Middle Yuba River
Our House Diversion Dam Reach
Our House Diversion Dam Site
Preliminary Draft Hydraulic Calibration Results

Model Used

The hydraulic model for the Our House Diversion Dam 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 Moonshine Creek site:

MYOHD.RHB

Modeling Methods

Water Surface Elevations (WSE)

For WSEs, these procedures included: the development of stage/discharge rating curves using log-log regression (IFG4); and/or Manning's formula (MANSQ; 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 was selected. 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 Our House Diversion Dam 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;
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.

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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 0.0 to 5.0. The first IFG4 criterion is not applicable to MANSQ.

Habitat Summary for Our House Diversion Dam Site

A hydraulic model was developed for the 10 instream flow transects on the Our House Diversion Dam Site on the Middle Yuba River above Englebright Reservoir. Meso-habitats represented in the Our House Diversion Dam Reach are presented in Table 1. Our House Diversion Dam Site is one 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 conducted for the entire Our House Diversion Dam Reach, which includes both the Our House Diversion Dam Site and the Upstream of Oregon Creek Site.

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

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Calibration Summary for Our House Diversion Dam Site

The Our House model was associated with three stage discharge pairs, and primary velocity calibration set at full channel flow of 283 cubic feet per second (cfs). This was consistent with the "one-velocity" method, as any given transect only has one velocity set. When velocities couldn't be measured safely at 283 cfs, they were measured at 154 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: 283 cfs, 154 cfs, and 55 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 model calibration notes for 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 Our House Diversion Dam Site

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.
- 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 Transect 01 (T-01), T-02, T-05 and T-09, based on 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 4.5.
- All MANSQ mean errors were less than 3 percent.
- Both MANSQ and Log/Log mean errors can be seen in Table 2. Refer to Table B-1 and B-2 in the Appendix for a comparison of measured versus modeled water surface elevations.
- Seven of the ten calculated discharges were within 10 percent of given discharges.
    - T-01 was 17 percent low. T-01 was a pool. Pools often have low measured discharges when compared to site averages.
    - T-04 was 15 percent high. This transect had challenging measurement conditions, which is why the velocity set had to be collected at mid flow rather than high flow.

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- T-10 was 67 percent low. This error is due to a deep, high velocity jet on this transect. We were unable to collect a complete velocity set for this transect due to the jet, so the calculated flow does not represent the entire transect.

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

	T-10	T-09	T-08	T-07	T-06
Log	0.1616%	0.3923%	0.8451%	1.1476%	1.3653%
MANSQ	0.4837%	0.4916%	1.6822%	0.1779%	0.3943%
MANSQ Beta	0.4948	0.0931	0.557	0.1136	0.4917
	T-05	**T-04**	**T-03**	**T-02**	**T-01**
Log	0.2104%	0.1034%	2.3038%	1.2692%	1.9949%
MANSQ	0.4128%	1.1007%	2.6446%	0.4635%	2.1753%
MANSQ Beta	0.1221	0.0832	0.3859	0.3767	0.361

Velocity Calibration

All transect velocity measurements were collected at the highest target flow possible for that transect. Limiting physical parameters included 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, T-02, and T-06 through T-09
  - Mid Flow: T-03 through T-05 and T-10

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 and Figure 3.

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Table 3. Velocity adjustment factors (VAF).

Transect	01			Transect	02			Transect	03		
WSL[1](ft)	Calibration Flow (cfs)	Calculated Flow (cfs)	VAF	WSL (ft)	Calibration Flow (cfs)	Calculated Flow (cfs)	VAF	WSL (ft)	Calibration Flow (cfs)	Calculated Flow (cfs)	VAF
87.06	22	85.8	0.2564	89.14	22	62.15	0.354	91.08	22	59.72	0.3684
87.74	55	135.19	0.4068	89.62	55	105.49	0.5214	91.65	55	92.12	0.597
88.73	154	229.89	0.6699	90.34	154	196.42	0.7841	92.49	154	159.98	0.9626
89.46	283	316.8	0.8933	90.91	283	284.33	0.9953	93.12	283	226.18	1.2512
90.83	707.5	542.34	1.3045	92.02	707.5	493.48	1.4337	94.28	707.5	382.26	1.8508
Transect	**04**			**Transect**	**05**			**Transect**	**06**		
WSL (ft)	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**	**WSL (ft)**	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**	**WSL (ft)**	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**
92.66	22	17.52	1.256	86.52	22	26.75	0.8225	92.58	22	105.34	0.2088
93.12	55	50.41	1.091	87.04	55	63.46	0.8667	93.05	55	145.26	0.3786
93.82	154	146.8	1.049	87.85	154	171.95	0.8956	93.74	154	227.31	0.6775
94.36	283	253.78	1.1152	88.47	283	303.88	0.9313	94.25	283	305.05	0.9277
95.4	707.5	540.71	1.3085	89.69	707.5	694.48	1.0188	95.19	707.5	492.65	1.4361
Transect	**07**			**Transect**	**08**			**Transect**	**09**		
WSL (ft)	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**	**WSL (ft)**	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**	**WSL (ft)**	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**
92.9	22	32.79	0.6709	93.02	22	116.65	0.1886	92.64	22	22.44	0.9802
93.39	55	70.34	0.7819	93.59	55	155.91	0.3528	93.3	55	54.96	1.0008
94.13	154	171.27	0.8992	94.43	154	224.3	0.6866	94.27	154	154.31	0.998
94.71	283	282.26	1.0026	95.06	283	285.31	0.9919	94.99	283	283.02	0.9999
95.82	707.5	565.28	1.2516	96.24	707.5	421.95	1.6768	96.38	707.5	682.9	1.036
Transect	**10**										
WSL (ft)	**Calibration Flow (cfs)**	**Calculated Flow (cfs)**	**VAF**								
90.25	22	64.27	0.3423								
90.84	55	96	0.5729								
91.75	154	155.62	0.9896								
92.46	283	211.33	1.3391								
93.83	707.5	345.63	2.047								

