Draft Wasteload Allocation Report For

Logan County Rural Water District #1

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1. Problem Definition

The Logan County, Rural Water, Sewer and Solid Waste Management District No. 1 (RWD#1) requests a sewer discharge permit for a property located northwest of the intersection of Waterloo Road and I35 in Logan County. The Logan County RWD#1 currently has operating lagoons that are near maximum capacity located several miles north of this property. Due the increasing demand for services and infrastructure in the area, the Logan County RWD#1 plans to add a sewer treatment facility to better service the growing community. The discharge would flow into an unnamed tributary of Cowbell Creek (OK520710010110_00), approximately 0.5 river mile above its confluence with the Cowbell Creek. Based on the projected population growth and to ensure compliance with DEQ standards, the Logan County RWD#1 requested a discharge flow of **0.225 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). Cowbell Creek is listed in the Oklahoma Water Quality Standards as having the following beneficial uses:

- Fish and Wildlife Propagation-Warm Water Aquatic Community
- Primary Body Contact Recreation
- Fish Consumption
- Agriculture
- Aesthetics

According to the Oklahoma 2014 303(d) list, Cowbell Creek has not been assessed of the above designated beneficial uses. Only the WWAC beneficial use is addressed in this report.

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).

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): 5.0 mg/L

Since no flow or water quality data were available for Cowbell 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 Cowbell creek since no data are available flow data.

Oklahoma's 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

Logan County RWD#1 Wastewater Treatment Facility

Facility Legal Description: SE1/4, SW1/4, S33, T15N, R2W, IM, Logan County, OK
(35°43'35.05"N, 97°25'05.67"W)

Discharge Location: SE1/4, SW1/4, S33, T15N, R2W, IM, Logan County, OK
(35°43'32.37"N, 97°25'03.22"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 Cowbell 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: 0.225 MGD
CBOD decay rate (**K_1**): 0.35/day
Reaeration rate (**K_2**): 14.51/day
NBOD decay rate (**K_n**): 0.30/day
CBOD settling rate (**K_s**): 0.03-0.05/day
Sediment Oxygen Demand (**SOD**): 0.080- 0.149 g/ft^2/day

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

Stream Slope: 21.20 ft/mi
Side Slope: 0.10 ft/ft
Manning's "n": 0.10

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

Table 1. Maximum Assimilative Capacity

Season	Maximum Assimilative Capacity **DO** (lbs/day)
Summer (Jun–Oct)	359.27
Spring (Apr–May)	275.41
Winter (Nov–Mar)	1365.46

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 Logan County RWD#1 WWTP discharge. The allocation of loads calculated by the desktop model is shown in the following **Table 2.**

Table 2. Allocations for DO

Season	Load Allocation (lb/day)	Wasteload Allocation (lb/day)	MOS (20%) (lb/day)	Reserved Capacity (lb/day)
Summer	171.2	108.3	71.9	8.0
Spring	43.2	134.2	55.1	42.9
Winter	49.7	198.7	273.1	843.9

7. Final Recommendations

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

Logan County RWD#1 Wastewater Treatment Facility Limits

Proposed Design Flow:	0.225 MGD
Summer (Jun–Oct):	12.0 mg/l $CBOD_5$; 7.0 mg/l NH_3; 5.0 mg/l DO
Spring (April–May):	18.0 mg/l $CBOD_5$; 7.0 mg/l NH_3; 4.0 mg/l DO
Winter (Nov–Mar):	18.0 mg/l $CBOD_5$; 30 mg/l TSS (Secondary Treatment)

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 Logan County RWD#1, 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 Logan County RWD#1 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 Cowbell Creek as well as in Cowbell 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. Logan County RWD#1 WWTF Receiving Stream (Overview)

