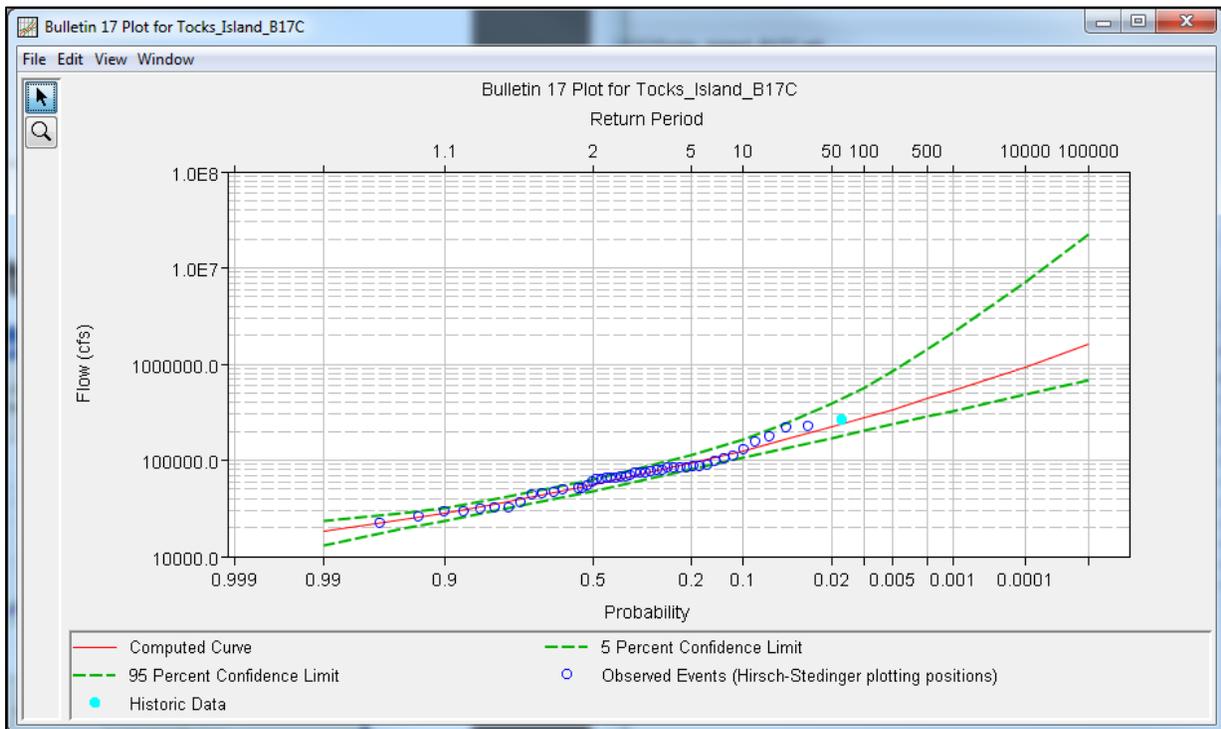




**US Army Corps  
of Engineers**  
Hydrologic Engineering Center

# HEC-SSP

## Statistical Software Package



## Release Notes

Version 2.1

July 2016

Approved for Public Release. Distribution Unlimited.

## **Statistical Software Package, HEC-SSP, User's Manual**

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Use of the software described by this document is controlled by certain terms and conditions. The user must acknowledge and agree to be bound by the terms and conditions of usage before the software can be installed or used.

HEC cannot provide technical support for this software to non-Corps users. Downloading this software indicates full acceptance of your responsibility in the use of this program. Please see the distribution policy for more details.

## Introduction

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 frequency analysis. Version 2.0 was released in October 2010 and included three new analyses: a duration analysis, a coincident frequency analysis, and a curve combination analysis. Version 2.1, released in July 2016, included improvements to the volume frequency analysis, general frequency analysis, and Bulletin 17B (Interagency Advisory Committee on Water Data, 1982) flow frequency analysis in addition to two new analyses: Bulletin 17C (England, et al., 2015) flow frequency using the Expected Moments Algorithm and a Balanced Hydrograph analysis. These new features are discussed in the User's Manual for Version 2.1.

