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Bryan W. Shaw, Ph.D., P.E., *Chairman*
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Texas Commission on Environmental Quality
Protecting Texas by Reducing and Preventing Pollution

July 17, 2015

Mr. Shawn M. Garcia, P.E.
 City of Wichita Falls
 P. O. Box 1431,
 Wichita Falls, TX 76307-1431

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TCEQ
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Subject: The City of Wichita Falls – PWS ID No. 2430001
 Public Drinking Water Supply Revised Contact Time Study
 Cypress Water Treatment – RO Membrane Plant – TCEQ Plant ID – TP21567
 Wichita County, Texas

CN600129316

RN105598759

Dear Mr. Garcia:

In order to correctly divide the raw water injection points into treatment trains rather than disinfection zones the Texas Commission on Environmental Quality (TCEQ) has revised the Contact Time (CT) study for the City of Wichita Falls (CWF) Cypress Water Treatment Plant (CWTP) 2008 Plant Reverse Osmosis (RO) Membrane Water Treatment Plant (MWTP). The information in this TCEQ letter for City of Wichita Falls CWTP 2008 RO Plant should replace, not supplement, all previous CT studies for this facility.

The CWF CWTP RO MWTP is a 14-million-gallons-per-day (MGD) microfiltration (MF) treatment facility receiving raw water from Lake Kemp via the Headquarters Road Reservoir and Pump Station (HRPS) located at the CWTP. The RO MWTP consists of a rapid mix basin, a clarifier, and five racks of a U.S. Filters/Memcor Model 540S10V MF membrane system and five (5) racks of RO units having 504 modules per rack. Filtrate water flows from the RO MWTP to the CWTP 1961 Plant, TCEQ Plant ID TP15131, and the CWTP 2010 Plant, TCEQ Plant ID TP10071, where it is combined with the filtered water in each plants' 0.10-million-gallon (MG) clearwell and pump station, increasing the capacity of the CWTP 1961 Plant to 26 MGD, and the CWTP 2010 Plant to 20 MGD. The combined water then flows to the CWF CWTP three ground storage tanks.

The disinfection protocol involves the injection of chlorine dioxide (ClO₂) downstream of the HRPS, and liquid ammonium sulfate (LAS) upstream of both the CWTP 1961, and CWTP 2010 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 HRPS, 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.

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 three disinfection zones at the CWF CWTP RO MWTP. The first disinfection zone, D1, contains three treatment trains: D1A, D1B and D1C. D1A consists of 85 linear feet (LF) of 42-inch raw water pipe, D1B consists of 2,200 LF of 42-inch raw water pipe, and D1C consists of 62,690 LF of 42-inch raw water pipe. The second disinfection zone is divided into two treatment trains: D2A and D2B. Each treatment train consists of a clearwell and transfer pump station. The final disinfection zone, D3, is divided into three treatment units: D3A, D3B and D3C for each of the three ground storage tanks. The treatment unit D3A consists of a 206-foot diameter, 10.0-MG ground storage tank. The treatment unit D3B consists of a 150-foot diameter, 5.0-MG ground storage tanks, and the treatment unit D3C consists of a 123-foot diameter, 3.0-MG ground storage tank.

Water systems using surface water or ground water under the influence of surface water must achieve a 3.0-log reduction of *Giardia*, a 2.0-log reduction for *Cryptosporidium*, and a 4.0-log reduction of viruses under the provision of the Surface Water Treatment Rule. A water system with a properly designed, operated, and maintained microfiltration (MF) system is given a 3.0-log credit for *Giardia* reduction and 2.0-log credit for virus reduction when coagulation, flocculation and clarification are applied upstream of the membranes. Therefore, **City of Wichita Falls Cypress RO Membrane WTP must provide at least a 2.0-log inactivation of viruses through the disinfection process.**

Contact Time (CT) calculations are used to evaluate the disinfection process. The time that the disinfectant is in contact with water in the disinfection segment must be determined on a daily basis to complete the CT calculations. This contact time, measured as T_{10} , is determined based on the peak hourly flow rate occurring during the 24-hour period and the detention time that is equaled or exceeded by 90 percent of the water passing through the basin. 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 CWF 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 October 11, 2011.

