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May 19, 2003

OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2003.04

SUBJECT: Release of WinRiver Software version 10.05 for Computing Streamflow from Acoustic Profiler Data

The purpose of this memorandum is to announce the availability of WinRiver 10.05 for collecting and processing data collected with RD Instruments (RDI) acoustic profilers (Broadband, Rio Grande, Workhorse, and others). The WinRiver software was developed by RDI, in cooperation with the USGS, as a part of a Cooperative Research and Development Agreement (CRADA). The use of WinRiver software by USGS offices was announced in Office of Surface Water Technical Memorandums No. 2000.03 and 2002.03.

RDI released version 10.04 of WinRiver to the public in late January 2003. However, while this release memo was in review, two some minor infrequently occurring bugs were identified. Therefore, a new version of WinRiver, version 10.05, is now being released.

RDI has continued to update and improve the WinRiver software. Various new features are included in WinRiver 10.05 and known problems have been fixed since the release of WinRiver 10.03. [Attachment A](#) contains detailed information about [major enhancements in WinRiver 10.05](#), including

- implementation of [configuration file locking](#),
- addition of a [discharge measurement summary wizard](#),
- updates to the [configuration wizard](#) for configuring RDI ADCP's, and
- addition of new [velocity profile extrapolation techniques](#).

The following policies and guidance are offered regarding the use of WinRiver 10.05 with RDI ADCP's. (A more detailed explanation of items 2 – 5 are presented in attachment A.)

1. All USGS users who collect streamflow data using RDI ADCP's should upgrade to WinRiver 10.05. The software is available to USGS personnel who own and use ADCP's manufactured by RDI at <http://hydroacoustics.usgs.gov/software/>.
2. OSW strongly recommends that users begin to use the file-locking feature immediately. Proper use of this feature will help insure that (a) inadvertent changes are not made to the data after the streamflow record is finalized and (b) ADCP data files are not archived with possible inadvertent changes.
3. Use of the new Discharge Measurement Wizard (DMW) is mandatory starting immediately for discharge measurements made in the basic streamflow data collection program. Use of the wizard will help standardize measurement summaries and make reviewing measurements easier. The ultimate goal is to import the measurement summary information into NWIS.

4. OSW strongly recommends that users always make use of the Configuration Wizard (CW) rather than existing configuration files. The Configuration Wizard was described in Office of Surface Water Policy Memo 2002.03. Each time a site is visited, the wizard should be used in order to insure that current site conditions are reflected in the measurement configuration. If any user commands are used to override direct commands created by the configuration wizard, users must document the reason for their use in the measurement notes.
5. With the implementation of new extrapolation techniques, OSW does not believe that there is any instance where a user should set the bottom extrapolation method to *Constant*.

Lists of new features, changes to existing features, and bugs fixed are provided in [Attachment B](#). For further information on use of the WinRiver, please refer to the *Help* menu and to the software release notes and documentation. If you have any questions or comments about the policies and guidance in this memo, please contact Kevin Oberg (kaoberg@usgs.gov) or the OSW Hydroacoustics Work Group (hawg@simon.er.usgs.gov).

/signed/

Stephen F. Blachard
Chief, Office of Surface Water

Attachment A (See attached file: sw2003_04AttachmentA.pdf)

Attachment B (See attached file: sw2003_04AttachmentB.pdf)

Distribution: Data Chiefs
Surface-Water Specialists
Office of Surface Water
HAWG
Cc: A, B, District Chiefs

Attachment A – Description of Important Enhancements in WinRiver 10.05

In the following sections, italicized text refers to menu options or buttons in the WinRiver software.

Configuration File Locking

Configuration files for each transect can now be “Locked” and “UnLocked” in Playback mode by selecting *Lock/Unlock Configuration File* under the *File* menu, clicking the *lock/unlock* quick button on the menu bar , or by pressing Ctrl-L. If a configuration file is locked, any changes made to the configuration file while in playback mode will not be saved unless the file first is unlocked. This action prevents accidental saving of changes made to configuration files while “experimenting” with different settings or while reviewing discharge measurements. Locking also is important because the new Discharge Measurement Wizard (DMW) processes transects in the background. Locking the file ensures the configuration file is set up the way you intended for each transect when processed by the DMW. If a file is not locked when processed by the DMW a “U” is placed to the right of the corresponding transect on the printout. Configuration files should be locked for each transect after all settings have been confirmed and prior to running the DMW. A locked file signifies to checkers and reviewers that the configuration settings for these transects have been verified as correct for processing.