## Installation

The installation program and all documentation are available on the HEC web site at <http://www.hec.usace.army.mil/>. This new release is installed independently of any previous versions of the program so you will need to remove Version 1.0, 1.1, or 2.0 if you do not want to use these versions anymore. However, you may keep different versions of the program installed for parallel use or testing if you choose to do so. This new version will automatically open projects developed with any previous version of the program. However, once a project has been opened in Version 2.1, it may not be possible to open it with older versions of the program.

The new installation package is designed to be easy to use. It will take you through the steps of selecting a directory for the program files and making other settings. Use the following steps to install the program on the Microsoft Windows® operating system:

1. Download the installation package from the HEC website to a temporary folder on the computer. If the software was provided to you on a CD-ROM or other media, insert it in the appropriate drive.
2. Run the installation program. In Windows Explorer, double-click the icon for the installation program. You must have administrator privileges to run the installer.
3. Follow the on-screen prompts to install the program.

## New Capabilities

The following paragraphs list the new capabilities that were added to HEC-SSP for Version 2.1.

*Flow Frequency Analysis (Bulletin 17)* – This component of the software allows the user to analytically perform annual peak flow frequency analyses. The software now implements two algorithms for computing annual peak flow frequencies. The first is

contained within Bulletin 17B, which was published by the Interagency Advisory Committee on Water Data in 1982. The Bulletin 17B algorithms were included in previous versions of HEC-SSP. The second algorithm, and brand new to HEC-SSP, is contained within Bulletin 17C, which was released in draft form by the Subcommittee on Hydrology in December 2015.

Bulletin 17C procedures allow the user to fit a Log Pearson Type III analytical distribution using the Expected Moments Algorithm (EMA). Additionally, the Multiple Grubbs-Beck Test is used within Bulletin 17C to screen for potentially influential low floods (low outliers). Previously, the Single Grubbs-Beck Test was used to screen for low outliers. Also, the Hirsch/Stedinger plotting position formula has been added for use with Bulletin 17C procedures. This new plotting position formula complements the existing Weibull, Median, Hazen, and user-specified plotting position formulas that were part of previous HEC-SSP versions. Finally, improved confidence limits are computed using Bulletin 17C procedures and EMA that incorporates skew uncertainty and diverse information appropriately, as historical data and censored values impact the uncertainty in the estimated frequency curve.

The Bulletin 17C methodology represents a shift in the determination of peak flow frequency and how data is used within peak flow frequency analyses. When using the 17C EMA methodology, additional data is required in order to compute peak flow frequency, confidence intervals, and plotting positions. This new information includes perception thresholds and flow ranges. Every year in the analysis period must have a perception threshold and a flow range specified.

Perception thresholds define the range of streamflow for which a flood event could have been observed. The inherent assumption and consequence is that any year for which an event was not observed and recorded must have had a peak flow rate outside of (usually below) the perception threshold/range.

Consider the example of an historical flood in 1882 estimated as 50,000 cfs, and then a gage was installed in 1926. This flood estimate suggests a perception threshold of 50,000 cfs to infinity, because there is evidence that a value as low as 50,000 cfs was noted/perceived (with high water marks, indirect evidence, and/or hydraulic modeling) during the ungaged period. One can further assume that any flow larger than 50,000 cfs would also have been perceived, and so any flow not perceived must have been less than 50,000 cfs. Therefore, for the unobserved period of 1883 to 1925, we assign the complementary flow range of 0 to 50,000 cfs to represent the likely range of peak flows during the unobserved period.

The perception threshold and flow range data necessary within a Bulletin 17 analysis using EMA and Bulletin 17C procedures is entered/ accessed on the **EMA Data** tab, as shown in Figure 1. Once computed, the resulting flow frequency curve, confidence limits, historical/systematic/flow ranges (for which there can be uncertainty in the actual flow value) using the Hirsch/Stedinger plotting position formula, and low outliers can be plotted as shown in Figure 2.

