Oregon Creek
Upper Log Cabin Reach
Draft Hydraulic Calibration Results

Model Used

The hydraulic model for the Upper Log Cabin Reach 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 files are associated with the Upper Log Cabin Reach:
UPLC.RHB

Modeling Methods

Water Surface Elevations (WSEs)

Hydraulic modeling procedures appropriate to the study site and level of data collection were used for modeling WSEs and velocities across each of the 9 cross sections comprising the study reach. For WSEs, these procedures included the development of stage-discharge rating curves using Log/Log regression (IFG4) and Manning's formula (MANSQ), direct comparison of results, and selection of the most appropriate and accurate method. Data file construction, calibration, and simulation followed standard procedures and guidelines outlined in Milhous et al. 1989 and Waddle 2001.

Modeling Guidelines

PHABSIM modeling guidelines considered for the Upper Log Cabin Reach were as follows:

- To determine whether the IFG4 model accurately predicts measured values:
  1. The beta value (a measure of the change in channel roughness with changes in streamflow) must be between 2.0 and 4.5;
  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; and
  4. There must be no more than a 0.1-foot difference between measured and simulated WSEs.
- 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

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used by MANSQ must be within the range of -0.5 to 0.5. The first IFG4 criterion is not applicable to MANSQ.

Habitat Summary for Upper Log Cabin Reach

A hydraulic model was developed for the 9 Instream flow transects on the Upper Log Cabin Reach on Oregon Creek. Meso-habitats represented in this reach are presented in Table 1. Final transect locations are presented in Figure 1.

Table 1. Habitat frequency based on ground mapping for the Log Cabin Diversion Dam Reach of Oregon Creek (Upper: RM 0.0 – 2.0, Lower: RM 3.1 – 4.2)

PHABSIM Habitat	Length	Length Frequency	Adjusted Length Frequency
High gradient riffles	647	4%	0%
Low gradient riffles	2,236	16%	17%
Runs/Step-Runs	1,906	13%	14%
Glides	551	4%	0%
Pocket Water	2,505	17%	19%
Pools	6,540	45%	50%
Total	**14,384**	**100%**	**100%**

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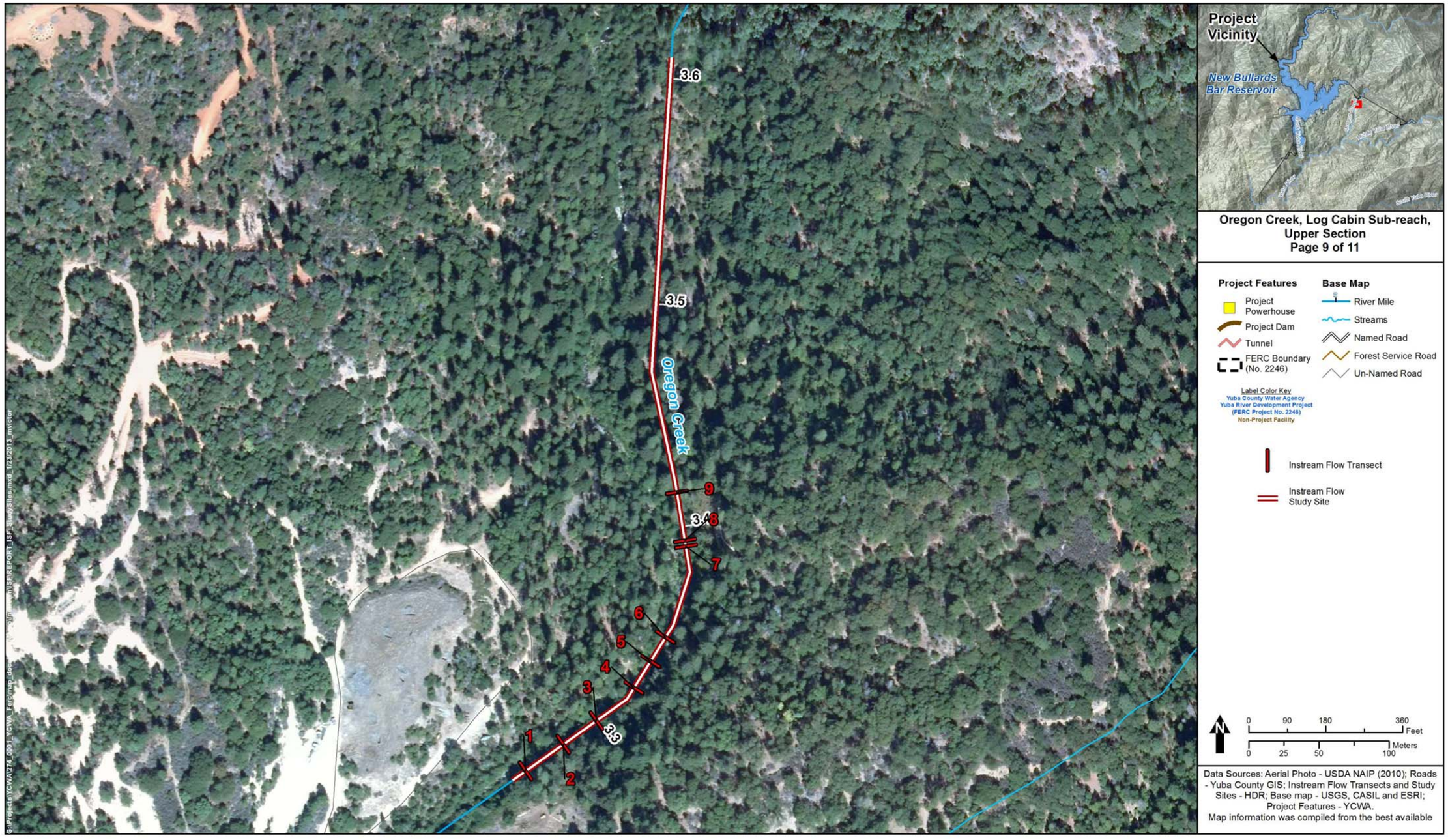