Discharge Measurement Wizard

The DMW is a tool that allows the user to summarize the transects that constitute a single discharge measurement. The DMW lets you enter station information (station number, station name, gage height, and other information about the measurement) and creates a summary of the measurement that can be printed and/or saved to a file.

The DMW can be run in Playback mode by selecting *Q Measurements Wizard* from the *File* menu or by pressing Control-Q. Afterwards, a dialog box similar to that shown in figure 1 will be displayed. The dialog box shown in figure 1 already contains user input. The user only needs to complete the entries in the dialog box. The diagnostic test, moving bed test, and compass calibration test files can be selected using the button to the right of the respective field.

Q Measurements Wizard [MARS07-10-2001.dmw]

General Information

Station Number: 05543500

Station Name: Illinois River at Marseilles, IL

Party: KAO, AMW Date of Measurement: 07/10/2001

Boat/Motor: Whaler w/ trolling motor Measurement Number: 370

Processed By: DSM/AMW ADCP Serial Number: 552

Meas. Location: 0.3 miles downstream of Marseilles Lock

Rating Information

Inside Gage Height [ft]: 2.39 Rating Number: 16

Outside Gage Height [ft]: 2.39 Measurement Rating: Fair (8%)

Gage Height Change [ft]: 0.01 Control Code 1: 1-Unspecified

Rating Discharge [ft³/s]: 7774 Control Code 2: 1-Unspecified

Index Velocity [ft/s]: 0 Control Code 3: 1-Unspecified

Rated Area [ft²]: 0 Water Temp. [°F]: 65.0

Support Files

Diagnostic Test Filename: mars0710.01

Moving Bed Test Filename: mars-mbed-071001.txt

Compass Calibration Filename: mars-ccal-071001.txt

Magnetic Variation Method: On Site

Remarks:

Concurrent Price AA comparison measurements were made upstream by another party

Open Save As Select/Process Files Print Close

Figure 1.--Discharge Measurement Wizard dialog box

When data entry on this form is complete, the user can select the rawdata files that comprise the measurement by clicking the *Select/Process Files* button at the bottom of the DMW dialog box (fig. 1). An example of file selection is shown in figure 2. All files to be used for the measurement must be selected at the same time. Multiple files may be selected by holding down the Ctrl key while clicking on the desired files.

