
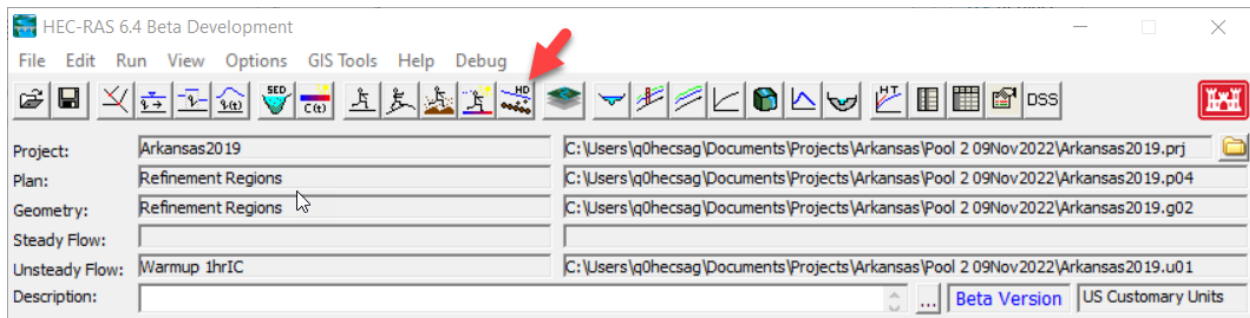


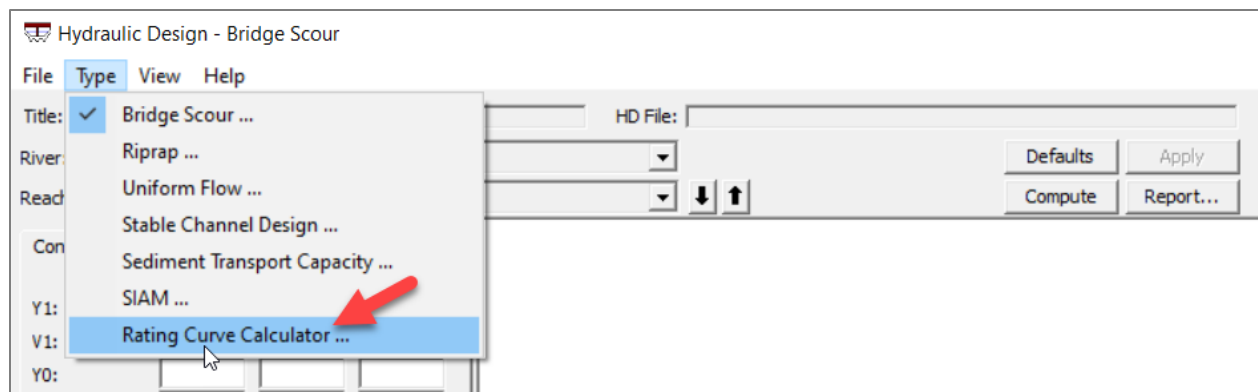
Sediment Data Analysis Tool Workshop


The first step in a sediment study is often collecting and analyzing the available sediment data. On large rivers, with USGS gages, that process starts with downloading the USGS sediment data. HEC-RAS has a new tool that downloads the available USGS sediment data and provides several “best-practice” statistical analyses.

The Sediment Data Analysis Tool is in the Hydraulic Design toolbox in HEC-RAS. Press the HD  button or select the **Run→Hydraulic Design Functions** menu.

