



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
1300 7th Street
Wichita Falls, TX 76307

Re: City of Wichita Falls - Public Water System ID No. 2430001
Proposed Temporary DPR Decommissioning Report
Engineer Contact Telephone: (940) 761-7477
Plan Review Log No. P-06032015-031
Wichita County, Texas

CN600129316; RN105598759

Dear Mr. Garcia:

On June 3, 2015, the Texas Commission on Environmental Quality (TCEQ) received planning material with your letter dated May 29, 2015 for the Temporary Direct Potable Reuse (DPR) decommissioning report. Additional material was received on June 25, 2015. Based on our review, the project generally meets the minimum requirements of Title 30 Texas Administrative Code (TAC) Chapter 290 – Rules and Regulations for Public Water Systems and is **conditionally approved for decommissioning**. Please review the requirements for decommissioning below:

1. The exceptions granted in our May 13, 2015 letter are addressed individually below. The conditions in TCEQ's May 13, 2015 letter **will no longer apply to your PWS when the temporary DPR WTP is decommissioned**. Those exceptions that are necessary to operate the 2008 reverse osmosis (RO) plant and to use chloramines have been amended to remove mention of the River Road wastewater treatment plant (RRWWTP) effluent. The amended exception letters are attached.
 - a) The use of RRWWTP effluent in lieu of groundwater or surface water as a source of water for a public water system [30 TAC §290.41] is **no longer valid** when the temporary DPR WTP is decommissioned.
 - b) The use of the Temporary DPR WTP equipment and piping in the DPR configuration which includes common walls between areas carrying water in prior stages of treatment [30 TAC §290.42(d)(2)] is **no longer valid** when the temporary DPR WTP is decommissioned.
 - c) The use of pre-formed chloramines as a pre-disinfectant [30 TAC §290.42(e)(3)(G)] is **no longer valid** when the temporary DPR WTP is decommissioned.

- d) The use of chloramines [30 TAC §290.42(e)(3)(G)] as a disinfectant is **granted** and the conditions can be found in the attached letter.
 - e) The use of Micro-filtration (MF) membranes for removal of pathogens [30 TAC §290.42(g)(3)] is **granted** and the conditions can be found the attached letter.
 - f) The use of reverse osmosis (RO) membranes for the removal of primary and secondary drinking water chemical contaminants [30 TAC §290.42(g)] is **granted** and the conditions can be found in the attached letter.
 - g) Post-RO membrane pH adjustment [30 TAC §290.42(g)] is **no longer valid** when the temporary DPR WTP is decommissioned.
 - h) The use of ultraviolet light (UV) for pathogen removal [30 TAC §290.42(g)(5)] is **no longer valid** when the temporary DPR WTP is decommissioned. If the UV system will be reinstalled in the future, please submit an exception request and plans and specifications for the new location showing how the configuration compares to that of the approved validation study.
2. The CT studies for the Temporary DPR WTP and Cypress 2010 WTP provided with TCEQ's May 13, 2015 letter must be used to complete the temporary DPR WTP and Cypress 2010 WTP SWMOR-alt forms until the Temporary DPR WTP stops sending water to the distribution system.
3. After the facility is reconfigured, adequately disinfected, and begins producing potable water without RRWWTP effluent as a source, the attached revised CT studies must be used to complete the SWMORs for the Cypress 2010 WTP, Cypress 2008 RO WTP, Cypress 1987 WTP, and Cypress 1961 WTP. Please be sure to use the May 13, 2015 Cypress 2010 WTP CT study when in DPR mode, and the revised Cypress 2010 WTP CT study when in normal SWTP mode.

The submittal consisted of 12 sheets of engineering drawings, decommissioning report, engineering report and technical specifications. The approved project consists of:

- Decommissioning of the City of Wichita Falls Temporary DPR system and transition to normal operation of conventional (surface water) Water Treatment Plants

An appointed engineer must notify the TCEQ's Region Office 3 in Abilene at (915) 698-9674 when construction will start. **Please keep in mind that upon completion of the decommissioning project, the City must notify the Water Supply Division and the TCEQ Abilene Regional Office, in writing,** as to its completion and attest to the fact that the work has been completed essentially according to the plans and change orders on file with the commission as required in 30 TAC §290.39(h)(3).

Please refer to the Utilities Technical Review Team's Log No. **P-06032015-031** in all correspondence for this project. This will help complete our review and prevent it from being considered a new project.

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If you have any questions regarding this letter or need further assistance, please contact Mr. Joel Klumpp at (512) 239-4453 or by e-mail at joel.klumpp@tceq.texas.gov or Ms. Vera Poe, P.E., at (512) 239-6988 or by e-mail at vera.poe@tceq.texas.gov.

Sincerely,



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



Vera Poe, P.E., Team Leader
Utilities Technical Review Team
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality



Linda Brookins, Director
Water Supply Division
Office of Water
Texas Commission on Environmental Quality

LB/JPK/VP/cas/mew

Enclosures:

- Amended Exception letter for the use of chloramines dated July 17, 2015;
- Amended Exception letter for Micro-filtration (MF) and reverse osmosis (RO) membranes dated July 17, 2015;
- CT Study Letter for the Cypress Water Treatment Plant - 1961 Plant dated July 17, 2015;
- CT Study Letter for the Cypress Water Treatment Plant - 1987 Plant dated July 17, 2015;
- CT Study Letter for the Cypress Water Treatment Plant - RO Membrane Plant dated July 17, 2015;
- CT Study Letter for the Cypress 2010 Water Treatment Plant dated July 17, 2015;

cc: City of Wichita Falls, Attn: Honorable Glenn Barham, P.O. Box, 1431 Wichita Falls, TX 76307-1431
City of Wichita Falls, Attn: Mr. Darron Leiker, City Manager, 1300 7th Street, Wichita Falls, TX 76301
City of Wichita Falls, Attn: Daniel K. Nix, Utilities Operations Manager, P.O. Box 1431, Wichita Falls, Texas 76307-1431

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bcc: TCEQ Region No. 3 Office - Abilene (w/approved materials)
TCEQ PWSINV, MC-155



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
1300 7th Street
Wichita Falls, TX 76307

Subject: Request for an Exception to Use HF/RO Membranes
City of Wichita Falls - Public Water System ID No. 2430001
TCEQ Plant ID No. 21567 Cypress 2008 RO Membrane Plant
Wichita County, Texas

CN600129316: RN105598759

Dear Mr. Garcia:

On June 3, 2015, the Texas Commission on Environmental Quality (TCEQ) received your letter dated May 29, 2015, for the decommissioning of the Temporary Direct Potable Reuse (DPR) water treatment plant (WTP). Your letter also requested approval for reconfiguring the Cypress 2008 Reverse Osmosis (RO) Membrane Plant (TCEQ ID 21567) to treat raw Lake Kemp water as it did before the configuration as the Temporary DPR WTP. TCEQ had previously reviewed and approved the hollow-fiber (HF) microfiltration (MF) and RO membranes for the surface water treatment plant (SWTP). As stated in our rules and regulations, the use of HF MF and RO membranes is considered innovative technology under Title 30 of the Texas Administrative Code (30 TAC) §290.42(g). The TCEQ rules require staff to review the proposed use of the HF MF and RO membranes for the production of potable water as an exception under 30 TAC §290.39(l).

The information provided below is for the Cypress 2008 RO Membrane Plant (TCEQ ID 21567) treating water from Lake Kemp. This letter completely replaces TCEQ's previous HF/RO approval letters for this treatment plant.

MF MEMBRANES FOR PATHOGEN REMOVAL

Each membrane facility providing treatment for pathogen removal credit must receive the following TCEQ approvals prior to the production of drinking water. This letter addresses each item individually.

1. Approval of the exception to use the membranes;
2. Approval of direct integrity test (DIT) and LRV_{DIT} calculation methods; and
3. Approval of a challenge study if membranes are installed or replaced after April 1, 2012.

Based on our review, we are **granting** an exception for the use of Evoqua (formerly Siemens Memcor distributed by USFilter) S10V MF membrane modules in lieu of granular media filters under the operating parameters and conditions listed on the following pages.

I EVOQUA S10V MF MEMBRANE MODULES CAPACITY – WITH SEDIMENTATION

The TCEQ finds that the proposed operating parameters are acceptable to yield 4,277 gallons per day (GPD) of net filtrate water available for use by the City's customers at an instantaneous flux rate of 19.6 gallons per square-foot per day (gfd) at a temperature of 20° C, for a 300-sf membrane element with the following characteristics and under the following conditions:

- A conventional pretreatment train consisting of a raw water reservoir, flocculation, coagulation and clarification;
- An MF pressure driven membrane element with a total feed-side surface area of 300 square-feet (sf) per membrane fiber bundle;
- A nominal pore size of 0.2-micron;
- Maximum transmembrane pressure (TMP) of -12 pounds per square-inch (psi);
- Water temperature range of 10 to 40°C;
- pH tolerance range of 2 to 12;
- Five tanks containing 504 submerged MF membrane elements per tank;
- A maximum instantaneous flux rate of 19.6 gallons per square-foot per day (gfd) at 20 °C;
- Typically a three-minute backwash duration (nine minutes out of service) once every 30 minutes of run-time;
- Typically a 32-minute maintenance clean (45 minutes out of service) once per 24 hours of run-time; and
- A CIP procedure once every 720 hours of run-time;
- A total of approximately 1,071 minutes per day in filtrate mode and 369 minutes per day in backwash and maintenance clean activities; and
- A gross filtrate production of 4,375 GPD per module and an in-plant use of filtrate of 98 GPD to yield a net filtrate of 4,277 GPD per 300-sf module at 20° C available for customer use.

Based on the new module's surface area and the previously approved flux rate, the TCEQ would calculate a capacity of 10.8 MGD for the HF MF membrane portion of the SWTP design using 504 Evoqua S10V MF membrane modules per train and 5 trains.

The TCEQ issues a net capacity rating for MF membrane facilities based on an instantaneous filtrate flux corrected to 20° C. This rating is determined by subtracting the total in-plant use of produced filtrate (such as backwashing the membranes, any "maintenance cleans", EFM, "mini CIP", CEB, soaks, or any other in-plant use) from the gross potential filtrate production when a membrane unit is actually in service for a 24-hour period of operation. The TCEQ understands that an increase in membrane feed water temperature normally results in an increase in the filtrate flux rate and a corresponding increase in potable water available for customer use. A decrease in water temperature will result in a reduction of the filtrate flux rate and a corresponding decrease in potable water available for customer use. This seasonal increase and decrease of water temperatures correspond to the accepted increase of summer and decrease of winter customer demands.

This increased production shall have TCEQ approval provided it does not exceed a temperature corrected filtrate flux rate based on the following calculation:

$$\text{filtrate flux}_{\text{at feed water temperature}} = \frac{(\text{filtrate flux}_{\text{at } 20^{\circ}\text{C}})}{[1.784 - (0.0757 * T) + (0.0011 * T^2) - (10^{-5} * T^3)]}$$

Where T is the MF membranes' feed water temperature in degrees centigrade (°C), and filtrate flux at 20°C is 19.6 gfd.

II EVOQUA S10V DIT RESOLUTION AND LRV_{DIT} SENSITIVITY CALCULATIONS

To comply with TCEQ rules and federal requirements, water treatment plants that use membranes for pathogen removal credit must submit a Surface Water Monthly Operating Report for Plants using Alternative Technologies (SWMOR-Alt) each month. This form, TCEQ Form 0102D, is an Excel® spreadsheet that must be customized based on site-specific design and operational conditions. When they create the customized SWMOR-Alt for WTP, the operators will need to enter the approved DIT parameters. The spreadsheet will use this information to compare the actual test conditions with the approved conditions and determine if the membrane units are continuing to meet minimum performance requirements.

To help the operators customize their SWMOR-Alt, we have prepared Table 1 which shows the approved minimum initial test pressure (P_{test} , or P_{initial}); the Upper Control Limit (UCL), which is the maximum allowable pressure decay rate allowed during a DIT; and the Log Removal Credit (LRC) that TCEQ has approved for the membrane units at the plant. The DIT parameters for the Cypress 2008 RO Membrane Plant (No. 21567) using Evoqua (formerly Siemens Memcor distributed by USFilter) S10V MF membrane are as follows.

**TABLE 1: DIT PARAMETERS FOR THE
CYPRESS 2008 RO MEMBRANE PLANT (No. 21567)**

Initial Test Pressure (P_{test}) (psi)	Log Removal Credit (LRC) (log)	Upper Control Limit (UCL) (psi/min)
16.5	3.0	0.98

(1) Based on the data and calculations shown in Attachments 1.

Please note that the DIT must be performed for a time period where the UCL (0.98 psi/min) can be detected. For example, with a P_{test} of 16.5 psi and UCL of 0.98 psi/min the test must be conducted for **less than 16.8 minutes** to be able to detect 0.98 psi/min pressure decay. This is because all pressure could be lost at 16.83 minutes if the decay rate was at the UCL. Therefore, for any test duration greater than 16.8 minutes where all pressure is lost, the calculated rate of pressure decay would be incorrect (it would show compliance with the UCL when a failure had actually occurred).

Based on the plant's special source water monitoring results, the Cypress 2008 RO Membrane Plant (No. 21567) has been classified as a Bin 1 facility. For a water system classified as a Bin 1 facility, the operators must conduct a DIT on each membrane unit, or rack, at least once every seven (7) days that the unit treats any water.

III CHALLENGE STUDY

In accordance with 30 TAC §290.42(g)(3), for membrane systems used for microbiological treatment, the level of removal credit granted for *Cryptosporidium* and *Giardia* shall not exceed the lower of:

- o the removal efficiency demonstrated during challenge testing conducted under the conditions specified in Title 40 of the Code of Federal Regulations §141.719(b)(2), or
- o the maximum removal efficiency that can be verified through direct integrity testing used with the membrane filtration process under the conditions specified in 30 TAC §290.42(g)(3)(B).

Because the source water is Bin 1 source water and the membranes were installed before April 1, 2012, the 3.0-log removal credit for *Cryptosporidium* and *Giardia* is now based on the direct integrity test parameters approved in this letter. The previously granted 2.8-log credit only applied to the temporary direct potable reuse water treatment plant which included the use of the Cypress 2008 RO Membrane Plant MF membranes.

