

BIGGS & MATHEWS, INC.

Consulting Engineers

July 25, 2013

Joel Klumpp, Team Leader
Technical Review & Oversight Team MC-159
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

RE: City of Wichita Falls
PWS ID No. 2430001
Temporary Direct Potable Reuse Project
Response to 3rd set of TCEQ Questions (7/05/13)

Dear Mr. Klumpp:

On July 5, 2013 the Texas Commission on Environmental Quality (TCEQ) provided us by E-Mail (Attached) a 3rd set of questions for the City to answer along with requests for submission of additional information and documentation, as TCEQ continues to review the Temporary Direct Potable Reuse Project (DPRP) proposed for the City of Wichita Falls.

As requested, please find attached our response to each of the questions along with all requested additional information and documentation for your review and comments. In addition to a PDF, we have sent three (3) hardcopies to Austin and one (1) to Region 8.

TCEQ GENERAL DISCUSSION:

The following bullet items requesting information were listed in the TCEQ's February 8, 2013 response letter (TCEQ Concept Response) to the City of Wichita Falls' (City) Concept Paper for the Emergency Reuse of Wastewater Effluent as a Source of Direct Potable Reuse in Wichita Falls (City Concept Paper) submitted November 13, 2012. They are repeated here to provide continuity for the discussion of removal and inactivation of viruses and Giardia in the DPR plant.

- *TCEQ Concept Response, Page 7 of 14*
The City will need to provide at least 9.0-log of total viral removal or inactivation through the temporary Cypress DPR WTP. Based on consultations with EPA Region 6 staff, the TCEQ has concluded that 1.0 log of additional viral log inactivation, for a total of 9.0-log, will provide an equivalent safety factor to that provided when chlorination precedes ammonia addition.
- *TCEQ Concept Response, Page 9 of 14*
Please note that 8.0-log or greater (based on the City's selected disinfection protocol), 6.0-log and 5.5-log of removal and/or inactivation of viruses, Giardia cysts and Cryptosporidium oocysts, respectively, only provide protection of public health for specific concentration

levels of these pathogens in the RR WWTP effluent. To date, the City has reported the following maximum pathogen concentration for the RR WWTP effluent:

- Giardia concentration of 34.82 cysts per liter;
 - Cryptosporidium concentration of 5.04 oocysts;
 - E. coli concentration of 160 most probable number (MPN) per 100 milliliters (1,600 MPN per liter);
 - Total coliform concentration of 3,200 MPN per 100 milliliters (32,000 MPN per liter); and
 - No maximum data was available for total culturable virus concentrations, but a 2009 average concentration of <0.387 MPN per 100 milliliters (<3.87 MPN per liter) was provided.
- TCEQ Concept Response, Page 10 of 14
The CT Study spreadsheet for the proposed temporary Cypress DPR WTP, including the dimensions of all pipelines and treatment units. The spreadsheet should include the minimum detention time in the MF and RO membrane portion of the Cypress DPR WTP, the conventional portion of the Cypress DPR WTP, and any subsequent storage before release to the distribution system.
 - TCEQ Concept Response, Page 10 of 14
A description of multi pathogen treatment barriers, an analysis of what levels of treatment will be provided if a single or multi-barriers should fail, and what safeguards will be in place to prevent failure and response actions and timelines for treatment failures.

TCEQ Comment:

The TCEQ staff continues our research regarding the health risk at different concentrations of pathogens in the water to be ingested. Surface water treatment plants (SWTPs) must provide a combined removal and inactivation treatment that only allows an average annual risk of 1 infection per 10,000 persons. To achieve this protection, **no more than 7.0×10^{-7} Giardia cysts/L** can be in the water ingested. A total of 6.0-log removal and inactivation will only provide this protection if the Giardia cyst concentration in a raw water source is no greater than 7.0 cysts/L. However, the City's reported maximum Giardia concentration in the RR WWTP effluent was 34.815 cysts/L.

This concentration of Giardia cysts will require **a combined minimum removal and inactivation of 7.0-log for the treatment processes** used by the City when treating the RR WWTP effluent as a raw water source for human consumption. In addition, Texas SWTPs are required to provide a minimum of 0.5-log inactivation of Giardia using disinfection regardless of the amount of removal achieved. This requirement provides for multiple barriers against Giardia. Therefore, at least 1.0-log inactivation of Giardia using an acceptable disinfection process must also be provided.

TCEQ Questions:

We have compared the TCEQ Concept Responses pasted on the previous page with the City's submitted preliminary engineering report (PER), exception requests, and proposed Full-Scale Verification Testing Protocol. Based on the change in minimum required log removal and inactivation for Giardia and our review, we have the following questions:

- 1. How do the submitted CT inactivation calculations in the PER's Appendix J, Items Nos. 1 through 4 provide for a total of 1.0-log inactivation for Giardia in the RR WWTP effluent at the reported chloramine residuals (measured as monochloramine) for the different disinfection zones? At different chloramine residuals? Please use the attached CT study template to show the inactivation provided by disinfection for both the WWTP effluent and the raw lake water sources.*

Please review the attached Table A: TCEQ Approved Maximum Log Removal Credits for the Proposed Temporary Cypress DPR WTP and Table B: TCEQ Minimum Required Log Inactivations for the Proposed Temporary Cypress DPR WTP prior to completing the TCEQ's v7 CT Template.

Response: See Attachment A "Recalculation of Overall Log Inactivation Credits Using New TCEQ CT Template (v.7) and Application of TCEQ Logic on Log Inactivation Requirements."

- 2. How do the submitted CT inactivation calculations in the PER's Appendix J, Items Nos. 1 - 4 provide for a total of 5.0-log inactivation of viruses in the RR WWTP effluent at the reported chloramine residuals (measured as monochloramine) for the different disinfection zones? At different chloramine residuals?*

This question is based on the observation that the proposed removal treatment processes for the RR WWTP effluent can achieve a maximum of 4.0-log removal of virus from the proposed treatment process (see attached Table A). Therefore, a minimum of 5.0-log inactivation must be achieved using either chemical or ultraviolet disinfection (see attached Table B).

Response: See Attachment A "Recalculation of Overall Log Inactivation Credits Using New TCEQ CT Template (v.7) and Application of TCEQ Logic on Log Inactivation Requirements"

- 3. Please provide all of the laboratory results for total culturable virus concentration in the RR WWTP effluent data.*

TCEQ staff found only six results for the total culturable virus concentration in the RR WWTP effluent. We would like to review the entire data set.

Response: See Attachment C for requested laboratory results.

TCEQ Requested Documents:

1. Addendum replacement pages will need to be included for the PER's Section 8.0, virus and Giardia tables on pages 17 and 18, Appendix J, and any other location in the PER where it is needed to address the TCEQ's comments regarding the required log removal and inactivation for the proposed temporary Cypress DPR WTP.

Response: Upon approval of the completed Templates by TCEQ, we will submit the necessary PER Addendums.

2. Once you have completed the two TCEQ CT Templates, please submit copies to the TCEQ. Please note:
 - a. TCEQ's version v7 CT Template (attached) **must be used** for demonstrating compliance for the RR WWTP effluent's disinfection protocol. At this time, under the "Log Inactivations" for "Performance Standards" on the "CT Calculator Worksheet":
 - i. 1.0 must be entered in the cell for "Giardia lamblia Cysts"; and
 - ii. 5.0 must be entered in the cell for "Viruses."

Response: See Attachment B for requested documents.

- b. Since the TCEQ does not have a CT Template that will allow the calculations for the proposed two separate raw source waters receiving different pre-treatments and requiring different minimum log removals and inactivation, **two separate CT Templates must be completed:** one for each of the following treatment processes:
 - i. 5.0-MGD of RR WWTP effluent being pre-treated with preformed chloramines, through the Cypress 2008 MF/RO SWTP, blended with 5.0-MGD Secondary Reservoir raw surface water after pre-disinfection with chlorine dioxide, and the 10.0-MGD of blended source waters being treated through the Cypress 2010 Conventional SWTP; **and**
 - ii. 5.0-MGD of Secondary Reservoir raw surface water pre-disinfected with chlorine dioxide, blended with 5.0-MGD of partially treated RR WWTP effluent, and the 10.0-MGD of blended source waters being treated through the Cypress 2010 Conventional SWTP.

Response: See Attachment B for requested documents.

- c. The minimum required inactivations in TCEQ's attached Table B for viruses, Giardia, and Cryptosporidium are contingent on:
- i. The maximum concentrations in the RR WWTP effluent for:
 - A. Viruses being no greater than 22.2 MPN/L;
 - B. Giardia being no greater than 70.0 cysts/L; **and**
 - C. Cryptosporidium being no greater than 9.48 oocysts/L
 - ii. The maximum concentrations in the water entering the distribution at the effluent of the 10.0-MG GST for:
 - A. Viruses being no greater than 2.22×10^{-7} MPN/L;
 - B. Giardia being no greater than 7.00×10^{-6} cysts/L;
 - C. Cryptosporidium being no greater than 2.999×10^{-5} oocysts/L;
 - and**
 - D. *E. coli* being zero organisms found in a sample (no detection).

Response: See Attachment B for requested documents.

3. Please provide the following analytical results with the laboratory reports for virus concentrations in the RR WWTP effluent:
- a. The complete sample set used to obtain the reported 2009 virus average concentration of 3.87 MPN/L in the RR WWTP effluent.
 - b. Any current virus concentration data for the RR WWTP effluent.

Response: See Attachment C for requested documents.

4. Provide any new onsite and offsite analytical results for Giardia and Cryptosporidium concentrations in the RR WWTP effluent.

Response: There are no new onsite results to report and all offsite Giardia and Cryptosporidium results have been submitted.

Table A
TCEQ Approved Maximum Log Removal Credits for the
Proposed Temporary Cypress DPR WTP

Individual Removal Barriers	TCEQ Approved Log Removal Pathogen Credit for Individual Removal Barriers		
	Virus	<i>Giardia</i>	<i>Cryptosporidium</i>
MF/RO SWTP's Coagulation, Flocculation and Clarification	0.5 ¹	0.5 ¹	0.5 ¹
MF Membranes	1.5 ¹	3.0 ^{1,2,3}	3.0 ^{1,2,3}
RO Membranes	0.0	0.0	0.0
Conventional SWTP'S Coagulation, Flocculation and Clarification	0.5 ¹	0.5 ¹	0.5
Conventional SWTP's Gravity Filters	1.5 ¹	2.5 ^{1,4}	2.5 ^{1,4}
Gravity Filters w/CFE $\leq$ 0.15 NTU	0.0	(+0.5) ⁵	(+0.5) ⁵
Gravity Filters w/IFE $\leq$ 0.15 NTU	0.0	(+1.0) ⁶	(+1.0) ⁶
Total of TCEQ Maximum Approved Log Removal Credits	4.0	6.5 (7.0 ⁵ or 7.5 ⁶) ⁷	6.5 (7.0 ⁵ or 7.5 ⁶) ⁷

Footnotes:

1. Maximum allowed removal by 30 TAC §290.111(d)(1).
2. If a TCEQ approved Challenge Test review does not result in a LRV_{C-test} value less than 3.0-log, based on maximum verifiable log removal of 3.0 by a direct integrity test (DIT) as approved in TCEQ's 4/30/2012 letter.
3. The combined filtrate effluent for the MF membrane units cannot exceed 0.100 NTU.
4. As specified in Footnote C of 30 TAC §290.111(c)(3)(B).
5. Additional credit allowed if the combined filter effluent (CFE) turbidity level for the conventional gravity filters is less than 0.15 NTU.
6. Additional credit allowed if the individual filter effluent (IFE) turbidity level for each of the conventional gravity filters is less than 0.15 NTU.
7. A system cannot simultaneously claim both the additional 0.5-log credit for CFE turbidity levels below 0.15 NTU and the additional 1.0-log credit for IFE turbidity levels below 0.15 NTU referenced in Footnotes 6 and 7 above. No more than one of two these additional removal credits can be claimed during any given month.

Table B
TCEQ Minimum Required Log Inactivations for the
Proposed Temporary Cypress DPR WTP

	Virus	<i>Giardia</i>	<i>Cryptosporidium</i>
TCEQ Required Log Removal and Inactivation Totals	9.0 ¹	7.0 ²	5.5 ³
TCEQ Maximum Approved Log Removal Credits ⁴	4.0	6.5	6.5
TCEQ Minimum Required Log Inactivation	5.0	1.0⁵	0.0

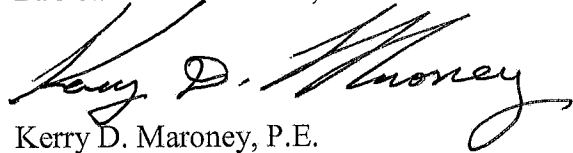
Footnotes:

1. Based on 8.0-log for a maximum reported total culturable virus concentration of 3.87 MPN/L average for 2009 and a required additional 1.0-log safety factor for using preformed chloramines as a predisinfectant of the wastewater treatment plant effluent (i.e., not providing a free chlorine, or another acceptable oxidant, residual prior to using chloramines).
2. Based on a maximum reported *Giardia* cyst concentration of 34.815 cysts per liter on 5/21/2012.
3. Based on a maximum reported *Cryptosporidium* oocyst concentration of 5.038 oocysts per liter on 9/18/2012.
4. Based on the minimum removal credits shown in Table A above.
5. A minimum 1.0-log inactivation using chemical disinfection or UV irradiance must be provided for *Giardia* regardless of total removal credit provided.

As you have additional questions please provide those in a timely manner for our response.

Sincerely,

BIGGS & MATHEWS, INC.

A handwritten signature in black ink, reading "Kerry D. Maroney". The signature is fluid and cursive, with the first name "Kerry" and last name "Maroney" clearly legible, and "D." as a middle initial.

Kerry D. Maroney, P.E.
President

Cc: Russell Schreiber, P.E.
Public Works Director
City of Wichita Falls, Texas

Daniel Nix
Public Utilities Operations Manager
City of Wichita Falls, Texas

Kerry D. Maroney

From: Joel Klumpp [joel.klumpp@tceq.texas.gov]
Sent: Friday, July 05, 2013 7:57 AM
To: Kerry D. Maroney; Daniel Nix; Russell Schreiber
Cc: Linda Brookins; Ada Lichaa; Vera Poe; Jaya Zyman-Ponebshek
Subject: [Wichita Falls] Third Set of Questions re Emergency DPR Project
Attachments: 2430001-07052013 3rd Set Questions.docx; Copy of CT Study Template v7 Excel2007 (2013-05-01).xlsm

Russell, Daniel, and Kerry,

Per discussion at our teleconference on Wednesday afternoon, please see attached for the TCEQ's third set of questions from our review of the materials submitted in support of the Wichita Falls Emergency DPR Project. Also attached is the TCEQ CT Study Spreadsheet v7.

Please let me know if you have any questions.

Thank you,

Joel

Joel Klumpp | Team Leader | Technical Review and Oversight Team | TCEQ

12100 Park 35 Circle, Bldg. F | Austin, Texas 78753 | ☎ (512) 239-4453 Fax: (512) 239-6050 | ✉: Joel.Klumpp@tceq.texas.gov

Wichita Falls Emergency Direct Potable Reuse Project TCEQ's Third Set of Questions and Requests for Information

The following bullet items requesting information were listed in the TCEQ's February 8, 2013 response letter (TCEQ Concept Response) to the City of Wichita Falls' (City) Concept Paper for the Emergency Reuse of Wastewater Effluent as a Source of Direct Potable Reuse in Wichita Falls (City Concept Paper) submitted November 13, 2012. They are repeated here to provide continuity for the discussion of removal and inactivation of viruses and *Giardia* in the DPR plant.

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Please note that 8.0-log or greater (based on the City's selected disinfection protocol), 6.0-log and 5.5-log of removal and/or inactivation of viruses, Giardia cysts and Cryptosporidium oocysts, respectively, only provide protection of public health for specific concentration levels of these pathogens in the RR WWTP effluent. To date, the City has reported the following maximum pathogen concentration for the RR WWTP effluent:
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A description of multi pathogen treatment barriers, an analysis of what levels of treatment will be provided if a single or multi-barriers should fail, and what safeguards will be in place to prevent failure and response actions and timelines for treatment failures.

TCEQ Comment

The TCEQ staff continues our research regarding the health risk at different concentrations of pathogens in the water to be ingested. Surface water treatment plants (SWTPs) must provide a combined removal and inactivation treatment that only allows an average annual risk of 1 infection per 10,000 persons. To achieve this protection, **no more than 7.0×10^{-7} *Giardia* cysts/L** can be in the water ingested. A total of 6.0-log removal and inactivation will only provide this protection if the *Giardia* cyst concentration in a raw water source is no greater than 7.0 cysts/L. However, the City's reported maximum *Giardia* concentration in the RR WWTP effluent was 34.815 cysts/L.

Wichita Falls Emergency Direct Potable Reuse Project TCEQ's Third Set of Questions and Requests for Information

This concentration of *Giardia* cysts will require **a combined minimum removal and inactivation of 7.0-log for the treatment processes** used by the City when treating the RR WWTP effluent as a raw water source for human consumption. In addition, Texas SWTPs are required to provide a minimum of 0.5-log inactivation of *Giardia* using disinfection regardless of the amount of removal achieved. This requirement provides for multiple barriers against *Giardia*. Therefore, at least 1.0-log inactivation of *Giardia* using an acceptable disinfection process must also be provided.

TCEQ Questions

We have compared the TCEQ Concept Responses pasted on the previous page with the City's submitted preliminary engineering report (PER), exception requests, and proposed Full-Scale Verification Testing Protocol. Based on the change in minimum required log removal and inactivation for *Giardia* and our review, we have the following questions:

1. How do the submitted CT inactivation calculations in the PER's Appendix J, Items Nos. 1 through 4 provide for a total of 1.0-log inactivation for *Giardia* in the RR WWTP effluent at the reported chloramine residuals (measured as monochloramine) for the different disinfection zones? At different chloramine residuals? Please use the attached CT study template to show the inactivation provided by disinfection for both the WWTP effluent and the raw lake water sources.

Please review the attached Table A: TCEQ Approved Maximum Log Removal Credits for the Proposed Temporary Cypress DPR WTP and Table B: TCEQ Minimum Required Log Inactivations for the Proposed Temporary Cypress DPR WTP prior to completing the TCEQ's v7 CT Template.

2. How do the submitted CT inactivation calculations in the PER's Appendix J, Items Nos. 1 - 4 provide for a total of 5.0-log inactivation of viruses in the RR WWTP effluent at the reported chloramine residuals (measured as monochloramine) for the different disinfection zones? At different chloramine residuals?

This question is based on the observation that the proposed removal treatment processes for the RR WWTP effluent can achieve a maximum of 4.0-log removal of virus from the proposed treatment process (see attached Table A). Therefore, a minimum of 5.0-log inactivation must be achieved using either chemical or ultraviolet disinfection (see attached Table B).

3. Please provide all of the laboratory results for total culturable virus concentration in the RR WWTP effluent data.

TCEQ staff found only six results for the total culturable virus concentration in the RR WWTP effluent. We would like to review the entire data set.

Requested Documents

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2. Once you have completed the two TCEQ CT Templates, please submit copies to the TCEQ. Please note:
 - a. TCEQ's version v7 CT Template (attached) **must be used** for demonstrating compliance for the RR WWTP effluent's disinfection protocol. At this time,

**Wichita Falls Emergency Direct Potable Reuse Project
TCEQ's Third Set of Questions and Requests for Information**

under the "Log Inactivations" for "Performance Standards" on the "CT Calculator Worksheet":

- i. 1.0 must be entered in the cell for "*Giardia lamblia* Cysts"; and
 - ii. 5.0 must be entered in the cell for "Viruses."
 - b. Since the TCEQ does not have a CT Template that will allow the calculations for the proposed two separate raw source waters receiving different pre-treatments and requiring different minimum log removals and inactivation, **two separate CT Templates must be completed**: one for each of the following treatment processes:
 - i. 5.0-MGD of RR WWTP effluent being pre-treated with preformed chloramines, through the Cypress 2008 MF/RO SWTP, blended with 5.0-MGD Secondary Reservoir raw surface water after pre-disinfection with chlorine dioxide, and the 10.0-MGD of blended source waters being treated through the Cypress 2010 Conventional SWTP; **and**
 - ii. 5.0-MGD of Secondary Reservoir raw surface water pre disinfected with chlorine dioxide, blended with 5.0-MGD of partially treated RR WWTP effluent, and the 10.0-MGD of blended source waters being treated through the Cypress 2010 Conventional SWTP.
 - c. The minimum required inactivations in TCEQ's attached Table B for viruses, *Giardia*, and *Cryptosporidium* are contingent on:
 - i. The maximum concentrations in the RR WWTP effluent for:
 - A. Viruses being no greater than 22.2 MPN/L;
 - B. *Giardia* being no greater than 70.0 cysts/L; **and**
 - C. *Cryptosporidium* being no greater than 9.48 oocysts/L.
 - ii. The maximum concentrations in the water entering the distribution at the effluent of the 10.0-MG GST for:
 - A. Viruses being no greater than 2.22×10^{-7} MPN/L;
 - B. *Giardia* being no greater than 7.00×10^{-6} cysts/L;
 - C. *Cryptosporidium* being no greater than 2.999×10^{-5} oocysts/L;
and
 - D. *E. coli* being zero organisms found in a sample (no detection).
3. Please provide the following analytical results with the laboratory reports for virus concentrations in the RR WWTP effluent:
 - a. The complete sample set used to obtain the reported 2009 virus average concentration of 3.87 MPN/L in the RR WWTP effluent.
 - b. Any current virus concentration data for the RR WWTP effluent.
4. Provide any new onsite and offsite analytical results for *Giardia* and *Cryptosporidium* concentrations in the RR WWTP effluent.

**Wichita Falls Emergency Direct Potable Reuse Project
TCEQ's Third Set of Questions and Requests for Information**

**Table A
TCEQ Approved Maximum Log Removal Credits for the
Proposed Temporary Cypress DPR WTP**

Individual Removal Barriers	TCEQ Approved Log Removal Pathogen Credit for Individual Removal Barriers		
	Virus	<i>Giardia</i>	<i>Cryptosporidium</i>
MF/RO SWTP's Coagulation, Flocculation and Clarification	0.5 ¹	0.5 ¹	0.5 ¹
MF Membranes	1.5 ¹	3.0 ^{1,2,3}	3.0 ^{1,2,3}
RO Membranes	0.0	0.0	0.0
Conventional SWTP'S Coagulation, Flocculation and Clarification	0.5 ¹	0.5 ¹	0.5
Conventional SWTP's Gravity Filters	1.5 ¹	2.5 ^{1,4}	2.5 ^{1,4}
Gravity Filters w/CFE $\leq$ 0.15 NTU	0.0	(+0.5) ⁵	(+0.5) ⁵
Gravity Filters w/IFE $\leq$ 0.15 NTU	0.0	(+1.0) ⁶	(+1.0) ⁶
Total of TCEQ Maximum Approved Log Removal Credits	4.0	6.5 (7.0 ⁵ or 7.5 ⁶) ⁷	6.5 (7.0 ⁵ or 7.5 ⁶) ⁷

Footnotes:

- Maximum allowed removal by 30 TAC §290.111(d)(1).
- If a TCEQ approved Challenge Test review does not result in a LRV_{C-test} value less than 3.0-log, based on maximum verifiable log removal of 3.0 by a direct integrity test (DIT) as approved in TCEQ's 4/30/2012 letter.
- The combined filtrate effluent for the MF membrane units cannot exceed 0.100 NTU.
- As specified in Footnote C of 30 TAC §290.111(c)(3)(B).
- Additional credit allowed if the combined filter effluent (CFE) turbidity level for the conventional gravity filters is less than 0.15 NTU.
- Additional credit allowed if the individual filter effluent (IFE) turbidity level for each of the conventional gravity filters is less than 0.15 NTU.
- A system cannot simultaneously claim both the additional 0.5-log credit for CFE turbidity levels below 0.15 NTU and the additional 1.0-log credit for IFE turbidity levels below 0.15 NTU referenced in Footnotes 6 and 7 above. No more than one of two these additional removal credits can be claimed during any given month.