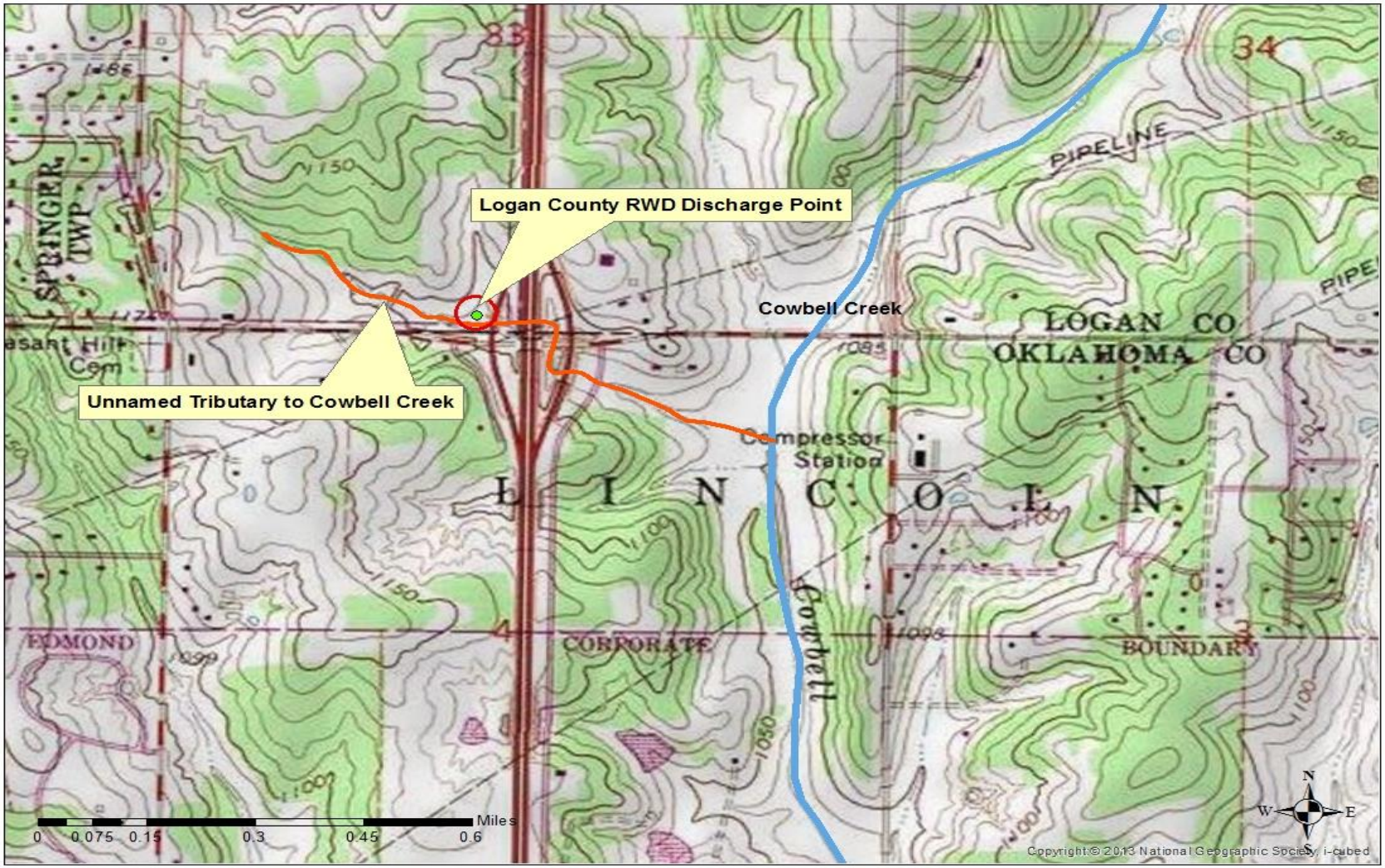


Figure 2. Logan County RWD#1 WWTF Receiving Stream (Detailed View)

Appendix A - Desktop Model

INPUT PARAMETERS FOR MODIFIED STREETER-PHELPS MODEL

		CITY:		Logan County Rural Water District #1							
		PERFORMED BY:		Ying							
		DATE:		12/8/2017							
I	**DISCHARGE INFORMATION**										
	LOCATION:	SE 1/4-23-T8S-R25E				BASIN:	520710				
	COUNTY:	LOGAN									
	PROPOSED PERMIT FLOW:	Summer	Spring	Winter							
		0.225	0.225	0.225	MGD						
II	**RECEIVING STREAM**										
	STREAM NAME	Unamed Tributary/Cowbell Creek									
	MODELED LENGTH	4.20	MILES			NUMBER OF SEGMENTS	40				
			Summer	Spring	Winter						
	UPSTREAM FLOW (7Q2)		1.00	1.00	1.00	CFS					
	STREAM SLOPE (S)		21.20			FT/MILE					
	SIDE SLOPE (P)		0.10			FT/FT					
	MANNING'S N		0.10								
	VELOCITY COEFFICIENT (Cv)		2.178								
	DEPTH COEFFICIENT (Ch)		0.164								

