Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedure for Operation of Mechanical Velocity Indicators

Version 1.0

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EAP059

Signatures on File

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Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method. Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology. Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)

Environmental Assessment Program

Standard Operating Procedure for Use of Mechanical Velocity Indicators

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Freshwater Monitoring Unit (FMU) Standard Operating Procedure (SOP) for use and maintenance of mechanical velocity indicators.

2.0 Applicability

2.1 This SOP should be followed when sampling stream flow using the Swoffer 2100 and Hydrological Services velocity indicators. This document includes the approved methods for calibration, troubleshooting, and operation of all Swoffer 2100 and Hydrological Services velocity indicators currently in operation with the FMU.

3.0 Definitions

3.1 HS – Hydrological Services.

3.2 Fan – The propeller that attaches to the meter used to determine velocity.

3.3 Meter – The counting unit that attaches to the wading rod, bridge reel or boat reelused to measure velocity.

3.4 Hydromate – The HS computer box that attaches to the meter and fan. Hydromate counts revolutions of the fan and converts them into a velocity measurement.

3.5 CFS – Cubic feet per second

3.6 FPS – Feet per second

3.7 ADV – Acoustic Doppler Velocimeter.

4.0 Personnel Qualifications/Responsibilities

4.1 This type of field work requires a minimum of two technicians to safely perform.

4.2 Training in the use of Swoffer and Hydrological Services equipment and hardware as well as experience with flow sampling and stream flow gaging.

4.3 Training in safety procedures for working in wadeable streams, on bridges, floating structures and near/over open water. Personnel must also possess and properly employ the approved safety gear for each specific environment.

4.4 Staff must understand and follow the Freshwater Monitoring Unit guidelines for stream flow monitoring outlined in the Quality Assurance Monitoring Plan.

5.0 Equipment, Reagents, and Supplies

5.1 Approved life jackets, waders, and foul weather gear
5.2 Field Log Notebook with "Write in the rain" field forms
5.3 300 ft. transect tape with tenths of a foot demarcation
5.4 Tool box with listed tools present (appendix B)
5.5 Replacement parts for hardware
5.6 Swoffer 2100 velocity indicator or HS "Hydromate" counter
5.7 Top set wading rod or bridge equipment with Swoffer 2100 or HS fan insert
5.8 Swoffer 2100 or HS connector cables (length dependent upon application)
5.9 Two 9 volt batteries
5.10 Keys to access station house for data collection platforms (DCP)

6.0 Summary of Procedure

6.1 Trip Preparation

6.1.1 Prepare a field/float plan before embarking which can be found on the Ecology SharePoint site at: http://ecywblcyadxd0/sites/eap/Field%20Schedules/Forms/AllItems.aspx

6.1.2 *For Swoffer 2100:* Set up a Swoffer fan on the wading rod or bridge crane/board meter and tighten the allen set screw taking care to not over tighten and damage or strip the threads in the meter.

6.1.2.1 Turn the selector knob on the Swoffer indicator to CALIBRATE. The number 186 should appear on the screen (fig 1). The Swoffer indicators are temperature sensitive and the calibration value will reflect this. Values between 184 and 188 are considered acceptable as these will result in approximately ±1% error in velocity. If the meter does not display a calibration value or the value is outside the acceptable ranges, change the 9 volt battery located in the back of the indicator and retry. This calibration number is discussed further in appendix A.

6.1.2.2 Next, gently blow on the fan to make it spin. The fan should spin in the meter with little breathing effort required. If there is difficulty or the fan seems sluggish clean and inspect the rotor and inside the fan for dirt or damage or replace it.

6.1.2.3 Thoroughly inspect the Swoffer cables and fittings for wear and replace if damaged, making sure to catalog what was broken and in need of repair/replacement.

6.1.2.4 Now you can perform a spin test to see if the sensor is working within specified tolerances. Set the wading rod or bridge unit on a flat surface with the fan facing straight up. "Turn the indicator knob to count mode and blow very hard straight down on to the fan. The instant you stop blowing on the fan hit the reset key on the indicator and allow the rotor to coast to a stop" (Swoffer, 2009). Any numbers greater than 400 are acceptable. If numbers do not exceed 400, replace the fan, otherwise lower stream velocities (<1.5ft/sec.) could be inaccurately measured. Retest until the readings are acceptable. You should check the fan regularly to avoid malfunctions.

