Tarrant Regional Water District
Watershed Project

Cedar Creek Reservoir
Wastewater Treatment Facilities Report

Evaluating Water Quality Management Practices for Reservoirs in North Central Texas

Revised

May 5, 2008

AgriLIFE RESEARCH
Texas A&M System

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS • DESIGNERS • SCIENTISTS

834-0101

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BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
CBOD	Carbonaceous Biological Oxygen Demand
DMR	Discharge Monitoring Reports
ENR	Engineering News Record
IP	Inorganic Phosphorous
MG	Millions of Gallons
MGD	Millions of Gallons per Day
NH3	Ammonia
NH3-N	Ammonia Nitrogen
NOx	Nitrogen Oxides
ON	Organic Nitrogen
OP	Organic Phosphorous
OPO_4	Ortho-Phosphate
OrgN	Organic Nitrogen
OrgP	Organic Phosphorous
SWD	Side Wall Depth
TCEQ	Texas Commission on Environmental Quality
TN	Total Nitrogen
TP	Total Phosphorous
TPDES	Texas Pollution Discharge Elimination System
TSS	Total Suspended Solids
UV	Ultra Violet
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Tarrant Regional Water District (District) provides raw water to numerous water suppliers in the North Texas area. The raw water originates in several of the District's reservoirs including Cedar Creek, Richland Chambers, and Eagle Mountain. As the demands for raw water increase, the need to protect the water quality becomes a critical issue. This report focuses on evaluating the various point sources of pollutants, particularly nutrients, into the Cedar Creek Reservoir watersheds. The objectives of the following report are to identify significant sources of pollutant sources, to quantify both current and long-term impacts, to evaluate the best management practices available for maintaining and improving water quality, and finally to address the costs of implementing those practices.

This report addresses the point sources, specifically wastewater treatment facilities, discharging directly into the Cedar Creek Reservoir through watershed streams that eventually enter the reservoir. Plants evaluated include:

- City of Athens' North Wastewater Treatment Plant
- Cherokee Shores Wastewater Treatment Facility
- East Cedar Creek Fresh Water Supply District North Wastewater Treatment Plant
- City of Eustace Wastewater Treatment Plant
- City of Kaufman Wastewater Treatment Plant
- City of Kemp Wastewater Treatment Plant
- City of Mabank Wastewater Treatment Plant
- City of Terrell King's Creek Wastewater Treatment Plant
- City of Will's Point Wastewater Treatment Plant

Figure ES-1 shows the locations of these plants within the Cedar Creek watershed. The evaluation of each facility included assessing the ability of each plant to properly treat projected 2050 flows under three varying discharge limit criteria. The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1.0 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reducing the phosphorus limit to 0.5 mg/L and total nitrogen to 5 mg/L. An assessment of facility needs is performed at all three effluent limitations for flows projected through 2050.

Sources of information for the evaluations included: site visits, interviews with the plant personnel, reviews of the existing plans and historical reports, data collected by plant personnel for the District, data acquired through Texas Commission on Environmental Quality (TCEQ), and responses to a questionnaire developed specifically for this project to aid in acquiring data and information on each plant. Each memorandum is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the existing treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

A brief summary of the assessment for each plant is provided in Table ES-1. Detailed evaluations of each plant are provided in the technical memoranda following this summary. Table ES-2 summarizes the costs associated with each of the expansions or upgrades and Table ES-3 examines the nitrogen and phosphorus loads that would be associated with the projected 2050 flows at each permit level. The average total nitrogen and total phosphorous concentrations that were determined as part of special nutrient testing were used to calculate the Level I loads at 2050 flows; this will best compare the impact of each permit level across time.

Figure ES-1
Cedar Creek Discharge Assessment
Wastewater Treatment Plant Locations

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
ATHENS CBOD = 10 mg/L (Mar. – Nov.) CBOD = 20 mg/L (Dec. – Feb.) TSS = 15 mg/L (Mar. – Nov.) TSS = 20 mg/L (Dec. – Feb.) NH_3 = 2 mg/L (Mar. – Nov.) NH_3 = 3 mg/L (Dec. – Feb.) Flow = 1.027 MGD	**North WWTP** 2005 = 0.50 2010 = 0.54 2020 = 0.65 2030 = 0.78 2040 = 0.94 2050 = 1.14 **West WWTP** 2005 = 0.74 2010 = 0.82 2020 = 0.98 2030 = 1.18 2040 = 1.42 2050 = 1.70	Bar screen, grit removal, Imhoff tanks, supernatant to tricking filters, aeration for six hours, final clarification, and chlorination. Sludge disposed on drying beds and periodically disposed of off-site.	Expand influent pumping system, replace tricking filter rock media with plastic media, duplicate aeration basin and aeration, and double drying bed size. Project cost: $3,428,914 Additional Annual O&M cost: $63,000	Add denitrifying filter to meet TN limit and alum addition for P removal. Increase in cost from Level I: $893,743 Increase in Annual O&M cost over Level I: $22,890	Add carbon source for denitrification, and increase alum dosage for lower P limit. Equipment is already in place. Increase in cost from Levels I and II: $76,507 Increase in Annual O&M cost over Levels I and II: $38,535
CHEROKEE SHORES BOD_5 = 10 mg/L TSS = 15 mg/L NH_3 = 5 mg/L TN = 20 mg/L TP = 2 mg/L Flow = 0.15 MGD	2005 = 0.08 2010 = 0.09 2020 = 0.11 2030 = 0.13 2040 = 0.15 2050 = 0.18	Equalization, activated sludge, final clarification, sand filtration, and chlorination. Sludge aerobically digested and disposed off-site.	Existing facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Add alum addition for P removal, a denitrifying filter for N reduction, and an in line mixer. Increase in cost over Level I: $592,351 Increase in Annual O&M cost over Level I: $13,020	Add carbon source for denitrification, and increase alum dosage for lower P limit. Increase in cost over Levels I and II: $64,915 Increase in Annual O&M cost over Levels I and II: $34,230

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
EAST CEDAR CREEK FWSD BOD_5 = 10 mg/L TSS = 15 mg/L Flow = 0.626 MGD	2005 = 0.71 2010 = 0.82 2020 = 1.00 2030 = 1.17 2040 = 1.36 2050 = 1.60	Treatment facility currently under expansion. Bar screen, two oxidation ditches w/ RAS, final clarification, sand filtration, and chlorination. Sludge is dried and landfilled.	Once treatment units are optimized, expansion required between 2030 and 2040. Add oxidation ditch, clarifier, filter, and chlorine contact basin. Project cost: $4,915,008 Additional Annual O&M cost: $63,000	Operate oxidation ditch for de-nitrification. Alum addition for P removal. Increase in cost from Level I: $127,512 Increase in Annual O&M cost over Level I: $5,775	Denitrifying filter to meet TN limit. Add carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $912,290 Increase in Annual O&M cost over Levels I and II: $89,040

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
EUSTACE BOD_5 = 30 mg/L TSS = 90 mg/L Flow = 0.125 MGD	2005 = 0.084 2010 = 0.088 2020 = 0.097 2030 = 0.106 2040 = 0.115 2050 = 0.126	Bar screen, oxidation ditch w/o RAS as pre-aeration basins, two stabilization ponds w/ 21-day detention time. Disinfection not required.	Add two 15 hp aerators, clarifier, RAS/WAS pumps and piping, and disinfection system Project cost: $217,930 Additional Annual O&M cost: $63,000	Add alum for P removal. Increase in cost from Level I: $51,005 Increase in Annual O&M cost over Level I: $4,683	Denitrifying filter to meet TN limit, and additional carbon source for denitrification. Additional alum for lower P limit. Increase in cost from Levels I and II: $549,461 Increase in Annual O&M cost over Levels I and II: $30,030

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
KAUFMAN CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 3 mg/L (May – Oct.) NH_3 = 5 mg/L (Nov. – Apr.) Flow = 1.2 MGD	2005 = 0.73 2010 = 0.83 2020 = 1.09 2030 = 1.30 2040 = 1.47 2050 = 1.65	Bar screen, grit removal, storm water holding basins, two aeration basins w/ RAS, two final clarifiers, sand filtration and ultraviolet disinfection. Sludge belt press and lime blending. Sludge disposed offsite	Convert existing aeration system to fine bubble diffusers instead of adding aeration basins. Expand WAS and RAS system. Add IFAS to aeration basins, add final clarifier, and additional ultraviolet disinfection equipment. Project cost: $2,088,878 Additional Annual O&M cost: $127,470	Denitrifying filter to meet TN limit. Alum addition required for P removal. Increase in cost from Level I: $1,659,974 Increase in Annual O&M cost over Level I: $6,930	Add carbon source for denitrification, and additional alum for lower P limit. Increase in cost from Levels I and II: $92,736 Increase in Annual O&M cost over Levels I and II: $55,440
KEMP CBOD = 5 mg/L TSS = 5 mg/L NH_3 = 2.0 mg/L Flow = 0.2 MGD	2005 = 0.113 2010 = 0.113 2020 = 0.113 2030 = 0.113 2040 = 0.113 2050 = 0.113	Bar screen, grit removal, oxidation ditch w/ RAS, two final clarifiers, and chlorination. Sludge drying beds.	Existing facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Operate oxidation ditch for denitrification. Alum addition for P removal. May require additional drying beds for alum sludge. Increase in cost from Level I: $51,005 Increase in Annual O&M cost over Level I: $4,442	Add denitrifying filter to meet TN limit, carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $537,869 Increase in Annual O&M cost over Levels I and II: $21,630

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
MABANK CBOD = 30 mg/L TSS = 90 mg/L NH_3 = 2 mg/L Flow = 0.4 MGD	2005 = 0.24 2010 = 0.27 2020 = 0.33 2030 = 0.38 2040 = 0.44 2050 = 0.52	Bar screen, grit removal, oxidation ditch w/o RAS followed by three stabilization ponds, and a nitrifying bio-tower. Disinfection not required. Sludge is periodically dredged from the ponds and disposed offsite.	Expansion required between 2030 and 2040. Expand headworks and pumping capacity. Add aerators to stabilization ponds and uprate the bio-tower. Add chlorine disinfection and drying beds. Project cost: $635,242 Additional Annual O&M cost: $98,700	Maintain pond volume for N removal and add alum for P removal. Increase in cost from Level I: $127,512 Increase in Annual O&M cost over Level I: $5,355	Add denitrifying filter to meet TN limit, carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $835,783 Increase in Annual O&M cost over Levels I and II: $31,290
TERRELL CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 6.0 mg/L Flow = 4.5 MGD	2005 = 3.23 2010 = 3.42 2020 = 4.19 2030 = 4.87 2040 = 5.32 2050 = 5.76 [3]	Flow equalization, bar screen, grit removal, primary clarification, two-stage trickling filter, final clarification, with chlorination and de-chlorination. Portable belt press solids dewatering.	Expansion required between 2020 and 2030. Add additional headworks with screens and grit removal. Add influent pump capacity, Sequencing Batch Reactors and sand filters. Expand chlorine contact basin and add gravity belt thickener. Project cost: $7,416,562 Additional Annual O&M cost: $101,115	Add denitrifying filters to existing treatment train. Optimize SBRs for de-nitrification. Alum addition for P removal. Increase in cost from Level I: $3,192,437 Increase in Annual O&M cost over Level I: $15,855	Carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $146,059 Increase in Annual O&M cost over Levels I and II: $178,500

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
WILLS POINT Present BOD_5 = 30 mg/L TSS = 90 mg/L Flow = 0.51 MGD Planned CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 3 mg/L Flow = 0.80 MGD	2005 = 0.37 2010 = 0.39 2020 = 0.42 2030 = 0.46 2040 = 0.48 2050 = 0.51	Two new stabilization ponds are currently under expansion. Bar screen, two facultative lagoons, three stabilization ponds exist. Disinfection not required. Sludge is periodically dredged from the ponds and disposed offsite.	Once current expansion is complete, facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Operate ponds for de-nitrification, and dredge ponds to maintain volume. Add earthen pond divider. Alum addition for P removal. Increase in cost from Level I: $231,840 Increase in Annual O&M cost over Level I: $4,935	Denitrifying filter to meet TN limit., with possible additional carbon source. Additional alum for lower P limit. Increase in cost from Levels I and II: $835,783 Increase in Annual O&M cost over Levels I and II: $31,290

[1] Flow projections based on TWDB population projections and 100 gpcd unless otherwise noted.
[2] Level II O&M costs are in addition to current operating costs.
[3] Level III capital costs are in addition to Level I costs. Level III capital costs are in addition to Level I and Level II costs.

The initial opinion of costs presented herein represents a Class 5 estimate based upon ANSI Standard Reference Z94.2-1989 and AACE International Recommended Practice No. 17R-97.

Table ES-2: Comparison of Costs for Each Plant's Expansion or Upgrade

City or Facility	*Costs Associated with Upgrades*		
	Level I	**Level II**	**Level III**
Athens	$3,428,914	$893,743	$76,507
Cherokee Shores	$0	$592,351	$64,915
East Cedar Creek	$4,915,008	$127,512	$912,290
Eustace	$217,930	$51,005	$549,461
Kaufman	$2,088,878	$1,659,974	$92,736
Kemp	$0	$51,005	$537,869
Mabank	$635,242	$127,512	$835,783
Terrell	$7,416,562	$3,192,437	$146,059
Wills Point	$0	$231,840	$835,783
Total Costs	**$18,702,534**	**$6,927,379**	**$4,051,403**

Table ES-3: Nutrient Loads in Lbs/day and Tons/year for Each Plant at Each Permit Level

City or Facility	*Loads Associated with 2050 Flows (lbs/day)*						*Loads Associated with 2050 Flows (tons/yr)*					
	Total Nitrogen			**Total Phosphorous**			**Total Nitrogen**			**Total Phosphorous**		
	Level I*	**Level II**	**Level III**	**Level I***	**Level II**	**Level III**	**Level I**	**Level II**	**Level III**	**Level I**	**Level II**	**Level III**
Athens	129	95	48	27	10	5	23	17	9	5	2	1
Cherokee Shores	57	15	8	6	2	0.8	10	3	1	1	0.27	0.14
East Cedar Creek	312	133	67	29	13	7	57	24	12	5	2	1
Eustace	25	11	5	5	1	0.5	5	2	1	1	0.19	0.10
Kaufman	186	138	69	39	14	7	34	25	13	7	3	1
Kemp	14	9	5	3	0.9	0.5	2	2	1	1	0.17	0.09
Mabank	51	43	22	17	4	2	9	8	4	3	1	0.40
Terrell	947	480	240	194	48	24	173	88	44	35	9	4
Wills Point	51	43	21	11	4	2	9	8	4	2	1	0.39
Level I Loads	**1,771**	**967**	**484**	**332**	**97**	**48**	**323**	**177**	**88**	**61**	**18**	**9**
Load Reduction from Level I to Level II	**804**			**235**			**147**			**43**		
Load Reduction from Level II to Level III	**484**			**48**			**88**			**9**		

* Level I loads calculated from average TN and TP as reported in each chapter's Table 3

SECTION I

CITY OF ATHENS
NORTH WASTEWATER TREATMENT PLANT

SECTION I

CITY OF ATHENS
NORTH WASTEWATER TREATMENT PLANT

INTRODUCTION

The Athens North WWTP discharges into Caney Creek and then flows into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Athens operates two wastewater treatment plants. One is referred to as the North plant and the other as the West. The West plant, which does not discharge into the Cedar Creek watershed, is permitted for a flow of 1.32 million gallons per day (MGD). The West plant operates under TPDES Permit No. 10143-001. Since the West plant does not discharge into the Cedar Creek sewershed, an evaluation of the WWTP is not presented in this study.

The North plant discharges into the Cedar Creek sewershed and has a rated capacity of 1.027 MGD. The plant presently treats about 40% of the City's wastewater. The North wastewater treatment plant operates under TPDES Permit No. 10143-001-A with the current permit limits for the North plant as shown in Table I-1; limits shown are the current permit limits, which may have changed throughout the course of historical data collection and report writing.

Table I-1
City of Athens North WWTP
Current TPDES Permit Conditions
TPDES Permit 10143-001-A

Parameters	Permit Limits March - November	Permit Limits December - February
Carbonaceous Biochemical Oxygen Demand (CBOD)	10 mg/L	20 mg/L
Total Suspended Solids (TSS)	15 mg/L	20 mg/L
Ammonia Nitrogen (NH_3)	2 mg/L	3 mg/L
Annual Average Flow	1.027 MGD	1.027 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and

total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of the historical flows and effluent quality for the City of Athens' North plant are presented in Table I-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). The flow to the plant is currently about 40% of its rated capacity.

Table I-2
City of Athens North WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent		
		CBOD	TSS	NH_3-N
	(MGD)	(mg/L)	(mg/L)	(mg/L)
1999	0.42	9.1	7.9	3.7
2000	0.50	10.5	8.3	4.4
2001	0.45	7.8	9.8	3.1
2002	0.45	3.4	7.5	1.9
2003	0.42	3.1	8.7	0.6

The North plant typically meets its permit limits for CBOD and TSS. It has met its ammonia limit for the most recent years of data collection. At the request of the Tarrant Regional Water District, the city of Athens collected 12 months of effluent nutrient data. The data indicate that the plant typically meets its ammonia limit with occasional excursions. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the nutrient data is presented in Table I-3; all data may be found in Appendix A.

Table I-3
City of Athens WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	49	49	49	49	49	49	49
Average (mg/L)	1.68	10.91	1.72	1.16	1.34	13.53	2.85
Minimum (mg/L)	0.20	0.19	0.84	0.00	0.00	0.55	1.40
Maximum (mg/L)	20.00	27.00	3.70	2.40	8.05	27.52	4.40

Figures I-1 and I-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

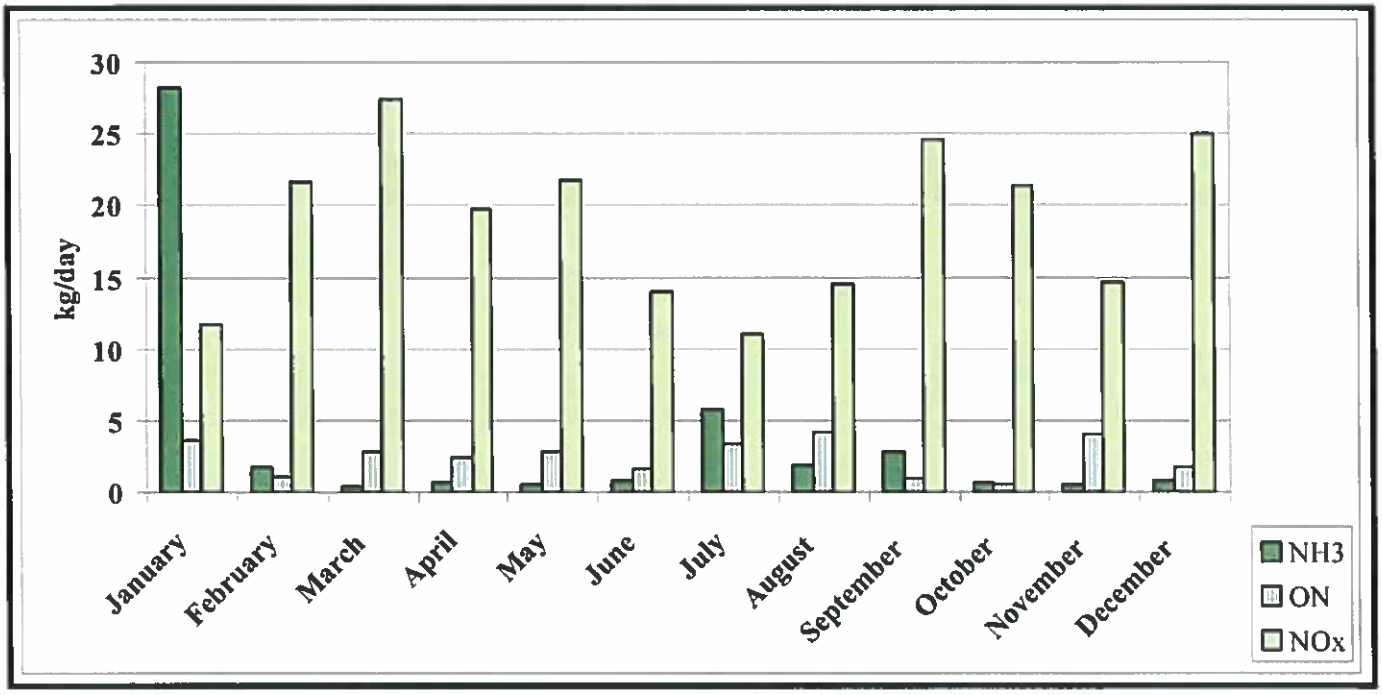

Figure I-1: Athens Effluent Total Nitrogen Monthly Average Loads

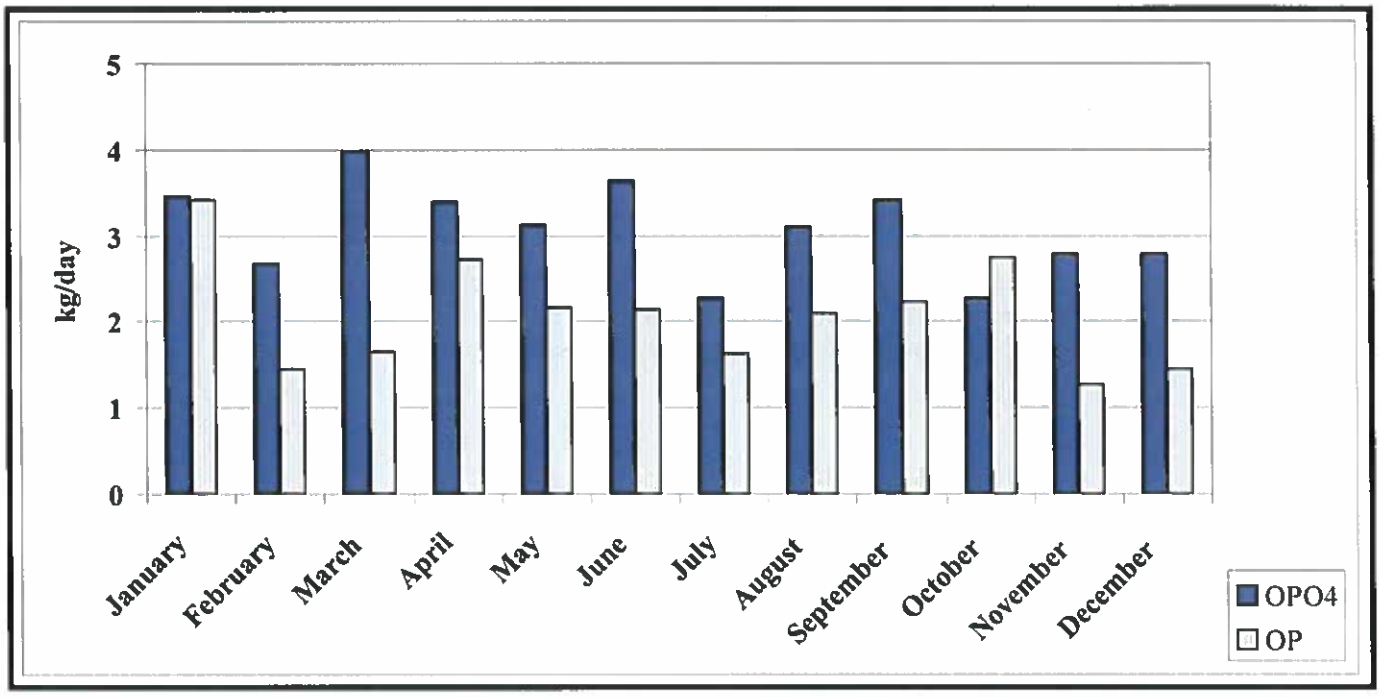

Figure I-2: Athens Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The City's North plant is a conventional wastewater treatment plant utilizing an Imhoff tank for primary settling, trickling filters, aeration basins, and final clarification for treatment. See Figure I-3 for the plant's process schematic. Table I-4 lists the existing treatment units and their dimensions.

Table I-4
City of Athens North WWTP
Existing Treatment Facilities

Treatment Units	Dimensions/Size
Imhoff Tank No. 1 Volume	517,000 gallons
Imhoff Tank No. 2 Volume	96,900 gallons
Trickling Filters Nos. 1and 2	60-ft diameter, 12-ft SWD
Aeration Basin	20-ft x 10-ft, 15-ft SWD 22,400 gallons
Final Clarifiers Nos. 1 and 2	40-ft diameter, 12-ft SWD 112,800 gallons
Chlorine Contact Basin Volume	92,000 gallons

Wastewater from the City of Athens enters the treatment facility through an 18-inch diameter gravity sewer line. The raw wastewater is passed through a manually cleaned bar screen to remove larger solids after which the grit is removed. The raw wastewater is pumped into Imhoff tanks. Settling occurs in the top compartment and degradation of the sludge under absence of oxygen occurs in the lower unheated compartment. The supernatant from the Imhoff tanks is routed to a tricking filter for further treatment of organic matter present in the wastewater; Trickling Filter No. 1 utilizes rock while No. 2 employs a plastic media. The tricking filter effluent is aerated in an aeration basin for nitrification. From the aeration basin, flow is sent to secondary clarifiers to separate the liquid and the biomass. The supernatant from the secondary clarifiers is then disinfected with chlorine solution and discharged into a creek.

Primary sludge and biological sludge are periodically wasted to the sludge drying beds. Decant water from the sludge drying bed is mixed with the raw wastewater prior to the Imhoff tanks. Dried sludge is periodically removed from the drying beds and disposed of off-site.

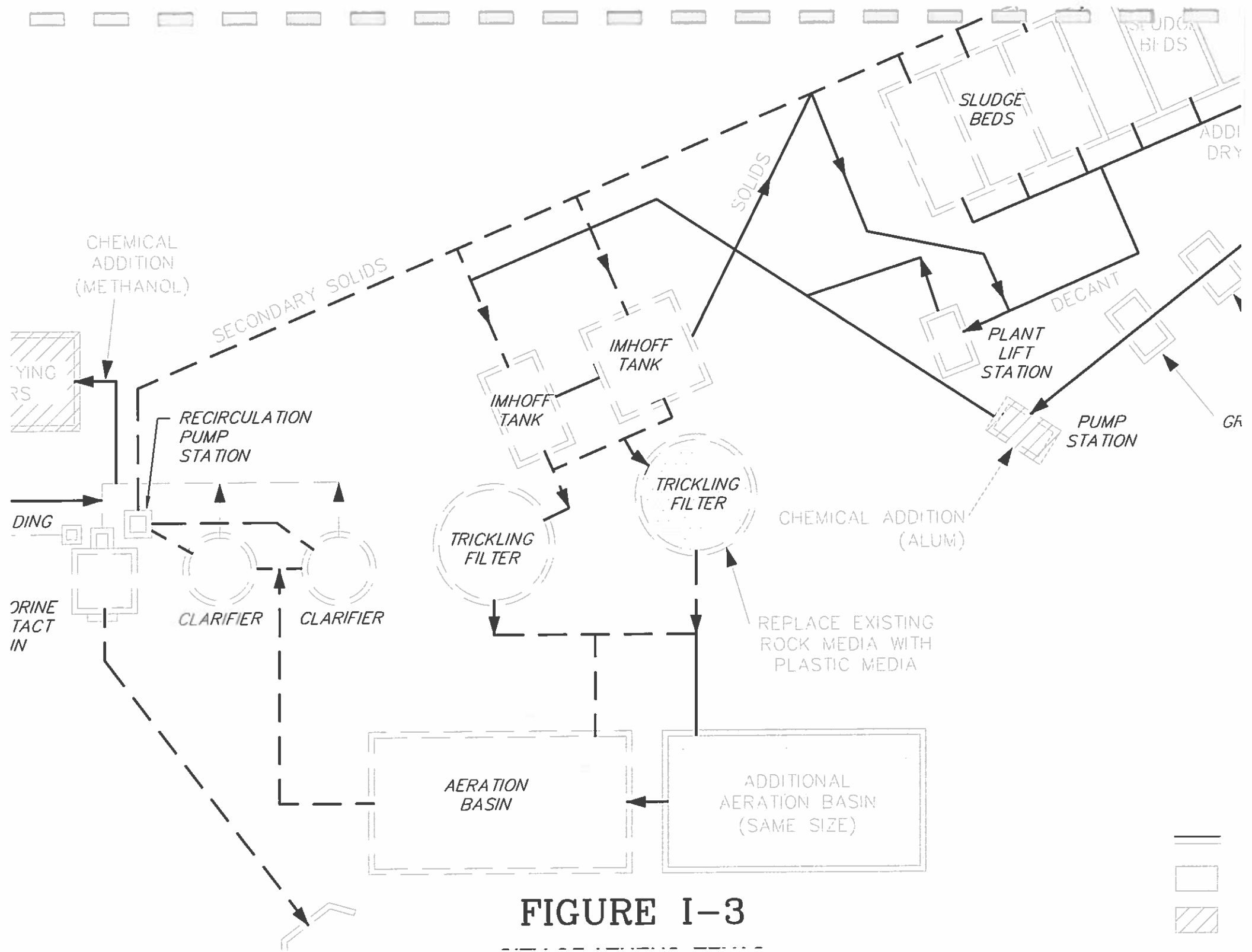
SLUDGE BEDS
SOLIDS
CHEMICAL ADDITION (METHANOL)
SECONDARY SOLIDS
IMHOFF TANK
IMHOFF TANK
DECANT
PLANT LIFT STATION
PUMP STATION
RECIRCULATION PUMP STATION
TRICKLING FILTER
TRICKLING FILTER
CHEMICAL ADDITION (ALUM)
CLARIFIER
CLARIFIER
REPLACE EXISTING ROCK MEDIA WITH PLASTIC MEDIA
AERATION BASIN
ADDITIONAL AERATION BASIN (SAME SIZE)

FIGURE I–3

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Athens was 11,297. Projected populations and flows through the year 2050 are listed in Table I-5.

Table I-5
City of Athens
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	12,390	13,588	16,343	19,657	23,643	28,438
Projected Flow (MGD)[2] North WWTP	0.50	0.54	0.65	0.78	0.94	1.14
Projected Flow (MGD)[2] West WWTP	0.74	0.82	0.98	1.18	1.42	1.7

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = assumed 100 gal/capita/day (Figure 1, 30 TAC 317.4 (a))

Table I-5 flow projections are based on the assumption that the flow split between the North (40%) and West (60%) WWTPs will continue as it is currently. The projected 2050 flow for the North plant is 1.14 MGD. The projected flow will exceed the rated capacity of the North plant around the year 2045.

FACILITY NEEDS EVALUATION

This section describes the facilities identified for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities will be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the plant's current permitted daily average flow is 1.027 MGD. Around the year 2045, the projected flow will exceed the current plant capacity, and there will be a need to expand the plant.

To treat year 2050 projected flows, the existing plant needs to be expanded to 1.14 MGD. An additional capacity of 0.109 MGD is required. The North WWTP needs to expand its influent pumping system to handle the higher flows. One of the existing trickling filters has rock media that can be replaced with plastic media to expand its treatment capability. An aeration basin of similar size to the existing basin needs to be added to achieve treatment capacity to treat year 2050 projected flows. Three additional sludge-drying beds of existing bed size would provide sufficient capacity through the year 2050.

The capital costs involved to improve the City's plant to treat the year 2050 flow are listed in Table I-6, as well as additional annual operation costs.

Table I-6
City of Athens North WWTP
Facility Needs to Meet Level I Effluent Requirements and 2050 Flows

Item Description			Cost
Influent Pumping			$139,000
Replace Rock Media with Plastic Media			$94,000
New Aeration Basin			$1,186,000
Three Additional Drying Beds			$60,000
Sub-Total			**$1,479,000**
Site Work and Yard Piping		20%	$295,800
Sub-Total			**$1,774,800**
Electrical and Instrumentation		20%	$354,960
Sub-Total			**$2,129,760**
Contingencies		25%	$532,440
Contractor OHP		15%	$319,464
Total Construction Cost			**$2,981,664**
Engineering		10%	$298,166
Permitting		5%	$149,083
Total Project Cost			**$3,428,914**
Power	75 hp and $0.12 per kW-hr		$60,000
Chemical			$0
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$3,000
Total O&M Cost per Year			**$63,000**

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L, total nitrogen to 10 mg/L, CBOD to 10 mg/L, TSS to 15 mg/L, and ammonia nitrogen to 2 mg/L. As total phosphorus average concentrations measured during the nutrient testing were greater than 1 mg/L, this evaluation assumes phosphorus effluent concentration reduction is necessary. To consistently achieve phosphorus concentrations of less than 1 mg/L, the addition of aluminum sulfate (alum) is recommended. Alum solution will be fed at the influent pump station to achieve required mixing of the alum solution. The use of alum may retard drying of the sludge on the drying beds. It may be necessary to add more drying beds or modify the existing ones to accommodate alum sludge.

A denitrifying filter will be added to meet the effluent total nitrogen limits. An alternative to the denitrifying filter would involve constructing anoxic zones in the aeration basin and recirculating nitrified effluent to the anoxic zone. This alternative should be evaluated during preliminary design.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table I-7.

Table I-7
City of Athens North WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Denitrification Filter			$330,500
Chemical Feed System for Alum			$55,000
Sub-Total			**$385,500**
Site Work and Yard Piping		20%	$77,100
Sub-Total			**$462,600**
Electrical and Instrumentation		20%	$92,520
Sub-Total			**$555,120**
Contingencies		25%	$138,780
Contractor OHP		15%	$83,268
Total Construction Cost			**$777,168**
Engineering		10%	$77,717
Permitting		5%	$38,858
Total Project Cost			**$893,743**
Power	25 hp and $0.12 per kW-hr		$20,000
Chemical			$1,800
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,090
Total O&M Cost per Year			**$22,890**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L, total nitrogen to 5 mg/L, CBOD to 10 mg/L, TSS to 15 mg/L, and ammonia nitrogen to 2 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be required. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table I-8.

Table I-8
City of Athens North WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$33,000
Sub-Total			**$33,000**
Site Work and Yard Piping		20%	$6,600
Sub-Total			**$39,600**
Electrical and Instrumentation		20%	$7,920
Sub-Total			**$47,520**
Contingencies		25%	$11,880
Contractor OHP		15%	$7,128
Total Construction Cost			**$66,528**
Engineering		10%	$6,653
Permitting		5%	$3,326
Total Project Cost			**$76,507**
Power			$0
Chemical			$36,700
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,835
Total O&M Cost per Year			**$38,535**

SECTION II

CHEROKEE SHORES WASTEWATER TREATMENT PLANT

SECTION II

CHEROKEE SHORES
WASTEWATER TREATMENT PLANT

INTRODUCTION

The Cherokee Shores wastewater treatment facility (WWTF) discharges into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

Tecon Water Company, L.P., owns and operates the Cherokee Shores wastewater treatment facility. The wastewater treatment plant is operated under TPDES Permit No. 13879-001 and has a rated capacity of 0.15 million gallons per day (MGD). The permit limits are shown in Table II-1; limits shown are final permit limits, which may have changed throughout the course of historical data collection and report writing.