**Table B
TCEQ Minimum Required Log Inactivations for the
Proposed Temporary Cypress DPR WTP**

	Virus	<i>Giardia</i>	<i>Cryptosporidium</i>
TCEQ Required Log Removal and Inactivation Totals	9.0 ¹	7.0 ²	5.5 ³
TCEQ Maximum Approved Log Removal Credits ⁴	4.0	6.5	6.5
TCEQ Minimum Required Log Inactivation	5.0	1.0⁵	0.0

Footnotes:

- Based on 8.0-log for a maximum reported total culturable virus concentration of 3.87 MPN/L average for 2009 and a required additional 1.0-log safety factor for using preformed chloramines as a predisinfectant of the wastewater treatment plant effluent (i.e., not providing a free chlorine, or another acceptable oxidant, residual prior to using chloramines).
- Based on a maximum reported *Giardia* cyst concentration of 34.815 cysts per liter on 5/21/2012.
- Based on a maximum reported *Cryptosporidium* oocyst concentration of 5.038 oocysts per liter on 9/18/2012.
- Based on the minimum removal credits shown in Table A above.
- A minimum 1.0-log inactivation using chemical disinfection or UV irradiance must be provided for *Giardia* regardless of total removal credit provided.

ATTACHMENT A

Response To TCEQ Questions 1 & 2

Recalculation of Overall Log Inactivation Credits Using New TCEQ CT Template (v.7)

And

Application of TCEQ Logic on Log Inactivation Requirements

On the 7/18/13 Conference Call, the TCEQ clarified an answer to a City question regarding the application of 7.0 log Giardia & 9.0 log Virus inactivation requirements as they applied to the Raw Surface water coming from the Secondary Reservoir. The City was concerned that the 7.0/9.0 requirement made treating the Secondary Reservoir untreatable at any temperature below 8.8 degrees Celsius, which is the temperature that the City anticipates the water being at while conducting the Full Scale Verification Study. The TCEQ offered the following explanation (though not endorsed by all TCEQ officials on the Conference Call):

- A) If the Wastewater Effluent stream can meet the 7.0 log Giardia & 9.0 log Virus inactivation without any assistance from the 2010 SWTP, then the inactivation calculations for the Secondary Reservoir water could revert back to a removal requirement of 3.0 log for Giardia and 4.0 log for Virus.
- B) If the Wastewater Effluent stream required any removal credits from the 2010 SWTP to meet the 7.0 log Giardia & 9.0 log Virus inactivation, then the inactivation calculations for the Secondary Reservoir water had to utilize the same 7.0 log Giardia & 9.0 log Virus inactivation requirements as the Wastewater Effluent.

The City has performed the following detailed analysis of the inactivation credits, as they relate to the application of the above requirements and the operation of the facilities.

Water Temperature at 25.0° C (or greater)

At 25.0° C and using a Monochloramine residual of 1.3 ppm down the Wastewater Effluent pipeline, the TCEQ CT Template indicates that the City can achieve a 7.24 log Giardia inactivation and a 9.3 log Virus inactivation, without any assistance from the 2010 SWTP. (See attached Table A & Table B).

Therefore, the Secondary Reservoir water inactivation credits can be calculated using 0.5 log Giardia and 2.0 log Virus requirements in the CT Template.

Water Temperature at 20.0° C

At 20.0° C and 1.3 ppm Monochloramine residual, the Wastewater Effluent can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements without 2010 SWTP assistance. (See Table C & Table D). The City has recalculated the CT's utilizing a Monochloramine residual of 1.8 ppm and the 7.0 log Giardia/9.0 log Virus requirements are once again met. (See Table E & Table F).

At this temperature and residual the Secondary Reservoir water inactivation credits can continue to be calculated using 0.5 log Giardia and 2.0 log Virus requirements in the CT Template.

Water Temperature at 19.7° C

At 19.7° C and a 1.8 ppm Monochloramine residual, the Wastewater Effluent once again can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements without the 2010 SWTP assistance. See Table G & Table H). The City has recalculated the CT's utilizing a Monochloramine residual of 2.0 ppm and the 7.0 log Giardia/9.0 log Virus requirements are once again met. (See Table I & Table J).

At this temperature and residual the Secondary Reservoir water inactivation credits can continue to be calculated using 0.5 log Giardia and 2.0 log Virus requirements in the CT Template.

Water Temperature at 18.2° C

At any temperature below 18.2° C and a 2.0 ppm Monochloramine residual, the Wastewater Effluent can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements without the 2010 SWTP assistance. (See Table K & Table L).

At this temperature, any CT calculations for the Secondary Reservoir water inactivation credits would need to utilize the 1.0 log Giardia & 5.0 log Virus requirements. Table M & Table N demonstrates that the Secondary Reservoirs source water can meet the 7.0 log Giardia & 9.0 log Virus requirements of the Wastewater Effluent, at a water temperature of 18.2° C and a Chlorine Dioxide residual of 0.1 ppm down the pipeline from the Secondary Reservoir.

Water Temperature at 16.5° C

At 16.5° C and a 0.1 ppm Chlorine Dioxide, the Secondary Reservoir source water can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements. (See Table O & Table P). The City has recalculated the Secondary Reservoir CT's utilizing a Chlorine Dioxide residual of 0.2 ppm and the 7.0 log Giardia/9.0 log Virus requirements are once again met. (See Table Q & Table R).

Water Temperature at 13.0° C

At 13.0° C and a 0.2 ppm Chlorine Dioxide, the Secondary Reservoir source water can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements. (See Table S & Table T). The City has recalculated the Secondary Reservoir CT's utilizing a Chlorine Dioxide residual of 0.3 ppm and the 7.0 log Giardia/9.0 log Virus requirements are once again met. (See Table U & Table V).

Water Temperature at 8.8° C

At 8.8° C and a 0.3 ppm Chlorine Dioxide, the Secondary Reservoir source water can no longer meet the 7.0 log Giardia and 9.0 log Virus requirements. (See Table W & Table X).

The City has stopped its recalculation of the Secondary Reservoir CT's at a Chlorine Dioxide residual of 0.3 ppm, due to the fact that it has no data to support that the Chlorite Disinfection By-Product could be blended out with the Wastewater Effluent water treated through the Reverse Osmosis Plant.

Water Temperature less than 8.8° C

The City respectfully request that the TCEQ re-evaluate their stance on the application of Wastewater Effluent Log inactivation Credits on the Secondary Reservoir source water. If the TCEQ did allow the City to apply the normal inactivation requirements of 3.0 log Giardia and 4.0 log Virus for the Secondary Reservoir water, independent of the Wastewater Effluent status, then the City could treat water down to a temperature of 5.0° C using a 0.1 ppm Chlorine Dioxide residual (down the Secondary Reservoir pipeline) and meet all of the inactivation requirements. (See Table Y & Table Z).

However, the Wastewater Effluent can only achieve its inactivation credits down to 5.4° C. (See Table AA & Table AB). Therefore, the coldest water temperature that the City of Wichita Falls would be able to effectively treat is 5.4° C.

Cryptosporidium Issue

Since Cryptosporidium is not inactivated by Monochloramine, and the Secondary Reservoir Chlorine Dioxide is not of sufficient concentration or duration to achieve any appreciable inactivation credits, the application of 5.5 log Cryptosporidium inactivation on the Secondary Reservoir renders it untreatable at any temperature.

Therefore, the City of Wichita Falls request that the TCEQ reconsider its stance on the application of the 5.5 log Cryptosporidium inactivation requirement for the Secondary Reservoir source water and allow the continuation of the 2.0 log inactivation credit that the City of Wichita falls already has to meet as provided by 30TAC, Subchapter F, §290.111 (c)(3)(B).

Analysis of Single Barrier Failure on Inactivation Credits

The City has put together a spreadsheet that calculates all inactivation credits and then recalculates based on the removal of a single treatment barrier. (See Tables A through AF)

Viruses

The City analysis indicates that the Wastewater Effluent had problems meeting virus inactivation at a temperature of 5.4° C (see Table AA), with a single barrier removed. These values were significantly below the 9.0 log removal that is required, so the City performed additional analysis to determine at what temperature a single barrier loss would create a treatment issue.

Analysis indicates that the Wastewater Effluent can be treated down to a temperature of 11.5° C and lose any single treatment barrier and still meet the Virus inactivation requirement of 9.0 log. (See Table AC & Table AD)

The City's analysis of the Secondary Reservoir water indicates that losing a single barrier for this source water would cause it to fail to meet the 9.0 log Virus inactivation requirements at temperatures below 18.2° C with 0.1 ppm Chlorine Dioxide residual down the Secondary Reservoir pipeline. (See Table M). This is a consistent failure for all temperatures and Chlorine Dioxide residuals. (See Table O, Q, S, U & W).

However, if the TCEQ relaxes their stance on the application of Wastewater Effluent Log inactivation Credits on the Secondary Reservoir source water and allowed the City to utilize the existing 4.0 log inactivation for Virus in the Secondary Reservoir water, then the City's analysis indicates that it could meet all inactivation requirements with the loss of a single treatment barrier down to a temperature of 5.0°C with a 0.1 ppm Chlorine Dioxide residual. (See Table Y)

Giardia

The City analysis indicates that the Wastewater Effluent had no problems meeting Giardia inactivation at a temperature of 5.0° C (see Table AA), with a single barrier removed.

The City's analysis of the Secondary Reservoir water indicates that losing a single barrier for this source water would cause it to fail to meet the 7.0 log Virus inactivation requirements at temperatures below 20.0° C with 0.3 ppm Chlorine Dioxide residual down the Secondary Reservoir pipeline. (See Table AE & AF). Raising the Chlorine Dioxide residual any higher than this may prove problematic, due to Chlorite disinfection by-product concerns.

However, if the TCEQ relaxes their stance on the application of Wastewater Effluent Log inactivation Credits on the Secondary Reservoir source water and allowed the City to utilize the existing

3.0 log inactivation for Giardiasis in the Secondary Reservoir water, then the City's analysis indicates that it could meet all inactivation requirements with the loss of a single treatment barrier down to a temperature of 5.0°C with a 0.1 ppm Chlorine Dioxide residual. (See Table Y)

Cryptosporidium

Since the inactivation credits for Cryptosporidium rely solely on physical removals, the loss of either the MF Membrane Process (3.0 log removal) or the 2010 Conventional SWTP Gravity Filters (2.5 log removal) would render the removal credit for the Wastewater Effluent attainable.

The City has established triggers that would indicate whether or not either one of these processes were failing and would either shut those filters down and switch to other filters while the deficient filter was evaluated, or shutdown the entire DPR.

With the application of 5.5 log Cryptosporidium inactivation on the Secondary Reservoir source water, and only being treated through the 2010 Conventional SWTP (max log removal credits of 3.0), the Secondary Reservoir water would never be able to meet log removal requirements even with all treatment processes functioning.

Therefore, the City of Wichita Falls request that the TCEQ reconsider its stance on the application of the 5.5 log Cryptosporidium inactivation requirement for the Secondary Reservoir source water and allow the continuation of the 2.0 log inactivation credit that the City of Wichita falls already has to meet as provided by 30TAC, Subchapter F, §290.111 (c)(3)(B). Using this protocol, the only treatment barrier that would present a problem if it were lost would be the 2010 Conventional SWTP Gravity Filters. (See Table Y)

Table A

RRWTP

25.0 degrees Celsius 1.3 ppm down effluent pipeline

	Virus 9	Giardia 7	Crypto 5.5	
Removal Credit Required				
Pipeline RRWTP (Disinfection Zone 1)	4.4	2.25	0	
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5	
MF/RO Clarifier Disinfection (Disinfection Zone 2)	2.87	1.47	0	
MF Filtration	1.5	3	3	
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.03	0.02	0	
RO Membrane Filtration	0	0	0	w/o 2010 SWTP Credit
Conven Coag/Floc/Clarif	0.5	0.5	0.5	Virus 9.3 Giardia 7.24 Crypto 3.5
Conven Filtration	1.5	2.5	2.5	
Optional CFE Credit	0	0.5	0.5	2010 Plant can use
Optional IFE Credit	0	1	1	0.5 log Giardia
Convent Disinfection (Disinfection Zone 4)	1.8	0.92	0	2.0 log Virus
Ground Storage (Disinfectin Zone 5)	6.51	3.33	0	
Total w/o CFE/IFE Options	19.61	14.49	6.5	
Total w/CFE	19.61	14.99	7	
Total w/IFE	19.61	15.49	7.5	

WITHOUT CFE/IFE

Total removing Zone 1	15.21	12.24	6.5
Total removing MF/RO Coag/Floc/Clarif	19.11	13.99	6
Total removing Zone 2	16.74	13.02	6.5
Total removing MF Filtration	18.11	11.49	3.5
Total removing Zone 3	19.58	14.47	6.5
Total removing RO filtration	19.61	14.49	6.5
Total removing Conven Coag/Floc/Clarif	19.11	13.99	6
Total removing Conven Filtration	18.11	11.99	4
Total removing Zone 4	17.81	13.57	6.5
Total removing Zone 5	13.1	11.16	6.5

WITH CFE

Total removing Zone 1	N/A	12.74	7
Total removing MF/RO Coag/Floc/Clarif	N/A	14.49	6.5
Total removing Zone 2	N/A	13.52	7
Total removing MF Filtration	N/A	11.99	4
Total removing Zone 3	N/A	14.97	7
Total removing RO filtration	N/A	14.99	7
Total removing Conven Coag/Floc/Clarif	N/A	14.49	6.5
Total removing Conven Filtration	N/A	12.49	4.5
Total removing Zone 4	N/A	14.07	7
Total removing Zone 5	N/A	11.66	7

WITH IFE

Total removing Zone 1	N/A	13.24	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	14.99	7
Total removing Zone 2	N/A	14.02	7.5
Total removing MF Filtration	N/A	12.49	4.5
Total removing Zone 3	N/A	15.47	7.5
Total removing RO filtration	N/A	15.49	7.5
Total removing Conven Coag/Floc/Clarif	N/A	14.99	7
Total removing Conven Filtration	N/A	12.99	5
Total removing Zone 4	N/A	14.57	7.5
Total removing Zone 5	N/A	12.16	7.5

Table B

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 Reuse Project PLANT NAME OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{calc}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	1.3	7.500	25.0	7.5	572.9	255.0	651.6	2.25	4.40			
CLA D2	1.3	7.500	25.0	7.5	374.4	255.0	651.6	1.47	2.87			
CLA D3	1.3	7.500	25.0	7.5	4.3	255.0	651.6	0.02	0.03	7.98	15.61	3.12
CLA D4	3.5	10.000	25.0	9.0	234.9	255.0	651.6	0.92	1.80			(V)
CLA D5	3.8	10.000	25.0	8.9	848.5	255.0	651.6	3.33	6.51			

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

Table C

RRWTP

20.0 degrees Celsius 1.3ppm down Effluent Pipeline

	Virus	Giardia	Crypto
Removal Credit Required	9	7	5.5
Pipeline RRWTP (Disinfection Zone 1)	3.11	1.55	0
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5
MF/RO Clarifier Disinfection (Disinfection Zone 2)	2.03	1.01	0
MF Filtration	1.5	3	3
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.02	0.01	0
RO Membrane Filtration	0	0	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Convent Disinfection (Disinfection Zone 4)	1.27	0.63	0
Ground Storage (Disinfectin Zone 5)	4.6	2.29	0
Total w/o CFE/IFE Options	15.03	11.99	6.5
Total w/CFE	15.03	12.49	7
Total w/IFE	15.03	12.99	7.5

w/o 2010 SWTP Credit

Virus	Giardia	Crypto
7.16	6.07	3.5

Requires Secondary Reservoir to use
1.0 log Giardia
5.0 log Virus

WITHOUT CFE/IFE

Total removing Zone 1	11.92	10.44	6.5
Total removing MF/RO Coag/Floc/Clarif	14.53	11.49	6
Total removing Zone 2	13	10.98	6.5
Total removing MF Filtration	13.53	8.99	8.5
Total removing Zone 3	15.01	11.98	6.5
Total removing RO filtration	15.03	11.99	6.5
Total removing Conven Coag/Floc/Clarif	14.53	11.49	6
Total removing Conven Filtration	13.53	9.49	4
Total removing Zone 4	13.76	11.36	6.5
Total removing Zone 5	10.43	9.7	6.5

WITH CFE

Total removing Zone 1	N/A	10.94	7
Total removing MF/RO Coag/Floc/Clarif	N/A	11.99	6.5
Total removing Zone 2	N/A	11.48	7
Total removing MF Filtration	N/A	9.49	4
Total removing Zone 3	N/A	12.48	7
Total removing RO filtration	N/A	12.49	7
Total removing Conven Coag/Floc/Clarif	N/A	11.99	6.5
Total removing Conven Filtration	N/A	9.99	4.5
Total removing Zone 4	N/A	11.86	7
Total removing Zone 5	N/A	10.2	7

WITH IFE

Total removing Zone 1	N/A	11.44	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	12.49	7
Total removing Zone 2	N/A	11.98	7.5
Total removing MF Filtration	N/A	9.99	4.5
Total removing Zone 3	N/A	12.98	7.5
Total removing RO filtration	N/A	12.99	7.5
Total removing Conven Coag/Floc/Clarif	N/A	12.49	7
Total removing Conven Filtration	N/A	10.49	5
Total removing Zone 4	N/A	12.36	7.5
Total removing Zone 5	N/A	10.7	7.5

Table D

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 Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL		
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	1.3	7.500	20.0	7.5	572.9	370.0	921.5	1.55	3.11			
CLA D2	1.3	7.500	20.0	7.5	374.4	370.0	921.5	1.01	2.03			
CLA D3	1.3	7.500	20.0	7.5	4.3	370.0	921.5	0.01	0.02	5.50	11.04	2.21
CLA D4	3.5	10.000	20.0	9.0	234.9	370.0	921.5	0.63	1.27			(1)
CLA D5	3.8	10.000	20.0	8.9	848.5	370.0	921.5	2.29	4.60			

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

Table E

RRWTP

20.0 degrees Celsius 1.8ppm down Effluent Pipeline

	Virus	Giardia	Crypto	
Removal Credit Required	9	7	5.5	
Pipeline RRWTP (Disinfection Zone 1)	4.3	2.14	0	
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5	
MF/RO Clarifier Disinfection (Disinfection Zone 2)	2.81	1.4	0	
MF Filtration	1.5	3	3	
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.03	0.02	0	
RO Membrane Filtration	0	0	0	
Conven Coag/Floc/Clarif	0.5	0.5	0.5	
Conven Filtration	1.5	2.5	2.5	
Optional CFE Credit	0	0.5	0.5	
Optional IFE Credit	0	1	1	
Convent Disinfection (Disinfection Zone 4)	1.27	0.63	0	
Ground Storage (Disinfectin Zone 5)	4.6	2.29	0	
				w/o 2010 SWTP Credit
				Virus Giardia Crypto
				9.14 7.06 3.5
				2010 Plant can use
				0.5 log Giardia
				2.0 log Virus
Total w/o CFE/IFE Options	17.01	12.98	6.5	
Total w/CFE	17.01	13.48	7	
Total w/IFE	17.01	13.98	7.5	

WITHOUT CFE/IFE

Total removing Zone 1	12.71	10.84	6.5
Total removing MF/RO Coag/Floc/Clarif	16.51	12.48	6
Total removing Zone 2	14.2	11.58	6.5
Total removing MF Filtration	15.51	9.98	3.5
Total removing Zone 3	16.98	12.96	6.5
Total removing RO filtration	17.01	12.98	6.5
Total removing Conven Coag/Floc/Clarif	16.51	12.48	6
Total removing Conven Filtration	15.51	10.48	4
Total removing Zone 4	15.74	12.35	6.5
Total removing Zone 5	12.41	10.69	6.5

WITH CFE

Total removing Zone 1	N/A	11.34	7
Total removing MF/RO Coag/Floc/Clarif	N/A	12.98	6.5
Total removing Zone 2	N/A	12.08	7
Total removing MF Filtration	N/A	10.48	4
Total removing Zone 3	N/A	13.46	7
Total removing RO filtration	N/A	13.48	7
Total removing Conven Coag/Floc/Clarif	N/A	12.98	6.5
Total removing Conven Filtration	N/A	10.98	4.5
Total removing Zone 4	N/A	12.85	7
Total removing Zone 5	N/A	11.19	7

WITH IFE

Total removing Zone 1	N/A	11.84	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	13.48	7
Total removing Zone 2	N/A	12.58	7.5
Total removing MF Filtration	N/A	10.98	4.5
Total removing Zone 3	N/A	13.96	7.5
Total removing RO filtration	N/A	13.98	7.5
Total removing Conven Coag/Floc/Clarif	N/A	13.48	7
Total removing Conven Filtration	N/A	11.48	5
Total removing Zone 4	N/A	13.35	7.5
Total removing Zone 5	N/A	11.69	7.5

Table F

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 Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	1.8	7.500	20.0	7.5	793.3	370.0	921.5	2.14	4.30			
CLA D2	1.8	7.500	20.0	7.5	518.4	370.0	921.5	1.40	2.81			
CLA D3	1.8	7.500	20.0	7.5	5.9	370.0	921.5	0.02	0.03	6.49	13.03	2.61
CLA D4	3.5	10.000	20.0	9.0	234.9	370.0	921.5	0.63	1.27			(V)
CLA D5	3.8	10.000	20.0	8.9	848.5	370.0	921.5	2.29	4.60			

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

Table G

RRWTP

19.7 degrees Celsius 1.8ppm down Effluent Pipeline

	Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5	
Pipeline RRWWTP (Disinfection Zone 1)		4.22	2.1	0	
MF/RO Coag/Floc/Clarif		0.5	0.5	0.5	
MF/RO Clarifier Disinfection (Disinfection Zone 2)		2.75	1.38	0	
MF Filtration		1.5	3	3	
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)		0.03	0.02	0	
RO Membrane Filtration		0	0	0	
Conven Coag/Floc/Clarif		0.5	0.5	0.5	
Conven Filtration		1.5	2.5	2.5	
Optional CFE Credit		0	0.5	0.5	
Optional IFE Credit		0	1	1	
Convent Disinfection (Disinfection Zone 4)		1.25	0.62	0	
Ground Storage (Disinfectin Zone 5)		4.51	2.25	0	
Total w/o CFE/IFE Options		16.76	12.87	6.5	
Total w/CFE		16.76	13.37	7	
Total w/IFE		16.76	13.87	7.5	

w/o 2010 SWTP Credit

Virus	Giardia	Crypto
9	7	3.5

Would Require Secondary Reservoir to use
1.0 log Giardia
5.0 log Virus

WITHOUT CFE/IFE

Total removing Zone 1	12.54	10.77	6.5
Total removing MF/RO Coag/Floc/Clarif	16.26	12.37	6
Total removing Zone 2	14.01	11.49	6.5
Total removing MF Filtration	15.26	9.87	3.5
Total removing Zone 3	16.73	12.85	6.5
Total removing RO filtration	16.76	12.87	6.5
Total removing Conven Coag/Floc/Clarif	16.26	12.37	6
Total removing Conven Filtration	15.26	10.37	4
Total removing Zone 4	15.51	12.25	6.5
Total removing Zone 5	12.25	10.62	6.5

WITH CFE

Total removing Zone 1	N/A	11.27	7
Total removing MF/RO Coag/Floc/Clarif	N/A	12.87	6.5
Total removing Zone 2	N/A	11.99	7
Total removing MF Filtration	N/A	10.37	4
Total removing Zone 3	N/A	13.35	7
Total removing RO filtration	N/A	13.37	7
Total removing Conven Coag/Floc/Clarif	N/A	12.87	6.5
Total removing Conven Filtration	N/A	10.87	4.5
Total removing Zone 4	N/A	12.75	7
Total removing Zone 5	N/A	11.12	7

WITH IFE

Total removing Zone 1	N/A	11.77	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	13.37	7
Total removing Zone 2	N/A	12.49	7.5
Total removing MF Filtration	N/A	10.87	4.5
Total removing Zone 3	N/A	13.85	7.5
Total removing RO filtration	N/A	13.87	7.5
Total removing Conven Coag/Floc/Clarif	N/A	13.37	7
Total removing Conven Filtration	N/A	11.37	5
Total removing Zone 4	N/A	13.25	7.5
Total removing Zone 5	N/A	11.62	7.5

Table H

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 Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES											
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Inact. Ratio
CLA D1	1.8	7.500	19.7	7.5	793.3	376.9	376.9	940.9	2.10	4.22	
CLA D2	1.8	7.500	19.7	7.5	518.4	376.9	376.9	940.9	1.38	2.75	
CLA D3	1.8	7.500	19.7	7.5	5.9	376.9	376.9	940.9	0.02	0.03	
CLA D4	3.5	10.000	19.7	9.0	234.9	376.9	376.9	940.9	0.62	1.25	2.55
CLA D5	3.8	10.000	19.7	8.9	848.5	376.9	376.9	940.9	2.25	4.51	(N)
PLANT TOTAL											
										6.37	12.76
											(N)