Fig.1 Swoffer 2100 indicator box

6.1.2.5 Re-pack Swoffer and spare parts removing the fan from the meter and store it in a safe place. Make sure to include a spare 9-volt battery.

6.1.3 *For Hydrological Services current meter:* the Hydromate counter box is equipped with a series of equations stored in the memory bank. For each fan there is an exclusively paired meter having a specifically derived equation that is unique to that pair. Be sure to select the appropriate fan serial number from the fan S/N list (see section 6.1.3.5 for further details), otherwise you will compromise the accuracy of your measurements.

6.1.3.1 After ensuring you have the proper fan/meter combination, you will need to add oil to the fan assembly. In the case of the OSS-B1 meter (the HS type unit the FMU uses for bridge measurements) the oil goes into the reservoir in the fan and the OSS-B1 is threaded securely into the meter. When you screw the bearing assembly back on, some oil should ooze out of the reservoir. If no oil comes out, add more oil until it does ooze out. This is somewhat messy so have on hand a couple of shop rags. For the purposes of spot checking individual velocity measurements the oil should be changed once daily but check to insure oil is in fact present in the reservoir at every measurement site. If a complete flow measurement is done with this equipment, oil should be changed after each measurement or if abnormal operation is noted.

Fig. 2 Hydromate indicator

6.1.3.2 After oiling, a spin test must be done to determine any defects in the fan assembly. Spin tests vary depending upon the size and application for each fan. For our application, the A-style OSS-B1 which is most commonly used (velocities of .08-16.4 ft/sec) requires a minimum spin test of 110 seconds (HS, 2009).

6.1.3.3 Turn on the Hydromate indicator (Fig. 2) by depressing the blue “on/off” button in upper right corner. Keep depressed for about 2 seconds until you hear a faint beep and the display screen activates.

6.1.3.4 The screen is a touch screen; all of the command buttons are activated by touching the screen lightly with your finger tip. Do not hit or beat on the touch screen pad, this will eventually ruin the unit. Be gentle. The touch screen perates by touching the on-screen buttons twice. The first touch highlights the button, the second touch activates it.

6.1.3.5 When the Hydromate is turned on the main menu screen will appear. Next, select the equation which matches the serial number of the fan you will be using. At the main screen observe the "Fan S/N" button. The number at the bottom of this button is the serial number of the fan currently selected. If this is not the serial number of the fan you intend to use tap the "Fan S/N" button two times, and at this screen tap the "New Fan" button twice.

6.1.3.6 This new screen displays all of the serial numbers for the fans we have. Tap the up or down arrow buttons to scroll through the list of serial numbers. When the desired fan serial number is highlighted tap the Sel (select) button. **Note that this screen displays the equation of the selected fan. You can double check the correctness of the equation from the Certificate of Calibration.**

6.1.3.7 If for some reason the equation is not correct select the "Edit Fan" button. The arrow buttons direct you to the portion of the equation you need to edit. Once you have selected the part of the equation you need to change choose the "change" button. At the next screen select the 0-9 button and make the necessary changes. Press "OK". On the next screen press "Save". This will put you back to the screen with now updated equation. Select the button "Back to Main".

6.1.3.8 Attach the wiring harness to the meter. Connect the banana plug connectors in proper jacks on the Hydromate (red plug to red jack, black plug to black jack). Tap the "measure" button twice. The counter will immediately begin to measure the velocity. To stop this tap the "Stop" button twice. You will now need to perform a spin test.

6.1.3.9 Prior to spin test hold the meter and fan in the horizontal position and spin by hand for approx. one minute to get rid of the static hydraulic pressure from the oil inside it. Spin test the meter and fan against time. This is required to test the performance of the shaft and bearings Spin test results are dependent on the fan type and temperature (see table below). After the spin test is performed connect your velocity indicator to the counter using the lead. It is important to test the lead, reed switch and counter. Upon completion, breakdown and repack HS instrumentation. A pre-measurement spin test is also advised.