[1] Water surface level (elevation)

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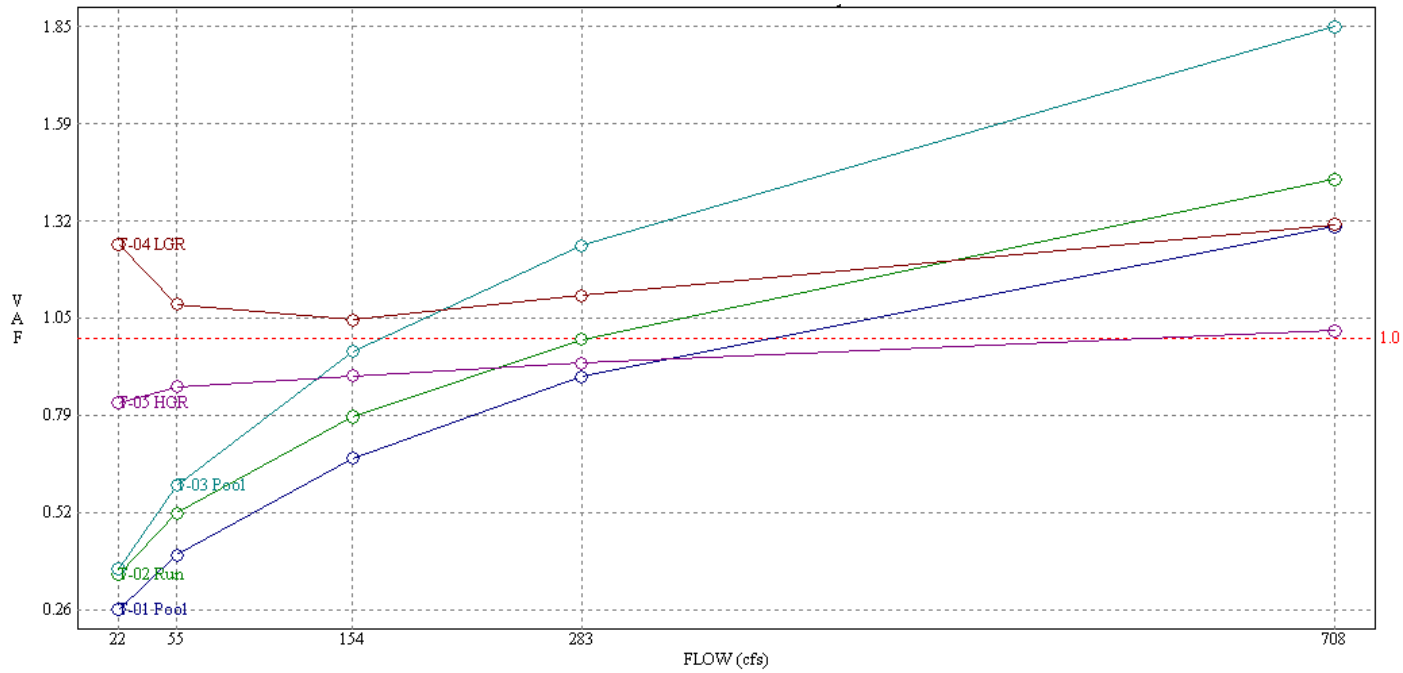

Figure 2. VAF by flow (T-01 to T-05).

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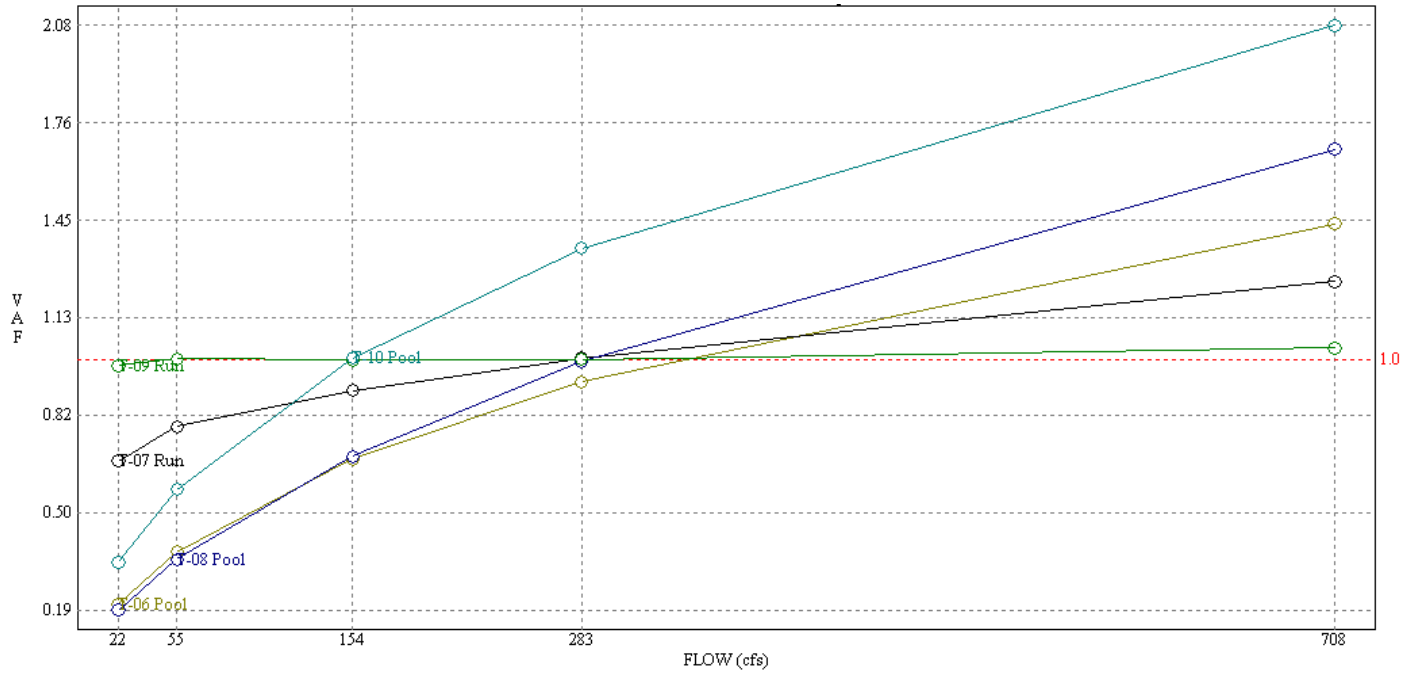

