Middle Yuba River
Our House Diversion Dam Reach
Upstream of Oregon Creek Site
Draft Hydraulic Calibration Results

Model Used

The hydraulic model for the Upstream of Oregon Creek Site PHABSIM study was calibrated by HDR using RHABSIM 3.0 (Riverine Habitat Simulation), a commercial software program written by Thomas R. Payne and Associates of Arcata, California. RHABSIM is a commercial version of the PHABSIM computer model (Milhous et al. 1984).

Model Files

The following RHABSIM file is associated with the Upstream of Oregon Creek site:

MYABOC.RHB

Modeling Methods

Water Surface Elevations (WSE)

For WSEs, these procedures included: the development of stage/discharge rating curves using log-log regression (IFG4); Manning's formula (MANSQ); and/or step backwater models (WSP); direct comparison of results; and selection of the most appropriate and accurate method. Log-log and MANSQ were run for each transect, with MANSQ set as the default modeling method. If individual transects did not calibrate sufficiently well using MANSQ, based on general guidelines of maximum Beta (5.0), and/or professional judgment, then log/log or WSP was selected. The WSP model was used where suitable sections of the study site were surveyed to a common datum and a reliable rating curve at the downstream control or transect was available. For transects that the WSP model was calibrated, results were compared to results from Log/Log and MANSQ. WSP was generally preferred in pools or where uphill flow between transects was predicted by either Log/Log or MANSQ. Data file construction, calibration, and simulation followed standard procedures and guidelines outlined in the PHABSIM Reference Manual Version II, Instream Flow Information Paper No.26 (Milhous, R.T., M.A. Updike, and D.M. Schneider 1989).

Modeling Guidelines

PHABSIM modeling guidelines considered for the Upstream of Oregon Creek Site were as follows:

1. The beta value (a measure of the change in channel roughness with changes in streamflow) must be between 2.0 and 4.5;

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2. The mean error in calculated versus given discharges must be less than 10 percent;
3. There must be no more than a 25 percent difference for any calculated versus given discharge;
4. There must be no more than a 0.1-foot difference between measured and simulated WSEs;
5. To determine whether the MANSQ model accurately predicts measured values, the second through fourth of the above criteria must be met, and the beta value parameter used by MANSQ must be within the range of -5.0 to 5.0. The first IFG4 criterion is not applicable to MANSQ; and
6. To determine accuracy of predictions of the WSP model, model predicted water surfaces are compared to field measured values across all measured flows. Manning's N values should be consistent between transects within a study site.

Habitat Summary for Upstream of Oregon Creek Site

A hydraulic model was developed for the 12 instream flow transects on the Upstream of Oregon Creek Site on the Middle Yuba River above Englebright Reservoir. Meso-habitats represented in Our House Diversion Dam Reach are presented in Table 1. Upstream of Oregon Creek in on of two sites in the Our House Diversion Dam Reach. Final transect locations are presented in Figure 1.

Table 1. Habitat frequency based on video-mapped data and target transects for the Our House Dam Reach of the Middle Yuba River.

PHABSIM Habitat	Number	Number Frequency	Adjusted Number Frequency	Potential # Target Transects
High gradient riffles	29	10%	11%	2
Low gradient riffles	45	16%	17%	3
Runs/Step-Runs	69	24%	25%	4
Glides	11	4%	0%	0
Pocket Water	4	1%	0%	0
Pools	129	45%	48%	8
Total	**286**	**100%**	**100%**	**17**[1]

[1] There are more potential transects listed in this table than there are transects at this site because the habitat frequency analysis was for the entire Our House Diversion Dam Reach, which includes both the Upstream of Oregon Creek Site and the Our House Diversion Dam Site.

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Figure 1. PHABSIM transects in the Upstream of Oregon Creek Site of the Our House Diversion Dam Reach on the Middle Yuba.

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Calibration Summary for Upstream of Oregon Creek Site

The Upstream of Oregon Creek model was associated with three stage discharge pairs, and primary velocity calibration set at full channel flow of 288 cubic feet per second (cfs). When velocities couldn't be measured safely at 288 cfs, they were measured at 149 cfs. Each transect in the site had one velocity set measured, which is consistent with the "one-velocity" method.

Stage/discharge regressions were developed using the three calibration discharges: 288 cfs, 149 cfs, and 78 cfs. Table 2 summarizes modeling statistics for each transect and modeling method, while Tables B-1 and B-2, in Appendix B, summarize the given calibration stage and the modeled stages for each flow, at each transect, using all modeling methods used on a given transect. Appendix C provides the calibration notes on each transect.

Cross Sections

Cross sectional profile graphs, with measured WSEs, have been included in Appendix A, in addition to transect photos.

Calibration Details for Upstream of Oregon Creek Site

Stage/Discharge Calibration

- All transects in the study site were calibrated using both Log/Log and MANSQ.
- One group of transects was modeled using WSP. These transects were part of a pool.
  - T-03 to T-05
- For model calibration, water surface elevations were selected within the range of field collected data only.
- Cross-sectional geometry and a realistic rating curve fit were considered when choosing the primary modeling method.
- MANSQ was selected as the primary calibration method on T-03, T-04, and T-09 through T-12, based on the modeling guidelines outlined above.
- All Log/Log betas were between 2.0 and 4.5.
- WSP was not selected for any of the transects.
- All transects had MANSQ betas inside the range of -5.0 to 5.0.
- All MANSQ mean errors were less than 2 percent.
- Both MANSQ and Log/Log mean errors can be seen in Table 2. No mean error values are available for the WSP routine. Refer to Table B-1 and B-2 in the Appendix for a comparison of measured versus modeled water surface elevations.
- Seven of the twelve calculated discharges were within 5 percent of given discharges.
  - T-03 was within 11 percent.

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- T-06 was within 17 percent high.
- T-07 and T-11 were within 24 percent. Both of these transects had their velocity sets measured at mid flow. With a lower discharge, any deviation from the expected value will result in a much larger percent error than a similar deviation at a higher discharge.
- T-01 was within 28 percent. There is a gap in the velocity data, so no discharge was calculated in that relatively deep and fast moving section of the transect. This gap at least partially explains why the calculated discharge was so much lower than the expected.

Table 2. Percent Mean Error for Stage/Discharge Relationships.

