Draft Wasteload Allocation Report

Town of Haworth

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1. Problem Definition

The Town of Haworth is currently operating a total retention lagoon system and requesting permission to discharge to an unnamed tributary of Norwood Creek (OK410100010050_00), approximately 1 mile above its confluence with the Norwood Creek. Based on the projected population growth and to ensure compliance with DEQ standards, the Town has requested a discharge flow of 0.155 MGD.

Since the unnamed tributary is not listed in Appendix A of the Oklahoma Water Quality Standards (OAC 785:45), it is assumed to have the designated use of Warm Water Aquatic Community (WWAC). Norwood Creek is listed in the Oklahoma Water Quality Standards as having the following beneficial uses:

- Primary Body Contact Recreation
- Public and Private Water Supplies
- Warm Water Aquatic Community
- Agriculture
- Aesthetics

Among the above designated beneficial uses, only the WWAC beneficial use is addressed in this report. According to the Oklahoma 2014 303(d) list, Norwood Creek is impaired for the following pollutants:

- Enterococcus
- Escherichia coli
- Oxygen, Dissolved

This report addresses dissolved-oxygen demanding substances only and does not address any other pollutant on the State's 303(d) list of impaired waters. This report addresses instream organic enrichment and Dissolved Oxygen (DO) through the use of wasteload allocations of DO-demanding substances (CBOD and Ammonia). It also accounts for non-point source impacts through the use of conservative kinetic inputs and assumptions.

This Wasteload Allocation (WLA) has been developed in order to ensure that the limits assigned to the discharge are stringent enough to maintain DO standards under critical conditions. Controls for any necessary pollutants will be established in the permitting process.

2. Endpoint Identification

The Oklahoma Water Quality Standards define DO criteria for two flow regimes: critical low-flow and nuisance conditions. The critical low-flow will be either 7Q2 or 1.0 cfs, whichever is greater. Nuisance condition applies only when there is no upstream flow.

The following numerical dissolved oxygen criteria for WWAC apply to the receiving stream:

Critical Low-Flow Condition (7Q2)
Summer (Jun–Oct): 5.0 mg/L
Spring (Apr–May): 6.0 mg/L
Winter (Nov–Mar): 6.0 mg/L

Since no flow or water quality data were available for Norwood Creek, this waterbody was not included in the WLA modeling. In according with OAC 785:45-5-12, a flow of 1 cfs was used for unnamed tributary to Norwood creek since no data are available flow data.

Oklahoma antidegradation policy (OAC 785:45-3) requires protecting all waters of the state from degradation of water quality. The allocated loadings/concentrations in this report were set with regard for all elements of the Oklahoma Water Quality standards, which includes the antidegradation policy.

3. Source Analysis

3.1. Point Sources

Haworth Wastewater Treatment Facility (WWTF)

Facility Legal Description: SE¼ - S23-T8S-R25E, McCurtain County, OK
Proposed Point of Discharge: SE¼ - S23-T8S-R25E
Latitude: 33°50'51.18"N
Longitude: 94°39'33.79"W

3.2. Non-Point Sources

The allocations in this waterbody assessment are driven by critical instream dissolved oxygen conditions (low-flow, high temperature) as defined in the Oklahoma Water Quality Standards. Low-flow conditions, by definition, assume little or no runoff.

3.3. Background

The following background conditions for the unnamed tributary were used:

Unnamed Tributary to Norwood Creek
Flow (7Q2): 1.0 cfs
$CBOD_5$: 2.0 mg/L
Ammonia: 0.15 mg/L
DO: 85% * temperature

* = saturation at the regulatory seasonal temperature

4. Linkage between Sources and Receiving Water

The links between sources and the receiving streams can be established through typical water quality models such as spreadsheet mass balance, desktop Streeter-Phelps model, modified Streeter-Phelps model, QUAL2E, QUALTX, SWAT, and HSPF etc. The more complicated a model becomes, the better it represents the system being studied. However, a complex model also requires more data. According the complexity of the problem, available data and policy, Oklahoma's desktop model was chosen for this project.

Oklahoma's desktop model is based on the modified Streeter-Phelps equation. The modified Streeter-Phelps model can be found in Oklahoma Continuing Planning Process (CPP).

4.1. Model Inputs

The water quality model used to determine the impact of DO-demanding substances on the instream DO concentration is based on a modified version of the Streeter-Phelps equation. The primary kinetic inputs were derived from literature values and the past WLAs performed by Oklahoma Department of Environmental Quality. Turney-Harris equation was used to calculate the reaeration rates (K_2) used in the model. The other primary kinetic inputs were derived from literature values and are as follows:

Proposed Permitted Flow:	0.155 MGD
CBOD decay rate (**K_1**):	0.35/day
Reaeration rate (**K_2**):	10.47/day
NBOD decay rate (**K_n**):	0.30/day
CBOD settling rate (**K_s**):	0.03-0.05/day
Sediment Oxygen Demand (**SOD**):	0.072- 0.149 g/ft^2/day

Hydraulic parameters were estimated using topographic map data and general assumptions. They are as follows:

Stream Slope:	9.10 ft/mi
Side Slope:	0.10 ft/ft
Manning's "n":	0.12

7Q2 for the unnamed tributary was assigned 1.0 cfs because there is no data available for the stream. The model inputs were included in the **Appendix A.**

4.2. Maximum Assimilative Capacity

The model was used to determine the stream's maximum assimilative capacity during various seasons under regulatory flow condition of 1.0 cfs for the unnamed tributary. To do this, the concentration of $CBOD_5$ and NH_3 of the point source are increased at the same rate until the predicted instream DO reaches the DO criteria. The resultant mass loading represents the maximum assimilative capacity of the stream for DO-demanding substances. The maximum assimilative capacity is measured in terms of DO as shown in the following table 1.

Table 1. Maximum Assimilative Capacity

Season	Maximum Assimilative Capacity (lbs/day)
Summer (Jun–Oct)	222.93
Spring (Apr–May)	161.99
Winter (Nov–Mar)	548.18

The complete model results are provided in **Appendix A**.