IV CONDITIONS OF APPROVED EXCEPTION FOR THE USE OF MF MEMBRANES

1. To comply with TCEQ rules and federal requirements, water treatment plants that use membranes for pathogen removal credit must conduct periodic DITs to verify the removal efficiency of the membrane treatment process. These plants must also submit a monthly operating report designed specifically for plants that use alternative technologies such as membrane filters. This form, TCEQ -00102D, is called the Surface Water Monthly Operating Report SWMOR-ALT version 15 for plants using membrane treatment. The spreadsheet has been released and is available at:

<http://www.tceq.texas.gov/drinkingwater/swmor/swmor/swmor-forms-and-instructions#form-alt>.
2. Approval from the TCEQ will be necessary prior to the use of any raw water source(s) other than Lake Kemp. If the City desires to use water from a source other than Lake Kemp, an additional pilot study needs to be initiated using water from the alternate source(s).
3. Indirect integrity monitoring of each unit's filtrate turbidity levels must be continuously monitored and recorded at least once every five minutes using the HACH FilterTrak Method No. 10133, approved by the U.S. Environment Protection Agency. Please contact TCEQ if particle counters or monitors will be used instead of turbidimeters.
4. As stated in 290.42(g)(3)(F), membrane systems must be designed so that membrane units' feed water, filtrate, backwash supply, waste and chemical cleaning piping shall have cross-connection protection to prevent chemicals from all chemical cleaning processes from contaminating other membrane units in other models of operations. This may be accomplished by the installation of a three-valve block and bleed arrangement, a removable spool system or other alternative methods approved by the executive director.
5. A direct integrity test (DIT) must be conducted:
 - a) Once every 7-days based on the Bin 1 classification for this plant, as determined by the results of the source water monitoring for *Cryptosporidium*, and as required by 30 TAC §290.111(f)(2)(D)(iii);

- b) After every CIP procedure;
 - c) On any membrane unit that produces water with a turbidity level above 0.15 NTU on two consecutive readings as required by 30 TAC §290.111(f)(2)(D)(v); and
 - d) In accordance with the requirements in 30 TAC §290.42(g)(3)(B).
6. Membrane units that fail a DIT cannot produce water until the defective unit is inspected and repaired, and then subsequently passes the DIT as required in 30 TAC §290.111(f)(2)(D)(vi).
7. Pressure monitors used for DIT measurements shall be calibrated or verified at least once every 12 months.
8. Combined filter effluent and individual filter effluent must be monitored in accordance with 30 TAC §290.111(f)(2).
9. A turbidity level exceeding 1.0 NTU in the combined filter effluent of membrane filters will result in an acute treatment technique violation as specified in 30 TAC §290.111(i)(4).
10. In accordance with 30 TAC §290.42(j), all treatment chemicals and media used in the full-scale facility must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 60 for direct additives and ANSI/NSF Standard 61 for indirect additives and must be certified by an organization accredited by ANSI. This includes coagulants, disinfectants, acids, caustics, citric acid, and other membrane cleaning chemicals.
11. As required by 30 TAC §290.46(e)(6), the membrane filtration facilities must be operated and maintained at all times under the direct supervision of an operator with a Class "C" or higher surface water license. The qualified operator must be present anytime:
- a) The membrane elements are replaced and/or repairs are made to the membrane unit;
 - b) A CIP is performed;
 - c) A direct integrity test is performed;
 - d) Changes are made to the treatment process; or,
 - e) The membrane units' operating parameters are changed.
12. A qualified operator must be present at the membrane facility whenever water is being treated unless the membrane plant is provided with continuous monitors, alarms, and shutdowns. Specifically, the water system must provide:
- a) An alarm system maintained to summon the operators in the event of an apparent degradation in filtrate quality. The alarm must summon the operators if an individual turbidimeter has two consecutive readings above 100 mNTU (0.10 NTU).
 - b) Controls to automatically take a membrane rack out of service if the turbidity level for the rack rises above 0.15 NTU for two consecutive readings.

RO MEMBRANE USE FOR CHEMICAL REMOVAL

The RO system is comprised of 6 units with a two-stage single-pass RO process. Currently, the plant uses 40-inch (in length) Hydranautics RO elements with an **average unit flux rate of 14.9 gallons** per square-foot per day (gfd). Based on our review, we are **granting** an exception for the use of the RO membrane modules under the operating parameters and conditions listed on the following pages.

- 1) All media including RO elements, and cartridge filters must be American National Standards Institute/NSF International (ANSI/NSF) Standard 61 certified.
- 2) The RO elements must be operated within the allowable operating parameters defined by the manufacturer.
- 3) The RO elements must be cleaned or replaced when fouling causes either: a) loss of water output, b) operation of equipment outside the allowable limits of the manufacturer, or c) failure to meet the State's water quality standards.

The membrane system shall be cleaned, or replaced, in accordance with the allowable operating conditions of the manufacturer and shall be based on one or more of the following: increased salt passage, increased or decreased pressure differential, and/or change in normalized permeate flow.

- 4) The system will provide an onsite cleaning system where the elements can be removed and cleaned as needed. The system must maintain records of each cleaning process including the date, duration, and procedure used for each event for two years.
- 5) The RO filtration facilities must be operated and maintained at all times under the direct supervision of an operator with a Class "C", or higher, license as required by TCEQ rules. The qualified operator must be present anytime:
 - a) the RO elements are replaced and/or any repairs are made to the RO unit;
 - b) anytime changes are made to the treatment process; and,
 - c) anytime the RO units' operating parameters are changed.

Please be aware that TCEQ's Commissioners approved a rule package on July 1, 2015 that includes the requirement for PWS that use RO to have an operator that has successfully completed at least one executive director-approved training course or event specific to the operations and maintenance of reverse osmosis or nanofiltration membrane treatment by September 1, 2016.

- 6) The water system must ensure that the operator has been trained regarding the use of all chemicals at the facility (see 30 TAC §290.46(e)(2)(B)). The training programs must meet applicable standards established by the Occupational Safety and Health Administration or the Texas Hazard Communication Act, Texas Health and Safety Code, Title 6, Chapter 502.
- 7) All treatment chemicals and media, including cartridge filters, used in the full-scale facility must conform to ANSI/NSF Standard 60 for Drinking Water Treatment Chemicals or ANSI/NSF Standard 61 for Drinking Water System Components and be certified by an organization accredited by ANSI (30 TAC §290.42(j)).
- 8) Chemical storage and chemical feed facility must meet the standards in 290.42(f)(1) and (2).
- 9) The RO membrane system must be designed so that feed water, cleaning chemicals, RO concentrate, and RO permeate are protected from cross-connections during other modes of operation.
- 10) The pipes and pipe galleries shall meet the minimum requirements specified in 290.42(d)(12) and (13).

- 11) The RO membrane system shall be equipped to measure conductivity or total dissolved solids in the feed and permeate water.
- 12) The water system must provide pressure measuring and recording devices before and after each membrane stage.
- 13) Flow meters on the feed, permeate, and concentrate water must be provided. Metering devices shall be located to facilitate use and to assist in the determination of chemical dosages, the accumulation of water production data, and the operation of plant facilities.
- 14) The water system must provide equipment to monitor the temperature of the water. The temperature of the water must be measured using a thermometer or thermocouple with a minimum accuracy of plus or minus 0.5 degrees Celsius.
- 15) The system must monitor the conductivity (or total dissolved solids) of the feed and permeate water once per day.
- 16) The system must record the amount of water treated each week.
- 17) Conductivity (or total dissolved solids) monitors and pressure instruments used for reverse osmosis membrane systems shall be calibrated at least once every 12 months.
- 18) Flow measuring devices and rate-of-flow controllers that are required by this exception shall be calibrated at least once every 12 months.
- 19) Any temperature monitoring devices used for reverse osmosis shall be verified and calibrated in accordance with the manufacturer's specifications.
- 20) A plant operations manual is required by 290.42(l). In addition to the items listed, the manual must also include the system's configuration, baseline performance data, and any set point for membrane cleaning or replacement.
- 21) Treatment effectiveness monitoring records must be kept for 3 years. Treatment effectiveness monitoring includes the parameters for determining when maintenance is required. Examples of parameters to be monitored include conductivity (or total dissolved solids), transmembrane pressure differential, flow, flux, and water temperature.
- 22) The production capacity of a reverse osmosis or nanofiltration membrane system shall be the quantity of permeate water after post-treatment that can be delivered to the distribution system. The amount available for customer use must consider:
 - a) the quantity of feed water discharged to waste;
 - b) the quantity of bypass water used for blending;
 - c) the quantity of permeate water used for cleaning and maintenance; and
 - d) any other loss of raw water or groundwater available for use due to other processes at the reverse osmosis or nanofiltration facility.
- 23) All waste discharge must be in accordance with federal and state requirements as described in 30 TAC §290.42(i). Your submittal states that you will use evaporation lagoons with periodic withdrawal and disposal by a contractor.

Mr. Shawn M. Garcia, P.E.
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All exceptions are subject to periodic review and may be revoked or amended if warranted. All conditions contained in this letter for granted exceptions are site specific design, operation, maintenance, and reporting requirements for the City's membrane filtration SWTP as specified in 30 TAC §290.39(l)(4). Failure by the City to comply with these conditions will result in the City being in noncompliance with TCEQ's minimum requirements.

Also, if the TCEQ Regional staff determines during their on-site inspections that the membranes are causing degradation of the finished water quality or the plant's ability to meet the customers' quantity demands, the applicable exception, or exceptions, will be revoked or revised.

If you have any questions concerning our evaluation of the exception request, or if we may be of further assistance, please contact me at the letterhead address, by email at marlo.berg@tceq.texas.gov or by phone at (512) 239-6967.

Sincerely,



Joel Klumpp, Manager
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

JPK/mew

Enclosures: Attachment 1: Direct Integrity Test Parameter Calculations

cc: City of Wichita Falls, Attn: Honorable Glenn Barham, P.O. Box, 1431 Wichita Falls, TX 76307-1431
City of Wichita Falls, Attn: Mr. Darron Leiker, City Manager, 1300 7th Street, Wichita Falls, TX 76301
City of Wichita Falls, Attn: Daniel K. Nix, Utilities Operations Manager, P.O. Box 1431, Wichita Falls, Texas 76307-1431
Mr. Mark Southard, Water Superintendent, City of Wichita Falls, P.O. Box 1431, Wichita Falls, TX 76307-1431

Mr. Shawn M. Garcia, P.E.

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July 17, 2015

bcc: TCEQ Abilene Region - R3
TCEQ Tracer Study File
Mr. Donald Hunter, TCEQ DWQT, MC 155

Attachment 1: Direct Integrity Test Parameter Calculations

City Of Wichita Falls **Cypress 2008 RO Membrane Plant**

Direct Integrity Test (DIT) Resolution and Sensitivity Calculations:

Title 30 of Texas Administrative Code (TAC) §290.42(G)(3)(B) was amended in January 2008 to require removal credit awarded to a membrane filtration system to be based on the lower of either the log removal value (LRV) proven by a direct integrity test (LRV_{DIT}) or the log removal value proven by a challenge study (LRV_{C-Test}). The regulations describe the resolution and sensitivity requirements for the Direct Integrity Test (DIT). The values used in these calculations are required for the TCEQ to approve removal credits for the Cypress 2008 RO Membrane Plant, which includes Evoqua (formerly Siemens Memcor distributed by USFilter) S10V MF membrane system consisting of five microfiltration cells containing 504 modules each.

In accordance with the requirements in 30 TAC §290.42(G)(3)(B), detailed descriptions of the calculation methods and values for the DIT performed during the pilot study were provided. All formulas and methods of calculation are from the US EPA *Membrane Filtration Guidance Manual* (Guidance Manual) and are in accordance with the DIT requirements of 40 Code of Federal Regulations (CFR) §141.719(b)(3). To receive removal credit for *Cryptosporidium parvum* removal, the DIT procedure must be conducted at a pressure high enough to detect a 3-micron breach in the membrane. **Based on our review of the calculations and data submitted, TCEQ accepts the following values for DITs performed on the membrane system at Cypress 2008 RO Membrane Plant.**

Approved Initial Test Pressure (P_{test} or $P_{initial}$) for the Cypress 2008 RO Membrane Plant

1. The TCEQ accepts 16.5 psi as the Minimum Test Pressure (P_{test}).

The approved minimum P_{test} is based on the following equation:

$$\text{Equation 4.1 (for a 3.0 micron defect): } P_{test} = (0.193 * \kappa * \sigma * \cos(\theta) + BP_{max})$$

where: κ = the membrane specific pore shape correction factor
= 1.0;

σ = the surface tension at the air-liquid interface
= 74.9 dynes/centimeter;

θ = the liquid-membrane contact angle
= 0 degrees; and

BP_{max} = the maximum back pressure on the system
= 2.0 pounds per square inch (psi).

The TCEQ accepts the use of the most conservative values for κ , σ , and θ (as described above) and the $BP_{(max)}$ provided by the membrane vendor.

Please note that the plant may conduct its DIT's at any pressure that is greater than or equal to the approved minimum test pressure shown above.

Approved Upper Control Limit (UCL) for the Cypress 2008 RO Membrane Plant**2. The TCEQ approves the use of an upper control limit (UCL) of 0.98psi/min.**

The approved UCL is maximum allowable pressure decay rate during a DIT and based on the following equation from the Guidance Manual:

$$\text{Equation 4.17: Upper control limit (UCL)} = (Q_p \times \text{ALCR} \times P_{\text{atm}}) / (10^{\text{LRC}} \times V_{\text{sys}} \times \text{VCF})$$

where: Q_p = the design capacity filtrate flow, calculated as shown below
= 7,798 liters per minute (L/min);

ALCR = the air-liquid conversion ratio, calculated as shown below
= 40.23;

P_{atm} = the absolute atmospheric pressure
= 14.7 psia;

LRC = the log removal credit demonstrated by the DIT
= 3.0;

V_{sys} = the volume of pressurized air in the system during a DIT,
as discussed below
= 3,122 L; and

VCF = the volumetric concentration factor, as discussed below
= 1.5

a. The TCEQ accepts 7,798 L/min as the Q_p .

The approved Q_p is based on information provided by the approved TCEQ pilot study dated August 5, 2002, and on the following equation.

$$\text{Maximum flow rate } (Q_p) = j \times A_m \times N$$

where: j = maximum approved flux, based on the approved pilot study
= 19.60 gallons per day per square foot (gpd/ft²);

A_m = the total surface area of the membrane fibers in each membrane module, per the manufacturer specifications
= 300.3 ft²;

N = number of membrane modules in a single membrane unit,
or cell, based on the approved pilot study
= 504;

b. The TCEQ accepts the use of 40.23 as the ALCR;

The approved minimum ALCR is based on the Darcy Pipe Flow Model assuming turbulent flow such as from a broken hollow fiber (as defined in the Guidance Manual) and the following equation from the Guidance Manual:

$$\text{Equation C.4: ALCR} = 170 \times Y \times \{(P_{\text{test}} - \text{BP}) \times (P_{\text{test}} + P_{\text{atm}}) / (460 + T) \times \text{TMP}\}^{1/2}$$

where: Y = Net expansion factor for compressible flow through pipe to
a larger area

= 0.910 (from Appendix C, Equation C.5
in the Membrane Filtration Guidance Manual)

P_{test} = minimum initial test pressure for the DIT
= 16.5 psi;

P_{atm} = 14.7 psia;

BP = 2.0 psi;

T = Temperature
= 95°F (35°C);

TMP = Transmembrane pressure
= 12.0 psi maximum (per manufacturer)

c. The TCEQ accepts 3,122 L as the V_{sys} .

The approved V_{sys} is based on the value provided by the membrane manufacturer.

d. The TCEQ is approving a VCF of 1.5.