Figure 1. PHABSIM transects in the Upper Log Cabin Reach.

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Calibration Summary for Upper Log Cabin Reach

The Upper Log Cabin model was associated with a three stage discharge pairs, and primary velocity calibration set at full channel flow of 100 cubic feet per second (cfs). All velocities were successfully measured at 100 cfs. Each transect in the site had one velocity set measured, which is consistent with the "one-velocity" method.

Stage/discharge relationships were developed using three main channel calibration discharges: 100 cfs, 48 cfs, and 13 cfs.
Table 2
Table 2 summarizes modeling statistics for each transect and modeling method, while Table C-1, in Appendix C, summarize the given calibration stage and the modeled stages for each flow, at each transect, using all modeling methods used on a given transect.

Cross Sections

One limitation of 1D hydraulic flow models is that a single water surface must be used for the entirety of each transect at a given flow. When a transect involves more than one significantly different water surface, RHABSIM will over- or underwater parts of the transect, depending on what water surface elevation is used. In order to create the most realistic representation of wetted area and water depths, Transect T-05 had part of its bed shifted. The higher bed elevation of the left branch of the split channel was lowered by an amount equal to the difference between the average WSEs of the left and right channels. The average WSE from the right channel was then used for the entire transect. Cross sectional profiles with measured WSEs have been included in Appendix A.

Calibration Details for Upper Log Cabin Reach

Stage/Discharge Calibration

- All transects in the study site were calibrated using both Log/Log and MANSQ.
- For model calibration, WSEs were selected within the range of field collected data only.
- The water surface longitudinal profile, cross-sectional geometry and a realistic rating curve fit were considered when choosing the primary modeling method.
- MANSQ was selected as the primary modeling method on T-01, T-03, T-04, T-05, and T-07 – T-09, based on the modeling guidelines outlined above.
- Log/Log was selected as the primary modeling method on 2 transects. T-02 had a lower mean error with this model and T-06 had MANSQ beta of 0.71, which is outside the range described in the modeling guidelines outlined above.
- All Log/Log betas were between 2.0 and 4.5.
- All transects had MANSQ betas inside the range of 0.0 to 0.5 except for T-06 which had a value of 0.71 and the Log/Log modeling method was selected.

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- All of the MANSQ mean errors were less than 2 percent.
- Both MANSQ and Log/Log mean errors can be seen in Table 2.
- Table 2Refer to Table C-1 and C-2 in the Appendix for a comparison of measured versus modeled WSEs.
- All calculated discharges were within 10 percent of given discharges.
- All transect velocity measurements were collected at the highest target flow possible for that transect. All transects were successfully measured and then modeled at the 100 cfs high flow release. Additional velocities were measured during the 48 cfs release at Transects T-03 and T-05 and during the 13 cfs release at Transects T-03 and T-04 for model calibration.

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

	T-09	T-08	T-07	T-06	T-05
Log/Log	0.6719	3.2163	0.1751	2.9277	3.9156
MANSQ	0.3024	0.7415	0.1660	0.1720	0.9460
MANSQ BETA	0.2419	0.2464	0.2701	0.7101	0.3541
	T-04	**T-03**	**T-02**	**T-01**	
Log/Log	2.5014	0.2135	0.3297	0.9189	
MANSQ	0.8944	0.1584	0.6716	0.2501	
MANSQ BETA	0.3870	0.4912	0.1762	0.3381	

Velocity Calibration

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. Graphical representations of this can be found in Figure 2.

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Table 3. Velocity adjustment factors (VAF).