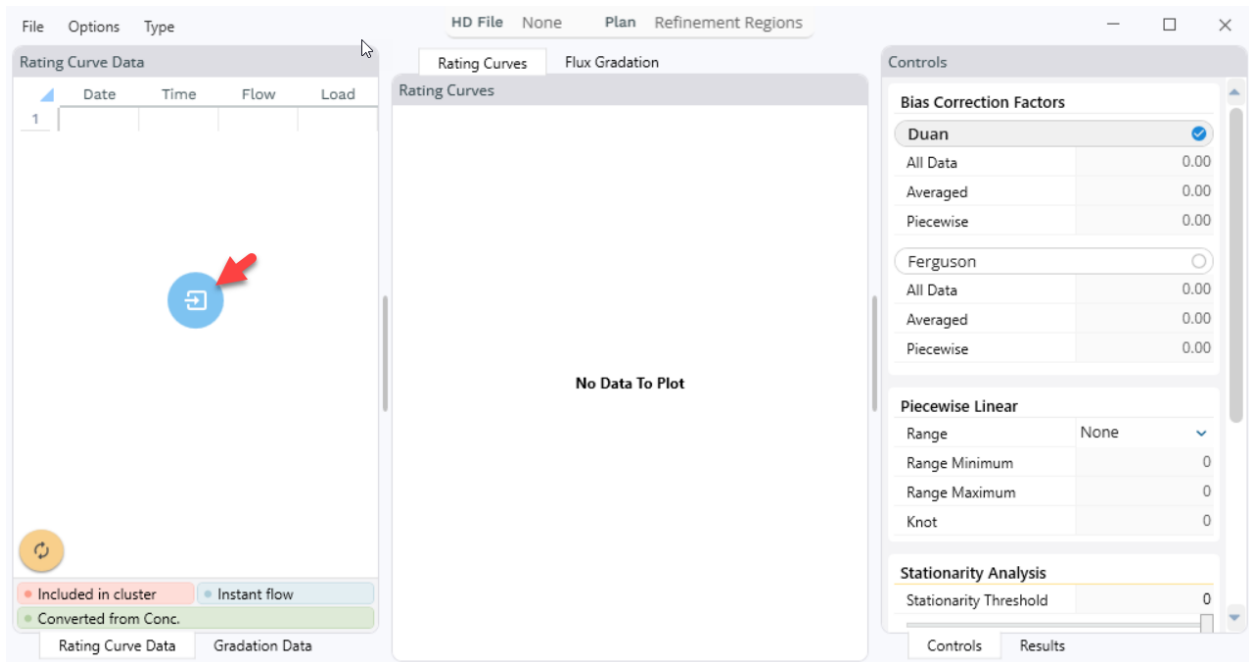


The HD editor will open to the Bridge Scour tool. To navigate to the other tools, including the Sediment Data Analysis Tool, select the Type Menu, then select **Type→Rating Curve Calculator**.

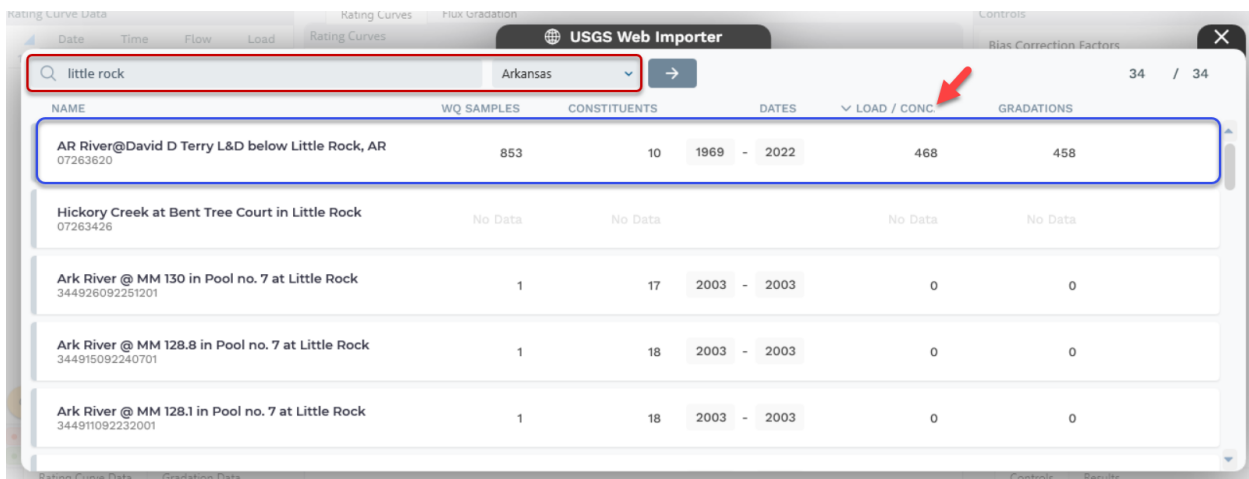


This will launch the tool. The tool starts empty, without data, so you will need to download data by pressing the  button in the left pane or selecting **File→Import→USGS Web Importer**.