Table II-1
Cherokee Shores WWTF
Current TPDES Permit Conditions
TPDES Permit No. 13879-001

Parameters	Permit Limits
BOD_5	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Ammonia Nitrogen (NH_3)	5 mg/L
Total Nitrogen	20 mg/L
Total Phosphorus	2 mg/L
Flow	0.15 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of the historical flows and effluent quality for Cherokee Shores wastewater treatment facility are presented in Table II-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about one-half of its rated capacity.

Table II-2
Cherokee Shores WWTF
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent	
		BOD_5	TSS
	(MGD)	(mg/L)	(mg/L)
1999	0.06	9.7	8.3
2000	0.05	11.3	11.5
2001	0.06	18.4	25.3
2002	0.08	9.4	20.4
2003	0.09	8.4	18.3
ND: No Data			

Historically, the plant has not met its effluent permit limits for TSS, and has had some difficulty in consistently meeting the BOD_5 limit. The plant has applied for and received a permit for expansion, the limits of which are those in Table II-1, and these final limits after expansion will be considered Level I for the purposes of this report. During the course of writing this report, the plant was subject to no permit limits for total nitrogen, phosphorous, or ammonia and the permitted flow was 0.075 MGD.

At the request of the Tarrant Regional Water District, Cherokee Shores collected 12 months of effluent nutrient data. During the 12 months of data collection, the plant's average nutrient concentrations were above the effluent limits for the final permit. A review of operations should be done to determine the reason for non-compliance. Operational and facility changes will be required to meet Level II and Level III effluent goals. A summary of the data is presented in Table II-3; all data may be found in Appendix A.

Table II-3
Cherokee Shores WWTF
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	50	50	50	50	50	50	50
Average (mg/L)	30.6	1.8	3.4	0.9	5.6	37.8	4.3
Minimum (mg/L)	5.5	0.4	0.2	0.0	0.0	18.4	0.5
Maximum (mg/L)	42.0	27.0	16.5	3.4	30.3	50.7	18.6

Figures II-1 and II-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

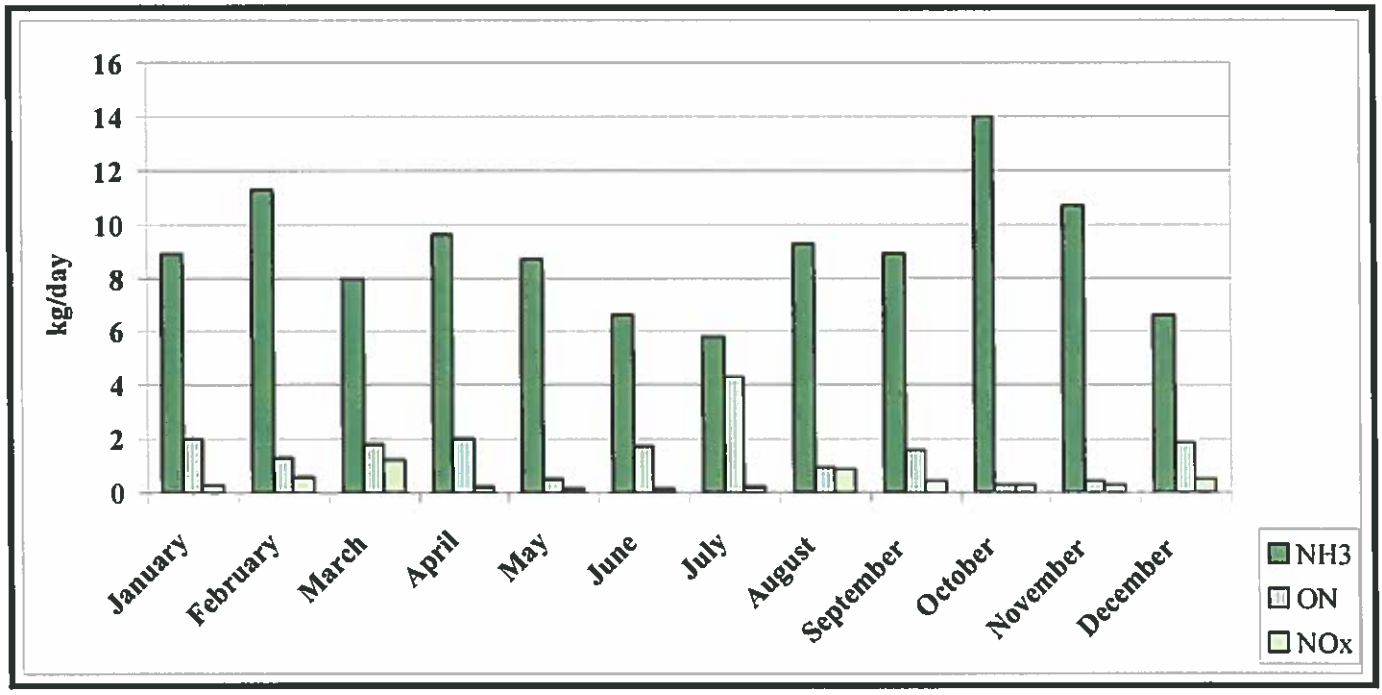

Figure II-1: Cherokee Shores Effluent Total Nitrogen Monthly Average Loads

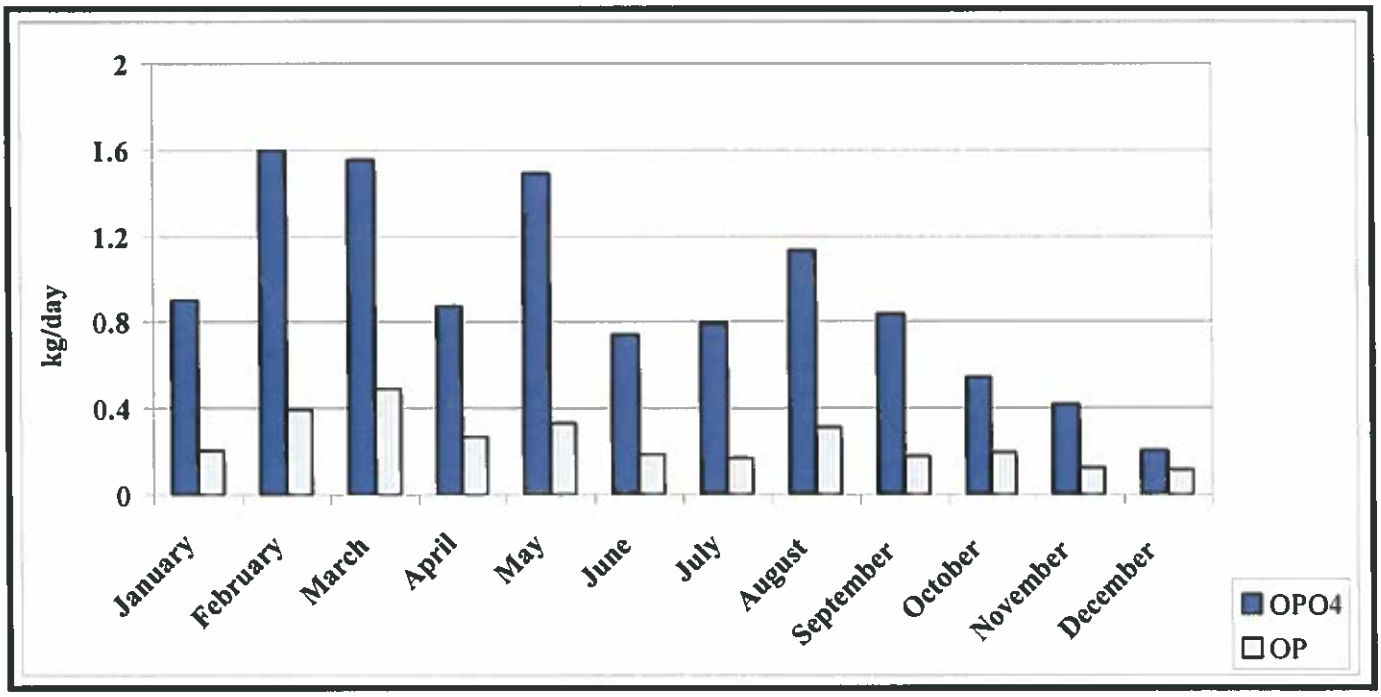

Figure II-2: Cherokee Shores Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The Cherokee Shores WWTF is a conventional wastewater treatment plant utilizing flow equalization, aeration basins, final clarification, filtration, and disinfection for treatment. The City's WWTF rated treatment capacity will be 0.15 MGD, but at the time of this report the plant was operating under a 0.075 MGD limit. See Figure II-3 for a schematic of the facilities processes. Table II-4 lists the existing treatment units and their current sizes.

Table II-4
Cherokee Shores WWTF
Existing Treatment Facilities

Treatment Units	Dimensions/Sizes
Aeration Basin	72-ft x 12-ft, 8-ft SWD 51,700 gallons
Circular Clarifier	20-ft diameter, 6-ft SWD 14,000 gallons
Filter Surface Area	80 square feet (each)
Chlorine Contact Basin Volume	7,200 gallons
Equalization Basin Volume	2,350 gallons
Aerobic Digester Volume	16,150 gallons

Influent wastewater is either routed to the aeration basin or to a flow equalization tank. The primary purpose of the equalization tank is to hold peak flows for short time periods so as not to exceed the capacity of the other treatment units. The equalization tank can also be used to equalize flow with varying characteristics. The wastewater is treated in an aeration basin where microorganisms stabilize the organics present in the wastewater. Flow from the aeration basin is settled in the clarifier to separate out the biomass. The clarifier overflow is then passed through a sand filtration system and disinfected with chlorine solution prior to discharge.

A portion of settled sludge is returned to the aeration basin as return activated sludge and the remainder is sent to an aerobic digester. Digested sludge is pumped from the digester and disposed off-site.

Tarrant Regional Water District
Watershed Project

Cedar Creek Reservoir
Wastewater Treatment Facilities Report

Evaluating Water Quality Management Practices for Reservoirs in North Central Texas

Revised

May 5, 2008

AgriLIFE RESEARCH
Texas A&M System

ALAN PLUMMER ASSOCIATES, INC.
ENVIRONMENTAL ENGINEERS • DESIGNERS • SCIENTISTS

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List of Abbreviations

BOD	Biochemical Oxygen Demand/Biological Oxygen Demand
CBOD	Carbonaceous Biological Oxygen Demand
DMR	Discharge Monitoring Reports
ENR	Engineering News Record
IP	Inorganic Phosphorous
MG	Millions of Gallons
MGD	Millions of Gallons per Day
NH3	Ammonia
NH3-N	Ammonia Nitrogen
NOx	Nitrogen Oxides
ON	Organic Nitrogen
OP	Organic Phosphorous
OPO_4	Ortho-Phosphate
OrgN	Organic Nitrogen
OrgP	Organic Phosphorous
SWD	Side Wall Depth
TCEQ	Texas Commission on Environmental Quality
TN	Total Nitrogen
TP	Total Phosphorous
TPDES	Texas Pollution Discharge Elimination System
TSS	Total Suspended Solids
UV	Ultra Violet
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Tarrant Regional Water District (District) provides raw water to numerous water suppliers in the North Texas area. The raw water originates in several of the District's reservoirs including Cedar Creek, Richland Chambers, and Eagle Mountain. As the demands for raw water increase, the need to protect the water quality becomes a critical issue. This report focuses on evaluating the various point sources of pollutants, particularly nutrients, into the Cedar Creek Reservoir watersheds. The objectives of the following report are to identify significant sources of pollutant sources, to quantify both current and long-term impacts, to evaluate the best management practices available for maintaining and improving water quality, and finally to address the costs of implementing those practices.

This report addresses the point sources, specifically wastewater treatment facilities, discharging directly into the Cedar Creek Reservoir through watershed streams that eventually enter the reservoir. Plants evaluated include:

- City of Athens' North Wastewater Treatment Plant
- Cherokee Shores Wastewater Treatment Facility
- East Cedar Creek Fresh Water Supply District North Wastewater Treatment Plant
- City of Eustace Wastewater Treatment Plant
- City of Kaufman Wastewater Treatment Plant
- City of Kemp Wastewater Treatment Plant
- City of Mabank Wastewater Treatment Plant
- City of Terrell King's Creek Wastewater Treatment Plant
- City of Will's Point Wastewater Treatment Plant

Figure ES-1 shows the locations of these plants within the Cedar Creek watershed. The evaluation of each facility included assessing the ability of each plant to properly treat projected 2050 flows under three varying discharge limit criteria. The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1.0 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reducing the phosphorus limit to 0.5 mg/L and total nitrogen to 5 mg/L. An assessment of facility needs is performed at all three effluent limitations for flows projected through 2050.

Sources of information for the evaluations included: site visits, interviews with the plant personnel, reviews of the existing plans and historical reports, data collected by plant personnel for the District, data acquired through Texas Commission on Environmental Quality (TCEQ), and responses to a questionnaire developed specifically for this project to aid in acquiring data and information on each plant. Each memorandum is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the existing treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

A brief summary of the assessment for each plant is provided in Table ES-1. Detailed evaluations of each plant are provided in the technical memoranda following this summary. Table ES-2 summarizes the costs associated with each of the expansions or upgrades and Table ES-3 examines the nitrogen and phosphorus loads that would be associated with the projected 2050 flows at each permit level. The average total nitrogen and total phosphorous concentrations that were determined as part of special nutrient testing were used to calculate the Level I loads at 2050 flows; this will best compare the impact of each permit level across time.

Figure ES-1
Cedar Creek Discharge Assessment
Wastewater Treatment Plant Locations

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
ATHENS CBOD = 10 mg/L (Mar. – Nov.) CBOD = 20 mg/L (Dec. – Feb.) TSS = 15 mg/L (Mar. – Nov.) TSS = 20 mg/L (Dec. – Feb.) NH_3 = 2 mg/L (Mar. – Nov.) NH_3 = 3 mg/L (Dec. – Feb.) Flow = 1.027 MGD	**North WWTP** 2005 = 0.50 2010 = 0.54 2020 = 0.65 2030 = 0.78 2040 = 0.94 2050 = 1.14 **West WWTP** 2005 = 0.74 2010 = 0.82 2020 = 0.98 2030 = 1.18 2040 = 1.42 2050 = 1.70	Bar screen, grit removal, Imhoff tanks, supernatant to tricking filters, aeration for six hours, final clarification, and chlorination. Sludge disposed on drying beds and periodically disposed of off-site.	Expand influent pumping system, replace tricking filter rock media with plastic media, duplicate aeration basin and aeration, and double drying bed size. Project cost: $3,428,914 Additional Annual O&M cost: $63,000	Add denitrifying filter to meet TN limit and alum addition for P removal. Increase in cost from Level I: $893,743 Increase in Annual O&M cost over Level I: $22,890	Add carbon source for denitrification, and increase alum dosage for lower P limit. Equipment is already in place. Increase in cost from Levels I and II: $76,507 Increase in Annual O&M cost over Levels I and II: $38,535
CHEROKEE SHORES BOD_5 = 10 mg/L TSS = 15 mg/L NH_3 = 5 mg/L TN = 20 mg/L TP = 2 mg/L Flow = 0.15 MGD	2005 = 0.08 2010 = 0.09 2020 = 0.11 2030 = 0.13 2040 = 0.15 2050 = 0.18	Equalization, activated sludge, final clarification, sand filtration, and chlorination. Sludge aerobically digested and disposed off-site.	Existing facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Add alum addition for P removal, a denitrifying filter for N reduction, and an in line mixer. Increase in cost over Level I: $592,351 Increase in Annual O&M cost over Level I: $13,020	Add carbon source for denitrification, and increase alum dosage for lower P limit. Increase in cost over Levels I and II: $64,915 Increase in Annual O&M cost over Levels I and II: $34,230

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
EAST CEDAR CREEK FWSD BOD_5 = 10 mg/L TSS = 15 mg/L Flow = 0.626 MGD	2005 = 0.71 2010 = 0.82 2020 = 1.00 2030 = 1.17 2040 = 1.36 2050 = 1.60	Treatment facility currently under expansion. Bar screen, two oxidation ditches w/ RAS, final clarification, sand filtration, and chlorination. Sludge is dried and landfilled.	Once treatment units are optimized, expansion required between 2030 and 2040. Add oxidation ditch, clarifier, filter, and chlorine contact basin. Project cost: $4,915,008 Additional Annual O&M cost: $63,000	Operate oxidation ditch for de-nitrification. Alum addition for P removal. Increase in cost from Level I: $127,512 Increase in Annual O&M cost over Level I: $5,775	Denitrifying filter to meet TN limit. Add carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $912,290 Increase in Annual O&M cost over Levels I and II: $89,040

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD)[1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
EUSTACE BOD_5 = 30 mg/L TSS = 90 mg/L Flow = 0.125 MGD	2005 = 0.084 2010 = 0.088 2020 = 0.097 2030 = 0.106 2040 = 0.115 2050 = 0.126	Bar screen, oxidation ditch w/o RAS as pre-aeration basins, two stabilization ponds w/ 21-day detention time. Disinfection not required.	Add two 15 hp aerators, clarifier, RAS/WAS pumps and piping, and disinfection system Project cost: $217,930 Additional Annual O&M cost: $63,000	Add alum for P removal. Increase in cost from Level I: $51,005 Increase in Annual O&M cost over Level I: $4,683	Denitrifying filter to meet TN limit, and additional carbon source for denitrification. Additional alum for lower P limit. Increase in cost from Levels I and II: $549,461 Increase in Annual O&M cost over Levels I and II: $30,030

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
KAUFMAN CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 3 mg/L (May – Oct.) NH_3 = 5 mg/L (Nov. – Apr.) Flow = 1.2 MGD	2005 = 0.73 2010 = 0.83 2020 = 1.09 2030 = 1.30 2040 = 1.47 2050 = 1.65	Bar screen, grit removal, storm water holding basins, two aeration basins w/ RAS, two final clarifiers, sand filtration and ultraviolet disinfection. Sludge belt press and lime blending. Sludge disposed offsite	Convert existing aeration system to fine bubble diffusers instead of adding aeration basins. Expand WAS and RAS system. Add IFAS to aeration basins, add final clarifier, and additional ultraviolet disinfection equipment. Project cost: $2,088,878 Additional Annual O&M cost: $127,470	Denitrifying filter to meet TN limit. Alum addition required for P removal. Increase in cost from Level I: $1,659,974 Increase in Annual O&M cost over Level I: $6,930	Add carbon source for denitrification, and additional alum for lower P limit. Increase in cost from Levels I and II: $92,736 Increase in Annual O&M cost over Levels I and II: $55,440
KEMP CBOD = 5 mg/L TSS = 5 mg/L NH_3 = 2.0 mg/L Flow = 0.2 MGD	2005 = 0.113 2010 = 0.113 2020 = 0.113 2030 = 0.113 2040 = 0.113 2050 = 0.113	Bar screen, grit removal, oxidation ditch w/ RAS, two final clarifiers, and chlorination. Sludge drying beds.	Existing facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Operate oxidation ditch for denitrification. Alum addition for P removal. May require additional drying beds for alum sludge. Increase in cost from Level I: $51,005 Increase in Annual O&M cost over Level I: $4,442	Add denitrifying filter to meet TN limit, carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $537,869 Increase in Annual O&M cost over Levels I and II: $21,630

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
MABANK CBOD = 30 mg/L TSS = 90 mg/L NH_3 = 2 mg/L Flow = 0.4 MGD	2005 = 0.24 2010 = 0.27 2020 = 0.33 2030 = 0.38 2040 = 0.44 2050 = 0.52	Bar screen, grit removal, oxidation ditch w/o RAS followed by three stabilization ponds, and a nitrifying bio-tower. Disinfection not required. Sludge is periodically dredged from the ponds and disposed offsite.	Expansion required between 2030 and 2040. Expand headworks and pumping capacity. Add aerators to stabilization ponds and uprate the bio-tower. Add chlorine disinfection and drying beds. Project cost: $635,242 Additional Annual O&M cost: $98,700	Maintain pond volume for N removal and add alum for P removal. Increase in cost from Level I: $127,512 Increase in Annual O&M cost over Level I: $5,355	Add denitrifying filter to meet TN limit, carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $835,783 Increase in Annual O&M cost over Levels I and II: $31,290
TERRELL CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 6.0 mg/L Flow = 4.5 MGD	2005 = 3.23 2010 = 3.42 2020 = 4.19 2030 = 4.87 2040 = 5.32 2050 = 5.76 [3]	Flow equalization, bar screen, grit removal, primary clarification, two-stage trickling filter, final clarification, with chlorination and de-chlorination. Portable belt press solids dewatering.	Expansion required between 2020 and 2030. Add additional headworks with screens and grit removal. Add influent pump capacity, Sequencing Batch Reactors and sand filters. Expand chlorine contact basin and add gravity belt thickener. Project cost: $7,416,562 Additional Annual O&M cost: $101,115	Add denitrifying filters to existing treatment train. Optimize SBRs for de-nitrification. Alum addition for P removal. Increase in cost from Level I: $3,192,437 Increase in Annual O&M cost over Level I: $15,855	Carbon source for denitrification and additional alum for lower P limit. Increase in cost from Levels I and II: $146,059 Increase in Annual O&M cost over Levels I and II: $178,500

Table ES-1
Tarrant Regional Water District
Cedar Creek Lake
Wastewater Plant Dischargers Assessment

Treatment Plant & Permit Limits	Flow Projections (MGD) [1]	Existing Process Description	Facility Needs for 2050 and Estimates of Probable Construction and O&M Costs		
			Level I Existing Permit Limits	Level II[2] TN = 10 mg/L TP = 1 mg/L	Level III[3] TN = 5 mg/L TP = 0.5 mg/L
WILLS POINT Present BOD_5 = 30 mg/L TSS = 90 mg/L Flow = 0.51 MGD Planned CBOD = 10 mg/L TSS = 15 mg/L NH_3 = 3 mg/L Flow = 0.80 MGD	2005 = 0.37 2010 = 0.39 2020 = 0.42 2030 = 0.46 2040 = 0.48 2050 = 0.51	Two new stabilization ponds are currently under expansion. Bar screen, two facultative lagoons, three stabilization ponds exist. Disinfection not required. Sludge is periodically dredged from the ponds and disposed offsite.	Once current expansion is complete, facility is capable of treating the projected flows through the year 2050. Project cost: $0 Additional Annual O&M cost: $0	Operate ponds for de-nitrification, and dredge ponds to maintain volume. Add earthen pond divider. Alum addition for P removal. Increase in cost from Level I: $231,840 Increase in Annual O&M cost over Level I: $4,935	Denitrifying filter to meet TN limit., with possible additional carbon source. Additional alum for lower P limit. Increase in cost from Levels I and II: $835,783 Increase in Annual O&M cost over Levels I and II: $31,290

[1] Flow projections based on TWDB population projections and 100 gpcd unless otherwise noted.
[2] Level II O&M costs are in addition to current operating costs.
[3] Level III capital costs are in addition to Level I costs. Level III capital costs are in addition to Level I and Level II costs.

The initial opinion of costs presented herein represents a Class 5 estimate based upon ANSI Standard Reference Z94.2-1989 and AACE International Recommended Practice No. 17R-97.

Table ES-2: Comparison of Costs for Each Plant's Expansion or Upgrade

City or Facility	*Costs Associated with Upgrades*		
	Level I	**Level II**	**Level III**
Athens	$3,428,914	$893,743	$76,507
Cherokee Shores	$0	$592,351	$64,915
East Cedar Creek	$4,915,008	$127,512	$912,290
Eustace	$217,930	$51,005	$549,461
Kaufman	$2,088,878	$1,659,974	$92,736
Kemp	$0	$51,005	$537,869
Mabank	$635,242	$127,512	$835,783
Terrell	$7,416,562	$3,192,437	$146,059
Wills Point	$0	$231,840	$835,783
Total Costs	**$18,702,534**	**$6,927,379**	**$4,051,403**

Table ES-3: Nutrient Loads in Lbs/day and Tons/year for Each Plant at Each Permit Level

City or Facility	*Loads Associated with 2050 Flows (lbs/day)*						*Loads Associated with 2050 Flows (tons/yr)*					
	Total Nitrogen			**Total Phosphorous**			**Total Nitrogen**			**Total Phosphorous**		
	Level I*	**Level II**	**Level III**	**Level I***	**Level II**	**Level III**	**Level I**	**Level II**	**Level III**	**Level I**	**Level II**	**Level III**
Athens	129	95	48	27	10	5	23	17	9	5	2	1
Cherokee Shores	57	15	8	6	2	0.8	10	3	1	1	0.27	0.14
East Cedar Creek	312	133	67	29	13	7	57	24	12	5	2	1
Eustace	25	11	5	5	1	0.5	5	2	1	1	0.19	0.10
Kaufman	186	138	69	39	14	7	34	25	13	7	3	1
Kemp	14	9	5	3	0.9	0.5	2	2	1	1	0.17	0.09
Mabank	51	43	22	17	4	2	9	8	4	3	1	0.40
Terrell	947	480	240	194	48	24	173	88	44	35	9	4
Wills Point	51	43	21	11	4	2	9	8	4	2	1	0.39
Level I Loads	**1,771**	**967**	**484**	**332**	**97**	**48**	**323**	**177**	**88**	**61**	**18**	**9**
Load Reduction from Level I to Level II	**804**			**235**			**147**			**43**		
Load Reduction from Level II to Level III	**484**			**48**			**88**			**9**		

* Level I loads calculated from average TN and TP as reported in each chapter's Table 3

SECTION I

CITY OF ATHENS
NORTH WASTEWATER TREATMENT PLANT

SECTION I

CITY OF ATHENS
NORTH WASTEWATER TREATMENT PLANT

INTRODUCTION

The Athens North WWTP discharges into Caney Creek and then flows into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Athens operates two wastewater treatment plants. One is referred to as the North plant and the other as the West. The West plant, which does not discharge into the Cedar Creek watershed, is permitted for a flow of 1.32 million gallons per day (MGD). The West plant operates under TPDES Permit No. 10143-001. Since the West plant does not discharge into the Cedar Creek sewershed, an evaluation of the WWTP is not presented in this study.

The North plant discharges into the Cedar Creek sewershed and has a rated capacity of 1.027 MGD. The plant presently treats about 40% of the City's wastewater. The North wastewater treatment plant operates under TPDES Permit No. 10143-001-A with the current permit limits for the North plant as shown in Table I-1; limits shown are the current permit limits, which may have changed throughout the course of historical data collection and report writing.

Table I-1
City of Athens North WWTP
Current TPDES Permit Conditions
TPDES Permit 10143-001-A

Parameters	Permit Limits March - November	Permit Limits December - February
Carbonaceous Biochemical Oxygen Demand (CBOD)	10 mg/L	20 mg/L
Total Suspended Solids (TSS)	15 mg/L	20 mg/L
Ammonia Nitrogen (NH_3)	2 mg/L	3 mg/L
Annual Average Flow	1.027 MGD	1.027 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and

total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of the historical flows and effluent quality for the City of Athens' North plant are presented in Table I-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). The flow to the plant is currently about 40% of its rated capacity.

Table I-2
City of Athens North WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent		
		CBOD	TSS	NH_3-N
	(MGD)	(mg/L)	(mg/L)	(mg/L)
1999	0.42	9.1	7.9	3.7
2000	0.50	10.5	8.3	4.4
2001	0.45	7.8	9.8	3.1
2002	0.45	3.4	7.5	1.9
2003	0.42	3.1	8.7	0.6

The North plant typically meets its permit limits for CBOD and TSS. It has met its ammonia limit for the most recent years of data collection. At the request of the Tarrant Regional Water District, the city of Athens collected 12 months of effluent nutrient data. The data indicate that the plant typically meets its ammonia limit with occasional excursions. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the nutrient data is presented in Table I-3; all data may be found in Appendix A.

Table I-3
City of Athens WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	49	49	49	49	49	49	49
Average (mg/L)	1.68	10.91	1.72	1.16	1.34	13.53	2.85
Minimum (mg/L)	0.20	0.19	0.84	0.00	0.00	0.55	1.40
Maximum (mg/L)	20.00	27.00	3.70	2.40	8.05	27.52	4.40

Figures I-1 and I-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

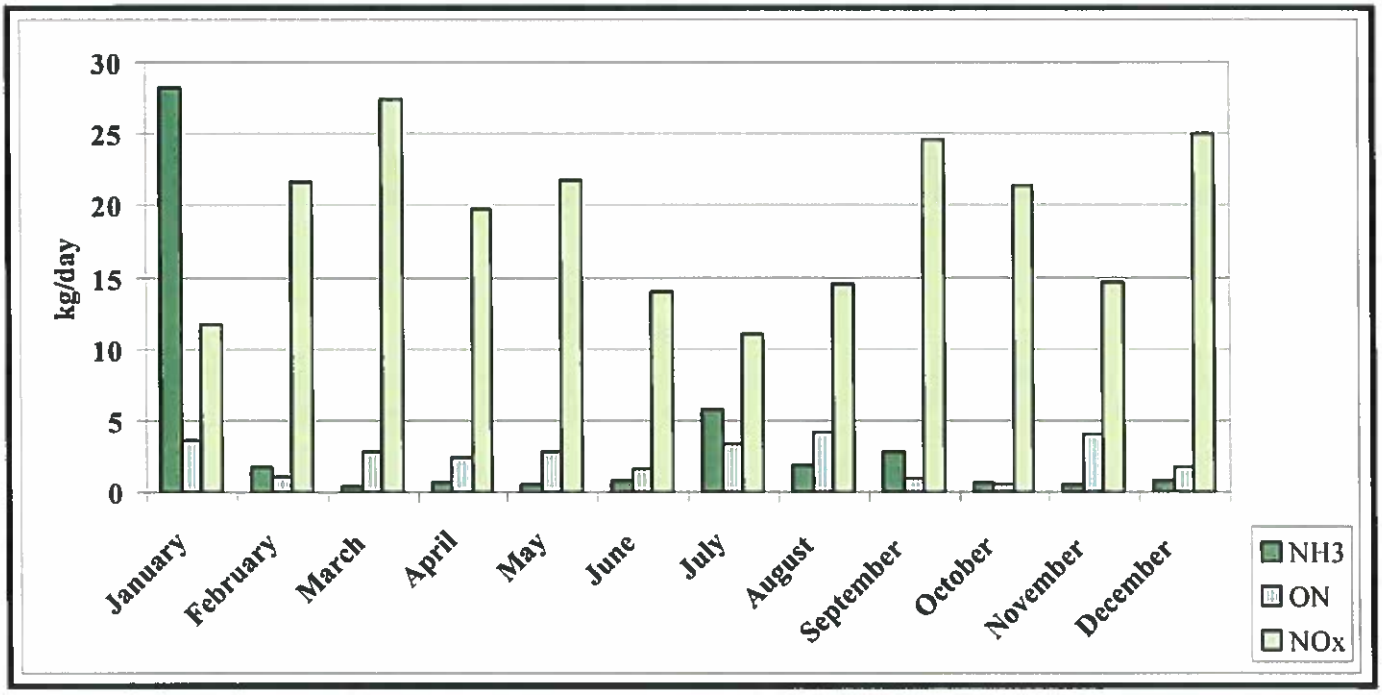

Figure I-1: Athens Effluent Total Nitrogen Monthly Average Loads

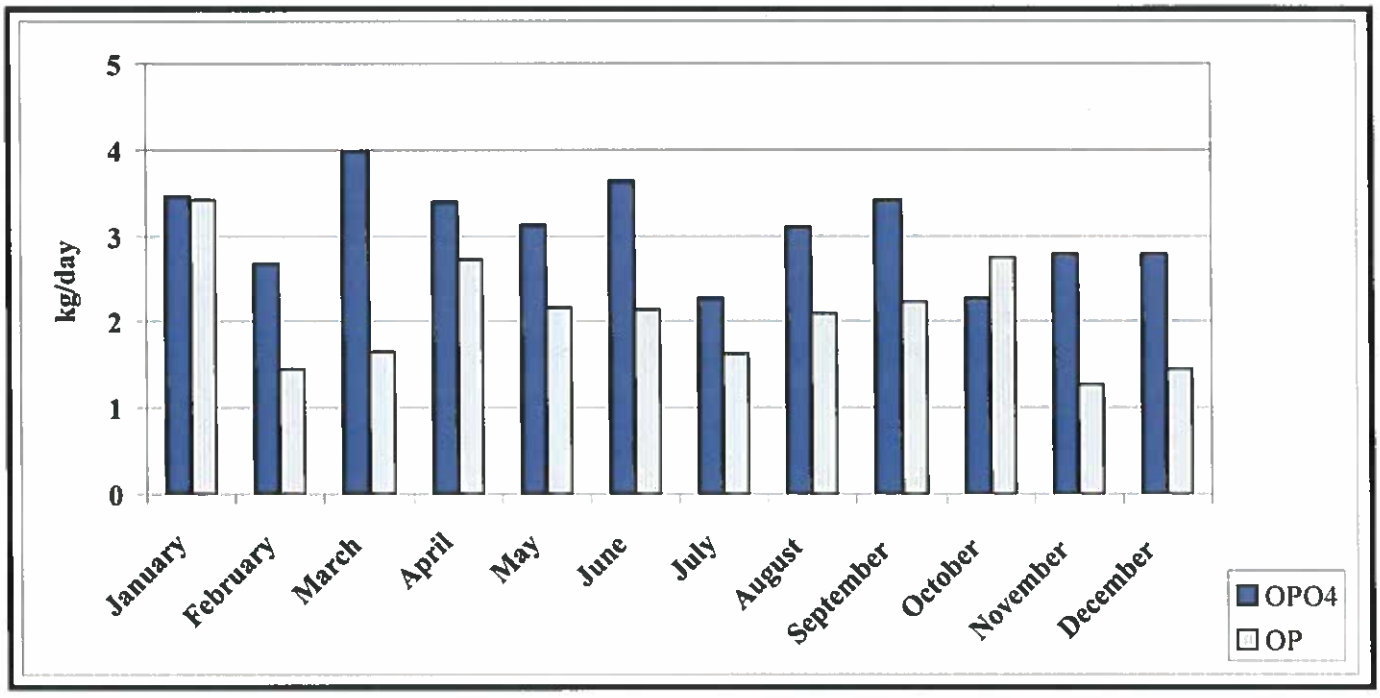

Figure I-2: Athens Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The City's North plant is a conventional wastewater treatment plant utilizing an Imhoff tank for primary settling, trickling filters, aeration basins, and final clarification for treatment. See Figure I-3 for the plant's process schematic. Table I-4 lists the existing treatment units and their dimensions.

Table I-4
City of Athens North WWTP
Existing Treatment Facilities

Treatment Units	Dimensions/Size
Imhoff Tank No. 1 Volume	517,000 gallons
Imhoff Tank No. 2 Volume	96,900 gallons
Trickling Filters Nos. 1and 2	60-ft diameter, 12-ft SWD
Aeration Basin	20-ft x 10-ft, 15-ft SWD 22,400 gallons
Final Clarifiers Nos. 1 and 2	40-ft diameter, 12-ft SWD 112,800 gallons
Chlorine Contact Basin Volume	92,000 gallons

Wastewater from the City of Athens enters the treatment facility through an 18-inch diameter gravity sewer line. The raw wastewater is passed through a manually cleaned bar screen to remove larger solids after which the grit is removed. The raw wastewater is pumped into Imhoff tanks. Settling occurs in the top compartment and degradation of the sludge under absence of oxygen occurs in the lower unheated compartment. The supernatant from the Imhoff tanks is routed to a tricking filter for further treatment of organic matter present in the wastewater; Trickling Filter No. 1 utilizes rock while No. 2 employs a plastic media. The tricking filter effluent is aerated in an aeration basin for nitrification. From the aeration basin, flow is sent to secondary clarifiers to separate the liquid and the biomass. The supernatant from the secondary clarifiers is then disinfected with chlorine solution and discharged into a creek.

