Arkansas Department of Environmental Quality
Water Quality Management Plan Update Summary Sheet

Date: December 21, 2020 Prepared by: Shane Byrum

☐ New Permit ☒ Renewal Permit ☐ Amended Permit

Type of Discharge: Municipal Wastewater **Facility Name:** City of Yellville

Permit No.: AR0034037 **Flow Rate (MGD):** 0.75

Receiving Stream: Crooked Creek, thence to the White River

HUC + Reach Code: 11010003 + 048 **7Q10:** 0 cfs[1]

Planning Segment: 4I **County:** Marion

Proposed Monthly Average Effluent Limits in mg/L:

May-October:	10/15/1/6.2*	(CBOD5/TSS/NH3-N/DO)	*DO is Inst. Min.
November-March:	10/15/5/6.0*	(CBOD5/TSS/NH3-N/DO)	*DO is Inst. Min.
April:	10/15/3.9/6.0*	(CBOD5/TSS/NH3-N/DO)	*DO is Inst. Min.

Current Monthly Average Effluent Limits in mg/L:

May-October:	10/15/1/6.0	(CBOD5/TSS/NH3-N/DO)
November-March:	10/15/5/6.0	(CBOD5/TSS/NH3-N/DO)
April:	10/15/3.9/6.0	(CBOD5/TSS/NH3-N/DO)

TMDL Limits: None

Justification (Sag = Minimum Modeled Value ≠ Difference in Value):

Reach No.	Length (miles)	DO WQS_C (mg/L)	DO Sag_C (mg/L)	Distance to DO Sag_C (miles)	DO WQS_P (mg/L)	DO Sag_P (mg/L)	Distance to DO Sag_P (miles)
1	0.5	6.0	6.0	0.2	6.0	6.0	0.0

Values in above table are from modeling analysis dated December 21, 2020.

Outfall Location (Lat/Long): 36° 13’ 15” N; 92° 39’ 50” W

Remarks: This is for the reissuance of the discharge permit for this existing facility. A new model was performed with updated stream hydraulics. Based on the updated model, the 208 Plan is being updated to revise the instantaneous minimum DO limit from 6.0 mg/L to 6.2 mg/L during May-October.

[1] The entire surface flow in Crooked Creek is diverted underground at Yellville at river mile 23 during low-flow conditions, based on a USGS report entitled, “Streamflow Gain and Loss of Selected Streams in Northern Arkansas”, 1987, Freiwald, David A., USGS Scientific Investigations Report No. 86-4185. Therefore, this stream segment is considered a losing stream based on Reg. 6.301(B), and the 7Q10 of Crooked Creek at Yellville is considered to be zero at this discharge location.

			Ammonia Calculations			
POTW?	Yes	(Yes or No)			COLOR KEY	
Facility Name	City of Yellville					User Inputs
Major or Minor	Minor					Calculated values
Permit Number	AR0034037					
Receiving Stream	Crooked Creek		Ecoregion or River name	Ozark Highlands		
7Q10, cfs	0	Losing Stream Segment	Watershed area (mi^2)	425		
0.25/0.67 multiplier	0.67		Regulation No. 2 Chronic Toxicity Critieria (Instream Concentration)			
Qb, cfs	0.00			AML, mg/l	DML, mg/l	
Qe, MGD	0.75	Design flow	April	3.9	3.9	
Qe, cfs	1.16		May - October	3.9	3.9	
Cb, mg/l	0.016	Model input upstream	November - March	10.3	10.3	
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	7-Day Avg, mg/l
Qb	% of Low Flow of Receiving Stream			April	3.90	3.90
Cb	Background Concentration			May - October	3.90	3.90
IWC	Instream Waste Concentration Chronic Toxicity Criteria			November - March	10.30	10.30

Chronic Toxicity Criteria vs. D.O. Model Limits

	Monthly Average, mg/l		**Permit Limits**	7-Day Average, mg/l		**Permit Limits**
Month	Toxicity limit	D.O. limit		Toxicity limit	D.O. limit	
April	3.90	5	3.90	3.90	7.5	3.90
May - October	3.90	1	1.00	3.90	1.5	1.50
November - March	10.30	5	5.00	10.30	7.5	7.50

			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. Missouri to LA state line)	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 #1 to 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. Missouri to LA state line)	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 #1 to Mouth)	32	7.7	2.9	2.9

StreamStats Data-Collection Station Report

USGS Station Number	**07055608**
Station Name	**Crooked Creek at Yellville, AR**

Click here to link to available data on NWIS-Web for this site.