		Summer		Spring		Winter	
Upstream Flow 7Q2 (cfs)	Velocity (fps)	1.0	0.40	1.0	0.40	1.0	0.40
	Depth (ft)		0.29		0.29		0.29
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	5.00	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	
REAERATION RATES (K2)	UPSTREAM FLOW 1.0 (cfs)	-	UPSTREAM FLOW 1.0 (cfs)	-	UPSTREAM FLOW 1.0 (cfs)	-
1). TURNEY-HARRIS						
K2=1.33*S^0.32/n^0.64	15.43	-	15.43	-	15.43	-
2). TEXAS						
K2=4.022*V^0.273/H^0.894	9.53	-	9.53	-	9.53	-

	Flag	Formula	Flag	Formula	Flag	Formula
SELECTTED K2 FORMULA	1	TURNEY-HARRIS	1	TURNEY-HARRIS	1	TURNEY-HARRIS
	15.43	-	15.43	-	15.43	-

		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	0.080	0.105	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	12.0	7.0	5.0	32	- MG/L	5.78 MG/L	YES
SPRING	18.0	7.0	4.0	25	- MG/L	6.23 MG/L	YES
WINTER	18.0	15.0	2.0	18	- MG/L	6.47 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	12.0	7.0	5.0	1.74
SPRING	18.0	7.0	4.0	1.73
WINTER	18.0	15.0	2.0	6.62

Margin Of Safety
Required MOS
20.0%

Maximum Wasteload Allocations

	Maximum Wasteload (lbs/day)
	Dissolved Oxygen
SUMMER	188.1
SPRING	232.2
WINTER	1315.8

Maximum Assimilative Capacity

	Max Assimilative Capacity (lbs/day)
	Dissolved Oxygen
SUMMER	359.27
SPRING	275.41
WINTER	1365.46

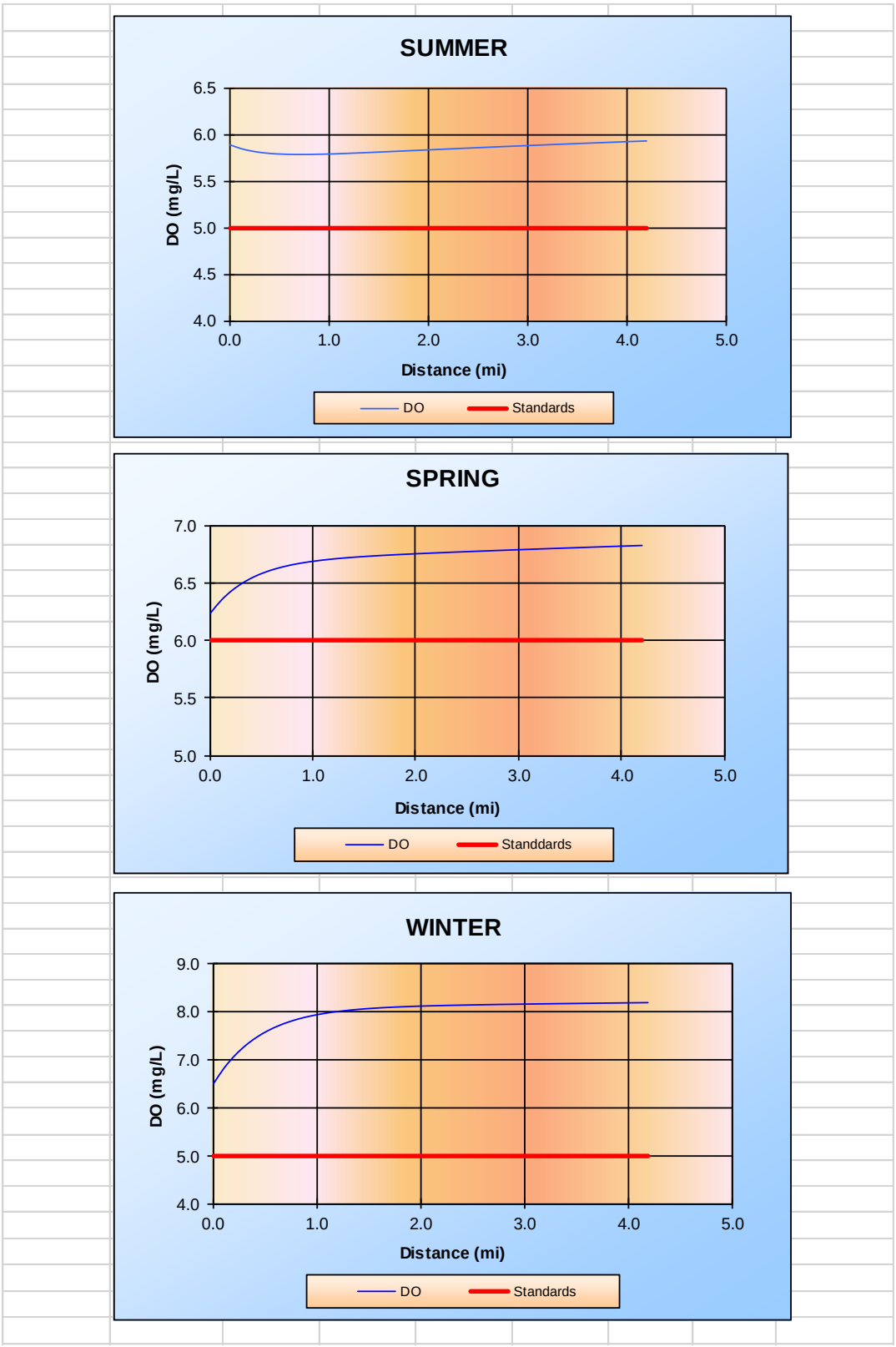
Allocations (in Dissolved Oxygen)