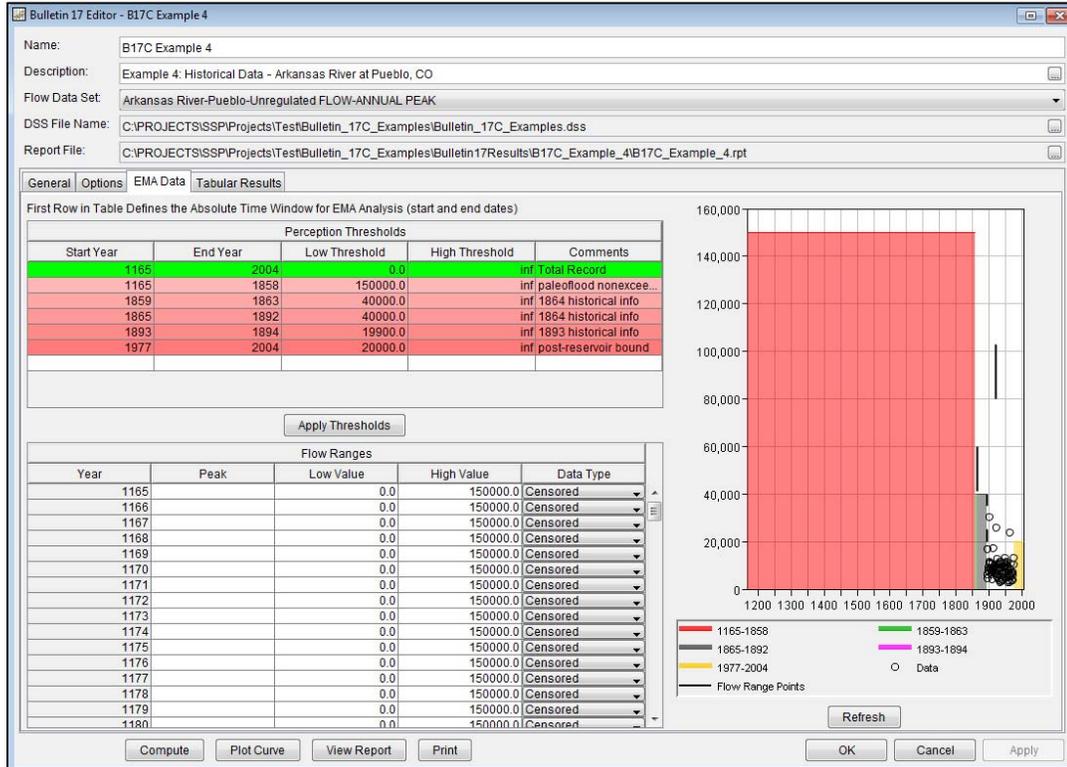


Figure 1. Bulletin 17 EMA Data Tab.

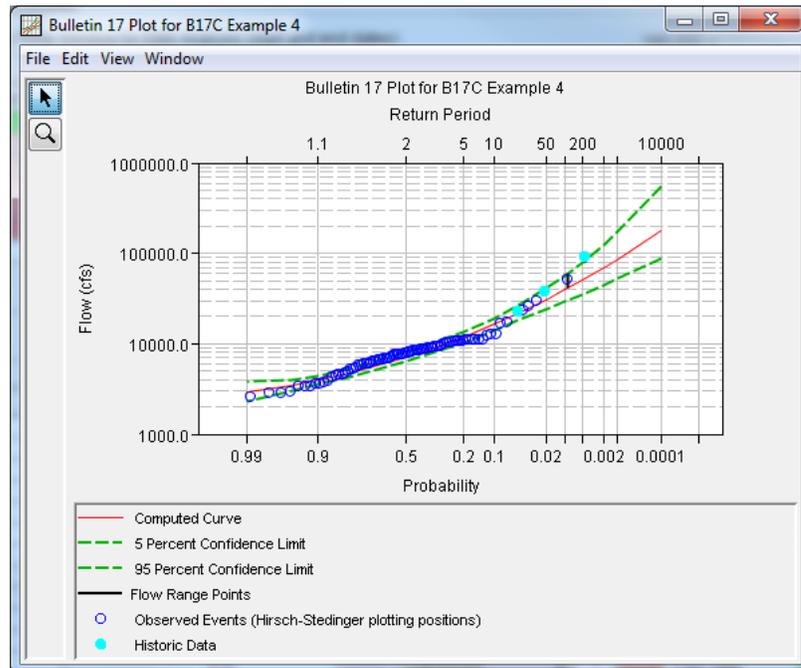


Figure 2. Bulletin 17 Flow Frequency Analysis Plot.

**General Frequency Analysis** – This component of the software allows the user to perform peak flow frequency analyses using various methods not accessible through the Bulletin 17 analysis or Volume Frequency analysis. Additionally, the user can perform frequency analysis of variables other than peak flows, such as stage and precipitation data.

