Appendix A: Example CT Study Approval Letter

PWS_1234567_CO_2010325_CTSTUDY

Texas Commission on Environmental Quality
Protecting Texas by Reducing and Preventing Pollution

March 25, 2019

Mr. Robert Smith, Chief Operator
City of Everywhere
110 Main Street
Everywhere, Texas 19997

Subject: City of Everywhere Public Water System – PWS ID No. 1234567
Public Drinking Water System Concentration Time Study - Revision
Plant 2 Surface Water Treatment Plant – TP9999
ABC County, Texas
CN600543211; RN101777600

Dear Mr. Smith:

On March 1, 2019 the Texas Commission on Environmental Quality (TCEQ) received your submittal dated February 28, 2019, requesting a revised Concentration Time (CT) Study for the City of Everywhere, Plant 2 Surface Water Treatment Plant (SWTP), TCEQ Plant ID– TP9999. The revised CT Study is necessary for the addition of two racks of hollow fiber (HF) microfiltration (MF) membranes to Plant 2 at the City of Everywhere public water system (PWS) (TCEQ PWS ID No. 1234567). The PWS has procured and will install two racks of HF MF membranes downstream of the two clarifiers. The CT study is necessary to assess the disinfection process at the facility to ensure compliance with the disinfection requirements of the Surface Water Treatment Rule. **The information in this letter will replace, not supplement, all previous CT study approval letters for the City of Everywhere Plant 2 TP9999 SWTP and should be reflected on the PWS's Surface Water Monthly Operating Report-Alternative Technologies (SWMOR-ALT).**

The City of Everywhere Plant 2 SWTP has the capacity to treat 1.151 million gallons per day (MGD). Raw water from the approved source on Lake Good (TCEQ Source ID No. S1234567A) is conveyed to the SWTP. The raw water is piped to two (2) upflow solids contact clarifiers, followed by ten (10) gravity filters with granular activated carbon (GAC) media, this is for Total Organic Carbon (TOC) removal, a filter effluent sump and then to the two racks of HF MF membranes. The filtrate flows to two clearwells, a 0.12-million gallon (MG) and a 0.048-MG, which operate in parallel. Finally, the finished water is pumped into the distribution via the high service pump station.

The disinfection protocol involves the injection of chlorine (Cl_2) upstream of the clarifiers and in the filter effluent sump. The final disinfectant injection site, upstream of the 0.12-MG clearwell, are for Cl_2 and liquid ammonium sulfate (LAS) to form chloramines (CLA). Free chlorine residual is monitored in the settled water line, downstream of the gravity filters and in the filtrate line. Total chlorine residual will be monitored downstream of the clearwells, prior to entry into 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 application 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 four (4) disinfection zones at the City of Everywhere Plant 2 SWTP. The first disinfection zone, D1, consists of the two upflow solids contact clarifiers. The second disinfection zone, D2, consists of the 10 gravity filters with granular activated carbon (GAC) media. The next disinfection zone, D3, contains the filter effluent sump and the filtrate line. The final disinfection zone, D4, contains the 0.12-MG and 0.048-MG clearwells which operate in parallel.

Concentration Time (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 Everywhere Plant 2 SWTP. The T_{10} values are based on the information provided in your CT template dated February 28, 2019 and the most recent TCEQ-approved CT Study dated February 14, 2004.

TABLE 1: T_{10} TABLE FOR THE CITY OF EVERYWHERE SWTP CT STUDY

Disinfection Zone	Treatment Unit	Volume (Gal)	Flow Rate (MGD)	Baffling Factor	T_{10} (min)	
					Unit	Sum
D1	Upflow Solids Contact Clarifiers (2)	138,000[1]	0.575[8]	0.3[8]	103.913	103.91
D2	Gravity Filters (10)	2,600[2]	0.115[8]	0.7[9]	22.723	22.72
D3	Filter Effluent Sump	3,200[3]	1.151[7]	0.3[10]	1.214	1.56
	MF Filtrate Line	274[4]		1.0[11]	0.343	
D4	0.12 and 0.048 MG Clearwells	82,100[5]	1.151[7]	0.1[12]	10.283	10.28

Notes: The T_{10} values are based on the information provided in your CT template dated February 28, 2019 and the most recent TCEQ-approved CT Study dated February 14, 2004.