5. Margin of Safety

The Oklahoma CPP specifies a 20% margin of safety (MOS) for uncalibrated, simple source models. This is implemented in the model by increasing the inputs of DO-demanding substances ($CBOD_5$ and NH_3) proportionally just until the DO criteria are met. The quantified MOS is equal to 20% of maximum wasteload allocations. Together with the MOS, load allocation, wasteload allocation and reserved capacity are calculated in the model and will be presented in the next section.

6. Allocations

There are no other wastewater discharges in the vicinity of the Town of Haworth's discharge. The allocation of loads calculated by the desktop model is shown in the following table 2.

Table 2. Allocations

Season	Load Allocation (lb/day)	Wasteload Allocation (lb/day)	MOS (20%) (lb/day)	Reserved Capacity (lb/day)
Summer	125.2	49.0	44.6	4.1
Spring	36.9	69.0	32.4	23.7
Winter	45.5	157.7	109.6	235.4

7. Final Recommendations

The following changes are recommended for inclusion in the Oklahoma Water Quality Management Plan (208 Plan).

Town of Haworth WWTP Limits

Proposed Design Flow:	0.155 MGD
Summer (Jun–Oct):	No Discharge
Spring (April–May):	No Discharge
Winter (Nov–Mar):	(Lagoon Secondary) 30 mg/l BOD_5, 90 mg/l TSS

8. Public Participation

This Draft WLA report will be submitted to EPA for technical approval. After technical approval is received, the proposed permit limits will be sent for public comments. Public comments received during this period will be responded to and become part of the WLA report.

The proposed limits will be implemented through the Oklahoma Pollutant Discharge Elimination System (OPDES) permit for the Town of Haworth, which represents an adequate implementation of the wasteload allocation. The water quality model in this report shows clearly that the recommended allocation of DO-demanding substances effectively addresses the DO problem that can be potentially caused by the proposed discharge of the facility.

The Town of Haworth will be required to submit monthly Discharge Monitoring Reports (DMR) to the Oklahoma Department of Environmental Quality. The DMR will ensure that the beneficial uses will be maintained in unnamed tributary to Norwood Creek as well as in Norwood Creek.

9. References

1. *Title 785, Oklahoma Administrative Code, Chapter 45 Oklahoma's Water Quality Standards,* State Of Oklahoma, 2011.

2. *Oklahoma Desktop Model – One Reach, version 3.0,* Watershed Planning Section, Oklahoma Department of Environmental Quality, Oklahoma City Oklahoma, 2008.

3. *Oklahoma Continuing Planning Process, 2012 edition*, Oklahoma Department of Environmental Quality, State of Oklahoma, 2013.

Figure 1. Haworth WWTF Receiving Streams (Overview)