Spin Test Parameters

Fan Number	Time (seconds)
A	Minimum 110 s
1	Minimum 90 s
2	Minimum 90 s
4	Minimum 90 s

6.1.4 Using the trip packing lists (Appendices B, C) load the vehicle with the necessary equipment/tools needed for the amount of stations you will visit including one of the FlowTracker ADV units used for calibration comparison with the Mechanical instruments. Please see the FlowTracker SOP for pre-trip calibration and maintenance procedures.

6.2 Pre-Measurement Calibration of mechanical meters by FlowTracker Comparison

6.2.1 Upon arriving at your chosen cross section (see Measuring and Calculating Stream Discharge SOP for details on choosing cross sections) you will perform a pre-measurement discrete velocity comparison with the FlowTracker (see FlowTracker SOP for operating instructions) in a section of water that has an average velocity between 0.5 and 1.0 fps (Butkus, 2005). This pre-measurement test is to determine if the mechanical meter used is operating accurately at lower velocities.

6.2.2 *Pre- measurement preparations for the Swoffer meter:* Re-attach the fan to the Swoffer meter wading/bridge assembly with the allen set screw. Gently blow on the fan again to make sure it spins freely.

6.2.2.1 After connecting the cables for the Swoffer and mounting the prop on the wading rod, turn the indicator knob to the medium velocity setting on the meter (20 seconds).Once the wading rod is set to the proper depth, is held level, and the knob on the Swoffer meter is set in the correct position, press the reset button on the meter. You are now taking a 20 second measurement. Skip ahead to section 6.2.4 for the FlowTracker comparison.

6.2.3 *Pre-measurement preparations for the HS meter:* Install the fan onto the shaft of the meter. Push onto the shaft until you hear or feel a click. Attach the meter/fan assembly to the wading rod or bridge unit using the allen wrench provided. Repeat sections 6.1.3.3 through 6.1.3.9.

6.2.4 Set up your cross section tape as described in the wading or bridge measurement SOP. Locate water moving approximately 0.5 to 1.0 fps. Place the FlowTracker at the determined location and take a measurement. This location does not necessarily have to be located along your transect line. If the velocity is between 0.5 and 1.0 fps make a note of the velocity and location in your note sheet and follow up immediately in the same location with the mechanical meter. Take two twenty second measurements with the Swoffer Indicator or one 40 second measurement with the HS indicator to compare with the 40 second FlowTracker measurement. Average the two Swoffer readings for comparison. If the results of the comparison show a difference of 10% or less, write down your calibration values in the Vel. Unc. line on the discharge measurement form. You are now ready to begin your measurements.

6.3 Collecting a Stream Flow Measurement with a Mechanical Velocity Indicator

6.3.1 After you have successfully completed all of the steps in the Stream Hydrology Site Visit SOP you are ready to take a stream flow measurement. Following the guidelines in the Measuring and Calculating Stream Discharge SOP you should have a suitable cross section set up and your descriptive notes taken.

6.3.2 Taking a Stream Flow Measurement with a Swoffer 2100 Velocity Indicator

6.3.3 At your starting edge take a depth measurement at your first station and set your wading rod depth accordingly (see Measuring and Calculating Stream Discharge SOP and/or Bridge Measurement SOP's for detailed descriptions).

6.3.4 Turn the indicator knob to the medium velocity setting on the meter (20 seconds). Repeat step 6.2.2.1 for measurement collection.

6.3.5 After the measurement is taken the velocity value will appear on the LCD display. Record this value in your notes and press the reset button again to collect your second measurement. You will use the reset button for each of the velocity measurements taken until you have completed your transect. Record these numbers in the appropriate location on the field form (appendix C).

6.4 Taking a Stream Flow Measurement with a Hydrological Services OSS-B1 Velocity Indicator

6.4.1 Reassemble the HS velocity indicator (if not already assembled) as described in section 6.1.3 including re-oiling, spin testing and setting up the Hydromate.