	T-12	T-11	T-10	T-09	T-08	T-07
Log/Log	0.481	0.214	0.448	0.003	0.162	0.817
MANSQ	0.171	0.242	0.685	0.239	0.872	0.538
MANSQ BETA	0.427	0.333	0.399	0.489	0.263	0.420
	T-06	**T-05**	**T-04**	**T-03**	**T-02**	**T-01**
Log/Log	1.606	2.481	2.208	0.194	2.531	1.612
MANSQ	1.738	1.812	1.703	0.262	1.107	1.067
MANSQ BETA	0.683	0.561	0.714	0.476	0.367	0.514

Velocity Calibration

All transect velocity measurements were collected at the highest target flow possible for that transect. Limiting physical parameters included deep swift water to deep to safely wade or deep water with entrained air which limited ADCP data collection.

- Velocity measurements were modeled at the highest flow possible for each transects.
  - High Flow: T-01 through T-04, T-06, T-09, and T-12
  - Mid Flow: T-05, T-07, T-08, T-10, and T-11

Table 3 provides the velocity adjustment factor (VAF) for each calibration flow on each transect. VAF is the index of the difference between the requested simulation discharge and computed discharge derived from the velocity simulations (Waddle 2001). These velocity adjustments are used to prevent the model from over or under estimating the discharge at flows other than the velocity calibration discharge. A graphical representation can be found in Figure 2.

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Table 3. Velocity adjustment factors (VAF).

Transect	**01**			**Transect**	**02**			**Transect**	**03**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
87.36	31.2	59.35	0.5257	91.05	31.2	61.67	0.5059	91.18	31.2	81.96	0.3807
87.93	78	101.18	0.7709	91.48	78	117.43	0.6642	91.65	78	131.37	0.5937
88.38	143	142.35	1.0045	91.81	143	177.54	0.8055	92.01	143	180.9	0.7905
89.01	296	211.82	1.3974	92.28	296	285.19	1.0379	92.51	296	264.46	1.1193
89.94	720	338	2.1302	92.96	720	484.08	1.4874	93.26	720	417.99	1.7225
Transect	**04**			**Transect**	**05**			**Transect**	**06**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
91.21	31.2	179.6	0.1737	91.22	31.2	122.48	0.2547	87.22	31.2	233.12	0.1338
91.7	78	217.59	0.3585	91.72	78	173.26	0.4502	87.69	78	265.54	0.2937
92.08	143	248.59	0.5753	92.12	143	218.99	0.653	88.09	143	295.73	0.4835
92.59	296	292.9	1.0106	92.69	296	290.94	1.0174	88.67	296	343.8	0.861
93.32	720	358.85	2.0064	93.55	720	411.44	1.75	89.59	720	427.71	1.6834
Transect	**07**			**Transect**	**08**			**Transect**	**09**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
87.21	31.2	79.99	0.3901	87.01	31.2	49.3	0.6328	88.99	31.2	96.33	0.3239
87.69	78	125.14	0.6233	87.55	78	93.42	0.835	89.42	78	154.09	0.5062
88.1	143	170.67	0.8379	87.98	143	145.17	0.9851	89.77	143	210.22	0.6802
88.7	296	249.83	1.1848	88.6	296	240.15	1.2325	90.26	296	303.6	0.975
89.65	720	400.6	1.7973	89.53	720	421.91	1.7065	90.99	720	469.22	1.5345
Transect	**10**			**Transect**	**11**			**Transect**	**12**		
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
93.73	31.2	58	0.538	94.93	31.2	54.18	0.5759	95.5	31.2	84.85	0.3677
94.19	78	97.79	0.7977	95.35	78	103.14	0.7563	95.93	78	140.97	0.5533
94.57	143	138.77	1.0305	95.7	143	158.52	0.9021	96.27	143	198.81	0.7193
95.12	296	211.89	1.3969	96.21	296	264.16	1.1205	96.76	296	298.86	0.9904
95.96	720	359.25	2.0042	97	720	482.78	1.4913	97.51	720	488.17	1.4749

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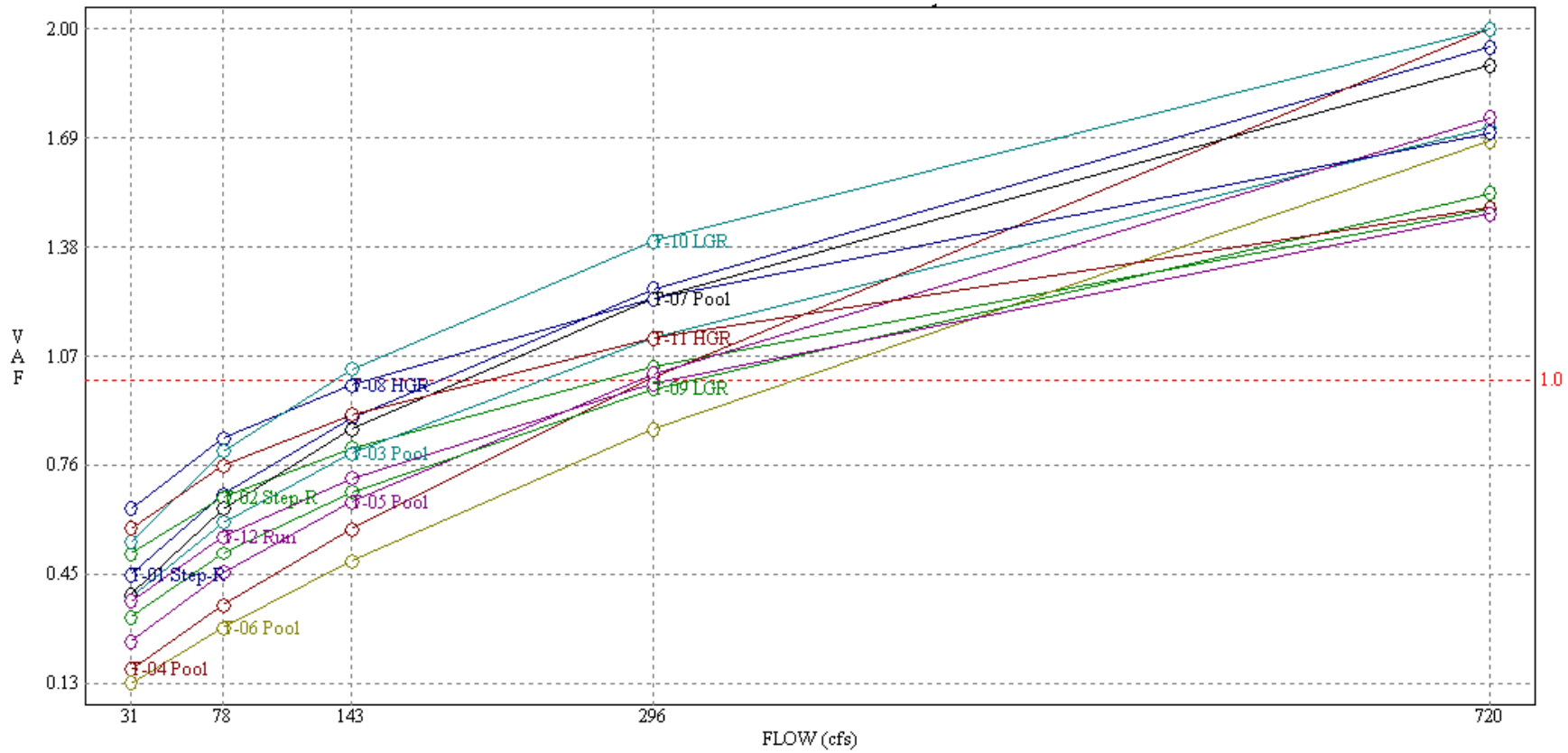

Figure 2. Velocity Adjustment Factor by flow.