1. Based on a 34-foot by 34-foot solids contact upflow clarifier with a side water depth of 16 feet.
2. Based on a 6-foot by 6-foot gravity filter with a media depth of 3.75 feet, an underdrain of 1.25 feet and a minimum of water over media of 6.5 feet. A porosity of 50% is assumed.
3. Based on an 8-foot by 6-foot filter effluent sump with minimum operating level of 9 feet, 69%.
4. Based on 105 LF of 8-inch filtrate line.
5. Worst operating volume for each clearwell is based on the overflow pipe height, resulting in a 119,000-gallon and a 45,250-gallon clearwells, with a nominal operating capacity of 50%.
6. Based on even flow split between like treatment units.
7. Treatment capacity of the HF MF membranes, 1.151 MGD.
8. Based on the assumption of "poor" baffling characteristics for clarifiers.
9. Based on the assumption of "superior" baffling characteristics for a gravity filter.

10. Based on the assumption of "poor" baffling characteristics for storage tank top entry with 2.0-foot air gap.
11. Based on the assumption of "perfect" baffling characteristics for pipe.
12. Based on the assumption of "unbaffled" baffling characteristics for storage tank without baffles.

We have prepared Disinfection Process Parameters in Table 2 to help operators complete their Surface Water Monthly Operating Report-Alt (SWMOR-alt). We have also provided the operators with the disinfection requirements that they must meet on a continual basis. Based on Water systems using surface water or groundwater 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 provisions of the Surface Water Treatment Rule. **With pretreatment being applied upstream of the membranes (defined as coagulation, flocculation and clarification), the City of Everywhere Plant 2 SWTP (TP9999) must provide a 2.0-log inactivation of viruses through the disinfection process.**

TABLE 2: DISINFECTION PROCESS PARAMETERS

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivation	
	D1	D2	D3	D4	D5	Giardia	Viruses
Flow Rate (MGD)	0.575	0.115	1.151	1.151	NA	0.0	2.0
T_{10} (minutes)	104.0	22.7	1.6	10.3	NA		

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

https://www.tceq.texas.gov/drinkingwater/monitoring_plans

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

Please note that City of Everywhere Plant 2 SWTP (TP9999) is **required** to meet all of the process monitoring requirements found in Title 30 of the Texas Administrative Code (TAC) §290.42(e)(7), as well as the "*Chloramine Effectiveness*" monitoring requirements as per 30 TAC §290.110(C)(5).

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 Everywhere **PWS ID No.:** 1234567

PLANT NAME OR NUMBER: Plant 2 TP9999

Month: March
Day: 13
Year: 2019

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

The City of Everywhere SWTP will have the capacity to treat 1.15 million gallons per day (MGD). Raw water from the approved source on Lake Good (TCEQ Source ID No. S1234567A) is conveyed to the SWTP. The raw water is piped to two (2) upflow solids contact clarifier, followed by ten gravity filters with granular activated carbon (GAC) media for TOC removal, a filter effluent sump and then to the Hollow Fiber (HF) Microfiltration (MF)Membranes. The filtrate flows to two clearwells, 0.32 MG and 0.048 MG. Finally, the finished water is pumped into distribution via the high service pump station.

There are optional chlorine injection sites upstream of the clarifiers and filter effluent sump. Chlorine and Liquid Amminium Sulfate (LAS) are injected upstream of the clearwells. Chlorine residual is monitored downstream of the clarifers, filters and the membrane filtrate line . Total chlorine is monitored downstream of the clearwells, prior to entry to the distribution system.

City of Everywhere CT Study contains four (4) disinfection zones:

D1 contains the upflow solids contact clarifiers;
D2 consists of gravity filters with GAC media for TOC removal;
D3 encompasses the filter effluent sump and the filtrate line; and
D4 are the two clearwells (0.120-MG and 0.048-MG).