Transect		1		Transect		2		Transect		3	
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
93.39	5.08	10.93	0.4649	95.82	5.08	3.33	1.5234	94.57	5.08	23.57	0.2155
93.73	12.70	21.54	0.5897	96.18	12.70	9.88	1.2849	94.92	12.70	36.44	0.3485
94.35	44.00	53.19	0.8273	96.85	44.00	39.65	1.1096	95.56	44.00	66.21	0.6646
94.90	100.00	100.24	0.9976	97.46	100.00	93.05	1.0747	96.11	100.00	98.04	1.0200
95.69	250.0	197.12	1.2682	98.33	250.0	210.06	1.1901	96.82	250.0	150.10	1.6655
Transect		**4**		**Transect**		**5**		**Transect**		**6**	
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
93.13	5.08	18.43	0.2756	93.22	5.08	19.45	0.2612	96.36	5.08	79.40	0.0640
93.42	12.70	31.47	0.4036	93.56	12.70	32.01	0.3968	96.62	12.70	85.21	0.1490
93.97	44.00	64.67	0.6804	94.07	44.00	58.83	0.7480	97.12	44.00	96.67	0.4552
94.47	100.00	104.70	0.9551	94.49	100.00	90.82	1.1011	97.55	100.00	107.55	0.9298
95.20	250.0	179.62	1.3918	95.06	250.0	150.38	1.6624	98.19	250.0	124.57	2.0070
Transect		**7**		**Transect**		**8**		**Transect**		**9**	
WSL	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**	**WSL**	**Calibration Flow**	**Calculated Flow**	**VAF**
92.77	5.08	10.61	0.4786	94.27	5.08	12.97	0.3917	94.27	5.08	15.15	0.3354
93.02	12.70	22.05	0.5759	94.51	12.70	24.15	0.5258	94.55	12.70	26.46	0.4799
93.47	44.00	57.96	0.7592	94.96	44.00	57.53	0.7649	95.01	44.00	60.35	0.7291
93.86	100.00	109.83	0.9105	95.38	100.00	102.20	0.9785	95.41	100.00	108.82	0.9187
94.40	250.0	224.55	1.1134	96.04	250.0	191.60	1.3048	95.97	250.0	212.66	1.1756

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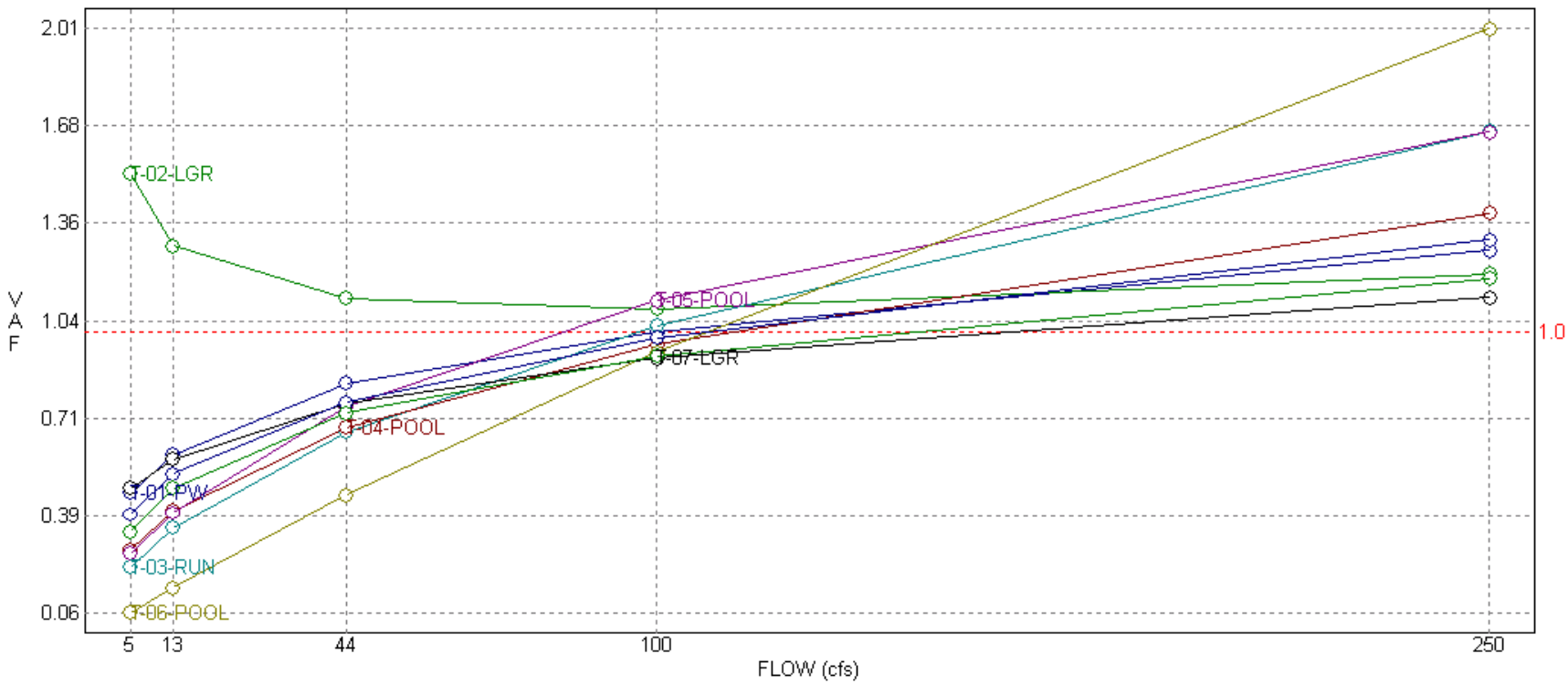

Figure 2. Velocity adjustment factor by Flow

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Target Discharge and Field Discharge

Discharge, like WSE, is used to calibrate stage/discharge relationships in the PHABSIM hydraulic models. Modeled discharges used in the Log/Log and MANSQ routines were modified slightly from best estimates to improve model calibration. 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 Upper Log Cabin Reach.