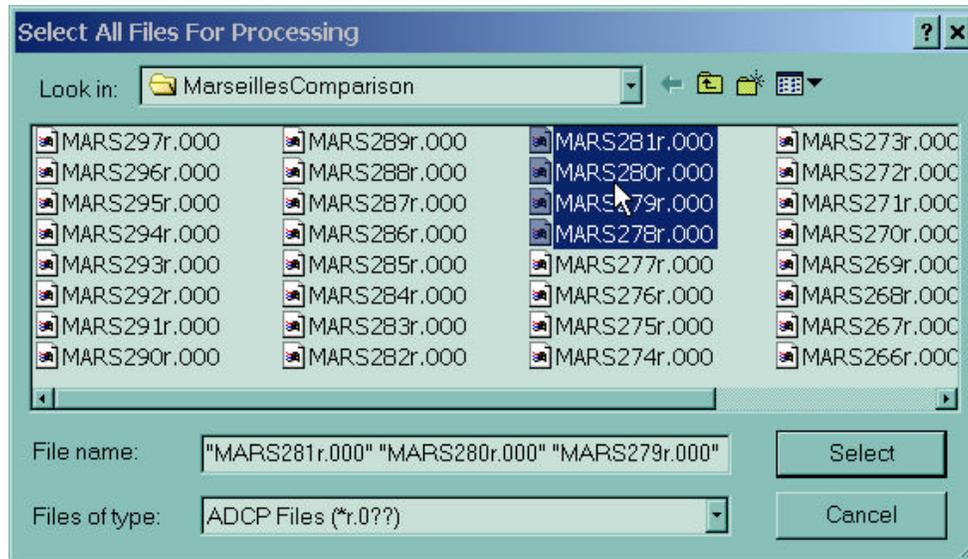


Figure 2.--File selection dialog box for the Discharge Measurement Wizard

Once the files are selected and processed, the DMW processes the files in the background. The results then can be displayed on the screen and, subsequently, printed by clicking the *Print* button from DMW dialog box. Finally, the results of the DMW can be saved by clicking the *Save As* button. It is recommended that the DMW file be saved and archived with the other measurement data files. The DMW printout can be trimmed and folded to standard measurement note size (5x8 inches).

The DMW summary includes user-entered data (shaded areas in figure 3) and values computed from the selected transects.

An example output from the DMW is shown in figure 3.

Station No.: 05543500

Meas. No: 370

Station Name: Illinois River at Marseilles, IL

Date: 07/10/2001

Party: KAO, AMW	Width: 573 ft	Processed by: DSM/AMW
Boat/Motor: Whaler w/ trolling motor	Area: 5,730 ft ²	Mean Velocity: 1.03 ft/s
Gage Height: 2.39 ft	G.H.Change: 0.01	Discharge: 5,900 ft ³ /s

Area Method: Mean Flow	ADCP Depth: 0.58 ft	Index Vel.: 0.00 ft/s	Rating No.: 16
Nav. Method: Bottom Track	Shore Ens.: 10	Adj. Mean Vel: 0.00 ft/s	Qm Rating: F
MagVar Method: On Site (0.0°)	Top Est: Power (0.1667)	Rated Area: 0.000 ft ²	% Diff: -3.3%
Depth Sounder: Not Used	Bottom Est: Power (0.1667)	Control: Unspecified	

Screening Thresholds:	ADCP:	
BT 3-Beam Solution: ON	Type/Freq.: Rio Grande / 600 kHz	
WT 3-Beam Solution: OFF	Serial #: 552	Firmware: 10.07
BT Error Vel.: 32.81 ft/s	Bin Size: 10 cm	Blank: 25 cm
WT Error Vel.: 32.81 ft/s	BT Mode: 5	BT Pings: 1
BT Up Vel.: 32.81 ft/s	WT Mode: 5	WT Pings: 1
WT Up Vel.: 32.81 ft/s	ADCP Temp.: 84.6 °F	WZ: 5
Max. Vel.: 2.46 ft/s		
Max. Depth: 15.6 ft		
Mean Depth: 10.0 ft		
% Meas.: 74.88%		

Diag. Test: mars0710.01

Filename Prefix: MARS

Moving Bed Test: mars-mbed-071001.txt

Software: 10.04.00

Compass Test: mars-cca-071001.txt

Meas. Location: 0.3 miles downstream of Marseilles Lock

Tr.#	Edge D.		#Ens	Discharge						Width	Area	Time		Mean Vel.		% Bad		
	L	R		Top	Middle	Bottom	Left	Right	Total			Start	End	Boat	Water	Ens	Bins	
266	R	25	29	891	918	4502	500	14.0	32.7	5967	572	5728	10:41	10:48	1.27	1.04	1	8
267	L	25	28	914	910	4386	486	14.2	32.9	5830	574	5694	10:49	10:57	1.27	1.02	1	8
268	R	25	28	1206	931	4504	542	20.1	38.3	6035	572	5760	10:59	11:09	0.93	1.05	2	10
269	L	25	28	735	900	4375	526	13.4	33.5	5848	575	5771	11:10	11:16	1.47	1.01	6	10
270	R	26	28	910	900	4312	550	21.1	24.0	5806	571	5704	11:27	11:34	1.37	1.02	5	12
Mean	25	28	931	912	4416	521	16.6	32.3	5897	573	5731	Total	00:53		1.26	1.03	2	10
SDev	0	0	171	13.1	84.4	27.0	3.74	5.17	98.9	2	34				0.20	0.02		
R/M%	4	4	50.6	3.4	4.4	12.2	46.7	44.3	3.9	0.7	1.4				42.18	3.34		

Remarks: Concurrent Price AA comparison measurements were made upstream by another party.
Flow is relatively slow and not altogether uniform across the measuring section.