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Target Discharge and Field Discharge

Discharge, like WSE, is used to calibrate stage/discharge relationships in the PHABSIM hydraulic models. The best estimate of discharge used in the model was calculated based on averaging numerous measurements from each site. Discharge selections were within the range of flows observed during data collection if the average discharge for the day was not used. Average daily discharge calculated from all field measurements are summarized below in Table 4.

Table 4. Target and measured flows for the Upstream of Oregon Creek Site.

Transect	Type	Discharge					
		Low - Target 75 cfs		Mid - Target 150 cfs		High - Target 300 cfs	
		Measured (cfs)	Method	Measured (cfs)	Method	Measured (cfs)	Method
1	Step-run	--	--	--	--	207	ADCP/ Swoffer
2	Step-run	--	--	--	--	285	Swoffer
3	Pool	--	--	--	--	260	Swoffer
4	Pool	--	--	--	--	297	ADCP/ Swoffer
5	Pool	--	--	--	--	291	ADCP/ Swoffer
6	Pool	--	--	--	--	344	ADCP/ Swoffer
7	Pool	--	--	177	Swoffer	--	--
8	High gradient riffle	--	--	143	Swoffer	--	--
9	Low gradient riffle	--	--	--	--	301	Swoffer
10	Low gradient riffle	--	--	143	Swoffer	--	--
11	High gradient riffle	--	--	161	Swoffer	--	--
12	Run	--	--	--	--	294	Swoffer
Q1	Near T-01	76	Swoffer	--	--	--	--
Q2	Near T-01	79	Swoffer	--	--	--	--
Q3	Near T-01	80	Swoffer	--	--	--	--
Given Flow Averages using best transects		**78**	(Q1, Q2, Q3)	**149**	(T-08, T-10, T-11)	**305**	(T-02, T-03, T-04, T-05, T-09, T-12)

References

Milhous, R. T., D. L. Wegner, and T. Waddle. 1984. User's Guide to the Physical Habitat Simulation System (PHABSIM). Instream Flow Information Paper No. 11. U.S. Fish and Wildlife Service. FWS/OBS-81/43.

Milhous, R. T., M. A. Updike, and D. M. Schneider. 1989. PHABSIM Reference Manual Version II, Instream Flow Information Paper No. 26. U.S. Fish and Wildlife Service Biological Report 89(16).

Waddle, T. J. (ed.) 2001. PHABSIM for Windows: User's Manual and Exercises. U.S. Geological Survey Open-File Report 2001-340.

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Appendix A
Upstream of Oregon Creek Site Cross Sectional Profiles and Photos

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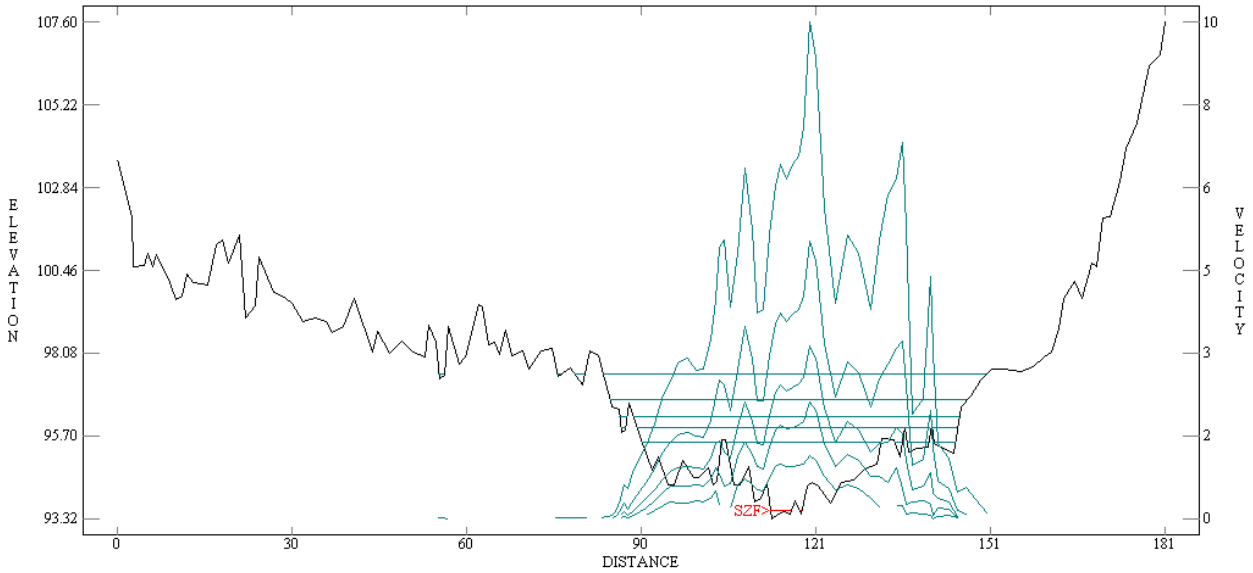

Figure A-1. Cross section for Transect 12 (Run).

Figure A-2. Transect 12-Looking from left bank to right bank at mid flow.

