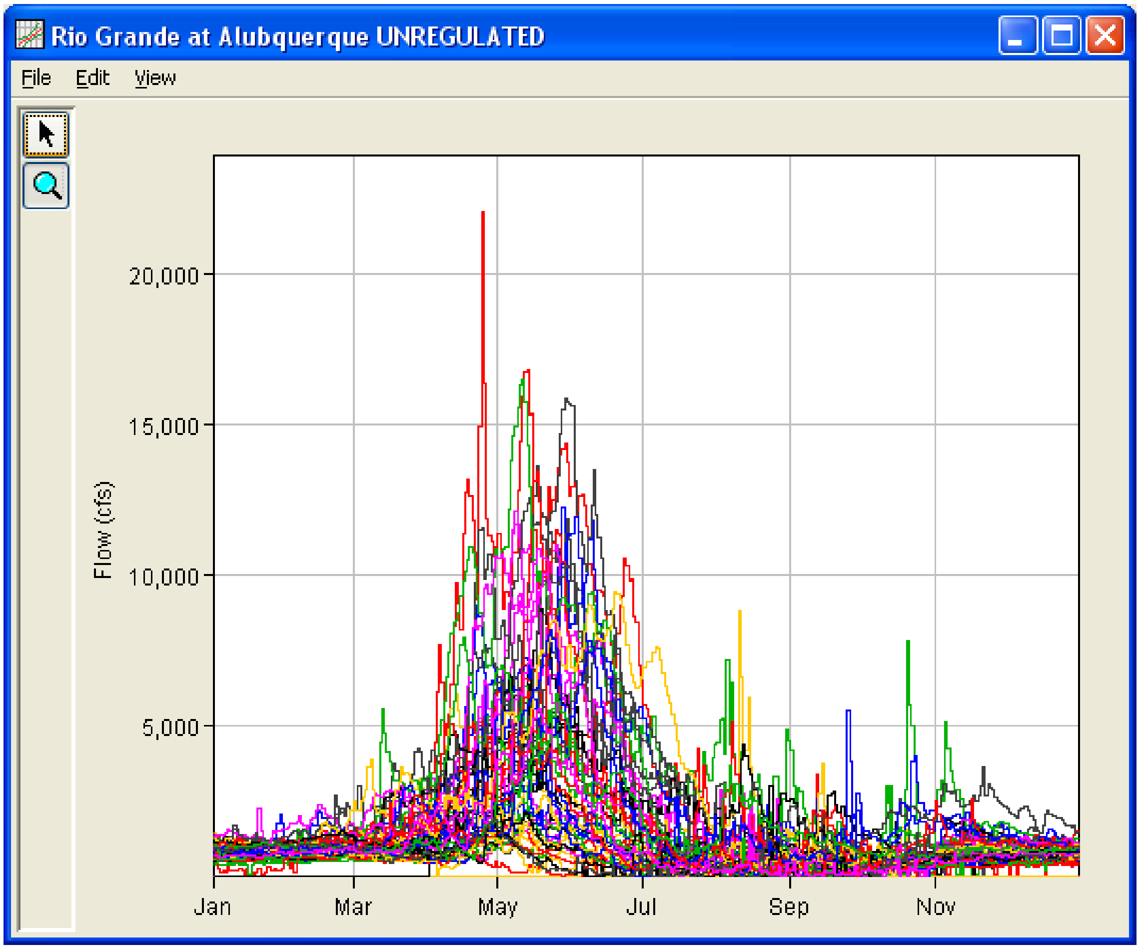
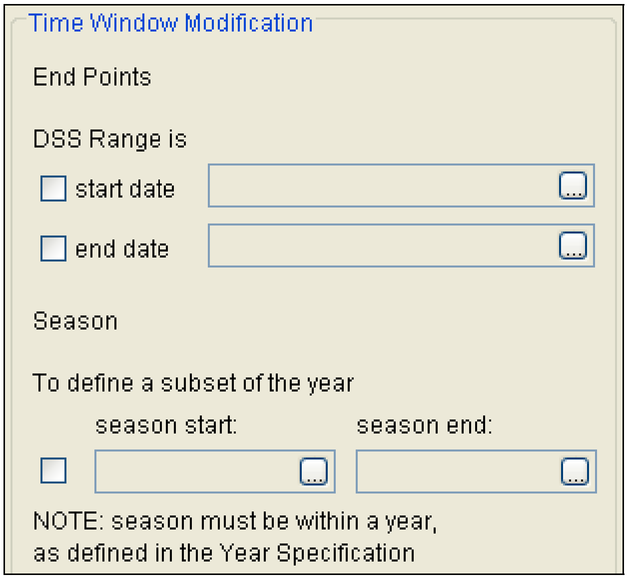


Figure 7-2. Plot Showing when Flood Events Typically Occur.

Time Window Modification

This option allows the user to narrow the time window used for the analysis. When left unchecked, the program will use all of the data contained in the selected data set. The user can enter either a start or end date or both a start and end date. If a start and/or end date are used, they must be dates that are included within the selected data set. The date range for the selected data set is shown in the editor just above the Start Date field.

An additional option at the bottom of the time window modification section allows the user to define a shorter duration, a **Season**, within the year in which the program extracts maximum or minimum flows. This option allows the user to analyze floods that typically occur during a specific season, like snowmelt floods. When left unchecked, the program will examine all flow records during the year. The season start and end dates must be entered using a two digit day followed by the month, example 15May. The season start and end dates must fall within a year as defined in the Year Specification. The user must enter both start and end dates to define the season subset.



Options

In addition to the general settings, there are also several options available to the user for modifying the computation of the volume-frequency curves. These options include:

- Flow-durations
- User-Specified Frequency Ordinates
- Output Labeling
- Low Outlier Threshold
- Historic Period Data

When the Options tab is selected, the Volume-Duration Frequency editor will appear as shown in Figure 7-3.

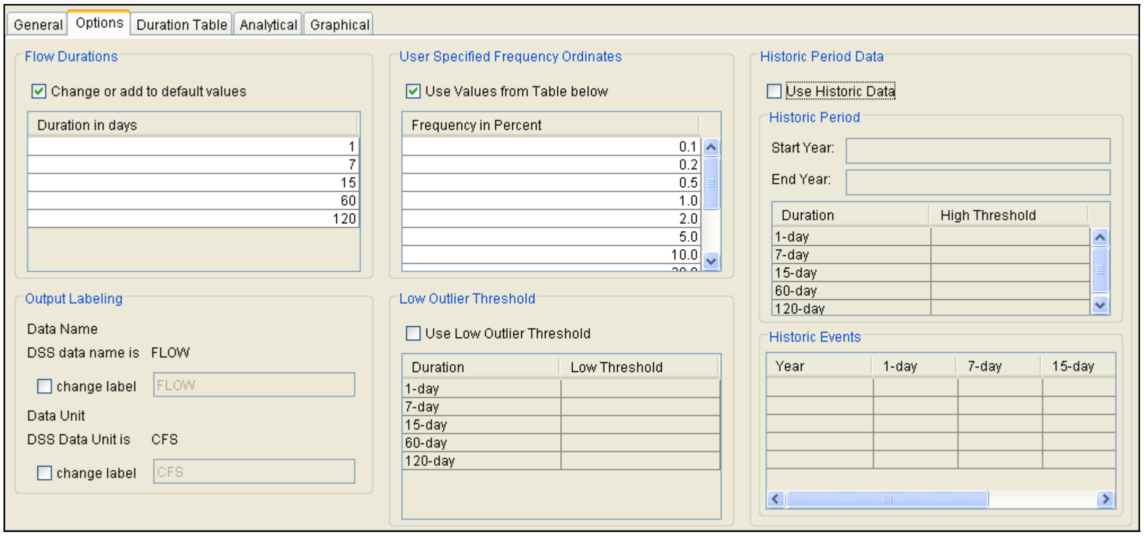
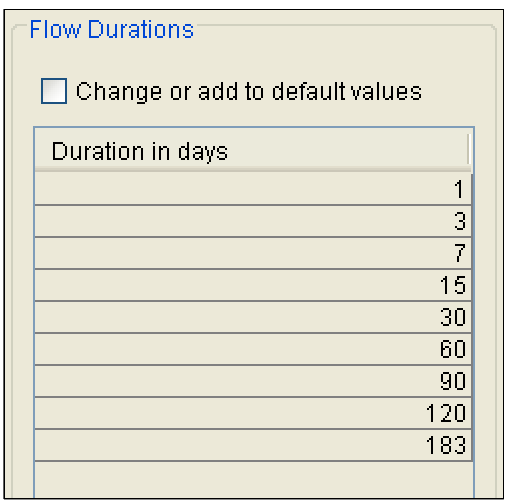


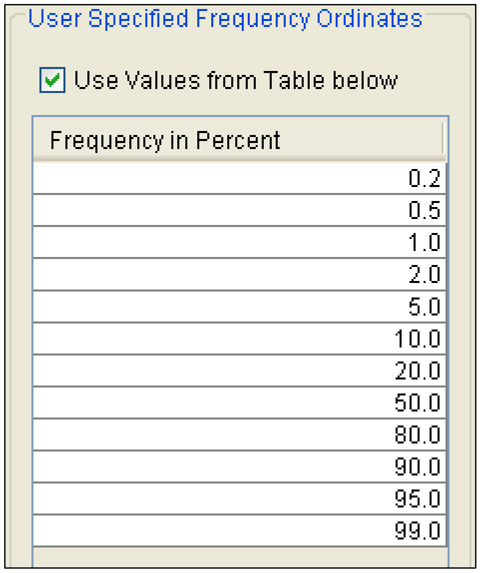
Figure 7-3. Volume-Duration Frequency Editor with Options Tab Selected.

Flow-Durations

This option lets the user define which durations are used in the volume-frequency analysis. The program will extract annual maximum or minimum volumes based on the durations defined in this table. The default durations are 1, 3, 7, 15, 30, 60, 120, and 183 days. Check the box next to **Change or add to default values** to change or add additional durations to the analysis. Once this box is checked, the user can add/remove rows and edit the duration values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default durations, even if they are not contained in the table, when the **Change or add to default values** option is not checked.



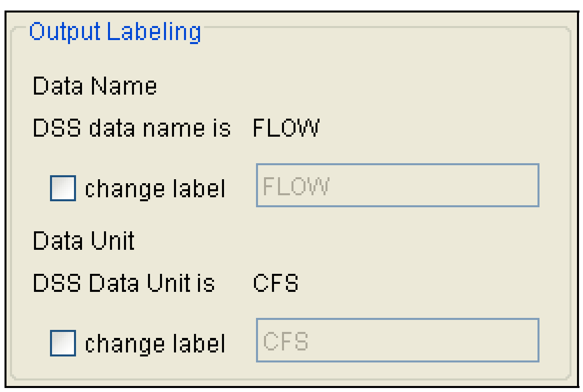
User Specified Frequency Ordinates



This option allows the user to change the frequency ordinates used for creating result tables and graphs. The default values listed in percent chance exceedance are 0.2, 0.5, 1, 2, 5, 10, 20, 50, 80, 90, 95, and 99. Check the box next to **Use Values from Table below** to change or add additional values. Once this box is checked, the user can add/remove rows and edit the frequency values. To add or remove a row from the table, select the row(s), place the mouse over the highlighted row(s) and click the right mouse button. The shortcut menu contains options to **Insert Row(s)** and **Delete Row(s)**. The program will use the default values, even if they are not contained in the table, when the **Use Values from Table below** option is not checked. Finally, all values in the table must be between 0 and 100.

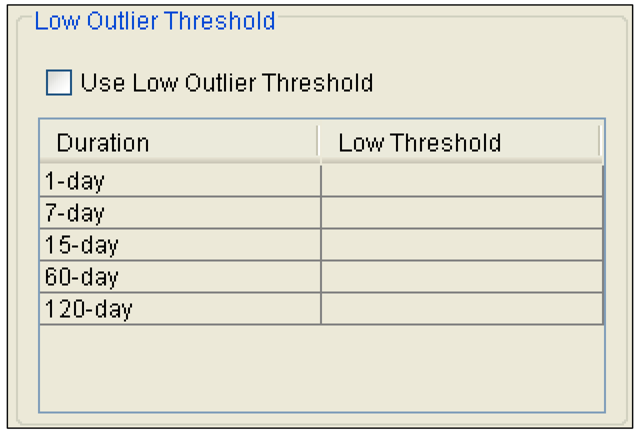
Output Labeling

This option allows the user to change the default labels for data contained in the output tables and plots. The user can change both the name of the data and how the units of the data are labeled.



Low Outlier Threshold

High and low outlier tests are based on the procedures outlined in Bulletin 17B, and are applied in the same manner in the Volume-Duration Frequency Analysis. The calculated outlier magnitudes, by the Bulletin 17B procedure, are used as default values for the high and low outlier thresholds in HEC-SSP. The user has the option to enter a different low outlier threshold for each duration. If a value is entered for the low outlier threshold, then this value will override the computed value from the Bulletin 17B methodology. When analyzing maximum flows, HEC-SSP will identify both high and low outliers. However, only low outliers will be removed from the data set when performing the analysis. If a high outlier is identified in the data set, the analysts should try to incorporate historical period information to extend the time period for which the high outlier(s) is considered to be the maximum value(s). Further discussion of outlier thresholds can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide. To use the low outlier threshold, simply check the box and enter a value for one duration or all durations.



When **Analyzing Minimums** is selected on the General tab, then the Low Outlier Threshold criteria becomes the High Outlier Threshold. When applying the outlier tests, HEC-SSP will identify both high and low outliers. However, only high outliers will be removed from the data set when performing the analysis. If a low outlier is identified in the data set, the analysts should try to incorporate historical period information to extend the time period for which the low outlier(s) is considered to be the minimum value(s).

Historic Period Data

Any historic data that provides reliable estimates outside the systematic record should be used in order to modify and improve the frequency computations. Information outside of the systematic record can often be used to extend the record of the largest events to a historic period much longer than that of the systematic record. HEC-SSP uses historic data as recommended in Bulletin 17B. This calculation is applied in the same manner in the Generalized Frequency Analysis. To use historic data, check the box labeled **Use Historic Data**. The user can enter a starting year for the historic period, ending year for a historic period and a High Threshold value for each duration as shown in Figure 7-4. If the user enters a high threshold value, then any data in the systematic record greater than that value will also be treated as a historical annual maximum. The user can also enter historic data that are not contained in the systematic record. This is done in the table at the bottom labeled **Historic Events**. If a start year is not entered, then the assumed start year is the earliest year of the systematic record and any historical values that have been entered. If an end year is not entered, then the assumed end year is the latest year in the systematic record and any entered historic values. Further discussion of the use of historical data can be found in Bulletin 17B and the HEC-SSP Statistical Reference Guide. If **Analyze Minimums** is selected on the General tab then the High Threshold becomes the Low Threshold. The program will treat systematic values that are lower than the low threshold as historic annual minimums.

Note: The program treats all data in the data set as systematic data. If historic events are included in the data set, then the user can define the analysis time window (General tab – Time Window Modification) so that it only bounds the systematic record. Then define the historic events in the Historic Events table. Instead of using the Time Window Modification option, another option is to enter a High Threshold value so that the historic data point(s) would be treated as historic data (rather than part of the systematic record).

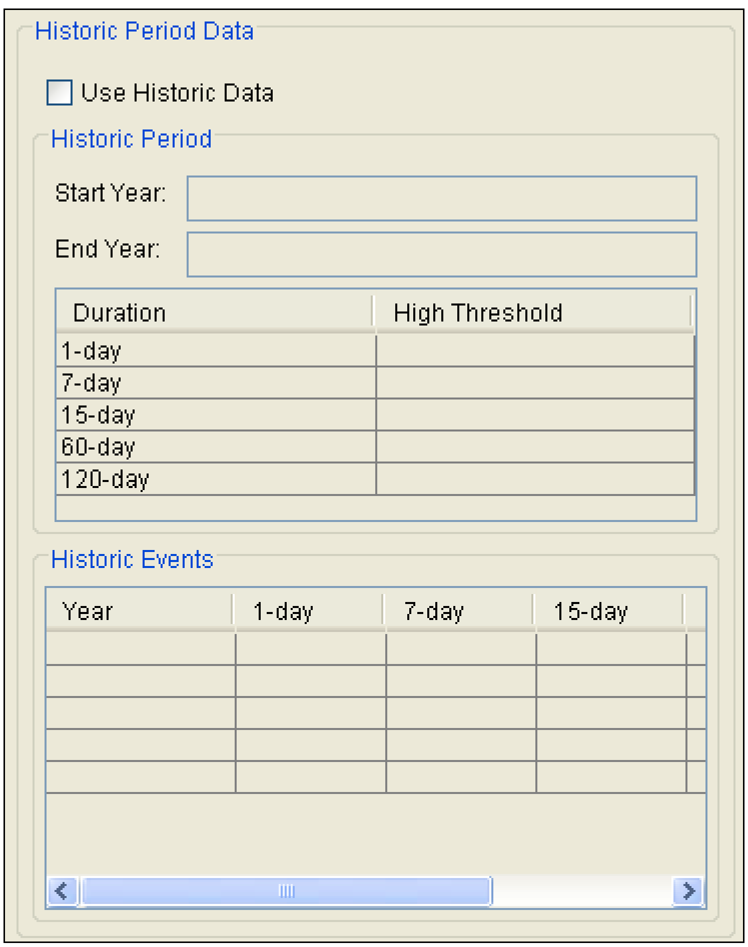


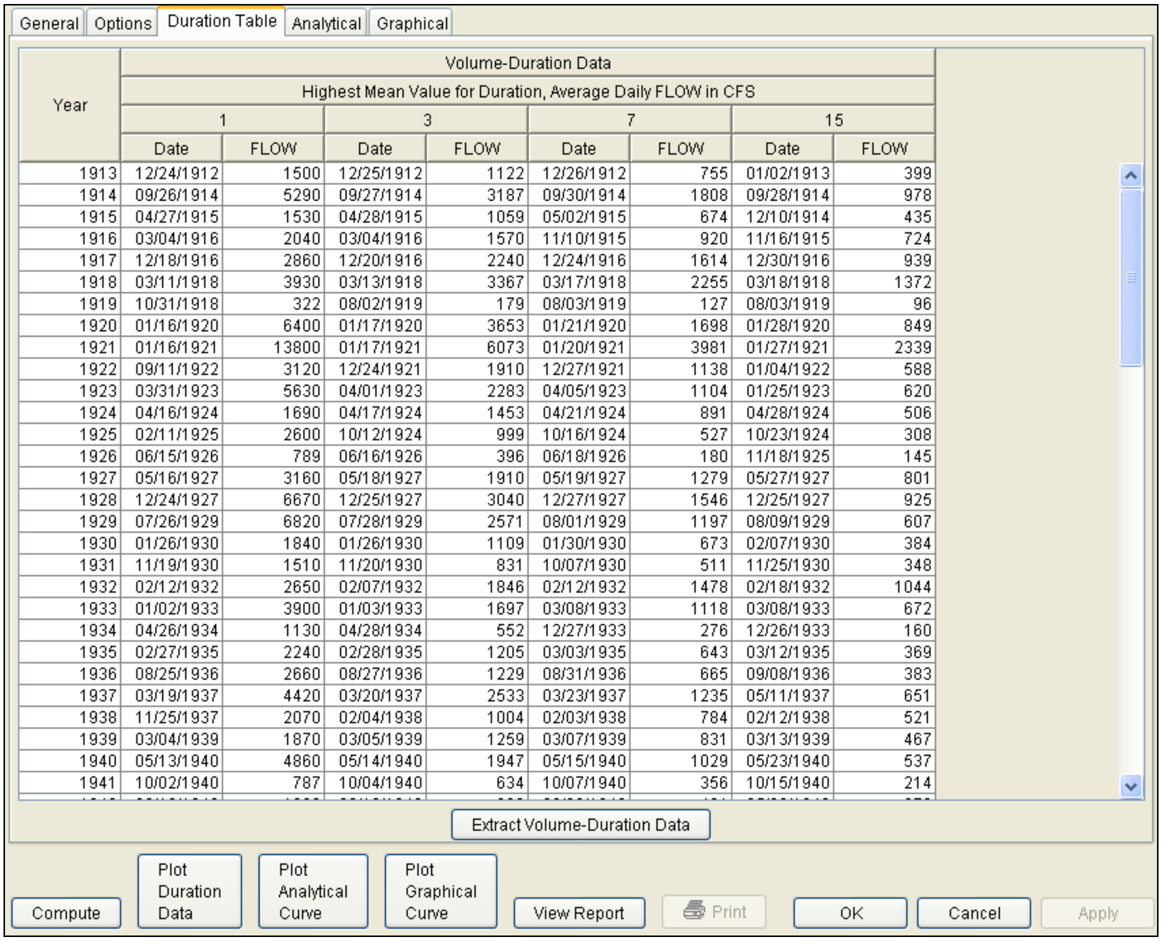
Figure 7-4. Historic Period Data on the Options Tab.

Duration Table

The user can extract the volume-duration data once settings have been defined on the General and Options tabs. When the Duration Table tab is selected, the Volume-Duration Frequency editor will appear as shown in Figure 7-5. The program will compute the annual maximum or minimum average flows for the durations specified on the Options tab when the user presses the **Extract Volume-Duration Data** button at the bottom of the Duration Table.

The program computes the maximum/minimum flows by evaluating the flow record as one continuous record. For each duration, the program computes a time-series of average flow. These time-series are written to the study DSS file and can be viewed using HEC-DSSVue. Then the program extracts the annual maximum/minimum flows and populates the duration table.

When computing the analysis, the program will issue a warning message if any of the maximum/minimum flows occur a specific number of days after the beginning of the year. The number of days is determined by the duration plus five days. For example, for a fifteen-day duration, the program issues a warning if the maximum/minimum is within twenty days after the beginning of the year. If water year is chosen, then the program issues a warning if the maximum/minimum occurs between October 1 – October 20. This warning is an attempt to let the user know if a maximum or minimum flow is generated by an event that began in the previous year. The goal is to prevent a scenario in which the same flow event causes maximum/minimum flows in consecutive years; this is why it is important to choose an appropriate annual starting date.



Year	Volume-Duration Data							
	Highest Mean Value for Duration, Average Daily FLOW in CFS							
	1		3		7		15	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1913	12/24/1912	1500	12/25/1912	1122	12/26/1912	755	01/02/1913	399
1914	09/26/1914	5290	09/27/1914	3187	09/30/1914	1808	09/28/1914	978
1915	04/27/1915	1530	04/28/1915	1059	05/02/1915	674	12/10/1914	435
1916	03/04/1916	2040	03/04/1916	1570	11/10/1915	920	11/16/1915	724
1917	12/18/1916	2860	12/20/1916	2240	12/24/1916	1614	12/30/1916	939
1918	03/11/1918	3930	03/13/1918	3367	03/17/1918	2255	03/18/1918	1372
1919	10/31/1918	322	08/02/1919	179	08/03/1919	127	08/03/1919	96
1920	01/16/1920	6400	01/17/1920	3653	01/21/1920	1698	01/28/1920	849
1921	01/16/1921	13800	01/17/1921	6073	01/20/1921	3981	01/27/1921	2339
1922	09/11/1922	3120	12/24/1921	1910	12/27/1921	1138	01/04/1922	588
1923	03/31/1923	5630	04/01/1923	2283	04/05/1923	1104	01/25/1923	620
1924	04/16/1924	1690	04/17/1924	1453	04/21/1924	891	04/28/1924	506
1925	02/11/1925	2600	10/12/1924	999	10/16/1924	527	10/23/1924	308
1926	06/15/1926	789	06/16/1926	396	06/18/1926	180	11/18/1925	145
1927	05/16/1927	3160	05/18/1927	1910	05/19/1927	1279	05/27/1927	801
1928	12/24/1927	6670	12/25/1927	3040	12/27/1927	1546	12/25/1927	925
1929	07/26/1929	6820	07/28/1929	2571	08/01/1929	1197	08/09/1929	607
1930	01/26/1930	1840	01/26/1930	1109	01/30/1930	673	02/07/1930	384
1931	11/19/1930	1510	11/20/1930	831	10/07/1930	511	11/25/1930	348
1932	02/12/1932	2650	02/07/1932	1846	02/12/1932	1478	02/18/1932	1044
1933	01/02/1933	3900	01/03/1933	1697	03/08/1933	1118	03/08/1933	672
1934	04/26/1934	1130	04/28/1934	552	12/27/1933	276	12/26/1933	160
1935	02/27/1935	2240	02/28/1935	1205	03/03/1935	643	03/12/1935	369
1936	08/25/1936	2660	08/27/1936	1229	08/31/1936	665	09/08/1936	383
1937	03/19/1937	4420	03/20/1937	2533	03/23/1937	1235	05/11/1937	651
1938	11/25/1937	2070	02/04/1938	1004	02/03/1938	784	02/12/1938	521
1939	03/04/1939	1870	03/05/1939	1259	03/07/1939	831	03/13/1939	467
1940	05/13/1940	4860	05/14/1940	1947	05/15/1940	1029	05/23/1940	537
1941	10/02/1940	787	10/04/1940	634	10/07/1940	356	10/15/1940	214

Figure 7-5. Volume-Duration Table.

The user must **Compute** the analysis before viewing a plot of the volume-duration data. The plot created by pressing the **Plot Duration Data** button, located at the bottom of a Volume-Duration Frequency editor, shows the annual maximum/minimum volumes plotted using the user specified plotting position method, as shown in Figure 7-6.

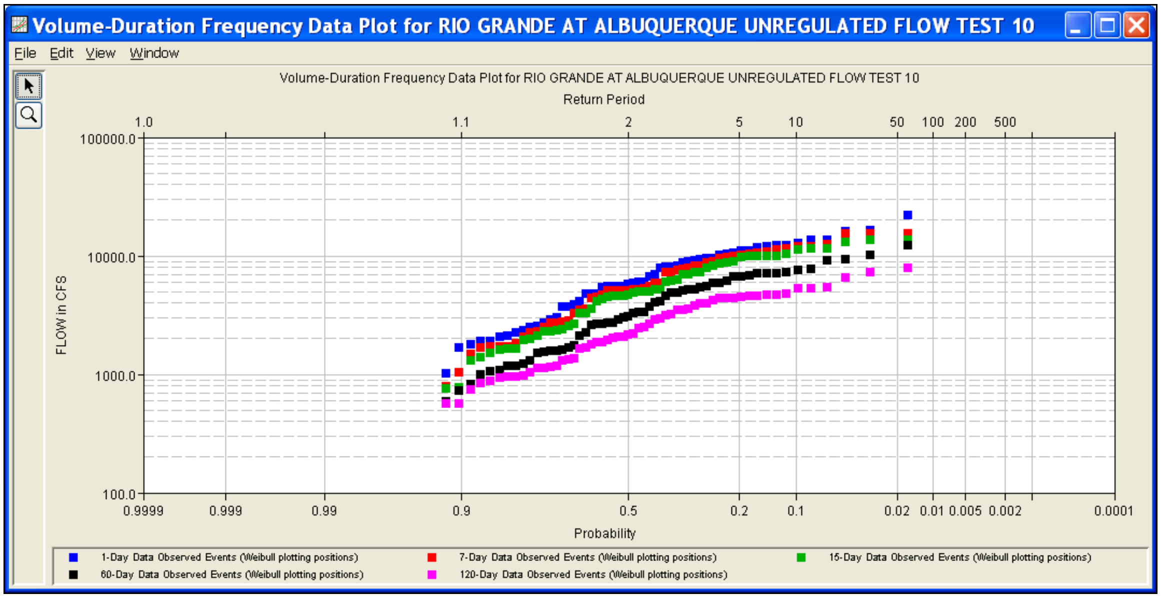


Figure 7-6. Plot of Volume-Duration Data.

Analytical Frequency Analysis

The user can choose between performing an Analytical Frequency Analysis or a Graphical Frequency Analysis once settings have been defined on the General and Options tabs. The Duration Data does not have to be extracted before computing an analysis. The program will automatically extract the duration data when the **Compute** button is pressed. This section of the manual describes how to compute and view results for an Analytical Frequency Analysis.

When the user selects the **Analytical** tab on the Volume-Duration Frequency editor, the window will appear as shown in Figure 7-7. As shown, four additional tabs will appear on the screen: Settings, Tabular Results, Plot, and Statistics.

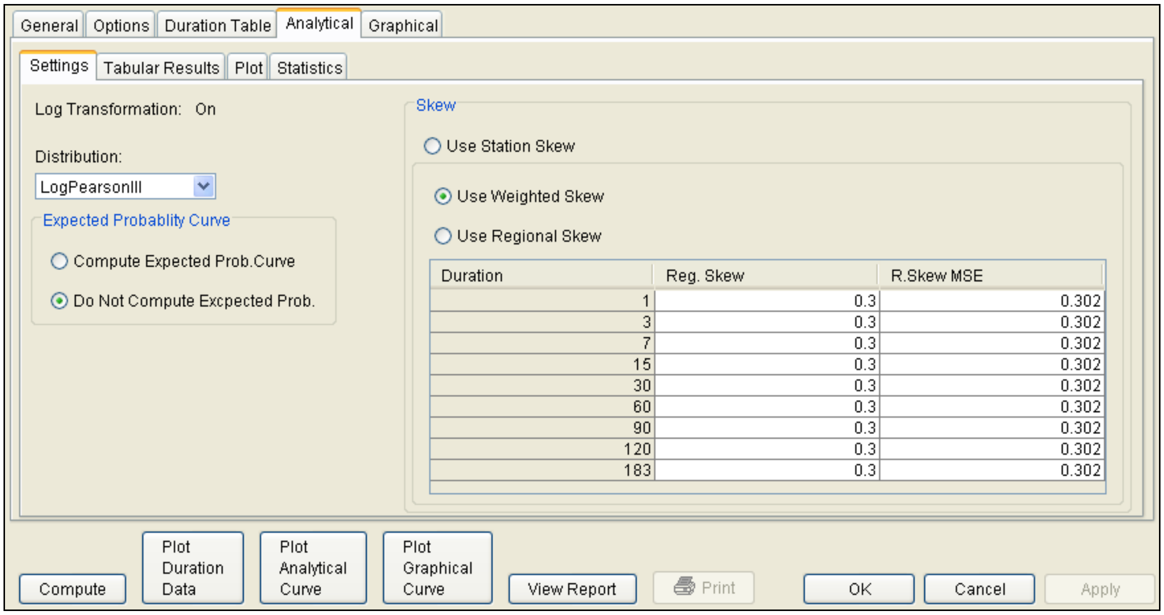


Figure 7-7. Analytical Tab of the Volume-Duration Frequency Editor.

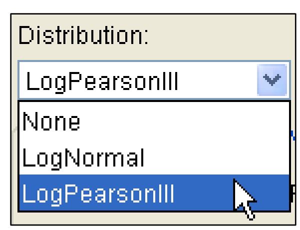
Settings

In addition to settings on the General and Options tabs, there are more options on the Settings tab the user must define in order to perform an Analytical Frequency analysis on the volume-duration data. These settings include:

- Distribution
- Expected Probability Curve
- Skew

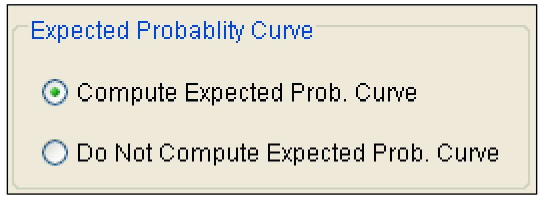
Distribution

This option allows the user to select a distribution to perform the frequency analysis. The current version of HEC-SSP contains five distribution choices: None, Normal, LogNormal, Pearson III, and LogPearson III. If the user has selected the **Use Log Transform** option, located on the General tab, then the available choices for distribution are None, LogNormal, and LogPearson III. If the user has selected the **Do not use Log Transform** option, located on the General tab, then the distribution choices are None, Normal, and Pearson III.



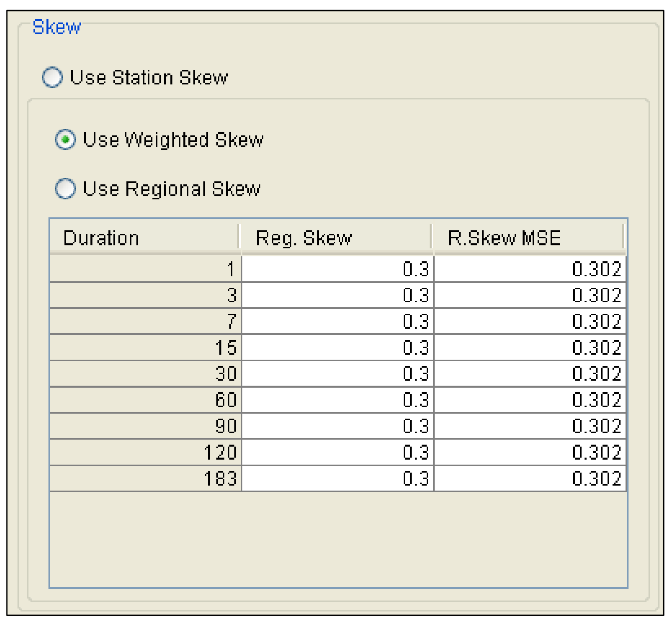
Expected Probability Curve

This setting has two options, **Compute Expected Prob. Curve** and **Do Not Compute Expected Prob. Curve**. The default setting is to have the expected probability curve computed. When computed, this curve will be shown in both the result table and the plot as an additional curve to the computed curve. The expected probability adjustment is an attempt to correct for a certain bias in the frequency curve computation due to the shortness of the record. Please review the discussion in Bulletin 17B about the expected probability curve adjustment for an explanation of how and why it is computed. The use of the expected probability curve is a policy decision. It is most often used in establishing design flood criteria. The basic flood frequency curve without the expected probability curve adjustment is the curve used in computation of confidence limits, risk, and in obtaining weighted averages of independent estimates of flood frequency discharge (WRC, 1982).



Skew

The skew option is only available whenever the analytical distribution is set to PearsonIII or LogPearsonIII. There are three options contained within the skew setting, **Use Station Skew**, **Use Weighted Skew**, and **Use Regional Skew**. The default skew setting is **Use Station Skew**. With this setting, the skew of the computed curve will be based solely on computing a skew from the data points.



Duration	Reg. Skew	R.Skew MSE
1	0.3	0.302
3	0.3	0.302
7	0.3	0.302
15	0.3	0.302
30	0.3	0.302
60	0.3	0.302
90	0.3	0.302
120	0.3	0.302
183	0.3	0.302

The **Use Weighted Skew** option requires the user to enter a generalized regional skew and a mean-square error (MSE) of the generalized regional skew. This option weights the computed station skew with the generalized regional skew. The equation for performing this weighting can be found in Bulletin 17B (Equation 6). If a regional skew is taken from Plate I of Bulletin 17B (the skew map of the United States), the value of MSE = 0.302.

The **Use Regional Skew** option requires the user to enter a generalized regional skew and a mean-square error (MSE) of the generalized regional skew. The program will ignore the computed station skew and use only the generalized regional skew.

Compute

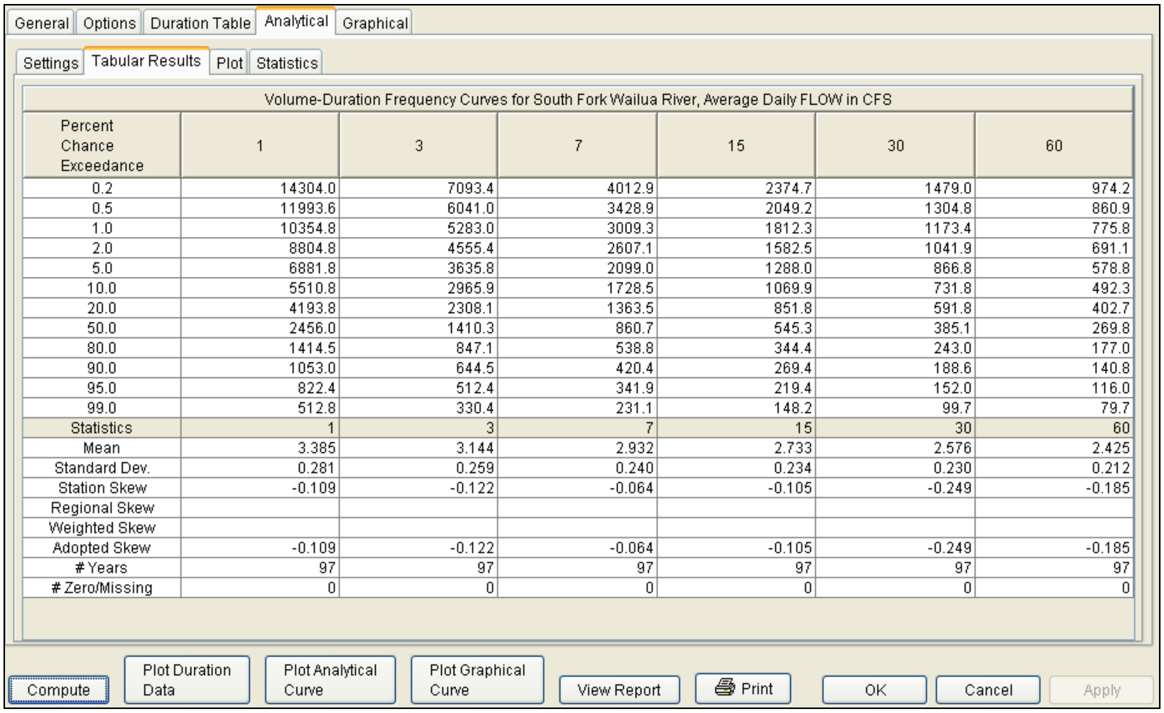
Press the **Compute** button, located at the bottom of the Volume-Duration Frequency editor, once options have been set on the General, Options, and Settings tabs. If the compute is successful, the user will receive a message that says **Compute Complete**. At this point, the user can review results from the analytical analysis by selecting the Tabular Results and Plot tabs.

Multiple Volume-Duration Frequency analyses can be computed using the **Compute Manager**. Select the **Analysis→Compute Manager** menu option to open the Compute Manager. Select the analyses to be computed and then press the **Compute** button. Close the compute dialogs and Compute Manager when the program finished computing the analyses.

Tabular Results

The **Tabular Results** tab contains a table of results for the analytical frequency analysis. An example of the results table is shown in Figure 7-8. The top portion of this table contains volumes from the analytical frequency curve for each duration and frequency ordinate defined on the Options tab. The Statistics of the analytical frequency curves are contained below the frequency curve ordinates. The statistics include the mean, standard deviation, station skew, regional skew, weighted skew, adopted skew, number of years of record, and number of years with zero or missing flow.

User-adjusted statistics can be defined by the user on the **Statistics** tab. If the user has not entered statistics on the Statistics tab, then the results table will look similar to Figure 7-8. If the user does enter statistics on the Statistics tab, then the results table will include the adjusted mean, adjusted standard deviation, and adjusted skew. If specified by the user, the program will use the user-adjusted statistics when computing the analytical curves.



Volume-Duration Frequency Curves for South Fork Wailua River, Average Daily FLOW in CFS						
Percent Chance Exceedance	1	3	7	15	30	60
0.2	14304.0	7093.4	4012.9	2374.7	1479.0	974.2
0.5	11993.6	6041.0	3428.9	2049.2	1304.8	860.9
1.0	10354.8	5283.0	3009.3	1812.3	1173.4	775.8
2.0	8804.8	4555.4	2607.1	1582.5	1041.9	691.1
5.0	6881.8	3635.8	2099.0	1288.0	866.8	578.8
10.0	5510.8	2965.9	1728.5	1069.9	731.8	492.3
20.0	4193.8	2308.1	1363.5	851.8	591.8	402.7
50.0	2456.0	1410.3	860.7	545.3	385.1	269.8
80.0	1414.5	847.1	538.8	344.4	243.0	177.0
90.0	1053.0	644.5	420.4	269.4	188.6	140.8
95.0	822.4	512.4	341.9	219.4	152.0	116.0
99.0	512.8	330.4	231.1	148.2	99.7	79.7
Statistics	1	3	7	15	30	60
Mean	3.385	3.144	2.932	2.733	2.576	2.425
Standard Dev.	0.281	0.259	0.240	0.234	0.230	0.212
Station Skew	-0.109	-0.122	-0.064	-0.105	-0.249	-0.185
Regional Skew						
Weighted Skew						
Adopted Skew	-0.109	-0.122	-0.064	-0.105	-0.249	-0.185
# Years	97	97	97	97	97	97
# Zero/Missing	0	0	0	0	0	0

Figure 7-8. Tabular Results for a Volume-Frequency Analysis.

Plot

In addition to tabular results, a **Plot** tab is available for viewing results, as shown in Figure 7-9. The results graph includes the systematic annual maximum/minimum volumes, plotted using the specified plotting position method, and the analytical frequency curves. The analytical frequency curves are based on the computed statistics or user-adjusted statistics if they are defined on the Statistics tab.

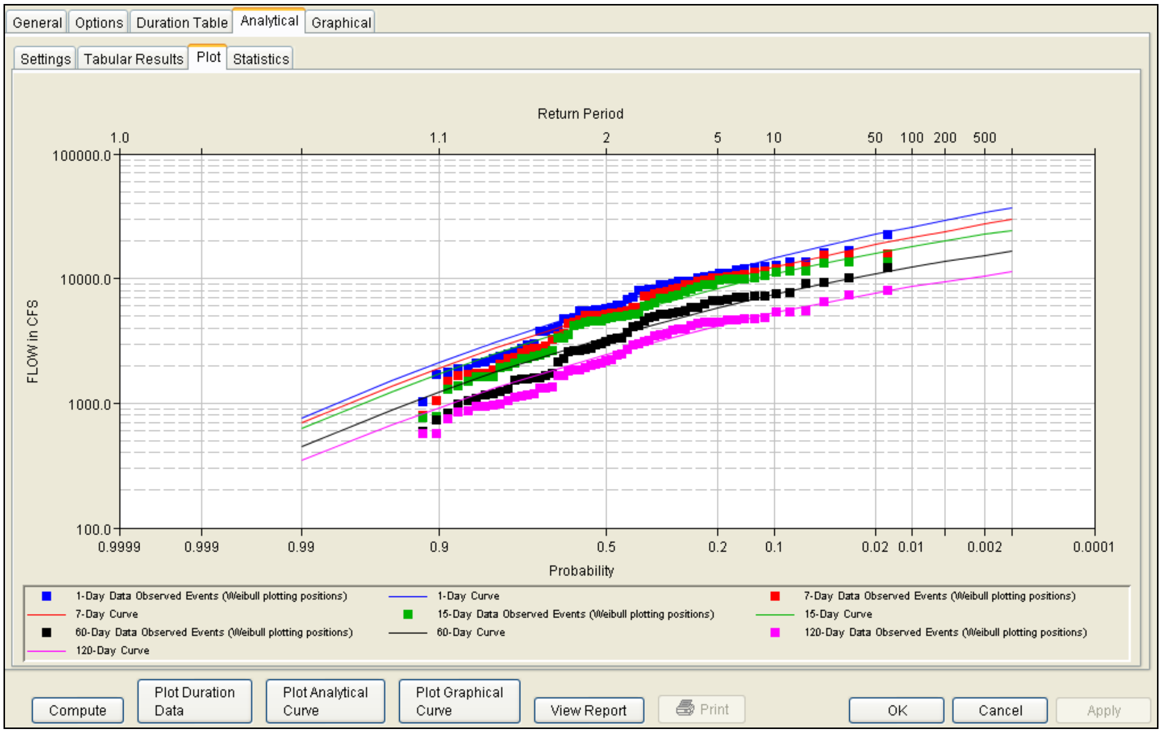


Figure 7-9. Plot of Analytical Results for a Volume-Frequency Analysis.

Statistics

As discussed in EM 1110-2-1415, a necessary step in a volume-frequency analysis is to make sure the analytical frequency curves are consistent across all durations (USACE, 1993). In some situations, frequency curves from different durations might cross one another. The **Statistics** tab contains tools allowing the user to modify the mean, standard deviation, and skew to make sure frequency curves do not cross one another.

When the user selects the **Statistics** tab, the window will appear as shown in Figure 7-10. The upper portion of the Statistics tab contains a plot of the computed and user-adjusted statistics. The user has the option of choosing the parameter to be plotted in the comparison graph. Computed statistics are plotted as black data points and user-adjusted statistics are plotted as blue data points. The first table, **Sample Statistics**, contains the statistics computed from the systematic data. In addition, the adopted skew value in this table can be the station skew, weighted skew, or regional skew. The adopted skew is set by the user on the **Settings** tab. The lower table is where the user enters the adjusted statistics. Before entering adjusted statistics, the user must check the box in Column 1. User-adjusted statistics entered in this table are used when the program computes the analytical frequency curve.

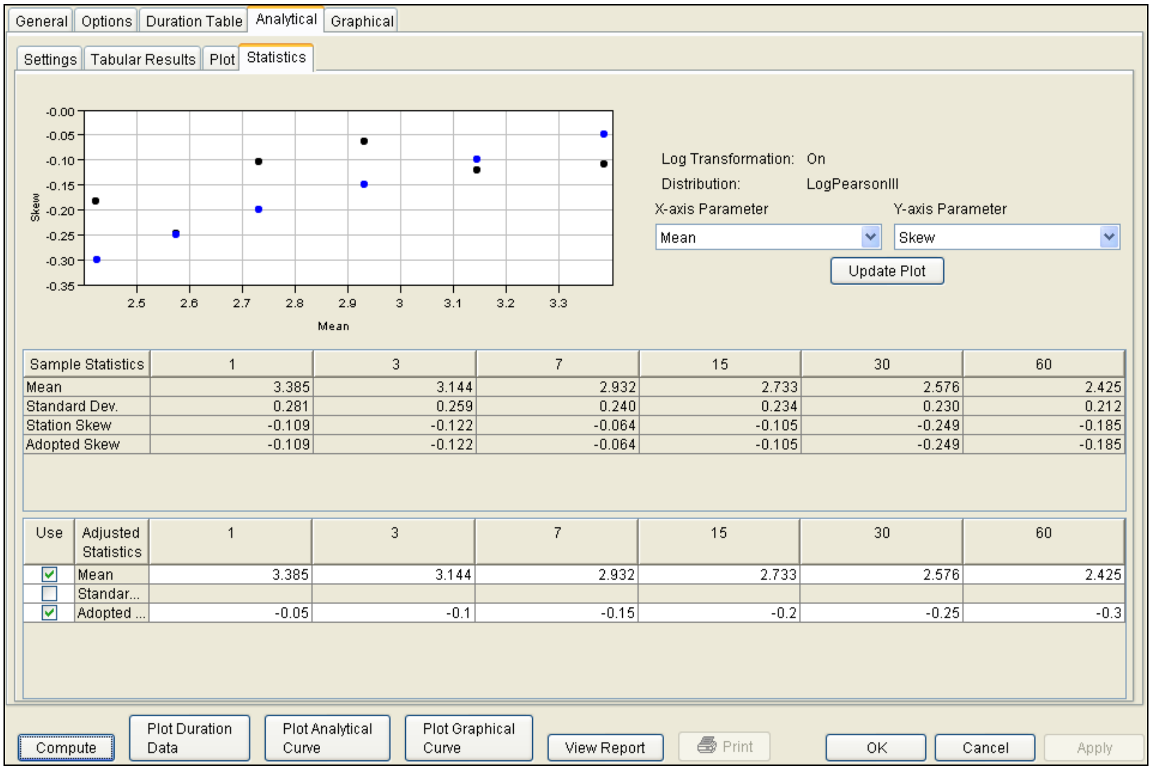


Figure 7-10. Statistics Tab in the Volume-Duration Frequency Editor.

Graphical Frequency Analysis

In addition to an analytical frequency analysis, which uses a statistical distribution to fit the data, the user has the option to graphically fit the data. A graphical fit to data can be very useful when the available analytical distributions do not provide a good fit. One example of when a graphical frequency analysis is more appropriate is when plotting a frequency curve for flow data that is downstream of a flood control reservoir. Analytical frequency distributions are often not appropriate for fitting flow data that is significantly regulated by upstream reservoirs. In general, a portion of the flow frequency data for a highly regulated stream will be very flat in the zone in which upstream regulation can control the flow. This type of data lends itself to a graphical fit.

When the **Graphical** tab is selected on the Volume-Duration Frequency editor, the window will appear as shown in Figure 7-11. As indicated, two additional tabs will appear on the screen, **Curve Input** and **Plot**.

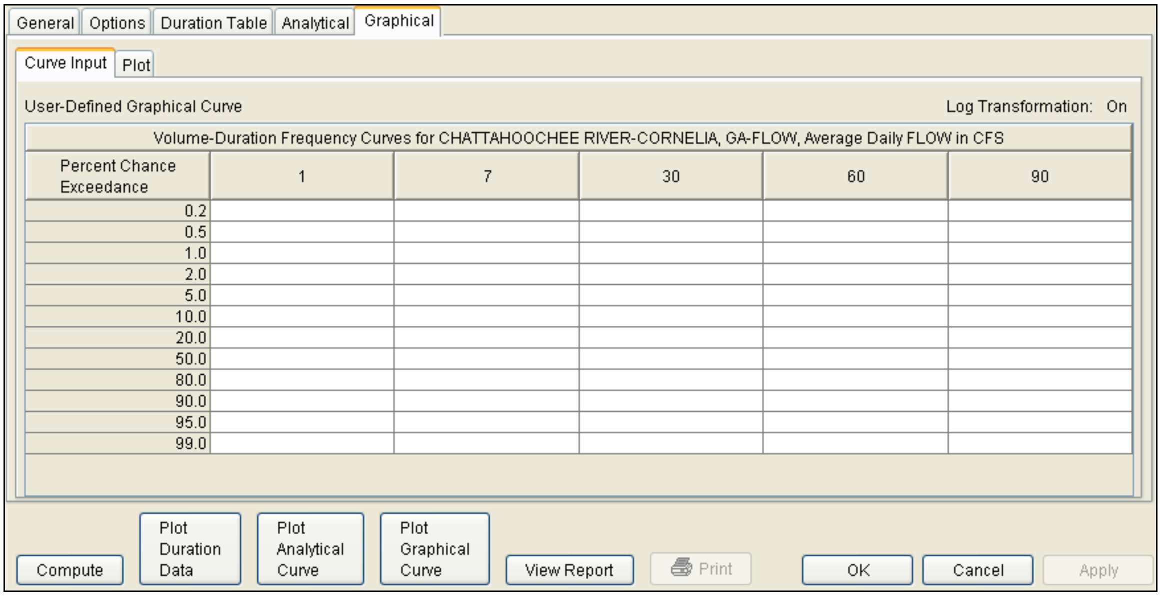


Figure 7-11. Graphical Curve Table for a Volume-Duration Frequency Analysis.

Curve Input

The user manually enters the frequency ordinates for all durations in the table on the **Curve Input** tab. As previously mentioned, the number of frequency ordinates and durations are set on the Options tab. The idea is to enter values in the table that will create a best fit line of the data, based on the user's judgment. Data entered in the graphical curve table will be plotted as a line in the graph on the **Plot** tab after the **Compute** button is pressed.

Plot

The graphical analysis **Plot** tab is available for viewing results, as shown in Figure 7-12. The results graph includes the historic annual maximum/minimum flows, plotted using the specified plotting position method, and the user-defined graphical curve, which was entered in the table on the **Curve Input** tab.

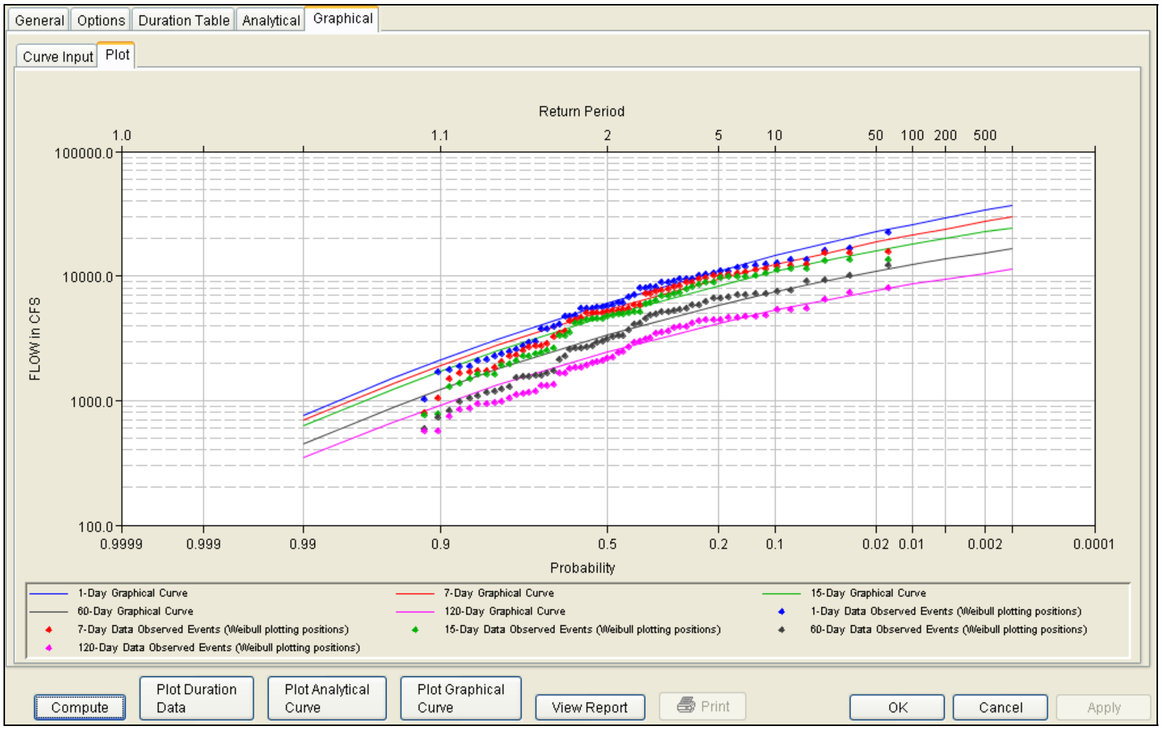


Figure 7-12. Plot Tab for a Graphical Analysis.

Viewing and Printing Results – Volume-Duration Frequency Analysis

The user can view output for the frequency analysis directly from the Volume-Duration Frequency editor (Tabular and Graphical output) or by using the plot and view report buttons at the bottom of the editor. The output consists of tabular results, an analytical frequency curve plot, a graphical frequency curve plot, and a report documenting the data and computations performed.

Tabular Output

Once the computations for the analytical frequency analysis are completed, the user can view tabular output by opening the **Tabular Results** tab under the **Analytical** analysis tab. The details of this table were discussed above. The tabular results can be printed by using the **Print** button at the bottom of the Volume-Duration Frequency editor. When the print button is pressed, a window will appear, giving the user options for how the table is to be printed.

