

MEMORANDUM

December 15, 2003

TO: Karl Dreher
FROM: Cindy Yenter
CC: Brian Patton, Jennifer Berkey, Tim Luke
RE: Water Right Review and Sufficiency of Measuring Devices, Rangen Aquaculture

Water Rights Review

Rangen, Inc. holds three water rights for fish propagation use at the hatchery and research facility on Billingsley Creek. They are as follows:

36-15501	7/01/1957	1.46 cfs
36-2551	7/13/1962	48.54 cfs (includes 0.1 cfs for domestic use)
36-7694	4/12/1977	<u>26.00 cfs</u>
Total authorized diversion		76.00 cfs

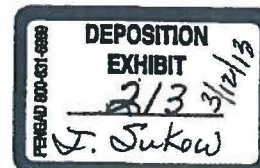
Additionally, Rangen, Inc. holds two earlier water rights for irrigation and domestic uses:

36-134B	10/09/1884	0.09 cfs	
36-135A	4/01/1908	<u>0.05 cfs</u>	
Total authorized diversion		0.14 cfs	7 acres

According to historical flow data which Rangen submitted, flows at the head of Billingsley Creek have not been available to fully satisfy the most junior fish propagation right, 36-7694, since October 1972¹, a period predating the priority of the right. In fact, it is unclear whether diversion and beneficial use have ever actually occurred under right no. 36-7694. Reported average monthly flows during the development period of the water right permit, April 1977 through 1979, never exceeded 50 cfs, the amount of the two earlier rights. The licensing examination from 1979 appears to base the recommendation for an additional 26 cfs diversion rate, on average estimated spring flows of 76 cfs which occurred in October 1972, *five years prior to the filing of the permit*. Even though there may have been some historical basis for the issuance of this license, there is no actual beneficial use documented.

The last year in which flows may have been available to satisfy right no. 36-2551 was during October 1987, when average available flows at the head of Billingsley Creek were estimated to

¹ See Rangen's table entitled "Head of Billingsley Creek at Curren Tunnel". Per Jennifer Berkey's 12-04-03 Memo, these figures reflect total available flows from the source, rather than actual hatchery diversions.



be above 50 cfs². However, a breakdown of submitted data indicates that Rangen had only diverted a maximum of about 42 cfs to hatchery raceways during that same month³. It is not clear where the balance of the flows were used. A portion may have been diverted for late-season irrigation under the Musser and Candy rights (at the tunnel pipelines), although an average of 10 cfs was measured over the creek weir during that month. This may indicate a significant bypass of flows around the hatchery.

The largest beneficial-use diversion indicated in post-1981 data occurred during November 1983, when nearly 48 cfs was measured at the large raceways. Prior to 1981, submitted data cannot be parsed to individual measurements, but the estimated total flows in Billingsley Creek exceeded 50 cfs during November in every year from 1966 to 1976, indicating that flows were available at least part of those years, to satisfy right nos. 36-15501 and 36-2551.

Because of a lack of documentation to support historical use of right no. 36-7694, any indication of injury at Rangen should be limited to the documented reduction of available flows to satisfy right no. 36-2551.

Sufficiency of Measuring Devices

1. 6" PVC Pipeline from Curren Tunnel

This pipeline has no measuring device. It may be used to divert an unspecified portion of the Rangen fish propagation rights to the hatch house and research lab, and is the sole conveyance for domestic water to the lab, shop, office, and manager's house, as well as irrigation water for 3 to 5 acres of landscaping. Instantaneous flow through the hatch house incubation and rearing tanks may be estimated by determining the number of tanks in operation and applying pre-determined flows per unit, as shown on the attached worksheet. The unit flows were calculated by previous Rangen facility managers, using timed fill tests. All hatch house flows are returned to the Billingsley Creek channel, above the diversion to the lower raceways, and are measured again at the raceways.

Diversions for domestic and irrigation uses are not measured. The hatch house worksheet uses a constant 20 gpm for domestic (including irrigation) uses. This is likely on the high side for winter diversions, and too low for summer when irrigation is occurring. Authorized diversion rate for these uses is 0.14 cfs, from right nos. 36-134B and 36-135A, plus 0.1 cfs as a non-additive element of right no. 36-2551. This is a comparatively small portion of Rangen's total diversions, nevertheless, it is the only consumptive portion.

In July 2001, Tim Luke conducted a measurement certification on the 6" pipeline using a polysonic meter. Concurrently, the hatchery manager estimated flow through the pipeline using the worksheet. On that date, indicated pipeline flow was 18% higher than the standard meter.

