Analyzing Your Data

Once the data has been collected, it is entered into a spreadsheet template which computes the peak-to-peak (maximum of the six measurements minus minimum measurement) water-level change for each reference point. This water-level change is the tidal range. The spreadsheet should be set up to compute the tidal range as well as the ratio of the upstream to downstream tidal ranges.

The data can be visualized by graphing both upstream and downstream water-level changes for each crossing on the same axes. To do this, compute the mean distance to the water surface for both the upstream and downstream data sets, then subtract the mean from each data set, and then plot the resulting values as a function of time of day.

If the crossing creates no restriction, then the upstream and downstream curves should lay over each other and the measured peak-to-peak upstream and downstream level changes will be within 1-2 inches of each other (Figure 16). If there are significant differences between the curves of the upstream and downstream tidal ranges, then the crossing is altering the tidal flow (Figure 17).

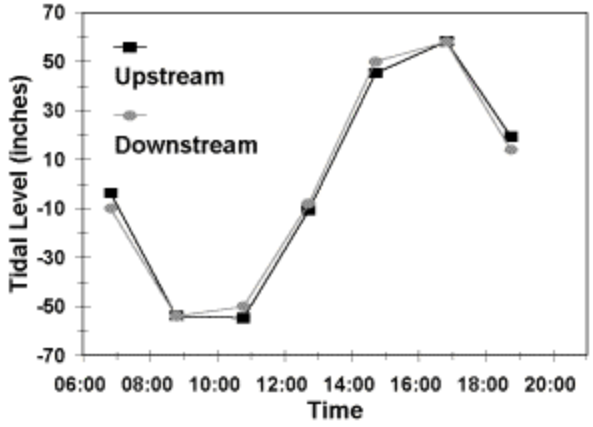

Figure 16. *Example tidal data from an unrestricted site. Note that the upstream and downstream curves are almost identical. Tidal level at each time point for the upstream curve is computed as the difference between the measured value and the average value for the upstream data and likewise for the downstream data.*

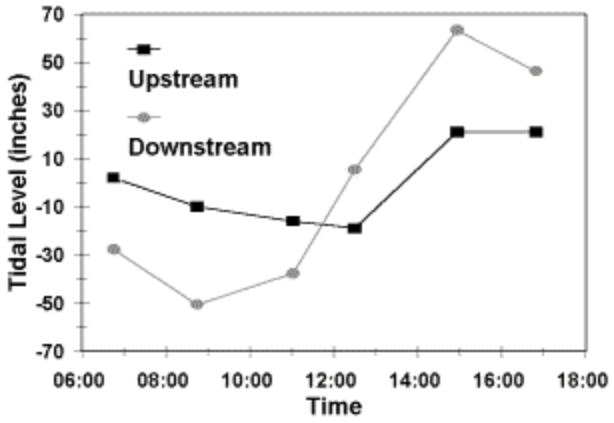

Figure 17. *Example tidal data from a restricted site. The large difference between the upstream and downstream curves is the result of a severe restriction due to the collapse of a culvert.*

Notice in Figure 17 that the upstream tide cycle is delayed somewhat with respect to the downstream data. This is typical of an extremely restricted site and is due to the fact that the upstream high tide is so much lower than the downstream tide that water is still moving through the restriction to the upstream tide, even when the downstream tide is starting to go out.

We chose to define a crossing as being significantly restricted if the difference between the upstream and downstream tidal range was more than 5 inches. This may or may not mean that the marshes are suffering because of the reduction of tidal now. To determine the effects on the salt-marsh habitat may take years of research, but it is likely that, if a culvert or bridge is limiting the amount of salt water entering a marsh, marsh productivity will be diminished or the salt-marsh habitat will change to brackish or fresh marsh and in some cases upland species may invade the former marsh. Also, the alteration of salt-water flow will increase the chances that invasive species such as phragmites will take hold.

The most common type of restriction in our study area was the case where the culvert was located too high. At these sites, water becomes trapped on the upstream side of the crossing, once the tide drops below the bottom of the culvert. The result is a tidal curve on the upstream side that has a narrow peak at high tide and is flat over much of the rest of the tidal cycle (Figure 18).

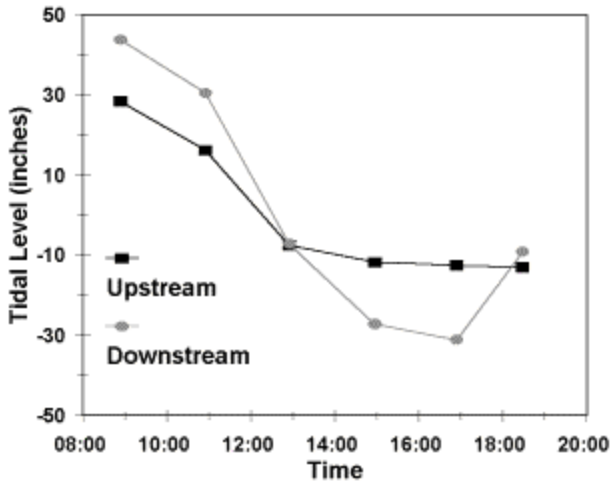

Figure 18. *Example tidal data from a site where the culvert was located too high. The upstream curve exhibits little tidal change during the four afternoon data points due to water trapped behind the culvert.*

The rise and fall of the tide should progress gradually on both sides of the crossing as shown in Figure 16. If any of the curves have more than one peak or otherwise look irregular, the data should be questioned. The most common error we found was that, on a few occasions, volunteers would switch their upstream and downstream measurements when they recorded them on the data sheets. This error can usually be spotted as irregularity in both curves at the same time point.