Figure 3. VAF by flow (T-06 to T-10).

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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 Our House Diversion Dam Site.

Transect Number	Mesohabitat Type	Discharge					
		Low - Target 75 cfs		Mid - Target 150 cfs		High - Target 300 cfs	
		Measured (cfs)	Measurement Method	Measured (cfs)	Measurement Method	Measured (cfs)	Measurement Method
1	Pool	--	--	--	--	211	ADCP/ Swoffer
2	Run	--	--	--	--	280	Swoffer
3	Pool	--	--	152	Swoffer	--	--
4	Low gradient riffle	--	--	167	Swoffer	--	--
5	High gradient riffle	--	--	145	Swoffer	--	--
6	Pool	--	--	--	--	300	ADCP/ Swoffer
7	Run	--	--	--	--	283	Swoffer
8	Pool	--	--	--	--	285	ADCP/ Swoffer
9	Run	--	--	--	--	269	ADCP/ Swoffer
10	Pool	--	--	N/A		--	--
Q1	Above Study Site	53	Swoffer	--	--	--	--
Q2	Above Study Site	49	Swoffer	--	--	--	--
Q3	Above Study Site	62	Swoffer	--	--	--	--
Given Flows Averages using best transects		**55**	(Q1, Q2, Q3)	**154**	(T-03, T-04, T-05)	**283**	(T-02, T-06, T-07, T-08, T-09)

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
Our House Diversion Dam Site Cross Sectional Profiles and Photos

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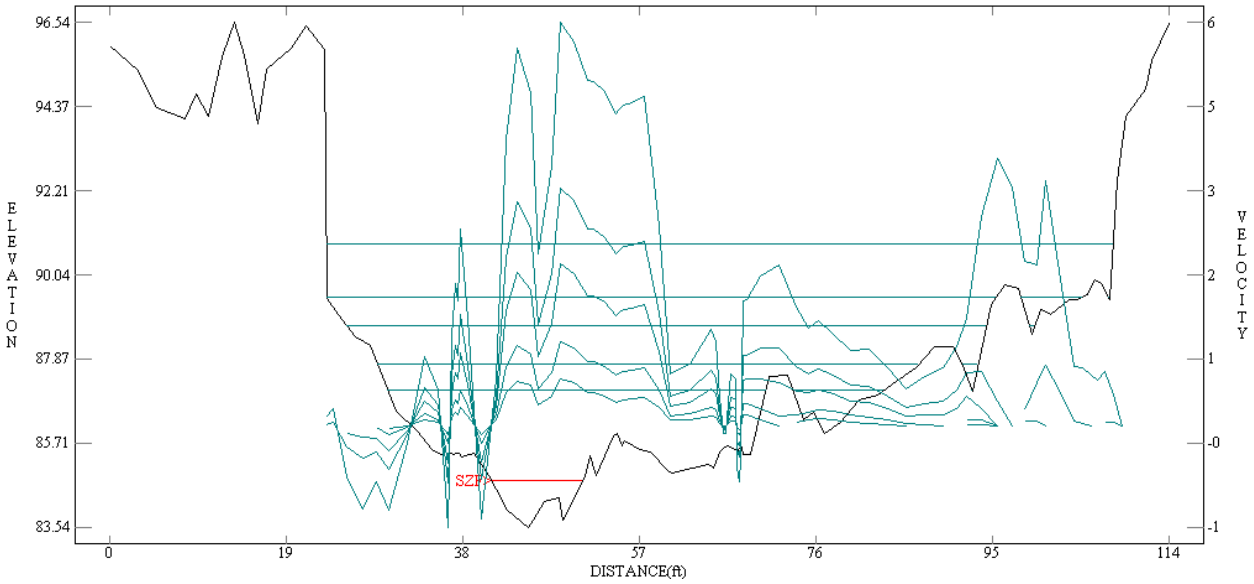

Figure A-1. Cross section for Transect 10 (Pool Head).

Figure A-2. Transect 10-Looking upstream to whole transect at high flow.