Transect	Type	Discharge					
		Low - Target 20 cfs		Mid - Target 50 cfs		High - Target 100 cfs	
		Measured (cfs)	Method	Measured (cfs)	Method	Measured (cfs)	Method
1	Pocketwater					106	Swoffer
2	Low gradient riffle					91	Swoffer
3	Run	13	Swoffer	44	Swoffer	92	Swoffer
		13	Swoffer				
4	Pool	12	Swoffer			92	Swoffer
5	Pool			52	Swoffer	95	Swoffer
6	Pool					109	ADCP/Swoffer
7	Low gradient riffle					104	Swoffer
8	Pocketwater					98	Swoffer
9	Step Run					114	Swoffer
Given Flow Averages using best transects		**13**	(T-03, T-04)	**48**	(T-03, T-05)	**100**	(T-01 – T09)

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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
Upper Log Cabin Reach Cross Sectional Profiles and Photos

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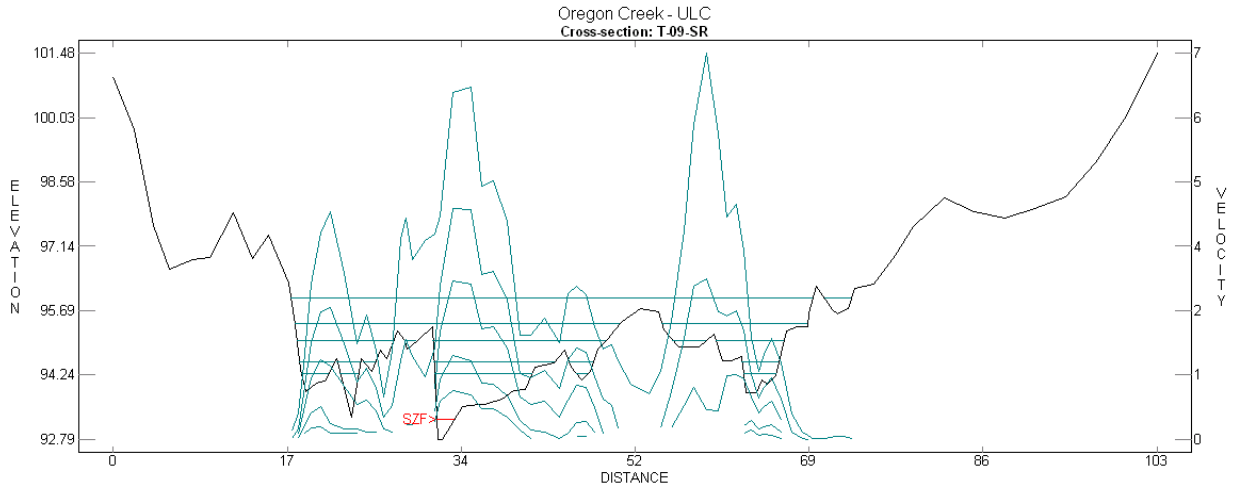

Figure A-1. Transect 09 (Step Run)

Figure A-2. Transect 09-looking from right bank towards left bank at Mid Flow (48 cfs)

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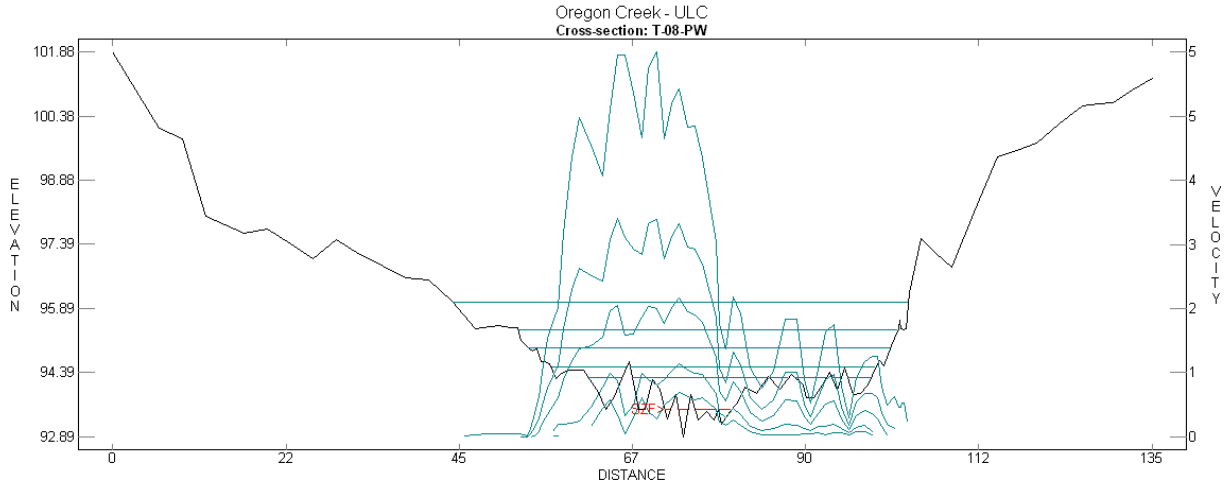