New features as part of this analysis include the ability to ingest and make use of partial duration series in lieu of an annual maximum series. When using a partial duration series, the **Axis Type** options on the **Graphical** tab will become enabled. By default the **Normal (Top N Events)** option will be set as the default. The Normal (Top N Events) option will use the Period of Record Years that was defined on the General Tab to extract and plot the top N events. For instance, if the user defined an Equivalent Years of Record of 79 on the Graphical Tab, the top 79 events within the associated partial duration series will be plotted using the Plotting Position defined on the General tab. When using the **Log (All Events)** axis option, all events will be plotted using the average number of events per year to define the x-axis. Examples of these axis options are shown in Figure 3 and Figure 4.

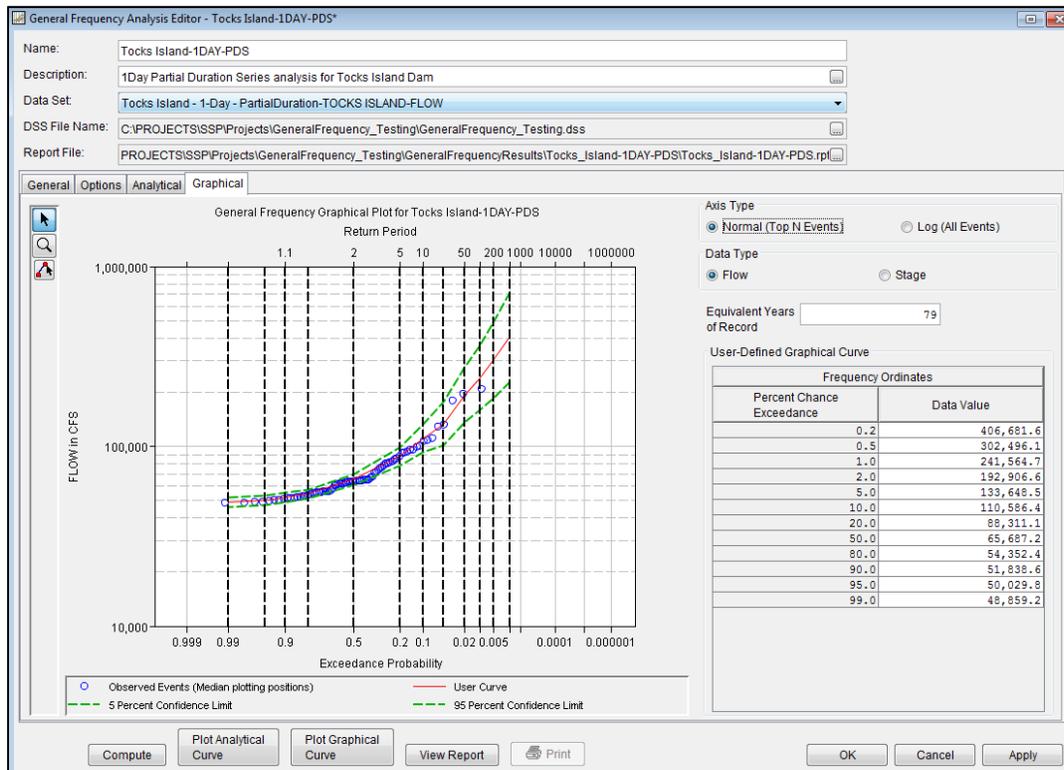


Figure 3. Normal (Top N Events) Axis Type Option on the Graphical Tab.

