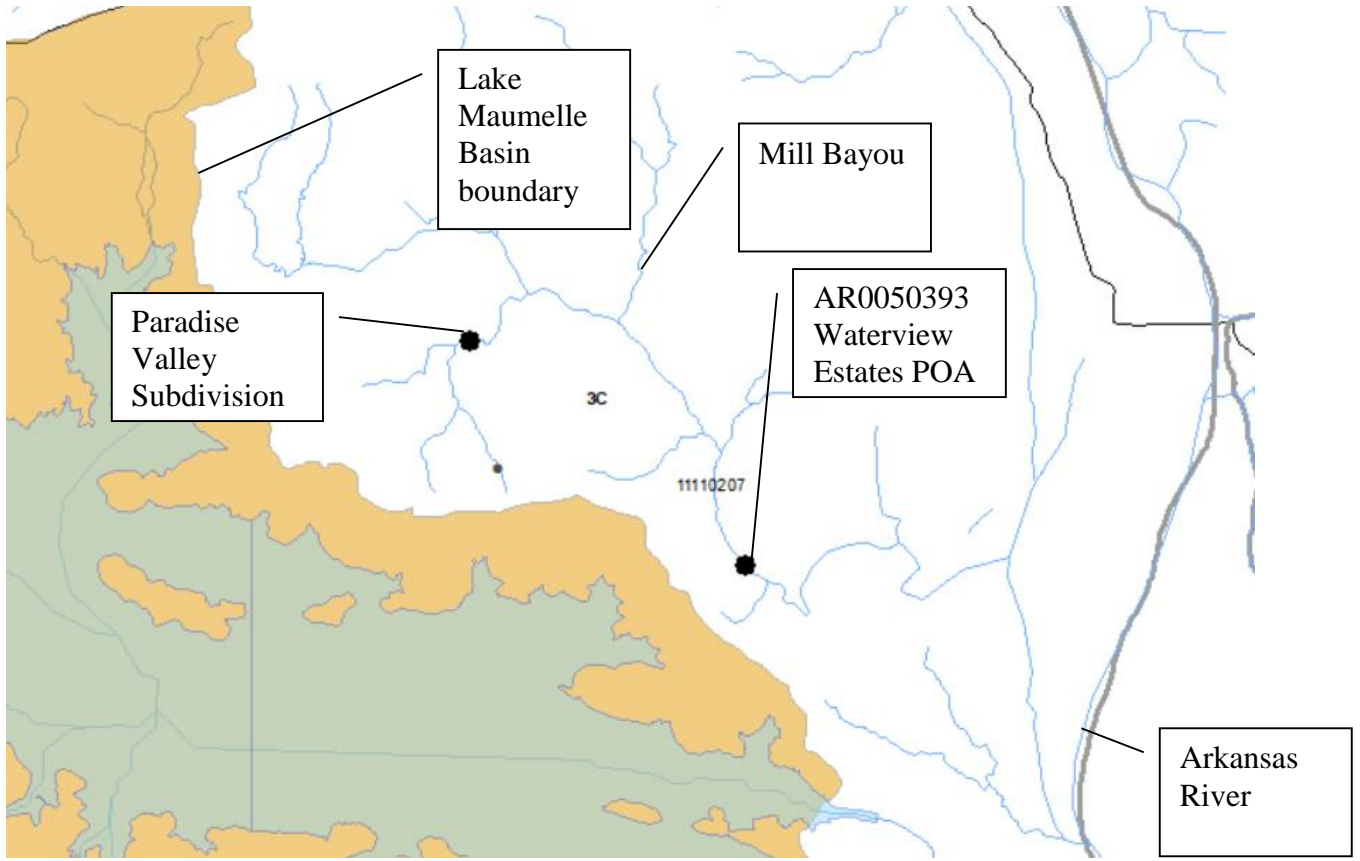
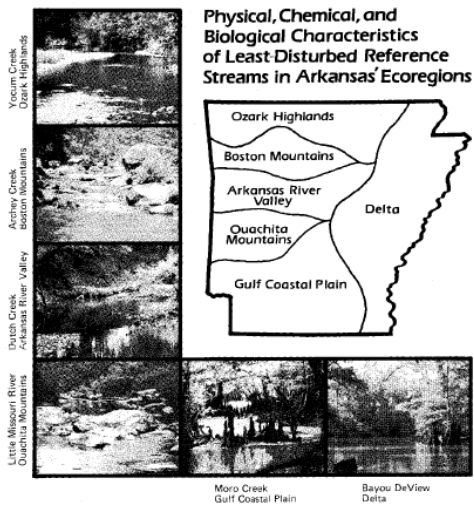


