



Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

June 27, 2014

Mr. Mark Southard
Water Source/Purification Superintendent
City of Wichita Falls
4801 Big Ed Neal Drive
Wichita Falls, Texas 76310

Subject: Public Drinking Water System Contact Time Study
City of Wichita Falls - PWS ID No. 2430001
Cypress Temporary Direct Potable Reuse Water Treatment Plant,
TCEQ Plant ID No. TP410791
Wichita County, Texas

CN600129316

RN105598759

Dear Mr. Southard:

The Texas Commission on Environmental Quality (TCEQ) Technical Review and Oversight Team (TROT) has completed the review of the CT Study for the full-scale Direct Potable Reuse Water Treatment Plant (Temporary DPR WTP) which was submitted on April 25, 2014. Based on the information provided, we are approving the proposed disinfection protocol.

Please note this letter does not waive any of the conditions required in the TCEQ's exception letter dated June 27, 2014 and applies when the temporary DPR Project is in operation. As you are aware, the City will need to submit another CT Study update at that time.

During the temporary DPR Project, the raw water for the Temporary DPR WTP will be supplied by a transmission line that delivers treated effluent from the River Road Waste Water Treatment Plant (RR WWTP). For the duration of the Project, the DPR WTP will include:

- all of the treatment units at the 2008 Cypress Microfiltration/Reverse Osmosis Water Treatment Plant (2008 Cypress MF/RO WTP), which includes a Flocc-Clarifier; five MF filters; and six two-stage RO units;
- all of the treatment units at 2010 Cypress WTP, which includes a splitter box that, under normal (non-DPR) operating conditions, distributes water between the 1961, 1987, and 2010 plants; a mechanical rapid mix; a Parshall Flume meter; a solids contact, slurry recirculation clarifier; a recarbonation basin; five dual-media gravity filters; and the small 2010 Clearwell and filtered water transfer pump station;
- a 10 million gallon (MG) 2010 Ground Storage Tank (GST) that has been isolated from the rest of the GSTs at the Cypress site; and
- the 2010 High Service Pump Station (HSPS) that discharges to the distribution system.

The proposed disinfection protocol at the DPR WTP involves the injection of chlorine at the RR WWTP chlorine contact chamber and the injection of chlorine (Cl₂) and ammonia (NH₃) at the outlet of the splitter box. There is also a standby liquid ammonium sulfate (LAS) injection point

at the RR WWTP chlorine contact chamber, standby/secondary Cl_2 and LAS injection points at the 2008 clarifier, and standby/secondary Cl_2 and NH_3 injection points at the 2010 Clearwell and the HSPS. Disinfectant residual monitoring can be performed at three designated sample sites on the Secondary Reservoir transmission line, and upstream of the rechloramination points at the 2010 Clearwell and HSPS.

A disinfection zone is a segment of the treatment process which begins at a disinfectant application point and ends at a subsequent disinfectant application or residual sampling point. Hence, each disinfectant application point, regardless of the frequency of use, represents the beginning of a separate disinfection zone. Similarly, a plant may have only one disinfectant point, but may also choose to monitor disinfection residuals at more than one point, thus creating multiple disinfection zones.

Based on your proposal, we concur that there are five disinfection zones at the DPR WTP. The first disinfection zone, D1, consists of the treated effluent water line from the RR WWTP. The second disinfection zone, D2, consists of the Clari-flocculator in the 2008 MF/RO WTP and the third disinfection zone, D3, includes the MF cells and their inlet channel and associated piping. The fourth zone, D4, contains the rapid mix, clarifier, recarbonation basin, granular media filters, and associated piping at the 2010 Cypress WTP. The last disinfection zone, D5, incorporates the 2010 Clearwell and 2010 GST and the associated piping.

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. Since T_{10} values are required to calculate the CT for the treatment process, Table 1 was developed for the DPR WTP. The T_{10} values are based on the information provided the CT Study template you submitted on April 25, 2014.

