## Pre-Processing Geometric Data
Solution

View HTAB Parameters and Analyze the Hydraulic Property Tables

The Cross Section Table Parameters were viewed by depressing the HTAB Parameters button found in **the Geometric Data Editor**, located in the "Tools" section. The default parameters are sufficient for this example because the table extends to the top of each cross section with an incremental increase in elevation well below one foot.
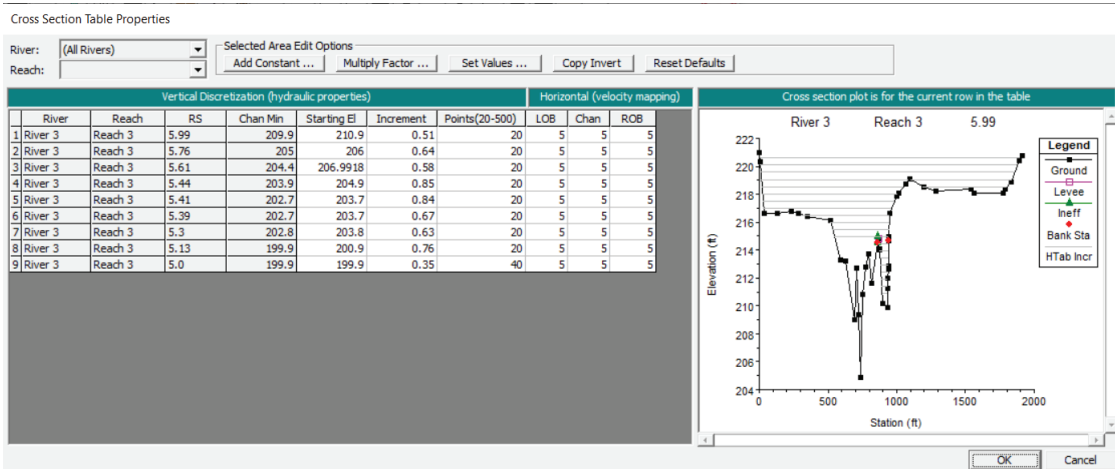