TABLE 1: T_{10} TABLE FOR CWF CWTP RO MWTP

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1A	42-inch Raw Water Pipe	6,100 ⁽¹⁾	14.00 ⁽⁹⁾	1.0 ⁽¹⁵⁾	0.629	0.63
D1B	42-inch Raw Water Pipe	160,200 ⁽²⁾			16.474	16.47
D1C	42-inch Raw Water Pipe	4,512,500 ⁽³⁾			464.15	464.15
D2A	0.20 MG Clearwell '10 Plant	109,100 ⁽⁴⁾	20.00 ⁽¹⁰⁾	0.5 ⁽¹⁶⁾	3.928	3.93
D2B	0.10 MG Clearwell '61 Plant	60,000 ⁽⁵⁾	26.00 ⁽¹¹⁾	0.55 ⁽¹⁷⁾	1.828	1.83
D2A	10.0 MG Ground Storage Tank	4,987,000 ⁽⁶⁾	36.40 ⁽¹²⁾	0.3 ⁽¹⁸⁾	59.186	59.19
D3B	5.0 MG Ground Storage Tank	2,485,500 ⁽⁷⁾	6.76 ⁽¹³⁾	0.1 ⁽¹⁹⁾	52.951	52.95
D3C	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 0.2 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 (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 (TPC) 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-Alternative (SWMOR-alt). 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	
	D1A	D1B	D1C	D2A	D2B	Giardia	Viruses
Flow Rate (MGD)	14.00	14.00	14.00	20.00	26.00	0.0	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	
	D3A	D3B	D3C	D5	D6	Giardia	Viruses
Flow Rate (MGD)	36.40	6.76	8.84	na	na	0.0	2.0
T ₁₀ (minutes)	59.2	53.0	24.3	na	na		

Please note the City must use the approved Amperometric method to measure the chlorine dioxide residuals at the disinfection zones D1A, D1B, and D1C sampling of the Cypress '61 Plant and at the entry point to the distribution system, if necessary, the residual may be analyzed using the colorimetric method and a colorimeter in the distribution.

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. Shawn M. Garcia, P.E., Project Manager
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July 17, 2015

If you have any questions concerning our evaluation or if we may be of further assistance, please contact Ms. Sylvana (Sam) Turner at (903) 535-5162, by e-mail at Sylvana.Turner@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,



Joel Plumpp, Manager
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

JPK/ SAT

Enclosure: CT Worksheet

cc: w/ enclosure: Mr. Mark Southard, Water Purification,
City of Wichita Falls
P. O. Box 1431, Wichita Falls, TX 76307-1431

Mr. Shawn M. Garcia, P.E., Project Manager

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July 17, 2015

bcc: w/ enclosure: TCEQ Tracer Study File

Mr. Donald Hunter, TCEQ, DWQT MC 155

TCEQ Region 3, Abilene

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

OR NUMBER: Cypress WTP: RO Membrane Plant Month: June

Day: 24

Year: 2015

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 2008 Plant (RO 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 MG 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.