Primary sludge and biological sludge are periodically wasted to the sludge drying beds. Decant water from the sludge drying bed is mixed with the raw wastewater prior to the Imhoff tanks. Dried sludge is periodically removed from the drying beds and disposed of off-site.

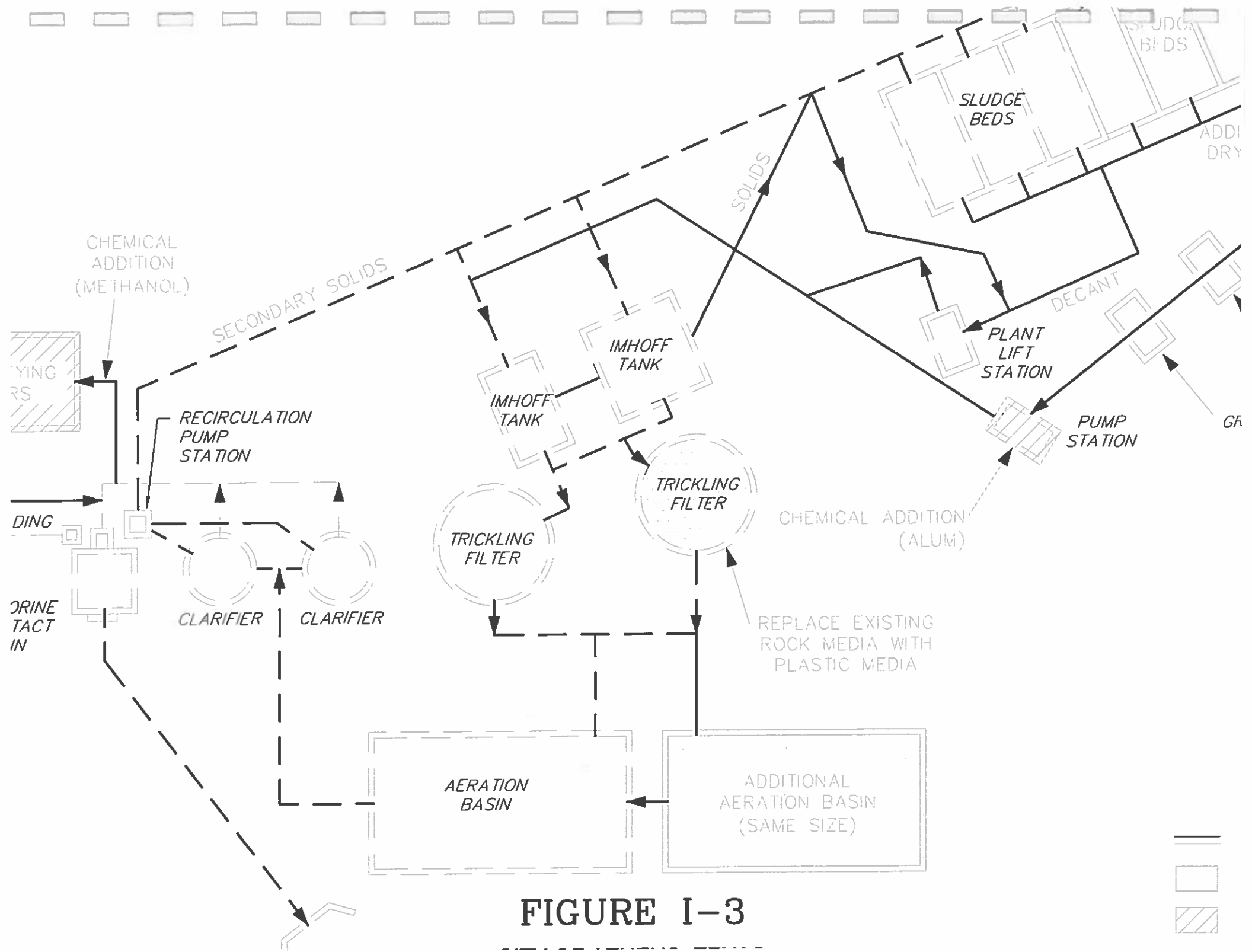
SLUDGE BEDS
SOLIDS
CHEMICAL ADDITION (METHANOL)
SECONDARY SOLIDS
IMHOFF TANK
IMHOFF TANK
DECANT
PLANT LIFT STATION
PUMP STATION
RECIRCULATION PUMP STATION
TRICKLING FILTER
TRICKLING FILTER
CHEMICAL ADDITION (ALUM)
CLARIFIER
CLARIFIER
REPLACE EXISTING ROCK MEDIA WITH PLASTIC MEDIA
AERATION BASIN
ADDITIONAL AERATION BASIN (SAME SIZE)

FIGURE I–3

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Athens was 11,297. Projected populations and flows through the year 2050 are listed in Table I-5.

Table I-5
City of Athens
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	12,390	13,588	16,343	19,657	23,643	28,438
Projected Flow (MGD)[2] North WWTP	0.50	0.54	0.65	0.78	0.94	1.14
Projected Flow (MGD)[2] West WWTP	0.74	0.82	0.98	1.18	1.42	1.7

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = assumed 100 gal/capita/day (Figure 1, 30 TAC 317.4 (a))

Table I-5 flow projections are based on the assumption that the flow split between the North (40%) and West (60%) WWTPs will continue as it is currently. The projected 2050 flow for the North plant is 1.14 MGD. The projected flow will exceed the rated capacity of the North plant around the year 2045.

FACILITY NEEDS EVALUATION

This section describes the facilities identified for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities will be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the plant's current permitted daily average flow is 1.027 MGD. Around the year 2045, the projected flow will exceed the current plant capacity, and there will be a need to expand the plant.

To treat year 2050 projected flows, the existing plant needs to be expanded to 1.14 MGD. An additional capacity of 0.109 MGD is required. The North WWTP needs to expand its influent pumping system to handle the higher flows. One of the existing trickling filters has rock media that can be replaced with plastic media to expand its treatment capability. An aeration basin of similar size to the existing basin needs to be added to achieve treatment capacity to treat year 2050 projected flows. Three additional sludge-drying beds of existing bed size would provide sufficient capacity through the year 2050.

The capital costs involved to improve the City's plant to treat the year 2050 flow are listed in Table I-6, as well as additional annual operation costs.

Table I-6
City of Athens North WWTP
Facility Needs to Meet Level I Effluent Requirements and 2050 Flows

Item Description			Cost
Influent Pumping			$139,000
Replace Rock Media with Plastic Media			$94,000
New Aeration Basin			$1,186,000
Three Additional Drying Beds			$60,000
Sub-Total			**$1,479,000**
Site Work and Yard Piping		20%	$295,800
Sub-Total			**$1,774,800**
Electrical and Instrumentation		20%	$354,960
Sub-Total			**$2,129,760**
Contingencies		25%	$532,440
Contractor OHP		15%	$319,464
Total Construction Cost			**$2,981,664**
Engineering		10%	$298,166
Permitting		5%	$149,083
Total Project Cost			**$3,428,914**
Power	75 hp and $0.12 per kW-hr		$60,000
Chemical			$0
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$3,000
Total O&M Cost per Year			**$63,000**

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L, total nitrogen to 10 mg/L, CBOD to 10 mg/L, TSS to 15 mg/L, and ammonia nitrogen to 2 mg/L. As total phosphorus average concentrations measured during the nutrient testing were greater than 1 mg/L, this evaluation assumes phosphorus effluent concentration reduction is necessary. To consistently achieve phosphorus concentrations of less than 1 mg/L, the addition of aluminum sulfate (alum) is recommended. Alum solution will be fed at the influent pump station to achieve required mixing of the alum solution. The use of alum may retard drying of the sludge on the drying beds. It may be necessary to add more drying beds or modify the existing ones to accommodate alum sludge.

A denitrifying filter will be added to meet the effluent total nitrogen limits. An alternative to the denitrifying filter would involve constructing anoxic zones in the aeration basin and recirculating nitrified effluent to the anoxic zone. This alternative should be evaluated during preliminary design.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table I-7.

Table I-7
City of Athens North WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Denitrification Filter			$330,500
Chemical Feed System for Alum			$55,000
Sub-Total			**$385,500**
Site Work and Yard Piping		20%	$77,100
Sub-Total			**$462,600**
Electrical and Instrumentation		20%	$92,520
Sub-Total			**$555,120**
Contingencies		25%	$138,780
Contractor OHP		15%	$83,268
Total Construction Cost			**$777,168**
Engineering		10%	$77,717
Permitting		5%	$38,858
Total Project Cost			**$893,743**
Power	25 hp and $0.12 per kW-hr		$20,000
Chemical			$1,800
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,090
Total O&M Cost per Year			**$22,890**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L, total nitrogen to 5 mg/L, CBOD to 10 mg/L, TSS to 15 mg/L, and ammonia nitrogen to 2 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be required. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table I-8.

Table I-8
City of Athens North WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$33,000
Sub-Total			**$33,000**
Site Work and Yard Piping		20%	$6,600
Sub-Total			**$39,600**
Electrical and Instrumentation		20%	$7,920
Sub-Total			**$47,520**
Contingencies		25%	$11,880
Contractor OHP		15%	$7,128
Total Construction Cost			**$66,528**
Engineering		10%	$6,653
Permitting		5%	$3,326
Total Project Cost			**$76,507**
Power			$0
Chemical			$36,700
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,835
Total O&M Cost per Year			**$38,535**

SECTION II

CHEROKEE SHORES WASTEWATER TREATMENT PLANT

SECTION II

CHEROKEE SHORES
WASTEWATER TREATMENT PLANT

INTRODUCTION

The Cherokee Shores wastewater treatment facility (WWTF) discharges into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

Tecon Water Company, L.P., owns and operates the Cherokee Shores wastewater treatment facility. The wastewater treatment plant is operated under TPDES Permit No. 13879-001 and has a rated capacity of 0.15 million gallons per day (MGD). The permit limits are shown in Table II-1; limits shown are final permit limits, which may have changed throughout the course of historical data collection and report writing.

Table II-1
Cherokee Shores WWTF
Current TPDES Permit Conditions
TPDES Permit No. 13879-001

Parameters	Permit Limits
BOD_5	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Ammonia Nitrogen (NH_3)	5 mg/L
Total Nitrogen	20 mg/L
Total Phosphorus	2 mg/L
Flow	0.15 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of the historical flows and effluent quality for Cherokee Shores wastewater treatment facility are presented in Table II-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about one-half of its rated capacity.

Table II-2
Cherokee Shores WWTF
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent	
		BOD_5	TSS
	(MGD)	(mg/L)	(mg/L)
1999	0.06	9.7	8.3
2000	0.05	11.3	11.5
2001	0.06	18.4	25.3
2002	0.08	9.4	20.4
2003	0.09	8.4	18.3
ND: No Data			

Historically, the plant has not met its effluent permit limits for TSS, and has had some difficulty in consistently meeting the BOD_5 limit. The plant has applied for and received a permit for expansion, the limits of which are those in Table II-1, and these final limits after expansion will be considered Level I for the purposes of this report. During the course of writing this report, the plant was subject to no permit limits for total nitrogen, phosphorous, or ammonia and the permitted flow was 0.075 MGD.

At the request of the Tarrant Regional Water District, Cherokee Shores collected 12 months of effluent nutrient data. During the 12 months of data collection, the plant's average nutrient concentrations were above the effluent limits for the final permit. A review of operations should be done to determine the reason for non-compliance. Operational and facility changes will be required to meet Level II and Level III effluent goals. A summary of the data is presented in Table II-3; all data may be found in Appendix A.

Table II-3
Cherokee Shores WWTF
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	50	50	50	50	50	50	50
Average (mg/L)	30.6	1.8	3.4	0.9	5.6	37.8	4.3
Minimum (mg/L)	5.5	0.4	0.2	0.0	0.0	18.4	0.5
Maximum (mg/L)	42.0	27.0	16.5	3.4	30.3	50.7	18.6

Figures II-1 and II-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

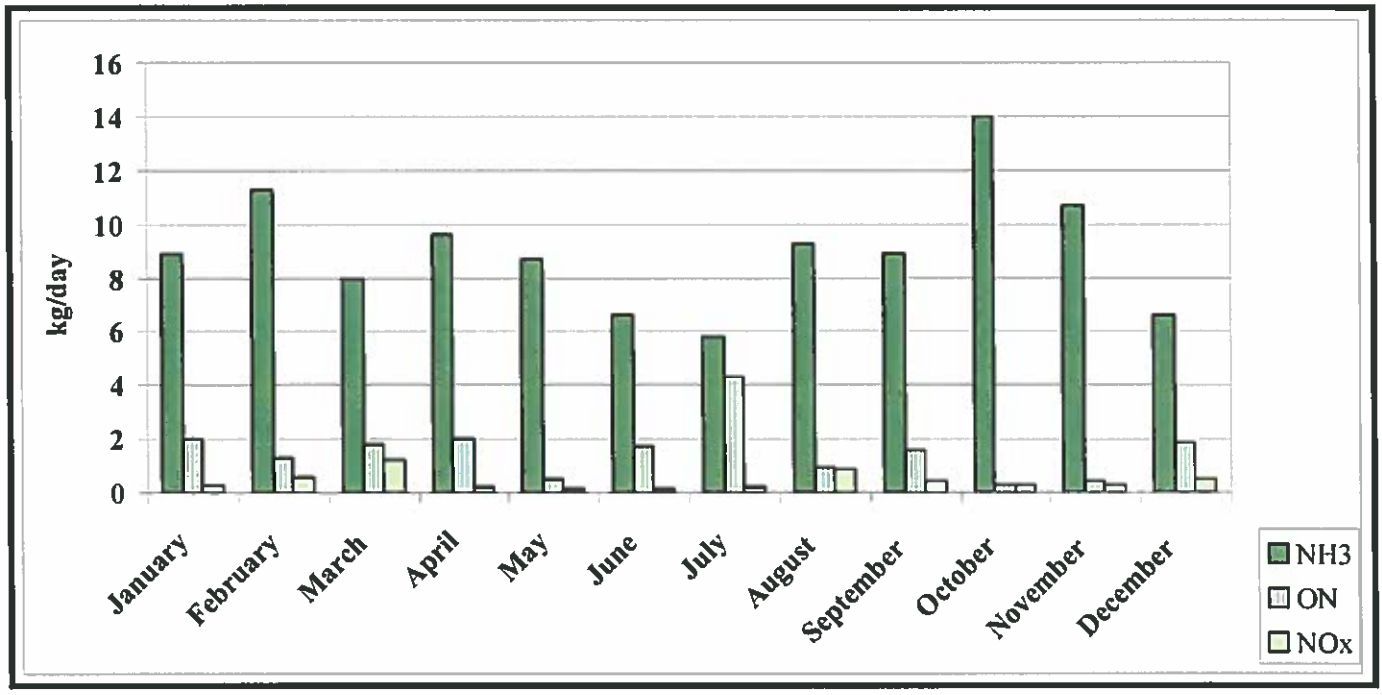

Figure II-1: Cherokee Shores Effluent Total Nitrogen Monthly Average Loads

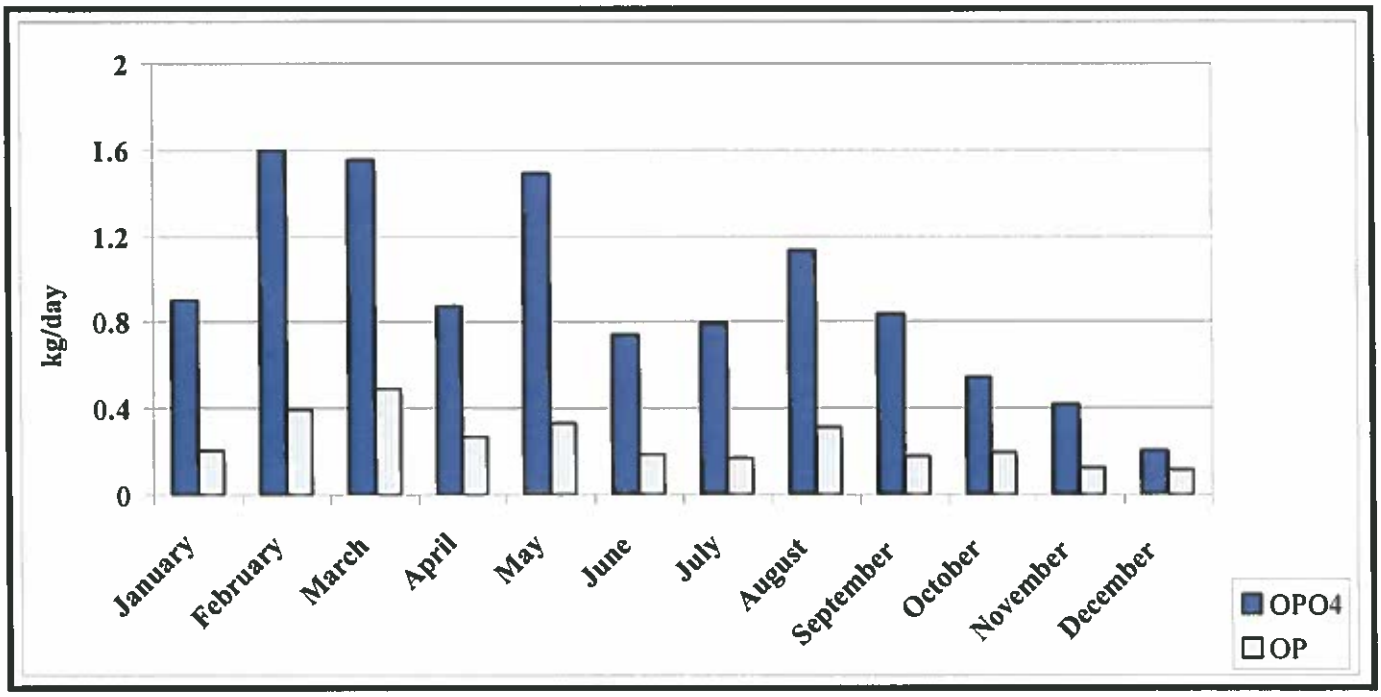

Figure II-2: Cherokee Shores Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The Cherokee Shores WWTF is a conventional wastewater treatment plant utilizing flow equalization, aeration basins, final clarification, filtration, and disinfection for treatment. The City's WWTF rated treatment capacity will be 0.15 MGD, but at the time of this report the plant was operating under a 0.075 MGD limit. See Figure II-3 for a schematic of the facilities processes. Table II-4 lists the existing treatment units and their current sizes.

Table II-4
Cherokee Shores WWTF
Existing Treatment Facilities

Treatment Units	Dimensions/Sizes
Aeration Basin	72-ft x 12-ft, 8-ft SWD 51,700 gallons
Circular Clarifier	20-ft diameter, 6-ft SWD 14,000 gallons
Filter Surface Area	80 square feet (each)
Chlorine Contact Basin Volume	7,200 gallons
Equalization Basin Volume	2,350 gallons
Aerobic Digester Volume	16,150 gallons

Influent wastewater is either routed to the aeration basin or to a flow equalization tank. The primary purpose of the equalization tank is to hold peak flows for short time periods so as not to exceed the capacity of the other treatment units. The equalization tank can also be used to equalize flow with varying characteristics. The wastewater is treated in an aeration basin where microorganisms stabilize the organics present in the wastewater. Flow from the aeration basin is settled in the clarifier to separate out the biomass. The clarifier overflow is then passed through a sand filtration system and disinfected with chlorine solution prior to discharge.

A portion of settled sludge is returned to the aeration basin as return activated sludge and the remainder is sent to an aerobic digester. Digested sludge is pumped from the digester and disposed off-site.

Table V-7
City of Kaufman WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Alum			$55,000
Denitrification Filters			$661,000
Sub-Total			**$716,000**
Site Work and Yard Piping		20%	$143,200
Sub-Total			**$859,200**
Electrical and Instrumentation		20%	$171,840
Sub-Total			**$1,031,040**
Contingencies		25%	$257,760
Contractor OHP		15%	$154,656
Total Construction Cost			**$1,443,456**
Engineering		10%	$144,346
Permitting		5%	$72,173
Total Project Cost			**$1,659,974**
Power	5 hp and $0.12 per kW-hr		$4,000
Chemical			$2,600
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$330
Total O&M Cost per Year			**$6,930**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L, total nitrogen to 5 mg/L, and ammonia nitrogen to 3 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be needed.

Minor additional capital investment is necessary for the Level II to Level III transition, as the majority the required infrastructure would be in placed in the Level II improvements. Operational cost would increase, as additional chemicals are required. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table V-8.

Table V-8
City of Kaufman WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$40,000
Sub-Total			**$40,000**
Site Work and Yard Piping		20%	$8,000
Sub-Total			**$48,000**
Electrical and Instrumentation		20%	$9,600
Sub-Total			**$57,600**
Contingencies		25%	$14,400
Contractor OHP		15%	$8,640
Total Construction Cost			**$80,640**
Engineering		10%	$8,064
Permitting		5%	$4,032
Total Project Cost			**$92,736**
Power			
Chemical			$52,800
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$2,640
Total O&M Cost per Year			**$55,440**

SECTION VI

CITY OF KEMP
WASTEWATER TREATMENT PLANT

SECTION VI

CITY OF KEMP
WASTEWATER TREATMENT PLANT

INTRODUCTION

The Kemp WWTP discharges into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Kemp operates its wastewater treatment plant under TPDES Permit No. 10695-001 and has a rated capacity of 0.2 million gallons per day (MGD). The permit limits are shown in Table VI-1; limits shown are existing permit limits, which may have changed throughout the course of historical data collection and report writing.

Table VI-1
City of Kemp WWTP
Current TPDES Permit Conditions
TPDES Permit No. 10695-001

Parameters	Permit Limits
Carbonaceous Biochemical Oxygen Demand (CBOD)	5 mg/L
Total Suspended Solids (TSS)	5 mg/L
Ammonia Nitrogen (NH_3-N)	2 mg/L
Flow	0.2 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of historical flows and effluent quality for the City of Kemp's wastewater treatment plant are presented in Table VI-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about one-half of its rated capacity.

Table VI-2
City of Kemp WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent		
		CBOD	TSS	NH_3-N
	(MGD)	(mg/L)	(mg/L)	(mg/L)
1999	0.1	6.9	20.4	ND
2000	ND	ND	ND	ND
2001	ND	ND	ND	ND
2002*	0.07	2.2	8.4	0.6
2003*	0.1	2.9	11.7	0.9

ND: No Data
*Incomplete year's worth of data; average of seven and eight months, respectively

Data indicate that the plant met its CBOD and NH_3-N limit for the past two years. At the request of the Tarrant Regional Water District, the city of Kemp collected 12 months of effluent nutrient data. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the data is presented in Table VI-3; all data may be found in Appendix A.

Table VI-3
City of Kemp WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	53	53	53	53	53	53	53
Average (mg/L)	0.39	11.92	2.73	0.45	2.05	14.36	3.18
Minimum (mg/L)	0.02	0.00	0.50	0.00	0.06	1.65	0.93
Maximum (mg/L)	3.00	29.70	7.46	3.32	4.82	37.52	8.55

Figures VI-1 and VI-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

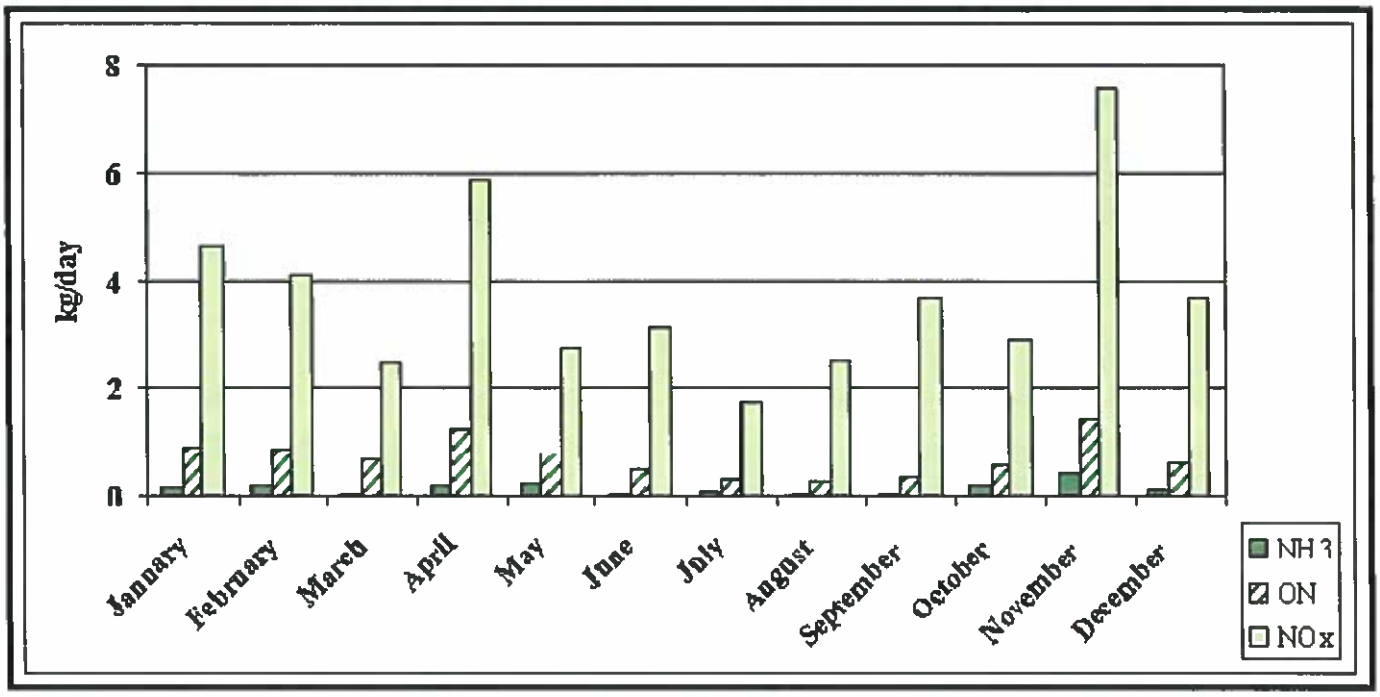

Figure VI-1: Kemp Effluent Total Nitrogen Monthly Average Loads

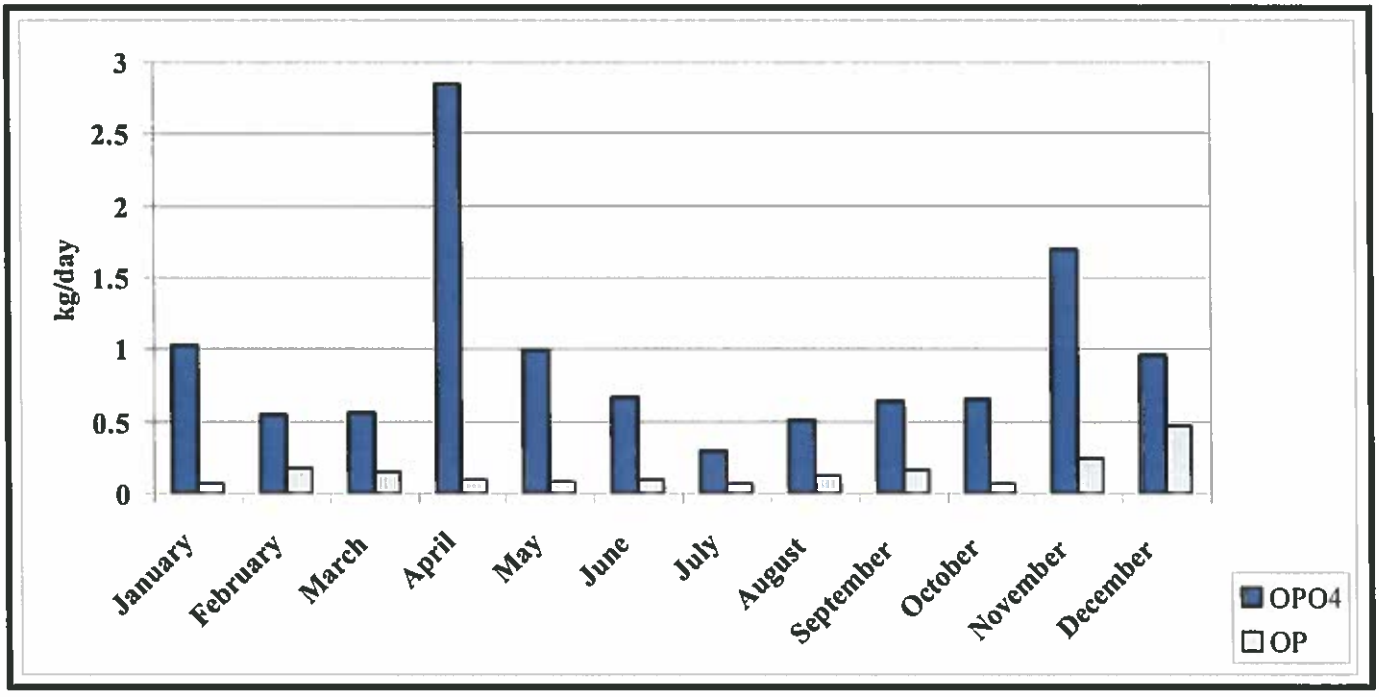

Figure VI-2: Kemp Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The City's WWTP is a conventional wastewater treatment plant utilizing screening, grit removal, aeration basins, final clarification, and chlorine disinfection for treatment. See Figure VI-3 for the plant's process schematic. Table VI-4 lists the existing treatment units and their current sizes.

Table VI-4
City of Kemp WWTP
Existing Treatment Facilities

Treatment Units	Dimension/Size
Oxidation Ditch Volume	117-ft x 51-ft, 10-ft SWD 446,000 gallons
Circular Clarifier (typ.2) Volume	28-ft diameter, 10-ft SWD 46,000 gallons (each)
Chlorine Contact Basin Volume	17,200 gallons
Sludge Drying Beds Total Area	5,644 square feet

Wastewater from the collection system passes through a bar screen and continues through a grit removal system at the headworks. The wastewater then flows into an oxidation ditch, where the wastewater is mixed with return activated sludge from the clarifier. The activated sludge is then settled in the circular clarifiers. The clarified effluent is disinfected with chlorine prior to discharge. The portion of sludge settled in the clarifier is returned to aeration basin as return activated sludge and the remaining portion is dewatered in sludge drying beds.

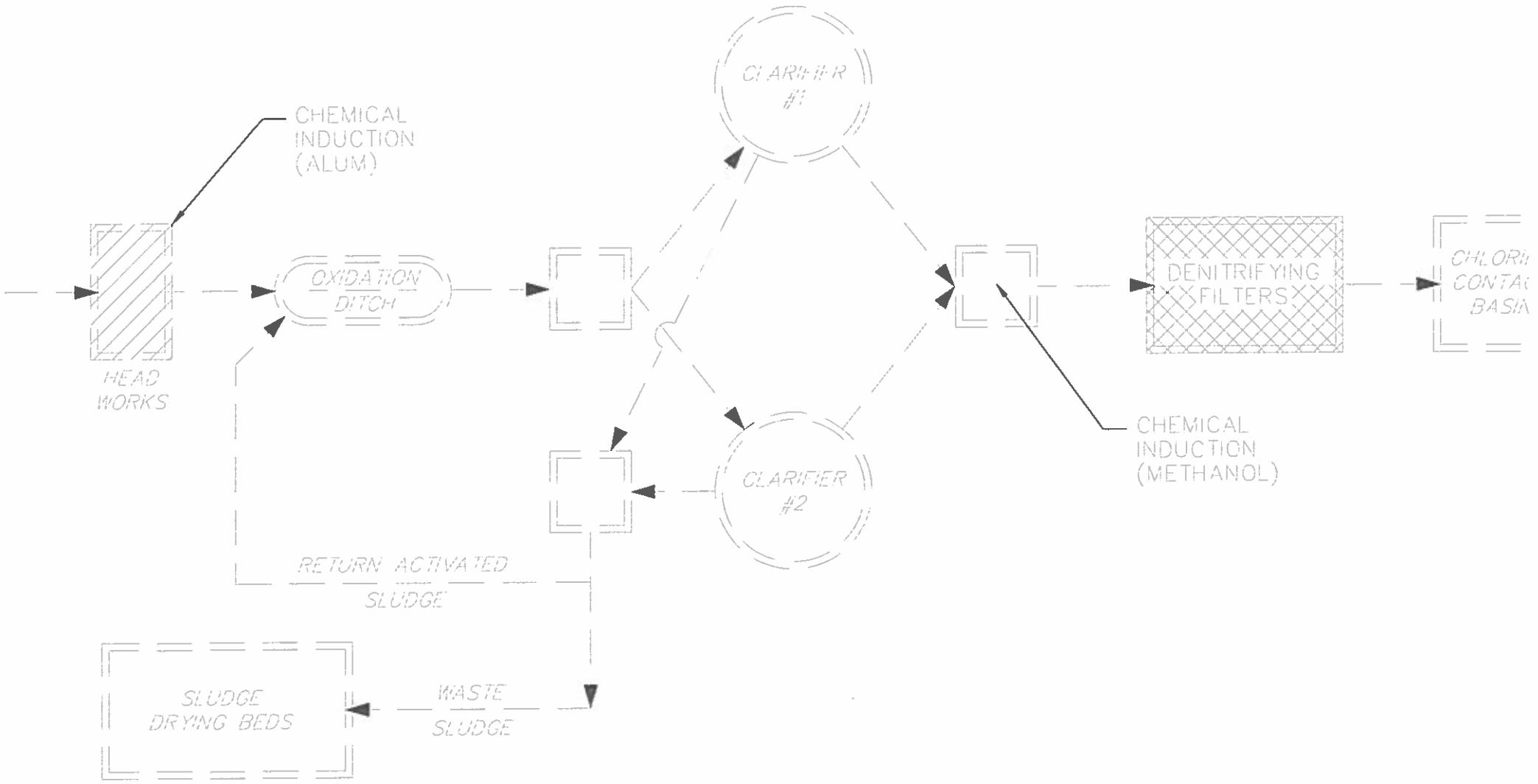

FIGURE VI-3

CITY OF KEMP, TEXAS

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Kemp was 1,133. Projected populations and flows through the year 2050 are listed in Table VI-5.

Table VI-5
City of Kemp
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	1,133	1,133	1,133	1,133	1,133	1,133
Projected Flow (MGD)[2]	0.113	0.113	0.113	0.113	0.113	0.113

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = 100 gal/capita/day (Figure 1: 30 TAC 317.4 (a))

The City of Kemp plant has enough capacity to treat the projected flows through the year 2050.

FACILITY NEEDS EVALUATION

This section describes the facilities identified for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities will be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the permitted daily average flow through the City's plant is 0.2 MGD and the current plant is capable of treating the projected flows through the year 2050.

