

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

WATER QUALITY MANAGEMENT PLAN UPDATE

SUMMARY SHEET

Type of Discharge: Municipal X, Industrial    , Other    

Facility Name Gentry

Receiving Stream Little Flint Creek

Segment 3J County Benton

Permit No. AR 0020184 Update Method    

Date     Flow     0.5 MGD

Critical Limits CBOD5/TSS/NH3-N/EFF. D.O. 10/15/5/6 May-Oct

Seasonal Limits CBOD5/TSS/NH3-N/EFF. D.O. 10/15/10/6 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 30 mg/l BOD5

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 GENTRY STP  
DISCHARGE TO LITTLE FLINT CREEK

MAY 10, 1988

I. Introduction

A desk top model was performed on Little Flint Creek, the current receiving stream of the Gentry 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 Little Flint Creek in the SW 1/4 Section 18, Range 33 West, Township 18 North in Benton County. Gentry is currently operating under NPDES # AR0020184, which is being reviewed for renewal.

The present discharge site is located in planning segment 3J of the Arkansas River basin. The design flow of the present facility is 0.5 MGD (million gallons per day).

Little Flint Creek, with a drainage area of approximately 15 mi<sup>2</sup> at the discharge site, is classified as an Ozark Highlands mid-size watershed fishery, and as such, has an applicable critical season dissolved oxygen standard of 5 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 critical and primary season discharge periods.

II. Data Used in the Model

The input parameters for the Gentry STP discharge are:

Q7-10 flow = 0 cfs  
Primary season stream flow = 0.2 cfs\*  
Primary season D.O. saturation = 90%\*\*  
Stream depth = 1 foot  
Stream velocity = .2 feet/second  
Stream slope = 21 feet/mile  
Critical temperature = 28°C  
Seasonal temperature = 20°C  
\*Based on seasonal watershed runoff from a 15 mi<sup>2</sup> watershed  
\*\*As determined from ecoregion studies

The reaeration rate,  $K_a$ , was calculated using the Tsivoglou formula:

$$K_a = CV^S$$

where C = proportionality constant of 1.8  
 V = velocity, feet/second  
 S = stream slope, feet/mile

This resulted in  $K_a$  of 7.6/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 gravel/rock 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 0.5 gm/m<sup>2</sup>/day for the 10/15 (CBOD<sub>5</sub>/TSS) projections into the receiving stream.