Although the submerged membrane system operates in a particle deposition mode, site-specific investigations have demonstrated that VCF values for the submerged tanks vary with time and position. In lieu of a site-specific VCF study, the TCEQ will accept a VCF of 1.5 as a sufficiently conservative estimate.



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
1300 7th Street
Wichita Falls, TX 76307

Re: City of Wichita Falls - PWS ID No. 2430001
Review of the Use of Chloramines
Wichita County, Texas

RN 105598759 | CN 600129316

Dear Mr. Garcia,

On June 3, 2015, the Texas Commission on Environmental Quality (TCEQ) received your letter, dated March 29, 2015, notifying the TCEQ that the City of Wichita Falls is decommissioning the temporary direct potable reuse water treatment plant. The City of Wichita Falls will continue to utilize water treatment plants that have surface water to which they add chlorine and ammonia. Because of this, it is necessary for the City to be issued an updated chloramines exception letter with the current monitoring requirements. Regulations in Title 30 of the Texas Administrative Code (30 TAC) §290.42(e)(3)(G) require that the use of chloramines be reviewed by TCEQ on a case-by-case basis. Based on our review of the information submitted, we are **granting** the use of chloramines as a disinfectant under the following conditions. **This exception will remain in place until July 30, 2015** when the amended 30 TAC 290 rules which includes the chloramine monitoring, notification, design and the other conditions in this letter will be effective.

- 1) **Notification:** We note that the City of Wichita Falls has been distributing chloraminated water for several years. Consequently, public notice of the use of chloramines will be required only for **new** customers. Each of the City of Wichita Falls' new customers, both retail and wholesale, must be notified of the use of chloramine disinfectant prior to providing this treated water to its customers at least 14 days before the water is delivered. This notification must contain the exact wording included in Enclosure 1 of this letter: *Sample Language for Notification Upon Changing from Free Chlorine to Chloramines*.
- 2) **Distribution Residual:** Please note that the minimum distribution residual shall be maintained at 0.5 mg/L chloramine residual (measured as total chlorine) throughout the distribution system, including the far reaches of the distribution system, at all times, as specified in 30 TAC §290.110. When using free chlorine to shock the system, maintain a free chlorine residual of at least 0.2 mg/L.

- 3) **Periodic testing:** Monochloramine, total chlorine, free ammonia, and nitrite/nitrate levels need to be tested periodically to ensure that an adequate disinfectant residual is being maintained and that nitrification is not occurring in the distribution system. Nitrification can result in loss of residual, regrowth of bacteria, odor problems, and elevated nitrate/nitrite levels. Consequently, systems using chloramines must meet the following requirements as a condition of the exception:

The plant must obtain a test kit(s) or use a laboratory procedure that can measure the following:

- a) Free Ammonia—Acceptable analytical methods are EPA 350.1 and SM 4500-NH₃-G.
- b) Monochloramine—The kit or procedure must have the ability to distinguish between monochloramine and other forms of total chlorine using methods SM4500-Cl-D, -F, or -G.
- c) Total Chlorine—Standard methods 4500-CL D, E, F, and EPA method 334 are acceptable total chlorine analytical methods.
- d) Free Chlorine—The water system must have the ability to measure free chlorine when the water system switches from chloramines to free chlorine during a “burnout.” See 30 TAC §290.110 for acceptable analytical methods.
- e) Nitrite/Nitrate—You must either obtain a kit for measuring nitrite and nitrate OR identify a laboratory that can perform nitrite and nitrate analysis and can provide you with results within 48 hours of sample delivery. Acceptable analytical methods are EPA 300.0, 300.1 and SM 4110 B.

The water system must, at a minimum, measure and record the following^a:

	At Entry Point(s) to the Distribution System	In the Distribution System	Downstream of any Chlorine or Ammonia Injection Points
Free Ammonia	Weekly	At least weekly ^b	Weekly and before and after adjusting the chlorine or ammonia feed rate
Mono- chloramine	Weekly	At least weekly ^b	Weekly and before and after adjusting the chlorine or ammonia feed rate
Total Chlorine	Weekly	Daily ^c	Weekly and before and after adjusting the chlorine or ammonia feed rate
Nitrite and Nitrate	As needed to set baseline, then quarterly	At least quarterly, and in response to action level triggers	Routine sampling not required

- a. If levels are below disinfectant Action Levels, or over nitrite/nitrate or other Base Line levels, more frequent monitoring will be needed.
- b. When collecting a routine sample such as a bacteriological or disinfectant residual sample. The free ammonia and monochloramine should be measured at the same time.
- c. Total chlorine must be collected daily based on the system size of 49,082 connections at locations representing the entire distribution system in accordance with 30 TAC §290.110.

- 4) **Nitrification action plan:** You must set system-specific action levels to detect and prevent nitrification. If concentrations are inconsistent with system-specific action levels, corrective action shall be taken. For examples of corrective actions, please see Enclosure 2: *Nitrification Action Plan*. You must document in writing the system-specific plan for monitoring free

ammonia, monochloramine, total chlorine, and nitrite/nitrate; and the levels for taking corrective action. This information shall be maintained as a part of the systems monitoring plan [30 TAC §290.121] and provided to operators and to the TCEQ upon request.

Additional information is available on the TCEQ web page, ***Controlling Nitrification in Chloraminating Water Systems:***

www.tceq.texas.gov/drinkingwater/disinfection/nitrification.html

Note that this exception requires increased monitoring for nitrite and nitrate in addition to the compliance sampling required at entry points by 30 TAC §290.106. Entry point samples collected for compliance with 30 TAC §290.106 must not exceed the health-based maximum contaminant levels (MCLs) for nitrite and nitrate of 1 mg/L and 10 mg/L, respectively. Samples taken for managing chloramination treatment are not considered in determining compliance, but levels over the MCLs are a concern, and may indicate extreme nitrification, cross connection, or backflow. Determine and remediate the cause of high levels immediately.

- 5) **Record retention:** Records of monochloramine, total chlorine, ammonia, nitrite, and nitrate monitoring described above must be maintained with the system's disinfectant records for a period of three years and made available to the TCEQ staff upon request as specified in 30 TAC §290.46(f)(3)(B).
- 6) **Notification of reversion to free chlorine:** The TCEQ monitors disinfection byproduct (DBP) levels at all public water systems. The City may find that it needs to revert back to free chlorine periodically to control the levels of nitrifying bacteria in its distribution system. This reversion process, if accomplished in a month or less, does not reflect normal operating conditions and may result in temporary increases in DBP levels. Consequently, the TCEQ may adjust a system's DBP monitoring schedule during these events. To ensure that DBP samples are not collected under abnormal operating conditions, you must notify us of any temporary reversion back to free chlorine. These notices should be issued in the following manner:
 - a) The notice should state the date that the system will begin distributing water with a free chlorine residual as well as the anticipated duration of the event.
 - b) The notice to TCEQ should be sent via email to DBP@tceq.texas.gov, and may also be sent by fax to (512) 239-6050, phone at (512) 239-4691, or correspondence to:

Drinking Water Quality Team (MC 155)
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Public water systems that wholesale chloraminated water are required to notify wholesale customers in writing or via fax that they are temporarily switching to free chlorine at least 14 days before the reversion begins.

- 7) **Design Requirements for Chloramine Feed Facilities:** Chloramine disinfection shall be performed in a manner which assures that the proper chlorine to ammonia (as nitrogen) ratio is achieved in order to maintain a monochloramine residual and limit nitrification.
 - a) The order of chlorine and ammonia injection must be accomplished the following manner.

- i) When chlorine is injected upstream of any other disinfectant, the ammonia injection point must be downstream of the chlorine injection point.
 - ii) When chlorine and ammonia are added to distribution water that has a chloramine residual, ammonia should be added first.
 - iii) When chlorine and ammonia are added to distribution water that has a free chlorine residual, chlorine should be added first.
 - b) Mixing shall be provided to disperse chemicals. This may be accomplished by a static in-line mixer, or by at least five minutes of detention time in turbulent flow.
 - c) Sampling taps must be provided at locations that allow for chlorine and ammonia to be added to the water to form monochloramine as the primary chloramine species. These locations must be listed in the system's monitoring plan as described in §290.121 of this title (relating to Monitoring Plans). Sample taps must be provided as follows:
 - i) upstream of the chlorine or ammonia chemical injection point, whichever is furthest upstream; and
 - ii) at a point after mixing to be able to measure fully-formed monochloramine levels.
 - d) All chemical storage and feed facilities must comply with 30 TAC §§290.42(f)(1) & (2). Feed pump(s) and chemical storage tank(s) must be sized to meet chemical feed and storage capacity requirements.
 - e) All chemicals used must be certified under American National Standards Institute/NSF International (ANSI/NSF) Standard 60. This is consistent with the requirement that all chemicals used in the treatment of water supplied by public water systems must conform to ANSI/NSF Standard 60 for Drinking Water Treatment Chemicals.
- 8) **Plans and Specifications:** Engineering plans and specifications for the chlorine and ammonia feed and storage infrastructure currently in place and/or for the reference proposed project are not required to be submitted to the TCEQ's Utilities Technical Review Team (MC 159) for review and approval prior to construction as specified in 30 TAC §290.39(j)(1)(A).

Engineering plans and specifications that show compliance with the 30 TAC Chapter 290 rules and the conditions of this letter will be required to be submitted and approved for all future chlorine or ammonia feed and storage facilities.

- 9) **Blending chloraminated and chlorinated water in distribution:** We note that your system currently only has chloraminated sources. If you plan to blend chloraminated and chlorinated sources in the future, this will be a concern, because the ratio of chlorine to ammonia-nitrogen ($\text{Cl}_2:\text{NH}_4\text{-N}$) can be out of control. An off-balance chlorine to ammonia-nitrogen ratio may lead to the formation of dichloramine and trichloramine, which can cause odor complaints and loss of residual with potential violations.

If the water system proposes to blend chloraminated and chlorinated water in the future, the system must request a revised exception for the use of chloramines.

Mr. Shawn M. Garcia, P.E.

Page 5 of 5

July 17, 2015

All exceptions are subject to periodic review and may be revoked or amended if warranted. A copy of this letter and all related monitoring data must be maintained with the water system's records for as long as this exception is in effect. These records must be made available to TCEQ staff upon request.

Please note that this exception is not intended to waive compliance with any other TCEQ requirement in 30 TAC Chapter 290. This exception cannot be used as a defense in any enforcement action resulting from noncompliance with any other requirement of 30 TAC Chapter 290.

The TCEQ has approved the adoption of rules that include the requirements for chloramination in 30 TAC Chapter 290. Please see rule number 2013-046-290-OW at www.tceq.texas.gov/rules for more information.

If you have questions concerning this letter, or if we can be of additional assistance, please contact Ms. Marlo Wanielista Berg, P.E., by e-mail at marlo.berg@tceq.texas.gov, or by telephone at (512) 239-6967, or by correspondence at the following address:

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

Sincerely,



Tamira Konkin-Garcia, Team Leader
Technical Review & Oversight Team
Plan & Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

TKG/mew

Enclosure 1: Public Notice Materials
Enclosure 2: Nitrification Action Plan

cc: City of Wichita Falls, Attn: Honorable Glenn Barham, P.O. Box, 1431 Wichita Falls, TX 76307-1431
City of Wichita Falls, Attn: Mr. Darron Leiker, City Manager, 1300 7th Street, Wichita Falls, TX 76301
City of Wichita Falls, Attn: Daniel K. Nix, Utilities Operations Manager, P.O. Box 1431, Wichita Falls, Texas 76307-1431
Mr. Mark Southard, Water Superintendent, City of Wichita Falls, P.O. Box 1431, Wichita Falls, TX 76307-1431

BLIND COPIES:

BCC: TCEQ Abilene Regional Office – R3

Enclosure 1: Public Notice Materials

A public water system (PWS) must notify its customers, in writing, at least 14 days prior to commencing the use of chloramines. This notification must contain the Sample Language for Notification Upon Changing from Free Chlorine to Chloramines included below. The notification should be provided to the news media, renal disease facilities, dialysis clinics, hospitals, physicians, local health departments, etc.

Sample Language for Notification Upon Changing from Free Chlorine to Chloramines

“On <Date>, the <Water System Name> will be changing the disinfectant that we use from chlorine to chloramines. This change is intended to benefit our customers by reducing the levels of disinfection byproducts (DBPs) in the system, while still providing protection from waterborne disease.

However, the change to chloramines can cause problems to persons dependent on dialysis machines. A condition known as hemolytic anemia can occur if the disinfectant is not completely removed from the water that is used for the dialysate. Consequently, the pretreatment scheme used for the dialysis units must include some means, such as a charcoal filter, for removing the chloramine prior to this date. Medical facilities should also determine if additional precautions are required for other medical equipment. In addition, chloraminated water may be toxic to fish. If you have a fish tank, please make sure that the chemicals or filters that you are using are designed for use in water that has been treated with chloramines. You may also need to change the type of filter that you use for fish tanks.”

OPTIONAL: *“When the chloraminated water first flushes out the chlorinated water there may be a slight taste and odor, and possibly discoloration for a short period of time. This will not compromise the safety of the water.”*

Spanish Language for Notification Upon Changing from Free Chlorine to Chloramines

“El <Date>, el <Water System Name> cambiará el desinfectante de cloro que usamos a otro de cloramina. El propósito de este cambio es beneficiar a nuestros clientes reduciendo los niveles de los productos secundarios relacionados a la desinfección (DBPs) en el sistema, proporcionando al mismo tiempo la protección contra las enfermedades originadas por los gérmenes del agua.

No obstante, el cambio a cloramina puede causar problemas a las personas cuya vida depende de las máquinas de diálisis. Si el desinfectante no es completamente eliminado del agua que se usa para la diálisis, puede conducir a una anemia hemolítica. Por lo tanto, el esquema de tratamiento previo usado por las unidades de diálisis debe incluir algunos medios, tales como filtros de carbón, para eliminar la cloramina antes de esta fecha. Las instituciones médicas deben determinar si otros equipos médicos también pueden requerir precauciones adicionales. Además, el agua con cloramina podría ser tóxica para los peces. Si tiene un tanque para peces, asegúrese de que los filtros o los productos químicos que están siendo usados están diseñados para ser usados en agua que ha sido tratado con cloramina. También puede ser necesario cambiar el tipo de filtro que usa para el tanque.”

OPCIONAL: *“Al tiempo de la primera aspersión del agua cloraminada, se puede percibir por periodos cortos de tiempo algún sabor, olor y posiblemente alguna pérdida del color del agua. Esto no compromete la seguridad del agua.”*

Important notes:

1. The PWS may not begin using chloramines prior to the date shown in the notice.
2. The TCEQ does not currently require the PWS to include the name or contact number of a PWS employee that the customers can contact if they have questions. However, several systems have included this additional information as a courtesy to its consumers.