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L, total nitrogen to 10 mg/L, and ammonia nitrogen to 2 mg/L. The historical data shows that the total nitrogen effluent concentration averages about 15 mg/L and total phosphorus effluent concentration averages around 3 mg/L. To consistently achieve phosphorus concentrations of less than 1 mg/L, the addition of aluminum sulfate (alum) is recommended. The use of alum may retard drying of the sludge on the drying beds. It may be necessary to add drying beds or modify the existing ones to accommodate alum sludge. The existing oxidation ditch can be operated for denitrification to achieve total nitrogen removal to less than 10 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table VI-6.

Table VI-6
City of Kemp WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Alum			$22,000
Sub-Total			**$22,000**
Site Work and Yard Piping		20%	$4,400
Sub-Total			**$26,400**
Electrical and Instrumentation		20%	$5,280
Sub-Total			**$31,680**
Contingencies		25%	$7,920
Contractor OHP		15%	$4,752
Total Construction Cost			**$44,352**
Engineering		10%	$4,435
Permitting		5%	$2,218
Total Project Cost			**$51,005**
Power	5 hp and $0.12 per kW-hr		$4,000
Chemical			$230
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$212
Total O&M Cost per Year			**$4,442**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L, total nitrogen to 5 mg/L, and ammonia nitrogen to 2 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be needed. A denitrifying filter will also be required to meet the effluent total nitrogen limits. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table VI-7.

Table VI-7
City of Kemp WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$28,000
Denitrification Filter			$204,000
	Sub-Total		**$232,000**
Site Work and Yard Piping		20%	$46,400
	Sub-Total		**$278,400**
Electrical and Instrumentation		20%	$55,680
	Sub-Total		**$334,080**
Contingencies		25%	$83,520
Contractor OHP		15%	$50,112
	Total Construction Cost		**$467,712**
Engineering		10%	$46,771
Permitting		5%	$23,386
	Total Project Cost		**$537,869**
Power	20 hp and $0.12 per kW-hr		$16,000
Chemical			$4,600
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,030
	Total O&M Cost per Year		**$21,630**

SECTION VII

CITY OF MABANK
WASTEWATER TREATMENT PLANT

SECTION VII

CITY OF MABANK
WASTEWATER TREATMENT PLANT

INTRODUCTION

The Mabank WWTP discharges into the Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Mabank operates its wastewater treatment plant under TPDES Permit No. 10579-001 and has a rated capacity of 0.4 million gallons per day (MGD). The permit limits are shown in Table VII-1; limits shown are existing permit limits, which may have changed throughout the course of historical data collection and report writing.

Table VII-1
City of Mabank WWTP
Current TPDES Permit Conditions
TPDES Permit No. 10579-001

Parameters	Permit Limits
Carbonaceous Biochemical Oxygen Demand (CBOD)	30 mg/L
Total Suspended Solids (TSS)	90 mg/L
Ammonia Nitrogen (NH_3)	2 mg/L
Flow	0.4 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of historical flows and effluent quality for the City of Mabank's wastewater treatment plant are presented in Table VII-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about one-third of its rated capacity. The plant is consistently meeting its current effluent permit conditions.

Table VII-2
City of Mabank WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent		
		CBOD	TSS	NH_3-N
	(MGD)	(mg/L)	(mg/L)	(mg/L)
1999	0.17	8.0	35.9	1.1
2000*	0.16	6.8	24.1	0.3
2001	ND	ND	ND	ND
2002	ND	ND	ND	ND
2003	0.11	10.7	46.8	1.3

ND: No Data
*Incomplete year's worth of data; only one month reported

At the request of the Tarrant Regional Water District, the city of Mabank collected 12 months of effluent nutrient data. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the data is presented in Table VII-3; all data may be found in Appendix A.

Table VII-3
City of Mabank WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	52	52	52	52	52	52	52
Average (mg/L)	1.15	6.35	3.29	0.60	4.28	11.77	3.89
Minimum (mg/L)	0.16	1.56	1.20	0.00	0.00	6.23	1.78
Maximum (mg/L)	3.88	14.50	4.67	1.19	10.26	19.12	5.16

Figures VII-1 and VII-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

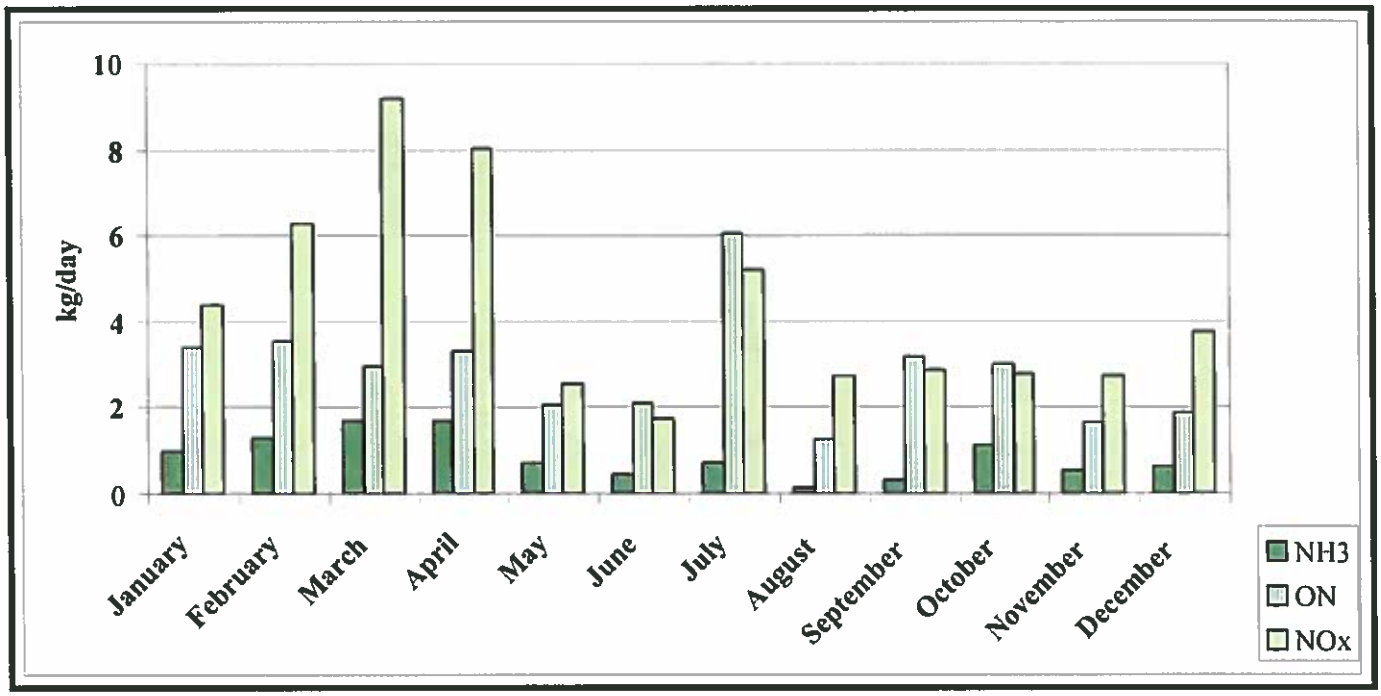

Figure VII-1: Mabank Effluent Total Nitrogen Monthly Average Loads

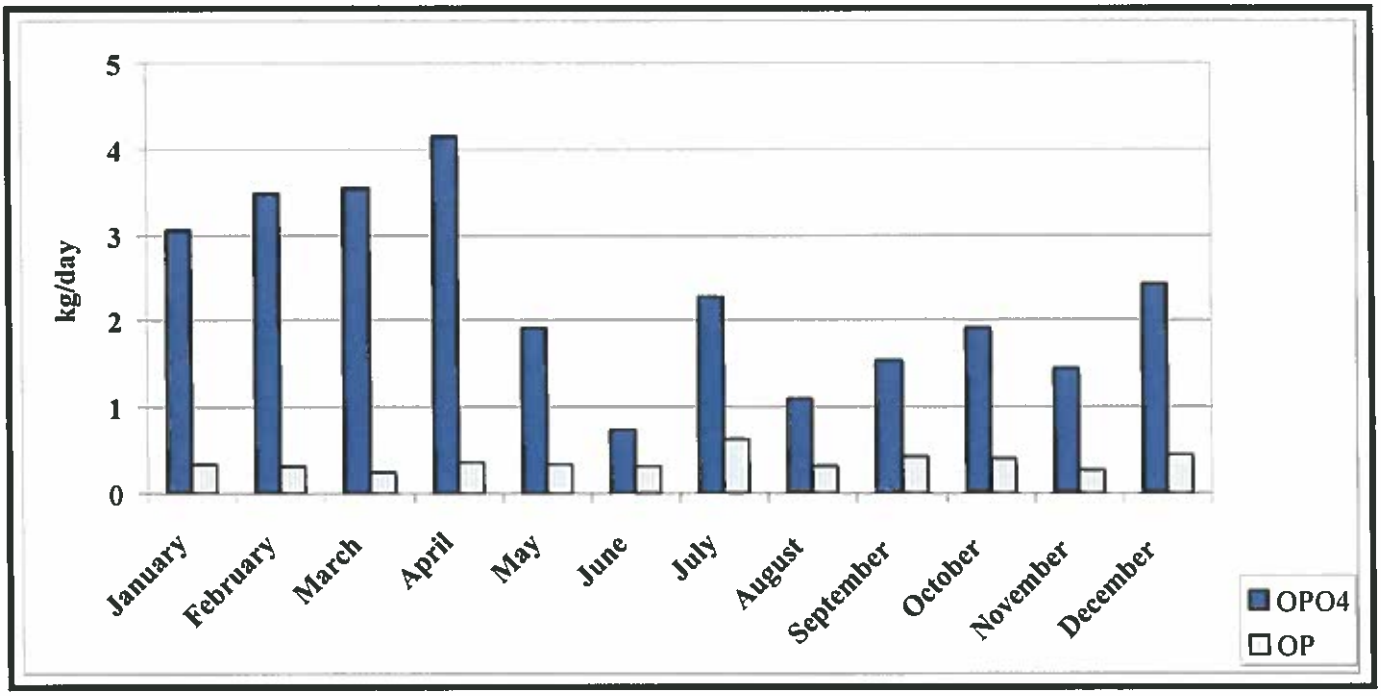

Figure VII-2: Mabank Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The City's WWTP is a conventional wastewater treatment plant utilizing screening, aeration basins, stabilization ponds, and nitrifying towers for treatment. See Figure VII-3 for the plant's process schematic. Table VII-4 lists the existing treatment units and their current sizes.

Table VII-4
City of Mabank WWTP
Existing Treatment Facilities

Treatment Units	Dimension/Size
Oxidation Ditch Volume	240,000 gallons
Stabilization pond No. 1 Volume	6.63 MG
Stabilization pond No. 2 Volume	1.82 MG
Stabilization pond No. 3 Volume	1.82 MG
Diameter of Biotower	34 feet
Media Depth of Biotower	16 feet

Wastewater flows under gravity into the plant and is routed through a manually cleaned bar screen followed by an automatic grit removal system. The collected solids and grit are disposed of at an off-site landfill facility. An influent lift station pumps the screened and degritted wastewater to an oxidation ditch. The oxidation ditch is operated as pre-aeration basins only. There is no return sludge system. The aerated wastewater is then routed to three stabilization ponds, which have an approximately 30-day retention time. The stabilization ponds are operated as a low–rate facultative ponds without aeration. Sludge is periodically removed from the ponds by dredging and disposed offsite. The ammonia nitrogen is removed from the effluent wastewater through a nitrifying biotower. A Parshall flume measures the effluent before discharging into the creek.

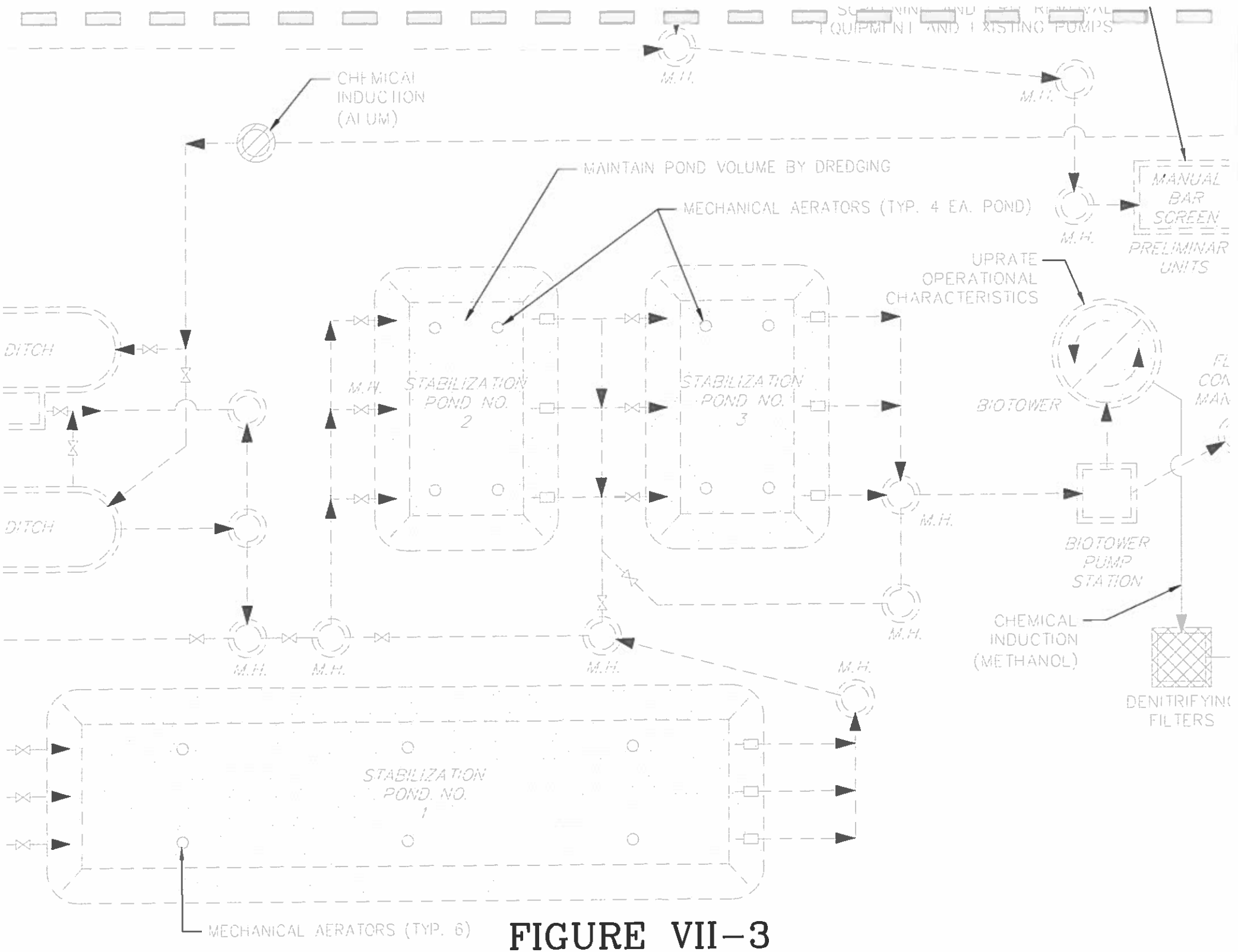
CHEMICAL INDUCTION (ALUM)
MAINTAIN POND VOLUME BY DREDGING
MECHANICAL AERATORS (TYP. 4 EA. POND)
MANUAL BAR SCREEN
PRELIMINAR UNITS
UPRATE OPERATIONAL CHARACTERISTICS
DITCH
DITCH
STABILIZATION POND NO. 2
STABILIZATION POND NO. 3
STABILIZATION POND NO. 1
BIOTOWER
BIOTOWER PUMP STATION
CHEMICAL INDUCTION (METHANOL)
DENITRIFYIN FILTERS
M.H.
MECHANICAL AERATORS (TYP. 6)

FIGURE VII-3

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Mabank was 2,151. Projected populations and flows through the year 2050 are listed in Table VII-5.

Table VII-5
City of Mabank
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	2,400	2,708	3,254	3,814	4,433	5,199
Projected Flow (MGD)[2]	0.24	0.27	0.33	0.38	0.44	0.52

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = 100 gal/capita/day (Figure 1: 30 TAC 317.4 (a))

The projected flow will exceed the current plant capacity in the decade between 2030 and 2040.

FACILITY NEEDS EVALUATION

This section describes the facilities identified for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities would be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the plant's current permitted daily average is 0.4 MGD. During the decade between 2030 and 2040, the projected flow will exceed the existing plant capacity, and there will be a need to expand the plant.

To treat year 2050-projected flows, the existing plant needs to be expanded to 0.52 MGD. An additional capacity of 0.08 MGD needs to be added. The headworks structure, consisting of a manually cleaned bar screen, grit removal unit, and a pump station, needs to be expanded to handle higher flows. The existing headworks structure is designed for a peaking factor of 2.5 or a flow of 1 MGD. The headworks structure and influent pump station need to be expanded to handle the peak flow of 1.3 MGD.

Maintaining the current volume of the stabilization ponds and adding surface aerators in each of the ponds should provide the required treatment capacity for the 2050 projected flows under current discharge limits. Four 30-hp surface aerators in each pond are recommended. It should be emphasized that the volumes of the ponds must be maintained through regularly scheduled dredging for solids removal.

The existing biotower is designed as a nitrifying biotower with a low loading rate. The existing biotower has the capacity to treat the year 2050 projected flows. Since the detention time in the stabilization ponds will be reduced at the higher flows, the effluent from the biotower will need to be disinfected once the flow exceeds 1 MGD. A chlorine disinfection system with chlorine gas cylinders

and chlorine feed equipment is recommended. Alternative disinfection technologies may be considered when the expansion is required.

The costs involved to improve the City's plant to treat the year 2050 flow are listed in Table VII-6, as well as additional annual operation costs.

Table VII-6
City of Mabank WWTP
Facility Needs to Meet Level I Effluent Requirements and 2050 Flows

Item Description			Cost
Fine Screens and Grit Removal			$17,000
Influent Pumping			$31,000
Aeration Equipment			$133,000
Disinfection System			$33,000
Three Sludge Drying Beds			$60,000
Sub-Total			**$274,000**
Site Work and Yard Piping		20%	$54,800
Sub-Total			**$328,800**
Electrical and Instrumentation		20%	$65,760
Sub-Total			**$394,560**
Contingencies		25%	$98,640
Contractor OHP		15%	$59,184
Total Construction Cost			**$552,384**
Engineering		10%	$55,238
Permitting		5%	$27,619
Total Project Cost			**$635,242**
Power	120 hp and $0.12 per kW-hr		$94,000
Chemical			$0
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$4,700
Total O&M Cost per Year			**$98,700**

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L, total nitrogen to 10 mg/L, CBOD to 5 mg/L, TSS to 5 mg/L, and ammonia nitrogen to 2 mg/L. The historical effluent data show that total nitrogen concentrations average about 12 mg/L and total phosphorus concentrations average about 4 mg/L. To consistently achieve phosphorus concentrations of less than 1 mg/L, the addition of aluminum sulfate (alum) is recommended. Alum solution will be fed prior to the oxidation ditch to provide the required mixing of the alum solution. The stabilization ponds need to be dredged and regularly maintained to utilize the design pond volume and achieve total nitrogen removal down to less than 10 mg/L.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table VII-7.

Table VII-7
City of Mabank WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Alum			$55,000
Sub-Total			**$55,000**
Site Work and Yard Piping		20%	$11,000
Sub-Total			**$66,000**
Electrical and Instrumentation		20%	$13,200
Sub-Total			**$79,200**
Contingencies		25%	$19,800
Contractor OHP		15%	$11,880
Total Construction Cost			**$110,880**
Engineering		10%	$11,088
Permitting		5%	$5,544
Total Project Cost			**$127,512**
Power	5 hp and $0.12 per kW-hr		$4,000
Chemical			$1,100
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$255
Total O&M Cost per Year			**$5,355**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L, total nitrogen to 5 mg/L, CBOD to 5 mg/L, TSS to 5 mg/L, and ammonia nitrogen to 2 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be needed.

To meet the effluent total nitrogen limits, a denitrifying filter will be required. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L. As with the Level I and II facilities, maintaining the pond volume is also crucial to provide the detention time necessary to produce the required effluent quality.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table VII-8.

Table VII-8
City of Mabank WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$30,000
Denitrification Filters			$330,500
	Sub-Total		**$360,500**
Site Work and Yard Piping		20%	$72,100
	Sub-Total		**$432,600**
Electrical and Instrumentation		20%	$86,520
	Sub-Total		**$519,120**
Contingencies		25%	$129,780
Contractor OHP		15%	$77,868
	Total Construction Cost		**$726,768**
Engineering		10%	$72,677
Permitting		5%	$36,338
	Total Project Cost		**$835,783**
Power	20 hp and $0.12 per kW-hr		$16,000
Chemical			$13,800
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,490
	Total O&M Cost per Year		**$31,290**

SECTION VIII

CITY OF TERRELL
KING'S CREEK WASTEWATER TREATMENT PLANT

SECTION VIII

CITY OF TERRELL
KING'S CREEK WASTEWATER TREATMENT PLANT

INTRODUCTION

The Terrell WWTP discharges into King's Creek and then it flows into Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historical reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions and projected future limits
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Terrell operates its wastewater treatment plant under TPDES Permit No. 10747-001 and has a rated capacity of 4.5 million gallons per day (MGD). The permit limits are shown in Table VIII-1; limits shown are existing permit limits, which may have changed throughout the course of historical data collection and report writing.

Table VIII-1
City of Terrell King's Creek WWTP
Current TPDES Permit Conditions
TPDES Permit No. 10747-001

Parameters	Permit Limits
Carbonaceous Biochemical Oxygen Demand (CBOD)	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Ammonia Nitrogen (NH_3)	6 mg/L
Flow	4.5 MGD

The existing permit conditions are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of historical flows and effluent quality for the King's wastewater treatment plant are presented in Table VIII-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about two-thirds of its rated capacity. The plant is consistently meeting its effluent permit conditions.

Table VIII-2
City of Terrell King's Creek WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent		
		CBOD	TSS	NH_3-N
	(MGD)	(mg/L)	(mg/L)	(mg/L)
1999	2.4	8.2	5.9	4.4
2000*	2.0	9.2	8.4	6.3
2001	ND	ND	ND	ND
2002	ND	ND	ND	ND
2003*	2.8	9.2	7.7	5.0

ND: No Data
*Incomplete year's worth of data; average of seven and eleven months, respectively

At the request of the Tarrant Regional Water District, the city of Terrell collected 12 months of effluent nutrient data. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the data is presented in Table VIII-3; all data may be found in Appendix A.

Table VIII-3
City of Terrell King's Creek WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	52	52	52	52	52	52	52
Average (mg/L)	4.50	11.86	4.10	0.24	3.35	19.71	4.03
Minimum (mg/L)	0.62	2.27	1.70	0.00	0.00	9.77	0.72
Maximum (mg/L)	9.10	53.50	6.21	1.95	9.90	62.50	5.63

Figures VIII-1 and VIII-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

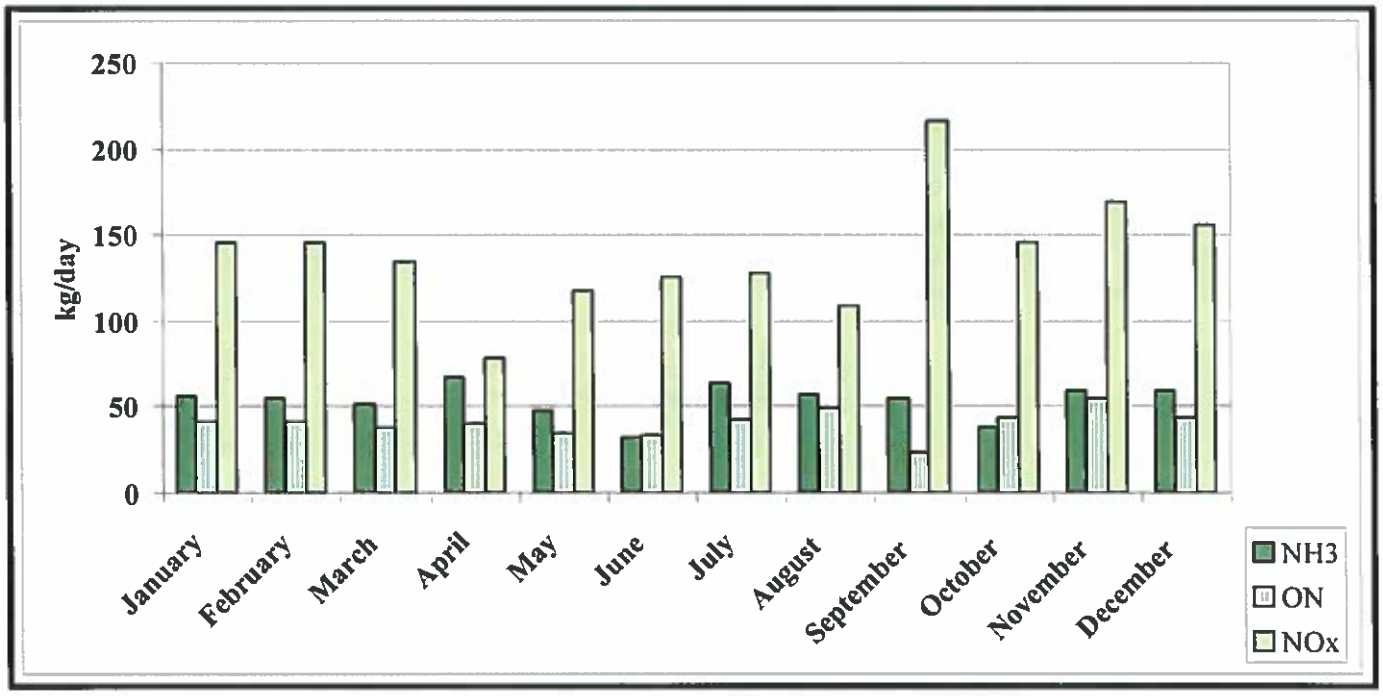

Figure VIII-1: Terrell Effluent Total Nitrogen Monthly Average Loads

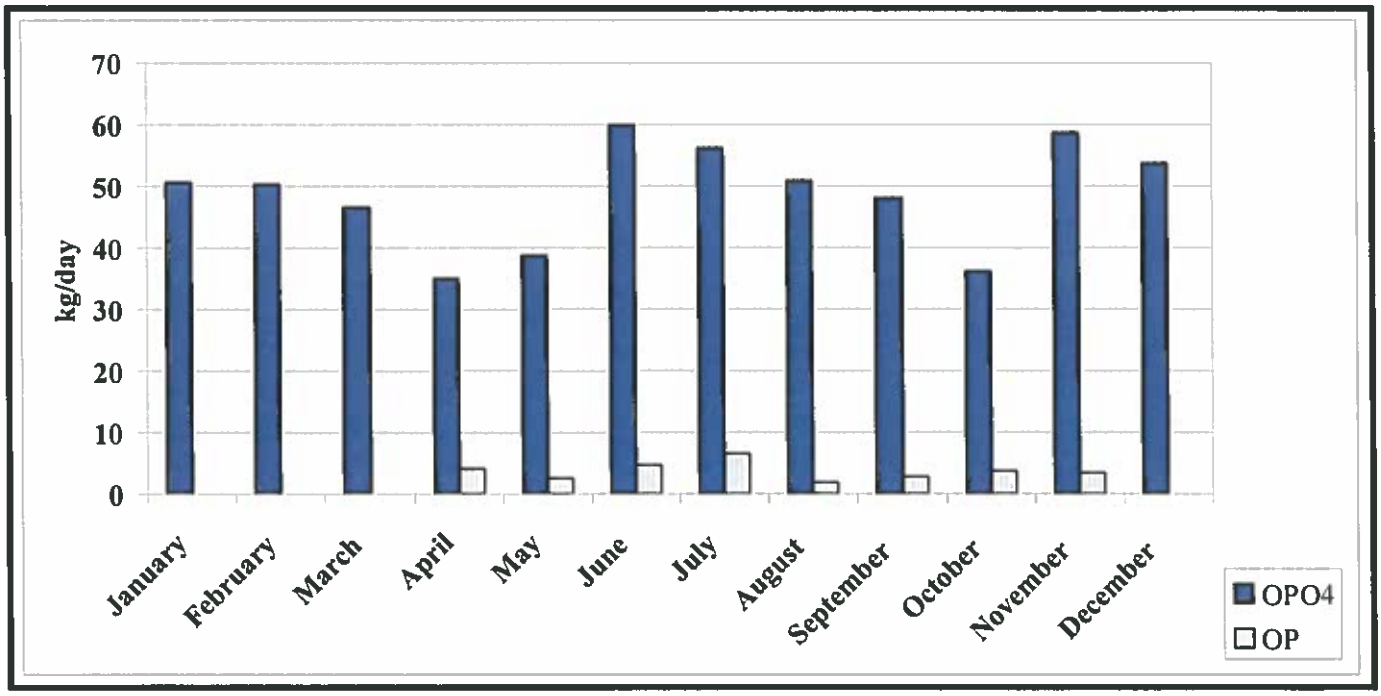

Figure VIII-2: Terrell Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

The King's Creek WWTP is a conventional wastewater treatment plant utilizing equalization, screening, grit removal, primary clarification, trickling filters, final clarification, and disinfection for treatment. See Figure VIII-3 for the plant's process schematic. Table VIII-4 lists the existing treatment units and their current sizes.

Table VIII-4
City of Terrell King's Creek WWTP
Existing Treatment Facilities

Treatment Units	Dimension/Size
Equalization Basin Volume	0.66 million gallons
Primary Clarifier Volume	85-ft diameter, 7-ft SWD 297,000 gallons
First Trickling Filter Volume	140-ft diameter, 7-ft SWD 806,000 gallons
Intermediate Clarifier Volume	75-ft diameter, 7-ft SWD 231,000 gallons
Second Trickling Filters 1 and 2 Volume	100-ft diameter, 6-ft SWD 352,000 gallons
Final Clarifiers 1 and 2 Volume	85-ft diameter, 10-ft SWD 424,000 gallons (each)
Chlorine Contact Basin Volume	147,500 gallons
Anaerobic Digesters 1 and 2 Volume	0.27 MG
Sludge Holding Tank Volume	0.13 MG

Wastewater flows under gravity to an equalization basin and then to the headworks. Headworks structure utilizes a mechanically cleaned bar screen with ¾-inch opening to remove larger solids and two aerated grit removal chambers. The screenings and grit are disposed at an off-site landfill facility.

Wastewater is clarified under gravitational force in the primary clarification basin to separate a portion of the suspended solids and organic matter from the wastewater. The King's Creek WWTP uses a two-stage trickling filter system. In this system, wastewater trickles through a bed of plastic packing materials, to which the microorganisms are attached, and then passes through a clarification unit. The clarified wastewater passes through a second-stage trickling filter and to another clarifier for settling. The first-stage trickling filter is primarily utilized to reduce the carbonaceous biochemical oxygen demand in the wastewater and the second-stage trickling filter reduces the concentrations of ammonia nitrogen present in the wastewater. A portable belt press serves to dewater the sludge.

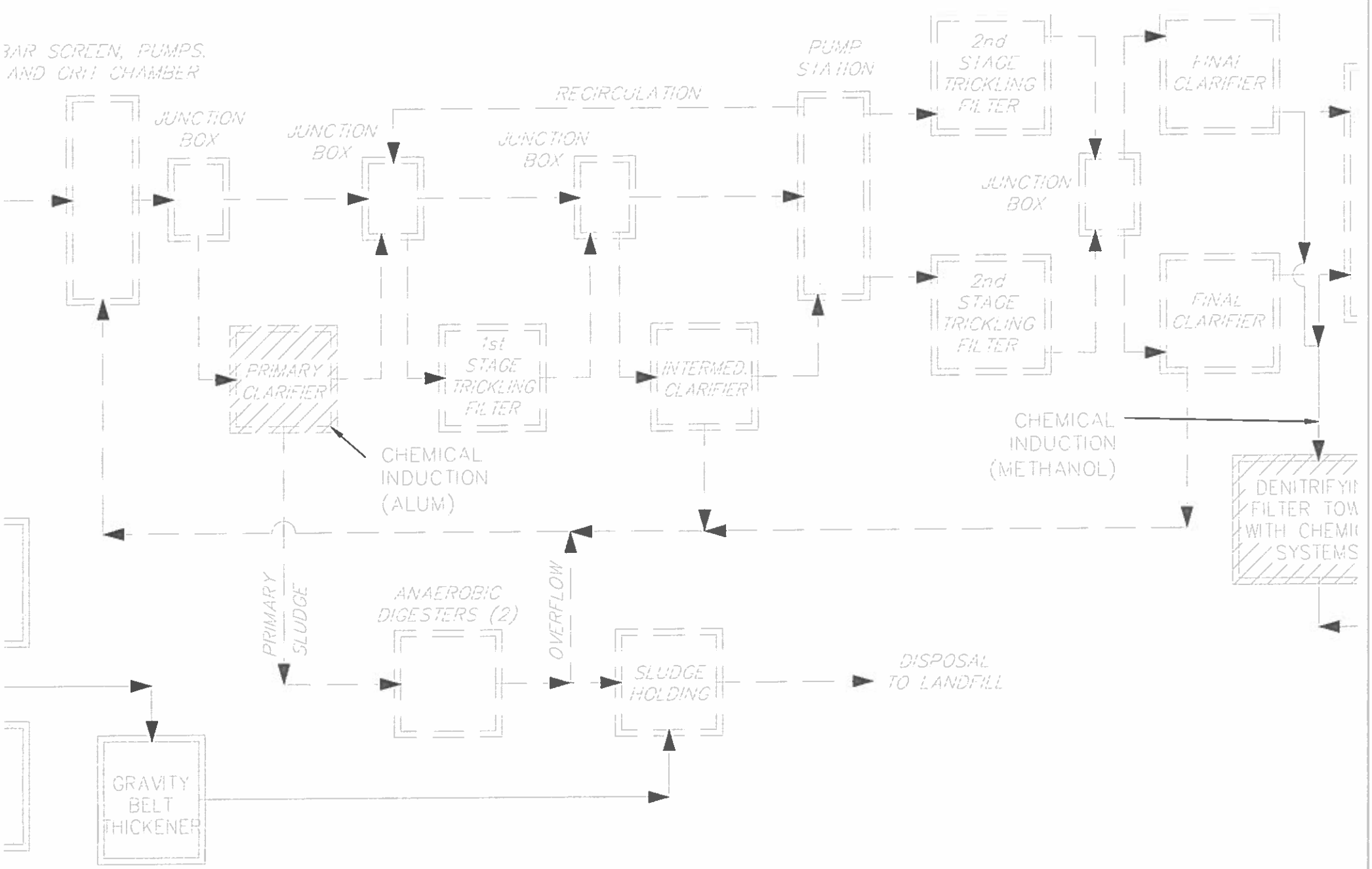

FIGURE VIII-3

CITY OF TERRELL, TEXAS

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Terrell was 13,606. Projected populations and flows through the year 2050 are listed in Table VIII-5.