Stream Location Map



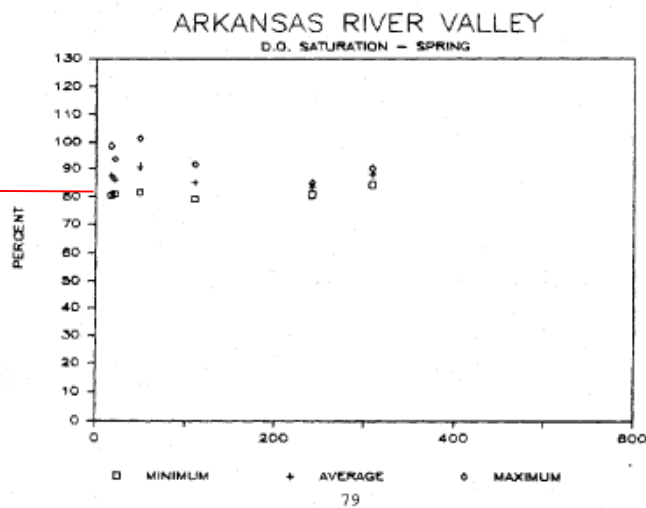
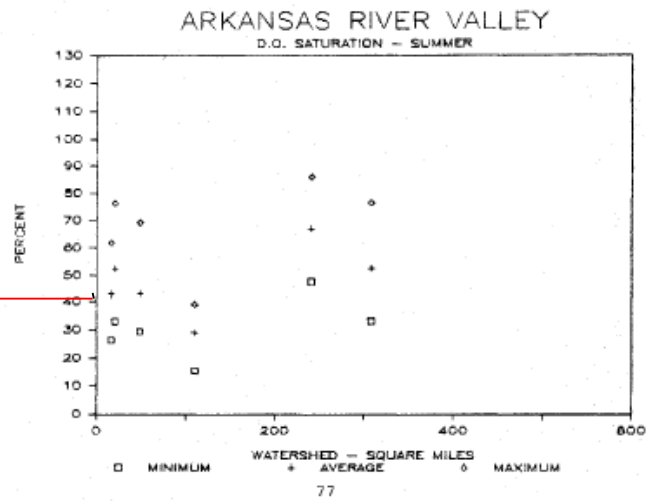
		Ammonia Calculations			COLOR KEY	
POTW?	No	(Yes or No)				
Facility Name	Paradise Subdivision					User Inputs
Major or Minor	Minor					Calculated values
Permit Number	AR0053210					
Receiving Stream	Tributary of Mill Bayou		Ecoregion or River name	Arkansas River Valley		
7Q10, cfs	0	USGS Msp	Watershed area (mi ²)	1.38		
0.25/0.67 multiplier	0.67		Regulation No. 2 Chronic Toxicity Criteria (Instream Concentration)			
Qb, cfs	0.00			AML, mg/l	DML, mg/l	
Qe, MGD	0.05	Design flow	April	5.6	5.6	
Qe, cfs	0.08		May - October	5.6	5.6	
Cb, mg/l	0.1	Model input upstream	November - March	16.7	16.7	
Allowable Effluent Conc., mg/l						
(Qe * Ce) + (Qb* Cb) = (Qe + Qb) * IWC				Allowable Effluent Conc. (Ce), mg/l		
Qe	Effluent Flow		Ce = (IWC (Qe + Qb) - Cb X Qb) / Qe			
Ce	Allowable Effluent Concentration		Monthly Avg.,mg/l		Daily Max, mg/l	
Qb	% of Low Flow of Receiving Stream		April	5.60	5.60	
Cb	Background Concentration		May - October	5.60	5.60	
IWC	Instream Waste Concentration Chronic Toxicity Criteria		November - March	16.70	16.70	
Chronic Toxicity Criteria vs. D.O. Model Limits						
	Monthly Average, mg/l		Permit Limits		Daily Maximum, mg/l	
Month	Toxicity limit	D.O. limit			Toxicity limit	D.O. limit
April	5.60	10	5.60		5.60	15
May - October	no fishery	5	5.00		no fishery	7.5
November - March	16.70	10	10.00		16.70	15