Some PWSs find it beneficial to periodically convert back to free chlorine for 21-28 days once or twice each year. This procedure can minimize the growth of nitrifying bacteria and make it easier to maintain an adequate chloramine residual during the rest of the year. If the PWS wishes to use this procedure, it must notify the TCEQ and any wholesale customer prior to making this type of temporary switch. The TCEQ also suggests that the PWS notify its customers just days before making the temporary change because this procedure occasionally results in slight changes in the taste and odor of the water. However, it does not have to reissue the public notice described above.



Texas Commission on Environmental Quality
CERTIFICATION of DELIVERY of PUBLIC NOTICE to CUSTOMERS

Public Water System (PWS) Name: _____

PWS I.D. (7-digit number required): _____

Date of Change to Chloramines: _____

I, _____, certify that the following information is true and accurate: (signature)

- The public water system named above has distributed the Public Notice (PN) for changing the disinfectant to chloramines at least 14 days prior to the change by mail or direct delivery to bill-paying customers; **and**
- The information contained in this public notification is correct and complies with required public notification condition in the letter authorizing the public water system to use chloramines; **and**
- The above system has made an adequate good-faith effort to reach non-bill-paying consumers by appropriate methods as follows (check all that apply):

_____ Posting the PN on the Internet at www. _____

_____ Mailing the PN to postal patrons within the service area that do not receive a bill

_____ Advertising the PN in news media

_____ Publication of PN in local newspaper

_____ Posting the PN in public places

_____ Delivery of multiple copies to single bill addresses serving several persons

_____ Delivery to community organizations

Date of Delivery to Customers: _____

Certified by: Name (print): _____

Title: _____

Phone No: _____ Date: _____

Signature: _____

Send one copy of this completed form and one copy of the Public Notification that you delivered to your customers to:

Plan and Technical Review Section - Mail Code 159
Texas Commission on Environmental Quality
P. O. Box 13087
Austin, Texas 78711-3087

Enclosure 2: Nitrification Action Plan

Note: This is intended to help you develop a system-specific flow chart for your system. You need to set system specific baseline and action levels and responses. If you don't understand the reason for a change or corrective action recommended by this flow chart, review your training and/or contact the TCEQ to request on-site assistance.

Setting Baseline & Action Levels

Monitor daily/weekly at sites representative of distribution system (in milligrams per liter (mg/L)) for disinfectants and ammonia:

- Total Available Chlorine (**TAC** or “combined” chlorine)
- Monochloramine (“**Mono**”)
- Free Available Ammonia (**FAA**)

Set **Action Levels (ALs)** for each disinfection chemical:

►**BL:** Normal baseline operating level.

The normal baseline is the range you can operate in without having nitrification.

►**AL-1:** Moderately off-spec water.

Exceeding the AL-1 triggers additional sampling and moderate corrective action such as flushing or changing chemical feed.

►**AL-2:** Potential risk, potential violation.

Exceeding the AL-2 triggers immediate corrective action, additional sampling, and potential notification of customers

Monitor weekly/monthly at entry point and representative distribution site(s):

- Nitrite (**NO₂**) (& Nitrate (**NO₃**)) (*Labs can do these tests together*)
- Heterotrophic Plate Count (on R2A agar) (**HPC**) measured in colony-forming units per milliliter (cfu/mL) (*Recommendation, not requirement*)

Determine normal **Baselines (BLs)**—the system-specific background level for naturally occurring nitrate, nitrite and HPC. The BL will be the normal range for naturally occurring nitrite, nitrate, and HPC.

►**BL:** Baseline. The normal, naturally occurring level of a constituent.

►**AL-1:** Moderately off-spec water. Triggers moderate action.

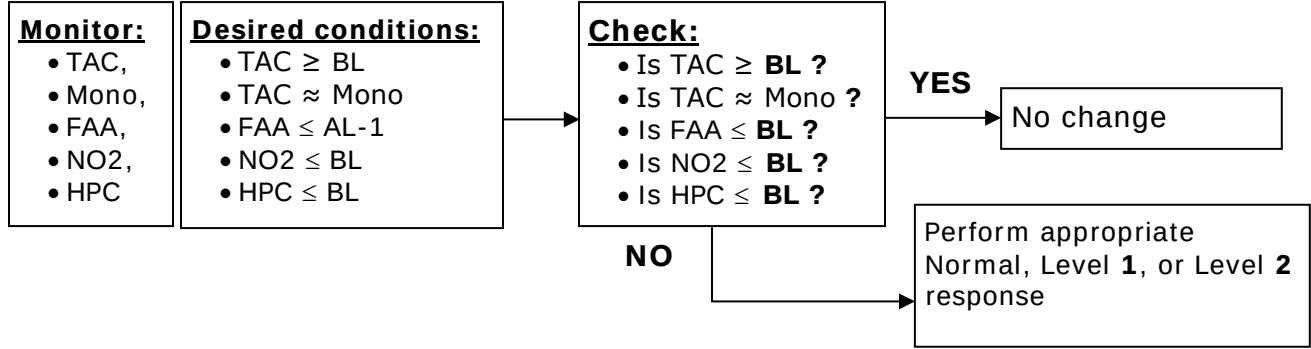
►**AL-2:** Potential risk, potential violation. Triggers immediate correction

EXAMPLE Chloramine Alert and Action Levels

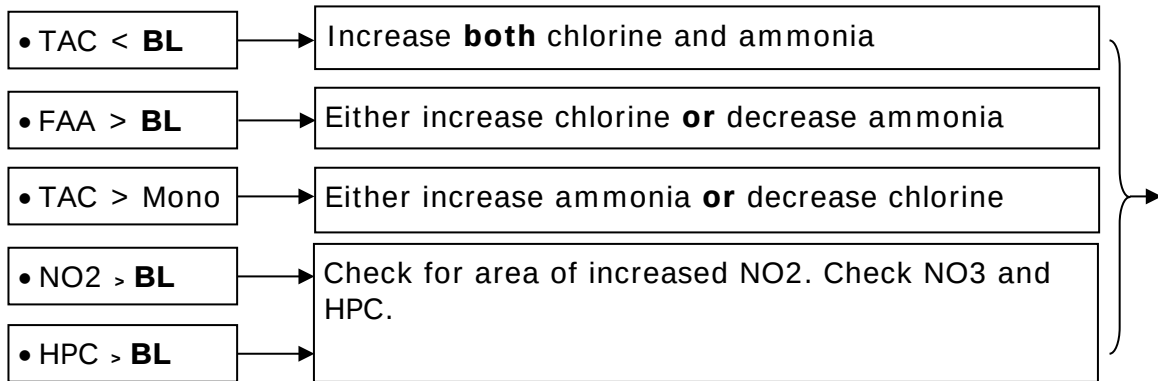
Parameter	Target at EP	Target in Distribution	Normal Baseline Range	AL-1: Action Needed	AL-2: Violation Possible
TAC at Entry Point (mg/L)	≥ 2 mg/L		1.4 to 2 mg/L	1 mg/L	0.5 mg/L
TAC at Dead End (mg/L)		≥ 1.6 mg/L	1.4 to 1.8 mg/L	0.8 mg/L	0.5 mg/L
NO₂ (mg/L)	At baseline	At baseline	0.1 mg/L over baseline	0.2 mg/L over baseline	0.4 mg/L over baseline
FAA (mg/L)	~0.1 mg/L	~ 0.3 mg/L	0.5 mg/L	1 mg/L	2 mg/L
HPC (mg/L)*	< 100 cfu/mL	< 100 cfu/mL	> 100 cfu/mL	> 200 cfu/mL	> 500 cfu/mL

* HPC is recommended, but not required. HPC varies a great deal between systems.

This is an example. You must develop system-specific levels and procedures.

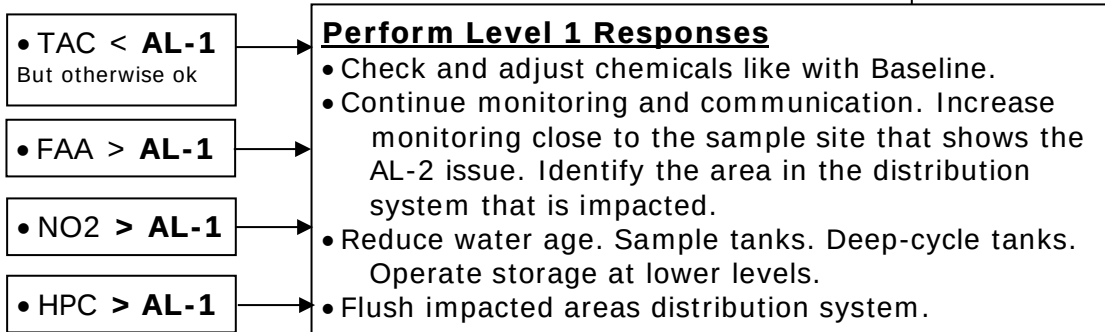


Normal Baseline Conditions Normal Responses

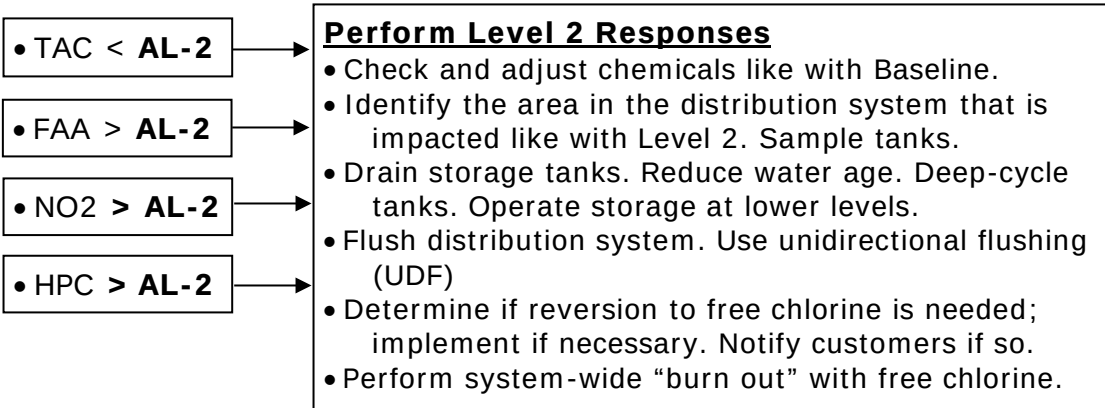


Are levels back to normal? If so, done. If not, repeat / increase monitoring.

Level 1 Conditions Level 1 Responses (Yellow Flag)



Level 2 Conditions Level 2 Responses (Red Flag)



The following table is provided for your convenience, to record your site-specific Alert, Action, and Base Line levels:

BLANK Chloramine Alert and Action Levels

Parameter	Target at EP	Target in Distribution	Normal Baseline Range	AL-1: Action Needed	AL-2: Violation Possible
TAC (mg/L)					0.5 mg/L
NO ₂ (mg/L)					
FAA (mg/L)					
HPC (mg/L)*					

* Remember, HPC is recommended, but not required. HPC varies a great deal between systems.

** You can use this blank table to document your system-specific levels.

Table 1. Critical Control Parameters for Chloramination

Parameter	Level or ratio	Reason
Total chlorine (TAC)	0.5 mg/L	Minimum regulatory limit.
Ratio of total chlorine to Monochloramine (TAC:Mono)	Plus or minus 10%	If most of the chlorine is present as monochloramine (as desired), the levels of total chlorine and monochloramine should be almost equal—within 10% is good.
Ratio of total chlorine to Free ammonia (TAC:FAA)	2 to 3 times	If the total chlorine is 2 to 3 times the free ammonia, it means there is an effective disinfectant residual present to help control potential nitrifying organisms.
Free available ammonia (as nitrogen) (FAA)	Low	Industry recommendations range from 0 to 0.3 mg/L free ammonia. Some systems operate with as much as 0.5 mg/L. The more ammonia that is present, the more 'food' available for nitrifying organisms. NOTE: Most test equipment can only measure up to 0.55 mg/L. If you measure 0.55 mg/L, you must dilute the sample and calculate the actual concentration.
	Present	When there is a little bit of free ammonia present, it indicates that monochloramine is the dominant species, as desired.
Free chlorine (FCL)	Very low/absent	Most methods show a very small amount of free chlorine in every test—a "drop." The level should not be over about 0.1 mg/L, or it is recommended that the method be checked for accuracy. Letting a sample sit--for example to allow bubbles to dissipate--can give falsely high free chlorine readings
Nitrite (NO ₂ -)	Equal to normal baseline	Most source water contains trace amounts of nitrite or nitrate, or both. Low levels are not of concern, but if levels within the distribution system are greater than the baseline levels, it can indicate either nitrification or intrusion of fecal matter. A change of 0.1 to 0.2 or 15% should be followed up on with additional sampling to verify whether nitrification is occurring.
Nitrate (NO ₃ -)		

Entry Point Nitrite/Nitrate Data

The TCEQ requires periodic nitrite and nitrate monitoring for all public water systems. You may be able to use the entry point nitrite and nitrate levels from this compliance monitoring as your Base Line levels, particularly if the entry point represents a single well.

If your entry point(s) represent water from more than one well, you will need to do monitoring determine the contribution of nitrite and nitrate from each source. Then, if you have an unusual nitrite or nitrate reading in the distribution system, you will be able to tell if it is due to a particular well or other source.

The TCEQ's data for your system is available on-line on our Drinking Water Watch web site at:

dww.tceq.state.tx.us/DWW/

Data management

At a minimum, you must record the measured distribution system levels by hand and keep those data sheets. A blank example of a chloramine data sheet is provided below:

Blank Example of a Chloramine Data Sheet

PWS Name _____					Operator name _____			
(Target Free Chlorine = _____ mg/L)					Date _____			
Location Address	Total Chlorine	Mono-chloramine	Free Ammonia	Free Chlorine	Mono: Total %	Trigger Exceeded? Y / N	Nitrite / Nitrate (if triggered, note date and time of collection)	
							Nitrite	Nitrate

Note – this data sheet may work better if you format it in “landscape” instead of “portrait.”

You may be able to track the data better and optimize your system by recording it in a computer spreadsheet program like Microsoft Excel or Corel QuattroPro. The benefit of those programs is that they can be used to do calculations of the percent of monochloramine, the ratio of total chlorine to ammonia, and other useful calculations.

Record retention

You must retain your distribution monitoring for at least three years, and have it available for the TCEQ's Regional Investigators to look at during their visits. If you use an electronic record keeping system, you should be able to provide printouts to the TCEQ upon request. Other considerations for electronic recordkeeping include:

- Back up. You should routinely back up your data. Computer glitches can lose your data.
- Organization: You should give files unique names that clearly specify the data they contain, like the specific month and year. A good example of a file name is “2014-March-ChloramineData.xlsx.” An example of a bad file name is “data.xlsx.”



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

Subject: The City of Wichita Falls – PWS ID No. 2430001
Public Drinking Water Supply Revised Contact Time Study
Cypress Water Treatment – 1961 Plant – TCEQ Plant ID - TP15131
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) studies for the City of Wichita Falls Cypress Water Treatment Plants (CWTP), including the 1961 Plant ('61 Plant). The information in this TCEQ letter for City of Wichita Falls CWTP 1961 Plant should replace, not supplement, all previous CT studies for this facility.