### III. Results

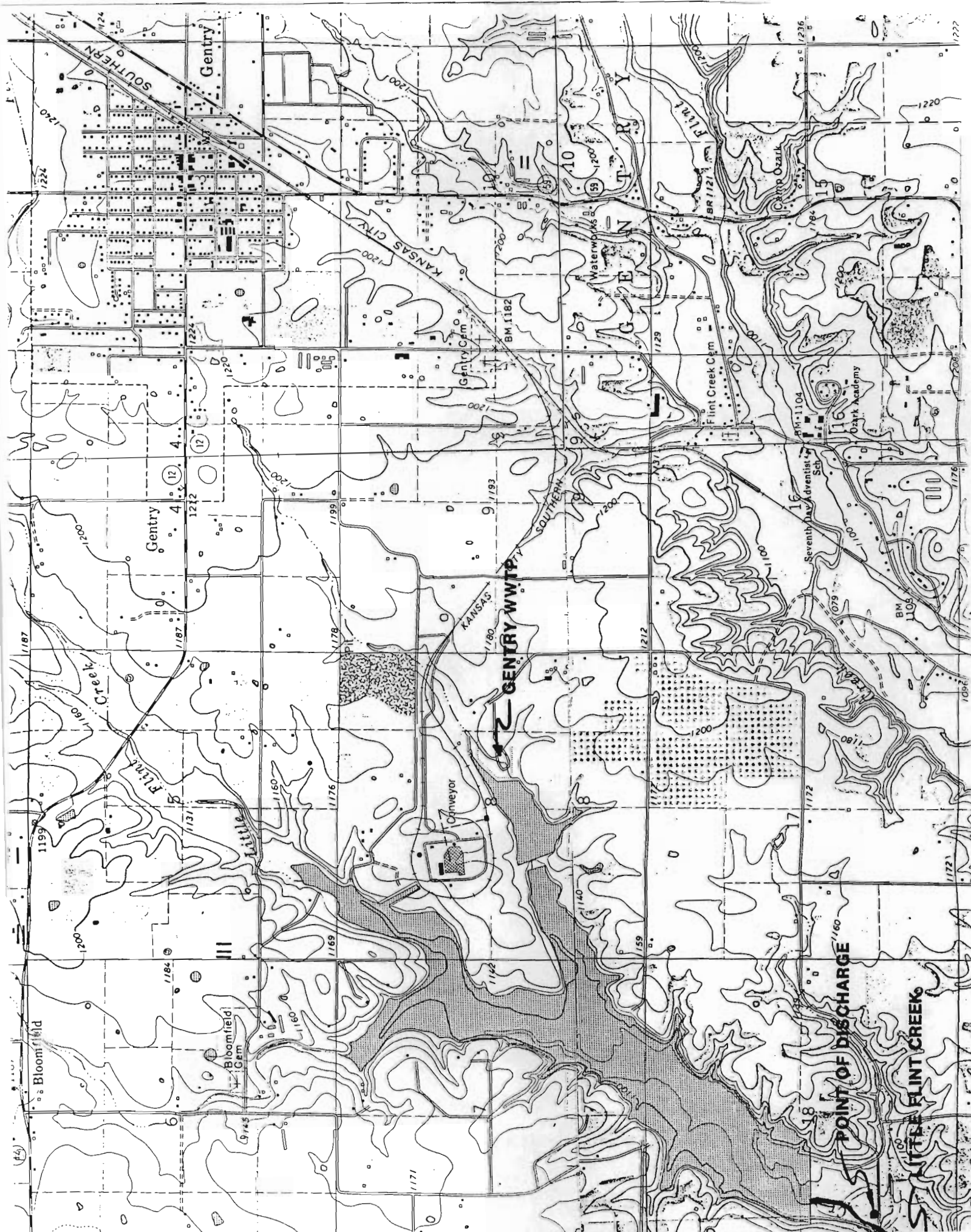
The results of the computer runs applicable to the Gentry STP discharge are tabulated below. The last three entries are included for Construction Grants A.T. review.

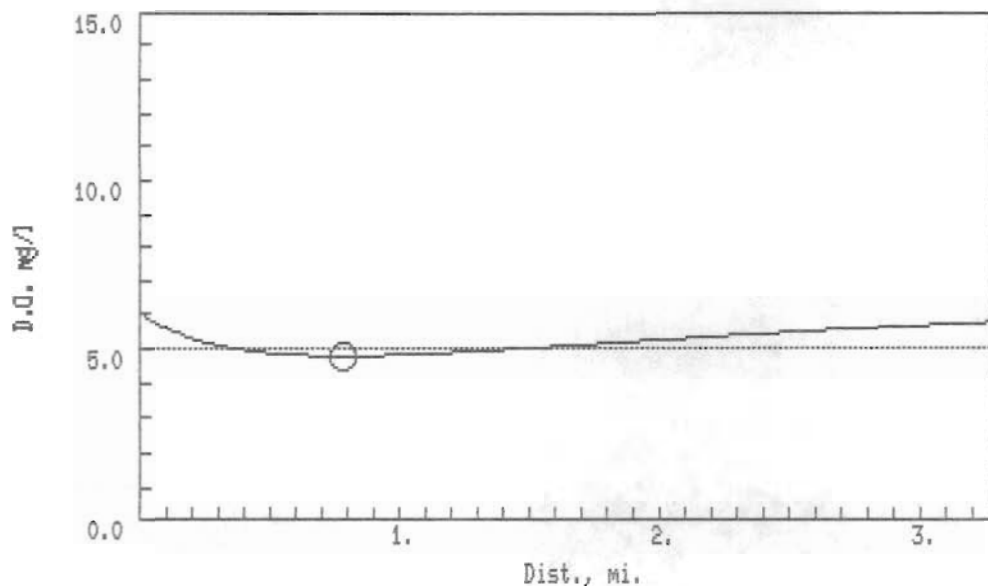
EFFLUENT LIMITS-MONTHS (CBOD <sub>5</sub> /TSS/NH <sub>3</sub> N/EFF.DO)	Q <sub>e</sub> MGD	Q <sub>s</sub> CFS	TEMP. C°	RECEIVING STREAM	D.O. (MG/L)
10/15/5/6--MAY-OCT	.5	0	28	L. FLINT CR.	4.8
10/15/10/6--NOV-APR	.5	.2	20	L. FLINT CR.	6.1
10/15/5/6 (D.O. STD.)	.5	.2	22	L. FLINT CR.	6.4
15/15/5/5--MAY-OCT	.5	0	28	L. FLINT CR.	4.0
20/20/5/5--MAY-OCT	.5	0	28	L. FLINT CR.	3.1
30/30/5/5--MAY-OCT	.5	0	28	L. FLINT CR.	1.5