Figure A-3. Transect 08 (Pocketwater)

Figure A-4. Transect 08-looking from right bank towards left bank at Low Flow (13 cfs)

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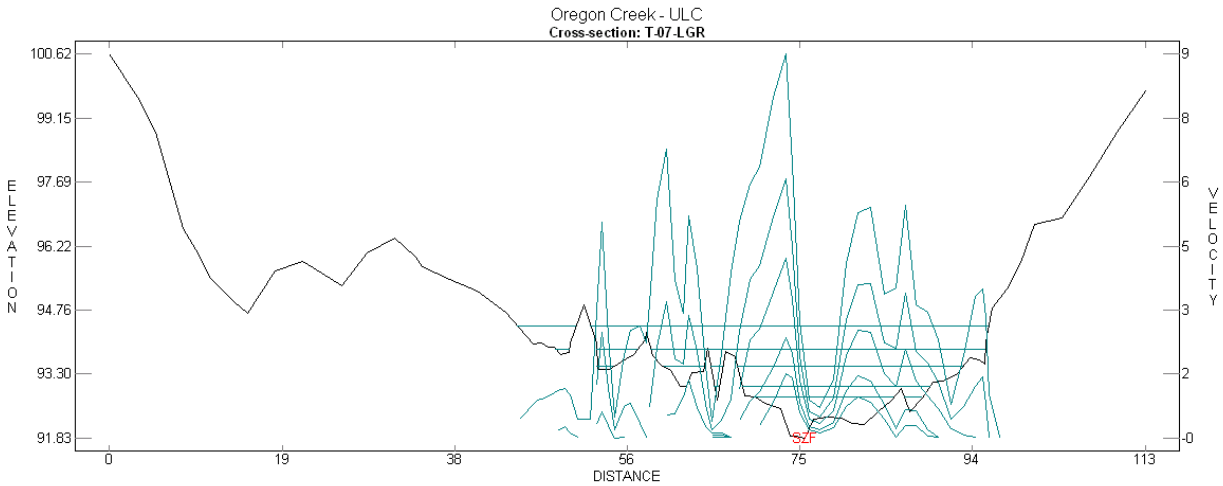

Figure A-5. Transect 07 (Low Gradient Riffle)

Figure A-6. Transect 07-looking from left bank towards right bank at Mid Flow (48 cfs)

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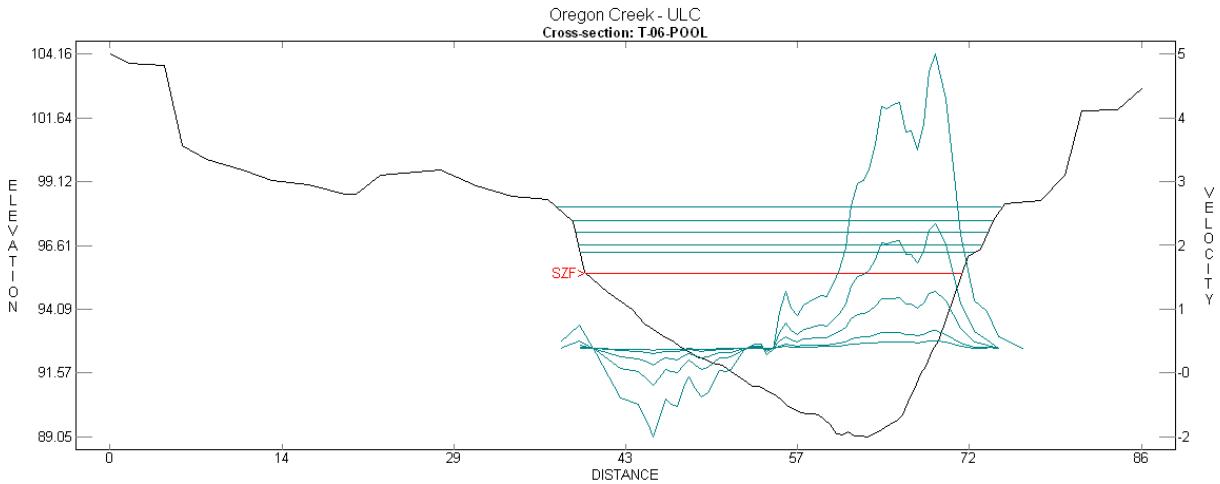

Figure A-7. Transect 6 (Pool)

