



PUBLIC WORKS DEPARTMENT

March 25, 2014

RE: Updated DPR Full Scale Operation CTs.

Dear Sir or Madam,

I have reviewed the TCEQ changes to the City's Full Scale Operation CTs (Enclosures H-1 and H2), and I have also made the requested changes in the T10 Details Worksheet regarding the flow through the 10 MG ground storage tank.

I was not able to update the schematic in the enclosures, as requested, due to the forms being password protected. I am including the schematic as an attachment to the H-1 and H-2 enclosures for your review.

I would request the TCEQ provide an unprotected form so that the schematics may be updated.

Sincerely,

Mark Southard
Water Source/Purification Superintendent
City of Wichita Falls, TX
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Ph 940-691-1153
Fax 940-691-4121

Enclosure H1: 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 City of Wichita Falls Cypress Water Treatment Plant (CWF CWTP) Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis (MF/RO) treatment facilities with the conventional 2010 CWTP. This CT study takes into account the treated water pumped from the CWF River Road Waste Water Treatment Plant (RRWWTP) to the CWTP through a 32-inch outside diameter (O.D.) HDPE raw water pipe (with a 27-inch inside diameter, I.D.) at a flow of 7.5 million gallons per day (MGD), through the MF/RO treatment facility to a raw water lagoon where 5 MG will then be mixed with 5 MG raw surface water and treated through the conventional 2010 CWTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 5 MG permeate will be sent to a raw water lagoon, pumped back the the splitter basin and mixed with 5 MG of raw surface water prior to the 2010 CWTP. The 2010 CWTP consists of a rapid mix basin, a 90 foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20 million gallon (MG) clearwell and pump station and a 10.0-MG ground storage tank. Total capacity through the 2010 CWTP is 10.0-MGD.

The treatment processes for the water from the RRWWTP must achieve a 5.5-log removal or inactivation of Cryptosporidium, a 6.0-log removal or inactivation of Giardia, and a 9.0-log removal or inactivation of viruses before water is distributed to the customers. Based on the combination of treatment processes that will be used at the MF/RO facilities and 2010 CWTP, the disinfection process must be able to achieve a 1.0-log inactivation of Giardia and a 5.0-log inactivation of viruses before treated water enters the distribution system.

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

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

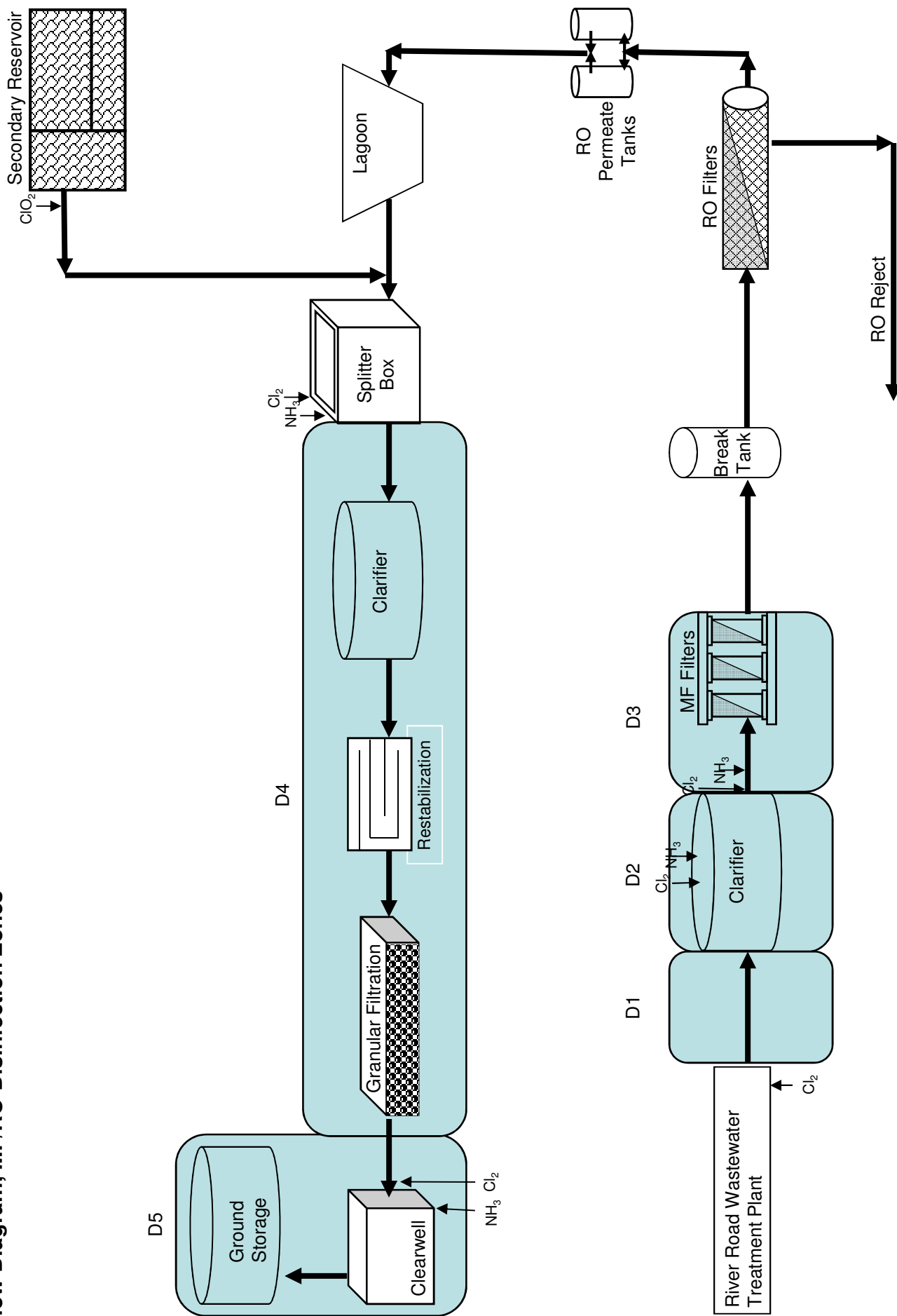
The disinfection process will utilize five disinfection zones which are summarized as follows:

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

Submitted by: _____
Contact
Information: _____

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

Flow Diagram, MF/RO Disinfection Zones



Enclosure H1: CT STUDY

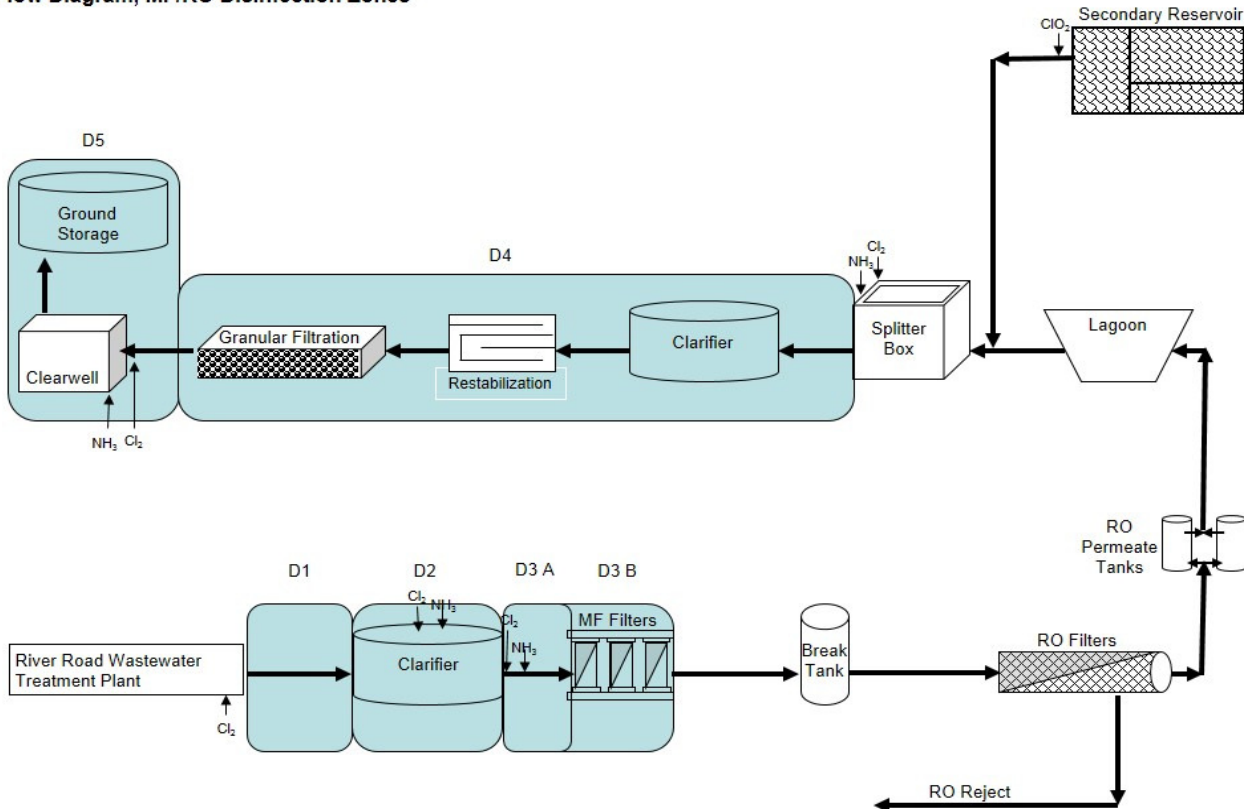
FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES
OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)
Schematic Worksheet