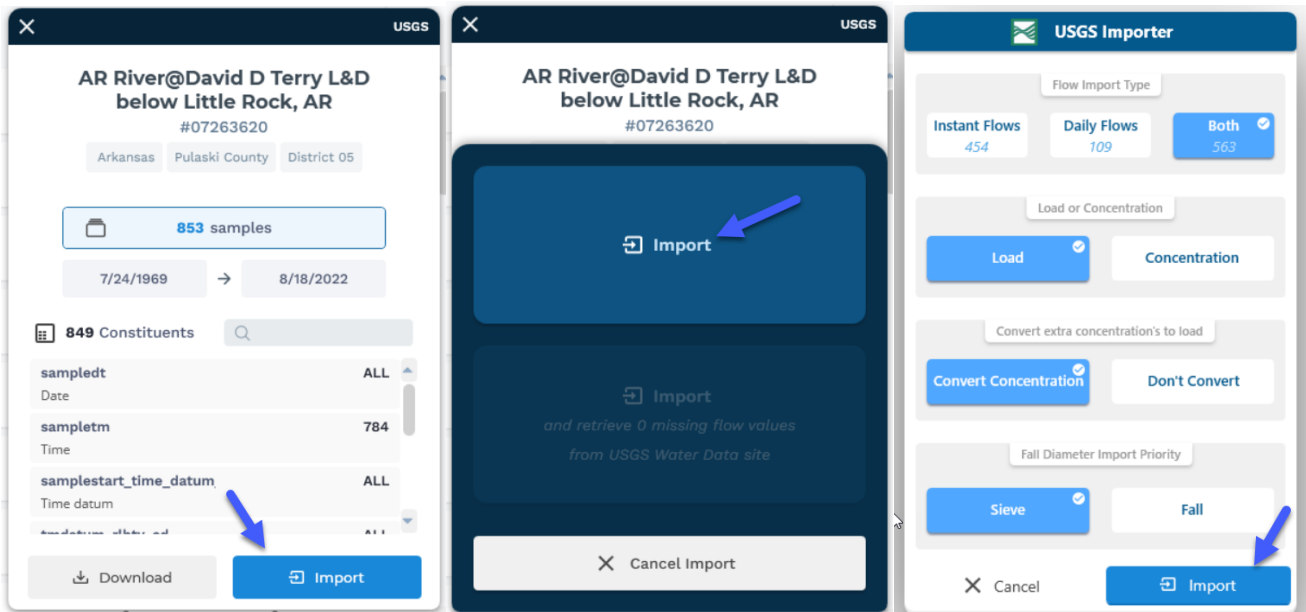
This will launch the gage search function. To search for gages, choose the state and type in an identifying text string (e.g. the gage number or river name). For this exercise, choose **Arkansas** as the state, and type **“Arkansas” into the text string**. It will take about a minute to download all the data, but when it is downloaded, click on the Load/Conc Heading to sort by (Note: you can find more Arkansas River data by searching for “Ark” or “AR”, which we will do later). Click on that Little Rock gage with the most data.



The tool will launch a window with detailed metadata on this gage, including the other water quality constituents available at this gage and the time window of the data. Press the import button to import the data.