6.4.2 Upon completion of the pre-measurement setup return to the main menu. Tap the "measure" button twice.

6.4.3 The counter will immediately begin to try to measure a velocity. To stop this tap the "Stop" button twice.

6.4.4 Get set at the desired vertical and set the wading rod or bridge unit to the proper depth. Next, tap the "Start" button twice.

6.4.5 The counter will then start to measure velocity. You will hear a beep every time the fan makes a revolution. The screen will show the number of pulses or fan revolutions and the elapsed time up to 40 seconds. It will also show the number of pulses per second, and a running average of velocities over the last 5 seconds. Record these numbers in the appropriate location on the field form (appendix C). Continue this process until you reach the end of your transect.

6.4.6 When you reach the end of the transect you may turn the Hydromate off. To turn the unit off press the blue "On/Off button" and it will power down.

6.5 Care and Storage of Mechanical Velocity Indicators

6.5.1 Mechanical velocity indicators are affected by extreme temperatures which may cause drifting, sluggish LCD display time (in cold weather), poor battery performance, and loss of accuracy. Protect the meter from direct sunlight and heat as they can ruin the LCD display. Store the velocity indicators in your vehicle's flow box to avoid being jostled or beaten up. Do not use any chemicals to clean the velocity indicators, a damp rag will suffice to wipe down the outside of the instrument. Periodically inspect the cable, meter, and it's connectors for wear and tear. In extreme cold weather, keep the Swoffer meter or Hydromate inside of your coat to reduce the impacts of temperature on the calibration values.. If the Swoffer meter or Hydromate is immersed in water, immediately disconnect the battery and dry the terminals, as well as the internal components of the meter. Air drying or heaters work the best for this. If obvious water infiltration into the LCD or window can be seen the sensor needs to be completely dried out. The circuit board may require repairs from the factory if this happens.

6.6 Data Management and Interpretation

6.6.1 Upon completion of your flow run, you must submit your discharge measurement notes (form ECY 040-56 (Rev. 12/07)) to the basin lead for entry and review. Mechanical instrument discharge measurements must be calculated via Q-Win software and submitted with your field forms. For operation of Q-Win software and data entry refer to appendix D.

6.6.2 All measurements are peer reviewed. Reviewed materials include completed Discharge Measurement Notes and the Discharge Measurement Summary. Before review, the measurement is entered to the Hydstra Gagings database.

6.6.3 The reviewer checks measurement notes to ensure proper measurement procedures were followed and the data reflects the assigned quality code. The Hydstra Gagings database is checked to verify measurement statistics, stage height, quality assignments, and notes are entered correctly. After the Gagings database is verified, the reviewer enters his or her initials in the check box provided.

6.6.4 The reviewer compares the Q-Win Discharge Measurement Summary to the Discharge Measurement Notes to evaluate potential discrepancies of location, depth, and velocity. Though it is the decision of the Basin Lead, the reviewer may suggest an alternative quality rating for the measurement.

6.6.5 When the review is complete the reviewer initials the field note sheet in the space provided in the upper right corner and returns the submitted materials along with any written comments to the Basin Lead.

6.7. Files for each measurement are electronically archived on the EAP SH-TCT shared server (H:\FLOWS\Projects), under the specific station name and water year in which the measurement was conducted.

6.8. A record of peer reviews of all discharge measurements is located in the EAP SH-TCT shared server (H:\FLOWS\QAData).

7.0 Records Management

7.1 Processed files are saved in windows file system folders exclusive to individual station visits. These files can be located within the FMU shared server.

7.2 Field log sheets are stored in the central filing locations at Ecology headquarters and regional offices.

7.3 Quality checked and reviewed report storage is the responsibility of the lead investigator in charge of the WRIA basin where the data was collected.

7.4 Records of all peer reviewed discharge measurements can be found in the FMU shared server as well as with the principal investigator responsible for them.

8.0 Quality Assurance and Quality Control

8.1 One of the most important parameters in assuring statistically relevant, accurate data collection with mechanical measuring devices is consistent maintenance and calibration of all measuring components. Being able to identify a drifting or worn out fan, failing batteries and worn cables is very necessary in attaining accurate data.