Ammonia Toxicity Criteria					
Minor Permits					
Fish Early Life Stages Absent - Primary Season (November - March), mg/L					
Ecoregion	Temperature	pH	4-day average	30-day average	
Arkansas River	14	7.6	10.3	10.3	
Arkansas River Valley	14	6.7	16.7	16.7	
Boston Mountains	14	6.9	15.8	15.8	
Delta	14	7.1	14.7	14.7	
Gulf Coastal Plains	14	6.6	17	17	
Ouachita Mountains	14	7.1	14.7	14.7	
Ouachita River (L. Mo. to Mouth)	14	6.7	16.7	16.7	
Ozark Highlands	14	7.6	10.3	10.3	
Red River	14	7.5	11.3	11.3	
White River (Dam #10 Mouth)	14	7.7	9.3	9.3	
Fish Early Life Stages Present - Critical Season (April - October), mg/L					
Ecoregion	Temperature	pH	4-day average	30-day average	
Arkansas River	32	7.6	3.2	3.2	
Arkansas River Valley	31	6.7	5.6	5.6	
Boston Mountains	31	6.9	5.3	5.3	
Delta	30	7.1	5.2	5.2	
Gulf Coastal Plains	30	6.6	6.1	6.1	
Ouachita Mountains	30	7.1	5.2	5.2	
Ouachita River (L. Mo. to Mouth)	32	6.7	5.2	5.2	
Ozark Highlands	29	7.6	3.9	3.9	
Red River	32	7.5	3.5	3.5	
White River (Dam #10 Mouth)	32	7.7	2.9	2.9	



**Volume II: Data Analysis
1987**

**State of Arkansas
Department of Pollution Control and Ecology**



Sediment Oxygen Demand (SOD) for Various Temperatures and Ecoregion ⁵

Rocky Substrate ⁴						Applicable Ecoregions ⁶ Ozark Highlands Boston Mountains Ouachita Mountains
TSS ¹	SOD ₂₀	SOD ₂₂	SOD ₂₉	SOD ₃₀	SOD ₃₁	
15 ²	0.3	0.34	0.51	0.54	0.57	
20 ²	0.5	0.56	0.84	0.90	0.95	
30 ²	1.0	1.12	1.69	1.79	1.90	
45 ³	1.4	1.57	2.37	2.51	2.66	
90 ³	1.8	2.02	3.04	3.22	3.42	
Mixed Substrate						Arkansas River Valley Gulf Coastal Plain
TSS ¹	SOD ₂₀	SOD ₂₂	SOD ₂₉	SOD ₃₀	SOD ₃₁	
15 ²	0.4	0.45	0.68	0.72	0.76	
20 ²	0.7	0.79	1.18	1.25	1.33	
30 ²	1.3	1.46	2.20	2.33	2.47	
45 ³	1.6	1.80	2.70	2.87	3.04	
90 ³	1.9	2.13	3.21	3.40	3.61	
Sandy Substrate ⁴						Arkansas River Valley Gulf Coastal Plain Delta
TSS ¹	SOD ₂₀	SOD ₂₂	SOD ₃₀	SOD ₃₁	SOD ₃₂	
15 ²	0.5	0.56	0.90	0.95	1.01	
20 ²	0.8	0.90	1.43	1.52	1.61	
30 ²	1.5	1.69	2.69	2.85	3.0	
45 ³	1.8	2.02	3.22	3.42	3.62	
90 ³	2.0	2.25	3.58	3.80	4.02	

¹ Projected TSS instream after mixing.

² TSS values are from MOA with EPA found in the CPP. SOD values for rocky substrate are the lower end of range given in the MOA. SOD values for sandy substrate are the upper end of range given in the MOA.

³ These TSS concentrations are outside of the range given in the MOA, so the corresponding SOD values are estimated.

⁴ SOD values given in this table are the lower and upper ends of the recommended range. SOD values between the upper and lower values are acceptable based on nature of substrate.

⁵ Deviations from these rates may take place in situations of high instream dilution, which significantly reduces the impact of the benthic (sediment) deposits on oxygen consumption. In these situations, justification on a case by case basis will be provided in the documentation submitted to EPA.

⁶ Applicable ecoregions are based on the general characteristics of waterbodies within each ecoregion (Rocky, Gravel, or Mixed). A different substrate type may be used based on site specific observations of the particular stream in question.