Descriptive Information

Station Type	Streamgage, continuous record
Location	Lat 36°13'23", long 92°40'47" referenced to North American Datum of 1983, in NW 1/4 NE 1/4 sec.09, T.18 N., R.16 W., Marion County, AR, Hydrologic Unit 11010003, on left bank at bridge on State Hwy 14 at Yellville.
Gage	
Regulation and Diversions	No known regulation and diversions. It has been observed that extreme low-water flow disappears into streambed a short distance above station. Simultaneous discharge measurements also indicate that there is a large loss in channel flow between mouth of Grassy Creek, 10.3 mi upstream, and station

			Drainage_Area			406	square miles			
		second								
Harmonic_Mean_Streamflow	6.3	cubic feet per second	325	Y	8				10/1/1988	9/30/2003

Upstream Data for Station WHI0193

Average - Critical Season					
DO (mg/l)	T (deg C)	DO Sat (%)	BOD (mg/l)	NH3-N (mg/l)	TSS (mg/l)
9.40476744	23.9884	97.13%	#DIV/0!	0.016011628	7.578736

Average - Primary Season					
DO (mg/l)	T (deg C)	DO sat (%)	BOD (mg/l)	NH3-N (mg/l)	TSS (mg/l)
11.75073	10.94578	97.14%	#DIV/0!	0.024702381	3.97381

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

Rocky Substrate[4]						Applicable Ecoregions[6]
TSS[1]	SOD_{20}	SOD_{22}	SOD_{29}	SOD_{30}	SOD_{31}	Ozark Highlands Boston Mountains Ouachita Mountains
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 benthal (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 (mi^2) : 425

Ecoregion: Ozark Highlands

Q_{DESIGN} : 0.75 MGD

7Q10: 0 cfs[2]

Input Model Coefficients

Reach 1		
Coefficient – at 20^o C	Input value	Justification
$BOD_{ult.}/BOD_5$	2.3	EPA Guidance
K_d (1/day)	0.5	MOA, rocky substrate
K_n (1/day)	0.4	MOA, rocky substrate
SOD (g/m^2/day)	0.3	MOA, rocky substrate, TSS = 15
K_a (1/day)	10.6 (critical season) 10.6 (primary season)	O'Conner Dobbins equation 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)	6.0	6.0
Temp. Standard (°C)	29	22

[2] The entire surface flow in Crooked Creek is diverted underground at Yellville at river mile 23 during low-flow conditions, based on a USGS report entitled, "Streamflow Gain and Loss of Selected Streams in Northern Arkansas", 1987, Freiwald, David A., USGS Scientific Investigations Report No. 86-4185. Therefore, this stream segment is considered a losing stream based on Reg. 6.301(B), and the 7Q10 of Crooked Creek at Yellville is considered to be zero at this discharge location.