8.2 Assessment of sampling location and cross section characteristics are very important factors in determining quality of data. The description and quality of these parameters are determined via professional rating as described in the flow measurement SOP. The field investigator should also consider factors such as cross-section quality, and flow conditions as part of the quality assignment. Be sure to completely and concisely fill out the discharge measurement notes.

8.3 Upon completion of the flow measurement and Q-win data assessment, turn in the measurement notes and data collected to the principal investigator for the basin you sampled in. They will then review the information and compile a basin report. This report is then reviewed by senior staff and checked for quality before being finalized and used to update the Hydstra QA database.

9.0 Safety

9.1 All field staff must understand and comply with the Environmental Assessment Program (EAP) safety manual (2006) with extra emphasis on sections; (1-15, 1-19, 1-23, 1-35, 1-37, 2-17, 2-45)

9.2 All field staff must also possess the proper, up to date safety equipment approved by the SHU safety officer and understand its complete operation.

10.0 References

10.1 Burks, Tyler. 2009. Standard Operating Procedure for Measuring Stream Discharge Using the Son-Tek FlowTracker Hand held ADV. Environmental Assessment Program, Washington State Department of Ecology. Document available at: http://www.ecy.wa.gov/programs/eap/quality.html

10.2 Butkus, Steven. 2005. Quality Assurance Monitoring Plan – Stream Flow Gaging Network. Environmental Assessment Program, Washington State Department of Ecology. Publication No. 05-03-204.

10.3 Environmental Assessment Program, 2006. Environmental Assessment Program Safety Manual.

10.4 Myers, Jason. 2009. Standard Operating Procedure for Stream Hydrology Site Visits. Environmental Assessment Program, Washington State Department of Ecology. Document available at: http://www.ecy.wa.gov/programs/eap/quality.html

10.5 Shedd, James R. 2009. Standard Operating Procedure for Measuring and Calculating Discharge. Environmental Assessment Program, Washington State Department of Ecology. Document available at: http://www.ecy.wa.gov/programs/eap/quality.html

10.6 Hydrological Services OSS-B1 manual. 2009. Hydrological Services Pty Ltd. PO BOX 332, Liverpool B.C NSW 1871, Australia. Document available at: http://www.hydrologicalservices.com/products/wfmus.shtml

10.7 Hydrological Services Hydromate manual. 2009. Hydrological Services Pty Ltd.PO BOX 332, Liverpool B.C NSW 1871, Australia. Document available at: http://www.hydrologicalservices.com/products/wfmus.shtml

10.8 Instructions for Operation and Maintenance of 2100 Indicator. 2009. Swoffer Instruments, Inc 1048 Industry Drive Seattle, Washington 98188, USA Document available at: http://www.swoffer.com/

11.0 Appendices

Appendix A

PRE/POST FIELD EXCURSION CHECKLIST

Before embarking in the field all FMU staff must:

1. Arrange for lodging (if necessary)
2. Update outlook calendar indicating basin location and duration of trip
3. Prepare current rating curve sheets for basin
4. Notify basin contacts (if necessary)
5. Prepare field/float plan form with emergency contact information for specific trip location and duration
6. Be sure to check van packing lists and pre trip vehicle inspection before embarking from the Operations Center

Pre-Trip Vehicle Inspection:

1. Inspect tires for wear/damage on both sides of sidewall. Be sure to check tire pressure as well
2. Check fluid levels (oil, transmission, windshield washer, radiator) before embarking in order to minimize possible breakdowns
3. Make sure that the vehicle safety equipment is packed and that a spare tire, jack and lug wrench are in the van and in working order
4. If any of these listed items are not in satisfactory working order please notify Sarah Barrie or Oliver Brock as soon as possible. Do not embark with a vehicle that is in need of service or may be damaged

Upon return from the field:

End of Day-
If staying at a hotel; notify your contact person each evening that you are finished with field sampling so they do not initiate the rescue protocol. If your trip is only a day trip refer to end of trip protocol.