In March 2002, I conducted the same test, again working with the hatchery manager. On that date, indicated pipeline flow was 9% lower than the standard meter.

²See Rangen's table entitled "Head of Billingsley Creek at Curren Tunnel".

³ See tables attached to Jennifer Berkey's 12-11-03 memo. Measurements taken in the Large Raceways are most representative of total hatchery diversions.

There seems to be a great deal of variability in pipeline estimations. Because the majority of the flow returns to the creek to be reused and re-measured, this is probably not of great concern. However, the magnitude of diversions to domestic and irrigation uses is still unknown.

2. Rangen Hatchery Raceways

Raceway flows are measured by Rangen personnel over dam boards in the two lowest blocks of raceways ("large" raceways and "CTR" raceways - see facility diagram submitted by Rangen). The CTR raceways are situated downstream from the large raceways. Each block of raceways contains three sets of check dams; heads are collected at the uppermost set of checks in each block. A measurement is also taken over a check dam in the Billingsley Creek channel.

At the time of our visit, Mr. Wayne Courtney (Rangen Inc) indicated that measurements are taken weekly in both the large and the CTR raceways, and the two results averaged for a final flow. Presently, all flows from the large raceways are being sent to the CTR raceways, so these measurements should cross-check.

On the day of our investigation, Brian Patton and I took measurements at both the large and CTR raceways. Width of the individual raceway openings, and thus crest length, varied slightly from raceway to raceway. Most checks were not entirely level. We took crest width measurements at each opening, and, using a standard hand-held 3-foot staff gage, took the average of three head readings across each check. Applying the Francis formula for rectangular suppressed weirs, Brian Patton calculated a flow of 18.49 cfs in the large raceways and 18.21 cfs in the CTR raceways. These measurements are representative of the total diverted flow through the facility. We also measured 0.48 cfs over the dam in the creek, using the same techniques. This measurement is representative of the unappropriated flows which bypass all or part of the facility.

Aside from Mr. Courtney, there were no hatchery workers present during our investigation to confirm either the measurement points or the measurement methods used by Rangen staff. I made a call to the hatchery on Friday, December 12, and spoke with Lonnie Tate, who confirmed that all measurements are made at the first set of checks in each block. Mr. Tate indicated that heads were read at the middle of the crest, with a 2" wide metal ruler rather than a standard staff gage. Measurements taken by hatchery personnel on November 24, the day before our visit, indicated flows of 16.6 cfs in the large raceways and 15.9 cfs in the CTR raceways. These flows are as related to me by Mr. Tate, and are not documented. They are 10% to 12% lower than the flows we measured the next day. The chances of actual inflows changing 2 cfs over a 24-hour period is possible but not probable. Mr. Tate confirmed that no operational changes were made within the hatchery during that period. Mr. Tate also confirms that Rangen is still using some form of averaging between the large and CTR raceways and the creek dam flow, to derive flows for reporting purposes.

Brian Patton applied the Francis formula individually to each set of data we collected, but Rangen uses weir discharge tables calculated with fixed 44 inch (for large raceway) or 58 inch (for CTR raceway) openings. In the large raceway measurement section, crest lengths ranged from 43.44 to 44.04 inches. In the CTR block, crest lengths ranged from 58.32 inches to 58.8 inches. To test the sufficiency of the fixed-length discharge tables, I applied our head measurements to the Rangen tables, and calculated total flows of at 18.55 cfs for the large raceways and 18.03 for CTR raceways, a difference of less than 1% in each case, from the flows derived from the sum of independent equations.

The 10% difference found in total flow measurements taken by Rangen and by DWR is not greater than the range of accuracy expected for open-channel measurements under these conditions, and therefore Rangen also passes the sufficiency test with respect to measurement methodology. My experience has been that measurements taken at flat-crested dam boards are generally less accurate than those taken at sharp-crested weirs, and that flat-crested dam measurements return indications of flow which are typically 5-10% lower than actual flow, when checked against other methods of measurement. Because I have not had the opportunity to check flows at this particular facility against a more standard method of measurement, I can only compare one set of measurements against the other.

The most likely cause of the discrepancy between the DWR measurement and the Rangen measurement is a data collection error due to the hatchery staff's use of a narrow metal ruler to measure head. The best measurement location for head readings is upstream from the crest, past the point of crest drawdown. When this is not possible, proper technique for using a hand-held staff gage directly on the crest is to turn the surface of the gage into the flow slightly, to overcome the drawdown and simulate a true head reading. Without actually observing the hatchery staff's measurement techniques, I suspect that the head readings taken by them are probably more indicative of crest drawdown rather than true head over the dam. This would result in a slightly lower head reading and a lower total flow.