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

CT STUDY

Table I

RRWTP

19.7 degrees Celsius 2.0ppm down Effluent Pipeline

	Virus	Giardia	Crypto	
Removal Credit Required	9	7	5.5	
Pipeline RRWWTP (Disinfection Zone 1)	4.68	2.34	0	
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5	
MF/RO Clarifier Disinfection (Disinfection Zone 2)	3.06	1.53	0	
MF Filtration	1.5	3	3	
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.03	0.02	0	w/o 2010 SWTP Credit
RO Membrane Filtration	0	0	0	Virus Giardia Crypto
Conven Coag/Floc/Clarif	0.5	0.5	0.5	9.77 7.39 3.5
Conven Filtration	1.5	2.5	2.5	
Optional CFE Credit	0	0.5	0.5	2010 Plant can use
Optional IFE Credit	0	1	1	0.5 log Giardia
Convent Disinfection (Disinfection Zone 4)	1.25	0.62	0	2.0 log Virus
Ground Storage (Disinfectin Zone 5)	4.51	2.25	0	
Total w/o CFE/IFE Options	17.53	13.26	6.5	
Total w/CFE	17.53	13.76	7	
Total w/IFE	17.53	14.26	7.5	

WITHOUT CFE/IFE

Total removing Zone 1	12.85	10.92	6.5
Total removing MF/RO Coag/Floc/Clarif	17.03	12.76	6
Total removing Zone 2	14.47	11.73	6.5
Total removing MF Filtration	16.03	10.26	3.5
Total removing Zone 3	17.5	13.24	6.5
Total removing RO filtration	17.53	13.26	6.5
Total removing Conven Coag/Floc/Clarif	17.03	12.76	6
Total removing Conven Filtration	16.03	10.76	4
Total removing Zone 4	16.28	12.64	6.5
Total removing Zone 5	13.02	11.01	6.5

WITH CFE

Total removing Zone 1	N/A	11.42	7
Total removing MF/RO Coag/Floc/Clarif	N/A	13.26	6.5
Total removing Zone 2	N/A	12.23	7
Total removing MF Filtration	N/A	10.76	4
Total removing Zone 3	N/A	13.74	7
Total removing RO filtration	N/A	13.76	7
Total removing Conven Coag/Floc/Clarif	N/A	13.26	6.5
Total removing Conven Filtration	N/A	11.26	4.5
Total removing Zone 4	N/A	13.14	7
Total removing Zone 5	N/A	11.51	7

WITH IFE

Total removing Zone 1	N/A	11.92	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	13.76	7
Total removing Zone 2	N/A	12.73	7.5
Total removing MF Filtration	N/A	11.26	4.5
Total removing Zone 3	N/A	14.24	7.5
Total removing RO filtration	N/A	14.26	7.5
Total removing Conven Coag/Floc/Clarif	N/A	13.76	7
Total removing Conven Filtration	N/A	11.76	5
Total removing Zone 4	N/A	13.64	7.5
Total removing Zone 5	N/A	12.01	7.5

Table J

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: _____ PLANT NAME OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

City of Wichita Falls Reuse Project

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS													
APPROVED CT STUDY PARAMETERS								PERFORMANCE STANDARDS					
Parameters		Disinfection Zones					Log Inactivations			Viruses			
		D1	D2	D3	D4	D5	Giardia lamblia Cysts	Log					
Flow Rate (MGD)		7.500	7.500	2.788	9.999	9.999	1.0			5.0			
T ₁₀ (minutes)		440.7	288.0	8.8	67.1	223.3							

DISINFECTION PROCESS DATA													
INDIVIDUAL DISINFECTION ZONES													
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio	
CLA D1	2.0	7.500	19.7	7.5	881.4	376.9	940.9	2.34	4.68				
CLA D2	2.0	7.500	19.7	7.5	576.0	376.9	940.9	1.53	3.06				
CLA D3	2.0	7.500	19.7	7.5	6.5	376.9	940.9	0.02	0.03	6.76	13.54	2.71	
CLA D4	3.5	10.000	19.7	9.0	234.9	376.9	940.9	0.62	1.25				(W)
CLA D5	3.8	10.000	19.7	8.9	848.5	376.9	940.9	2.25	4.51				

SUBMITTED BY: _____ Date: _____

Certificate No. _____ and Grade: _____

TCEQ - (05-01-13)

CT STUDY

Table K

RRWTP HIGH Temperature

18.2 degrees Celsius down effluent pipeline

	Virus	Giardia	Crypto	
Removal Credit Required	9	7	5.5	
Pipeline RRWWTP (Disinfection Zone 1)	4.22	2.14	0	
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5	
MF/RO Clarifier Disinfection (Disinfection Zone 2)	2.76	1.4	0	
MF Filtration	1.5	3	3	
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.03	0.02	0	
RO Membrane Filtration	0	0	0	
Conven Coag/Floc/Clarif	0.5	0.5	0.5	<u>w/o 2010 SWTP Credit</u>
Conven Filtration	1.5	2.5	2.5	Virus Giardia Crypto
Optional CFE Credit	0	0.5	0.5	9.01 7.06 3.5
Optional IFE Credit	0	1	1	Would Require Secondary Reservoir to use
Convent Disinfection (Disinfection Zone 4)	1.13	0.57	0	1.0 log Giardia
Ground Storage (Disinfectin Zone 5)	4.06	2.06	0	5.0 log Virus
Total w/o CFE/IFE Options	16.2	12.69	6.5	
Total w/CFE	16.2	13.19	7	
Total w/IFE	16.2	13.69	7.5	

WITHOUT CFE/IFE

Total removing Zone 1	11.98	10.55	6.5
Total removing MF/RO Coag/Floc/Clarif	15.7	12.19	6
Total removing Zone 2	13.44	11.29	6.5
Total removing MF Filtration	14.7	9.69	3.5
Total removing Zone 3	16.17	12.67	6.5
Total removing RO filtration	16.2	12.69	6.5
Total removing Conven Coag/Floc/Clarif	15.7	12.19	6
Total removing Conven Filtration	14.7	10.19	4
Total removing Zone 4	15.07	12.12	6.5
Total removing Zone 5	12.14	10.63	6.5

WITH CFE

Total removing Zone 1	N/A	11.05	7
Total removing MF/RO Coag/Floc/Clarif	N/A	12.69	6.5
Total removing Zone 2	N/A	11.79	7
Total removing MF Filtration	N/A	10.19	4
Total removing Zone 3	N/A	13.17	7
Total removing RO filtration	N/A	13.19	7
Total removing Conven Coag/Floc/Clarif	N/A	12.69	6.5
Total removing Conven Filtration	N/A	10.69	4.5
Total removing Zone 4	N/A	12.62	7
Total removing Zone 5	N/A	11.13	7

WITH IFE

Total removing Zone 1	N/A	11.55	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	13.19	7
Total removing Zone 2	N/A	12.29	7.5
Total removing MF Filtration	N/A	10.69	4.5
Total removing Zone 3	N/A	13.67	7.5
Total removing RO filtration	N/A	13.69	7.5
Total removing Conven Coag/Floc/Clarif	N/A	13.19	7
Total removing Conven Filtration	N/A	11.19	5
Total removing Zone 4	N/A	13.12	7.5
Total removing Zone 5	N/A	11.63	7.5

Table L

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 Reuse Project PLANT NAME RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES											
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CLA D1	2.0	7.500	18.2	7.5	881.4	411.4	1044.0	2.14	4.22	6.19	12.20
CLA D2	2.0	7.500	18.2	7.5	576.0	411.4	1044.0	1.40	2.76		
CLA D3	2.0	7.500	18.2	7.5	6.5	411.4	1044.0	0.02	0.03		
CLA D4	3.5	10.000	18.2	9.0	234.9	411.4	1044.0	0.57	1.13		
CLA D5	3.8	10.000	18.2	8.9	848.5	411.4	1044.0	2.06	4.06		
PLANT TOTAL											

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

TCEQ - (05-01-13)

CT STUDY

Table M

Secondary Reservoir
18.2 degrees Celsius @ 0.1 ClO2

	Virus	Giardia	Crypto
Removal Credit Required	9	7	5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.17	0.15	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.21	0.19	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	2.36	2.15	0
2010 SWTP Disinfection (Disinfection Zone 4)	1.13	0.57	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	4.06	2.06	0
Total w/o CFE/IFE Options	9.93	8.12	3
Total w/CFE	9.93	8.62	3.5
Total w/IFE	9.93	9.12	4

Meets the requirements for
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	9.76	7.97	3
Total removing Zone 2	9.72	7.93	3
Total removing Zone 3	7.57	5.97	3
Total removing Zone 4	8.8	7.55	3
Total removing Conven Coag/Floc/Clarif	9.43	7.62	2.5
Total removing Conven Filtration	8.43	5.62	0.5
Total removing Zone 5	5.87	6.06	3

WITH CFE

Total removing Zone 1	N/A	8.47	3.5
Total removing Zone 2	N/A	8.43	3.5
Total removing Zone 3	N/A	6.47	3.5
Total removing Zone 4	N/A	8.05	3.5
Total removing Conven Coag/Floc/Clarif	N/A	8.12	3
Total removing Conven Filtration	N/A	6.12	1
Total removing Zone 5	N/A	6.56	3.5

WITH IFE

Total removing Zone 1	N/A	8.97	4
Total removing Zone 2	N/A	8.93	4
Total removing Zone 3	N/A	6.97	4
Total removing Zone 4	N/A	8.55	4
Total removing Conven Coag/Floc/Clarif	N/A	8.62	3.5
Total removing Conven Filtration	N/A	6.62	1.5
Total removing Zone 5	N/A	7.06	4

Table N

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:	Cypress WTP Reuse Project	PLANT NAME OR NUMBER:	Secondary Res. Through Cypress Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CL02 D1	0.1	5.000	18.2	8.2	0.8	5.4	24.6	0.15	0.17	0.21		
CL02 D2	0.1	5.000	18.2	8.2	1.0	5.4	24.6	0.19	0.21	0.21		
CL02 D3	0.1	5.000	18.2	8.2	11.6	5.4	24.6	2.15	2.36	2.36	5.13	1.59
CLA D4	3.5	10.000	18.2	9.0	234.9	411.4	1044.0	0.57	1.13	1.13		(N)
CLA D5	3.8	10.000	18.2	8.9	848.5	411.4	1044.0	2.06	4.06	4.06		

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

Table 0

Secondary Reservoir

16.5 degrees Celsius @ 0.1 ClO2

	Virus	Giardia	Crypto
Removal Credit Required	9	7	5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.15	0.14	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.19	0.18	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	2.1	1.98	0
2010 SWTP Disinfection (Disinfection Zone 4)	1	0.52	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	3.61	1.88	0
Total w/o CFE/IFE Options	9.05	7.7	3
Total w/CFE	9.05	8.2	3.5
Total w/IFE	9.05	8.7	4

Meets the requirements for
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	8.9	7.56	3
Total removing Zone 2	8.86	7.52	3
Total removing Zone 3	6.95	5.72	3
Total removing Zone 4	8.05	7.18	3
Total removing Conven Coag/Floc/Clarif	8.55	7.2	2.5
Total removing Conven Filtration	7.55	5.2	0.5
Total removing Zone 5	5.44	5.82	3

WITH CFE

Total removing Zone 1	N/A	8.06	3.5
Total removing Zone 2	N/A	8.02	3.5
Total removing Zone 3	N/A	6.22	3.5
Total removing Zone 4	N/A	7.68	3.5
Total removing Conven Coag/Floc/Clarif	N/A	7.7	3
Total removing Conven Filtration	N/A	5.7	1
Total removing Zone 5	N/A	6.32	3.5

WITH IFE

Total removing Zone 1	N/A	8.56	4
Total removing Zone 2	N/A	8.52	4
Total removing Zone 3	N/A	6.72	4
Total removing Zone 4	N/A	8.18	4
Total removing Conven Coag/Floc/Clarif	N/A	8.2	3.5
Total removing Conven Filtration	N/A	6.2	1.5
Total removing Zone 5	N/A	6.82	4

Table P

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: Cypress WTP Reuse Project PLANT NAME OR NUMBER: Secondary Res. Through Cypress Conventional

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
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 D1	0.1	5.000	16.5	8.2	0.8	5.9	27.6	0.14	0.15			
CLO2 D2	0.1	5.000	16.5	8.2	1.0	5.9	27.6	0.18	0.19			
CLO2 D3	0.1	5.000	16.5	8.2	11.6	5.9	27.6	1.98	2.10	4.71	7.05	1.41
CLA D4	3.5	10.000	16.5	9.0	234.9	450.5	1174.6	0.52	1.00			(N)
CLA D5	3.8	10.000	16.5	8.9	848.5	450.5	1174.6	1.88	3.61			
PLANT TOTAL												

SUBMITTED BY: _____ Certificate No. _____ and Grade: _____ Date: _____

TCEQ - (05-01-13)

CT STUDY

Table Q

Secondary Reservoir
16.5 degrees Celsius @ 0.2 ClO2

Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.3	0.28	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.38	0.35	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	4.2	3.97	0
2010 SWTP Disinfection (Disinfection Zone 4)	1	0.52	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	3.61	1.88	0
Total w/o CFE/IFE Options	11.49	10	3
Total w/CFE	11.49	10.5	3.5
Total w/IFE	11.49	11	4

Meets the requirements for
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	11.19	9.72	3
Total removing Zone 2	11.11	9.65	3
Total removing Zone 3	7.29	6.03	3
Total removing Zone 4	10.49	9.48	3
Total removing Conven Coag/Floc/Clarif	10.99	9.5	2.5
Total removing Conven Filtration	9.99	7.5	0.5
Total removing Zone 5	7.88	8.12	3

WITH CFE

Total removing Zone 1	N/A	10.22	3.5
Total removing Zone 2	N/A	10.15	3.5
Total removing Zone 3	N/A	6.53	3.5
Total removing Zone 4	N/A	9.98	3.5
Total removing Conven Coag/Floc/Clarif	N/A	10	3
Total removing Conven Filtration	N/A	8	1
Total removing Zone 5	N/A	8.62	3.5

WITH IFE

Total removing Zone 1	N/A	10.72	4
Total removing Zone 2	N/A	10.65	4
Total removing Zone 3	N/A	7.03	4
Total removing Zone 4	N/A	10.48	4
Total removing Conven Coag/Floc/Clarif	N/A	10.5	3.5
Total removing Conven Filtration	N/A	8.5	1.5
Total removing Zone 5	N/A	9.12	4

Table R

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:

Cypress WTP Reuse Project

PLANT NAME
OR NUMBER:

Secondary Res. Through Cypress Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters		Disinfection Zones					Log Inactivations		
	D1	D2	D3	D4	D5	Giardia lamblia Cysts	Viruses		
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0			
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				5.0

DISINFECTION PROCESS DATA									
INDIVIDUAL DISINFECTION ZONES									
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log
CLO2 D1	0.2	5.000	16.5	8.2	1.7	5.9	27.6	0.28	0.30
CLO2 D2	0.2	5.000	16.5	8.2	2.1	5.9	27.6	0.35	0.38
CLO2 D3	0.2	5.000	16.5	8.2	23.2	5.9	27.6	3.97	4.20
CLA D4	3.5	10.000	16.5	9.0	234.9	450.5	1174.6	0.52	1.00
CLA D5	3.8	10.000	16.5	8.9	848.5	450.5	1174.6	1.88	3.61

PLANT TOTAL				
	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
	7.01	9.49		1.90

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (05-01-13)

CT STUDY

Table S

Secondary Reservoir
13.0 degrees Celsius @ 0.2 ClO2

Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.24	0.24	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.29	0.31	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	3.3	3.42	0
2010 SWTP Disinfection (Disinfection Zone 4)	0.78	0.44	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	2.83	1.6	0
Total w/o CFE/IFE Options	9.44	9.01	3
Total w/CFE	9.44	9.51	3.5
Total w/IFE	9.44	10.01	4

Meets the requirement
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	9.2	8.77	3
Total removing Zone 2	9.15	8.7	3
Total removing Zone 3	6.14	5.59	3
Total removing Zone 4	8.66	8.57	3
Total removing Conven Coag/Floc/Clarif	8.94	8.51	2.5
Total removing Conven Filtration	7.94	6.51	0.5
Total removing Zone 5	6.61	7.41	3

WITH CFE

Total removing Zone 1	N/A	9.27	3.5
Total removing Zone 2	N/A	9.2	3.5
Total removing Zone 3	N/A	6.09	3.5
Total removing Zone 4	N/A	9.07	3.5
Total removing Conven Coag/Floc/Clarif	N/A	9.01	3
Total removing Conven Filtration	N/A	7.01	1
Total removing Zone 5	N/A	7.91	3.5

WITH IFE

Total removing Zone 1	N/A	9.77	4
Total removing Zone 2	N/A	9.7	4
Total removing Zone 3	N/A	6.59	4
Total removing Zone 4	N/A	9.57	4
Total removing Conven Coag/Floc/Clarif	N/A	9.51	3.5
Total removing Conven Filtration	N/A	7.51	1.5
Total removing Zone 5	N/A	8.41	4

Table T

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: Cypress WTP Reuse Project

PWS ID No.: 2430001

PLANT NAME OR NUMBER: Secondary Res. Through Cypress Conventional

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES											
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CLO2 D1	0.2	5.000	13.0	8.2	1.7	6.8	35.2	0.24	0.24	6.01	1.49 (V)
CLO2 D2	0.2	5.000	13.0	8.2	2.1	6.8	35.2	0.31	0.29		
CLO2 D3	0.2	5.000	13.0	8.2	23.2	6.8	35.2	3.42	3.30		
CLA D4	3.5	10.000	13.0	9.0	234.9	531.0	1497.1	0.44	0.78		
CLA D5	3.8	10.000	13.0	8.9	848.5	531.0	1497.1	1.60	2.83		
PLANT TOTAL											

SUBMITTED BY: _____

TCEQ - (05-01-13)

Certificate No. _____

and Grade: _____

Date: _____

CT STUDY

Table 4

Secondary Reservoir

13.0 degrees Celsius @ 0.3 ClO₂

Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.35	0.37	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.44	0.46	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	4.94	5.13	0
2010 SWTP Disinfection (Disinfection Zone 4)	0.78	0.44	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	2.83	1.6	0

Total w/o CFE/IFE Options

11.34 11 3

Total w/CFE

11.34 11.5 3.5

Total w/IFE

11.34 12 4

Meets the requirements for
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	10.99	10.63	3
Total removing Zone 2	10.9	10.54	3
Total removing Zone 3	6.4	5.87	3
Total removing Zone 4	10.56	10.56	3
Total removing Conven Coag/Floc/Clarif	10.84	10.5	2.5
Total removing Conven Filtration	9.84	8.5	0.5
Total removing Zone 5	8.51	9.4	3

WITH CFE

Total removing Zone 1	N/A	11.13	3.5
Total removing Zone 2	N/A	11.04	3.5
Total removing Zone 3	N/A	6.37	3.5
Total removing Zone 4	N/A	11.06	3.5
Total removing Conven Coag/Floc/Clarif	N/A	11	3
Total removing Conven Filtration	N/A	9	1
Total removing Zone 5	N/A	9.9	3.5

WITH IFE

Total removing Zone 1	N/A	11.63	4
Total removing Zone 2	N/A	11.54	4
Total removing Zone 3	N/A	6.87	4
Total removing Zone 4	N/A	11.56	4
Total removing Conven Coag/Floc/Clarif	N/A	11.5	3.5
Total removing Conven Filtration	N/A	9.5	1.5
Total removing Zone 5	N/A	10.4	4

Table V

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:

Cypress WTP Reuse Project

PLANT NAME
OR NUMBER:

Secondary Res. Through Cypress Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters		Disinfection Zones			Log Inactivations			Viruses	
	D1	D2	D3	D4	D5	Giardia lamblia Cysts			
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0			
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				5.0

DISINFECTION PROCESS DATA										
INDIVIDUAL DISINFECTION ZONES										
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{calc}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Inact. Ratio
CLO2 D1	0.3	5.000	13.0	8.2	2.5	6.8	35.2	0.37	0.35	
CLO2 D2	0.3	5.000	13.0	8.2	3.1	6.8	35.2	0.46	0.44	
CLO2 D3	0.3	5.000	13.0	8.2	34.8	6.8	35.2	5.13	4.94	
CLA D4	3.5	10.000	13.0	9.0	234.9	531.0	1497.1	0.44	0.78	
CLA D5	3.8	10.000	13.0	8.9	848.5	531.0	1497.1	1.60	2.83	
PLANT TOTAL										
								8.00	9.36	1.87
										(V)

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (05-01-13)

CT STUDY

Table W

Secondary Reservoir
8.8 degrees Celsius @ 0.3 ClO2

Removal Credit Required	Virus	Giardia	Crypto
	9	7	5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.26	0.31	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.33	0.39	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	3.7	4.41	0
2010 SWTP Disinfection (Disinfection Zone 4)	0.59	0.37	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	2.12	1.35	0
Total w/o CFE/IFE Options	9	9.83	3
Total w/CFE	9	10.33	3.5
Total w/IFE	9	10.83	4

Meets the requirement
1.0 Giardia
5.0 Virus

WITHOUT CFE/IFE

Total removing Zone 1	8.74	9.52	3
Total removing Zone 2	8.67	9.44	3
Total removing Zone 3	5.3	5.42	3
Total removing Zone 4	8.41	9.46	3
Total removing Conven Coag/Floc/Clarif	8.5	9.33	2.5
Total removing Conven Filtration	7.5	7.33	0.5
Total removing Zone 5	6.88	8.48	3

WITH CFE

Total removing Zone 1	N/A	10.02	3.5
Total removing Zone 2	N/A	9.94	3.5
Total removing Zone 3	N/A	5.92	3.5
Total removing Zone 4	N/A	9.96	3.5
Total removing Conven Coag/Floc/Clarif	N/A	9.83	3
Total removing Conven Filtration	N/A	7.83	1
Total removing Zone 5	N/A	8.98	3.5

WITH IFE

Total removing Zone 1	N/A	10.52	4
Total removing Zone 2	N/A	10.44	4
Total removing Zone 3	N/A	6.42	4
Total removing Zone 4	N/A	10.46	4
Total removing Conven Coag/Floc/Clarif	N/A	10.33	3.5
Total removing Conven Filtration	N/A	8.33	1.5
Total removing Zone 5	N/A	9.48	4

Table X

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: Cypress WTP Reuse Project

PWS ID No.: 2430001

PLANT NAME OR NUMBER: Secondary Res. Through Cypress Conventional

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters		Disinfection Zones			Log Inactivations				
		D1	D2	D3	D4	D5	Giardia lamblia Cysts		
Flow Rate (MGD)		5.000	5.000	5.000	9.999	9.999			
T ₁₀ (minutes)		8.3	10.4	116.1	67.1	223.3	1.0		
							Viruses		
							5.0		

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{calc}	Giardia CT _{read}	Virus CT _{read}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CL02 D1	0.3	5.000	8.8	8.2	2.5	7.9	47.1	0.31	0.26			
CL02 D2	0.3	5.000	8.8	8.2	3.1	7.9	47.1	0.39	0.33			
CL02 D3	0.3	5.000	8.8	8.2	34.8	7.9	47.1	4.41	3.70			
CLA D4	3.5	10.000	8.8	9.0	234.9	627.6	2002.9	0.37	0.59	6.84	6.99	1.40
CLA D5	3.8	10.000	8.8	8.9	848.5	627.6	2002.9	1.35	2.12			
										PLANT TOTAL		

SUBMITTED BY: _____

TCEQ - (05-01-13)

Certificate No. _____ and Grade: _____

Date: _____

CT STUDY

Table Y

Secondary Reservoir

5.0 degrees Celsius @ 0.1 ClO2

Removal Credit Required	Virus 4	Giardia 3	Crypto 2
Secondary Reservoir Pipeline (Disinfection Zone 1)	0.29	0.09	0
Secondary Reservoir Pipeline (Disinfection Zone 2)	0.36	0.12	0
Secondary Reservoir Pipeline (Disinfection Zone 3)	4.06	1.3	0
2010 SWTP Disinfection (Disinfection Zone 4)	0.55	0.33	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)	1.98	1.19	0
Total w/o CFE/IFE Options	9.24	6.03	3
Total w/CFE	9.24	6.53	3.5
Total w/IFE	9.24	7.03	4

WITHOUT CFE/IFE

Total removing Zone 1	8.95	5.94	3
Total removing Zone 2	8.88	5.91	3
Total removing Zone 3	5.18	4.73	3
Total removing Zone 4	8.69	5.7	3
Total removing Conven Coag/Floc/Clarif	8.74	5.53	2.5
Total removing Conven Filtration	7.74	3.53	0.5
Total removing Zone 5	7.26	4.84	3