The computer modeling addressed only one discharge option. Advanced treatment will be required for discharge to the receiving stream of Little Flint Creek during the critical and seasonal periods in order to maintain the dissolved oxygen standard.

IV. Recommendations

It is our recommendation that the Gentry STP discharge a 10/15/5/6 effluent into Little Flint Creek during the months of May through October, and a 10/15/10/6 effluent during the months of November through April in order to maintain the dissolved oxygen standard of this stream. The model input data and dissolved oxygen sag curves are attached.





GENTRY CRITICAL 10-15-5-6 TO LITTLE FLINT CREEK  
 Date of this run: 05/10/88

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 = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 6.0 mg/l  
 Waste BODU = 23.0 mg/l

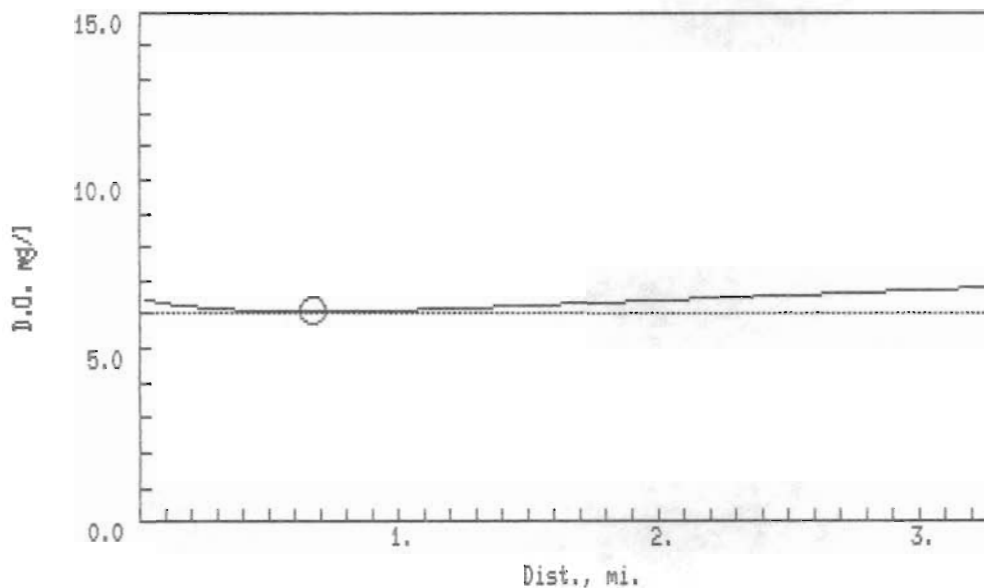
Benthall Demand = 0.5 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 1.6 g/m\*\*3/day  
 S corrected = 2.9 g/m\*\*3/day

Ammonia\_nitrogen = 5.0 mg/l  
 NUOD = 22.9 mg/l  
 Total UOD of waste = 45.9 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5                      Kd corrected = 0.7  
 Ka = 7.6                      Ka corrected = 9.2  
 Kn = 0.4                      Kn corrected = 0.6

Temperature of MIX = 28.0 deg C  
 UOD of mix = 45.9 mg/l  
 D.O. of mix = 6.0 mg/l

D.O. saturation = 7.9 mg/l  
 Minimum D.O. = 4.8 mg/l  
 Critical distance = 0.8 miles



GENTRY SEASONAL 10-15-10-6 LITTLE FLINT CREEK  
 Date of this run: 05/10/88

Stream Temperature = 20.0 deg C  
 Stream flow = 0.20 cfs  
 Stream D.O. = 8.3 mg/l  
 Stream UOD = 3.0 mg/l  
 Stream Velocity = 0.2 fps

