

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

WATER QUALITY MANAGEMENT PLAN UPDATE

SUMMARY SHEET

Type of Discharge: Municipal X , Industrial , Other

Facility Name Yellville

Receiving Stream Crooked Creek

Segment 4I County Marion

Permit No. AR 0034037 Update Method

Date Flow 1.0 MGD

Critical Limits CBOD5/TSS/NH3-N/EFF. D.O. 10/15/1/6 May-Oct

Seasonal Limits CBOD5/TSS/NH3-N/EFF. D.O. 25/30/5 Nov-Apr

Justification Desk Top Model

Already included in WQMP Y/N Y

If Yes, list the information currently in the Plan:

Receiving Stream Same

Limits 0/0 BOD5/NH3-N

Section, Range & Township, or Latitude and Longitude

Existing

New Site

Water Quality Standards Change by Use Attainability Analysis Y/N N

If yes, list changes

DESK TOP MODEL
FOR THE YELLVILLE STP
DISCHARGE TO CROOKED CREEK

FEBRUARY 9, 1989

I. Introduction

A desk top model was performed on Crooked Creek, the current receiving stream of the Yellville effluent discharge, in order to determine effluent limits that will maintain the dissolved oxygen standard of this stream. The present sewage treatment facility consists of a two stage biofiltration system. The discharge is into Crooked Creek in the NE 1/4 Section 10, Range 16 West, Township 18 North in Marion County. Yellville is currently operating under NPDES # AR0034037, which is being reviewed for renewal.

The present discharge site is located in planning segment 4I of the White River basin. The design flow of the present facility is 1.0 MGD (million gallons per day).

Crooked Creek, with a drainage area of approximately 400 mi² at the discharge site, is classified as an Ozark Highlands large watershed fishery, and as such, has an applicable dissolved oxygen standard of 6 mg/l, with a 1 mg/l diurnal fluctuation being allowed for not more than 8 hours in any 24 hour period, when the stream temperature exceeds 22°C. At stream temperatures of 22°C or less, a 6 mg/l dissolved oxygen standard applies to this stream.

The desk top model, utilizing the steady state Streeter-Phelps equation, was used to determine the effluent limits necessary to protect the dissolved oxygen standard in the receiving stream during both critical and primary season discharge periods.

II. Data Used in the Model

The input parameters used in the model for the Yellville STP discharge are:

Q7-10 flow = 0 cfs
Primary season stream flow = 5 cfs*
Stream depth = 1 foot
Stream velocity = .2 feet/second
Critical temperature = 28°C
Seasonal temperature = 20°C
Seasonal D.O. saturation = 85%**
*based on seasonal runoff from a 400 mi² watershed
**As determined by ecoregion studies

The reaeration rate, K_a , was calculated using the O'Connor-Dobbins formula:

$$K_a = \frac{12.9 V^{0.5}}{1.5 H}$$

where V = velocity, feet/second
 H = depth, feet

This resulted in K_a of 5.8/day. The formula used is recommended in Appendix A of Technical Guidance Manual for Performing Wasteload Allocations.

The deoxygenation rate, K_d , used was 0.5/day, which is a literature value applicable to oxygen demanding waste discharges into rock/gravel bottom streams. This rate is within the range suggested by the above reference.

The EPA accepted literature value of 0.4/day was used for the ammonia removal rate, K_n .

The benthic demand, B , used in the model was 0.4 gm/m²/day for the 10/15 (CBOD5/TSS) projection, and 1.0 gm/m²/day for the 25/30 projection into the receiving stream.