Next, (after running the Geometry Preprocessor on the Unsteady Flow Analysis window) the figure below is displayed by selecting View and then Hydraulic Property Plots from the main program window. As can be seen from the figure, there is a smooth increase in conveyance as elevation increases from the channel invert.
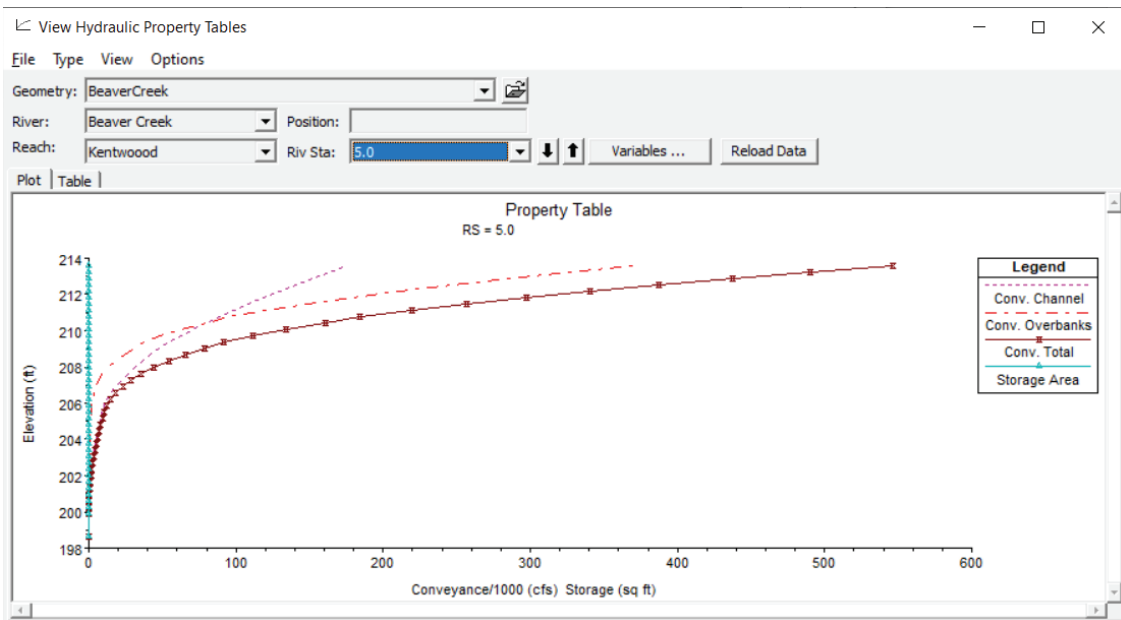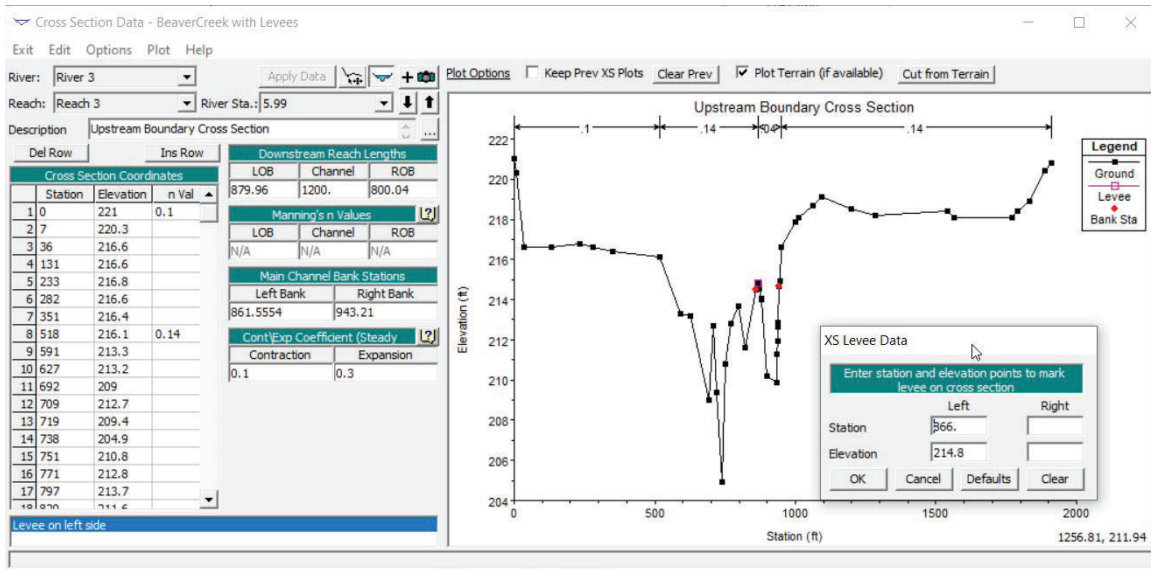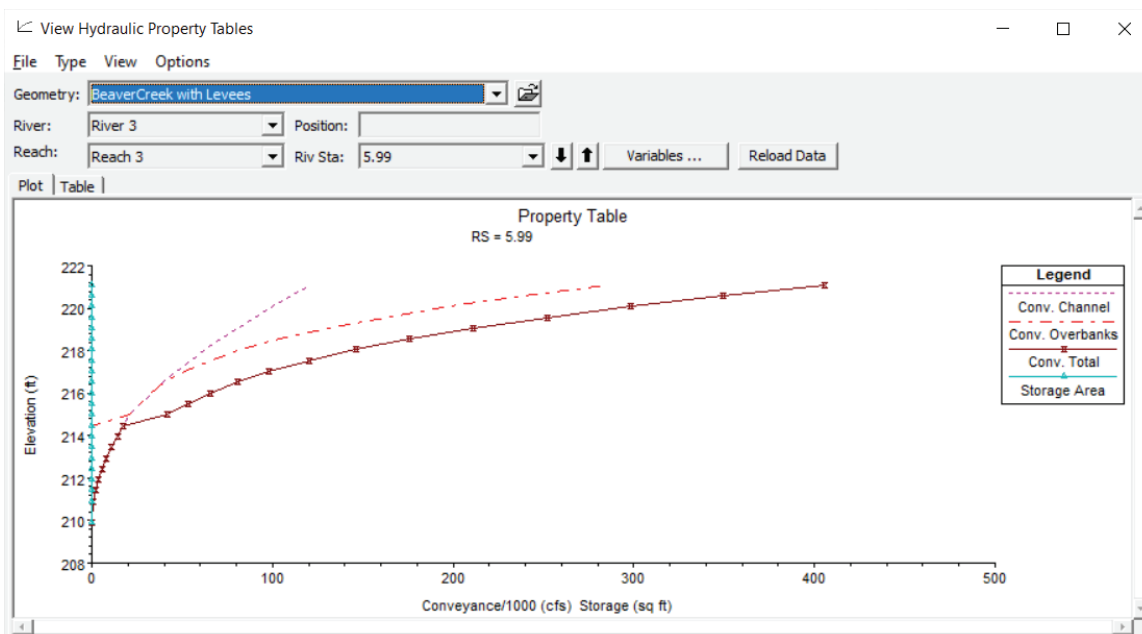
Place Levees