It seems reasonable to conclude that, while Rangen's measuring techniques for the hatchery raceways may not be absolutely correct, they are fairly consistent, and are resulting in reported measurements which are no more than about 10% lower than actual flows. However, the reported measurements continue to be measurements of available flow, which usually includes at least some bypass flow, and not actual diverted flow.

Attachment A
Rangen Worksheet for Estimating Hatch House Use

IDWR record	Hatchery/Lab water use			
Date				
Location	# possible	# in use	GPM/unit	Total GPM
Hatchery 1-6	6	0		
Hatchery 7-12	6	0	22	132
Greenhouse A-D	4	4	9.56	38.2
Greenhouse 1-20	20	20	9.56	191.2
Greenhouse 1H-3H	3		19.86	
Barrels 1-36	36		2.00	
Greenhouse E,F	2		9.56	
Swamp Cooler	1		2.00	
Cleanroom 1-34	34		0.50	
Isolation tanks 1-18	18		2.00	
Domestic	1	2.0	20.00	20
Total GPM				381.4
CFS				0.85

(calibrated by timed fill by previous mgr)
 hatchery tanks w/ calibrated inlets & standpipes, hd. table & variable flows
 hatchery barrels w/ flow restrictors, always run full open, calibrated volumetrically (timed fill) by Caroline
 est.
 timed fill calibration? ~~Not used~~
 est.

to - Cindy / Dept. Water Resources

From - Lanny - Rangen Aquaculture

INCHES	LG RW	CTR	SM	DAM
1 0	0.25	0.33	0.23	0.28
1 1/8	0.30	0.40	0.27	0.33
1 1/4	0.35	0.47	0.31	0.39
1 3/8	0.41	0.54	0.36	0.45
1 1/2	0.47	0.61	0.41	0.51
1 5/8	0.52	0.69	0.47	0.57
1 3/4	0.59	0.77	0.52	0.64
1 7/8	0.65	0.86	0.58	0.71
2 0	0.72	0.95	0.64	0.78
2 1/8	0.79	1.04	0.70	0.86
2 1/4	0.93	1.22	0.82	1.01
2 3/8	1.00	1.32	0.89	1.09
2 1/2	1.08	1.42	0.96	1.18
2 5/8	1.16	1.53	1.03	1.26
2 3/4	1.24	1.63	1.10	1.35
2 7/8	1.32	1.74	1.17	1.44
3 0	1.40	1.85	1.24	1.53
3 1/8	1.48	1.96	1.32	1.62
3 1/4	1.57	2.07	1.40	1.72
3 3/8	1.66	2.19	1.47	1.81
3 1/2	1.75	2.31	1.55	1.91
3 5/8	1.84	2.43	1.63	2.01
3 3/4	1.93	2.55	1.72	2.11
3 7/8	2.12	2.80	1.89	2.32
4 0	2.22	2.93	1.97	2.43
4 1/8	2.32	3.06	2.06	2.53
4 1/4	2.42	3.19	2.15	2.64
4 3/8	2.52	3.33	2.24	2.75
4 1/2	2.62	3.46	2.33	2.87
4 5/8	2.73	3.60	2.42	2.98
4 3/4	2.83	3.74	2.52	3.10
4 7/8	2.94	3.89	2.61	3.21
5 0	3.05	4.02	2.71	3.33
5 1/8	3.16	4.17	2.80	3.45
5 1/4	3.27	4.31	2.90	3.57
5 3/8	3.38	4.46	3.00	3.69
5 1/2	3.49	4.61	3.10	3.82
5 5/8	3.61	4.76	3.20	3.94
5 3/4	3.72	4.92	3.31	4.07
5 7/8	3.84	5.07	3.41	4.20
6 0	3.96	5.23	3.52	4.33
6 1/8	4.08	5.38	3.62	4.46
6 1/4	4.20	5.54	3.73	4.59
6 3/8	4.32	5.70	3.84	4.72
6 1/2	4.44	5.86	3.95	4.86
6 5/8	4.57	6.03	4.06	4.99
6 3/4	4.69	6.19	4.17	5.13
6 7/8	4.82	6.36	4.28	5.27