III. Results

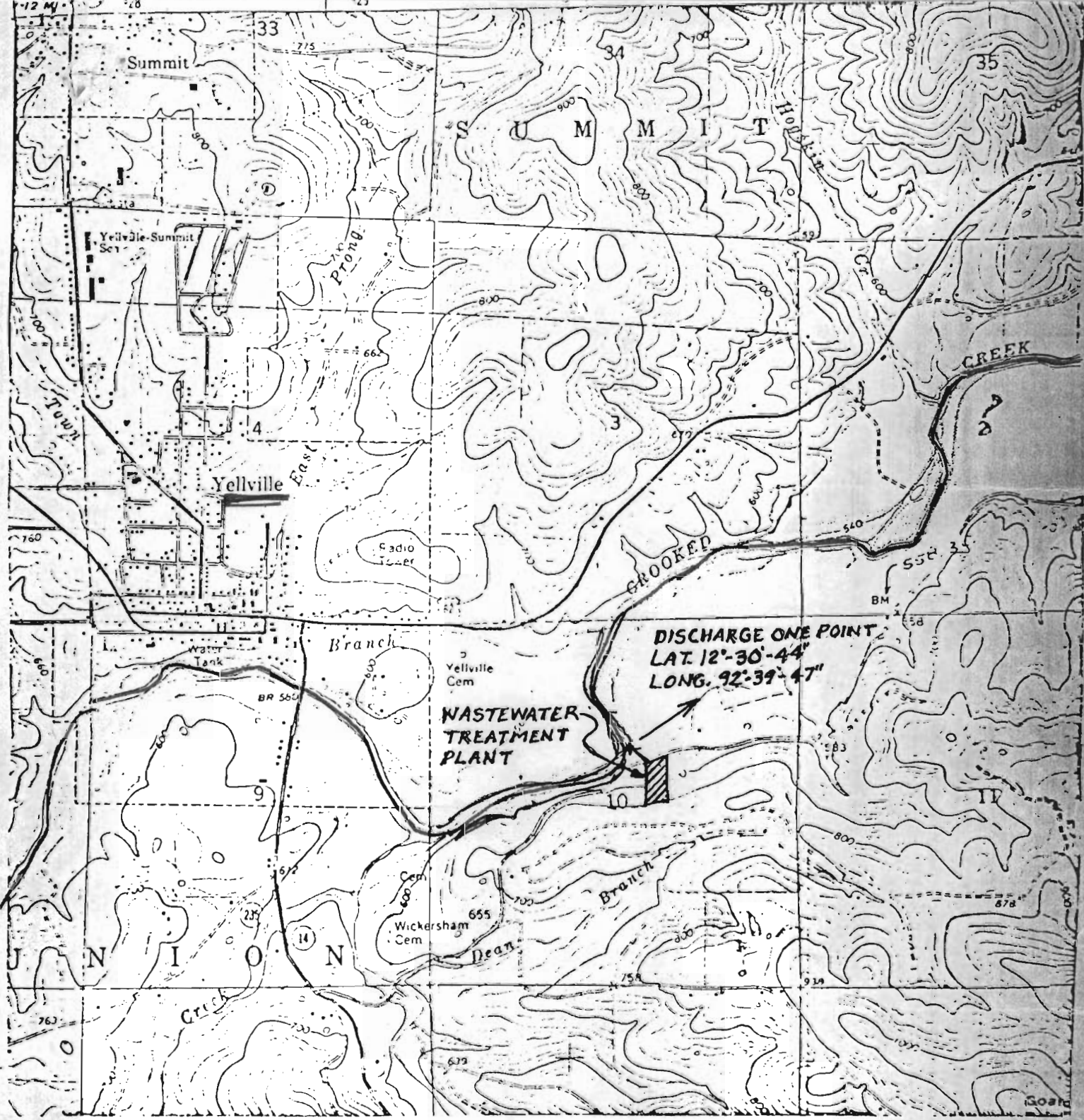
The results of the computer runs applicable to the Yellville STP discharge are tabulated below.