Model Input Data

W.S. Drainage Area (mi²) : 1.38

Ecoregion: Arkansas River Valley

Q_{DESIGN} : 0.05 MGD

7Q10: 0 cfs (StreamStats)

Input Model Coefficients

Reach 1		
Coefficient – at 20° C	Input value	Justification
BOD _{ult} /BOD ₅	2.3	EPA Guidance
K _d (1/day)	0.4	MOA, sandy substrate
K _n (1/day)	0.4	MOA, sandy substrate
SOD (g/m ² /day)	0.8	MOA, sandy substrate
K _a (1/day)	8.5 (critical season)	O’Conner Dobbins equation
	8.1 (primary season)	O’Conner Dobbins equation
Applicable Water Quality Standards		
	Critical Season (May-Oct.)	Primary Season (Nov.-Apr.)
	Reach 1	Reach 1
D.O. Standard (mg/L)	2.0	5.0
Temp. Standard (°C)	31	22

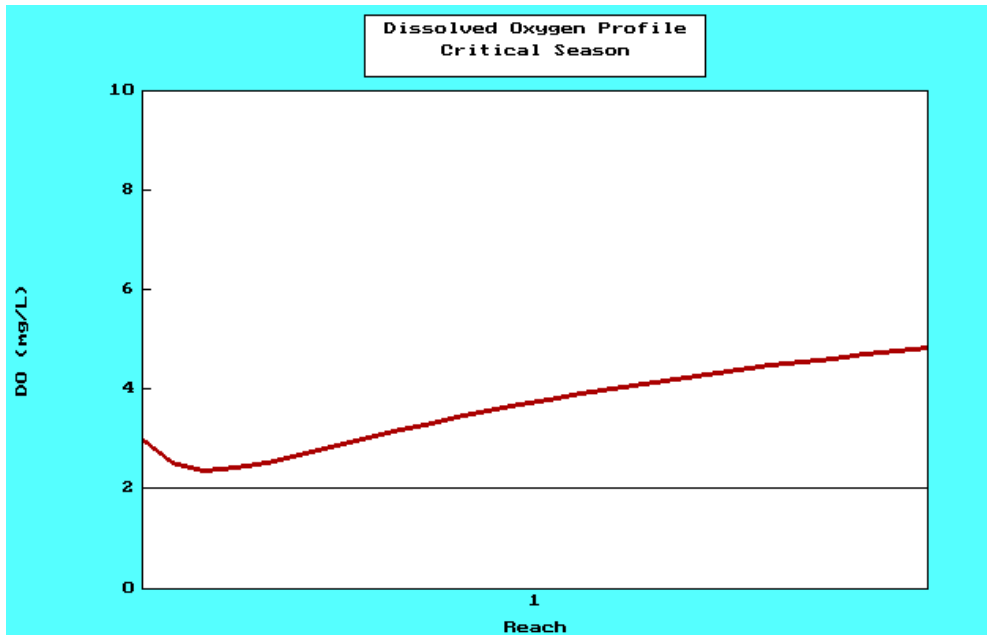
Critical Season Stream Hydraulics

Q mgd	V	D	W	Ka (O'Conner Dobbins)	Velocity Coefficient	Depth Coefficient	Width Coefficient	Product of Coefficients (should equal 1)
0.005	0.005	0.175	9.635	11.980	0.085	0.751	15.665	1.000
0.01	0.007	0.215	10.327	10.797				
0.015	0.009	0.243	10.754	10.160	Velocity Exponent	Depth Exponent	Width Exponent	Sum of Exponents (should equal 1)
0.02	0.011	0.265	11.068	9.730				
0.025	0.012	0.283	11.318	9.410	0.6	0.3	0.1	1.0
0.03	0.013	0.299	11.526	9.156				
0.035	0.015	0.313	11.705	8.947				
0.04	0.016	0.326	11.862	8.770				
0.045	0.017	0.338	12.003	8.616	This worksheet is the hydraulics for stream flows up to 0.2 MGD.			
0.05	0.018	0.349	12.130	8.481				
0.055	0.019	0.359	12.246	8.361	The Velocity, Depth, and Width values in chart to left are from the following			
0.06	0.020	0.368	12.353	8.252	empirical equations which were developed based on the empirical relationships			
0.065	0.021	0.377	12.452	8.154	presented on page 2-33 of EPA September 1983 Technical Guidance Manual for			
0.07	0.022	0.386	12.545	8.064	Performing Waste Load Allocations, Book II (Streams and Rivers).			
0.075	0.023	0.394	12.632	7.981				
0.08	0.024	0.401	12.714	7.904	Velocity = $0.085 Q^{0.6}$			
0.085	0.025	0.409	12.791	7.832				
0.09	0.026	0.416	12.864	7.765	Depth = $0.751 Q^{0.3}$			
0.095	0.027	0.423	12.934	7.702				
0.1	0.028	0.429	13.001	7.643	Width = $15.665 Q^{0.1}$			