SEASON	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin Of Safety (20%) (lbs/day)	Reserved Capacity (lbs/day)
SUMMER	171.2	108.3	71.9	8.0
SPRING	43.2	134.2	55.1	42.9
WINTER	49.7	198.7	273.1	843.9

Locations of D.O. Sags

	MINIMUM D.O. 0.0 CFS	RIVER MILE	MINIMUM D.O. 1.0 CFS	RIVER MILE
SUMMER	- MG/L	-	5.78 MG/L	0.74
SPRING	- MG/L	-	6.23 MG/L	0.00
WINTER	- MG/L	-	6.47 MG/L	0.00

Plots for 7Q2 Headwater Flow:



OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

DESKTOP WASTELOAD ANALYSIS - SUMMER

Logan County Rural Water District #1

PROPOSED PERMIT FLOW =	0.225	MGD		1.0	CFS UPSTREAM FLOW							PROPOSED PERMIT FLOW =	0.225	MGD		-	CFS UPSTREAM FLOW						
				32	° C TEMPERATURE											32	° C TEMPERATURE						
INITIAL CONDITIONS ARE AS FOLLOWS.....												INITIAL CONDITIONS ARE AS FOLLOWS.....											
REACH LENGTH (MILES):	4.20											REACH LENGTH (MILES):	4.20										
NUMBER OF SEGMENTS:	40			STREAM VELOCITY:	6.61	MILES/DAY						NUMBER OF SEGMENTS:	40			STREAM VELOCITY:	6.61	MILES/DAY					
NUMBER OF REACHES:	1			STREAM DEPTH:	0.29	FEET						NUMBER OF REACHES:	1			STREAM DEPTH:	0.29	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:	0.23	MGD		UPSTREAM FLOW:	0.65	MGD						EFFLUENT FLOW:	0.23	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:	7.0	MG/L		UPSTREAM NH3N:	0.15	MG/L						EFFLUENT NH3N:	7.0	MG/L		UPSTREAM NH3N:	0.15	MG/L					
EFFLUENT D.O.:	5.0	MG/L		UPSTREAM D.O.:	6.20	MG/L						EFFLUENT D.O.:	5.0	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			15.43				20.51		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):			0.08				0.16		1.060		SOD	(G/FT2/DAY):			0.08				0.16		1.060	
RESULTS ARE AS FOLLOWS....												RESULTS ARE AS FOLLOWS....											