EFFLUENT LIMITS-MONTHS (CBOD5/TSS/NH3N/EFF.DO)	Qe MGD	Qs CFS	TEMP. C°	RECEIVING STREAM	D.O. (MG/L)
10/15/1/6--MAY-OCT	1	0	28	CROOKED CR.	5.3
25/30/5/3--NOV-APR	1	5	20	CROOKED CR.	6.7
10/15/1/6 (D.O. STD.)	1	5	22	CROOKED CR.	7.1

Due to the absence of a perennial stream within reasonable distance from the city, the computer modeling addressed only one discharge option. Advanced treatment will be required for discharge to the receiving stream of Crooked Creek during the critical period in order to maintain the dissolved oxygen standard.

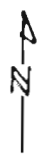
IV. Recommendations

Based on the fact that Crooked Creek is a losing stream, with the flow entering the groundwater below the effluent discharge, ADPC&E is requiring either sand filtration of the effluent or a hydrogeological study to determine the possibility of well pollution downstream of the discharge. Based on the modeling, it is our recommendation that the Yellville STP discharge a 10/15/1/6 (CBOD5/TSS/NH3N/Eff.D.O.) effluent into Crooked Creek during the months of May through October, and a 25/30/5 (CBOD5/TSS/NH3N) effluent during the months of November through April in order to maintain the dissolved oxygen standard of this stream. The ammonia limits assigned to the effluent are based on ammonia toxicity requirements rather than assimilative capability. The toxicity limits are based on maintaining no more than 0.05 mg/l un-ionized ammonia instream through evaluation of instream pH, temperature and minimum stream flow. The model input data and dissolved oxygen sag curves are attached.

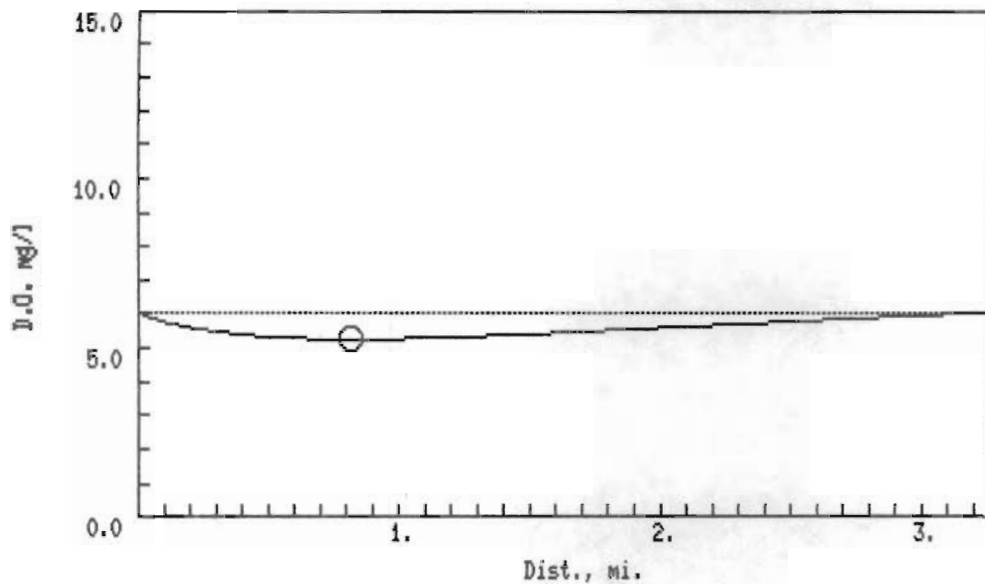


NOTE: DISCHARGE INTO CROOKED CREEK to WHITE RIVER (TRIBUTARY to ARKANSAS RIVER)

FIGURE 2
 LOCATION MAP
 WASTEWATER FACILITIES
 YELLVILLE, ARKANSAS



MCGOODWIN, WILLIAMS AND YATES, INC.
 CONSULTING ENGINEERS FAYETTEVILLE, ARK.