Table VIII-5
City of Terrell
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	14,379	15,196	18,642	21,664	23,650	25,599
Projected Flow (MGD)[2]	3.23	3.42	4.19	4.87	5.32	5.76

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = 135 gal/Capita/day (Observed by the plant) and 40% Industrial Flow

The King's Creek WWTP has historically received more flow than the TCEQ design criteria of 100 gal/capita/day. The 135 gal/capita/day observed by the plant was used to project flows. The projected flows will exceed the current plant capacity of 4.5 MGD around the year 2025.

FACILITY NEEDS EVALUATION

This section describes the facilities identified for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities will be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the plant's current permitted daily average flow is 4.5 MGD. To treat higher flows through the year 2050, the existing plant needs to be expanded to add an additional 1.26 MGD of capacity between the decade of 2020 and 2030.

To achieve the expanded capacity, an additional treatment train is required. Fine screens and grit removal are needed for preliminary treatment. Two new sequencing batch reactors (SBRs) and single media automatic backwash filters (ABW) could supply the required capacity to treat the higher flows. The existing chorine contact basin would be expanded. To handle the higher solids volume, a gravity belt thickener is recommended.

The capital costs, as well as the annual operational costs, involved to improve the City's plant to treat the year 2050 flow are listed in Table VIII-6.

Table VIII-6
City of Terrell King's Creek WWTP
Facility Needs to Meet Level I Effluent Requirements and 2050 Flows

Item Description			Cost
Fine Screens and Grit Removal			$218,000
Sequencing Batch Reactors			$1,759,000
Automatic Backwash Filters			$724,000
Expansion of Chlorine Contact Basin			$277,000
Gravity Belt Thickener			$221,000
Sub-Total			**$3,199,000**
Site Work and Yard Piping		20%	$639,800
Sub-Total			**$3,838,800**
Electrical and Instrumentation		20%	$767,760
Sub-Total			**$4,606,560**
Contingencies		25%	$1,151,640
Contractor OHP		15%	$690,984
Total Construction Cost			**$6,449,184**
Engineering		10%	$644,918
Permitting		5%	$322,459
Total Project Cost			**$7,416,562**
Power	120 hp and $0.12 per kW-hr		$94,000
Chemical			$2,300
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$4,815
Total O&M Cost per Year			**$101,115**

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L, total nitrogen to 10 mg/L, CBOD to 10 mg/L, TSS to 15 mg/L, and ammonia nitrogen to 6 mg/L. As detailed in Table VIII-3, the average effluent total nitrogen concentration was about 20 mg/L and the average effluent total phosphorus concentration was about 4 mg/L.

To consistently achieve total phosphorus concentrations of 1 mg/L, add aluminum sulfate (alum) to precipitate with the phosphorous in the wastewater. To consistently achieve a total nitrogen effluent concentration of less than 10 mg/L, add a denitrifying filter to the existing treatment train and operate the new SBRs for denitrification.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table VIII-7.

Table VIII-7
City of Terrell King's Creek WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Alum			$55,000
Denitrification Filters			$1,322,000
Sub-Total			**$1,377,000**
Site Work and Yard Piping		20%	$275,400
Sub-Total			**$1,652,400**
Electrical and Instrumentation		20%	$330,480
Sub-Total			**$1,982,880**
Contingencies		25%	$495,720
Contractor OHP		15%	$297,432
Total Construction Cost			**$2,776,032**
Engineering		10%	$277,603
Permitting		5%	$138,802
Total Project Cost			**$3,192,437**
Power	5 hp and $0.12 per kW-hr		$4,000
Chemical			$11,100
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$755
Total O&M Cost per Year			**$15,855**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L and total nitrogen to 5 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be needed. The denitrifying filter required for Level II can reduce the total nitrogen to the Level III limits. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L.
The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table VIII-8.

Table VIII-8
City of Terrell King's Creek WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$63,000
Sub-Total			**$63,000**
Site Work and Yard Piping		20%	$12,600
Sub-Total			**$75,600**
Electrical and Instrumentation		20%	$15,120
Sub-Total			**$90,720**
Contingencies		25%	$22,680
Contractor OHP		15%	$13,608
Total Construction Cost			**$127,008**
Engineering		10%	$12,701
Permitting		5%	$6,350
Total Project Cost			**$146,059**
Power			
Chemical			$170,000
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$8,500
Total O&M Cost per Year			**$178,500**

SECTION IX

CITY OF WILLS POINT
WASTEWATER TREATMENT PLANT

SECTION IX

CITY OF WILLS POINT
WASTEWATER TREATMENT PLANT

INTRODUCTION

The Wills Point WWTP discharges into Little Allen Creek; thence Allen Creek; thence Cedar Creek; thence Cedar Creek Reservoir in Segment 0818 of the Trinity River Basin. Sources of information for the evaluation included: a site visit, an interview with the plant personnel, review of the existing plans and historic reports, data collected by plant personnel for the District, and the data acquired through Texas Commission on Environmental Quality (TCEQ). This section is organized as follows:

- Description of the existing TPDES permit conditions
- Historical effluent data
- Brief description of the treatment process
- Population growth and flow projections
- Facility needs and costs to meet Level I effluent limits through 2050
- Facility needs and costs to meet Level II effluent limits through 2050
- Facility needs and costs to meet Level III effluent limits through 2050

EXISTING PERMIT CONDITIONS

The City of Wills Point operates its wastewater treatment plant under TPDES Permit No. 10623-001. The current permitted capacity is 0.51 million gallons per day (MGD). The City has established plans to expand the plant to treat and average daily flow of 0.80 MGD. The permit limits are shown in Table IX-1; limits shown are existing permit limits, which may have changed throughout the course of historical data collection and report writing.

Table IX-1
City of Wills Point WWTP
Current TPDES Permit Conditions
TPDES Permit No. 10623-001

Parameters	Permit Limits
	Existing/Interim
Biochemical Oxygen Demand (BOD_5)	30 mg/L
Total Suspended Solids (TSS)	90 mg/L
Flow	0.51 MGD
	Future
Carbonaceous Biochemical Oxygen Demand (CBOD)	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Ammonia Nitrogen	3 mg/L
Flow	0.80 MGD

The permit conditions after the planned expansion are referred to as Level I. The next level of treatment, referred to as Level II, includes reduction of phosphorus to 1 mg/L and total nitrogen to 10 mg/L. The most stringent level of treatment considered, referred to as Level III, includes reduction of

phosphorus to 0.5 mg/L and total nitrogen to 5 mg/L. The assessment of facility needs is performed at all three levels for flows projected for 2050.

HISTORICAL PLANT FLOWS AND EFFLUENT QUALITY

A summary of the historical flows and effluent quality for the City of Wills Point wastewater treatment plant are presented in Table IX-2; all data in this table were derived from the plant Discharge Monitoring Reports (DMRs). As shown, the flow to the plant is currently about 80% of its present rated capacity, which explains the need to expand to 0.8 MGD. As of the writing of this report, the plant was still operating under the interim permit limits.

Table IX-2
City of Wills Point WWTP
Historical Plant Flows and Effluent Quality

Year	Average Daily Flow	Effluent	
		BOD_5	TSS
	(MGD)	(mg/L)	(mg/L)
1999	0.45	27.5	73.8
2000	0.44	32.5	89.0
2001*	0.54	22.5	68.0
2002	0.42	28.6	79.0
2003*	0.38	29.4	79.0
*Incomplete year's worth of data; average of ten and eleven months, respectively			

The plant is usually meeting interim effluent permit limits for BOD_5. At the request of the Tarrant Regional Water District, the city of Wills Point collected 12 months of effluent nutrient data. Operational and facility changes will be required to meet Level II and III effluent goals. A summary of the data is presented in Table IX-3; all data may be found in Appendix A.

Table IX-3
City of Wills Point WWTP
Special Nutrient Testing for Tarrant Regional Water District

	NH_3-N	NO_x	IP	Org P	Org N	TN	TP
No. of Data Points	49	49	49	49	49	49	49
Average (mg/L)	3.15	1.55	1.72	1.17	7.33	12.03	2.64
Minimum (mg/L)	0.18	0.08	0.09	0.00	0.56	0.87	0.72
Maximum (mg/L)	9.98	6.57	3.88	2.57	36.00	36.48	4.45

Figures IX-1 and IX-2 illustrate the seasonal variability of total nitrogen and phosphorous loads.

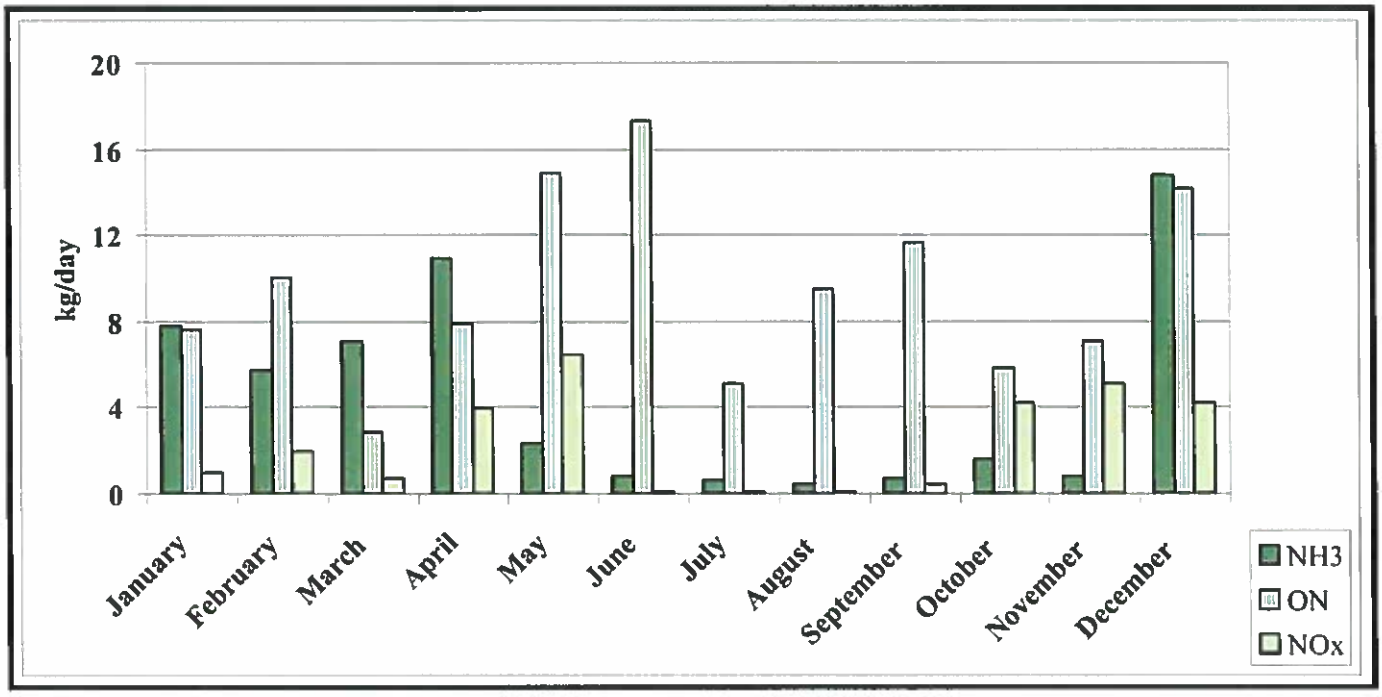

Figure IX-1: Wills Point Effluent Total Nitrogen Monthly Average Loads

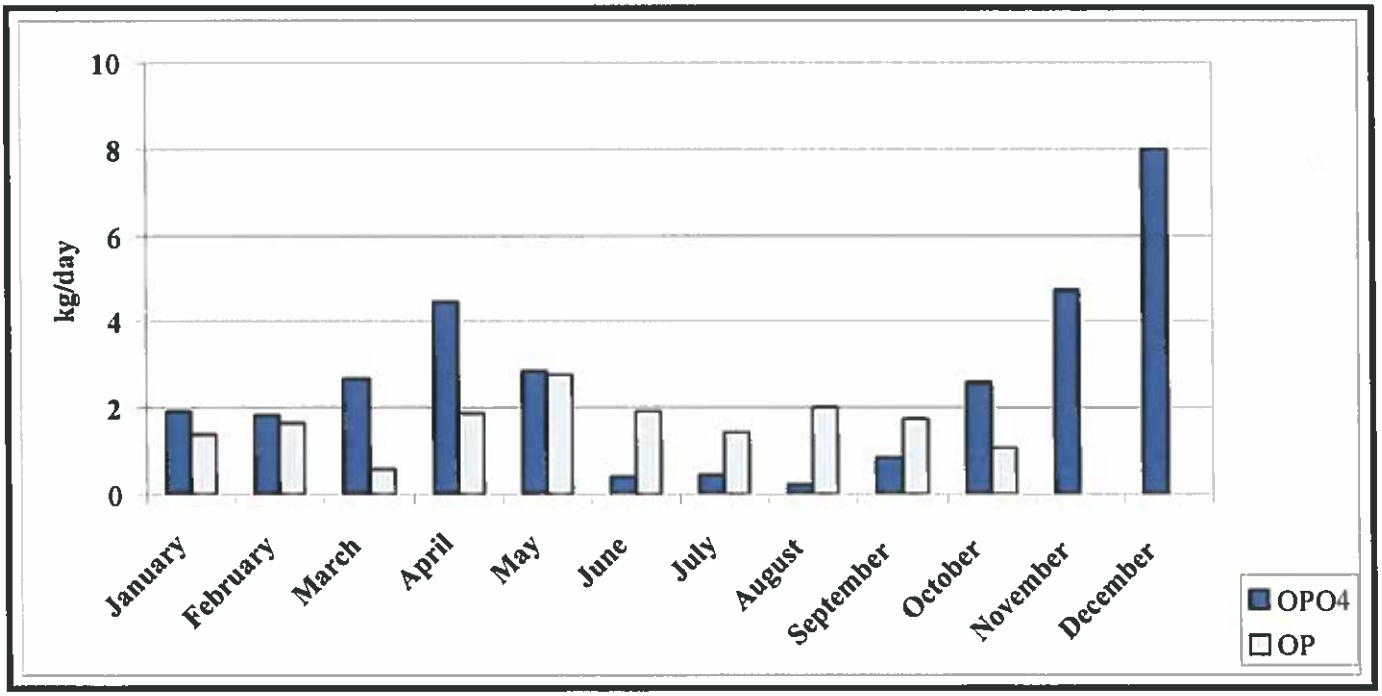

Figure IX-2: Wills Point Effluent Total Phosphorous Monthly Average Loads

PROCESS OVERVIEW

See Figure IX-3 for the plant's process schematic. Table IX-4A and Table IX-4B list the existing treatment units and their current and planned sizes, respectively.

Table IX-4A
City of Wills Point WWTP
Existing Treatment Facilities

Treatment Units	Dimension/Size
Facultative Pond No. 1 Volume	5.43 MG
Facultative Pond No. 2 Volume	4.90 MG
Stabilization Pond No. 3 Volume	9.94 MG
Stabilization Pond No. 4 Volume	14.50 MG
Stabilization Pond No. 5 Volume	7.38 MG

Table IX-4B
City of Wills Point WWTP
Planned Treatment Facilities

Treatment Units	Dimension/Size
Stabilization Pond No. 6 Volume	3.38 MG
Stabilization Pond No. 7 Volume	3.42 MG

The City of Wills Point sewer collection system brings wastewater to the headworks of the plant. The headworks structure consists of influent junction box, a manually cleaned bar screen, a Parshall flume to measure the influent, and two lift stations. From the headworks, the wastewater is pumped to facultative ponds and then the wastewater flows by gravity through a series of stabilization ponds. The facultative lagoons have two layers: the top/surface layer is aerobic and bottom layer is anaerobic. Oxygen is supplied to the surface layer by the natural diffusion and photosynthetic algae. The sludge settled in the facultative and stabilization ponds is periodically dredged, dried and disposed in a sanitary landfill. A Parshall flume meters the effluent prior to discharge.

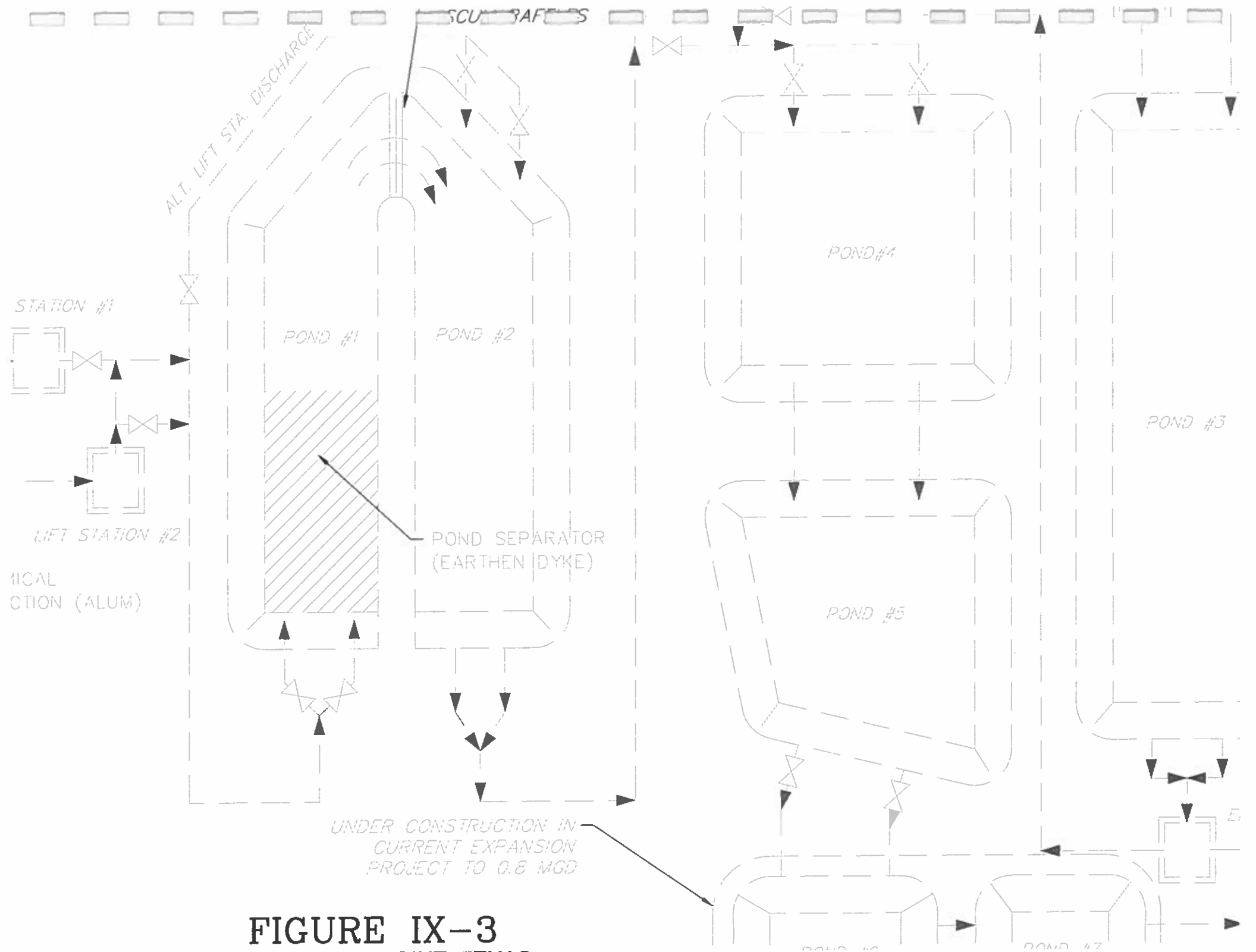
ALT. LIFT STA. DISCHARGE
STATION #1
POND #1
POND #2
POND#4
POND #3
POND #5
LIFT STATION #2
POND SEPARATOR
(EARTHEN DYKE)
UNDER CONSTRUCTION IN
CURRENT EXPANSION
PROJECT TO 0.8 MGD

FIGURE IX-3

FUTURE FLOW PROJECTIONS

In the year 2000, the population of the City of Wills Point was 3,496. Projected populations and flows through the year 2050 are listed in Table IX-5.

Table IX-5
City of Wills Point
Population and Flow Projections

Year	2005	2010	2020	2030	2040	2050
Population[1]	3,700	3,860	4,243	4,566	4,809	5,117
Projected Flow (MGD)[2]	0.37	0.39	0.42	0.46	0.48	0.51

[1] Texas Water Development Board 2006 Regional Water Plan
[2] Average Flow = 100 gal/capita/day (Figure 1, 30 TAC 317.4 (a))

The current capacity of the plant is able to treat the projected flows through the year 2050.

FACILITY NEEDS EVALUATION

This section describes the facilities that are required for the plant to meet each of the three levels of treatment for flows through the year 2050. It should be noted that many of the existing facilities will be beyond their useful lives by the year 2050. The identification of the facility needs does not include the replacement of worn out equipment or treatment units.

Level I Facility Needs for 2050 Wastewater Flows

Level I treatment requirements are identified based on continuing to meet its existing effluent limits. As mentioned above, the permitted daily average flow through the City's plant is 0.80 MGD, which is more than the projected flow through the year 2050. No additional modifications and/or expansions are required.

Level II Facility Needs for 2050 Wastewater Flows

The Level II effluent set facility needs are based on reducing the effluent phosphorus concentration to 1 mg/L and total nitrogen to 10 mg/L. As detailed in Table IX-3, the historical average total nitrogen effluent concentration was about 12 mg/L, and the historical average total phosphorus concentration was about 3 mg/L. To consistently achieve a total nitrogen effluent concentration of less than 10 mg/L, an earthen pond separator or dyke should be constructed in the first facultative pond to create a new 1 million gallon pond at the inlet to the facultative pond system. The stabilization ponds need to be dredged often to maintain and utilize the design pond volume.

To consistently achieve total phosphorus effluent concentrations of less than 1 mg/L, the addition of aluminum sulfate (alum) is recommended. Alum solution will be fed at the influent pump station that would provide the required mixing of the alum solution.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level II effluent requirements are listed in Table IX-6.

Table IX-6
City of Wills Point WWTP
Facility Needs to Meet Level II Effluent Requirements and 2050 Flows

Item Description			Cost
Dredging Ponds			$50,000
Chemical Feed System for Alum			$22,000
Earthen Pond Separator			$28,000
Sub-Total			**$100,000**
Site Work and Yard Piping		20%	$20,000
Sub-Total			**$120,000**
Electrical and Instrumentation		20%	$24,000
Sub-Total			**$144,000**
Contingencies		25%	$36,000
Contractor OHP		15%	$21,600
Total Construction Cost			**$201,600**
Engineering		10%	$20,160
Permitting		5%	$10,080
Total Project Cost			**$231,840**
Power	5 hp and $0.12 per kW-hr		$4,000
Chemical			$700
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$235
Total O&M Cost per Year			**$4,935**

Level III Facility Needs for 2050 Wastewater Flows

The Level III effluent set facility needs are based on reducing the effluent phosphorus concentration to 0.5 mg/L and total nitrogen to 5 mg/L. To achieve the Level III concentrations of phosphorus, higher dosages of alum will be needed. To meet the effluent total nitrogen limits, a denitrifying filter is required. Additional carbon may be required at the denitrifying filters to reduce total nitrogen levels to less than 5 mg/L. As with the Level I and II facilities, maintaining the pond volume is also crucial to provide the biological treatment necessary to produce the required effluent quality.

The planning level estimates of probable costs involved to improve the City's plant to treat the year 2050 flow to Level III effluent requirements are listed in Table IX-7.

Table IX-7
City of Wills Point WWTP
Facility Needs to Meet Level III Effluent Requirements and 2050 Flows

Item Description			Cost
Chemical Feed System for Methanol			$30,000
Denitrification Filter			$330,500
	Sub-Total		**$360,500**
Site Work and Yard Piping		20%	$72,100
	Sub-Total		**$432,600**
Electrical and Instrumentation		20%	$86,520
	Sub-Total		**$519,120**
Contingencies		25%	$129,780
Contractor OHP		15%	$77,868
	Total Construction Cost		**$726,768**
Engineering		10%	$72,677
Permitting		5%	$36,338
	Total Project Cost		**$835,783**
Power	20 hp and $0.12 per kW-hr		$16,000
Chemical			$13,800
Labor	No Added Personnel		$0
Maintenance	Assume 5% of additional operation cost	5%	$1,490
	Total O&M Cost per Year		**$31,290**

APPENDIX A

City of Athens Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON (calc)	OP (calc)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
04-Dec-01	0.46	1.10	2.30	14.00	16.30	3.10	2.00	1.20	1.10	1.93	4.03	24.51	28.54	5.43	3.50	2.10	1.93	24.51	3.50	1.93	0.00
11-Dec-01	0.46	0.20	2.00	14.00	16.00	2.40	1.70	1.80	0.70	0.35	3.50	24.51	28.01	4.20	2.98	3.15	1.23	24.51	2.98	0.35	0.00
18-Dec-01	0.46	0.21	1.30	9.30	10.60	1.50	1.30	1.09	0.20	0.37	2.28	16.28	18.56	2.63	2.28	1.91	0.35	16.28	2.28	0.37	0.00
27-Dec-01	0.46	0.20	0.20	20.00	20.20	2.70	1.40	0.00	1.30	0.35	0.35	35.01	35.36	4.73	2.45	0.00	2.28	35.01	2.45	0.35	0.00
03-Jan-02	0.63	11.00	14.00	3.00	17.00	3.20	1.40	3.00	1.80	26.32	33.50	7.18	40.68	7.66	3.35	7.18	4.31	7.18	3.35	26.32	0.00
08-Jan-02	0.63	20.00	0.36	0.19	0.55	2.60	1.50	0.00	1.10	47.86	0.86	0.45	1.32	6.22	3.59	0.00	2.63	0.45	3.59	47.86	0.00
15-Jan-02	0.63	16.00	18.00	0.47	18.47	2.50	1.30	2.00	1.20	38.29	43.07	1.12	44.20	5.98	3.11	4.79	2.87	1.12	3.11	38.29	0.00
29-Jan-02	0.63	0.20	1.20	16.00	17.20	3.20	1.60	1.00	1.60	0.48	2.87	38.29	41.16	7.66	3.83	2.39	3.83	38.29	3.83	0.48	0.00
05-Feb-02	0.35	0.25	0.79	15.00	15.79	2.50	1.20	0.54	1.30	0.33	1.03	19.63	20.67	3.27	1.57	0.71	1.70	19.63	1.57	0.33	0.00
12-Feb-02	0.35	0.29	0.88	19.00	19.88	3.10	1.60	0.59	1.50	0.38	1.15	24.87	26.02	4.06	2.09	0.77	1.96	24.87	2.09	0.38	0.00
19-Feb-02	0.35	4.20	5.00	18.00	23.00	3.80	2.20	0.80	1.60	5.50	6.54	23.56	30.10	4.97	2.88	1.05	2.09	23.56	2.88	5.50	0.00
26-Feb-02	0.35	0.71	2.00	14.00	16.00	3.00	3.20	1.29	0.00	0.93	2.62	18.32	20.94	3.93	4.19	1.69	0.00	18.32	4.19	0.93	0.00
05-Mar-02	0.48	0.26	2.30	17.00	19.30	2.90	2.90	2.04	0.00	0.47	4.20	31.05	35.26	5.30	5.30	3.73	0.00	31.05	5.30	0.47	0.00
12-Mar-02	0.48	0.20	2.20	7.20	9.40	2.80	3.10	2.00	0.00	0.37	4.02	13.15	17.17	5.11	5.66	3.65	0.00	13.15	5.66	0.37	0.00
19-Mar-02	0.48	0.23	2.10	8.90	11.00	3.40	1.40	1.87	2.00	0.42	3.84	16.26	20.09	6.21	2.56	3.42	3.65	16.26	2.56	0.42	0.00
26-Mar-02	0.48	0.26	0.40	27.00	27.40	2.90	1.30	0.14	1.60	0.47	0.73	49.32	50.05	5.30	2.37	0.26	2.92	49.32	2.37	0.47	0.00
02-Apr-02	0.55	0.20	1.20	9.00	10.20	2.40	1.60	1.00	0.80	0.41	2.48	18.59	21.07	4.96	3.30	2.07	1.65	18.59	3.30	0.41	0.00
09-Apr-02	0.55	0.34	2.40	10.00	12.40	2.60	1.40	2.06	1.20	0.70	4.96	20.66	25.61	5.37	2.89	4.26	2.48	20.66	2.89	0.70	0.00
16-Apr-02	0.55	0.38	1.00	10.00	11.00	3.00	1.80	0.62	1.20	0.78	2.07	20.66	22.72	6.20	3.72	1.28	2.48	20.66	3.72	0.78	0.00
23-Apr-02	0.55	0.20	1.10	9.50	10.60	3.20	1.60	0.90	1.60	0.41	2.27	19.62	21.90	6.61	3.30	1.86	3.30	19.62	3.30	0.41	0.00
30-Apr-02	0.55	0.56	1.90	9.40	11.30	3.60	1.80	1.34	1.80	1.16	3.92	19.42	23.34	7.44	3.72	2.77	3.72	19.42	3.72	1.16	0.00
07-May-02	0.49	0.24	1.60	6.10	7.70	2.50	0.84	1.36	1.66	0.45	2.97	11.32	14.28	4.64	1.56	2.52	3.08	11.32	1.56	0.45	0.00
14-May-02	0.49	0.20	1.60	14.00	15.60	2.50	1.40	1.40	1.10	0.37	2.97	25.97	28.94	4.64	2.60	2.60	2.04	25.97	2.60	0.37	0.00
21-May-02	0.49	0.25	1.50	15.00	16.50	3.10	2.50	1.25	0.60	0.46	2.78	27.83	30.61	5.75	4.64	2.32	1.11	27.83	4.64	0.46	0.00
28-May-02	0.49	0.35	2.30	12.00	14.30	3.30	2.00	1.95	1.30	0.65	4.27	22.26	26.53	6.12	3.71	3.62	2.41	22.26	3.71	0.65	0.00
04-Jun-02	0.53	0.20	1.00	6.40	7.40	3.00	1.60	0.80	1.40	0.40	1.99	12.75	14.74	5.98	3.19	1.59	2.79	12.75	3.19	0.40	0.00
11-Jun-02	0.53	0.82	1.80	6.50	8.30	2.70	1.20	0.98	1.50	1.63	3.59	12.95	16.54	5.38	2.39	1.95	2.99	12.95	2.39	1.63	0.00
18-Jun-02	0.53	0.20	0.62	8.90	9.52	2.90	1.50	0.42	1.40	0.40	1.24	17.73	18.97	5.78	2.99	0.84	2.79	17.73	2.99	0.40	0.00
25-Jun-02	0.53	0.49	1.60	6.40	8.00	3.00	3.00	1.11	0.00	0.98	3.19	12.75	15.94	5.98	5.98	2.21	0.00	12.75	5.98	0.98	0.00
02-Jul-02	0.51	4.50	7.90	5.00	12.90	1.70	1.20	3.40	0.50	8.75	15.36	9.72	25.08	3.30	2.33	6.61	0.97	9.72	2.33	8.75	0.00
09-Jul-02	0.51	3.90	5.70	6.10	11.80	2.60	0.90	1.80	1.70	7.58	11.08	11.86	22.94	5.05	1.75	3.50	3.30	11.86	1.75	7.58	0.00
16-Jul-02	0.51	0.60	1.30	6.00	7.30	1.70	1.40	0.70	0.30	1.17	2.53	11.66	14.19	3.30	2.72	1.36	0.58	11.66	2.72	1.17	0.00
23-Jul-02	0.51	0.84	2.20	6.00	8.20	2.30	0.95	1.36	1.35	1.63	4.28	11.66	15.94	4.47	1.85	2.64	2.62	11.66	1.85	1.63	0.00
30-Jul-02	0.51	0.26	1.60	7.80	9.40	2.80	1.10	1.34	1.70	0.51	3.11	15.16	18.27	5.44	2.14	2.61	3.30	15.16	2.14	0.51	0.00
13-Aug-02	0.50	0.82	2.60	7.10	9.70	2.70	1.60	1.78	1.10	1.54	4.89	13.36	18.26	5.08	3.01	3.35	2.07	13.36	3.01	1.54	0.00
20-Aug-02	0.50	0.61	0.82	9.70	10.52	3.20	3.20	0.21	0.00	1.15	1.54	18.26	19.80	6.02	6.02	0.40	0.00	18.26	6.02	1.15	0.00
27-Aug-02	0.50	2.40	7.00	7.70	14.70	2.60	1.30	4.60	1.30	4.52	13.18	14.49	27.67	4.89	2.45	8.66	2.45	14.49	2.45	4.52	0.00
03-Sep-02	0.47	0.58	1.40	13.00	14.40	3.40	3.50	0.82	0.00	1.02	2.47	22.92	25.38	5.99	6.17	1.45	0.00	22.92	6.17	1.02	0.00
10-Sep-02	0.47	4.00	4.60	12.00	16.60	2.50	1.10	0.60	1.40	7.05	8.11	21.15	29.26	4.41	1.94	1.06	2.47	21.15	1.94	7.05	0.00
24-Sep-02	0.47	0.31	0.44	17.00	17.44	3.60	1.20	0.13	2.40	0.55	0.78	29.97	30.74	6.35	2.12	0.23	4.23	29.97	2.12	0.55	0.00
01-Oct-02	0.43	0.20	0.72	9.60	10.32	3.40	1.50	0.52	1.90	0.32	1.17	15.59	16.76	5.52	2.44	0.84	3.09	15.59	2.44	0.32	0.00
08-Oct-02	0.43	0.34	0.52	27.00	27.52	3.70	1.50	0.18	2.20	0.55	0.84	43.85	44.70	6.01	2.44	0.29	3.57	43.85	2.44	0.55	0.00
15-Oct-02	0.43	0.20	0.66	12.00	12.66	3.00	1.50	0.46	1.50	0.32	1.07	19.49	20.56	4.87	2.44	0.75	2.44	19.49	2.44	0.32	0.00
22-Oct-02	0.43	0.20	0.55	9.20	9.75	2.40	0.98	0.35	1.42	0.32	0.89	14.94	15.84	3.90	1.59	0.57	2.31	14.94	1.59	0.32	0.00
29-Oct-02	0.43	1.30	1.60	8.10	9.70	2.90	1.50	0.30	1.40	2.11	2.60	13.16	15.75	4.71	2.44	0.49	2.27	13.16	2.44	2.11	0.00
05-Nov-02	0.34	0.20	2.60	9.80	12.40	2.60	1.00	2.40	1.60	0.26	3.33	12.55	15.88	3.33	1.28	3.07	2.05	12.55	1.28	0.26	0.00
12-Nov-02	0.34	0.20	1.70	9.40	11.10	4.40	3.70	1.50	0.70	0.26	2.18	12.04	14.22	5.64	4.74	1.92	0.90	12.04	4.74	0.26	0.00
21-Nov-01	0.35	0.55	8.60	13.00	21.60	1.40	2.30	8.05	0.00	0.72	11.31	17.09	28.40	1.84	3.02	10.59	0.00	17.09	3.02	0.72	0.00
27-Nov-01	0.35	0.66	1.20	13.00	14.20	3.20	1.60	0.54	1.60	0.86	1.58	17.09	18.67	4.21	2.10	0.71	2.10	17.09	2.10	0.86	0.00
Averages	**0.48**	**1.68**	**2.62**	**10.91**	**13.53**	**2.85**	**1.72**	**1.34**	**1.16**	**3.57**	**5.01**	**19.02**	**24.03**	**5.14**	**3.08**	**2.40**	**2.11**	**19.02**	**3.08**	**3.57**	**0.00**

