Comparative Analysis of Discharge Measurement Methodologies in an Urban Environment

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Abstract

Restoration projects within urban systems frequently encounter data collection related to flow and stage at various cross sections. One of the common complexities associated with urban projects relates to the influence of stormwater on the hydrograph. While restoration practitioners rely on tools such as Manning’s equation and hydraulic and hydrologic modeling for estimates of bankfull discharge, it can often be challenging to determine a reliable value for a given reach. Verifying this discharge and the associated elevation of bankfull is critical to the design of a successful restoration project. The collection of field data to achieve an accurate bankfull discharge measurement has previously been limited by the ability to be on-site during various flow conditions and collect velocity data over a range of flows. In an effort to collect reliable data at the Meadow Creek restoration site prior to design and construction, an Acoustic Doppler Current Meter (Sonartec Argonaut SW) was installed to take continuous measurements of stage and velocity at a given cross section. The data are stored on a data logger and downloaded periodically. That information is processed and over time it is information necessary to create a stage-discharge relationship for that given location. To augment that information, a number of spring storms. The upper graph shows recorded water temperature and voltage readings. The lower graph displays the stage and velocity data. The students measured channel cross-sectional stage and velocity over a number of months to build a discharge relationship. In the stage-discharge graph below two storm events are plotted to compare the data collected and downloaded separately. Data are exported and entered into Excel. Individual storm hydrographs can then be analyzed and a stage-discharge relationship can be established from the measured and calculated data.

Argonaut Post—Collection Data Processing

Data collected from the Argonaut was compared to those collected by the students. Their data set is comparable to the Argonaut data, in that the flow meter is capable of collecting accurate flow data at lower water surface elevations than the Doppler gauge. Also, our goal is to verify the stage-discharge relationship and no relationship exists or an effort to obtain additional data. The limitations of the Argonaut is that it is located at one point in the cross section (mid-channel) and does not sample the entire cross section at any given location across the channel. With the hand-held flow meter, the students are collecting depth integrations samples across the channel. The Argonaut does however, measure velocity in individual cells through the water column and averages this value. As the students collect more comprehensive data set in a wide variety of flow conditions, additional comparisons can be made between the two methods.

Method Comparison

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Conclusions

The use of automatic data collection for the purpose of measuring stage and flow is a valuable addition to this data set and restoration practitioners, previously limited only to locating and monitoring stations. The inability to accurately and safely measure flow during storm events limited designers to the use of models to predict the discharge associated with bankfull water surface elevation and flows of greater magnitude. The issues we have encountered throughout the use of the Argonaut SW Acoustic Doppler Current Meter include loss of usable data sets due to sediment deposition on the sensors, battery failure, and inability of the gage to measure stage and velocity accurately at depths less than one (1) foot. Augmenting the Argonaut data set with hand-held flow meter data collection has helped to reduce this problem and lack of flow measurement data at shallow depths. As seen in the table below, values calculated for a given storm event can vary considerably by the use of modeling alone. It is much more desirable to have the data provided by a gage such as the Argonaut to more accurately determine the bankfull discharge that the designer should be using for restoration. Further, data collection will be conducted on the Argonaut at different times of the year and during the rain events that result in the various stage and flow conditions.