WITH CFE

Total removing Zone 1	N/A	6.44	3.5
Total removing Zone 2	N/A	6.41	3.5
Total removing Zone 3	N/A	5.23	3.5
Total removing Zone 4	N/A	6.2	3.5
Total removing Conven Coag/Floc/Clarif	N/A	6.03	3
Total removing Conven Filtration	N/A	4.03	1
Total removing Zone 5	N/A	5.34	3.5

WITH IFE

Total removing Zone 1	N/A	6.94	4
Total removing Zone 2	N/A	6.91	4
Total removing Zone 3	N/A	5.73	4
Total removing Zone 4	N/A	6.7	4
Total removing Conven Coag/Floc/Clarif	N/A	6.53	3.5
Total removing Conven Filtration	N/A	4.53	1.5
Total removing Zone 5	N/A	5.84	4

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

Secondary Res. Through Cypress Conventional

Date:

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	Inact. Ratio
ClO2 D1	0.1	5.000	5.0	8.2	0.8	4.5	5.7	0.09	0.29	
ClO2 D2	0.1	5.000	5.0	8.2	1.0	4.5	5.7	0.12	0.36	
ClO2 D3	0.1	5.000	5.0	8.2	11.6	4.5	5.7	1.30	4.06	
CLA D4	3.5	10.000	5.0	9.0	234.9	357.5	857.0	0.33	0.55	3.62
CLA D5	3.8	10.000	5.0	8.9	848.5	357.5	857.0	1.19	1.98	(A)

Date:

CT STUDY

Table AA

RRWTP

5.4 degrees Celsius @ 2.0 ppm down pipeline

	Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Pipeline RRWWTP (Disinfection Zone 1)		1.74	1.25	0
MF/RO Coag/Floc/Clarif		0.5	0.5	0.5
MF/RO Clarifier Disinfection (Disinfection Zone 2)		1.14	0.82	0
MF Filtration		1.5	3	3
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)		0.01	0.01	0
RO Membrane Filtration		0	0	0
Conven Coag/Floc/Clarif		0.5	0.5	0.5
Conven Filtration		1.5	2.5	2.5
Optional CFE Credit		0	0.5	0.5
Optional IFE Credit		0	1	1
Convent Disinfection (Disinfection Zone 4)		0.46	0.33	0
Ground Storage (Disinfectin Zone 5)		1.67	1.2	0
Total w/o CFE/IFE Options		9.02	10.11	6.5
Total w/CFE		9.02	10.61	7
Total w/IFE		9.02	11.11	7.5

WITHOUT CFE/IFE

Total removing Zone 1	7.28	8.86	6.5
Total removing MF/RO Coag/Floc/Clarif	8.52	9.61	6
Total removing Zone 2	7.88	9.29	6.5
Total removing MF Filtration	7.52	7.11	3.5
Total removing Zone 3	9.01	10.1	6.5
Total removing RO filtration	9.02	10.11	6.5
Total removing Conven Coag/Floc/Clarif	8.52	9.61	6
Total removing Conven Filtration	7.52	7.61	4
Total removing Zone 4	8.56	9.78	6.5
Total removing Zone 5	7.35	8.91	6.5

WITH CFE

Total removing Zone 1	N/A	9.36	7
Total removing MF/RO Coag/Floc/Clarif	N/A	10.11	6.5
Total removing Zone 2	N/A	9.79	7
Total removing MF Filtration	N/A	7.61	4
Total removing Zone 3	N/A	10.6	7
Total removing RO filtration	N/A	10.61	7
Total removing Conven Coag/Floc/Clarif	N/A	10.11	6.5
Total removing Conven Filtration	N/A	8.11	4.5
Total removing Zone 4	N/A	10.28	7
Total removing Zone 5	N/A	9.41	7

WITH IFE

Total removing Zone 1	N/A	9.86	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	10.61	7
Total removing Zone 2	N/A	10.29	7.5
Total removing MF Filtration	N/A	8.11	4.5
Total removing Zone 3	N/A	11.1	7.5
Total removing RO filtration	N/A	11.11	7.5
Total removing Conven Coag/Floc/Clarif	N/A	10.61	7
Total removing Conven Filtration	N/A	8.61	5
Total removing Zone 4	N/A	10.78	7.5
Total removing Zone 5	N/A	9.91	7.5

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

RRWWTP to Cypress through MF/RO/Conventional

Date:

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	Inact. Ratio		
CLA D1	2.0	7.500	5.4	7.5	881.4	705.8	2535.2	1.25	1.74			
CLA D2	2.0	7.500	5.4	7.5	576.0	705.8	2535.2	0.82	1.14			
CLA D3	2.0	7.500	5.4	7.5	6.5	705.8	2535.2	0.01	0.01			
CLA D4	3.5	10.000	5.4	9.0	234.9	705.8	2535.2	0.33	0.46			
CLA D5	3.8	10.000	5.4	8.9	848.5	705.8	2535.2	1.20	1.67			
								3.61	5.02	1.00	(A)	

Date:

CT STUDY

Table AC

RRWTP

11.5 degrees Celsius @ 2.0 ppm down pipeline

Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Pipeline RRWWTP (Disinfection Zone 1)	2.65	1.56	0
MF/RO Coag/Floc/Clarif	0.5	0.5	0.5
MF/RO Clarifier Disinfection (Disinfection Zone 2)	1.73	1.02	0
MF Filtration	1.5	3	3
MF Pipeline/Trough/Filter Disinfection (Disinfection Zone 3)	0.02	0.01	0
RO Membrane Filtration	0	0	0
Conven Coag/Floc/Clarif	0.5	0.5	0.5
Conven Filtration	1.5	2.5	2.5
Optional CFE Credit	0	0.5	0.5
Optional IFE Credit	0	1	1
Convent Disinfection (Disinfection Zone 4)	0.71	0.42	0
Ground Storage (Disinfectin Zone 5)	2.55	1.5	0
Total w/o CFE/IFE Options	11.66	11.01	6.5
Total w/CFE	11.66	11.51	7
Total w/IFE	11.66	12.01	7.5

WITHOUT CFE/IFE

Total removing Zone 1	9.01	9.45	6.5
Total removing MF/RO Coag/Floc/Clarif	11.16	10.51	6
Total removing Zone 2	9.93	9.99	6.5
Total removing MF Filtration	10.16	8.01	3.5
Total removing Zone 3	11.64	11	6.5
Total removing RO filtration	11.66	11.01	6.5
Total removing Conven Coag/Floc/Clarif	11.16	10.51	6
Total removing Conven Filtration	10.16	8.51	4
Total removing Zone 4	10.95	10.59	6.5
Total removing Zone 5	9.11	9.51	6.5

WITH CFE

Total removing Zone 1	N/A	9.95	7
Total removing MF/RO Coag/Floc/Clarif	N/A	11.01	6.5
Total removing Zone 2	N/A	10.49	7
Total removing MF Filtration	N/A	8.51	4
Total removing Zone 3	N/A	11.5	7
Total removing RO filtration	N/A	11.51	7
Total removing Conven Coag/Floc/Clarif	N/A	11.01	6.5
Total removing Conven Filtration	N/A	9.01	4.5
Total removing Zone 4	N/A	11.09	7
Total removing Zone 5	N/A	10.01	7

WITH IFE

Total removing Zone 1	N/A	10.45	7.5
Total removing MF/RO Coag/Floc/Clarif	N/A	11.51	7
Total removing Zone 2	N/A	10.99	7.5
Total removing MF Filtration	N/A	9.01	4.5
Total removing Zone 3	N/A	12	7.5
Total removing RO filtration	N/A	12.01	7.5
Total removing Conven Coag/Floc/Clarif	N/A	11.51	7
Total removing Conven Filtration	N/A	9.51	5
Total removing Zone 4	N/A	11.59	7.5
Total removing Zone 5	N/A	10.51	7.5

Table AD

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 Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{calc}	Giardia CT _{reqd}	Virus CT _{reqd}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	2.0	7.500	11.5	7.5	881.4	565.5	1661.1	1.56	2.65			
CLA D2	2.0	7.500	11.5	7.5	576.0	565.5	1661.1	1.02	1.73			
CLA D3	2.0	7.500	11.5	7.5	6.5	565.5	1661.1	0.01	0.02	4.50	7.67	1.53
CLA D4	3.5	10.000	11.5	9.0	234.9	565.5	1661.1	0.42	0.71			
CLA D5	3.8	10.000	11.5	8.9	848.5	565.5	1661.1	1.50	2.55			
PLANT TOTAL												

SUBMITTED BY: _____ Date: _____

Certificate No. _____ and Grade: _____

Table AE

Secondary Reservoir

20 degrees Celsius @ 0.3 ClO2

	Removal Credit Required	Virus 9	Giardia 7	Crypto 5.5
Secondary Reservoir Pipeline (Disinfection Zone 1)		0.57	0.51	0
Secondary Reservoir Pipeline (Disinfection Zone 2)		0.72	0.63	0
Secondary Reservoir Pipeline (Disinfection Zone 3)		8.03	7.08	0
2010 SWTP Disinfection (Disinfection Zone4)		1.27	0.63	0
Conven Coag/Floc/Clarif		0.5	0.5	0.5
Conven Filtration		1.5	2.5	2.5
Optional CFE Credit		0	0.5	0.5
Optional IFE Credit		0	1	1
Clearwell/Ground Storage (Disinfection Zone 5)		4.6	2.29	0
Total w/o CFE/IFE Options		17.19	14.14	3
Total w/CFE		17.19	14.64	3.5
Total w/IFE		17.19	15.14	4

WITHOUT CFE/IFE

Total removing Zone 1	16.62	13.63	3
Total removing Zone 2	16.47	13.51	3
Total removing Zone 3	9.16	7.06	3
Total removing Zone 4	15.92	13.51	3
Total removing Conven Coag/Floc/Clarif	16.69	13.64	2.5
Total removing Conven Filtration	15.69	11.64	0.5
Total removing Zone 5	12.59	11.85	3

WITH CFE

Total removing Zone 1	N/A	14.13	3.5
Total removing Zone 2	N/A	14.01	3.5
Total removing Zone 3	N/A	7.56	3.5
Total removing Zone 4	N/A	14.01	3.5
Total removing Conven Coag/Floc/Clarif	N/A	14.14	3
Total removing Conven Filtration	N/A	12.14	1
Total removing Zone 5	N/A	12.35	3.5

WITH IFE

Total removing Zone 1	N/A	14.63	4
Total removing Zone 2	N/A	14.51	4
Total removing Zone 3	N/A	8.06	4
Total removing Zone 4	N/A	14.51	4
Total removing Conven Coag/Floc/Clarif	N/A	14.64	3.5
Total removing Conven Filtration	N/A	12.64	1.5
Total removing Zone 5	N/A	12.85	4

Table AF

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:

Cypress WTP Reuse Project

PLANT NAME
OR NUMBER:

Secondary Res. Through Cypress Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS												
APPROVED CT STUDY PARAMETERS						PERFORMANCE STANDARDS						
Disinfection Zones						Log Inactivations						
Parameters		D1	D2	D3	D4	D5	Giardia lamblia Cysts			Viruses		
Flow Rate (MGD)		5.000	5.000	5.000	9.999	9.999	1.0			5.0		
T ₁₀ (minutes)		8.3	10.4	116.1	67.1	223.3						

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES											
Disinfectant		C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{calc}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Inact. Ratio
CLO2	D1	0.3	5.000	20.0	8.2	2.5	4.9	21.7	0.51	0.57	
CLO2	D2	0.3	5.000	20.0	8.2	3.1	4.9	21.7	0.63	0.72	
CLO2	D3	0.3	5.000	20.0	8.2	34.8	4.9	21.7	7.08	8.03	
CLA	D4	3.5	10.000	20.0	9.0	234.9	370.0	921.5	0.63	1.27	3.04
CLA	D5	3.8	10.000	20.0	8.9	848.5	370.0	921.5	2.29	4.60	(*)

PLANT TOTAL					
Giardia Log	Virus Log	Inact. Ratio	Giardia Log	Virus Log	Inact. Ratio
11.15	15.20	3.04			

Certificate No.
and Grade:

Date:

SUBMITTED BY:

TCEQ - (05-01-13)

CT STUDY

ATTACHMENT B

Response To TCEQ Requested Documents

2a, 2b, & 2c

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 Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional Month: _____

Day: _____

Year: _____

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

The CWF CWTP Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis plants with the conventional 2010 WTP. This CT takes into account the treated water pumped from the CWF River Road WWTP to the CWTP through a 30 inch raw water pipe at a flow of 7.5 million gallons per day (MGD), through micro-filtration/reverse osmosis to a raw water lagoon where 5 MG will then be mixed with 5 MG raw surface water and treated through the conventional 2010 WTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 5 MG permeate will be sent to a raw water lagoon, pumped back to the splitter basin and mixed with 5 MG of raw surface water prior to the 2010 WTP. The 2010 WTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10MG ground storage tank. Total capacity through the 2010 WTP is 10 MGD.

The proposed disinfection protocol involves the injection of chlorine (Cl₂) at the RRWWTP chlorine contact basin before being pumped to the CWTP through the 30 inch raw water pipe. In the micro-filtration clarifier, chlorine (Cl₂) and liquid ammonium sulfate are injected in the mix zone to form chloramines. Chlorine (Cl₂) and liquid ammonium sulfate are again added at the clarifier effluent to form chloramines through the micro-filtration trough and cells. Once the reverse osmosis permeate is mixed with the raw surface water in the splitter basin, chlorine (Cl₂) and liquid ammonia gas (NH₄) is added to the effluent of the basin and again just upstream of the 0.20 MG clearwell and transfer pump station. Chloramine residuals are monitored in the raw water vault, prior to the micro-filtration clarifier, in the mix zone of the clarifier, at the effluent collection box of the clarifier, in the micro-filtration trough and cell permeate. Chloramine residuals are also monitored downstream of the five multi-media gravity filters, downstream of the 0.20 MG clearwell and transfer pump station and downstream of the 10 MG ground storage tank, prior to entering the distribution system.

Submitted by: _____
Contact _____
Information: _____

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

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

CT STUDY

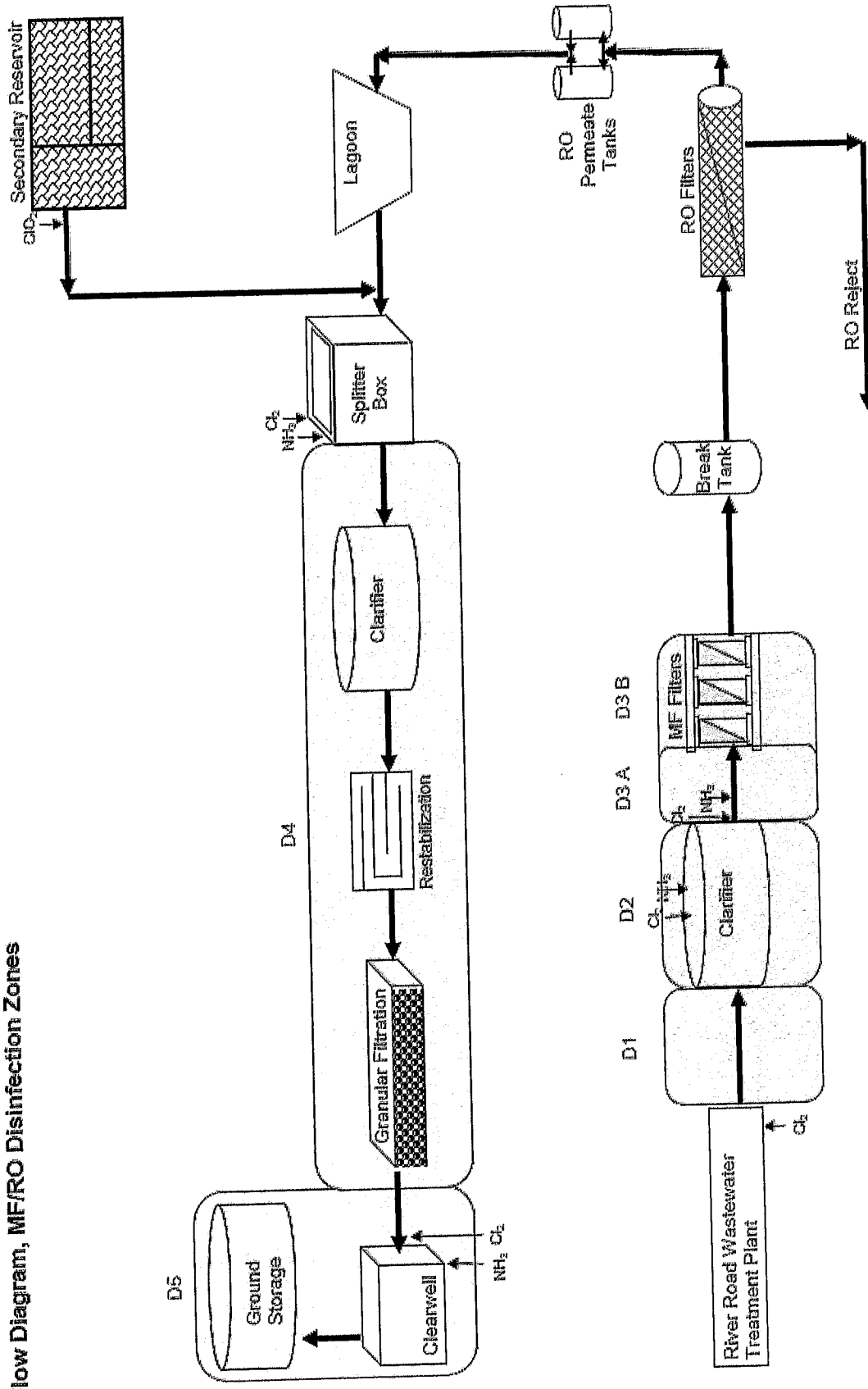
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Schematic Worksheet

PUBLIC WATER SYSTEM NAME:	City of Wichita Falls Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/
	PWS ID No.: 2430001	Date:	

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.

Flow Diagram, MF/RO Disinfection Zones



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 Reuse Project

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: RRWWTP to Cypress through MF/RO/Conventior

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

Disinfection Zone:

D1

Disinfectant:

Chloramines

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 13 Mile Pipe from RRWWTP to Cypress WTP

Characteristic

Number of Units

1

Comments

Diameter

30 in

Pipe from RRWWTP to CWTP

Length

62500 ft

Volume (each)

2,295,295 gal

Flow Rate (each)

5,208 gpm

7.5 MGD Flow

Detention Time

440.7 min

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor: _____

T₁₀

440.7 min

D1 FLOW RATE

7.500 mgd

T10 SUM FOR D1

440.7 min

Disinfection Zone:

D2

Disinfectant:

Chloramines

Unit - 1

Type: Other

Shape: Other

Further Description: Micro-filtration Clarifier

Characteristic

Number of Units

1

Comments

Volume (each)

5,000,000 gal

5 MG Clarifier

Volume (each)

5,000,000 gal

Flow Rate (each)

5,208 gpm

7.5 MGD Flow

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

Detention Time 960.1 min

Baffling Factor 0.3

Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 288.0 min

D2 FLOW RATE	7.500 mgd
T10 SUM FOR D2	288.0 min

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

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

Unit - 2 Type: Other Shape: Other

Further Description: Micro-filtration Trough

Characteristic		Comments
Number of Units	1	
Volume (each)	30,637 gal	
Volume (each)	30,637 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	5.9 min	
Baffling Factor	0.5	Baffling Characteristics: Average
		Approved Baffling Factor:
T ₁₀	2.9 min	

Unit - 3 Type: Other Shape: Other

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

Further Description: Micro-filtration Cells

Characteristic		Comments
Number of Units	1	
Volume (each)	9,208 gal	
Volume (each)	9,208 gal	TCEQ Approved Max Flow Through a Single Micro-filtration Cell (5 Cells Total)
Flow Rate (each)	1,936 gpm	
Detention Time	4.8 min	
Baffling Factor	0.7	Typical Baffling Factor for Filters Baffling Characteristics: Superior Approved Baffling Factor:
T ₁₀	3.3 min	

D3 FLOW RATE	2.788 mgd
T10 SUM FOR D3	8.8 min

Disinfection Zone: D4 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	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	1.7 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe Baffling Characteristics: Perfect Approved Baffling Factor:
T ₁₀	1.7 min	
Unit - 2	Type: <u>Rapid Mix</u> Shape: <u>Rectangular</u>	

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

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

Volume (each) 4,848 gal
Flow Rate (each) 6,944 gpm 10 MGD Flow
Detention Time 0.7 min

Baffling Factor 0.1 Typical Baffling Factor for an "Unbaffled" Basin
Baffling Characteristics: Unbaffled
Approved Baffling Factor:

T₁₀ 0.1 min

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011

Volume (each) 3,122 gal
Flow Rate (each) 6,944 gpm 10 MGD Flow
Detention Time 0.4 min

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 0.4 min

Unit - 4 Type: Clarifier Shape: Circular

Further Description: Clarifier

Characteristic		Comments
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 10 MGD Flow
Detention Time 133.4 min

Baffling Factor 0.3 Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 40.0 min

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

Characteristic		Comments
Number of Units	1	

CT STUDY

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

T10 Details Worksheet

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	10 MGD Flow
Flow Rate (each)	6,944 gpm	
Detention Time	26.4 min	

Baffling Factor 0.5

Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)

Baffling Characteristics: Average

Approved Baffling Factor:

T₁₀ 13.2 min

Unit - 6 Type: Filter Shape: Rectangular

Further Description: Gravity Filters

Characteristic		Comments
Number of Units	5	As per CT Submittal Dated April 4, 2011
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	

Volume (each)	29,088 gal	10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each), Fifth Filter Remains on Standby Until Backwash Initiated.
---------------	------------	--

Flow Rate (each)	1,736 gpm
Detention Time	16.8 min

Baffling Factor 0.7

Typical Baffling Factor for Filters

Baffling Characteristics: Superior

Approved Baffling Factor:

T₁₀ 11.7 min

D4 FLOW RATE	9.999 mgd
T10 SUM FOR D4	67.1 min

Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

Characteristic	Comments
----------------	----------

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

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)	6,944 gpm	10 MGD Flow
Detention Time	15.7 min	

Baffling Factor	0.5	Typical Baffling Factor for Basins with Two Internal Baffles Length to Width (30:1)
		Baffling Characteristics: Average
		Approved Baffling Factor:
T ₁₀	7.9 min	

Unit - 2 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 "Worst 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)	6,944 gpm	100% of 10 MGD Max at Cypress (7 MGD)
Detention Time	718.2 min	

Baffling Factor	0.3	Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles
		Baffling Characteristics: Poor
		Approved Baffling Factor:
T ₁₀	215.5 min	

D5 FLOW RATE **9.999 mgd**

T10 SUM FOR D5 **223.3 min**

Disinfection Zone: D6 Disinfectant: _____

Disinfection Zone: D7 Disinfectant: _____

Disinfection Zone: D8 Disinfectant: _____

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: D9

Disinfectant:

Disinfection Zone: D10

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 Reuse Project PWS ID No.: 2430001

PLANT NAME OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	13 Mile Pipe from RRWWTP to Cypress WTP (1)	2,295,295	7.500	1	440.725	440.72
D2	Micro-filtration Clarifier (1)	5,000,000	7.500	0.3	288.018	288.02
D3	36 Inch Raw Water Pipe (1)	13,221	7.500	1	2.539	8.81
	Micro-filtration Trough (1)	30,637	7.500	0.5	2.941	
	Micro-filtration Cells (1)	9,208	2.788	0.7	3.329	
D4	36 Inch Raw Water Pipe (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Raw Water 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	2.500	0.7	11.729	
	Clearwell/Transfer Pump Station (1)	109,102	9.999	0.5	7.856	
D5	10 MG Ground Storage Tank (1)	4,987,042	9.999	0.3	215.454	223.31

* These values are calculated on the T10 Details Sheet

CT STUDY

TCEQ - (05-01-13)

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 Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA											
INDIVIDUAL DISINFECTION ZONES											
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio
CLA D1	1.0	7.500	30.0	7.5	440.7	255.0	460.8	1.73	4.78		
CLA D2	1.0	7.500	30.0	7.5	288.0	255.0	460.8	1.13	3.13		
CLA D3	1.0	7.500	30.0	7.5	3.3	255.0	460.8	0.01	0.04		
CLA D4	3.5	10.000	30.0	9.0	234.9	255.0	460.8	0.92	2.55	7.12	3.94
CLA D5	3.8	10.000	30.0	8.9	848.5	255.0	460.8	3.33	9.21		(M)
PLANT TOTAL											

SUBMITTED BY: _____ Date: _____

Certificate No. _____ and Grade: _____

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 Reuse Project PLANT NAME OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.: 2430001 Date: _____

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Disinfection Zones					Log Inactivations				
Parameters	D6	D7	D8	D9	D10	Giardia lamblia Cysts	Viruses		
Flow Rate (MGD)						1.0			
T ₁₀ (minutes)							5.0		

DISINFECTION PROCESS DATA										
INDIVIDUAL DISINFECTION ZONES										
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Inact. Ratio
D6										
D7										
D8										
D9										
D10										

PLANT TOTAL				
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH
D6				
D7				
D8				
D9				
D10				

SUBMITTED BY: _____ Date: _____

Certificate No. and Grade: _____

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.)