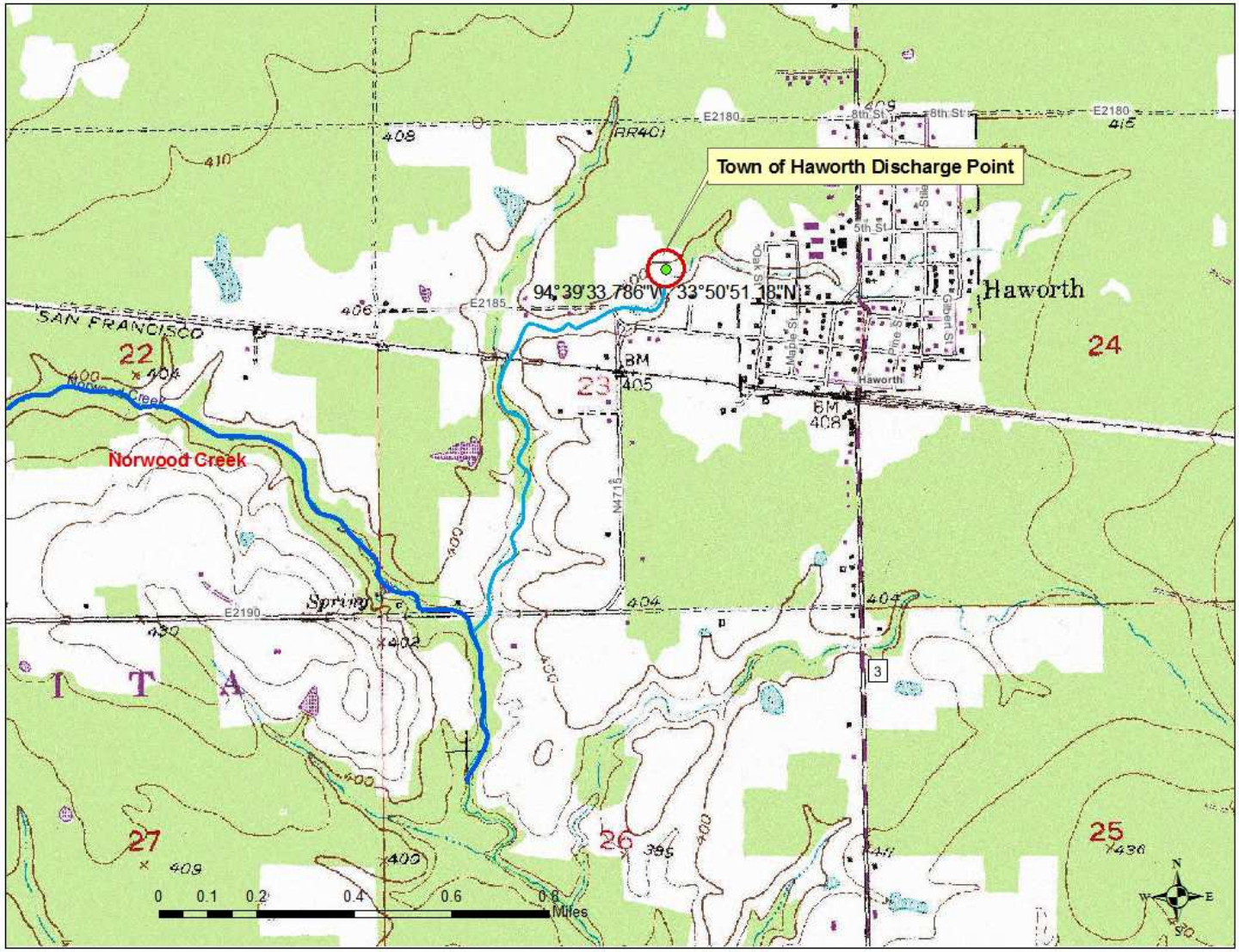
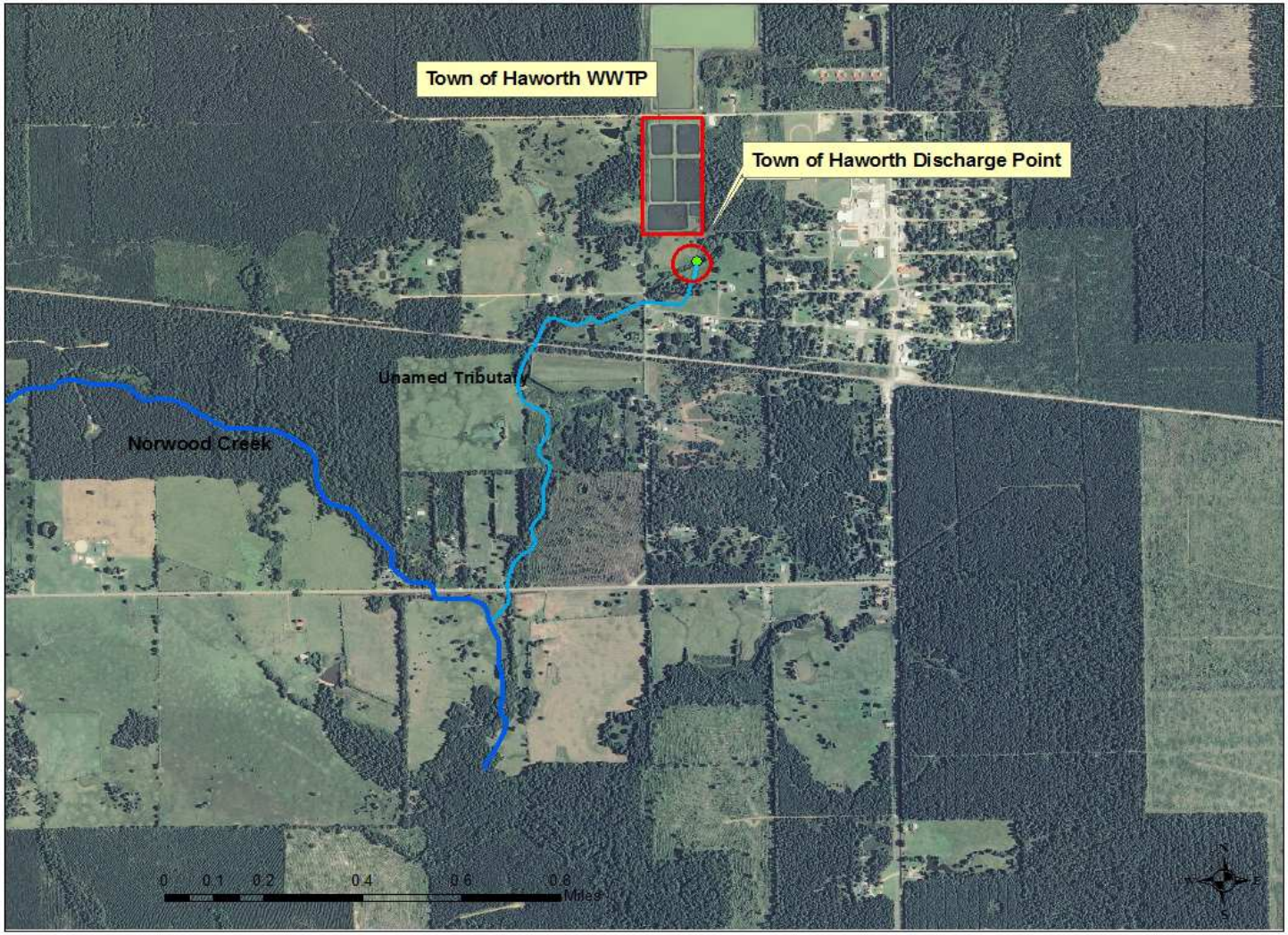


Figure 2. Haworth WWTF Receiving Stream (Detailed View)



Appendix A - Desktop Model

INPUT PARAMETERS FOR MODIFIED STREETER-PHELPS MODEL

CITY:	Haworth
PERFORMED BY:	Ying
DATE:	3/24/2016

I DISCHARGE INFORMATION

LOCATION:	SE 1/4-23-T8S-R25E	BASIN:	410100
COUNTY:	MCCURTAIN		

PROPOSED PERMIT FLOW:	Summer	Spring	Winter	
	0.155	0.155	0.155	MGD

II RECEIVING STREAM

STREAM NAME	Unamed Tributary/Norwood Creek		
MODELED LENGTH	1.10	MILES	NUMBER OF SEGMENTS 40

	Summer	Spring	Winter	
UPSTREAM FLOW (7Q2)	1.00	1.00	1.00	CFS
STREAM SLOPE (S)	9.10			FT/MILE
SIDE SLOPE (P)	0.10			FT/FT
MANNING'S N	0.12			
VELOCITY COEFFICIENT (Cv)	1.899			
DEPTH COEFFICIENT (Ch)	0.176			

		Summer		Spring		Winter	
Upstream Flow 7Q2 (cfs)	Velocity (fps)	1.0	0.25	1.0	0.25	1.0	0.25
	Depth (ft)		0.35		0.35		0.35
Upstream Flow 0.0 (cfs)	Velocity (fps)	-	-	-	-	-	-
	Depth (ft)		-		-		-

III WATER QUALITY CRITERIA OF RECEIVING STREAM

AQUATIC COMMUNITY FLAG	2		WARM WATER AQUATIC COMMUNITY
AVERAGE D.O. REQUIREMENT		SUMMER	5.00 MG/L
		SPRING	6.00 MG/L
		WINTER	6.00 MG/L