Graphical Output

Graphical output can be opened by selecting one of the plot buttons at the bottom of the Volume-Duration Frequency editor or by selecting the **Plot** tab under the Analytical or Graphical tabs. There are three plot buttons at the bottom of the Volume-Duration Frequency editor, Plot Duration Data, Plot Analytical Curve, and Plot Graphical Curve. Pressing the Plot Duration Data button will open a new window containing a graph showing the systematic data plotted using the user-defined plotting position method. Pressing the Plot Analytical Curve button will open a new window containing a graph with both the systematic data and the computed analytical frequency curves, as shown in Figure 7-13. Pressing the Plot Graphical Curve button will open a new window containing a graph with both the systematic data and the user-defined frequency curves.

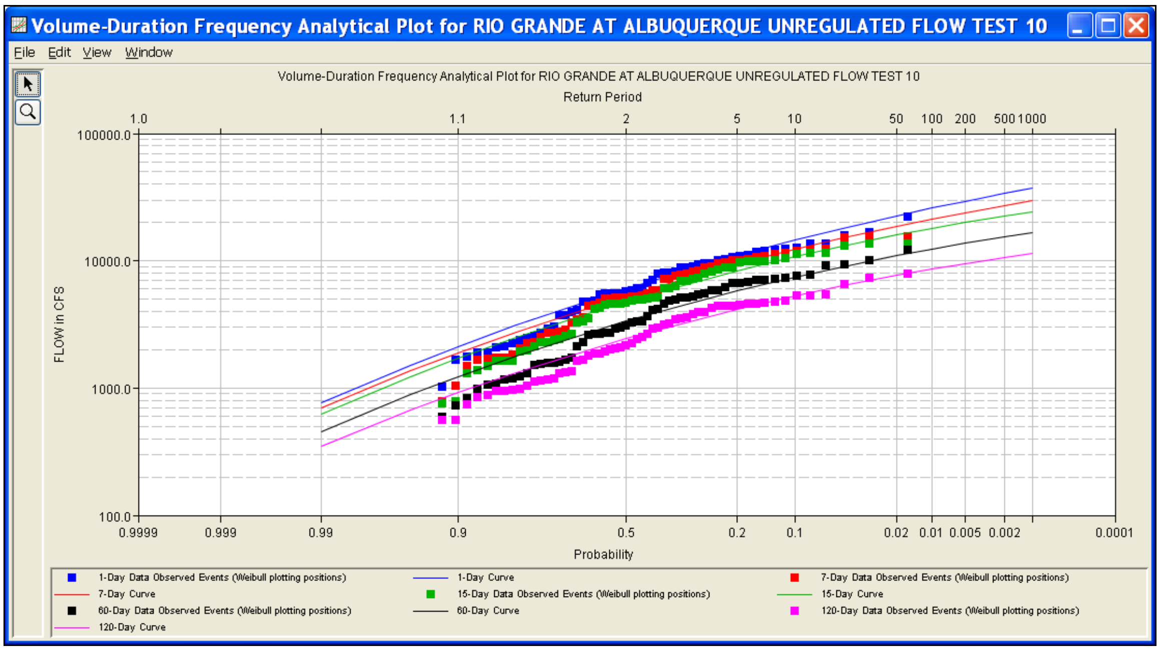


Figure 7-13. Plot of Systematic Data and Analytical Frequency Curves.

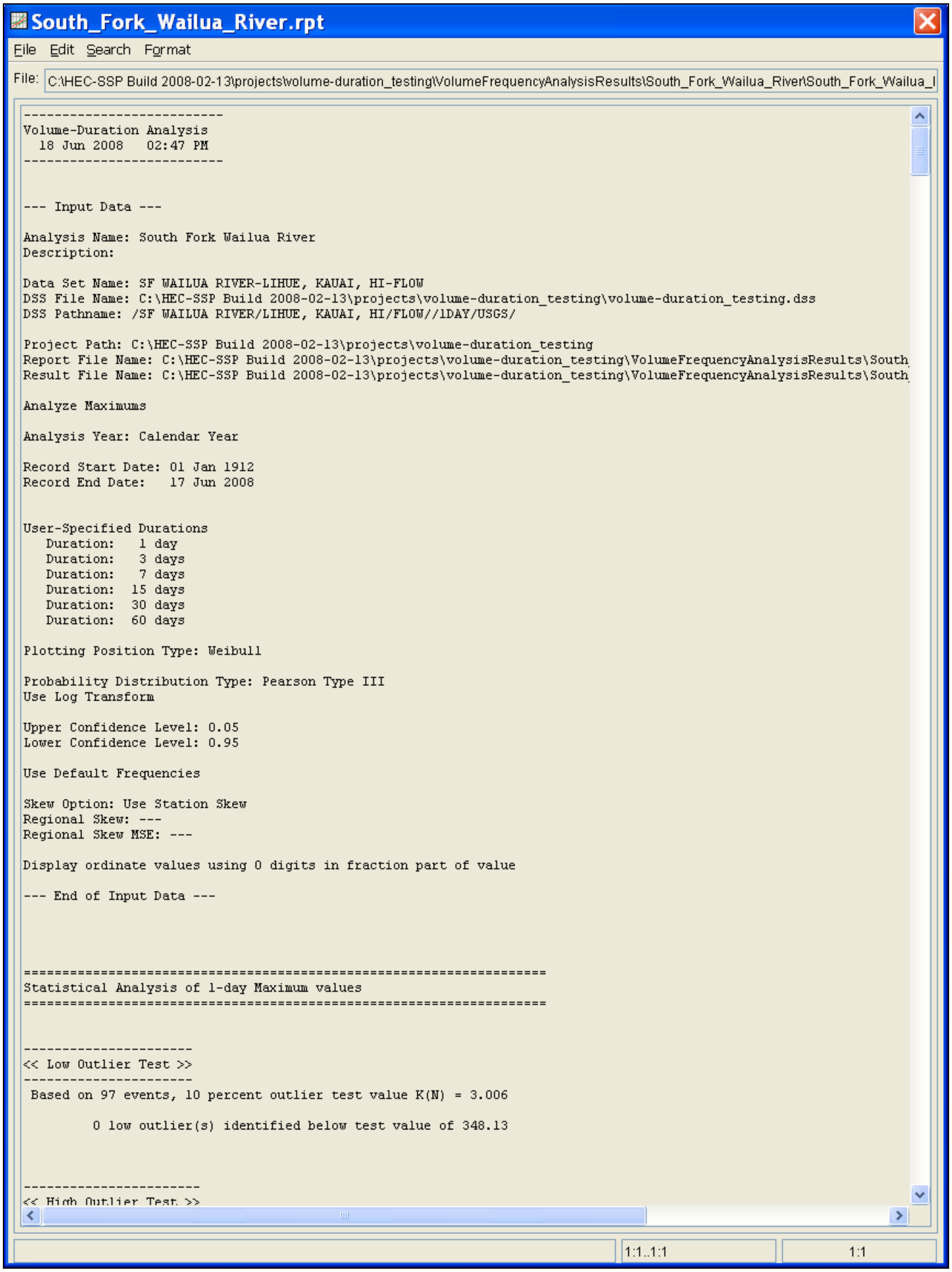
All plots opened by selecting one of the plot buttons at the bottom of the Volume-Duration Frequency editor contain menu options for printing, editing, and saving the plots.

Plots can be sent to the printer by selecting the **Print** option located on the **File** menu. Additional printing options available from the File menu are Page Setup, Print Preview, and Print Multiple (used for printing multiple graphs on the same page). The plot can also be sent to the Windows Clipboard by selecting **Copy to Clipboard** from the File menu. Additionally, the plot can be saved to a file by selecting the **Save As** option from the File menu. When the Save As option is selected, a window will appear allowing the user to select a directory, enter a filename, and select the format for saving the file. Currently four file formats are available for saving the plot to disk: windows metafile, postscript, JPEG, and portable network graphic. The data contained within the plot can also be tabulated by selecting **Tabulate** from the File menu. When this option is selected, a separate window will appear with the data tabulated. Additional options are available from the File menu for saving the plot properties as a template (**Save Template**) and applying previously saved templates to the current plot (**Apply Template**).

The **Edit** menu contains several options for customizing the plot properties. These options include Plot Properties, Configure Plot Layout, Default Line Styles, and Default Plot Properties. Also, the user can right-click on a line or data point in the plot area or in the legend and a shortcut menu will open with customization options. The graphic customizing capabilities within HEC-SSP are very powerful, but are also somewhat complex to use. The code used in developing the plots in HEC-SSP is the same code that is used for developing plots in HEC-DSSVue and several other HEC software programs. Please refer to the HEC-DSSVue User's Manual for details on customizing plots.

Viewing the Report File

Computational results for a volume-duration frequency analysis are written to a report file. The report file lists all of the input data and user settings, plotting positions of the data points, intermediate results, each of the various statistical tests performed (i.e. high and low outliers, historical data, etc…), and the final results. This file is often useful for understanding how the software arrived at the final frequency curves. Press the **View Report** button at the bottom of the Volume-Duration Frequency editor to open the report, as shown in Figure 7-14.



South_Fork_Wailua_River.rpt

File Edit Search Format

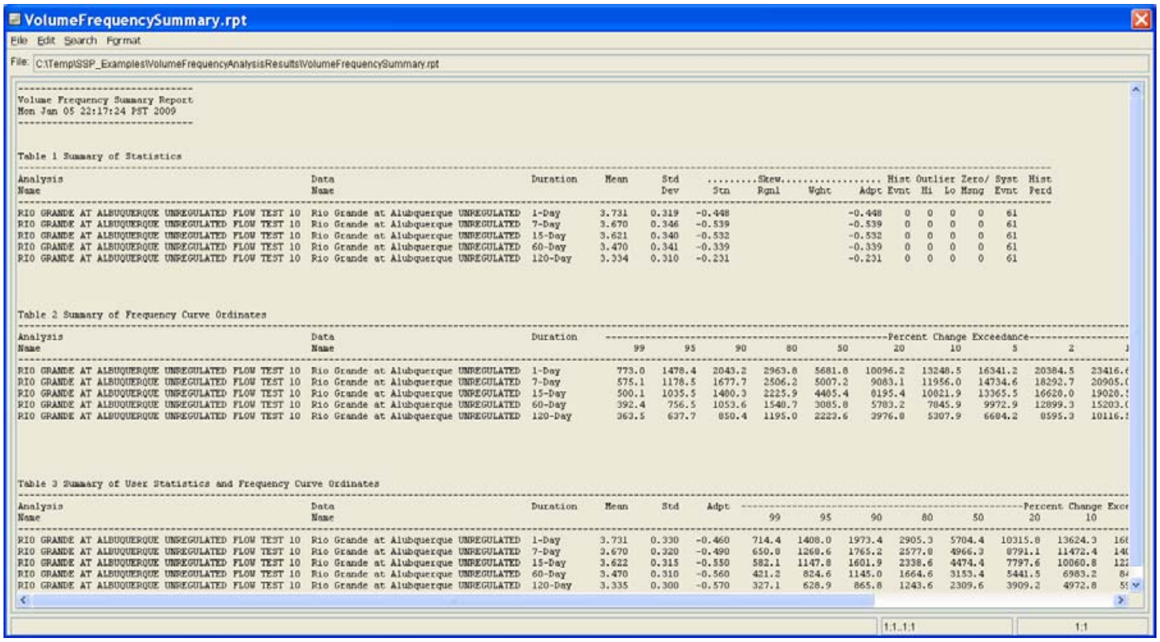
File: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\VolumeFrequencyAnalysisResults\South_Fork_Wailua_River\South_Fork_Wailua_I

```
-------------------------
Volume-Duration Analysis
  18 Jun 2008   02:47 PM
-------------------------


--- Input Data ---

Analysis Name: South Fork Wailua River
Description:

Data Set Name: SF WAILUA RIVER-LIHUE, KAUAI, HI-FLOW
DSS File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\volume-duration_testing.dss
DSS Pathname: /SF WAILUA RIVER/LIHUE, KAUAI, HI/FLOW//1DAY/USGS/

Project Path: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing
Report File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\VolumeFrequencyAnalysisResults\South
Result File Name: C:\HEC-SSP Build 2008-02-13\projects\volume-duration_testing\VolumeFrequencyAnalysisResults\South

Analyze Maximums

Analysis Year: Calendar Year

Record Start Date: 01 Jan 1912
Record End Date:   17 Jun 2008


User-Specified Durations
   Duration:    1 day
   Duration:    3 days
   Duration:    7 days
   Duration:   15 days
   Duration:   30 days
   Duration:   60 days

Plotting Position Type: Weibull

Probability Distribution Type: Pearson Type III
Use Log Transform

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Use Default Frequencies

Skew Option: Use Station Skew
Regional Skew: ---
Regional Skew MSE: ---

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---




====================================================================
Statistical Analysis of 1-day Maximum values
====================================================================


----------------------
<< Low Outlier Test >>
----------------------
 Based on 97 events, 10 percent outlier test value K(N) = 3.006

         0 low outlier(s) identified below test value of 348.13



-----------------------
<< High Outlier Test >>
```

1:1..1:1 1:1

Figure 7-14. Volume-Duration Frequency Report.

Plots, tables and reports can also be created by selecting menu options from the **Results** menu. At least one volume-duration frequency analysis must be selected in the tree before selecting one of the menu options on the Results menu. Results from multiple analyses are combined in one graph if they are selected in the study tree when the **Graph** menu option is selected. The **Results→Summary Report** menu option will create a summary table of statistics and frequency curve ordinates for the selected analyses as shown in Figure 7-15.



Volume Frequency Summary Report
Mon Jan 05 22:17:24 PST 2009

Table 1 Summary of Statistics

Analysis Name	Data Name	Duration	Mean	Std Dev	Skew Stn	Skew Rgnl	Skew Wght	Skew Adpt	Hist Evnt	Outlier Hi	Outlier Lo	Zero/ Msng	Syst Evnt	Hist Perd
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	3.731	0.319	-0.448			-0.448	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	3.670	0.346	-0.539			-0.539	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	3.621	0.340	-0.532			-0.532	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	3.470	0.341	-0.339			-0.339	0	0	0	0	61	
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	3.334	0.310	-0.231			-0.231	0	0	0	0	61	

Table 2 Summary of Frequency Curve Ordinates

Analysis Name	Data Name	Duration	Percent Change Exceedance 99	95	90	80	50	20	10	5	2	1
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	773.0	1478.4	2043.2	2963.8	5681.8	10096.2	13248.5	16341.2	20384.5	23416.6
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	575.1	1178.5	1677.7	2506.2	5007.2	9083.1	11956.0	14734.6	18292.7	20905.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	500.1	1035.5	1400.3	2225.9	4405.4	8195.4	10821.9	13365.5	16620.0	19020.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	392.4	756.5	1053.6	1540.7	3085.8	5783.2	7845.9	9972.9	12899.3	15203.
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	363.5	637.7	850.4	1195.0	2223.6	3976.8	5307.9	6684.2	8595.3	10116.

Table 3 Summary of User Statistics and Frequency Curve Ordinates

Analysis Name	Data Name	Duration	Mean	Std	Adpt	Percent Change Exce… 99	95	90	80	50	20	10
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	1-Day	3.731	0.330	-0.460	714.4	1408.0	1973.4	2905.3	5704.4	10315.8	13624.3
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	7-Day	3.670	0.320	-0.490	650.8	1260.6	1765.2	2577.8	4966.3	8791.1	11472.4
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	15-Day	3.622	0.315	-0.550	582.1	1147.8	1601.9	2338.6	4474.4	7797.6	10060.8
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	60-Day	3.470	0.310	-0.560	421.2	824.6	1145.0	1664.6	3153.4	5441.5	6983.2
RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10	Rio Grande at Alubquerque UNREGULATED	120-Day	3.335	0.300	-0.570	327.1	628.9	865.8	1243.6	2309.6	3909.2	4972.8

Figure 7-15. Summary Table for a Volume-Duration Frequency Analysis.

APPENDIX A

References

Interagency Advisory Committee on Water Data, March 1982. Bulletin 17B, "Guidelines for Determining Flood Flow Frequency", Published by the U.S. Department of the Interior, Geologic Survey.

U.S. Army Corps of Engineers, Hydrologic Engineering Center, May 1992. HEC-FFA, Flood Frequency Analysis, User's Manual.

U.S. Army Corps of Engineers, Hydrologic Frequency Analysis, EM 1110-2-1415. March 1993, Washington, D.C.

APPENDIX B

Example Data Sets

The input and output for eleven example data sets are provided to illustrate the use of selected options and to assist in verifying the correct execution of the program.

The first six example data sets are the same examples that were found in the HEC-FFA program documentation. The first six examples were duplicated with a Bulletin 17B and General Frequency analysis. This manual only shows these examples using the Bulletin 17B analysis; however, the example data sets show that results are the same whether a Bulletin 17B or General Frequency analysis was performed. As shown in the example data sets, the HEC-SSP software produces the same results as HEC-FFA for these six data sets. All of these test examples are provided with the software as a single HEC-SSP study labeled "SSP Examples". You can install this study on your computer by selecting the **Help→Install Example Data** menu option. After opening this study for the first time on your computer, you must compute each example before viewing tabular and graphical results.

A brief description of each test example is provided. In most cases the weighted skew option was selected, and a regional skew value was entered from the generalized skew map of the United States provided within Bulletin 17B (Plate 1).

The example problems shown in this section are entitled:

1. Fitting the Log-Pearson Type III Distribution.

2. Analysis with High Outliers.

3. Testing and Adjusting for a Low Outlier.

4. Zero Flood Years.

5. Confidence Limits and Low Threshold Discharge.

6. Use of Historic Data and Median Plotting Positions.

7. Analyzing Stage Data.

8. Using User-Adjusted Statistics.

9. General Frequency - Graphical Analysis.

10. Volume-Duration Frequency Analysis, Maximum Flows.

11. Volume-Duration Frequency Analysis, Minimum Flows.

When the "SSP Examples" study file is open, the screen will appear as shown in Figure B-1.

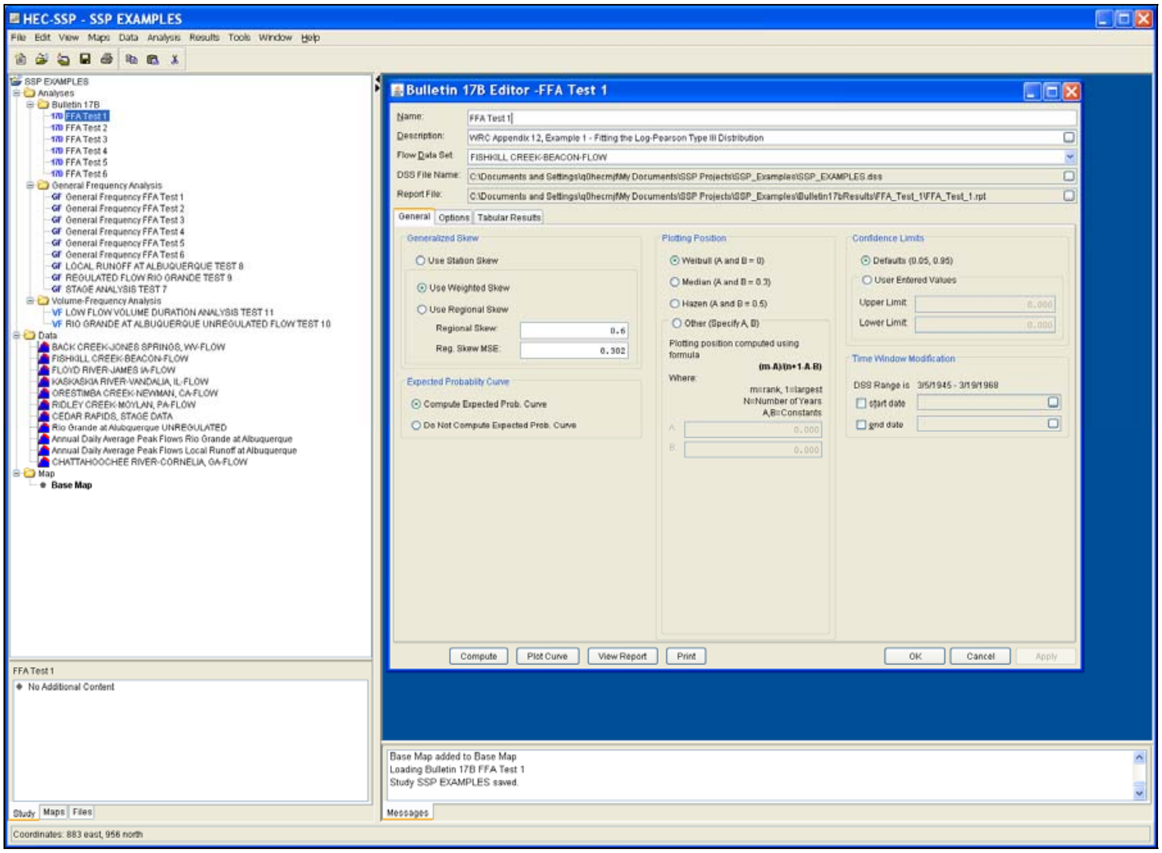


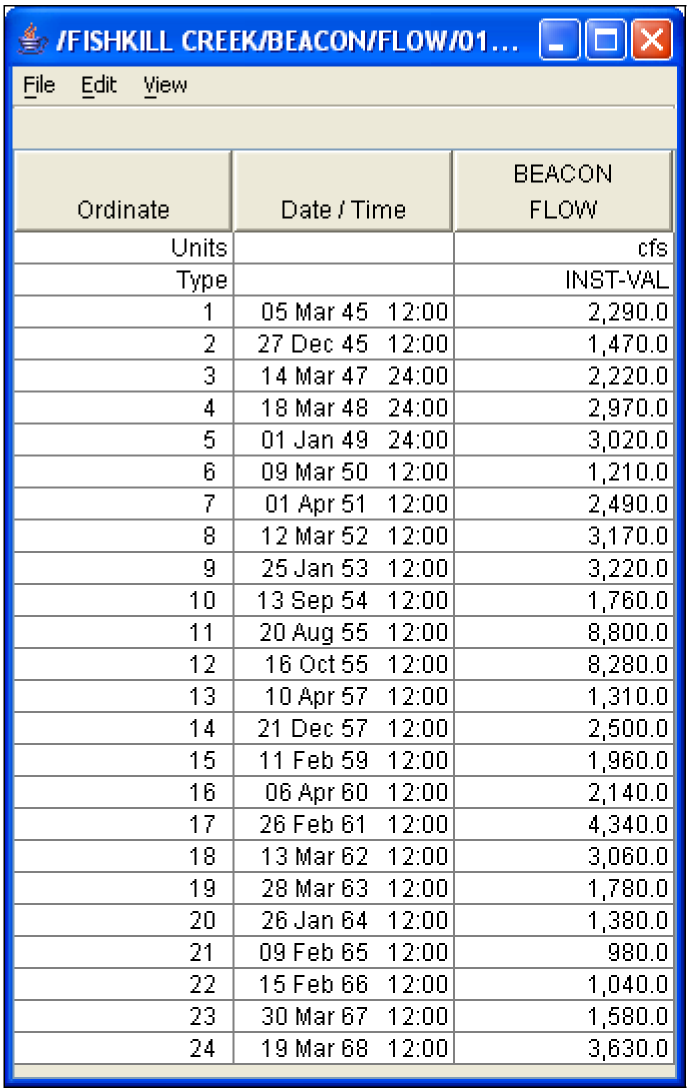
Figure B-1. SSP Examples Study.

As shown in Figure B-1, there are six Bulletin 17B analyses, nie General Frequency analyses, and two Volume-Frequency analyses in this study. The following sections document each of the example data sets.

Example 1: Fitting the Log-Pearson Type III Distribution

The input data for the HEC-SSP Example 1 is the same as that for Example 1 in Appendix 12, Guidelines for Determining Flood Flow Frequency, Water Resources Council Bulletin 17B. Example 1 illustrates the routine computation of a frequency curve by the Bulletin 17B methodology.

The data for this example is from Fishkill Creek in Beacon, New York. The period of record used for this example is from 1945 to 1968. To view the data from HEC-SSP, right-click on the data record labeled "**FISHKILL CREEK – BEACON- FLOW**" in the study tree and then select **Tabulate**. The data will appear as shown in Figure B-2.



Ordinate	Date / Time	BEACON FLOW
Units		cfs
Type		INST-VAL
1	05 Mar 45 12:00	2,290.0
2	27 Dec 45 12:00	1,470.0
3	14 Mar 47 24:00	2,220.0
4	18 Mar 48 24:00	2,970.0
5	01 Jan 49 24:00	3,020.0
6	09 Mar 50 12:00	1,210.0
7	01 Apr 51 12:00	2,490.0
8	12 Mar 52 12:00	3,170.0
9	25 Jan 53 12:00	3,220.0
10	13 Sep 54 12:00	1,760.0
11	20 Aug 55 12:00	8,800.0
12	16 Oct 55 12:00	8,280.0
13	10 Apr 57 12:00	1,310.0
14	21 Dec 57 12:00	2,500.0
15	11 Feb 59 12:00	1,960.0
16	06 Apr 60 12:00	2,140.0
17	26 Feb 61 12:00	4,340.0
18	13 Mar 62 12:00	3,060.0
19	28 Mar 63 12:00	1,780.0
20	26 Jan 64 12:00	1,380.0
21	09 Feb 65 12:00	980.0
22	15 Feb 66 12:00	1,040.0
23	30 Mar 67 12:00	1,580.0
24	19 Mar 68 12:00	3,630.0

Figure B-2. Tabulation of the Peak Flow Data for Fishkill Creek.

To plot the data for this example, right-click on the data record again and then select **Plot**. A plot of the data will appear as shown in Figure B-3.

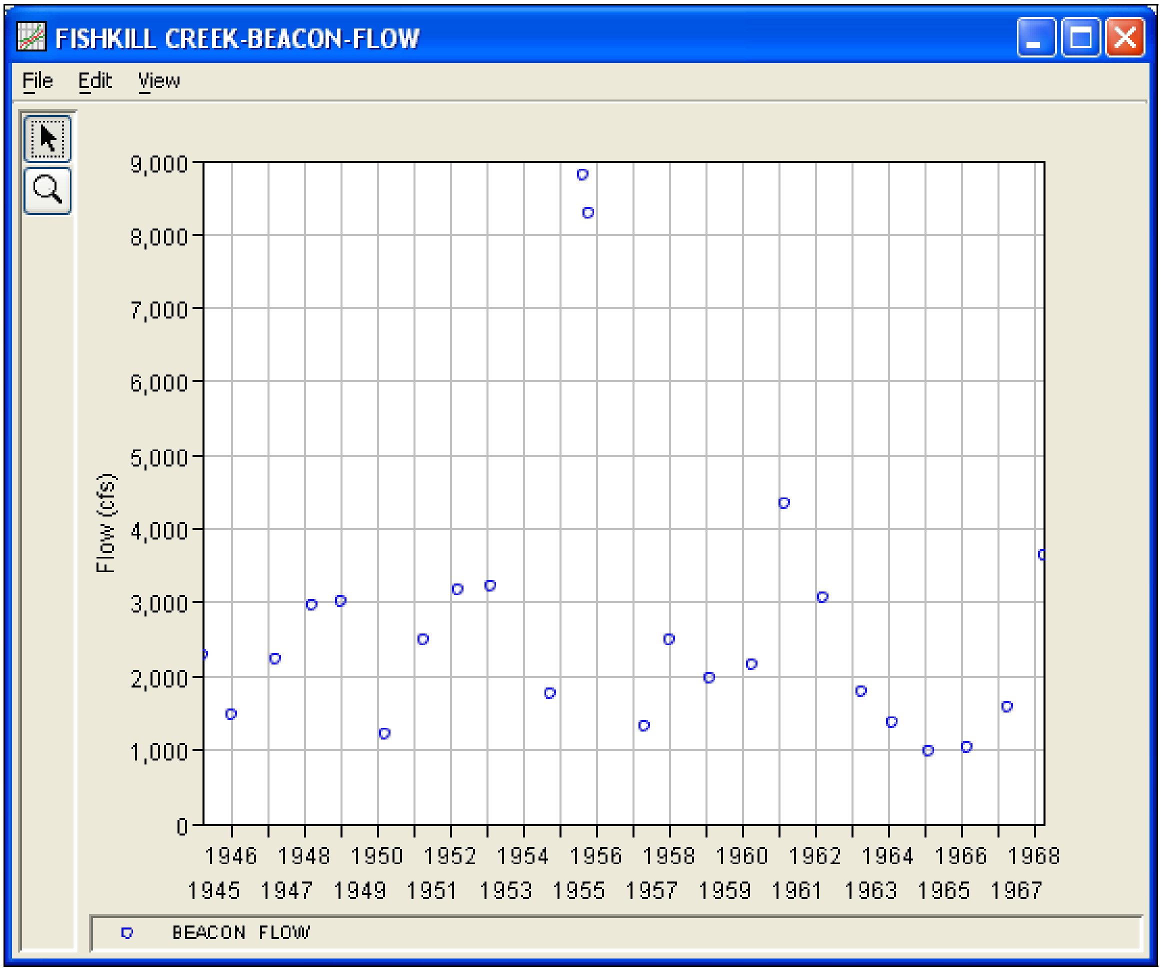


Figure B-3. Plot of the Fishkill Creek Data.

A Bulletin 17B and a General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 1, either double-click on the analysis labeled **FFA Test 1** from the Study Explorer, or from the **Analysis** menu select open, then select **FFA Test 1** from the list of available analyses. When FFA Test 1 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-4.

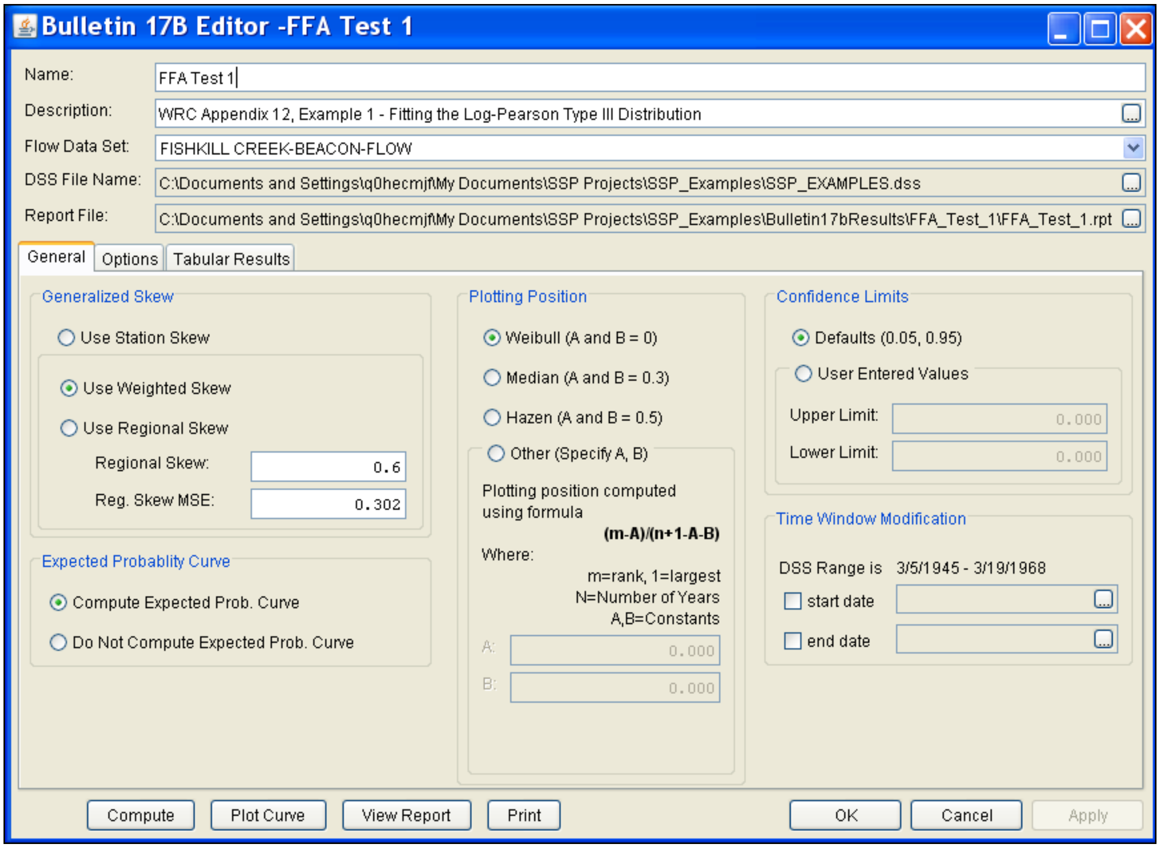


Figure B-4. Bulletin 17B Analysis Editor with Test Example 1 Data Set.

Shown in Figure B-4 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of 0.6 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-5 is the Bulletin 17B editor with the **Options Tab** selected.

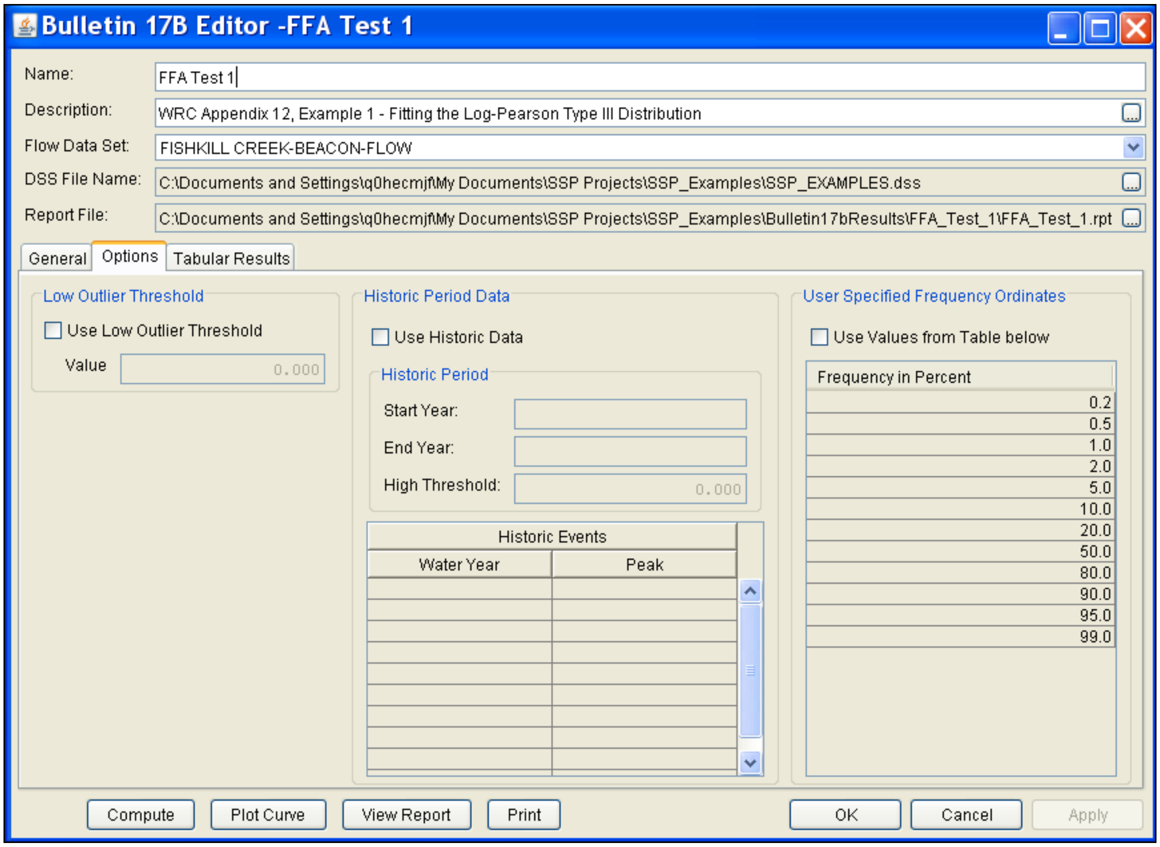


Figure B-5. Bulletin 17B Editor with Options Tab Selected for Test Example 1.

As shown in Figure B-5, none of the available options for modifying the frequency analysis were selected for this example. These options include changing the **Low Outlier Threshold** and using **Historic Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look like Figure B-6.

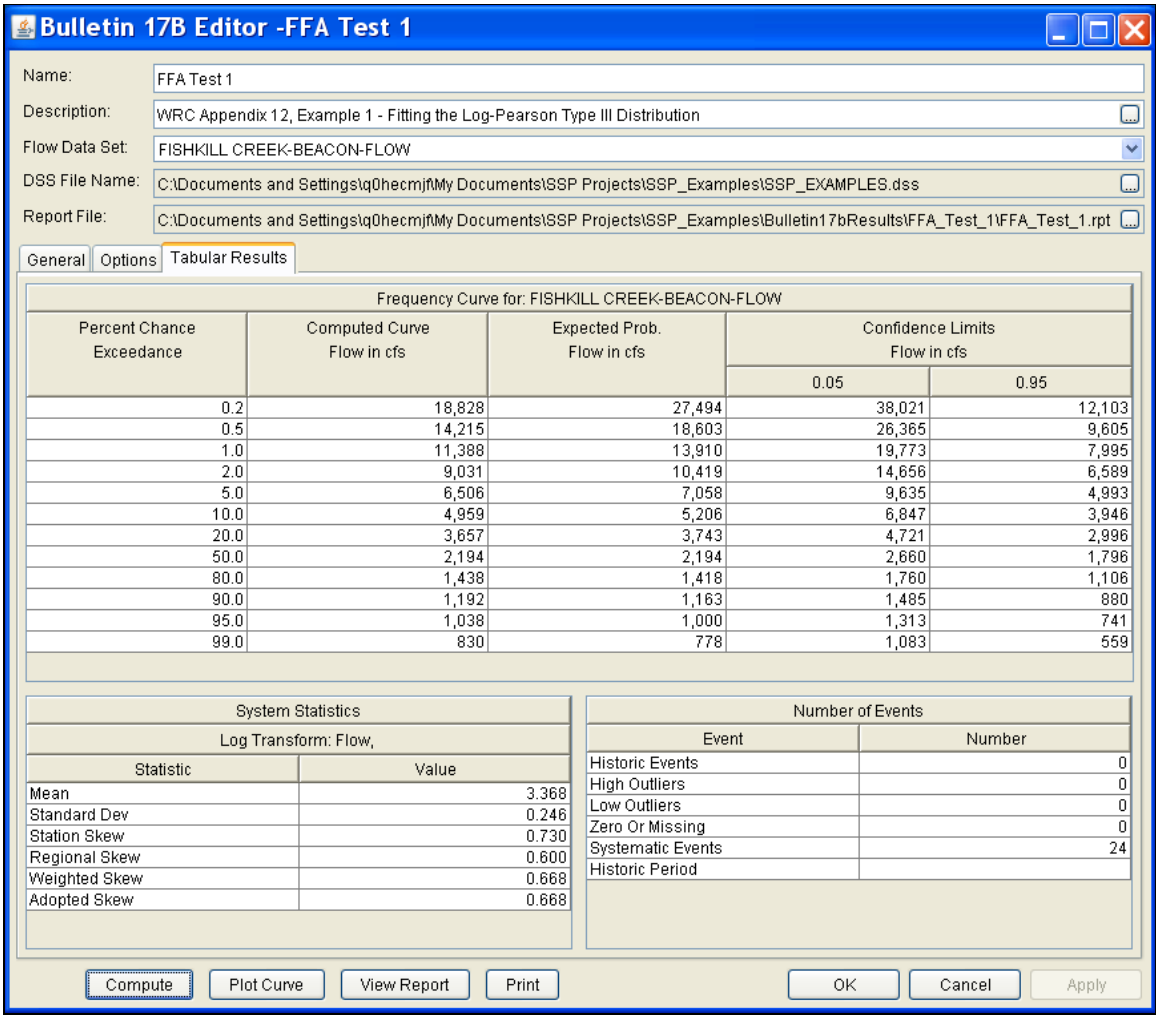


Figure B-6. Bulletin 17B Analysis Window with Results Tab Shown for Test Example 1.

As shown in Figure B-6, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom, left side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom, right side of the results tab is a Number of Events table showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-7.

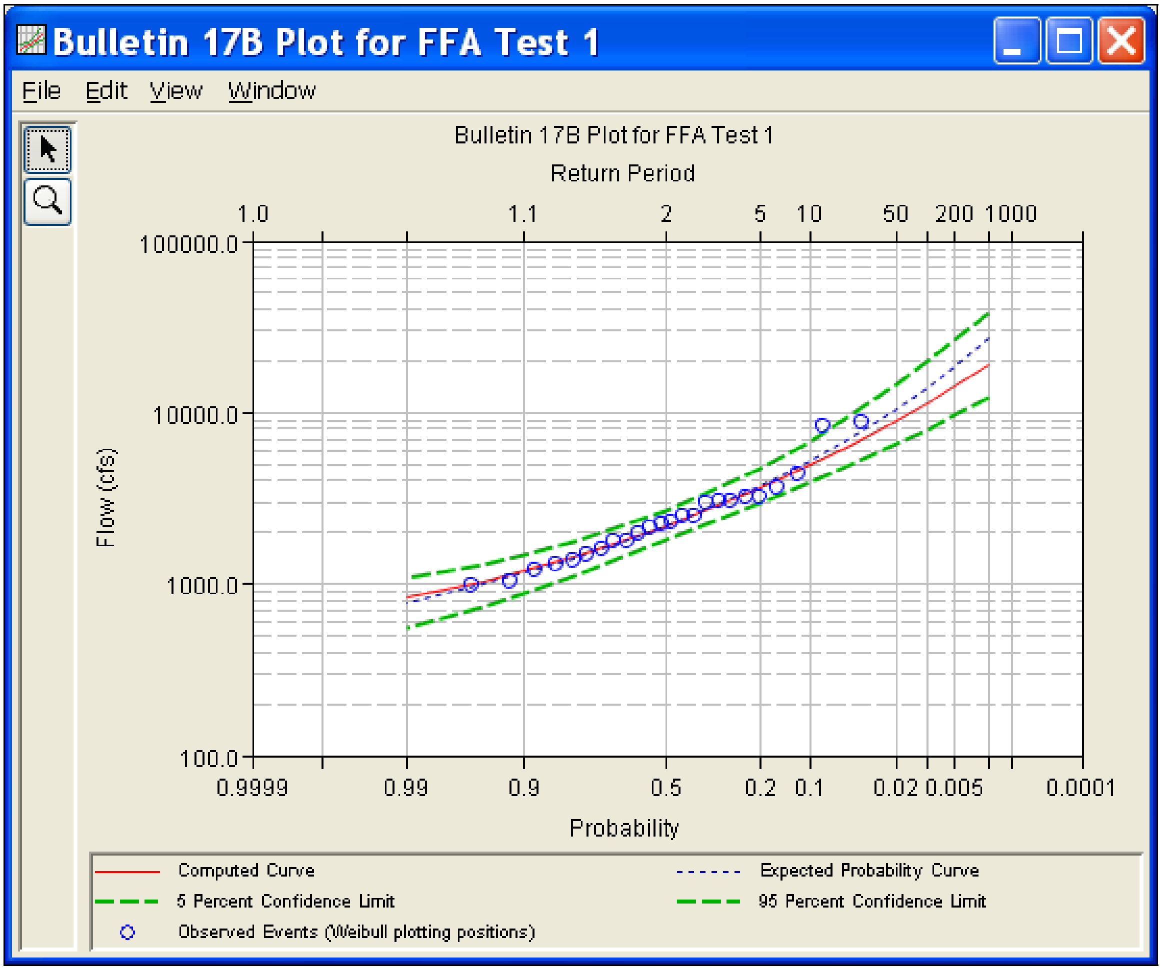


Figure B-7. Plotted Frequency Curves for Test Example 1.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-8 is the report file for test example 1.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis. The user should review the report file to understand how HEC-SSP performed the Bulletin 17B frequency curve calculations.

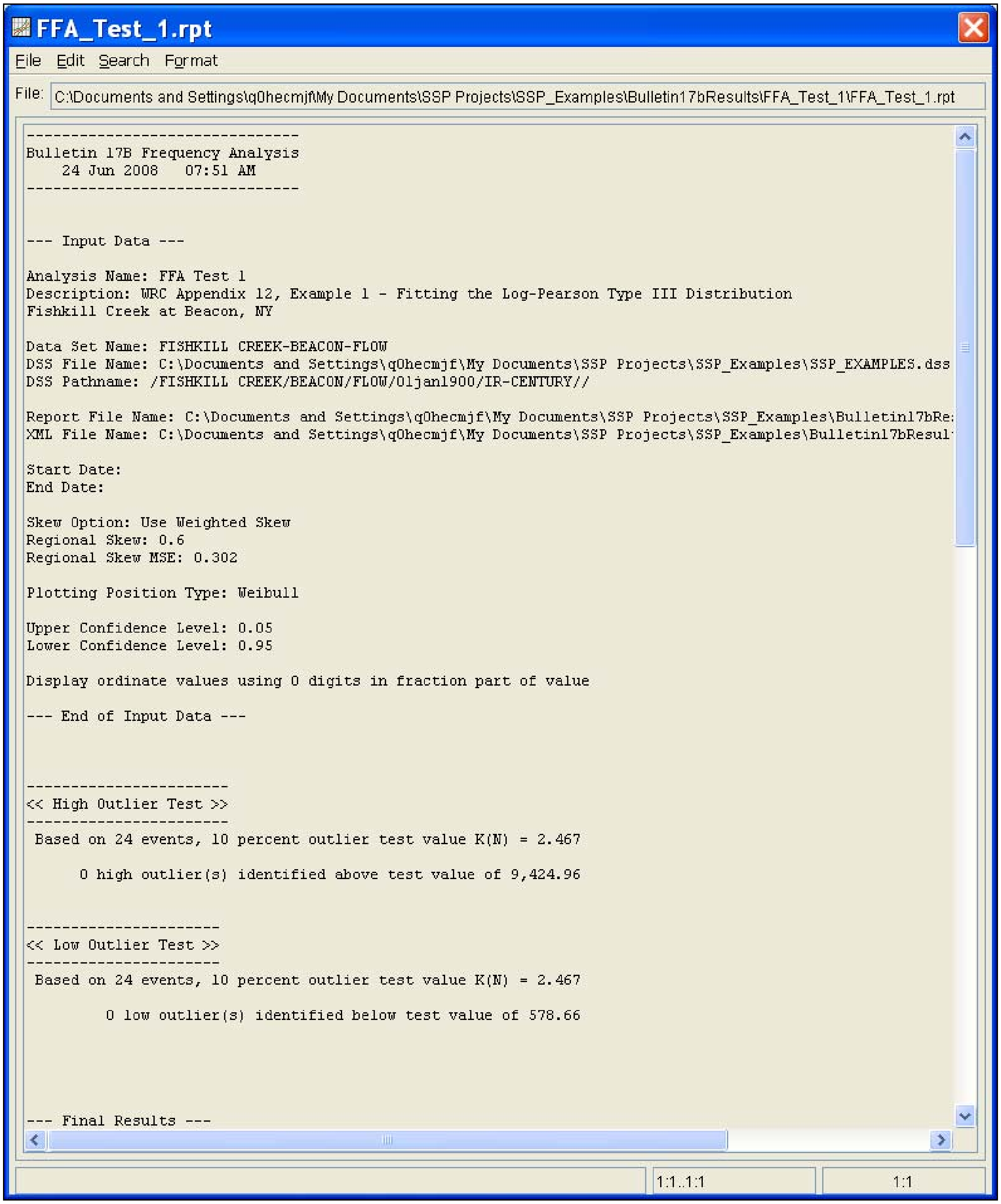
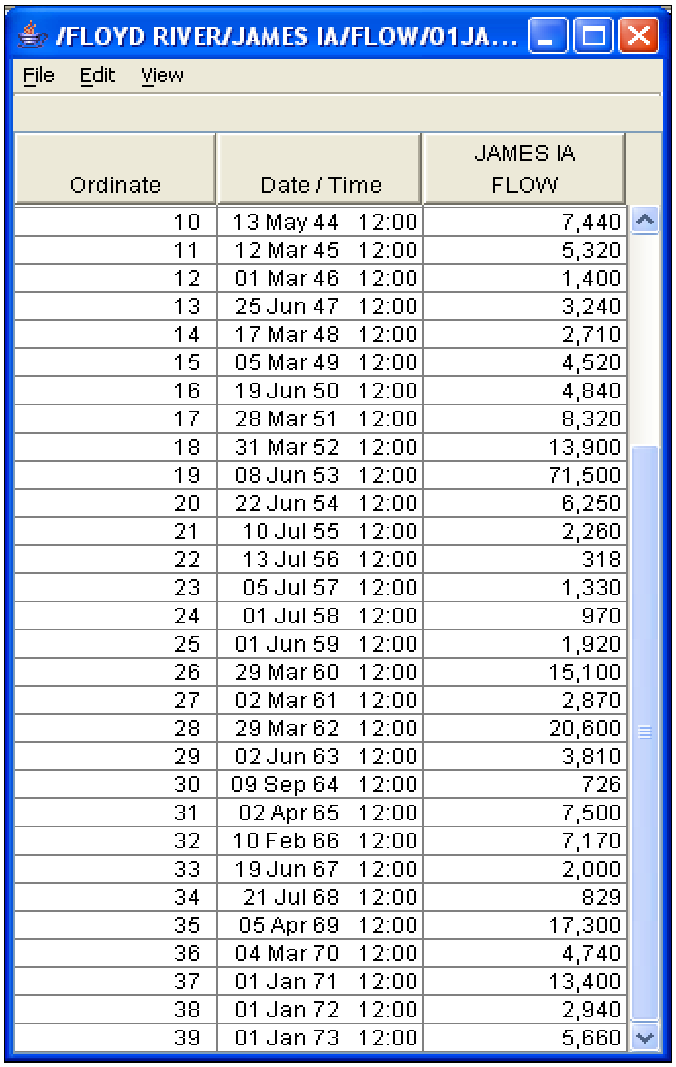


Figure B-8. Test Example 1 Report File.

Example 2: Analysis with High Outliers

The input data for the Example 2 is the same as that for Example 2 in Appendix 12, Guidelines for Determining Flood Flow Frequency, Water Resources Council Bulletin 17B. Example 2 illustrates the application to data with a high outlier.

The data for this example is from Floyd River in James, Iowa. The period of record used is from 1935 to 1973. To view the data from HEC-SSP, right-click on the data record labeled "**FLOYD RIVER-JAMES IA-FLOW**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-9.


/FLOYD RIVER/JAMES IA/FLOW/01JA...

File Edit View

Ordinate	Date / Time	JAMES IA FLOW
10	13 May 44 12:00	7,440
11	12 Mar 45 12:00	5,320
12	01 Mar 46 12:00	1,400
13	25 Jun 47 12:00	3,240
14	17 Mar 48 12:00	2,710
15	05 Mar 49 12:00	4,520
16	19 Jun 50 12:00	4,840
17	28 Mar 51 12:00	8,320
18	31 Mar 52 12:00	13,900
19	08 Jun 53 12:00	71,500
20	22 Jun 54 12:00	6,250
21	10 Jul 55 12:00	2,260
22	13 Jul 56 12:00	318
23	05 Jul 57 12:00	1,330
24	01 Jul 58 12:00	970
25	01 Jun 59 12:00	1,920
26	29 Mar 60 12:00	15,100
27	02 Mar 61 12:00	2,870
28	29 Mar 62 12:00	20,600
29	02 Jun 63 12:00	3,810
30	09 Sep 64 12:00	726
31	02 Apr 65 12:00	7,500
32	10 Feb 66 12:00	7,170
33	19 Jun 67 12:00	2,000
34	21 Jul 68 12:00	829
35	05 Apr 69 12:00	17,300
36	04 Mar 70 12:00	4,740
37	01 Jan 71 12:00	13,400
38	01 Jan 72 12:00	2,940
39	01 Jan 73 12:00	5,660

Figure B-9. Tabulation of the Peak Flow Data for the Floyd River.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-10.

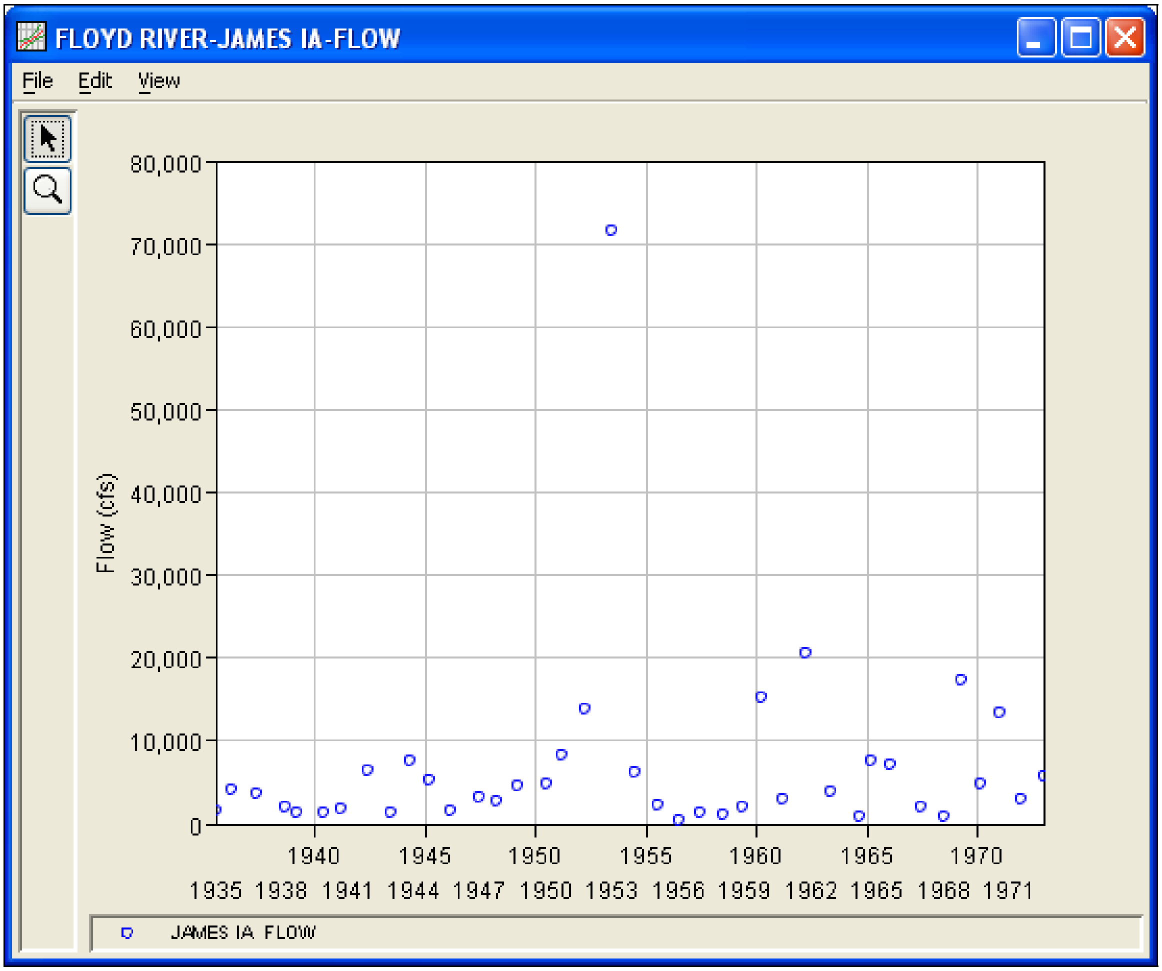


Figure B-10. Plot of Floyd River Data

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 2, either double-click on the analysis labeled **FFA Test 2** from the study pane, or from the **Analysis** menu select open and then select **FFA Test 2** from the list of available analyses. When FFA Test 2 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-11.