DISTANCE	CBOD5	ULT BOD	NH3-N	ULT NOD	D.O.	FLOW
(MILES)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MGD)
0.00	4.58	10.54	1.92	8.25	5.89	0.87
0.11	4.54	10.43	1.90	8.16	5.85	0.87
0.21	4.49	10.33	1.88	8.07	5.82	0.87
0.32	4.44	10.22	1.86	7.98	5.80	0.87
0.42	4.40	10.12	1.84	7.90	5.79	0.87
0.53	4.35	10.01	1.82	7.81	5.78	0.87
0.63	4.31	9.91	1.80	7.72	5.78	0.87
0.74	4.27	9.81	1.78	7.64	5.78	0.87
0.84	4.22	9.71	1.76	7.55	5.78	0.87
0.95	4.18	9.61	1.74	7.47	5.78	0.87
1.05	4.14	9.51	1.72	7.39	5.79	0.87
1.16	4.09	9.41	1.70	7.31	5.79	0.87
1.26	4.05	9.32	1.68	7.22	5.79	0.87
1.37	4.01	9.22	1.66	7.15	5.80	0.87
1.47	3.97	9.13	1.64	7.07	5.80	0.87
1.58	3.93	9.04	1.63	6.99	5.81	0.87
1.68	3.89	8.94	1.61	6.91	5.81	0.87
1.79	3.85	8.85	1.59	6.84	5.82	0.87
1.89	3.81	8.76	1.57	6.76	5.82	0.87
2.00	3.77	8.67	1.55	6.69	5.83	0.87
2.10	3.73	8.58	1.54	6.61	5.84	0.87
2.21	3.69	8.50	1.52	6.54	5.84	0.87
2.31	3.66	8.41	1.50	6.47	5.85	0.87
2.42	3.62	8.32	1.49	6.39	5.85	0.87
2.52	3.58	8.24	1.47	6.32	5.86	0.87
2.63	3.54	8.15	1.45	6.25	5.86	0.87
2.73	3.51	8.07	1.44	6.19	5.87	0.87
2.84	3.47	7.99	1.42	6.12	5.87	0.87
2.94	3.44	7.91	1.41	6.05	5.88	0.87
3.05	3.40	7.82	1.39	5.98	5.88	0.87
3.15	3.37	7.74	1.38	5.92	5.89	0.87
3.26	3.33	7.67	1.36	5.85	5.89	0.87
3.36	3.30	7.59	1.35	5.79	5.89	0.87
3.47	3.27	7.51	1.33	5.72	5.90	0.87
3.57	3.23	7.43	1.32	5.66	5.90	0.87
3.68	3.20	7.36	1.30	5.60	5.91	0.87
3.78	3.17	7.28	1.29	5.54	5.91	0.87
3.89	3.13	7.21	1.27	5.47	5.92	0.87
3.99	3.10	7.13	1.26	5.41	5.92	0.87
4.10	3.07	7.06	1.25	5.35	5.93	0.87
4.20	3.04	6.99	1.23	5.30	5.93	0.87

DISTANCE	CBOD5	ULT BOD	NH3-N	ULT NOD	D.O.	FLOW
(MILES)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MG/L)	(MGD)
0.00	-	-	-	-	-	-
0.11	-	-	-	-	-	-
0.21	-	-	-	-	-	-
0.32	-	-	-	-	-	-
0.42	-	-	-	-	-	-
0.53	-	-	-	-	-	-
0.63	-	-	-	-	-	-
0.74	-	-	-	-	-	-
0.84	-	-	-	-	-	-
0.95	-	-	-	-	-	-
1.05	-	-	-	-	-	-
1.16	-	-	-	-	-	-
1.26	-	-	-	-	-	-
1.37	-	-	-	-	-	-
1.47	-	-	-	-	-	-
1.58	-	-	-	-	-	-
1.68	-	-	-	-	-	-
1.79	-	-	-	-	-	-
1.89	-	-	-	-	-	-
2.00	-	-	-	-	-	-
2.10	-	-	-	-	-	-
2.21	-	-	-	-	-	-
2.31	-	-	-	-	-	-
2.42	-	-	-	-	-	-
2.52	-	-	-	-	-	-
2.63	-	-	-	-	-	-
2.73	-	-	-	-	-	-
2.84	-	-	-	-	-	-
2.94	-	-	-	-	-	-
3.05	-	-	-	-	-	-
3.15	-	-	-	-	-	-
3.26	-	-	-	-	-	-
3.36	-	-	-	-	-	-
3.47	-	-	-	-	-	-
3.57	-	-	-	-	-	-
3.68	-	-	-	-	-	-
3.78	-	-	-	-	-	-
3.89	-	-	-	-	-	-
3.99	-	-	-	-	-	-
4.10	-	-	-	-	-	-
4.20	-	-	-	-	-	-

