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PWS/2430001/CO
CN 600129316
RN 105598759

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

October 3, 2011

Mr. Tyson Traw, P.E.
Biggs & Mathews, Inc. Consulting Engineers
2500 Brook Avenue
Wichita Falls, Texas 76301-6105

Subject: Revised Contact Time Study
City of Wichita Falls – PWS ID No. 2430001
Cypress Water Treatment – RO Membrane Plant – TCEQ ID 21567
Wichita County, Texas

Dear Mr. Traw:

On April 4, 2011, the Texas Commission on Environmental Quality (TCEQ) received your letter dated April 1, 2011 requesting a revised Contact Time (CT) study for the City of Wichita Falls Cypress Reverse Osmosis Membrane Water Treatment Plant (MWTP) in order to demonstrate that the MWTP can meet applicable disinfection requirements for the modifications to the MWTP. The information in this TCEQ letter for City of Wichita Falls MWTP should replace, not supplement, all previous CT studies for this facility.

The City of Wichita Falls MWTP is a 14 million gallons per day (MGD) microfiltration (MF) treatment facility receiving raw water from Lake Kemp to the Headquarters Road Reservoir and Pump Station located at the MWTP. The MWTP consists of a rapid mix basin, a clarifier, and five racks of a U.S. Filters/Memcor Model 540S10V MF membrane system and RO unit having 504 modules per rack. Filtrate water flows from the MWTP to the 1961 Water Treatment Plant, TCEQ ID 15131, and the 2010 Water Treatment Plant, where it is combined with the filtered water in each plant's 0.10-million-gallon (MG) clearwell and pump station increasing the capacity of the 1961 Water Treatment Plant to 26 MGD, and the 2010 Water Treatment Plant to 20 MGD. The combined water then flows to the combined WTPs three ground storage tanks.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO_2) downstream of the Headquarters Road Reservoir and Pump Station, and liquid ammonium sulfate (LAS) upstream of both the 1961 WTP and 2010 WTP 0.10-MG clearwells and transfer pump stations. Chlorine residual is monitored at three locations along the 42-inch raw water pipe at 400, 900 and 6,500 linear feet downstream of the Headquarters Road Reservoir and Pump Station, prior to entering the rapid mix basin. Chloramine residual is monitored downstream of both the 0.10-MG clearwell and transfer pump stations, and downstream of the three ground storage tanks, prior to entering the distribution system.

Chlorine and liquid ammonia gas (NH_4), chloramines, is injected at this location, not LAS.

A disinfection zone is a segment of the treatment process which begins at a disinfectant application point and ends at the subsequent disinfectant application or residual sampling point. Each disinfectant application point, regardless of the frequency of use, represents the beginning of a separate disinfection zone. However, a plant may have only one disinfectant point and choose to monitor at more than one point, creating multiple disinfection zones. Based on the information we had at the time of our review, we have identified five disinfection zones at the City of Wichita Falls Cypress MWTP. The first disinfection zone, D1, consists of 85 linear feet (LF) of 42-inch raw water pipe. The second disinfection zone, D2, consists of 2,225 LF of 42-inch raw water pipe. The third disinfection zone, D3, consists of 62,690 LF of 42-inch raw water pipe. The fourth disinfection zone is divided into two treatment units, D4A and D4B. Each treatment train consists of a 0.10-MG clearwell and transfer pump station. The fifth disinfection zone, D5, is divided into three treatment units D5A, D5B and D5C for each of the three ground storage tanks. The treatment unit D5A consists of a 206-foot diameter, 10.0-MG ground storage tank. The treatment unit D5B consists of a 150-foot diameter, 5.0-MG ground storage tanks, and the treatment unit D5C consists of a 123-foot diameter, 3.0-MG ground storage tank.

CT calculations are used to evaluate the disinfection process. Since T_{10} values are required to calculate the CT for the treatment process, Table 1 was developed for the City of Wichita Falls CWTP RO MWTP. The T_{10} values are based on the information provided in your CT template dated April 4, 2011, TCEQ Comprehensive Compliance Investigation (CCI) conducted September 3, 2008, and the most recent TCEQ-approved CT Study dated January 31, 2007.

