User's Guide for the Baseline Streamflow Estimator (BaSE)

Appendix 5 to accompany

Scientific Investigations Report 2012–5142

U.S. Department of the Interior
U.S. Geological Survey

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By Marla Stuckey, Edward Koerkle, James Ulrich

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KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2012

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User's Guide for the Baseline Streamflow Estimator (BaSE)

By Marla Stuckey, Edward Koerkle, and James Ulrich

Introduction

The **Ba**seline **S**treamflow **E**stimator (BaSE) is a tool to simulate minimally altered streamflow at a daily time step for an ungaged location during water years 1960–2008. BaSE was developed by the U.S. Geological Survey (USGS), in cooperation with the Pennsylvania Department of Environmental Protection, Susquehanna River Basin Commission, and The Nature Conservancy. The tool uses a modified QPPQ approach (Fennessey, 1994; Archfield and others, 2010), which relates probability exceedances at a gaged site to an ungaged location. An appropriate streamgage is selected in BaSE using streamflow correlation or the user can manually select a different streamgage. The streamgage selected, termed "reference" streamgage, should be representative of the ungaged basin with similar hydrologic and basin characteristics and have minimally altered streamflow by human activities. A report file is generated documenting the reference streamgage and ungaged location information, any warnings, and basic statistics including the median flow. The estimated daily flows for the ungaged location can be easily exported to a .csv file that can be used as input into a statistical software package to determine further streamflow statistics.

Computer Requirements and Installation Instructions

Microsoft Excel® 97–2010 (or later) and .net framework 4.0 are required on the machine running BaSE. The tool and associated report can be downloaded from the USGS Publications Warehouse. To download BaSE, go to *http://pubs.usgs.gov/sir/2012/5142/*, click on the link for the Baseline Streamflow Estimator, and download BaSE_v.1.0.zip. Extract the files from the zip file and save them to your computer. Install BaSE by double clicking on the file "setup.exe" (administrative privileges are not typically required to install/uninstall this application). During this step, the program checks for prerequisites and will notify you of any problems or missing software. After successful installation, the program will be found in your start menu in a folder named "USGS PA WSC" and a shortcut will also be created on your desktop.

Data Input Requirements

BaSE requires basin characteristics for the ungaged location to be entered on the opening screen (fig. 5–1). The tool can obtain these values from a downloaded geodatabase file from StreamStats (*http://water.usgs.gov/osw/streamstats/pennsylvania.html*) or the user can manually enter the basin characteristics. The following basin characteristics are required entries: longitude of the outlet of the basin, drainage area, mean annual precipitation, mean maximum daily temperature, soil depth to bedrock, drainage runoff number, percent of basin underlain by carbonate bedrock, percent of impervious surface area in basin, x-location at the center of the basin, y-location at the center of the basin, x-location at the outlet of the basin, and y-location at the outlet of the basin. More information about these basin characteristics, including data sources, can be found in the body of this report. It is important to use the same data source as was used to develop the regression equations for determination of the basin characteristics to maintain consistent accuracy in the regression estimates. To clear entered basin characteristics, click on the button "**Clear Form**".

To use StreamStats to obtain basin characteristics for the ungaged location, go to StreamStats for Pennsylvania at *http://water.usgs.gov/osw/streamstats/pennsylvania.html* and click on the Interactive Map link in the middle of the screen (fig. 5–2). Detailed instructions for using StreamStats can be found at the StreamStats website. Zoom to the area of interest by selecting an area using the magnify button, or enter a latitude and longitude. A scale of 1:24,000 or larger must be used to delineate a basin; use the zoom button to set the scale. Delineate the basin using the button with a black dot and plus sign (fig. 5–2, yellow arrow), and check the basin to make sure it is correctly delineated. After the basin has been correctly delineated, select the button with a table and question mark (fig. 5–2, green arrow) to compute basin characteristics. You can select all basin characteristics or only those needed. To download the data, click on the button with the arrow pointing down to a disk drive (fig. 5–2, red arrow) using the .mdb option (note–default is shapefile so you need to click on the circle for .mdb). This will save a zip file to your computer; the file will be named with a series of numbers that includes the date and time. The file must be unzipped before using BaSE.

