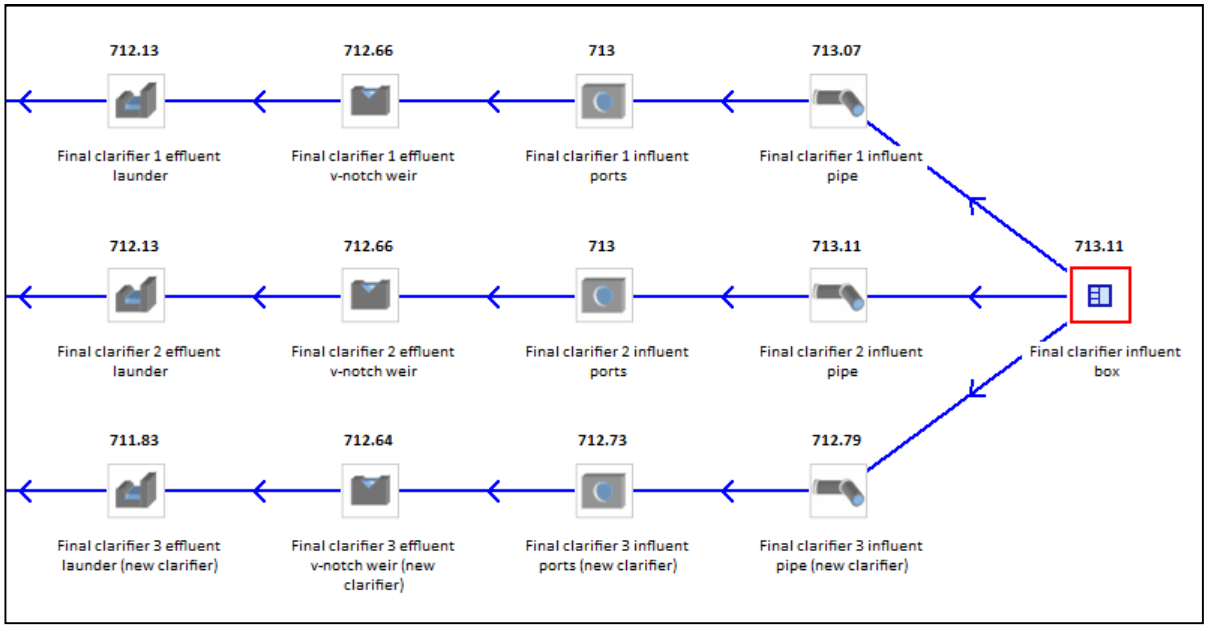
Visual Hydraulics Example II – Flow Distribution Analysis

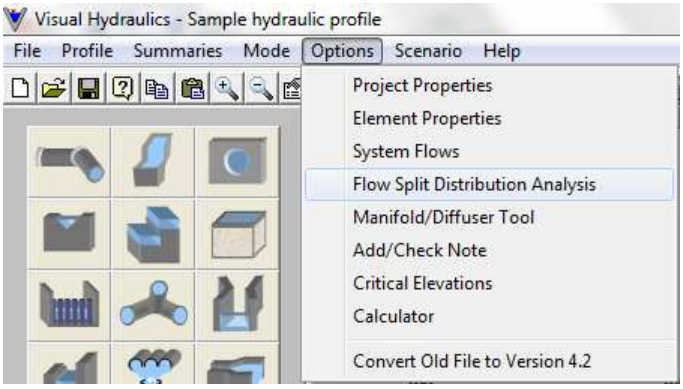
One of the more challenging tasks in plant hydraulic analysis is the determination of how flow is split between two or more unequal flow paths. Although proper design calls for adequate flow splitting techniques to insure equal flow distribution among paths, this is often not the case and may not even be possible. The individual performing the calculations is often left with an assumption of equal flow or an assumption of how the flow may be split. The most advanced feature of Version 4.2 is the flow distribution analysis tool, and it is examined in detail in this example.