Primary Season Stream Hydraulics

Quick Calculator									
0.92	Headwater in CFS		0.072323	0.5	0.567722	0.4	24.355	0.1	Accum
				FPS		Feet		Feet	MGD
0.05	Discharger 1 in MGD	Reach 1 Velocity	0.072	Depth	0.567	Width	24.349		0.645

**Critical Season Model (53210_C.smp)
15/20/5/3 simulation (CBOD5/TSS/NH3/DO)**



Critical Season		TABULAR MODEL OUTPUT		
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	0.50	3.00	34.50	5.00
2	0.48	2.50	32.98	4.69
3	0.46	2.37	31.53	4.41
4	0.44	2.41	30.14	4.13
5	0.42	2.52	28.82	3.88
6	0.40	2.67	27.55	3.64
7	0.38	2.83	26.33	3.42
8	0.36	2.98	25.18	3.21
9	0.34	3.13	24.07	3.01
10	0.32	3.28	23.01	2.83
11	0.30	3.42	22.00	2.65
12	0.28	3.55	21.03	2.49
13	0.26	3.68	20.10	2.34
14	0.24	3.79	19.22	2.19
15	0.22	3.91	18.37	2.06

16	0.20	4.01	17.56	1.93
17	0.18	4.11	16.79	1.82
18	0.16	4.21	16.05	1.70
19	0.14	4.30	15.34	1.60
20	0.12	4.38	14.67	1.50
21	0.10	4.47	14.02	1.41
22	0.08	4.54	13.41	1.32
23	0.06	4.62	12.82	1.24
24	0.04	4.68	12.25	1.17
25	0.02	4.75	11.71	1.09
26	-0.00	4.81	11.20	1.03

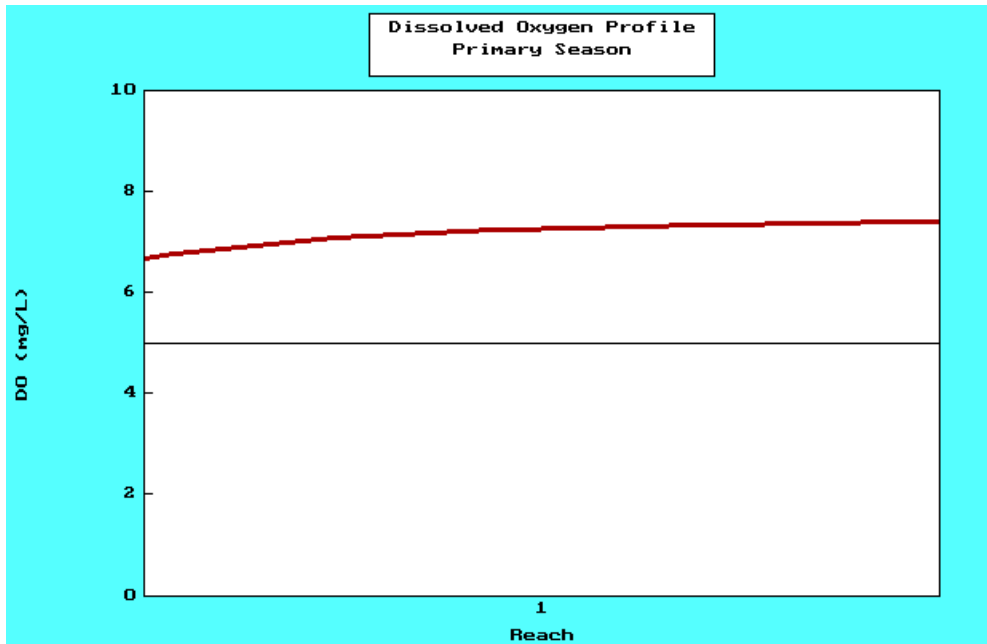
Critical Season	Run information screen	
Name of receiving stream		trib of Mill Bayou
Number of discharges	(max = 10)	1
Number of reaches	(max = 10)	1
Reaeration type	(O, T, M)	O'Connor-Dobbins
Run title for screen display		Critical Season
Graphics printer type	(HP, FX, LQ, None)	None
Printed graph resolution	(Low, Med, High)	None

Critical Season	Upstream River Parameters		Comments
Flow	(cfs)	0.00	40%sat ERstudy
Temperature	(°C)	31.00	
Dissolved Oxygen	(mg/l)	3.00	
5-Day BOD	(mg/l)	1.00	
Ult. CBOD / 5-Day BOD		2.30	
pH	(su)	7.00	
Ammonia	(mg/l)	0.10	
Alkalinity	(mg/l)	-0.00	
Upstream river mile		0.50	