Basin characteristic notations in the geodatabase file downloaded from StreamStats may be different than those used in the regression equations. The naming conventions used in StreamStats for the basin characteristics needed to run BaSE are listed in table 5–1.

Running the BaSE Tool

The opening screen of BaSE includes cells to enter basin characteristics. If a file from StreamStats is to be used to enter basin characteristics, select the button at the top, Import StreamStats database (fig. 5–3, black circle), and navigate to the downloaded file. The user can enter the basin characteristics manually, if they are known. The range of values for each basin characteristic used to develop the regression equations is shown. A warning message will appear if the basin characteristic entered is outside this range (fig. 5–3, red circle), indicating the resulting flow-duration estimates determined from regression equations may not be valid.

After basin characteristics have been entered for the ungaged location, click on Compute Baseline Flows button (fig. 5–3, arrow) to select the reference streamgage and compute baseline daily flows. The user will have to agree to the disclaimer that appears before continuing. The computation of daily flows will take a few minutes, depending on the computing capacity of your computer. A status bar indicates progress. When computations are completed, a box will open asking you to save the resulting Microsoft Excel® file. This file is the output from the tool. After saving the file, close the file before attempting to run BaSE for another location. BaSE may not function properly when this file is open.

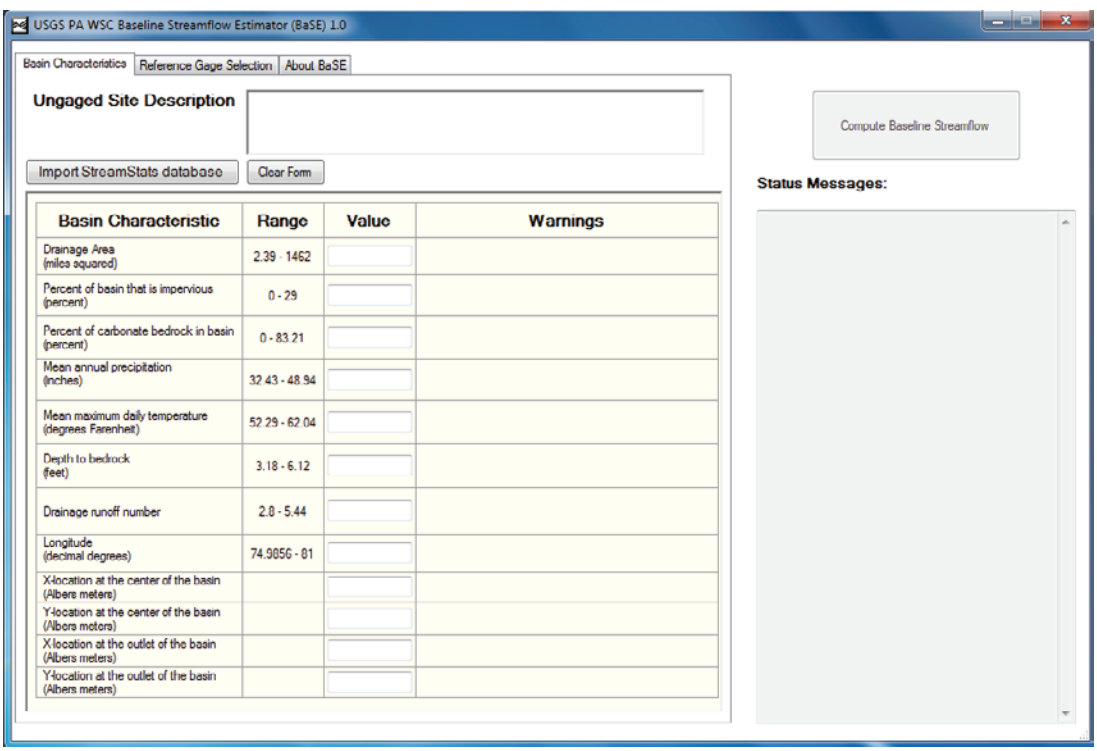

Figure 5–1. The opening screen of BaSE.