The City of Wichita Falls CWTP '61 Plant is a 16 million-gallons-per-day (MGD) conventional treatment facility receiving raw water from Lake Kickapoo and Lake Arrowhead via a secondary raw water reservoir located at the '61 Plant. Raw water from the reservoir travels through a 42-inch raw water pipe into a splitter basin where it is divided into the three separate conventional treatment facilities within the CWTP. The '61 Plant consists of a rapid mix basin, two flocculation/sedimentation basins operating in parallel, eight multi-media gravity filters, a 0.10-million-gallon (MG) clearwell and pump station, and three ground storage tanks. Upstream of the 0.10-MG clearwell and pump station, finished water from the RO Membrane treatment plant is combined with filtered water from the '61 Plant increasing the capacity of the '61 Plant to 26 MGD.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO_2) downstream of the secondary reservoir, and liquid ammonium sulfate (LAS) downstream of the splitter basin, and upstream of the 0.10-MG clearwell and transfer pump station. 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 reservoir pump station, prior to entering the splitter basin. Chloramine residual is monitored downstream of the eight multi-media gravity filters, downstream of the 0.10-MG clearwell and transfer pump station, 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

July 17, 2015

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 four disinfection zones at the City of Wichita Falls CWTP '61 Plant. The first disinfection zone, D1, contains three treatment trains D1A, D1B and D1C. D1A consists of 400 linear feet (LF) of 42-inch raw water pipe, D1B consists of 500 LF of 42-inch raw water pipe, and D1C consists of 5,600 LF of 42-inch raw water pipe. The next disinfection zone, D2, consists of 760 LF of 36-inch pipe, the two flocculation/sedimentation basins and eight multi-media gravity filters. The third disinfection zone, D3, is the 0.10-MG clearwell and transfer pump station. The final disinfection zone, D4, is also divided into three treatment trains D4A, D4B and D4C for each of the three ground storage tanks. The treatment unit D4A consists of a 206-foot diameter, 10.0-MG ground storage tank. The treatment unit D4B consists of a 150-foot diameter, 5.0-MG ground storage tanks, and the treatment unit D4C consists of a 123-foot diameter, 3.0-MG ground storage tank.

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 City of Wichita Falls CWTP WTP. 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 CWTP 1961 WTP

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1A	42-inch Raw Water Pipe	28,800 ⁽¹⁾	42.00 ⁽¹¹⁾	1.0 ⁽¹⁹⁾	0.987	0.99
D1B	42-inch Raw Water Pipe	36,000 ⁽²⁾			1.234	1.23
D1C	42-inch Raw Water Pipe	403,100 ⁽³⁾			13.82	13.82
D2	36-inch Raw Water Pipe	40,200 ⁽⁴⁾	16.00 ⁽¹²⁾	1.0 ⁽¹⁹⁾	3.617	142.7
	Flocc/Sed Basins (2)	2,345,000 ⁽⁵⁾	8.00 ⁽¹³⁾	0.28 ⁽²⁰⁾	118.19	
	Filters (8)	67,500 ⁽⁶⁾	2.00 ⁽¹⁴⁾	0.43 ⁽²¹⁾	20.90	
D3	0.10 MG Clearwell	60,000 ⁽⁷⁾	26.00 ⁽¹⁵⁾	0.55 ⁽²²⁾	1.828	1.83
D4A	10.0 MG Ground Storage Tank	4,987,000 ⁽⁸⁾	36.40 ⁽¹⁶⁾	0.3 ⁽²³⁾	59.186	59.19
D4B	5.0 MG Ground Storage Tank	2,485,500 ⁽⁹⁾	6.76 ⁽¹⁷⁾	0.1 ⁽²⁴⁾	52.951	52.95
D4C	3.0 MG Ground Storage Tank	1,493,500 ⁽¹⁰⁾	8.84 ⁽¹⁸⁾		24.328	24.33

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Notes:

- (1) Based on 400 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 500 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (3) Based on 5,600 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (4) Based on 760 LF of 36-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (5) Based on one flocculation/sedimentation basin, as per the CT submittal by BMI dated April 4, 2011.
- (6) Based on one filter, as per the CT submittal by BMI dated April 4, 2011. An average porosity of 50% is assumed for the media.
- (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 0.1 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 10.0 MG.
- (9) 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.
- (10) 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.
- (11) Based on the design capacity of the combined SWTP (42 MGD), this flow volume represents all flow from the secondary reservoir to the splitter basin, where flow is regulated to all three separate treatment facilities. As per the CT submittal by BMI dated April 4, 2011.
- (12) Based on the design capacity of the City of Wichita Falls '61 Plant, TCEQ ID 15131 (16 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (13) Based on the design capacity of the City of Wichita Falls '61 Plant, TCEQ ID 15131 (16 MGD), divided equivalently between the two flocculation/sedimentation basins which operate in parallel (8.0 MGD each), as per the CT submittal by BMI dated April 4, 2011.
- (14) Based on the design capacity of the City of Wichita Falls '61 Plant (16 MGD), divided equivalently between the eight filtration units (2.0 MGD per filter), as per the CT submittal by BMI dated April 4, 2011.
- (15) Based on the design capacity for the City of Wichita Falls '61 Plant (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.
- (16) 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.
- (17) 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.
- (18) 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.
- (19) Based on the assumption of "perfect" baffling characteristics for pipe.
- (20) Based on the approved TCEQ tracer study dated July 13, 1992 for the flocculation/sedimentation basins.
- (21) Based on the approved TCEQ tracer study dated July 13, 1992 for the eight filter units.
- (22) Based on the approved TCEQ tracer study dated July 13, 1992 for the 0.1 MG clearwell.
- (23) Based on the assumption of "poor" baffling characteristics for basins having two inlets, one outlet and three interior baffle walls.
- (24) Based on the assumption of "unbaffled" baffling characteristics for Ground Storage Tanks.

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 T₁₀ 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	D2	D3	Giardia	Viruses
Flow Rate (MGD)	42.00	42.00	42.00	8.00	26.00	0.5	2.0
T ₁₀ (minutes)	1.0	1.2	13.8	142.7	1.8		

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D4A	D4B	D4C	D5	D6	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		

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

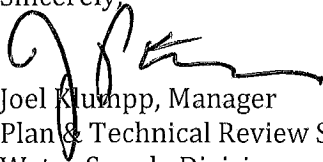
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July 17, 2015

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 Klumpp, 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

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

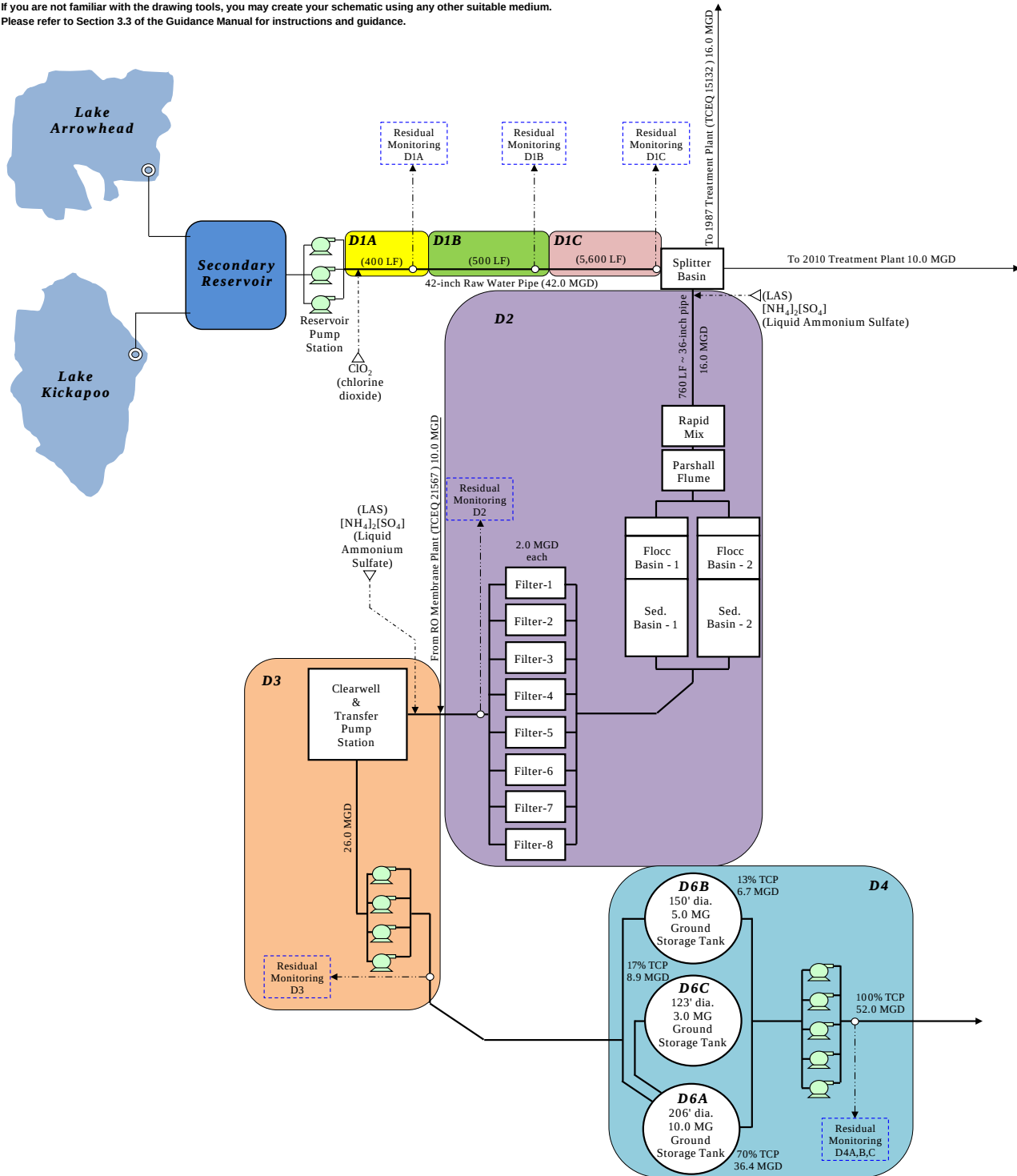
CT STUDY

CT STUDY

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

PUBLIC WATER SYSTEM NAME: City of Wichita Falls PLANT NAME: Cypress Water Treatment Plant: '61 Plant
OR NUMBER:
PWS ID No.: 2430001 Date: July 1, 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 Water Treatment Plant: '61 Plant

Date: July 1, 2015

Treatment Plant Capacity 16.000 mgd
11,111 gpm

--

Disinfection Zone: D1A

Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic

Number of Units

1

Comments

First Sample Location

Diameter

42 in

As per CT Submittal dated April 4, 2011

Length

400 ft

As per CT Submittal dated April 4, 2011

Volume (each)

28,792 gal

Flow Rate (each)

29,167 gpm

Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants

Detention Time

1.0 min

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor:

T₁₀

1.0 min

D1A FLOW RATE	42.000 mgd
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T10 SUM FOR D1A	1.0 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: D1B Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Second Sample Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	500 ft	As per CT Submittal dated April 4, 2011
Volume (each)	35,990 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	1.2 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.2 min	

D1B FLOW RATE 42.000 mgd

T10 SUM FOR D1B 1.2 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	5600 ft	As per CT Submittal dated April 4, 2011
Volume (each)	403,091 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	13.8 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	13.8 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

D1C FLOW RATE	42.000 mgd
T10 SUM FOR D1C	13.8 min

Disinfection Zone: D2 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36-inch Raw Water Pipe (splitter box - static mixer)

Characteristic		Comments
Number of Units	1	
Diameter	36 in	As per CT Submittal dated April 4, 2011
Length	760 ft	As per CT Submittal dated April 4, 2011
Volume (each)	40,192 gal	
Flow Rate (each)	11,111 gpm	Treatment Plant Capacity for City of Wichita Falls '61 Plant (TCEQ 15131)
Detention Time	3.6 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T₁₀	3.6 min	

Unit - 2 Type: Floc/Sed Comb. Shape: Other

Further Description: Flocculation/Sedimentation Basins

Characteristic		Comments
Number of Units	2	As per TCEQ CCI Investigation dated September 3, 2008
Volume (each)	2,345,000 gal	As per CT Submittal dated April 4, 2011
Volume (each)	2,345,000 gal	
Flow Rate (each)	5,556 gpm	Treatment Plant Capacity for City of Wichita Falls '61 Plant (TCEQ 15131) divided equally between the two similar Flocculation/Sedimentation Basins
Detention Time	422.1 min	
Baffling Factor	0.3	As per Approved TCEQ Tracer Study dated July 13, 1992
		Baffling Characteristics: <u>Tracer Study</u>
		Approved Baffling Factor: <u>0.28</u>
T₁₀	118.2 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

Unit - 3 Type: Other Shape: Other

Further Description: Mixed-Media Gravity Filters

Characteristic		Comments
Number of Units	8	As per TCEQ CCI Investigation dated September 3, 2008
Volume (each)	67,500 gal	As per CT Submittal dated April 4, 2011
Volume (each)	67,500 gal	
Flow Rate (each)	1,389 gpm	Treatment Plant Capacity for City of Wichita Falls '61 Plant (TCEQ 15131) divided equally between the eight similar Filter Units
Detention Time	48.6 min	
Baffling Factor	0.4	As per Approved TCEQ Tracy Study dated July 13, 1992
		Baffling Characteristics: <u>Tracer Study</u>
		Approved Baffling Factor: <u>0.43</u>
T ₁₀	20.9 min	

D2 FLOW RATE 8.000 mgd

T10 SUM FOR D2 142.7 min

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Other

Further Description: 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	assumes "worse case" operating volume
Percent of Maximum Volume	50 %	
Worst Case Volume (each)	60,000 gal	
Flow Rate (each)	18,055 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 Tracy Study dated July 13, 1992
		Baffling Characteristics: <u>Tracer Study</u>
		Approved Baffling Factor: <u>0.55</u>
T ₁₀	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

D3 FLOW RATE	25.999 mgd
T10 SUM FOR D3	1.8 min

Disinfection Zone: D4A 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 Basins having 2 inlets, 1 outlet, and 3 interior baffles
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T ₁₀	59.2 min	

D4A FLOW RATE	36.400 mgd
T10 SUM FOR D4A	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: D4B 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: <u></u>
T ₁₀	53.0 min	

D4B FLOW RATE	6.759 mgd
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T10 SUM FOR D4B	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: D4C 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: <u></u>
T ₁₀	24.3 min	