Figure 3.--Example output from Discharge Measurement Wizard

Configuration Wizard

The configuration wizard (CW) is the tool that should be used to set up an ADCP for data collection. Since this feature became available in version 10.03, the number of user errors in configuring an ADCP has been greatly reduced. Data collected when the CW has been used tends to be better quality and with many fewer mistakes. The CW is invoked in Acquire mode by selecting *Configuration Wizard* under the *Settings* menu or by pressing Shift-F6. OSW recommends that the CW be used every time a site is visited, so that the user can enter information that reflects the current site conditions. An example of the configuration wizard is shown below.

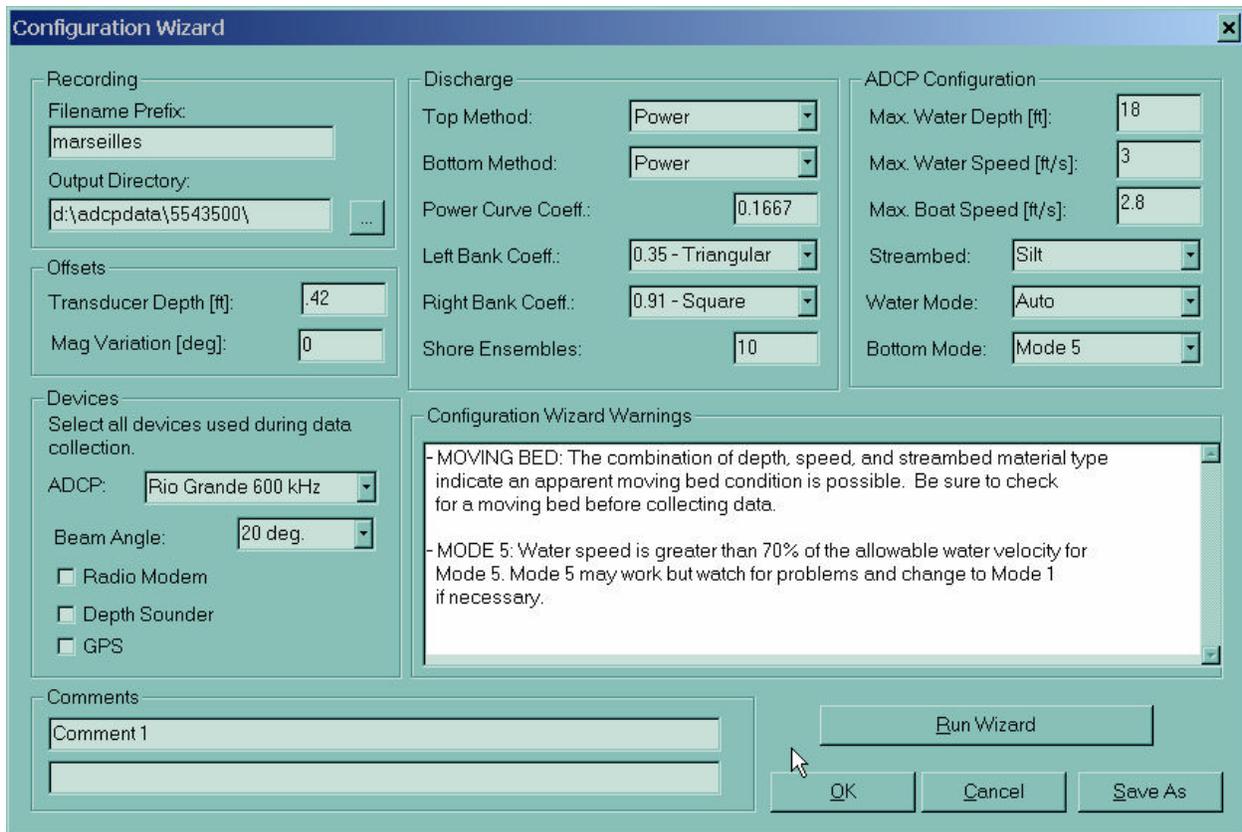


Figure 4.--Configuration Wizard Dialog Box

When the *Run Wizard* button is clicked, the wizard verifies that the required fields have been entered by the user and uses these values to generate a configuration file for the measurement. The appropriate direct commands are specified, based on rules supplied by the USGS to RD Instruments, including depth cell size, number of depth cells, ambiguity velocity, and water mode. Any questionable configuration settings are displayed in the *Configuration Wizard Warnings* window. The CW also scales the chart properties accordingly based upon the entered values.

Support for new water and bottom modes has been added to the CW. OSW currently does not have guidance on the use of water modes 11 and 12, or bottom mode 7; therefore care should be exercised prior to using these water modes. Water modes 11 and 12 never are chosen when the water mode is set to *Auto*, and the CW always selects bottom mode 5 by default. OSW suggests

that the Hydroacoustics Work Group (HAWG) (hawg@simon.er.usgs.gov) be contacted for guidance prior to use of these modes. It also is important to remember that these modes are not available on every ADCP.

Velocity Profile Extrapolation Techniques

As a result of suggestions by the USGS, RDI has implemented two new extrapolation methods in WinRiver 10.05 based on algorithms the USGS proposed.

3-point Slope Method