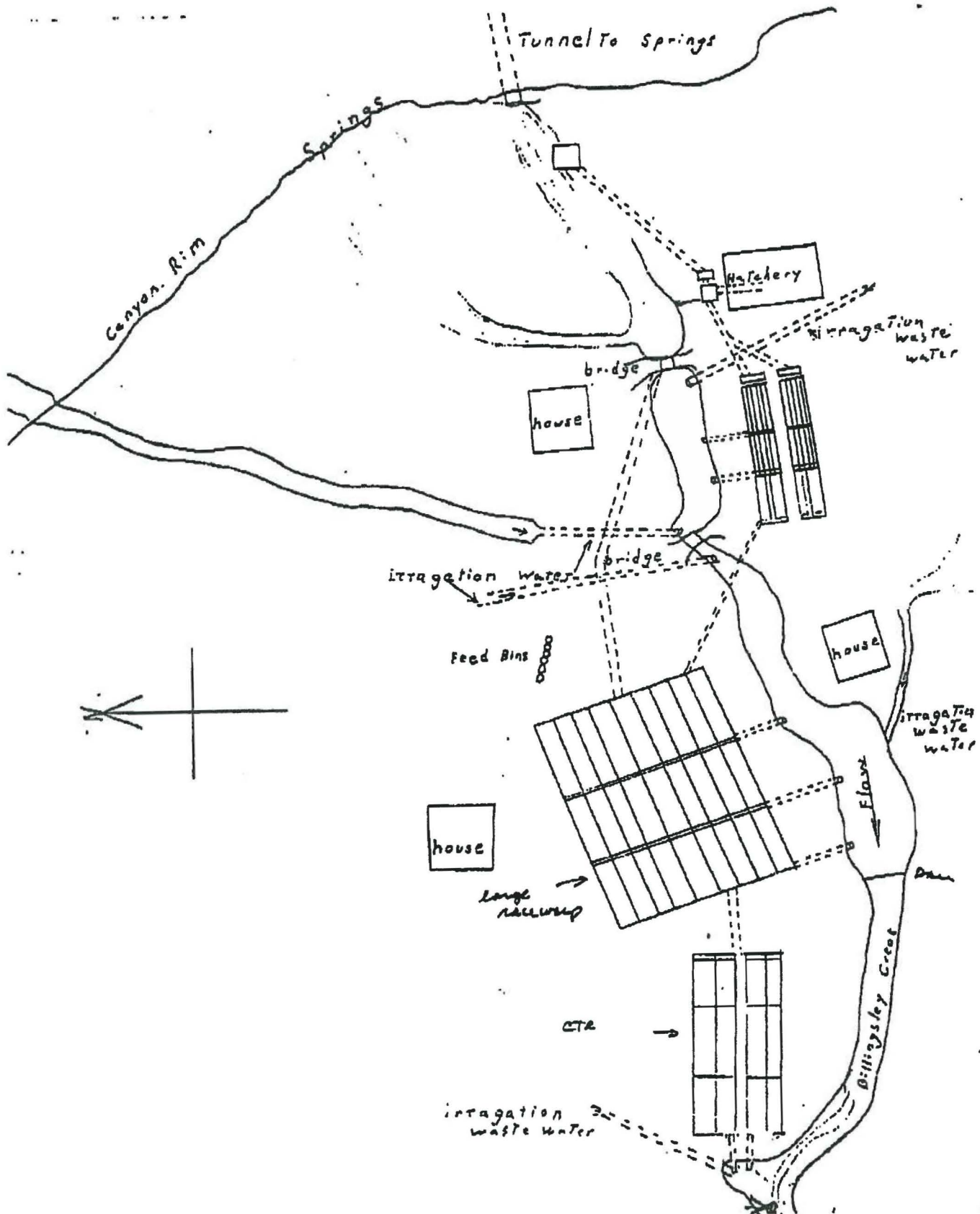
** table adjusted for measurement over 2" boards