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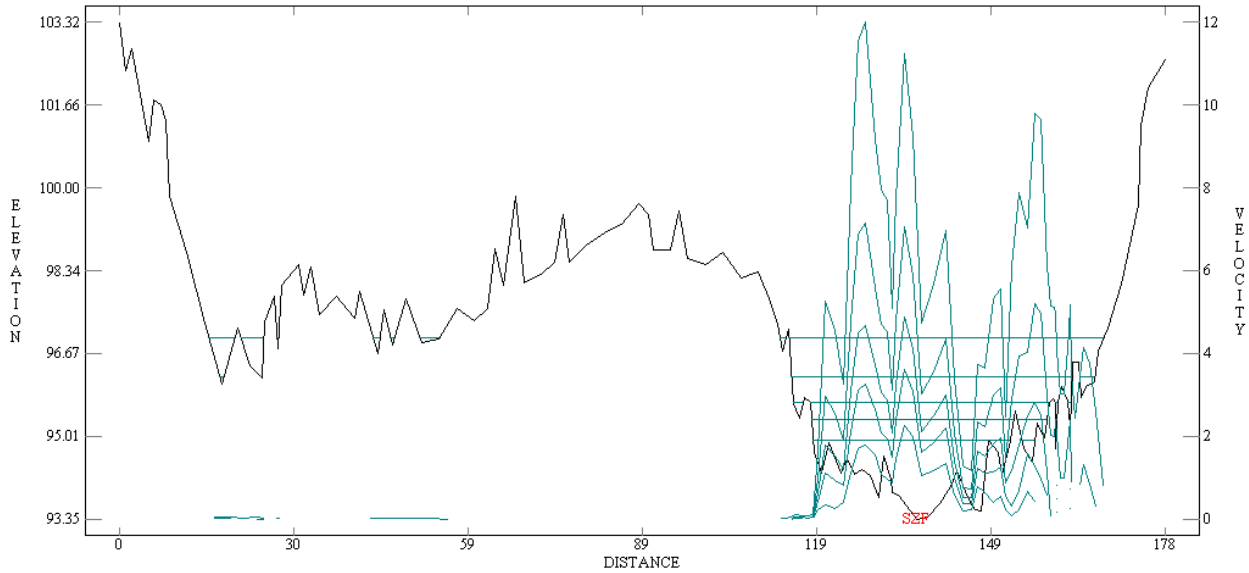

Figure A-3. Cross section for Transect 11 (High Gradient Riffle).

Figure A-4. Transect 11-Looking from right bank to left bank at mid flow.

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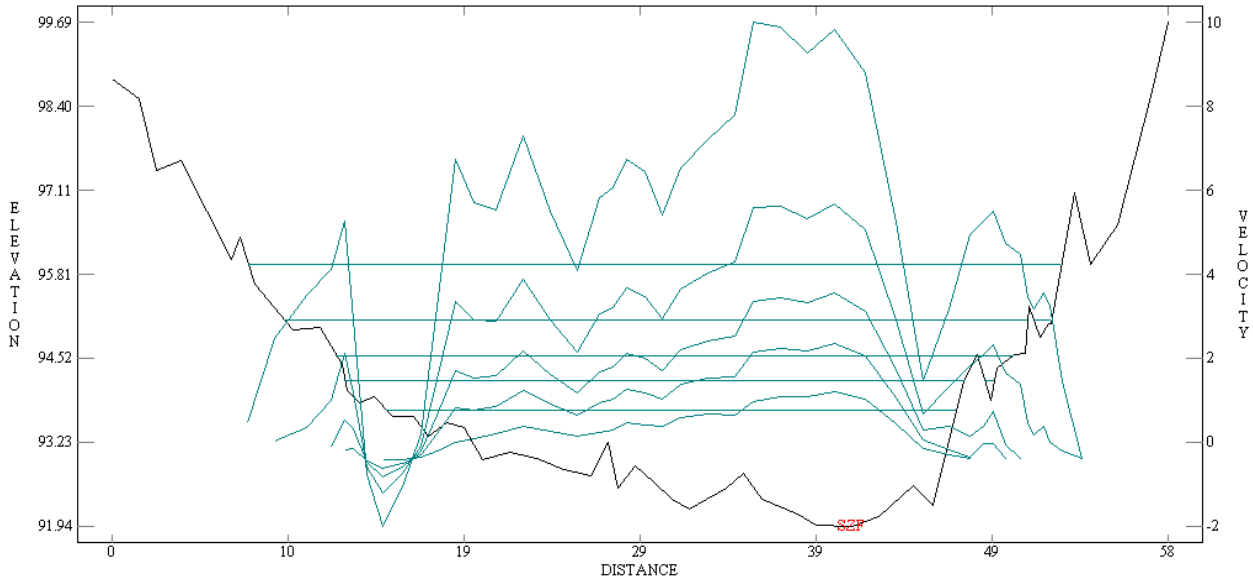

Figure A-5. Cross section for Transect 10 (Low Gradient Riffle).

Figure A-6. Transect 10-Looking from right bank to left bank at mid flow.

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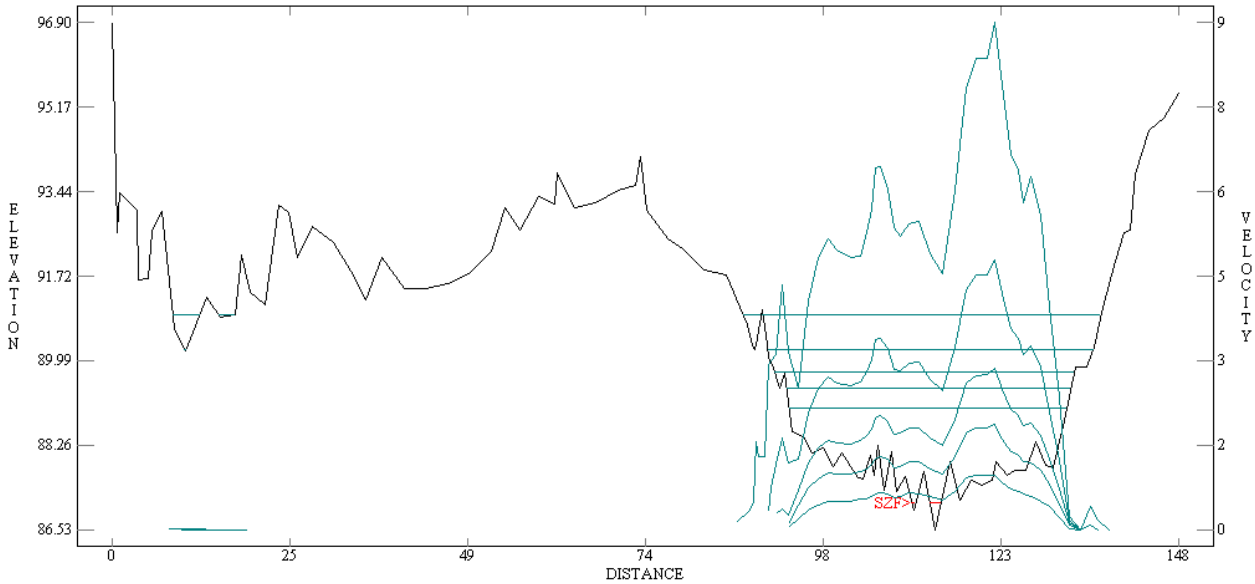

Figure A-7. Cross section for Transect 09 (Low Gradient Riffle).