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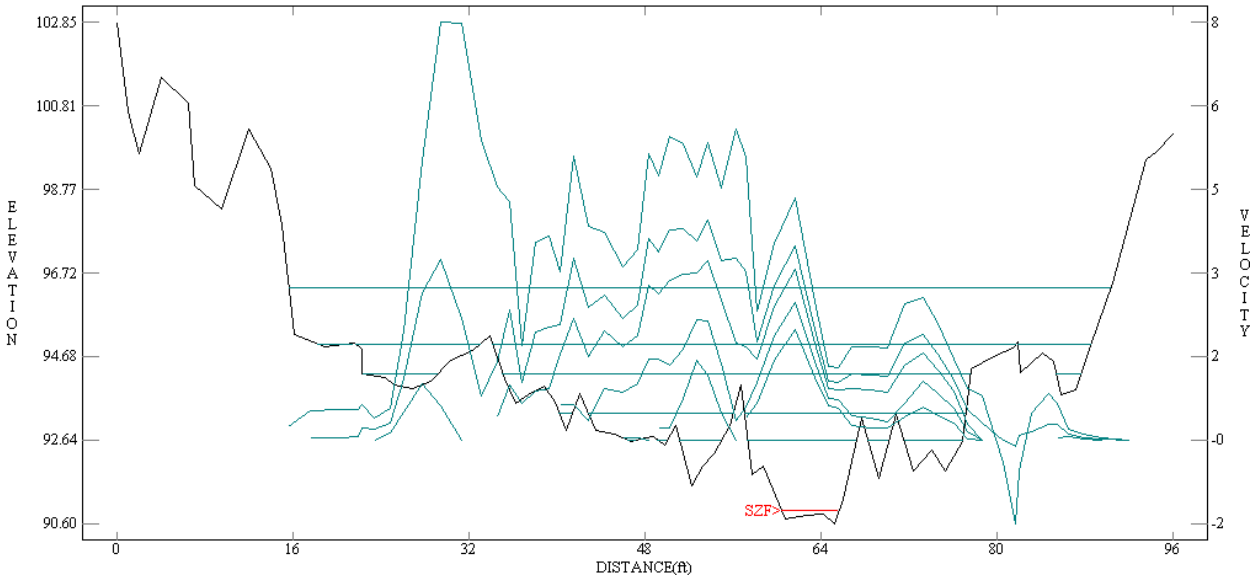

Figure A-3. Cross section for Transect 09 (Run).

Figure A-4. Transect 09-Looking upstream to whole transect at mid flow.

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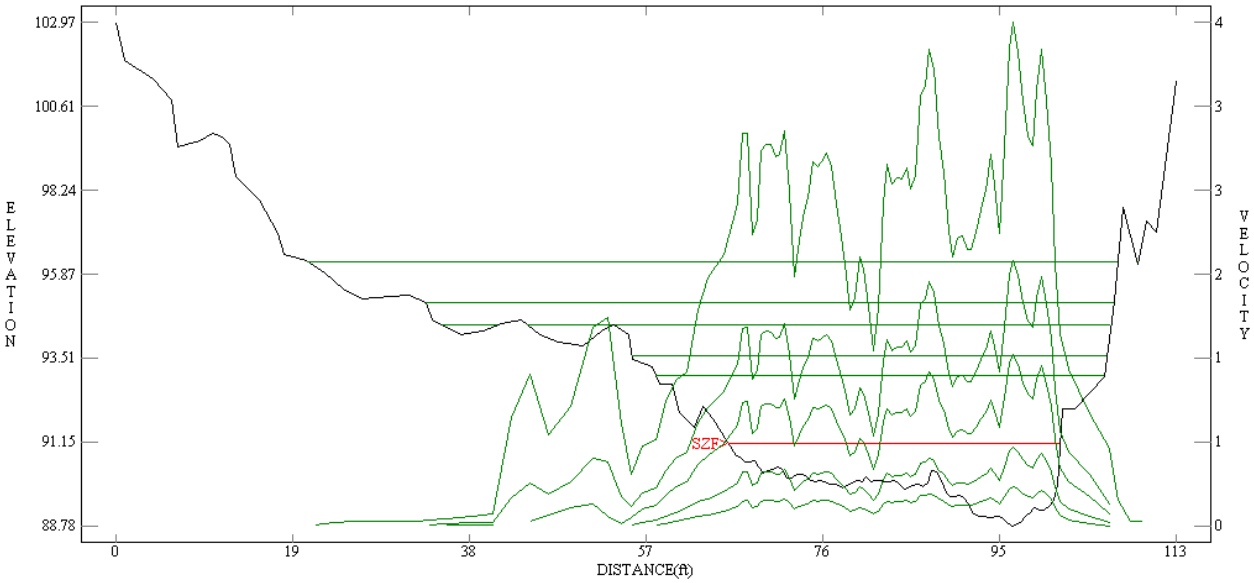

Figure A-5. Cross section for Transect 08 (Pool Belly).

Figure A-6. Transect 08-Looking from right bank to left bank at mid flow.