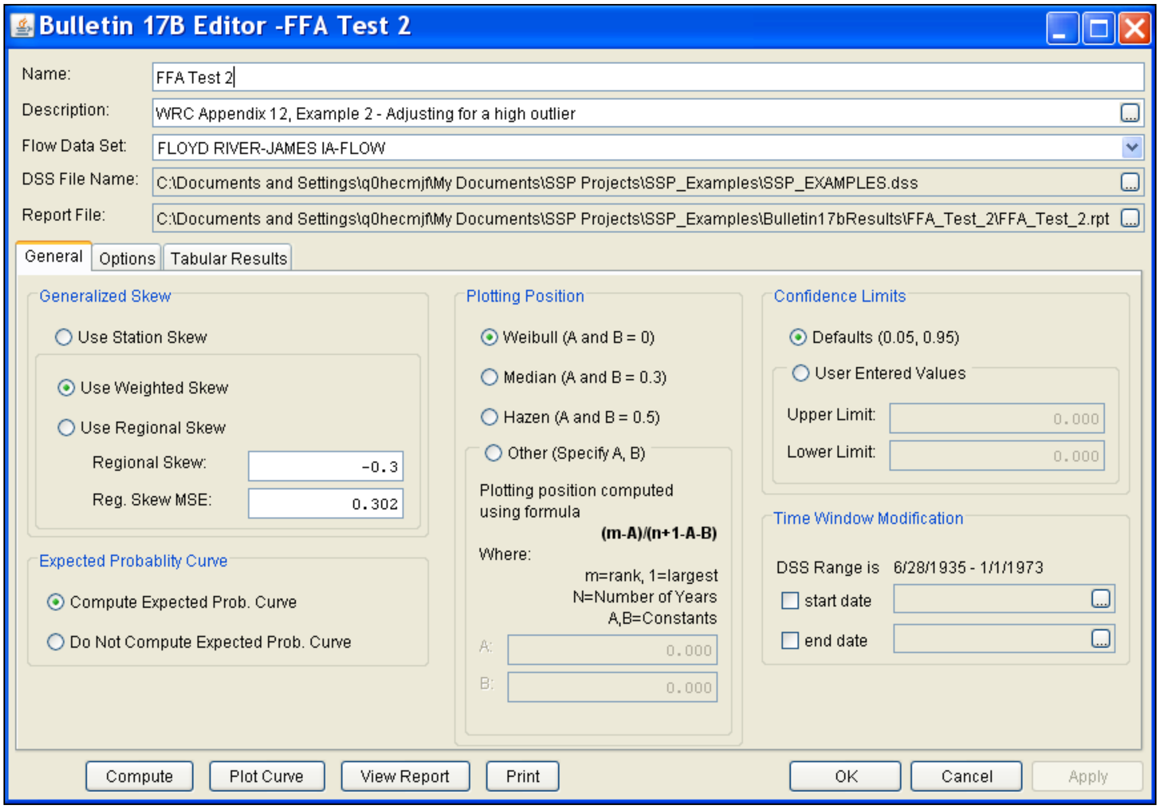


Figure B-11. Bulletin 17B Analysis Editor with Test Example 2 Data Set.

Shown in Figure B-11 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.3 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-12 is the Bulletin 17B editor with the **Options Tab** selected.

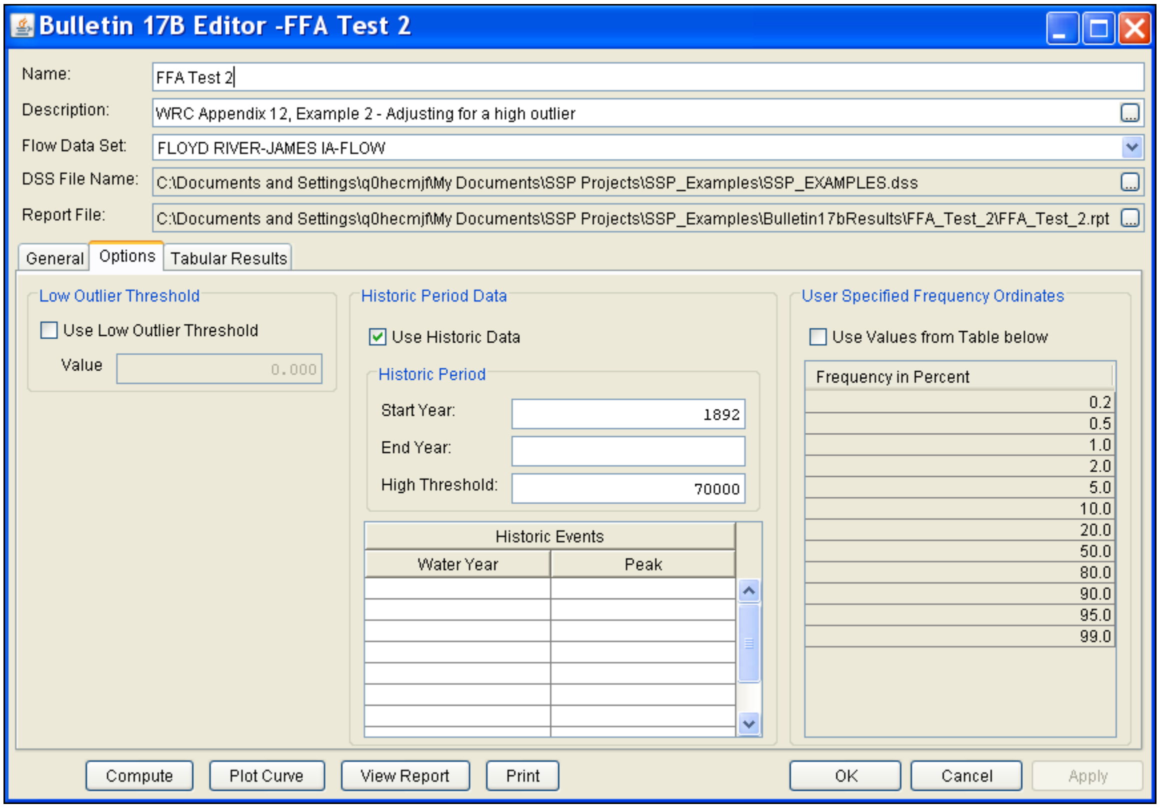
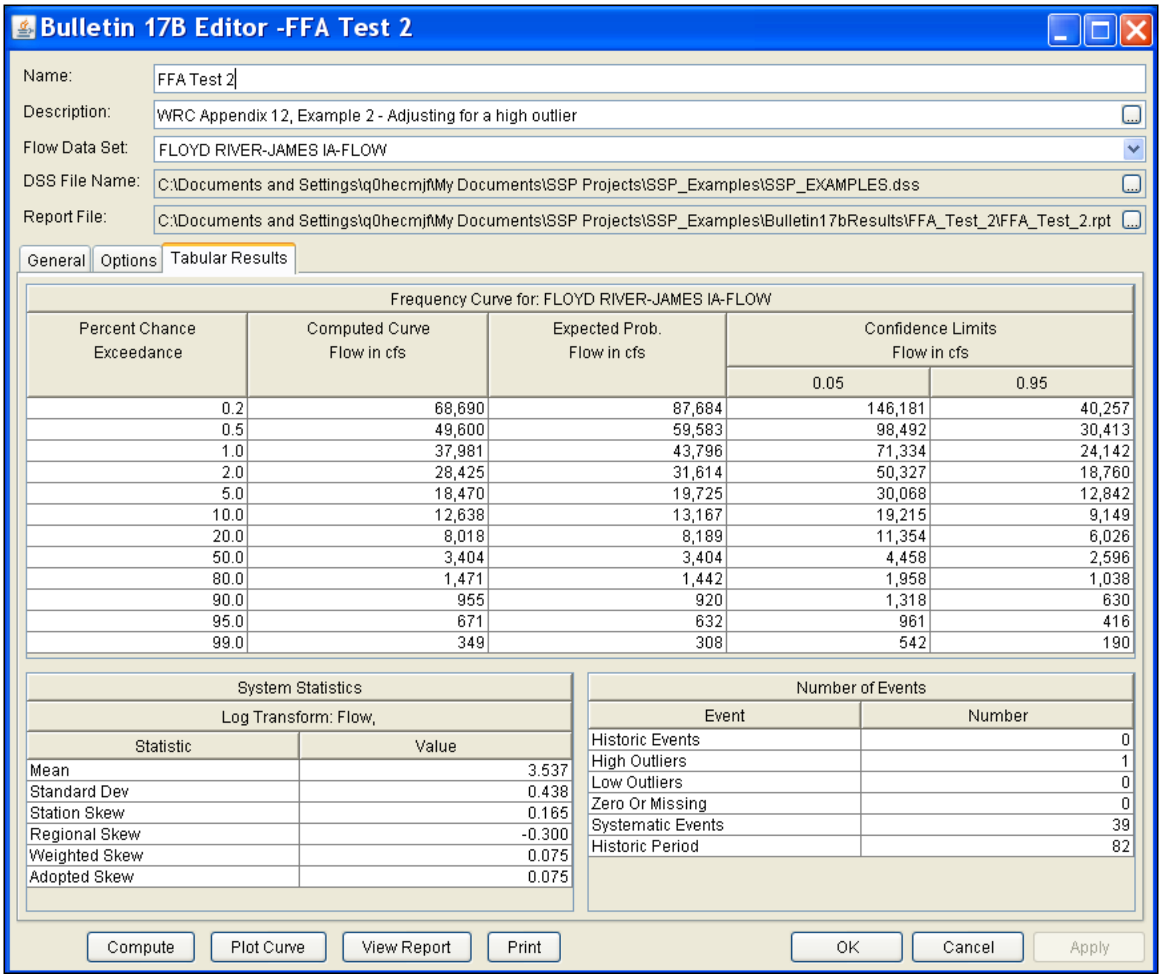


Figure B-12. Bulletin 17B Editor with Options Tab Selected for Test Example 2.

As shown in Figure B-12, the **Historic Period Data** option has been selected to reflect the fact that the 1953 flood peak of 71,500 cfs is known to be the largest flood since 1892. When the analysis was originally performed on this data set, the 1953 event was found to be a high outlier. (The reader may replicate this result by un-checking the "Use Historic Data" box, hitting the Compute button, and reviewing the Tabular Results tab.) High outliers should not be eliminated from an analysis, as they are valuable pieces of the flow record. However, when a high outlier is found in a data set, it suggests that the event might actually be the largest in a much longer period of record. The analyst should always try to locate and incorporate historic information to define a longer record and improve the quality of the frequency analysis. Since it was known that the 1953 event was the largest value since 1892, the year 1892 is entered as the **Start Year** for the historic period. Additionally, a **High Threshold Value** of 70,000 cfs was entered. By entering the High Threshold Value of 70,000 cfs, the 1953 flood of 71,500 cfs was removed from the systematic record and treated as a historic data value during the historic data adjustment calculations performed by HEC-SSP and outlined in Bulletin 17B, Appendix 6. Since no End Year was entered for the historic period, the last year of the systematic data set will be used as the End Year.

Other features on this tab include the **Low Outlier Threshold** and the option to override the default **Frequency Ordinates,** neither of which are selected in this example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look like Figure B-13.



Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs 0.05	Confidence Limits Flow in cfs 0.95
0.2	68,690	87,684	146,181	40,257
0.5	49,600	59,583	98,492	30,413
1.0	37,981	43,796	71,334	24,142
2.0	28,425	31,614	50,327	18,760
5.0	18,470	19,725	30,068	12,842
10.0	12,638	13,167	19,215	9,149
20.0	8,018	8,189	11,354	6,026
50.0	3,404	3,404	4,458	2,596
80.0	1,471	1,442	1,958	1,038
90.0	955	920	1,318	630
95.0	671	632	961	416
99.0	349	308	542	190

Statistic	Value
Mean	3.537
Standard Dev	0.438
Station Skew	0.165
Regional Skew	-0.300
Weighted Skew	0.075
Adopted Skew	0.075

Event	Number
Historic Events	0
High Outliers	1
Low Outliers	0
Zero Or Missing	0
Systematic Events	39
Historic Period	82

Figure B-13. Bulletin 17B Editor with Results Tab Selected for Test Example 2.

As shown in Figure B-13, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is the System Statistics table for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is the Number of Events table showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-14.

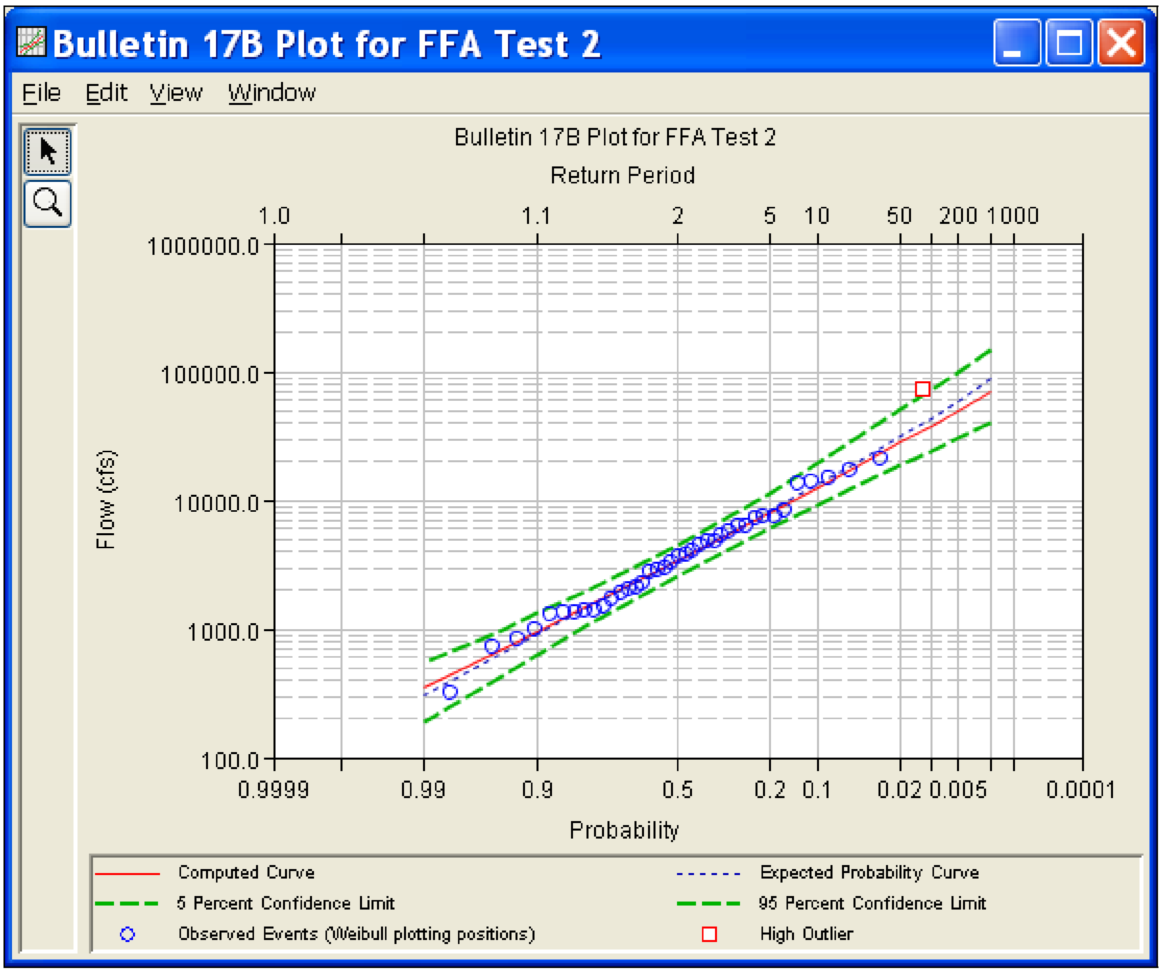
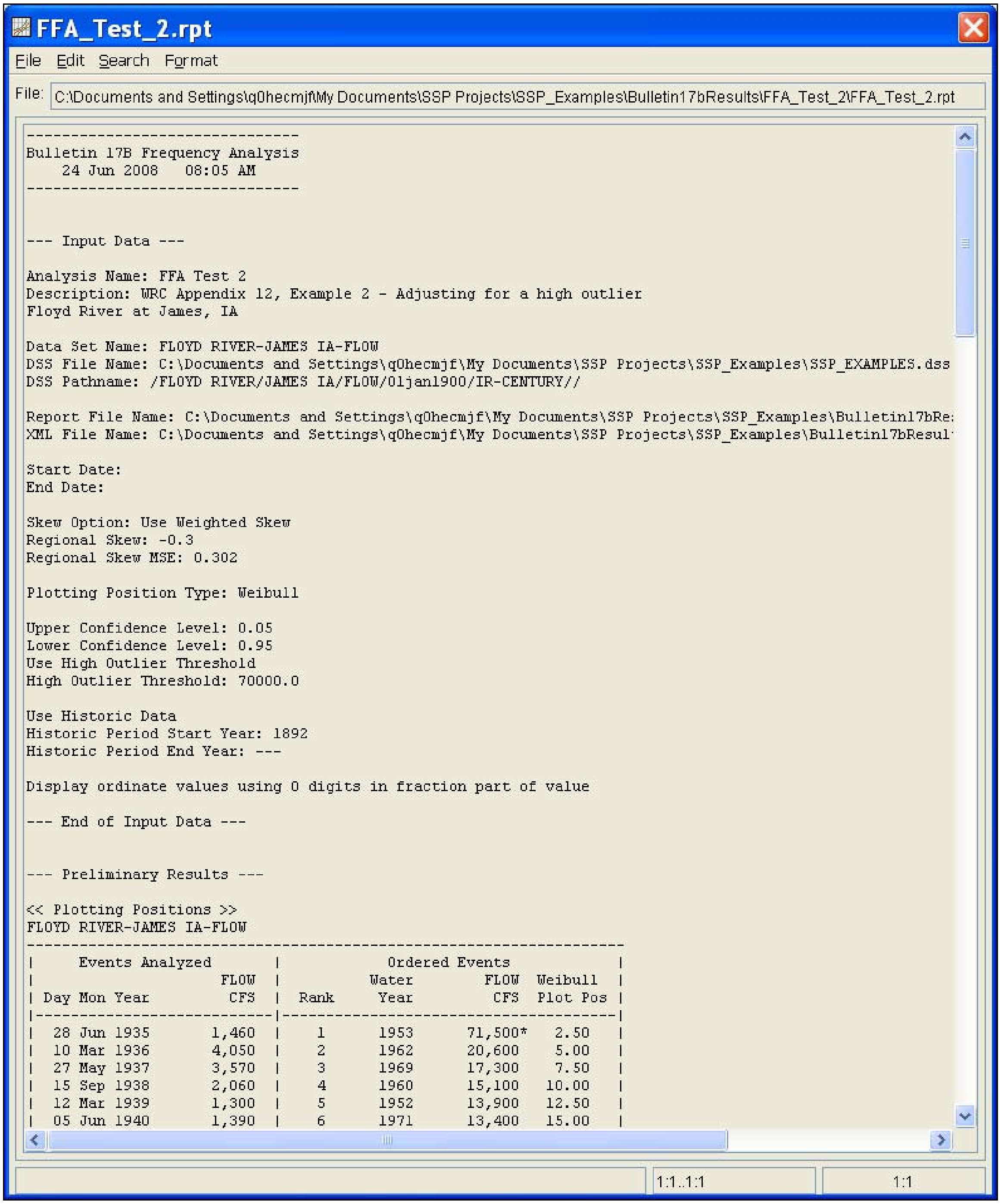


Figure B-14. Plotted Frequency Curves for Test Example 2.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-15 is the report file for Test Example 2.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis. The user should review the report file to understand how HEC-SSP performed the frequency curve calculations.



FFA_Test_2.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_2\FFA_Test_2.rpt

```
-------------------------------
Bulletin 17B Frequency Analysis
    24 Jun 2008    08:05 AM
-------------------------------


--- Input Data ---

Analysis Name: FFA Test 2
Description: WRC Appendix 12, Example 2 - Adjusting for a high outlier
Floyd River at James, IA

Data Set Name: FLOYD RIVER-JAMES IA-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /FLOYD RIVER/JAMES IA/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.3
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95
Use High Outlier Threshold
High Outlier Threshold: 70000.0

Use Historic Data
Historic Period Start Year: 1892
Historic Period End Year: ---

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

<< Plotting Positions >>
FLOYD RIVER-JAMES IA-FLOW
--------------------------------------------------------------------
|     Events Analyzed        |           Ordered Events            |
|                     FLOW   |          Water        FLOW  Weibull  |
| Day Mon Year         CFS   |  Rank     Year         CFS  Plot Pos |
|----------------------------|-------------------------------------|
|   28 Jun 1935       1,460  |    1      1953     71,500*    2.50   |
|   10 Mar 1936       4,050  |    2      1962     20,600     5.00   |
|   27 May 1937       3,570  |    3      1969     17,300     7.50   |
|   15 Sep 1938       2,060  |    4      1960     15,100    10.00   |
|   12 Mar 1939       1,300  |    5      1952     13,900    12.50   |
|   05 Jun 1940       1,390  |    6      1971     13,400    15.00   |
```

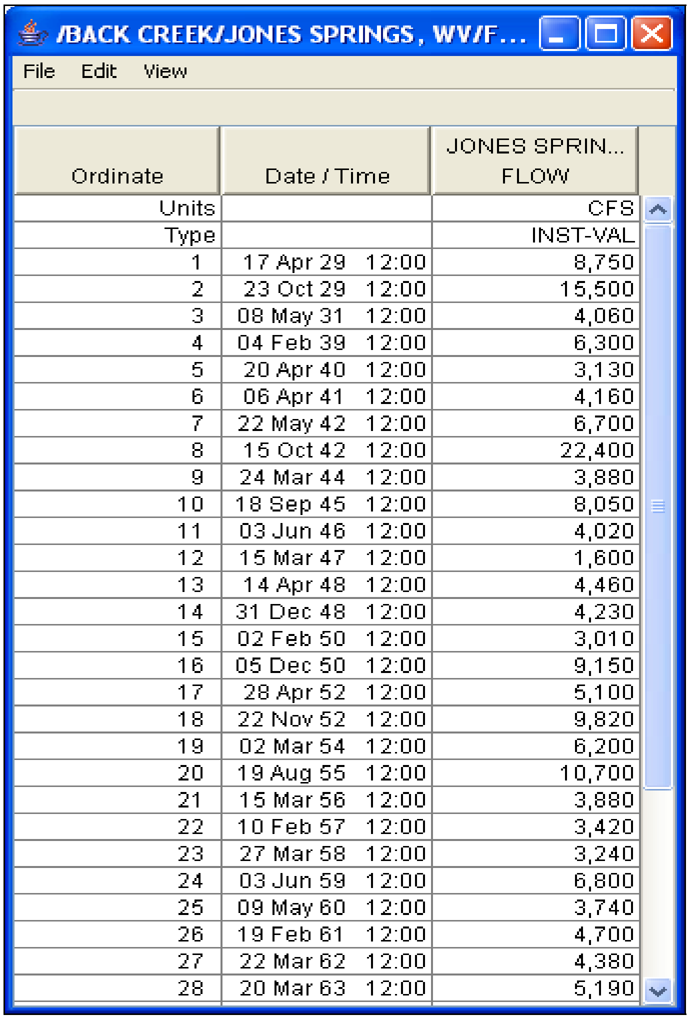
1:1..1:1 1:1

Figure B-15. Test Example 2 Report File.

Example 3: Testing and Adjusting for a Low Outlier

The input data for Test 3 are the same as that for Example 3 in Appendix 12 of the WRC Guidelines. Test 3 illustrates the application to data with a low outlier. Note that the program automatically screens for low outliers and, if low outliers are found, outputs the preliminary results in the report file in order to allow for comparison with the final results.

The data for this example is from Back Creek in Jones Springs, West Virginia. The period of record used for this example is from 1929 to 1973. To view the data, right-click on the data record labeled "**BACK CREEK-JONES SPRINGS, WV-FLOW**" in the study pane and then select **Tabulate**. The data will appear as shown in Figure B-16.



Ordinate	Date / Time	JONES SPRIN... FLOW
Units		CFS
Type		INST-VAL
1	17 Apr 29 12:00	8,750
2	23 Oct 29 12:00	15,500
3	08 May 31 12:00	4,060
4	04 Feb 39 12:00	6,300
5	20 Apr 40 12:00	3,130
6	06 Apr 41 12:00	4,160
7	22 May 42 12:00	6,700
8	15 Oct 42 12:00	22,400
9	24 Mar 44 12:00	3,880
10	18 Sep 45 12:00	8,050
11	03 Jun 46 12:00	4,020
12	15 Mar 47 12:00	1,600
13	14 Apr 48 12:00	4,460
14	31 Dec 48 12:00	4,230
15	02 Feb 50 12:00	3,010
16	05 Dec 50 12:00	9,150
17	28 Apr 52 12:00	5,100
18	22 Nov 52 12:00	9,820
19	02 Mar 54 12:00	6,200
20	19 Aug 55 12:00	10,700
21	15 Mar 56 12:00	3,880
22	10 Feb 57 12:00	3,420
23	27 Mar 58 12:00	3,240
24	03 Jun 59 12:00	6,800
25	09 May 60 12:00	3,740
26	19 Feb 61 12:00	4,700
27	22 Mar 62 12:00	4,380
28	20 Mar 63 12:00	5,190

Figure B-16. Tabulation of the Peak Flow Data for Back Creek.

To plot the data for this example, right-click on the data record and select **Plot**. A plot of the data will appear as shown in Figure B-17.

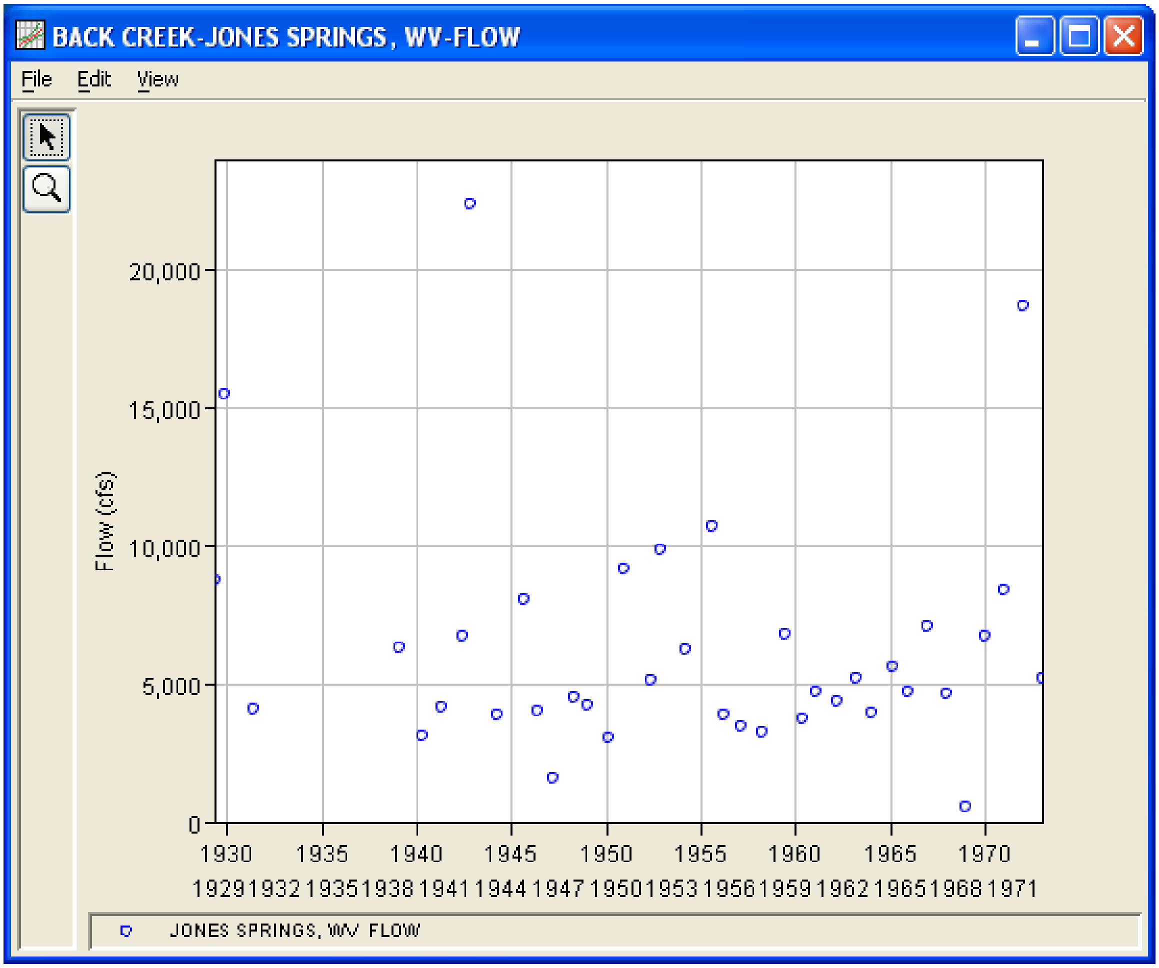


Figure B-17. Plot of Back Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 3, either double-click on the analysis labeled **FFA Test 3** from the study explorer, or from the **Analysis** menu select open and then select **FFA Test 3** from the list of available analyses. When FFA Test 3 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-18.

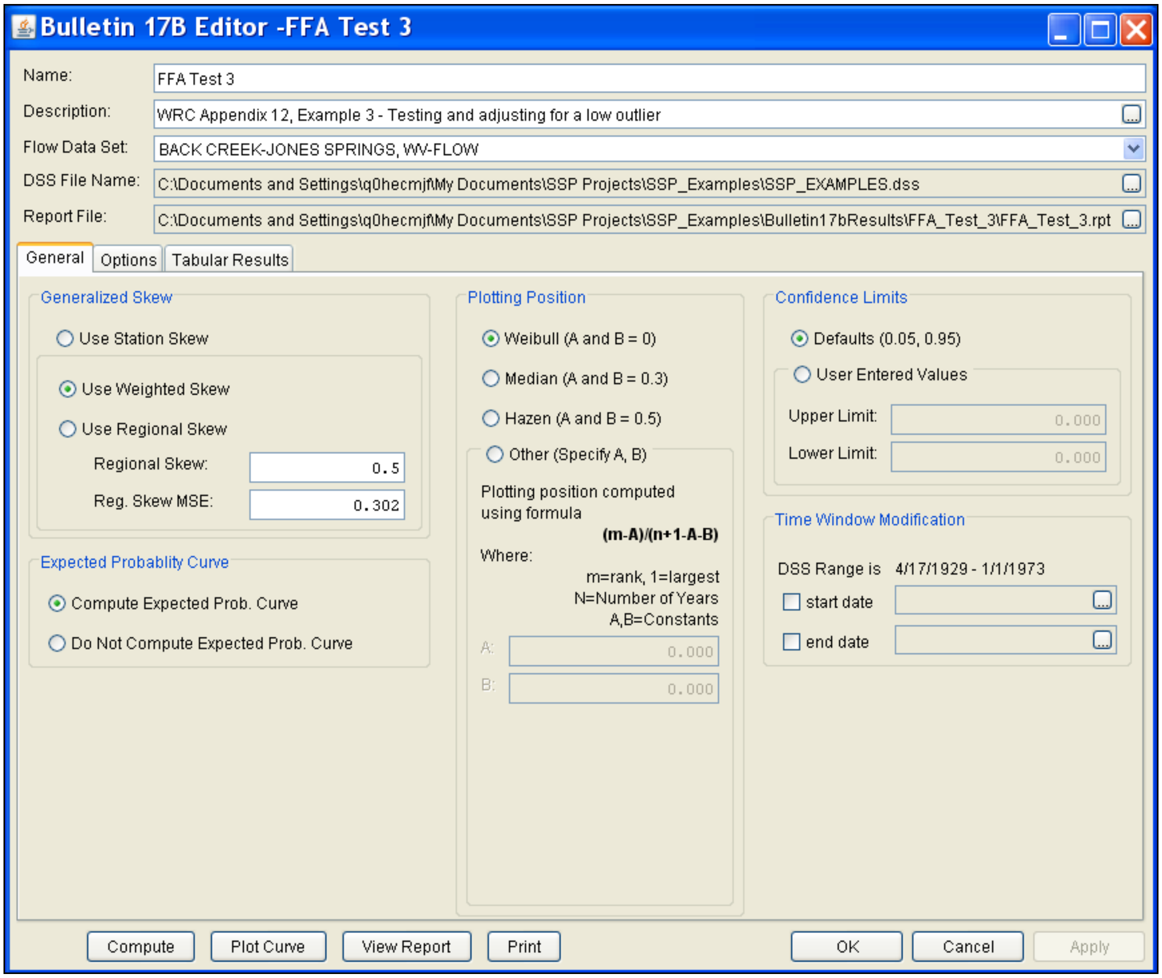


Figure B-18. Bulletin 17B Analysis Editor with Test Example 3 Data Set.

Shown in Figure B-18 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example, a value of 0.5 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-19 is the Bulletin 17B editor with the **Options Tab** selected.

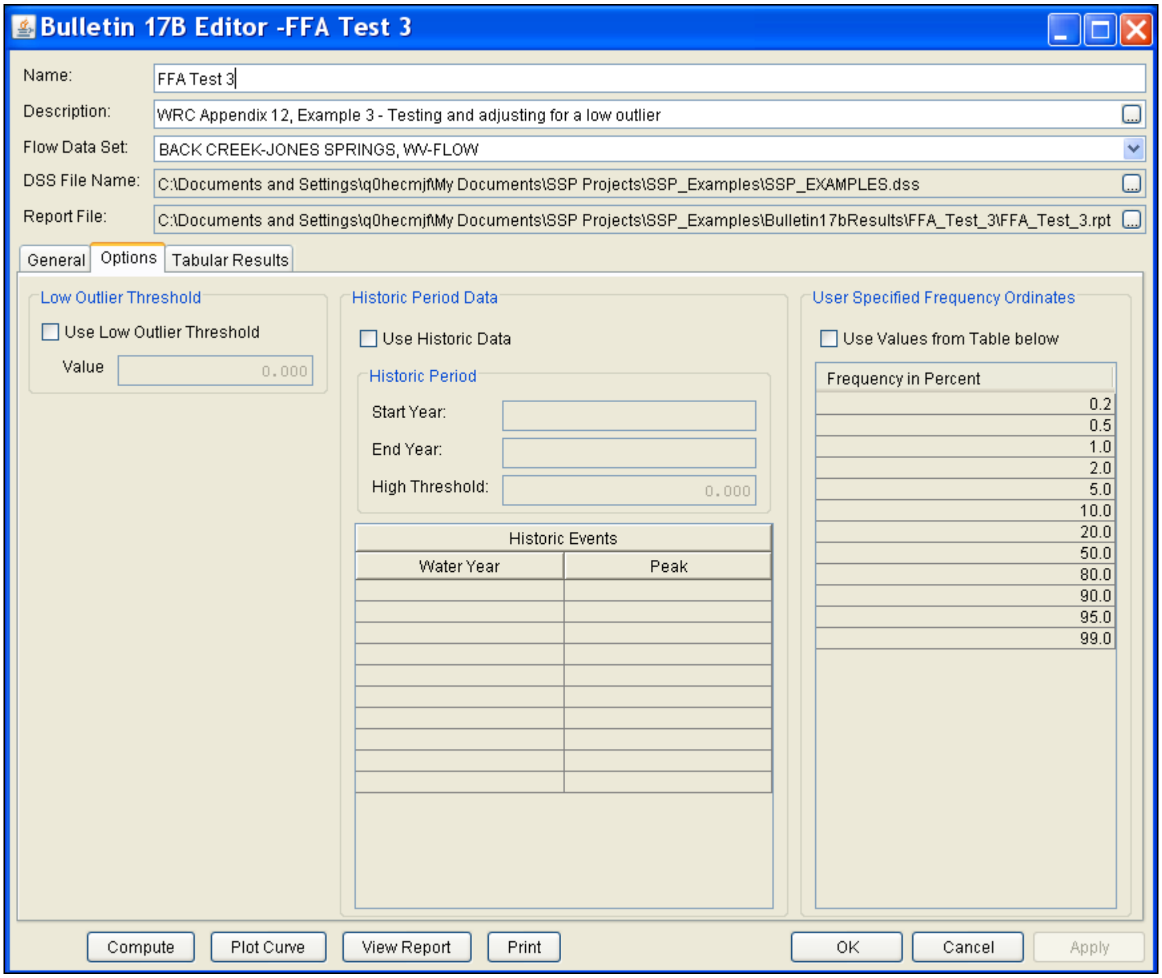
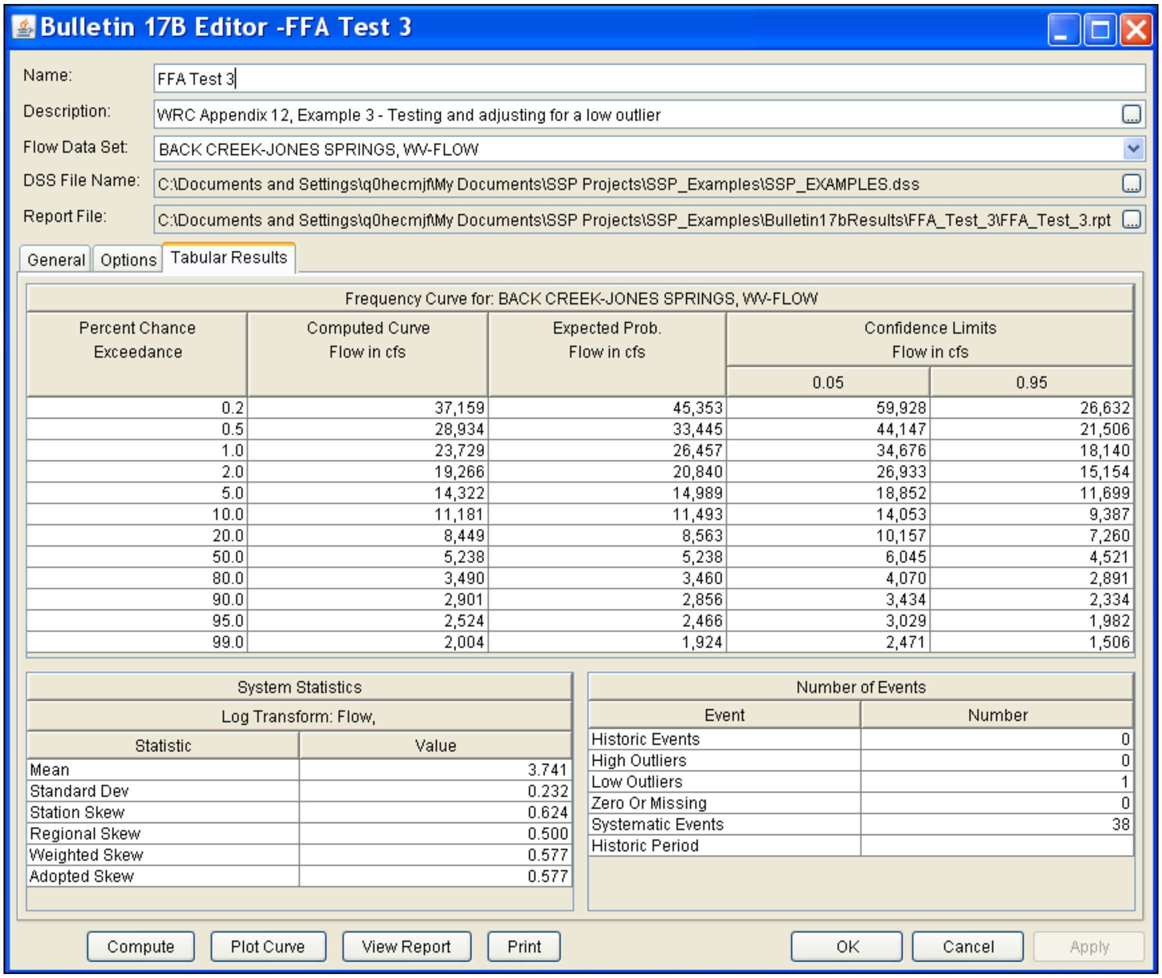


Figure B-19. Bulletin 17B Editor with the Options Tab Selected for Test Example 3.

As shown in Figure B-19, none of the available options for modifying the frequency curve were selected for this test example. These options include the **Low Outlier Threshold** and **Historic Period Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and select the **Tabular Results** tab. The analysis window should look like Figure B-20.



Bulletin 17B Editor -FFA Test 3

Name: FFA Test 3

Description: WRC Appendix 12, Example 3 - Testing and adjusting for a low outlier

Flow Data Set: BACK CREEK-JONES SPRINGS, WV-FLOW

DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss

Report File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_3\FFA_Test_3.rpt

General | Options | Tabular Results

Frequency Curve for: BACK CREEK-JONES SPRINGS, WV-FLOW

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	37,159	45,353	59,928	26,632
0.5	28,934	33,445	44,147	21,506
1.0	23,729	26,457	34,676	18,140
2.0	19,266	20,840	26,933	15,154
5.0	14,322	14,989	18,852	11,699
10.0	11,181	11,493	14,053	9,387
20.0	8,449	8,563	10,157	7,260
50.0	5,238	5,238	6,045	4,521
80.0	3,490	3,460	4,070	2,891
90.0	2,901	2,856	3,434	2,334
95.0	2,524	2,466	3,029	1,982
99.0	2,004	1,924	2,471	1,506

System Statistics

Log Transform: Flow,

Statistic	Value
Mean	3.741
Standard Dev	0.232
Station Skew	0.624
Regional Skew	0.500
Weighted Skew	0.577
Adopted Skew	0.577

Number of Events

Event	Number
Historic Events	0
High Outliers	0
Low Outliers	1
Zero Or Missing	0
Systematic Events	38
Historic Period	

Compute | Plot Curve | View Report | Print | OK | Cancel | Apply

Figure B-20. Bulletin 17B Editor with the Results Tab Selected for Test Example 3.

As shown in Figure B-20, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

In this analysis, the software detected 1 low outlier in the systematic record. As recommended in Bulletin 17B, if a low outlier is detected, then that data point will be removed and the Conditional Probability Adjustment will be used to recalculate the frequency curve and then the statistics without that point. Review the report file to see the original statistics, computed curves, the low outlier test, and recomputed curves.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-21.

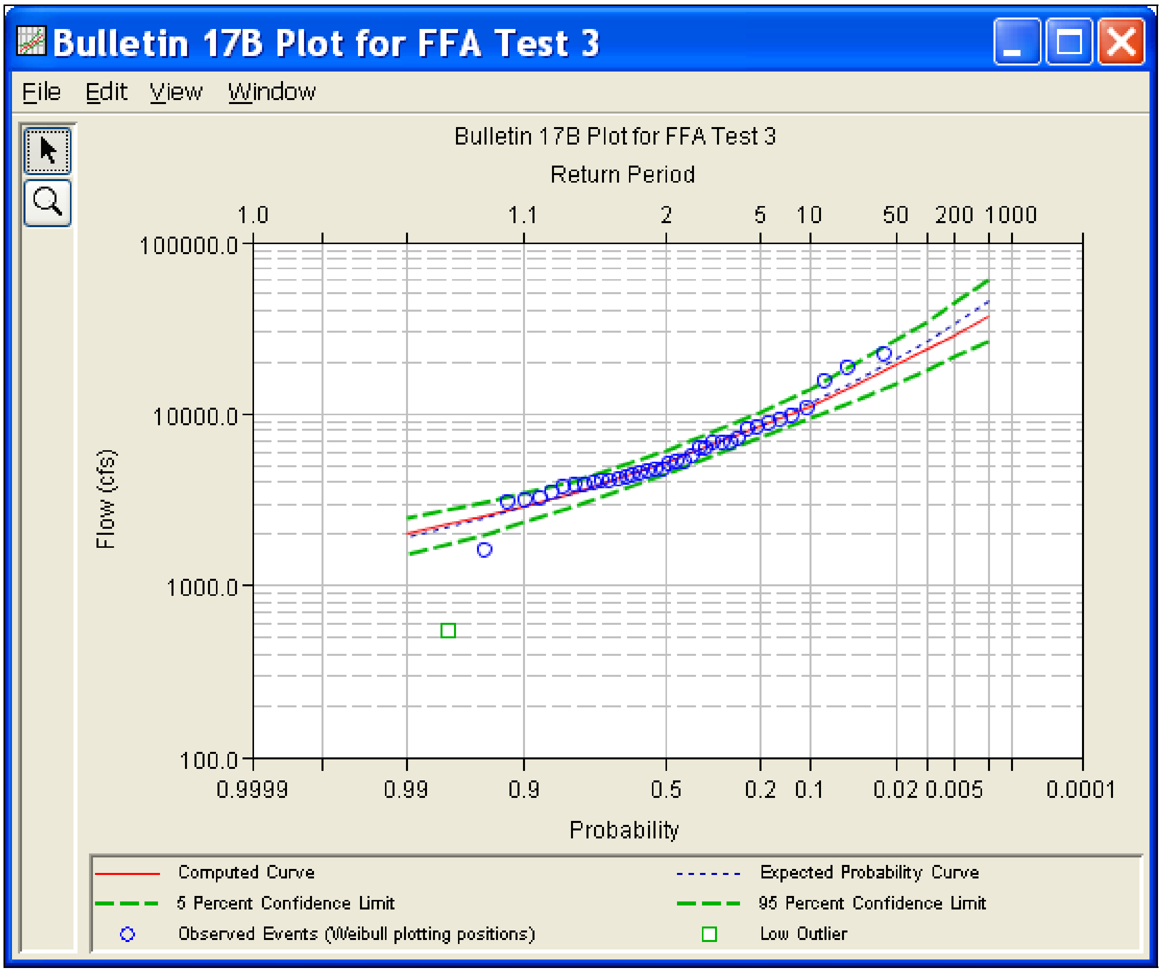
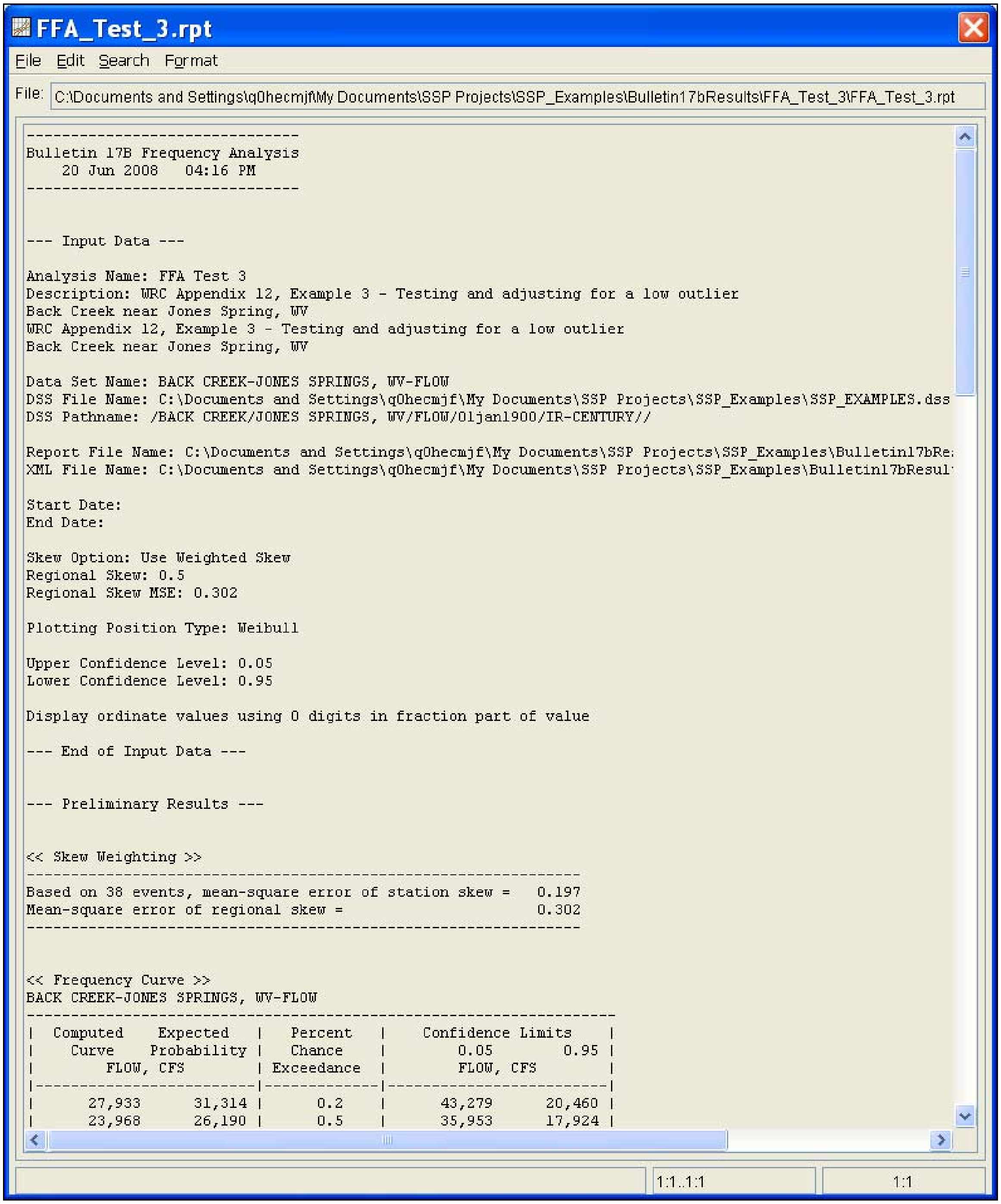


Figure B-21. Pot for Test Example 3.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-22 is the report file for test example 3.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



FFA_Test_3.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_3\FFA_Test_3.rpt

```
------------------------------
Bulletin 17B Frequency Analysis
    20 Jun 2008    04:16 PM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 3
Description: WRC Appendix 12, Example 3 - Testing and adjusting for a low outlier
Back Creek near Jones Spring, WV
WRC Appendix 12, Example 3 - Testing and adjusting for a low outlier
Back Creek near Jones Spring, WV

Data Set Name: BACK CREEK-JONES SPRINGS, WV-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /BACK CREEK/JONES SPRINGS, WV/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.5
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---


<< Skew Weighting >>
--------------------------------------------------------------
Based on 38 events, mean-square error of station skew =   0.197
Mean-square error of regional skew =                      0.302
--------------------------------------------------------------


<< Frequency Curve >>
BACK CREEK-JONES SPRINGS, WV-FLOW
------------------------------------------------------------------
|  Computed    Expected   |   Percent    |    Confidence Limits    |
|    Curve    Probability |   Chance     |     0.05         0.95   |
|        FLOW, CFS        | Exceedance   |        FLOW, CFS        |
|-------------------------|--------------|-------------------------|
|      27,933      31,314 |      0.2     |     43,279       20,460 |
|      23,968      26,190 |      0.5     |     35,953       17,924 |
```

1:1..1:1 1:1

Figure B-22. Report File for Test Example 3.

Example 4: Zero-Flood Years

The input data for Test 4 are the same as that for Example 4 in Appendix 12 of the WRC Guidelines. Test 4 illustrates the application to data that includes several zero flow years.

The data for this example is from Orestimba Creek in Newman, California. The period of record used for this example is from 1932 to 1973. To view the data from HEC-SSP, right-click on the data record labeled "**ORESTIMBA CREEK-NEWMAN, CA-FLOW**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-23.

Ordinate	Date / Time	NEWMAN, CA FLOW
Units		CFS
Type		INST-VAL
1	08 Feb 32 12:00	4,260
2	29 Jan 33 12:00	345
3	01 Jan 34 12:00	516
4	08 Apr 35 12:00	1,320
5	13 Feb 36 12:00	1,200
6	13 Feb 37 12:00	2,180
7	11 Feb 38 12:00	3,230
8	09 Mar 39 12:00	115
9	27 Feb 40 12:00	3,440
10	04 Apr 41 12:00	3,070
11	24 Jan 42 12:00	1,880
12	21 Jan 43 12:00	6,450
13	29 Feb 44 12:00	1,290
14	02 Feb 45 12:00	5,970
15	25 Dec 45 12:00	782
16	30 Sep 47 12:00	0
17	30 Sep 48 12:00	0
18	12 Mar 49 12:00	335
19	05 Feb 50 12:00	175
20	03 Dec 50 12:00	2,920
21	12 Jan 52 12:00	3,660
22	07 Dec 52 12:00	147
23	30 Sep 54 12:00	0
24	19 Jan 55 12:00	16
25	23 Dec 55 12:00	5,620
26	24 Feb 57 12:00	1,440
27	02 Apr 58 12:00	10,200
28	16 Feb 59 12:00	5,380

Figure B-23. Tabulation of the Peak Flow Data for Orestimba Creek.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-24. The years with peak flows measuring zero are visible.