Figure A-8. Transect 09-Looking from left bank to right bank at mid flow.

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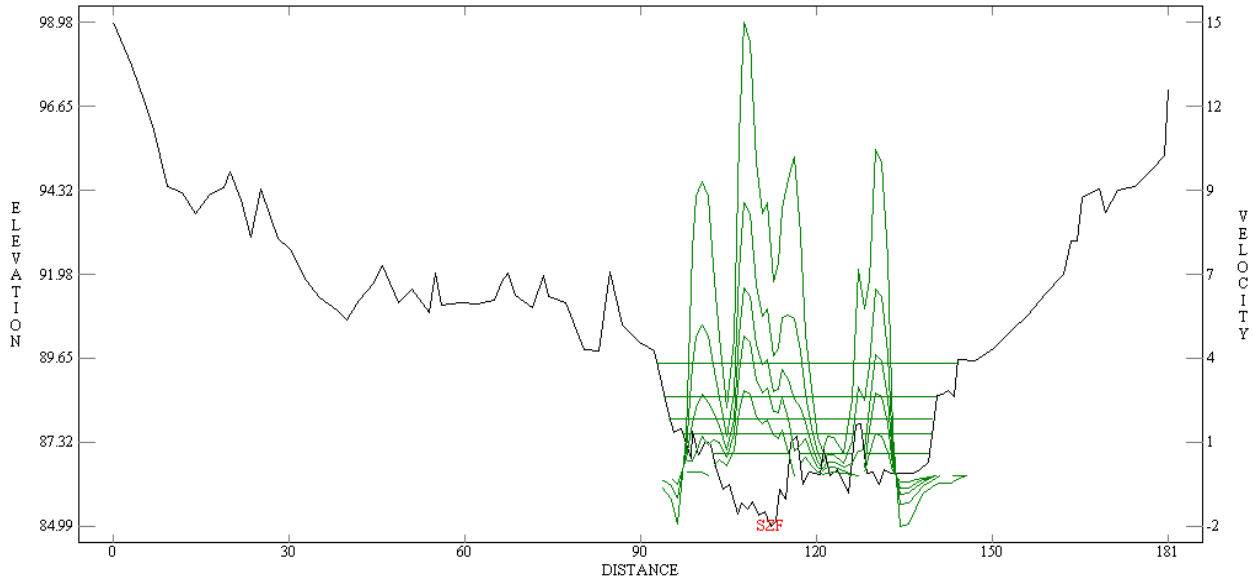

Figure A-9. Cross section for Transect 08 (High Gradient Riffle).

Figure A-10. Transect 08-Looking from right bank to left bank at low flow.

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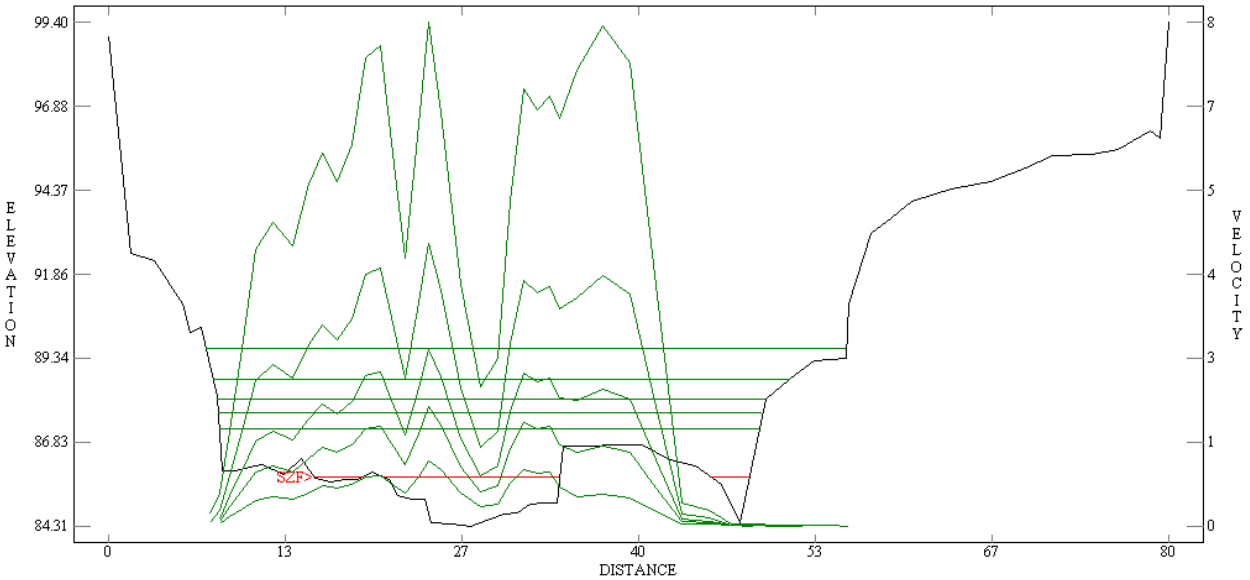

Figure A-11. Cross section for Transect 07 (Pool Head).

Figure A-12. Transect 07-Looking upstream to whole transect at mid flow.

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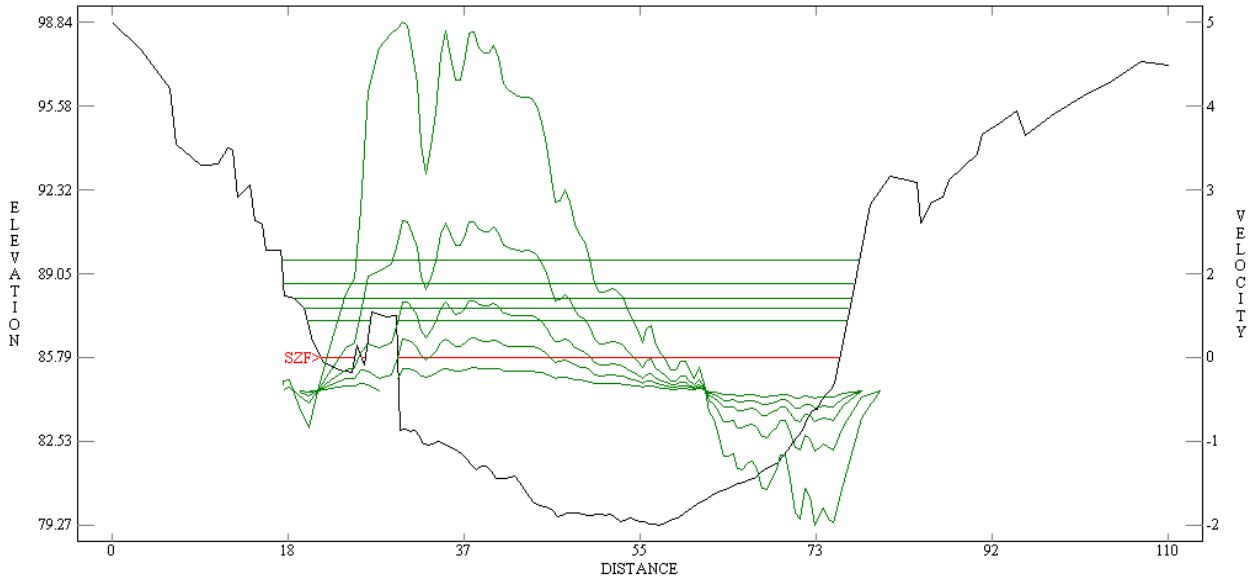

Figure A-13. Cross section for Transect 06 (Pool Belly).