RECEIVED
 DEC 18 2003
 Department of Water Resources
 Southern Region

736-7067

		LGRW	CTR	DAM
7	0	4.95	6.53	5.41
7	1/8	5.08	6.70	5.55
7	1/4	5.21	6.87	5.69
7	3/8	5.34	7.04	5.83
7	1/2	5.47	7.22	5.98
7	5/8	5.60	7.39	6.12
7	3/4	5.73	7.57	6.27
7	7/8	5.87	7.75	6.41
8	0	6.01	7.92	6.56
8	1/8	6.14	8.11	6.71
8	1/4	6.28	8.29	6.86
8	3/8	6.42	8.47	7.02
8	1/2	6.56	8.66	7.17
8	5/8	6.70	8.84	7.32
8	3/4	6.84	9.03	7.48
8	7/8	6.99	9.22	7.63
9	0	7.13	9.41	7.79
9	1/8	7.27	9.60	7.95
9	1/4	7.42	9.79	8.11
9	3/8	7.57	9.99	8.27
9	1/2	7.72	10.18	8.43
9	5/8	7.86	10.38	8.59
9	3/4	8.01	10.58	8.76
9	7/8	8.16	10.77	8.92
10	0	8.32	10.97	9.09
10	1/8	8.47	11.18	9.26
10	1/4	8.62	11.38	9.42
10	3/8	8.78	11.58	9.59
10	1/2	8.93	11.79	9.76
10	5/8	9.09	11.99	9.93
10	3/4	9.25	12.20	10.10
10	7/8	9.40	12.41	10.28
11	0	9.56	12.62	10.45
11	1/8	9.72	12.83	10.63
11	1/4	9.88	13.04	10.80
11	3/8	10.04	13.26	10.98
11	1/2	10.21	13.47	11.16
11	5/8	10.37	13.69	11.33
11	3/4	10.53	13.90	11.51
11	7/8	10.70	14.12	11.69
12	0	10.87	14.34	11.87

Rangers Research Hatchery Hagerman Ida.



11-25-03 Cindy Yenter Brian Patton J Dee May
Wayne Courtney Frank Erwin
(Doug Ramsey - hatchery lead)

- Config of diversion works
- Sufficiency of meas devices
- ↳ Amount of water diverted now
- ↳ any undiverted flows? How much
- ↳ alternate sources

11-25-03 Ransen Tour

- Irr pipes L to R Cindy - Musser - Morris
- White pipes from RH Box → middle box (Crandellmire)
- White pipes from middle box → ^{upper} raceways
+ spill to creek
- Div @ bridge → lower raceways
+ outflow from upper
- numerous seeps, all captured.
- How much irrigation use on hatchery grounds?
- everything below bridge not retrievable?
 - minor seep @ headgate 1 gpm
 - 40-50 gpm over checks
 - 2 anti-freeze pipes from dom. systems (house & shop)
1-2 gpm
- Upper raceways 2 of 8
- lower " 4 of 10 A Block
2 of 4 B Block
(1 used as settling pond) - pond is
pumped, does not spill
all discharges to creek channel.

11-25-03 Ranger (cont)

- Uncaptured flows in ck meas @ check next to Lower Block B (CTR)

May send a packet to Karl containing a system diagram and historical diversion data.

I asked that discharge tables being used for dam board measurements be sent to Brian for review

Need to assess how much irrigation, and what right it is authorized under.

At Rangen's measuring point in upper bank in lower raceways

Large
Raceway

2nd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	3.65	0.34	2.41
Right Middle	3.65	0.34	2.41
Left Middle	3.62	0.3	1.98
Left	3.67	0.34	2.42

Q (cfs) from Rangen tables
2.42
2.42
2.01
2.42

3rd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	3.67	0.3	2.01
Right Middle	3.66	0.36	2.63
Left Middle	3.66	0.34	2.42
Left	3.66	0.32	2.21
TOTAL			18.49

2.01 (avg width = 43.86")
2.64
2.42
2.21
18.55 21%

At d/s end of upper bank in Lower raceways

2nd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	3.66	0.3	2.00
Right Middle	3.65	0.32	2.20
Left Middle	3.63	0.28	1.79
Left	3.71	0.28	1.83

3rd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	3.65	0.28	1.80
Right Middle	3.66	0.3	2.00
Left Middle	3.68	0.3	2.01
Left	3.55	0.36	2.55
TOTAL			16.19

At lower bank of lower raceways

CTR
Raceway

2nd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	4.9	0.34	3.23
Middle	4.87	0.36	3.50
Left	4.86	0.32	2.93

Q from Rangen table
3.19
3.47
2.91

3rd Raceway from right			
	W (ft)	H (ft)	Q (cfs)
Right	4.88	0.32	2.94
Middle	4.89	0.3	2.68
Left	4.86	0.32	2.93
TOTAL			18.21

avg width = 58.52"
2.91
2.64
2.91
18.03 1%

At wler in stream near d/s of facility

W (ft)	H (ft)	Q (cfs)
3.5	0.12	0.48

12-11-03 phone call

Lonnie - Don measures

@ 1st check in Log

@ 1st check in CTR (capacity ~ 30 cfs)

@ creek weir

Meas on 24th 16.6 Log

15.9 CTR

1.62 Creek