Levees were placed at the following locations using the Graphical Cross Section Editor.

River Station	Station	Elevation
5.99	866	214.8
5.76	906	214.3
5.29	223	209.6
5.13	358	209
5.00	518	209

Levees could also have been placed using the Cross Section Editor


How did the conveyance vs. elevation relationship change due to the addition of the levee?

As seen in the figure above, when the levee is overtopped there is an abrupt increase in conveyance with a small change in elevation. This occurs because RAS is a one-dimensional model, and as soon as the levee is overtopped the area protected by the levee is instantaneously filled with water. The area instantly filled is from Station 500 to 900, up to an elevation of 214.8 feet.

Ineffective Flow Areas

Permanent ineffective flow areas were placed in generally the same manner as the levees. The **Graphical Cross Section Editor** can be used by selecting Add Normal Ineffective Area (1 pt) from the Options menu. The default setting for ineffective flow areas is non-permanent. After the ineffective flow areas are placed, they need to be changed from non-permanent to permanent. This was done by selecting **Tools | Ineffective Areas | Set Ineffective Areas To Permanent Mode**… from the Geometric Data Editor under the Tools menu.
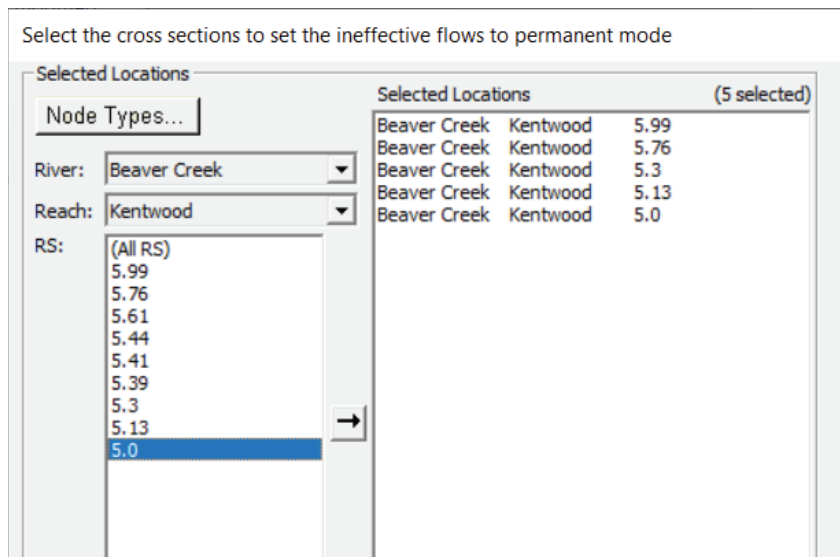