Waste Temperature = 20.0 deg C  
 Waste flow = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 6.0 mg/l  
 Waste BODU = 23.0 mg/l

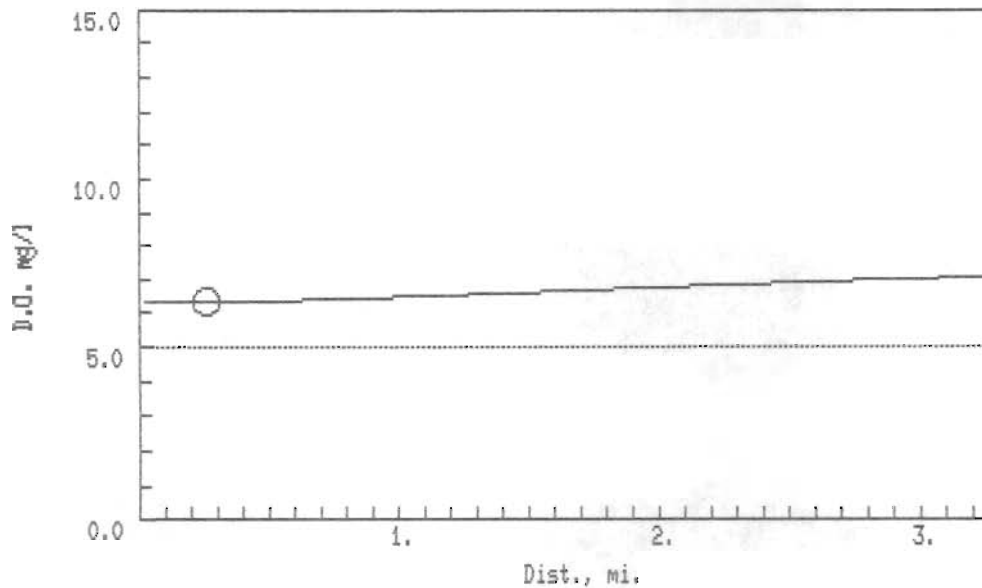
Benthic Demand = 0.5 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 1.6 g/m\*\*3/day  
 S corrected = 1.6 g/m\*\*3/day

Ammonia\_nitrogen = 10.0 mg/l  
 NUOD = 45.7 mg/l  
 Total UOD of waste = 68.7 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5 Kd corrected = 0.5  
 Ka = 7.6 Ka corrected = 7.6  
 Kn = 0.4 Kn corrected = 0.4

Temperature of MIX = 20.0 deg C  
 UOD of mix = 55.2 mg/l  
 D.O. of mix = 6.5 mg/l

D.O. saturation = 9.2 mg/l  
 Minimum D.O. = 6.1 mg/l  
 Critical distance = 0.7 miles



GENTRY 10-15-5-6 TO LITTLE FLINT CREEK AT 22 DEGREES  
 Date of this run: 05/10/88

Stream Temperature = 22.0 deg C  
 Stream flow = 0.20 cfs  
 Stream D.O. = 7.9 mg/l  
 Stream UOD = 3.0 mg/l  
 Stream Velocity = 0.2 fps

Waste Temperature = 22.0 deg C  
 Waste flow = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 6.0 mg/l  
 Waste BODU = 23.0 mg/l