YELLVILLE CRITICAL 10-15-1-6 TO CROOKED CREEK
 Date of this run: 02/14/89

Stream Temperature = 28.0 deg C
 Stream flow = 0.00 cfs
 Stream D.O. = 0.0 mg/l
 Stream UOD = 0.0 mg/l
 Stream Velocity = 0.2 fps

Waste Temperature = 28.0 deg C
 Waste flow = 1.00 mgd
 Waste flow = 1.5 cfs
 Waste D.O. = 6.0 mg/l
 Waste BODU = 23.0 mg/l

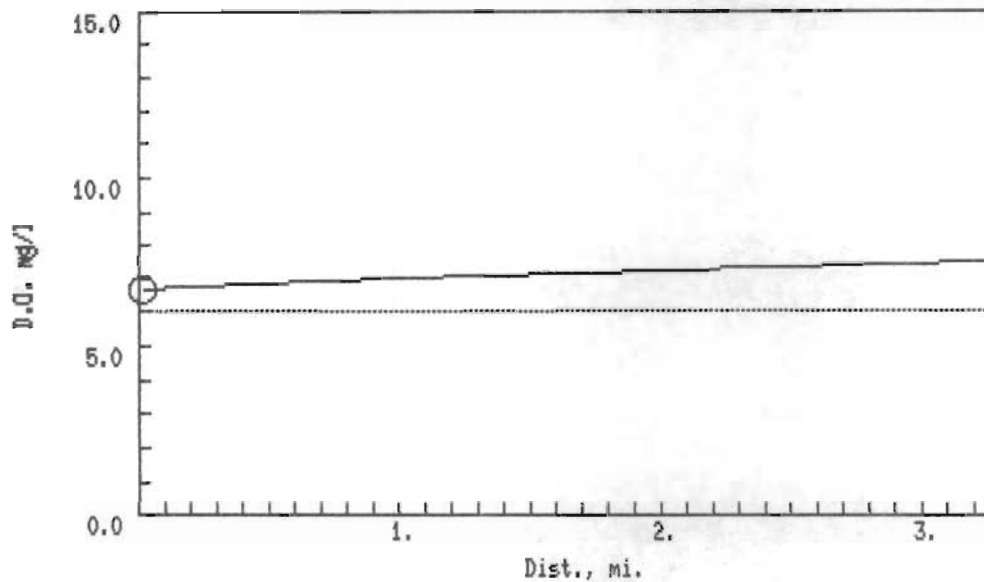
Benthal Demand = 0.4 g/m**2/day
 Mean Depth = 1.0 ft.
 S = 1.3 g/m**3/day
 S corrected = 2.3 g/m**3/day

Ammonia_nitrogen = 1.0 mg/l
 NUOD = 4.6 mg/l
 Total UOD of waste = 27.6 mg/l

Rate constants, per day, (base e)
 Kd = 0.5 Kd corrected = 0.7
 Ka = 5.8 Ka corrected = 7.0
 Kn = 0.4 Kn corrected = 0.6

Temperature of MIX = 28.0 deg C
 UOD of mix = 27.6 mg/l
 D.O. of mix = 6.0 mg/l

D.O. saturation = 7.9 mg/l
 Minimum D.O. = 5.3 mg/l
 Critical distance = 0.8 miles



YELLVILLE SEASONAL 25-30-5-3 TO CROOKED CREEK
 Date of this run: 02/14/89

Stream Temperature = 20.0 deg C
 Stream flow = 5.00 cfs
 Stream D.O. = 7.8 mg/l
 Stream UOD = 3.0 mg/l
 Stream Velocity = 0.2 fps

Waste Temperature = 20.0 deg C
 Waste flow = 1.00 mgd
 Waste flow = 1.5 cfs
 Waste D.O. = 3.0 mg/l
 Waste BODU = 57.5 mg/l