**TABLE 1: T_{10} TABLE FOR THE
TEMPORARY DIRECT POTABLE REUSE WATER TREATMENT PLANT (TP410791)**

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1	Treated Effluent Transmission Line	1,859,200 ⁽¹⁾	7.5 ⁽¹³⁾	1.0 ⁽¹⁷⁾	357.0	357.0
D2	2008 Flocc-Clarifier	3,875,600 ⁽²⁾		0.3 ⁽¹⁸⁾	223.2	223.2
D3	Piping	13,200 ⁽³⁾		1.0 ⁽¹⁷⁾	2.5	5.9
	Microfiltration Inlet Trough	5,500 ⁽⁴⁾	3.0 ⁽¹⁴⁾	0.1 ⁽¹⁹⁾	0.1	
	Microfiltration Cells	9,650 ⁽⁵⁾		0.7 ⁽²⁰⁾	3.2	
D4	Piping	14,800 ⁽⁶⁾	10.0 ⁽¹⁵⁾	1.0 ⁽¹⁷⁾	2.1	67.1
	Rapid Mix	4,850 ⁽⁷⁾		0.1 ⁽²¹⁾	0.1	
	2010 Clarifier	926,500 ⁽⁸⁾		0.3 ⁽²²⁾	40.0	
	Recarbonation Basin	183,000 ⁽⁹⁾		0.5 ⁽²³⁾	13.2	
	Granular Media Filters	29,100 ⁽¹⁰⁾	2.5 ⁽¹⁶⁾	0.7 ⁽²⁴⁾	11.7	
D5	2010 Clearwell	109,100 ⁽¹¹⁾	10.0 ⁽¹⁵⁾	0.5 ⁽²⁵⁾	7.9	223.3
	2010 Ground Storage Tank	4,987,000 ⁽¹²⁾		0.3 ⁽²⁶⁾	215.4	

Notes: (see following page)

Table 1 Notes:

1. Based on a 27-inch diameter pipe that is 62,500 feet long.
2. Based on a flocculation clarification unit that has a 155-foot diameter, a 25.3-foot side water depth, and a 31.76-foot center water depth.
3. Based on a 36-inch diameter pipe that is 250 feet long.
4. Based on the section of the influent trough from the trough inlet to the closest of the microfiltration cells. This section of the trough is 25.16 feet long and 11 feet wide and has a 2.66-foot side water depth.
5. Based on the volume of water contained in a single filter cell containing 504 submerged microfiltration membrane modules.
6. Based on cumulative volume in 220 linear feet of 36-inch piping between the splitter box to the rapid mix and 85 linear feet of 30-inch piping from the rapid mix to the 2010 clarifier.
7. Based on a basin that is 27 feet long and 6 feet wide with a water depth of 4 feet.
8. Based on a basin that has a 90-foot diameter, an 18.9-foot side water depth, and a 20.6-foot center water depth.
9. Based on a basin that is 45.5 feet long and 32 feet wide and has a 16.8 foot side water depth.
10. Based on one dual-media gravity filter that is 24 feet long and 15 feet wide, contains 6 feet of gravel and media, and an underdrain system that is 1 foot tall. The minimum water depth over the media was reported to be 6.8 feet and a 50% porosity of the filter media is assumed.
11. Based on a clearwell that is 98.4 feet long and 26 feet wide. The maximum water depth and minimum operating levels in the clearwell are 11.3 feet and 5.7 feet, respectively.
12. Based on a tank that has a 206-foot diameter, a 40-foot maximum water depth, and a 20-foot minimum operating level.
13. Based on the maximum anticipated flow rate of treated effluent from the RRWTP.
14. Based on the rated capacity of 504 submerged membrane modules with a total surface area of 334.9 square feet per module and a TCEQ-approved flux rate of 19.6 gallons per square foot per day.
15. Based on the design capacity of the DPR Project and the assumption that 50% of the source water for the 2010 Cypress WTP will be obtained from the raw water transfer pumps at the Secondary Reservoir.
16. Based on the design capacity of the DPR Project and the assumption that flow will be evenly distributed between four of the five filters.
17. Assumes that the flow conditions that exist in long pipeline segments will virtually eliminate the possibility of short-circuiting and create "perfect" baffling characteristics.
18. Assumes that a Flocc-Clarifier with a central, single-stage flocculation chamber and a single baffle wall between the flocculation and settling zones will result in some short-circuiting and an overall "poor" baffling characteristic within the unit.
19. Assumes that the signification hydraulic short-circuiting occurring in a trough with a single inlet and a 2.5:1 length to width ratio will result in an "unbaffled" baffling characteristic within the basin.
20. Assumes that the hydraulic conditions that exist in a filter cell with 504 membrane unit will create "superior" baffling characteristics within the cell.
21. Assumes the rapid mix completely mixes the water within the unit and results in an "unbaffled" baffling characteristic within the basin.
22. Assumes that the mixing zone within the solids contact clarifier results in sufficient short-circuiting that the overall baffling characteristic of the clarifier will be "poor".
23. Assumes that "average" baffling conditions will occur in a tank that contains multiple baffle walls that create a contactor with an effective length:width ratio greater than 20:1 but less than 50:1.
24. Assumes that the hydraulic conditions that exist in a gravity filter will create "superior" baffling characteristics within the filter.
25. Assumes that a tank with two inlets, three internal baffle walls, and a single outlet will exhibit some short-circuiting and demonstrate "poor" baffling characteristics.