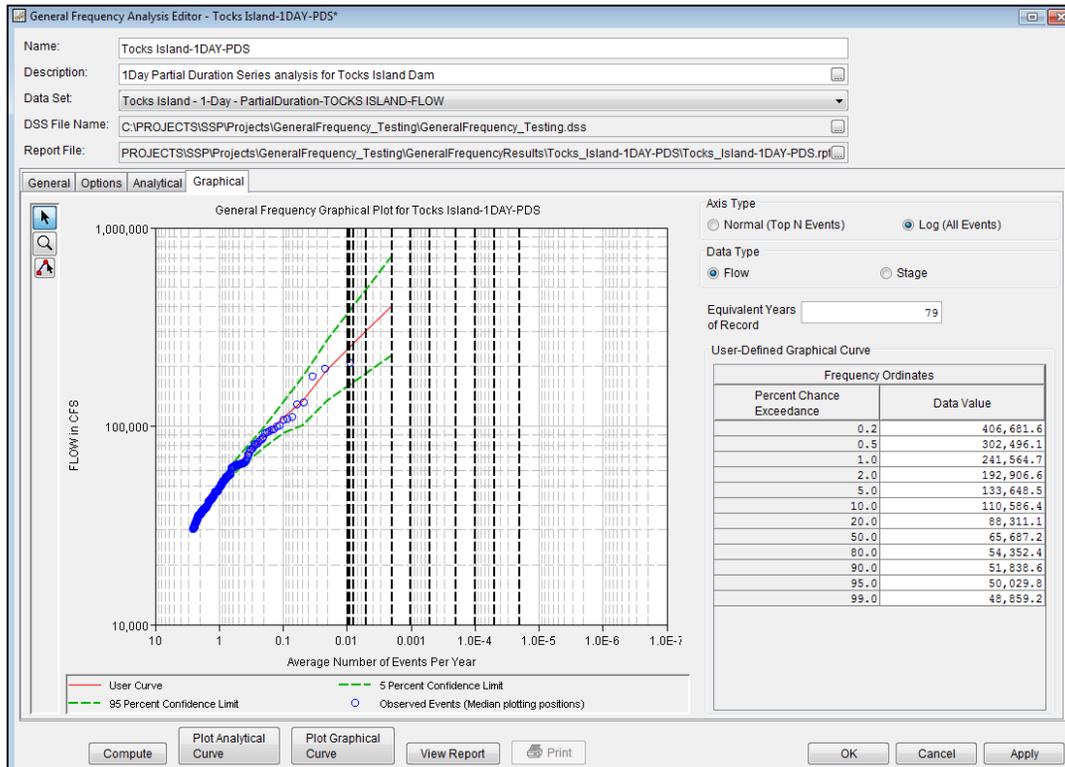


Figure 4. Log (All Events) Axis Type Option on the Graphical Tab.

Whether using a partial duration series or an annual maximum series, the user now has the ability graphically draw a frequency curve using the **Multi-Point Edit** tool. Bold, dashed lines are displayed on the plot that correspond to the frequency ordinates defined by the user. These vertical lines help to visually identify the locations where flow frequency information will be extracted from the drawn curve.

Volume Frequency Analysis – This component of the software allows the user to perform a volume frequency analyses on daily flow or stage data. The algorithm used to extract annual maximum volumes/flows was slightly modified for HEC-SSP version 2.1. The program computes the maximum/minimum flows by evaluating the flow record as one continuous record. For each volume (duration), the program computes a time-series of average flow using a moving average. For example, the 5-day average flow on January 5 is computed by averaging flow from January 1 through January 5. These time-series of average flow are written to the study DSS file and can be viewed using HEC-DSSVue. Once the moving average time-series have been computed, the program extracts annual maximum/minimum flows. A similar procedure is followed when a Season has been defined within the Time Window Modification panel, the program will only extract the annual maximum from within the season, but the moving average time-series is computed for the entire time-series.

**Balanced Hydrograph Analysis** – This component provides a tool for the creation of balanced hydrographs. Within a balanced hydrograph, the flow and/or volume across multiple durations satisfies the relationship between flow/volume and duration for a given frequency. For example, a 5-day 0.2 percent annual chance exceedance (ACE) balanced hydrograph would have individual hydrograph ordinates arranged in such a way that the flow volumes for the 1-hr, 1-day, ..., 5-day durations would each equal the 0.2 percent ACE flow rates and/or volumes. Although such hydrographs do not necessarily preserve the random character of natural hydrographs, use of balanced hydrographs ensures an appropriate flow rate and/or volume (in terms of frequency), regardless of the characteristics of a particular watershed or location.

When the user selects the **Results** tab on the Balanced Hydrograph Analysis editor, the window will appear as shown in Figure 5. Both tabular and graphical results are included. The durations and probabilities for the balanced hydrographs are the same as those defined on the **General** tab.