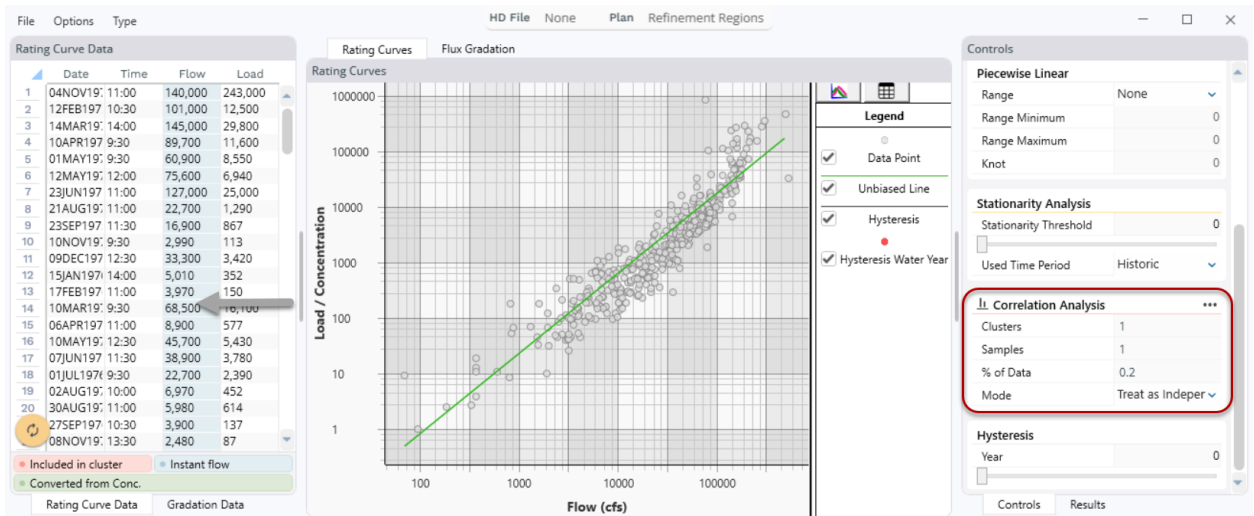


The Little Rock gage is unusual because all the sediment samples have associated flows. Often sediment samples do not have flows, so the tool will go to the USGS flow site to find the best available flow to pair with the data. But for this exercise, just press the Import button.



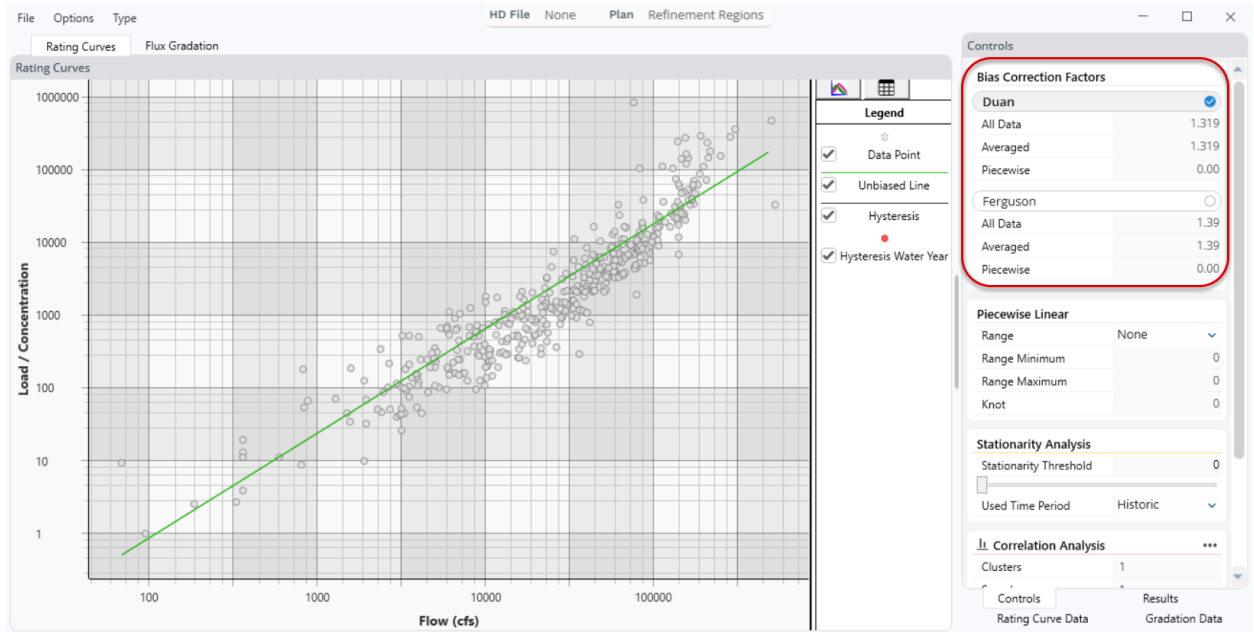
Then the tool launches an importer tool that asks several data preference questions. But the default choices are usually appropriate (you can convert between load and concentration later). Press **Import** in this screen too.