We have prepared a Disinfection Process Parameters table to help the operators 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 the Temporary Direct Potable Reuse WTP must meet on a continuous basis.

**TABLE 2: DISINFECTION PROCESS PARAMETERS FOR THE
TEMPORARY DIRECT POTABLE REUSE WATER TREATMENT PLANT (TP410791)**

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivation	
	D1	D2	D3	D4	D5	Giardia	Viruses
Flow Rate (MGD)	7.50	7.50	3.308	10.00	10.00	2.0	5.0
T_{10} (minutes)	357.0	223.2	5.6	67.1	223.3		

As you are aware, zone D4 includes the 2010 clarifier, recarbonation basin, and conventional filters. As we have discussed, this grouping of treatment processes results in some constraints on the manner in which the plant must be operated and monitored. Specifically:

- **The operators must monitor the pH in disinfection zone D4 at the outlet of the 2010 clarifier.** Historically, the 2010 Cypress WTP has practiced full lime softening and, therefore, the clarifier has operated at a higher pH range in order to achieve greater hardness reductions and improved total organic carbon removal. During the temporary DPR project, the Temporary DPR WTP expects to meet these two treatment objectives by blending the surface water (from Lake Kickapoo and Lake Arrowhead) with RO permeate produced by the 2008 Cypress MF/RO WTP plant. However, the City would like to retain the flexibility to practice partial lime softening when conditions warrant.

This desired level of flexibility is understandable. However, the US Environmental Protection Agency's CT Tables for chloramine only apply when pH levels are between 6 and 9, i.e., from 5.5 through 9.49. Because zone D4 includes both the clarification and recarbonation processes and recarbonation lowers pH, the pH in zone D4 must be measured before recarbonation. Consequently, the operators must monitor the pH for disinfection zone D4 at the outlet of the clarifiers rather than at the typical site located at end of the disinfection zone. The alternate location will ensure that the Temporary DPR WTP does not overestimate disinfection levels when the pH in the 2010 Clarifier reaches 9.5.

- **The operators must have at least four filters in operations whenever the plant is treating water.** This operational constraint is needed because zone D4 contains both the plant's gravity filters and the disinfection contact time within the zone depends on the flow rate of the water and the total volume of water contained in the treatment units. Consequently, the CT calculations will underestimate the level of viral inactivation achieved if fewer than four filters are on line whenever the plant is treating water.