Description Worksheet

PUBLIC WATER
SYSTEM NAME:

City of Wichita Falls Reuse Project

PWS ID No.: 2430001

PLANT NAME
OR NUMBER:

RRWWTP to Cypress through MF/RO/Conventional

Month:

Day:

Year:

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

The CWF CWTP Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis plants with the conventional 2010 WTP. This CT takes into account the treated water pumped from the CWF River Road WWTP to the CWTP through a 30 inch raw water pipe at a flow of 7.5 million gallons per day (MGD), through micro-filtration/reverse osmosis to a raw water lagoon where 5 MG will then be mixed with 5 MG raw surface water and treated through the conventional 2010 WTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 5 MG permeate will be sent to a raw water lagoon, pumped back to the splitter basin and mixed with 5 MG of raw surface water prior to the 2010 WTP. The 2010 WTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10MG ground storage tank. Total capacity through the 2010 WTP is 10 MGD.

The proposed disinfection protocol involves the injection of chlorine (Cl₂) at the RRWWTP chlorine contact basin before being pumped to the CWTP through the 30 inch raw water pipe. In the micro-filtration clarifier, chlorine (Cl₂) and liquid ammonium sulfate are injected in the mix zone to form chloramines. Chlorine (Cl₂) and liquid ammonium sulfate are again added at the clarifier effluent to form chloramines through the micro-filtration trough and cells. Once the reverse osmosis permeate is mixed with the raw surface water in the splitter basin, chlorine (Cl₂) and liquid ammonia gas (NH₄) is added to the effluent of the basin and again just upstream of the 0.20 MG clearwell and transfer pump station. Chloramine residuals are monitored in the raw water vault, prior to the micro-filtration clarifier, in the mix zone of the clarifier, at the effluent collection box of the clarifier, in the micro-filtration trough and cell permeate. Chloramine residuals are also monitored downstream of the five multi-media gravity filters, downstream of the 0.20 MG clearwell and transfer pump station and downstream of the 10 MG ground storage tank, prior to entering the distribution system.

Submitted by: _____

Contact _____

Information: _____

CT STUDY

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

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CT STUDY

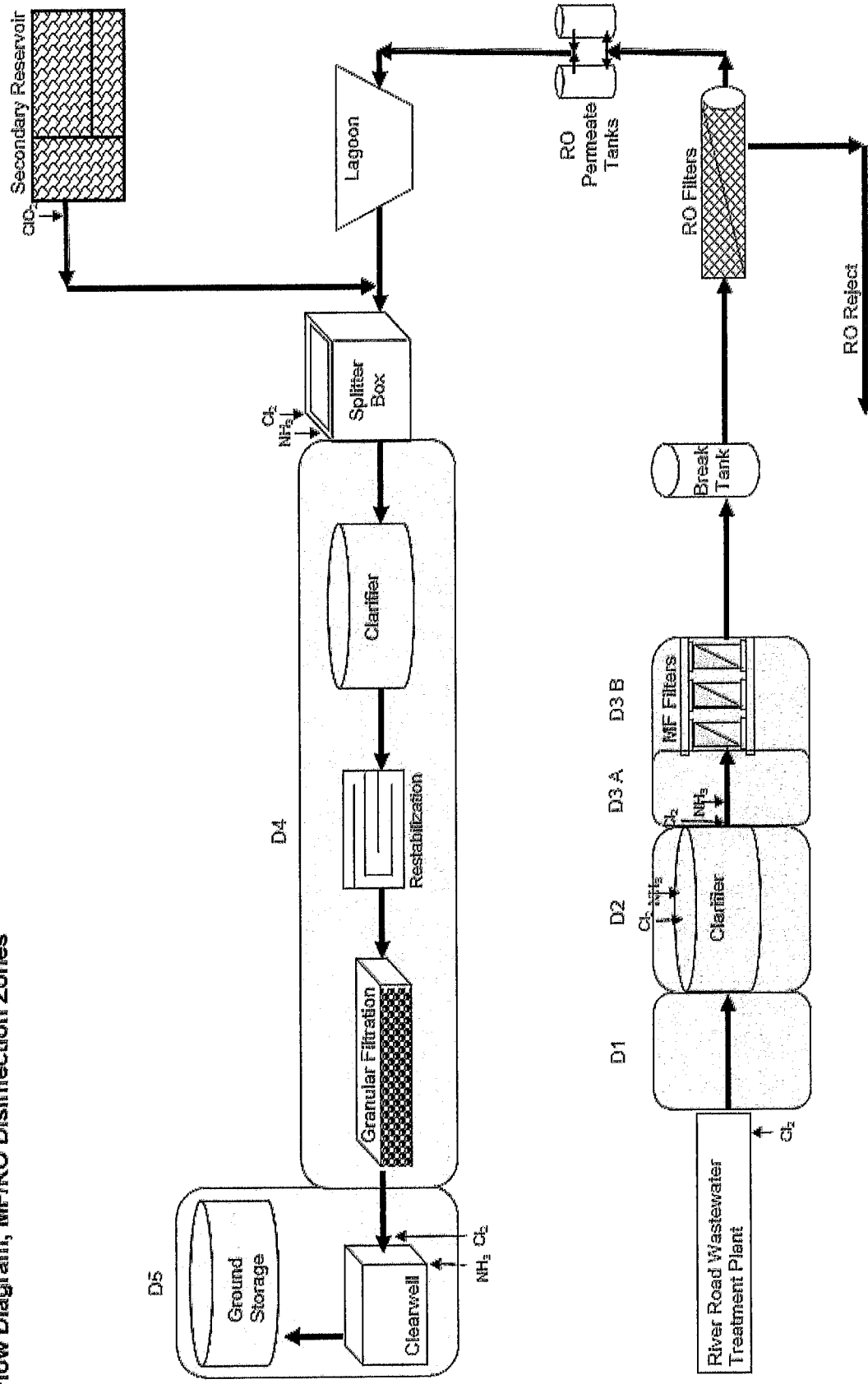
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Schematic Worksheet

PUBLIC WATER SYSTEM NAME:	City of Wichita Falls Reuse Project	PLANT NAME OR NUMBER:	RRWWTP to Cypress through MF/RO/
PWS ID No.:	2430001	Date:	

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.

Flow Diagram, MF/RO Disinfection Zones



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 Reuse Project

PWS ID No.: 2430001

PLANT NAME
OR NUMBER: RRWWTP to Cypress through MF/RO/Conventior

Date: _____

Treatment Plant Capacity 10,000 mgd
6,944 gpm

Disinfection Zone: D1 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 13 Mile Pipe from RRWWTP to Cypress WTP

Characteristic

Number of Units

1

Diameter

30 in

Length

62500 ft

Comments

Pipe from RRWWTP to CWTP

Volume (each)

2,295,295 gal

Flow Rate (each)

5,208 gpm

Detention Time

440.7 min

7.5 MGD Flow

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor: _____

T₁₀

440.7 min

D1 FLOW RATE

7,500 mgd

T10 SUM FOR D1

440.7 min

Disinfection Zone: D2

Disinfectant: Chloramines

Unit - 1

Type: Other

Shape: Other

Further Description: Micro-filtration Clarifier

Characteristic

Number of Units

1

Volume (each)

5,000,000 gal

Comments

5 MG Clarifier

Volume (each)

5,000,000 gal

Flow Rate (each)

5,208 gpm

7.5 MGD Flow

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

Detention Time 960.1 min

Baffling Factor 0.3

Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 288.0 min

D2 FLOW RATE 7.500 mgd

T10 SUM FOR D2 288.0 min

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

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

Unit - 2 Type: Other Shape: Other

Further Description: Micro-filtration Trough

Characteristic		Comments
Number of Units	1	
Volume (each)	30,637 gal	
Volume (each)	30,637 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	5.9 min	
Baffling Factor	0.5	
		Baffling Characteristics: Average
		Approved Baffling Factor:
T ₁₀	2.9 min	

Unit - 3 Type: Other Shape: Other

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

Further Description: Micro-filtration Cells

Characteristic		Comments
Number of Units	1	
Volume (each)	9,208 gal	
Volume (each)	9,208 gal	TCEQ Approved Max Flow Through a Single Micro-filtration Cell (5 Cells Total)
Flow Rate (each)	1,936 gpm	
Detention Time	4.8 min	
Baffling Factor	0.7	Typical Baffling Factor for Filters Baffling Characteristics: <u>Superior</u> Approved Baffling Factor: _____
T ₁₀	3.3 min	

D3 FLOW RATE	2.788 mgd
T10 SUM FOR D3	8.8 min

Disinfection Zone: D4 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	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	1.7 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe Baffling Characteristics: <u>Perfect</u> Approved Baffling Factor: _____
T ₁₀	1.7 min	
Unit - 2	Type: <u>Rapid Mix</u> Shape: <u>Rectangular</u>	

Further Description: Rapid Mix Basin

Characteristic		Comments
Number of Units	1	As per CT Submittal Dated April 4, 2011
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

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

Volume (each) 4,848 gal
Flow Rate (each) 6,944 gpm
Detention Time 0.7 min

10 MGD Flow

Baffling Factor 0.1

Typical Baffling Factor for an "Unbaffled" Basin
Baffling Characteristics: Unbaffled
Approved Baffling Factor:

T₁₀ 0.1 min

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

Characteristic	1	Comments
Number of Units	30	Rapid Mix to Clarifier
Diameter	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
Detention Time 0.4 min

10 MGD Flow

Baffling Factor 1.0

Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 0.4 min

Unit - 4 Type: Clarifier Shape: Circular

Further Description: Clarifier

Characteristic	1	Comments
Number of Units	90	As per CT Submittal Dated April 4, 2011
Diameter	18.9 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth		

Volume (each) 926,521 gal
Flow Rate (each) 6,944 gpm
Detention Time 133.4 min

10 MGD Flow

Baffling Factor 0.3

Typical Baffling Factor for Clarifiers
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 40.0 min

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

Characteristic	1	Comments
Number of Units		

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

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	10 MGD Flow
Flow Rate (each)	6,944 gpm	
Detention Time	26.4 min	

Baffling Factor 0.5

Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)

Baffling Characteristics: Average

Approved Baffling Factor:

T₁₀ 13.2 min

Unit - 6 Type: Filter Shape: Rectangular

Further Description: Gravity Filters

Characteristic		Comments
Number of Units	5	As per CT Submittal Dated April 4, 2011
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	

Volume (each)	29,088 gal	10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each), Fifth Filter Remains on Standby Until Backwash Initiated.
---------------	------------	--

Flow Rate (each)	1,736 gpm
Detention Time	16.8 min

Baffling Factor 0.7

Typical Baffling Factor for Filters

Baffling Characteristics: Superior

Approved Baffling Factor:

T₁₀ 11.7 min

D4 FLOW RATE	9.999 mgd
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T10 SUM FOR D4	67.1 min
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Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: Clearwell/Transfer Pump Station

Characteristic	Comments
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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

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)	6,944	gpm
Detention Time	15.7	min

10 MGD Flow

Baffling Factor	0.5	Typical Baffling Factor for Basins with Two Internal Baffles Length to Width (30:1)
		Baffling Characteristics: Average
		Approved Baffling Factor:

T₁₀ 7.9 min

Unit - 2 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 "Worst 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)	6,944	gpm 100% of 10 MGD Max at Cypress (7 MGD)
Detention Time	718.2	min

Baffling Factor	0.3	Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles
		Baffling Characteristics: Poor
		Approved Baffling Factor:

T₁₀ 215.5 min

D5 FLOW RATE 9.999 mgd

T10 SUM FOR D5 223.3 min

Disinfection Zone: D6 Disinfectant:

Disinfection Zone: D7 Disinfectant:

Disinfection Zone: D8 Disinfectant:

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

Disinfection Zone: D9 Disinfectant: _____

Disinfection Zone: D10 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 Reuse Project PWS ID No.: 2430001

PLANT NAME
OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	13 Mile Pipe from RRWWTP to Cypress WTP (1)	2,295,295	7.500	1	440.725	440.72
D2	Micro-filtration Clarifier (1)	5,000,000	7.500	0.3	288.018	288.02
D3	36 Inch Raw Water Pipe (1)	13,221	7.500	1	2.539	8.81
	Micro-filtration Trough (1)	30,637	7.500	0.5	2.941	
	Micro-filtration Cells (1)	9,208	2.788	0.7	3.329	
D4	36 Inch Raw Water Pipe (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Raw Water 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	2.500	0.7	11.729	
D5	Clearwell/Transfer Pump Station (1)	109,102	9.999	0.5	7.856	223.31
	10 MG Ground Storage Tank (1)	4,987,042	9.999	0.3	215.454	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

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 Reuse Project
PWS ID No.: 2430001
PLANT NAME OR NUMBER: RRWWTP to Cypress through MFIRO/Conventional
Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Disinfection Zones					Log Inactivations				
Parameters	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	7.500	7.500	2.788	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	440.7	288.0	8.8	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Inact. Ratio	
CLA D1	1.0	7.500	7.0	7.5	440.7	669.0	669.0	2269.1	0.66	0.97		
CLA D2	1.0	7.500	7.0	7.5	288.0	669.0	669.0	2269.1	0.43	0.63		
CLA D3	1.0	7.500	7.0	7.5	3.3	669.0	669.0	2269.1	0.00	0.01		
CLA D4	3.5	10.000	7.0	9.0	234.9	669.0	669.0	2269.1	0.35	0.52		
CLA D5	3.8	10.000	7.0	8.9	848.5	669.0	669.0	2269.1	1.27	1.87		
PLANT TOTAL										2.71	4.00	0.80
										(V)		

SUBMITTED BY: _____ Date: _____
Certificate No. _____ and Grade: _____

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 Reuse Project

PLANT NAME
OR NUMBER:

RRWWTP to Cypress through MF/RO/Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones				Log Inactivations				
	D6	D7	D8	D9	D10	Giardia lamblia Cysts		Virus	Viruses
Flow Rate (MGD)						1.0			5.0
T ₁₀ (minutes)									

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	Inact. Ratio
D6									
D7									
D8									
D9									
D10									

SUBMITTED BY:

Certificate No.
and Grade:

Date:

TCEQ - (05-01-13)

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.)

Description Worksheet

PUBLIC WATER

SYSTEM NAME:

Cypress WTP Reuse Project

PWS ID No.:

2430001

PLANT NAME

OR NUMBER:

Secondary Res. Through Cypress Conventional

Month:

Day:

Year:

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

The CWF CWTP Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis plants with the conventional 2010 WTP. This CT takes into account the surface water from Lake Kickapoo and Lake Arrowhead pumped to the CWF Secondary Reservoir. 5 million gallons per day (MGD) will then be pumped to the CWTP through a 42 inch raw water pipe into a splitter basin where it will be combined with 5 MGD of Reverse Osmosis permeate from a lagoon with the use of the lagoon water return pump station. From the splitter basin, the WTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10 MG ground storage tank. Total capacity through the 2010 WTP is 10 MGD.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO_2) downstream of the secondary reservoir, and chlorine (Cl_2) and liquid ammonia gas (NH_4) downstream of the splitter basin and upstream of the 0.20 MG clearwell and transfer pump station. Chlorine dioxide residual can be measured at three locations along the 42 inch raw water pipe at 400, 900 and 5600 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 10 MG ground storage tank, prior to entering the distribution system.

Submitted by:

Contact

Information:

TCEQ - (05-01-13)

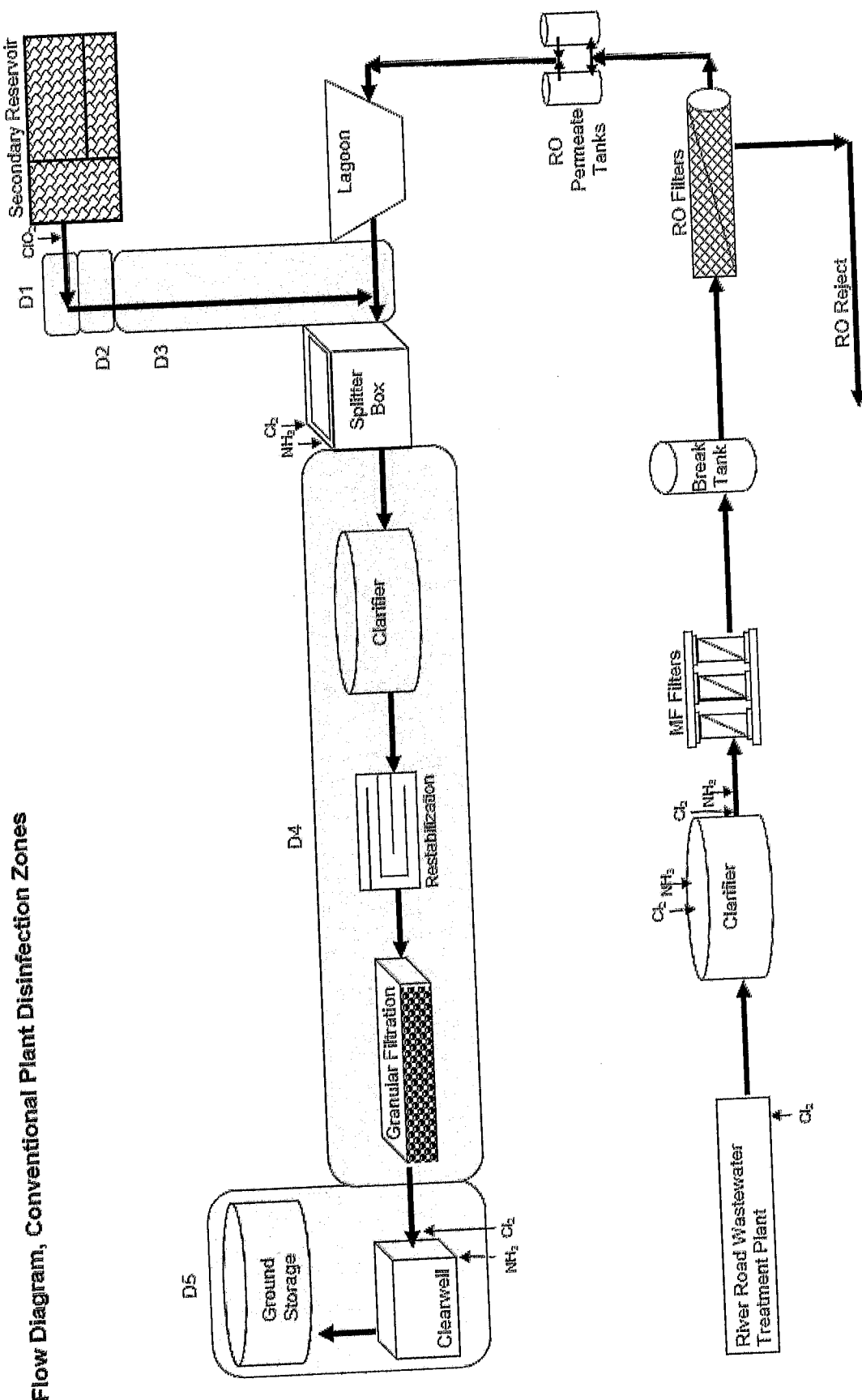
CT STUDY

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:	Cypress WTP Reuse Project	PLANT NAME OR NUMBER:	Secondary Res. Through Cypress Co
	2430001	Date:	
PWS ID No.:			

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.



Flow Diagram, Conventional Plant Disinfection Zones

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: Cypress WTP Reuse Project

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Secondary Res. Through Cypress Conventional

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

--

Disinfection Zone: D1

Disinfectant: Chlorine Dioxide

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic

Number of Units

1

Comments

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)

3,472 gpm

5 MGD Flow

Detention Time

8.3 min

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor: _____

T₁₀

8.3 min

D1 FLOW RATE	5.000 mgd
--------------	-----------

T10 SUM FOR D1	8.3 min
----------------	---------

Disinfection Zone: D2

Disinfectant: Chlorine Dioxide

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic

Number of Units

1

Comments

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

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

Flow Rate (each) 3,472 gpm 5 MGD Flow
Detention Time 10.4 min
Baffling Factor 1.0
Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:
T₁₀ 10.4 min

D2 FLOW RATE 5.000 mgd

T10 SUM FOR D2 10.4 min

Disinfection Zone: D3 Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic		Comments
Number of Units	1	
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) 3,472 gpm 5 MGD Flow
Detention Time 116.1 min

Baffling Factor 1.0
Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 116.1 min

D3 FLOW RATE 5.000 mgd

T10 SUM FOR D3 116.1 min

Disinfection Zone: D4 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: Raw Water Pipe from Splitter Box to Rapid Mix

Characteristic		Comments
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011

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

Length 220 ft As per CT Submittal Dated April 4, 2011

Volume (each) 11,634 gal
Flow Rate (each) 6,944 gpm 10 MGD Flow
Detention Time 1.7 min

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 1.7 min

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

Characteristic		Comments
Number of Units	1	
Length	27 ft	<u>As per CT Submittal Dated April 4, 2011</u>
Width	6 ft	<u>As per CT Submittal Dated April 4, 2011</u>
Side Water Depth	4 ft	<u>As per CT Submittal Dated April 4, 2011</u>
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	<u>10 MGD Flow</u>
Detention Time	0.7 min	

Baffling Factor 0.1 Typical Baffling Factor for an "Unbaffled" Basin
Baffling Characteristics: Unbaffled
Approved Baffling Factor:

T₁₀ 0.1 min

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Pipe from Rapid Mix to Clarifier

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

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 0.4 min

Unit - 4 Type: Clarifier Shape: Circular

Further Description: 2010 Plant Clarifier

Characteristic	Comments
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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

Number of Units	1	
Diameter	90	ft
Side Water Depth	18.9	ft
Center Water Depth	20.6	ft

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Volume (each)	926,521	gal
Flow Rate (each)	6,944	gpm
Detention Time	133.4	min

10 MGD Flow

Baffling Factor	0.3
-----------------	-----

Typical Baffling Factor for Clarifiers

Baffling Characteristics: Poor

Approved Baffling Factor:

T ₁₀	40.0	min
-----------------	------	-----

Unit - 5	Type: Other	Shape: Rectangular
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Further Description: Recarbonation Basin

Characteristic		Comments
Number of Units	1	
Length	45.5	ft
Width	32	ft
Side Water Depth	16.8	ft

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Volume (each)	183,003	gal
Flow Rate (each)	6,944	gpm
Detention Time	26.4	min

10 MGD Flow

Baffling Factor	0.5
-----------------	-----

Typical Baffling Factor for Basins with 4 Internal
Baffles and Length to Width (40:1)

Baffling Characteristics: Average

Approved Baffling Factor:

T ₁₀	13.2	min
-----------------	------	-----

Unit - 6	Type: Filter	Shape: Rectangular
----------	--------------	--------------------

Further Description: 2010 Plant Gravity Filters

Characteristic		Comments
Number of Units	5	
Length	24	ft
Width	15	ft
Media Depth	6	ft
Underdrain Depth	1	ft
Minimum Water Depth Over Media	6.8	ft
Average Porosity	50	%

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Volume (each)	29,088	gal
---------------	--------	-----

10 MGD Flow Divided Equally Between Four
Filters (Filters Rated at 2.5 MGD Flow Each),
Fifth Filter Remains on Standby Until Backwash
Initiated.