TABLE 1: T_{10} TABLE FOR CITY OF WICHITA FALLS CYPRESS WTP RO MWTP

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1	42-inch Raw Water Pipe	6,100 ⁽¹⁾	14.00 ⁽⁹⁾	1.0 ⁽¹⁵⁾	0.629	0.63
D2	42-inch Raw Water Pipe	160,200 ⁽²⁾			16.474	16.47
D3	42-inch Raw Water Pipe	4,512,500 ⁽³⁾			464.15	464.15
D4A	0.10 MG Clearwell '10 Plant	109,100 ⁽⁴⁾	20.00 ⁽¹⁰⁾	0.5 ⁽¹⁶⁾	3.928	3.93
D4B	0.10 MG Clearwell '61 Plant	60,000 ⁽⁵⁾	26.00 ⁽¹¹⁾	0.55 ⁽¹⁷⁾	1.828	1.83
D5A	10.0 MG Ground Storage Tank	4,987,000 ⁽⁶⁾	36.40 ⁽¹²⁾	0.3 ⁽¹⁸⁾	59.186	59.19
D5B	5.0 MG Ground Storage Tank	2,485,500 ⁽⁷⁾	6.76 ⁽¹³⁾	0.1 ⁽¹⁹⁾	52.951	52.95
D5C	3.0 MG Ground Storage Tank	1,493,500 ⁽⁸⁾	8.84 ⁽¹⁴⁾		24.33	24.33

Notes:

- (1) Based on 85 linear feet (LF) of 42-inch raw water pipe, as per the CT submittal by Biggs & Mathews, Inc. Consulting Engineers (BMI) dated April 4, 2011.
- (2) Based on a 2,225 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (3) Based on 62,690 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (4) Based on a "worst case" operating condition. In the absence of site-specific information, a minimum operating level of 50% of the nominal capacity is assumed. As per the CT submittal by BMI dated April 4, 2011, the WTP '10 Plant clearwell is 0.1 MG.
- (5) Based on a "worst case" operating condition. In the absence of site-specific information, a minimum operating level of 50% of the nominal capacity is assumed. As per the CT submittal by BMI dated April 4, 2011, the WTP '61 Plant clearwell is 0.1 MG.
- (6) Based on a "worst case" operating condition. In the absence of site-specific information, a minimum operating level of 50% of the nominal capacity is assumed. As per the CT submittal by BMI dated April 4, 2011, the clearwell is 10.0 MG.
- (7) Based on a "worst case" operating condition. In the absence of site-specific information, a minimum operating level of 50% of the nominal capacity is assumed. As per the CT submittal by BMI dated April 4, 2011, the clearwell is 5.0 MG.
- (8) Based on a "worst case" operating condition. In the absence of site-specific information, a minimum operating level of 50% of the nominal capacity is assumed. As per the CT submittal by BMI dated April 4, 2011, the clearwell is 3.0 MG.
- (9) Based on the design capacity of the City of Wichita Falls RO Membrane Plant, TCEQ ID 21567 (14 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (10) Based on the design capacity for the City of Wichita Falls '10 WTP (10 MGD) combined with the design capacity for the City of Wichita Falls RO Membrane WTP (10 MGD), for a total combined capacity of (20 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (11) Based on the design capacity for the City of Wichita Falls '61 WTP (16 MGD) combined with the design capacity for the City of Wichita Falls RO Membrane WTP (10 MGD), for a total combined capacity of (26 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (12) Based on 70% of the overall design capacity of the City of Wichita Falls Cypress Surface Water Treatment Plant (52 MGD) divided between the three ground storage tanks. 70% of the TPC for the 10.0 MG GST is equal to 36.4 MGD. As per the CT submittal by BMI dated April 4, 2011.
- (13) Based on 13% of the overall design capacity of the City of Wichita Falls Cypress Surface Water Treatment Plant (52 MGD) divided between the three ground storage tanks. 13% of the TPC for the 5.0 MG GST is equal to 6.76 MGD. As per the CT submittal by BMI dated April 4, 2011.
- (14) Based on 17% of the overall design capacity of the City of Wichita Falls Cypress Surface Water Treatment Plant (52 MGD) divided between the three ground storage tanks. 17% of the TPC for the 3.0 MG GST is equal to 8.84 MGD. As per the CT submittal by BMI dated April 4, 2011.
- (15) Based on the assumption of "perfect" baffling characteristics for pipe.
- (16) Based on the assumption of "average" baffling characteristics for basins with two internal baffles and a length to width of 30:1. As per the CT submittal by BMI dated April 4, 2011.
- (17) Based on the approved TCEQ tracer study dated July 13, 1992 for the 0.1 MG clearwell.
- (18) Based on the assumption of "poor" baffling characteristics for basins having two inlets, one outlet and three interior baffle walls.
- (19) Based on the assumption of "unbaffled" baffling characteristics.