Figure A-14. Transect 06-Looking from left bank to right bank at mid flow.

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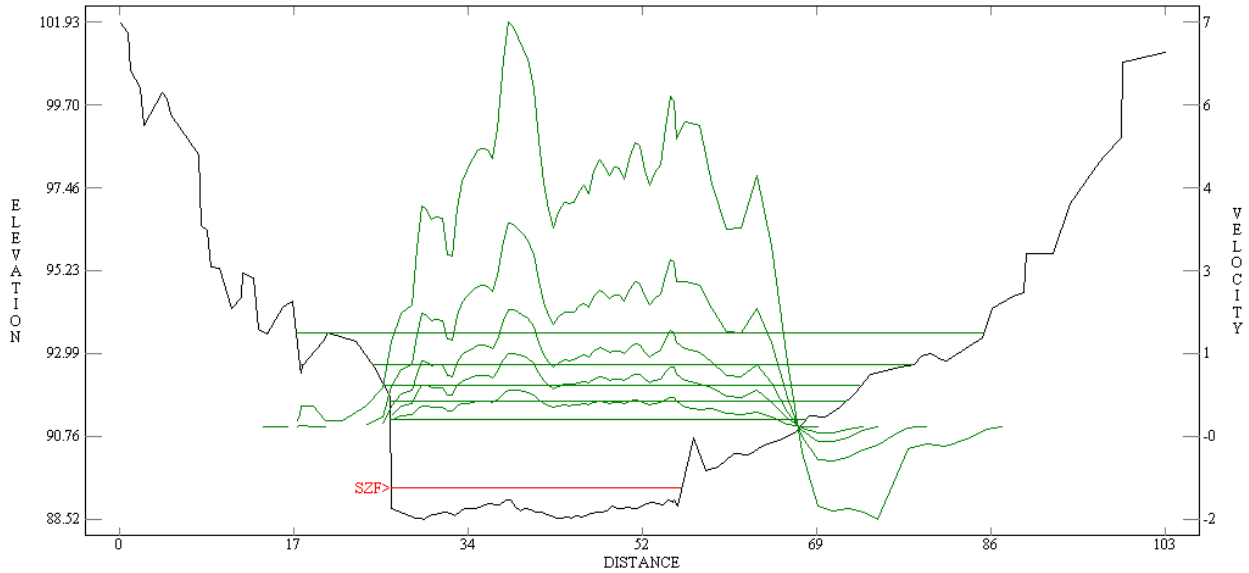

Figure A-15. Cross section for Transect 05 (Pool Head).

Figure A-16. Transect 05 (Pool Head)-Looking from left bank to right bank at mid flow.

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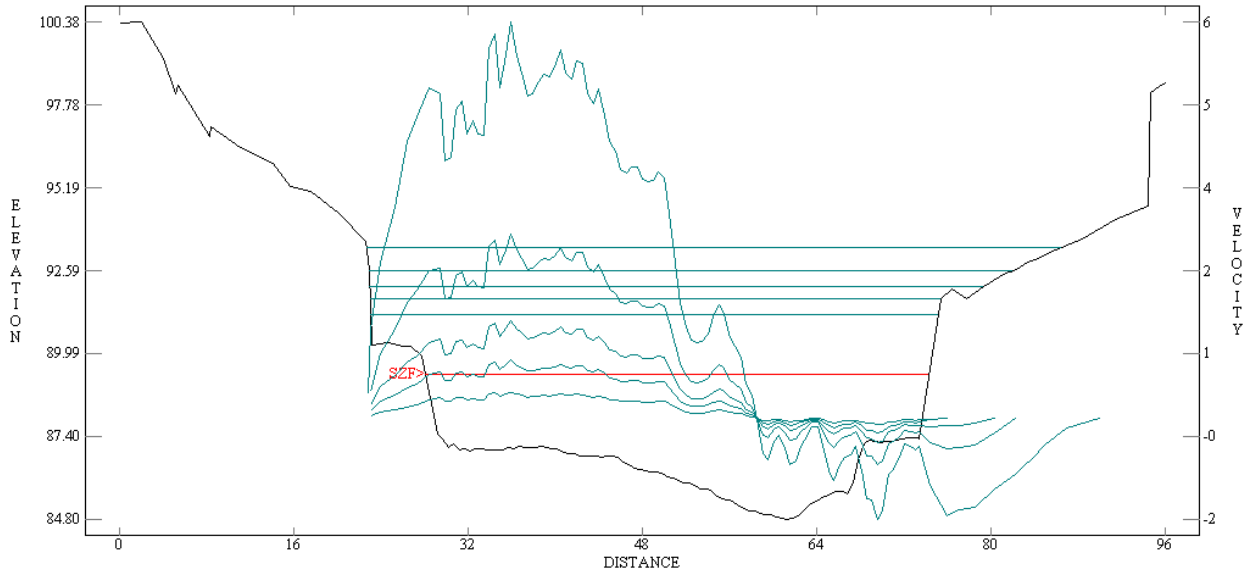

Figure A-17. Cross section for Transect 04 (Pool Belly).

Figure A-18. Transect 04-Looking upstream to whole transect at mid flow.