Flow Rate (each)	1,736	gpm
Detention Time	16.8	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

Baffling Factor

0.7

Typical Baffling Factor for Filters

Baffling Characteristics: Superior

Approved Baffling Factor:

T₁₀

11.7 min

D4 FLOW RATE

9.999 mgd

T10 SUM FOR D4

67.1 min

Disinfection Zone:

D5

Disinfectant:

Chloramines

Unit - 1

Type: Clearwell

Shape: Rectangular

Further Description: 2010 Plant Clearwell/Transfer Pump Station

Characteristic

Number of Units

7

Length

98.4 ft

Width

26 ft

Side Water Depth

11.3 ft

Maximum Volume (each)

216,290 gal

Minimum Operating Level

5.7 ft

Worst Case Volume (each)

109,102 gal

Percent of Maximum Volume

50 %

Comments

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

50% of Total Volume

Worst Case Volume (each)

109,102 gal

Flow Rate (each)

6,944 gpm

Detention Time

15.7 min

10 MGD Flow

Baffling Factor

0.5

Typical Baffling Factor for Basins with Two
Internal Baffles Length to Width (30:1)

Baffling Characteristics: Average

Approved Baffling Factor:

T₁₀

7.9 min

Unit - 2

Type: Clearwell

Shape: Circular

Further Description: 10 MG Ground Storage Tank

Characteristic

Number of Units

1

Diameter

206 ft

Side Water Depth

40 ft

Center Water Depth

40 ft

Maximum Volume (each)

9,974,083 gal

Minimum Operating Level

20 ft

Worst Case Volume (each)

4,987,042 gal

Percent of Maximum Volume

50 %

Comments

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Assumes "Worst Case" Operating Level

Worst Case Volume (each)

4,987,042 gal

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

Flow Rate (each) 6,944 gpm 100% of 10 MGD Max at Cypress (7 MGD)
Detention Time 718.2 min

Baffling Factor 0.3 Typical Baffling Factor for Basins Having 2 Inlets, 1 Outlet and 3 Interior Baffles
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 215.5 min

D5 FLOW RATE 9.999 mgd

T10 SUM FOR D5 223.3 min

Disinfection Zone: D6 Disinfectant:

Disinfection Zone: D7 Disinfectant:

Disinfection Zone: D8 Disinfectant:

Disinfection Zone: D9 Disinfectant:

Disinfection Zone: D10 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: Cypress WTP Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Secondary Res. Through Cypress Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	Raw Water Line From Secondary Reservoir to Cypress	28,792	5.000	1	8.293	8.29
D2	Raw Water Line From Secondary Reservoir to Cypress	35,990	5.000	1	10.366	10.37
D3	Raw Water Line From Secondary Reservoir to Cypress	403,091	5.000	1	116.098	116.10
D4	Raw Water Pipe from Splitter Box to Rapid Mix (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Pipe from Rapid Mix to Clarifier (1)	3,122	9.999	1	0.450	
	2010 Plant Clarifier (1)	926,521	9.999	0.3	40.028	
	Recarbonation Basin (1)	183,003	9.999	0.5	13.177	
	2010 Plant Gravity Filters (5)	29,088	2.500	0.7	11.729	
D5	2010 Plant Clearwell/Transfer Pump Station (7)	109,102	9.999	0.5	7.856	223.31
	10 MG Ground Storage Tank (1)	4,987,042	9.999	0.3	215.454	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

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:	Cypress WTP Reuse Project	PLANT NAME OR NUMBER:	Secondary Res. Through Cypress Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones				Log Inactivations				
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Inact. Ratio	
CLO2 D1	0.1	5.000	30.0	8.2	0.8	3.6	10.8	0.23	0.38	8.00	17.97	
CLO2 D2	0.1	5.000	30.0	8.2	1.0	3.6	10.8	0.29	0.48			
CLO2 D3	0.1	5.000	30.0	8.2	11.6	3.6	10.8	3.24	5.35			
CLA D4	3.5	10.000	30.0	9.0	234.9	255.0	460.8	0.92	2.55	(V)		
CLA D5	3.8	10.000	30.0	8.9	848.5	255.0	460.8	3.33	9.21			
PLANT TOTAL												

SUBMITTED BY:	Certificate No. and Grade:	Date:
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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.)
CT Calculator Worksheet

PUBLIC WATER SYSTEM NAME: Cypress WTP Reuse Project PLANT NAME OR NUMBER: Secondary Res. Through Cypress Conventional
PWS ID No.: 2430001 Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones				Log Inactivations				
	D6	D7	D8	D9	D10	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)						1.0		5.0	
T ₁₀ (minutes)									

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	Inact. Ratio
D6										
D7										
D8										
D9										
D10										

Certificate No. and Grade:

Date:

SUBMITTED BY:

CT STUDY

TCEQ - (05-01-13)

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: Cypress WTP Reuse Project PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Secondary Res. Through Cypress Conventional Month: _____

Day: _____

Year: _____

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

The CWF CWTP Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis plants with the conventional 2010 WTP. This CT takes into account the surface water from Lake Kickapoo and Lake Arrowhead pumped to the CWF Secondary Reservoir. 5 million gallons per day (MGD) will then be pumped to the CWTP through a 42 inch raw water pipe into a splitter basin where it will be combined with 5 MGD of Reverse Osmosis permeate from a lagoon with the use of the lagoon water return pump station. From the splitter basin, the WTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10 MG ground storage tank. Total capacity through the 2010 WTP is 10 MGD.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO_2) downstream of the secondary reservoir, and chlorine (Cl_2) and liquid ammonia gas (NH_4) downstream of the splitter basin and upstream of the 0.20 MG clearwell and transfer pump station. Chlorine dioxide residual can be measured at three locations along the 42 inch raw water pipe at 400, 900 and 5600 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 10 MG ground storage tank, prior to entering the distribution system.

Submitted by: _____

Contact _____

Information: _____

CT STUDY

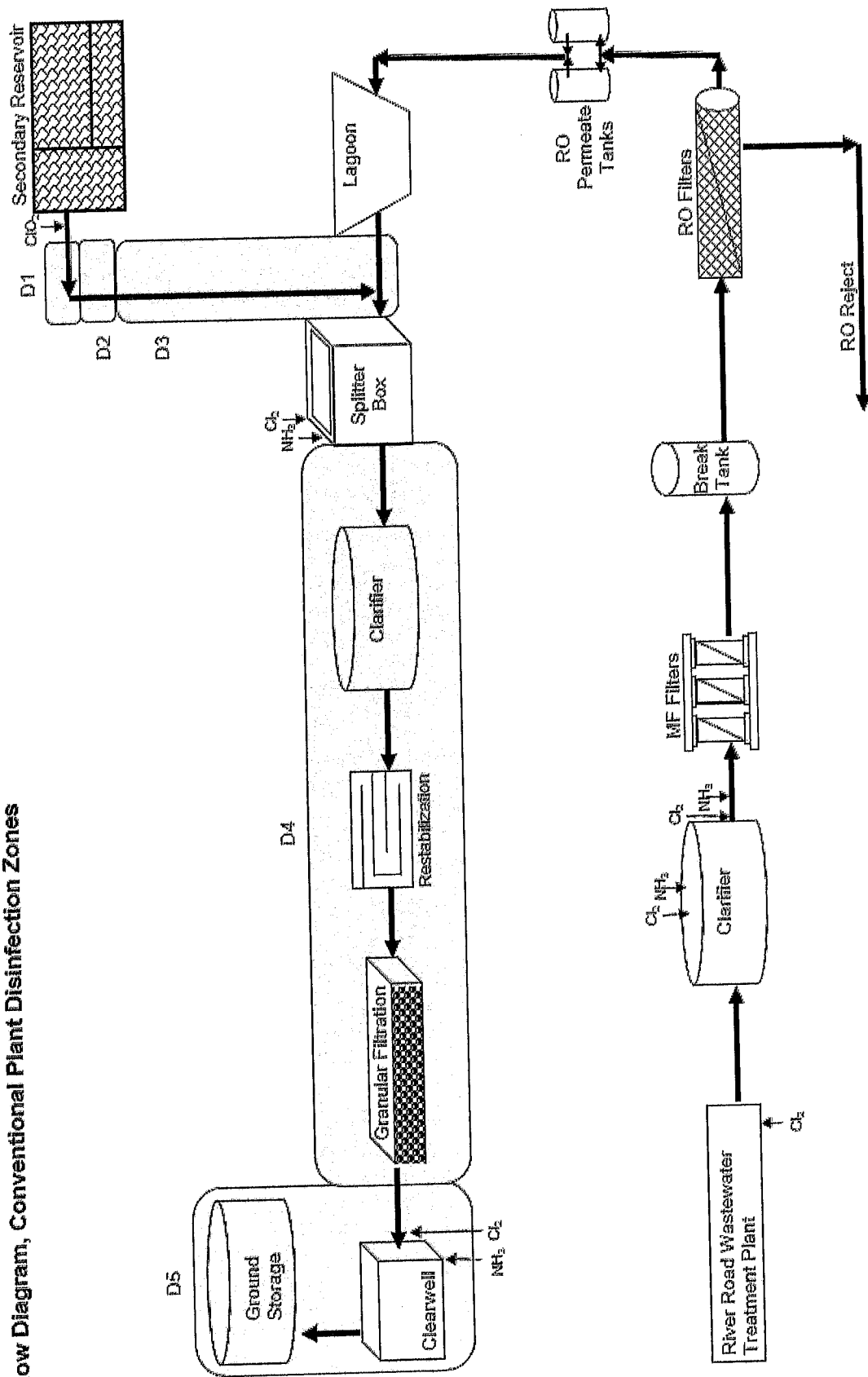
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)

Schematic Worksheet

PUBLIC WATER SYSTEM NAME:	Cypress WTP Reuse Project	PLANT NAME OR NUMBER:	Secondary Res. Through Cypress Co
PWS ID No.:	2430001	Date:	

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.

Flow Diagram, Conventional Plant Disinfection Zones



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: Cypress WTP Reuse Project

PWS ID No.: 2430001

PLANT NAME

OR NUMBER: Secondary Res. Through Cypress Conventiona

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

--

Disinfection Zone: D1

Disinfectant: Chlorine Dioxide

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic

Number of Units

1

Diameter

42 in

Length

400 ft

Comments

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Volume (each)

28,792 gal

Flow Rate (each)

3,472 gpm

Detention Time

8.3 min

5 MGD Flow

Baffling Factor

1.0

Typical Baffling Factor for Pipe

Baffling Characteristics: Perfect

Approved Baffling Factor: _____

T₁₀

8.3 min

D1 FLOW RATE	5.000 mgd
--------------	-----------

T10 SUM FOR D1	8.3 min
----------------	---------

Disinfection Zone: D2

Disinfectant: Chlorine Dioxide

Unit - 1

Type: Piping

Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic

Number of Units

1

Diameter

42 in

Length

500 ft

Comments

As per CT Submittal Dated April 4, 2011

As per CT Submittal Dated April 4, 2011

Volume (each)

35,990 gal

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

Flow Rate (each) 3,472 gpm 5 MGD Flow
Detention Time 10.4 min
Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:
T₁₀ 10.4 min

D2 FLOW RATE 5.000 mgd

T10 SUM FOR D2 10.4 min

Disinfection Zone: D3 Disinfectant: Chlorine Dioxide

Unit - 1 Type: Piping Shape: Pipe

Further Description: 42 Inch Raw Water Line From Secondary Reservoir to Cypress WTP

Characteristic		Comments
Number of Units	1	
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) 3,472 gpm 5 MGD Flow
Detention Time 116.1 min

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor:

T₁₀ 116.1 min

D3 FLOW RATE 5.000 mgd

T10 SUM FOR D3 116.1 min

Disinfection Zone: D4 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: Raw Water Pipe from Splitter Box to Rapid Mix

Characteristic		Comments
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011

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

Length 220 ft As per CT Submittal Dated April 4, 2011

Volume (each) 11,634 gal
Flow Rate (each) 6,944 gpm 10 MGD Flow
Detention Time 1.7 min

Baffling Factor 1.0 Typical Baffling Factor for Pipe
Baffling Characteristics: Perfect
Approved Baffling Factor: _____

T₁₀ 1.7 min

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

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

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Pipe from Rapid Mix to Clarifier

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

Unit - 4 Type: Clarifier Shape: Circular

Further Description: 2010 Plant Clarifier

Characteristic	Comments
----------------	----------

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

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	10 MGD Flow
Detention Time	133.4 min	

Baffling Factor	0.3	Typical Baffling Factor for Clarifiers
		Baffling Characteristics: Poor
		Approved Baffling Factor:

T₁₀ 40.0 min

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	10 MGD Flow
Detention Time	26.4 min	

Baffling Factor	0.5	Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)
		Baffling Characteristics: Average
		Approved Baffling Factor:

T₁₀ 13.2 min

Unit - 6 Type: Filter Shape: Rectangular

Further Description: 2010 Plant 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	10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each), Fifth Filter Remains on Standby Until Backwash Initiated.
Flow Rate (each)	1,736 gpm	
Detention Time	16.8 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

Baffling Factor 0.7 Typical Baffling Factor for Filters
Baffling Characteristics: Superior
Approved Baffling Factor:

T₁₀ 11.7 min

D4 FLOW RATE 9.999 mgd

T10 SUM FOR D4 67.1 min

Disinfection Zone: D5 Disinfectant: Chloramines

Unit - 1 Type: Clearwell Shape: Rectangular

Further Description: 2010 Plant Clearwell/Transfer Pump Station

Characteristic		Comments
Number of Units	7	
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)	6,944 gpm	10 MGD Flow
Detention Time	15.7 min	

Baffling Factor 0.5 Typical Baffling Factor for Basins with Two
Internal Baffles Lenth to Width (30:1)
Baffling Characteristics: Average
Approved Baffling Factor:

T₁₀ 7.9 min

Unit - 2 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 "Worst Case" Operating Level
Worst Case Volume (each)	4,987,042 gal	
Percent of Maximum Volume	50 %	
Worst Case Volume (each)	4,987,042 gal	

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

Flow Rate (each) 6,944 gpm 100% of 10 MGD Max at Cypress (7 MGD)
Detention Time 718.2 min

Baffling Factor 0.3 Typical Baffling Factor for Basins Having 2
Inlets, 1 Outlet and 3 Interior Baffles
Baffling Characteristics: Poor
Approved Baffling Factor:

T₁₀ 215.5 min

D5 FLOW RATE 9.999 mgd

T10 SUM FOR D5 223.3 min

Disinfection Zone: D6 Disinfectant:

Disinfection Zone: D7 Disinfectant:

Disinfection Zone: D8 Disinfectant:

Disinfection Zone: D9 Disinfectant:

Disinfection Zone: D10 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: Cypress WTP Reuse Project PWS ID No.: 2430001

PLANT NAME
OR NUMBER: Secondary Res. Through Cypress Conventional Date: _____

Disinfection Zone	Treatment Unit	Volume* (each) (gal)	Flow Rate* (each) (MGD)	Baffling Factor*	T ₁₀ * (min)	
					Unit	Zone
D1	Raw Water Line From Secondary Reservoir to Cypress	28,792	5.000	1	8.293	8.29
D2	Raw Water Line From Secondary Reservoir to Cypress	35,990	5.000	1	10.366	10.37
D3	Raw Water Line From Secondary Reservoir to Cypress	403,091	5.000	1	116.098	116.10
D4	Raw Water Pipe from Splitter Box to Rapid Mix (1)	11,634	9.999	1	1.675	67.13
	Rapid Mix Basin (1)	4,848	9.999	0.1	0.070	
	30 Inch Pipe from Rapid Mix to Clarifier (1)	3,122	9.999	1	0.450	
	2010 Plant Clarifier (1)	926,521	9.999	0.3	40.028	
	Recarbonation Basin (1)	183,003	9.999	0.5	13.177	
	2010 Plant Gravity Filters (5)	29,088	2.500	0.7	11.729	
D5	2010 Plant Clearwell/Transfer Pump Station (7)	109,102	9.999	0.5	7.856	223.31
	10 MG Ground Storage Tank (1)	4,987,042	9.999	0.3	215.454	

* These values are calculated on the T10 Details Sheet

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:

Cypress WTP Reuse Project

PLANT NAME
OR NUMBER:

Secondary Res. Through Cypress Conventional

PWS ID No.:

2430001

Date:

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Parameters	Disinfection Zones					Log Inactivations			
	D1	D2	D3	D4	D5	Giardia lamblia Cysts		Virus	Viruses
Flow Rate (MGD)	5.000	5.000	5.000	9.999	9.999	1.0		5.0	
T ₁₀ (minutes)	8.3	10.4	116.1	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES												
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 D1	0.1	5.000	7.0	8.2	0.8	8.4	53.4	0.10	0.08			
CLO2 D2	0.1	5.000	7.0	8.2	1.0	8.4	53.4	0.12	0.10			
CLO2 D3	0.1	5.000	7.0	8.2	11.6	8.4	53.4	1.39	1.09	3.23	3.65	0.73
CLA D4	3.5	10.000	7.0	9.0	234.9	669.0	2269.1	0.35	0.52			(V)
CLA D5	3.8	10.000	7.0	8.9	848.5	669.0	2269.1	1.27	1.87			
PLANT TOTAL												

Certificate No.
and Grade:

Date:

SUBMITTED BY:

TCEQ - (05-01-13)

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:	Cypress WTP Reuse Project	PLANT NAME OR NUMBER:	Secondary Res. Through Cypress Conventional
PWS ID No.:	2430001	Date:	

DISINFECTION PROCESS PARAMETERS									
APPROVED CT STUDY PARAMETERS					PERFORMANCE STANDARDS				
Disinfection Zones					Log Inactivations				
Parameters	D6	D7	D8	D9	D10	Giardia lamblia Cysts		Viruses	
Flow Rate (MGD)						1.0		5.0	
T ₁₀ (minutes)									

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	Inact. Ratio
D6									
D7									
D8									
D9									
D10									

Certificate No. and Grade:

Date:

SUBMITTED BY:

CT STUDY

TCEQ - (05-01-13)

ATTACHMENT C

Response To TCEQ Requested Documents

3a – 2001 & 2008 Pilot Virus Results

3b – Current Virus Results

Virus Results From 2001 Pilot

Total Culturable Virus Sample Results from 2001 Pilot Study

Date	Raw Water (Secondary Reservoir)	Feed Water (Wastewater Effluent)
February 2001	<1.0 MPN / 100 L	<0.1 MPN / 100 L
March 2001	18.34 MPN / 100 L	<1.03 MPN / 100 L
March 2001	2.1 MPN / 100 L	<0.1 MPN / 100 L
April 2001	<2.21 MPN / 100 L	<0.10 MPN / 100 L
April 2001	<1 MPN / 100 L	0.1 MPN / 100 L
May 2001	<0.65 MPN / 100 L	<0.10 MPN / 100 L
May 2001	<1.0 MPN / 100 L	<0.1 MPN / 100 L

As you can see, the Wastewater Effluent was significantly less on Total Culturable Viruses than the Raw Water that was being treated from the Lakes for drinking water.

The geometric Mean for this sample set was 1.68 MPN / 100 L for Raw Water from the Secondary Reservoir and 0.72 MPN / 100 L from the Wastewater Effluent.

Serological Viral Sample Results from 2001 Pilot Study

Date	Serotype	Raw Water (Sec. Res.)	Feed Water (WW Effluent)
March 2001	Adenovirus	Negative	Negative
	Enterovirus	Negative	Negative
	Astrovirus	Negative	Negative
	Rotavirus	Negative	Negative
May 2001	Adenovirus	Negative	Negative
	Enterovirus	Negative	Negative
	Astrovirus	Negative	Negative
	Rotavirus	Negative	Negative

All samples from both the Secondary Reservoir and the Wastewater Effluent were negative for the 4 different virus serotypes tested.



Environmental Health Laboratories

The Nation's Drinking Water Laboratory

110 S. Hill Street

South Bend, IN 46617

219.233.4777

800.332.4345

Fax: 219.233.8207

www.mastechnology.com

LABORATORY REPORT

Client: Camp Dresser & McKee

Attn: Bill Marriott

801 Cherry Street

Suite 2340

Fort Worth, TX 76102

Report#: 571853-55

Priority: Standard Written

Status: Final

Project/Site: City of Wichita Falls / Pilot Plant

Samples Submitted: Two drinking water samples and one surface water sample

Copies to: Dean Hinton

Collected: 02/05 to 02/06/01

By: Client

Received: 02/07/01

REPORT RESULTS

TOTAL CULTURABLE VIRUS - Water

Lab#	Sampling Point	Results (MPN/100L)	95% Confidence Limits (MPN/100L)
571853	Raw Water	< 1.0	N/A
571854	Feed Water	< 0.1	N/A
571855	Permeate	< 0.1	N/A

Analyzed: 02/07 to 03/30/01

Analyst: RW

Method: ICR Virus

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call us at (219) 233-4777.

Note: This report may not be reproduced, except in full, without written approval from Environmental Health Laboratories (div. of MAS Technology Corporation).

REVIEWED BY:

Steve Dungey

DATE:

4/3/01

FINALIZED BY:

[Signature]

DATE:

4-3-01



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
 Wichita Falls, TX 76302

Date Received: March 16, 2001
Analyst: am

Virological Results

Sample ID	Date Collected	Lab ID	Volume Assayed (Liters)	Parameters	Results by ICC/nPCR*
Raw Water	March 15, 2001	2001-0316-051	22.7	Adenovirus	Negative
				Enteroviruses	Negative
			22.7	Astrovirus	Negative
				Rotavirus	Negative
Feed Water	March 14, 2001	2001-0316-052	151.4	Adenovirus	Negative
				Enteroviruses	Negative
			151.4	Astrovirus	Negative
				Rotavirus	Negative
Permeate	March 14, 2001	2001-0316-053	152.9	Adenovirus	Negative
				Enteroviruses	Negative
			152.9	Astrovirus	Negative
				Rotavirus	Negative

*ICC/nPCR = Integrated Cell Culture/Nested Polymerase Chain Reaction

The samples were screened for viruses by ICC/nPCR, a hybrid method that combines traditional cell culture with molecular techniques.

Negative ICC/nPCR results indicate that no viral amplicons were detected by gel electrophoresis for the target virus group.

Project No.: 2001-0316-051R



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: April 24, 2001
Sample Collection Date: March 15, 2001
Date Received: March 16, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0316-052

UNH #: 2010316-2

Treatment Plant: City of Wichita Falls, TX - Pilot Plant
Sample ID No.: Feed Water

Sample Information

Laboratory ICR ID No.: ICRNH201

Elution Date: 3/16/01

QA Code: A **Comment:**

Completion Date: 4/23/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A			<	1.03	0	3.47

Volume Information

Sample Volume Collected (L): 1514

Amount of Sample Assayed (L): 1000

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable

R = Rejected

N = Negative

P = Positive

NA = Not Applicable

Project No.: 2001-0316-051F



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: April 24, 2001
Sample Collection Date: March 15, 2001
Date Received: March 16, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0316-051

UNH #: 2010316-1

Treatment Plant: City of Wichita Falls, TX - Pilot Plant

Sample ID: Raw Water

Sample Information

Laboratory ICR ID No.: ICRNH201

Elution Date: 3/16/01

QA Code: A **Comment:**

Completion Date: 4/23/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A				18.34	9.00	30.43

Volume Information

Sample Volume Collected (L): 227

Amount of Sample Assayed (L): 100

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable R = Rejected N = Negative P = Positive NA = Not Applicable

Project No.: 2001-0316-051F



Environmental Health Laboratories
The Nation's Drinking Water Laboratory

110 S. Hill Street
South Bend, IN 46617
219.233.4777
800.332.4345
Fax: 219.233.8207
www.ehl.cc

LABORATORY REPORT

Client: Camp Dresser & McKee
Attn: Bill Marriott
801 Cherry Street
Suite 2340
Fort Worth, TX 76102

Report#: 583991-93
Priority: Standard Written
Status: Final

Project/Site: City of Wichita Falls, TX

PWS ID#: 24-30-001

Samples Submitted: One drinking water sample, one surface water sample and one wastewater sample

Copies to: None

Collected: 03/14 to 03/15/01

By: Client

Received: 03/16/01

REPORT RESULTS

TOTAL CULTURABLE VIRUS - Water

Lab#	Sampling Point	Results (MPN/100L)	95% Confidence Limits (MPN/100L)
583991	Permeate	< 0.1	N/A
583992	Raw Water	2.1	0.848 - 6.783
583993	Feed Water	< 0.1	N/A

Analyzed: 03/16 to 04/20/01

Analyst: RW

Method: ICR Virus

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call us at (219) 233-4777.

Note: This report may not be reproduced, except in full, without written approval from Environmental Health Laboratories (div. of MAS Technology Corporation).