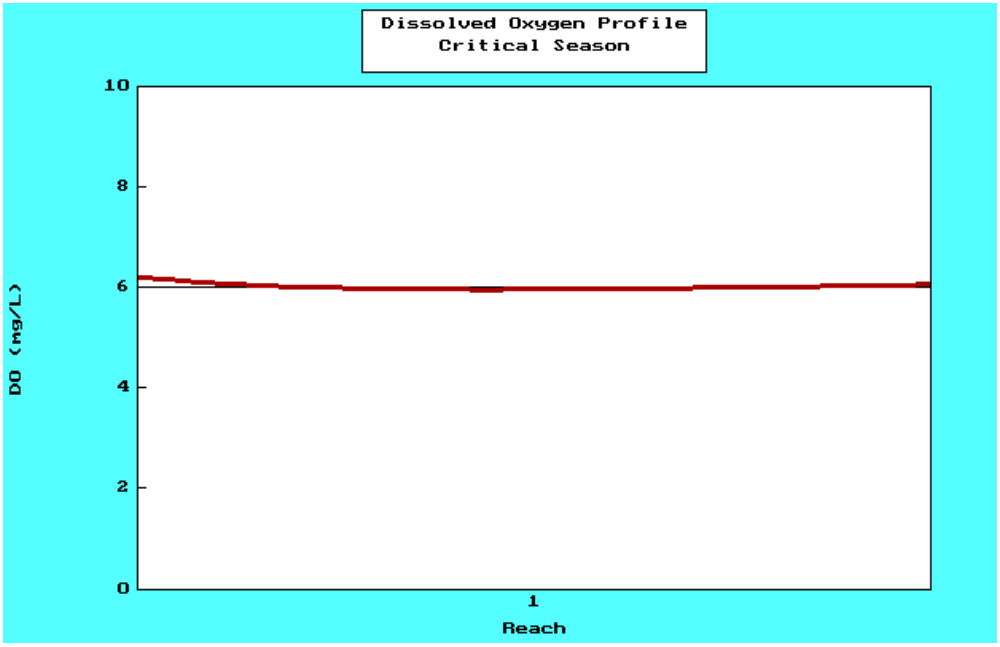
Critical Season Stream Hydraulics

Quick Calculator									
0	Headwater in CFS		0.088886	0.5	0.492814	0.4	22.8288	0.1	Accum
				FPS		Feet		Feet	MGD
0.75	Discharger 1 in MGD	Reach 1 Velocity		0.096	Depth	0.523	Width	23.171	0.750

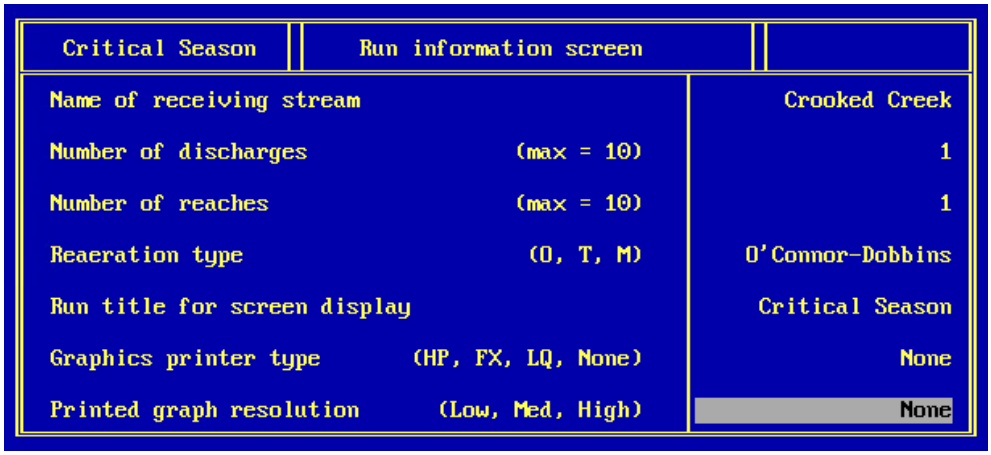
Primary Season Stream Hydraulics

Quick Calculator									
0	Headwater in CFS		0.088886	0.5	0.492814	0.4	22.8288	0.1	Accum
				FPS		Feet		Feet	MGD
0.75	Discharger 1 in MGD	Reach 1 Velocity		0.096	Depth	0.523	Width	23.171	0.750