Mr. Mark Southard
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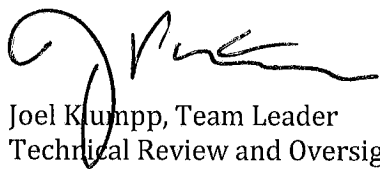
During the duration of the temporary DPR process, the operators must continue to measure monochloramine, as opposed to total chlorine, residuals at the end of disinfection zones D1, D2, and D3. Because the source water for the Temporary DPR WTP is the treated effluent from the River Road WWTP, there is a possibility that the water in these three disinfection zones will contain significant amounts of organic chloramines and other chemical compounds that can be detected by the total chlorine test methods. Since the effectiveness of these chemicals as a disinfectant has not been studied, measuring monochloramine levels will reduce the potential for significantly overestimating the level of disinfection in these zones if elevated levels of these other chemicals are present. On the other hand, the operators must continue to measure total chlorine residuals in zones D4 and D5 using an approved total chlorine method since the water is dechlorinated at the end of disinfection zone D3.

Please note that this approved CT study is only applicable for the duration of the temporary DPR Project and only if the plant adheres to the operational constraints identified above. **Therefore, you must submit another revised CT study when the plant returns to its traditional source water and operational practices.**

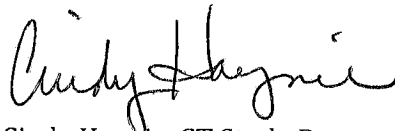
If you have any questions concerning our evaluation or if we may be of other assistance, please contact Mr. Joel Klumpp at (512) 239-4453, by e-mail at joel.klumpp@tceq.texas.gov, or by correspondence at:

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

Sincerely,



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Technical Review and Oversight Team
Plan & Technical Review Section
Water Supply Division
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Cindy Haynie, CT Study Program Manager
Technical Review and Oversight Team
Plan & Technical Review Section
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JPK/jcs

Enclosure: CT Study Worksheet

cc w/ enclosure: Mr. Daniel K. Nix,
Operations Manager, Public Utilities
City of Wichita Falls

Mr. Mark Southard

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Blind Copies:

bcc w/ enclosure: TCEQ Region 3, Abilene
TCEQ Tracer Study File
Mr. Donald Hunter, TCEQ DWQT, MC 155

CT Study for the Wichita Falls Temporary DPR WTP

CT STUDY TEMPLATE

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: Temporary Direct Potable Reuse Water Treatment Plant Month: April

Day: 25

Year: 2014

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

The City of Wichita Falls Cypress Water Treatment Plant (CWF CWTP) Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis (MF/RO) treatment facilities with the conventional 2010 CWTP. This CT study takes into account the treated water pumped from the CWF River Road Waste Water Treatment Plant (RRWWTP) to the CWTP through a 32-inch outside diameter (O.D.) HDPE raw water pipe (with a 27-inch inside diameter, I.D.) at a flow of 7.5 million gallons per day (MGD), through the MF/RO treatment facility to a raw water lagoon where 5 MG will then be mixed with 5 MG raw surface water and treated through the conventional 2010 CWTP.

The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 5 MG permeate will be sent to a raw water lagoon, pumped back to the splitter basin and mixed with 5 MG of raw surface water prior to the 2010 CWTP. The 2010 CWTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10.0-MG ground storage tank. Total capacity through the 2010 CWTP is 10.0-MGD.

The treatment processes for the water from the RRWWTP must achieve a 5.5-log removal or inactivation of Cryptosporidium, an 8.0-log removal or inactivation of Giardia, and a 9.0-log removal or inactivation of viruses before water is distributed to the customers. Based on the combination of treatment processes that will be used at the MF/RO facilities and 2010 CWTP, the disinfection process must be able to achieve a 2.0-log inactivation of Giardia and a 5.0-log inactivation of viruses before treated water enters the distribution system.