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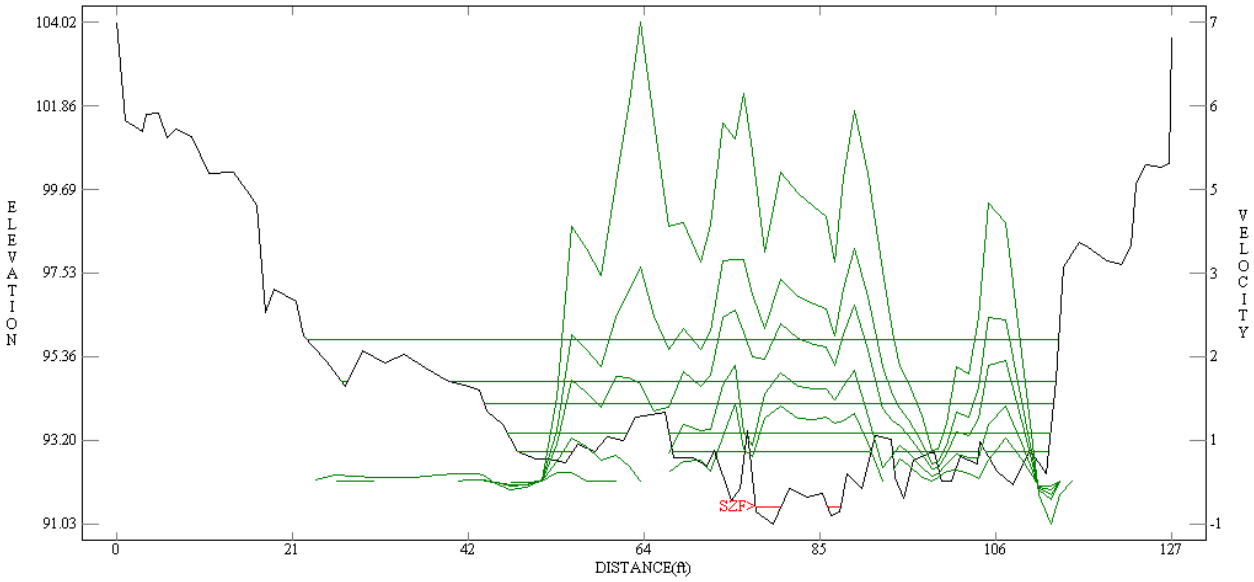

Figure A-7. Cross section for Transect 07 (Run).

Figure A-8. Transect 07-Looking upstream to transect at mid flow.

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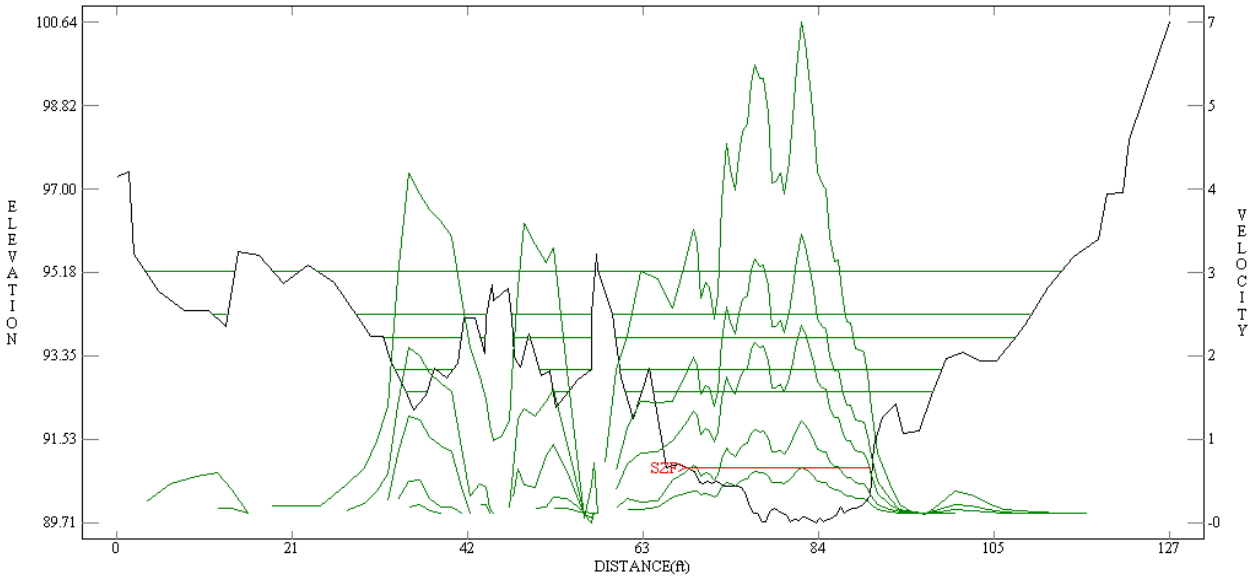

Figure A-9. Cross section for Transect 06 (Pool Belly).

Figure A-10. Transect 06 (Pool Belly)-Looking from right bank to left bank at mid flow.