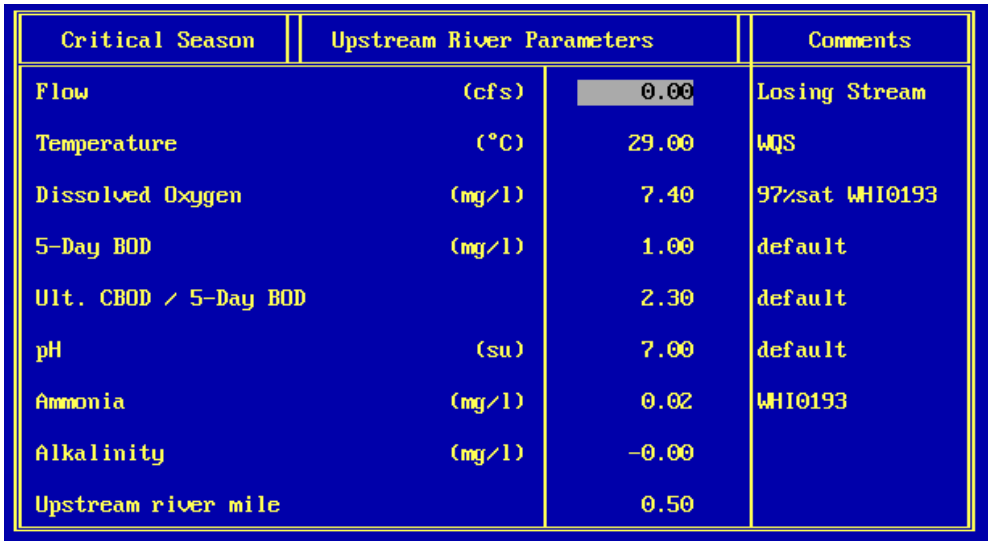
Critical Season Model (34037_C.smp)
10/15/1/6.2 simulation (CBOD5/TSS/NH3/DO)



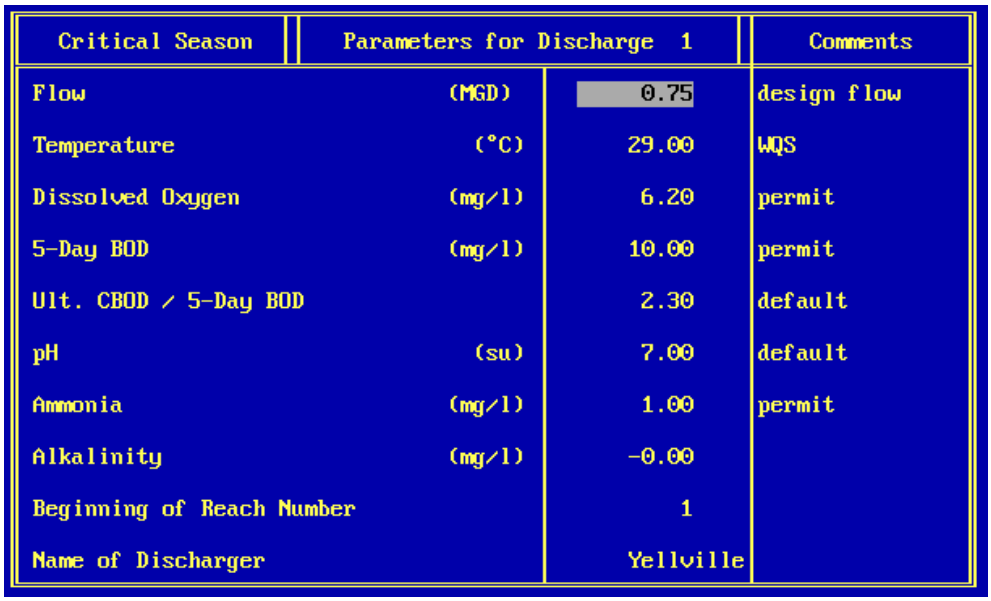
Critical Season	TABULAR MODEL OUTPUT		
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	0.50	6.20	23.00	1.00
2	0.48	6.14	22.80	0.99
3	0.46	6.09	22.60	0.98
4	0.44	6.06	22.40	0.97
5	0.42	6.03	22.20	0.96
6	0.40	6.00	22.01	0.95
7	0.38	5.98	21.82	0.95
8	0.36	5.97	21.63	0.94
9	0.34	5.96	21.44	0.93
10	0.32	5.95	21.25	0.92
11	0.30	5.95	21.06	0.91
12	0.28	5.95	20.88	0.90
13	0.26	5.95	20.70	0.89
14	0.24	5.95	20.51	0.89
15	0.22	5.96	20.33	0.88
16	0.20	5.96	20.16	0.87
17	0.18	5.97	19.98	0.86
18	0.16	5.97	19.80	0.85
19	0.14	5.98	19.63	0.85
20	0.12	5.99	19.46	0.84
21	0.10	6.00	19.29	0.83
22	0.08	6.01	19.12	0.82
23	0.06	6.02	18.95	0.81
24	0.04	6.03	18.79	0.81
25	0.02	6.04	18.62	0.80
26	-0.00	6.05	18.46	0.79