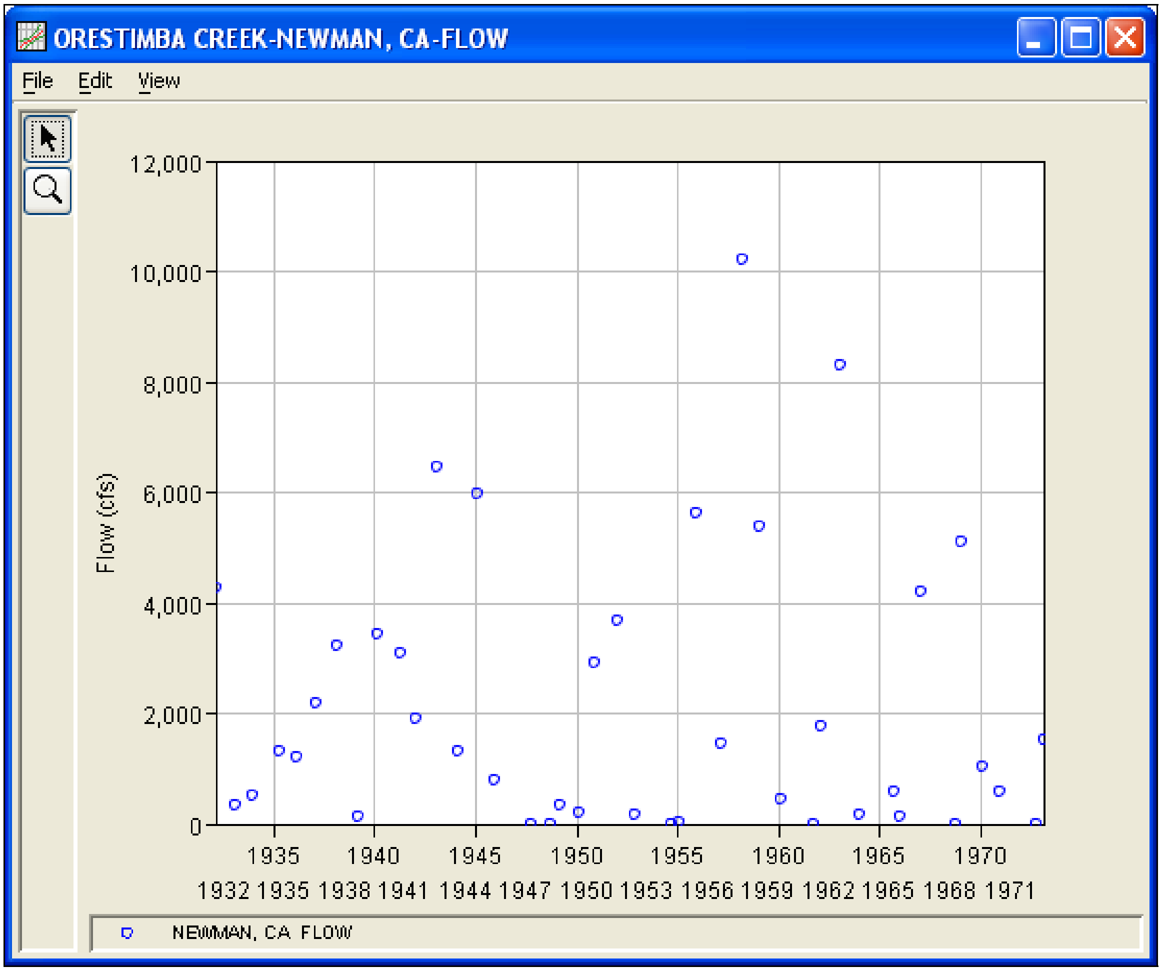


Figure B-24. Plot of Orestimba Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 4, either double-click on the analysis labeled **FFA Test 4** from the study explorer, or from the **Analysis** menu select open, then select **FFA Test 4** from the list of available analyses. When FFA Test 4 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-25.

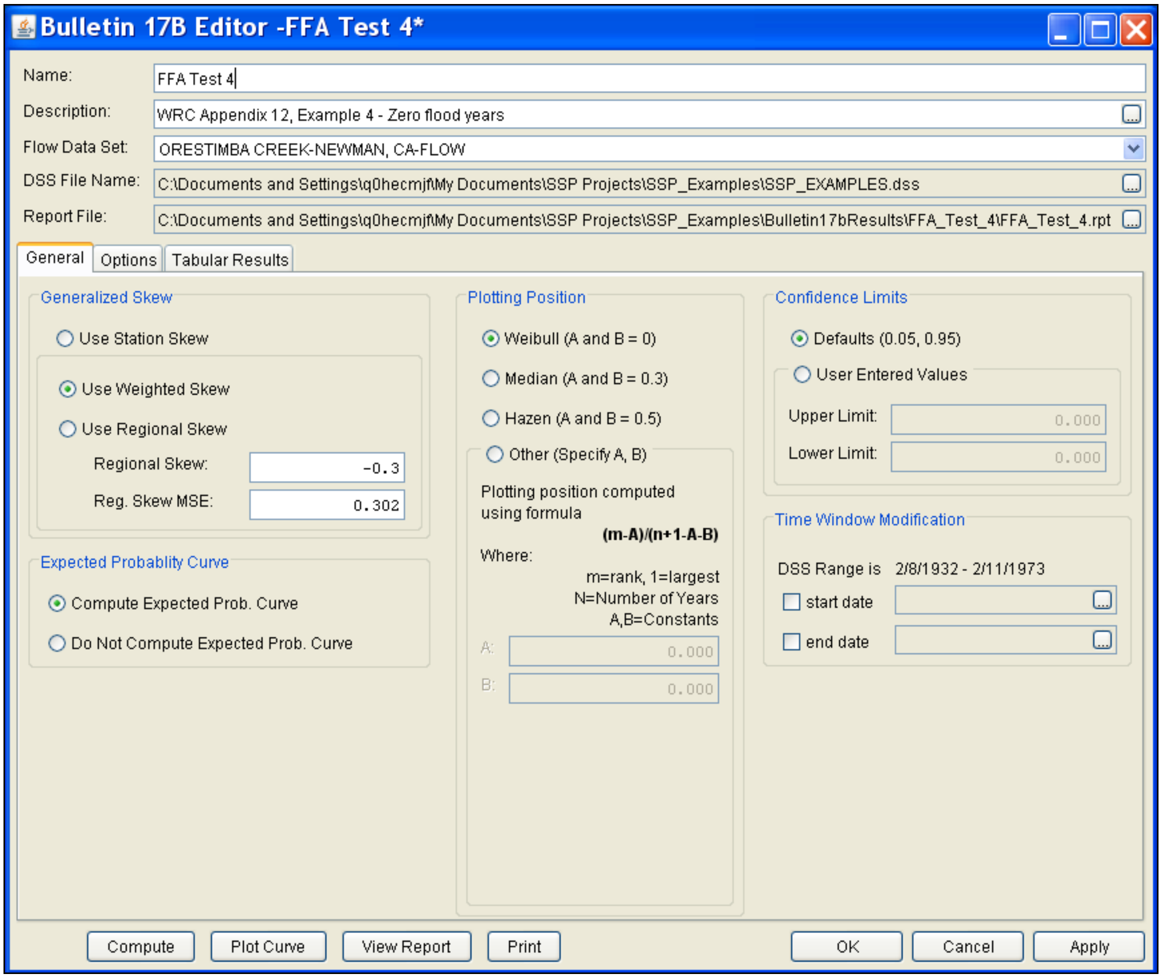


Figure B-25. Bulletin 17B Analysis Editor with Test Example 4 Data Set.

Shown in Figure B-25 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.3 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Weibull** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-26 is the Bulletin 17B editor with the **Options Tab** selected.

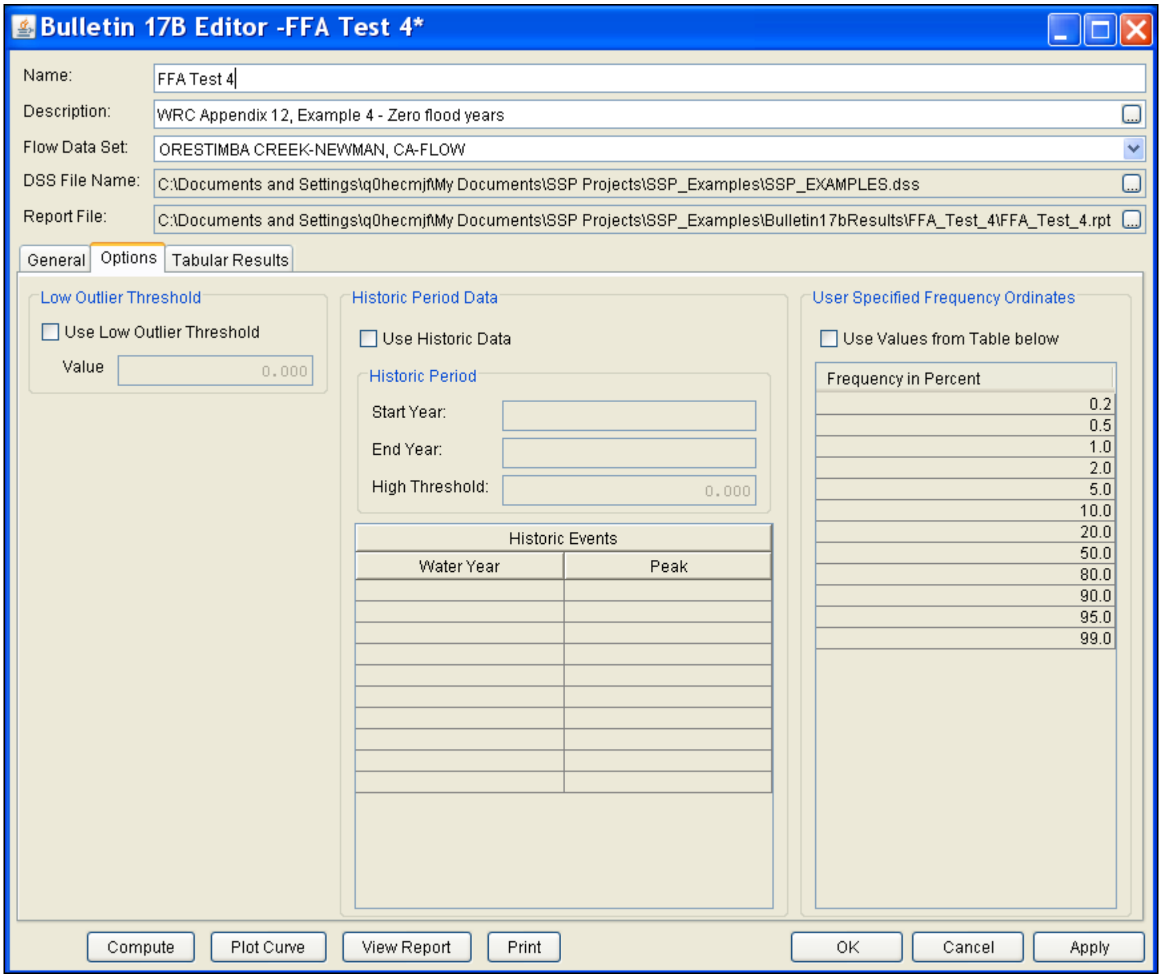
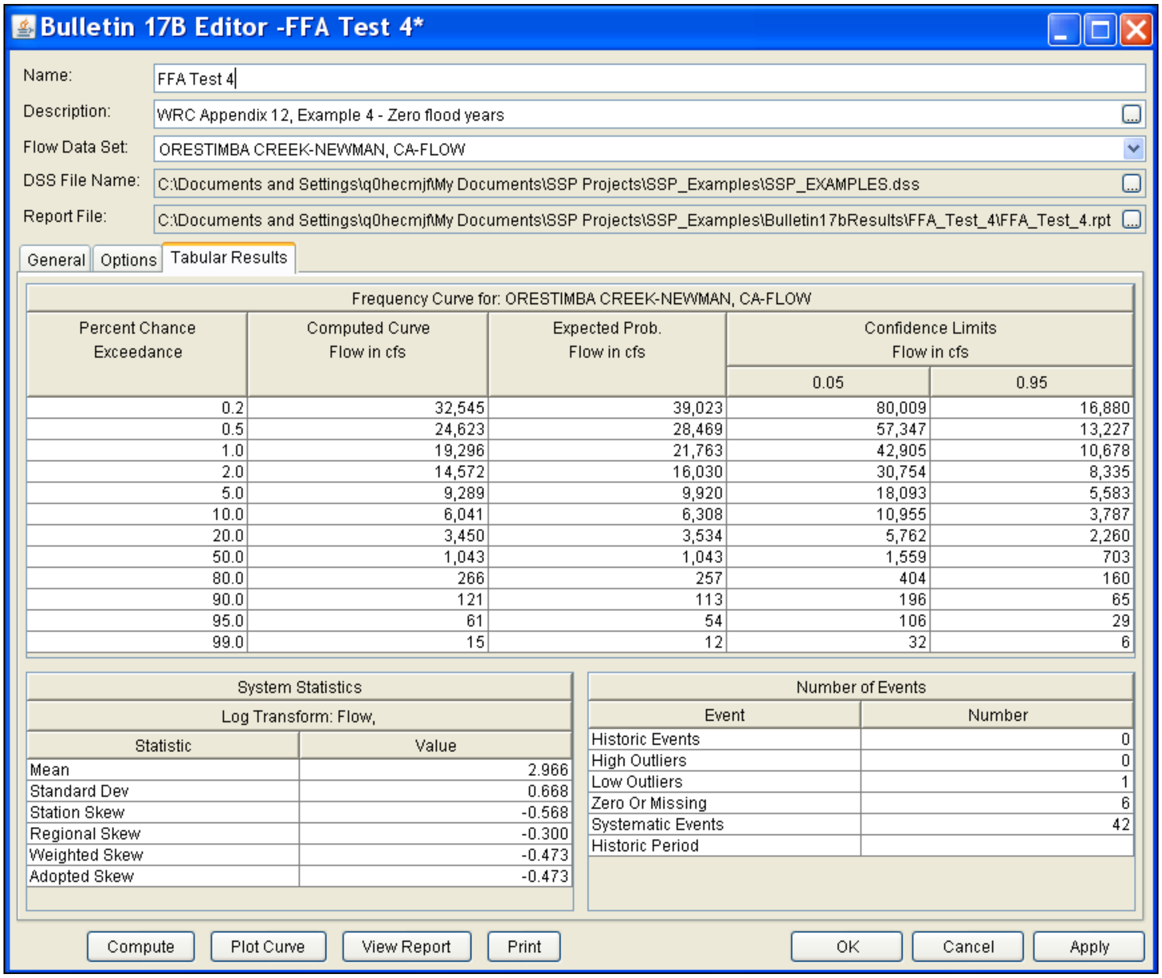


Figure B-26. Bulletin 17B Editor with the Options Tab Selected for Test Example 4.

As shown in Figure B-26, none of the available options for modifying the frequency curve were selected for this test example. These options include the **Low Outlier Threshold** and **Historic Period Data**. Additionally, the option to override the default **Frequency Ordinates** was not selected.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab. The analysis window should look Figure B-27.



Frequency Curve for: ORESTIMBA CREEK-NEWMAN, CA-FLOW

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs 0.05	Confidence Limits Flow in cfs 0.95
0.2	32,545	39,023	80,009	16,880
0.5	24,623	28,469	57,347	13,227
1.0	19,296	21,763	42,905	10,678
2.0	14,572	16,030	30,754	8,335
5.0	9,289	9,920	18,093	5,583
10.0	6,041	6,308	10,955	3,787
20.0	3,450	3,534	5,762	2,260
50.0	1,043	1,043	1,559	703
80.0	266	257	404	160
90.0	121	113	196	65
95.0	61	54	106	29
99.0	15	12	32	6

System Statistics

Log Transform: Flow,

Statistic	Value
Mean	2.966
Standard Dev	0.668
Station Skew	-0.568
Regional Skew	-0.300
Weighted Skew	-0.473
Adopted Skew	-0.473

Number of Events

Event	Number
Historic Events	0
High Outliers	0
Low Outliers	1
Zero Or Missing	6
Systematic Events	42
Historic Period	

Figure B-27. Bulletin 17B Editor with the Results Tab Selected for Test Example 4.

As shown in Figure B-27, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

As noted earlier, there were 6 zero values in this record, and also a low outlier. A zero value causes difficulty because the first step in fitting a Log Pearson III distribution is computing the base-10 log of each flow value, which is undefined for zero. Bulletin 17B recommends removing the zero values (and the low outlier) from the systematic record to compute a preliminary frequency curve, and then adjusting that curve with the Conditional Probability Adjustment. The final frequency curve and statistics are shown in the table, and the preliminary calculations can be reviewed in the report file.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-28.

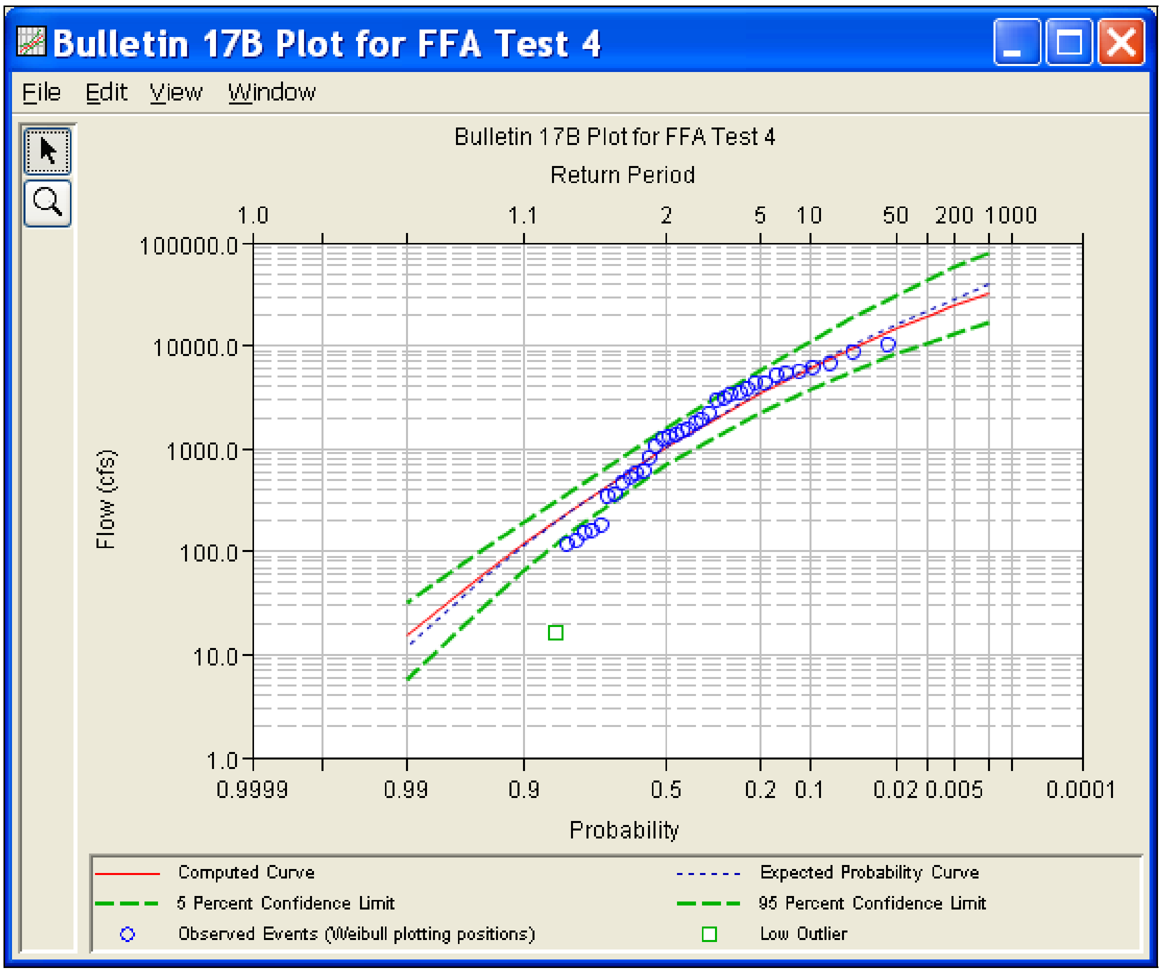


Figure B-28. Plot of Test Example 4 Results.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-29 is the report file for Test Example 4.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

FFA_Test_4.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_4\FFA_Test_4.rpt

```
-------------------------------
Bulletin 17B Frequency Analysis
    20 Jun 2008   04:17 PM
-------------------------------


--- Input Data ---

Analysis Name: FFA Test 4
Description: WRC Appendix 12, Example 4 - Zero flood years
Orestimba Creek near Newman, CA
WRC Appendix 12, Example 4 - Zero flood years
Orestimba Creek near Newman, CA

Data Set Name: ORESTIMBA CREEK-NEWMAN, CA-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /ORESTIMBA CREEK/NEWMAN, CA/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.3
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

Note: Adopted skew equals station skew and preliminary
frequency statistics are for the conditional frequency curve
because of zero or missing events.



<< Frequency Curve >>
ORESTIMBA CREEK-NEWMAN, CA-FLOW
-------------------------------------------------------------------
|  Computed    Expected   |   Percent     |    Confidence Limits    |
|    Curve    Probability |   Chance      |       0.05        0.95  |
|        FLOW, CFS        | Exceedance    |       FLOW, CFS         |
|-------------------------|---------------|-------------------------|
|      20,376      22,737 |      0.2      |      46,565      11,197 |
|      17,439      19,187 |      0.5      |      38,604       9,771 |
|      15,067      16,403 |      1.0      |      32,382       8,593 |
|      12,590      13,525 |      2.0      |      26,116       7,332 |
```

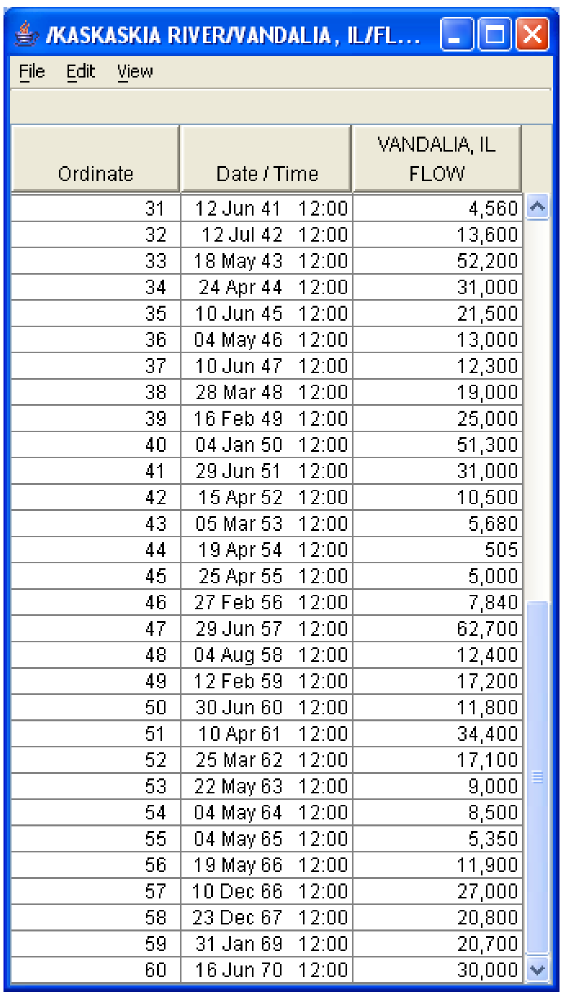
1:1..1:1 1:1

Figure B-29. HEC-SSP Report File for Test Example 4.

Example 5: Confidence Limits and Low Threshold Discharge

This test illustrates the use of user-entered confidence limits. Probabilities of .01 and .99 were entered for the computed confidence limit curves. This data set also includes two very low values, the higher of which is just above the default low outlier threshold. This example therefore also demonstrates the use of a user-entered low outlier threshold set to be higher than both values.

The data for this example is from Kaskaskia River in Vandalia, Illinois. The period of record used for this example is from 1908 to 1970. To view the data from HEC-SSP, right-click on the data record labeled "**KASKASKIA RIVER-VANDALIA, IL-FLOW**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-30.



Ordinate	Date / Time	VANDALIA, IL FLOW
31	12 Jun 41 12:00	4,560
32	12 Jul 42 12:00	13,600
33	18 May 43 12:00	52,200
34	24 Apr 44 12:00	31,000
35	10 Jun 45 12:00	21,500
36	04 May 46 12:00	13,000
37	10 Jun 47 12:00	12,300
38	28 Mar 48 12:00	19,000
39	16 Feb 49 12:00	25,000
40	04 Jan 50 12:00	51,300
41	29 Jun 51 12:00	31,000
42	15 Apr 52 12:00	10,500
43	05 Mar 53 12:00	5,680
44	19 Apr 54 12:00	505
45	25 Apr 55 12:00	5,000
46	27 Feb 56 12:00	7,840
47	29 Jun 57 12:00	62,700
48	04 Aug 58 12:00	12,400
49	12 Feb 59 12:00	17,200
50	30 Jun 60 12:00	11,800
51	10 Apr 61 12:00	34,400
52	25 Mar 62 12:00	17,100
53	22 May 63 12:00	9,000
54	04 May 64 12:00	8,500
55	04 May 65 12:00	5,350
56	19 May 66 12:00	11,900
57	10 Dec 66 12:00	27,000
58	23 Dec 67 12:00	20,800
59	31 Jan 69 12:00	20,700
60	16 Jun 70 12:00	30,000

Figure B-30. Tabulation of the Peak Flow Data for Kaskaskia River.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-31.

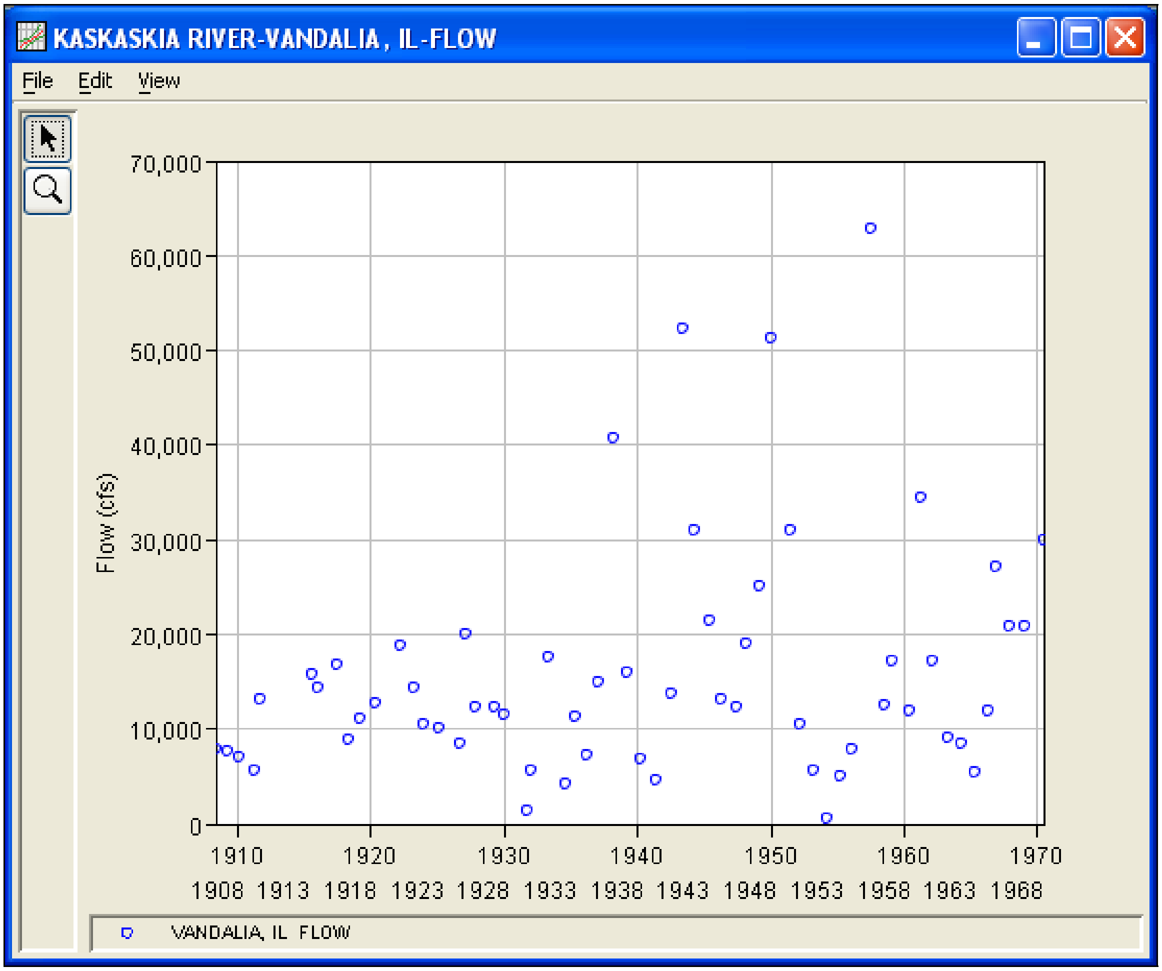


Figure B-31. HEC-SSP Plot of the Kaskaskia River Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 5, either double-click on the analysis labeled **FFA Test 5** from the study explorer, or from the **Analysis** menu select **Open** and then select **FFA Test 5** from the list of available analyses. When FFA Test 5 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-32.

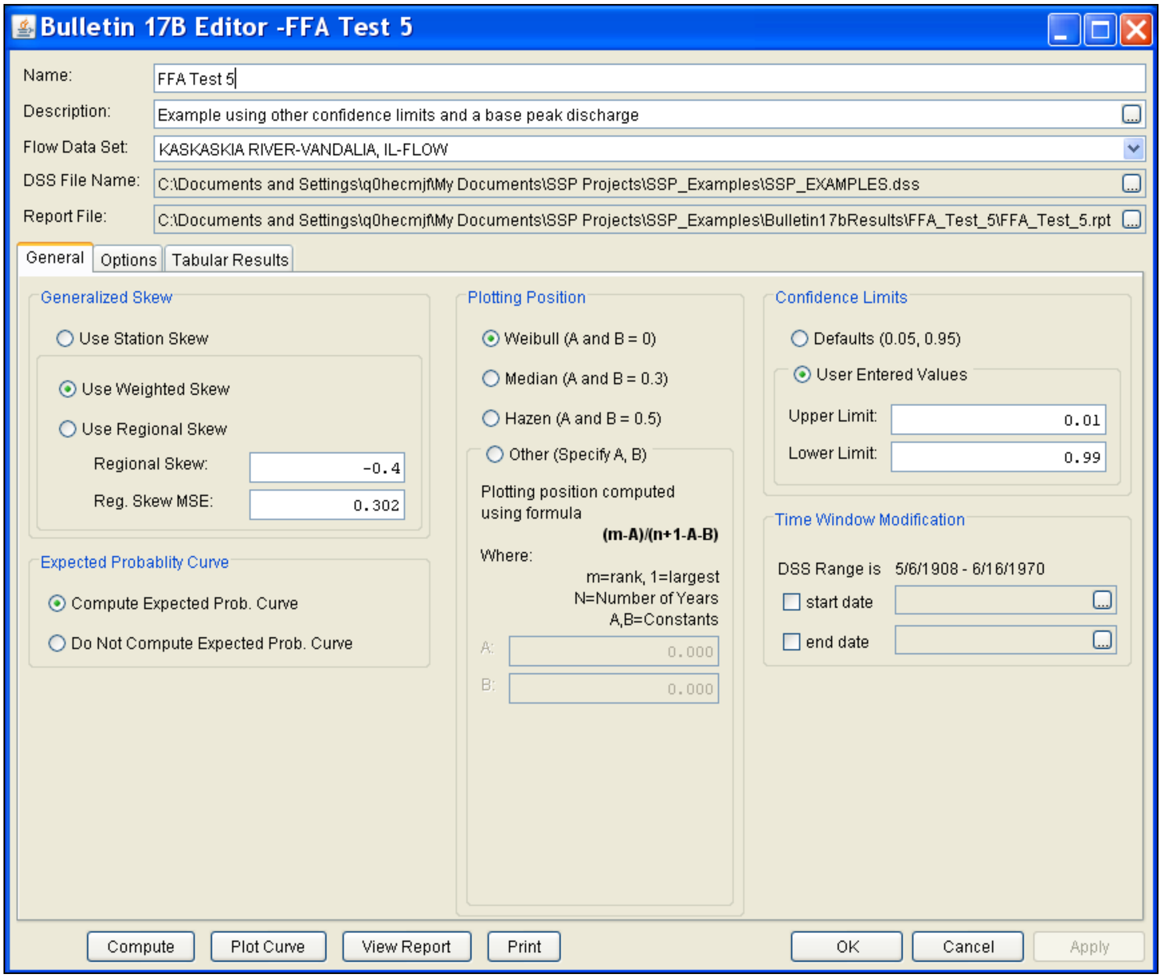


Figure B-32. Bulletin 17B Analysis Editor for Test Example 5.

Shown in Figure B-32 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of -0.4 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The default method of **Weibull** plotting positions was selected. The default values for confidence limits (.05 and .95) were changed to 0.01 (1 percent chance exceedance) and 0.99 (99% chance exceedance). Shown in Figure B-33 is the Bulletin 17B editor with the **Options Tab** selected.

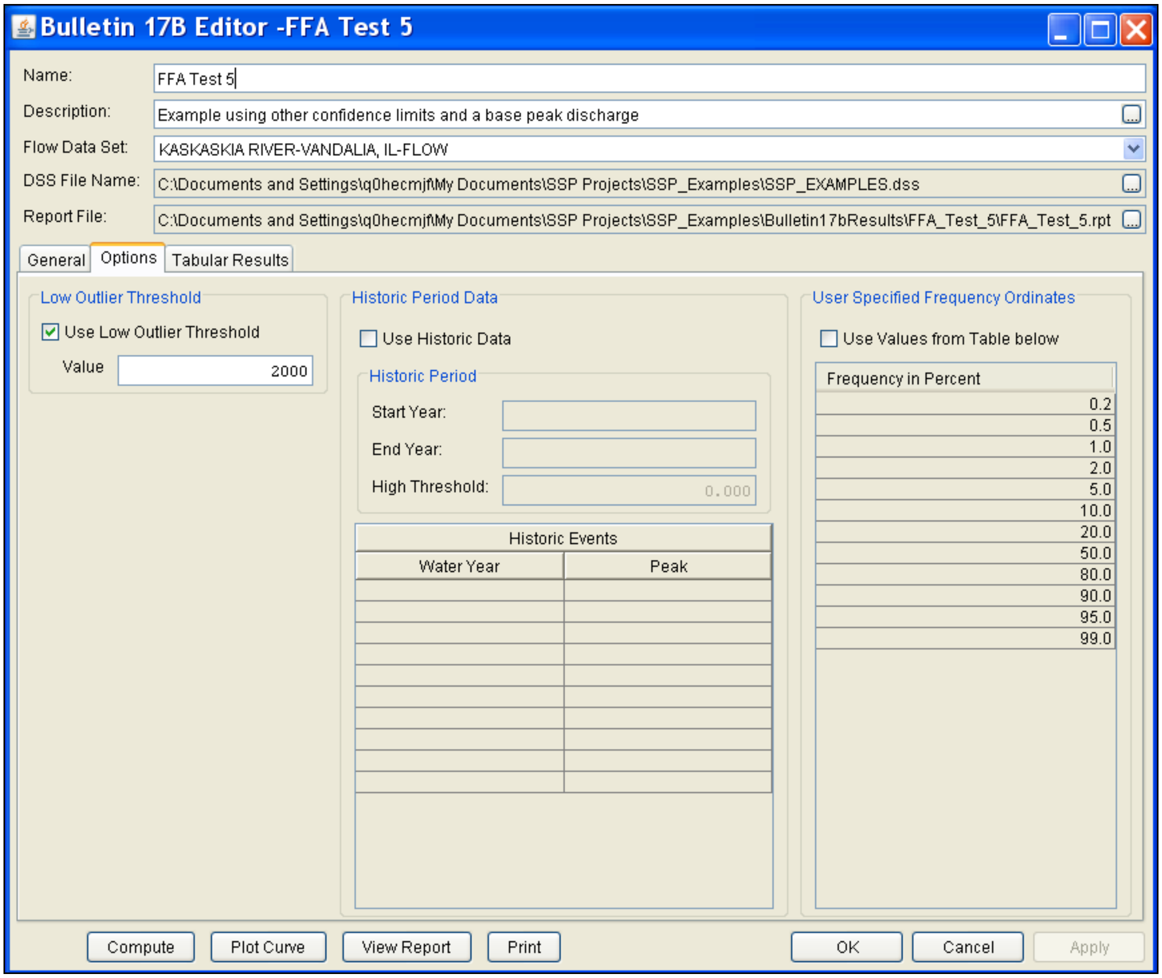


Figure B-33. Bulletin 17B Editor with the Options Tab Shown for Test Example 5.

As shown in Figure B-33, a **Low Outlier Threshold** of 2000 was entered. In the initial computation with this data (which the reader can reproduce by Computing without the "Use Low Outlier Threshold" box checked), the default low outlier threshold was 1,253 cfs, just below the second lowest value of 1,270 cfs. A look at the statistics and computed frequency curve from that run shows that the 1,270 cfs value is well below the computed curve and with a station skew of -0.21 the frequency curve does not fit the upper data well. By choosing to also censor the 1,270 cfs value with a threshold of 2000 cfs, the fit is improved. None of the other available options, such as **Historic Period Data** and the option to override the default **Frequency Ordinates** were selected for this test example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the

Tabular Results tab from the analysis window. The analysis window should look Figure B-34.

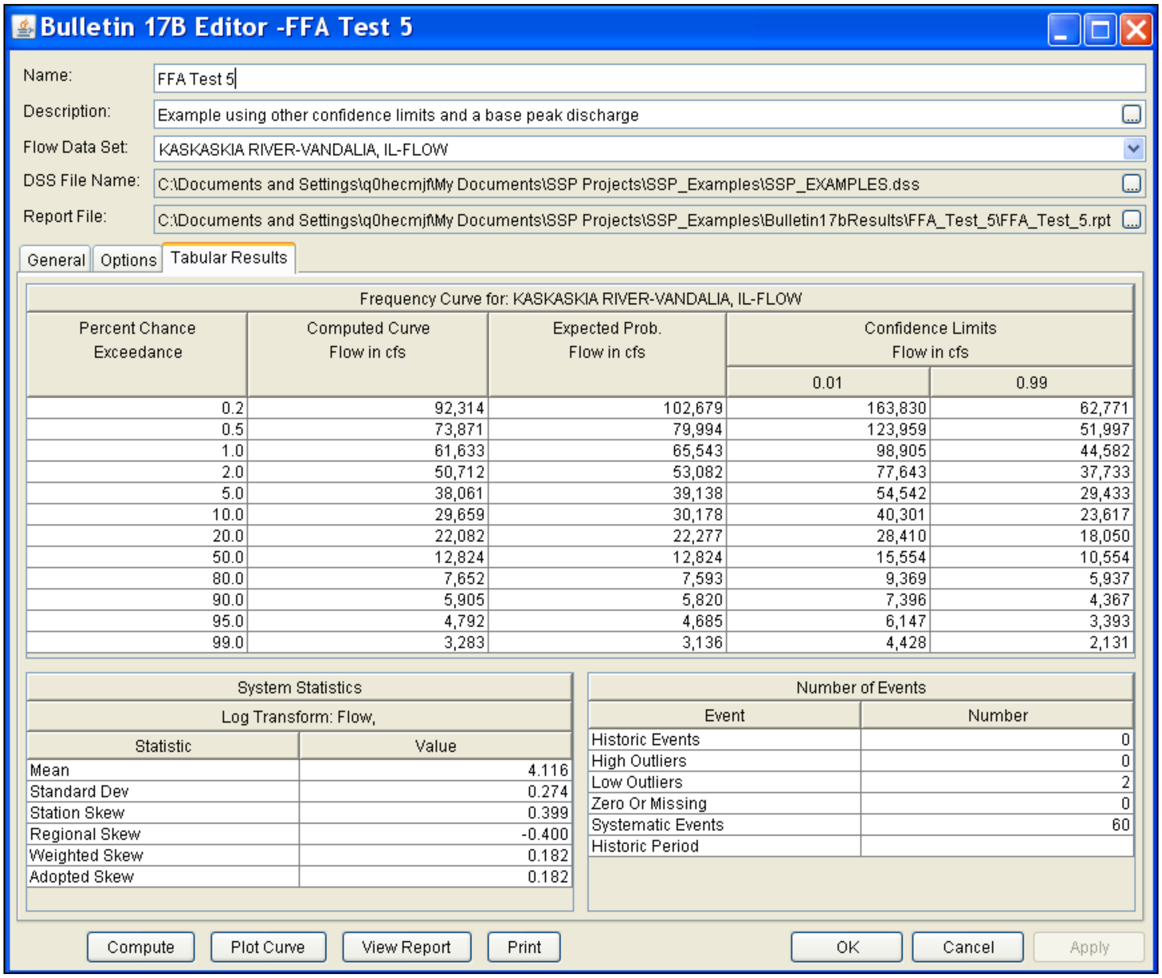


Figure B-34. Bulletin 17B Editor with the Results Tab Selected for Test Example 5.

As shown in Figure B-34, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (1% and 99% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (only if historic data was entered).

With the user-defined low-outlier threshold of 2000 cfs, there are two low-outliers detected. The analysis report shows the program omitted these values and used the Conditional Probability Adjustment to recompute the resulting frequency curve and statistics. The report file (described below) includes the preliminary computation before removal of outliers and the default and user-defined outlier thresholds, as well as the final frequency curve and statistics.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-35.

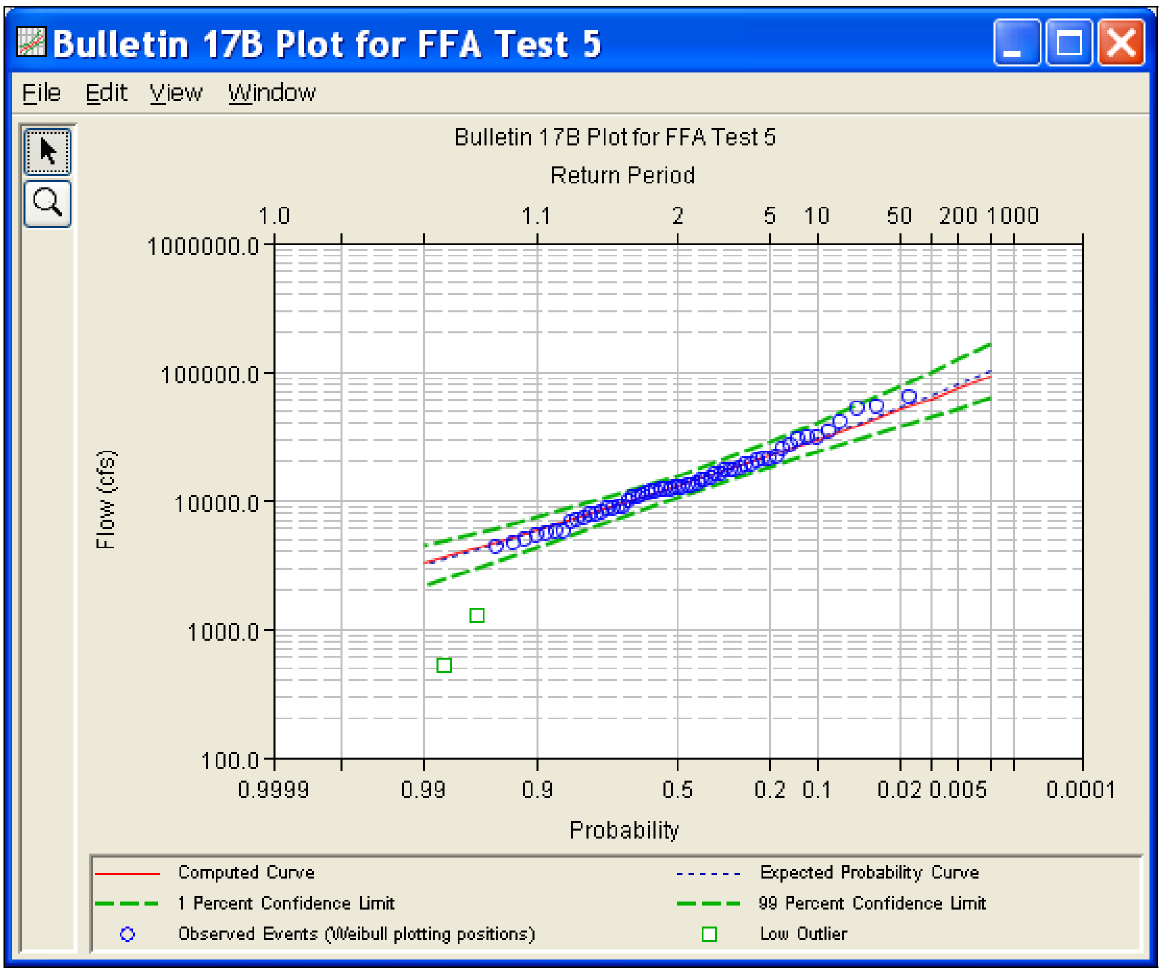
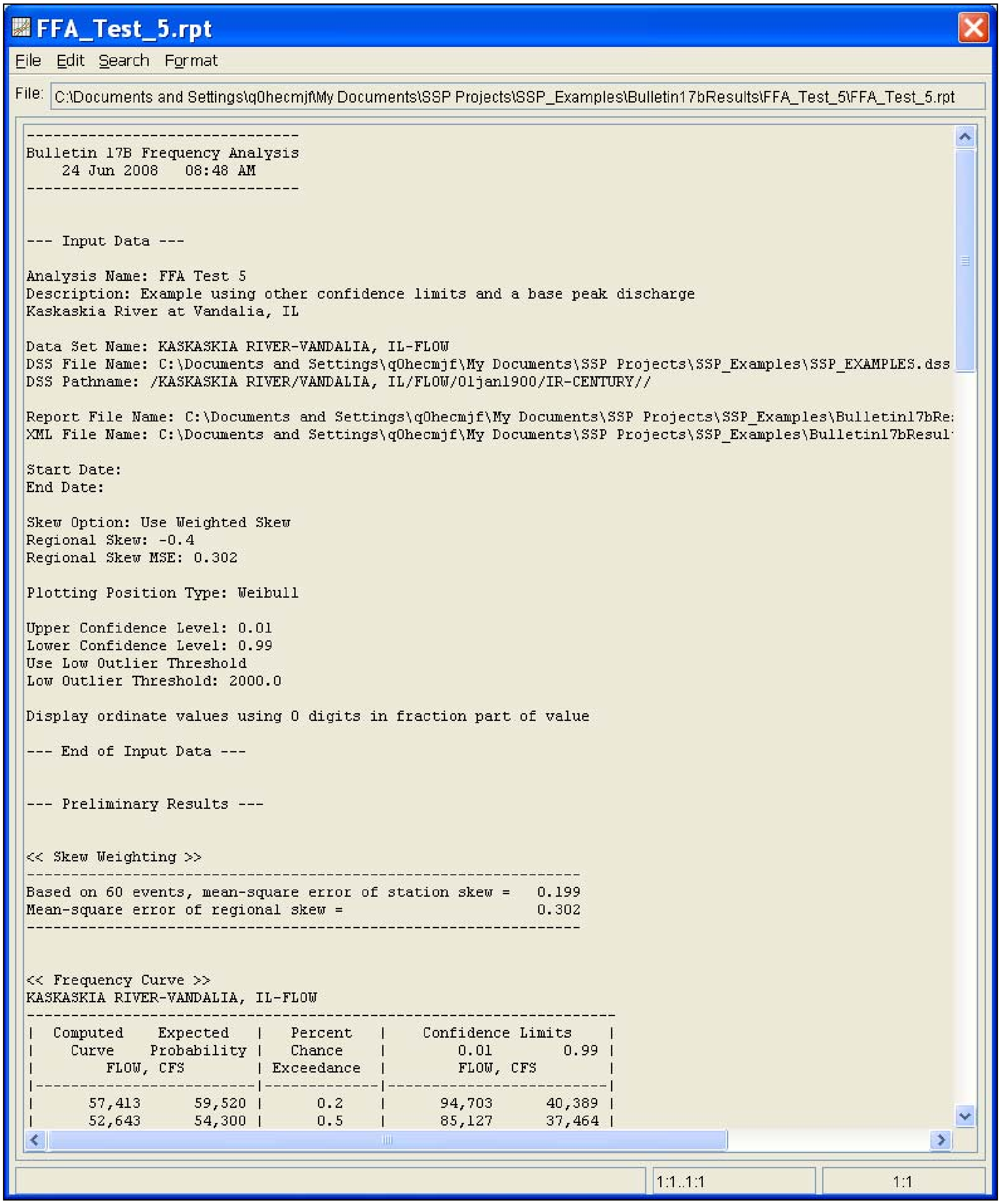


Figure B-35. Plot of the Frequency Curve Results for Test Example 5.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-36 is the report file for Test Example 5.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



FFA_Test_5.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_5\FFA_Test_5.rpt

```
------------------------------
Bulletin 17B Frequency Analysis
    24 Jun 2008    08:48 AM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 5
Description: Example using other confidence limits and a base peak discharge
Kaskaskia River at Vandalia, IL

Data Set Name: KASKASKIA RIVER-VANDALIA, IL-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /KASKASKIA RIVER/VANDALIA, IL/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe:
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: -0.4
Regional Skew MSE: 0.302

Plotting Position Type: Weibull

Upper Confidence Level: 0.01
Lower Confidence Level: 0.99
Use Low Outlier Threshold
Low Outlier Threshold: 2000.0

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---


<< Skew Weighting >>
--------------------------------------------------------------
Based on 60 events, mean-square error of station skew =   0.199
Mean-square error of regional skew =                      0.302
--------------------------------------------------------------


<< Frequency Curve >>
KASKASKIA RIVER-VANDALIA, IL-FLOW
------------------------------------------------------------------
|  Computed    Expected   |  Percent    |    Confidence Limits    |
|    Curve    Probability |   Chance    |       0.01        0.99  |
|        FLOW, CFS        | Exceedance  |        FLOW, CFS        |
|-------------------------|-------------|-------------------------|
|      57,413      59,520 |      0.2    |      94,703      40,389 |
|      52,643      54,300 |      0.5    |      85,127      37,464 |
```

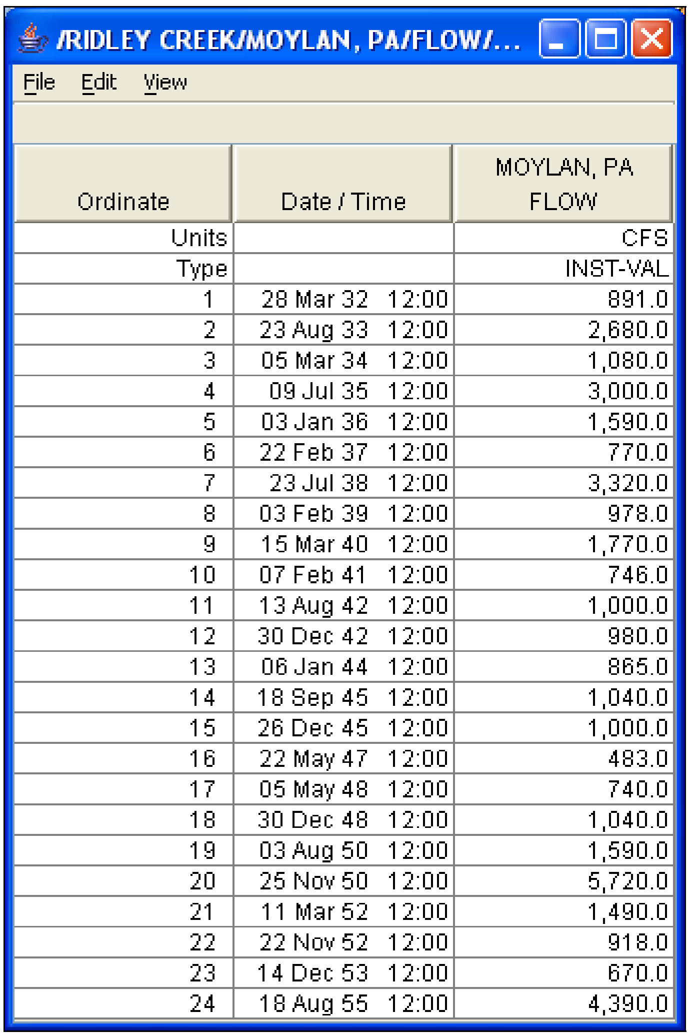
1:1..1:1 1:1

Figure B-36. Report File for Test Example 5.

Example 6: Use of Historic Data and Median Plotting Position

This test demonstrates how to use historic information to improve a flow frequency analysis. A historic flood peak of 15,000 cfs which occurred in 1843 is included in the analysis. This value is the highest known value up to the present time (1974 for this example), even though the systematic record stopped in 1955.

The data for this example is from Ridley Creek in Moylan, Pennsylvania. The period of record used for this example is from 1932 to 1955. To view the data from HEC-SSP, right-click on the data record labeled "**RIDLEY CREEK-MOYLAN, PA-FLOW**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-37.



Ordinate	Date / Time	MOYLAN, PA FLOW
Units		CFS
Type		INST-VAL
1	28 Mar 32 12:00	891.0
2	23 Aug 33 12:00	2,680.0
3	05 Mar 34 12:00	1,080.0
4	09 Jul 35 12:00	3,000.0
5	03 Jan 36 12:00	1,590.0
6	22 Feb 37 12:00	770.0
7	23 Jul 38 12:00	3,320.0
8	03 Feb 39 12:00	978.0
9	15 Mar 40 12:00	1,770.0
10	07 Feb 41 12:00	746.0
11	13 Aug 42 12:00	1,000.0
12	30 Dec 42 12:00	980.0
13	06 Jan 44 12:00	865.0
14	18 Sep 45 12:00	1,040.0
15	26 Dec 45 12:00	1,000.0
16	22 May 47 12:00	483.0
17	05 May 48 12:00	740.0
18	30 Dec 48 12:00	1,040.0
19	03 Aug 50 12:00	1,590.0
20	25 Nov 50 12:00	5,720.0
21	11 Mar 52 12:00	1,490.0
22	22 Nov 52 12:00	918.0
23	14 Dec 53 12:00	670.0
24	18 Aug 55 12:00	4,390.0

Figure B-37. Tabulation of the Peak Flow Data for Ridley Creek.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-38.