Figure 5–2. StreamStats toolbar. (Yellow arrow shows *Basin delineation from a point*; green arrow shows *Obtain Basin Characteristics*; red arrow shows *Download option*)

Table 5–1. Basin characteristics with naming conventions used in StreamStats and regression equations for predicting flow-duration exceedance probabilities for Pennsylvania streams.

[—, not used in regression equations]

Basin characteristic	Notation used in regression equations	Naming convention used in StreamStats
Longitude at the outlet of the basin	Long	LONG_OUT
Drainage area	DA	DRNAREA
Mean annual precipitation	Ppt	PRECIP
Mean maximum daily temperature	MaxT	MAXTEMP
Soil depth to bedrock	Thk	ROCKDEP
Drainage runoff number	Drn	DRN
Percent of basin underlain by carbonate bedrock	Carb	CARBON
Percent of impervious surface area	Imp	IMPNLCD01
x-location at the center of the basin	—	CENTROIDX
y-location at the center of the basin	—	CENTROIDY
x-location at the outlet of the basin	—	OUTLETX
y-location at the outlet of the basin	—	OUTLETY

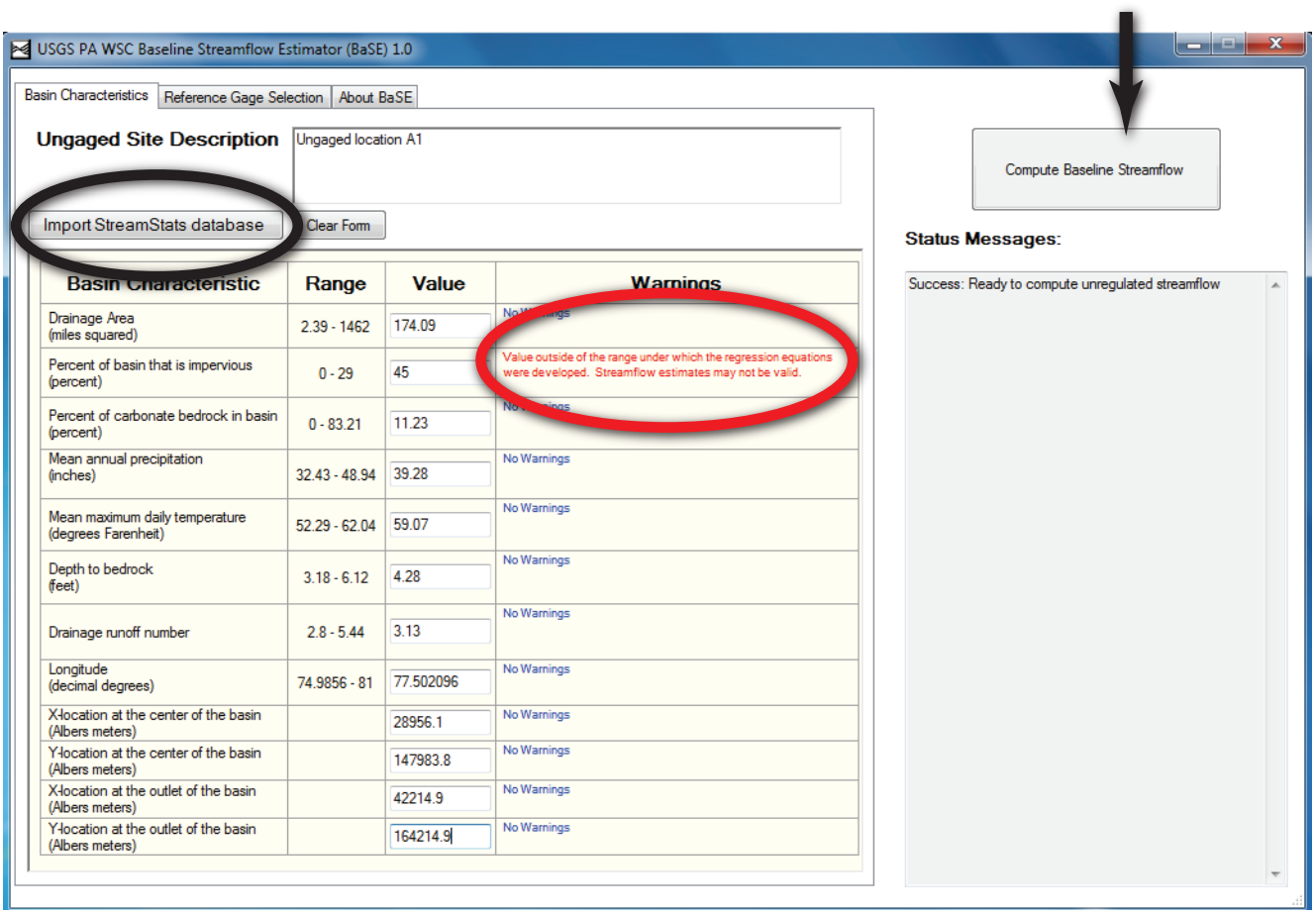

Figure 5–3. An example entry of basin characteristics into BaSE. (Black oval shows button to import data from StreamStats; red oval shows basin characteristic warning; black arrow points to the button to compute baseline daily mean streamflow)

The output Microsoft Excel® file contains worksheets with reference gage information, daily flows for the reference site and ungaged location, probability exceedances for the reference site and ungaged location, and a summary report with hydrographs and flow duration curves (fig. 5–4). Reference streamgages located outside a 75-mile radius from the ungaged location will result in a warning message. Correlations outside this radius may not be valid because of the method used to develop the correlation maps. The worksheet named ReferenceGageSelection