The proposed disinfection protocol involves the injection of chlorine (Cl₂) at the RRWWTP chlorine contact basin to create "per-formed chloramines" as a disinfectant (i.e, not adding enough Cl₂ to reach breakpoint) before being pumped to the CWTP through the 32-inch O.D. raw water pipe to. In the micro-filtration clarifier, chlorine (Cl₂) and liquid ammonium sulfate (LAS) are injected in the mix zone to form chloramines. Chlorine (Cl₂) and liquid ammonium sulfate are again added at the clarifier effluent to form chloramines through the micro-filtration trough and cells. Once the reverse osmosis permeate is mixed with the raw surface water in the splitter basin, chlorine (Cl₂) and liquid ammonia gas (NH₄) are added in the splitter box and again just upstream of the CWTP's 0.20 MG clearwell and transfer pump station.

Chloramine residuals are monitored in the raw water vault, prior to the micro-filtration clarifier, in the mix zone of the clarifier, at the effluent collection box of the clarifier, in the micro-filtration feed trough and cell filtrate. Chloramine residuals are also monitored downstream of the five multi-media gravity filters, downstream of the 0.20 MG clearwell and transfer pump station and downstream of the 10 MG ground storage tank, prior to entering the distribution system.

Submitted by: Mark Southard, Water Source/Purification Superintendent

Contact: mark.southard@wichitafallstx.gov Reviewed by Jack C. Schulze, P.E.

Information: 940-691-1153, 940-691-4121 Fax

CT Study for the Wichita Falls Temporary DPR WTP

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

The disinfection process will utilize five disinfection zones which are summarized as follows:

- D1: 32-inch O.D. HDPE raw water pipeline from the River Road WWTP to the Cypress WTP
- D2: 2008 SWTP's clarification unit at the MF/RO treatment facility
- D3: 2008 SWTP's MF treatment units and associated piping
- D4: 2010 SWTP's clarifier, recarbonation basin, filters, and associated piping
- D5: 2010 SWTP's 0.20-MG clearwell and Cypress 10-MG ground storage tank