Critical Season	Run information screen	
Name of receiving stream		Crooked Creek
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



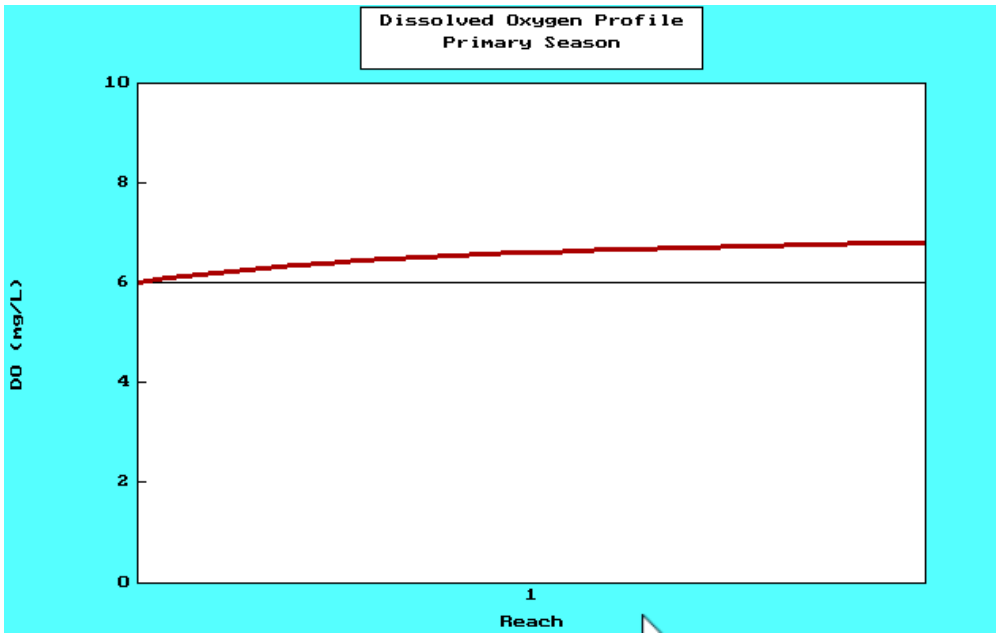
Critical Season	Upstream River Parameters		Comments
Flow	(cfs)	0.00	Losing Stream
Temperature	(°C)	29.00	WQS
Dissolved Oxygen	(mg/l)	7.40	97%sat WHI0193
5-Day BOD	(mg/l)	1.00	default
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	0.02	WHI0193
Alkalinity	(mg/l)	-0.00	
Upstream river mile		0.50	



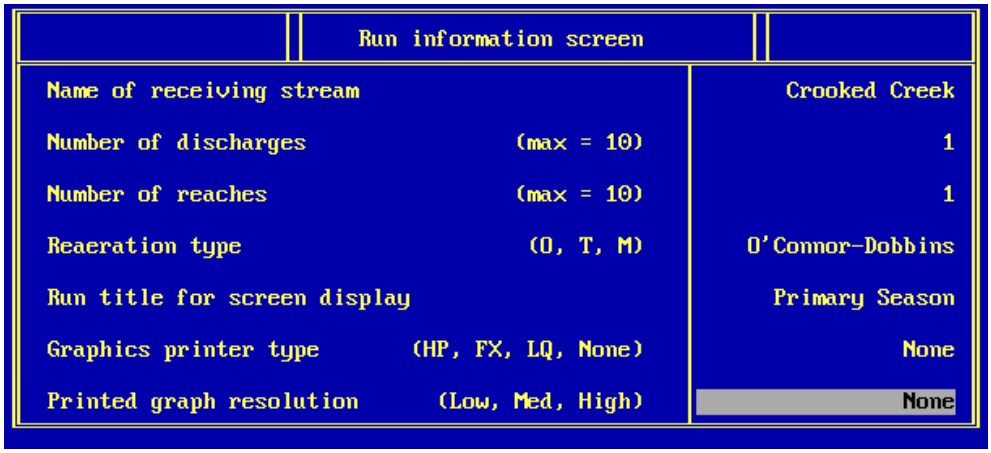
Critical Season	Parameters for Discharge 1		Comments
Flow	(MGD)	0.75	design flow
Temperature	(°C)	29.00	WQS
Dissolved Oxygen	(mg/l)	6.20	permit
5-Day BOD	(mg/l)	10.00	permit
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	1.00	permit
Alkalinity	(mg/l)	-0.00	
Beginning of Reach Number		1	
Name of Discharger		Yellville	