Problem: An older treatment plant has never had an equal flow split for flows that are conveyed through its biological and secondary process (aeration tanks and final clarifiers). In addition, the plant has recently gone through an upgrade, adding additional final clarification to the plant, further complicating the flow split issue. Assumptions have been made regarding the flow splits based on observation and testing, but a more accurate flow split analysis is desired. Visual Hydraulics can be used to model the various flow paths and determine the approximate flow split based on water elevations. Consider the following Visual Hydraulics model, which has been developed for the secondary clarifiers:

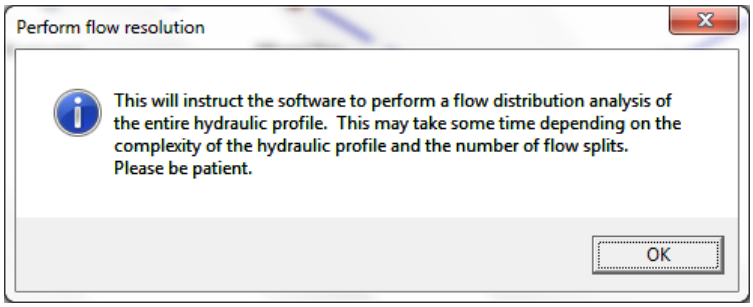


The model above preliminarily assumes an equal flow distribution between all three trains. The total flow through the plant is 30 MGD, so the flow to each path is currently set at 10 MGD. As can be seen from the elevations of the various elements within each flow path, that assumption is not correct. The elements just downstream of the flow split (titled Final clarifier influent box) are not equal. So what is the true flow split between the various paths? The flow split analysis tool can be used to determine how the flow is actually split.

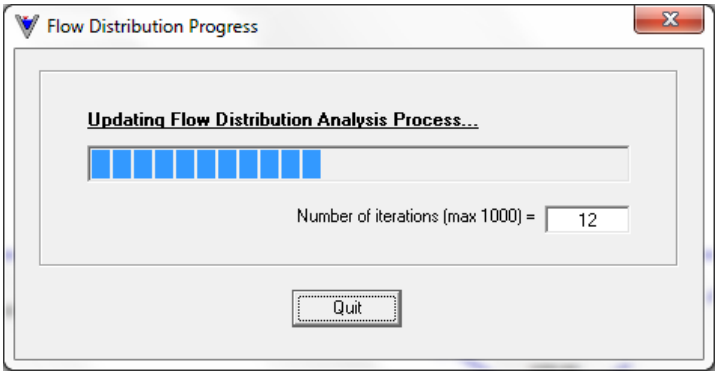
In order to run a flow split analysis, the user should select the “Flow Split Distribution Analysis” option from the “Options” drop down menu on the main screen:



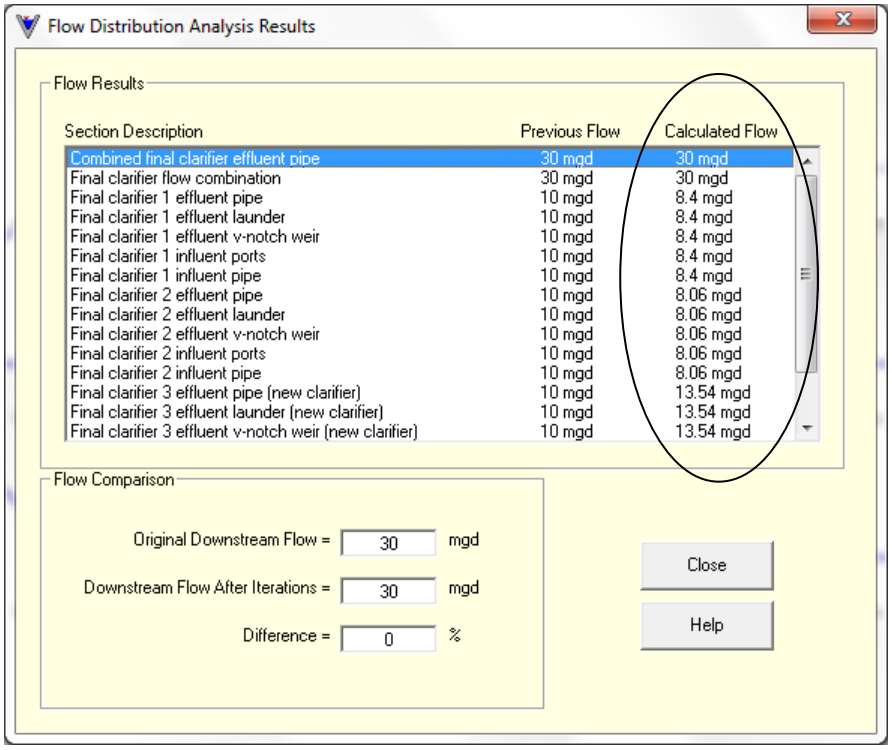
Selecting this option from the menu will instruct the software to perform a flow distribution analysis on the current hydraulic profile. The following confirmation message will be provided before proceeding:



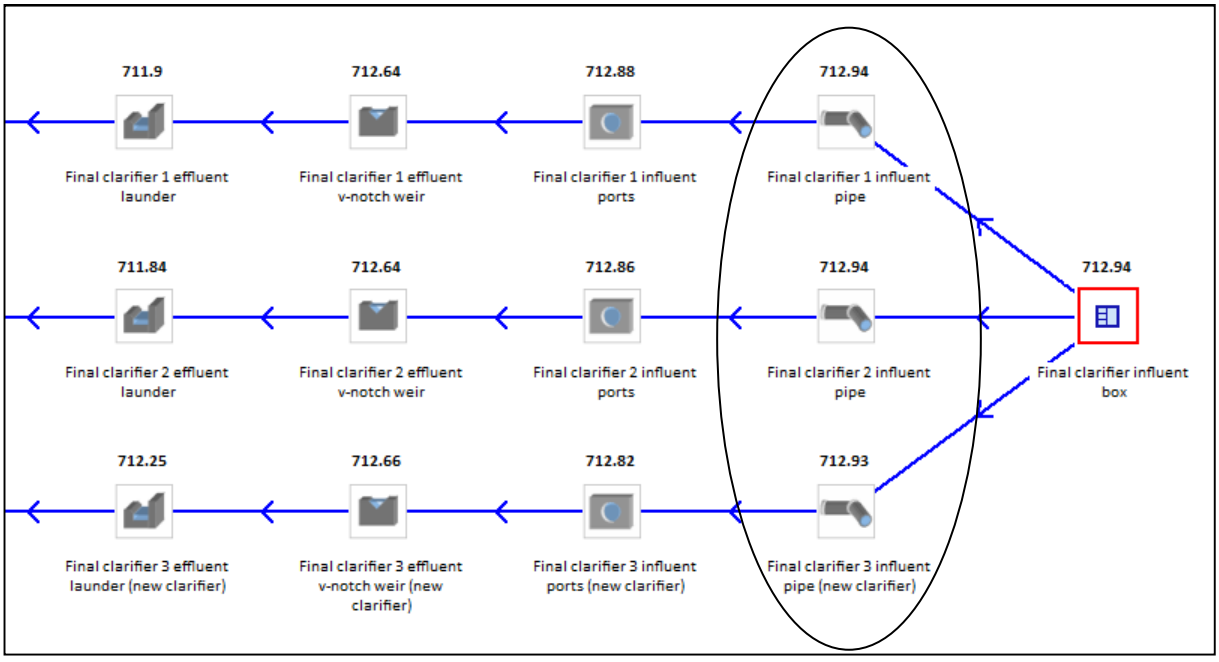
Something to note from this confirmation message, depending on the size of the hydraulic profile, number of flow splits, and complexity of the flow distribution, the analysis may take some time. During the analysis, the software will provide an update progress of the analysis:



The progress screen provides the number of iterations performed as well as a progress bar that summarizes how many of the flow paths have been calibrated successfully. When all of the flow splits have been calibrated, the analysis is complete and the results will be displayed in tabular format. This summary form is shown as follows for the simple flow split just analyzed:



As can be seen from the results above, the path through final clarifier no. 1 receives 8.4 MGD, the path through final clarifier no. 2 receives 8.06 MGD, and the path through final clarifier no. 3 receives 13.54 MGD. Based on the elevations of the preliminary hydraulic profile, it is not surprising that the path through final clarifier no. 3 receives significantly more flow than the other 2 paths. The hydraulic profile is also updated accordingly:



As can be seen from the updated hydraulic profile diagram, the water elevations of the elements just downstream of the flow split are now virtually equal. This is how Visual Hydraulics performs flow split calculations…the flows are iterated through each flow path until an equal water elevation is reached just downstream of the flow split or flow splits. Note that weirs and other scenarios can affect how the flow distribution analysis is performed.