Reviewed By: TCEQ, WSD, TROT Staff

Submitted by: Mr. Robert Smith, Chief Operator, City of Everywhere

Contact Information: 915.555.4321

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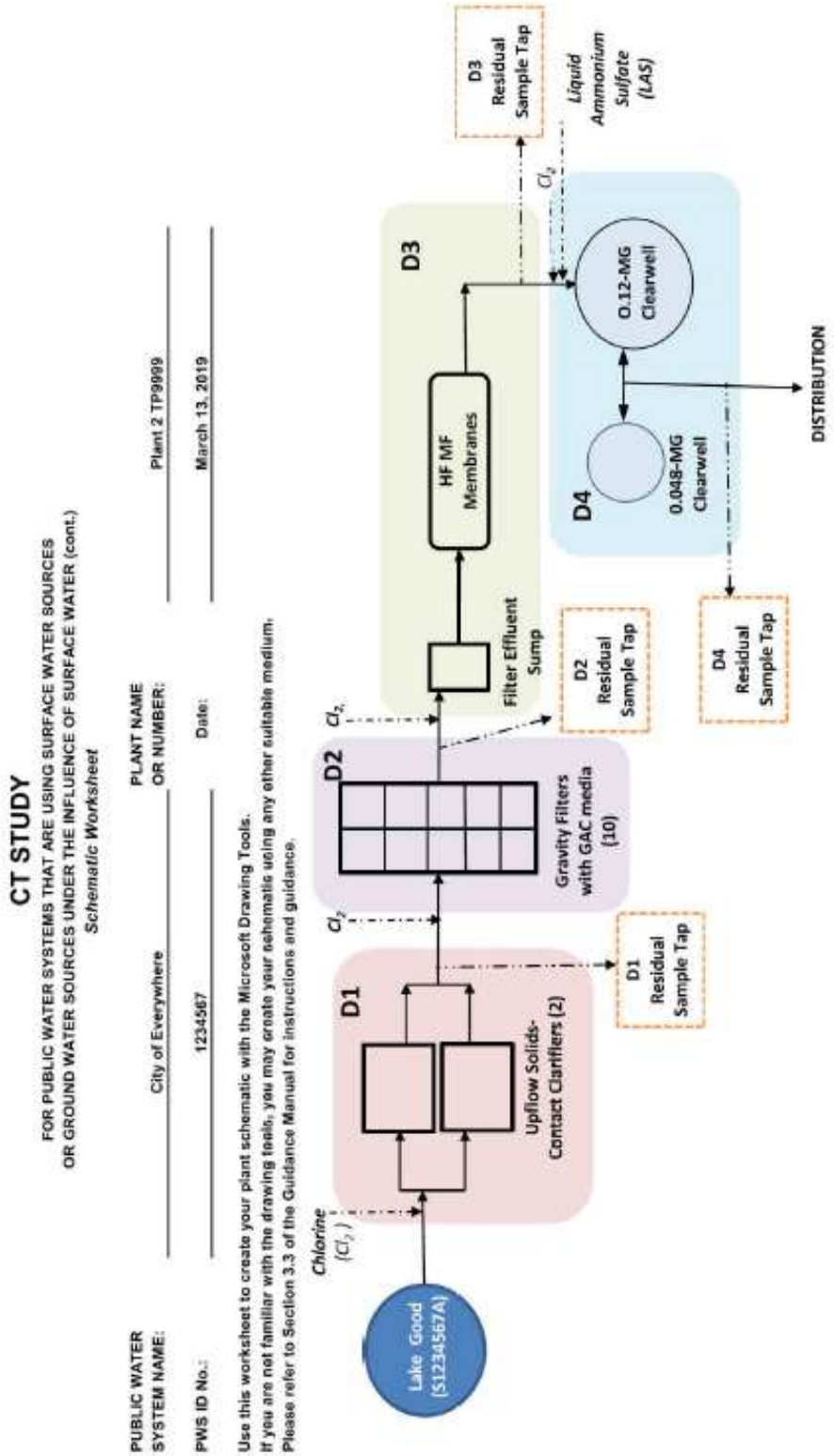
CT STUDY
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Schematic Worksheet
PUBLIC WATER SYSTEM NAME: City of Everywhere
PLANT NAME OR NUMBER: Plant 2 TP9999
PWS ID No.: 1234567
Date: March 13, 2019
Use this worksheet 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.
Chlorine (Cl_2)
Lake Good (S1234567A)
D1
Upflow Solids-Contact Clarifiers (2)
D1 Residual Sample Tap
Cl_2
D2
Gravity Filters with GAC media (10)
D2 Residual Sample Tap
Cl_2
D3
Filter Effluent Sump
HF MF Membranes
D3 Residual Sample Tap
Liquid Ammonium Sulfate (LAS)
Cl_2
D4
0.12-MG Clearwell
0.048-MG Clearwell
D4 Residual Sample Tap
DISTRIBUTION

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 Everywhere **PWS ID No.:** 1234567

PLANT NAME OR NUMBER: Plant 2 TP9999 **Date:** March 13, 2019

Treatment Plant Capacity 1.151 mgd / 799 gpm

Disinfection Zone: D1 **Disinfectant:** Free Chlorine

Unit - 1 Type: Clarifier Shape: Rectangular

Further Description: Upflow Clarifier

Characteristic			Comments
Number of Units	2		
Length	34	ft	Based on TCEQ approved CT Study dated 1/14/2004
Width	34	ft	
Side Water Depth	16	ft	
Volume (each)	138,378	gal	
Flow Rate (each)	400	gpm	Even flow split between like units;
Detention Time	346.2	min	
Baffling Factor	0.3		
			Baffling Characteristics: Poor
			Approved Baffling Factor:
T_{10}	**103.9**	**min**	
D1 FLOW RATE	**0.576**	**mgd**	
T10 SUM FOR D1	**103.9**	**min**	