End of trip-
- Fill vehicle with fuel before returning to the Operations Center
- Upon return to the Operations Center, please unload your gear and measuring equipment
- Don't forget to download Flow-Tracker files to your laptop
- Unload spent batteries and carefully refill them with DI water if needed
- Place spent batteries on appropriate chargers after servicing them
- Load spent desiccant (packs or loose crystals) into appropriate drying ovens and check to be sure that the oven temperatures are set at the pre-determined levels correctly
- Hang any wet ropes in their designated locations to dry
- Store ADCP's in their designated locations, tethered to the wall to prevent falling over
- Clean the interior of the van (if needed) Wash vehicle if possible
- Close field/float plan and notify contact person that your trip is over

Vehicle and Equipment Checklist

Standard Vehicle Equipment:

This equipment should be present anytime the vehicle is used.

- Cell Phone and Charger

Vehicle Folder containing

- Mileage Logs
- Emergency Information
- Fuel Card
- Maps

Safety Equipment

- First Aid Kit
- MUTCD compliant Safety Vests (2)
- CG Approved PFD (1 per person)
- PFD CO_2 Refill
- Road Cones
- Signs
- Hard Hats (2)
- Orange Strobe

Tools / Other

- Mechanic's Toolbox
- Shovel
- Loppers/Clippers/Machete
- Tire Chains
- 2- 150 ft. Ropes
- Spare Key
- Jack, jack handle, adequate spare
- Flashlight
- Lighter
- Electrical Tool Box
- Pens
- Pencils
- Note Paper
- Flagging Tape
- Orange Spray Paint
- Spare Bucket

Standard Flow Gear

Flow Box:

- Weighted Tape for Tape Down
- Tag Line
- 300 ft. Transect Tape
- Line Clamps
- Swoffer Kit w/ Cables and Fans
- Swoffer Meter
- Bridge Depth Sounding Correction Sheets (2/10, 6/10, 8/10's)
- Survey Pins and Hammer
- Flow Tracker
- Wading rod
- Laser Level
- Stadia Rod
- Thermistor
- Spare Batteries for All Devices
- Battery Chargers
- Discharge Measurement Sheets

Station Visit

- Station Visit Data Flash Card
- Multi-meter
- Logger Menu Flow Chart
- Desiccant
- Station Key
- USGS key
- Other Keys as needed
- Appropriate DCP Batteries

ADCP Gear

- ADCP Unit
- PDA (CHECK BATTERY STATUS)
- SD card for PDA
- Tow Ropes and Carabiners
- ADCP Data Sheet

Bridge Gear (If Needed)

- Lead Flow Weights, all sizes
- Bridge Board
- T-bar
- Reel w/ Swoffer Cable

3-Wheel Crane

- Reel
- Crane Assembly

4-Wheel Crane

- HS Meter Box
- Props
- Meter Body w/Fiber-Fin
- Cleaning Soln.
- Lubricant
- Reel
- Crane Assembly/Boom
- Counterweights
- Wheel Chocks

Personal Equipment

- Water
- Food
- Dry Clothes
- Rain Gear
- Sunscreen
- Gloves
- Waders/Hip Boots
- Up to Date Ratings Sheets
- Maps/Station Directions
- Notebook w/ Extra Data Sheets

Decontamination Equipment

- To Be Determined

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Meas.No. .....

Comp. by.....

DISCHARGE MEASUREMENT NOTES

Check by .....

Sta. No. ..... Prop. No.....

Name:.....

Date ....., 20 ..... Party.....

Width..... Area..... Vel. ..... G.H. ..... Disch.....

Method..... No. secs..... G.H. change..... in ..... hrs.

Max Depth..... Hor. angle coef..... Wetted Perim..... Meter No.....

GAGE READINGS

Time	TD/WT	Logger	Staff	+/-
REW				
LEW				
WW				
Cell Width				

Type of meter.....

Calibration Pre:..... Post: .....

QA form attached Y/N

Vel Unc .....

Depth Unc .....

Overall Unc .....

Wading, cable, ice, boat, upstr., downstr., side bridge .... feet, mile, above, below gage, and .....

Check-bar, found .....

changed to..... at .....