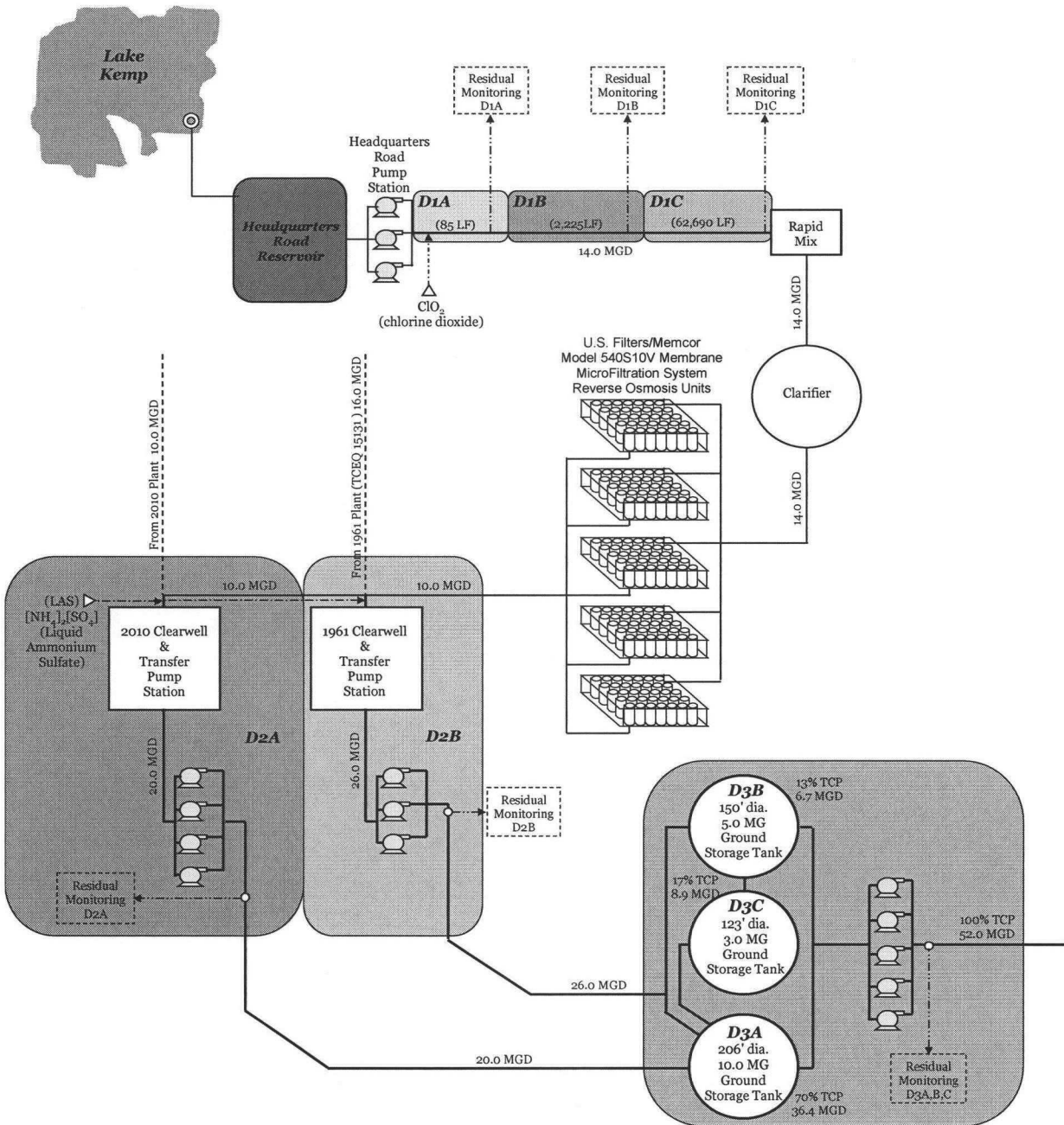
Disinfection of the water through the RO Membrane Plant is accomplished using a combination of chlorine dioxide and chloramines. Chlorine dioxide is injected into the 42 in. raw water line at the Lake Kemp HRPS and sampled for residual at three locations along the pipeline with distances of 85 ft., 2,310 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: D1A - 85 ft., D1B - 2225 ft., and D1C 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 second disinfection zone (D2A or D2B). The ground storage system consists of three tanks: 10 MG, 5 MG, & 3 MG with an approximate proportion of flow 70%, 13%, & 17%, respectively. After the ground storage system, the water is sampled a last time for the third disinfection zone (D3A, D3B, or D3C) at the High Service Pump Station discharge header just prior to entering the distribution system. One residual sample will be taken downstream of the High Service Pumps Station. The residual concentration and appropriate flow will be entered into each treatment train on the SWMOR for each ground storage tank online at the time the sample was taken.

