OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM NO. 2003.01

SUBJECT: Discharges computed using Sontek RiverSurveyor Acoustic Doppler Current Profiler

To ensure that data collected by the U.S. Geological Survey is of the highest quality and scientifically defendable, the Office of Surface Water (OSW) is conducting a field evaluation of commercially available acoustic Doppler current profilers (ADCPs) for use on moving boats. This evaluation has identified two computational problems in SonTek RiverSurveyor software. The first of these problems introduces a negative bias into all discharges processed with versions of RiverSurveyor prior to version 3.4. The second problem is associated with processing data collected using GPS.

The first problem results because versions of RiverSurveyor prior to 3.4 did not include the "mounting/transducer depth" in the depth of flow used to compute the edge discharges. Thus, edge discharges were computed with a water depth less than the actual water depth and measured discharges are smaller than they should be. The magnitude of this error depends on the measurement section; however, errors between 1 and 2 percent have been observed in the evaluation data collected by the OSW. Version 3.4 of the RiverSurveyor software corrects this error. *All discharges* processed with versions of Sontek RiverSurveyor prior to 3.4 during the 2002 Water Year should be reprocessed with River Surveyor version 3.4.

Sontek identified the second problem, which occurred when processing GPS-based discharges using versions of RiverSurveyor prior to version 3.1. OSW personnel have not evaluated RiverSurveyor version 3.1, but did identify this change in version 3.33. To understand problems associated with GPS-based measurements computed using versions of River Surveyor prior to version 3.1, you need to understand two groups of buttons that RiverSurveyor uses to set the velocity reference and bottom track display (figure 1). The bottom track display is a confusing title for this group of buttons because when set to GPS it displays the GPS track, not the bottom track. The bottom track display set of buttons, based on their title, (figure 1) appears to only control the display, and this was the case for versions prior to version 3.1. However, in version 3.1 and later, the rightmost buttons (bottom track display) also determines how the widths of the cross section and individual profiles are

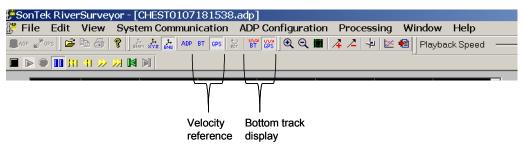


Figure 1. Toolbar from RiverSurveyor with velocity reference and bottom track display buttons identified.

Table 1. Combination of water velocity and boat references available in RiverSurveyor versions prior to 3.1.

	Velocity Reference Buttons	Bottom Track Display Buttons
1	Bottom Track	Bottom Track
2	Bottom Track	GPS
3	GPS	Bottom Track
4	GPS	GPS

computed (either based on bottom tracking or GPS) and thus alters the computed discharge. In RiverSurveyor version 3.1 and later, the user can compute four different discharges (table 1). Only the first and last combinations are valid, where both the velocity and track display references are the same. The speed and direction of the boat is needed to correct the measured velocity for the instrument motion and to measure how far the instrument has moved across the stream. If the two sets of buttons are not set to the same value, RiverSurveyor will use different references for computing the velocity and the width of the cross section. For example, using the second combination in Table 1 would cause RiverSurveyor to correct the measured velocity with a boat velocity measured from bottom tracking but compute the distance traveled across the river based on GPS. RiverSurveyor 3.1 and later will permit any of the four combinations, so the user must be careful to properly set both the velocity reference buttons and the bottom track display buttons to the same reference. In RiverSurveyor versions prior to 3.1, combination 3 was always used when the velocity reference was set to GPS. The bottom track display had no effect and bottom tracking was always used to compute the widths of the cross section and individual profile. Therefore, because of the improper computation of GPS-based discharges prior to RiverSurveyor 3.1 and the edge discharge bias discussed herein, all GPS-based discharges should be reprocessed with RiverSurveyor 3.4 with both the velocity reference buttons and track display buttons set to GPS.

Sontek RiverSurveyor version 3.4 can be downloaded from Sontek's website using either the main RiverSurveyor page:

http://www.sontek.com/product/sw/rivsurv/rssw.htm

or the direct download request:

http://www.sontek.com/cgi-bin/download.cgi?rsrv

Sontek RiverSurveyor version 3.4 also can be downloaded from OSW's Hydroacoustics Web pages, http://hydroacoustics.usgs.gov/software/. Links to other SonTek software and SonTek documentation are also available from the above url.

Issues addressed in this memorandum are the direct result of the hydroacoustics quality-assurance testing program implemented by the Office of Surface Water and the WRD Instrumentation Committee. As new hardware and software becomes available, additional testing and evaluation will be completed. As problems are identified and (or) resolved and sufficient experience is gained to provide sound operational guidance, additional memorandums will be released. Those using acoustic Doppler profilers are encouraged to visit the USGS hydroacoustics web pages for guidance and tools. The URL is: http://hydroacoustics.usgs.gov/

If you have any questions please contact David Mueller (email: dmueller@usgs.gov; phone: 502-493-1935) or Kevin Oberg (email kaoberg@usgs.gov; phone: 217-344-0037 ext. 3004).

/signed/

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