D4C FLOW RATE 8.840 mgd

T10 SUM FOR D4C 24.3 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 Wichita Falls PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Cypress Water Treatment Plant: '61 Plant Date: July 1, 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)	28,792	42.000	1	0.987	0.99
D1B	42-inch Raw Water Pipe (1)	35,990	42.000	1	1.234	1.23
D1C	42-inch Raw Water Pipe (1)	403,091	42.000	1	13.820	13.82
D2	36-inch Raw Water Pipe (splitter box - static mixer) (1)	40,192	16.000	1	3.617	142.70
	Flocculation/Sedimentation Basins (2)	2,345,000	8.000	0.28	118.189	
	Mixed-Media Gravity Filters (8)	67,500	2.000	0.43	20.896	
D3	Clearwell/Transfer pump station (1)	60,000	25.999	0.55	1.828	1.83
D4A	10 MG Ground Storage Tank (1)	4,987,042	36.400	0.3	59.186	59.19
D4B	5 MG Ground Storage Tank (1)	2,485,530	6.759	0.1	52.951	52.95
D4C	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 Water Treatment Plant: '61 Plant

PWS ID No.:

2430001

Date:

July 1, 2015

DISINFECTION PROCESS PARAMETERS

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D1A	D1B	D1C	D2	D3	Giardia lamblia Cysts	Viruses
Flow Rate (MGD)	42.000	42.000	42.000	8.000	25.999	0.5	2.0
T ₁₀ (minutes)	1.0	1.2	13.8	142.7	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	0.1	42.000	10.0	8.5	0.1	3.8	4.0	0.01	0.05			
CLO2 D1B	0.1	42.000	10.0	8.5	0.1	3.8	4.0	0.02	0.06			
CLO2 D1C	0.8	42.000	10.0	8.5	11.1	3.8	4.0	1.46	5.47	1.14	2.28	1.14
CLA D2	4.0	8.000	10.0	8.5	570.8	300.0	606.0	0.95	1.88			
CLA D3	4.0	25.999	10.0	8.5	7.3	300.0	606.0	0.01	0.02			

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	
	D4A	D4B	D4C	D5	D6	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	Virus Log	Inact. Ratio
CLA D4A	4.0	36.400	10.0	8.5	236.7	300.0	606.0	0.39	0.78			
CLA D4B	4.0	6.759	10.0	8.5	211.8	300.0	606.0	0.35	0.70			
CLA D4C	4.0	8.840	10.0	8.5	97.3	300.0	606.0	0.16	0.32	SEE	PAGE	1
D5												
D6												

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (06-01-09)

CT STUDY



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

Subject: The City of Wichita Falls – PWS ID No. 2430001
Public Drinking Water System Revised Contact Time Study
Cypress Water Treatment – 1987 Plant – TCEQ Plant ID- TP15132
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) studies for the City of Wichita Falls (CWF) Cypress Water Treatment Plants (CWTP), including the 1987 Plant ('87 Plant). The information in this TCEQ letter for City of Wichita Falls CWTP 1987 Plant should replace, not supplement, all previous CT studies for this facility.

The CWF CWTP '87 Plant is a 16-million-gallons-per-day (MGD) conventional treatment facility receiving raw water from Lake Kickapoo and Lake Arrowhead via a secondary raw water reservoir located at the CWTP. Raw water from the reservoir travels through a 42-inch raw water pipe into a splitter basin where it is divided into the three separate conventional treatment facilities within the CWTP. The '87 Plant consists of two clarification basins operating in parallel, a re-carbonation basin, four multi-media gravity filters, a 0.10-million-gallon (MG) clearwell and pump station, and three ground storage tanks.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO₂) downstream of the secondary reservoir, and liquid ammonium sulfate (LAS) downstream of the splitter basin, and upstream of the 0.10-MG clearwell and transfer pump station. Chlorine dioxide residual is monitored at three locations along the 42-inch raw water pipe at 400, 900 and 6,500 linear feet downstream of the reservoir pump station, prior to entering the splitter basin. Chloramine residual is monitored downstream of the four multi-media gravity filters, downstream of the 0.10-MG clearwell and transfer pump station, 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

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had at the time of our review, we have identified four disinfection zones at the CWF Cypress 1987 Plant WTP. The first disinfection zone, D1, contains three treatment trains D1A, D1B and D1C. D1A consists of 400 linear feet (LF) of 42-inch raw water pipe. D1B consists of 500 LF of 42-inch raw water pipe and D1C consists of 5,600 LF of 42-inch raw water pipe. The fourth next disinfection zone, D2, consists of 1,045 LF of 36-inch pipe, 175 LF of 30-inch pipe, the two clarification basins, and the four multi-media gravity filters. The third disinfection zone, D3, consists of the 0.10-MG clearwell and transfer pump station. The final disinfection zone, D4, is also divided into three treatment trains D4A, D4B and D4C, for each of the three ground storage tanks. The treatment unit D4A consists of a 206-foot diameter, 10.0-MG ground storage tank. The treatment unit D4B consists of a 150-foot diameter, 5.0-MG ground storage tanks, and the treatment unit D4C consists of a 123-foot diameter, 3.0-MG ground storage tank.

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 City of Wichita Falls CWTP WTP '87 Plant. 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 21, 2011.

TABLE 1: T_{10} TABLE FOR CITY OF WICHITA FALLS CYPRESS 1987 WTP

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1A	42-inch Raw Water Pipe	28,800 ⁽¹⁾	42.00 ⁽¹²⁾	1.0 ⁽¹⁹⁾	0.987	0.99
D1B	42-inch Raw Water Pipe	36,000 ⁽²⁾			1.234	1.23
D1C	42-inch Raw Water Pipe	403,100 ⁽³⁾			13.82	13.82
D2	36-inch Raw Water Pipe	55,300 ⁽⁴⁾	16.00 ⁽¹³⁾	0.44 ⁽²⁰⁾	4.974	76.83
	30-inch Raw Water Pipe	6,400 ⁽⁵⁾			0.578	
	Clarifiers (2)	680,000 ⁽⁶⁾	8.00 ⁽¹⁴⁾	0.7 ⁽²¹⁾	53.852	
	Filters (4)	69,200 ⁽⁷⁾	4.00 ⁽¹⁵⁾		17.424	
D3	0.10 MG Clearwell	69,900 ⁽⁸⁾	16.00 ⁽¹³⁾	0.3 ⁽²²⁾	1.888	1.89
D4A	10.0 MG Ground Storage Tank	4,987,000 ⁽⁹⁾	36.40 ⁽¹⁶⁾	0.3 ⁽²³⁾	59.186	59.19
D4B	5.0 MG Ground Storage Tank	2,485,500 ⁽¹⁰⁾	6.76 ⁽¹⁷⁾	0.1 ⁽²⁴⁾	52.951	52.95
D4C	3.0 MG Ground Storage Tank	1,493,500 ⁽¹¹⁾	8.84 ⁽¹⁸⁾		24.328	24.33

Notes:

- (1) Based on 400 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 500 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (3) Based on 5,600 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (4) Based on 1,045 LF of 36-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (5) Based on 175 LF of 30-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.

- (6) Based on one clarification basin, as per the CT submittal by BMI dated April 4, 2011.
- (7) Based on one filter, as per the CT submittal by BMI dated April 4, 2011. An average porosity of 50% is assumed for the media.
- (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 0.1 MG.
- (9) 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.
- (10) 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.
- (11) 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.
- (12) Based on the design capacity of the combined SWTP (42 MGD), this flow volume represents all flow from the secondary reservoir to the splitter basin, where flow is regulated to all three separate treatment facilities. As per the CT submittal by BMI dated April 4, 2011.
- (13) Based on the design capacity of the City of Wichita Falls '87 Plant, TCEQ ID 15132 (16 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (14) Based on the design capacity of the City of Wichita Falls '87 Plant, TCEQ ID 15132 (16 MGD), divided equivalently between the two clarification basins which operate in parallel (8.0 MGD each), as per the CT submittal by BMI dated April 4, 2011.
- (15) Based on the design capacity of the City of Wichita Falls '87 Plant (16 MGD), divided equivalently between the four filtration units (4.0 MGD per filter), as per the CT submittal by BMI dated April 4, 2011.
- (16) 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.
- (17) 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.
- (18) 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.
- (19) Based on the assumption of "perfect" baffling characteristics for pipe.
- (20) Based on the approved TCEQ tracer study dated July 13, 1992 for the clarification basins.
- (21) Based on the assumption of "superior" baffling characteristics for filters.
- (22) Based on the assumption of "poor" baffling characteristics for clearwells having one baffle wall.
- (23) Based on the assumption of "poor" baffling characteristics for basins having two inlets, one outlet and three interior baffle walls.
- (24) Based on the assumption of "unbaffled" baffling characteristics for a 3.0 and 5.0 MG Ground Storage Tanks.

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	
	D1A	D1B	D1C	D2	D3	Giardia	Viruses
Flow Rate (MGD)	42.00	42.00	42.00	8.00	26.00	0.5	2.0
T ₁₀ (minutes)	1.0	1.2	13.8	76.83	1.8		

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D4A	D4B	D4C	D5	D6	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		

As you are aware, zone D2 includes the 1987 clarifier, re-carbonation basin, and gravity filters; this grouping of treatment processes results in some constraints on the manner in which the plant can be operated and monitored. Specifically:

- **The operators must monitor the pH in disinfection zone D2 at the outlet of the 1987 clarifier.** Historically, the plant 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. If the City would like to retain the flexibility to practice partial lime softening when conditions warrant, please be reminded that the US Environmental Protection Agency's CT Tables for chloramine only apply at pH levels between 6 and 9, i.e., from 5.5 through 9.49. Because zone D2 includes both the clarification and re-carbonation processes and re-carbonation lowers pH, the **pH in zone D2 must be measured before re-carbonation.** Consequently, the operators must monitor the pH for disinfection zone D2 at the outlet of the clarifiers rather than at the typical site located at the end of the disinfection zone. The alternate location will ensure that the 1987 Cypress WTP plant does not overestimate disinfection levels when the clarifier pH reaches 9.5.
- **The operators must have at least three filters in operations whenever the plant is treating water.** This operational constraint is needed because zone D2 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 overestimate the level of viral inactivation achieved if fewer than four filters are on line whenever the plant is treating water.

Please be aware that the plant staff must continue using the approved Amperometric method to measure the chlorine dioxide residuals at the disinfection zone D1A, D1B, D1C sampling points as well as at the entry point to the distribution system. However, chlorine dioxide samples collected in the distribution system, if necessary, may be analyzed using the colorimetric method and a colorimeter in the field.

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

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July 17, 2015

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

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 Klumpp, 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

Page 6 of 5

July 17, 2015

bcc: w/ enclosure: TCEQ Tracer Study File

Mr. Donald Hunter, TCEQ, DWQT MC 155

TCEQ Region 3, Abilene

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

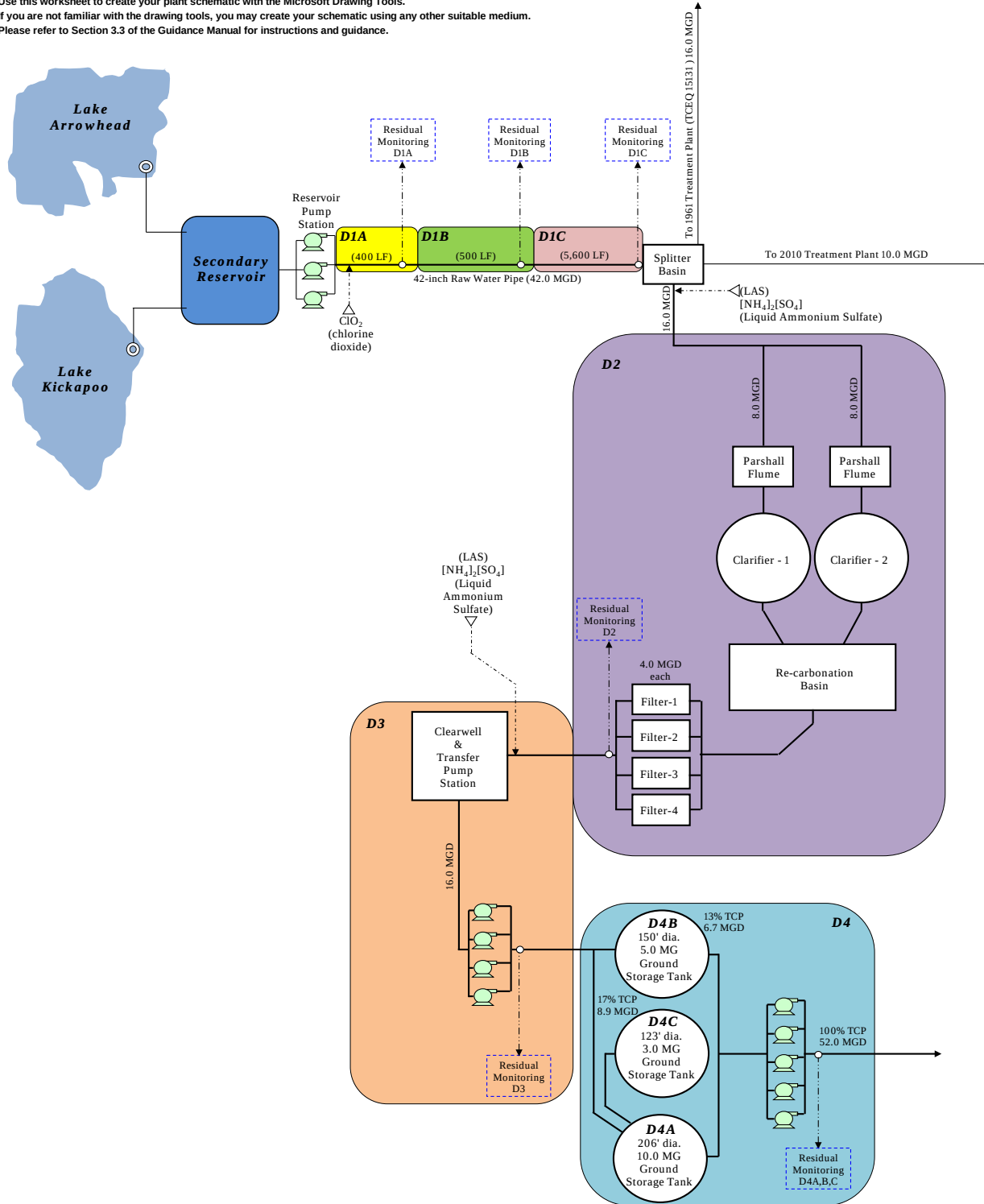
CT STUDY

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 Water Treatment Plant: '87 Plant

PWS ID No.: 2430001 Date: June 23, 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 Water Treatment Plant: '87 Plant

Date: June 23, 2015

Treatment Plant Capacity 16.000 mgd
11,111 gpm

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 Sample Location

Diameter

42 in

As per CT Submittal dated April 4, 2011

Length

400 ft

As per CT Submittal dated April 4, 2011

Volume (each)

28,792 gal

Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants

Flow Rate (each)

29,167 gpm

Detention Time

1.0 min

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor:

T₁₀

1.0 min

D1A FLOW RATE

42.000 mgd

T10 SUM FOR D1A

1.0 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: D1B Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Second Sample Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	500 ft	As per CT Submittal dated April 4, 2011
Volume (each)	35,990 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	1.2 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.2 min	