lists information about the reference streamgage selected and four other reference streamgages with the highest correlations to the ungaged location. The distances between the ungaged location and reference streamgages are listed in the table and can be used to evaluate the appropriateness of the selected streamgage. To save the estimated daily flows and dates for the ungaged location as a comma delimited file, click on the Export Daily Values button on the report worksheet (fig. 5–4, black circle). Macros need to be enabled to use this feature. To enable macros, click on enable content from the message bar or under File; Info; Security Warning; Enable Content; select Enable All Content. The exported .csv file can then be used as input into a number of statistical software packages to determine low-flow, flow-duration exceedance, base-flow, or mean-flow statistics.

The reference streamgage can be chosen by the user, overriding the spatial map correlation process. After the basin characteristics have been entered for the ungaged location in BaSE, go to the tab Reference Gage Selection (fig. 5–5, black circle), and choose the reference streamgage you want to use. Click on Compute Baseline Streamflows to proceed with calculations. Review the results and follow the data export procedures to save the data into a file for further use.

References Cited

Archfield, S.A., Vogel, R.M., Steeves, P.A., Brandt, S.L., Weiskel, P.K., and Garabedian, S.P., 2010, The Massachusetts Sustainable-Yield Estimator: A decision-support tool to assess water availability at ungaged stream locations in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2009–5227, 41 p., plus CD-ROM.

Fennessey, N.M., 1994, A hydro-climatological model of daily streamflow for the northeast United States: Medford, Mass., Tufts University, Ph.D. dissertation [variously paged].