IV UPSTREAM CONDITIONS

D.O. SATURATION	85.00	%
UPSTREAM CBOD5	2.00	MG/L
UPSTREAM NH3-N	0.15	MG/L

V RATE CONSTANTS at 20° C

	Summer	Spring	Winter
CBOD DECAY RATE (K1)	0.35	0.35	0.35
(/DAY)	0.35	0.35	0.35

	SUMMER		SPRING		WINTER	
	UPSTREAM FLOW		UPSTREAM FLOW		UPSTREAM FLOW	
REAERATION RATES (K2)	1.0 (cfs)	-	1.0 (cfs)	-	1.0 (cfs)	-
1). TURNEY-HARRIS						
K2=1.33*S^0.32/n^0.64	10.47	-	10.47	-	10.47	-
2). TEXAS						
K2=4.022*V^0.273/H^0.89	7.03	-	7.03	-	7.03	-

SELECTTED K2 FORMULA	Flag	Formula	Flag	Formula	Flag	Formula
	1	TURNEY-HARRIS	1	TURNEY-HARRIS	1	TURNEY-HARRIS
	10.47	-	10.47	-	10.47	-

		SUMMER	SPRING	WINTER	
		0	0	0	
CBOD SETTLING RATE (Ks)	KS	0.03	0.03	0.05	/DAY
		0	0	0	
NBOD DECAY (Kn)	KN	0.30	0.30	0.30	/DAY
		0	0	0	
SEDIMENT OXYGEN DEMAND	SOD	0.072	0.080	0.149	G/FT2/D

VI PROPOSED WASTELOAD ALLOCATIONS (WLA)

	CBOD5 (MG/L)	NH3-N (MG/L)	EFFLUENT D.O. (MG/L)	TEMP (° C)	MINIMUM D.O. 0.00 CFS	MINIMUM D.O. 7Q2 / 1.0 CFS	Reserved Capacity?
SUMMER	9.0	4.0	2.0	32	- MG/L	5.38 MG/L	YES
SPRING	12.0	6.0	2.0	25	- MG/L	6.04 MG/L	YES
WINTER	25.0	15.0	2.0	18	- MG/L	6.87 MG/L	YES

VII MARGIN OF SAFETY AND ALLOCATIONS

WLAs and Multiplier

	CBOD5 (MG/L)	NH3-N (MG/L)	D.O. (MG/L)	Factor
SUMMER	9.0	4.0	2.0	1.99
SPRING	12.0	6.0	2.0	1.81
WINTER	25.0	15.0	2.0	3.19

Margin Of Safety

Required MOS

20.0%

Maximum Wasteload Allocations

	Maximum Wasteload (lbs/day)
	Dissolved Oxygen
SUMMER	97.7
SPRING	125.1
WINTER	502.7

Maximum Assimilative Capacity

	Max Assimilative Capacity (lbs/day)
	Dissolved Oxygen
SUMMER	**222.93**
SPRING	**161.99**
WINTER	**548.18**

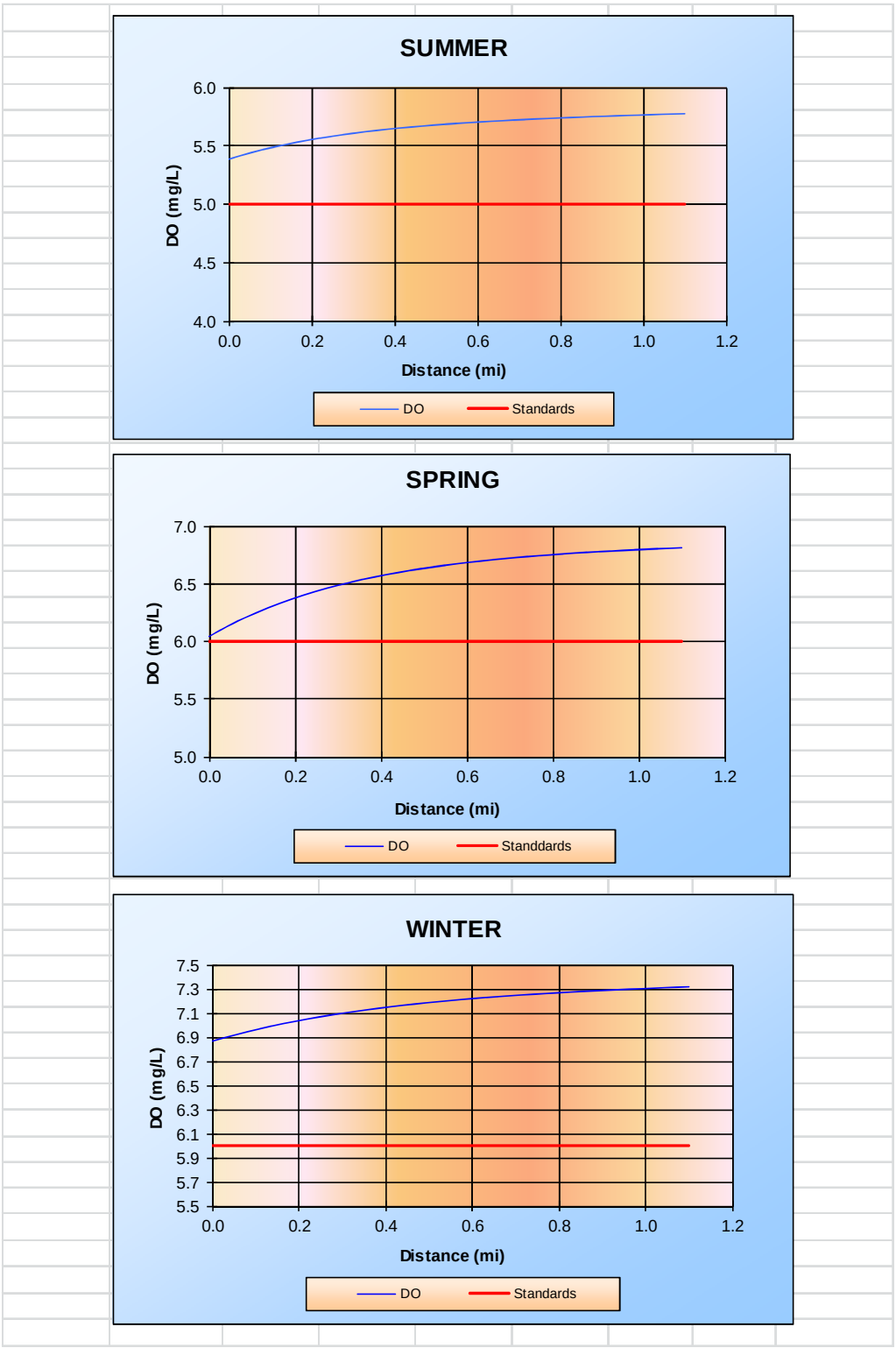
Allocations (in Dissolved Oxygen)