D1B FLOW RATE 42.000 mgd

T10 SUM FOR D1B 1.2 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 Sample Location
Diameter	42 in	As per CT Submittal dated April 4, 2011
Length	5600 ft	As per CT Submittal dated April 4, 2011
Volume (each)	403,091 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	13.8 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	13.8 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

D1C FLOW RATE	42.000 mgd
T10 SUM FOR D1C	13.8 min

Disinfection Zone: **D2** 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	
Diameter	36 in	As per CT Submittal dated April 4, 2011
Length	1045 ft	As per CT Submittal dated April 4, 2011
Volume (each)	55,263 gal	
Flow Rate (each)	11,111 gpm	Treatment Plant Capacity for City of Wichita Falls
Detention Time	5.0 min	'87 Plant (TCEQ 15132)
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T₁₀	5.0 min	

Unit - 2 Type: **Piping** Shape: **Pipe**

Further Description: 30-inch Raw Water Pipe

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	30 in	As per CT Submittal dated April 4, 2011
Length	175 ft	As per CT Submittal dated April 4, 2011
Volume (each)	6,427 gal	
Flow Rate (each)	11,111 gpm	Treatment Plant Capacity for City of Wichita Falls
Detention Time	0.6 min	'87 Plant (TCEQ 15132)
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T₁₀	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

Unit - 3 Type: Clarifier Shape: Other

Further Description: Clarifier

Characteristic		Comments
Number of Units	2	As per TCEQ CCI Investigation dated September 3, 2008
Volume (each)	680,000 gal	As per CT Submittal dated April 4, 2011
Volume (each)	680,000 gal	
Flow Rate (each)	5,556 gpm	Treatment Plant Capacity for City of Wichita Falls '87 Plant (TCEQ 15132) divided equally between the two similar Clarification Basins
Detention Time	122.4 min	
Baffling Factor	0.4	As per Approved TCEQ Tracer Study dated July 13, 1992
		Baffling Characteristics: <u>Tracer Study</u>
		Approved Baffling Factor: <u>0.44</u>
T ₁₀	53.9 min	

Unit - 4 Type: Filter Shape: Rectangular

Further Description: Filters

Characteristic		Comments
Number of Units	4	As per TCEQ CCI Investigation dated September 3, 2008
Length	28.25 ft	As per CT Submittal dated April 4, 2011
Width	25.5 ft	As per CT Submittal dated April 4, 2011
Media Depth	3 ft	As per CT Submittal dated April 4, 2011
Underdrain Depth	2 ft	As per CT Submittal dated April 4, 2011
Minimum Water Depth Over Media	9.33 ft	As per CT Submittal dated April 4, 2011
Average Porosity	50 %	
Volume (each)	69,147 gal	
Flow Rate (each)	2,778 gpm	Treatment Plant Capacity for City of Wichita Falls '87 Plant (TCEQ 15132) divided equally between the four similar Filter Units
Detention Time	24.9 min	
Baffling Factor	0.7	Typical Baffling Factor for Filters
		Baffling Characteristics: <u>Superior</u>
		Approved Baffling Factor: <u></u>
T ₁₀	17.4 min	

D2 FLOW RATE 8.001 mgd

T10 SUM FOR D2 76.8 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: D3 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	1	As per TCEQ CCI Investigation dated September 3, 2008
Length	57 ft	As per CT Submittal dated April 4, 2011
Width	20.5 ft	As per CT Submittal dated April 4, 2011
Side Water Depth	16 ft	As per CT Submittal dated April 4, 2011
Maximum Volume (each)	139,874 gal	
Minimum Operating Level	8 ft	
Worst Case Volume (each)	69,937 gal	assumes "worse case" operating volume
Percent of Maximum Volume	50 %	
Worst Case Volume (each)	69,937 gal	
Flow Rate (each)	11,111 gpm	Treatment Plant Capacity for City of Wichita Falls '87 Plant (TCEQ 15132)
Detention Time	6.3 min	
Baffling Factor	0.3	Typical Baffling Factor for Clearwell having one baffle wall
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.9 min	

D3 FLOW RATE	16.000 mgd
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T10 SUM FOR D3	1.9 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: D4A 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 Basins having 2 inlets, 1 outlet, and 3 interior baffles
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T ₁₀	59.2 min	

D4A FLOW RATE	36.400 mgd
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T10 SUM FOR D4A	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: D4B 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 volume
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: <u></u>
T ₁₀	53.0 min	

D4B FLOW RATE	6.759 mgd
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T10 SUM FOR D4B	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: D4C 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 volume
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: <u></u>
T ₁₀	24.3 min	

D4C FLOW RATE	8.840 mgd
----------------------	------------------

T10 SUM FOR D4C	24.3 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 Wichita Falls PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Cypress Water Treatment Plant: '87 Plant Date: June 23, 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)	28,792	42.000	1	0.987	0.99
D1B	42-inch Raw Water Pipe (1)	35,990	42.000	1	1.234	1.23
D1C	42-inch Raw Water Pipe (1)	403,091	42.000	1	13.820	13.82
D2	36-inch Raw Water Pipe (1)	55,263	16.000	1	4.974	76.83
	30-inch Raw Water Pipe (1)	6,427	16.000	1	0.578	
	Clarifier (2)	680,000	8.001	0.44	53.852	
	Filters (4)	69,147	4.000	0.7	17.424	
D3	Clearwell/Transfer Pump Station (1)	69,937	16.000	0.3	1.888	1.89
D4A	10 MG Ground Storage Tank (1)	4,987,042	36.400	0.3	59.186	59.19
D4B	5 MG Ground Storage Tank (1)	2,485,530	6.759	0.1	52.951	52.95
D4C	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 Water Treatment Plant: '87 Plant

PWS ID No.:

2430001

Date:

June 23, 2015

DISINFECTION PROCESS PARAMETERS

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D1A	D1B	D1C	D2	D3	Giardia lamblia Cysts	Viruses
Flow Rate (MGD)	42.000	42.000	42.000	8.001	16.000	0.5	2.0
T ₁₀ (minutes)	1.0	1.2	13.8	76.8	1.9		

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	42.000	12.0	8.5	0.8	3.5	3.5	0.11	0.45			
CLO2 D1B	0.8	42.000	12.0	8.5	1.0	3.5	3.5	0.14	0.56			
CLO2 D1C	0.8	42.000	12.0	8.5	11.1	3.5	3.5	1.57	6.28	0.86	2.01	1.01
CLA D2	4.0	8.001	12.0	8.5	307.3	277.0	527.5	0.55	1.17			
CLA D3	4.0	16.000	12.0	8.5	7.6	277.0	527.5	0.01	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	
	D4A	D4B	D4C	D5	D6	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	Virus Log	Inact. Ratio
CLA D4A	4.0	36.400	12.0	8.5	236.7	277.0	527.5	0.43	0.90			
CLA D4B	4.0	6.759	12.0	8.5	211.8	277.0	527.5	0.38	0.80			
CLA D4C	4.0	8.840	12.0	8.5	97.3	277.0	527.5	0.18	0.37	SEE	PAGE	1
D5												
D6												

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (06-01-09)

CT STUDY



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

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

July 17, 2015

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

July 17, 2015

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
Page 5 of 5
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,

A handwritten signature in black ink, appearing to read 'Joel Klumpp', with a long horizontal line extending to the right.

Joel Klumpp, 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

Page 6 of 5

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 Cypress WTP: RO Membrane Plant Month: June

OR NUMBER: Cypress WTP: RO Membrane Plant 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.

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

June 24, 2015

The diagram illustrates the water treatment process for Lake Kemp. The process begins with water from Lake Kemp entering the Headquarters Road Reservoir. This water then flows through three distribution tanks: D1A (85 LF), D1B (2,225 LF), and D1C (62,690 LF). Each tank has a corresponding Residual Monitoring point (D1A, D1B, D1C). The water then passes through a Rapid Mix stage and a Clarifier. The clarified water then goes through a U.S. Filters/Memcor Model 540S10V Membrane MicroFiltration System Reverse Osmosis Units. The treated water is then distributed to two Clearwell & Transfer Pump Stations: D2A (2010) and D2B (1961). D2A is monitored by Residual Monitoring D2A, and D2B is monitored by Residual Monitoring D2B. The water from D2A and D2B is then stored in three Ground Storage Tanks: D3A (206' dia., 10.0 MG), D3B (150' dia., 5.0 MG), and D3C (123' dia., 3.0 MG). The tanks are monitored by Residual Monitoring D3A,B,C. The final output is 100% TCP (52.0 MGD).

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

--

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: Perfect

Approved Baffling Factor:

T₁₀

0.6 min

D1A FLOW RATE	14.000 mgd
---------------	------------

T10 SUM FOR D1A	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: 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: <u></u>
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
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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: 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

T10 SUM FOR D3A 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: 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: <u></u>
T ₁₀	53.0 min	

D3B FLOW RATE	6.759 mgd
----------------------	------------------

T10 SUM FOR D3B	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: 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: <u></u>
T ₁₀	24.3 min	

D3C FLOW RATE 8.840 mgd

T10 SUM FOR D3C 24.3 min

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	0.30	0.84	0.42
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			
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	SEE	PAGE	1
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			
D4												
D5												

SUBMITTED BY: Certificate No. and Grade: Date:

TCEQ - (06-01-09) CT STUDY

Bryan W. Shaw, Ph.D, P.E., *Chairman*
Toby Baker, *Commissioner*
Zak Covar, *Commissioner*
Richard A. Hyde, P.E., *Executive Director*



PWS_2430001_CO_20150717_CTStudy

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

Subject: City of Wichita Falls - PWS ID No. 2430001
Public Drinking Water System Revised Contact Time Study
Cypress 2010 Water Treatment Plant, TCEQ Plant ID No. TP410071
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) revised the Contact Time (CT) study for the City of Wichita Falls (CWF) Cypress Water Treatment Plant (CWTP) 2010 ('10 Plant) Water Treatment Plant (WTP). The information in this TCEQ letter for City of Wichita Falls CWTP 2010 Plant should replace, not supplement, all previous CT studies for this facility.

The CWF CWTP 2010 Plant is a 10-million-gallons-per-day (MGD) conventional treatment facility receiving raw water from Lake Kickapoo and Lake Arrowhead via a secondary raw water reservoir located at the WTP. Raw water from the reservoir travels through a 42-inch raw water pipe into a splitter basin where it is divided into the three separate conventional treatment facilities within the CWTP. The '10 Plant consists of a rapid mix basin, a clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20-million-gallon (MG) clearwell and pump station, and three ground storage tanks. Upstream of the 0.20-MG clearwell and pump station, finished water from the RO Membrane treatment plant, is combined with filtered water from the '10 Plant increasing the capacity of the '10 Plant to 20 MGD.

The disinfection protocol involves the injection of chlorine dioxide (ClO_2) downstream of the secondary reservoir, and chlorine (Cl_2) and liquid ammonia gas (NH_3) downstream of the splitter basin, and upstream of the 0.20-MG clearwell and transfer pump station. Chlorine dioxide residual is monitored at three locations along the 42-inch raw water pipe at 400, 500 and 5,600 linear feet downstream of the reservoir pump station, prior to entering the splitter basin. Chloramine residual is monitored downstream of the five multi-media gravity filters, downstream of the 0.20-MG clearwell and transfer pump station, and downstream of the three ground storage tanks, prior to entering the distribution system.

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July 17, 2015

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 four disinfection zones at the City of Wichita Falls Cypress WTP 2010 WTP. The first disinfection zone, D1, contains three treatment trains D1A, D1B and D1C. D1A consists of 400 linear feet (LF) of 42-inch raw water pipe. D1B consists of 500 LF of 42-inch raw water pipe and D1C consists of 5,600 LF of 42-inch raw water pipe. D2 consists of consists of 1,045 LF of 36-inch pipe, 175 LF of 30-inch pipe, the rapid mix basin, a clarification basin, a recarbonation basin and five multi-media gravity filters. The third disinfection zone, D3, consists of the 0.20-MG clearwell and transfer pump station. The final disinfection zone, D4, is divided into three treatment trains: D4A, D4B and D4C for each of the three ground storage tanks. The treatment unit in D4A consists of a 206-foot diameter, 10.0-MG ground storage tank. The treatment unit in D4B consists of a 150-foot diameter, 5.0-MG ground storage tanks, and the treatment unit in D4C consists of a 123-foot diameter, 3.0-MG ground storage tank.

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 '10 Plant. 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 3, 2011.

TABLE 1: T_{10} TABLE FOR CWF CWTP 2010 WTP

DISINFECTION ZONE	TREATMENT UNIT	VOLUME (GAL)	FLOW RATE (MGD)	BAFFLING FACTOR	T_{10} (MIN)	
					Unit	Sum
D1A	42-inch Raw Water Pipe	28,800 ⁽¹⁾	42.00 ⁽¹⁴⁾	1.0 ⁽²¹⁾	0.987	0.99
D1B	42-inch Raw Water Pipe	36,000 ⁽²⁾			1.234	1.23
D1C	42-inch Raw Water Pipe	403,100 ⁽³⁾			13.82	13.82
D2	36-inch Raw Water Pipe	11,600 ⁽⁴⁾	10.00 ⁽¹⁵⁾	1.0 ⁽²¹⁾	1.675	70.06
	Rapid Mix Basin	4,850 ⁽⁵⁾		0.1 ⁽²²⁾	0.07	
	30-inch Water Pipe	3,100 ⁽⁶⁾		1.0 ⁽²¹⁾	0.45	
	Clarifier	926,500 ⁽⁷⁾		0.3 ⁽²³⁾	40.028	
	Re-carbonation Basin	183,000 ⁽⁸⁾		0.5 ⁽²⁴⁾	13.177	
	Multi-media Filters (5)	29,100 ⁽⁹⁾	2.00 ⁽¹⁶⁾	0.7 ⁽²⁵⁾	14.659	
D3	0.20 MG Clearwell	109,100 ⁽¹⁰⁾	20.00 ⁽¹⁷⁾	0.5 ⁽²⁶⁾	3.928	3.93
D4A	10.0 MG Ground Storage Tank	4,987,000 ⁽¹¹⁾	36.40 ⁽¹⁸⁾	0.3 ⁽²⁷⁾	59.186	59.19
D4B	5.0 MG Ground Storage Tank	2,485,500 ⁽¹²⁾	6.76 ⁽¹⁹⁾	0.1 ⁽²⁸⁾	52.951	52.95
D4C	3.0 MG Ground Storage Tank	1,493,500 ⁽¹³⁾	8.84 ⁽²⁰⁾		24.328	24.33

Notes:

- (1) Based on 400 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 500 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (3) Based on 5,600 LF of 42-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (4) Based on 220 LF of 36-inch raw water pipe, as per the CT submittal by BMI dated April 4, 2011.
- (5) Based on one rapid mix basin 27-feet long by 6-feet wide with a side water depth of 4-feet, as per the CT submittal by BMI dated April 4, 2011.
- (6) Based on 85 LF of 30-inch pipe, as per the CT submittal by BMI dated April 4, 2011.
- (7) Based on one clarifier basin having a 90-foot diameter, a side water depth of 18.9-feet and a center water depth of 20.6-feet, as per the CT submittal by BMI dated April 4, 2011.
- (8) Based on one re-carbonation basin 45.5-feet long by 32-feet wide with a side water depth of 16.8-feet, as per the CT submittal by BMI dated April 4, 2011.
- (9) Based on one filter, 24-feet by 15-feet each, with a media depth of 6 feet, an underdrain depth of 1 foot and a minimum water depth of 6.8-feet over the media as per the approved TCEQ CT study dated January 31, 2007. An average porosity of 50% is assumed for the media.
- (10) 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 0.2 MG.
- (11) 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.
- (12) 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.
- (13) 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.
- (14) Based on the design capacity of the combined SWTP (42 MGD), this flow volume represents all flow from the secondary reservoir to the splitter basin, where flow is regulated to all three separate treatment facilities. As per the CT submittal by BMI dated April 4, 2011.
- (15) Based on the design capacity of the City of Wichita Falls '10 Plant, TCEQ ID 15134 (10 MGD), as per the CT submittal by BMI dated April 4, 2011.
- (16) Based on the design capacity of the City of Wichita Falls '10 Plant (10 MGD), divided equivalently between the five filtration units (2.0 MGD per filter), as per the CT submittal by BMI dated April 4, 2011.
- (17) 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.
- (18) 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.
- (19) 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.