Additionally, the ineffective flow areas may be added by selecting Ineffective Flow Areas… from the Options menu of the Cross Section Data Editor. To set the ineffective flow areas to permanent, the box labeled "Permanent" was checked.
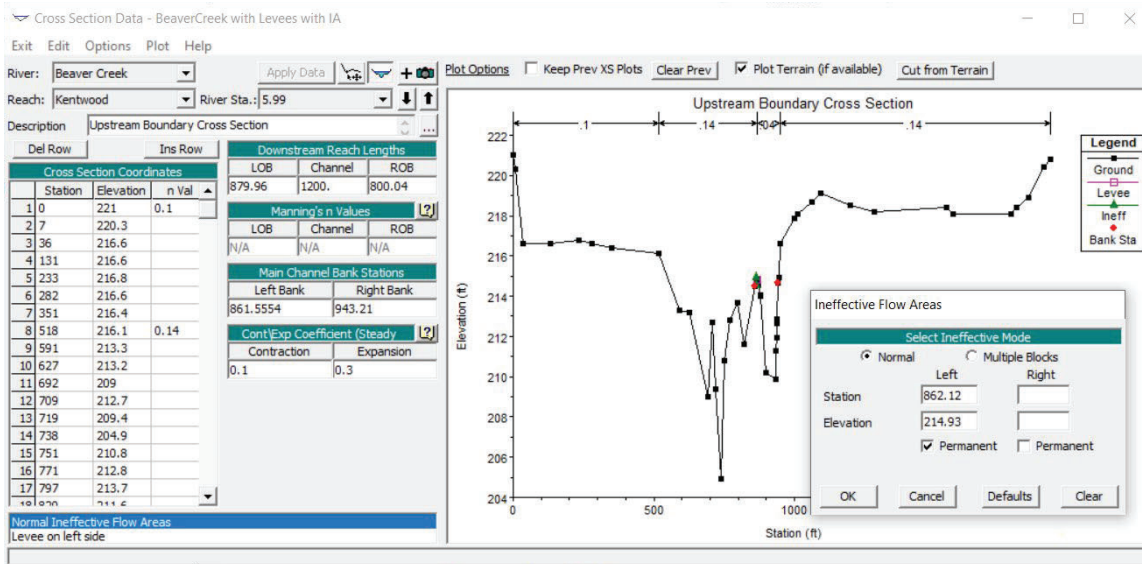
How did the conveyance vs. elevation relationship change compared with the previous task?

The addition of the permanent ineffective area smoothed out the transition of increasing conveyance with increasing elevation. The permanent ineffective flow area behind the levee provides a better representation of what is physically occurring because as the levee is initially overtopped the conveyance in the overbanks will gradually increase.
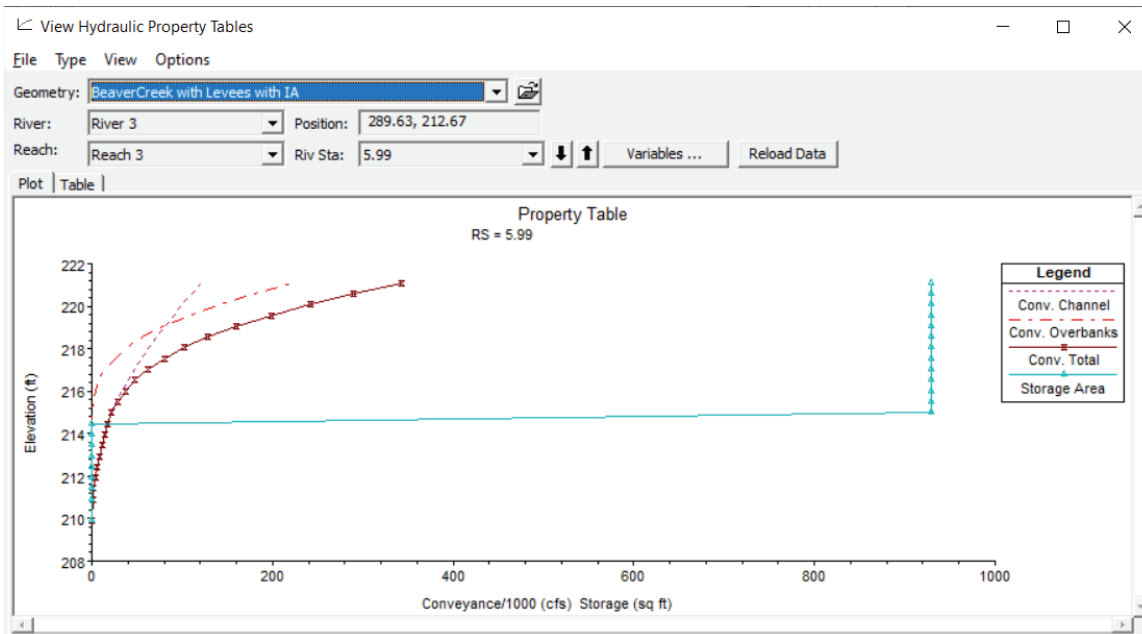
Questions

1. ***Considering that HEC-RAS is a one-dimensional model, what problems will occur if a levee is overtopped during a simulation? What options in RAS can be used to model a levee being overtopped?***

   Because the program is one-dimensional, there can only be one water surface elevation. Thus, when a levee is overtopped the water surface level behind the levee will instantaneously be the same elevation as the water in the main channel. Of course, this is not actually occurring and must be taken into account when modeling. To model this phenomenon correctly a permanent ineffective flow area can be placed behind the levee. The sudden increase in water behind the levee will be seen by the program as storage, and not conveyance.