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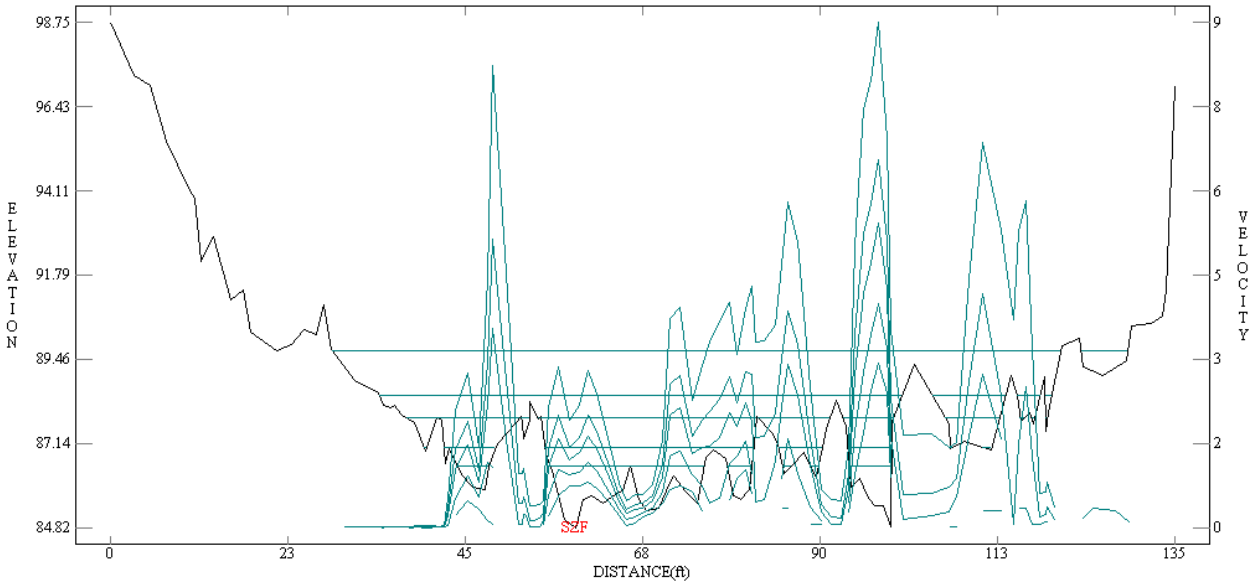

Figure A-11. Cross section for Transect 05 (High Gradient Riffle).

Figure A-12. Cross section for Transect 5 will be included in final document.

Figure A-13. Transect 05-Looking from right bank to left bank at mid flow.

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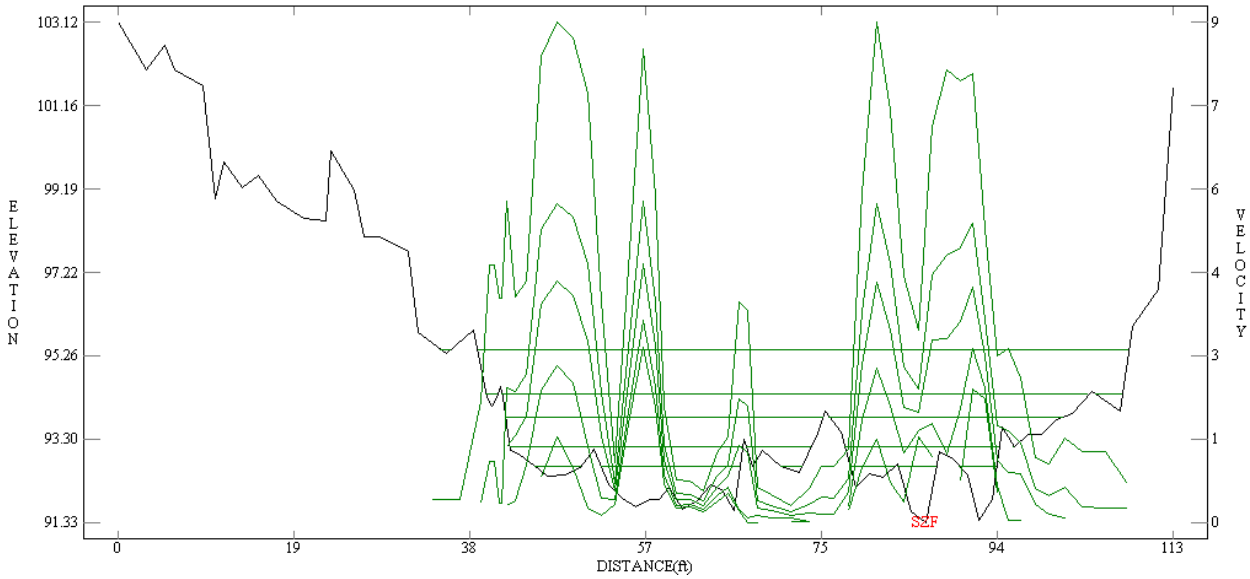

Figure A-14. Cross section for Transect 04 (Low Gradient Riffle).

Figure A-15. Transect 04-Looking upstream to whole transect at mid flow.

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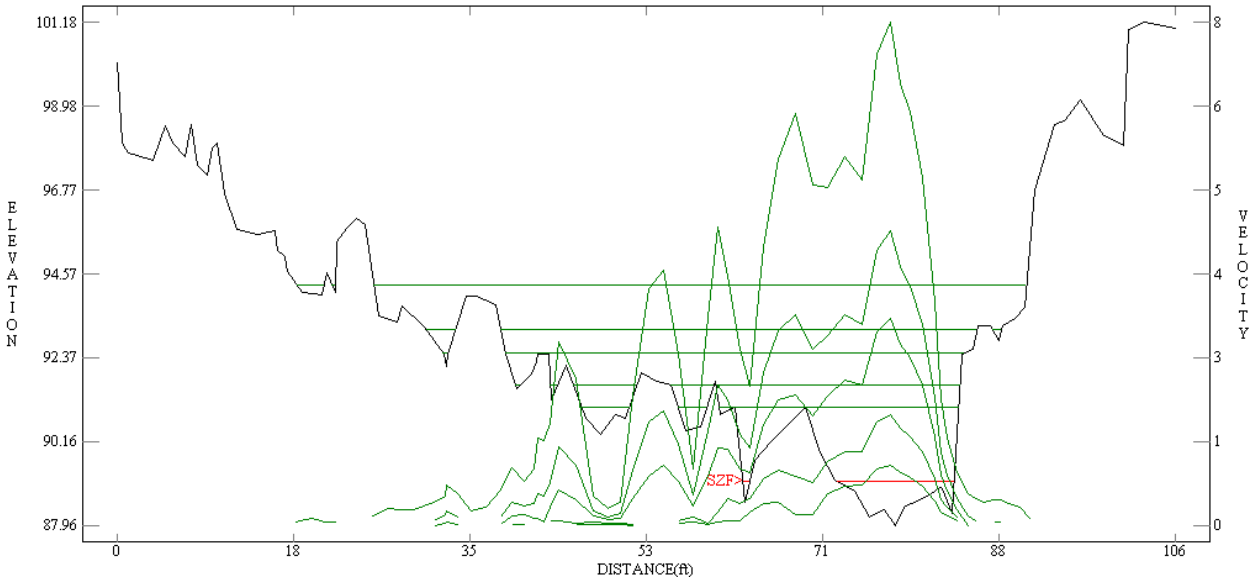