This should import the data into the rating curve tool and plot the flow-load relationship. You can shift the data pane (or dock it behind the controls) to give the plot more of your screen.



The first thing I look at is the **Correlation Analysis** box (red box above).

The **Correlation Analysis** indicates how many of your data are temporally “clustered” (e.g. collected on the same day). Almost none of these data are same-day replicates. So it will be reasonable to treat the data as independent (note: This is often not the case. Data sets like this often mix single samples with multiple same-day replicates. The latter should be averaged, and this tool does that for you).



Bias Correction

Next, look at the bias correction (Duan and Ferguson at the top of the controls).

What is the range of bias correction? _____

What does this mean for your flow-load relationship? _____

Piecewise Linear

Next, look at the bias-corrected power function fit through the data.

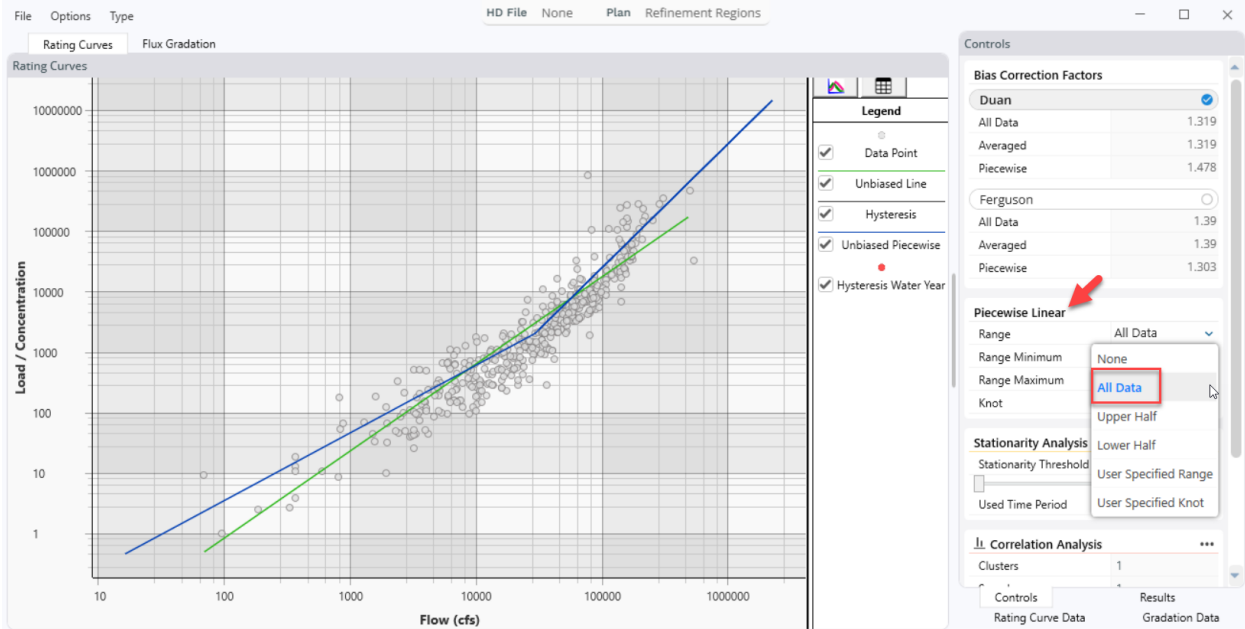
Does the model fit the data from all flows well? _____

Which flows fit the model better and which flows do not fit as well? _____

If you were to try to fit two separate slopes through these data, where would you change slopes? _____

This does look like a classic “concave” sediment rating curve (i.e. “concave” rating curves have steeper flow-load relationships for high flows, “convex” have steeper flow-load relationships at low flows). The Rating Curve Analysis Tool has a piecewise linear tool that will fit a continuous 2-slope model to the data.