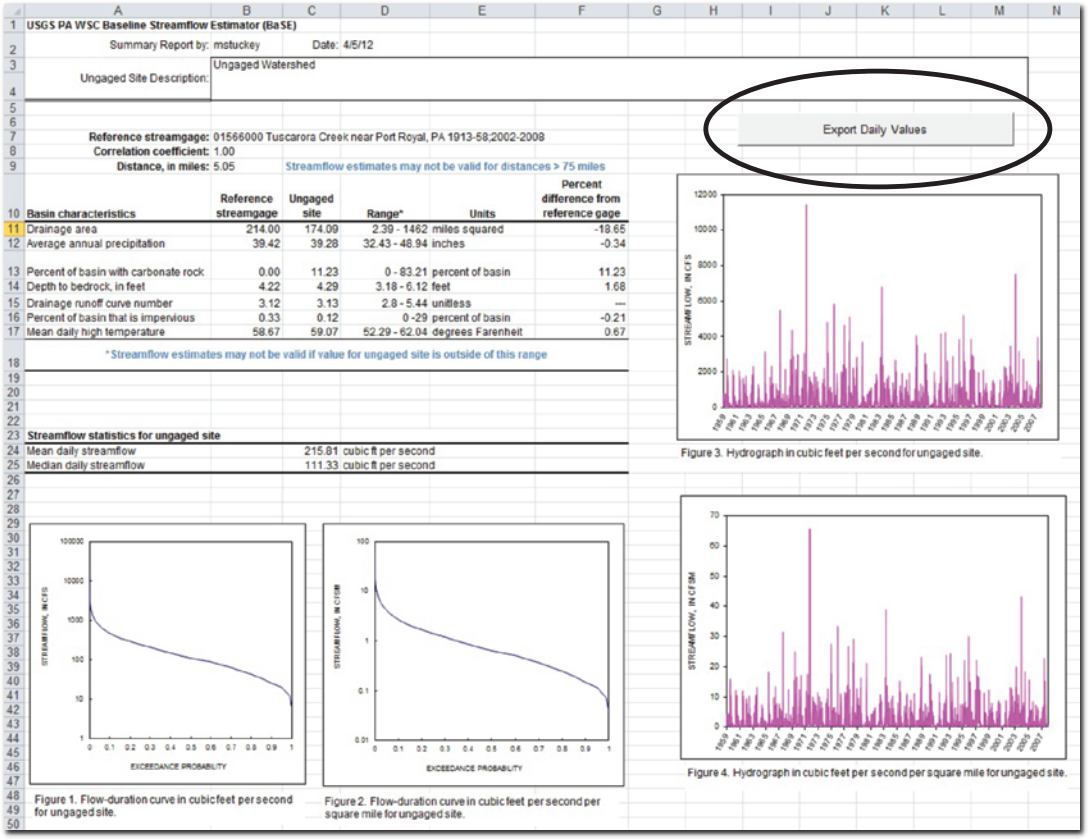

Figure 5–4. Summary report generated from BaSE. (Black oval shows the button to export daily streamflow for the ungaged location as a .csv file.)

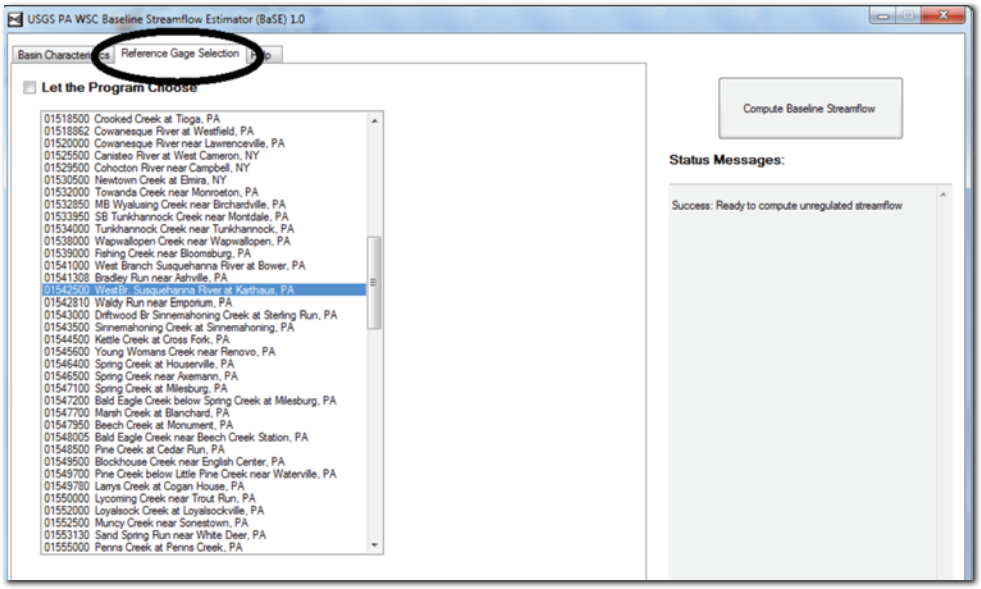

Figure 5–5. Manually selecting a reference streamgage for use with BaSE.

Prepared by the West Trenton Publishing Service Center

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