Disinfection Zone: D2 **Disinfectant:** Free Chlorine

Unit - 1 Type: Filter Shape: Rectangular

Further Description: Gravity Filters with GAC media

Characteristic			Comments
Number of Units	10		
Length	6	ft	Based on TCEQ approved CT Study dated 1/14/2004
Width	6	ft	

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

Media Depth	3.75	ft	
Underdrain Depth	1.25	ft	
Minimum Water Depth Over Media	6.5	ft	
Average Porosity	50	%	Assumed
Volume (each)	2,592	gal	
Flow Rate (each)	80	gpm	even flow split between like units
Detention Time	32.4	min	
Baffling Factor	0.7		
			Baffling Characteristics: Superior
			Approved Baffling Factor:
T_{10}	**22.7**	**min**	
D2 FLOW RATE	**0.115**	**mgd**	
T10 SUM FOR D2	**22.7**	**min**	

Disinfection Zone: D3 **Disinfectant:** Free Chlorine

Unit - 1 Type: Transfer Well Shape: Rectangular

Further Description: Filter Effluent Sump

Characteristic			Comments
Number of Units	1		
Length	8	ft	Based on TCEQ approved CT Study dated 1/14/2004
Width	6	ft	
Side Water Depth	13.1	ft	
Maximum Volume (each)	4,704	gal	
Minimum Operating Level	9	ft	Minimum operating level
Worst Case Volume (each)	3,232	gal	
Percent of Maximum Volume	69	%	
Worst Case Volume (each)	3,232	gal	
Flow Rate (each)	799	gpm	Pall Mobile MF treatment plant capacity
Detention Time	4.0	min	
Baffling Factor	0.3		Top entry with a 2 ft air gap to the top of the water.
			Baffling Characteristics: Poor
			Approved Baffling Factor:
T_{10}	**1.2**	**min**	

Unit - 2 Type: Piping Shape: Pipe

Further Description: MF Filtrate Line

Characteristic		Comments
Number of Units	1	

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

Diameter	8	in	Based on CT Study submitted by Mr. Robert Smith, Chief Operator 2/28/2019
Length	105	ft	
Volume (each)	274	gal	
Flow Rate (each)	799	gpm	membrane treatment capacity
Detention Time	0.3	min	
Baffling Factor	1.0		
			Baffling Characteristics: Perfect
			Approved Baffling Factor:
T_{10}	**0.3**	**min**	
D3 FLOW RATE	**1.151**	**mgd**	
T10 SUM FOR D3	**1.6**	**min**	

Disinfection Zone: D4 **Disinfectant:** Chloramines

Unit - 1 Type: Clearwell Shape: Other

Further Description: 0.12-MG and 0.048-MG Cleawells

Characteristic			Comments
Number of Units	1		Using the overflow pipe as the top of the tanks, the large tank is 119000 gallons and the small tank 45,250 gallons.
Maximum Volume (each)	164,250	gal	Based on CT Study submitted by Mr. Robert Smith, Chief Operator 2/28/2019
Worst Case Volume (each)	82,125	gal	minimum operating level
Percent of Maximum Volume	50	%	
Worst Case Volume (each)	82,125	gal	
Flow Rate (each)	799	gpm	membrane treatment capacity
Detention Time	102.7	min	
Baffling Factor	0.1		
			Baffling Characteristics: Unbaffled
			Approved Baffling Factor:
T_{10}	**10.3**	**min**	
D4 FLOW RATE	**1.151**	**mgd**	
T10 SUM FOR D4	**10.3**	**min**	

Disinfection Zone: D5 **Disinfectant:**

Disinfection Zone: D6 **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 Everywhere **PWS ID No.:** 1234567

PLANT NAME OR NUMBER: Plant 2 TP9999 **Date:** March 13, 2019

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T_{10}* (min)	
					Unit	Zone
D1	Upflow Clarifier (2)	138,378	0.576	0.3	103.873	103.87
D2	Gravity Filters with GAC media (10)	2,592	0.115	0.7	22.703	22.70
D3	Filter Effluent Sump (1)	3,232	1.151	0.3	1.213	1.56
	MF Filtrate Line (1)	274	1.151	1	0.343	
D4	0.12-MG and 0.048-MG Clearwells (1)	82,125	1.151	0.1	10.274	10.27

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13) CT STUDY