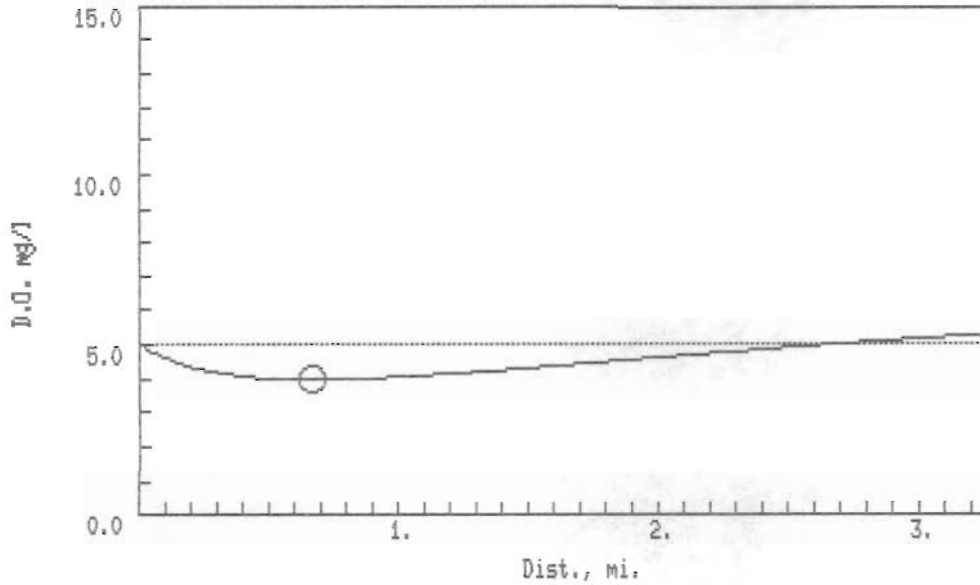
Benthic Demand = 0.5 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 1.6 g/m\*\*3/day  
 S corrected = 1.9 g/m\*\*3/day

Ammonia\_nitrogen = 5.0 mg/l  
 NUOD = 22.9 mg/l  
 Total UOD of waste = 45.9 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5                      Kd corrected = 0.5  
 Ka = 7.6                      Ka corrected = 8.0  
 Kn = 0.4                      Kn corrected = 0.4

Temperature of MIX = 22.0 deg C  
 UOD of mix = 37.0 mg/l  
 D.O. of mix = 6.4 mg/l

D.O. saturation = 8.8 mg/l  
 Minimum D.O. = 6.4 mg/l  
 Critical distance = 0.3 miles



GENTRY CRITICAL 15-15-5-5 LITTLE FLINT CREEK  
 Date of this run: 05/10/88

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 = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 5.0 mg/l  
 Waste BODU = 34.5 mg/l

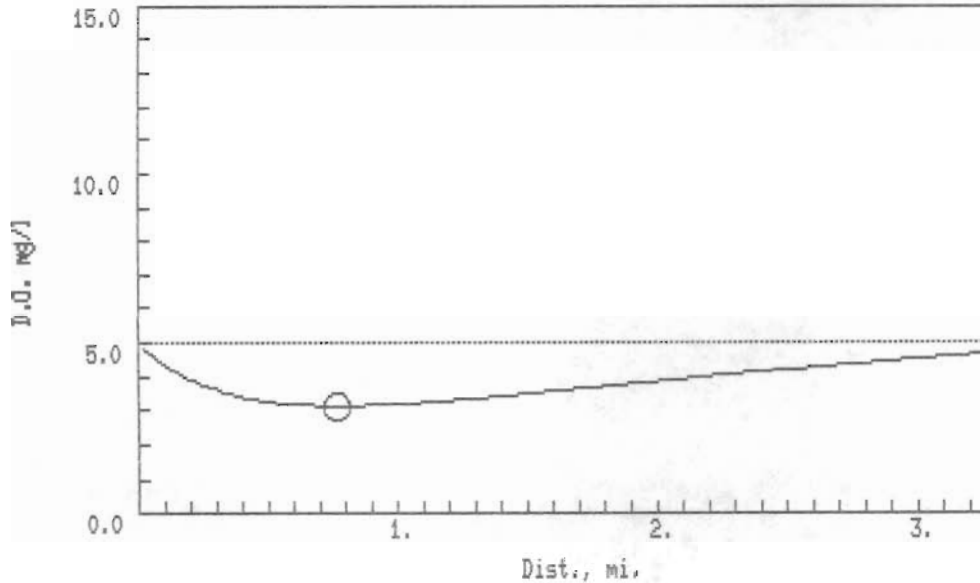
Benthall Demand = 0.5 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 1.6 g/m\*\*3/day  
 S corrected = 2.9 g/m\*\*3/day

Ammonia\_nitrogen = 5.0 mg/l  
 NUOD = 22.9 mg/l  
 Total UOD of waste = 57.4 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5                      Kd corrected = 0.7  
 Ka = 7.6                      Ka corrected = 9.2  
 Kn = 0.4                      Kn corrected = 0.6