Below is a Disinfection Process Parameters Table to help operators at the plant complete their Surface Water Monthly Operating Report (SWMOR). In Table 2, we have characterized the T_{10} available in each of the disinfection zones based on the flow rate through the unit(s) that contributes most to the disinfection process within that zone. We have also provided the operators with the disinfection requirements that they must meet on a continual basis.

TABLE 2: DISINFECTION PROCESS PARAMETERS

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D1	D2	D3	D4A	D4B	Giardia	Viruses
Flow Rate (MGD)	14.00	14.00	14.00	20.00	26.00	0.5	2.0
T ₁₀ (minutes)	0.6	16.5	464.1	3.9	1.8		
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D5A	D5B	D5C	D7	D8	Giardia	Viruses
Flow Rate (MGD)	36.40	6.76	8.84	na	na	0.5	2.0
T ₁₀ (minutes)	59.2	53.0	24.3	na	na		

If your monitoring plan has changed as a result of this CT study, please submit an updated monitoring plan at the address below.

Monitoring Plan Coordinator (MC – 155)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711

Further information can be found in Regulatory Guidance (RG) 384 “How to Develop a Monitoring Plan for a Public Water System” or at TCEQ’s website:

http://www.tceq.state.tx.us/permitting/water_supply/pdw/monitoring_plans/monitoring_plans.html

Mr. Tyson Traw, P.E.
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If you have any questions concerning our evaluation or if we may be of further assistance, please contact Ms. Rian McMorris at (512) 239-4487, by e-mail at Rian.McMorris@tceq.texas.gov or correspondence at:

Technical Review and Oversight Team (MC-159)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Sincerely,



Ada Lichaa, P.G., Manager
Plan & Groundwater Review Section
Water Supply Division
Texas Commission on Environmental Quality

AL/RM

Enclosure: CT Worksheet

cc: w/ enclosure: TCEQ Tracer Study File
TCEQ PWS File
TCEQ Region 3, Abilene
The Honorable Lanham Lyne, Mayor, City of Wichita Falls,
Attn: Mr. Mark Southard, Water Purification, P. O. Box 1431,
Wichita Falls, TX 76307-1431

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Description Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls PWS ID No.: 2430001