REVIEWED BY:

Steve Durgay

DATE: 4/23/01

FINALIZED BY:

Paul Bann

DATE:

4-23-01



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: May 21, 2001
Sample Collection Date: April 11, 2001
Date Received: April 12, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0413-011

UNH #: 2010412-1

Treatment Plant:	City of Wichita Falls, TX	Sample ID:	Raw Water
------------------	---------------------------	------------	-----------

Sample Information

Laboratory ICR ID No.:	ICR NH201	Elution Date:	4/13/01
QA Code:	A	Comment:	
		Completion Date:	5/16/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A			<	2.21	0	7.52

Volume Information

Sample Volume Collected (L):	140
Amount of Sample Assayed (L):	46

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable R = Rejected N = Negative P = Positive NA = Not Applicable

Project No.: 2001-0413-011



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: May 21, 2001
Sample Collection Date: April 10, 2001
Date Received: April 12, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0413-013

UNH #: 2010412-3

Treatment Plant: City of Wichita Falls, TX

Sample ID No.: Feed Water

Sample Information

Laboratory ICR ID No.: ICRNH201

Elution Date: 4/13/01

QA Code: A **Comment:**

Completion Date: 5/16/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A			<	0.10	0	0.34

Volume Information

Sample Volume Collected (L): 1514

Amount of Sample Assayed (L): 1000

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable R = Rejected N = Negative P = Positive NA = Not Applicable

Project No.: 2001-0413-011



Environmental Health Laboratories
The Nation's Drinking Water Laboratory

110 S. Hill Street
South Bend, IN 46617
219.233.4777
800.332.4345
Fax: 219.233.8207
www.ehl.cc

LABORATORY REPORT

Client: Camp Dresser & McKee
Attn: Bill Marriott
801 Cherry Street
Suite 2340
Fort Worth, TX 76102

Report#: 593436-38
Priority: Standard Written
Status: Final

Project/Site: City of Wichita Falls TX / Pilot Plant

PWS ID: 24-30-001

Samples Submitted: One drinking water sample, one surface water samples and one wastewater sample

Copies to: None

Collected: 04/10 & 04/11/01

By: Client

Received: 04/12/01

REPORT RESULTS

TOTAL CULTURABLE VIRUS - Water

Lab#	Sampling Point	Results (MPN/100L)	95% Confidence Limits(MPN/100L)
593436	Raw Water	< 1	NA
593437	Feed Water	0.1	0.0185 -0.3471
593438	Permeate	< 0.1	NA

Analyzed: 04/12 to 05/29/01

Analyst: RW

Method: ICR Virus

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call us at (219) 233-4777.

Note: This report may not be reproduced, except in full, without written approval from Environmental Health Laboratories.

REVIEWED BY: Jim Marriott

DATE: 06/05/2001

FINALIZED BY: Ra. J. Sullivan

DATE: 6/5/2001



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: June 20, 2001
Sample Collection Date: May 7, 2001
Date Received: May 9, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0510-038

UNH #: 2010509-9

Treatment Plant: Pilot Plant, City of Wichita Falls, TX

Sample ID No.: Feed Water

Sample Information

Laboratory ICR ID No.: ICRNH201

Elution Date: 5/9/01

QA Code: A

Comment:

Completion Date: 6/15/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A			<	0.10	0	0.34

Volume Information

Sample Volume Collected (L): 1514

Amount of Sample Assayed (L): 1000

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable R = Rejected N = Negative P = Positive NA = Not Applicable

Project No.: 2001-0510-036



Client: Corlett, Probst & Boyd
Address: 4605 Jacksboro Highway
Wichita Falls, TX 76302

Report Date: June 20, 2001
Sample Collection Date: May 8, 2001
Date Received: May 9, 2001
Analyst: am

Total Culturable Virus Report

ASI Sample ID No.: 2001-0510-037

UNH #: 2010509-8

Treatment Plant: Pilot Plant, City of Wichita Falls, TX

Sample ID No.: Raw Water

Sample Information

Laboratory ICR ID No.: ICRNH201

Elution Date: 5/9/01

QA Code: A **Comment:**

Completion Date: 6/15/01

Analytical Result

QA Code	QA Comment	Qualitative Result Code	< DL	MPN/100 L	Lower 95% Conf. Limit	Upper 95% Conf. Limit
A			<	0.65	0	2.21

Volume Information

Sample Volume Collected (L): 238

Amount of Sample Assayed (L): 100

Method: Samples processed, stained and examined using the Information Collection Rule (ICR) Total Culturable Virus Method.

Codes: A = Acceptable R = Rejected N = Negative P = Positive NA = Not Applicable

Project No.: 2001-0510-036

Client: Corlett, Probst & Boyd
4605 Jacksboro Highway
Address: Wichita Falls, TX 76302

Date Received: May 9, 2001
Analysis Start Date: May 10, 2001
Analyst: am

Virological Results

Sample ID	Date Collected	Lab ID	Volume Assayed (Liters)	Parameters	Results by ICC/nPCR*
Permeate	May 7, 2001	2001-0510-033	151.4	Adenovirus	Negative
				Enteroviruses	Negative
			151.4	Astrovirus	Negative
				Rotavirus	Negative
Raw Water	May 8, 2001	2001-0510-034	23.8	Adenovirus	Negative
				Enteroviruses	Negative
			23.8	Astrovirus	Negative
				Rotavirus	Negative
Feed Water	May 7, 2001	2001-0510-035	151.4	Adenovirus	Negative
				Enteroviruses	Negative
			151.4	Astrovirus	Negative
				Rotavirus	Negative

*ICC/nPCR = Integrated Cell Culture/Nested Polymerase Chain Reaction

The samples were screened for viruses by ICC/nPCR, a hybrid method that combines traditional cell culture with molecular techniques.

Negative ICC/nPCR results indicate that no viral amplicons were detected by gel electrophoresis for the target virus group.

Project No.: 2001-0510-033



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800.332.4345
Fax: 219.233.8207
www.ehl.cc

LABORATORY REPORT

Client: Camp Dresser & McKee
Attn: Bill Marriott
801 Cherry Street
Suite 2340
Fort Worth, TX 76102

Report#: 602844-46
Priority: Standard Written
Status: Final

Project/Site: City of Wichita Falls / Pilot Plant

Samples Submitted: Three surface water samples

Copies to: Dean Hinton

Collected: 05/07 to 05/08/01

By: Client

Received: 05/09/01

REPORT RESULTS

TOTAL CULTURABLE VIRUS - Water

Lab#	Sampling Point	Results (MPN/100L)	95%Confidence Limits(MPN/100L)
602844	Raw Water	< 1.0	NA
602845	Permeate	< 0.1	NA
602846	Feed Water	< 0.1	NA

Analyzed: 05/09 to 06/18/01

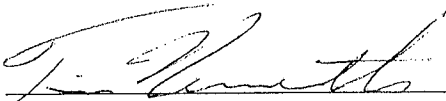
Analyst: RW

Method: ICR Virus

Note: See attached page for additional comments.

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call us at (219) 233-4777.

Note: This report may not be reproduced, except in full, without written approval from Environmental Health Laboratories.

REVIEWED BY: 

DATE: 06/19/2001

FINALIZED BY: 

DATE: 6/20/2001

Virus Results From 2008 Pilot

Total Culturable Virus Sample Results from 2009 Pilot Study

Date	Raw Water (Secondary Reservoir)	Feed Water (Wastewater Effluent)
December 2007	<0.390 MPN / 100 L	<0.387 MPN / 100 L
January 2008	<0.813 MPN / 100 L	<0.278 MPN / 100 L

Eight years after the original Pilot test was conducted, the same results were seen between the Raw water from the Secondary Reservoir and the Wastewater Effluent. While the Geometric Mean can not be determined between the two sample sets because they were all recorded as less than (<), the detection limits for the wastewater effluent were much lower for the wastewater effluent. Once again, the Wastewater Effluent has shown to be potentially lower in Total Culturable Viruses concentrations than the Raw lake water that was being treated for drinking water.

Scientific Methods

Laboratory Report

Client: Underwriters Laboratories, Inc.
110 South Hill Street
South Bend, IN 46617

Report #: 2649
Priority: Standard Written

Location: River Road WWTP

Project Name: Non-Compliance testing

Sample collected date: December 10 & 11, 2007

Received date: December 12, 2007

Total Culturable Virus					
SMI Lab ID	Sample ID	UL SBN #	Results (MPN/100L)	Vol. Filtered	Vol Assayed
2649	Be	194109/1759034	<0.161	847.9L	621.1L
2650	Ae	194105/1758962	<0.130	1158.3L	772.2L
2651	Feed	194102/1758889	<0.387	352.0L	258.1L
2652	Raw	194103/1758907	<0.390	367.2L	256.3L

SMI appreciates the opportunity to provide you with this analysis. Please feel free to contact us (574-277-4078) if you have any questions regarding this report.

Note: This report may not be reproduced, except in full, without written approval from Scientific Methods Inc. (SMI).

Reviewed by: *Scheuan Wong* Date: 2-4-2008
Finalized by: *Matt Heger* Date: 2-7-08

Scientific Methods

Laboratory Report

Client: Underwriters Laboratories, Inc.
110 South Hill Street
South Bend, IN 46617

Report #: 2748
Priority: Standard Written

Location: River Road WWTP

Project Name: Non-Compliance testing

Sample collected date: January 7 & 8, 2008

Received date: January 9, 2008

Total Culturable Virus					
SMI Lab ID	Sample ID	UL SBN #	Results (MPN/100L)	Vol. Filtered	Vol Assayed
2748	Pilot A	1771360	<0.158	797.6L	634.4L
2749	Pilot B	1771318	<0.184	721.7L	543.3L
2750	Feed	1771282	<0.278	479.6L	359.6L
2751	Raw	1771262	<0.813	163.9L	122.9L

SMI appreciates the opportunity to provide you with this analysis. Please feel free to contact us (574-277-4078) if you have any questions regarding this report.

Note: This report may not be reproduced, except in full, without written approval from Scientific Methods Inc. (SMI).

Reviewed by:

Rebecca Jones

Date:

2-26-2008

Finalized by:

Matt Hays

Date:

2-28-08

Current Virus Results

Total Culturable Virus Sample Results from 2012/2013 DPR Request

Date	Raw Water (Secondary Reservoir)	Feed Water (Wastewater Effluent)
October 2012	<1.1 MPN / 100 L	<3.2 MPN / 100 L
November 2012	<1.0 MPN / 100 L	<3.0 MPN / 100 L
January 2013		≤3.0 MPN / 100 L
March 2013		<3.0 MPN / 100 L
April 2013	<2.0 MPN / 100 L	<7.0 MPN / 100 L
May 2013		<2.0 MPN / 100 L

Serological Viral Sample Results from 2012/2013 DPR Request

Date	Serotype	Raw Water (Sec. Res.)	Feed Water (WW Effluent)
October 2012	Enterovirus	Non-detect / 40 L	Non-detect / 13.2 L
	Norovirus GI	Non-detect / 40 L	Non-detect / 13.2 L
	Norovirus GIB	Non-detect / 40 L	Non-detect / 13.2 L
	Norovirus GII	Non-detect / 40 L	Non-detect / 13.2 L
November 2012	Enterovirus	Non-detect / 15.6 L	Non-detect / 15.6 L
	Norovirus GI	Non-detect / 15.6 L	Non-detect / 15.6 L
	Norovirus GIB	Non-detect / 15.6 L	Non-detect / 15.6 L
	Norovirus GII	Non-detect / 15.6 L	Non-detect / 15.6 L
January 2013	Enterovirus		Non-detect / 12.8 L
	Norovirus GI		Non-detect / 12.8 L
	Norovirus GII		1.76 X 10 ⁹ copies / 12.8 L
March 2013	Enterovirus		Non-detect
	Norovirus GI		3.75 X 10 ⁶ copies / L
	Norovirus GII		2.2 X 10 ⁹ copies / L
April 2013	Enterovirus	Non-detect	Non-detect
	Norovirus GI	Non-detect	Non-detect
	Norovirus GII	Non-detect	Non-detect
May 2013	Enterovirus		Non-detect
	Norovirus GI		Non-detect
	Norovirus GII		5.7 X 10 ³ copies / L



EPA Method 1615: Measurement of Enterovirus and
Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: City of Wichita Falls Cypress Plant 4801 Bagdad Road Wichita Falls, TX 76310		SAMPLE DATE: 10/16/12	
NAME OF SAMPLER: Calvin McPherson		SAMPLE TIME:	
SAMPLE SOURCE: Treated Waste Water Effluent		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
SAMPLE LOCATION: River Rd Wastewater aeration outfall		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Yes ☐ No ☒ Free Chlorine (mg/L): Metering pump model and serial no.: Chlorine meter model and serial no.:	
SAMPLE VOLUME: (Meter # 78900277) TURBIDITY (NTU): 1.40 Meter Start: 1497 Meter Stop: 1529 Turbidity (NTU): 1.40		Total Volume: 32 Gallons / 124 Liters	

Client ID #: W10002	P.O. #: P1300791
---------------------	------------------

ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only

COMMENTS:

RELINQUISHED BY: Blair Ransom	DATE / TIME: 10/17/12
RECEIVED BY:	DATE / TIME: 10/18/12 7:47

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



685 Stone Road, Unit 6 • Benicia, CA 94510 • (707) 747-5906 • 1-800-GIARDIA • FAX (707) 747-1751 • WEB: www.biovir.com

REPORT NO.: 121503
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO: P1300791

ASSAY RESULTS:

Test: EPA 1615 Culture		Method: EPA 1615			
BioVir #	Sample ID	Site	Analyte	Result	Units
121503-001	Treated Wastewater Effluent	River Rd Aeration Outfall	Total Culturable Virus	<0.032	MPN/L
Collector:		CollectDate 10/16/2012	CollectTime: 2:30:00 PM		
ReceiveDate 10/18/2012 9:47:00 AM		Matrix: Waste Water, treated	Temp 1.1		
Volume:		Analysis Start Date: 10/18/12	Analysis Start Time: 1405		
Analyst: ValLog		Analysis End: 11/26/2012			
Comment					

Test: EPA 1615 PCR		Method: EPA 1615			
BioVir #	Sample ID	Site	Analyte	Result	Units
121503-001	Treated Wastewater Effluent	River Rd Aeration Outfall	Enterovirus (PCR)	Non-detect/13.2L	
Collector:		CollectDate 10/16/2012	CollectTime: 2:30:00 PM		
ReceiveDate 10/18/2012 9:47:00 AM		Matrix: Waste Water, treated	Temp 1.1		
Volume:		Analysis Start Date: 12/12/12	Analysis Start Time: 1500		
Analyst: RNewton		Analysis End: 1/4/2013			
Comment					
121503-001	Treated Wastewater Effluent	River Rd Aeration Outfall	Norovirus GIA (PCR)	Non-detect/13.2L	
Collector:		CollectDate 10/16/2012	CollectTime: 2:30:00 PM		
ReceiveDate 10/18/2012 9:47:00 AM		Matrix: Waste Water, treated	Temp 1.1		
Volume:		Analysis Start Date: 12/12/12	Analysis Start Time: 1500		
Analyst: RNewton		Analysis End: 1/4/2013			
Comment					

REPORT NO.: 121503
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
 WICHITA FALLS, TX 76307
CLIENT NO: WIC002 **CLIENT PO:** P1300791

ASSAY RESULTS:

Test: EPA 1615 PCR **Method:** EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121503-001	Treated Wastewater Effluent	River Rd Aeration Outfall	Norovirus GIB (PCR)	Non-detect/13.2L	

Collector: CollectDate 10/16/2012 CollectTime: 2:30:00 PM
 ReceiveDate 10/18/2012 9:47:00 AM Matrix: Waste Water, treated Temp 1.1
 Volume: Analysis Start Date: 12/12/12 Analysis Start Time: 1500
 Analyst: RNewton Analysis End: 1/4/2013
 Comment:

121503-001	Treated Wastewater Effluent	River Rd Aeration Outfall	Norovirus GII (PCR)	Non-detect/13.2L	
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Collector: CollectDate 10/16/2012 CollectTime: 2:30:00 PM
 ReceiveDate 10/18/2012 9:47:00 AM Matrix: Waste Water, treated Temp 1.1
 Volume: Analysis Start Date: 12/12/12 Analysis Start Time: 1500
 Analyst: RNewton Analysis End: 1/4/2013
 Comment:

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.
 COMPANY IS NOT AN INSURER: BioVir Laboratories is not an insurer or guarantor of the quality and/or purity of water, wastewater, biosolid or other material from which the sample was taken. BioVir offers no express or implied warranties whatsoever concerning the quality or purity of any water, wastewater, biosolid or other material which is ultimately consumed, distributed, applied or disposed.
 MAINTENANCE OF RECORDS: BioVir Laboratories, Inc. shall maintain records pertaining to the historical reconstruction of client's data for a minimum of five years from the date of issuance of the final report. Records may be destroyed after that date unless a written client's request for records transfer is received by BioVir which requests otherwise. Records transfer or storage charges may apply after the 5 year period. THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF BIOVIR LABORATORIES, INC.

1/29/2013

Date:

Signature

Quality
Checked

DCelio



EPA Method 1615: Measurement of Enterovirus and
Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

24°C
1505-1

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: <i>City of Wichita Falls 4801 Big Ed Neal</i>	SAMPLE DATE: <i>10/18/12</i>	
	SAMPLE TIME: <i>3:50pm</i>	
NAME OF SAMPLER: <i>Calvin McPherson</i>	pH: <i>8.93</i>	Water Temp (C): <i>20.0°C</i>
	pH (adjusted): <i>6.78</i>	Temp. meter model and serial no.:
SAMPLE SOURCE: <i>Lake Arrowhead Surface water raw</i>	TREATMENT CHARACTERISTICS (Check One):	
	Raw Surface Water ☒ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☐ Untreated Ground water ☐ Other: ☐	
SAMPLE LOCATION: <i>Lake Arrowhead</i>	DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Yes ☐ No ☒ Free Chlorine (mg / L):	
	Metering pump model and serial no.:	Chlorine meter model and serial no.:
SAMPLE VOLUME: (Meter # <i>97961143</i>) TURBIDITY (NTU): <i>41 NTU</i> Meter Start: <i>1536</i> Meter Stop: <i>1631</i> Turbidity (NTU): <i>31.6</i>	Total Volume: <i>95</i> Gallons _____ Liters	

Client ID #:	P.O. #:
--------------	---------

ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS:

RELINQUISHED BY: <i>Blair Ramon</i>	DATE / TIME: <i>10/18/12</i>
RECEIVED BY: <i>[Signature]</i>	DATE / TIME: <i>10/19/12 9:51</i>

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



685 Stone Road, Unit 6 • Benicia, CA 94510 • (707) 747-5906 • 1-800-GIARDIA • FAX (707) 747-1751 • WEB: www.biovir.com

REPORT NO.: 121505
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121505-001		Lake Arrowhead	Total Culturable Virus	<0.011	MPN/L
Collector: Calvin McPherson CollectDate 10/18/2012 CollectTime: 3:50:00 PM					
ReceiveDate 10/19/2012 9:51:00 AM Matrix: Raw Water Temp 2.4					
Volume: 359.58 L Analysis Start Date: 10/19/2012 Analysis Start Time: 1050					
Analyst: ValLog Analysis End: 11/26/2012					
Comment Active I button rec'd. on housing containing MDS filter.					

Test: EPA 1615 PCR

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121505-001		Lake Arrowhead	Enterovirus (PCR)	Non-detect/40L	
Collector: Calvin McPherson CollectDate 10/18/2012 CollectTime: 3:50:00 PM					
ReceiveDate 10/19/2012 9:51:00 AM Matrix: Raw Water Temp 2.4					
Volume: 359.58 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500					
Analyst: RNewton Analysis End: 1/4/2013					
Comment Active I button rec'd. on housing containing MDS filter.					
121505-001		Lake Arrowhead	Norovirus GIA (PCR)	Non-detect/40L	
Collector: Calvin McPherson CollectDate 10/18/2012 CollectTime: 3:50:00 PM					
ReceiveDate 10/19/2012 9:51:00 AM Matrix: Raw Water Temp 2.4					
Volume: 359.58 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500					
Analyst: RNewton Analysis End: 1/4/2013					
Comment Active I button rec'd. on housing containing MDS filter.					

REPORT NO.: 121505
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS
PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 CLIENT PO:

ASSAY RESULTS:**Test: EPA 1615 PCR****Method: EPA 1615**

BioVir #	Sample ID	Site	Analyte	Result	Units
121505-001		Lake Arrowhead	Norovirus GIB (PCR)	Non-detect/40L	
Collector: Calvin McPherson CollectDate 10/18/2012 CollectTime: 3:50:00 PM					
ReceiveDate 10/19/2012 9:51:00 AM Matrix: Raw Water Temp 2.4					
Volume: 359.58 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500					
Analyst: RNewton Analysis End: 1/4/2013					
Comment Active I button rec'd. on housing containing MDS filter.					
121505-001		Lake Arrowhead	Norovirus GII (PCR)	Non-detect/40L	
Collector: Calvin McPherson CollectDate 10/18/2012 CollectTime: 3:50:00 PM					
ReceiveDate 10/19/2012 9:51:00 AM Matrix: Raw Water Temp 2.4					
Volume: 359.58 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500					
Analyst: RNewton Analysis End: 1/4/2013					
Comment Active I button rec'd. on housing containing MDS filter.					

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

COMPANY IS NOT AN INSURER: BioVir Laboratories is not an insurer or guarantor of the quality and/or purity of water, wastewater, biosolid or other material from which the sample was taken. BioVir offers no express or implied warranties whatsoever concerning the quality or purity of any water, wastewater, biosolid or other material which is ultimately consumed, distributed, applied or disposed.

MAINTENANCE OF RECORDS: BioVir Laboratories, Inc. shall maintain records pertaining to the historical reconstruction of client's data for a minimum of five years from the date of issuance of the final report. Records may be destroyed after that date unless a written client's request for records transfer is received by BioVir which requests otherwise. Records transfer or storage charges may apply after the 5 year period. THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF BIOVIR LABORATORIES, INC.

1/29/2013

Date:



Signature

Quality
Checked DCelio



EPA Method 1615: Measurement of Enterovirus and
Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET
(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: <i>City of Wichita Falls 4801 Ring Rd NE Wichita Falls, TX 76310</i>		SAMPLE DATE: <i>11/28/12</i>	
NAME OF SAMPLER: <i>Mack McNeilson</i>		SAMPLE TIME: <i>2:00</i>	
SAMPLE SOURCE: <i>Wastewater Effluent</i>		pH: pH (adjusted): pH meter model and serial no.:	Water Temp (C): <i>12°C</i> Temp. meter model and serial no.:
SAMPLE LOCATION: <i>Wastewater Effluent</i>		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): Meter Start: <i>61861.50</i> Meter Stop: <i>6182</i> Turbidity (NTU):		DECLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): ☒ Yes ☐ No Free Chlorine (mg / L): Metering pump model and serial no.: Chlorine meter model and serial no.:	
		Total Volume: _____ Gallons <i>120</i> Liters	

Client ID #:	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☐	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only

COMMENTS:

<i>100% Free of detectable virus</i>	
RELINQUISHED BY: <i>Blair Ramon</i>	DATE / TIME: <i>11/29/12</i>
RECEIVED BY:	DATE / TIME:

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



EPA Method 1615: Measurement of Enterovirus and
Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: City of Wichita Falls 4801 Big Ed Neal Wichita Falls TX 76310		SAMPLE DATE: 11/29/12	
NAME OF SAMPLER: Mack McPherson		SAMPLE TIME: 3:15	
SAMPLE SOURCE: Raw surface water		pH: 8.79 pH (adjusted): pH meter model and serial no.:	Water Temp (C): Temp. meter model and serial no.:
SAMPLE LOCATION: Lake Arrowhead		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☒ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☐ Untreated Groundwater ☐ Other: ☐	
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): Meter Start: Meter Stop: Turbidity (NTU):		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Free Chlorine (mg / L): Metering pump model and serial no.: Chlorine meter model and serial no.:	
		Total Volume: 100 Gallons _____ Liters	

Client ID #:	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☐	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS:

The meter did not work, so we used the volume on
the container to determine gallons.

RELINQUISHED BY: <u>Brian Cannon</u>	DATE / TIME: <u>11/28/12</u>
RECEIVED BY: _____	DATE / TIME: _____

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 121654
PAGE NO.: 1 of 4
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121654-001		Wastewater Effluent	Total Culturable Virus	<0.03	MPN/L
Collector: Mack McPherson CollectDate 11/28/2012 CollectTime: 2:00:00 AM					
ReceiveDate 11/30/2012 9:55:00 AM Matrix: Waste Water, treated Temp 0.0					
Volume: 121 L Analysis Start Date: 11/30/12 Analysis Start Time: 1231					
Analyst: ValentinaL Analysis End: 1/9/2013					
Comment Rec'd. I button read: -0.5 deg C. in transit. Client contacted. OK to run, per e-mail from Mark Southard; confirmed smp date 11/28/12; confirmed analysis req'd.					