Note: There is not data available from the TRWD SRD database for Athens.
Therefore, the flows obtained from Athens DMR data, and the weekly concentration data from Kaufman WWTP were used to estimate the loads for Athens.
Detection limit values estimated at face value
Estimated/Corrected Values are in RED

Cherokee Shores Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (mgd)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON	OP	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
09-Oct-01	0.14	29.6	31.6	0.4	32	1.49	0.698	2	0.792	15.52	16.57	0.21	16.78	0.78	0.37	1.05	0.42	0.21	0.37	15.52	0
16-Oct-01	0.11	27.6	28.1	1	29.1	1.19	0.591	0.5	0.599	11.54	11.75	0.42	12.16	0.50	0.25	0.21	0.25	0.42	0.25	11.54	0
23-Oct-01	0.13	32.5	31.9	0.66	32.56	1.73	1.49	0	0.24	16.18	15.88	0.33	16.21	0.86	0.74	0.00	0.12	0.33	0.74	16.18	0
30-Oct-01	0.11	31.6	31.6	0.73	32.33	2.04	2.03	0	0.01	12.85	12.85	0.30	13.15	0.83	0.83	0.00	0.00	0.30	0.83	12.85	0
06-Nov-01	0.08	32.8	33.3	0.75	34.05	2.59	2.13	0.5	0.46	9.97	10.12	0.23	10.35	0.79	0.65	0.15	0.14	0.23	0.65	9.97	0
13-Nov-01	0.10	31.6	34.1	0.99	35.09	0.75	0.383	2.5	0.367	12.49	13.48	0.39	13.87	0.30	0.15	0.99	0.15	0.39	0.15	12.49	0
19-Nov-01	0.08	32.7	32.7	0.7	33.4	2.86	2.46	0	0.4	9.94	9.94	0.21	10.15	0.87	0.75	0.00	0.12	0.21	0.75	9.94	0
27-Nov-01	0.08	33.7	35.7	0.63	36.33	0.741	0.398	2	0.343	10.24	10.85	0.19	11.04	0.23	0.12	0.61	0.10	0.19	0.12	10.24	0
04-Dec-01	0.08	30.8	35.7	0.82	36.52	0.674	0.419	4.9	0.255	9.36	10.85	0.25	11.10	0.20	0.13	1.49	0.08	0.25	0.13	9.36	0
11-Dec-01	0.08	26.5	31.4	0.93	32.33	0.551	0.389	4.9	0.162	8.06	9.55	0.28	9.83	0.17	0.12	1.49	0.05	0.28	0.12	8.06	0
18-Dec-01	0.10	5.5	14.9	3.5	18.4	1.57	0.909	9.4	0.661	2.17	5.89	1.38	7.27	0.62	0.36	3.71	0.26	1.38	0.36	2.17	0
26-Dec-01	0.07	26.2	29	0.75	29.75	1.15	0.799	2.8	0.351	6.87	7.60	0.20	7.80	0.30	0.21	0.73	0.09	0.20	0.21	6.87	0
02-Jan-02	0.07	29	32.4	0.85	33.25	4.87	3.64	3.4	1.23	7.16	8.00	0.21	8.21	1.20	0.90	0.84	0.30	0.21	0.90	7.16	0
08-Jan-02	0.08	28.4	47.8	0.83	48.63	1.42	1.09	19.4	0.33	8.85	14.89	0.26	15.15	0.44	0.34	6.05	0.10	0.26	0.34	8.85	0
15-Jan-02	0.06	30.5	33.9	0.7	34.6	2.4	1.92	3.4	0.48	7.07	7.86	0.16	8.02	0.56	0.45	0.79	0.11	0.16	0.45	7.07	0
22-Jan-02	0.07	33.8	38.1	0.75	38.85	3.41	2.72	4.3	0.69	8.86	9.99	0.20	10.19	0.89	0.71	1.13	0.18	0.20	0.71	8.86	0
29-Jan-02	0.09	35.2	38.2	2	40.2	6.85	5.94	3	0.91	12.57	13.65	0.71	14.36	2.45	2.12	1.07	0.33	0.71	2.12	12.57	0
05-Feb-02	0.08	35.4	34.4	1.6	36	6.74	5.83	0	0.91	11.03	10.72	0.50	11.22	2.10	1.82	0.00	0.28	0.50	1.82	11.03	0
12-Feb-02	0.08	33.2	37.4	4.2	41.6	5.94	4.88	4.2	1.06	10.60	11.94	1.34	13.28	1.90	1.56	1.34	0.34	1.34	1.56	10.60	0
19-Feb-02	0.09	29.1	33.6	0.49	34.09	2.94	1.16	4.5	1.78	9.51	10.98	0.16	11.14	0.96	0.38	1.47	0.58	0.16	0.38	9.51	0
26-Feb-02	0.10	35.5	41.1	1.05	42.15	7.58	6.66	5.6	0.92	14.03	16.24	0.41	16.66	3.00	2.63	2.21	0.36	0.41	2.63	14.03	0
05-Mar-02	0.10	29.1	38.4	7	45.4	4.64	4.16	9.3	0.48	11.28	14.88	2.71	17.60	1.80	1.61	3.60	0.19	2.71	1.61	11.28	0
12-Mar-02	0.06	31.6	32.4	5.7	38.1	7.83	5.19	0.8	2.64	7.44	7.63	1.34	8.98	1.84	1.22	0.19	0.62	1.34	1.22	7.44	0
19-Mar-02	0.08	25	32.9	1.8	34.7	11.8	8.44	7.9	3.36	7.70	10.13	0.55	10.68	3.63	2.60	2.43	1.03	0.55	2.60	7.70	0
26-Mar-02	0.06	26	30.4	1.7	32.1	4.26	3.69	4.4	0.57	5.43	6.35	0.36	6.71	0.89	0.77	0.92	0.12	0.36	0.77	5.43	0
02-Apr-02	0.08	30	37.2	0.54	37.74	0.958	0.545	7.2	0.413	9.46	11.73	0.17	11.90	0.30	0.17	2.27	0.13	0.17	0.17	9.46	0
09-Apr-02	0.05	21.6	31.6	0.5	32.1	3.09	1.75	10	1.34	3.86	5.64	0.09	5.73	0.55	0.31	1.79	0.24	0.09	0.31	3.86	0
16-Apr-02	0.11	36	46.9	0.67	47.57	6.89	5.41	10.9	1.48	14.64	19.07	0.27	19.34	2.80	2.20	4.43	0.60	0.27	2.20	14.64	0
23-Apr-02	0.09	28.6	29.1	0.64	29.74	1.68	1.21	0.5	0.47	9.67	9.84	0.22	10.06	0.57	0.41	0.17	0.16	0.22	0.41	9.67	0
30-Apr-02	0.07	39.8	44.7	0.61	45.31	5.66	4.85	4.9	0.81	10.44	11.72	0.16	11.88	1.48	1.27	1.28	0.21	0.16	1.27	10.44	0
07-May-02	0.06	38.4	41.3	0.68	41.98	11.6	11.1	2.9	0.5	8.90	9.57	0.16	9.73	2.69	2.57	0.67	0.12	0.16	2.57	8.90	0
14-May-02	0.07	30	32.6	0.73	33.33	0.918	0.53	2.6	0.388	7.87	8.55	0.19	8.74	0.24	0.14	0.68	0.10	0.19	0.14	7.87	0
21-May-02	0.07	38	38.2	0.7	38.9	6.35	4.29	0.2	2.06	10.40	10.45	0.19	10.64	1.74	1.17	0.05	0.56	0.19	1.17	10.40	0
28-May-02	0.05	36.4	38.7	0.39	39.09	12.9	10.2	2.3	2.7	7.47	7.94	0.08	8.02	2.65	2.09	0.47	0.55	0.08	2.09	7.47	0
04-Jun-02	0.05	33.2	40.6	0.61	41.21	0.806	0.57	7.4	0.236	6.18	7.56	0.11	7.67	0.15	0.11	1.38	0.04	0.11	0.11	6.18	0
11-Jun-02	0.06	26	44.6	0.7	45.3	7.12	5.18	18.6	1.94	5.43	9.32	0.15	9.47	1.49	1.08	3.89	0.41	0.15	1.08	5.43	0
18-Jun-02	0.07	40	44.4	0.99	45.39	0.67	0.35	4.4	0.32	10.49	11.64	0.26	11.90	0.18	0.09	1.15	0.08	0.26	0.09	10.49	0
25-Jun-02	0.03	42	46	1.1	47.1	18.6	16.5	4	2.1	4.31	4.72	0.11	4.83	1.91	1.69	0.41	0.22	0.11	1.69	4.31	0
01-Jul-02	0.07	19.4	44.2	0.46	44.66	1.07	0.482	24.8	0.588	5.09	11.59	0.12	11.71	0.28	0.13	6.50	0.15	0.12	0.13	5.09	0
09-Jul-02	0.06	17.2	47.5	0.9	48.4	7.12	6.63	30.3	0.49	3.66	10.11	0.19	10.30	1.52	1.41	6.45	0.10	0.19	1.41	3.66	0
16-Jul-02	0.10	34.6	44.9	1.3	46.2	5.61	4.54	10.3	1.07	12.49	16.21	0.47	16.68	2.03	1.64	3.72	0.39	0.47	1.64	12.49	0
23-Jul-02	0.02	25.2	32.8	1	33.8	0.484	0.15	7.6	0.334	2.11	2.74	0.08	2.83	0.04	0.01	0.64	0.03	0.08	0.01	2.11	0
06-Aug-02	0.09	33.8	42.6	1.1	43.7	12.96	11.1	8.8	1.86	11.56	14.57	0.38	14.95	4.43	3.80	3.01	0.64	0.38	3.80	11.56	0
13-Aug-02	0.02	32.4	23.7	27	50.7	6.07	4.41	0	1.66	2.59	1.89	2.15	4.05	0.48	0.35	0.00	0.13	2.15	0.35	2.59	0
20-Aug-02	0.08	27.2	29.5	1.6	31.1	0.74	0.407	2.3	0.333	8.27	8.97	0.49	9.45	0.22	0.12	0.70	0.10	0.49	0.12	8.27	0
27-Aug-02	0.10	37.6	38	0.89	38.89	1.59	0.64	0.4	0.95	14.72	14.87	0.35	15.22	0.62	0.25	0.16	0.37	0.35	0.25	14.72	0
03-Sep-02	0.07	37.2	40.8	1.2	42	10.8	9.31	3.6	1.49	9.47	10.39	0.31	10.69	2.75	2.37	0.92	0.38	0.31	2.37	9.47	0
10-Sep-02	0.08	34.4	35.5	2	37.5	1.1	0.842	1.1	0.258	10.98	11.33	0.64	11.97	0.35	0.27	0.35	0.08	0.64	0.27	10.98	0
17-Sep-02	0.09	20	27.4	1.7	29.1	1.93	1.36	7.4	0.57	7.14	9.79	0.61	10.39	0.69	0.49	2.64	0.20	0.61	0.49	7.14	0
24-Sep-02	0.08	26.00	34.30	1.00	35.30	0.87	0.77	8.30	0.11	7.90	10.43	0.30	10.73	0.27	0.23	2.52	0.03	0.30	0.23	7.90	0

East Cedar Creek FWSD Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON	OP	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
08-May-01	0 48	20 7	42 30	1 00	43 30	2 51	2 07	21 60	0 44	37 76	77 16	1 82	78 98	4 58	3 78	39 40	0 80	1 82	3 78	37 76	0
15-May-01	0 511	19 7	34 90	1 90	36 80	3 02	2 45	15 20	0 57	38 25	67 77	3 69	71 46	5 86	4 76	29 52	1 11	3 69	4 76	38 25	0
22-May-01	0 488	23	26 20	1 60	27 80	0 97	0 92	3 20	0 05	42 65	48 59	2 97	51 55	1 80	1 71	5 93	0 10	2 97	1 71	42 65	0
29-May-01	0 511	25 3	34 30	0 95	35 25	5 04	3 67	9 00	1 37	49 13	66 60	1 84	68 45	9 79	7 13	17 48	2 66	1 84	7 13	49 13	0
05-Jun-01	0 511	25 9	26 50	0 92	27 42	2 02	0 20	0 60	1 82	50 29	51 46	1 79	53 24	3 92	0 39	1 17	3 54	1 79	0 39	50 29	0
12-Jun-01	0 525	25 3	25 60	1 71	27 31	13 50	8 91	0 30	4 59	50 47	51 07	3 41	54 48	26 93	17 78	0 60	9 16	3 41	17 78	50 47	0
19-Jun-01	0 524	24 3	19 60	1 32	20 92	6 08	1 72	0 00	4 36	48 39	39 03	2 63	41 66	12 11	3 42	0 00	8 68	2 63	3 42	48 39	0
26-Jun-01	0 501	24 5	24 80	1 53	26 33	1 76	1 23	0 30	0 54	46 64	47 21	2 91	50 13	3 35	2 33	0 57	1 02	2 91	2 33	46 64	0
02-Jul-01	0 6	33 2	34 80	1 95	36 75	7 99	7 12	1 60	0 87	75 70	79 34	4 45	83 79	18 22	16 23	3 65	1 98	4 45	16 23	75 70	0
10-Jul-01	0 527	26 9	27 00	2 00	29 00	1 25	0 31	0 10	0 94	53 87	54 07	4 01	58 08	2 50	0 63	0 20	1 87	4 01	0 63	53 87	0
17-Jul-01	0 51	29	30 50	1 24	31 74	3 37	2 77	1 50	0 60	56 20	59 11	2 40	61 51	6 53	5 37	2 91	1 16	2 40	5 37	56 20	0
24-Jul-01	0 505	21 3	19 30	1 00	20 30	0 49	0 40	0 00	0 09	40 87	37 04	1 92	38 96	0 93	0 76	0 00	0 17	1 92	0 76	40 87	0
31-Jul-01	0 492	23 5	27 20	1 10	28 30	0 48	0 32	3 70	0 15	43 94	50 85	2 06	52 91	0 89	0 60	6 92	0 29	2 06	0 60	43 94	0
07-Aug-01	0 526	29	33 40	1 64	35 04	0 59	0 43	4 40	0 16	57 97	66 76	3 28	70 04	1 17	0 85	8 79	0 32	3 28	0 85	57 97	0
14-Aug-01	0 481	25 1	25 10	1 62	26 72	3 02	2 16	0 00	0 86	45 88	45 88	2 96	48 84	5 52	3 95	0 00	1 57	2 96	3 95	45 88	0
21-Aug-01	0 561	3 2	10 50	1 91	12 41	1 67	1 15	7 30	0 52	6 82	22 38	4 07	26 46	3 56	2 45	15 56	1 11	4 07	2 45	6 82	0
28-Aug-01	0 554	18	18 60	1 64	20 24	0 35	0 24	0 60	0 11	37 89	39 16	3 45	42 61	0 74	0 51	1 26	0 23	3 45	0 51	37 89	0
04-Sep-01	0 908	17	17 30	1 80	19 10	1 55	1 28	0 30	0 26	58 66	59 69	6 21	65 90	5 33	4 43	1 04	0 90	6 21	4 43	58 66	0
11-Sep-01	0 481	20	21 80	0 80	22 60	1 39	0 93	1 80	0 46	36 56	39 85	1 46	41 31	2 53	1 69	3 29	0 84	1 46	1 69	36 56	0
18-Sep-01	0 529	22	24 00	0 83	24 83	0 66	0 48	2 00	0 18	44 22	48 24	1 67	49 91	1 32	0 95	4 02	0 37	1 67	0 95	44 22	0
25-Sep-01	0 442	15 3	19 90	0 75	20 65	2 54	2 17	4 60	0 37	25 70	33 42	1 26	34 68	4 27	3 64	7 73	0 62	1 26	3 64	25 70	0
02-Oct-01	0 453	18 4	20 20	0 92	21 12	0 18	0 10	1 80	0 07	31 67	34 77	1 58	36 36	0 30	0 18	3 10	0 12	1 58	0 18	31 67	0
09-Oct-01	0 545	25 6	27 40	1 20	28 60	1 10	0 98	1 80	0 12	53 02	56 75	2 49	59 23	2 27	2 03	3 73	0 24	2 49	2 03	53 02	0
16-Oct-01	0 578	4 4	20 60	2 90	23 50	2 51	2 29	16 20	0 22	9 66	45 25	6 37	51 62	5 51	5 03	35 58	0 49	6 37	5 03	9 66	0
23-Oct-01	0 473	12	12 30	0 78	13 08	1 20	1 08	0 30	0 12	21 57	22 11	1 40	23 51	2 16	1 94	0 54	0 22	1 40	1 94	21 57	0
30-Oct-01	0 465	11 2	12 30	0 82	13 12	0 57	0 46	1 10	0 11	19 79	21 73	1 45	23 18	1 00	0 81	1 94	0 19	1 45	0 81	19 79	0
06-Nov-01	0 457	9	9 10	1 10	10 20	0 28	0 16	0 10	0 12	15 63	15 80	1 91	17 71	0 49	0 28	0 17	0 21	1 91	0 28	15 63	0
13-Nov-01	0 478	13	21 30	0 80	22 10	0 55	0 31	8 30	0 24	23 61	38 69	1 45	40 14	1 00	0 56	15 08	0 44	1 45	0 56	23 61	0
20-Nov-01	0 565	3 9	5 80	1 10	6 90	0 93	0 82	1 90	0 11	8 37	12 45	2 36	14 81	1 99	1 75	4 08	0 23	2 36	1 75	8 37	0
27-Nov-01	0 503	3 9	6 20	1 00	7 20	1 08	0 98	2 30	0 10	7 45	11 85	1 91	13 76	2 06	1 87	4 40	0 19	1 91	1 87	7 45	0
04-Dec-01	0 572	7 4	7 50	2 10	9 60	0 90	0 72	0 10	0 19	16 08	16 30	4 56	20 87	1 96	1 56	0 22	0 40	4 56	1 56	16 08	0
11-Dec-01	0 542	3 1	5 90	2 60	8 50	0 75	0 66	2 80	0 09	6 38	12 15	5 35	17 51	1 54	1 36	5 77	0 19	5 35	1 36	6 38	0
18-Dec-01	0 703	2 2	8 60	1 20	9 80	0 31	0 11	6 40	0 21	5 88	22 97	3 21	26 18	0 84	0 29	17 10	0 55	3 21	0 29	5 88	0
26-Dec-01	0 55	16	18 60	0 64	19 24	0 53	0 29	2 60	0 24	33 44	38 87	1 34	40 21	1 10	0 60	5 43	0 50	1 34	0 60	33 44	0
02-Jan-02	0 468	12	13 90	1 20	15 10	0 45	0 31	1 90	0 14	21 34	24 72	2 13	26 85	0 81	0 55	3 38	0 26	2 13	0 55	21 34	0
08-Jan-02	0 438	14 6	42 40	0 73	43 13	0 64	0 50	27 80	0 15	24 30	70 57	1 22	71 79	1 07	0 83	46 27	0 24	1 22	0 83	24 30	0
15-Jan-02	0 45	17 4	24 60	0 75	25 35	1 61	1 46	7 20	0 15	29 75	42 07	1 28	43 35	2 75	2 50	12 31	0 26	1 28	2 50	29 75	0
22-Jan-02	0 464	16 2	20 70	0 66	21 36	0 79	0 61	4 50	0 19	28 56	36 50	1 16	37 66	1 39	1 07	7 93	0 33	1 16	1 07	28 56	0
29-Jan-02	0 474	20 4	40 00	0 99	40 99	1 77	1 52	19 60	0 25	36 74	72 05	1 78	73 83	3 19	2 74	35 30	0 45	1 78	2 74	36 74	0
05-Feb-02	0 503	13 2	14 30	1 30	15 40	0 91	0 75	0 90	0 16	25 23	26 95	2 48	29 44	1 74	1 43	1 72	0 31	2 48	1 43	25 23	0
12-Feb-02	0 445	16 4	20 10	2 70	22 80	2 48	2 26	3 70	0 22	27 73	33 99	4 57	38 55	4 19	3 82	6 26	0 37	4 57	3 82	27 73	0
19-Feb-02	0 446	9 9	28 60	0 91	29 51	1 78	1 33	18 70	0 45	16 78	48 47	1 54	50 01	3 02	2 25	31 69	0 76	1 54	2 25	16 78	0
26-Feb-02	0 398	17 2	19 20	1 90	21 10	0 41	0 11	2 00	0 29	26 01	29 04	2 87	31 91	0 61	0 17	3 02	0 44	2 87	0 17	26 01	0
05-Mar-02	0 467	15 4	24 10	5 50	29 60	1 76	1 42	8 70	0 34	27 33	42 77	9 76	52 53	3 12	2 52	15 44	0 60	9 76	2 52	27 33	0
12-Mar-02	0 42	14	15 50	7 60	23 10	3 32	2 99	1 50	0 33	22 34	24 74	12 13	36 87	5 30	4 77	2 39	0 53	12 13	4 77	22 34	0
19-Mar-02	0 529	9 8	11 20	2 30	13 50	5 01	4 13	1 30	0 88	19 70	22 51	4 62	27 14	10 07	8 30	2 81	1 77	4 62	8 30	19 70	0
26-Mar-02	0 361	6 6	6 90	1 50	8 40	4 27	3 86	0 30	0 41	9 05	9 47	2 06	11 52	5 86	5 30	0 41	0 56	2 06	5 30	9 05	0
02-Apr-02	0 479	10 4	16 00	1 70	17 70	3 21	2 94	5 60	0 27	18 93	29 12	3 09	32 22	5 84	5 35	10 19	0 49	3 09	5 35	18 93	0
09-Apr-02	0 518	12 1	14 70	2 30	17 00	3 41	2 66	2 60	0 75	23 82	28 94	4 53	33 46	6 71	5 24	5 12	1 48	4 53	5 24	23 82	0
16-Apr-02	0 494	20	29 30	1 20	30 50	7 19	6 86	9 30	0 33	37 54	55 00	2 25	57 25	13 50	12 88	17 46	0 62	2 25	12 88	37 54	0
23-Apr-02	0 213	22	40 60	6 60	47 20	1 07	0 75	18 60	0 32	17 81	32 86	5 34	38 20	0 87	0 61	15 05	0 26	5 34	0 61	17 81	0
30-Apr-02	0 466	19 2	27 30	0 70	28 00	1 56	1 35	8 10	0 21	34 00	48 34	1 24	49 58	2 76	2 39	14 34	0 37	1 24	2 39	34 00	0
07-May-02	0 58	15 6	23 50	0 74	24 24	4 57	4 47	7 90	0 10	34 38	51 79	1 63	53 42	10 07	9 85	17 41	0 22	1 63	9 85	34 38	0
14-May-02	0 58	15	16 90	0 59	17 49	2 30	2 02	1 90	0 28	33 06	37 25	1 30	38 55	5 07	4 45	4 19	0 62	1 30	4 45	33 06	0
21-May-02	0 58	9 8	11 10	1 30	12 40	1 42	1 30	1 30	0 12	21 60	24 46	2 87	27 33	3 13	2 87	2 87	0 26	2 87	2 87	21 60	0
28-May-02	0 56	29 6	35 20	0 47	35 67	21 70	19 30	5 60	2 40	62 99	74 91	1 00	75 91	46 18	41 07	11 92	5 11	1 00	41 07	62 99	0
04-Jun-02	0 496	17	6 60	0 42	7 02	2 02	1 78	0 00	0 24	32 04	12 44	0 79	13 23	3 81	3 35	0 00	0 45	0 79	3 35	32 04	0
11-Jun-02	0 462	16 4	31 80	0 84	32 64	2 94	1 71	15 40	1 23	28 79	55 83	1 47	57 30	5 16	3 00	27 04	2 16	1 47	3 00	28 79	0
18-Jun-02	0 415	26 4	28 10	1 20	29 30	0 32	0 24	1 70	0 07	41 63	44 31	1 89	46 21	0 50	0 38	2 68	0 12	1 89	0 38	41 63	0
25-Jun-02	0 466	21 7	23 60	1 10	24 70	1 98	1 36	1 90	0 62	38 43	41 79	1 95	43 74	3 51	2 41	3 36	1 10	1 95	2 41	38 43	0
01-Jul-02	1 173	13 2	22 30	0 64	22 94	3 09	2 11	9 10	0 98	58 84	99 40	2 85	102 25	13 77	9 41	40 56	4 37	2 85	9 41	58 84	0
09-Jul-02	0 482	21 6	31 80	1 00	32 80	2 63	1 71	10 20	0 92	39 56	58 24	1 83	60 08	4 82	3 13	18 68	1 69	1 83	3 13	39 56	0
16-Jul-02	0 555	18 2	24 50	1 00	25 50	0 49	0 15	6 30	0 34	38 38	51 67	2 11	53 78	1 03	0 32	13 29	0 71	2 11	0 32	38 38	0
23-Jul-02	0 497	22 8	29 20	1 50	30 70	1 24	0 60	6 30	0 64	43 06	55 15	2 83	57 98	2 34	1 13	12 09	1 21	2 83	1 13	43 06	0
30-Jul-02	0 524	25 6	30 90	0 92	31 82	1 39	0 85	5 30	0 54	50 97	61 53	1 83	63 36	2 77	1 69	10 55	1 08	1 83	1 69	50 97	0
06-Aug-02	0 453	12 4	23 20	1 40	24 60	1 37	1 16	10 80	0 21	21 35	39 94	2 41	42 35	2 36	2 00	18 59	0 36	2 41	2 00	21 35	0
13-Aug-02	0 496	23 6	25 00	5 70	30 70	2 16	1 33	1 40	0 83	44 48	47 12	10 74	57 86	4 07	2 51	2 64	1 56	10 74	2 51	44 48	0
20-Aug-02	0 521	18 8	28 30	1 60	29 90	5 06	4 12	9 50	0 94	37 22	56 03	3 17	59 20	10 02	8 16	18 81	1 86	3 17	8 16	37 22	0
03-Sep-02	0 459	24	37 20	2 20	39 40	2 74	2 07	13 20	0 67	41 86	64 88	3 84	68 72	4 78	3 61	23 02	1 17	3 84	3 61	41 86	0
10-Sep-02	0 393	27 6	42 00	2 30	44 30	3 29	3 08	14 40	0 21	41 22	62 72	3 43	66 16	4 91	4 60	21 50	0 31	3 43	4 60	41 22	0
17-Sep-02	0 487	16 8	32 50	0 61	33 11	1 52	1 27	15 70	0 25	31 09	60 14	1 13	61 27	2 81	2 35	29 05	0 46	1 13	2 35	31 09	0
24-Sep-02	0 454	24	30 90	1 20	32 10	4 11	3 70	6 90	0 41	41 40	53 31	2 07	55 38	7 09	6 38	11 90	0 71	2 07	6 38	41 40	0
Average	**0.51**	**17.63**	**23.10**	**1.58**	**24.68**	**2.49**	**1.94**	**5.71**	**0.54**	**33.75**	**43.96**	**2.93**	**46.89**	**4.93**	**3.85**	**10.67**	**1.08**	**2.93**	**3.85**	**33.75**	**0.00**

City of Eustace Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON (calc)	OP (calc)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
15-Nov-01	0.04	10.0	45.5	0.517	46.017	6.24	4.94	35.5	1.3	1.32	6.03	0.07	6.10	0.83	0.65	4.70	0.17	0.07	0.65	1.32	0.00
19-Nov-01	0.09	14.0	29.9	0.341	30.241	5.98	5.05	15.9	0.93	4.56	9.73	0.11	9.84	1.95	1.64	5.18	0.30	0.11	1.64	4.56	0.00
29-Nov-01	0.10	16.0	16	0.272	16.272	5.46	4.95	0	0.51	6.24	6.24	0.11	6.34	2.13	1.93	0.00	0.20	0.11	1.93	6.24	0.00
06-Dec-01	0.04	16.0	17.8	0.646	18.446	6.24	4.3	1.8	1.94	2.30	2.56	0.09	2.65	0.90	0.62	0.26	0.28	0.09	0.62	2.30	0.00
13-Dec-01	0.08	17.3	18.9	0.306	19.206	4.79	3.12	1.6	1.67	4.91	5.37	0.09	5.45	1.36	0.89	0.45	0.47	0.09	0.89	4.91	0.00
20-Dec-01	0.02	5.47	19.4	0.575	19.975	2.97	2.16	13.93	0.81	0.50	1.76	0.05	1.81	0.27	0.20	1.27	0.07	0.05	0.20	0.50	0.00
27-Dec-01	0.03	7.14	20.6	0.451	21.051	2.52	2.46	13.46	0.06	0.78	2.26	0.05	2.31	0.28	0.27	1.48	0.01	0.05	0.27	0.78	0.00
03-Jan-02	0.04	8.44	17.7	0.224	17.924	3.7	2.91	9.26	0.79	1.41	2.95	0.04	2.99	0.62	0.48	1.54	0.13	0.04	0.48	1.41	0.00
10-Jan-02	0.02	14.8	16.5	0.215	16.715	4.06	2.81	1.7	1.25	1.29	1.44	0.02	1.46	0.35	0.24	0.15	0.11	0.02	0.24	1.29	0.00
17-Jan-02	0.04	20.5	25.8	0.162	25.962	4.9	3.54	5.3	1.36	3.41	4.30	0.03	4.32	0.82	0.59	0.88	0.23	0.03	0.59	3.41	0.00
24-Jan-02	0.01	2.91	31.4	0.073	31.473	5.03	4.17	28.49	0.86	0.08	0.83	0.00	0.83	0.13	0.11	0.75	0.02	0.00	0.11	0.08	0.00
31-Jan-02	0.02	15.6	26.3	0.115	26.415	5.16	4.27	10.7	0.89	1.29	2.17	0.01	2.18	0.43	0.35	0.88	0.07	0.01	0.35	1.29	0.00
07-Feb-02	0.12	16.1	24.5	0.02	24.52	4.75	3.51	8.4	1.24	7.07	10.76	0.01	10.77	2.09	1.54	3.69	0.54	0.01	1.54	7.07	0.00
14-Feb-02	0.04	20.2	31.2	0.0501	31.2501	3.88	2.94	11	0.94	3.06	4.72	0.01	4.73	0.59	0.45	1.67	0.14	0.01	0.45	3.06	0.00
21-Feb-02	0.05	11.9	21.1	0.0695	21.1695	4.09	2.62	9.2	1.47	2.30	4.07	0.01	4.09	0.79	0.51	1.78	0.28	0.01	0.51	2.30	0.00
28-Feb-02	0.04	21.0	22.6	0.192	22.792	3.97	2.75	1.6	1.22	2.78	2.99	0.03	3.02	0.53	0.36	0.21	0.16	0.03	0.36	2.78	0.00
07-Mar-02	0.04	16.9	24.4	0.28	24.68	4.65	2.67	7.5	1.98	2.43	3.51	0.04	3.55	0.67	0.38	1.08	0.28	0.04	0.38	2.43	0.00
14-Mar-02	0.04	8.39	28.5	0.549	29.049	5.34	2.58	20.11	2.76	1.11	3.78	0.07	3.85	0.71	0.34	2.66	0.37	0.07	0.34	1.11	0.00
21-Mar-02	0.17	6.45	25.6	0.204	25.804	3.16	1.93	19.15	1.23	4.25	16.86	0.13	17.00	2.08	1.27	12.61	0.81	0.13	1.27	4.25	0.00
28-Mar-02	0.04	8.28	11.8	8.39	20.19	2.66	4.34	3.52	0	1.16	1.65	1.18	2.83	0.37	0.61	0.49	0.00	1.18	0.61	1.16	0.00
04-Apr-02	0.04	8.25	17.8	0.291	18.091	3.3	2.32	9.55	0.98	1.19	2.56	0.04	2.60	0.47	0.33	1.37	0.14	0.04	0.33	1.19	0.00
11-Apr-02	0.04	11.8	18.5	0.224	18.724	3.3	2.53	6.7	0.77	1.83	2.87	0.03	2.91	0.51	0.39	1.04	0.12	0.03	0.39	1.83	0.00
18-Apr-02	0.04	11.4	11.4	0.402	11.802	4.1	2.68	0	1.42	1.77	1.77	0.06	1.83	0.64	0.42	0.00	0.22	0.06	0.42	1.77	0.00
25-Apr-02	0.03	11.7	25.4	0.6	26	5.31	3.49	13.7	1.82	1.51	3.27	0.08	3.35	0.68	0.45	1.76	0.23	0.08	0.45	1.51	0.00
02-May-02	0.04	9.94	30.9	0.934	31.834	5.64	2.88	20.96	2.76	1.35	4.21	0.13	4.34	0.77	0.39	2.86	0.38	0.13	0.39	1.35	0.00
09-May-02	0.04	1.84	31.3	0.258	31.558	5.39	3.81	29.46	1.58	0.31	5.21	0.04	5.26	0.90	0.63	4.91	0.26	0.04	0.63	0.31	0.00
16-May-02	0.05	10.2	28.6	0.441	29.041	5.85	3.99	18.4	1.86	1.85	5.20	0.08	5.28	1.06	0.72	3.34	0.34	0.08	0.72	1.85	0.00
23-May-02	0.04	9.62	23.9	0.369	24.269	5.27	3.38	14.28	1.89	1.38	3.44	0.05	3.49	0.76	0.49	2.05	0.27	0.05	0.49	1.38	0.00
30-May-02	0.04	11.9	26.7	0.476	27.176	5.92	3.68	14.8	2.24	1.80	4.04	0.07	4.11	0.90	0.56	2.24	0.34	0.07	0.56	1.80	0.00
06-Jun-02	0.03	9.72	31.5	0.722	32.222	5.49	3.71	21.78	1.78	1.25	4.05	0.09	4.15	0.71	0.48	2.80	0.23	0.09	0.48	1.25	0.00
13-Jun-02	0.04	7.24	25.7	0.517	26.217	5.61	2.59	18.46	3.02	1.15	4.09	0.08	4.17	0.89	0.41	2.93	0.48	0.08	0.41	1.15	0.00
20-Jun-02	0.03	7.06	20	0.726	20.726	5.24	3.05	12.94	2.19	0.67	1.89	0.07	1.96	0.50	0.29	1.22	0.21	0.07	0.29	0.67	0.00
27-Jun-02	0.04	12.5	19.7	0.222	19.922	6.7	4.76	7.2	1.94	2.03	3.21	0.04	3.24	1.09	0.77	1.17	0.32	0.04	0.77	2.03	0.00
02-Jul-02	0.05	12.4	29	0.387	29.387	6.42	4.36	16.6	2.06	2.25	5.27	0.07	5.34	1.17	0.79	3.02	0.37	0.07	0.79	2.25	0.00
11-Jul-02	0.06	7.58	15.8	0.402	16.202	4.38	2.83	8.22	1.55	1.64	3.41	0.09	3.50	0.95	0.61	1.77	0.33	0.09	0.61	1.64	0.00
18-Jul-02	0.04	7.94	27.4	0.21	27.61	4.78	3.06	19.46	1.72	1.11	3.84	0.03	3.87	0.67	0.43	2.73	0.24	0.03	0.43	1.11	0.00
25-Jul-02	0.03	5.02	23.5	0.0654	23.5654	5.59	2.49	18.48	3.1	0.63	2.94	0.01	2.94	0.70	0.31	2.31	0.39	0.01	0.31	0.63	0.00
01-Aug-02	0.00	3.58	16.1	0.112	16.212	4.61	2.22	12.52	2.39	0.03	0.13	0.00	0.13	0.04	0.02	0.10	0.02	0.00	0.02	0.03	0.00
08-Aug-02	0.02	9.46	28.2	0.0714	28.2714	6.53	3.71	18.74	2.82	0.72	2.13	0.01	2.14	0.49	0.28	1.42	0.21	0.01	0.28	0.72	0.00
15-Aug-02	0.03	8.78	12.1	0.167	12.267	5.86	3.22	3.32	2.64	0.96	1.33	0.02	1.35	0.64	0.35	0.36	0.29	0.02	0.35	0.96	0.00
22-Aug-02	0.03	12.2	14.6	0.51	15.11	6.6	3.71	2.4	2.89	1.52	1.82	0.06	1.89	0.82	0.46	0.30	0.36	0.06	0.46	1.52	0.00
29-Aug-02	0.03	12.9	18.1	0.643	18.743	5.47	3.91	5.2	1.56	1.61	2.26	0.08	2.34	0.68	0.49	0.65	0.19	0.08	0.49	1.61	0.00
05-Sep-02	0.03	8.76	36.7	0.309	37.009	5.36	3.03	27.94	2.33	0.99	4.17	0.04	4.20	0.61	0.34	3.17	0.26	0.04	0.34	0.99	0.00
12-Sep-02	0.05	8.2	13.1	0.444	13.544	6.22	3.37	4.9	2.85	1.43	2.28	0.08	2.36	1.08	0.59	0.85	0.50	0.08	0.59	1.43	0.00
19-Sep-02	0.19	11.2	32.9	0.269	33.169	5.9	4.22	21.7	1.68	7.89	23.16	0.19	23.35	4.15	2.97	15.28	1.18	0.19	2.97	7.89	0.00
26-Sep-02	0.05	5.84	16.6	1.08	17.68	5.13	2.52	10.76	2.61	1.11	3.14	0.20	3.35	0.97	0.48	2.04	0.49	0.20	0.48	1.11	0.00
03-Oct-02	0.03	6.53	3.9	0.697	4.597	5	2.65	0	2.35	0.62	0.37	0.07	0.44	0.47	0.25	0.00	0.22	0.07	0.25	0.62	0.00
10-Oct-02	0.06	10.4	27.2	0.38	27.58	5.56	3.71	16.8	1.85	2.36	6.18	0.09	6.26	1.26	0.84	3.82	0.42	0.09	0.84	2.36	0.00
17-Oct-02	0.05	9.56	20.3	0.763	21.063	4.66	3.3	10.74	1.36	1.63	3.46	0.13	3.59	0.79	0.56	1.83	0.23	0.13	0.56	1.63	0.00
24-Oct-02	0.05	6.72	27.1	0.258	27.358	4.56	3.47	20.38	1.09	1.37	5.54	0.05	5.59	0.93	0.71	4.17	0.22	0.05	0.71	1.37	0.00
31-Oct-02	0.04	14.6	19.7	0.394	20.094	4.98	3.64	5.1	1.34	2.21	2.98	0.06	3.04	0.75	0.55	0.77	0.20	0.06	0.55	2.21	0.00
07-Nov-02	0.03	22.6	35.7	0.237	35.937	4.93	3.84	13.1	1.09	2.91	4.59	0.03	4.62	0.63	0.49	1.69	0.14	0.03	0.49	2.91	0.00
14-Nov-02	0.04	20.1	35.3	0.17	35.47	4.31	3.24	15.2	1.07	2.66	4.68	0.02	4.70	0.57	0.43	2.01	0.14	0.02	0.43	2.66	0.00
21-Nov-02	0.04	18	29.3	0.713	30.013	4.91	3.3	11.3	1.61	2.93	4.77	0.12	4.88	0.80	0.54	1.84	0.26	0.12	0.54	2.93	0.00
05-Dec-02	0.05	27.6	32.5	0.287	32.787	6.12	4.42	4.9	1.7	5.12	6.03	0.05	6.08	1.14	0.82	0.91	0.32	0.05	0.82	5.12	0.00
12-Dec-02	0.21	19.9	25.8	0.157	25.957	5.15	3.86	5.9	1.29	15.59	20.22	0.12	20.34	4.04	3.02	4.62	1.01	0.12	3.02	15.59	0.00
19-Dec-02	0.04	20.1	40.3	0.29	40.59	4.81	3.7	20.2	1.11	2.97	5.95	0.04	5.99	0.71	0.55	2.98	0.16	0.04	0.55	2.97	0.00
26-Dec-02	0.05	17.3	22.7	0.16	22.86	4.4	3.06	5.4	1.34	3.08	4.04	0.03	4.07	0.78	0.54	0.96	0.24	0.03	0.54	3.08	0.00
02-Jan-03	0.05	14.1	15.5	0.0636	15.5636	3.58	2.34	1.4	1.24	2.46	2.70	0.01	2.71	0.62	0.41	0.24	0.22	0.01	0.41	2.46	0.00
09-Jan-03	0.06	14.7	21.3	0.121	21.421	3.93	2.18	6.6	1.75	3.12	4.51	0.03	4.54	0.83	0.46	1.40	0.37	0.03	0.46	3.12	0.00
16-Jan-03	0.04	19.6	21.9	0.142	22.042	4.26	2.76	2.3	1.5	3.26	3.65	0.02	3.67	0.71	0.46	0.38	0.25	0.02	0.46	3.26	0.00
23-Jan-03	0.04	22.4	29.3	0.296	29.596	4.81	3.29	6.9	1.52	3.73	4.88	0.05	4.93	0.80	0.55	1.15	0.25	0.05	0.55	3.73	0.00
Average	**0.05**	**12.24**	**23.85**	**0.48**	**24.33**	**4.93**	**3.33**	**11.66**	**1.63**	**2.39**	**4.52**	**0.08**	**4.60**	**0.91**	**0.63**	**2.13**	**0.29**	**0.08**	**0.63**	**2.39**	**0.00**