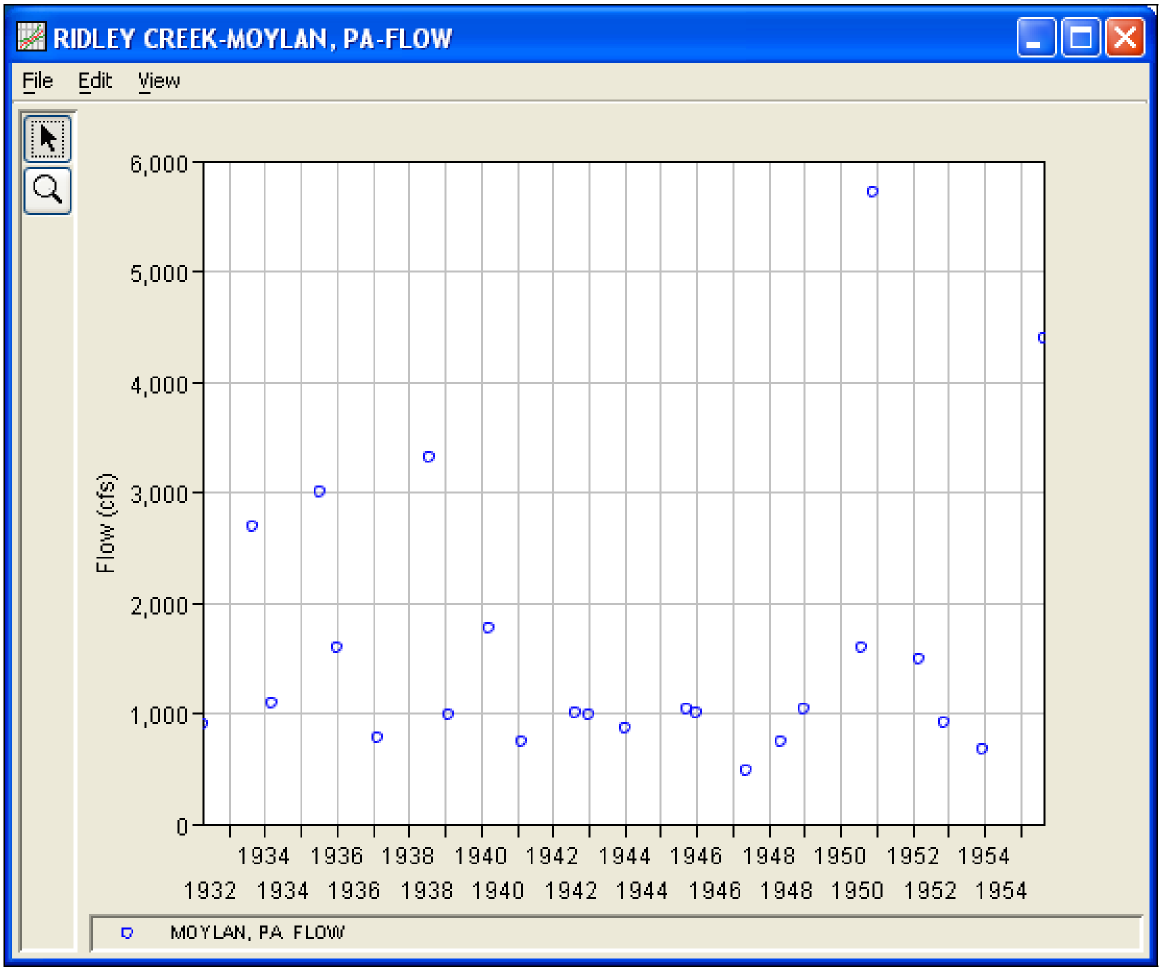


Figure B-38. Plot of the Ridley Creek Data.

A Bulletin 17B and General Frequency analysis have been developed for this example. To open the Bulletin 17B analysis editor for test example 6, either double-click on the analysis labeled **FFA Test 6** from the study explorer, or from the **Analysis** menu select open, then select **FFA Test 6** from the list of available analyses. When FFA Test 6 is selected, the Bulletin 17B analysis editor will appear as shown in Figure B-39.

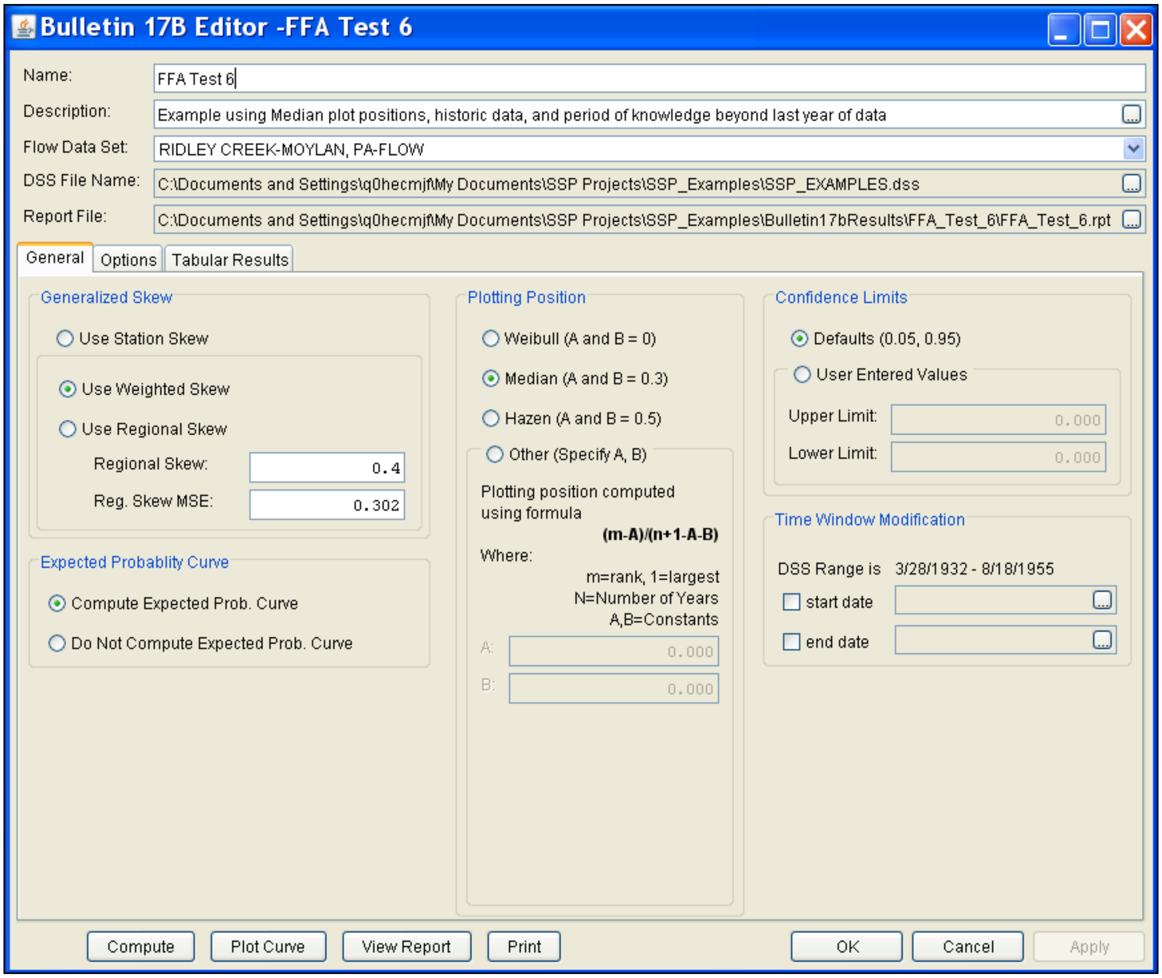


Figure B-39. Bulletin 17B Analysis Editor for Test Example 6.

Shown in Figure B-39 are the general settings that were used to perform this frequency analysis. As shown, the **Skew** option was set to use the **Weighted Skew**. To use the weighted skew option, the user must enter a value for the Regional Skew and the Regional Skew Mean Square Error (MSE). This selection requires the user to either look up a value from the generalized skew map of the United States, which is provided with Bulletin 17B, or develop a value from a regional analysis of nearby gages. In this example a value of 0.4 was taken from the generalized skew map of the U.S. from Bulletin 17B. Bulletin 17B suggests using a Regional Skew MSE of 0.302 whenever regional skew values are taken from the map.

Also for this example, the **Expected Probability Curve** option was selected to be computed in addition to the Log Pearson III computed curve. The **Median** plotting position method was selected, as well as the default **Confidence Limits** of 0.05 (5 percent chance exceedance) and 0.95 (95% chance exceedance). Shown in Figure B-40 is the Bulletin 17B editor with the **Options Tab** selected.

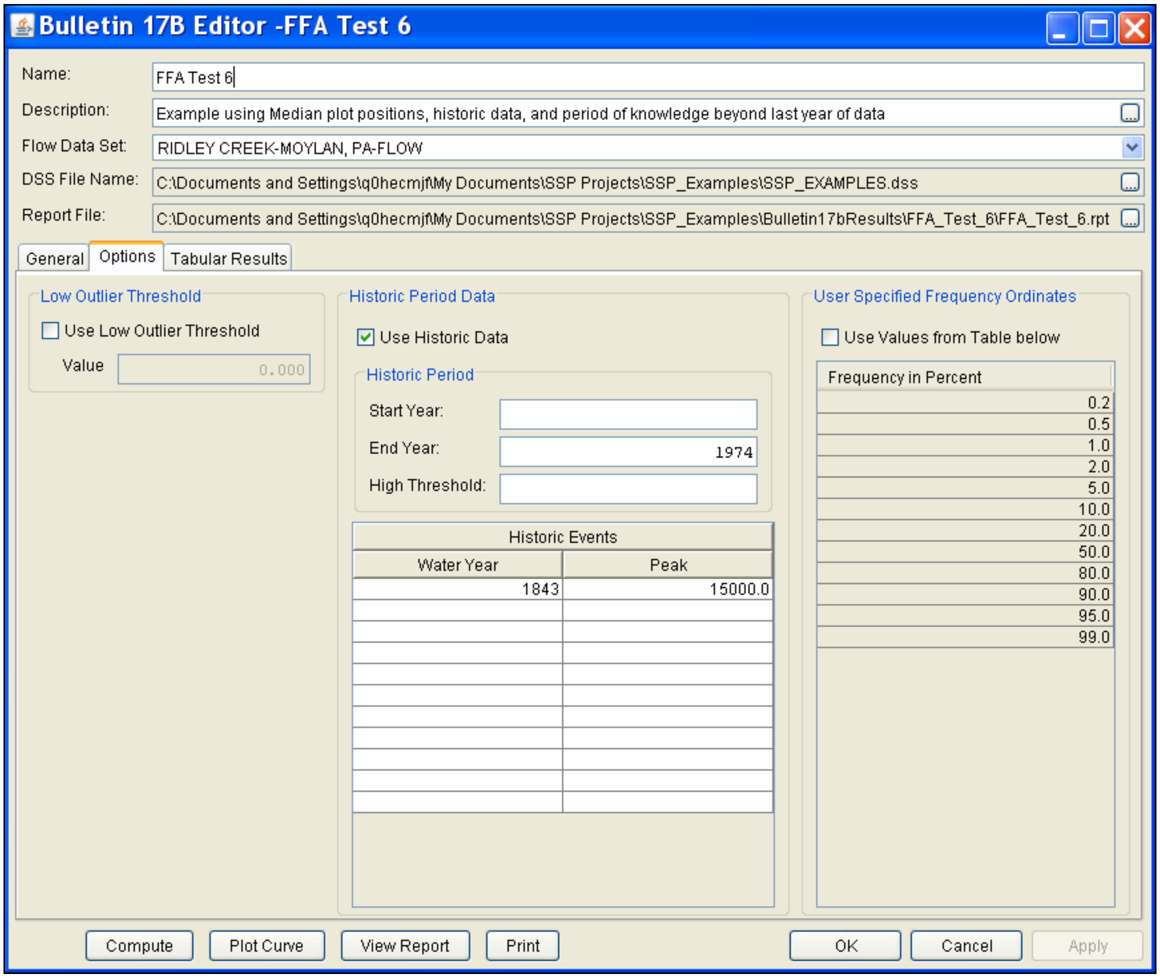
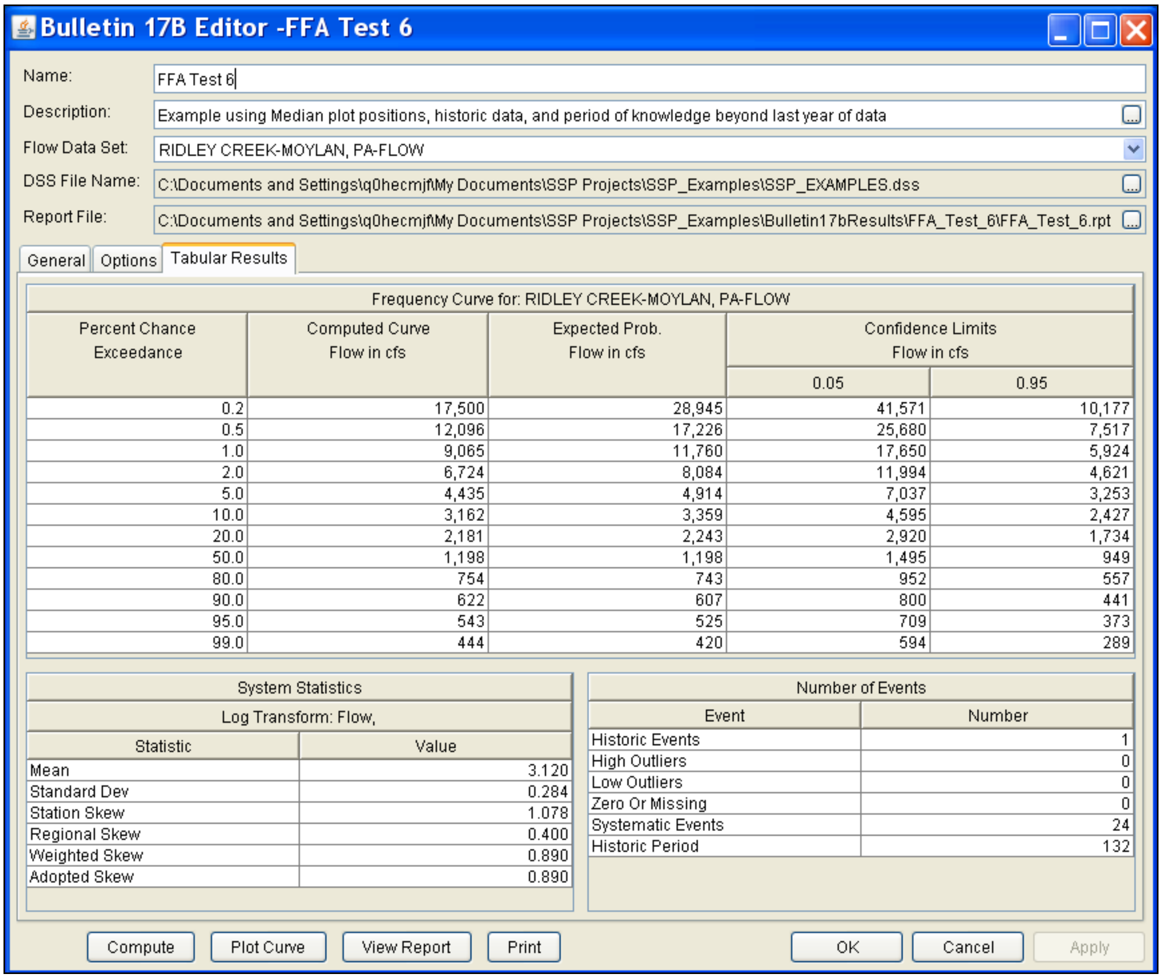


Figure B-40. Bulletin 17B Analysis Editor with Options Tab Shown for Test Example 6.

As shown in Figure B-40, the **Historic Period Data** option has been selected to reflect a historical flood event of 15,000 cfs in 1843 and an analysis period from 1843 to 1974. Historic data is used to account for historic flood events large enough to be relevant to the analysis and not contained in the systematic data record. The additional information provided by historic data can improve the flood frequency analysis, especially when the data collection period for a given area is relatively short. Information for a **Historic Flood Peak** has been entered to account for a peak flow of 15,000 cfs in the 1843 water year. The Historic Period **Start Year** has been left blank. By default this value will be the earliest year found in the historic flood peak data or the systematic record. Therefore for this example, 1843 will automatically be used for the Start Year of the Historic Period. An **End Year** of 1974 has been entered. The systematic record for the gage ended in 1955, however when this analysis was performed in 1974, no other flood peaks of consequence had been observed between 1955 and 1974. Therefore, 1974 is set as the End Year for the historic period analysis.

Other features on this tab include the **Low Outlier Threshold** and the option to override the default **Frequency Ordinates**. Neither option is selected in this example.

Once all of the General and Optional settings are set or selected, the user can press the **Compute** button to perform the analysis. Once the computations have been completed a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab from the analysis window. The analysis window should look Figure B-41.



Frequency Curve for: RIDLEY CREEK-MOYLAN, PA-FLOW

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	17,500	28,945	41,571	10,177
0.5	12,096	17,226	25,680	7,517
1.0	9,065	11,760	17,650	5,924
2.0	6,724	8,084	11,994	4,621
5.0	4,435	4,914	7,037	3,253
10.0	3,162	3,359	4,595	2,427
20.0	2,181	2,243	2,920	1,734
50.0	1,198	1,198	1,495	949
80.0	754	743	952	557
90.0	622	607	800	441
95.0	543	525	709	373
99.0	444	420	594	289

System Statistics

Log Transform: Flow,

Statistic	Value
Mean	3.120
Standard Dev	0.284
Station Skew	1.078
Regional Skew	0.400
Weighted Skew	0.890
Adopted Skew	0.890

Number of Events

Event	Number
Historic Events	1
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	24
Historic Period	132

Figure B-41. Bulletin 17B Editor with the Results Tab Selected for Test Example 6.

As shown in Figure B-41, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Expected Probability Curve

Confidence Limits (5% and 95% chance exceedance curves)

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

This example reports one historical flood event, and a historical period of 132 years, between 1843 and 1974. The reported statistics reflect the use of the historical data adjustment outlined in Bulletin 17B Appendix 6. The report file (described below) shows the initial computation of the statistics and frequency curve before the historical data was used, and the resulting statistics and frequency curve after the historical data is taken into account.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-42.

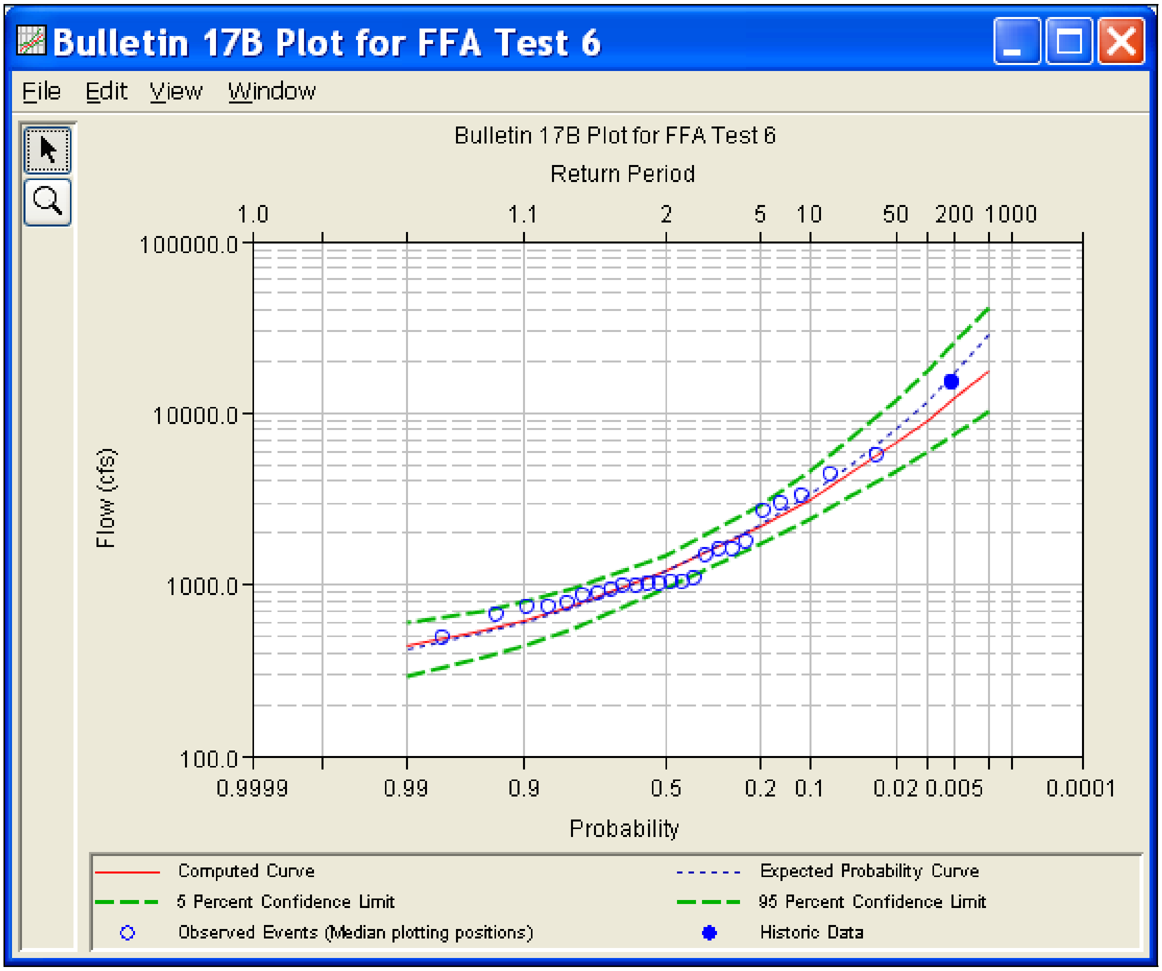


Figure B-42. Plot of the Frequency Curve Results for Test Example 6.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-43 is the report file for Test Example 6.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

FFA_Test_6.rpt

File Edit Search Format

File: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResults\FFA_Test_6\FFA_Test_6.rpt

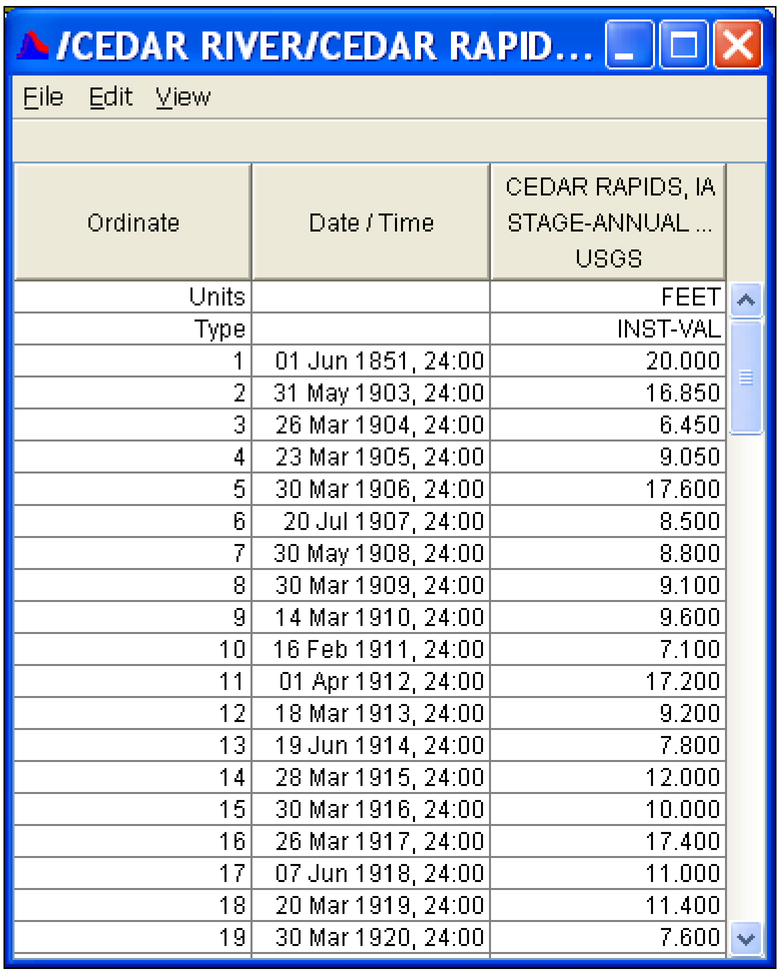
```
------------------------------
Bulletin 17B Frequency Analysis
    24 Jun 2008   09:19 AM
------------------------------


--- Input Data ---

Analysis Name: FFA Test 6
Description: Example using Median plot positions, historic data, and period of knowledge beyond last year
Ridley Creek at Moylan, PA
Example using Median plot positions, historic data, and period of knowledge beyond last year of data
Ridley Creek at Moylan, PA
Example using Median plot positions, historic data, and period of knowledge beyond last year of data
Ridley Creek at Moylan, PA

Data Set Name: RIDLEY CREEK-MOYLAN, PA-FLOW
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: /RIDLEY CREEK/MOYLAN, PA/FLOW/01jan1900/IR-CENTURY//

Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bRe:
XML File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Bulletin17bResul

Start Date:
End Date:

Skew Option: Use Weighted Skew
Regional Skew: 0.4
Regional Skew MSE: 0.302

Plotting Position Type: Median

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Use Historic Data
Historic Period Start Year: ---
Historic Period End Year: 1974
Year: 1843   Value: 15,000

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---


--- Preliminary Results ---

<< Plotting Positions >>
RIDLEY CREEK-MOYLAN, PA-FLOW
--------------------------------------------------------------------
|     Events Analyzed       |            Ordered Events            |
|                     FLOW  |          Water        FLOW   Median  |
| Day Mon Year         CFS  |  Rank     Year         CFS  Plot Pos |
|---------------------------|--------------------------------------|
|  28 Mar 1932         891  |    1      1951       5,720     2.87   |
|  23 Aug 1933       2,680  |    2      1955       4,390     6.97   |
|  05 Mar 1934       1,080  |    3      1938       3,320    11.07   |
```

1:1..1:1   1:1

Figure B-43. HEC-SSP Report File for Test Example 6.

Example 7: Analyzing Stage Data

This example demonstrates how to use the General Frequency analysis to analyze stage data. The data for this example is from the Cedar Rapids, Iowa stream gage (gage id 05464500). The period of record used for this example is from 1851 to 2007. In addition to the systematic record, an historic flooding event occurred in June 2008. To view the data, right-click on the data record labeled "**CEDAR RAPIDS, STAGE DATA**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-44.



Ordinate	Date / Time	CEDAR RAPIDS, IA STAGE-ANNUAL ... USGS
Units		FEET
Type		INST-VAL
1	01 Jun 1851, 24:00	20.000
2	31 May 1903, 24:00	16.850
3	26 Mar 1904, 24:00	6.450
4	23 Mar 1905, 24:00	9.050
5	30 Mar 1906, 24:00	17.600
6	20 Jul 1907, 24:00	8.500
7	30 May 1908, 24:00	8.800
8	30 Mar 1909, 24:00	9.100
9	14 Mar 1910, 24:00	9.600
10	16 Feb 1911, 24:00	7.100
11	01 Apr 1912, 24:00	17.200
12	18 Mar 1913, 24:00	9.200
13	19 Jun 1914, 24:00	7.800
14	28 Mar 1915, 24:00	12.000
15	30 Mar 1916, 24:00	10.000
16	26 Mar 1917, 24:00	17.400
17	07 Jun 1918, 24:00	11.000
18	20 Mar 1919, 24:00	11.400
19	30 Mar 1920, 24:00	7.600

Figure B-44. Tabulation of the Peak Stage Data for Cedar Rapids, Iowa.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-45.

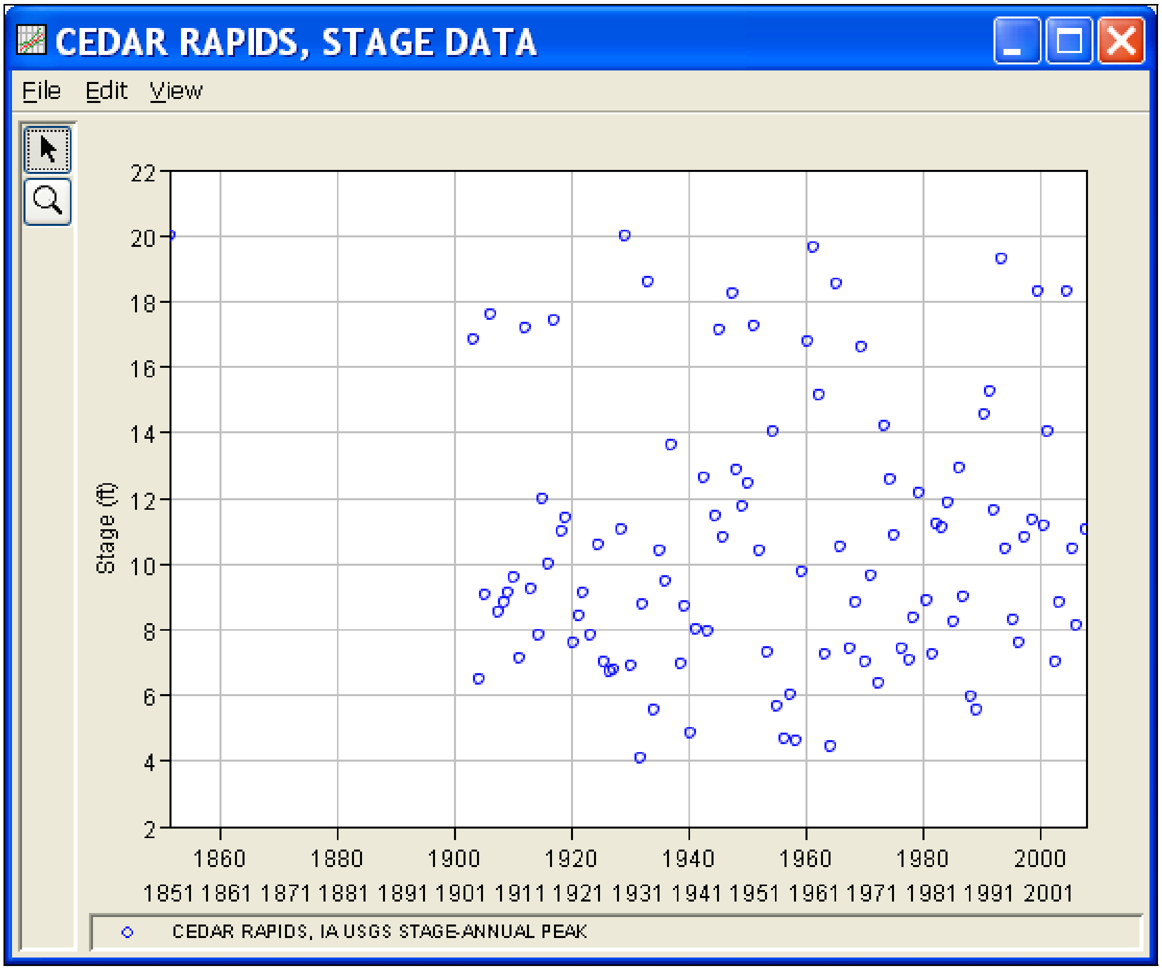


Figure B-45. Plot of the Cedar Rapids Data.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for Test Example 7, either double-click on the analysis labeled **STAGE ANALYSIS TEST 7** from the study explorer, or from the **Analysis** menu select open, then select **STAGE ANALYSIS TEST 7** from the list of available analyses. When test 7 is opened, the General Frequency analysis editor will appear as shown in Figure B-46. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the time window.

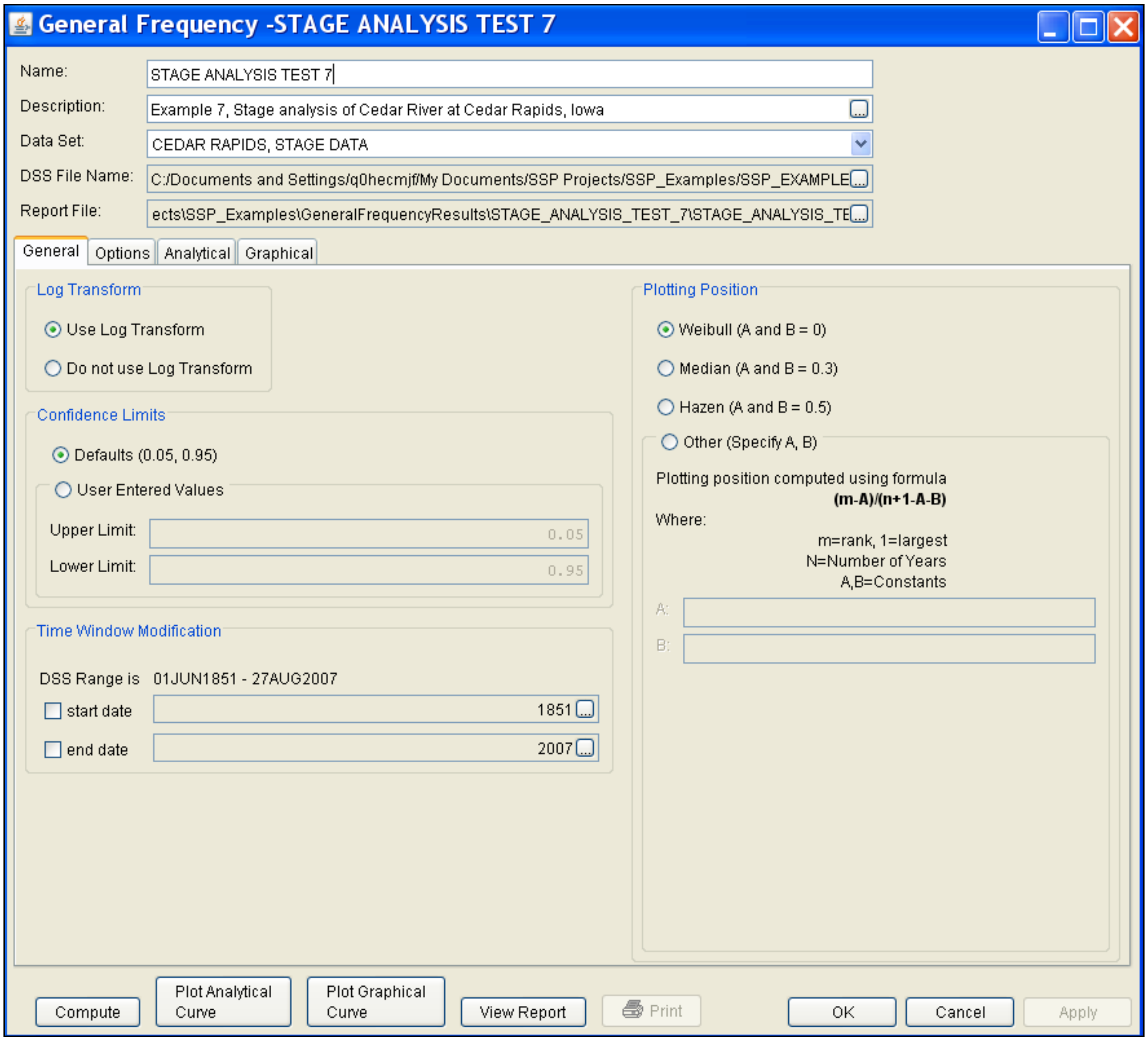


Figure B-46. General Frequency Analysis Editor for Test Example 7.

Shown in Figure B-47 is the General Frequency analysis editor with the **Options Tab** selected. The **Historic Period Data** option has been selected to reflect a historical flood event that produced a peak stage of 31.12 feet in June of 2008. The Historic Period **Start Year** has been left empty. By default this value will be the earliest year found in the historic flood peak data or the systematic record. Therefore for this example, 1851 will automatically be used for the Start Year of the Historic Period. This Historic Period **End Year** has also been left empty. By default this value will be the last year found in the historic flood peak data or the systematic record. Therefore for this example, 2008 will automatically be used for the End Year of the Historic Period.

Other features on this tab include the **Low Outlier Threshold**, an option to override the default **Frequency Ordinates**, and **Output Labeling**. The changes made to these options include adding the 0.1 percent frequency ordinate and the data name was changed from STAGE-ANNUAL PEAK to Stage.

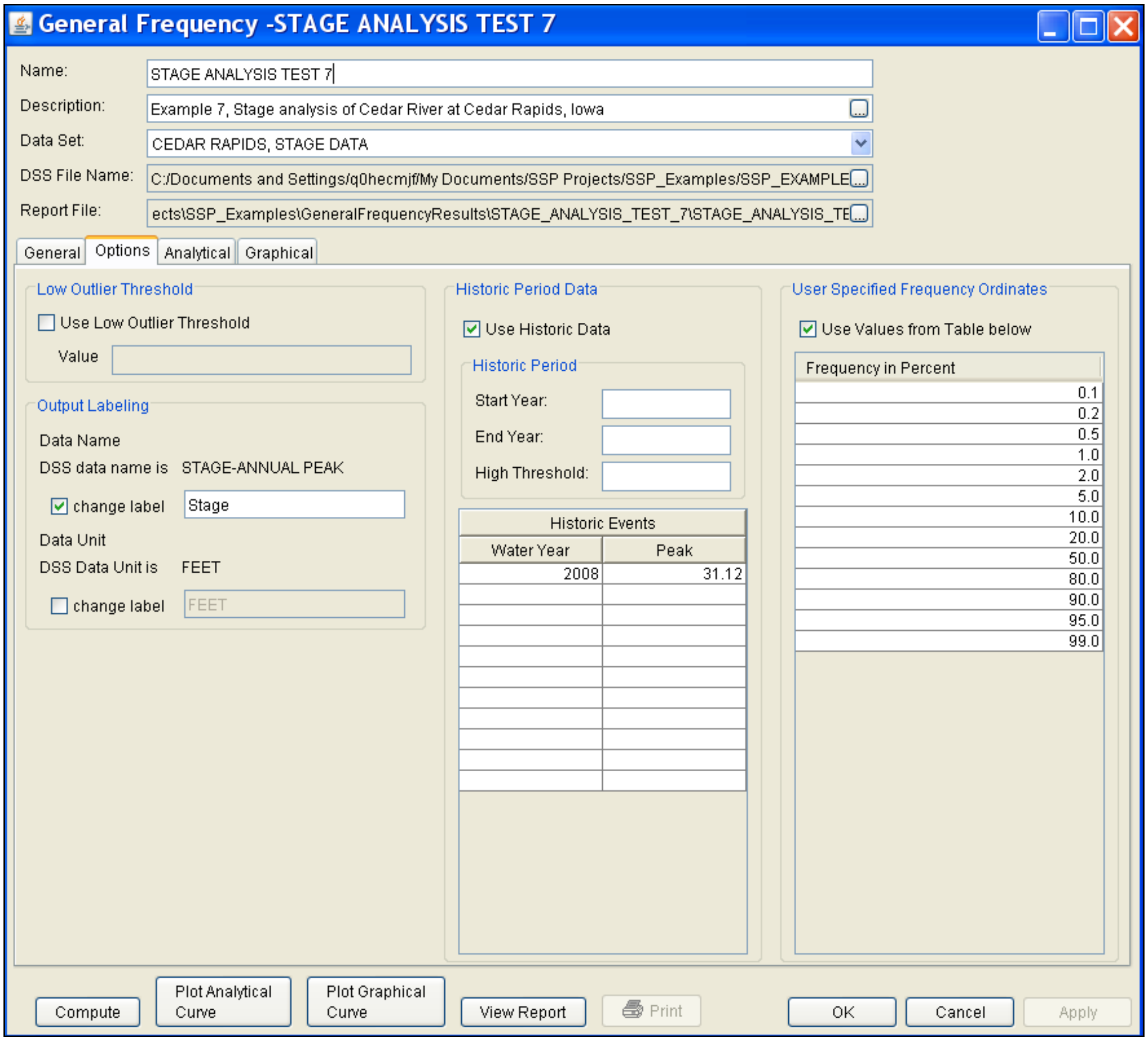


Figure B-47. General Frequency Analysis Editor with Options Tab Shown for Test Example 7.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed on the peak stage data. Shown in Figure B-48 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

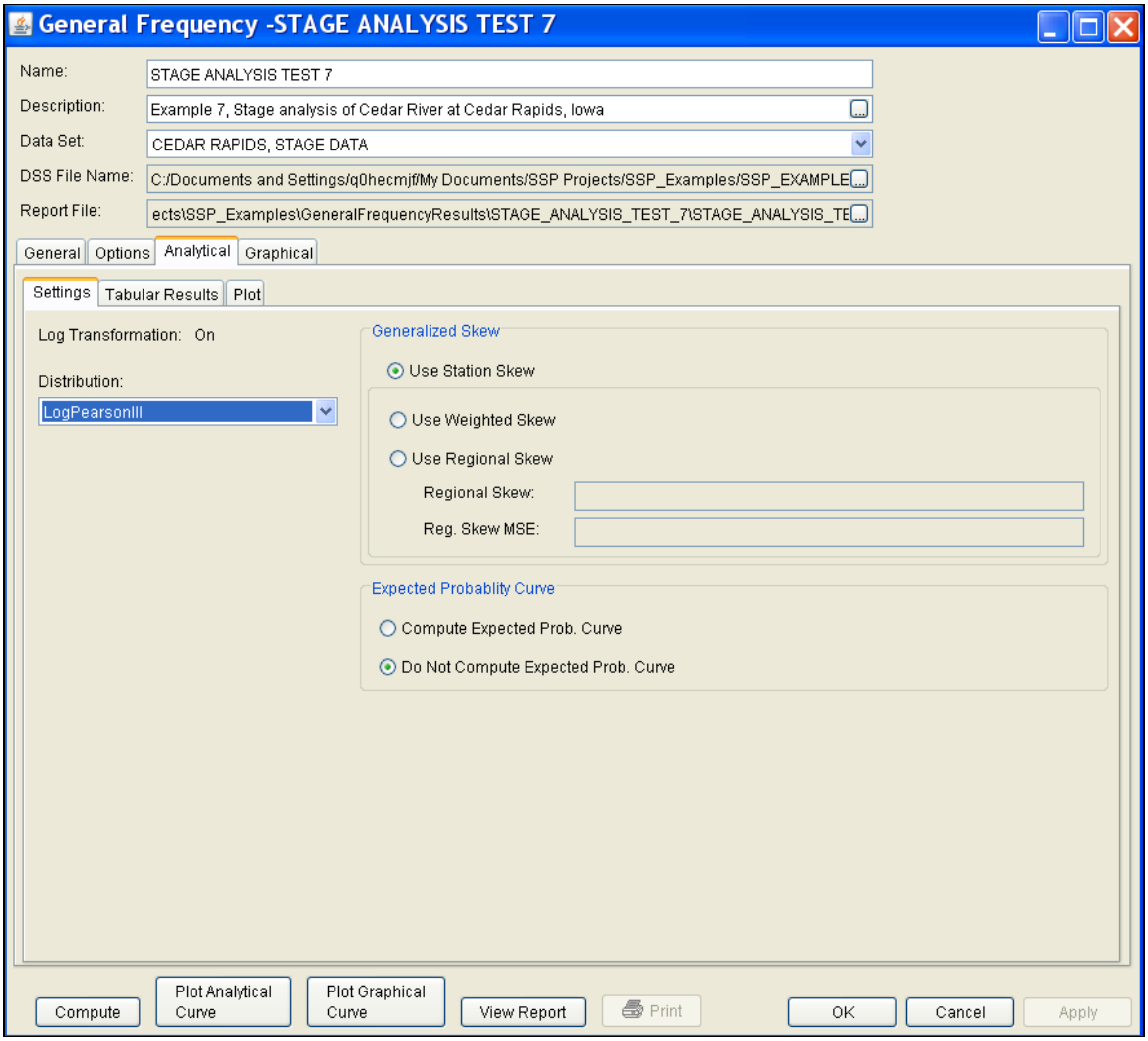


Figure B-48. General Frequency Analysis Editor with Settings Tab Shown for Test Example 7.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab within the analytical analysis. The tabular results window should look Figure B-49.

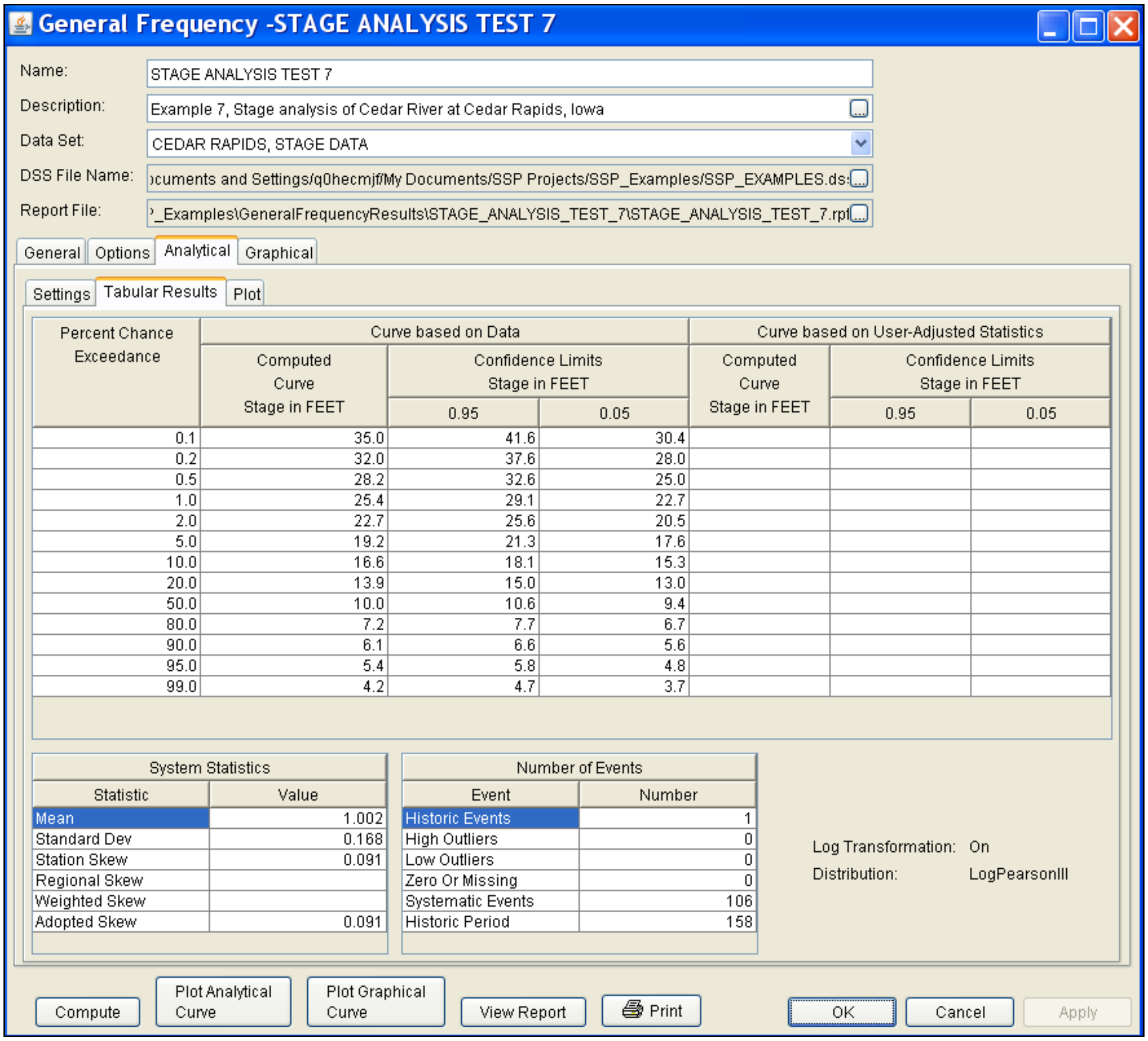


Figure B-49. General Frequency Editor with Tabular Results Tab Selected for Test Example 7.

As shown in Figure B-49, the Frequency Curve table contains the following results:

Percent Chance Exceedance

Computed Curve (Log-Pearson III results)

Confidence Limits (5% and 95% chance exceedance curves)

The frequency curve table contains results based on the data, systematic and historic, and results based on user-adjusted statistics. In this example no user-adjusted statistics were defined, therefore these columns are empty. On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).

This example reports one historical flood event, and a historical period of 158 years, between 1851 and 2008. The reported statistics reflect the use of the historical data adjustment outlined in Bulletin 17B, Appendix 6. The report file (described below) shows the initial computation of the statistics and frequency curve before the historical data was used, and the resulting statistics and frequency curve after the historical data is taken into account.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Analytical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-50.

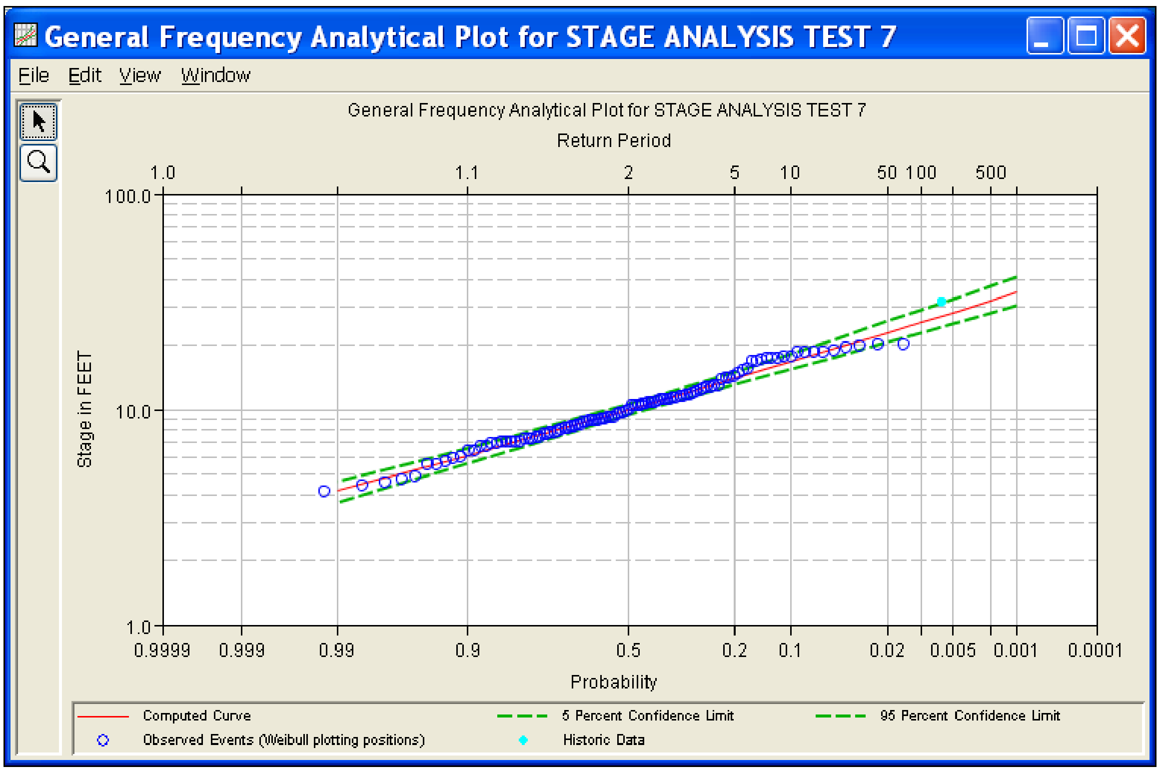


Figure B-50. Plot of the Frequency Curve Results for Test Example 7.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-51 is the report file for Test Example 7.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

STAGE_ANALYSIS_TEST_7.rpt

File Edit Search Format

File: nts\SSP Projects\SSP_Examples\GeneralFrequencyResults\STAGE_ANALYSIS_TEST_7\STAGE_ANALYSIS_TEST_7.rpt

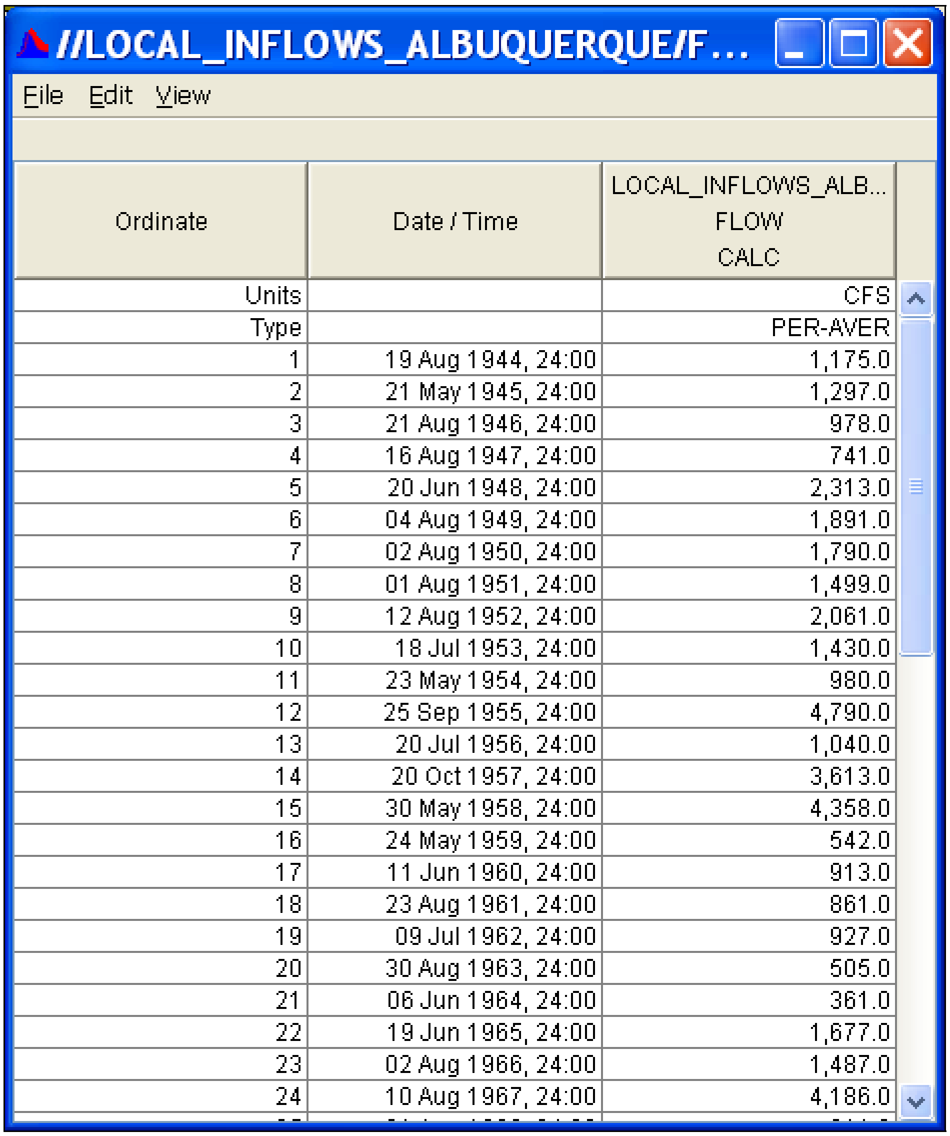
```
|  25 Jul 1999     18.3100  |   98      1988      5.9200    91.59   |
|  15 Jul 2000     11.1800  |   99      1955      5.6700    92.52   |
|  17 Apr 2001     14.0400  |  100      1934      5.5500    93.46   |
|  05 Jun 2002      7.0200  |  101      1989      5.5300    94.39   |
|  16 May 2003      8.8200  |  102      1940      4.8600    95.33   |
|  27 May 2004     18.3000  |  103      1956      4.6900    96.26   |
|  03 Jul 2005     10.4300  |  104      1958      4.5800    97.20   |
|  08 Apr 2006      8.1000  |  105      1964      4.4300    98.13   |
|  27 Aug 2007     11.0600  |  106      1931      4.1000    99.07   |
|---------------------------|-------------------------------------|



<< Skew Weighting >>
---------------------------------------------------------------
Based on 106 events, mean-square error of station skew =  0.052
Mean-square error of regional skew is undefined.
---------------------------------------------------------------


<< Frequency Curve >>
CEDAR RAPIDS, STAGE DATA
-------------------------------------------------------------------
|  Computed    Expected  |   Percent    |   Confidence Limits    |
|    Curve    Probability |   Chance     |     0.95        0.05   |
|      Stage, FEET       |  Exceedance  |      Stage, FEET       |
|------------------------|--------------|------------------------|
|     31.8174         --- |      0.1     |   37.4074     27.8953  |
|     29.4024         --- |      0.2     |   34.2504     25.9637  |
|     26.2688         --- |      0.5     |   30.2054     23.4306  |
|     23.9327         --- |      1.0     |   27.2316     21.5198  |
|     21.6136         --- |      2.0     |   24.3192     19.6010  |
|     18.5440         --- |      5.0     |   20.5340     17.0205  |
|     16.1795         --- |     10.0     |   17.6829     14.9924  |
|     13.7110         --- |     20.0     |   14.7825     12.8235  |
|      9.9774         --- |     50.0     |   10.6039      9.3882  |
|      7.2493         --- |     80.0     |    7.7507      6.7241  |
|      6.1307         --- |     90.0     |    6.6168      5.6088  |
|      5.3366         --- |     95.0     |    5.8159      4.8176  |
|      4.1106         --- |     99.0     |    4.5753      3.6087  |
|------------------------|--------------|------------------------|


<< Systematic Statistics >>
CEDAR RAPIDS, STAGE DATA
--------------------------------------------------------------------
```

1:1..1:1 1:1

Figure B-51. Report File for Test Example 7.