Figure A-8. Transect 6-looking from right bank to left bank at High Flow (100 cfs)

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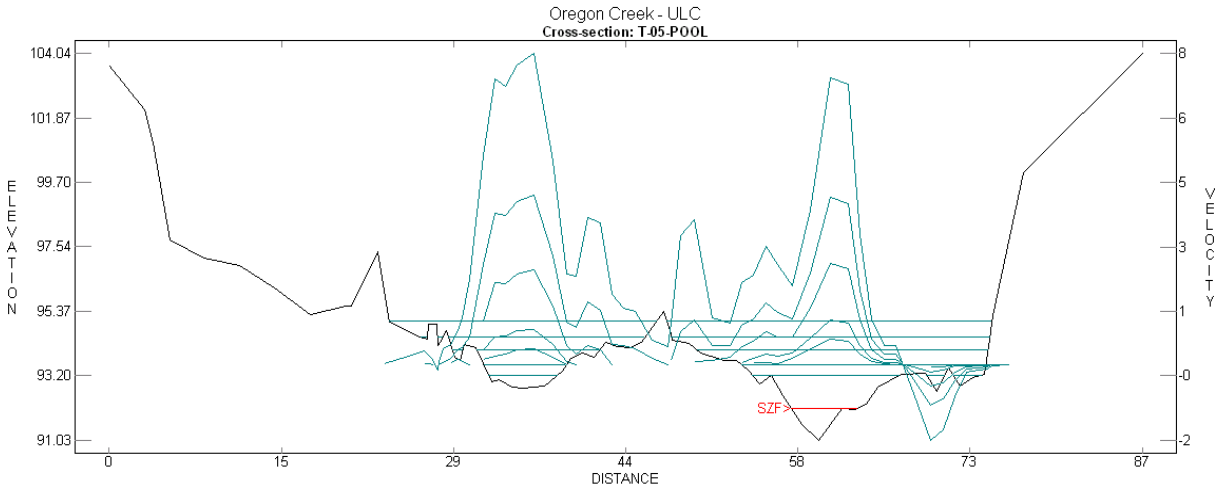

Figure A-9. Transect 5 (Pool)

Figure A-10. Transect 5-looking upstream at left channel (left) and at right channel (right) at Mid Flow (48 cfs)

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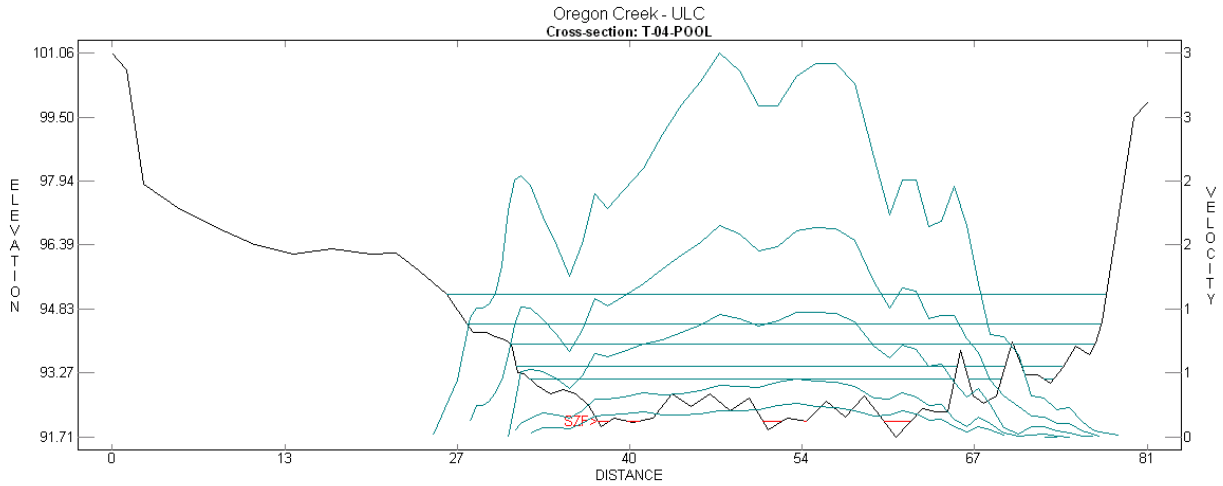

Figure A-11. Transect 04 (Pool)

Figure A-12. Transect 04-looking from right bank towards left bank at Low Flow (13 cfs)