PLANT NAME

Month: October

OR NUMBER: Cypress WTP: RO Membrane Plant

Day: 5

Year: 2011

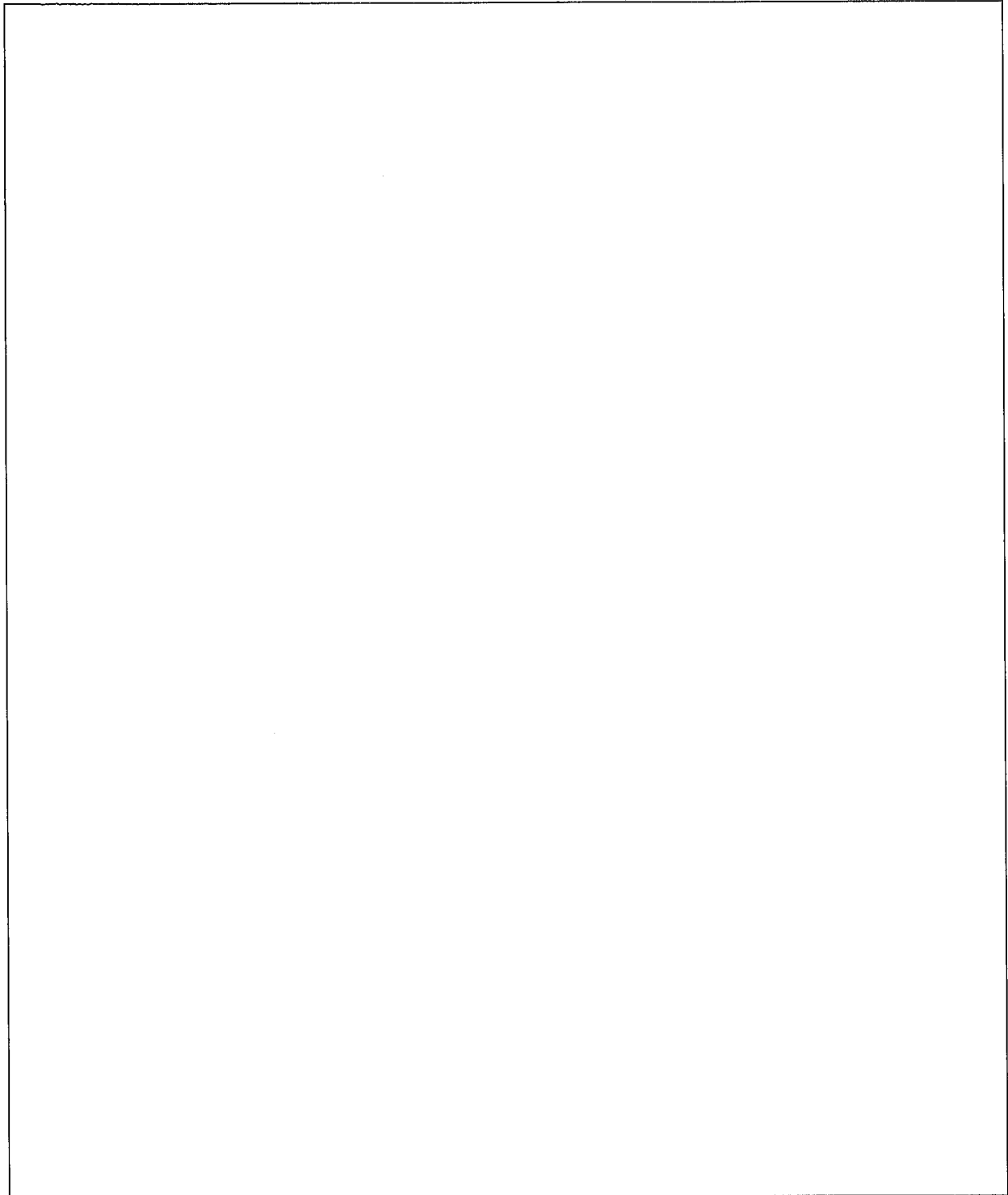
Enter a detailed narrative description of the plant treatment processes and disinfection protocol.

The RO Membrane Plant is a treatment train within the Cypress Water Treatment Plant which is one of two surface water treatment plants supplying the City of Wichita Falls. The Cypress WTP contains three conventional treatment trains that receive raw water from Lake Kickapoo and/or Lake Arrowhead and one micro-filtration/reverse osmosis treatment train that receives water from Lake Kemp. The four treatment trains combined have a total capacity of 52 MGD of treated water.

The RO Membrane Plant receives raw water through an approximately 65,000 ft. long 42 in. pipeline from the Lake Kemp Headquarters Road Pump Station (HRPS). The Lake Kemp HRPS pumps water from a 12 Mgal. reservoir which is fed by the Lake Kemp watershed through Lake Diversion and the Southside Canal system. Once the raw water is delivered to the plant, treatment is completed using clarification, micro-filtration, and reverse osmosis. The finished water is moved to clearwell/transfer well of either the '10 Plant or the '61 Plant and then transferred to ground storage prior to being pumped into distribution.