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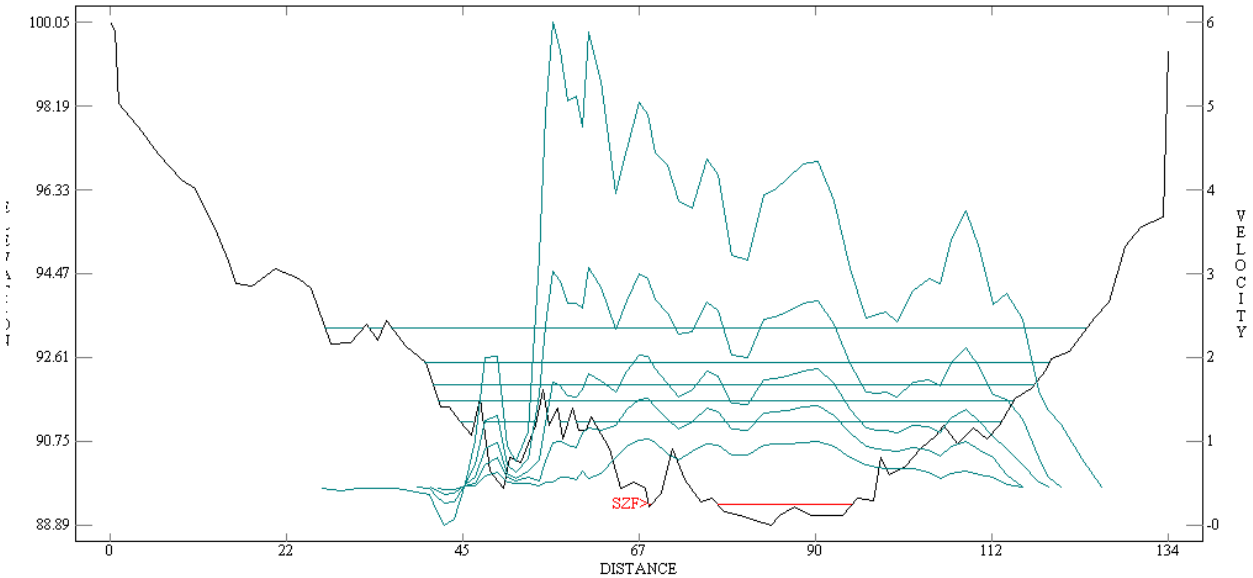

Figure A-19. Cross section for Transect 03 (Pool Tail).

Figure A-20. Transect 03-Looking from left bank to right bank at mid flow.

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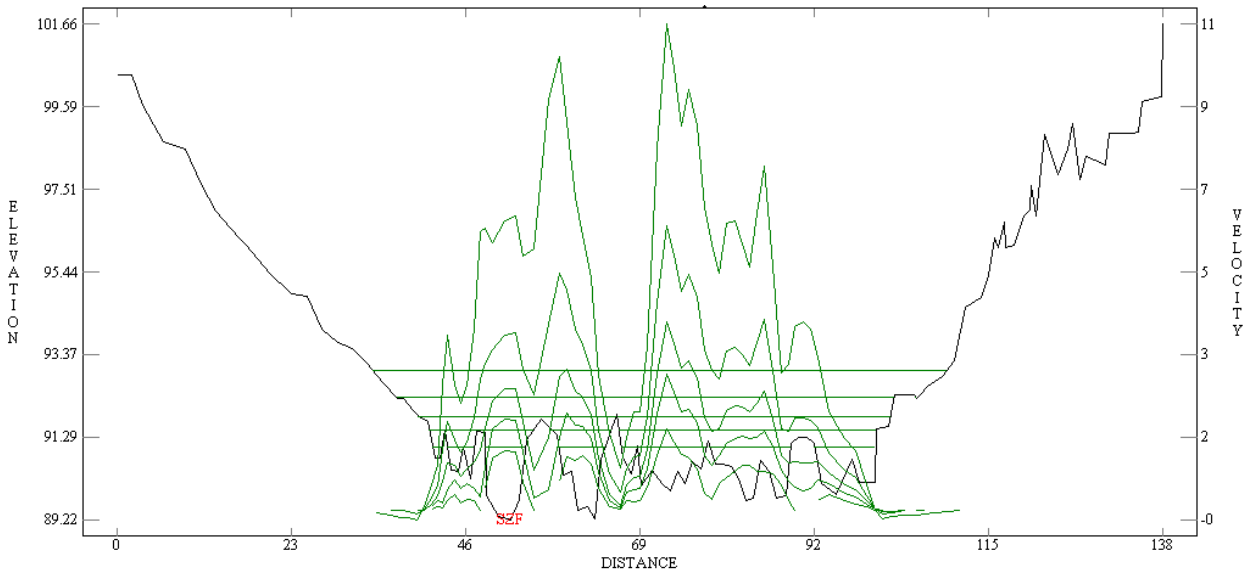

Figure A-21. Cross section for Transect 02 (Step-run).

Figure A-22. Transect 02-Looking upstream to transect at mid flow.

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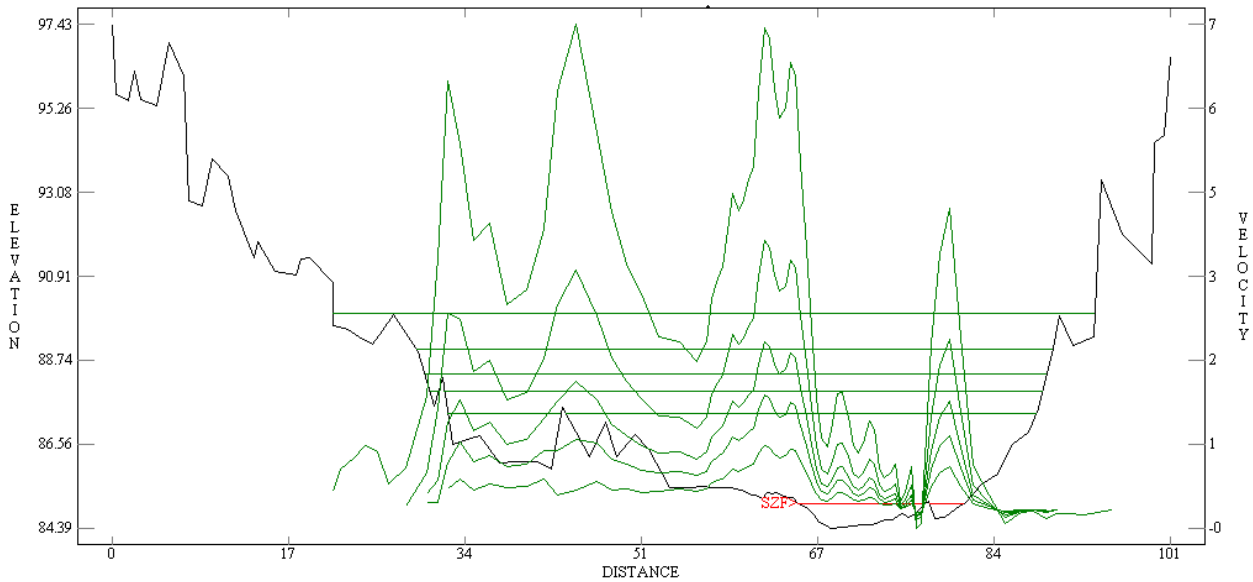

Figure A-23. Cross section for Transect 01 (Step-run).