Example 8: Using User-Adjusted Statistics

This example demonstrates how to use the General Frequency analysis and enter user-adjusted statistics. The data for this example is from an analysis that computed local runoff for the Rio Grande at Albuquerque. The data includes unregulated daily average flows generated by rainfall-runoff from areas downstream of upstream reservoirs. The period of record used for this example is from 1944 to 2000. To view the data, right-click on the data record labeled "**Annual Daily Average Peak Flows Local Runoff at Albuquerque**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-52.



Ordinate	Date / Time	LOCAL_INFLOWS_ALB... FLOW CALC
Units		CFS
Type		PER-AVER
1	19 Aug 1944, 24:00	1,175.0
2	21 May 1945, 24:00	1,297.0
3	21 Aug 1946, 24:00	978.0
4	16 Aug 1947, 24:00	741.0
5	20 Jun 1948, 24:00	2,313.0
6	04 Aug 1949, 24:00	1,891.0
7	02 Aug 1950, 24:00	1,790.0
8	01 Aug 1951, 24:00	1,499.0
9	12 Aug 1952, 24:00	2,061.0
10	18 Jul 1953, 24:00	1,430.0
11	23 May 1954, 24:00	980.0
12	25 Sep 1955, 24:00	4,790.0
13	20 Jul 1956, 24:00	1,040.0
14	20 Oct 1957, 24:00	3,613.0
15	30 May 1958, 24:00	4,358.0
16	24 May 1959, 24:00	542.0
17	11 Jun 1960, 24:00	913.0
18	23 Aug 1961, 24:00	861.0
19	09 Jul 1962, 24:00	927.0
20	30 Aug 1963, 24:00	505.0
21	06 Jun 1964, 24:00	361.0
22	19 Jun 1965, 24:00	1,677.0
23	02 Aug 1966, 24:00	1,487.0
24	10 Aug 1967, 24:00	4,186.0

Figure B-52. Tabulation of the Peak Stage Data for Example 8.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-53.

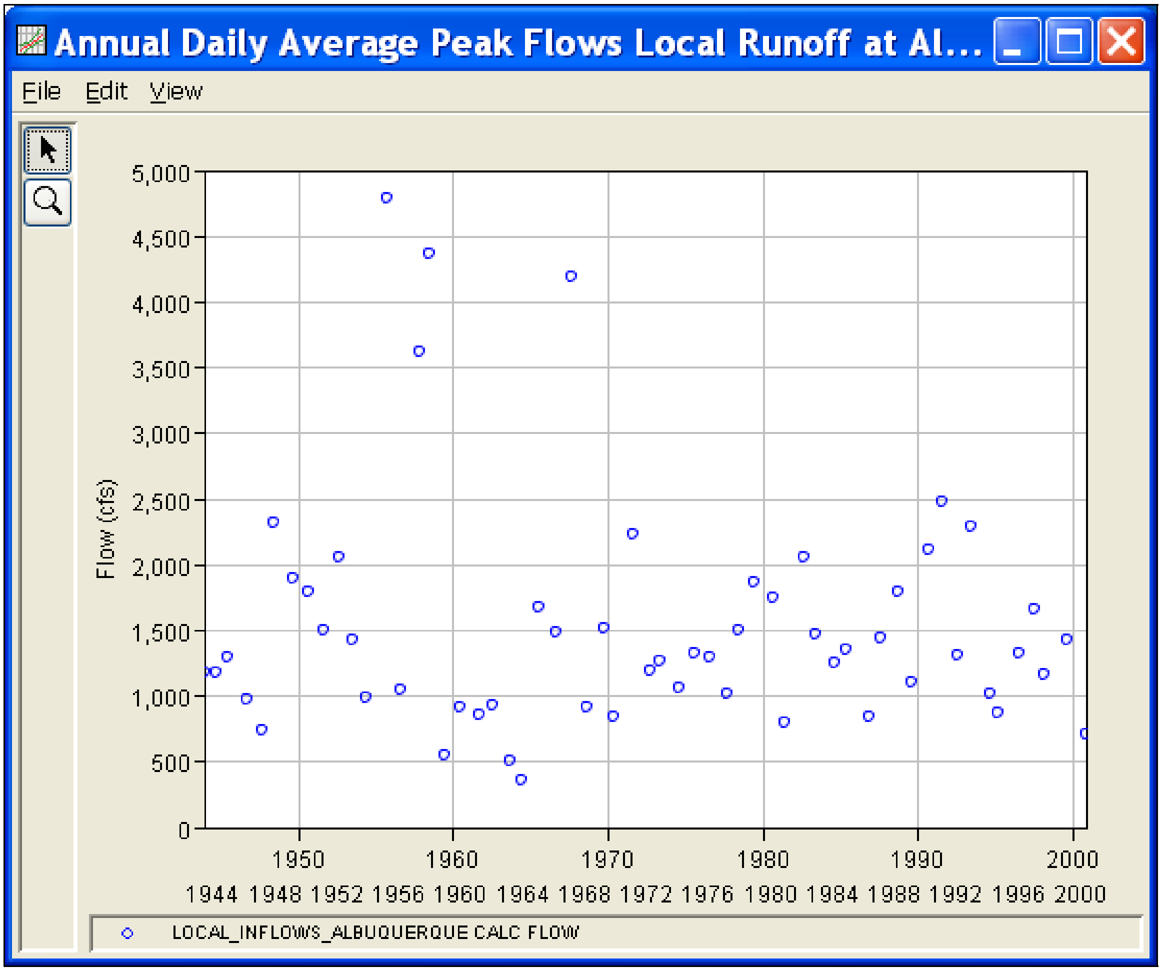


Figure B-53. Plot of Data for Example 8.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for Test Example 8, either double-click on the analysis labeled **LOCAL RUNOFF AT ALBUQUERQUE TEST 8** from the study explorer, or from the **Analysis** menu select open, then select **LOCAL RUNOFF AT ALBUQUERQUE TEST 8** from the list of available analyses. When test 8 is opened, the General Frequency analysis editor will appear as shown in Figure B-54.

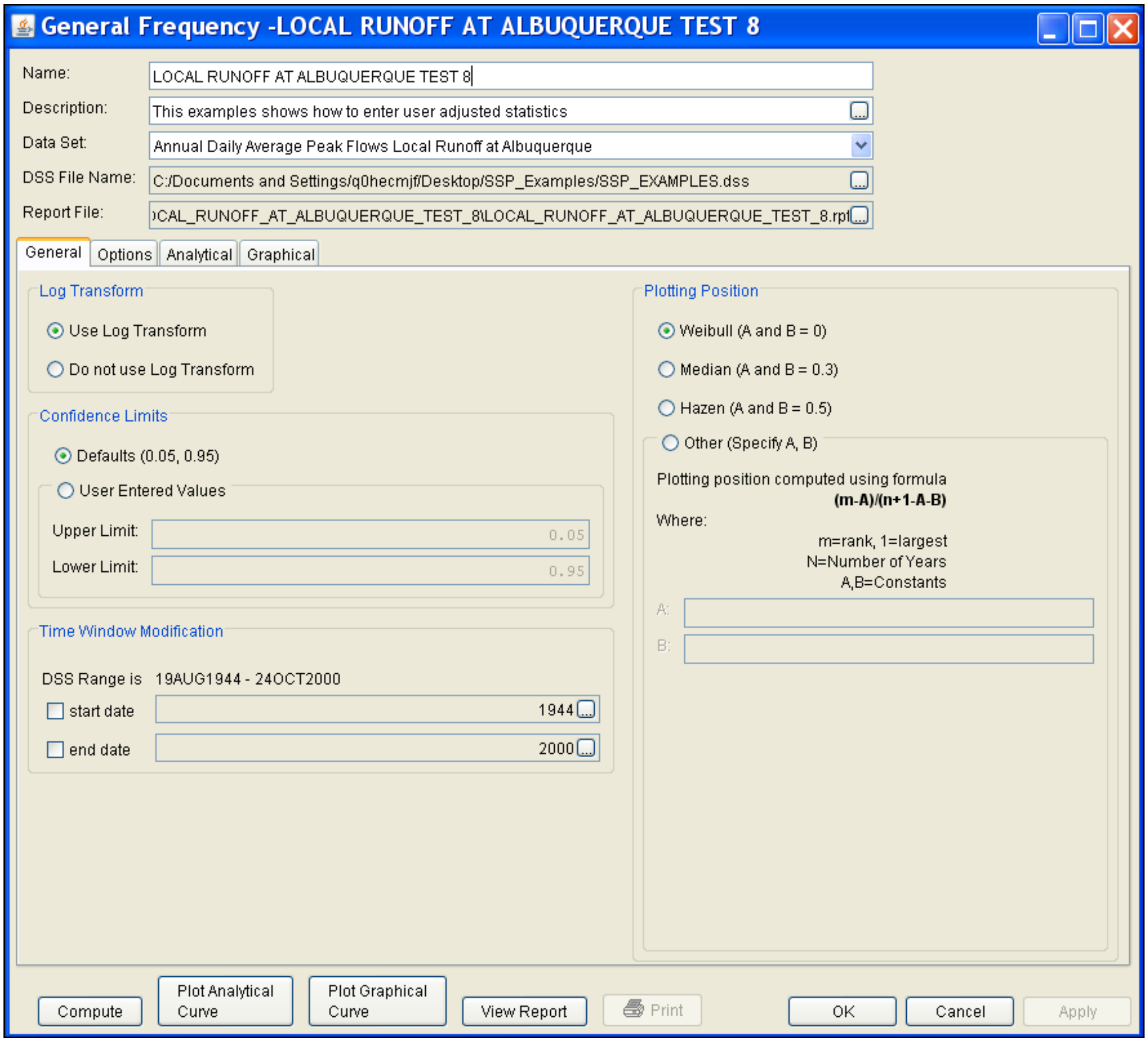


Figure B-54. General Frequency Analysis Editor for Test Example 8.

Shown in Figure B-53 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the **Time Window**.

Shown in Figure B-55 is the General Frequency analysis editor with the **Options Tab** selected. Features on this tab include the **Low Outlier Threshold**, an option to use **Historic Data**, an option to override the default **Frequency Ordinates**, and **Output Labeling**. All defaults settings were selected for this example.

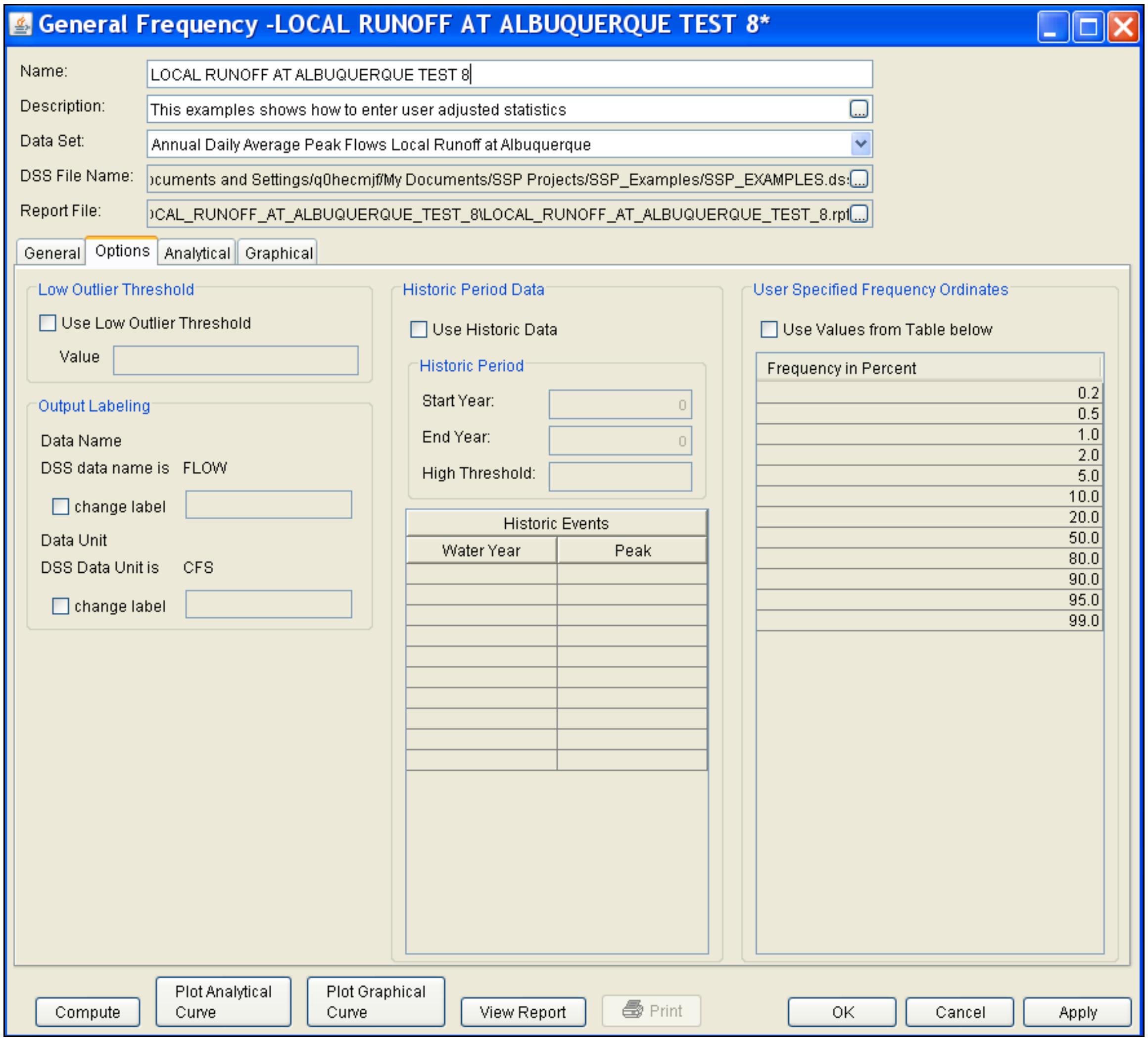


Figure B-55. General Frequency Analysis Editor with Options Tab Shown for Test Example 8.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-56 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

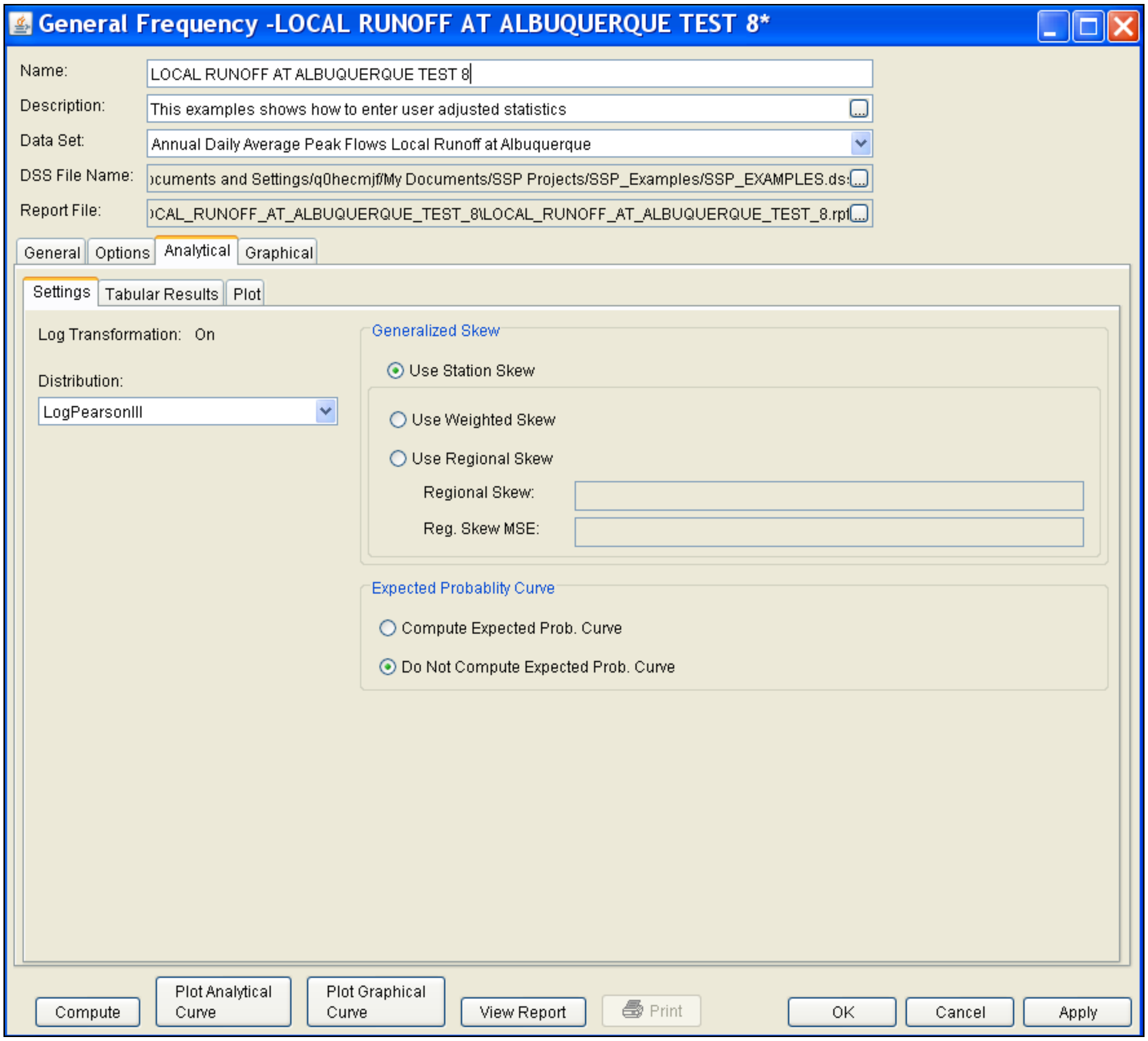


Figure B-56. General Frequency Analysis Editor with Settings Tab Shown for Test Example 8.

Press the **Compute** button to perform the analysis. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Plot** tab within the analytical analysis. The analytical plot window should look Figure B-57.

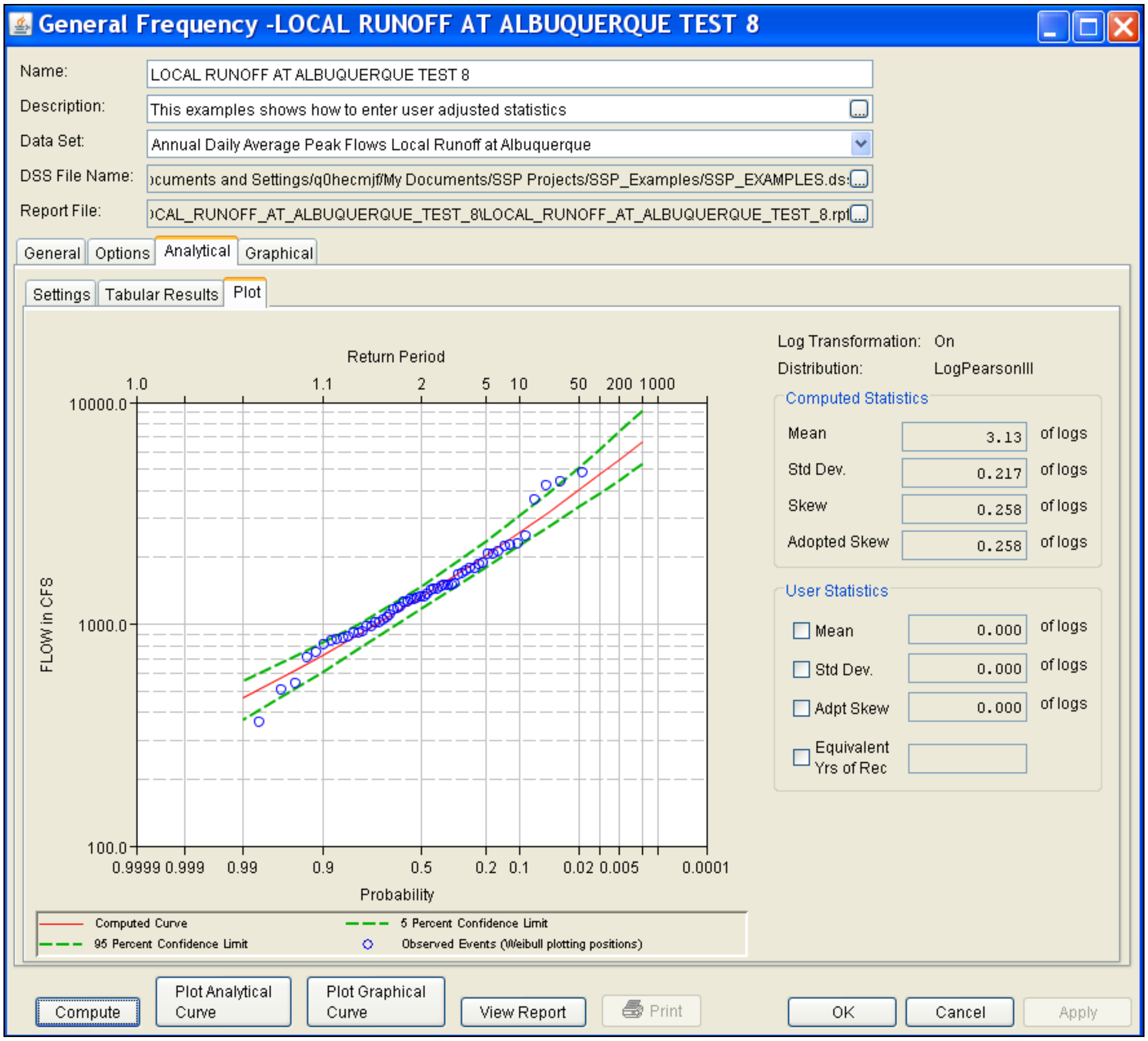


Figure B-57. The Plot Tab for Test Example 8.

As shown in Figure B-57, the **Plot** tab contains a graph of the systematic data, the computed frequency curve, and the confidence limits. The right side of the plot tab contains a table of **Computed Statistics** and **User Statistics**. The user has the option to enter a mean, standard deviation, adopted skew, and equivalent years of record in the User Statistics table. The **Compute** button must be pressed after User Statistics have been entered in order for the program to compute a frequency curve using the user statistics.

As mentioned at the beginning of this example, the annual peak flows were based on daily averaged flows. In order to compute an instantaneous peak flow frequency curve, a relationship between daily averaged flows and the corresponding instantaneous peak flows was developed. This was done by plotting daily averaged flow and the corresponding instantaneous peak flow for selected flood events. Using this relationship, a Mean of 3.731 was computed and entered in the User Statistics table and the analytical analysis was recomputed.

Figure B-58 shows that the frequency curve computed from the user-adjusted statistics is added to the graph. Figure B-58 also shows that the user does not have to enter values for all statistics in order for the program to compute a user-adjusted frequency curve. The program will use statistics computed from the systematic and historic data if the statistics are not defined in the User Statistics table. In this example, the program used the computed statistics for standard deviation, adopted skew, equivalent years of record and the user-defined mean of 3.731 when computing the user-adjusted frequency curve.

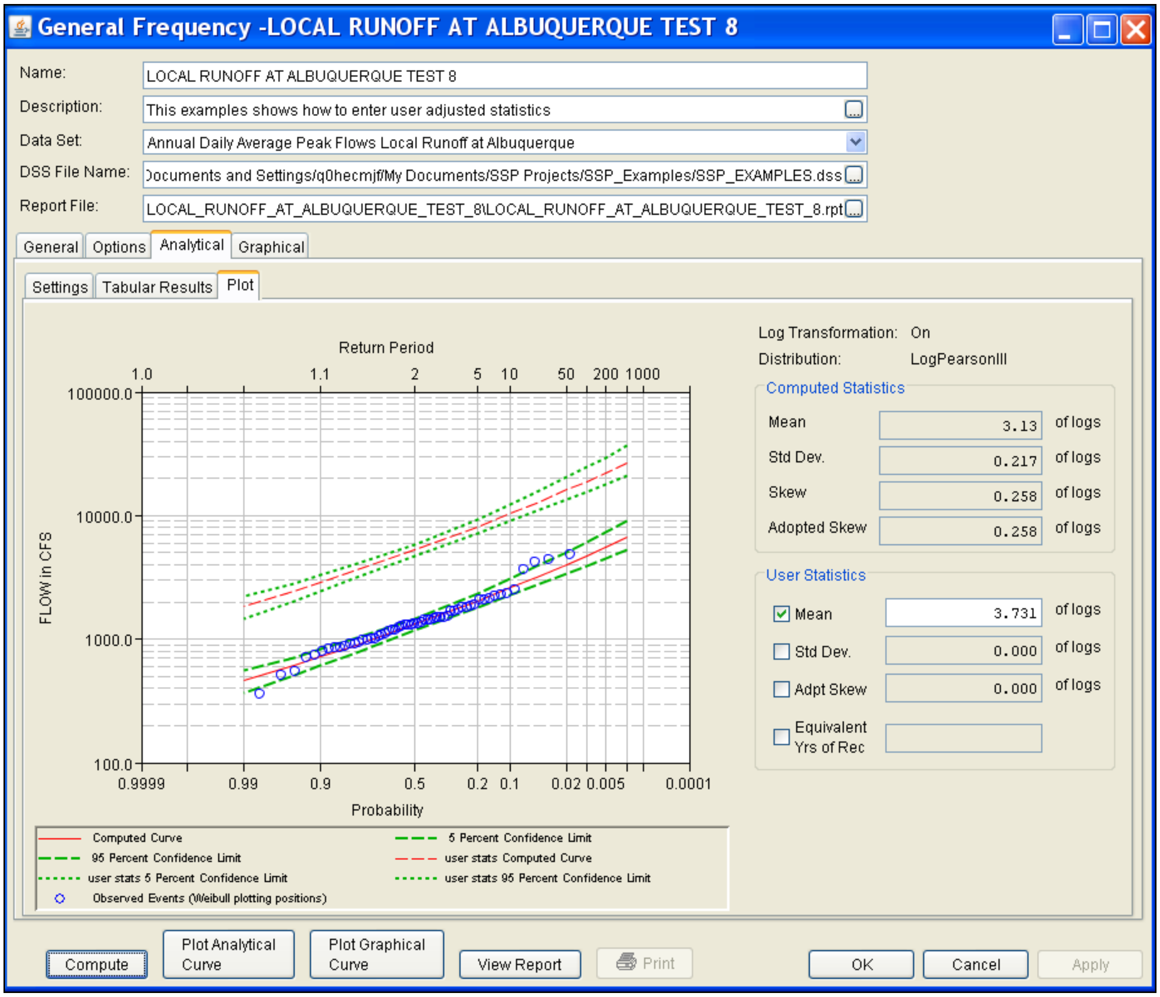
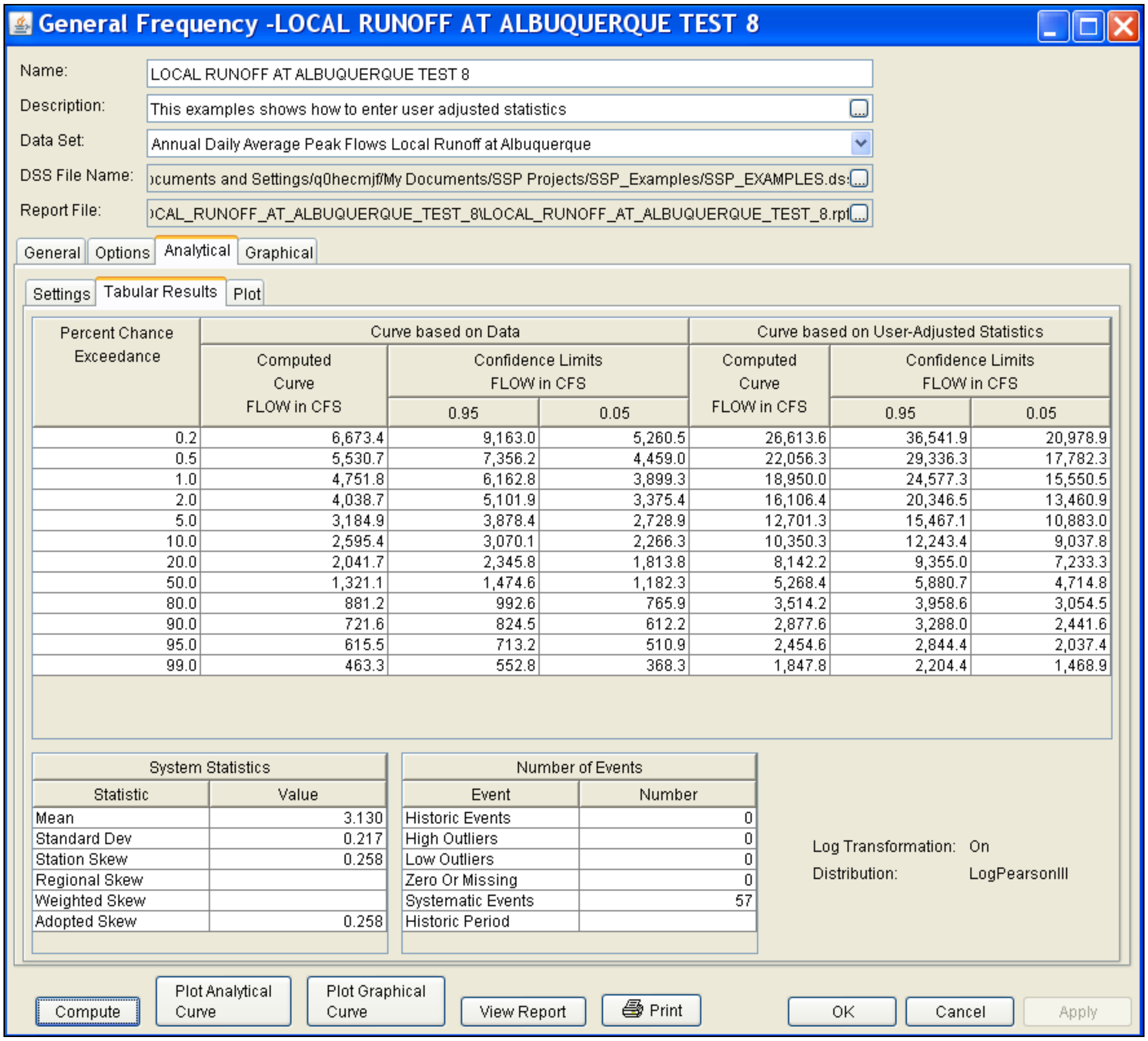


Figure B-58. Plot Tab with User-Adjusted Statistics and Frequency Curves for Test Example 8.

Select the **Tabular Results** tab to see information for both the computed and user-adjusted frequency curves. As shown in Figure B-59, the Frequency Curve table contains the percent chance exceedance, computed curves (Log-Pearson III results), and the Confidence Limits (5% and 95% chance exceedance curves) for both the computed and user-adjusted statistics.

On the bottom left-hand side of the results tab is a table of System Statistics for the observed station data (mean, standard deviation, station skew) and regional adjustment (regional skew, weighted skew, and adopted skew). Also on the bottom right-hand side of the results tab is a table of Number of Events showing the number of historic events used in the analysis, number of high outliers found, number of low outliers, number of zero or missing data years, number of systematic events in the gage record, and the historic record length (if historic data was entered).



Percent Chance Exceedance	Curve based on Data			Curve based on User-Adjusted Statistics		
	Computed Curve FLOW in CFS	Confidence Limits FLOW in CFS		Computed Curve FLOW in CFS	Confidence Limits FLOW in CFS	
		0.95	0.05		0.95	0.05
0.2	6,673.4	9,163.0	5,260.5	26,613.6	36,541.9	20,978.9
0.5	5,530.7	7,356.2	4,459.0	22,056.3	29,336.3	17,782.3
1.0	4,751.8	6,162.8	3,899.3	18,950.0	24,577.3	15,550.5
2.0	4,038.7	5,101.9	3,375.4	16,106.4	20,346.5	13,460.9
5.0	3,184.9	3,878.4	2,728.9	12,701.3	15,467.1	10,883.0
10.0	2,595.4	3,070.1	2,266.3	10,350.3	12,243.4	9,037.8
20.0	2,041.7	2,345.8	1,813.8	8,142.2	9,355.0	7,233.3
50.0	1,321.1	1,474.6	1,182.3	5,268.4	5,880.7	4,714.8
80.0	881.2	992.6	765.9	3,514.2	3,958.6	3,054.5
90.0	721.6	824.5	612.2	2,877.6	3,288.0	2,441.6
95.0	615.5	713.2	510.9	2,454.6	2,844.4	2,037.4
99.0	463.3	552.8	368.3	1,847.8	2,204.4	1,468.9

System Statistics	
Statistic	Value
Mean	3.130
Standard Dev	0.217
Station Skew	0.258
Regional Skew	
Weighted Skew	
Adopted Skew	0.258

Number of Events	
Event	Number
Historic Events	0
High Outliers	0
Low Outliers	0
Zero Or Missing	0
Systematic Events	57
Historic Period	

Figure B-59. General Frequency Editor with Results Tab Selected for Test Example 8.

In addition to the tabular results, a graphical plot of the computed frequency curves can be obtained by pressing the **Plot Analytical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-60.

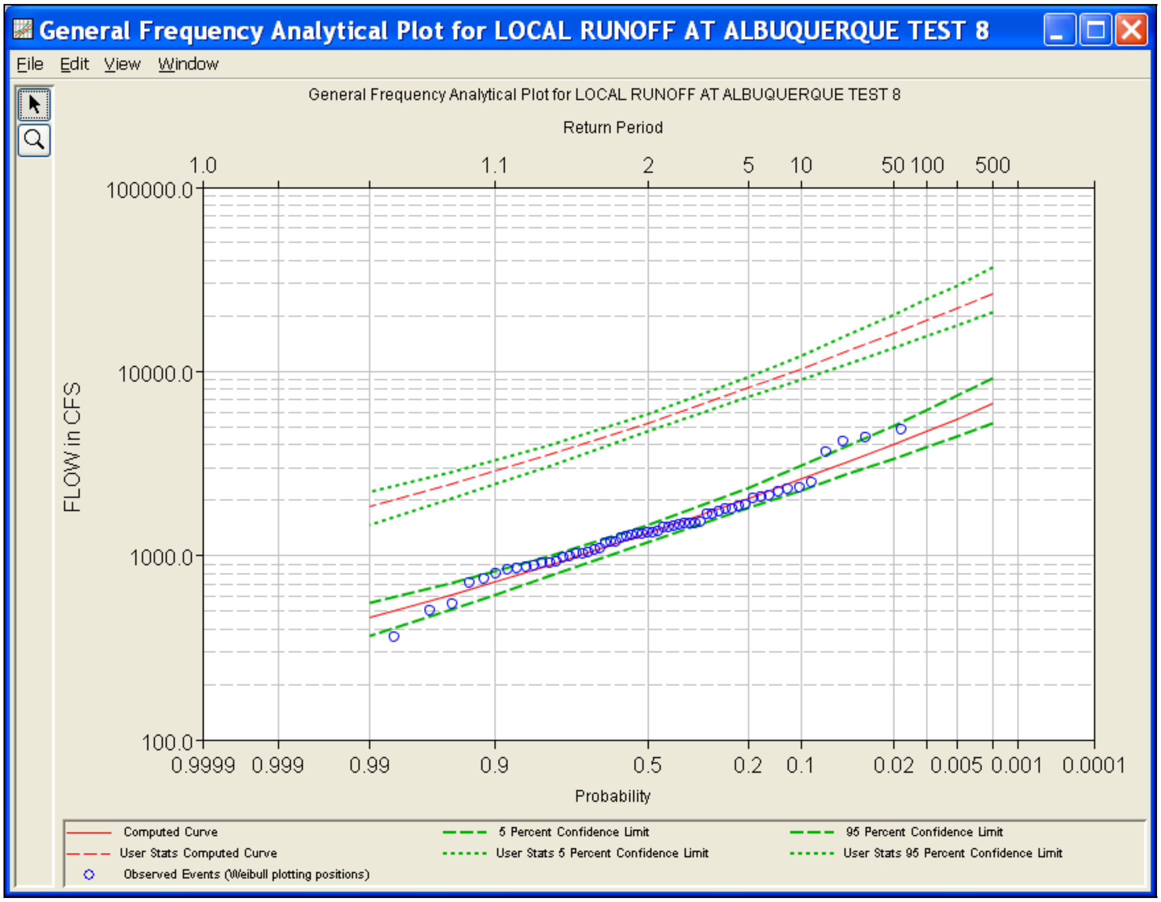
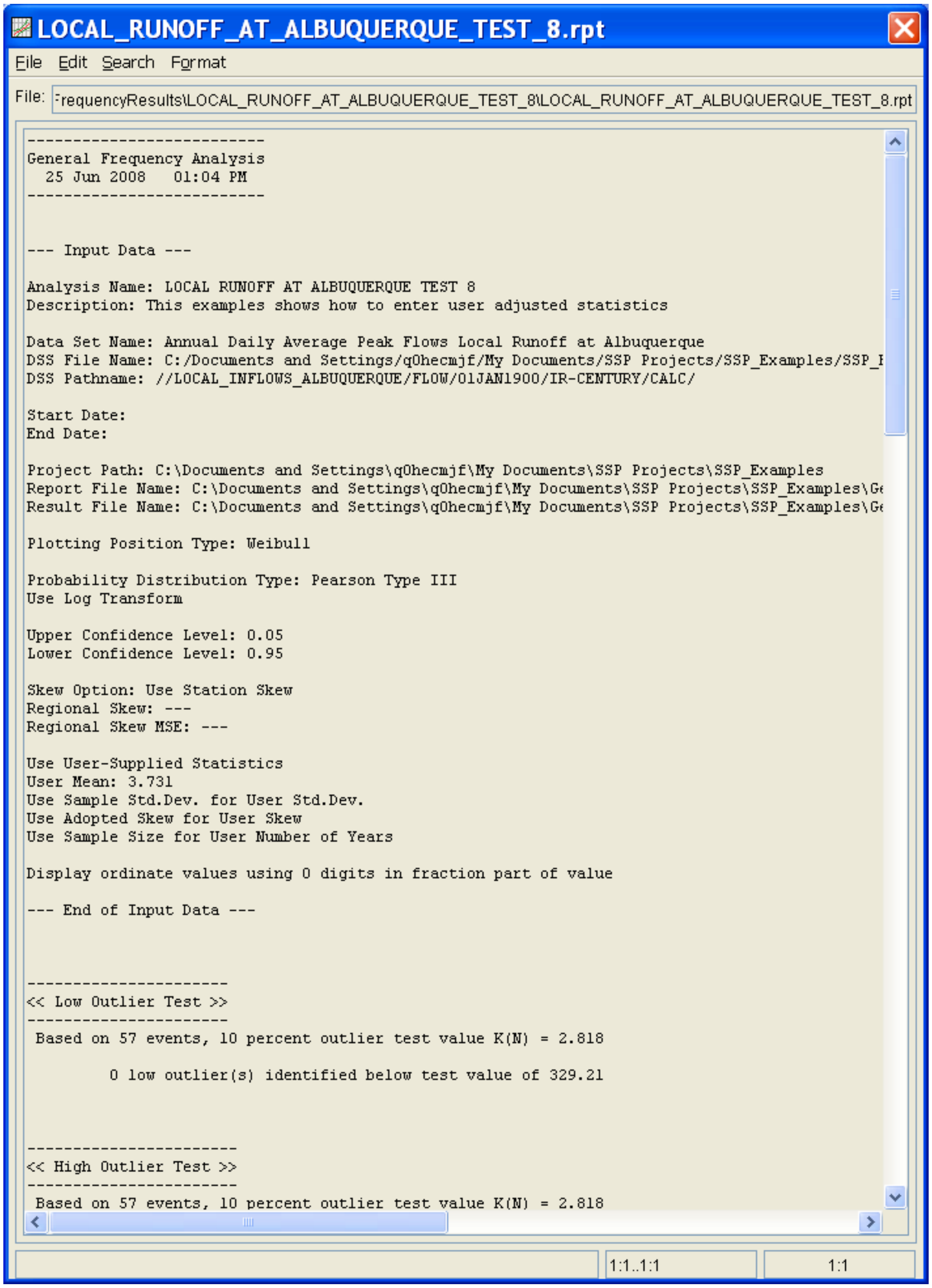


Figure B-60. Plot of the Frequency Curve Results for Test Example 8.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-61 is the report file for Test Example 8.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.

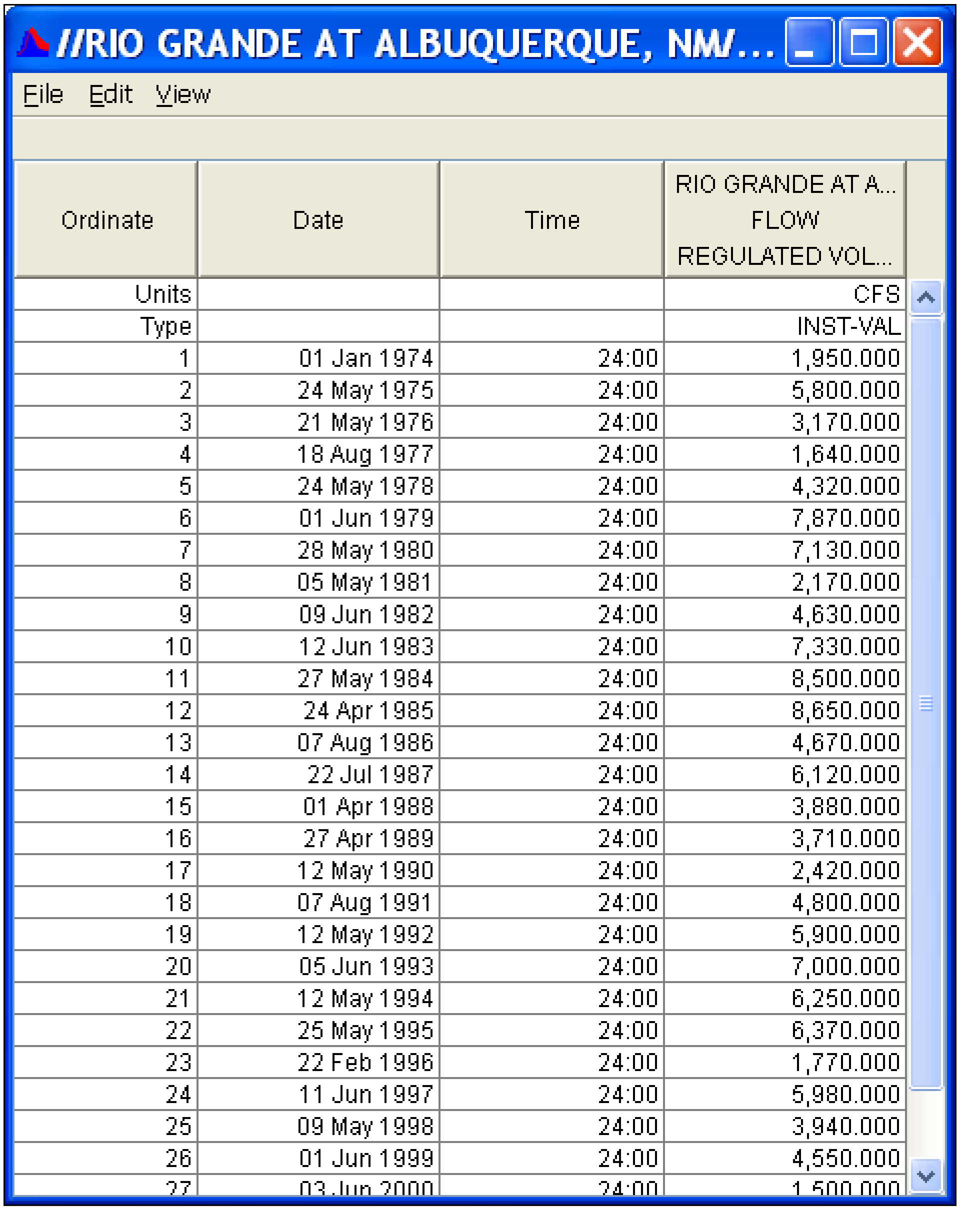


```
LOCAL_RUNOFF_AT_ALBUQUERQUE_TEST_8.rpt
File  Edit  Search  Format
File: FrequencyResults\LOCAL_RUNOFF_AT_ALBUQUERQUE_TEST_8\LOCAL_RUNOFF_AT_ALBUQUERQUE_TEST_8.rpt

--------------------------
General Frequency Analysis
  25 Jun 2008    01:04 PM
--------------------------


--- Input Data ---

Analysis Name: LOCAL RUNOFF AT ALBUQUERQUE TEST 8
Description: This examples shows how to enter user adjusted statistics

Data Set Name: Annual Daily Average Peak Flows Local Runoff at Albuquerque
DSS File Name: C:/Documents and Settings/q0hecmjf/My Documents/SSP Projects/SSP_Examples/SSP_E
DSS Pathname: //LOCAL_INFLOWS_ALBUQUERQUE/FLOW/01JAN1900/IR-CENTURY/CALC/

Start Date:
End Date:

Project Path: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Ge
Result File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Ge

Plotting Position Type: Weibull

Probability Distribution Type: Pearson Type III
Use Log Transform

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

Skew Option: Use Station Skew
Regional Skew: ---
Regional Skew MSE: ---

Use User-Supplied Statistics
User Mean: 3.731
Use Sample Std.Dev. for User Std.Dev.
Use Adopted Skew for User Skew
Use Sample Size for User Number of Years

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
 Based on 57 events, 10 percent outlier test value K(N) = 2.818

        0 low outlier(s) identified below test value of 329.21



-----------------------
<< High Outlier Test >>
-----------------------
 Based on 57 events, 10 percent outlier test value K(N) = 2.818

1:1..1:1    1:1
```

Figure B-61. Report File for Test Example 8.

Example 9: General Frequency – Graphical Analysis

This example demonstrates how to create a Graphical Analysis within a General Frequency analysis. The data for this example is from an analysis that computed regulated flow for the Rio Grande at Albuquerque. The data includes regulated daily average flows from upstream reservoirs routed downstream to Albuquerque. The period of record used for this example is from 1974 to 2002. To view the data, right-click on the data record labeled "**Annual Daily Average Peak Flows Rio Grande at Albuquerque**" in the study explorer and then select **Tabulate**. The data will appear as shown in Figure B-62.



Ordinate	Date	Time	RIO GRANDE AT A... FLOW REGULATED VOL...
Units			CFS
Type			INST-VAL
1	01 Jan 1974	24:00	1,950.000
2	24 May 1975	24:00	5,800.000
3	21 May 1976	24:00	3,170.000
4	18 Aug 1977	24:00	1,640.000
5	24 May 1978	24:00	4,320.000
6	01 Jun 1979	24:00	7,870.000
7	28 May 1980	24:00	7,130.000
8	05 May 1981	24:00	2,170.000
9	09 Jun 1982	24:00	4,630.000
10	12 Jun 1983	24:00	7,330.000
11	27 May 1984	24:00	8,500.000
12	24 Apr 1985	24:00	8,650.000
13	07 Aug 1986	24:00	4,670.000
14	22 Jul 1987	24:00	6,120.000
15	01 Apr 1988	24:00	3,880.000
16	27 Apr 1989	24:00	3,710.000
17	12 May 1990	24:00	2,420.000
18	07 Aug 1991	24:00	4,800.000
19	12 May 1992	24:00	5,900.000
20	05 Jun 1993	24:00	7,000.000
21	12 May 1994	24:00	6,250.000
22	25 May 1995	24:00	6,370.000
23	22 Feb 1996	24:00	1,770.000
24	11 Jun 1997	24:00	5,980.000
25	09 May 1998	24:00	3,940.000
26	01 Jun 1999	24:00	4,550.000
27	03 Jun 2000	24:00	1,500.000

Figure B-62. Tabulation of the Peak Stage Data for Example 9.

To plot the data for this example, right-click on the data record and then select **Plot**. A plot of the data will appear as shown in Figure B-63.

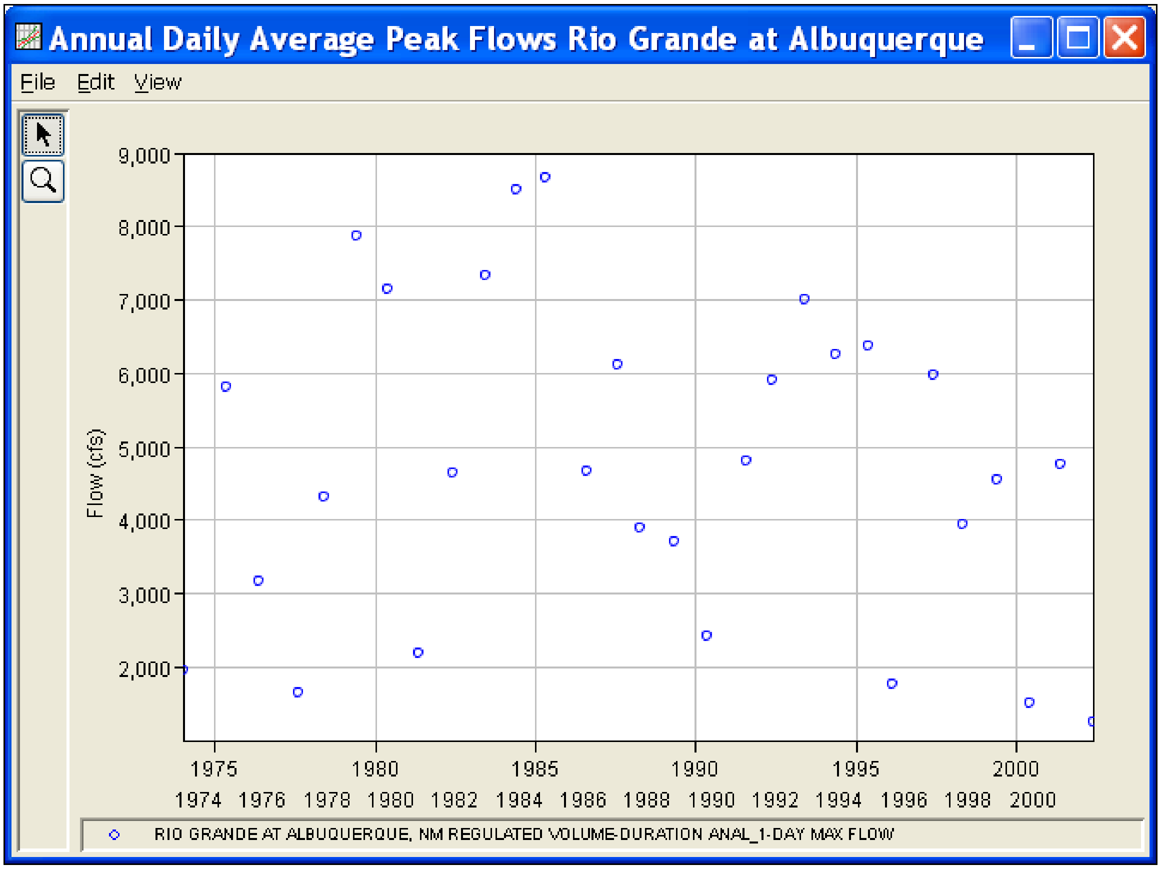


Figure B-63. Plot of Data for Example 9.

A General Frequency analysis has been developed for this example. To open the General Frequency analysis editor for test example 9, either double-click on the analysis labeled **REGULATED FLOW RIO GRANDE TEST 9** from the study explorer, or from the **Analysis** menu select open, then select **REGULATED FLOW RIO GRANDE TEST 9** from the list of available analyses. When Test 9 is opened, the General Frequency analysis editor will appear as shown in Figure B-64.