The 3-point slope method uses the velocity cross-product for the top 3 bins to estimate a slope. This slope then is applied from the first depth cell below the water surface having valid velocity data to the surface. If there are less than 6 depth cells with valid data in the profile, a constant value or zero slope is assumed. It is believed that this method may prove useful in situations where the ADCP measurements indicate that there is bi-directional flow or wind induced shear. However, this method should be used with caution, especially in situations where the slope of the velocity cross-product is large in the top 3 depth cells.

No-Slip Method

The No-Slip method is used for extrapolation near the bed. A power curve is fit to the velocity cross-product data for depth cells having valid data in the lower 20% of the water column and assuming the power curve is zero at the bed. In the absence of valid velocity data in depth cells located in the lower 20% of the water column, the velocity cross-product for the last valid depth cell is used and the power curve is assumed to be zero at the bed. When electing to use the no-slip method, the user is specifying that a power curve does not accurately represent the entire profile.

Normally, the power curve method is used to estimate discharges for depth cells that (a) have invalid velocity data and (b) are NOT located such that they are either the first (near surface) or last (near bed) depth cell in the profile. However, if the No-Slip method is selected, discharges for depth cells with invalid or missing data are estimated by linearly interpolating between the first depth cell with valid data immediately above and the first depth cell with valid data immediately below the depth cell with missing data. In this case, the measured discharge (the discharge for that part of the water column directly measured using the ADCP and NOT including the top, bottom, left and right discharge estimates) reported by WinRiver will be different from that reported if either the Constant or power curve methods are used.

Although the WinRiver software and the two methods described above have been tested thoroughly prior to the release of 10.05, the methods are new and OSW suggests that users exercise caution when applying them. Please contact either Kevin Oberg (kaoberg@usgs.gov) or David Mueller (dmueller@usgs.gov) if you have questions about the application of the software and/or methods. Users **never** should choose the *Constant* extrapolation method for the bottom.