- (20) 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.

- (21)Based on the assumption of “perfect” baffling characteristics for pipe.
- (22)Based on the assumption of “unbaffled” baffling characteristics.
- (23)Based on the assumption of “poor” baffling characteristics for clarifiers.
- (24)Based on the assumption of “average” baffling characteristics. The re-carbonation basin has four internal baffles and a length to width of (40:1) as per the CT submittal by BMI dated April 4, 2011.
- (25)Based on the assumption of “superior” baffling characteristics for filters.
- (26)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.
- (27)Based on the assumption of “poor” baffling characteristics for basins having two inlets, one outlet and three interior baffle walls.
- (28)Based on the assumption of “unbaffled” 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 T₁₀ 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 2010 Cypress WTP must meet on a continuous basis.

TABLE 2: DISINFECTION PROCESS PARAMETERS

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D1A	D1B	D1C	D2	D3	Giardia	Viruses
Flow Rate (MGD)	42.00	42.00	42.00	10.00	20.00	0.5	2.0
T ₁₀ (minutes)	1.0	1.2	13.8	70.1	3.9		

APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS	
Parameters	Disinfection Zones					Log Inactivations	
	D4A	D4B	D4C	D5	D6	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		

As you are aware, zone D2 includes the 2010 clarifier, recarbonation basin, and filters. As we have discussed, this grouping of treatment processes results in some constraints on the manner in which the plant can be operated and monitored. Specifically:

- **The operators must monitor the pH in disinfection zone D2 at the outlet of the 2010 clarifier.** Historically, the plant 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. This desired level of flexibility is understandable. However, the US Environmental Protection Agency's CT Tables for chloramine only apply at pH levels between 6 and 9, i.e, from 5.5 through 9.49. Because zone D2 includes both the clarification and recarbonation

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processes and recarbonation lowers pH, the pH in zone D2 must be measured before recarbonation. Consequently, the operators must monitor the pH for disinfection zone D2 at the outlet of the clarifiers rather than at the typical site located at the end of the disinfection zone. The alternate location will ensure that the 2010 Cypress WTP plant does not overestimate disinfection levels when the clarifier pH reaches 9.5.

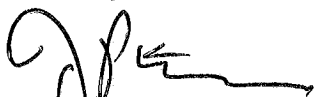
- **The operators must have at least four filters in operations whenever the plant is treating water.** This operational constraint is needed because zone D2 contains both the plant's gravity filters and the disinfection contact time within the zone depends on the flow rate of the water and the total volume of water contained in the treatment units. Consequently, the CT calculations will overestimate the level of viral inactivation achieved if fewer than four filters are on line whenever the plant is treating water.

Please be aware that the plant staff must continue using the approved Amperometric method to measure the chlorine dioxide residuals at the disinfection zone D1A, D1B, D1C sampling points as well as at the entry point to the distribution system. However, chlorine dioxide samples collected in the distribution system, if necessary, may be analyzed using the colorimetric method and a colorimeter in the field.

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

JPK/SAT

Enclosure: CT Study Template

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

July 17, 2015

Blind Copies:

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

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

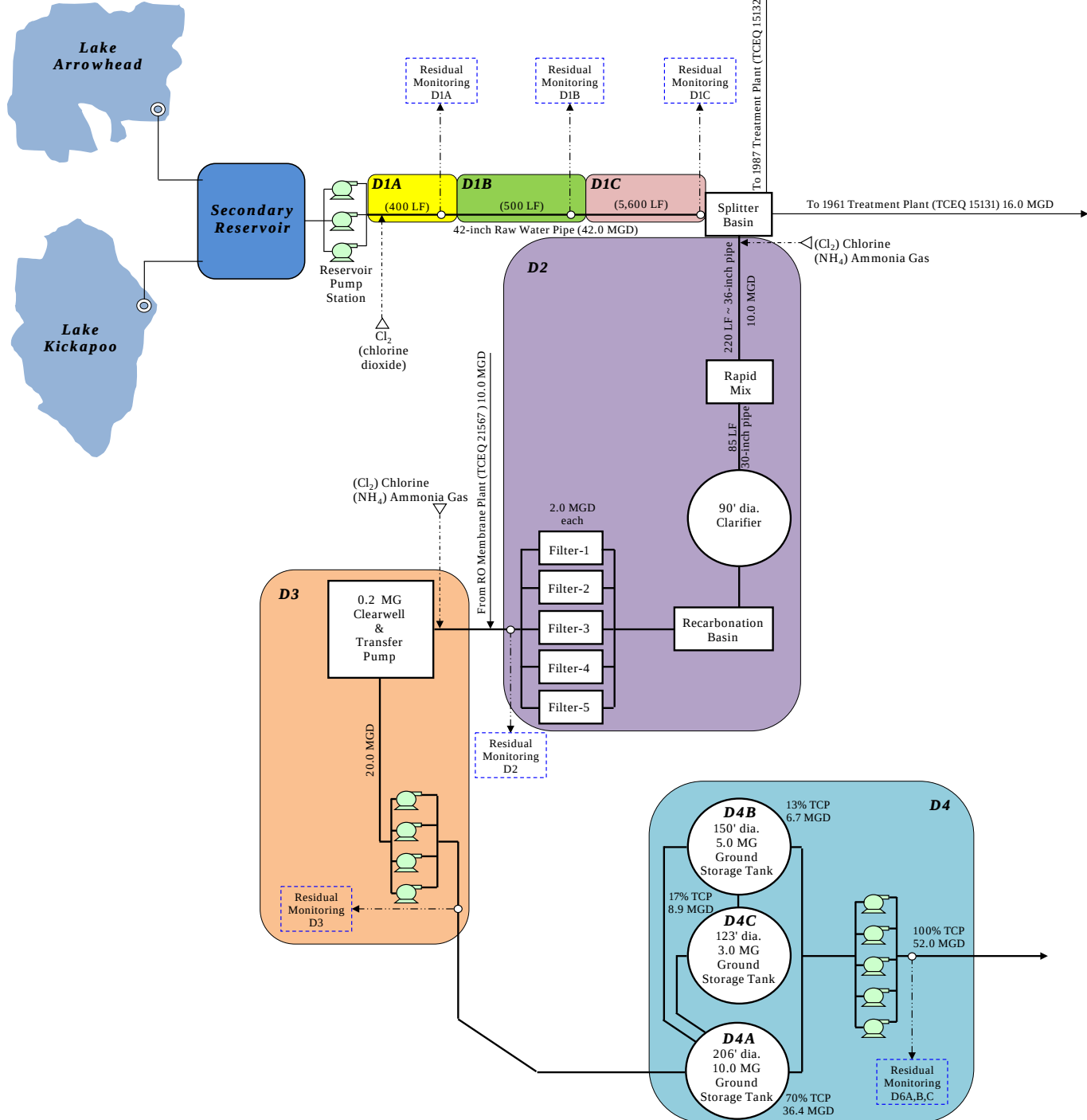
The proposed disinfection protocol involves the injection of chlorine dioxide (ClO₂) downstream of the secondary reservoir, and chlorine (Cl₂) and liquid ammonia gas (NH₄) downstream of the splitter basin, and upstream of the 0.20-MG clearwell and transfer pump station. Chlorine dioxide residual is monitored at three locations along the 42-inch raw water pipe at 400, 900 and 5,600 linear feet downstream of the reservoir pump station, prior to entering the splitter basin. Chloramine residual is monitored downstream of the five multi-media gravity filters, downstream of the 0.10-MG clearwell and transfer pump station, and downstream of the three ground storage tanks, prior to entering the distribution system.

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 Water Treatment Plant: '10 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 Water Treatment Plant: '10 Plant

Date: June 24, 2015

Treatment Plant Capacity 10.000 mgd
6,944 gpm

--

Disinfection Zone: D1A

Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42-inch Raw Water Pipe

Characteristic

Number of Units

1

Comments

First Sampling Location

Diameter

42 in

As per CT Submittal dated April 4, 2011

Length

400 ft

As per CT Submittal dated April 4, 2011

Volume (each)

28,792 gal

Flow Rate (each)

29,167 gpm

Combined SWTP Capacity. Flow represents all
flow from Secondary Reservoir to Splitter Basin
where flow is regulated to all 3 treatment plants

Detention Time

1.0 min

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor:

T₁₀

1.0 min

D1A FLOW RATE 42.000 mgd

T10 SUM FOR D1A 1.0 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: 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	500 ft	As per CT Submittal dated April 4, 2011
Volume (each)	35,990 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	1.2 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	1.2 min	

D1B FLOW RATE 42.000 mgd

T10 SUM FOR D1B 1.2 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	5600 ft	As per CT Submittal dated April 4, 2011
Volume (each)	403,091 gal	
Flow Rate (each)	29,167 gpm	Combined SWTP Capacity. Flow represents all flow from Secondary Reservoir to Splitter Basin where flow is regulated to all 3 treatment plants
Detention Time	13.8 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T ₁₀	13.8 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

D1C FLOW RATE	42.000 mgd
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T10 SUM FOR D1C	13.8 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: D2 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36-inch Raw Water Pipe

Characteristic		Comments
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	Treatment Plant Capacity for City of Wichita Falls '10 Plant (TCEQ 15134)
Flow Rate (each)	6,944 gpm	
Detention Time	1.7 min	
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

Characteristic		Comments
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	Treatment Plant Capacity for City of Wichita Falls '10 Plant (TCEQ 15134)
Flow Rate (each)	6,944 gpm	
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	

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

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30-inch 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	Treatment Plant Capacity for City of Wichita Falls
Detention Time	0.4 min	'10 Plant (TCEQ 15134)
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: <u></u>
T₁₀	0.4 min	

Unit - 4 Type: Clarifier Shape: Circular

Further Description: 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	Treatment Plant Capacity for City of Wichita Falls
Detention Time	133.4 min	'10 Plant (TCEQ 15134)
Baffling Factor	0.3	Typical Baffling Factor for Clarifiers
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T₁₀	40.0 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

Unit - 5

Type: Other

Shape: Rectangular

Further Description: Recarbonation Basin

Characteristic		Comments
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	Treatment Plant Capacity for City of Wichita Falls
Detention Time	26.4 min	'10 Plant (TCEQ 15134)
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	

Unit - 6

Type: Filter

Shape: Rectangular

Further Description: Gravity Filters

Characteristic		Comments
Number of Units	5	
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	
Flow Rate (each)	1,389 gpm	Treatment Plant Capacity for City of Wichita Falls
Detention Time	20.9 min	'10 Plant (TCEQ 15134) equally divided between the five like filter units
Baffling Factor	0.7	Typical Baffling Factor for Filters
		Baffling Characteristics: <u>Superior</u>
		Approved Baffling Factor: _____
T ₁₀	14.7 min	

D2 FLOW RATE	9.999 mgd
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T10 SUM FOR D2	70.1 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: D3 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: 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: <u></u>
T ₁₀	3.9 min	

D3 FLOW RATE	19.999 mgd
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T10 SUM FOR D3	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: D4A 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 Basins having 2 inlets, 1 outlet, and 3 interior baffles
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T ₁₀	59.2 min	

D4A FLOW RATE	36.400 mgd
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T10 SUM FOR D4A	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: D4B 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: <u></u>
T ₁₀	53.0 min	

D4B FLOW RATE	6.759 mgd
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T10 SUM FOR D4B	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: D4C 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	asumes "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: <u></u>
T ₁₀	24.3 min	

D4C FLOW RATE 8.840 mgd

T10 SUM FOR D4C 24.3 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 Wichita Falls PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Cypress Water Treatment Plant: '10 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)	28,792	42.000	1	0.987	0.99
D1B	42-inch Raw Water Pipe (1)	35,990	42.000	1	1.234	1.23
D1C	42-inch Raw Water Pipe (1)	403,091	42.000	1	13.820	13.82
D2	36-inch Raw Water Pipe (1)	11,634	9.999	1	1.675	70.06
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30-inch pipe (1)	3,122	9.999	1	0.450	
	Clarifier (1)	926,521	9.999	0.3	40.028	
	Recarbonation Basin (1)	183,003	9.999	0.5	13.177	
	Gravity Filters (5)	29,088	2.000	0.7	14.659	
D3	Clearwell/Transfer Pump Station (1)	109,102	19.999	0.5	3.928	3.93
D4A	10 MG Ground Storage Tank (1)	4,987,042	36.400	0.3	59.186	59.19
D4B	5 MG Ground Storage Tank (1)	2,485,530	6.759	0.1	52.951	52.95
D4C	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 Water Treatment Plant: '10 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	D2	D3	Giardia lamblia Cysts		Viruses		
Flow Rate (MGD)	42.000	42.000	42.000	9.999	19.999	0.5		2.0		
T ₁₀ (minutes)	1.0	1.2	13.8	70.1	3.9					

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	42.000	14.0	8.5	0.8	3.3	3.1	0.12	0.52			
CLO2 D1B	0.8	42.000	14.0	8.5	1.0	3.3	3.1	0.15	0.64			
CLO2 D1C	0.8	42.000	14.0	8.5	11.1	3.3	3.1	1.70	7.21	0.90	2.23	1.11
CLA D2	4.0	9.999	14.0	8.5	280.2	254.0	459.3	0.55	1.22			(N/A)
CLA D3	4.0	19.999	14.0	8.5	15.7	254.0	459.3	0.03	0.07			

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				
	D4A	D4B	D4C	D5	D6	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	Virus Log	Inact. Ratio
CLA D4A	4.0	36.400	14.0	8.5	236.7	254.0	459.3	0.47	1.03			
CLA D4B	4.0	6.759	14.0	8.5	211.8	254.0	459.3	0.42	0.92			
CLA D4C	4.0	8.840	14.0	8.5	97.3	254.0	459.3	0.19	0.42	SEE	PAGE	1
D5												
D6												

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CT STUDY