Figure A-24. Transect 01-Looking upstream to whole transect at mid flow.

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Appendix B
Upstream of Oregon Creek Site Water Surface Elevation Comparison Tables

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Table B-1. Measured and Modeled WSEs (Q in cfs, all other values in ft).

Transect		**01**			**Transect**		**02**			**Transect**		**03**		
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**
78	87.94	87.93	87.94	-	**78**	91.49	91.49	91.48	91.49	**78**	91.65	91.65	91.65	91.65
143	88.36	88.38	88.38	-	**143**	91.81	91.79	91.81	91.81	**143**	92.01	92.01	92.01	92.01
296	89.02	89.01	89.01	-	**296**	92.29	92.29	92.28	92.29	**296**	92.51	92.51	92.51	92.51
Transect		**04**			**Transect**		**05**			**Transect**		**06**		
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**
78	91.7	91.7	91.69	91.7	**78**	91.73	91.73	91.72	91.73	**78**	87.7	87.7	87.69	87.7
143	92.08	92.04	92.06	92.08	**143**	92.13	92.09	92.12	92.13	**143**	88.11	88.07	88.09	88.11
296	92.59	92.6	92.59	92.59	**296**	92.69	92.7	92.69	92.69	**296**	88.67	88.68	88.67	88.67
Transect		**07**			**Transect**		**08**			**Transect**		**09**		
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**
78	87.71	87.71	87.71	87.71	**78**	87.55	87.55	87.55	87.55	**78**	89.42	89.42	89.42	89.42
143	88.11	88.1	88.11	88.11	**143**	87.96	87.98	87.98	87.96	**143**	89.77	89.77	89.77	89.75
296	88.71	88.71	88.71	88.71	**296**	88.6	88.6	88.6	88.6	**296**	90.26	90.26	90.26	90.22
Transect		**10**			**Transect**		**11**			**Transect**		**12**		
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**WSP**
78	94.19	94.19	94.19	94.19	**78**	95.35	95.35	95.35	95.35	**78**	95.93	95.93	95.93	95.93
143	94.57	94.58	94.58	94.57	**143**	95.7	95.7	95.7	95.7	**143**	96.27	96.27	96.27	96.26
296	95.12	95.12	95.12	95.12	**296**	96.21	96.21	96.21	96.21	**296**	96.76	96.76	96.76	96.74

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Table B-2. Differences Between Measured and Modeled WSEs (Q in cfs, all other values in ft).

Transect		01			Transect		02			Transect		03		
Q	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**
78	**87.94**	-0.01	0.00	-	**78**	**91.49**	0.00	-0.01	-	**78**	**91.65**	0.00	0.00	0.00
143	**88.36**	0.02	0.02	-	**143**	**91.81**	-0.02	0.00	-	**143**	**92.01**	0.00	0.00	0.00
296	**89.02**	-0.01	-0.01	-	**296**	**92.29**	0.00	-0.01	-	**296**	**92.51**	0.00	0.00	0.00
Transect		**04**			**Transect**		**05**			**Transect**		**06**		
Q	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**MANS Q**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**MANS Q**
78	**91.7**	0.00	-0.01	0.00	**78**	**91.73**	0.00	-0.01	0.00	**78**	**87.7**	0.00	-0.01	-
143	**92.08**	-0.04	-0.02	0.00	**143**	**92.13**	-0.04	-0.01	0.00	**143**	**88.11**	-0.04	-0.02	-
296	**92.59**	0.01	0.00	0.00	**296**	**92.69**	0.01	0.00	0.00	**296**	**88.67**	0.01	0.00	-
Transect		**07**			**Transect**		**08**			**Transect**		**09**		
Q	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**MANS Q**
78	**87.71**	0.00	0.00	-	**78**	**87.55**	0.00	0.00	-	**78**	**89.42**	0.00	0.00	-
143	**88.11**	-0.01	0.00	-	**143**	**87.96**	0.02	0.02	-	**143**	**89.77**	0.00	0.00	-
296	**88.71**	0.00	0.00	-	**296**	**88.6**	0.00	0.00	-	**296**	**90.26**	0.00	0.00	-
Transect		**10**			**Transect**		**11**			**Transect**		**12**		
Q	**Cal Stage**	**Log/Log**	**MANS Q**	**MANS Q**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**	**Q**	**Cal Stage**	**Log/Log**	**MANS Q**	**WSP**
78	**94.19**	0.00	0.00	-	**78**	**95.35**	0.00	0.00	-	**78**	**95.93**	0.00	0.00	-
143	**94.57**	0.01	0.01	-	**143**	**95.7**	0.00	0.00	-	**143**	**96.27**	0.00	0.00	-
296	**95.12**	0.00	0.00	-	**296**	**96.21**	0.00	0.00	-	**296**	**96.76**	0.00	0.00	-

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Appendix C
Model Calibration Notes

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T-01

- High VAF.
- Station 38.50 – Adjusted N value to decrease a velocity trough; based on an adjacent cell.
- Stations 77.99 to 80.50 – Adjusted N values to dampen a negative velocity spike; based on an adjacent cell.

T-02

- No changes made.

T-03

- No changes made.

T-04

- No changes made.

T-05

- Stations 72.50 and 74.00 - Adjusted N values to dampen a negative velocity spike; based on adjacent cells.

T-06

- No changes made.

T-07

- High VAF.
- Stations 34.40 to 38.40 – Adjusted N values to dampen a velocity spike; based on adjacent cells and averaging.

T-08

- Stations 99.10, 101.50, and 102.30 – Adjusted N values to dampen a velocity spike; based on averaging with adjacent cells.

T-09

- High initial Log-Log beta seemed to potentially indicate that a higher SZF than had been measured in the field. When SZF was raised to bring plotting stage closer in line with T-10, another low gradient riffle, beta decreased and the mean error went down.
- Stations 0.0 to 27.6 – Raised N values to prevent unrealistic flow on the left side cobble bar.
- Station 94.20 – Adjusted N value to decrease a velocity trough; based on an adjacent cell.

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T-10

- Stations 44.40 and 45.50 – Adjusted N values to decrease a velocity trough; based on adjacent cells.

T-11

- Low VAF.
- Stations 128.20, 130.50, and 152.90 – Adjusted N values to dampen a velocity spike; based on adjacent cells.

T-12

- High initial Log-Log beta seemed to potentially indicate that a higher SZF than had been measured in the field. When SZF was raised to bring plotting stage closer in line with T-10, another low gradient riffle, beta decreased and the mean error went down.

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