Attachment B – Changes to WinRiver since release of version 10.03 and Known Problems with version 10.05

Features Added

1. Added the Discharge Measurement Wizard
2. Add configuration file locking.
3. Added 3-point slope and no-slip extrapolation methods
4. Add new plot windows
 - Combo Shiptrack Plot. Plots both bottom track and GGA reference (DGPS) shiptrack on one plot when available.
 - Total Discharge Time Series Plot. Plots the total discharge of each transect in the discharge tabular history and time.
5. ASCII out Batch Processing
 - Multiple files can be selected for ASCII out batch processing at one time. After selecting various files, the program loads, processes, and outputs ASCII data to files (with automatically generated names *t.000). Any existing file with the default ASCII name will be overwritten automatically without any warning. Clicking the Cancel button on the message box that appears while processing can stop the conversion.
6. Default direct commands now include &E000000011
7. GPS update rate added to the GPS Tabular View.
8. In Acquire mode configuration comments are open now for edit until recording has been turned off.
9. Default user options setting has been changed to NOT start pinging immediately upon entering acquire mode.
10. Added menu item to execute an external program for running a self-test, and for executing an external program for calibrating and reading a pressure sensor.
11. Minor serial communications changes. Ensemble size limited to 10 kilobytes
12. A Date/Time stamp corresponding to the time when a transect was started now can be added automatically to the file name prefix. This option is enabled with a checkbox in the configuration settings under the recording tab.
13. Added capability to edit comment lines during data collection. If this option is checked each transect will have a unique filename prefix. This is not recommended for discharge measurements
14. Added depth screening option. Filters out a beam depth if the depth is greater than 1.75X any other beam. This option is disabled by default and should only be enabled to remove obvious depth errors.

Changes made to existing features

1. Added functionality to the Configuration Wizard.
2. Modified Subsection behavior. When a user changes the subsectioning if the current ensemble is equal to the last ensemble and the new last ensemble is greater than the current ensemble, WinRiver assumes that they want to playback the file to the end (new last ensemble).
3. Discharge profile now plots the bottom and top fit used for both the top and bottom extrapolation methods. The measured discharge displayed on this plot is computed as $Q = ((\sum (q / dt) / n) * Dt) / N$ where q = the discharge of a valid bin, dt = time of the valid bin, n = the number of valid bins, N = the number of ensembles, and Dt = total time of all bins (both valid and invalid) in the average.
4. Stick Ship track Stick Magnitude now is scaled to the chart properties maximum velocity magnitude.
5. Changed BX to be twice the old length in the configuration wizard, to correct inconsistency with the way the firmware handles BX and &R.
6. Changed the way ensembles are flushed to the hard drive. File buffers are flushed every ensemble instead of every 20 ensembles.

Bugs Fixed

1. Fixed the problem with PC clock time in navigation file in the \$RDENS line
2. Fixed problem with number of pings per ensemble in averaged data (ASCII-out). The number would stay constant during averaging.
3. Changed software break from "====" to "===== ". Users had problems in stopping pinging when using modems.
4. Fixed problem with computer not responding at the end of long transects.
5. Fixed auto-detect function that still was sending a hardware break even when a soft break was selected.
6. Fixed bug in ASCII Out when "as Received from ADCP" was selected.
7. Increased DBT section size by 10 bytes. In the previous versions, 38 bytes were reserved and a customer had an echo sounder that sent a longer string.
8. Fixed problem with incorrect scaling of VTG velocity.
9. Fixed auto-detect function. The program would crash on some machines.
10. Fixed the problem with opening ports > COM9.
11. Fixed a typo on Expert Menu.
12. Fixed a bug that happened when a user opened a discharge measurement wizard file that had GPS as the reference. The values displayed in the DMW summary were incorrect.

13. Changed the method for detecting available COM ports. Some COM ports were not always correctly detected by WinRiver.
14. Fixed a problem in properly handling the decoding of GPS data when no data were available in the GGA string (ie., no satellite fix was available).

Known Problems

1. After installing WinRiver 10.05, it is possible for the program to crash when switching from Playback Mode to Acquire Mode (*Ctrl-M*). A description of the problem follows. When switching from Playback Mode to Acquire Mode, the user is prompted as follows: **“Would you like to load a different configuration file?”** If the user selects **“No”**, the program can crash if a configuration file has never been loaded in Acquire mode.

This problem can be avoided by first running WinRiver in Acquire mode, either by double-clicking the corresponding desktop icon or by going to the start menu and selecting "Programs—RD Instruments—WinRiver (Acquire)" menu. After that, the user should load an existing configuration file or create a new one. After doing so, and exiting WinRiver, this problem should not occur again.