Disinfection of the water through the RO Membrane Plant is accomplished using a combination of chlorine dioxide and chloramines. Chlorine dioxide is injected into the 42 in. raw water line at the Lake Kemp HRPS and sampled for residual at three locations along the pipeline with distances of 85 ft., 2,310 ft., and 65,000 ft. from the injection location. These three sampling locations define the end of the first three disinfection zones with their corresponding lengths of 42 in. pipe as follows: D1 - 85 ft., D2 - 2225 ft., and D3 62,690 ft. Chloramines are introduced at the clearwell/transfer well of either the '10 Plant or the '61 Plant while being mixed with the respective plant's finished water. Before the water is transferred to the ground storage system a sample is taken at the transfer pump discharge header for the fourth disinfection zone (D4 a or b). The ground storage system consists of three tanks: 10 Mgal., 5 Mgal., & 3 Mgal. with an approximate proportion of flow 70%, 13%, & 17%, respectively. After the ground storage system, the water is sampled a last time for the fifth disinfection zone (D5 a, b, or c) at the High Service Pump Station discharge header just prior to entering the distribution system.

Detailed narrative description of the plant treatment processes and disinfection protocol (cont)

A large, empty rectangular box with a black border, intended for a detailed narrative description of plant treatment processes and disinfection protocols. The box occupies the majority of the page area below the header and above the footer.

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Schematic Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls

PLANT NAME
OR NUMBER:

Cypress WTP: RO Membrane Plant

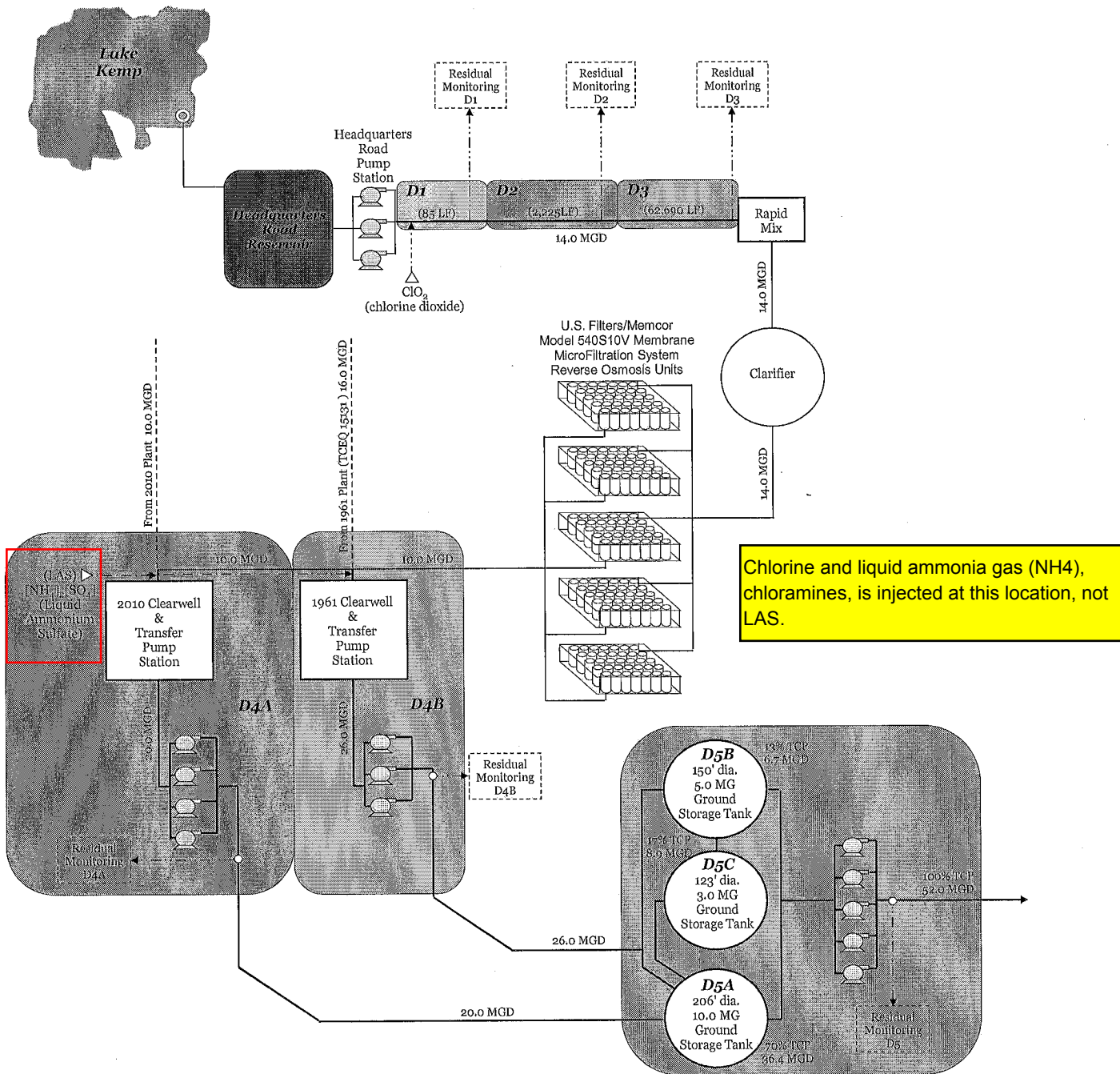
PWS ID No.:

2430001

Date:

October 5, 2011

Use this worksheet to create your plant schematic with the Microsoft Drawing Tools.
If you are not familiar with the drawing tools, you may create your schematic using any other suitable medium.
Please refer to Section 3.3 of the Guidance Manual for instructions and guidance.



CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Cypress WTP: RO Membrane Plant

Date: October 5, 2011

Treatment Plant Capacity 14.000 mgd
9,722 gpm

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Disinfection Zone:

D1

Disinfectant:

Chlorine Dioxide

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic

Number of Units

1

Diameter

42 in

Length

85 ft

Comments

First Sampling Location

As per CT Submittal dated April 4, 2011

As per CT Submittal dated April 4, 2011

Volume (each)

6,118 gal

Flow Rate (each)

9,722 gpm

Detention Time

0.6 min

Treatment Plant Capacity

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor:

T₁₀

0.6 min

D1 FLOW RATE

14.000 mgd

T10 SUM FOR D1

0.6 min

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D2 Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Second Sampling Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	2225 ft	As per CT Submittal dated April 4, 2011
Volume (each)	160,157 gal	Treatment Plant Capacity
Flow Rate (each)	9,722 gpm	
Detention Time	16.5 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	16.5 min	

D2 FLOW RATE 14.000 mgd

T10 SUM FOR D2 16.5 min

Disinfection Zone: D3 Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Third Sampling Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	62690 ft	As per CT Submittal dated April 4, 2011
Volume (each)	4,512,455 gal	Treatment Plant Capacity
Flow Rate (each)	9,722 gpm	
Detention Time	464.1 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	464.1 min	

D3 FLOW RATE 14.000 mgd

T10 SUM FOR D3 464.1 min

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D4A Disinfectant: Chloramines
Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: 2010 Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	1	
Length	98.4 ft	As per CT Submittal dated April 4, 2011
Width	26 ft	As per CT Submittal dated April 4, 2011
Side Water Depth	11.3 ft	As per CT Submittal dated April 4, 2011
Maximum Volume (each)	216,290 gal	
Minimum Operating Level	5.7 ft	
Worst Case Volume (each)	109,102 gal	
Percent of Maximum Volume	50 %	50% of total volume
Worst Case Volume (each)	109,102 gal	
Flow Rate (each)	13,888 gpm	Treatment Plant Capacity for City of Wichita Falls '10 Plant - 10 MGD (TCEQ 15134) combined with Treatment Plant Capacity from RO Membrane Plant - 10 MGD (TCEQ 21567) for a total capacity of 20 MGD
Detention Time	7.9 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with two internal baffles length to width 30:1
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: _____
T ₁₀	3.9 min	