CT Study for the Wichita Falls Temporary DPR WTP

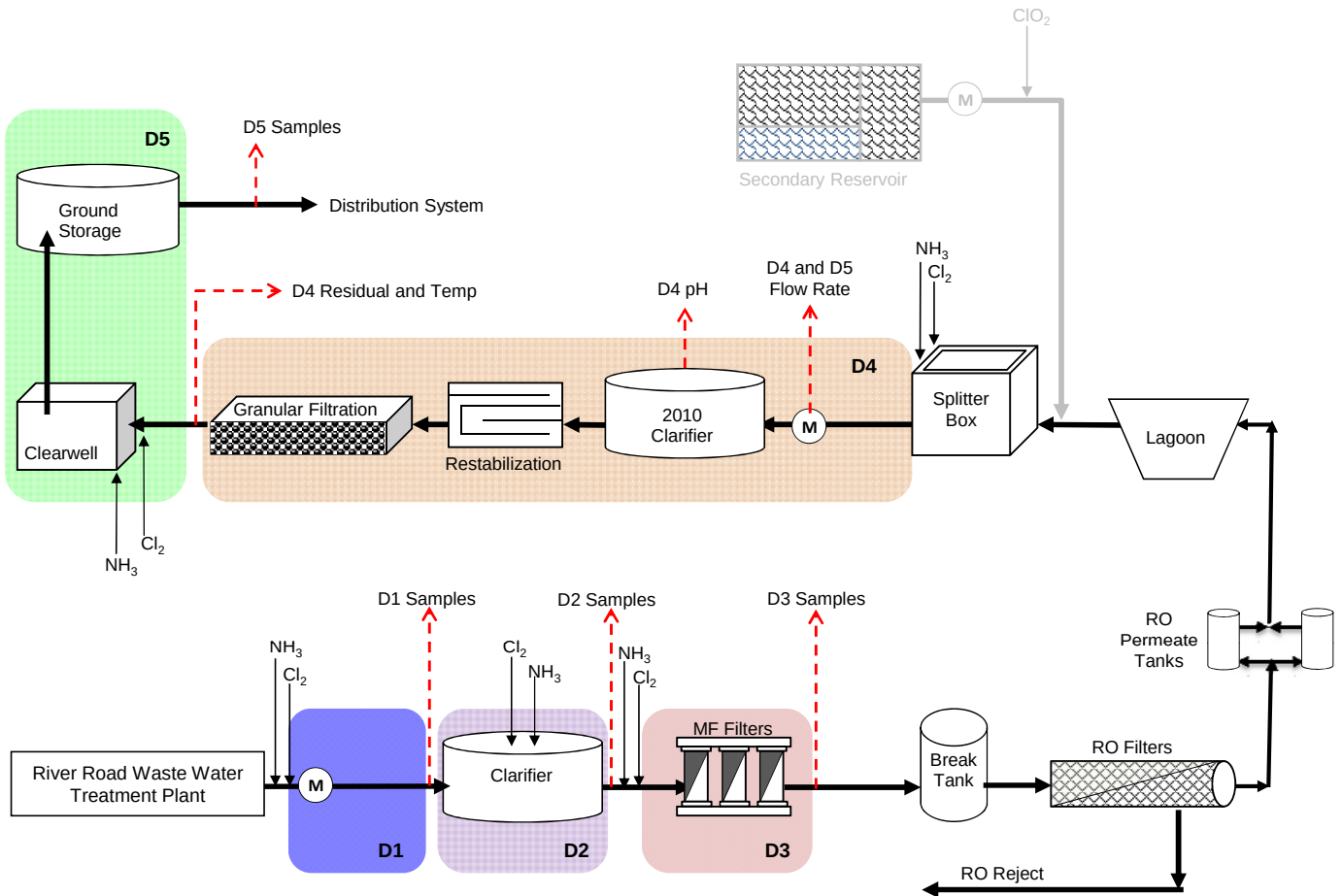
CT STUDY TEMPLATE

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: Temporary Direct Potable Reuse Water Treatment Plant

PWS ID No.: 2430001 Date: April 25, 2014

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 TEMPLATE

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: Temporary Direct Potable Reuse Water Treatment Pla Date: April 25, 2014

Treatment Plant Capacity 10.000 mgd
6,944 gpm

The peak flow rate through the MF/RO facilities will be 7.5 MGD but the peak flow rate through the rest of the 2010 CWTP will be 10 MGD, which is the combined flow rate from the MF/RO facilities and the secondary reservoir containing

Disinfection Zone: D1 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 13 Mile Pipe from RRWWTP to Cypress WTP

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Pipe from RRWWTP to CWTP
Diameter	27 in	32" O.D. HDPE with a 27" I.D. per K. Maroney
Length	62500 ft	8/29/2013 email
		8/15/2013 email
Volume (each)	1,859,189 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	357.0 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	357.0 min	

D1 FLOW RATE 7.500 mgd

T10 SUM FOR D1 357.0 min

CT Study for the Wichita Falls Temporary DPR WTP

Disinfection Zone: D2 Disinfectant: Chloramines

Unit - 1 Type: Clarifier Shape: Circular

Further Description: MF/RO Flocc-Clarifier

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	155 ft	Based on two engineer drawings for the clarifier structure (the CH2MHill DWG 4A-S-2, dated 2002 and the USFilter DWG 40507-101, dated 2004)
Side Water Depth	25.3 ft	" " "
Center Water Depth	31.76 ft	" " "
Volume (each)	3,875,583 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	744.1 min	
Baffling Factor	0.3	Based on a concentric cylindrical baffle wall with a diameter of approximately 50 ft that extends 10 ft into the basin and settled water launder along the perimeter of the basin
		Baffling Characteristics: <u> Poor </u>
		Approved Baffling Factor: <u> </u>
T ₁₀	223.2 min	
D2 FLOW RATE 7.500 mgd		
T10 SUM FOR D2 223.2 min		

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Clarifier to Micro-filtration Trough
Diameter	36 in	8/15/2013
Length	250 ft	8/15/2013
Volume (each)	13,221 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	2.5 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u> Perfect </u>
		Approved Baffling Factor: <u> </u>
T ₁₀	2.5 min	