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: June 24, 2015

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: June 24, 2015

Treatment Plant Capacity 14.000 mgd
9,722 gpm

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Disinfection Zone: D1A

Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	First Sampling Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	85 ft	As per CT Submittal dated April 4, 2011
Volume (each)	6,118 gal	
Flow Rate (each)	9,722 gpm	Treatment Plant Capacity
Detention Time	0.6 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	0.6 min	

D1A FLOW RATE	14.000 mgd
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T10 SUM FOR D1A	0.6 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: D1B 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	
Flow Rate (each)	9,722 gpm	Treatment Plant Capacity
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	

D1B FLOW RATE 14.000 mgd

T10 SUM FOR D1B 16.5 min

Disinfection Zone: D1C 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	
Flow Rate (each)	9,722 gpm	Treatment Plant Capacity
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	

D1C FLOW RATE 14.000 mgd

T10 SUM FOR D1C 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: D2A 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	

D2A FLOW RATE	19.999 mgd
T10 SUM FOR D2A	3.9 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: D2B 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	

D2B FLOW RATE	26.001	mgd
T10 SUM FOR D2B	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: D3A 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	

D3A FLOW RATE	36.400 mgd
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T10 SUM FOR D3A	59.2 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: D3B 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	

D3B FLOW RATE	6.759 mgd
T10 SUM FOR D3B	53.0 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: D3C 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	

D3C FLOW RATE	8.840 mgd
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T10 SUM FOR D3C	24.3 min
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Disinfection Zone: D4 Disinfectant: _____

Disinfection Zone: D5 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: June 24, 2015

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1A	42-inch Raw Water Pipe (1)	6,118	14.000	1	0.629	0.63
D1B	42-inch Raw Water Pipe (1)	160,157	14.000	1	16.474	16.47
D1C	42-inch Raw Water Pipe (1)	4,512,455	14.000	1	464.149	464.15
D2A	2010 Clearwell/Transfer Pump Station (1)	109,102	19.999	0.5	3.928	3.93
D2B	1961 Clearwell/Transfer Pump Station (1)	60,000	26.001	0.55	1.828	1.83
D3A	10 MG Ground Storage Tank (1)	4,987,042	36.400	0.3	59.186	59.19
D3B	5 MG Ground Storage Tank (1)	2,485,530	6.759	0.1	52.951	52.95
D3C	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:

June 24, 2015

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS			
Parameters	Disinfection Zones					Log Inactivations			
	D1A	D1B	D1C	D2A	D2B	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	14.000	14.000	14.000	19.999	26.001	0.0		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	Virus Log	Inact. Ratio
CLO2 D1A	0.8	14.000	15.0	8.5	0.5	NA	2.9	0.08	0.35			
CLO2 D1B	0.8	14.000	15.0	8.5	13.2	NA	2.9	2.11	9.22			
CLO2 D1C	0.8	14.000	15.0	8.5	371.3	NA	2.9	59.41	259.65	0.30	0.84	0.42
CLA D2A	4.0	19.999	15.0	8.5	15.7	NA	428.5	0.03	0.07			
CLA D2B	4.0	26.001	15.0	8.5	7.3	NA	428.5	0.02	0.03			

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (06-01-09)

CT STUDY

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS			
Parameters	Disinfection Zones					Log Inactivations			
	D3A	D3B	D3C	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	36.400	6.759	8.840			0.0		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	Virus Log	Inact. Ratio
CLA D3A	4.0	36.400	15.0	8.5	236.7	NA	428.5	0.49	1.11			
CLA D3B	4.0	6.759	15.0	8.5	211.8	NA	428.5	0.44	0.99			
CLA D3C	4.0	8.840	15.0	8.5	97.3	NA	428.5	0.20	0.45	SEE	PAGE	1
D4												
D5												

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (06-01-09)

CT STUDY