Detection limit values set to face value

City of Kaufman Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON (calc)	OP (calc)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
04-Dec-01	0.62	1.10	2.30	14.00	16.30	3.10	2.00	1.20	1.10	2.59	5.42	33.01	38.44	7.31	4.72	2.83	2.59	33.01	4.72	2.59	0.00
11-Dec-01	0.84	0.20	2.00	14.00	16.00	2.40	1.70	1.80	0.70	0.64	6.37	44.62	50.99	7.65	5.42	5.74	2.23	44.62	5.42	0.64	0.00
18-Dec-01	0.92	0.21	1.30	9.30	10.60	1.50	1.30	1.09	0.20	0.73	4.53	32.42	36.95	5.23	4.53	3.80	0.70	32.42	4.53	0.73	0.00
27-Dec-01	0.58	0.20	0.20	20.00	20.20	2.70	1.40	0.00	1.30	0.44	0.44	43.53	43.96	5.88	3.05	0.00	2.83	43.53	3.05	0.44	0.00
03-Jan-02	0.56	11.00	14.00	3.00	17.00	3.20	1.40	3.00	1.80	23.40	29.78	6.38	36.16	6.81	2.98	6.38	3.83	6.38	2.98	23.40	0.00
08-Jan-02	0.52	20.00	0.36	0.19	0.55	2.60	1.50	0.00	1.10	39.37	0.71	0.37	1.08	5.12	2.95	0.00	2.17	0.37	2.95	39.37	0.00
15-Jan-02	0.57	16.00	18.00	0.47	18.47	2.50	1.30	2.00	1.20	34.52	38.84	1.01	39.85	5.39	2.80	4.32	2.59	1.01	2.80	34.52	0.00
29-Jan-02	0.54	0.20	1.20	16.00	17.20	3.20	1.60	1.00	1.60	0.41	2.46	32.82	35.29	6.56	3.28	2.05	3.28	32.82	3.28	0.41	0.00
05-Feb-02	1.05	0.25	0.79	15.00	15.79	2.50	1.20	0.54	1.30	0.99	3.13	59.39	62.52	9.90	4.75	2.14	5.15	59.39	4.75	0.99	0.00
12-Feb-02	0.43	0.29	0.88	19.00	19.88	3.10	1.60	0.59	1.50	0.47	1.43	30.85	32.28	5.03	2.60	0.96	2.44	30.85	2.60	0.47	0.00
19-Feb-02	0.58	4.20	5.00	18.00	23.00	3.80	2.20	0.80	1.60	9.16	10.90	39.24	50.15	8.28	4.80	1.74	3.49	39.24	4.80	9.16	0.00
26-Feb-02	0.54	0.71	2.00	14.00	16.00	3.00	3.20	1.29	0.00	1.45	4.08	28.56	32.64	6.12	6.53	2.63	0.00	28.56	6.53	1.45	0.00
05-Mar-02	0.55	0.26	2.30	17.00	19.30	2.90	2.90	2.04	0.00	0.54	4.77	35.26	40.03	6.02	6.02	4.23	0.00	35.26	6.02	0.54	0.00
12-Mar-02	0.43	0.20	2.20	7.20	9.40	2.80	3.10	2.00	0.00	0.32	3.57	11.69	15.26	4.55	5.03	3.25	0.00	11.69	5.03	0.32	0.00
19-Mar-02	0.88	0.23	2.10	8.90	11.00	3.40	1.40	1.87	2.00	0.77	7.03	29.78	36.81	11.38	4.68	6.26	6.69	29.78	4.68	0.77	0.00
26-Mar-02	0.60	0.26	0.40	27.00	27.40	2.90	1.30	0.14	1.60	0.59	0.91	61.73	62.64	6.63	2.97	0.32	3.66	61.73	2.97	0.59	0.00
02-Apr-02	0.67	0.20	1.20	9.00	10.20	2.40	1.60	1.00	0.80	0.50	3.02	22.65	25.67	6.04	4.03	2.52	2.01	22.65	4.03	0.50	0.00
09-Apr-02	0.65	0.34	2.40	10.00	12.40	2.60	1.40	2.06	1.20	0.83	5.88	24.49	30.37	6.37	3.43	5.04	2.94	24.49	3.43	0.83	0.00
16-Apr-02	0.75	0.38	1.00	10.00	11.00	3.00	1.80	0.62	1.20	1.07	2.82	28.20	31.02	8.46	5.08	1.75	3.38	28.20	5.08	1.07	0.00
23-Apr-02	0.56	0.20	1.10	9.50	10.60	3.20	1.60	0.90	1.60	0.42	2.34	20.17	22.51	6.80	3.40	1.91	3.40	20.17	3.40	0.42	0.00
30-Apr-02	0.57	0.56	1.90	9.40	11.30	3.60	1.80	1.34	1.80	1.21	4.12	20.39	24.51	7.81	3.90	2.91	3.90	20.39	3.90	1.21	0.00
07-May-02	0.79	0.24	1.60	6.10	7.70	2.50	0.84	1.36	1.66	0.72	4.79	18.26	23.05	7.49	2.52	4.07	4.97	18.26	2.52	0.72	0.00
14-May-02	0.66	0.20	1.60	14.00	15.60	2.50	1.40	1.40	1.10	0.50	3.97	34.76	38.74	6.21	3.48	3.48	2.73	34.76	3.48	0.50	0.00
21-May-02	0.56	0.25	1.50	15.00	16.50	3.10	2.50	1.25	0.60	0.53	3.16	31.57	34.73	6.52	5.26	2.63	1.26	31.57	5.26	0.53	0.00
28-May-02	0.55	0.35	2.30	12.00	14.30	3.30	2.00	1.95	1.30	0.73	4.77	24.89	29.66	6.85	4.15	4.04	2.70	24.89	4.15	0.73	0.00
04-Jun-02	0.54	0.20	1.00	6.40	7.40	3.00	1.60	0.80	1.40	0.41	2.03	13.01	15.04	6.10	3.25	1.63	2.85	13.01	3.25	0.41	0.00
11-Jun-02	0.60	0.82	1.80	6.50	8.30	2.70	1.20	0.98	1.50	1.85	4.05	14.64	18.69	6.08	2.70	2.21	3.38	14.64	2.70	1.85	0.00
18-Jun-02	0.53	0.20	0.62	8.90	9.52	2.90	1.50	0.42	1.40	0.40	1.25	17.99	19.24	5.86	3.03	0.85	2.83	17.99	3.03	0.40	0.00
25-Jun-02	0.55	0.49	1.60	6.40	8.00	3.00	3.00	1.11	0.00	1.01	3.31	13.23	16.53	6.20	6.20	2.29	0.00	13.23	6.20	1.01	0.00
02-Jul-02	0.80	4.50	7.90	5.00	12.90	1.70	1.20	3.40	0.50	13.64	23.95	15.16	39.11	5.15	3.64	10.31	1.52	15.16	3.64	13.64	0.00
09-Jul-02	1.00	3.90	5.70	6.10	11.80	2.60	0.90	1.80	1.70	14.76	21.58	23.09	44.66	9.84	3.41	6.81	6.43	23.09	3.41	14.76	0.00
16-Jul-02	1.30	0.60	1.30	6.00	7.30	1.70	1.40	0.70	0.30	2.95	6.40	29.52	35.92	8.37	6.89	3.44	1.48	29.52	6.89	2.95	0.00
23-Jul-02	1.00	0.84	2.20	6.00	8.20	2.30	0.95	1.36	1.35	3.18	8.33	22.71	31.04	8.71	3.60	5.15	5.11	22.71	3.60	3.18	0.00
30-Jul-02	1.00	0.26	1.60	7.80	9.40	2.80	1.10	1.34	1.70	0.98	6.06	29.52	35.58	10.60	4.16	5.07	6.43	29.52	4.16	0.98	0.00
13-Aug-02	1.00	0.82	2.60	7.10	9.70	2.70	1.60	1.78	1.10	3.10	9.84	26.87	36.72	10.22	6.06	6.74	4.16	26.87	6.06	3.10	0.00
20-Aug-02	0.58	0.61	0.82	9.70	10.52	3.20	3.20	0.21	0.00	1.34	1.80	21.30	23.10	7.03	7.03	0.46	0.00	21.30	7.03	1.34	0.00
27-Aug-02	1.80	2.40	7.00	7.70	14.70	2.60	1.30	4.60	1.30	16.35	47.69	52.46	100.16	17.71	8.86	31.34	8.86	52.46	8.86	16.35	0.00
03-Sep-02	1.00	0.58	1.40	13.00	14.40	3.40	3.50	0.82	0.00	2.20	5.30	49.21	54.51	12.87	13.25	3.10	0.00	49.21	13.25	2.20	0.00
10-Sep-02	0.54	4.00	4.60	12.00	16.60	2.50	1.10	0.60	1.40	8.18	9.40	24.53	33.93	5.11	2.25	1.23	2.86	24.53	2.25	8.18	0.00
24-Sep-02	1.10	0.31	0.44	17.00	17.44	3.60	1.20	0.13	2.40	1.29	1.83	70.78	72.61	14.99	5.00	0.54	9.99	70.78	5.00	1.29	0.00
01-Oct-02	0.59	0.20	0.72	9.60	10.32	3.40	1.50	0.52	1.90	0.45	1.61	21.44	23.05	7.59	3.35	1.16	4.24	21.44	3.35	0.45	0.00
08-Oct-02	1.00	0.34	0.52	27.00	27.52	3.70	1.50	0.18	2.20	1.29	1.97	102.20	104.17	14.01	5.68	0.68	8.33	102.20	5.68	1.29	0.00
15-Oct-02	0.07	0.20	0.66	12.00	12.66	3.00	1.50	0.46	1.50	0.05	0.17	3.18	3.35	0.79	0.40	0.12	0.40	3.18	0.40	0.05	0.00
22-Oct-02	1.30	0.20	0.55	9.20	9.75	2.40	0.98	0.35	1.42	0.98	2.71	45.27	47.98	11.81	4.82	1.72	6.99	45.27	4.82	0.98	0.00
29-Oct-02	0.61	1.30	1.60	8.10	9.70	2.90	1.50	0.30	1.40	3.00	3.69	18.70	22.40	6.70	3.46	0.69	3.23	18.70	3.46	3.00	0.00
05-Nov-02	0.19	0.20	2.60	9.80	12.40	2.60	1.00	2.40	1.60	0.14	1.87	7.05	8.92	1.87	0.72	1.73	1.15	7.05	0.72	0.14	0.00
12-Nov-02	0.51	0.20	1.70	9.40	11.10	4.40	3.70	1.50	0.70	0.39	3.28	18.15	21.43	8.49	7.14	2.90	1.35	18.15	7.14	0.39	0.00
21-Nov-01	0.55	0.55	8.60	13.00	21.60	1.40	2.30	8.05	0.00	1.13	17.77	26.87	44.64	2.89	4.75	16.65	0.00	26.87	4.75	1.13	0.00
27-Nov-01	0.66	0.66	1.20	13.00	14.20	3.20	1.60	0.54	1.60	1.63	2.98	32.33	35.31	7.96	3.98	1.35	3.98	32.33	3.98	1.63	0.00
Average	**0.71**	**1.68**	**2.62**	**10.91**	**13.53**	**2.85**	**1.72**	**1.34**	**1.16**	**4.16**	**7.10**	**28.88**	**35.99**	**7.50**	**4.41**	**3.74**	**3.15**	**28.88**	**4.41**	**4.16**	**0.00**

Detection limit values estimated at reported value

City of Kemp Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON Calc	OP Calc	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
02-Oct-01	0 06	0 24	3 39	18 50	21 89	6 13	4 92	3 15	1 21	0 06	0 83	4 53	5 36	1 50	1 20	0 77	0 30	4 53	1 20	0 06	0 00
11-Oct-01	0 11	6 42	17 80	10 60	28 40	6 41	3 80	11 38	2 61	2 56	7 11	4 23	11 34	2 56	1 52	4 54	1 04	4 23	1 52	2 56	0 00
18-Oct-01	0 06	0 83	3 58	17 60	21 18	3 22	3 07	2 75	0 15	0 20	0 88	4 31	5 18	0 79	0 75	0 67	0 04	4 31	0 75	0 20	0 00
25-Oct-01	0 07	0 28	3 71	26 40	30 11	5 22	4 73	3 43	0 49	0 07	0 94	6 66	7 60	1 32	1 19	0 87	0 12	6 66	1 19	0 07	0 00
01-Nov-01	0 09	0 13	4 16	29 60	33 76	5 65	5 18	4 03	0 47	0 05	1 42	10 12	11 54	1 93	1 77	1 38	0 16	10 12	1 77	0 05	0 00
08-Nov-01	0 08	0 45	4 91	29 30	34 21	6 31	5 54	4 46	0 77	0 14	1 56	9 30	10 86	2 00	1 76	1 42	0 24	9 30	1 76	0 14	0 00
15-Nov-01	0 11	3 00	7 82	29 70	37 52	8 55	7 46	4 82	1 09	1 20	3 12	11 86	14 98	3 41	2 98	1 92	0 44	11 86	2 98	1 20	0 00
19-Nov-01	0 09	0 96	3 86	9 77	13 63	3 78	3 47	2 90	0 31	0 34	1 36	3 43	4 79	1 33	1 22	1 02	0 11	3 43	1 22	0 34	0 00
29-Nov-01	0 17	0 41	2 19	5 12	7 31	1 56	1 16	1 78	0 40	0 27	1 45	3 38	4 83	1 03	0 77	1 18	0 26	3 38	0 77	0 27	0 00
06-Dec-01	0 07	0 90	3 77	9 49	13 26	5 18	4 77	2 87	0 41	0 23	0 96	2 41	3 36	1 31	1 21	0 73	0 10	2 41	1 21	0 23	0 00
13-Dec-01	0 11	0 27	2 30	8 30	10 60	2 39	1 86	2 03	0 53	0 11	0 92	3 33	4 25	0 96	0 75	0 81	0 21	3 33	0 75	0 11	0 00
20-Dec-01	0 11	0 04	0 10	9 11	9 21	5 00	1 68	0 06	3 32	0 02	0 04	3 66	3 70	2 01	0 67	0 02	1 33	3 66	0 67	0 02	0 00
27-Dec-01	0 12	0 02	1 81	11 30	13 11	3 21	2 76	1 79	0 45	0 01	0 81	5 05	5 86	1 43	1 23	0 80	0 20	5 05	1 23	0 01	0 00
03-Jan-02	0 08	0 24	2 95	16 10	19 05	3 18	3 05	2 72	0 13	0 07	0 87	4 72	5 59	0 93	0 89	0 80	0 04	4 72	0 89	0 07	0 00
10-Jan-02	0 08	0 28	2 42	15 70	18 12	3 99	3 74	2 14	0 25	0 09	0 77	4 99	5 76	1 27	1 19	0 68	0 08	4 99	1 19	0 09	0 00
17-Jan-02	0 08	0 27	4 02	13 40	17 42	3 38	3 59	3 75	0 00	0 08	1 18	3 93	5 11	0 99	1 05	1 10	0 00	3 93	1 05	0 08	0 00
24-Jan-02	0 12	0 61	3 50	12 50	16 00	3 03	3 02	2 90	0 01	0 27	1 56	5 58	7 15	1 35	1 35	1 29	0 00	5 58	1 35	0 27	0 00
31-Jan-02	0 13	0 32	1 69	7 41	9 10	1 72	1 36	1 37	0 36	0 16	0 86	3 76	4 62	0 87	0 69	0 69	0 18	3 76	0 69	0 16	0 00
07-Feb-02	0 15	0 25	1 69	4 86	6 55	1 05	0 64	1 44	0 41	0 14	0 95	2 74	3 69	0 59	0 36	0 81	0 23	2 74	0 36	0 14	0 00
14-Feb-02	0 11	0 30	3 70	11 90	15 60	1 89	1 28	3 40	0 61	0 12	1 48	4 77	6 26	0 76	0 51	1 36	0 24	4 77	0 51	0 12	0 00
21-Feb-02	0 08	1 11	1 91	10 90	12 81	1 88	1 45	0 80	0 43	0 34	0 59	3 38	3 98	0 58	0 45	0 25	0 13	3 38	0 45	0 34	0 00
28-Feb-02	0 08	0 19	3 70	18 40	22 10	3 09	2 88	3 51	0 21	0 06	1 09	5 43	6 52	0 91	0 85	1 04	0 06	5 43	0 85	0 06	0 00
07-Mar-02	0 08	0 19	2 75	12 10	14 85	2 67	2 19	2 56	0 48	0 06	0 85	3 76	4 61	0 83	0 68	0 80	0 15	3 76	0 68	0 06	0 00
14-Mar-02	0 07	0 14	3 14	7 91	11 05	3 27	2 73	3 00	0 54	0 04	0 81	2 04	2 84	0 84	0 70	0 77	0 14	2 04	0 70	0 04	0 00
21-Mar-02	0 13	0 08	1 11	2 65	3 76	0 93	0 50	1 03	0 43	0 04	0 56	1 34	1 91	0 47	0 25	0 52	0 22	1 34	0 25	0 04	0 00
28-Mar-02	0 08	0 26	2 01	8 99	11 00	2 31	2 00	1 75	0 31	0 08	0 59	2 65	3 25	0 68	0 59	0 52	0 09	2 65	0 59	0 08	0 00
04-Apr-02	0 09	0 08	1 65	10 40	12 05	2 77	2 55	1 57	0 22	0 03	0 56	3 54	4 11	0 94	0 87	0 53	0 07	3 54	0 87	0 03	0 00
11-Apr-02	0 08	0 35	1 80	5 75	7 55	1 51	1 33	1 45	0 18	0 10	0 52	1 68	2 20	0 44	0 39	0 42	0 05	1 68	0 39	0 10	0 00
18-Apr-02	0 08	0 26	1 60	7 13	8 73	3 40	3 08	1 34	0 32	0 08	0 47	2 08	2 54	0 99	0 90	0 39	0 09	2 08	0 90	0 08	0 00
25-Apr-02	0 54	0 28	2 00	7 97	9 97	4 59	4 52	1 72	0 07	0 58	4 09	16 29	20 38	9 38	9 24	3 51	0 14	16 29	9 24	0 58	0 00
02-May-02	0 10	0 27	1 90	7 73	9 63	5 80	5 67	1 63	0 13	0 10	0 71	2 90	3 61	2 18	2 13	0 61	0 05	2 90	2 13	0 10	0 00
09-May-02	0 04	0 31	2 91	10 40	13 31	4 02	3 56	2 60	0 46	0 05	0 47	1 70	2 17	0 66	0 58	0 42	0 08	1 70	0 58	0 05	0 00
16-May-02	0 05	0 37	3 05	13 20	16 25	3 28	3 20	2 68	0 08	0 08	0 62	2 69	3 32	0 67	0 65	0 55	0 02	2 69	0 65	0 08	0 00
23-May-02	0 04	0 32	3 39	13 10	16 49	3 80	3 44	3 07	0 36	0 05	0 55	2 14	2 69	0 62	0 56	0 50	0 06	2 14	0 56	0 05	0 00
29-May-02	0 18	1 20	3 92	6 44	10 36	1 84	1 52	2 72	0 32	0 83	2 72	4 47	7 18	1 28	1 05	1 89	0 22	4 47	1 05	0 83	0 00
06-Jun-02	0 05	0 24	1 61	11 90	13 51	4 01	3 61	1 37	0 40	0 05	0 33	2 43	2 76	0 82	0 74	0 28	0 08	2 43	0 74	0 05	0 00
13-Jun-02	0 05	0 21	2 66	17 30	19 96	2 94	2 35	2 45	0 59	0 04	0 54	3 54	4 08	0 60	0 48	0 50	0 12	3 54	0 48	0 04	0 00
19-Jun-02	0 05	0 22	2 48	13 90	16 38	2 83	2 56	2 26	0 27	0 04	0 51	2 84	3 35	0 58	0 52	0 46	0 06	2 84	0 52	0 04	0 00
27-Jun-02	0 05	0 19	2 91	17 70	20 61	5 04	4 52	2 72	0 52	0 04	0 59	3 62	4 21	1 03	0 92	0 56	0 11	3 62	0 92	0 04	0 00
02-Jul-02	0 06	0 18	1 48	4 20	5 68	1 50	1 15	1 30	0 35	0 04	0 32	0 90	1 21	0 32	0 25	0 28	0 07	0 90	0 25	0 04	0 00
11-Jul-02	0 06	0 26	2 12	14 80	16 92	2 26	1 81	1 86	0 45	0 06	0 45	3 17	3 62	0 48	0 39	0 40	0 10	3 17	0 39	0 06	0 00
18-Jul-02	0 06	0 45	1 71	7 02	8 73	1 26	1 22	1 26	0 04	0 10	0 37	1 50	1 87	0 27	0 26	0 27	0 01	1 50	0 26	0 10	0 00
25-Jul-02	0 06	0 24	1 50	5 60	7 10	1 83	1 44	1 26	0 39	0 05	0 32	1 20	1 52	0 39	0 31	0 27	0 08	1 20	0 31	0 05	0 00
01-Aug-02	0 06	0 06	1 11	9 09	10 20	1 81	1 56	1 05	0 25	0 01	0 25	2 03	2 28	0 40	0 35	0 23	0 06	2 03	0 35	0 01	0 00
08-Aug-02	0 06	0 29	1 30	7 87	9 17	1 31	1 02	1 01	0 29	0 06	0 29	1 76	2 05	0 29	0 23	0 23	0 06	1 76	0 23	0 06	0 00
15-Aug-02	0 06	0 20	1 00	14 70	15 70	4 51	3 53	0 80	0 98	0 04	0 22	3 28	3 51	1 01	0 79	0 18	0 22	3 28	0 79	0 04	0 00
22-Aug-02	0 06	0 21	1 20	13 60	14 80	4 23	3 32	0 99	0 91	0 05	0 27	3 04	3 31	0 94	0 74	0 22	0 20	3 04	0 74	0 05	0 00
29-Aug-02	0 06	0 20	1 90	10 50	12 40	2 49	2 08	1 70	0 41	0 04	0 42	2 34	2 77	0 56	0 46	0 38	0 09	2 34	0 46	0 04	0 00
05-Sep-02	0 06	0 10	1 70	15 50	17 20	4 50	3 42	1 60	1 08	0 02	0 37	3 34	3 71	0 97	0 74	0 35	0 23	3 34	0 74	0 02	0 00
12-Sep-02	0 06	0 13	1 88	16 90	18 78	3 00	2 63	1 75	0 37	0 03	0 41	3 65	4 05	0 65	0 57	0 38	0 08	3 65	0 57	0 03	0 00
19-Sep-02	0 06	0 15	1 31	17 50	18 81	3 59	2 96	1 16	0 63	0 03	0 28	3 78	4 06	0 77	0 64	0 25	0 14	3 78	0 64	0 03	0 00
26-Sep-02	0 06	0 61	1 85	17 40	19 25	3 83	3 02	1 24	0 81	0 13	0 40	3 75	4 15	0 83	0 65	0 27	0 17	3 75	0 65	0 13	0 00
03-Oct-02	0 08	0 27	1 20	16 60	17 80	3 37	2 98	0 93	0 39	0 08	0 35	4 84	5 19	0 98	0 87	0 27	0 11	4 84	0 87	0 08	0 00
10-Oct-02	0 08	0 13	2 46	7 25	9 71	2 12	1 82	2 33	0 30	0 04	0 72	2 11	2 83	0 62	0 53	0 68	0 09	2 11	0 53	0 04	0 00
17-Oct-02	0 08	2 07	5 24	12 60	17 84	2 58	2 44	3 17	0 14	0 60	1 53	3 67	5 20	0 75	0 71	0 92	0 04	3 67	0 71	0 60	0 00
24-Oct-02	0 08	0 16	1 65	0 00	1 65	1 94	1 74	1 49	0 20	0 05	0 48	0 00	0 48	0 57	0 51	0 43	0 06	0 00	0 51	0 05	0 00
31-Oct-02	0 08	0 16	1 30	13 10	14 40	2 42	2 29	1 14	0 13	0 05	0 38	3 82	4 20	0 71	0 67	0 33	0 04	3 82	0 67	0 05	0 00
07-Nov-02	0 06	0 13	1 90	0 00	1 90	2 09	1 88	1 77	0 21	0 03	0 46	0 00	0 46	0 51	0 46	0 43	0 05	0 00	0 46	0 03	0 00
14-Nov-02	0 06	0 26	2 38	6 76	9 14	3 03	2 93	2 12	0 10	0 06	0 58	1 65	2 23	0 74	0 72	0 52	0 02	1 65	0 72	0 06	0 00
21-Nov-02	0 06	0 24	3 50	19 60	23 10	3 90	3 42	3 26	0 48	0 06	0 86	4 79	5 65	0 95	0 84	0 80	0 12	4 79	0 84	0 06	0 00
25-Nov-02	0 06	0 22	4 24	0 00	4 24	4 34	3 61	4 02	0 73	0 05	1 04	0 00	1 04	1 06	0 88	0 98	0 18	0 00	0 88	0 05	0 00
05-Dec-02	0 03	0 24	2 18	8 63	10 81	1 79	1 59	1 94	0 20	0 03	0 27	1 05	1 32	0 22	0 19	0 24	0 02	1 05	0 19	0 03	0 00
12-Dec-02	0 03	0 10	2 71	9 78	12 49	1 79	1 61	2 61	0 18	0 01	0 33	1 19	1 52	0 22	0 20	0 32	0 02	1 19	0 20	0 01	0 00
19-Dec-02	0 03	0 57	5 28	13 60	18 88	2 82	2 57	4 71	0 25	0 07	0 64	1 66	2 30	0 34	0 31	0 57	0 03	1 66	0 31	0 07	0 00
26-Dec-02	0 03	1 95	3 18	8 24	11 42	1 96	1 72	1 23	0 24	0 24	0 39	1 00	1 39	0 24	0 21	0 15	0 03	1 00	0 21	0 24	0 00
Average	**0.08**	**0.49**	**2.82**	**11.87**	**14.68**	**3.25**	**2.78**	**2.32**	**0.47**	**0.17**	**0.90**	**3.55**	**4.45**	**1.06**	**0.91**						