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions:

Cross section.....

Flow.....

Control.....

..... Photo taken Y / N

Gage.....

Weather.....

Other.....

Remarks.....

.....

.....

.....

.....

Zero flow = GH _____ -depth at control _____ = _____ ft.

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Meas.No.....

Comp. by.....

DISCHARGE MEASUREMENT NOTES

Check by.....

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REW				
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Wading, cable, ice, boat, upstr., downstr., side bridge ..... .feet, mile, above, below gage, and.....

Check-bar, found .....

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Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions:

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Control.....

..... Photo taken Y / N

Gage .....

Weather .....

Other .....

Remarks.....

.....

.....

.....

.....

Zero flow = GH _____ -depth at control _____ = _____ ft.

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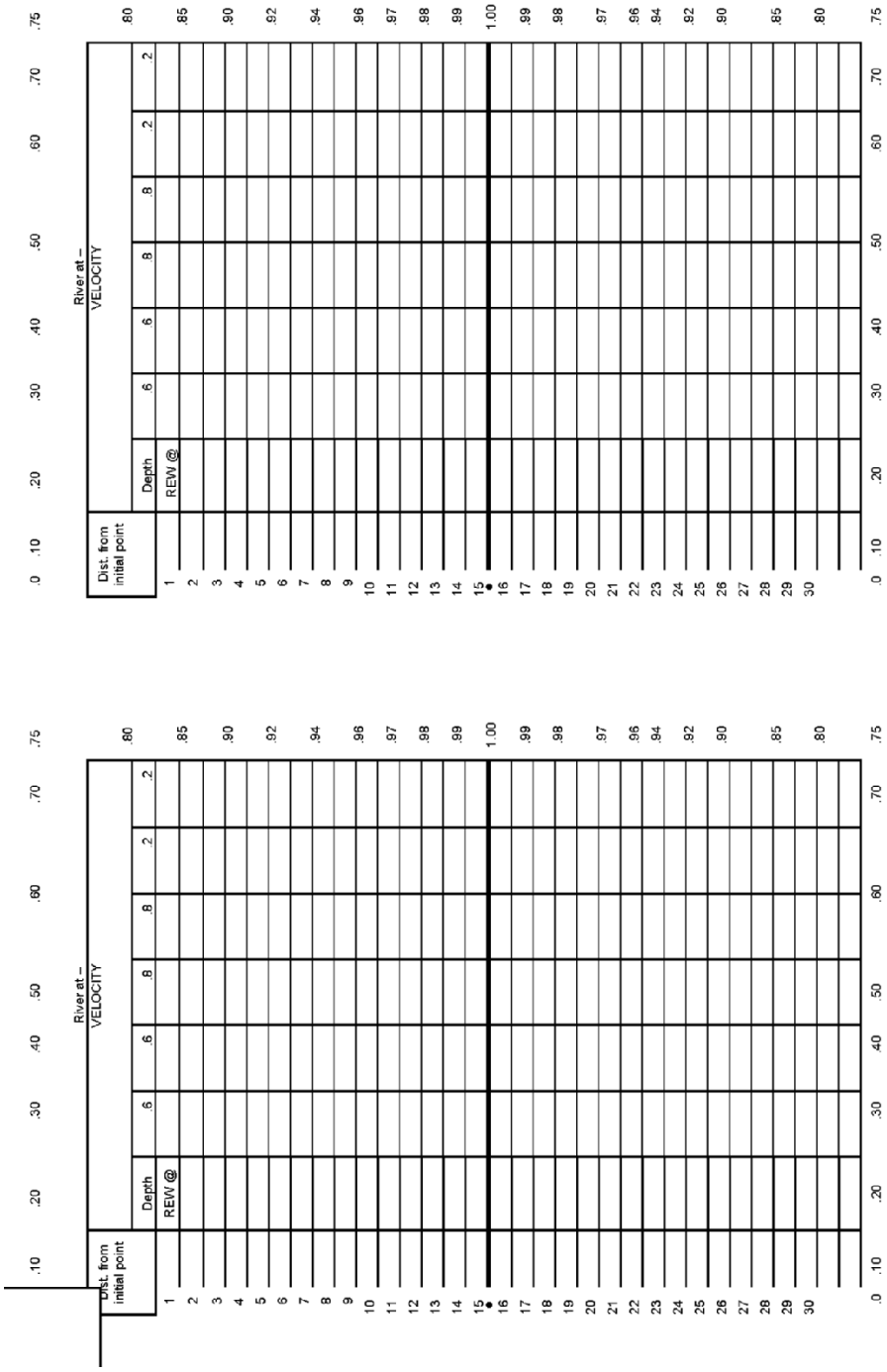
Appendix C