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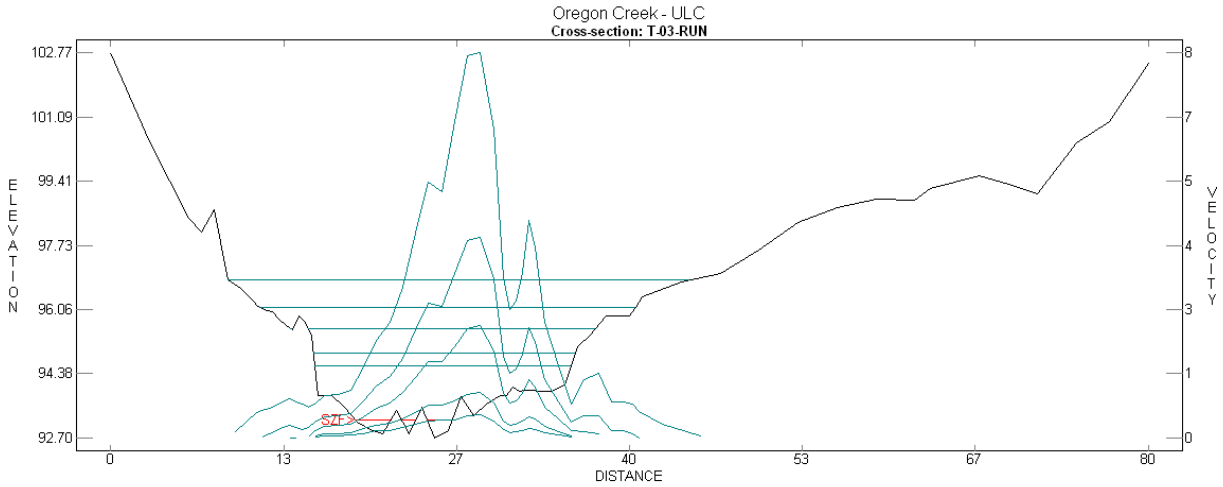

Figure A-13. Transect 03 (Run)

Figure A-14. Transect 03-looking from left bank to right bank at Mid Flow (48 cfs)

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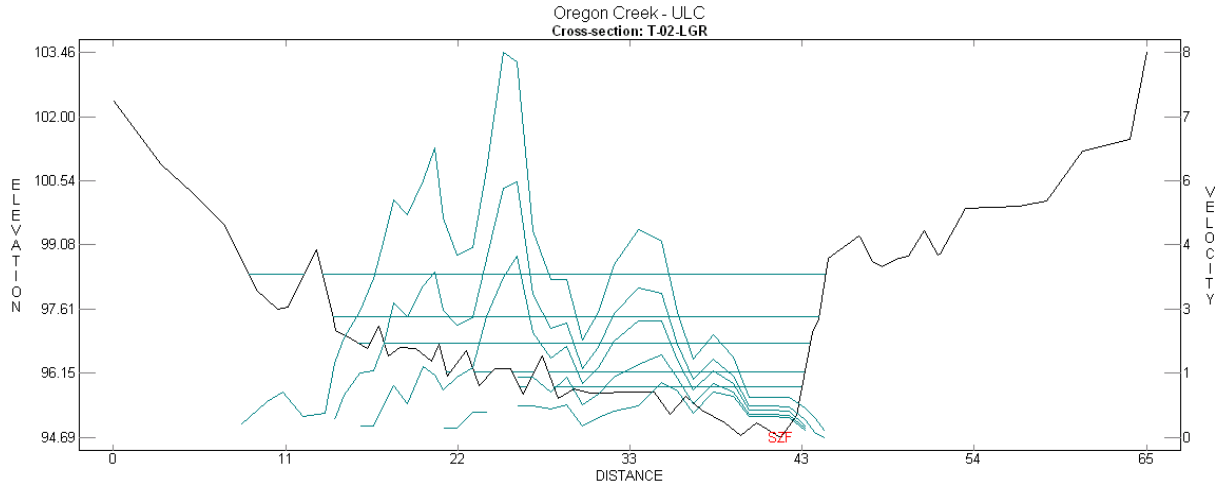

Figure A-15. Transect 02 (Low Gradient Riffle)

Figure A-16. Transect 02-looking from left bank to right bank at Low Flow (48 cfs)

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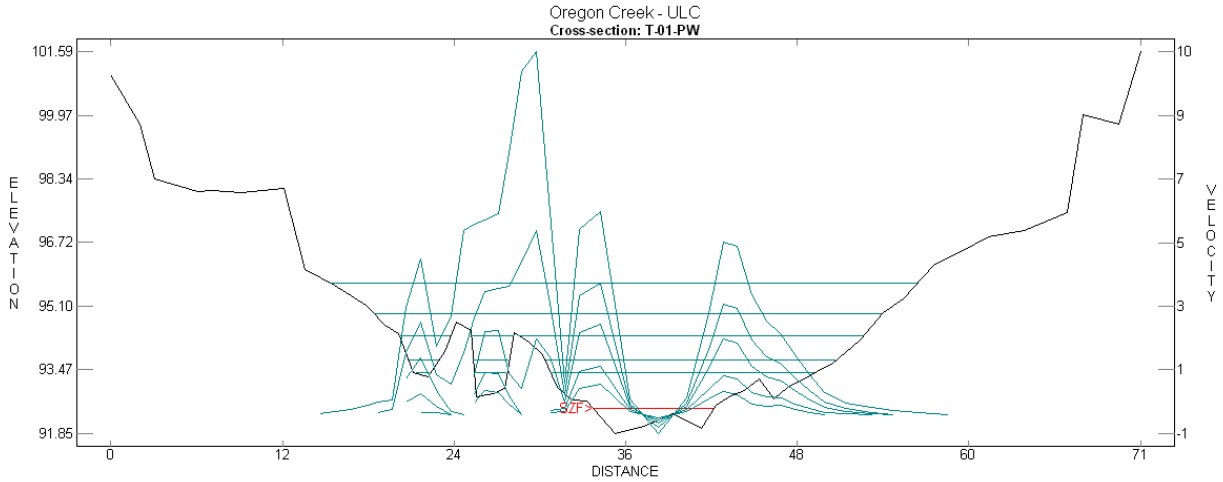