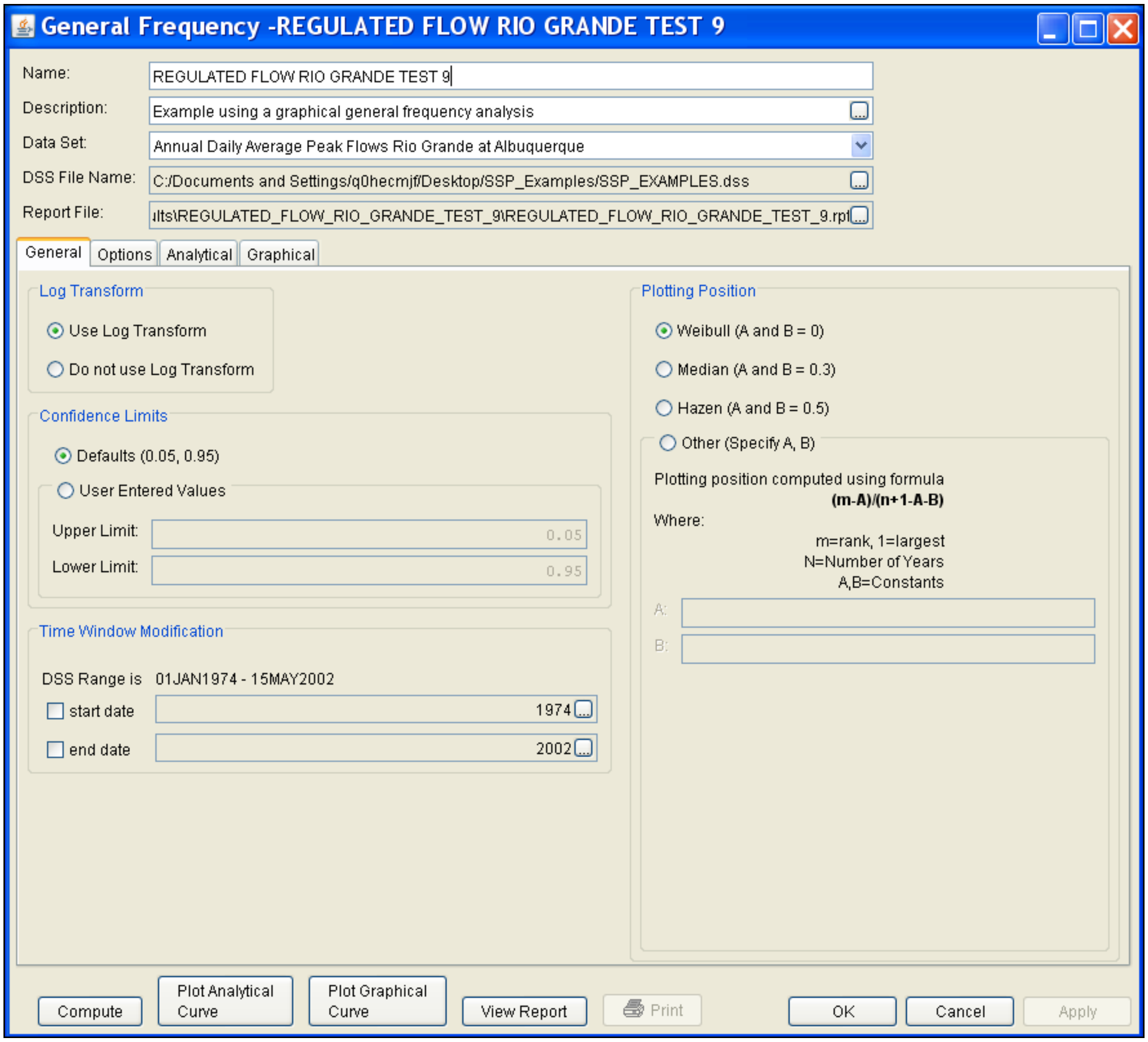


Figure B-64. General Frequency Analysis Editor for Test Example 9.

Shown in Figure B-64 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, the default **Confidence Limits** were selected, and no modification was made to the **Time Window**.

Shown in Figure B-65 is the General Frequency analysis editor with the **Options Tab** selected. Features on this tab include the **Low Outlier Threshold**, an option to use **Historic Data**, an option to override the default **Frequency Ordinates**, and **Output Labeling**. All defaults settings were selected for this example.

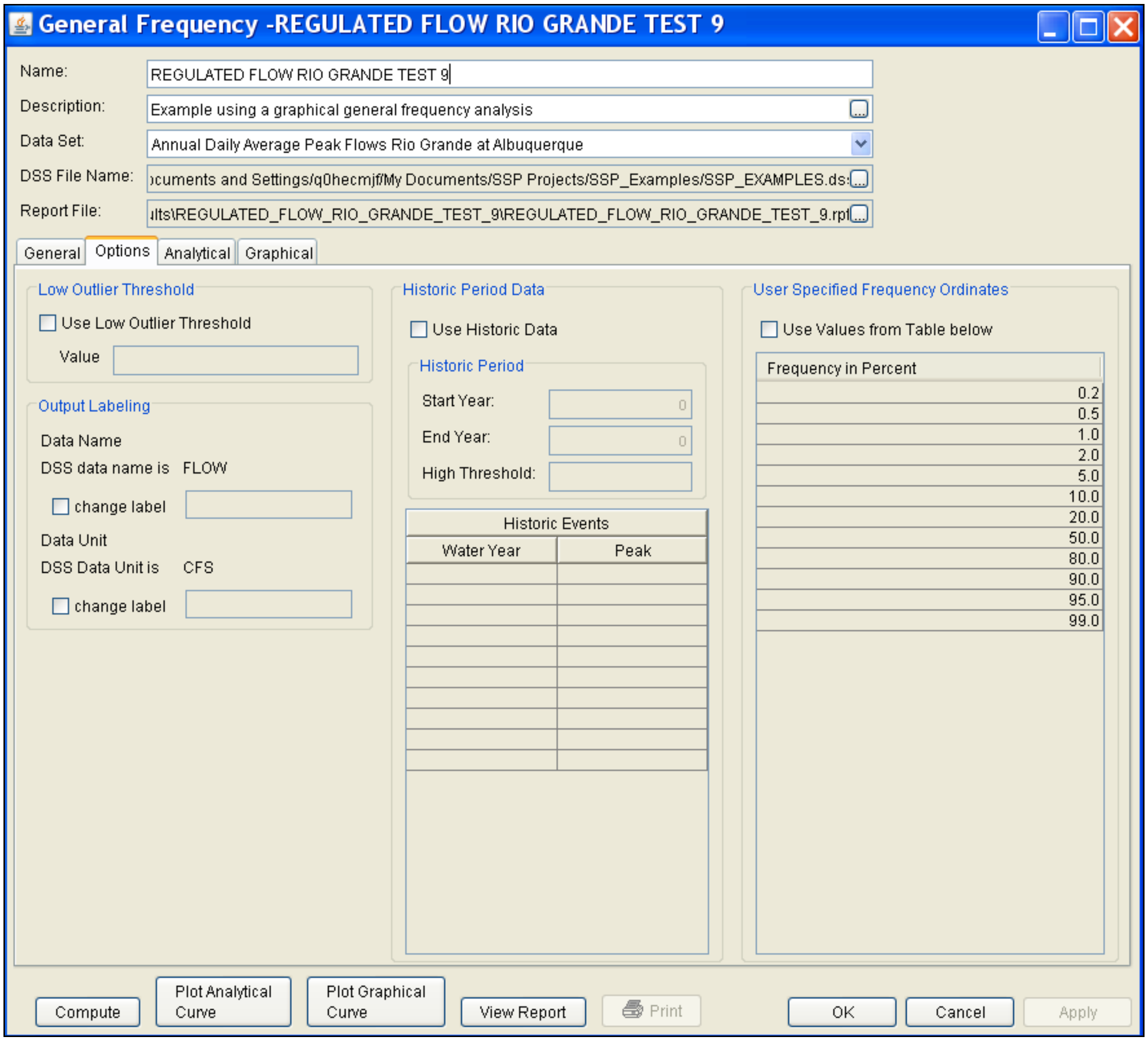


Figure B-65. General Frequency Analysis Editor with Options Tab Shown for Test Example 9.

Once all of the General and Optional settings are set or selected, the user can choose to perform an Analytical or Graphical analysis. In this example, a graphical analysis was performed. Shown in Figure B-66 is the **Graphical** analysis tab. As shown, a graph containing the systematic data and graphical curve is on the left side and a table containing the user-entered frequency curve is on the right side of the window. The user must manually enter a peak value for each frequency ordinate and then press the **Compute** button before the program plots the graphical curve. For this example, a reservoir model was used to route synthetic hydrographs through the reservoir network upstream of Albuquerque using current operating criteria. This was done for the 0.2, 0.5, 1.0, 2.0, 10, 20, and 50 percent events. Output from the model was input into the Frequency Ordinates table. For the more frequent events (10 year and below), the graphical curve was fit to the data visually. This example shows how a reservoir network can influence the frequency curve. Notice how the frequency curve is flat for the 20 through the 1 percent chance events. The reservoir network is able to control flooding in this range. This example also shows that as flood events become larger, the reservoir network has less influence on controlling downstream flooding.

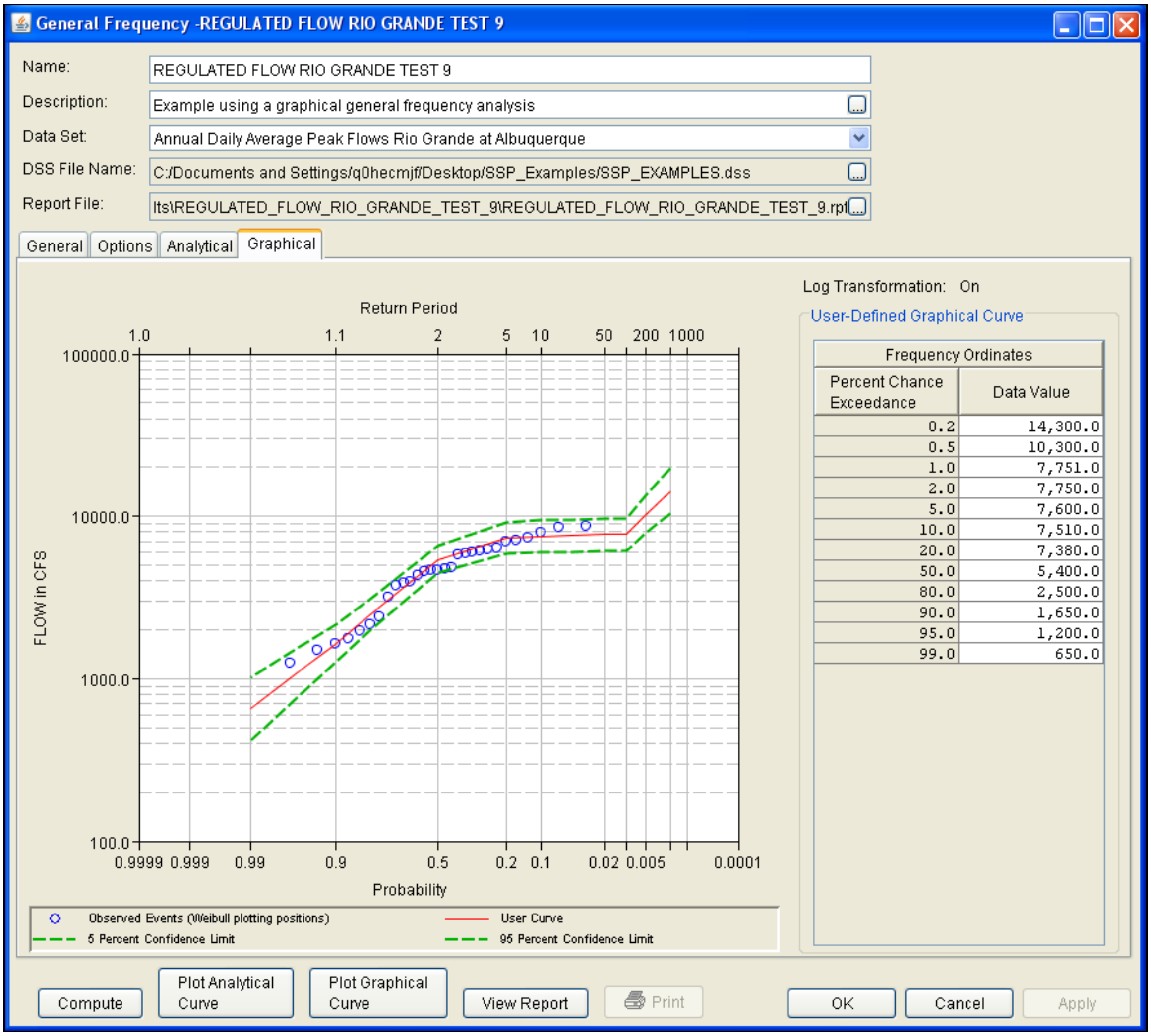


Figure B-66. Graphical Tab Shown for Test Example 9.

A graphical plot of the graphical frequency curve can be obtained by pressing the **Plot Graphical Curve** button at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-67.

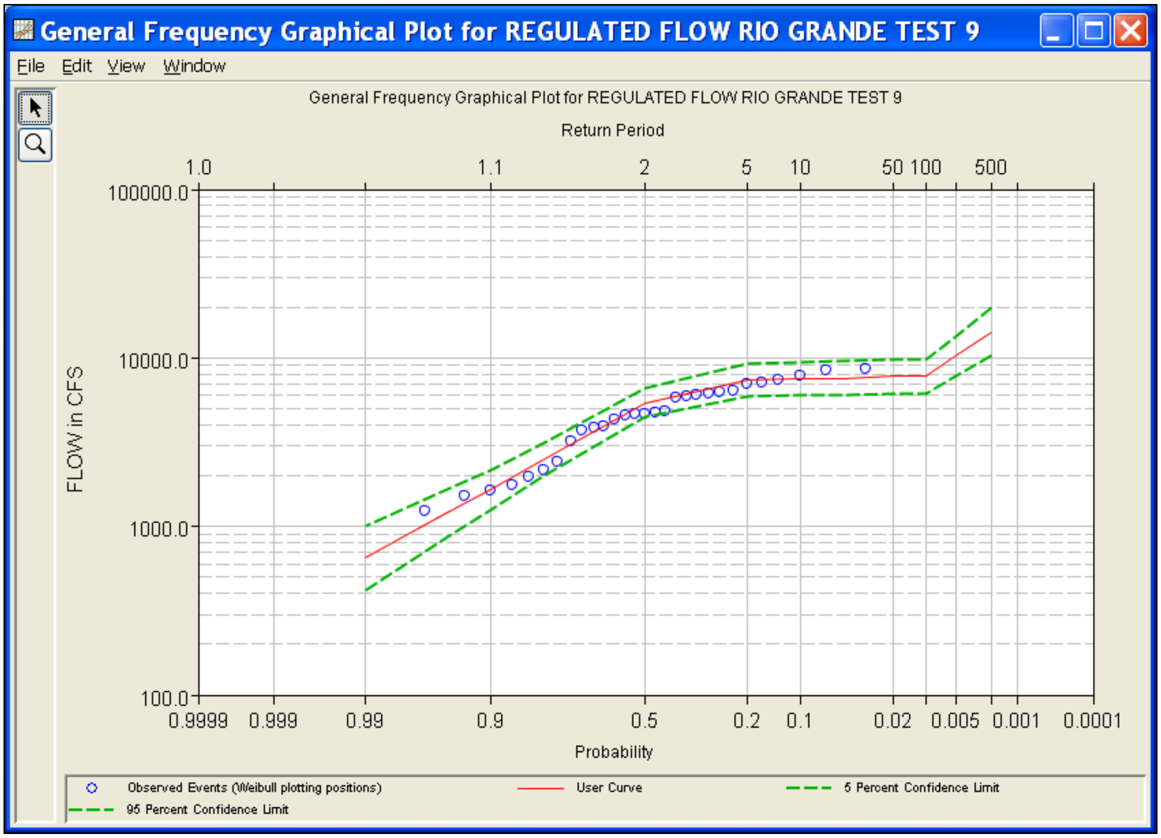
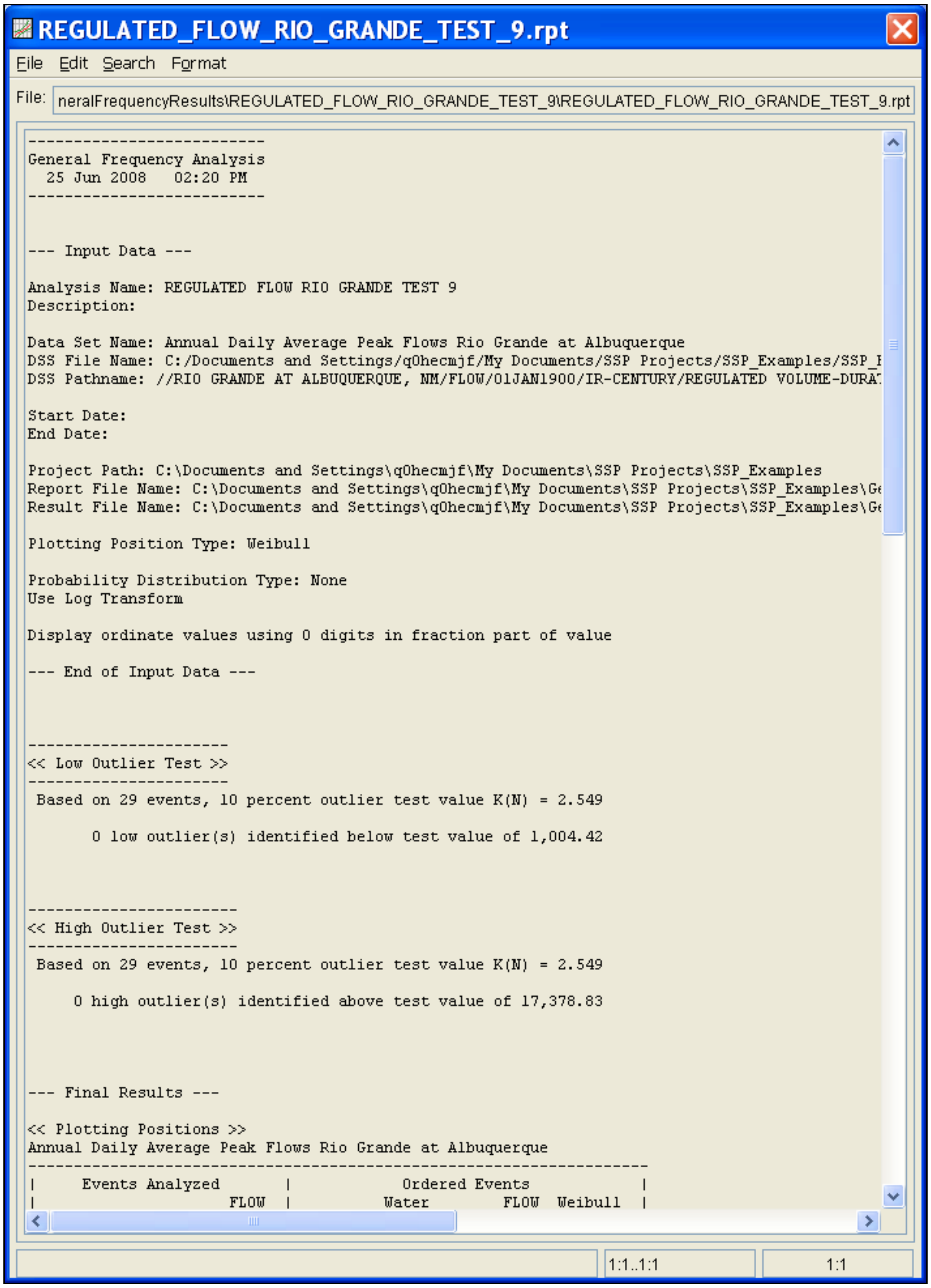


Figure B-67. Plot of the Frequency Curve Results for Test Example 9.

The graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-68 is the report file for Test Example 9.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, and additional calculations needed. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.




```
-------------------------
General Frequency Analysis
  25 Jun 2008   02:20 PM
-------------------------


--- Input Data ---

Analysis Name: REGULATED FLOW RIO GRANDE TEST 9
Description:

Data Set Name: Annual Daily Average Peak Flows Rio Grande at Albuquerque
DSS File Name: C:/Documents and Settings/q0hecmjf/My Documents/SSP Projects/SSP_Examples/SSP_F
DSS Pathname: //RIO GRANDE AT ALBUQUERQUE, NM/FLOW/01JAN1900/IR-CENTURY/REGULATED VOLUME-DURAT

Start Date:
End Date:

Project Path: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Ge
Result File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\Ge

Plotting Position Type: Weibull

Probability Distribution Type: None
Use Log Transform

Display ordinate values using 0 digits in fraction part of value

--- End of Input Data ---



----------------------
<< Low Outlier Test >>
----------------------
 Based on 29 events, 10 percent outlier test value K(N) = 2.549

       0 low outlier(s) identified below test value of 1,004.42



-----------------------
<< High Outlier Test >>
-----------------------
 Based on 29 events, 10 percent outlier test value K(N) = 2.549

     0 high outlier(s) identified above test value of 17,378.83



--- Final Results ---

<< Plotting Positions >>
Annual Daily Average Peak Flows Rio Grande at Albuquerque
--------------------------------------------------------------------
|     Events Analyzed      |            Ordered Events              |
|                FLOW  |         Water         FLOW  Weibull   |
```

Figure B-68. Report File for Test Example 9.

Example 10: Volume-Duration Frequency Analysis, Maximum Flows

This example demonstrates how to perform a Volume-Duration Frequency analysis for maximum flows. The data for this example was derived from an analysis where a time-series of daily average unregulated flows were computed for the Rio Grande at Albuquerque. The period of record for this example is from 1941 to 2002. To view the data, right-click on the data record labeled "**Rio Grande at Albuquerque UNREGULATED**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-69.

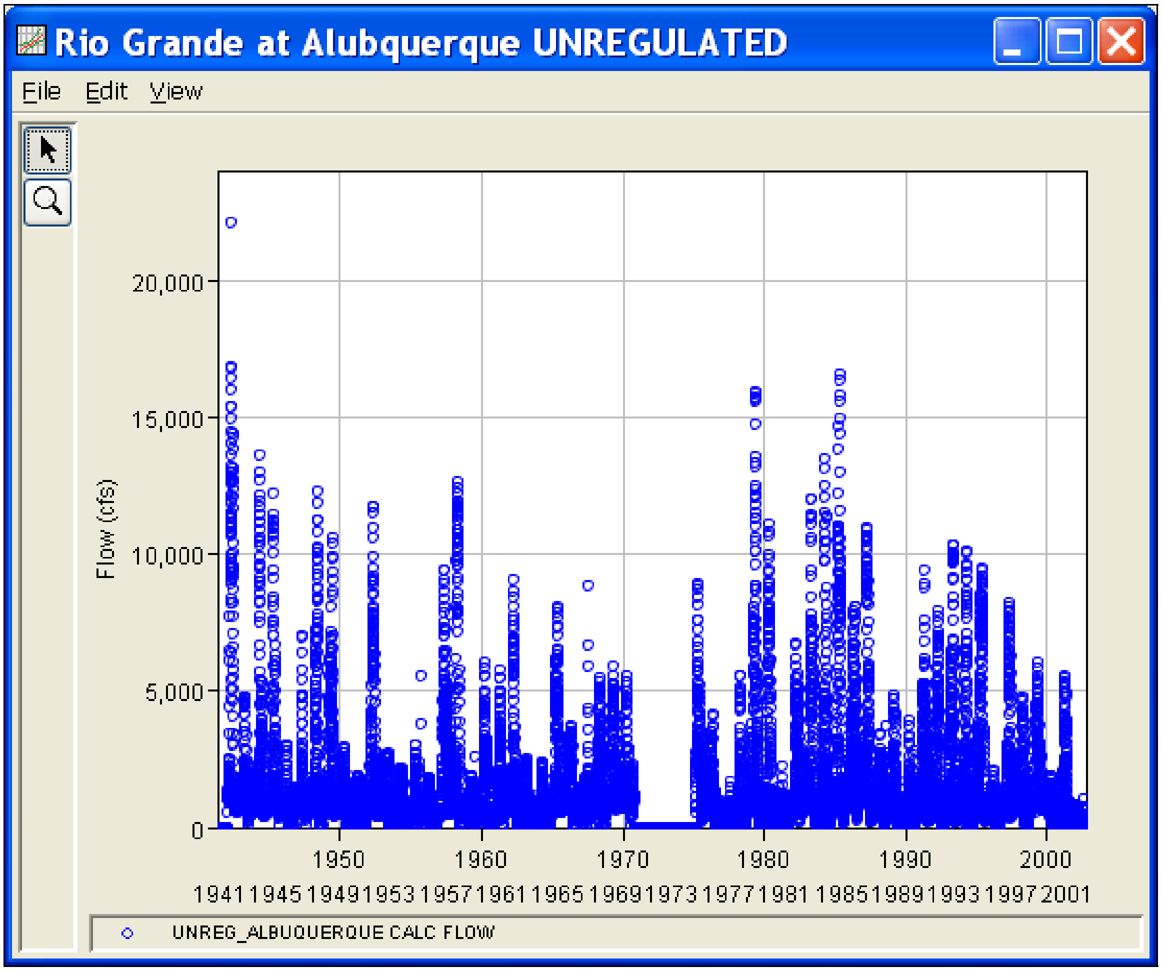


Figure B-69. Plot of Daily Average Flow for Example 10.

A Volume-Duration Frequency analysis has been developed for this example. To open the Volume-Duration Frequency analysis editor for test example 10, either double-click on the analysis labeled **RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10** from the study explorer, or from the **Analysis** menu select open, then select **RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW**

TEST 10 from the list of available analyses. When test 10 is opened, the Volume-Duration Frequency analysis editor will appear as shown in Figure B-70.

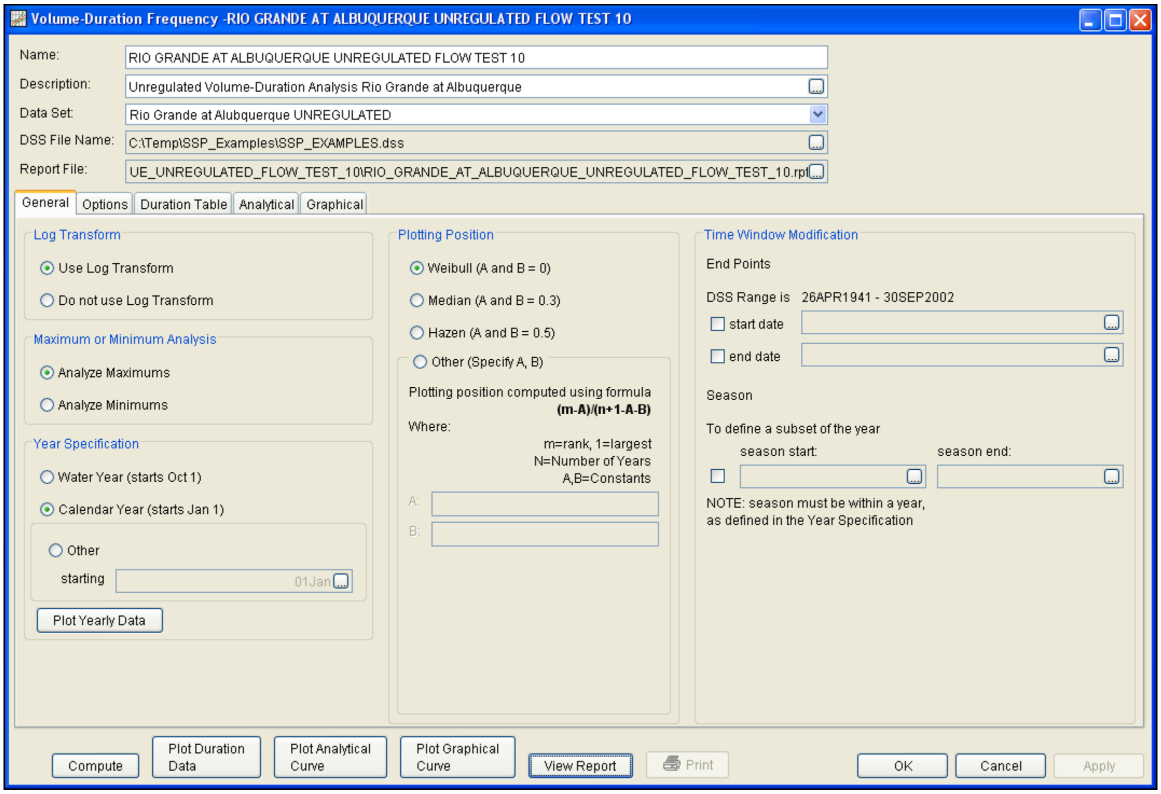


Figure B-70. Volume-Duration Frequency Analysis Editor for Test Example 10.

Shown in Figure B-70 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, **Analyze Maximums** was selected, the **Calendar Year** option was selected, and no modification was made to the **Time Window**.

Shown in Figure B-71 is the Volume-Duration Frequency analysis editor with the **Options Tab** selected. Features on this tab include an option to override the default **Flow-duration** values, an option to override the default **Frequency Ordinates**, and **Output Labeling**. Both the flow-duration and frequency ordinate tables were modified.

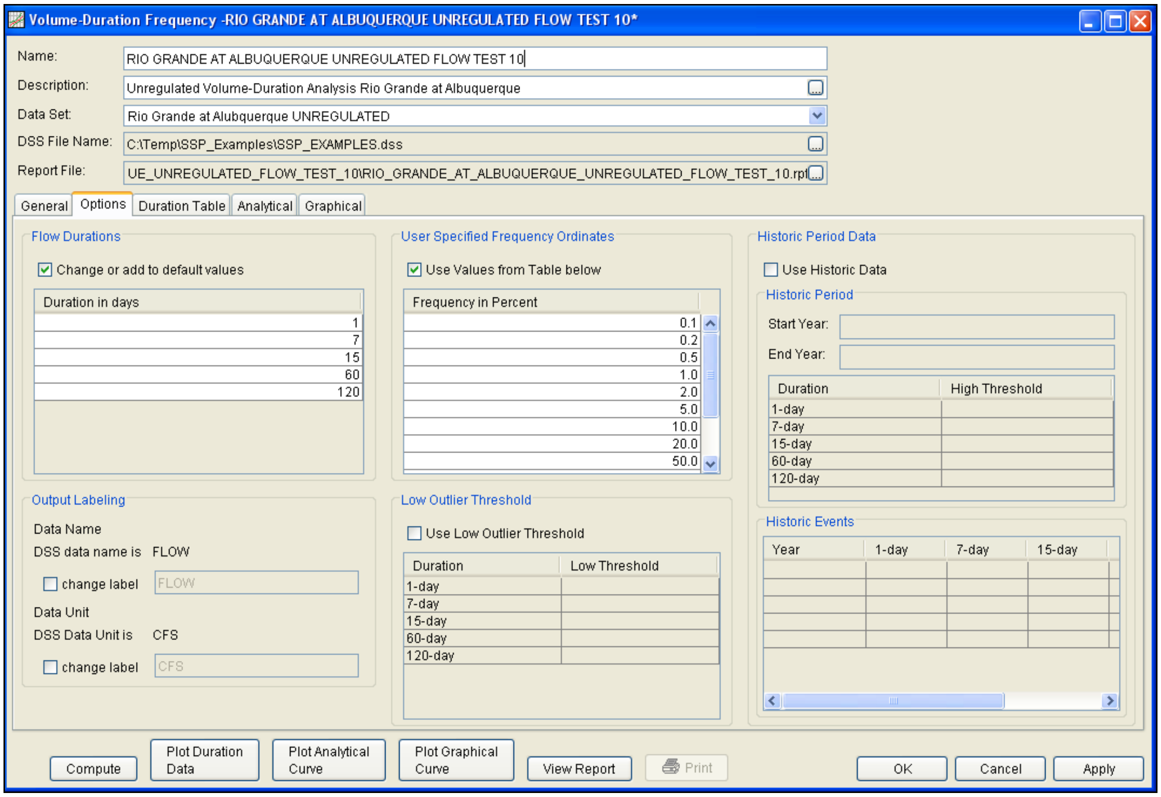
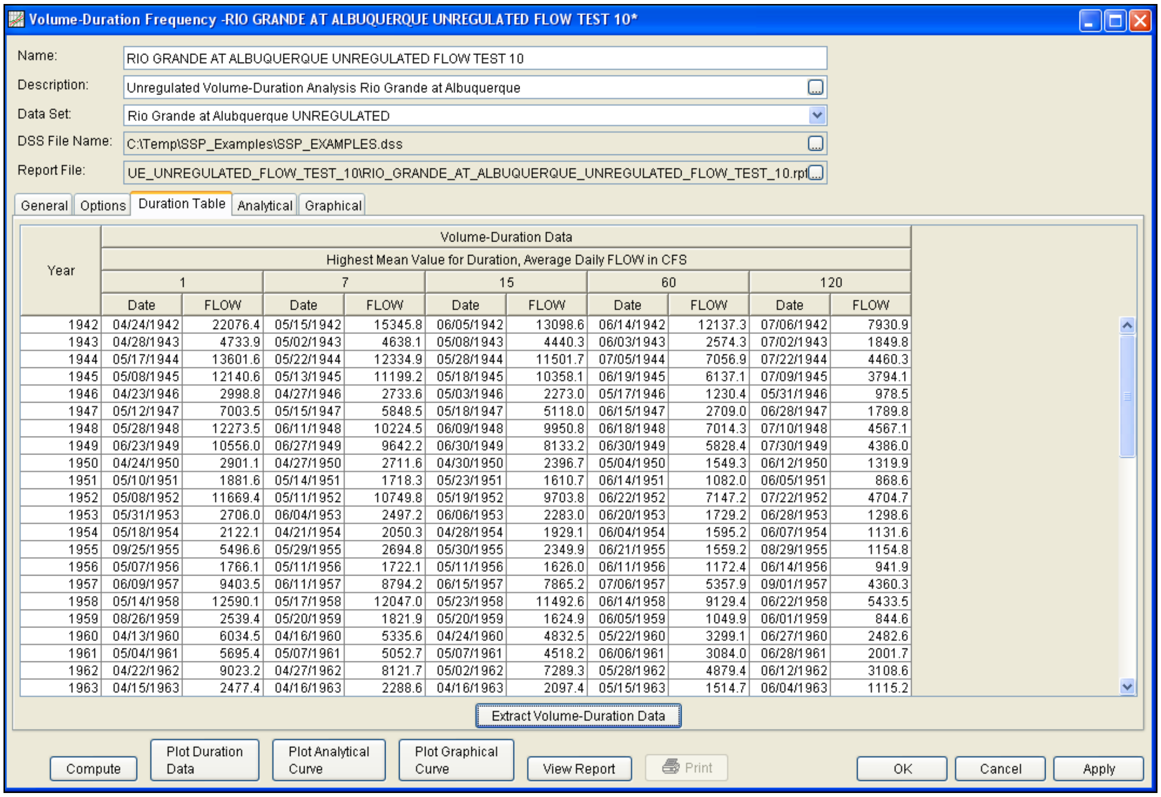


Figure B-71. Options Tab Shown for Test Example 10.

Once all of the General and Optional settings are set or selected, the user can extract the volume-duration data from the time-series of daily flows. Select the **Duration Data** tab and press the **Extract Volume-Duration Data** button at the bottom of the table. The table should then fill with the flow-duration values, as shown in Figure B-72.



Year	Volume-Duration Data									
	Highest Mean Value for Duration, Average Daily FLOW in CFS									
	1		7		15		60		120	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1942	04/24/1942	22076.4	05/15/1942	15345.8	06/05/1942	13098.6	06/14/1942	12137.3	07/06/1942	7930.9
1943	04/28/1943	4733.9	05/02/1943	4638.1	05/08/1943	4440.3	06/03/1943	2574.3	07/02/1943	1849.8
1944	05/17/1944	13601.6	05/22/1944	12334.9	05/28/1944	11501.7	07/05/1944	7056.9	07/22/1944	4460.3
1945	05/08/1945	12140.6	05/13/1945	11199.2	05/18/1945	10358.1	06/19/1945	6137.1	07/09/1945	3794.1
1946	04/23/1946	2998.8	04/27/1946	2733.6	05/03/1946	2273.0	05/17/1946	1230.4	05/31/1946	978.5
1947	05/12/1947	7003.5	05/15/1947	5848.5	05/18/1947	5118.0	06/15/1947	2709.0	06/28/1947	1789.8
1948	05/28/1948	12273.5	06/11/1948	10224.5	06/09/1948	9950.8	06/18/1948	7014.3	07/10/1948	4567.1
1949	06/23/1949	10556.0	06/27/1949	9642.2	06/30/1949	8133.2	06/30/1949	5828.4	07/30/1949	4386.0
1950	04/24/1950	2901.1	04/27/1950	2711.6	04/30/1950	2396.7	05/04/1950	1549.3	06/12/1950	1319.9
1951	05/10/1951	1881.6	05/14/1951	1718.3	05/23/1951	1610.7	06/14/1951	1082.0	06/05/1951	868.6
1952	05/08/1952	11669.4	05/11/1952	10749.8	05/19/1952	9703.8	06/22/1952	7147.2	07/22/1952	4704.7
1953	05/31/1953	2706.0	06/04/1953	2497.2	06/06/1953	2283.0	06/20/1953	1729.2	06/28/1953	1298.6
1954	05/18/1954	2122.1	04/21/1954	2050.3	04/28/1954	1929.1	06/04/1954	1595.2	06/07/1954	1131.6
1955	09/25/1955	5496.6	05/29/1955	2694.8	05/30/1955	2349.9	06/21/1955	1559.2	08/29/1955	1154.8
1956	05/07/1956	1766.1	05/11/1956	1722.1	05/11/1956	1626.0	06/11/1956	1172.4	06/14/1956	941.9
1957	06/09/1957	9403.5	06/11/1957	8794.2	06/15/1957	7865.2	07/06/1957	5357.9	09/01/1957	4360.3
1958	05/14/1958	12590.1	05/17/1958	12047.0	05/23/1958	11492.6	06/14/1958	9129.4	06/22/1958	5433.5
1959	08/26/1959	2539.4	05/20/1959	1821.9	05/20/1959	1624.9	06/05/1959	1049.9	06/01/1959	844.6
1960	04/13/1960	6034.5	04/16/1960	5335.6	04/24/1960	4832.5	05/22/1960	3299.1	06/27/1960	2482.6
1961	05/04/1961	5695.4	05/07/1961	5052.7	05/07/1961	4518.2	06/06/1961	3084.0	06/28/1961	2001.7
1962	04/22/1962	9023.2	04/27/1962	8121.7	05/02/1962	7289.3	05/28/1962	4879.4	06/12/1962	3108.6
1963	04/15/1963	2477.4	04/16/1963	2288.6	04/16/1963	2097.4	05/15/1963	1514.7	06/04/1963	1115.2

Figure B-72. Volume-Duration Data Table for Test Example 10.

Once the data has been extracted, the user must choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-73 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

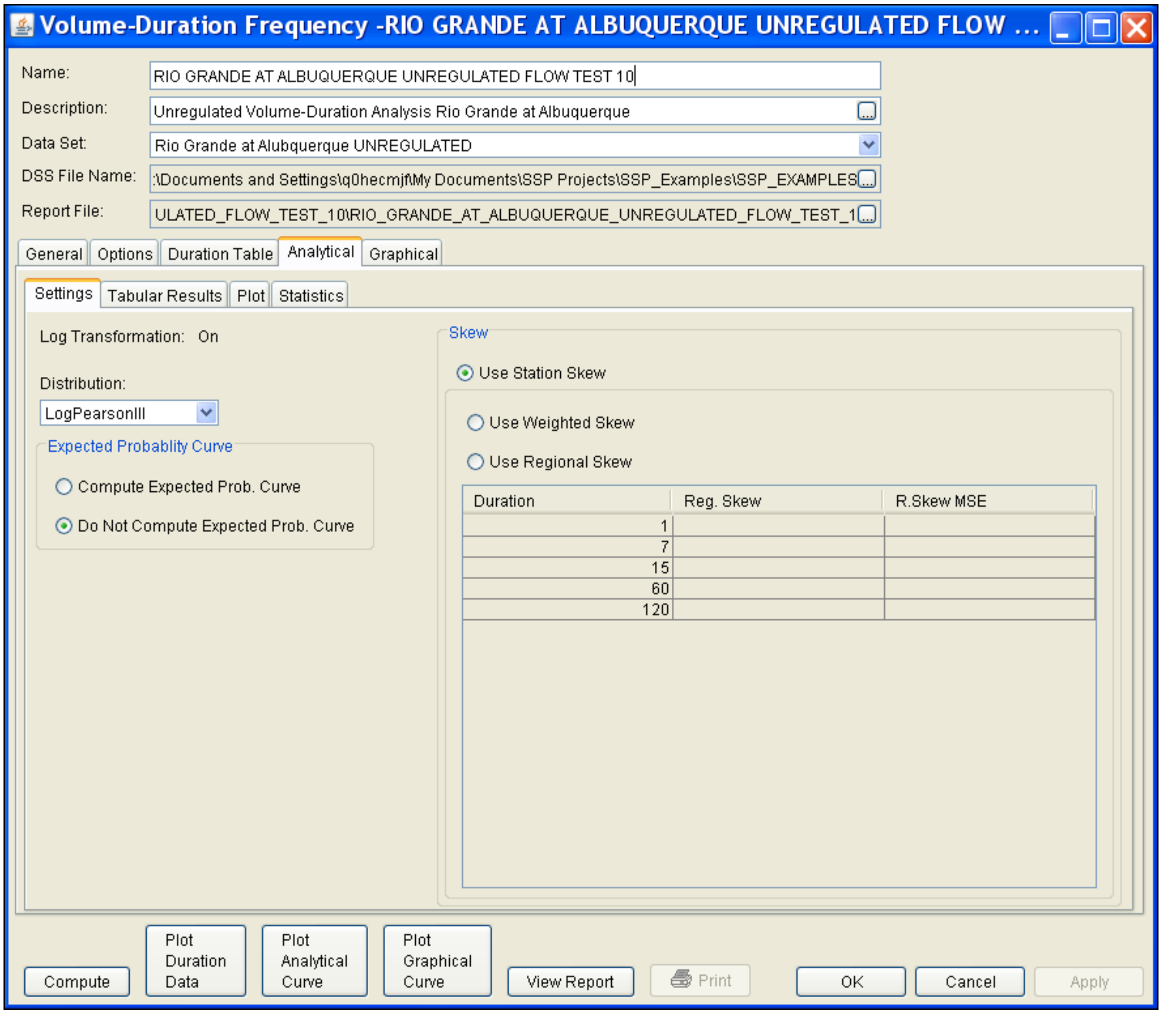
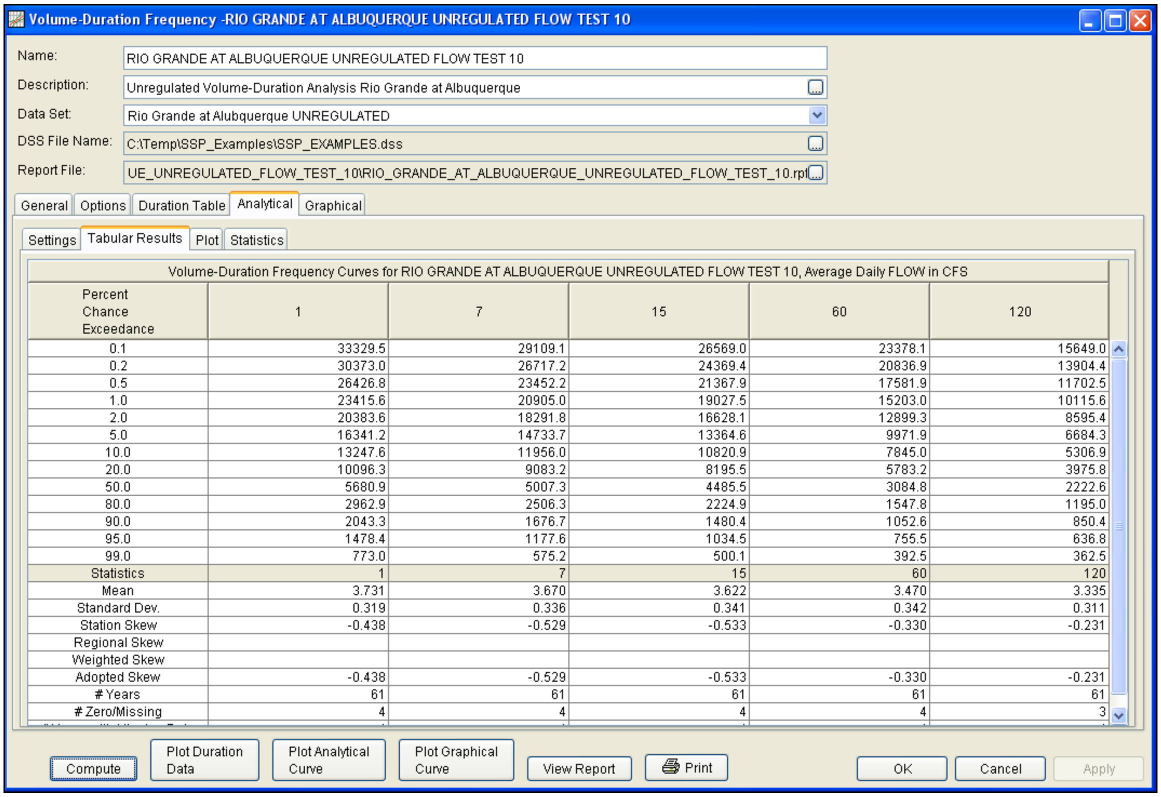


Figure B-73. Settings Tab Shown for Test Example 10.

Press the **Compute** button to perform the analysis. A message window will open stating that a few of the annual maximums occurred during the beginning of the year. The message suggests that the user change the year/season specification to capture independent events. You want to minimize the possibility that the same flood event is used for consecutive years. Press the OK button to finish the compute. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab within the analytical analysis. The results table should look Figure B-74. The top portion of the results table contains the percent chance exceedance for all durations (the report contains confidence limits). The bottom portion of the results table contains the statistics for all duration.



Percent Chance Exceedance	1	7	15	60	120
0.1	33329.5	29109.1	26569.0	23378.1	15649.0
0.2	30373.0	26717.2	24369.4	20836.9	13904.4
0.5	26426.8	23452.2	21367.9	17581.9	11702.5
1.0	23415.6	20905.0	19027.5	15203.0	10115.6
2.0	20383.6	18291.8	16628.1	12899.3	8595.4
5.0	16341.2	14733.7	13364.6	9971.9	6684.3
10.0	13247.6	11956.0	10820.9	7845.0	5306.9
20.0	10096.3	9083.2	8195.5	5783.2	3975.8
50.0	5680.9	5007.3	4485.5	3084.8	2222.6
80.0	2962.9	2506.3	2224.9	1547.8	1195.0
90.0	2043.3	1676.7	1480.4	1052.6	850.4
95.0	1478.4	1177.6	1034.5	755.5	636.8
99.0	773.0	575.2	500.1	392.5	362.5
Statistics	1	7	15	60	120
Mean	3.731	3.670	3.622	3.470	3.335
Standard Dev.	0.319	0.336	0.341	0.342	0.311
Station Skew	-0.438	-0.529	-0.533	-0.330	-0.231
Regional Skew					
Weighted Skew					
Adopted Skew	-0.438	-0.529	-0.533	-0.330	-0.231
# Years	61	61	61	61	61
# Zero/Missing	4	4	4	4	3

Figure B-74. Tabular Results Tab for Test Example 10.

As shown in Figure B-75, the **Plot** tab contains a graph of the systematic data and the computed frequency curves. Notice how some of the frequency curves look like they might cross if the lines were extended. The **Statistics** tab can be used to modify the computed statistics to ensure that the frequency curves are consistent.

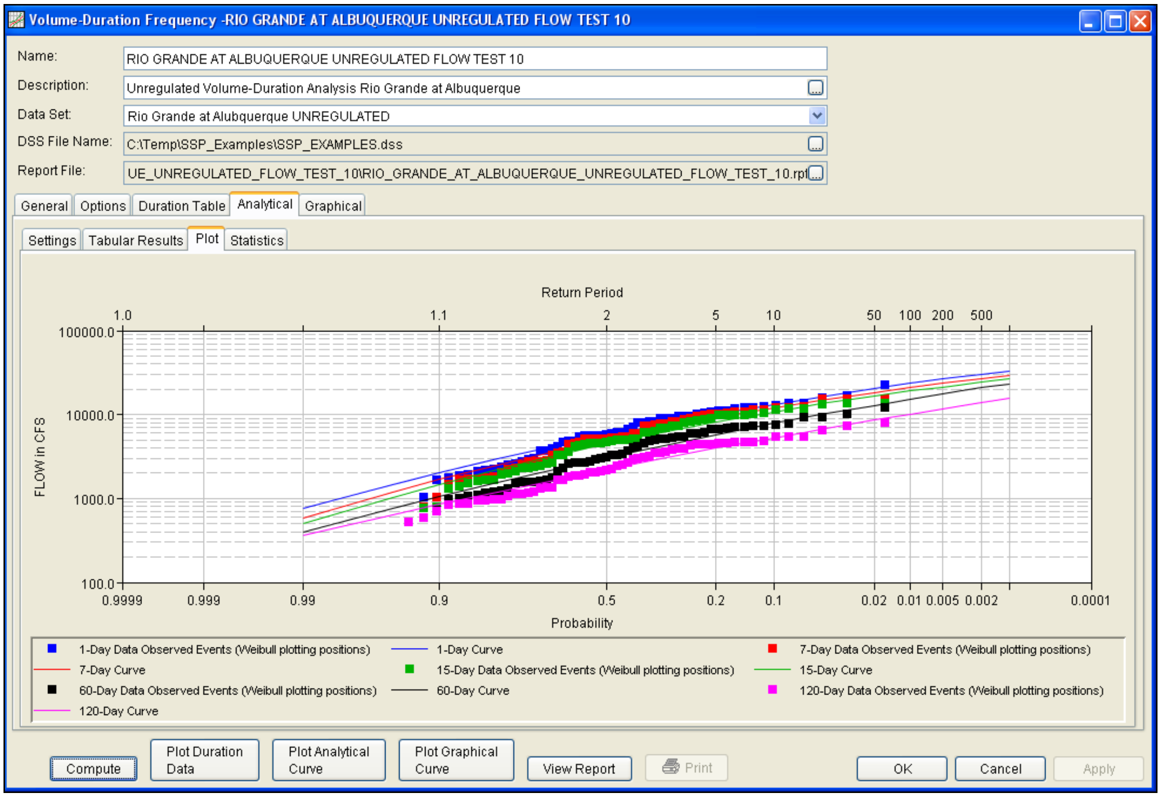


Figure B-75. Plot Tab for Example 10.

For this example, the standard deviation and the adopted skew values were modified to make sure the volume-duration frequency curves were consistent. As shown in Figure B-76, the check boxes next to mean, standard deviation, and adopted skew were checked and then user-adjusted statistics were entered into the table for all durations. The **Compute** button must be pressed after adjusted statistics have been entered in order for the program to recompute the frequency curves using the user-adjusted statistics. Figure B-77 shows the **Plot** tab after the user-adjusted statistics were entered on the **Statistics** tab. Results on the **Tabular Results** tab will also update when user-adjusted statistics are entered on the **Statistics** tab.

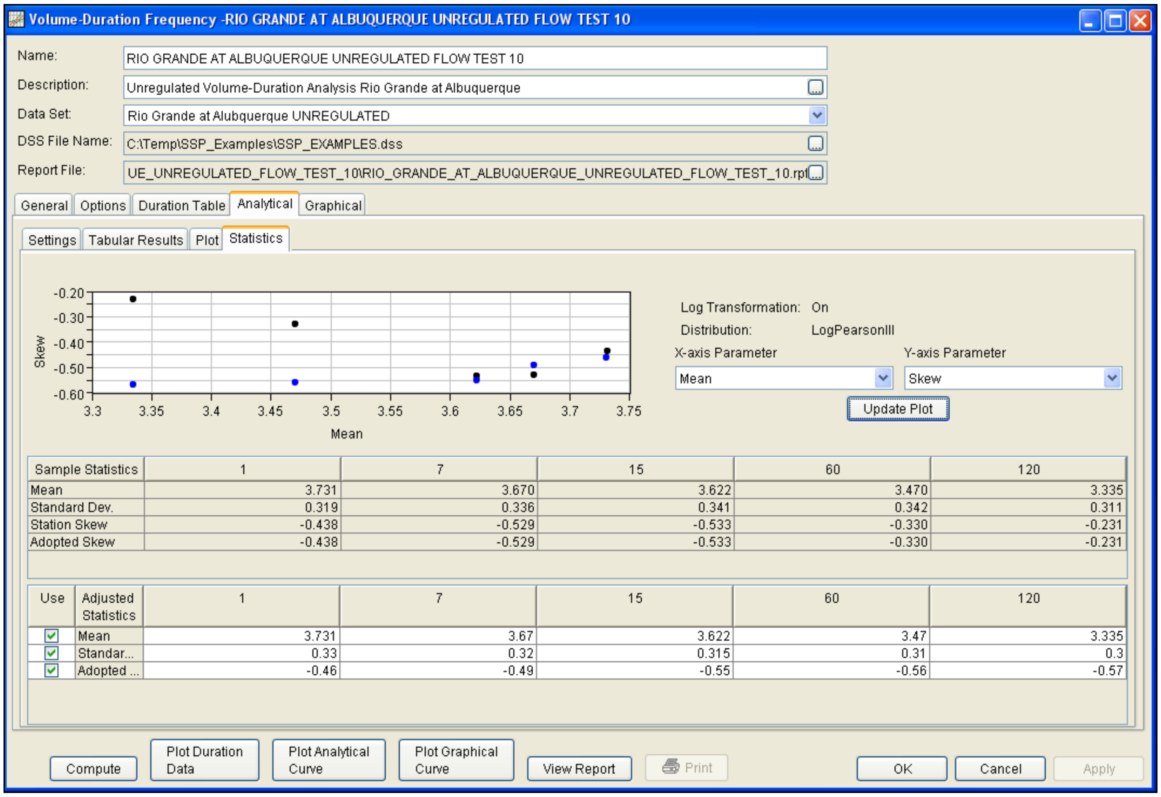


Figure B-76. Statistics Tab for Test Example 10.

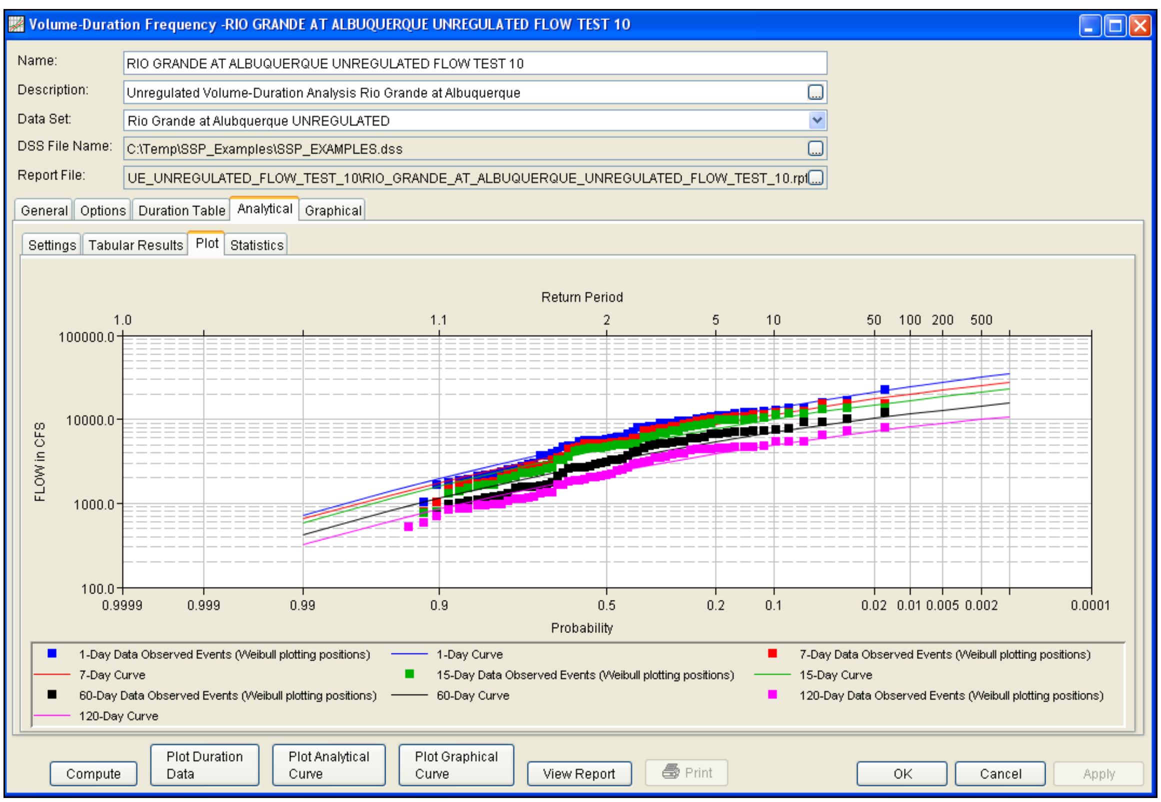


Figure B-77. Plot Tab for Example 10 After the Statistics were Adjusted on the Statistics Tab.