River at –
VELOCITY
Dist. from initial point
Depth
REW @
.0 .10 .20 .30 .40 .50 .60 .70 .75 .80 .85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85 .80 .75

Appendix D

Documentation - QWin.exe

Qwin is designed to calculate stream discharge from cross-section and velocity measurements. It calculates discharge following the USGS mid-section method. Basically the program is similar to a spreadsheet, allowing distance, depth and velocity measurements to be entered into individual cells. When data is complete a calculate button is pressed and the results in cfs are returned. Use of the program assumes you are familiar with measurement and recording of field data necessary to calculate stream discharge. Up to 44 cross-section points may be entered.

The Menu has two main entries - **File** and **Header**. The **File** menu allows you to **Save** a current file or **Open** an existing file, also to clear the form and prepare for a **New** entry. A Qwin data file is a simple text format and may be examined in NotePad. The **Print** command is also available from this menu. The print command simply sends the calculate results to the default printer, no other printers or special formatting are available.

The **Header** menu allows entry of the site information, including date and time, stage, and a comment.

In addition to the menu, there are six buttons on the **main form.** The top button is the **Calculate** button, pressing of this button after data entry is complete results in calculation of discharge. The results are presented in a pop-up window and include total area, average velocity, and total discharge. The area and Q columns of the spreadsheet are also filled in at this time.

The next button opens another window that presents a drawing of the measured **cross-section.** Included on this drawing is the percentage of total discharge that occurred in each cross-section cell.

The button **Remove-a-cell** removes the current cell and moves all remaining data in the column up one cell.

The button **Insert-a-cell** inserts an empty cell above the current cell and moves the data in all following cells down one cell.

Clear Grid clears the spreadsheet and sets up for new data entry - note: the **Header** is not affected.

Exit closes and exits.

In addition to the buttons, a text box is available to enter any **angle correction** that is to be applied to the final results. The angle correction may vary from 0.01 to 1.00 and is intended to correct for a cross-section that is not perpendicular to the stream flow - such as a measurement from a bridge angling across the stream. The discharge results (and the cross-sectional area) are multiplied by the angle correction to arrive at final values. The angle correction usually ranges between 0.90 and 1.00, with 1.00 being perpendicular to flow.

Velocity Cells - There are two columns of velocity cells. The second column is intended for use when the 0.2 and 0.8 depths method is used to measure velocity. However, they can be used in other ways. Qwin simply averages the two sister cells in each column to arrive at an average velocity for that point. Do not enter zero (0.0) in the second column unless you want it averaged with the value in the first column. An empty cell is ignored. When the focus is in a velocity cell, pressing the right mouse button brings up a pop-up window that allows you to enter up to six (6) individual velocity measurements, upon return, their average is entered in the velocity cell.

Note: If you do not have a mouse on your computer, you can use the arrow keys, tab key, and alt-Underlined letter to move around the form.

File Naming Convention used by SHU - Data is saved in a file with a standard 8 character file name with an extension of .qw. The first 4 characters are shorthand for the site name. The next 2 characters (numbers) represent the week of the year (1-52). The final 2 characters (numbers) represent the year. Example: **Pesh4103.qw** is Peshastin Creek - week 41 - 2003.

Note* The previously noted file naming system is an older version. The current naming system consists of the station ID number, the year, the month and finally the day. For example: 15F150_2009_04_27 is the file name for a measurement taken at Big Beef creek on April 27th, 2009. (edited 4-29-2009 by Z. Holt)