Figure A-17. Transect 01 (Pocketwater)

Figure A-18. Transect 1-looking from left bank towards right bank at Low Flow (13 cfs)

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Appendix B
Upper Log Cabin Reach Cross Section Adjustments

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T-01

- Stations 0.0 to 20.0 and 50.0 to end: Adjusted N values to allow flow to propagate up banks at simulated flows.
- Station 24.0, 28.0, and 29.0: Adjusted roughness, based on nearby cells, to dampen velocity spikes.

T-02

- Stations 0.0 to 13.8 and 40.5 to end: Adjusted N values to allow flow to propagate up banks at simulated flows.
- Stations 16.7 and 20.5: Adjusted N values, based on nearby cells, to dampen velocity spikes.

T-03

- Stations 16.0 to 19.0: Adjusted N values, based on nearby cells, to decrease velocity trough.

T-04

- Stations 66.1 and 70.1: Adjusted N values, based on nearby cells, to dampen velocity spikes.

T-05

- Stations 0.0 to 45.0: Bed shifted down 0.86 feet to allow left channel water depths to be properly simulated.
- Stations 0.0 to 27.0: Adjusted N values to allow flow to propagate up banks at simulated flows after bed shift.

T-06

- No changes.

T-07

- Stations 0.0 to 52.9 and 93.5 to end: Adjusted N values to allow flow to propagate up banks at simulated flows.
- Station 54 and 56.2-60.0: Adjusted N values, based on nearby cells, to dampen velocity spikes.

T-08

- Station 72.0: Adjusted N value, based on nearby cells, to decrease velocity trough.

T-09

- Stations 31.5 and 59.30: Adjusted N values, based on nearby cells, to dampen velocity spikes.

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Appendix C
Upper Log Cabin Reach
Water Surface Elevation Comparison Tables

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Table C-1. Measured and Modeled WSEs.

Transect		1		Transect		2		Transect		3	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.729	93.731	93.727	**13**	96.18	96.181	96.178	**13**	94.924	94.923	94.922
44	94.352	94.344	94.350	**44**	96.856	96.853	96.84	**44**	95.56	95.562	95.561
100	94.901	94.908	94.898	**100**	97.453	97.455	97.449	**100**	96.108	96.107	96.107
Transect		**4**		**Transect**		**5**		**Transect**		**6**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.424	93.418	93.423	**13**	93.558	93.772	93.557	**13**	96.63	96.624	96.63
44	93.95	93.97	93.971	**44**	94.105	94.347	94.067	**44**	97.095	97.116	97.141
100	94.47	94.456	94.466	**100**	94.489	94.834	94.489	**100**	97.57	97.555	97.565
Transect		**7**		**Transect**		**8**		**Transect**		**9**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.019	93.019	93.018	**13**	94.515	94.509	94.514	**13**	94.547	94.548	94.546
44	93.475	93.474	93.473	**44**	94.94	94.961	94.958	**44**	95.02	95.016	95.014
100	93.865	93.866	93.863	**100**	95.385	95.369	95.383	**100**	95.41	95.413	95.409

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Table C-2. Differences between Measured and Modeled WSEs.

Transect		1		Transect		2		Transect		3	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.729	-0.002	0.002	**13**	96.18	-0.001	0.002	**13**	94.924	0.001	0.002
44	94.352	0.008	0.002	**44**	96.856	0.003	0.016	**44**	95.56	-0.002	-0.001
100	94.901	-0.007	0.003	**100**	97.453	-0.002	0.004	**100**	96.108	0.001	0.001
Transect		**4**		**Transect**		**5**		**Transect**		**6**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.424	0.006	0.001	**13**	93.775	-0.214	0.001	**13**	96.63	0.006	0
44	93.95	-0.02	-0.021	**44**	94.336	-0.242	0.038	**44**	97.095	-0.021	-0.046
100	94.47	0.014	0.004	**100**	94.842	-0.345	0.000	**100**	97.57	0.015	0.005
Transect		**7**		**Transect**		**8**		**Transect**		**9**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
13	93.019	0	0.001	**13**	94.515	0.006	0.001	**13**	94.547	-0.001	0.001
44	93.475	0.001	0.002	**44**	94.94	-0.021	-0.018	**44**	95.02	0.004	0.006
100	93.865	-0.001	0.002	**100**	95.385	0.016	0.002	**100**	95.41	-0.003	0.001

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