Temperature of MIX = 28.0 deg C  
 UOD of mix = 57.4 mg/l  
 D.O. of mix = 5.0 mg/l

D.O. saturation = 7.9 mg/l  
 Minimum D.O. = 4.0 mg/l  
 Critical distance = 0.7 miles



GENTRY CRITICAL 20-20-5-5 TO LITTLE FLINT CREEK  
 Date of this run: 05/10/88

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 = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 5.0 mg/l  
 Waste BODU = 46.0 mg/l

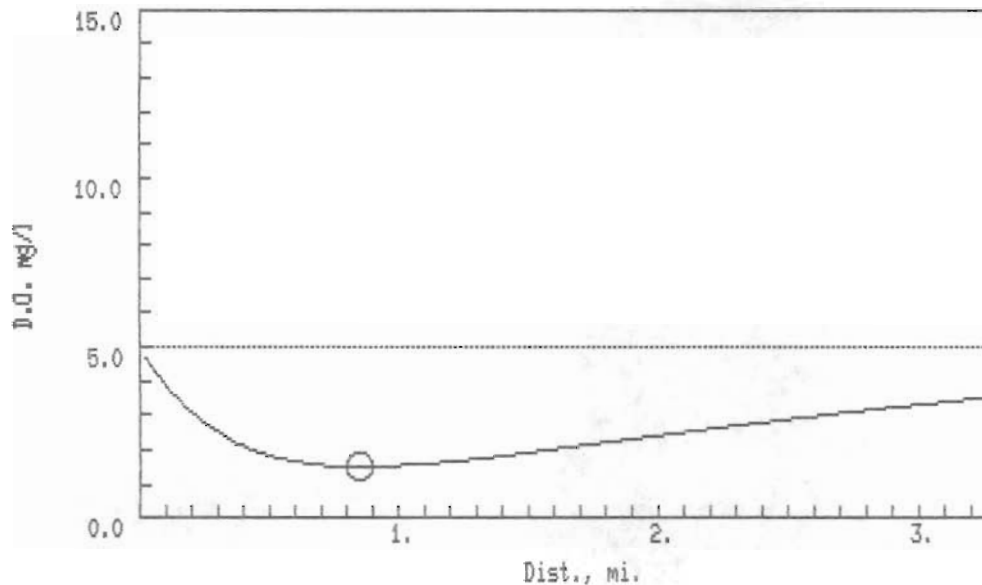
Benthal Demand = 0.7 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 2.3 g/m\*\*3/day  
 S corrected = 4.0 g/m\*\*3/day

Ammonia\_nitrogen = 5.0 mg/l  
 NUOD = 22.9 mg/l  
 Total UOD of waste = 68.8 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5                      Kd corrected = 0.7  
 Ka = 7.6                      Ka corrected = 9.2  
 Kn = 0.4                      Kn corrected = 0.6

Temperature of MIX = 28.0 deg C  
 UOD of mix = 68.8 mg/l  
 D.O. of mix = 5.0 mg/l

D.O. saturation = 7.9 mg/l  
 Minimum D.O. = 3.1 mg/l  
 Critical distance = 0.8 miles



GENTRY CRITICAL 30-30-5-5 TO LITTLE FLINT CREEK  
 Date of this run: 05/10/88

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 = 0.50 mgd  
 Waste flow = 0.8 cfs  
 Waste D.O. = 5.0 mg/l  
 Waste BODU = 69.0 mg/l

Benthall Demand = 1.0 g/m\*\*2/day  
 Mean Depth = 1.0 ft.  
 S = 3.3 g/m\*\*3/day  
 S corrected = 5.7 g/m\*\*3/day

Ammonia\_nitrogen = 5.0 mg/l  
 NUOD = 22.9 mg/l  
 Total UOD of waste = 91.8 mg/l

Rate constants, per day, (base e)  
 Kd = 0.5                      Kd corrected = 0.7  
 Ka = 7.6                      Ka corrected = 9.2  
 Kn = 0.4                      Kn corrected = 0.6

Temperature of MIX = 28.0 deg C  
 UOD of mix = 91.8 mg/l  
 D.O. of mix = 5.0 mg/l

D.O. saturation = 7.9 mg/l  
 Minimum D.O. = 1.5 mg/l  
 Critical distance = 0.9 miles