   Another application would be to place high Manning's n values behind the levee. The high Manning's n value will hinder conveyance in the same manner as a permanent ineffective flow area.

2. ***Are there any anomalies with the conveyance in the overbanks at River Station 5.3? If so, what is it caused by, and how can it be fixed?***

   There is a break in the smooth relationship between conveyance and elevation. By examining the table it is found that this break occurs between the elevations of 213.9 and 214.5.
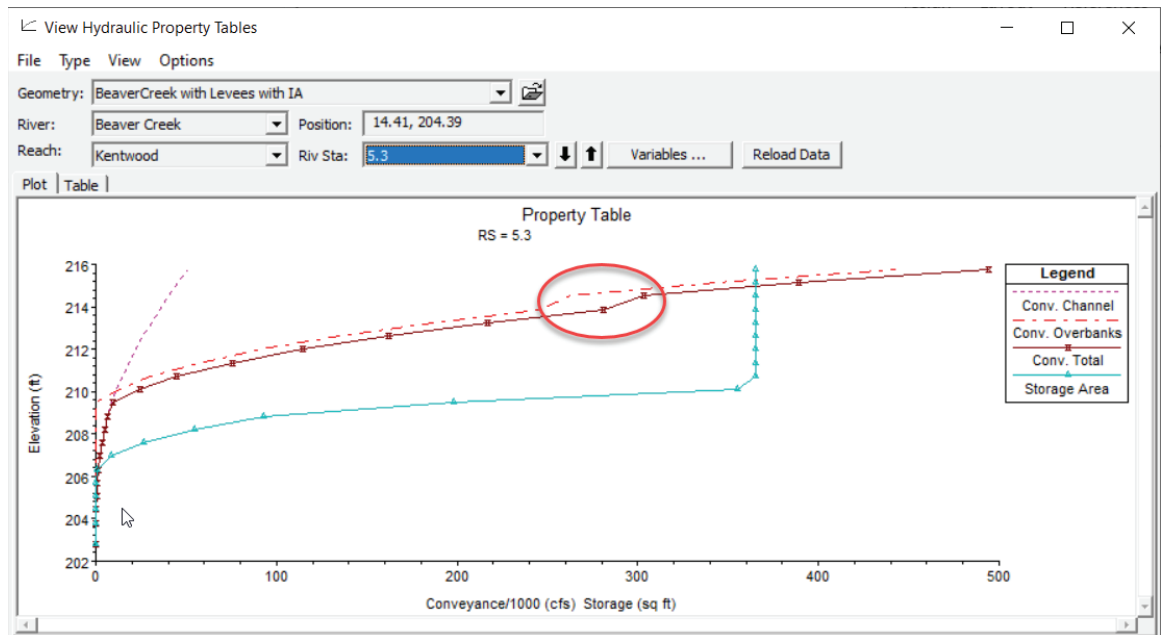
   Next, the cross section geometry is examined at this elevation. The right overbank geometry dramatically changes at this point.
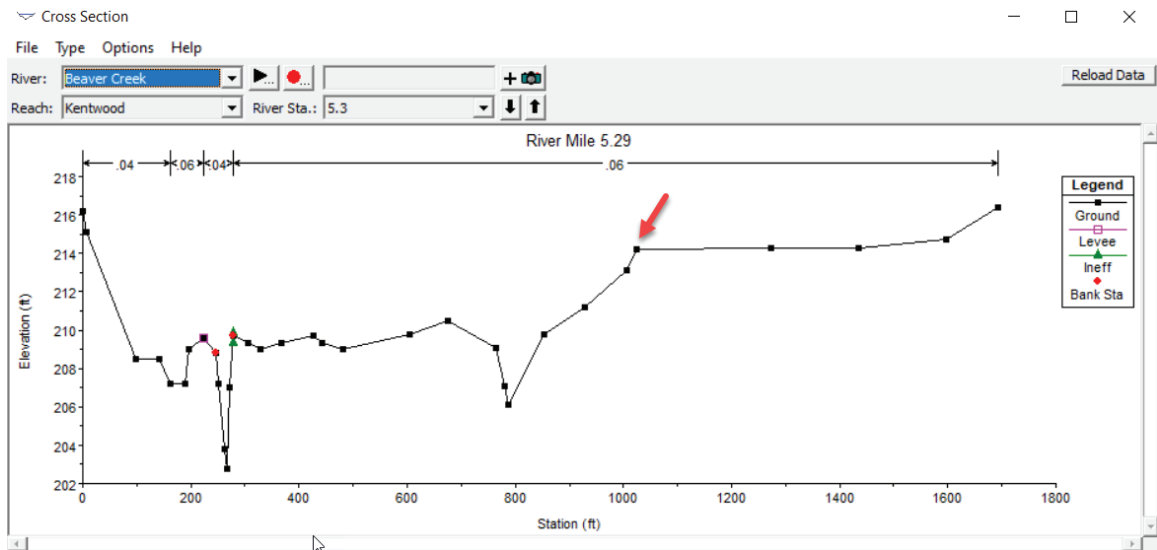
In HEC-RAS, the determination of total conveyance for a cross section requires that flow be subdivided into units for which the velocity is uniformly distributed. The approach used in RAS is to subdivide flow in the overbank areas using the locations where n-values change. The program sums up all the incremental conveyances in the overbanks to obtain a conveyance for the left overbank and the right overbank.