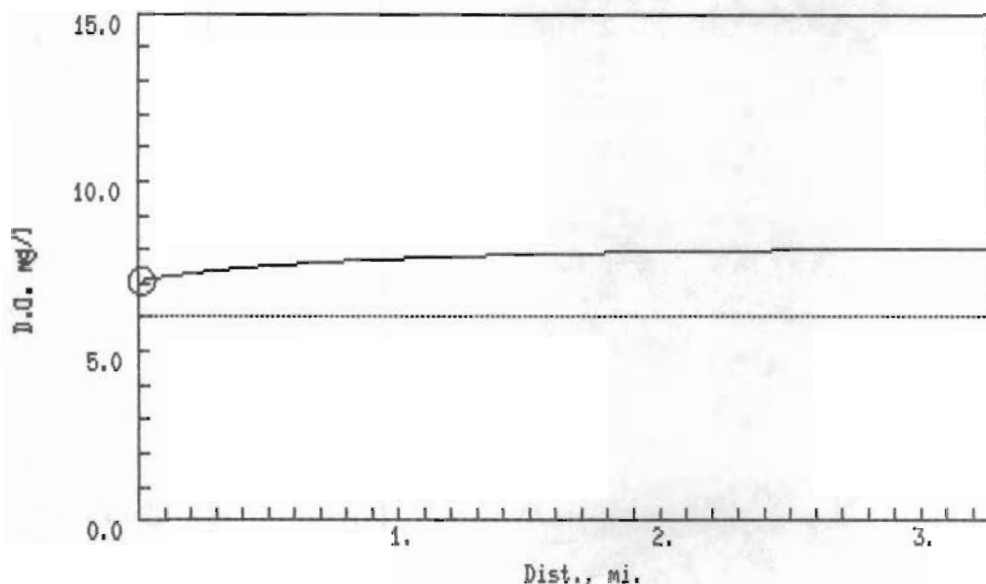
Benthal Demand = 1.0 g/m**2/day
 Mean Depth = 1.0 ft.
 S = 3.3 g/m**3/day
 S corrected = 3.3 g/m**3/day

Ammonia_nitrogen = 5.0 mg/l
 NUOD = 22.9 mg/l
 Total UOD of waste = 80.3 mg/l

Rate constants, per day, (base e)
 Kd = 0.5 Kd corrected = 0.5
 Ka = 5.8 Ka corrected = 5.8
 Kn = 0.4 Kn corrected = 0.4

Temperature of MIX = 20.0 deg C
 UOD of mix = 21.3 mg/l
 D.O. of mix = 6.7 mg/l

D.O. saturation = 9.2 mg/l
 Minimum D.O. = 6.7 mg/l
 Critical distance = 0.0 miles



YELLVILLE 10-15-1-6 TO CROOKED CREEK AT 22 DEGREES
 Date of this run: 02/14/89

Stream Temperature = 22.0 deg C
 Stream flow = 5.00 cfs
 Stream D.O. = 7.4 mg/l
 Stream UOD = 3.0 mg/l
 Stream Velocity = 0.2 fps

Waste Temperature = 22.0 deg C
 Waste flow = 1.00 mgd
 Waste flow = 1.5 cfs
 Waste D.O. = 6.0 mg/l
 Waste BODU = 23.0 mg/l

Benthal Demand = 0.4 g/m**2/day
 Mean Depth = 1.0 ft.
 S = 1.3 g/m**3/day
 S corrected = 1.5 g/m**3/day

Ammonia_nitrogen = 1.0 mg/l
 NUOD = 4.6 mg/l
 Total UOD of waste = 27.6 mg/l

Rate constants, per day, (base e)
 Kd = 0.5 Kd corrected = 0.5
 Ka = 5.8 Ka corrected = 6.1
 Kn = 0.4 Kn corrected = 0.4

Temperature of MIX = 22.0 deg C
 UOD of mix = 8.8 mg/l
 D.O. of mix = 7.1 mg/l

D.O. saturation = 8.8 mg/l
 Minimum D.O. = 7.1 mg/l
 Critical distance = 0.0 miles