Critical Season	Parameters for Discharge 1		Comments
Flow	(MGD)	0.00	
Temperature	(°C)	31.00	
Dissolved Oxygen	(mg/l)	3.00	
5-Day BOD	(mg/l)	15.00	
Ult. CBOD / 5-Day BOD		2.30	
pH	(su)	7.00	
Ammonia	(mg/l)	5.00	
Alkalinity	(mg/l)	-0.00	
Beginning of Reach Number		1	
Name of Discharger		Saddle Ranch	

Critical Season	Parameters for Reach 1		Comments	
Length	(mile)	0.50	Calculated	
Velocity	(fps)	0.02		
Slope	(ft/mile)	-0.00		
Average Depth	(ft)	0.35		
Temperature	(°C)	31.00		
BOD Removal Rate	(1/day)	0.40		
NH3 Decay Rate	(1/day)	0.40		
Sediment Oxygen Demand	(g/m ² /day)	1.52		k20=0.8(tss=20)
Photosynthesis/respiration	(mg/L/day)	-0.00		

**Primary Season Model (53210_P.smp)
20/20/10/2 simulation (CBOD5/TSS/NH3/DO)**



Primary Season		TABULAR MODEL OUTPUT		
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	0.50	6.65	5.69	0.87
2	0.48	6.75	5.64	0.86
3	0.46	6.83	5.60	0.85
4	0.44	6.90	5.56	0.85
5	0.42	6.96	5.51	0.84
6	0.40	7.01	5.47	0.83
7	0.38	7.06	5.43	0.82
8	0.36	7.10	5.39	0.82
9	0.34	7.14	5.35	0.81
10	0.32	7.17	5.31	0.80
11	0.30	7.20	5.27	0.80
12	0.28	7.22	5.23	0.79
13	0.26	7.24	5.19	0.78
14	0.24	7.26	5.15	0.78
15	0.22	7.28	5.11	0.77

16	0.20	7.29	5.07	0.77
17	0.18	7.31	5.03	0.76
18	0.16	7.32	4.99	0.75
19	0.14	7.33	4.95	0.75
20	0.12	7.34	4.91	0.74
21	0.10	7.35	4.88	0.73
22	0.08	7.36	4.84	0.73
23	0.06	7.37	4.80	0.72
24	0.04	7.37	4.77	0.72
25	0.02	7.38	4.73	0.71
26	-0.00	7.39	4.69	0.70

Primary Season	Run information screen	
Name of receiving stream		trib of Mill Bayou
Number of discharges	(max = 10)	1
Number of reaches	(max = 10)	1
Reaeration type	(O, T, M)	O'Connor-Dobbins
Run title for screen display		Primary Season
Graphics printer type	(HP, FX, LQ, None)	None
Printed graph resolution	(Low, Med, High)	None

Primary Season	Upstream River Parameters		Comments
Flow	(cfs)	0.92	seasonal fishery
Temperature	(°C)	22.00	
Dissolved Oxygen	(mg/l)	6.96	80% sat ERstudy
5-Day BOD	(mg/l)	1.00	
Ult. CBOD / 5-Day BOD		2.30	
pH	(su)	7.00	
Ammonia	(mg/l)	0.10	
Alkalinity	(mg/l)	-0.00	
Upstream river mile		0.50	

Primary Season	Parameters for Discharge 1		Comments
Flow	(MGD)	0.05	
Temperature	(°C)	31.00	
Dissolved Oxygen	(mg/l)	3.00	
5-Day BOD	(mg/l)	20.00	
Ult. CBOD / 5-Day BOD		2.30	
pH	(su)	7.00	
Ammonia	(mg/l)	10.00	
Alkalinity	(mg/l)	-0.00	
Beginning of Reach Number		1	
Name of Discharger		Saddle Ranch	

Primary Season	Parameters for Reach 1		Comments
Length	(mile)	0.50	Calculated k20=0.8(tss=20)
Velocity	(fps)	0.07	
Slope	(ft/mile)	-0.00	
Average Depth	(ft)	0.57	
Temperature	(°C)	22.70	
BOD Removal Rate	(1/day)	0.40	
NH3 Decay Rate	(1/day)	0.40	
Sediment Oxygen Demand	(g/m ² /day)	0.90	
Photosynthesis/respiration	(mg/L/day)	-0.00	