HEC-RAS uses Manning's equation to calculate conveyance. Imbedded in this equation are relationships for channel depth, channel area, and wetted perimeter. In this example, when the calculations go just above the elevation of 214 feet, Manning's equation sees an enormous increase in wetted perimeter for a minute increase in water depth. The conveyance answer found from this calculation is dramatically different from the conveyance answer found at the previous calculation below 214 feet.

To account for this situation another subdivision for Manning's n must be added at the point of discontinuity. The value does not need to be different, as long as the subdivision is present, RAS will calculate separate conveyances for the geometry.

As seen below, this subdivision for the conveyance calculations smoothed the relationship between conveyance and elevation.
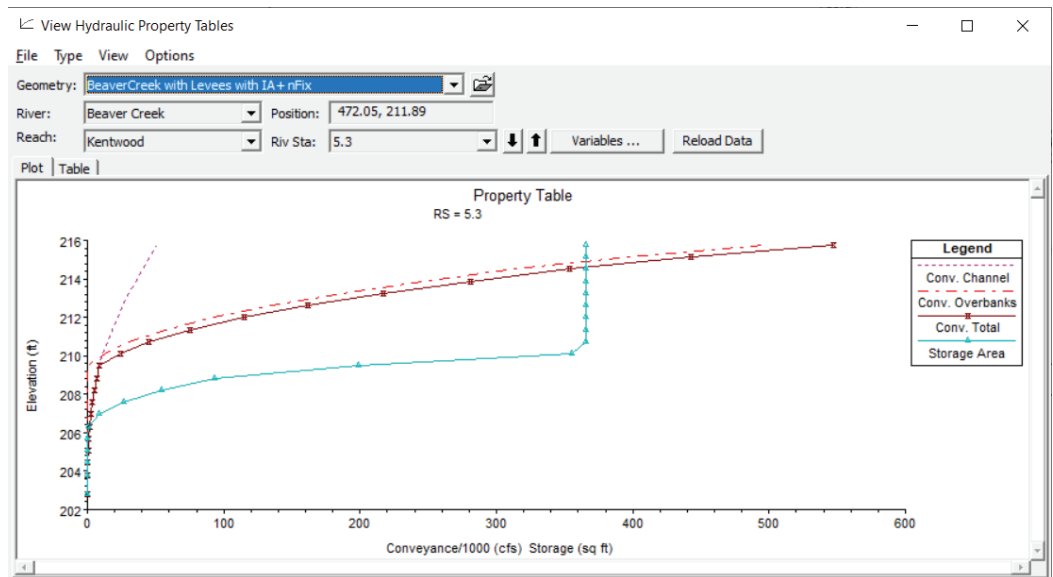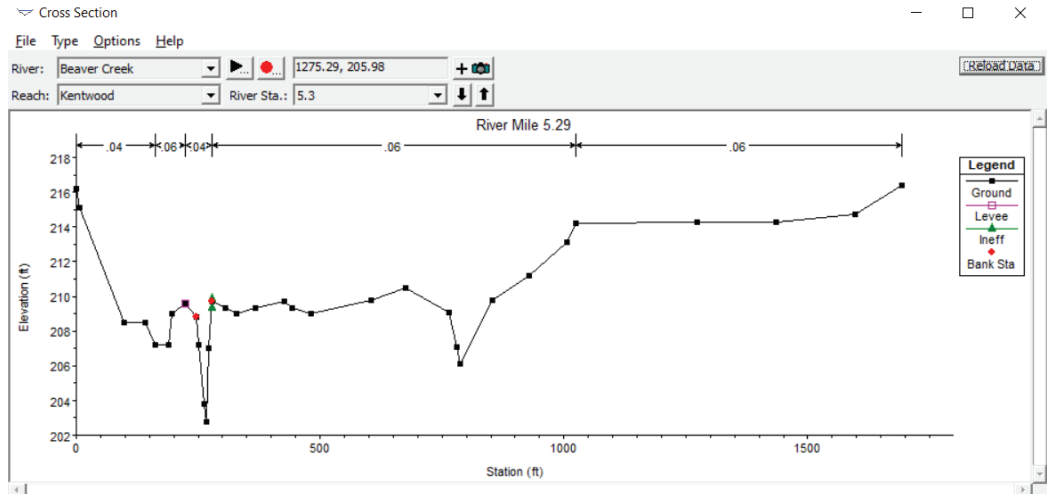
3. **How does a permanent ineffective area affect storage within the cross section?   When should a cross section be modeled with non-permanent ineffective areas and when should it be modeled with permanent ineffective areas?**