To fit a piecewise linear rating curve to these data, select **All Data**. The tool will fit the least-mean squared error piecewise linear model to the data.



Where is the inflection point in these data (e.g. the flow calculated at the “bend” in the rating curve)? _____

What physical process is responsible for the convex shape of this relationship? _____

Would you break the slope at a different flow from your knowledge of the system or visual inspection of the data? _____ If so, which flow? _____

Choose the **User Specified Knot** option and select the flow you would like to evaluate.

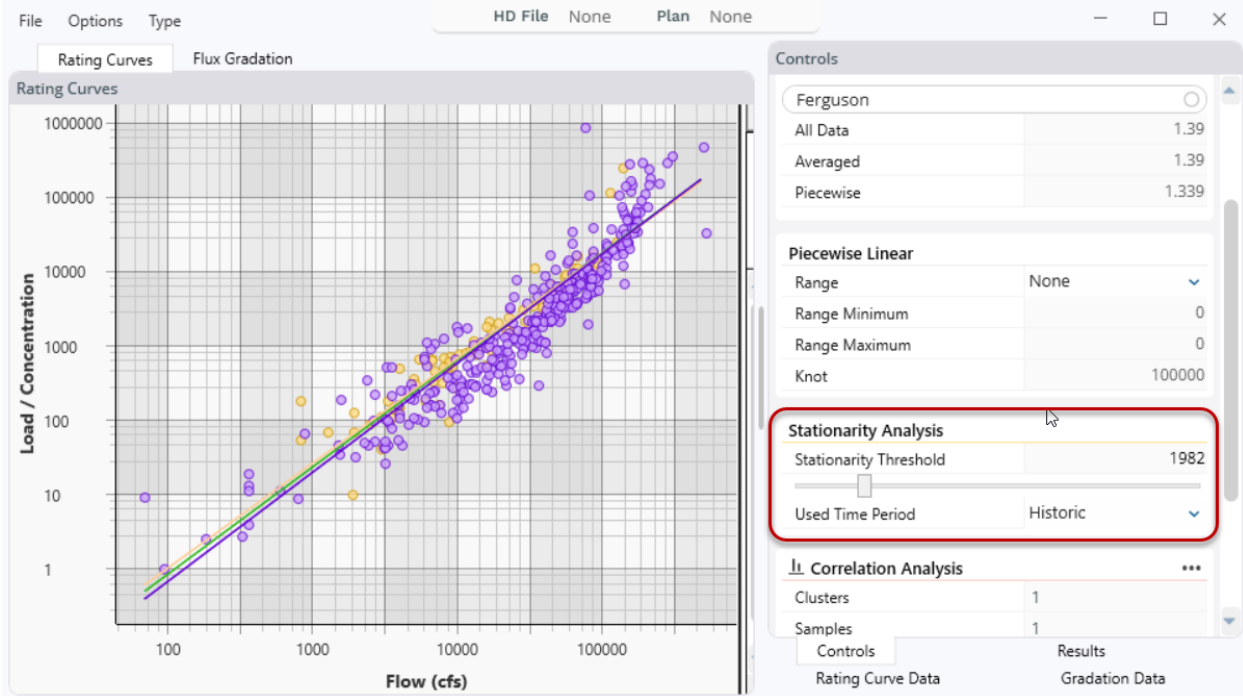
Stationarity

Stationarity is another important data test early in your sediment data analysis. This is a temporal data analysis. “Stationarity” means that the processes and data are relatively constant over time. Natural variability can lead to high flows or low flows from year to year, but if the system is stationary, the flow-load relationship should remain relatively consistent over time.

What are some potential sources of NON-Stationarity? (e.g. processes that could change the flow-load relationship over time) _____

Use the Stationarity time bar in the **Controls** tab to move through time in your data. As you move the scroll bar, the data before the indicated date will plot yellow while the data after will plot purple (and the tool will compute separate unbiased power functions for each).