Figure A-16. Cross section for Transect 03 (Pool Belly).

Figure A-17. Transect 03-Looking from right bank to left bank at low flow.

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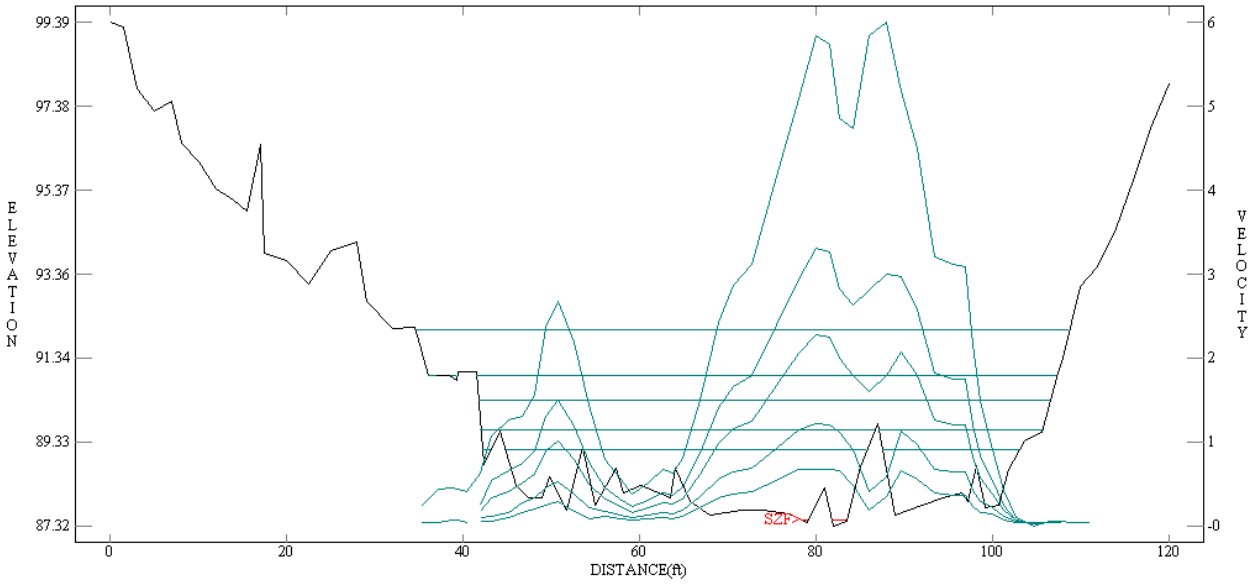

Figure A-18. Cross section for Transect 02 (Run).

Figure A-19. Transect 02-Looking from right bank to left bank at high flow.

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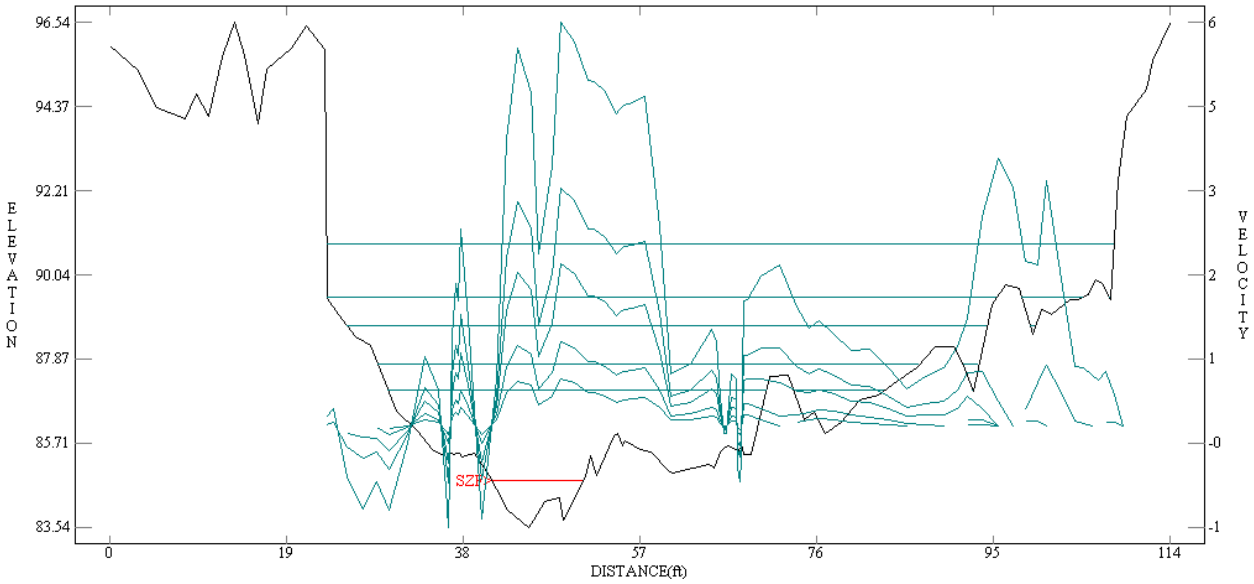

Figure A-20. Cross section for Transect 01 (Pool).