DESKTOP WASTELOAD ANALYSIS - SPRING

Logan County Rural Water District #1

PROPOSED PERMIT FLOW =			0.225	MGD			1.0	CFS UPSTREAM FLOW					PROPOSED PERMIT FLOW =			0.225	MGD		-	CFS UPSTREAM FLOW
							25	° C TEMPERATURE											25	° C TEMPERATURE
INITIAL CONDITIONS ARE AS FOLLOWS.....													INITIAL CONDITIONS ARE AS FOLLOWS.....							
REACH LENGTH (MILES):			4.20										REACH LENGTH (MILES):			4.20				
NUMBER OF SEGMENTS:			40		STREAM VELOCITY:			6.61	MILES/DAY				NUMBER OF SEGMENTS:			40		STREAM VELOCITY:		6.61	MILES/DAY
NUMBER OF REACHES:			1		STREAM DEPTH:			0.29	FEET				NUMBER OF REACHES:			1		STREAM DEPTH:		0.29	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:			0.23	MGD		UPSTREAM FLOW:			0.65	MGD			EFFLUENT FLOW:			0.23	MGD		UPSTREAM FLOW:		0.65	MGD
EFFLUENT CBOD5:			18.0	MG/L		UPSTREAM CBOD5:			2.00	MG/L			EFFLUENT CBOD5:			18.0	MG/L		UPSTREAM CBOD5:		2.00	MG/L
EFFLUENT NH3N:			7.0	MG/L		UPSTREAM NH3N:			0.15	MG/L			EFFLUENT NH3N:			7.0	MG/L		UPSTREAM NH3N:		0.15	MG/L
EFFLUENT D.O.:			4.0	MG/L		UPSTREAM D.O.:			7.01	MG/L			EFFLUENT D.O.:			4.0	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				15.43			17.37		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):				0.11			0.14		1.060			SOD	(G/FT2/DAY):					0.11			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)
0.00	6.13	14.11	1.92	8.25	6.23	0.87
0.11	6.09	14.00	1.91	8.20	6.35	0.87
0.21	6.04	13.90	1.89	8.14	6.43	0.87
0.32	6.00	13.79	1.88	8.09	6.50	0.87
0.42	5.95	13.69	1.87	8.03	6.55	0.87
0.53	5.91	13.59	1.86	7.98	6.59	0.87
0.63	5.86	13.48	1.84	7.93	6.62	0.87
0.74	5.82	13.38	1.83	7.87	6.65	0.87
0.84	5.77	13.28	1.82	7.82	6.67	0.87
0.95	5.73	13.18	1.81	7.77	6.68	0.87
1.05	5.69	13.08	1.79	7.71	6.70	0.87
1.16	5.65	12.99	1.78	7.66	6.71	0.87
1.26	5.60	12.89	1.77	7.61	6.72	0.87
1.37	5.56	12.79	1.76	7.56	6.72	0.87
1.47	5.52	12.70	1.75	7.51	6.73	0.87
1.58	5.48	12.60	1.73	7.46	6.74	0.87
1.68	5.44	12.51	1.72	7.41	6.74	0.87
1.79	5.40	12.41	1.71	7.36	6.75	0.87
1.89	5.36	12.32	1.70	7.31	6.75	0.87
2.00	5.32	12.23	1.69	7.26	6.76	0.87
2.10	5.28	12.13	1.68	7.21	6.76	0.87
2.21	5.24	12.04	1.66	7.16	6.76	0.87
2.31	5.20	11.95	1.65	7.11	6.77	0.87
2.42	5.16	11.86	1.64	7.06	6.77	0.87
2.52	5.12	11.77	1.63	7.02	6.78	0.87
2.63	5.08	11.69	1.62	6.97	6.78	0.87
2.73	5.04	11.60	1.61	6.92	6.78	0.87
2.84	5.01	11.51	1.60	6.87	6.79	0.87
2.94	4.97	11.43	1.59	6.83	6.79	0.87
3.05	4.93	11.34	1.58	6.78	6.79	0.87
3.15	4.89	11.25	1.57	6.74	6.80	0.87
3.26	4.86	11.17	1.56	6.69	6.80	0.87
3.36	4.82	11.09	1.55	6.65	6.80	0.87
3.47	4.78	11.00	1.53	6.60	6.81	0.87
3.57	4.75	10.92	1.52	6.56	6.81	0.87
3.68	4.71	10.84	1.51	6.51	6.81	0.87
3.78	4.68	10.76	1.50	6.47	6.82	0.87
3.89	4.64	10.68	1.49	6.42	6.82	0.87
3.99	4.61	10.60	1.48	6.38	6.82	0.87
4.10	4.57	10.52	1.47	6.34	6.83	0.87
4.20	4.54	10.44	1.46	6.29	6.83	0.87