Experiment with the stationarity tool on the Little Rock gage data:



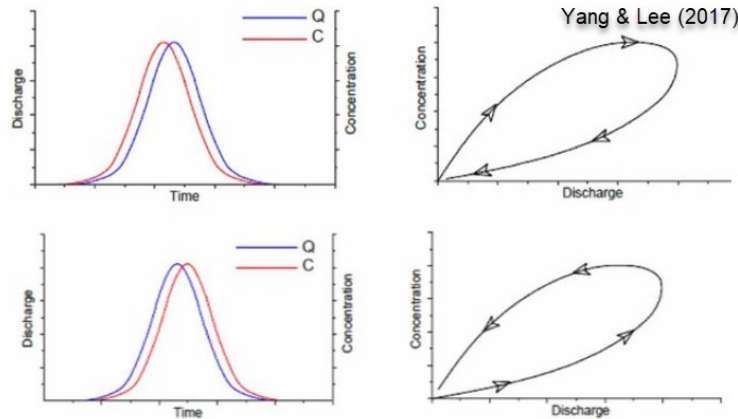
Are these data stationary? _____

If not, what date would you choose to separate the historic and contemporary rating curves? _____

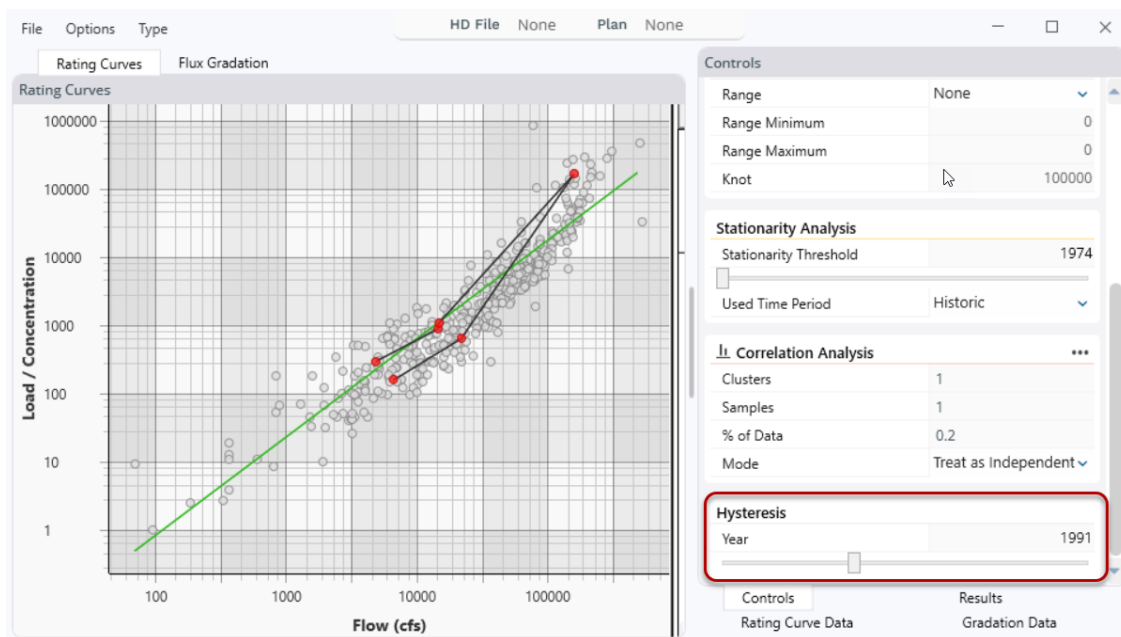
Which rating curve would you use for a future projection? _____ An historic calibration? _____

Hysteresis

Flow-Load relationships are “path dependent”, which means that they can have different loads on the rising and falling limbs of hydrographs. Hysteresis can be clockwise (sediment peak is before the flow peak) or counterclockwise (flow peak is before the sediment peak).



Use the Hysteresis tool bar to explore the path-dependence of the Little Rock data in different years.