In addition to the Tabular Results and Plot tabs, graphical plots can be opened by selecting the **Plot Duration Data** or **Plot Analytical Curve** buttons at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-78.

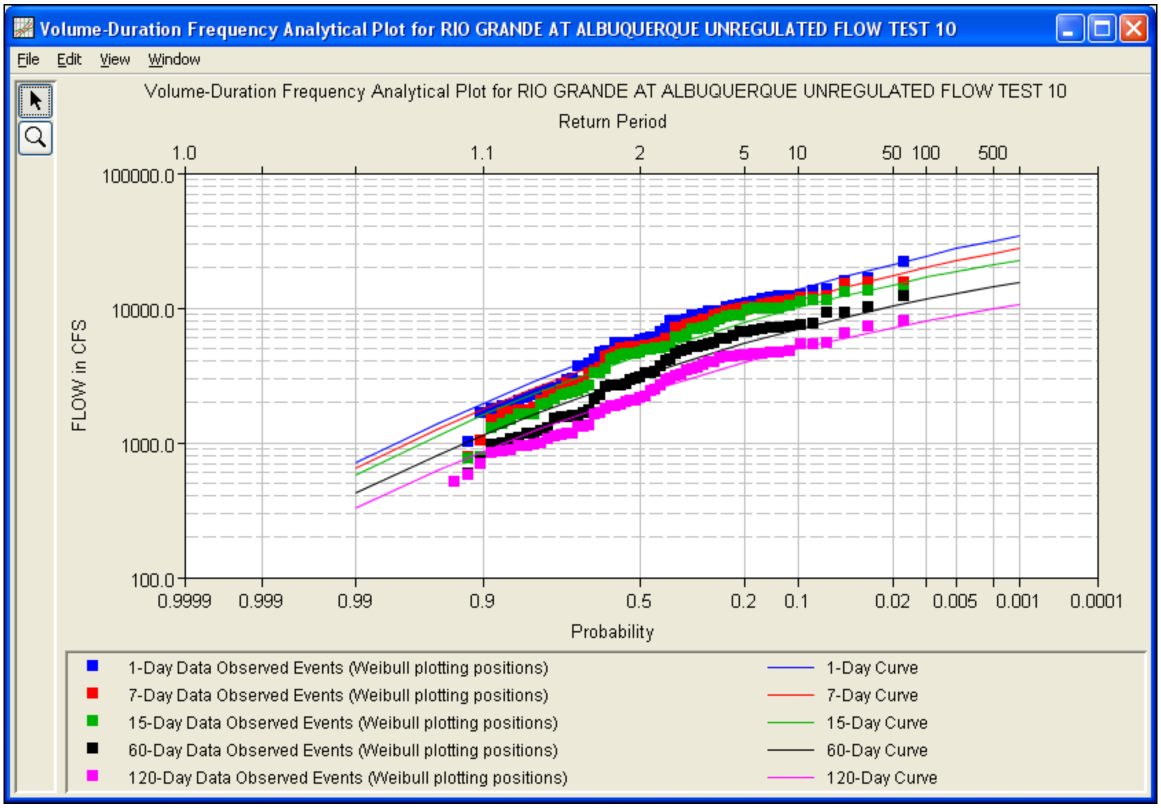
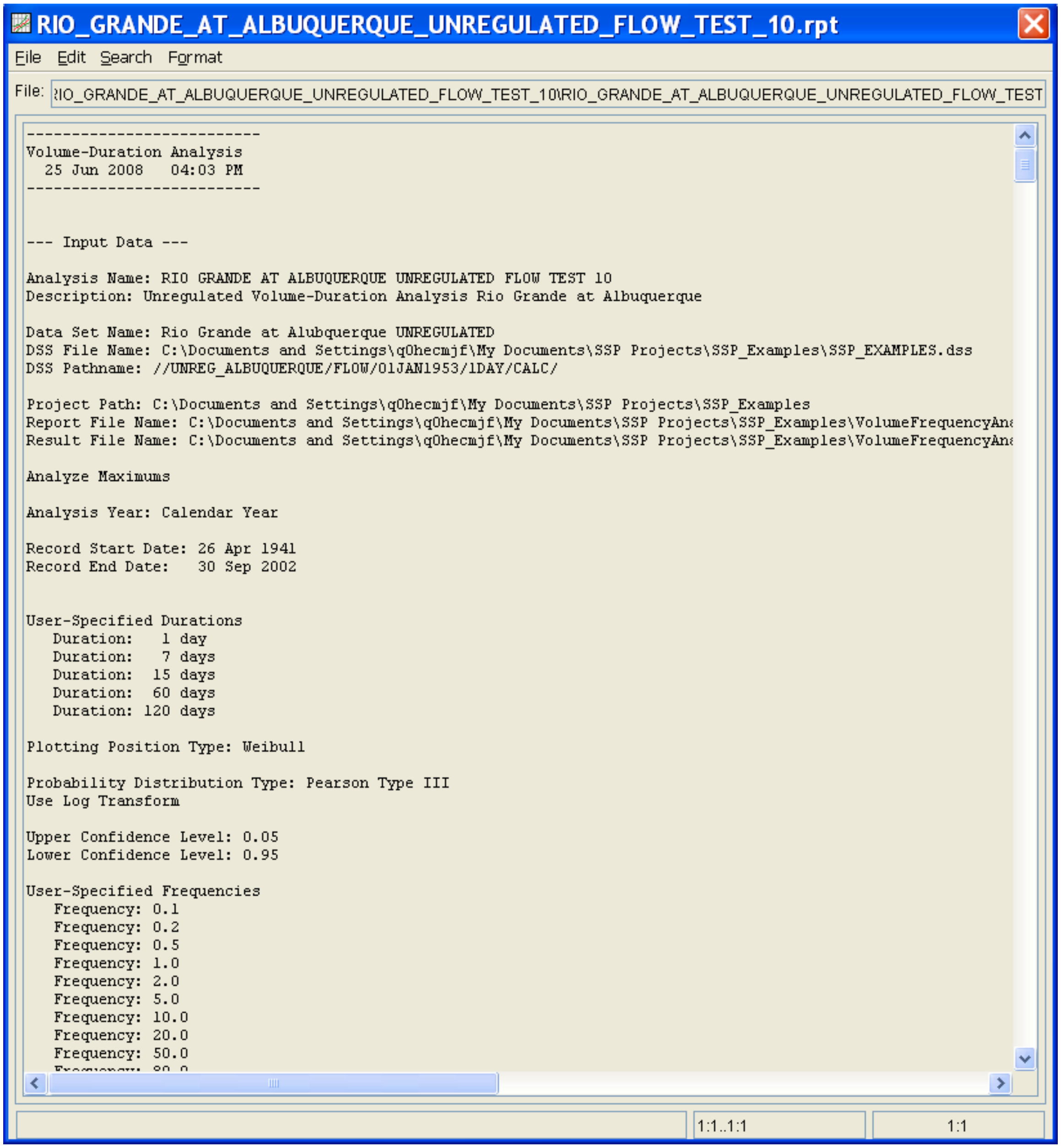


Figure B-78. Plot of the Frequency Curve Results for Test Example 10.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-79 is the report file for Test Example 10.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



```
RIO_GRANDE_AT_ALBUQUERQUE_UNREGULATED_FLOW_TEST_10.rpt
File  Edit  Search  Format
File: RIO_GRANDE_AT_ALBUQUERQUE_UNREGULATED_FLOW_TEST_10\RIO_GRANDE_AT_ALBUQUERQUE_UNREGULATED_FLOW_TEST

--------------------------
Volume-Duration Analysis
  25 Jun 2008   04:03 PM
--------------------------


--- Input Data ---

Analysis Name: RIO GRANDE AT ALBUQUERQUE UNREGULATED FLOW TEST 10
Description: Unregulated Volume-Duration Analysis Rio Grande at Albuquerque

Data Set Name: Rio Grande at Alubquerque UNREGULATED
DSS File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\SSP_EXAMPLES.dss
DSS Pathname: //UNREG_ALBUQUERQUE/FLOW/01JAN1953/1DAY/CALC/

Project Path: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples
Report File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\VolumeFrequencyAna
Result File Name: C:\Documents and Settings\q0hecmjf\My Documents\SSP Projects\SSP_Examples\VolumeFrequencyAna

Analyze Maximums

Analysis Year: Calendar Year

Record Start Date: 26 Apr 1941
Record End Date:   30 Sep 2002


User-Specified Durations
   Duration:   1 day
   Duration:   7 days
   Duration:  15 days
   Duration:  60 days
   Duration: 120 days

Plotting Position Type: Weibull

Probability Distribution Type: Pearson Type III
Use Log Transform

Upper Confidence Level: 0.05
Lower Confidence Level: 0.95

User-Specified Frequencies
   Frequency: 0.1
   Frequency: 0.2
   Frequency: 0.5
   Frequency: 1.0
   Frequency: 2.0
   Frequency: 5.0
   Frequency: 10.0
   Frequency: 20.0
   Frequency: 50.0

1:1..1:1        1:1
```

Figure B-79. Report File for Test Example 10.

Example 11: Volume-Duration Frequency Analysis, Minimum Flows

This example demonstrates how to create a low flow Volume-Duration Frequency analysis. The data for this example was downloaded from the USGS. It is comprised of daily average flow for the Chattahoochee River at Cornelia, Georgia. Drought conditions were occurring in the region at the time of this analysis. Among other things, a low flow analysis can be used to determine the severity of a drought. The period of record for this example is from 1957 to 2007. To view the data, right-click on the data record labeled "**CHATTAHOOCHEE RIVER-CORNELIA, GA-FLOW**" in the study explorer and then select **Plot**. The data will appear as shown in Figure B-80.

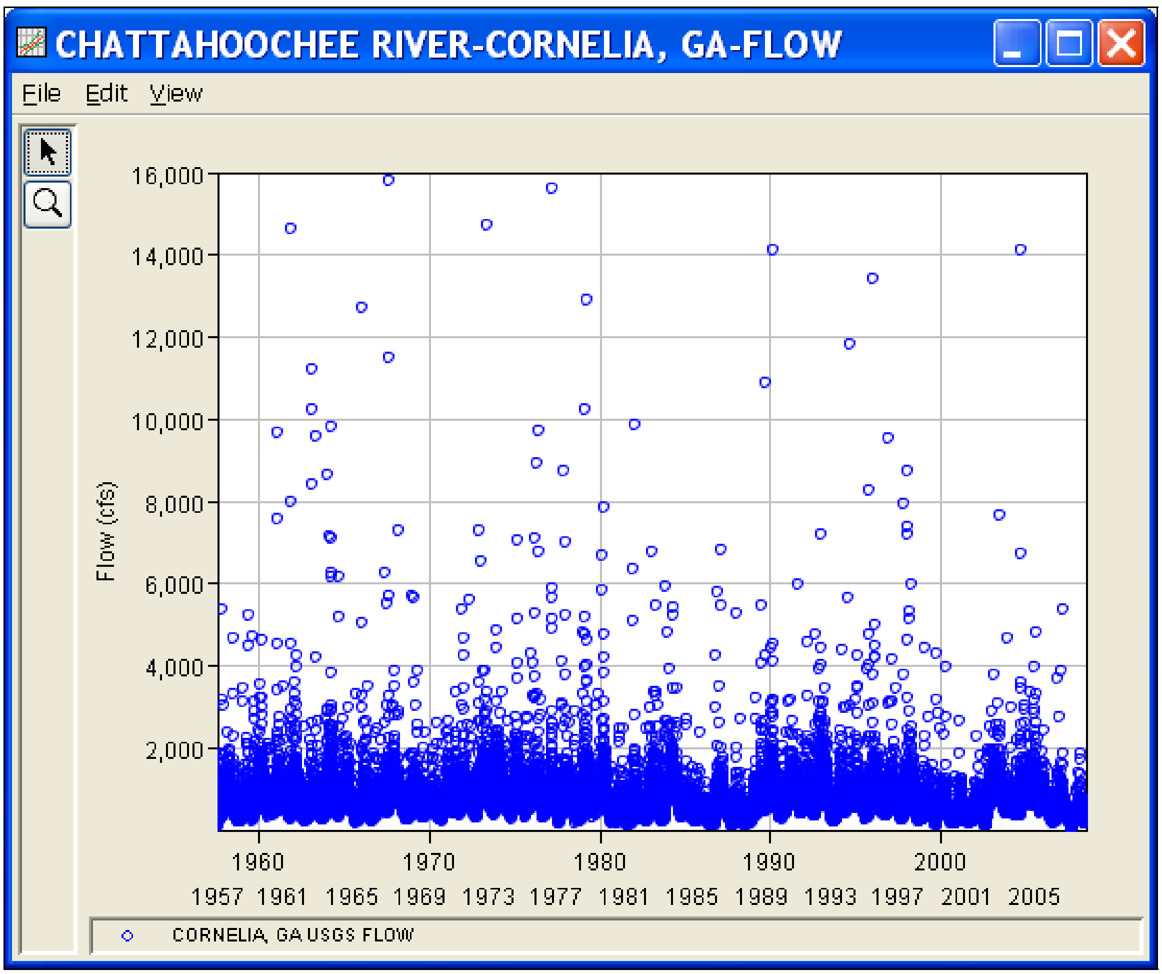


Figure B-80. Plot of Daily Average Flow for Example 11.

A Volume-Duration Frequency analysis has been developed for this example. To open the Volume-Duration Frequency analysis editor for test example 11, either double-click on the analysis labeled **LOW FLOW VOLUME-DURATION ANALYSIS TEST 11** from the study explorer, or from the **Analysis** menu select open, then select **LOW FLOW VOLUME-DURATION ANALYSIS TEST 11** from the list of available analyses. When test 11 is opened, the Volume-Duration Frequency analysis editor will appear as shown in Figure B-81.

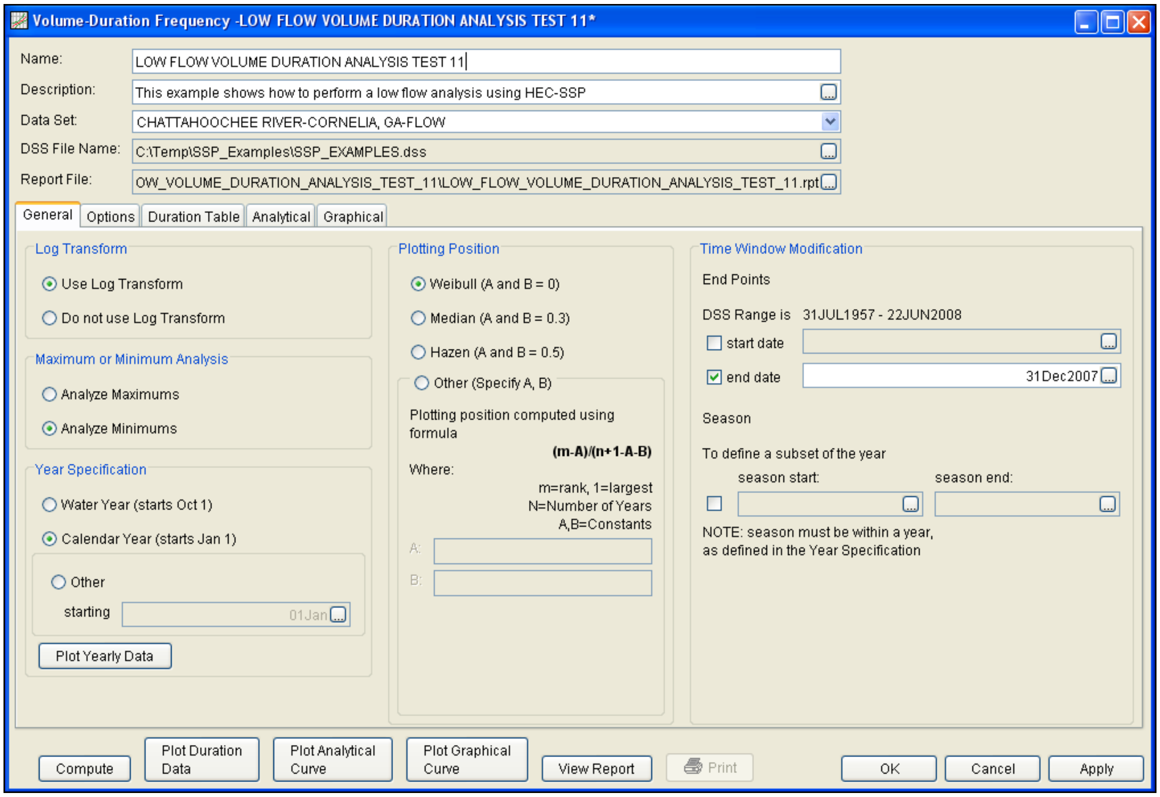


Figure B-81. Volume-Duration Frequency Analysis Editor for Test Example 11.

Shown in Figure B-81 are the general settings that were used to perform this frequency analysis. For this analysis, the **Use Log Transform** option was selected, the **Weibull** plotting position method was selected, **Analyze Minimums** was selected, and the **Calendar Year** option was selected. The Calendar Year option was selected because low flows are possible in late September, early November. Starting the year on January 1 minimizes the possibility of using the same low flow event in multiple years. An end date of 31 December 2007 was entered in the **Time Window Modification**. This end date was specified because not all the data for the summer of 2008 was available at the time of the analysis.

Shown in Figure B-82 is the Volume-Duration Frequency analysis editor with the **Options Tab** selected. Features on this tab include an option to override the default **Flow-duration** values, an option to override the default **Frequency Ordinates**, and **Output Labeling**.

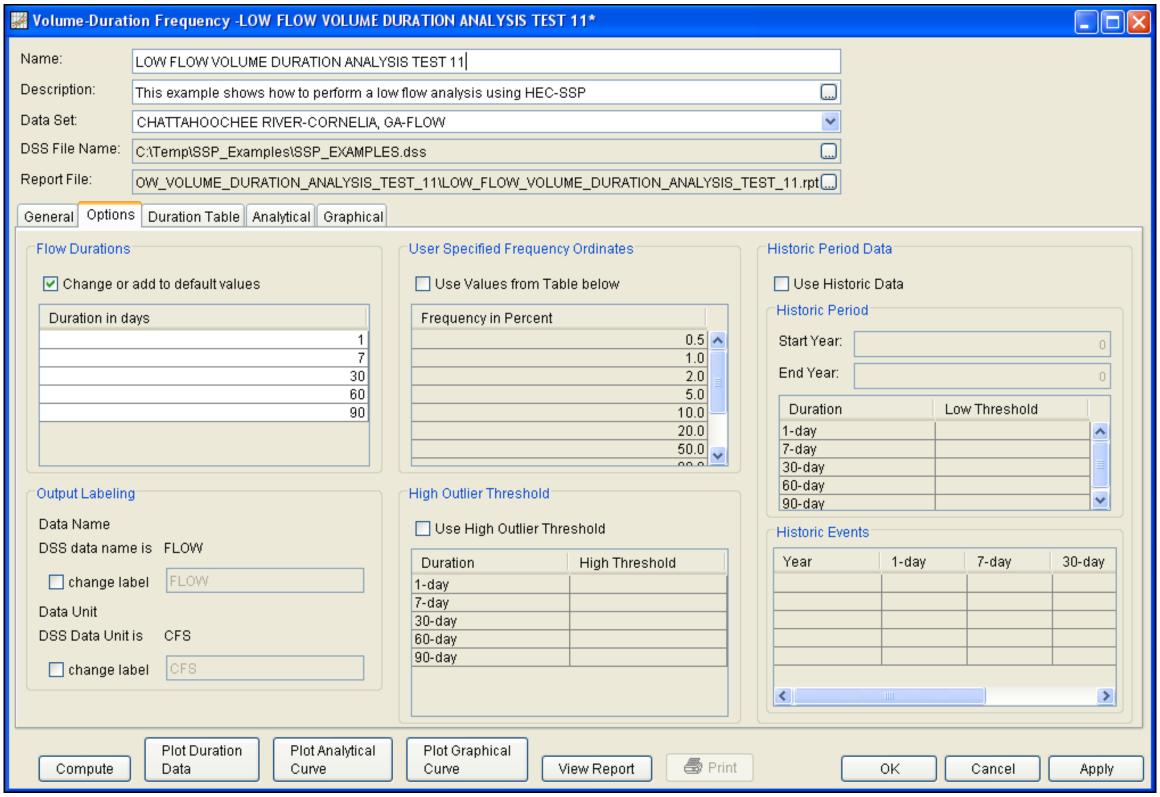
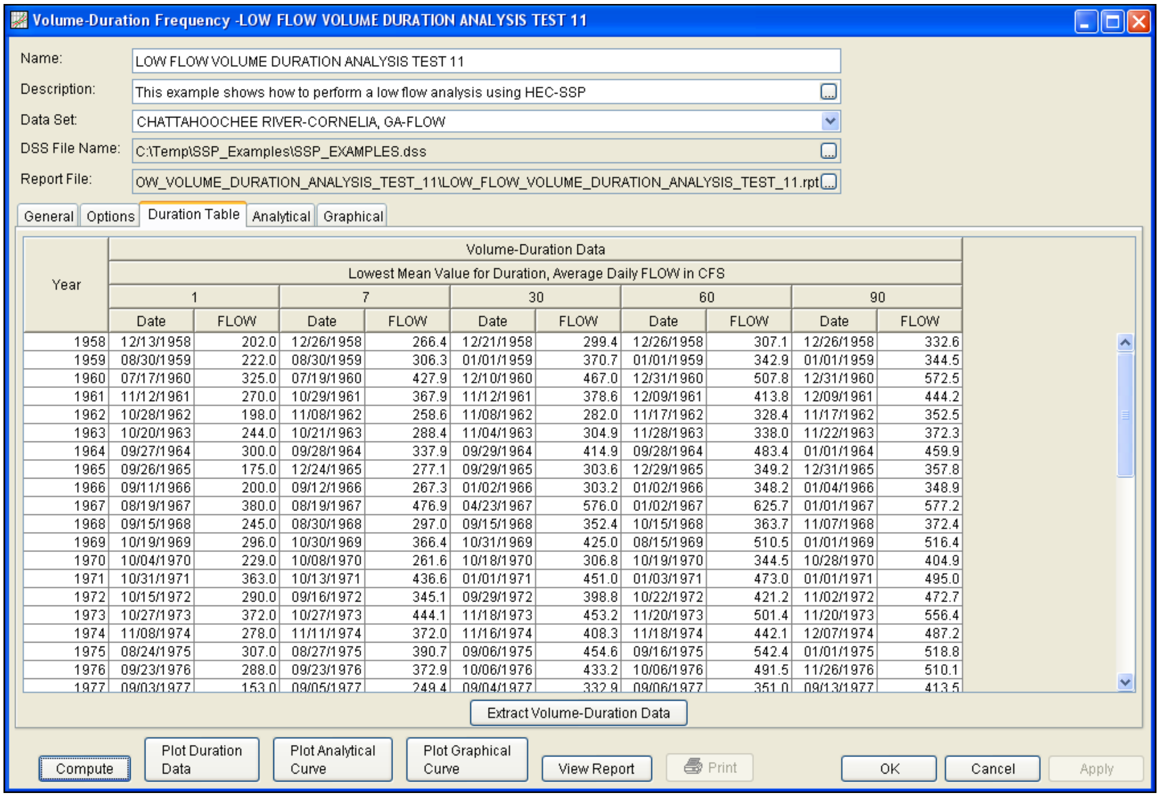


Figure B-82. Options Tab Shown for Test Example 11.

Once all of the General and Optional settings are set or selected, the user can extract the volume-duration data. Select the **Duration Data** tab and press the **Extract Volume-Duration Data** button at the bottom of the table. The table should then fill with the flow-duration values, as shown in Figure B-83.



Year	Volume-Duration Data									
	Lowest Mean Value for Duration, Average Daily FLOW in CFS									
	1		7		30		60		90	
	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW	Date	FLOW
1958	12/13/1958	202.0	12/26/1958	266.4	12/21/1958	299.4	12/26/1958	307.1	12/26/1958	332.6
1959	08/30/1959	222.0	08/30/1959	306.3	01/01/1959	370.7	01/01/1959	342.9	01/01/1959	344.5
1960	07/17/1960	325.0	07/19/1960	427.9	12/10/1960	467.0	12/31/1960	507.8	12/31/1960	572.5
1961	11/12/1961	270.0	10/29/1961	367.9	11/12/1961	378.6	12/09/1961	413.8	12/09/1961	444.2
1962	10/28/1962	198.0	11/08/1962	258.6	11/08/1962	282.0	11/17/1962	328.4	11/17/1962	352.5
1963	10/20/1963	244.0	10/21/1963	288.4	11/04/1963	304.9	11/28/1963	338.0	11/22/1963	372.3
1964	09/27/1964	300.0	09/28/1964	337.9	09/29/1964	414.9	09/28/1964	483.4	01/01/1964	459.9
1965	09/26/1965	175.0	12/24/1965	277.1	09/29/1965	303.6	12/29/1965	349.2	12/31/1965	357.8
1966	09/11/1966	200.0	09/12/1966	267.3	01/02/1966	303.2	01/02/1966	348.2	01/04/1966	348.9
1967	08/19/1967	380.0	08/19/1967	476.9	04/23/1967	576.0	01/02/1967	625.7	01/01/1967	577.2
1968	09/15/1968	245.0	08/30/1968	297.0	09/15/1968	352.4	10/15/1968	363.7	11/07/1968	372.4
1969	10/19/1969	296.0	10/30/1969	366.4	10/31/1969	425.0	08/15/1969	510.5	01/01/1969	516.4
1970	10/04/1970	229.0	10/08/1970	261.6	10/18/1970	306.8	10/19/1970	344.5	10/28/1970	404.9
1971	10/31/1971	363.0	10/13/1971	436.6	01/01/1971	451.0	01/03/1971	473.0	01/01/1971	495.0
1972	10/15/1972	290.0	09/16/1972	345.1	09/29/1972	398.8	10/22/1972	421.2	11/02/1972	472.7
1973	10/27/1973	372.0	10/27/1973	444.1	11/18/1973	453.2	11/20/1973	501.4	11/20/1973	556.4
1974	11/08/1974	278.0	11/11/1974	372.0	11/16/1974	408.3	11/18/1974	442.1	12/07/1974	487.2
1975	08/24/1975	307.0	08/27/1975	390.7	09/06/1975	454.6	09/16/1975	542.4	01/01/1975	518.8
1976	09/23/1976	288.0	09/23/1976	372.9	10/06/1976	433.2	10/06/1976	491.5	11/26/1976	510.1
1977	09/03/1977	153.0	09/05/1977	249.4	09/04/1977	332.9	09/06/1977	351.0	09/13/1977	413.5

Figure B-83. Volume-Duration Data Table for Example 11.

Once the data has been extracted, the user must choose to perform an Analytical or Graphical analysis. In this example, an analytical analysis was performed. Shown in Figure B-84 is the **Settings** tab for the analytical analysis. As shown, the distribution selected for this example is LogPearsonIII. The **Skew** option was set to **Use Station Skew** and the **Do Not Compute Excepted Probability** option was selected.

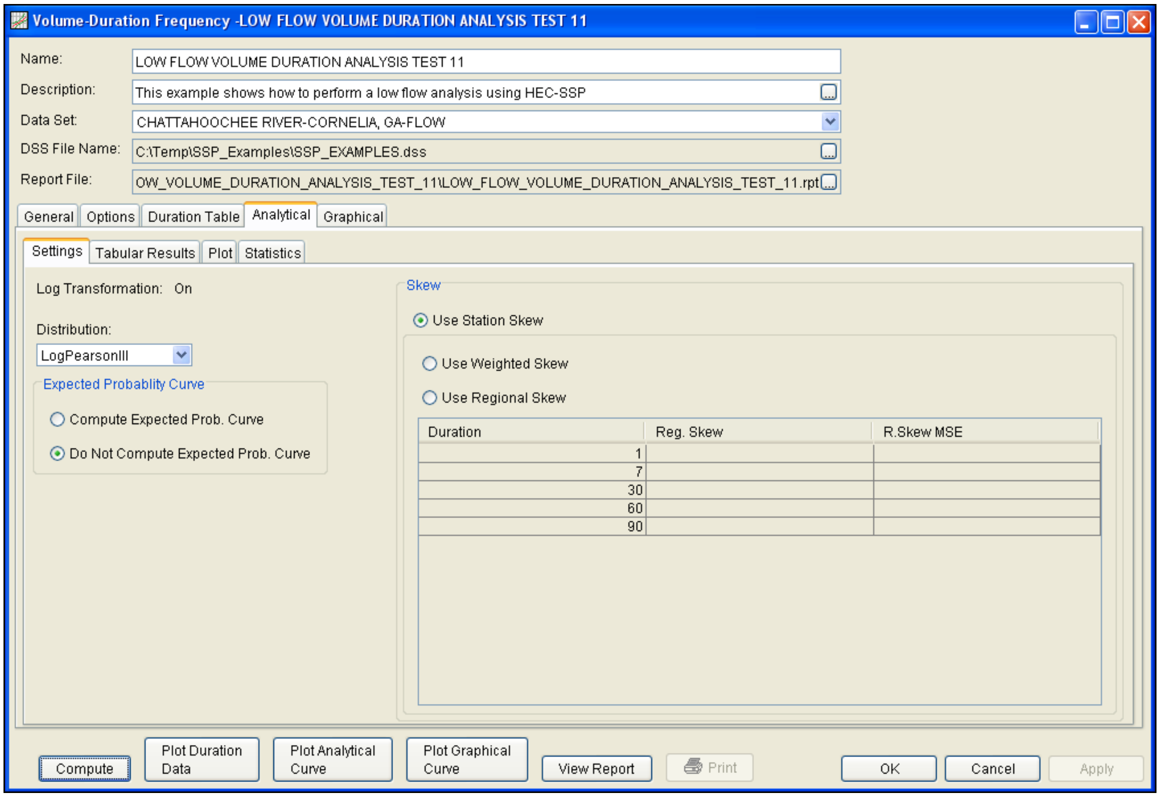
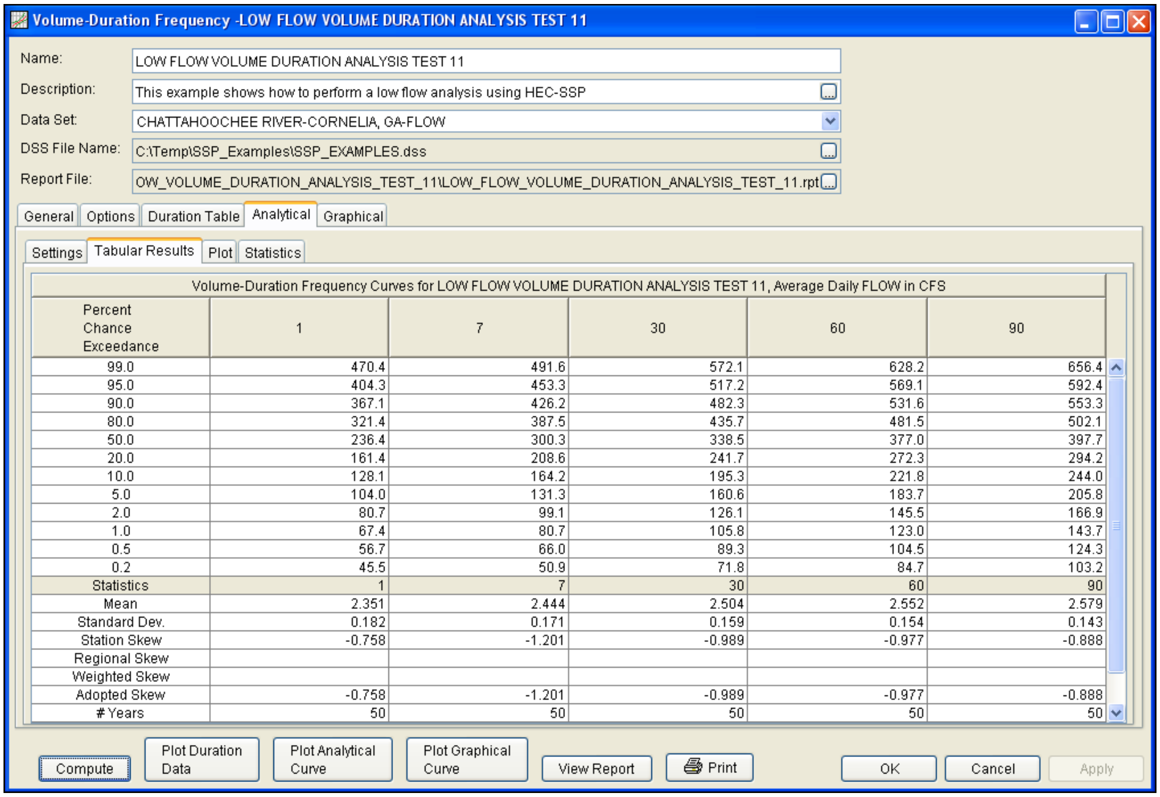


Figure B-84. Settings Tab Shown for Test Example 11.

Press the **Compute** button to perform the analysis. A message window will open stating that a few of the annual maximums occurred during the beginning of the year. The message suggests that the user change the year/season specification to capture independent events. You want to minimize the possibility that the same flood event is used for consecutive years. Press the OK button to finish the compute. Once the computations have been completed, a message window will open stating **Compute Complete.** Close this window and then select the **Tabular Results** tab within the analytical analysis. The results table should look Figure B-85. The top portion of the results table contains the percent chance exceedance for all durations (the report contains confidence limits). The bottom portion of the results table contains the statistics for all duration.



Volume-Duration Frequency Curves for LOW FLOW VOLUME DURATION ANALYSIS TEST 11, Average Daily FLOW in CFS

Percent Chance Exceedance	1	7	30	60	90
99.0	470.4	491.6	572.1	628.2	656.4
95.0	404.3	453.3	517.2	569.1	592.4
90.0	367.1	426.2	482.3	531.6	553.3
80.0	321.4	387.5	435.7	481.5	502.1
50.0	236.4	300.3	338.5	377.0	397.7
20.0	161.4	208.6	241.7	272.3	294.2
10.0	128.1	164.2	195.3	221.8	244.0
5.0	104.0	131.3	160.6	183.7	205.8
2.0	80.7	99.1	126.1	145.5	166.9
1.0	67.4	80.7	105.8	123.0	143.7
0.5	56.7	66.0	89.3	104.5	124.3
0.2	45.5	50.9	71.8	84.7	103.2
Statistics	1	7	30	60	90
Mean	2.351	2.444	2.504	2.552	2.579
Standard Dev.	0.182	0.171	0.159	0.154	0.143
Station Skew	-0.758	-1.201	-0.989	-0.977	-0.888
Regional Skew					
Weighted Skew					
Adopted Skew	-0.758	-1.201	-0.989	-0.977	-0.888
# Years	50	50	50	50	50

Figure B-85. Tabular Results Tab for Test Example 11.

As shown in Figure B-86, the **Plot** contains a graph of the systematic data and the computed frequency curves. Notice how some of the frequency curves look like they might cross if the lines were extended. The **Statistics** tab can be used to modify the computed statistics to ensure that the frequency curves are consistent.

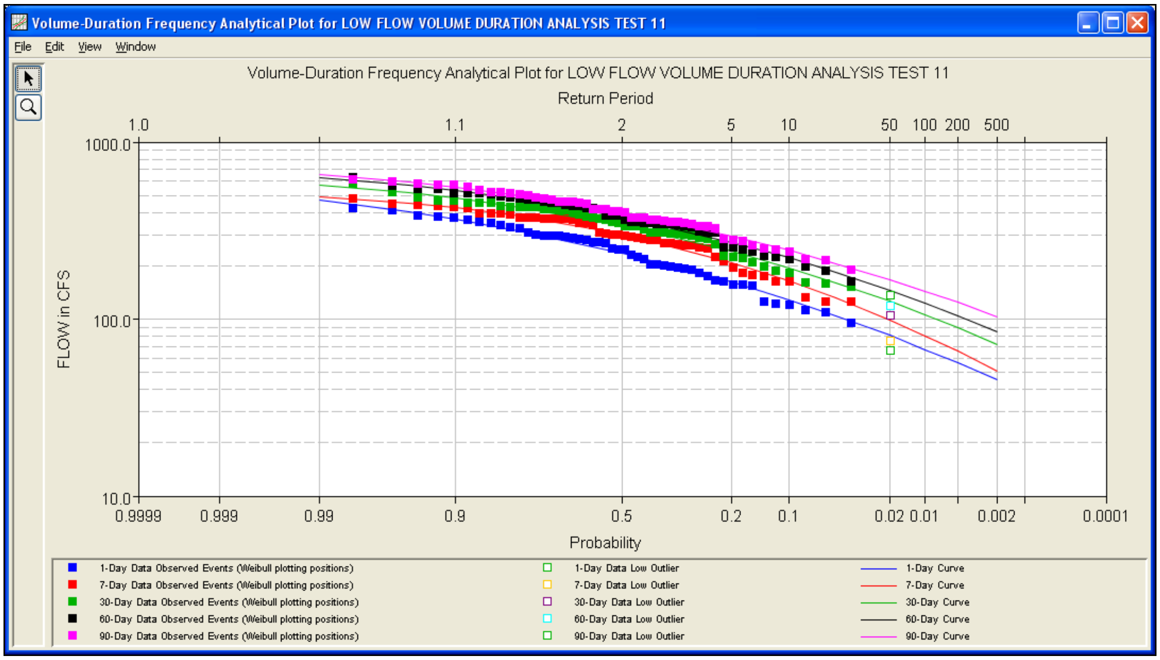


Figure B-86. Plot for Test Example 11.

For this example, the standard deviation and the adopted skew were modified to make sure the volume-duration frequency curves were consistent. As shown in Figure B-87, the check boxes next to mean, standard deviation, and adopted skew were checked and then user-adjusted statistics were entered into the table for all durations. The **Compute** button must be pressed after adjusted statistics have been entered in order for the program to recompute the frequency curves using the user-adjusted statistics. Figure B-88 shows the **Plot** tab after the user-adjusted statistics were entered on the **Statistics** tab. Results in the **Tabular Results** table will also update when user-adjusted statistics are entered on the **Statistics** tab.

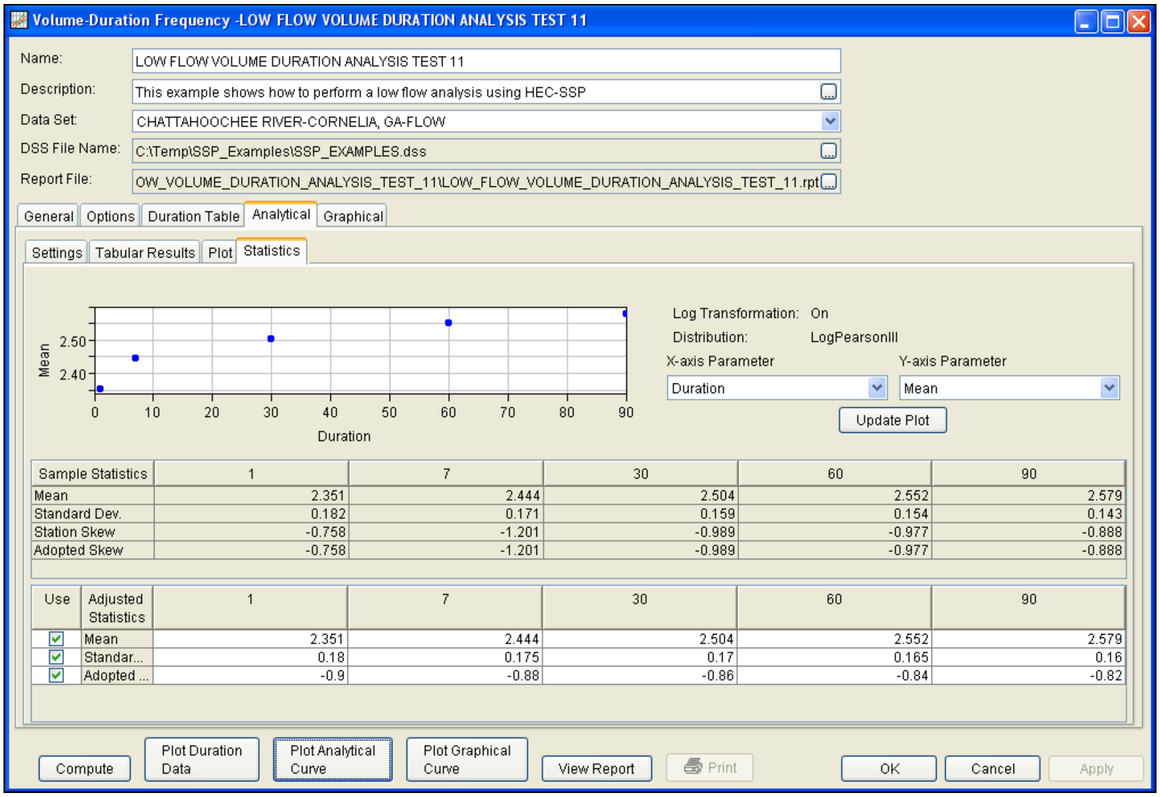


Figure B-87. Statistics Tab for Test Example 11.

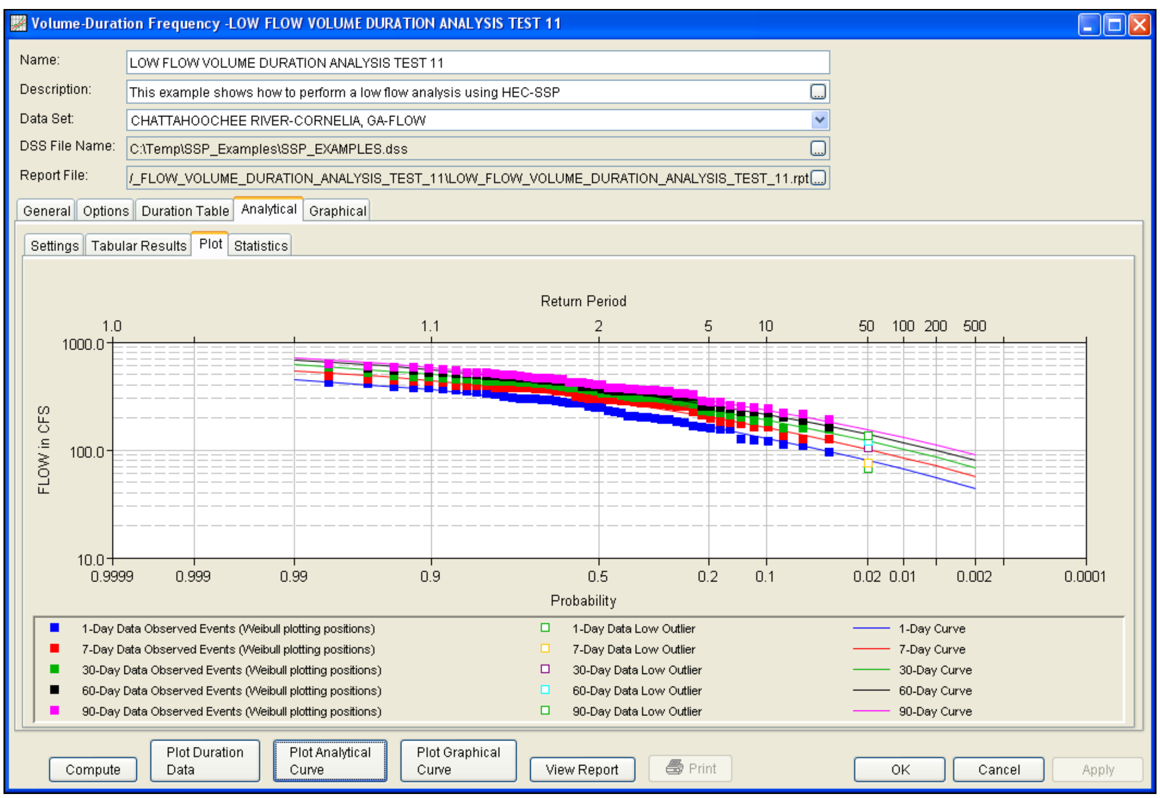


Figure B-88. Plot Tab for Test Example 11.

In addition to the Tabular Results and Plot tabs, graphical plots can be opened by selecting the **Plot Duration Data** or **Plot Analytical Curve** buttons at the bottom of the analysis window. A plot of the results for this test example is shown in Figure B-89.

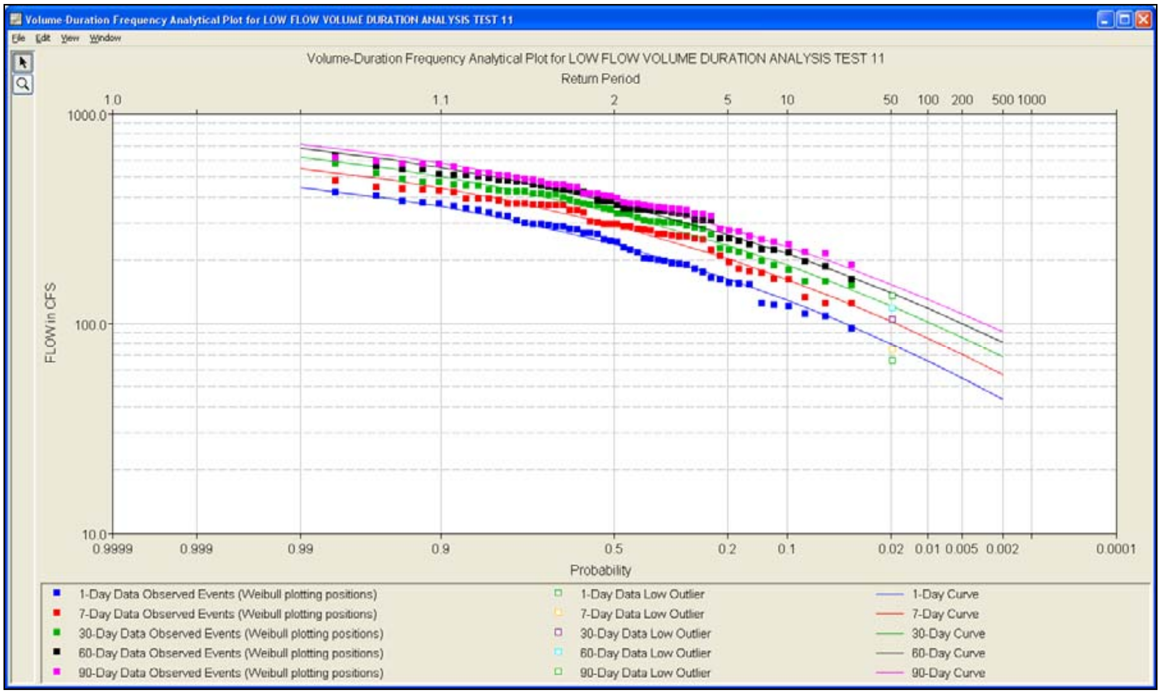
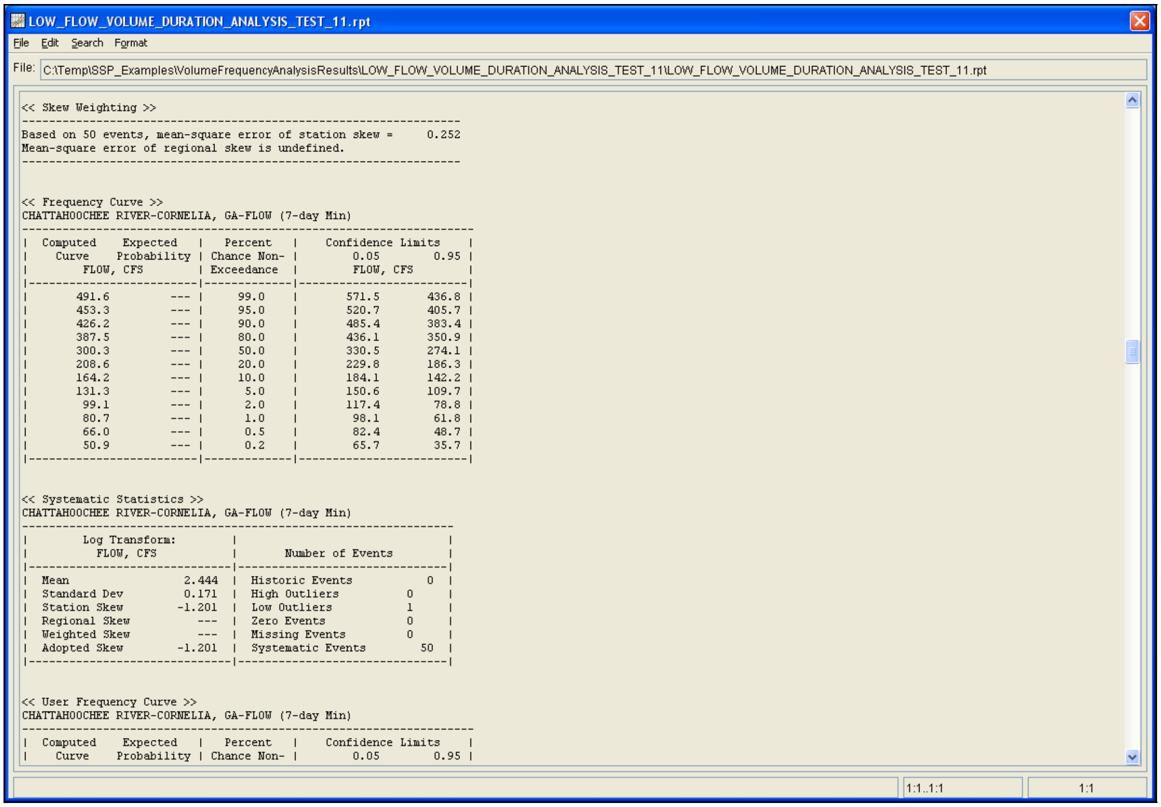


Figure B-89. Plot of the Frequency Curve Results for Test Example 11.

The tabular and graphical results can be sent to the printer or the windows clipboard for transfer into another piece of software. To print the tabular results, select **Print** from the bottom of the analysis window. To send the tabular results to the windows clipboard, highlight the data you want to send to the clipboard and then press the Control-C key sequence. To print the graphical results, first bring up the graphical plot and then select **Print** from the **File** menu. To send the graphic to the windows clipboard, select **Copy to Clipboard** from the **File** menu.

In addition to the tabular and graphical results, there is a report file that shows the order in which the calculations were performed. To review the report file, press the **View Report** button at the bottom of the analysis window. When this button is selected a text viewer will open the report file and display it on the screen. Shown in Figure B-90 is the report file for Test Example 11.

The report file contains a listing of the input data, preliminary results, outlier and historical data tests, additional calculations needed, and the final frequency curve results. Different types and amounts of information will show up in the report file depending on the data and the options that have been selected for the analysis.



LOW_FLOW_VOLUME_DURATION_ANALYSIS_TEST_11.rpt

File Edit Search Format

File: C:\Temp\SSP_Examples\VolumeFrequencyAnalysisResults\LOW_FLOW_VOLUME_DURATION_ANALYSIS_TEST_11\LOW_FLOW_VOLUME_DURATION_ANALYSIS_TEST_11.rpt

```
<< Skew Weighting >>
-----------------------------------------------------------------
Based on 50 events, mean-square error of station skew =     0.252
Mean-square error of regional skew is undefined.
-----------------------------------------------------------------


<< Frequency Curve >>
CHATTAHOOCHEE RIVER-CORNELIA, GA-FLOW (7-day Min)
-------------------------------------------------------------------
|  Computed    Expected   |   Percent    |    Confidence Limits    |
|    Curve    Probability | Chance Non-  |       0.05         0.95 |
|        FLOW, CFS        | Exceedance   |        FLOW, CFS        |
|-------------------------|--------------|-------------------------|
|       491.6         --- |     99.0     |      571.5       436.8 |
|       453.3         --- |     95.0     |      520.7       405.7 |
|       426.2         --- |     90.0     |      485.4       383.4 |
|       387.5         --- |     80.0     |      436.1       350.9 |
|       300.3         --- |     50.0     |      330.5       274.1 |
|       208.6         --- |     20.0     |      229.8       186.3 |
|       164.2         --- |     10.0     |      184.1       142.2 |
|       131.3         --- |      5.0     |      150.6       109.7 |
|        99.1         --- |      2.0     |      117.4        78.8 |
|        80.7         --- |      1.0     |       98.1        61.8 |
|        66.0         --- |      0.5     |       82.4        48.7 |
|        50.9         --- |      0.2     |       65.7        35.7 |
|-------------------------|--------------|-------------------------|


<< Systematic Statistics >>
CHATTAHOOCHEE RIVER-CORNELIA, GA-FLOW (7-day Min)
----------------------------------------------------------------
|        Log Transform:        |                               |
|          FLOW, CFS           |       Number of Events        |
|------------------------------|-------------------------------|
|  Mean                  2.444 |  Historic Events           0  |
|  Standard Dev          0.171 |  High Outliers          0     |
|  Station Skew         -1.201 |  Low Outliers           1     |
|  Regional Skew           --- |  Zero Events            0     |
|  Weighted Skew           --- |  Missing Events         0     |
|  Adopted Skew         -1.201 |  Systematic Events        50  |
|------------------------------|-------------------------------|


<< User Frequency Curve >>
CHATTAHOOCHEE RIVER-CORNELIA, GA-FLOW (7-day Min)
-------------------------------------------------------------------
|  Computed    Expected   |   Percent    |    Confidence Limits    |
|    Curve    Probability | Chance Non-  |       0.05         0.95 |
```

1:1..1:1 1:1

Figure B-90. Report File for Test Example 11.