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	-	-	-	-	-	-
0.11	-	-	-	-	-	-
0.21	-	-	-	-	-	-
0.32	-	-	-	-	-	-
0.42	-	-	-	-	-	-
0.53	-	-	-	-	-	-
0.63	-	-	-	-	-	-
0.74	-	-	-	-	-	-
0.84	-	-	-	-	-	-
0.95	-	-	-	-	-	-
1.05	-	-	-	-	-	-
1.16	-	-	-	-	-	-
1.26	-	-	-	-	-	-
1.37	-	-	-	-	-	-
1.47	-	-	-	-	-	-
1.58	-	-	-	-	-	-
1.68	-	-	-	-	-	-
1.79	-	-	-	-	-	-
1.89	-	-	-	-	-	-
2.00	-	-	-	-	-	-
2.10	-	-	-	-	-	-
2.21	-	-	-	-	-	-
2.31	-	-	-	-	-	-
2.42	-	-	-	-	-	-
2.52	-	-	-	-	-	-
2.63	-	-	-	-	-	-
2.73	-	-	-	-	-	-
2.84	-	-	-	-	-	-
2.94	-	-	-	-	-	-
3.05	-	-	-	-	-	-
3.15	-	-	-	-	-	-
3.26	-	-	-	-	-	-
3.36	-	-	-	-	-	-
3.47	-	-	-	-	-	-
3.57	-	-	-	-	-	-
3.68	-	-	-	-	-	-
3.78	-	-	-	-	-	-
3.89	-	-	-	-	-	-
3.99	-	-	-	-	-	-
4.10	-	-	-	-	-	-
4.20	-	-	-	-	-	-

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

DESKTOP WASTELOAD ANALYSIS - WINTER

Logan County Rural Water District #1

PROPOSED PERMIT FLOW =	0.225	MGD	1.0	CFS UPSTREAM FLOW			
			18	° C TEMPERATURE			
INITIAL CONDITIONS ARE AS FOLLOWS.....							
REACH LENGTH (MILES):	4.20						
NUMBER OF SEGMENTS:	40		STREAM VELOCITY:	6.61	MILES/DAY		
NUMBER OF REACHES:	1		STREAM DEPTH:	0.29	FEET		
REACH NUMBER:	1		REACH CL CONC:	150.0	MG/L		
BODU/CBOD5 RATIO:	2.30		D.O. SATURATION:	9.45	MG/L		
NODU/CBOD5 RATIO:	4.30		D.O. TARGET:	5.00	MG/L		
EFFLUENT FLOW:	0.23	MGD	UPSTREAM FLOW:	0.65	MGD		
EFFLUENT CBOD5:	18.0	MG/L	UPSTREAM CBOD5:	2.00	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		
RATE CONSTANTS(1/DAY, BASE E)			20 DEGREES	18 DEGREES		THETA	
K1:			0.35	0.32		1.047	
K2:	TURNEY-HARRIS		15.43	14.71		1.024	
KN:			0.30	0.26		1.073	
KS:			0.03	0.03		1.024	
SOD	(G/FT2/DAY):		0.11	0.09		1.060	