Critical Season	Parameters for Reach 1		Comments
Length	(mile)	0.50	
Velocity	(fps)	0.10	spreadsheet
Slope	(ft/mile)	9.06	streamstats
Average Depth	(ft)	0.52	spreadsheet
Temperature	(°C)	29.00	Calculated
BOD Removal Rate	(1/day)	0.50	MOA, rocky subs
NH3 Decay Rate	(1/day)	0.40	MOA, rocky subs
Sediment Oxygen Demand	(g/m^2/day)	0.51	k20=0.3(TSS=15)
Photosynthesis/respiration	(mg/L/day)	-0.00	

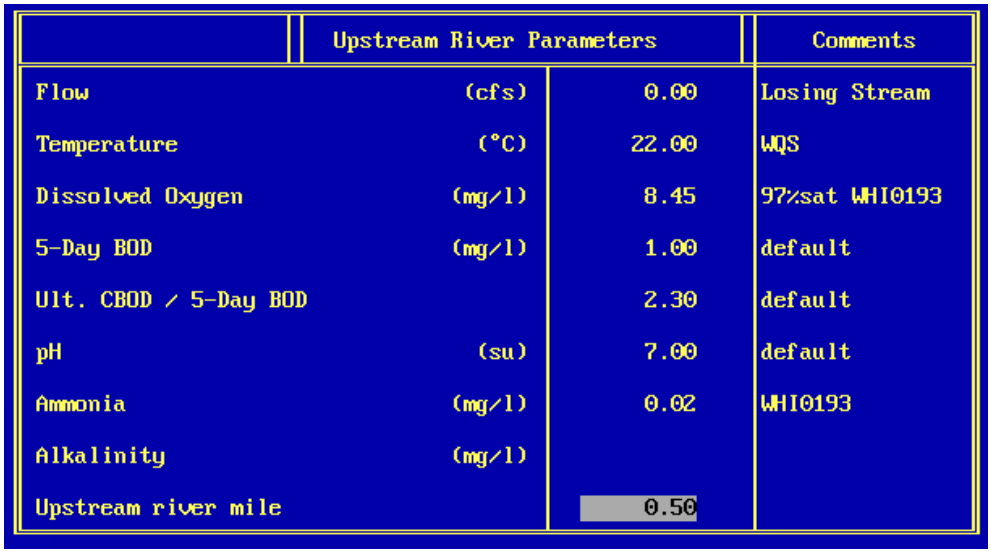
Primary Season Model (34037_P.smp)
10/15/5/6 simulation (CBOD5/TSS/NH3/DO)