121654-002		Raw Surface Water	Total Culturable Virus	<0.01	MPN/L
Collector: Mack McPherson CollectDate 11/29/2012 CollectTime: 3:15:00 AM					
ReceiveDate 11/30/2012 9:55:00 AM Matrix: Raw Water Temp 0.0					
Volume: 378.5 L Analysis Start Date: 11/30/12 Analysis Start Time: 1356					
Analyst: ValentinaL Analysis End: 1/9/2013					
Comment Rec'd. I button read: -0.5 deg. C. in transit; Client contacted. Per e-mail from Mark Southard, OK to run as rec'd.; confirmed analysis req'd; volume calculations.					

Test: EPA 1615 PCR

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121654-001		Wastewater Effluent	Enterovirus (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/28/2012 CollectTime: 2:00:00 AM					
ReceiveDate 11/30/2012 9:55:00 AM Matrix: Waste Water, treated Temp 0.0					
Volume: 121 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500					
Analyst: RNewton Analysis End: 1/4/2013					
Comment Rec'd. I button read: -0.5 deg C. in transit. Client contacted. OK to run, per e-mail from Mark Southard; confirmed smp date 11/28/12; confirmed analysis req'd.					

REPORT NO.: 121654
PAGE NO.: 2 of 4
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 PCR Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
121654-001		Wastewater Effluent	Norovirus G1A (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/28/2012 CollectTime: 2:00:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Waste Water, treated Temp 0.0 Volume: 121 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2013 Comment Rec'd. I button read: -0.5 deg C. in transit. Client contacted. OK to run, per e-mail from Mark Southard; confirmed smp date 11/28/12; confirmed analysis req'd.					
121654-001		Wastewater Effluent	Norovirus G1B (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/28/2012 CollectTime: 2:00:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Waste Water, treated Temp 0.0 Volume: 121 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2013 Comment Rec'd. I button read: -0.5 deg C. in transit. Client contacted. OK to run, per e-mail from Mark Southard; confirmed smp date 11/28/12; confirmed analysis req'd.					
121654-001		Wastewater Effluent	Norovirus G1I (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/28/2012 CollectTime: 2:00:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Waste Water, treated Temp 0.0 Volume: 121 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2013 Comment Rec'd. I button read: -0.5 deg C. in transit. Client contacted. OK to run, per e-mail from Mark Southard; confirmed smp date 11/28/12; confirmed analysis req'd.					
121654-002		Raw Surface Water	Enterovirus (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/29/2012 CollectTime: 3:15:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Raw Water Temp 0.0 Volume: 378.5 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2012 Comment Rec'd. I button read: -0.5 deg. C. In transit; Client contacted. Per e-mail from Mark Southard, OK to run as rec'd.; confirmed analysis req'd; volume calculations.					

REPORT NO.: 121654
PAGE NO.: 3 of 4
CLIENT: WICHITA FALLS
ADDRESS
 PO Box 1431
 WICHITA FALLS, TX 76307
CLIENT NO WIC002 **CLIENT PO:**

ASSAY RESULTS:

Test: EPA 1615 PCR **Method: EPA 1615**

BioVir #	Sample ID	Site	Analyte	Result	Units
121654-002		Raw Surface Water	Norovirus GIA (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/29/2012 CollectTime: 3:15:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Raw Water Temp 0.0 Volume: 378.5 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2012					
Comment Rec'd. I button read: -0.5 deg. C. in transit; Client contacted. Per e-mail from Mark Southard, OK to run as rec'd.; confirmed analysis req'd; volume calculations.					
121654-002		Raw Surface Water	Norovirus GIB (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/29/2012 CollectTime: 3:15:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Raw Water Temp 0.0 Volume: 378.5 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2012					
Comment Rec'd. I button read: -0.5 deg. C. in transit; Client contacted. Per e-mail from Mark Southard, OK to run as rec'd.; confirmed analysis req'd; volume calculations.					
121654-002		Raw Surface Water	Norovirus GII (PCR)	Non-detect/15.6L	
Collector: Mack McPherson CollectDate 11/29/2012 CollectTime: 3:15:00 AM ReceiveDate 11/30/2012 9:55:00 AM Matrix: Raw Water Temp 0.0 Volume: 378.5 L Analysis Start Date: 12/12/12 Analysis Start Time: 1500 Analyst: RNewton Analysis End: 1/4/2012					
Comment Rec'd. I button read: -0.5 deg. C. in transit; Client contacted. Per e-mail from Mark Southard, OK to run as rec'd.; confirmed analysis req'd; volume calculations.					

REPORT NO.: 121654
PAGE NO.: 4 of 4
CLIENT: WICHITA FALLS
ADDRESS
PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 **CLIENT PO:**

ASSAY RESULTS:

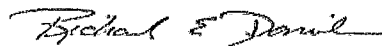
SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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1/29/2013

Date:



Signature

Quality
Checked D Celio



EPA Method 1615: Measurement of Enterovirus and Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET
(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: <i>City of Wickenburg</i>		SAMPLE DATE: <i>1/30/13</i>	
NAME OF SAMPLER: <i>Mark Meyers</i>		SAMPLE TIME: <i>11:00 AM</i>	
SAMPLE SOURCE: <i>Water from fountain</i>		pH: <i>6.10</i>	Water Temp (C): <i>11.0°C</i>
SAMPLE LOCATION: <i>1003 River Road outfall</i>		pH (adjusted):	Temp. meter model and serial no.:
		pH meter model and serial no.:	
		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Yes ☐ No ☒ Free Chlorine (mg/l):	
		Metering pump model and serial no.:	Chlorine meter model and serial no.:
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): Meter Start: <i>12691</i> Meter Stop: <i>12723</i>		Total Volume: <i>32</i> Gallons _____ Liters	
Turbidity (NTU):			

Client ID #:	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS:

RELINQUISHED BY: <i>Mark Meyers</i>	DATE / TIME: <i>1/30/13</i>
RECEIVED BY: _____	DATE / TIME: <i>1/21/13 9:20</i>

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc



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REPORT NO.: 130140
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130140-001	1615 Complete	Wastewater Effluent	Enterovirus	Non-Detect / 12.8L	
Collector: Mack McPherson CollectDate 1/30/2013 CollectTime: 11:00:00 AM ReceiveDate 1/31/2013 9:20:00 AM Matrix: Waste Water, treated Temp 3.8 Volume: 121.12 L Analysis Start Date: 2/5/13 Analysis Start Time: 1130 Analyst: RNewton Analysis End: 2/20/2013 Comment I button rec'd./read/ filed, printed.					
130140-001	1615 Complete	Wastewater Effluent	Norovirus GI	Non-Detect / 12.8L	
Collector: Mack McPherson CollectDate 1/30/2013 CollectTime: 11:00:00 AM ReceiveDate 1/31/2013 9:20:00 AM Matrix: Waste Water, treated Temp 3.8 Volume: 121.12 L Analysis Start Date: 2/5/13 Analysis Start Time: 1130 Analyst: RNewton Analysis End: 2/20/2013 Comment I button rec'd./read/ filed, printed.					
130140-001	1615 Complete	Wastewater Effluent	Norovirus GII	1.76 e9 copies/ 12.8L	
Collector: Mack McPherson CollectDate 1/30/2013 CollectTime: 11:00:00 AM ReceiveDate 1/31/2013 9:20:00 AM Matrix: Waste Water, treated Temp 3.8 Volume: 121.12 L Analysis Start Date: 2/5/13 Analysis Start Time: 1130 Analyst: RNewton Analysis End: 2/20/2013 Comment I button rec'd./read/ filed, printed.					

REPORT NO.: 130140
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 CLIENT PO:

ASSAY RESULTS:

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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4/19/2013

Date:



Signature

Quality
Checked

DCelio



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130140
PAGE NO.: 1 of 1
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
130140-001	1615 Complete	Wastewater Effluent	Total Culturable Virus	<=0.03	MPN/L
Collector: Mack McPherson CollectDate 1/30/2013 CollectTime: 11:00:00 AM					
ReceiveDate 1/31/2013 9:20:00 AM Matrix: Waste Water, treated Temp 3.8					
Volume: 121.12 L Analysis Start Date: 1/31/13 Analysis Start Time: 1140					
Analyst: ValentinaL Analysis End: 3/6/2013					
Comment I button rec'd./read/ filed, printed.					

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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MAINTENANCE OF RECORDS: BioVir Laboratories, Inc. shall maintain records pertaining to the historical reconstruction of client's data for a minimum of five years from the date of issuance of the final report. Records may be destroyed after that date unless a written client's request for records transfer is received by BioVir which requests otherwise. Records transfer or storage charges may apply after the 5 year period. THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF BIOVIR LABORATORIES, INC.

4/19/2013

Date:

Richard E. Davis

Signature

Quality
Checked DCellio

EPA Method 1615: Measurement of Enterovirus and
Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

SAMPLE DATA SHEET
(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

258-1
WI Co 2

0.0°C

Note: Please use waterproof ink

Note: Please use waterproof ink NAME AND ADDRESS OF WATER COMPANY OR UTILITY: <i>City of Wichita Falls</i>		SAMPLE DATE: <i>03/06/13</i>	
NAME OF SAMPLER: <i>Mark McPherson</i>		pH: <i>6.78</i> pH (adjusted): pH meter model and serial no.:	Water Temp (C): <i>16.9</i> Temp. meter model and serial no.:
SAMPLE SOURCE: <i>Wastewater effluent</i>		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
SAMPLE LOCATION: <i>Waste water effluent River Rd.</i>		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): ☒ Yes ☐ No Free Chlorine (mg / L):	
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): <i>2.40</i> Meter Start: <i>4042</i> Meter Stop: <i>4074</i> <i>gallons</i>		Metering pump model and serial no.: Chlorine meter model and serial no.:	
Turbidity (NTU):		Total Volume: <i>32</i> Gallons _____ Liters	

Client ID #: <i>WIC002</i>	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS:

COMMENTS: We are ~~sp~~ sending back the 2 large filters used for our lake sampling. They have NOT been filtered. ONLY the small single filter was used.

COPY

RELINQUISHED BY: <i>Blair Ramon</i>	DATE / TIME: <i>3/6/13 1:30pm</i>
RECEIVED BY: <i>[Signature]</i>	DATE / TIME: <i>3/7/13 8:30</i>

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510

position of head & neck



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



685 Stone Road, Unit 6 • Benicia, CA 94510 • (707) 747-5906 • 1-800-GIARDIA • FAX (707) 747-1751 • WEB: www.biovir.com

REPORT NO.: 130258
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130258-001	WIC002	Wastewater Effluent	Enterovirus	Non-detect	
Collector: Mack McPherson CollectDate 3/6/2013 CollectTime: 11:15:00 AM					
ReceiveDate 3/7/2013 8:30:00 AM Matrix: Waste Water, treated Temp 6.0					
Volume: 121.12 L Analysis Start Date: 3/7/13 Analysis Start Time: 1345					
Analyst: RNewton Analysis End: 3/25/2013					
Comment i-button rec'd.					
130258-001	WIC002	Wastewater Effluent	Norovirus GI	3.75e6 copies/L	
Collector: Mack McPherson CollectDate 3/6/2013 CollectTime: 11:15:00 AM					
ReceiveDate 3/7/2013 8:30:00 AM Matrix: Waste Water, treated Temp 6.0					
Volume: 121.12 L Analysis Start Date: 3/7/13 Analysis Start Time: 1345					
Analyst: RNewton Analysis End: 3/25/2013					
Comment i-button rec'd.					
130258-001	WIC002	Wastewater Effluent	Norovirus GII	2.2e9 copies/L	
Collector: Mack McPherson CollectDate 3/6/2013 CollectTime: 11:15:00 AM					
ReceiveDate 3/7/2013 8:30:00 AM Matrix: Waste Water, treated Temp 6.0					
Volume: 121.12 L Analysis Start Date: 3/7/13 Analysis Start Time: 1345					
Analyst: RNewton Analysis End: 3/25/2013					
Comment i-button rec'd.					

REPORT NO.: 130258
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

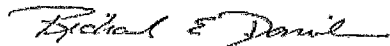
SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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4/16/2013

Date:


Signature

Quality
Checked ☐ DCellio



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130258
PAGE NO.: 1 of 1
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
130258-001	WIC002	Wastewater Effluent	Total Culturable Virus	< 0.03	MPN/L
Collector: Mack McPherson CollectDate 3/6/2013 CollectTime: 11:15:00 AM					
ReceiveDate 3/7/2013 8:30:00 AM Matrix: Waste Water, treated Temp 6.0					
Volume: 121.12 L Analysis Start Date: 3/7/13 Analysis Start Time: 1020					
Analyst: ValentinaL Analysis End: 4/8/2013					
Comment i-button rec'd.					

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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4/16/2013

Date:

Richard E. Daniel

Signature

Quality
Checked DCCello



EPA Method 1615: Measurement of Enterovirus and Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: City of Wichita Falls 4801 Big Ed Mack Dr Wichita Falls TX 76710		SAMPLE DATE: 4/9/13	
NAME OF SAMPLER: Mack McPherson		SAMPLE TIME: 10:45	
SAMPLE SOURCE: SW		pH: 7.21 pH (adjusted): pH meter model and serial no.:	Water Temp (C): 17°C Temp. meter model and serial no.:
SAMPLE LOCATION: 1005 River Road Recreation / out Fall		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): 2.80 Meter Start: Meter Stop: Turbidity (NTU): 2.80		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Yes ☒ No ☐ Free Chlorine (mg / L): Metering pump model and serial no.: Chlorine meter model and serial no.:	
		Total Volume: 15 Gallons _____ Liters	

Client ID #:	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only

COMMENTS:

RELINQUISHED BY: Mack McPherson	DATE / TIME: 4/9/13 2:10
RECEIVED BY: [Signature]	DATE / TIME: 4-10-13 6:26

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130474
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
130474-001	SW	River Rd Aeration Outfall	Total Culturable Virus	< 0.07	MPN/L
Collector: Mack McPherson CollectDate 4/9/2013 CollectTime: 10:45:00 AM					
ReceiveDate 4/10/2013 9:26:00 AM Matrix: Waste Water, treated Temp 7.3 C					
Volume: 15 gallons Analysis Start Date: 4/10/13 Analysis Start Time: 1415					
Analyst: ValentinaL Analysis End: 5/13/2013					
Comment					

Test: EPA 1615 PCR

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130474-001	SW	River Rd Aeration Outfall	Enterovirus	Non-detect	
Collector: Mack McPherson CollectDate 4/9/2013 CollectTime: 10:45:00 AM					
ReceiveDate 4/10/2013 9:26:00 AM Matrix: Waste Water, treated Temp 7.3 C					
Volume: 15 gallons Analysis Start Date: 4/12/13 Analysis Start Time: 0903					
Analyst: RNewton Analysis End: 4/30/2013					
Comment					

130474-001	SW	River Rd Aeration Outfall	Norovirus GI	Non-detect	
Collector: Mack McPherson CollectDate 4/9/2013 CollectTime: 10:45:00 AM					
ReceiveDate 4/10/2013 9:26:00 AM Matrix: Waste Water, treated Temp 7.3 C					
Volume: 15 gallons Analysis Start Date: 4/12/13 Analysis Start Time: 0903					
Analyst: RNewton Analysis End: 4/30/2013					
Comment					

REPORT NO.: 130474
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS
PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 PCR

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130474-001	SW	River Rd Aeration Outfall	Norovirus GII	Non-detect	
Collector: Mack McPherson CollectDate 4/9/2013 CollectTime: 10:45:00 AM					
ReceiveDate 4/10/2013 9:26:00 AM Matrix: Waste Water, treated Temp 7.3 C					
Volume: 15 gallons Analysis Start Date: 4/12/13 Analysis Start Time: 0903					
Analyst: RNewton Analysis End: 4/30/2013					
Comment					

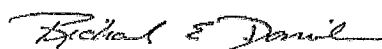
SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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5/31/2013

Date:



Signature

Quality
Checked D Cello



EPA Method 1615: Measurement of Enterovirus and Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

5481
WIC002 2.6°C

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: City of Wichita Falls 4801 Big Ed Neal Wichita Falls TX 76310		SAMPLE DATE: 04-24-13	
NAME OF SAMPLER: Blair Ramon		SAMPLE TIME: 2:30pm	
SAMPLE SOURCE: Surface water		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☒ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☐ Untreated Ground water ☐ Other: ☐	
SAMPLE LOCATION: Lake Arrowhead		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): Yes No N/A Free Chlorine (mg/L): Metering pump model and serial no.: Chlorine meter model and serial no.:	
SAMPLE VOLUME: (Meter #) TURBIDITY (NTU): Container Meter Start: 2 Turbidity (NTU): 33.2 Meter will not work w/ the pump that we have.		Container start amount: 225 gallons Total Volume: 50 Gallons Liters Container stop amount: 175 gallons	

Client ID #:	P.O. #:
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ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 800/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS: rec'd in ice bath - no insulation - around house

i bottle rec'd w/ previous sample - no i bottle w/ this sample	
RELIQUISHED BY: Blair Ramon	DATE / TIME: 04/24/13
RECEIVED BY:	DATE / TIME: 4/25/13 08:30

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130548
PAGE NO.: 1 of 1
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
130548-001A	A	Raw Surface Water	Total Culturable Virus	< 0.02	MPN/L
Collector: Blair Ramon CollectDate 4/24/2013 CollectTime: 2:30:00 PM					
ReceiveDate 4/25/2013 8:30:00 AM Matrix: Raw Water Temp 2.6					
Volume: 189.25 L Analysis Start Date: 4/25/13 Analysis Start Time: 1032					
Analyst: ValentinaL Analysis End: 5/28/2013					
Comment Lake Arrowhead					

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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6/7/2013

Date:

Richard E. Daniel

Signature

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BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130548
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130548-001B	B	Raw Surface Water	Enterovirus	Non-detect	
Collector: Blair Ramon CollectDate 4/24/2013 CollectTime: 2:30:00 PM					
ReceiveDate 4/25/2013 8:30:00 AM Matrix: Raw Water Temp 2.6					
Volume: 189.25 L Analysis Start Date: 4/26/13 Analysis Start Time: 0730					
Analyst: RNewton Analysis End: 5/10/2013					
Comment Lake Arrowhead					
130548-001B	B	Raw Surface Water	Norovirus GI	Non-detect	
Collector: Blair Ramon CollectDate 4/24/2013 CollectTime: 2:30:00 PM					
ReceiveDate 4/25/2013 8:30:00 AM Matrix: Raw Water Temp 2.6					
Volume: 189.25 L Analysis Start Date: 4/26/13 Analysis Start Time: 0730					
Analyst: RNewton Analysis End: 5/10/2013					
Comment Lake Arrowhead					
130548-001B	B	Raw Surface Water	Norovirus GII	Non-detect	
Collector: Blair Ramon CollectDate 4/24/2013 CollectTime: 2:30:00 PM					
ReceiveDate 4/25/2013 8:30:00 AM Matrix: Raw Water Temp 2.6					
Volume: 189.25 L Analysis Start Date: 4/26/13 Analysis Start Time: 0730					
Analyst: RNewton Analysis End: 5/10/2013					
Comment Lake Arrowhead					

REPORT NO.: 130548
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS
PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 **CLIENT PO:**

ASSAY RESULTS:

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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6/7/2013

Date:



Signature

Quality
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EPA Method 1615: Measurement of Enterovirus and Norovirus Occurrence in Water by Culture and RT-qPCR
SAMPLE DATA SHEET

(Please fill out completely and return to BioVir with the sample.)
Phone: 1-800-GIARDIA Fax: 707-747-1751 www.biovir.com

WI 0002

593..1

1.2°C

Note: Please use waterproof ink

NAME AND ADDRESS OF WATER COMPANY OR UTILITY: City of Wichita Falls 1401 Big Ed Neal Wichita Falls, TX 76310		SAMPLE DATE: 5/29/13	
NAME OF SAMPLER: Blair Raman		pH: 7.21 pH (adjusted): pH meter model and serial no.:	Water Temp (C): 21.7 Temp. meter model and serial no.:
SAMPLE SOURCE: Wastewater effluent		TREATMENT CHARACTERISTICS (Check One): Raw Surface Water ☐ Raw Wastewater ☐ Treated Surface or Groundwater ☐ Treated Wastewater ☒ Untreated Ground water ☐ Other: ☐	
SAMPLE LOCATION: Wastewater ccs		DECHLORINATION / DISINFECTANT NEUTRALIZATION: (If Treated Water): ☒ Yes ☐ No Free Chlorine (mg/L):	
SAMPLE VOLUME: (Meter # 97304713) TURBIDITY (NTU): Meter Start: 38115.1 Meter Stop: 38245 Turbidity (NTU): 280		Metering pump model and serial no.:	Chlorine meter model and serial no.:
		Total Volume: 50 Gallons _____ Liters	

Client ID #:	P.O. #:
--------------	---------

ASSAY REQUESTED: Please check one of the following	
☒	Method 1615 Complete: Culturable Virus and RT-qPCR (EPA 600/R-10/181)
☐	Method 1615 Culturable Virus Only.

COMMENTS:

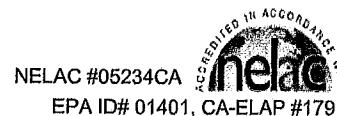
note: 49.9 Gal. 188.87L

RELINQUISHED BY: <i>Blair, Ramon</i>	DATE / TIME: <i>5/20/13 4:45pm</i>
RECEIVED BY:	<i>WML</i> DATE / TIME: <i>5/30/13 0952</i>

SHIPPING ADDRESS: BIOVIR LABORATORIES, INC., 685 STONE ROAD, UNIT 6, BENICIA, CALIFORNIA 94510



BioVir Laboratories, Inc



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REPORT NO.: 130593
PAGE NO.: 1 of 1
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 CLIENT PO:

ASSAY RESULTS:

Test: EPA 1615 Culture

Method: EPA 1615

BioVir #	Sample ID	Site	Analyte	Result	Units
130593-001	Wastewater CCB	Wastewater Effluent	Total Culturable Virus	< 0.02	MPN/L
Collector: Blair Ramon CollectDate 5/29/2013 CollectTime: 3:30:00 PM					
ReceiveDate 5/30/2013 9:52:00 AM Matrix: Waste Water, treated Temp 1.2					
Volume: 188.87 L Analysis Start Date: 5/30/13 Analysis Start Time: 1044					
Analyst: ValentinaL Analysis End: 7/2/2013					
Comment					

SAMPLE EVALUATION PERFORMANCE CRITERIA: The precise rates of recovery of organisms from environmental samples cannot be determined. BioVir Laboratories has analyzed your sample(s) in accordance with the method described with each analyte above, however, due to inherent limitations of these methods organisms may avoid detection. For additional information regarding the limitations of the method(s) referred to above please call us at 1-800-GIARDIA.

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7/8/2013

Date:

Richard E. Daniel

Signature

Quality
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BioVir Laboratories, Inc

NELAC #05234CA

EPA ID# 01401, CA-ELAP #179



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REPORT NO.: 130593
PAGE NO.: 1 of 2
CLIENT: WICHITA FALLS
ADDRESS: PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO: WIC002 **CLIENT PO:**

ASSAY RESULTS:

Test: EPA 1615

Method:

BioVir #	Sample ID	Site	Analyte	Result	Units
130593-001	Wastewater CCB	Wastewater Effluent	Enterovirus	Non-detect	
Collector: Blair Ramon CollectDate 5/29/2013 CollectTime: 3:30:00 PM					
ReceiveDate 5/30/2013 9:52:00 AM Matrix: Waste Water, treated Temp 1.2					
Volume: 188.87 L Analysis Start Date: 5/30/13 Analysis Start Time: 1352					
Analyst: RNewton Analysis End: 6/12/2013					
Comment					
130593-001	Wastewater CCB	Wastewater Effluent	Norovirus GI	Non-detect	
Collector: Blair Ramon CollectDate 5/29/2013 CollectTime: 3:30:00 PM					
ReceiveDate 5/30/2013 9:52:00 AM Matrix: Waste Water, treated Temp 1.2					
Volume: 188.87 L Analysis Start Date: 5/30/13 Analysis Start Time: 1352					
Analyst: RNewton Analysis End: 6/12/2013					
Comment					
130593-001	Wastewater CCB	Wastewater Effluent	Norovirus GII	5.7e3	
Collector: Blair Ramon CollectDate 5/29/2013 CollectTime: 3:30:00 PM					
ReceiveDate 5/30/2013 9:52:00 AM Matrix: Waste Water, treated Temp 1.2					
Volume: 188.87 L Analysis Start Date: 5/30/13 Analysis Start Time: 1352					
Analyst: RNewton Analysis End: 6/12/2013					
Comment					

REPORT NO.: 130593
PAGE NO.: 2 of 2
CLIENT: WICHITA FALLS
ADDRESS PO Box 1431
WICHITA FALLS, TX 76307
CLIENT NO WIC002 CLIENT PO:

ASSAY RESULTS:

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7/8/2013

Date:



Signature

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