    A permanent ineffective storage area behind a levee will quickly add storage to the cross section once the levee is overtopped. If there was no levee, the area of storage would gradually increase with elevation.
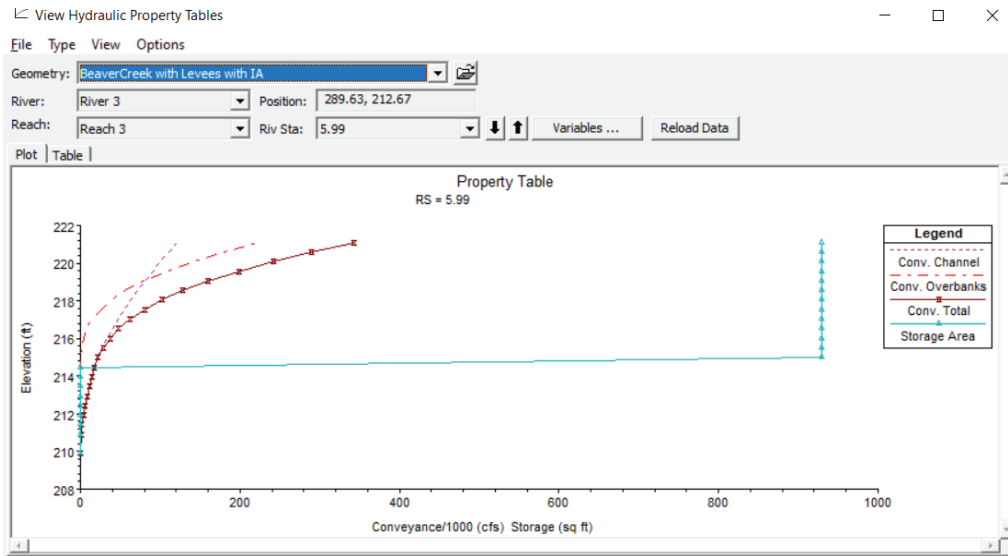
If it is assumed that the entire ineffective area will begin to convey flow once a particular water surface elevation is reached, then the ineffective area should be modeled as non-permanent. If it is assumed from the geometry that a particular area will never convey flow then the area should be modeled as permanent.

Note: If the cross sectional geometry denotes a significant change in storage or conveyance when a levee is overtopped then this cross section should be altered. The cross section should be terminated at the levee and the area that was deleted should be modeled as a storage area. Abrupt and significant changes in storage and conveyance should be avoided because they can cause instabilities in the unsteady flow model.