Is there much hysteresis in this gage? _____

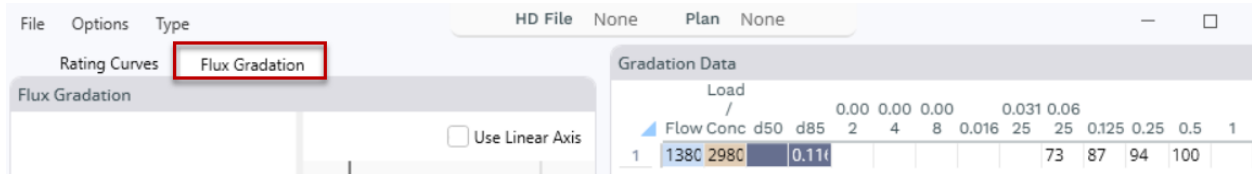
Is the hysteresis clockwise or counter clockwise? _____

What do you think causes this kind of hysteresis? _____

What is a year with significant hysteresis? _____

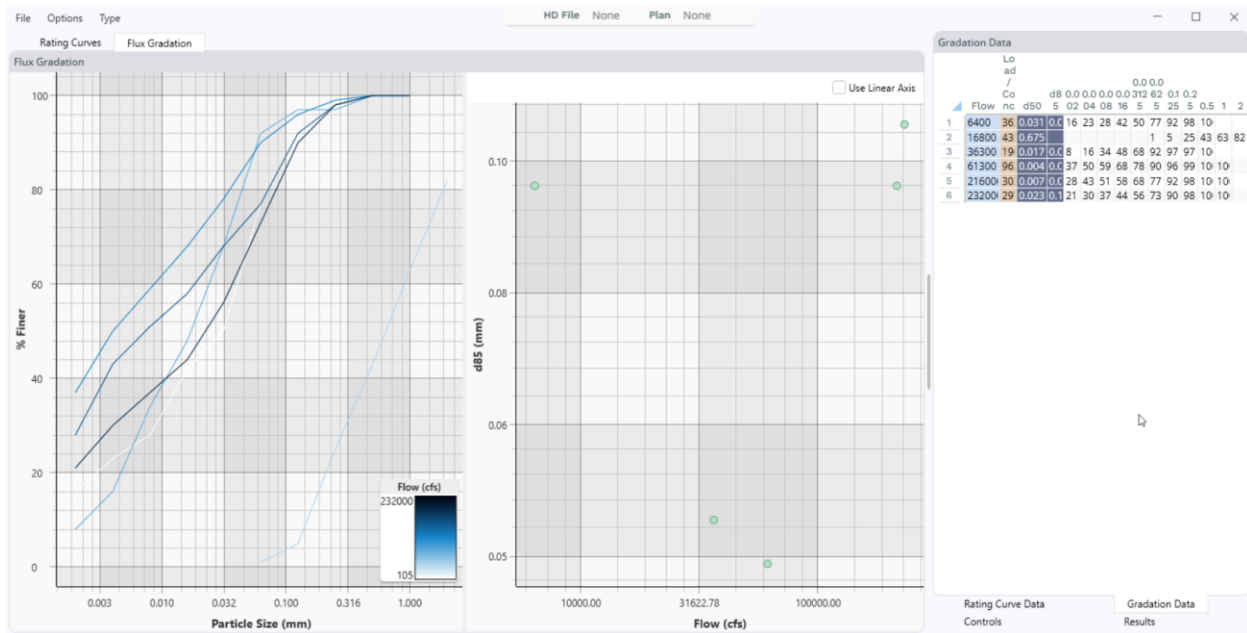
Gradation Analysis

The sediment data tool also imports flux gradation if the gage has these data. Click on the **Flux Gradation** tab to view the data available at this gage:



What is the flux gradation data availability like at this gage? _____

The Oklahoma gages have a little more gradation data. Try opening the data for one of those gages (e.g. Arkansas River at Tulsa, don't forget to switch states to Oklahoma). Click on the Gradation tab.



Is there a discernable trend in the gradation data? _____