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)
0.00	6.13	14.11	3.99	17.14	6.47	0.87
0.11	6.10	14.03	3.97	17.07	6.81	0.87
0.21	6.07	13.95	3.95	17.00	7.07	0.87
0.32	6.03	13.87	3.94	16.93	7.28	0.87
0.42	6.00	13.80	3.92	16.86	7.44	0.87
0.53	5.97	13.72	3.90	16.79	7.58	0.87
0.63	5.93	13.65	3.89	16.72	7.68	0.87
0.74	5.90	13.57	3.87	16.65	7.76	0.87
0.84	5.87	13.50	3.86	16.58	7.83	0.87
0.95	5.84	13.42	3.84	16.51	7.88	0.87
1.05	5.80	13.35	3.82	16.45	7.93	0.87
1.16	5.77	13.27	3.81	16.38	7.96	0.87
1.26	5.74	13.20	3.79	16.31	7.99	0.87
1.37	5.71	13.13	3.78	16.24	8.01	0.87
1.47	5.68	13.06	3.76	16.18	8.03	0.87
1.58	5.65	12.98	3.75	16.11	8.05	0.87
1.68	5.61	12.91	3.73	16.04	8.06	0.87
1.79	5.58	12.84	3.72	15.98	8.07	0.87
1.89	5.55	12.77	3.70	15.91	8.08	0.87
2.00	5.52	12.70	3.68	15.84	8.09	0.87
2.10	5.49	12.63	3.67	15.78	8.09	0.87
2.21	5.46	12.56	3.65	15.71	8.10	0.87
2.31	5.43	12.49	3.64	15.65	8.10	0.87
2.42	5.40	12.42	3.62	15.58	8.11	0.87
2.52	5.37	12.35	3.61	15.52	8.11	0.87
2.63	5.34	12.29	3.59	15.46	8.12	0.87
2.73	5.31	12.22	3.58	15.39	8.12	0.87
2.84	5.28	12.15	3.56	15.33	8.12	0.87
2.94	5.25	12.08	3.55	15.27	8.13	0.87
3.05	5.23	12.02	3.54	15.20	8.13	0.87
3.15	5.20	11.95	3.52	15.14	8.13	0.87
3.26	5.17	11.89	3.51	15.08	8.14	0.87
3.36	5.14	11.82	3.49	15.01	8.14	0.87
3.47	5.11	11.76	3.48	14.95	8.14	0.87
3.57	5.08	11.69	3.46	14.89	8.14	0.87
3.68	5.05	11.63	3.45	14.83	8.15	0.87
3.78	5.03	11.56	3.43	14.77	8.15	0.87
3.89	5.00	11.50	3.42	14.71	8.15	0.87
3.99	4.97	11.44	3.41	14.65	8.15	0.87
4.10	4.94	11.37	3.39	14.59	8.16	0.87
4.20	4.92	11.31	3.38	14.53	8.16	0.87

PROPOSED PERMIT FLOW =	0.225	MGD	-	CFS UPSTREAM FLOW			
			18	° C TEMPERATURE			
INITIAL CONDITIONS ARE AS FOLLOWS.....							
REACH LENGTH (MILES):	4.20						
NUMBER OF SEGMENTS:	40		STREAM VELOCITY:	6.61	MILES/DAY		
NUMBER OF REACHES:	1		STREAM DEPTH:	0.29	FEET		
REACH NUMBER:	1		REACH CL CONC:	150.0	MG/L		
BODU/CBOD5 RATIO:	2.30		D.O. SATURATION:	9.45	MG/L		
NODU/CBOD5 RATIO:	4.30		D.O. TARGET:	2.00	MG/L		
EFFLUENT FLOW:	0.23	MGD	UPSTREAM FLOW:	0.65	MGD		
EFFLUENT CBOD5:	18.0	MG/L	UPSTREAM CBOD5:	2.00	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		
RATE CONSTANTS(1/DAY, BASE E)			20 DEGREES	18 DEGREES		THETA	
K1:			0.35	0.32		1.047	
K2:	TURNEY-HARRIS		-	-		1.024	
KN:			0.30	0.26		1.073	
KS:			0.03	0.03		1.024	
SOD	(G/FT2/DAY):		0.11	0.09		1.060	

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)
0.00	-	-	-	-	-	-
0.11	-	-	-	-	-	-
0.21	-	-	-	-	-	-
0.32	-	-	-	-	-	-
0.42	-	-	-	-	-	-
0.53	-	-	-	-	-	-
0.63	-	-	-	-	-	-
0.74	-	-	-	-	-	-
0.84	-	-	-	-	-	-
0.95	-	-	-	-	-	-
1.05	-	-	-	-	-	-
1.16	-	-	-	-	-	-
1.26	-	-	-	-	-	-
1.37	-	-	-	-	-	-
1.47	-	-	-	-	-	-
1.58	-	-	-	-	-	-
1.68	-	-	-	-	-	-
1.79	-	-	-	-	-	-
1.89	-	-	-	-	-	-
2.00	-	-	-	-	-	-
2.10	-	-	-	-	-	-
2.21	-	-	-	-	-	-
2.31	-	-	-	-	-	-
2.42	-	-	-	-	-	-
2.52	-	-	-	-	-	-
2.63	-	-	-	-	-	-
2.73	-	-	-	-	-	-
2.84	-	-	-	-	-	-
2.94	-	-	-	-	-	-
3.05	-	-	-	-	-	-
3.15	-	-	-	-	-	-
3.26	-	-	-	-	-	-
3.36	-	-	-	-	-	-
3.47	-	-	-	-	-	-
3.57	-	-	-	-	-	-
3.68	-	-	-	-	-	-
3.78	-	-	-	-	-	-
3.89	-	-	-	-	-	-
3.99	-	-	-	-	-	-
4.10	-	-	-	-	-	-
4.20	-	-	-	-	-	-