SEASON	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin Of Safety (20%) (lbs/day)	Reserved Capacity (lbs/day)
SUMMER	125.2	49.0	44.6	4.1
SPRING	36.9	69.0	32.4	23.7
WINTER	45.5	157.7	109.6	235.4

Locations of D.O. Sags

	MINIMUM D.O. 0.0 CFS	RIVER MILE	MINIMUM D.O. 1.0 CFS	RIVER MILE
SUMMER	- MG/L	-	5.38 MG/L	0.00
SPRING	- MG/L	-	6.04 MG/L	0.00
WINTER	- MG/L	-	6.87 MG/L	0.00

Plots for 7Q2 Headwater Flow:



OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

DESKTOP WASTELOAD ANALYSIS - SUMMER

Haworth

PROPOSED PERMIT FLOW =	0.155	MGD		1.0	CFS	UPSTREAM	FLOW					PROPOSED PERMIT FLOW =	0.155	MGD		-	CFS	UPSTREAM	FLOW				
				32	° C	TEMPERATURE										32	° C	TEMPERATURE					
INITIAL CONDITIONS ARE AS FOLLOWS.....												INITIAL CONDITIONS ARE AS FOLLOWS.....											
REACH LENGTH (MILES):	1.10											REACH LENGTH (MILES):	1.10										
NUMBER OF SEGMENTS:	40			STREAM VELOCITY:	4.11	MILES/DAY						NUMBER OF SEGMENTS:	40			STREAM VELOCITY:	4.11	MILES/DAY					
NUMBER OF REACHES:	1			STREAM DEPTH:	0.35	FEET						NUMBER OF REACHES:	1			STREAM DEPTH:	0.35	FEET					
REACH NUMBER:	1			REACH CL CONC:	150.0	MG/L						REACH NUMBER:	1			REACH CL CONC:	150.0	MG/L					
BODU/CBOD5 RATIO:	2.30			D.O. SATURATION:	7.29	MG/L						BODU/CBOD5 RATIO:	2.30			D.O. SATURATION:	7.29	MG/L					
NODU/CBOD5 RATIO:	4.30			D.O. TARGET:	5.00	MG/L						NODU/CBOD5 RATIO:	4.30			D.O. TARGET:	2.00	MG/L					
EFFLUENT FLOW:	0.16	MGD		UPSTREAM FLOW:	0.65	MGD						EFFLUENT FLOW:	0.16	MGD		UPSTREAM FLOW:	0.65	MGD					
EFFLUENT CBOD5:	9.0	MG/L		UPSTREAM CBOD5:	2.00	MG/L						EFFLUENT CBOD5:	9.0	MG/L		UPSTREAM CBOD5:	2.00	MG/L					
EFFLUENT NH3N:	4.0	MG/L		UPSTREAM NH3N:	0.15	MG/L						EFFLUENT NH3N:	4.0	MG/L		UPSTREAM NH3N:	0.15	MG/L					
EFFLUENT D.O.:	2.0	MG/L		UPSTREAM D.O.:	6.20	MG/L						EFFLUENT D.O.:	2.0	MG/L		UPSTREAM D.O.:	6.20	MG/L					
RATE CONSTANTS(1/DAY, BASE E)				20 DEGREES	32 DEGREES	THETA						RATE CONSTANTS(1/DAY, BASE E)				20 DEGREES	32 DEGREES	THETA					
K1:				0.35	0.61	1.047						K1:				0.35	0.61	1.047					
K2:	TURNEY-HARRIS			10.47	13.92	1.024						K2:	TURNEY-HARRIS			-	-	1.024					
KN:				0.30	0.70	1.073						KN:				0.30	0.70	1.073					
KS:				0.03	0.04	1.024						KS:				0.03	0.04	1.024					
SOD	(G/FT2/DAY):			0.07	0.14	1.060						SOD	(G/FT2/DAY):			0.07	0.14	1.060					
RESULTS ARE AS FOLLOWS....												RESULTS ARE AS FOLLOWS....											

DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)	DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)
0.00	3.35	7.72	0.90	3.85	5.38	0.80	0.00	-	-	-	-	-	-
0.03	3.34	7.68	0.89	3.83	5.41	0.80	0.03	-	-	-	-	-	-
0.06	3.33	7.65	0.89	3.81	5.44	0.80	0.06	-	-	-	-	-	-
0.08	3.31	7.62	0.88	3.79	5.47	0.80	0.08	-	-	-	-	-	-
0.11	3.30	7.58	0.88	3.78	5.49	0.80	0.11	-	-	-	-	-	-
0.14	3.28	7.55	0.87	3.76	5.51	0.80	0.14	-	-	-	-	-	-
0.17	3.27	7.52	0.87	3.74	5.53	0.80	0.17	-	-	-	-	-	-
0.19	3.25	7.49	0.87	3.72	5.55	0.80	0.19	-	-	-	-	-	-
0.22	3.24	7.45	0.86	3.71	5.56	0.80	0.22	-	-	-	-	-	-
0.25	3.23	7.42	0.86	3.69	5.58	0.80	0.25	-	-	-	-	-	-
0.28	3.21	7.39	0.85	3.67	5.59	0.80	0.28	-	-	-	-	-	-
0.30	3.20	7.36	0.85	3.66	5.61	0.80	0.30	-	-	-	-	-	-
0.33	3.18	7.33	0.85	3.64	5.62	0.80	0.33	-	-	-	-	-	-
0.36	3.17	7.29	0.84	3.62	5.63	0.80	0.36	-	-	-	-	-	-
0.39	3.16	7.26	0.84	3.60	5.64	0.80	0.39	-	-	-	-	-	-
0.41	3.14	7.23	0.83	3.59	5.65	0.80	0.41	-	-	-	-	-	-
0.44	3.13	7.20	0.83	3.57	5.66	0.80	0.44	-	-	-	-	-	-
0.47	3.12	7.17	0.83	3.55	5.67	0.80	0.47	-	-	-	-	-	-
0.50	3.10	7.14	0.82	3.54	5.68	0.80	0.50	-	-	-	-	-	-
0.52	3.09	7.11	0.82	3.52	5.68	0.80	0.52	-	-	-	-	-	-
0.55	3.08	7.08	0.82	3.51	5.69	0.80	0.55	-	-	-	-	-	-
0.58	3.06	7.05	0.81	3.49	5.70	0.80	0.58	-	-	-	-	-	-
0.61	3.05	7.01	0.81	3.47	5.70	0.80	0.61	-	-	-	-	-	-
0.63	3.04	6.98	0.80	3.46	5.71	0.80	0.63	-	-	-	-	-	-
0.66	3.02	6.95	0.80	3.44	5.71	0.80	0.66	-	-	-	-	-	-
0.69	3.01	6.92	0.80	3.42	5.72	0.80	0.69	-	-	-	-	-	-
0.72	3.00	6.89	0.79	3.41	5.72	0.80	0.72	-	-	-	-	-	-
0.74	2.98	6.86	0.79	3.39	5.73	0.80	0.74	-	-	-	-	-	-
0.77	2.97	6.84	0.79	3.38	5.73	0.80	0.77	-	-	-	-	-	-
0.80	2.96	6.81	0.78	3.36	5.74	0.80	0.80	-	-	-	-	-	-
0.83	2.95	6.78	0.78	3.35	5.74	0.80	0.83	-	-	-	-	-	-
0.85	2.93	6.75	0.77	3.33	5.75	0.80	0.85	-	-	-	-	-	-
0.88	2.92	6.72	0.77	3.31	5.75	0.80	0.88	-	-	-	-	-	-
0.91	2.91	6.69	0.77	3.30	5.75	0.80	0.91	-	-	-	-	-	-
0.94	2.90	6.66	0.76	3.28	5.76	0.80	0.94	-	-	-	-	-	-
0.96	2.88	6.63	0.76	3.27	5.76	0.80	0.96	-	-	-	-	-	-
0.99	2.87	6.60	0.76	3.25	5.76	0.80	0.99	-	-	-	-	-	-
1.02	2.86	6.57	0.75	3.24	5.77	0.80	1.02	-	-	-	-	-	-
1.05	2.85	6.55	0.75	3.22	5.77	0.80	1.05	-	-	-	-	-	-
1.07	2.83	6.52	0.75	3.21	5.77	0.80	1.07	-	-	-	-	-	-
1.10	2.82	6.49	0.74	3.19	5.77	0.80	1.10	-	-	-	-	-	-

DESKTOP WASTELOAD ANALYSIS - SPRING

Haworth

PROPOSED PERMIT FLOW =	0.155	MGD		1.0	CFS UPSTREAM FLOW					PROPOSED PERMIT FLOW =	0.155	MGD		-	CFS UPSTREAM FLOW				
				25	° C TEMPERATURE									25	° C TEMPERATURE				
INITIAL CONDITIONS ARE AS FOLLOWS.....										INITIAL CONDITIONS ARE AS FOLLOWS.....									
REACH LENGTH (MILES):	1.10									REACH LENGTH (MILES):	1.10								
NUMBER OF SEGMENTS:	40		STREAM VELOCITY:	4.11	MILES/DAY					NUMBER OF SEGMENTS:	40		STREAM VELOCITY:	4.11	MILES/DAY				
NUMBER OF REACHES:	1		STREAM DEPTH:	0.35	FEET					NUMBER OF REACHES:	1		STREAM DEPTH:	0.35	FEET				
REACH NUMBER:	1		REACH CL CONC:	150.0	MG/L					REACH NUMBER:	1		REACH CL CONC:	150.0	MG/L				
BODU/CBOD5 RATIO:	2.30		D.O. SATURATION:	8.25	MG/L					BODU/CBOD5 RATIO:	2.30		D.O. SATURATION:	8.25	MG/L				
NODU/CBOD5 RATIO:	4.30		D.O. TARGET:	6.00	MG/L					NODU/CBOD5 RATIO:	4.30		D.O. TARGET:	2.00	MG/L				
EFFLUENT FLOW:	0.16	MGD	UPSTREAM FLOW:	0.65	MGD					EFFLUENT FLOW:	0.16	MGD	UPSTREAM FLOW:	0.65	MGD				
EFFLUENT CBOD5:	12.0	MG/L	UPSTREAM CBOD5:	2.00	MG/L					EFFLUENT CBOD5:	12.0	MG/L	UPSTREAM CBOD5:	2.00	MG/L				
EFFLUENT NH3N:	6.0	MG/L	UPSTREAM NH3N:	0.15	MG/L					EFFLUENT NH3N:	6.0	MG/L	UPSTREAM NH3N:	0.15	MG/L				
EFFLUENT D.O.:	2.0	MG/L	UPSTREAM D.O.:	7.01	MG/L					EFFLUENT D.O.:	2.0	MG/L	UPSTREAM D.O.:	7.01	MG/L				
RATE CONSTANTS(1/DAY, BASE E)			20 DEGREES	25	DEGREES	THETA				RATE CONSTANTS(1/DAY, BASE E)			20 DEGREES	25	DEGREES	THETA			
K1:			0.35	0.44		1.047				K1:			0.35	0.44		1.047			
K2:	TURNEY-HARRIS		10.47	11.79		1.024				K2:	TURNEY-HARRIS		-	-		1.024			
KN:			0.30	0.43		1.073				KN:			0.30	0.43		1.073			
KS:			0.03	0.03		1.024				KS:			0.03	0.03		1.024			
SOD	(G/FT2/DAY):		0.08	0.11		1.060				SOD	(G/FT2/DAY):		0.08	0.11		1.060			
RESULTS ARE AS FOLLOWS....										RESULTS ARE AS FOLLOWS....									

DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)	DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)
0.00	3.94	9.05	1.28	5.51	6.04	0.80	0.00	-	-	-	-	-	-
0.03	3.92	9.02	1.28	5.50	6.10	0.80	0.03	-	-	-	-	-	-
0.06	3.91	8.99	1.27	5.48	6.15	0.80	0.06	-	-	-	-	-	-
0.08	3.90	8.97	1.27	5.47	6.20	0.80	0.08	-	-	-	-	-	-
0.11	3.89	8.94	1.27	5.45	6.25	0.80	0.11	-	-	-	-	-	-
0.14	3.87	8.91	1.26	5.43	6.29	0.80	0.14	-	-	-	-	-	-
0.17	3.86	8.88	1.26	5.42	6.33	0.80	0.17	-	-	-	-	-	-
0.19	3.85	8.85	1.26	5.40	6.37	0.80	0.19	-	-	-	-	-	-
0.22	3.84	8.82	1.25	5.39	6.40	0.80	0.22	-	-	-	-	-	-
0.25	3.82	8.80	1.25	5.37	6.43	0.80	0.25	-	-	-	-	-	-
0.28	3.81	8.77	1.25	5.36	6.46	0.80	0.28	-	-	-	-	-	-
0.30	3.80	8.74	1.24	5.34	6.49	0.80	0.30	-	-	-	-	-	-
0.33	3.79	8.71	1.24	5.33	6.51	0.80	0.33	-	-	-	-	-	-
0.36	3.78	8.69	1.24	5.31	6.54	0.80	0.36	-	-	-	-	-	-
0.39	3.76	8.66	1.23	5.30	6.56	0.80	0.39	-	-	-	-	-	-
0.41	3.75	8.63	1.23	5.28	6.58	0.80	0.41	-	-	-	-	-	-
0.44	3.74	8.60	1.22	5.27	6.60	0.80	0.44	-	-	-	-	-	-
0.47	3.73	8.58	1.22	5.25	6.61	0.80	0.47	-	-	-	-	-	-
0.50	3.72	8.55	1.22	5.24	6.63	0.80	0.50	-	-	-	-	-	-
0.52	3.71	8.52	1.21	5.22	6.65	0.80	0.52	-	-	-	-	-	-
0.55	3.69	8.49	1.21	5.21	6.66	0.80	0.55	-	-	-	-	-	-
0.58	3.68	8.47	1.21	5.19	6.67	0.80	0.58	-	-	-	-	-	-
0.61	3.67	8.44	1.20	5.18	6.68	0.80	0.61	-	-	-	-	-	-
0.63	3.66	8.41	1.20	5.16	6.70	0.80	0.63	-	-	-	-	-	-
0.66	3.65	8.39	1.20	5.15	6.71	0.80	0.66	-	-	-	-	-	-
0.69	3.64	8.36	1.19	5.13	6.72	0.80	0.69	-	-	-	-	-	-
0.72	3.62	8.33	1.19	5.12	6.73	0.80	0.72	-	-	-	-	-	-
0.74	3.61	8.31	1.19	5.10	6.74	0.80	0.74	-	-	-	-	-	-
0.77	3.60	8.28	1.18	5.09	6.74	0.80	0.77	-	-	-	-	-	-
0.80	3.59	8.26	1.18	5.07	6.75	0.80	0.80	-	-	-	-	-	-
0.83	3.58	8.23	1.18	5.06	6.76	0.80	0.83	-	-	-	-	-	-
0.85	3.57	8.20	1.17	5.05	6.76	0.80	0.85	-	-	-	-	-	-
0.88	3.56	8.18	1.17	5.03	6.77	0.80	0.88	-	-	-	-	-	-
0.91	3.54	8.15	1.17	5.02	6.78	0.80	0.91	-	-	-	-	-	-
0.94	3.53	8.13	1.16	5.00	6.78	0.80	0.94	-	-	-	-	-	-
0.96	3.52	8.10	1.16	4.99	6.79	0.80	0.96	-	-	-	-	-	-
0.99	3.51	8.07	1.16	4.97	6.79	0.80	0.99	-	-	-	-	-	-
1.02	3.50	8.05	1.15	4.96	6.80	0.80	1.02	-	-	-	-	-	-
1.05	3.49	8.02	1.15	4.95	6.80	0.80	1.05	-	-	-	-	-	-
1.07	3.48	8.00	1.15	4.93	6.81	0.80	1.07	-	-	-	-	-	-
1.10	3.47	7.97	1.14	4.92	6.81	0.80	1.10	-	-	-	-	-	-

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

DESKTOP WASTELOAD ANALYSIS - WINTER

Haworth

PROPOSED PERMIT FLOW =		0.155	MGD		1.0	CFS	UPSTREAM	FLOW				PROPOSED PERMIT FLOW =		0.155	MGD		-	CFS	UPSTREAM	FLOW			
					18	° C	TEMPERATURE										18	° C	TEMPERATURE				
INITIAL CONDITIONS ARE AS FOLLOWS.....												INITIAL CONDITIONS ARE AS FOLLOWS.....											
REACH LENGTH (MILES):		1.10										REACH LENGTH (MILES):		1.10									
NUMBER OF SEGMENTS:		40		STREAM VELOCITY:		4.11	MILES/DAY					NUMBER OF SEGMENTS:		40		STREAM VELOCITY:		4.11	MILES/DAY				
NUMBER OF REACHES:		1		STREAM DEPTH:		0.35	FEET					NUMBER OF REACHES:		1		STREAM DEPTH:		0.35	FEET				
REACH NUMBER:		1		REACH CL CONC:		150.0	MG/L					REACH NUMBER:		1		REACH CL CONC:		150.0	MG/L				
BODU/CBOD5 RATIO:		2.30		D.O. SATURATION:		9.45	MG/L					BODU/CBOD5 RATIO:		2.30		D.O. SATURATION:		9.45	MG/L				
NODU/CBOD5 RATIO:		4.30		D.O. TARGET:		6.00	MG/L					NODU/CBOD5 RATIO:		4.30		D.O. TARGET:		2.00	MG/L				
EFFLUENT FLOW:		0.16	MGD	UPSTREAM FLOW:		0.65	MGD					EFFLUENT FLOW:		0.16	MGD	UPSTREAM FLOW:		0.65	MGD				
EFFLUENT CBOD5:		25.0	MG/L	UPSTREAM CBOD5:		2.00	MG/L					EFFLUENT CBOD5:		25.0	MG/L	UPSTREAM CBOD5:		2.00	MG/L				
EFFLUENT NH3N:		15.0	MG/L	UPSTREAM NH3N:		0.15	MG/L					EFFLUENT NH3N:		15.0	MG/L	UPSTREAM NH3N:		0.15	MG/L				
EFFLUENT D.O.:		2.0	MG/L	UPSTREAM D.O.:		8.03	MG/L					EFFLUENT D.O.:		2.0	MG/L	UPSTREAM D.O.:		8.03	MG/L				
RATE CONSTANTS(1/DAY, BASE E)				20	DEGREES	18	DEGREES	THETA				RATE CONSTANTS(1/DAY, BASE E)				20	DEGREES	18	DEGREES	THETA			
K1:				0.35		0.32		1.047				K1:				0.35		0.32		1.047			
K2:	TURNEY-HARRIS			10.47		9.99		1.024				K2:	TURNEY-HARRIS			-		-		1.024			
KN:				0.30		0.26		1.073				KN:				0.30		0.26		1.073			
KS:				0.05		0.05		1.024				KS:				0.05		0.05		1.024			
SOD	(G/FT2/DAY):			0.15		0.13		1.060				SOD	(G/FT2/DAY):			0.15		0.13		1.060			
RESULTS ARE AS FOLLOWS....												RESULTS ARE AS FOLLOWS....											

DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)	DISTANCE (MILES)	CBOD5 (MG/L)	ULT BOD (MG/L)	NH3-N (MG/L)	ULT NOD (MG/L)	D.O. (MG/L)	FLOW (MGD)
0.00	6.45	14.84	3.02	13.00	6.87	0.80	0.00	-	-	-	-	-	-
0.03	6.43	14.80	3.02	12.98	6.89	0.80	0.03	-	-	-	-	-	-
0.06	6.42	14.76	3.01	12.96	6.92	0.80	0.06	-	-	-	-	-	-
0.08	6.40	14.73	3.01	12.93	6.95	0.80	0.08	-	-	-	-	-	-
0.11	6.39	14.69	3.00	12.91	6.97	0.80	0.11	-	-	-	-	-	-
0.14	6.37	14.66	3.00	12.89	6.99	0.80	0.14	-	-	-	-	-	-
0.17	6.36	14.62	2.99	12.87	7.01	0.80	0.17	-	-	-	-	-	-
0.19	6.34	14.58	2.99	12.84	7.03	0.80	0.19	-	-	-	-	-	-
0.22	6.33	14.55	2.98	12.82	7.05	0.80	0.22	-	-	-	-	-	-
0.25	6.31	14.51	2.98	12.80	7.07	0.80	0.25	-	-	-	-	-	-
0.28	6.29	14.48	2.97	12.78	7.08	0.80	0.28	-	-	-	-	-	-
0.30	6.28	14.44	2.97	12.75	7.10	0.80	0.30	-	-	-	-	-	-
0.33	6.26	14.41	2.96	12.73	7.11	0.80	0.33	-	-	-	-	-	-
0.36	6.25	14.37	2.96	12.71	7.13	0.80	0.36	-	-	-	-	-	-
0.39	6.23	14.34	2.95	12.69	7.14	0.80	0.39	-	-	-	-	-	-
0.41	6.22	14.30	2.95	12.67	7.15	0.80	0.41	-	-	-	-	-	-
0.44	6.20	14.27	2.94	12.64	7.16	0.80	0.44	-	-	-	-	-	-
0.47	6.19	14.23	2.94	12.62	7.17	0.80	0.47	-	-	-	-	-	-
0.50	6.17	14.20	2.93	12.60	7.18	0.80	0.50	-	-	-	-	-	-
0.52	6.16	14.16	2.93	12.58	7.19	0.80	0.52	-	-	-	-	-	-
0.55	6.14	14.13	2.92	12.56	7.20	0.80	0.55	-	-	-	-	-	-
0.58	6.13	14.09	2.91	12.53	7.21	0.80	0.58	-	-	-	-	-	-
0.61	6.11	14.06	2.91	12.51	7.22	0.80	0.61	-	-	-	-	-	-
0.63	6.10	14.02	2.90	12.49	7.23	0.80	0.63	-	-	-	-	-	-
0.66	6.08	13.99	2.90	12.47	7.24	0.80	0.66	-	-	-	-	-	-
0.69	6.07	13.95	2.89	12.45	7.24	0.80	0.69	-	-	-	-	-	-
0.72	6.05	13.92	2.89	12.43	7.25	0.80	0.72	-	-	-	-	-	-
0.74	6.04	13.89	2.88	12.40	7.26	0.80	0.74	-	-	-	-	-	-
0.77	6.02	13.85	2.88	12.38	7.26	0.80	0.77	-	-	-	-	-	-
0.80	6.01	13.82	2.87	12.36	7.27	0.80	0.80	-	-	-	-	-	-
0.83	5.99	13.78	2.87	12.34	7.27	0.80	0.83	-	-	-	-	-	-
0.85	5.98	13.75	2.86	12.32	7.28	0.80	0.85	-	-	-	-	-	-
0.88	5.96	13.72	2.86	12.30	7.28	0.80	0.88	-	-	-	-	-	-
0.91	5.95	13.68	2.85	12.28	7.29	0.80	0.91	-	-	-	-	-	-
0.94	5.93	13.65	2.85	12.25	7.29	0.80	0.94	-	-	-	-	-	-
0.96	5.92	13.62	2.84	12.23	7.30	0.80	0.96	-	-	-	-	-	-
0.99	5.91	13.58	2.84	12.21	7.30	0.80	0.99	-	-	-	-	-	-
1.02	5.89	13.55	2.83	12.19	7.31	0.80	1.02	-	-	-	-	-	-
1.05	5.88	13.52	2.83	12.17	7.31	0.80	1.05	-	-	-	-	-	-
1.07	5.86	13.48	2.82	12.15	7.31	0.80	1.07	-	-	-	-	-	-
1.10	5.85	13.45	2.82	12.13	7.32	0.80	1.10	-	-	-	-	-	-