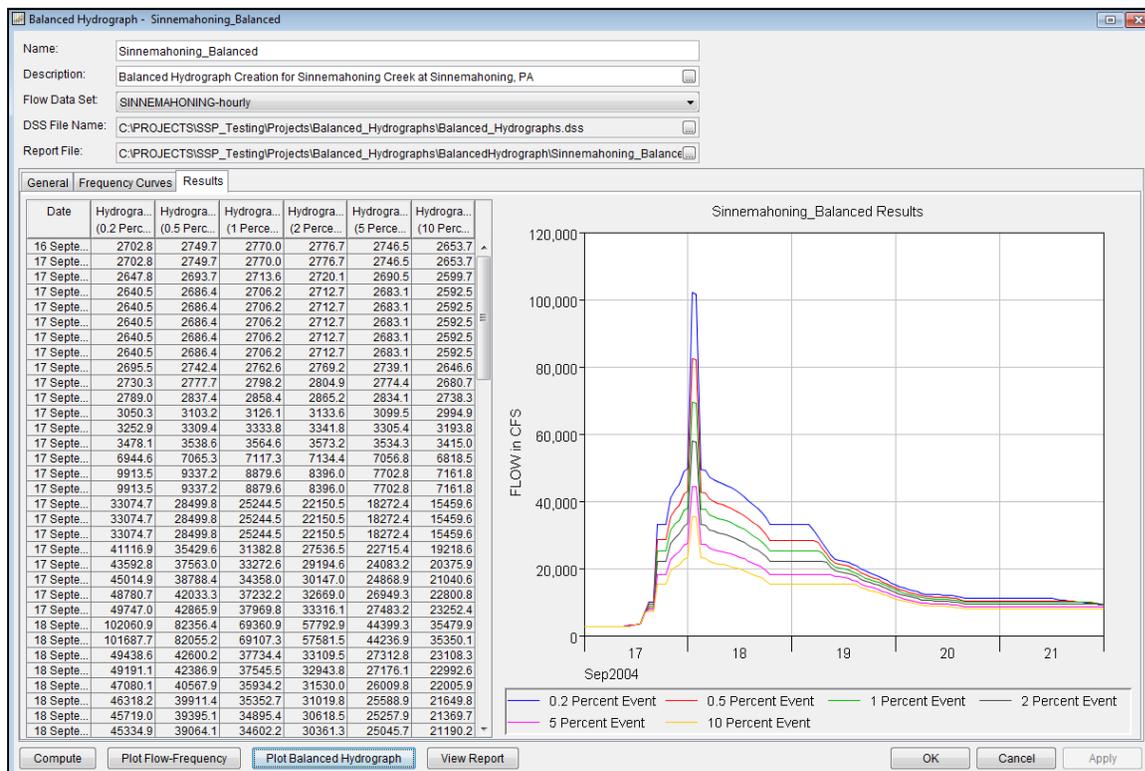


Figure 5. Results Tab of the Balanced Hydrograph Analysis Editor.

## Documentation

The Statistical Software Package HEC-SSP: User's Manual contains extensive information on installing and using the program. Details on the use of each feature and

capabilities in the program are included. The manual has been updated with information describing new features added to the program for this Version 2.1 release.

## Bug Fixes

The development team continues to test the software even after a new release is made. The team found and repaired a number of bugs since the release of Version 2.0.

While HEC does not provide technical support for this software to non-Corps users, we will respond to all documented instances of program errors. If you encounter a problem, then please take the time to send us a bug report. The report must be written and should be submitted directly to the HEC-SSP team at: [hec.ssp@usace.army.mil](mailto:hec.ssp@usace.army.mil). The bug report should include the following information:

1. Contact Information: Name, Phone, and E-mail address.
2. What version of the software are you using?
3. What operating system are you using?
4. An explanation of the problem.
5. If the problem is reproducible, please list the steps required to cause it. (Example: "1. Create a new file. 2. Insert some text ...")
6. If the problem is not reproducible (only happened once, or occasionally for no apparent reason) please describe the circumstances in which it occurred and the symptoms observed (note: it is much harder for us to diagnose and fix non-reproducible bugs).
7. If the problem causes any error messages to appear, please write down the exact text displayed.

Note: Please attach your data files if possible. This will assist in debugging the problem. If you have any suggestions or ideas for enhancing HEC-SSP, please e-mail your suggestions to [hec.ssp@usace.army.mil](mailto:hec.ssp@usace.army.mil).

Thank you for using HEC-SSP!