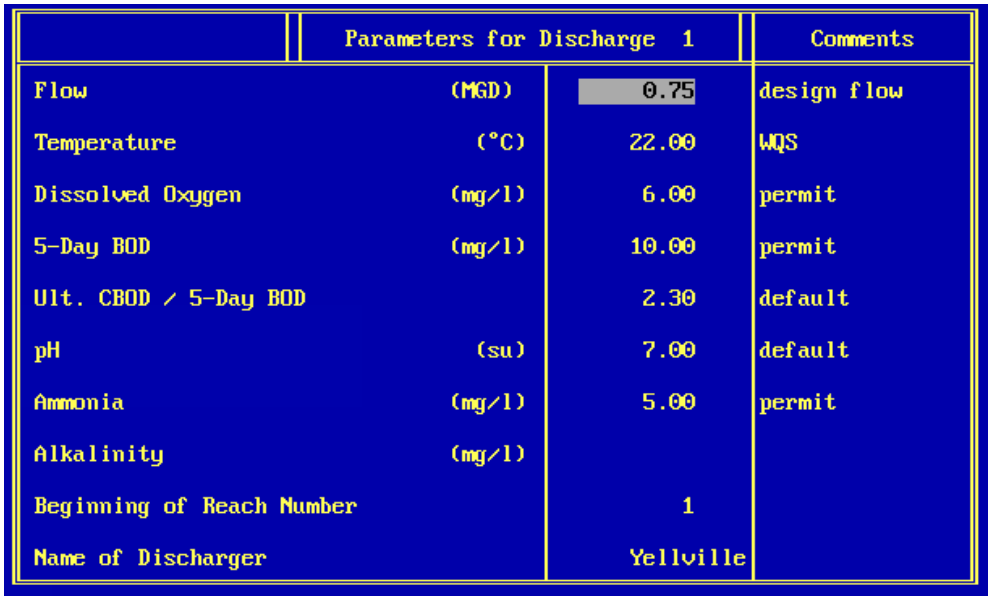
	TABULAR MODEL OUTPUT		
	River Mile	DO (mg/L)	BOD (mg/L)	NH3 (mg/L)
1	0.50	6.00	23.00	5.00
2	0.48	6.09	22.85	4.98
3	0.46	6.16	22.71	4.96
4	0.44	6.23	22.56	4.94
5	0.42	6.29	22.42	4.92
6	0.40	6.34	22.28	4.90
7	0.38	6.39	22.14	4.88
8	0.36	6.43	22.00	4.86
9	0.34	6.47	21.86	4.84
10	0.32	6.50	21.72	4.82
11	0.30	6.53	21.58	4.80
12	0.28	6.56	21.44	4.78
13	0.26	6.59	21.30	4.76
14	0.24	6.61	21.17	4.74
15	0.22	6.63	21.03	4.72
16	0.20	6.65	20.90	4.70
17	0.18	6.67	20.77	4.68
18	0.16	6.69	20.64	4.67
19	0.14	6.71	20.50	4.65
20	0.12	6.72	20.37	4.63
21	0.10	6.74	20.24	4.61
22	0.08	6.75	20.12	4.59
23	0.06	6.76	19.99	4.57
24	0.04	6.77	19.86	4.55
25	0.02	6.79	19.73	4.53
26	-0.00	6.80	19.61	4.52



Run information screen		
Name of receiving stream		Crooked Creek
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



Upstream River Parameters			Comments
Flow	(cfs)	0.00	Losing Stream
Temperature	(°C)	22.00	WQS
Dissolved Oxygen	(mg/l)	8.45	97%sat WHI0193
5-Day BOD	(mg/l)	1.00	default
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	0.02	WHI0193
Alkalinity	(mg/l)		
Upstream river mile		0.50	



Parameters for Discharge 1			Comments
Flow	(MGD)	0.75	design flow
Temperature	(°C)	22.00	WQS
Dissolved Oxygen	(mg/l)	6.00	permit
5-Day BOD	(mg/l)	10.00	permit
Ult. CBOD / 5-Day BOD		2.30	default
pH	(su)	7.00	default
Ammonia	(mg/l)	5.00	permit
Alkalinity	(mg/l)		
Beginning of Reach Number		1	
Name of Discharger		Yellville	

	Parameters for Reach 1		Comments
Length	(mile)	0.50	
Velocity	(fps)	0.10	spreadsheet
Slope	(ft/mile)	9.06	streamstats
Average Depth	(ft)	0.52	spreadsheet
Temperature	(°C)	22.00	Calculated
BOD Removal Rate	(1/day)	0.50	MOA, rocky subs
NH3 Decay Rate	(1/day)	0.30	MOA, rocky subs
Sediment Oxygen Demand	(g/m^2/day)	0.34	k20=0.3(TSS=15)
Photosynthesis/respiration	(mg/L/day)		