Detection limit values estimated at face value

City of Mabank Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON Calc	OP Calc	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGNI	ORGP	NO3	MINP	NH3	NO2
27-Sep-01	0.10	0.64	5.82	4.20	10.02	2.86	2.22	5.18	0.64	0.24	2.22	1.61	3.83	1.09	0.85	1.98	0.24	1.61	0.85	0.24	0.00
04-Oct-01	0.10	0.98	6.65	5.79	12.44	3.29	2.32	5.67	0.97	0.39	2.62	2.28	4.90	1.30	0.91	2.23	0.38	2.28	0.91	0.39	0.00
11-Oct-01	0.13	2.01	7.59	5.52	13.11	4.48	3.51	5.58	0.97	1.00	3.79	2.76	6.55	2.24	1.75	2.79	0.48	2.76	1.75	1.00	0.00
18-Oct-01	0.18	3.88	10.50	2.82	13.32	4.78	4.12	6.62	0.66	2.58	6.99	1.88	8.87	3.18	2.74	4.41	0.44	1.88	2.74	2.58	0.00
25-Oct-01	0.17	0.94	4.95	6.57	11.52	4.15	3.62	4.01	0.53	0.59	3.11	4.13	7.24	2.61	2.27	2.52	0.33	4.13	2.27	0.59	0.00
01-Nov-01	0.12	0.44	4.77	6.35	11.12	3.76	3.10	4.33	0.66	0.19	2.09	2.79	4.88	1.65	1.36	1.90	0.29	2.79	1.36	0.19	0.00
08-Nov-01	0.12	0.43	3.85	5.95	9.80	3.24	2.44	3.42	0.80	0.20	1.81	2.79	4.60	1.52	1.15	1.61	0.38	2.79	1.15	0.20	0.00
15-Nov-01	0.12	0.51	0.20	8.38	8.58	3.64	3.16	0.00	0.48	0.22	0.09	3.71	3.80	1.61	1.40	0.00	0.21	3.71	1.40	0.22	0.00
19-Nov-01	0.10	0.61	5.52	9.50	15.02	4.31	3.64	4.91	0.67	0.23	2.09	3.60	5.69	1.63	1.38	1.86	0.25	3.60	1.38	0.23	0.00
29-Nov-01	0.13	3.48	9.32	1.56	10.88	4.37	3.85	5.84	0.52	1.75	4.69	0.79	5.48	2.20	1.94	2.94	0.26	0.79	1.94	1.75	0.00
06-Dec-01	0.18	0.58	4.82	9.87	14.69	5.16	4.19	4.24	0.97	0.39	3.23	6.61	9.84	3.46	2.81	2.84	0.65	6.61	2.81	0.39	0.00
13-Dec-01	0.14	1.72	2.61	4.82	7.43	4.79	3.72	0.89	1.07	0.89	1.34	2.48	3.82	2.47	1.91	0.46	0.55	2.48	1.91	0.89	0.00
20-Dec-01	0.20	0.88	4.54	4.22	8.76	4.21	3.78	3.66	0.43	0.66	3.42	3.18	6.60	3.17	2.85	2.76	0.32	3.18	2.85	0.66	0.00
27-Dec-01	0.16	0.93	3.33	4.55	7.88	3.93	3.47	2.40	0.46	0.57	2.04	2.79	4.83	2.41	2.13	1.47	0.28	2.79	2.13	0.57	0.00
03-Jan-02	0.26	2.30	7.90	2.32	10.22	4.08	3.58	5.60	0.50	2.23	7.66	2.25	9.90	3.95	3.47	5.43	0.48	2.25	3.47	2.23	0.00
10-Jan-02	0.30	1.30	4.99	5.49	10.48	4.03	3.30	3.69	0.73	1.46	5.61	6.17	11.78	4.53	3.71	4.15	0.82	6.17	3.71	1.46	0.00
17-Jan-02	0.17	0.56	5.05	6.98	12.03	4.03	3.93	4.49	0.10	0.37	3.33	4.60	7.92	2.65	2.59	2.96	0.07	4.60	2.59	0.37	0.00
24-Jan-02	0.15	0.82	4.81	6.73	11.54	4.67	4.38	3.99	0.29	0.48	2.80	3.92	6.73	2.72	2.55	2.33	0.17	3.92	2.55	0.48	0.00
31-Jan-02	0.17	0.44	3.94	7.90	11.84	4.82	4.67	3.50	0.15	0.28	2.55	5.11	7.66	3.12	3.02	2.27	0.10	5.11	3.02	0.28	0.00
07-Feb-02	0.23	2.07	5.96	5.59	11.55	4.89	4.58	3.89	0.31	1.79	5.14	4.82	9.97	4.22	3.95	3.36	0.27	4.82	3.95	1.79	0.00
14-Feb-02	0.25	2.74	7.58	7.64	15.22	4.41	4.41	4.84	0.00	2.57	7.12	7.17	14.29	4.14	4.14	4.54	0.00	7.17	4.14	2.57	0.00
21-Feb-02	0.21	0.97	2.77	11.50	14.27	4.99	4.03	1.80	0.96	0.75	2.15	8.92	11.07	3.87	3.13	1.40	0.74	8.92	3.13	0.75	0.00
28-Feb-02	0.16	0.16	8.16	6.74	14.90	4.77	4.43	8.00	0.34	0.10	5.00	4.13	9.14	2.92	2.72	4.90	0.21	4.13	2.72	0.10	0.00
07-Mar-02	0.14	0.91	4.62	14.50	19.12	4.79	4.19	3.71	0.60	0.47	2.40	7.52	9.92	2.48	2.17	1.92	0.31	7.52	2.17	0.47	0.00
14-Mar-02	0.19	0.60	5.00	13.50	18.50	4.57	3.63	4.40	0.94	0.44	3.61	9.73	13.34	3.30	2.62	3.17	0.68	9.73	2.62	0.44	0.00
21-Mar-02	0.24	2.14	5.09	9.12	14.21	4.30	4.35	2.95	0.00	1.98	4.70	8.42	13.12	3.97	4.02	2.72	0.00	8.42	4.02	1.98	0.00
28-Mar-02	0.33	3.20	6.50	8.99	15.49	4.39	4.36	3.30	0.03	3.95	8.02	11.09	19.11	5.42	5.38	4.07	0.04	11.09	5.38	3.95	0.00
04-Apr-02	0.28	2.70	7.56	7.48	15.04	4.43	3.99	4.86	0.44	2.85	7.98	7.90	15.88	4.68	4.21	5.13	0.46	7.90	4.21	2.85	0.00
11-Apr-02	0.27	2.00	4.71	9.18	13.89	4.34	4.17	2.71	0.17	2.02	4.76	9.28	14.04	4.39	4.21	2.74	0.17	9.28	4.21	2.02	0.00
18-Apr-02	0.27	1.12	1.67	8.55	10.22	4.30	4.11	0.55	0.19	1.15	1.72	8.80	10.52	4.43	4.23	0.57	0.20	8.80	4.23	1.15	0.00
25-Apr-02	0.27	0.73	5.51	5.98	11.49	4.57	3.94	4.78	0.63	0.74	5.57	6.04	11.61	4.62	3.98	4.83	0.64	6.04	3.98	0.74	0.00
02-May-02	0.21	0.46	3.61	6.01	9.62	4.14	3.79	3.15	0.35	0.36	2.84	4.73	7.57	3.26	2.98	2.48	0.28	4.73	2.98	0.36	0.00
09-May-02	0.22	0.39	5.90	4.20	10.10	3.44	3.05	5.51	0.39	0.32	4.80	3.42	8.22	2.80	2.48	4.49	0.32	3.42	2.48	0.32	0.00
16-May-02	0.22	2.00	2.58	3.65	6.23	3.50	2.99	0.58	0.51	1.64	2.12	3.00	5.12	2.87	2.46	0.48	0.42	3.00	2.46	1.64	0.00
23-May-02	0.16	2.00	5.93	2.46	8.39	3.55	2.59	3.93	0.96	1.19	3.52	1.46	4.99	2.11	1.54	2.34	0.57	1.46	1.54	1.19	0.00
30-May-02	0.02	0.72	6.52	2.33	8.85	2.50	1.51	5.81	0.99	0.05	0.48	0.17	0.65	0.18	0.11	0.43	0.07	0.17	0.11	0.05	0.00
06-Jun-02	0.02	2.00	6.34	3.45	9.79	1.84	1.37	4.34	0.47	0.14	0.45	0.25	0.70	0.13	0.10	0.31	0.03	0.25	0.10	0.14	0.00
13-Jun-02	0.15	0.32	4.94	3.41	8.35	1.80	1.20	4.62	0.60	0.18	2.82	1.95	4.77	1.03	0.69	2.64	0.34	1.95	0.69	0.18	0.00
20-Jun-02	0.13	0.38	4.70	3.73	8.43	1.78	1.38	4.32	0.40	0.18	2.28	1.81	4.08	0.86	0.67	2.09	0.19	1.81	0.67	0.18	0.00
27-Jun-02	0.18	2.00	7.05	4.37	11.42	3.26	2.30	5.05	0.96	1.33	4.70	2.91	7.61	2.17	1.53	3.36	0.64	2.91	1.53	1.33	0.00
02-Jul-02	0.29	1.54	11.80	4.38	16.18	3.57	2.54	10.26	1.03	1.70	13.04	4.84	17.88	3.95	2.81	11.34	1.14	4.84	2.81	1.70	0.00
11-Jul-02	0.21	0.26	5.76	5.41	11.17	2.70	2.08	5.50	0.62	0.21	4.58	4.30	8.88	2.15	1.65	4.37	0.49	4.30	1.65	0.21	0.00
18-Jul-02	0.27	0.63	3.31	6.40	9.71	3.61	3.36	2.68	0.25	0.64	3.33	6.44	9.78	3.63	3.38	2.70	0.25	6.44	3.38	0.64	0.00
25-Jul-02	0.22	0.43	7.47	6.27	13.74	2.25	1.56	7.04	0.69	0.36	6.22	5.22	11.44	1.87	1.30	5.86	0.57	5.22	1.30	0.36	0.00
01-Aug-02	0.09	0.32	4.66	9.12	13.78	4.46	3.73	4.34	0.73	0.11	1.57	3.07	4.64	1.50	1.26	1.46	0.25	3.07	1.26	0.11	0.00
08-Aug-02	0.08	0.31	2.20	6.96	9.16	2.89	2.29	1.89	0.60	0.09	0.62	1.98	2.60	0.82	0.65	0.54	0.17	1.98	0.65	0.09	0.00
15-Aug-02	0.10	0.39	3.66	8.75	12.41	4.70	3.70	3.27	1.00	0.15	1.43	3.41	4.84	1.83	1.44	1.27	0.39	3.41	1.44	0.15	0.00
22-Aug-02	0.10	0.44	4.03	8.03	12.06	3.61	2.53	3.59	1.08	0.16	1.48	2.95	4.43	1.33	0.93	1.32	0.40	2.95	0.93	0.16	0.00
29-Aug-02	0.11	0.43	4.54	5.44	9.98	3.76	2.81	4.11	0.95	0.17	1.84	2.20	4.04	1.52	1.14	1.66	0.38	2.20	1.14	0.17	0.00
05-Sep-02	0.11	0.22	5.18	5.80	10.98	2.72	1.96	4.96	0.76	0.09	2.22	2.48	4.70	1.16	0.84	2.12	0.33	2.48	0.84	0.09	0.00
12-Sep-02	0.18	0.59	8.67	5.46	14.13	4.30	3.11	8.08	1.19	0.41	6.01	3.78	9.79	2.98	2.15	5.60	0.82	3.78	2.15	0.41	0.00
19-Sep-02	0.15	1.06	6.56	6.37	12.93	4.71	4.24	5.50	0.47	0.59	3.65	3.54	7.19	2.62	2.36	3.06	0.26	3.54	2.36	0.59	0.00
Average	**0.17**	**1.15**	**5.42**	**6.35**	**11.77**	**3.89**	**3.29**	**4.28**	**0.60**	**0.84**	**3.65**	**4.25**	**7.90**	**2.63**	**2.27**	**2.81**	**0.36**	**4.25**	**2.27**	**0.84**	**0.00**

Detection limit values estimated at face value.

Missing flow estimated by averaging 2 surrounding weeks, NH3 values not reported were estimated at permit limit of 2.0

City of Terrell Nutrient Data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-Ni	TKN	NOx-Ni	TN Calc	TP-P	OPO4-P	ON Calc	OP Calc	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
10-Oct-01	2 52	5 81	11 00	33 40	44 40	4 70	3 94	5 19	0 76	55 42	104 92	318 59	423 51	44 83	37 58	49 51	7 25	318 59	37 58	55 42	0 00
17-Oct-01	2 51	4 62	4 54	10 90	15 44	3 51	3 16	0.00	0 35	43 89	43 13	103 56	146 69	33 35	30 02	0 00	3 33	103 56	30 02	43 89	0 00
24-Oct-01	2 84	3 38	12 60	10 50	23 10	3 28	3 47	9 22	0 00	36 33	135 45	112 87	248 32	35 26	37 30	99 11	0 00	112 87	37 30	36 33	0 00
31-Oct-01	2 06	4 04	10 50	10 60	21 10	4 77	3 82	6 46	0 95	31 50	81 87	82 65	164 53	37 19	29 79	50 37	7 41	82 65	29 79	31 50	0 00
07-Nov-01	3 27	3 07	8 79	12 00	20 79	5 27	4 18	5 72	1 09	38 00	108 80	148 53	257 33	65 23	51 74	70 80	13 49	148 53	51 74	38 00	0 00
14-Nov-01	3 16	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	53 80	93 90	141 80	235 70	48 23	49 02	40 10	0 00	141 80	49 02	53 80	0 00
21-Nov-01	3 23	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	54 99	95 98	144 94	240 92	49 30	50 11	40 99	0 00	144 94	50 11	54 99	0 00
28-Nov-01	5 42	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	92 28	161 05	243 21	404 27	82 73	84 08	68 78	0 00	243 21	84 08	92 28	0 00
05-Dec-01	3 54	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	60 27	105 19	158 85	264 04	54 03	54 92	44 92	0 00	158 85	54 92	60 27	0 00
12-Dec-01	3 37	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	57 37	100 14	151 22	251 36	51 44	52 28	42 76	0 00	151 22	52 28	57 37	0 00
19-Dec-01	4 44	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	75 59	131 93	199 24	331 17	67 77	68 88	56 34	0 00	199 24	68 88	75 59	0 00
27-Dec-01	2 53	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	43 07	75 18	113 53	188 71	38 62	39 25	32 11	0 00	113 53	39 25	43 07	0 00
04-Jan-02	2 71	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	46 14	80 53	121 61	202 13	41 36	42 04	34 39	0 00	121 61	42 04	46 14	0 00
10-Jan-02	2 65	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	45 12	78 74	118 91	197 66	40 45	41 11	33 63	0 00	118 91	41 11	45 12	0 00
16-Jan-02	2 97	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	50 56	88 25	133 27	221 53	45 33	46 07	37 69	0 00	133 27	46 07	50 56	0 00
23-Jan-02	3 03	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	51 59	90 04	135 97	226 00	46 25	47 01	38 45	0 00	135 97	47 01	51 59	0 00
31-Jan-02	4 94	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	84 10	146 79	221 67	368 46	75 40	76 64	62 69	0 00	221 67	76 64	84 10	0 00
06-Feb-02	4 87	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	82 91	144 71	218 53	363 24	74 33	75 55	61 80	0 00	218 53	75 55	82 91	0 00
13-Feb-02	3	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	51 07	89 14	134 62	223 76	45 79	46 54	38 07	0 00	134 62	46 54	51 07	0 00
20-Feb-02	2 35	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	40 01	69 83	105 45	175 28	35 87	36 46	29 82	0 00	105 45	36 46	40 01	0 00
27-Feb-02	2 78	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	47 33	82 61	124 75	207 35	42 43	43 13	35 28	0 00	124 75	43 13	47 33	0 00
06-Mar-02	2 9	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	49 37	86 17	130 13	216 30	44 26	44 99	36 80	0 00	130 13	44 99	49 37	0 00
13-Mar-02	2 02	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	34 39	60 02	90 64	150 67	30 83	31 34	25 63	0 00	90 64	31 34	34 39	0 00
20-Mar-02	4 1	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	69 80	121 83	183 98	305 81	62 58	63 60	52 03	0 00	183 98	63 60	69 80	0 00
27-Mar-02	2 97	4 50	7 85	11 86	19 71	4 03	4 10	3 35	0 00	50 56	88 25	133 27	221 53	45 33	46 07	37 69	0 00	133 27	46 07	50 56	0 00
03-Apr-02	3 63	2 54	4 10	6 48	10 58	2 87	1 70	1 56	1 17	34 90	56 33	89 04	145 37	39 43	23 36	21 43	16 08	89 04	23 36	34 90	0 00
10-Apr-02	3 8	4 74	5 53	7 86	13 39	3 00	3 27	0 79	0 00	68 18	79 54	113 06	192 60	43 15	47 03	11 36	0 00	113 06	47 03	68 18	0 00
17-Apr-02	3 22	9 10	19 00	7 77	26 77	3 00	3 26	9 90	0 00	110 91	231 58	94 70	326 28	36 56	39 73	120 66	0 00	94 70	39 73	110 91	0 00
24-Apr-02	2 18	6 60	7 50	2 27	9 77	3 65	3 60	0 90	0 05	54 46	61 89	18 73	80 62	30 12	29 71	7 43	0 41	18 73	29 71	54 46	0 00
01-May-02	2 6	3 41	6 20	9 22	15 42	2 76	3 92	2 79	0 00	33 56	61 02	90 74	151 75	27 16	38 58	27 46	0 00	90 74	38 58	33 56	0 00
08-May-02	3 21	3 13	5 90	10 26	16 16	2 58	2 38	2 77	0 20	38 03	71 69	124 66	196 35	31 35	28 92	33 66	2 43	124 66	28 92	38 03	0 00
15-May-02	3 16	2 34	4 80	9 13	13 93	2 79	3 04	2 46	0 00	27 99	57 41	109 21	166 62	33 37	36 36	29 42	0 00	109 21	36 36	27 99	0 00
22-May-02	2 33	6 00	8 75	8 24	16 99	4 60	3 51	2 75	1 09	52 92	77 17	72 67	149 84	40 57	30 96	24 25	9 61	72 67	30 96	52 92	0 00
29-May-02	4 28	5 30	9 00	11 70	20 70	5 03	3 65	3 70	1 38	85 86	145 80	189 55	335 35	81 49	59 13	59 94	0 00	189 55	59 13	85 86	0 00
05-Jun-02	3 25	3 66	7 49	10 48	17 97	4 18	5 80	3 83	0 00	45 02	92 14	128 92	221 06	51 42	71 35	47 12	0 00	128 92	71 35	45 02	0 00
12-Jun-02	2 62	4 00	4 74	8 16	12 90	5 30	4 38	0 74	0 92	39 67	47 01	80 92	127 93	52 56	43 44	7 34	9 12	80 92	43 44	39 67	0 00
19-Jun-02	3 52	0 62	4 52	11 56	16 08	4 30	4 24	3 90	0 06	8 26	60 22	154 02	214 25	57 29	56 49	51 96	0 80	154 02	56 49	8 26	0 00
26-Jun-02	3 61	2 65	4 78	10 27	15 05	5 63	5 02	2 13	0 61	36 21	65 32	140 33	205 65	76 93	68 60	29 11	8 34	140 33	68 60	36 21	0 00
03-Jul-02	4 35	5 30	11 40	9 53	20 93	4 90	2 95	6 10	1 95	87 27	187 71	156 92	344 62	80 68	48 57	100 44	32 11	156 92	48 57	87 27	0 00
10-Jul-02	3 47	8 28	8 50	7 67	16 17	5 49	5 70	0 22	0 00	108 75	111 64	100 74	212 39	72 11	74 87	2 89	0 00	100 74	74 87	108 75	0 00
17-Jul-02	3 85	5 22	10 60	9 65	20 25	0 72	3 56	5 38	0 00	76 07	154 47	140 63	295 10	10 49	51 88	78 40	0 00	140 63	51 88	76 07	0 00
24-Jul-02	3 28	2 49	3 02	11 23	14 25	4 09	5 56	0 53	0 00	30 91	37 49	139 42	176 92	50 78	69 03	6 58	0 00	139 42	69 03	30 91	0 00
31-Jul-02	2 43	1 49	4 21	11 00	15 21	2 78	4 01	2 72	0 00	13 70	38 72	101 18	139 90	25 57	36 88	25 02	0 00	101 18	36 88	13 70	0 00
07-Aug-02	2 57	4 90	8 80	8 47	17 27	1 67	4 39	3 90	0 00	47 67	85 61	82 40	168 00	16 25	42 71	37 94	0 00	82 40	42 71	47 67	0 00
14-Aug-02	4 05	4 80	13 00	9 44	22 44	4 90	4 52	8 20	0 38	73 58	199 29	144 71	344 00	75 12	69 29	125 71	5 83	144 71	69 29	73 58	0 00
21-Aug-02	2 93	6 10	9 00	9 96	18 96	4 55	4 90	2 90	0 00	67 65	99 81	110 46	210 28	50 46	54 34	32 16	0 00	110 46	54 34	67 65	0 00
28-Aug-02	2 55	4 34	4 60	9 95	14 55	4 10	3 90	0 26	0 20	41 89	44 40	96 04	140 44	39 57	37 64	2 51	1 93	96 04	37 64	41 89	0 00
04-Sep-02	2 46	5 60	6 14	12 10	18 24	4 90	5 42	0 54	0 00	52 14	57 17	112 67	169 84	45 63	50 47	5 03	0 00	112 67	50 47	52 14	0 00
11-Sep-02	2 62	4 70	9 00	53 50	62 50	4 40	3 96	4 30	0 44	46 61	89 25	530 57	619 82	43 64	39 27	42 64	4 36	530 57	39 27	46 61	0 00
18-Sep-02	2 76	6 10	7 00	12 66	19 66	5 40	6 21	0 90	0 00	63 73	73 13	132 26	205 39	56 41	64 88	9 40	0 00	132 26	64 88	63 73	0 00
25-Sep-02	2 14	6 90	11 60	11 01	22 61	5 42	4 64	4 70	0 78	55 89	93 96	89 18	183 15	43 90	37 59	38 07	6 32	89 18	37 59	55 89	0 00
02-Oct-02	2 39	2 70	4 60	12 39	16 99	4 50	5 09	1 90	0 00	24 43	41 61	112 09	153 70	40 71	46 05	17 19	0 00	112 09	46 05	24 43	0 00
Average	**3.16**	**4.50**	**7.85**	**11.86**	**19.71**	**4.03**	**4.10**	**3.35**	**0.24**	**53.30**	**93.96**	**138.99**	**232.95**	**47.90**	**48.51**	**40.67**	**2.48**	**138.99**	**48.51**	**53.30**	**0.00**

Annual average concentrations used from 11/14/01 through 3/27/02 to eliminate bad lab data

		Weekly Concentration Data (mg/L)								Load Calculations (kg/d)						WWTP Loads (kg/d)					
Date	Flow (MGD)	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ON Calc	OP Calc	NH3-N	TKN	NOx-N	TN Calc	TP-P	OPO4-P	ORGN	ORGP	NO3	MINP	NH3	NO2
02-Oct-01	0 31	1 87	6 06	2 37	8 43	3 13	1 23	4 19	1 90	2 20	7 11	2 78	9 89	3 67	1 44	4 91	2 23	2 78	1 44	2 20	0 00
09-Oct-01	0 32	0 76	6 60	2 91	9 51	3 32	1 56	5 84	1 76	0 92	7 99	3 52	11 52	4 02	1 89	7 07	2 13	3 52	1 89	0 92	0 00
15-Oct-01	0 37	2 00	7 47	4 64	12 11	1 61	3 16	5 47	0 00	2 76	10 32	6 41	16 73	2 22	4 37	7 56	0 00	6 41	4 37	2 76	0 00
22-Oct-01	0 24	0 49	4 49	4 37	8 86	1 98	2 97	4 00	0 00	0 45	4 10	3 99	8 08	1 81	2 71	3 65	0 00	3 99	2 71	0 45	0 00
06-Nov-01	0 24	0 42	6 57	3 01	9 58	0 72	2 88	6 15	0 00	0 38	5 97	2 73	8 70	0 65	2 62	5 59	0 00	2 73	2 62	0 38	0 00
13-Nov-01	0 47	0 69	6 78	3 34	10 12	2 33	3 42	6 09	0 00	1 24	12 11	5 97	18 08	4 16	6 11	10 88	0 00	5 97	6 11	1 24	0 00
19-Nov-01	0 54	0 47	3 01	3 90	6 91	2 17	3 54	2 55	0 00	0 94	6 11	7 91	14 02	4 40	7 18	5 16	0 00	7 91	7 18	0 94	0 00
26-Nov-01	0 24	0 59	8 14	4 12	12 26	2 17	3 33	7 55	0 00	0 54	7 39	3 74	11 14	1 97	3 03	6 86	0 00	3 74	3 03	0 54	0 00
10-Dec-01	0 30	6 18	12 80	4 89	17 69	2 63	3 88	6 62	0 00	6 97	14 44	5 52	19 95	2 97	4 38	7 47	0 00	5 52	4 38	6 97	0 00
17-Dec-01	1 24	7 13	13 00	1 37	14 37	2 31	3 62	5 87	0 00	33 55	61 16	6 45	67 61	10 87	17 03	27 62	0 00	6 45	17 03	33 55	0 00
26-Dec-01	0 19	5 34	15 60	0 82	16 42	2 27	3 56	10 26	0 00	3 80	11 10	0 58	11 68	1 62	2 53	7 30	0 00	0 58	2 53	3 80	0 00
07-Jan-02	0 24	8 99	10 30	0 70	11 00	2 86	1 35	1 31	1 51	8 20	9 40	0 63	10 03	2 61	1 23	1 20	1 38	0 63	1 23	8 20	0 00
14-Jan-02	0 34	5 76	13 40	0 97	14 37	2 77	1 39	7 64	1 38	7 35	17 09	1 24	18 34	3 53	1 77	9 75	1 76	1 24	1 77	7 35	0 00
21-Jan-02	0 24	5 38	18 40	0 96	19 36	2 95	1 75	13 02	1 20	4 89	16 72	0 87	17 59	2 68	1 59	11 83	1 09	0 87	1 59	4 89	0 00
28-Jan-02	0 35	8 15	13 90	0 85	14 75	3 33	2 38	5 75	0 95	10 80	18 41	1 12	19 54	4 41	3 15	7 62	1 26	1 12	3 15	10 80	0 00
04-Feb-02	0 35	6 73	13 40	2 04	15 44	3 61	2 52	6 67	1 09	8 92	17 75	2 70	20 46	4 78	3 34	8 84	1 44	2 70	3 34	8 92	0 00
11-Feb-02	0 24	6 16	15 10	2 26	17 36	3 23	1 46	8 94	1 77	5 60	13 72	2 05	15 77	2 93	1 33	8 12	1 61	2 05	1 33	5 60	0 00
19-Feb-02	0 29	4 08	21 20	1 07	22 27	3 25	0 68	17 12	2 57	4 45	23 11	1 17	24 28	3 54	0 75	18 66	2 80	1 17	0 75	4 45	0 00
25-Feb-02	0 23	4 84	10 10	2 13	12 23	3 17	2 18	5 26	0 99	4 12	8 60	1 81	10 42	2 70	1 86	4 48	0 84	1 81	1 86	4 12	0 00
05-Mar-02	0 20	9 18	13 40	0 69	14 09	4 02	2 86	4 22	1 16	6 81	9 94	0 51	10 45	2 98	2 12	3 13	0 86	0 51	2 12	6 81	0 00
11-Mar-02	0 22	9 98	12 80	0 33	13 13	4 45	3 70	2 82	0 75	8 35	10 71	0 28	10 98	3 72	3 10	2 36	0 63	0 28	3 10	8 35	0 00
19-Mar-02	0 20	9 54	13 20	0 61	13 81	3 95	3 50	3 66	0 45	7 11	9 84	0 45	10 30	2 95	2 61	2 73	0 34	0 45	2 61	7 11	0 00
26-Mar-02	0 24	6 56	10 20	1 75	11 95	3 71	3 16	3 64	0 55	5 96	9 27	1 59	10 86	3 37	2 87	3 31	0 50	1 59	2 87	5 96	0 00
01-Apr-02	0 35	6 98	10 10	1 98	12 08	3 71	2 90	3 12	0 81	9 19	13 30	2 61	15 91	4 89	3 82	4 11	1 07	2 61	3 82	9 19	0 00
08-Apr-02	0 91	7 86	11 30	0 56	11 86	3 86	3 02	3 44	0 84	26 93	38 71	1 92	40 63	13 22	10 35	11 78	2 88	1 92	10 35	26 93	0 00
15-Apr-02	0 35	8 82	16 20	0 69	16 89	3 76	2 60	7 38	1 16	11 68	21 46	0 92	22 38	4 98	3 44	9 78	1 54	0 92	3 44	11 68	0 00
22-Apr-02	0 29	4 89	7 70	3 80	11 50	3 36	2 60	2 81	0 76	5 40	8 51	4 20	12 71	3 71	2 87	3 11	0 84	4 20	2 87	5 40	0 00
29-Apr-02	0 41	1 01	7 78	6 57	14 35	3 10	1 21	6 77	1 89	1 58	12 16	10 27	22 43	4 85	1 89	10 58	2 95	10 27	1 89	1 58	0 00
06-May-02	1 00	0 67	7 00	4 00	11 00	2 21	1 30	6 33	0 91	2 54	26 50	15 14	41 64	8 37	4 92	23 95	3 44	15 14	4 92	2 54	0 00
13-May-02	0 95	1 49	7 47	2 21	9 68	2 60	1 45	5 98	1 15	5 34	26 78	7 92	34 70	9 32	5 20	21 44	4 12	7 92	5 20	5 34	0 00
20-May-02	0 29	0 70	8 36	2 40	10 76	3 01	0 71	7 66	2 30	0 77	9 24	2 65	11 89	3 33	0 79	8 47	2 54	2 65	0 79	0 77	0 00
28-May-02	0 23	0 93	7 64	0 31	7 95	1 68	0 52	6 71	1 16	0 79	6 51	0 26	6 77	1 43	0 45	5 72	0 99	0 26	0 45	0 79	0 00
03-Jun-02	0 24	0 66	5 33	0 08	5 41	1 98	0 33	4 67	1 65	0 60	4 84	0 07	4 91	1 80	0 30	4 24	1 50	0 07	0 30	0 60	0 00
10-Jun-02	0 41	0 59	5 66	0 10	5 76	1 90	0 49	5 07	1 41	0 91	8 74	0 15	8 90	2 93	0 75	7 83	2 18	0 15	0 75	0 91	0 00
17-Jun-02	0 34	0 41	36 40	0 08	36 48	1 79	0 19	36 00	1 61	0 52	46 57	0 10	46 67	2 29	0 24	46 05	2 05	0 10	0 24	0 52	0 00
24-Jun-02	0 54	0 57	5 98	0 09	6 07	1 04	0 13	5 41	0 91	1 17	12 31	0 19	12 50	2 14	0 27	11 14	1 87	0 19	0 27	1 17	0 00
01-Jul-02	0 36	1 03	7 69	0 08	7 77	2 23	0 77	6 66	1 47	1 40	10 48	0 11	10 59	3 04	1 04	9 08	2 00	0 11	1 04	1 40	0 00
08-Jul-02	0 24	0 82	5 55	0 13	5 68	1 20	0 25	4 73	0 95	0 74	5 04	0 11	5 16	1 09	0 23	4 30	0 86	0 11	0 23	0 74	0 00
15-Jul-02	0 20	0 65	7 21	0 08	7 29	2 09	0 57	6 56	1 52	0 50	5 57	0 06	5 63	1 61	0 44	5 07	1 17	0 06	0 44	0 50	0 00
22-Jul-02	0 24	0 23	0 79	0 08	0 87	1 65	0 21	0 56	1 44	0 21	0 72	0 07	0 79	1 50	0 19	0 51	1 31	0 07	0 19	0 21	0 00
29-Jul-02	0 24	0 19	7 63	0 08	7 71	2 53	0 48	7 44	2 05	0 18	6 93	0 07	7 00	2 30	0 44	6 76	1 86	0 07	0 44	0 18	0 00
05-Aug-02	0 24	0 21	6 42	0 08	6 50	1 53	0 09	6 21	1 44	0 19	5 83	0 07	5 90	1 39	0 08	5 64	1 31	0 07	0 08	0 19	0 00
12-Aug-02	0 24	0 18	14 80	0 08	14 88	2 60	0 31	14 62	2 29	0 16	13 44	0 07	13 52	2 36	0 28	13 28	2 08	0 07	0 28	0 16	0 00
19-Aug-02	0 28	0 71	13 90	0 08	13 98	2 46	0 26	13 19	2 20	0 76	14 78	0 09	14 87	2 62	0 27	14 03	2 34	0 09	0 27	0 76	0 00
26-Aug-02	0 30	0 62	5 04	0 08	5 12	2 25	0 16	4 43	2 09	0 70	5 72	0 09	5 81	2 55	0 18	5 02	2 37	0 09	0 18	0 70	0 00
02-Sep-02	0 25	0 21	6 57	0 08	6 65	1 18	0 14	6 36	1 04	0 20	6 24	0 08	6 32	1 12	0 13	6 04	0 99	0 08	0 13	0 20	0 00
09-Sep-02	0 32	0 69	12 20	0 28	12 48	2 94	0 95	11 51	1 99	0 84	14 92	0 34	15 25	3 59	1 16	14 07	2 43	0 34	1 16	0 84	0 00
16-Sep-02	0 24	0 90	2 62	0 25	2 87	3 15	1 09	1 72	2 06	0 82	2 38	0 22	2 60	2 86	0 99	1 56	1 87	0 22	0 99	0 82	0 00
23-Sep-02	0 23	1 08	30 40	1 40	31 80	3 44	1 38	29 32	2 06	0 92	25 89	1 19	27 08	2 93	1 18	24 97	1 75	1 19	1 18	0 92	0 00
01-Oct-02	0 27	0 17	4 83	0 87	5 70	2 76	0 86	4 66	1 90	0 17	4 90	0 88	5 78	2 80	0 87	4 73	1 93	0 88	0 87	0 17	0 00
07-Oct-02	1 10	0 17	10 00	1 28	11 28	3 28	1 94	9 83	1 34	0 71	41 64	5 33	46 97	13 66	8 08	40 93	5 58	5 33	8 08	0 71	0 00
14-Oct-02	0 24	0 17	7 92	1 86	9 78	4 14	2 96	7 75	1 18	0 15	7 19	1 69	8 88	3 76	2 69	7 04	1 07	1 69	2 69	0 15	0 00
21-Oct-02	1 06	0 17	6 24	0 08	6 32	3 40	3 81	6 07	0 00	0 68	25 04	0 32	25 36	13 64	15 29	24 35	0 00	0 32	15 29	0 68	0 00
28-Oct-02	0 27	0 17	57 20	2 30	59 50	3 40	2 84	57 03	0 56	0 17	57 59	2 32	59 91	3 42	2 86	57 42	0 56	2 32	2 86	0 17	0 00
04-Nov-02	0 35	5 21	7 71	3 90	11 61	3 30	2 79	2 50	0 51	6 90	10 21	5 17	15 38	4 37	3 70	3 31	0 68	5 17	3 70	6 90	0 00
11-Nov-02	0 24	1 16	31 90	8 08	39 98	2 88	2 21	30 74	0 67	1 05	28 98	7 34	36 32	2 62	2 01	27 93	0 61	7 34	2 01	1 05	0 00
19-Nov-02	0 28	1 49	9 40	75 50	84 90	2 82	18 30	7 91	0 00	1 59	10 03	80 59	90 62	3 01	19 53	8 44	0 00	80 59	19 53	1 59	0 00
26-Nov-02	0 23	1 48	10 40	8 72	19 12	2 75	1 98	8 92	0 77	1 31	9 17	7 69	16 86	2 43	1 75	7 87	0 68	7 69	1 75	1 31	0 00
02-Dec-02	0 33	1 57	12 40	8 95	21 35	3 55	1 97	10 83	1 58	1 97	15 58	11 25	26 83	4 46	2 48	13 61	1 99	11 25	2 48	1 97	0 00
09-Dec-02	1 20	9 81	14 60	4 51	19 11	3 24	2 10	4 79	1 14	44 56	66 32	20 49	86 80	14 72	9 54	21 76	5 18	20 49	9 54	44 56	0 00
16-Dec-02	0 24	13 20	19 40	1 00	20 40	3 78	1 66	6 20	2 12	11 99	17 62	0 91	18 53	3 43	1 51	5 63	1 93	0 91	1 51	11 99	0 00
23-Dec-02	0 70	13 90	24 90	1 79	26 69	3 68	2 01	11 00	1 67	36 83	65 98	4 74	70 72	9 75	5 33	29 15	4 42	4 74	5 33	36 83	0 00
31-Dec-02	1 60	10 40	10 90	0 51	11 41	2 95	1 84	0 50	1 11	62 99	66 01	3 07	69 08	17 87	11 14	3 03	6 72	3 07	11 14	62 99	0 00
06-Jan-03	0 27	7 91	9 09	0 68	9 77	2 94	2 00	1 18	0 94	7 93	9 12	0 68	9 80	2 95	2 01	1 18	0 94	0 68	2 01	7 93	0 00
13-Jan-03	0 35	9 74	14 70	0 65	15 35	2 86	2 01	4 96	0 85	12 90	19 47	0 86	20 33	3 79	2 66	6 57	1 13	0 86	2 66	12 90	0 00
21-Jan-03	0 23	8 44	12 00	0 83	12 83	3 02	1 90	3 56	1 12	7 44	10 58	0 73	11 31	2 66	1 68	3 14	0 99	0 73	1 68	7 44	0 00
27-Jan-03	0 32	8 80	13 10	1 12	14 22	2 83	1 82	4 30	1 01	10 76	16 02	1 37	17 39	3 46	2 23	5 26	1 23	1 37	2 23	10 76	0 00
Average	**0.40**	**3.71**	**11.80**	**2.96**	**14.76**	**2.79**	**2.08**	**8.09**	**1.13**	**6.29**	**17.13**	**4.01**	**21.13**	**4.23**	**3.23**	**10.83**	**1.56**	**4.01**	**3.23**	**6.29**	**0.00**

NOx detection limit estimated at 0 08mg/L, NH3 detection limit estimated at 0 17 mg/L