D4A FLOW RATE	19.999 mgd
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T10 SUM FOR D4A	3.9 min
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CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D4B Disinfectant: Chloramines
Unit - 1 Type: Clearwell Shape: Other

Further Description: 1961 Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	1	
Maximum Volume (each)	120,000 gal	As per CT Submittal dated April 4, 2011
Worst Case Volume (each)	60,000 gal	As per CT Submittal dated April 4, 2011
Percent of Maximum Volume	50 %	
Worst Case Volume (each)	60,000 gal	
Flow Rate (each)	18,056 gpm	Treatment Plant Capacity for City of Wichita Falls '61 Plant - 16 MGD (TCEQ 15131) combined with Treatment Plant Capacity from RO Membrane Plant - 10 MGD (TCEQ 21567) for a total capacity of 26 MGD
Detention Time	3.3 min	
Baffling Factor	0.6	As per Approved TCEQ Tracer study dated July 13, 1992
		Baffling Characteristics: <u>Tracer Study</u>
		Approved Baffling Factor: <u>0.55</u>
T ₁₀	1.8 min	

D4B FLOW RATE	26.001 mgd
T10 SUM FOR D4B	1.8 min

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D5A Disinfectant: Chloramines
Unit - 1 Type: Clearwell Shape: Circular

Further Description: 10 MG Ground Storage Tank

Characteristic		Comments
Number of Units	1	
Diameter	206 ft	As per CT Submittal dated April 4, 2011
Side Water Depth	40 ft	As per CT Submittal dated April 4, 2011
Center Water Depth	40 ft	As per CT Submittal dated April 4, 2011
Maximum Volume (each)	9,974,083 gal	
Minimum Operating Level	20 ft	assumes "worse case" operating level
Worst Case Volume (each)	4,987,042 gal	
Percent of Maximum Volume	50 %	50% of total volume
Worst Case Volume (each)	4,987,042 gal	
Flow Rate (each)	25,278 gpm	Approximately 70% of the City of Wichita Falls, Cypress SWTP (36.4 MGD)
Detention Time	197.3 min	
Baffling Factor	0.3	Typical Baffling Factor for "unbaffled" Basins
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T ₁₀	59.2 min	

D5A FLOW RATE	36.400 mgd
T10 SUM FOR D5A	59.2 min

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone:

D5B

Disinfectant:

Chloramines

Unit - 1

Type: Clearwell

Shape: Circular

Further Description: 5 MG Ground Storage Tank

Characteristic

Comments

Number of Units	1	
Diameter	150 ft	As per CT Submittal dated April 4, 2011
Side Water Depth	37.6 ft	As per CT Submittal dated April 4, 2011
Center Water Depth	37.6 ft	As per CT Submittal dated April 4, 2011
Maximum Volume (each)	4,971,059 gal	
Minimum Operating Level	18.8 ft	assumes "worse case" operating level
Worst Case Volume (each)	2,485,530 gal	
Percent of Maximum Volume	50 %	50% of total volume
Worst Case Volume (each)	2,485,530 gal	
Flow Rate (each)	4,694 gpm	Approximately 13% of the City of Wichita Falls, Cypress SWTP (6.7 MGD)
Detention Time	529.5 min	
Baffling Factor	0.1	Typical Baffling Factor for "unbaffled" Basins
		Baffling Characteristics: <u>Unbaffled</u>
		Approved Baffling Factor: _____
T ₁₀	53.0 min	

D5B FLOW RATE	6.759 mgd
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T10 SUM FOR D5B	53.0 min
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CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

T10 Details Worksheet

Disinfection Zone: D5C Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Circular