Figure A-21. Transect 01-Looking upstream to whole transect at low flow.

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Appendix B
Our House Diversion Dam Site Water Surface Elevation Comparison Tables

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

Transect		01		Transect		02		Transect		03		Transect		04	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
55	87.74	87.75	87.74	**55**	89.62	89.62	89.62	**55**	91.66	91.65	91.66	**55**	93.12	93.12	93.12
154	88.78	88.75	88.73	**154**	90.34	90.36	90.34	**154**	92.46	92.49	92.52	**154**	93.82	93.82	93.79
283	89.46	89.49	89.46	**283**	90.92	90.91	90.91	**283**	93.14	93.12	93.13	**283**	94.36	94.36	94.36
Transect		**05**		**Transect**		**06**		**Transect**		**07**		**Transect**		**08**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
55	87.04	87.04	87.04	**55**	93.05	93.05	93.05	**55**	93.39	93.39	93.39	**55**	93.59	93.59	93.59
154	87.85	87.85	87.85	**154**	93.76	93.74	93.76	**154**	94.12	94.13	94.12	**154**	94.42	94.43	94.46
283	88.47	88.47	88.47	**283**	94.24	94.25	94.24	**283**	94.72	94.71	94.72	**283**	95.07	95.06	95.06
Transect		**09**		**Transect**		**10**									
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**								
55	93.3	93.3	93.3	**55**	90.84	90.84	90.84								
154	94.27	94.26	94.27	**154**	91.75	91.75	91.75								
283	95	95.01	94.99	**283**	92.46	92.46	92.45								

[1] Discharge

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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		Transect		04	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
55	**87.74**	0.01	0.00	**55**	**89.62**	0.00	0.00	**55**	**91.66**	-0.01	0.00	**55**	**93.12**	0.00	0.00
154	**88.78**	-0.03	-0.05	**154**	**90.34**	0.02	0.00	**154**	**92.46**	0.03	0.06	**154**	**93.82**	0.00	-0.03
283	**89.46**	0.03	0.00	**283**	**90.92**	-0.01	-0.01	**283**	**93.14**	-0.02	-0.01	**283**	**94.36**	0.00	0.00
Transect		**05**		**Transect**		**06**		**Transect**		**07**		**Transect**		**08**	
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**
55	**87.04**	0.00	0.00	**55**	**93.05**	0.00	0.00	**55**	**93.39**	0.00	0.00	**55**	**93.59**	0.00	0.00
154	**87.85**	0.00	0.00	**154**	**93.76**	-0.02	0.00	**154**	**94.12**	0.01	0.00	**154**	**94.42**	0.01	0.04
283	**88.47**	0.00	0.00	**283**	**94.24**	0.01	0.00	**283**	**94.72**	-0.01	0.00	**283**	**95.07**	-0.01	-0.01
Transect		**09**		**Transect**		**10**									
Q	**Cal Stage**	**Log/Log**	**MANSQ**	**Q**	**Cal Stage**	**Log/Log**	**MANSQ**								
55	**93.3**	0.00	0.00	**55**	**90.84**	0.00	0.00								
154	**94.27**	-0.01	0.00	**154**	**91.75**	0.00	0.00								
283	**95**	0.01	-0.01	**283**	**92.46**	0.00	-0.01								

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Appendix C
Model Calibration Notes

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T-01

- Stations 36.28 – Adjusted Manning's N values to negative based on adjacent cells.
- Station 37.42 – Selected an N value such that the velocity was mid point between adjacent cells.
- Stations 39.05 - Selected an N value such that the velocity was mid point between adjacent cells.
- Stations 88.50 and 104.00 through 113.70 – Adjusted Manning's N values to dampen velocity spikes; based on adjacent cells.

T-02

- No changes made.

T-03

- Station 45.0 - Adjusted Manning's N value to dampen velocity spike.

T-04

- Stations 48.00, 55.50, 80.50, 83.50, 88.0 and 94.70 – Adjusted Manning's N values to dampen velocity spikes; based on adjacent cells.

T-05

- Stations 0.00 to 40.00 – Adjusted Manning's N values to dampen an unrealistic velocity spike near water's edge; based on nearby cell.

T-06

- Station 41.0 to 43.7 - Adjusted Manning's N value to dampen a velocity spike; based on adjacent cell.

T-07

- Station 63.5 – Adjusted Manning's N value to dampen a velocity spike; based on adjacent cell002E.

T-08

- No changes made.

T-09

- Station 30.50 - Adjusted Manning's N value to dampen a velocity spike; based on adjacent cell.

T-10

- Velocity set was incomplete, so depth calibration within the model was used to estimate velocities.
- Stations 48.20– Adjusted Manning's N value to dampen a negative velocity spike; based on adjacent cell.
- Station 50.20 to 64.20 – Adjusted Manning's N value to simulate expected velocity pattern based on field photographs.

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