CT Study for the Wichita Falls Temporary DPR WTP

Unit - 2 Type: Other Shape: Rectangular

Further Description: Micro-filtration Trough

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	25.16 ft	Based on CH2MHill DWG 4-S-10 dated 2002, and the length of the channel from the inlet to the center of the first pair of filter cells
Width	11 ft	Based on DWG 4-S-10
Side Water Depth	2.66 ft	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	5,508 gal	
Flow Rate (each)	5,208 gpm	Based on the total flow to the first diversion point
Detention Time	1.1 min	
Baffling Factor	0.1	
		Baffling Characteristics: <u>Unbaffled</u>
		Approved Baffling Factor: <u></u>
T ₁₀	0.1 min	

Unit - 3 Type: Other Shape: Other

Further Description: Micro-filtration Cells

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	The flow rate through each individual MF tank must be monitored and the highest flow rate entered on the Calculator Worksheet.
Volume (each)	9,557 gal	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	9,557 gal	
Flow Rate (each)	2,060 gpm	Based on 504 modules with a total surface area of 300.3 ft ² per module and an approved flux rate of 19.6 gfd.
Detention Time	4.6 min	
Baffling Factor	0.7	Based on the configuration of the filter cell and the submerged membrane units
		Baffling Characteristics: <u>Superior</u>
		Approved Baffling Factor: <u></u>
T ₁₀	3.2 min	

D3 FLOW RATE	2.966 mgd
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T10 SUM FOR D3	5.9 min
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CT Study for the Wichita Falls Temporary DPR WTP

Disinfection Zone: D4 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011
Length	220 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	11,634 gal	
Flow Rate (each)	6,944 gpm	based on a total 10 MGD flow through the
Detention Time	1.7 min	conventional 2010 CWTP facilities
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u> Perfect </u>
		Approved Baffling Factor: <u> </u>
T ₁₀	1.7 min	

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	27 ft	As per CT Submittal Dated April 4, 2011
Width	6 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	4 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.7 min	
Baffling Factor	0.1	Typical Baffling Factor for an "Unbaffled" Basin
		Baffling Characteristics: <u> Unbaffled </u>
		Approved Baffling Factor: <u> </u>
T ₁₀	0.1 min	

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	3,122 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.4 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u> Perfect </u>
		Approved Baffling Factor: <u> </u>
T ₁₀	0.4 min	

CT Study for the Wichita Falls Temporary DPR WTP

Unit - 4 Type: Clarifier Shape: Circular

Further Description: 2010 Clarifier

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	90 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	18.9 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	926,521 gal	
Flow Rate (each)	6,944 gpm	Based on the rated capacity of the temporary DPR WTP. At this flow rate, the SOR = 1.09 gpm/ft ² and the HDT = 133.42 min.
Detention Time	133.4 min	
Baffling Factor	0.3	Typical Baffling Factor for Clarifiers
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: _____
T ₁₀	40.0 min	

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	45.5 ft	As per CT Submittal Dated April 4, 2011
Width	32 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	16.8 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	183,003 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	26.4 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: _____
T ₁₀	13.2 min	

CT Study for the Wichita Falls Temporary DPR WTP

Unit - 6 Type: Filter Shape: Rectangular

Further Description: Gravity Filters

<u>Characteristic</u>		<u>Comments</u>
Number of Units	4	To represent the City's operation with four filters always in service and the fifth filter on standby for when one the filters goes into backwash.
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	
Volume (each)	29,088 gal	
		10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each). Four filters must always be operated together at equal flow rates.
Flow Rate (each)	1,736 gpm	
Detention Time	16.8 min	
Baffling Factor	0.7	Typical Baffling Factor for Filters
		Baffling Characteristics: <u>Superior</u>
		Approved Baffling Factor: <u></u>
T ₁₀	11.7 min	
D4 FLOW RATE	10.000 mgd	
T10 SUM FOR D4	67.1 min	

Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

<u>Characteristic</u>		<u>Comments</u>
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 %	Based on the clearwell's minimum operating level, i.e., 50% of Total Volume
Worst Case Volume (each)	109,102 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	15.7 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with Two Internal Baffles Lenth to Width (30:1)
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: <u></u>
T ₁₀	7.9 min	

CT Study for the Wichita Falls Temporary DPR WTP

Unit - 2

Type: Clearwell

Shape: Circular

Further Description: 10 MG Ground Storage Tank

<u>Characteristic</u>		<u>Comments</u>
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	
		Assumes a "Worst Case" operating level that is 50% of the maximum water depth
Minimum Operating Level	20 ft	
Worst Case Volume (each)	4,987,042 gal	
Percent of Maximum Volume	50 %	
Worst Case Volume (each)	4,987,042 gal	
		100% of 10 MGD Max at Cypress. All water produced will pass through the 10 MG GST for the DPR full scale operation.
Flow Rate (each)	6,944 gpm	
Detention Time	718.1 min	
		Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles
Baffling Factor	0.3	Baffling Characteristics: Poor
		Approved Baffling Factor:
T₁₀	215.4 min	

D5 FLOW RATE	10.000 mgd
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T10 SUM FOR D5	223.3 min
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Disinfection Zone: D6 Disinfectant: _____

Disinfection Zone: D7 **Disinfectant:** _____

Disinfection Zone: D8 Disinfectant:

Disinfection Zone: **D9** **Disinfectant:**

Disinfection Zone: D10 **Disinfectant:** _____

CT Study for the Wichita Falls Temporary DPR WTP

CT STUDY TEMPLATE

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: Temporary Direct Potable Reuse Water Treatment Plant Date: April 25, 2014

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	13 Mile Pipe from RRWWTP to Cypress WTP (1)	1,859,189	7.500	1	356.964	356.96
D2	MF/RO Flocc-Clarifier (1)	3,875,583	7.500	0.3	223.234	223.23
D3	36 Inch Raw Water Pipe (1)	13,221	7.500	1	2.538	5.89
	Micro-filtration Trough (1)	5,508	7.500	0.1	0.106	
	Micro-filtration Cells (1)	9,557	2.966	0.7	3.247	
D4	36 Inch Raw Water Pipe (1)	11,634	10.000	1	1.675	67.12
	Rapid Mix Basin (1)	4,848	10.000	0.1	0.070	
	30 Inch Raw Water Pipe (1)	3,122	10.000	1	0.450	
	2010 Clarifier (1)	926,521	10.000	0.3	40.026	
	Recarbonation Basin (1)	183,003	10.000	0.5	13.176	
D5	Gravity Filters (4)	29,088	2.500	0.7	11.728	223.30
	Clearwell/Transfer Pump Station (1)	109,102	10.000	0.5	7.855	
	10 MG Ground Storage Tank (1)	4,987,042	10.000	0.3	215.440	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

CT STUDY

CT Study for the Wichita Falls Temporary DPR WTP

CT STUDY TEMPLATE

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: _____ mporary Direct Potable Reuse Water Treatment Pl _____
PWS ID No.: _____ 2430001 _____ Date: _____ April 25, 2014 _____

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS			
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.966	10.000	10.000	2.0		5.0	
T ₁₀ (minutes)	357.0	223.2	5.9	67.1	223.3				

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 D1	1.0	7.500	12.0	7.5	357.0	1108.0	1604.5	0.64	1.11			
CLA D2	1.0	7.500	12.0	7.5	223.2	1108.0	1604.5	0.40	0.70			
CLA D3	1.0	2.966	12.0	7.5	5.9	1108.0	1604.5	0.01	0.02	3.01	5.20	1.04
CLA D4	3.5	10.000	12.0	9.0	234.9	1108.0	1604.5	0.42	0.73	(V)		
CLA D5	3.8	10.000	12.0	8.9	848.5	1108.0	1604.5	1.53	2.64			

SUBMITTED BY: _____ Certificate No. and Grade: _____ Date: _____
TCEQ - (05-01-13) _____ CT STUDY