Further Description: 3 MG Ground Storage Tank

Characteristic		Comments
Number of Units	1	
Diameter	123 ft	As per CT Submittal dated April 4, 2011
Side Water Depth	33.6 ft	As per CT Submittal dated April 4, 2011
Center Water Depth	33.6 ft	As per CT Submittal dated April 4, 2011
Maximum Volume (each)	2,986,951 gal	
Minimum Operating Level	16.8 ft	assumes "worse case" operating level
Worst Case Volume (each)	1,493,475 gal	
Percent of Maximum Volume	50 %	50% of total volume
Worst Case Volume (each)	1,493,475 gal	
Flow Rate (each)	6,139 gpm	Approximately 17% of the City of Wichita Falls, Cypress SWTP (8.9 MGD)
Detention Time	243.3 min	
Baffling Factor	0.1	Typical Baffling Factor for "unbaffled" Basins
		Baffling Characteristics: <u>Unbaffled</u>
		Approved Baffling Factor: _____
T ₁₀	24.3 min	

D5C FLOW RATE	8.840 mgd
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T10 SUM FOR D5C	24.3 min
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Disinfection Zone: D6 Disinfectant: _____

Disinfection Zone: D7 Disinfectant: _____

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Summary Worksheet

PUBLIC WATER

SYSTEM NAME: City of Wichita Falls PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Cypress WTP: RO Membrane Plant Date: October 5, 2011

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	42-inch Raw Water Pipe (1)	6,118	14.000	1	0.629	0.63
D2	42-inch Raw Water Pipe (1)	160,157	14.000	1	16.474	16.47
D3	42-inch Raw Water Pipe (1)	4,512,455	14.000	1	464.149	464.15
D4A	2010 Clearwell/Transfer Pump Station (1)	109,102	19.999	0.5	3.928	3.93
D4B	1961 Clearwell/Transfer Pump Station (1)	60,000	26.001	0.55	1.828	1.83
D5A	10 MG Ground Storage Tank (1)	4,987,042	36.400	0.3	59.186	59.19
D5B	5 MG Ground Storage Tank (1)	2,485,530	6.759	0.1	52.951	52.95
D5C	3 MG Ground Storage Tank (1)	1,493,475	8.840	0.1	24.328	24.33

* These values are calculated on the T10 Details Sheet

TCEQ - (06-01-09)

CT STUDY

CT STUDY

FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
CT Calculator Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls

PLANT NAME
OR NUMBER:

Cypress WTP: RO Membrane Plant

PWS ID No.:

2430001

Date:

October 5, 2011

DISINFECTION PROCESS PARAMETERS											
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS					
Parameters	Disinfection Zones					Log Inactivations					
	D1	D2	D3	D4A	D4B	Giardia lamblia Cysts			Viruses		
Flow Rate (MGD)	14.000	14.000	14.000	19.999	26.001	0.5			2.0		
T ₁₀ (minutes)	0.6	16.5	464.1	3.9	1.8						

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL	
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CLO2 D1	0.1	14.000	5.0	8.5	0.1	4.5	5.7	0.01	0.02		
CLO2 D2	0.1	14.000	5.0	8.5	1.6	4.5	5.7	0.18	0.58		
CLO2 D3	0.1	14.000	5.0	8.5	46.4	4.5	5.7	5.21	16.23	5.41	8.42
CLA D4A	0.3	19.999	5.0	8.5	1.2	357.5	857.0	0.00	0.00		
CLA D4B	0.3	26.001	5.0	8.5	0.5	357.5	857.0	0.00	0.00		

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DISINFECTION PROCESS PARAMETERS											
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS					
Parameters	Disinfection Zones					Log Inactivations					
	D5A	D5B	D5C	D6	D7	Giardia lamblia Cysts			Viruses		
Flow Rate (MGD)	36.400	6.759	8.840			0.5			2.0		
T ₁₀ (minutes)	59.2	53.0	24.3								

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL	
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CLA D5A	0.3	36.400	5.0	8.5	17.8	357.5	857.0	0.02	0.04		
CLA D5B	0.3	6.759	5.0	8.5	15.9	357.5	857.0	0.02	0.04		
CLA D5C	0.3	8.840	5.0	8.5	7.3	357.5	857.0	0.01	0.02	SEE	PAGE 1
D6											
D7											

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