PUBLIC WATER
SYSTEM NAME: City of Wichita Falls Reuse Project PLANT NAME
OR NUMBER: RRWWTP to Cypress through MF/RO/Conventional

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



Enclosure H1: 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/Conventional

Date: _____

Treatment Plant Capacity 10.000 mgd
6,944 gpm

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

Disinfection Zone: D1

Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 13 Mile Pipe from RRWWTP to Cypress WTP

Characteristic		Comments
Number of Units	1	Pipe from RRWWTP to CWTP
Diameter	27 in	32" O.D. HDPE with a 27" I.D. per K. Maroney
Length	62500 ft	8/29/2013 email
		8/15/2013 email
Volume (each)	1,859,189 gal	
Flow Rate (each)	5,208 gpm	7.5 MGD Flow
Detention Time	357.0 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: _____
T ₁₀	357.0 min	
D1 FLOW RATE		
	7.500 mgd	
T10 SUM FOR D1		
	357.0 min	

Disinfection Zone: D2

Disinfectant: Chloramines

Unit - 1 Type: Clarifier Shape: Circular

Further Description: MF/RO Flocc-Clarifier

Characteristic		Comments
Number of Units	1	

Enclosure H1: CT STUDY

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

T10 Details Worksheet

Diameter 155 ft
Side Water Depth 25.3 ft
Center Water Depth 31.76 ft

Volume (each) 3,875,583 gal
Flow Rate (each) 5,208 gpm
Detention Time 744.1 min

Based on two engineer drawings for the clarifier structure (the CH2MHill DWG 4A-S-2, dated 2002 and the USFilter DWG 40507-101, dated 2004)

" " "
" " "

7.5 MGD Flow

Baffling Factor 0.3

T₁₀ 223.2 min

Based on a concentric cylindrical baffle wall with a diameter of approximately 50 ft that extends 10 ft into the basin and settled water launder along the perimeter of the basin

Baffling Characteristics: Poor
Approved Baffling Factor:

D2 FLOW RATE 7.500 mgd

T10 SUM FOR D2 223.2 min

Disinfection Zone: D3 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

Characteristic		Comments
Number of Units	1	Clarifier to Micro-filtration Trough
Diameter	36 in	8/15/2013
Length	250 ft	8/15/2013

Volume (each) 13,221 gal
Flow Rate (each) 5,208 gpm
Detention Time 2.5 min

7.5 MGD Flow

Baffling Factor 1.0

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

T₁₀ 2.5 min

Unit - 2 Type: Other Shape: Rectangular

Further Description: Micro-filtration Trough

Characteristic		Comments
Number of Units	1	

Enclosure H1: 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	25.16 ft	Based on CH2MHill DWG 4-S-10 dated 2002, and the length of the channel from the inlet to the center of the first pair of filter cells
Width	11 ft	Based on DWG 4-S-10
Side Water Depth	2.66 ft	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	5,508 gal	
Flow Rate (each)	5,208 gpm	Based on the total flow to the first diversion point
Detention Time	1.1 min	
Baffling Factor	0.1	Baffling Characteristics: Unbaffled
		Approved Baffling Factor:
T ₁₀	0.1 min	

Unit - 3 Type: Other Shape: Other

Further Description: Micro-filtration Cells

Characteristic		Comments
Number of Units	1	The flow rate through each individual MF tank must be monitored and the highest flow rate entered on the Calculator Worksheet.
Volume (each)	9,557 gal	Based on CH2MHill DWG 4-S-10 and DWG 4-S-11, both dated 2002
Volume (each)	9,557 gal	
Flow Rate (each)	2,297 gpm	Based on 504 modules with a total surface area of 334.9 ft ² per module and an approved flux rate of 19.6 gfd.
Detention Time	4.2 min	
Baffling Factor	0.7	Based on the configuration of the filter cell and the submerged membrane units
		Baffling Characteristics: Superior
		Approved Baffling Factor:
T ₁₀	2.9 min	

D3 FLOW RATE 3.308 mgd

T10 SUM FOR D3 5.6 min

Disinfection Zone: D4 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

Further Description: 36 Inch Raw Water Pipe

Enclosure H1: 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

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011
Length	220 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	11,634 gal	
Flow Rate (each)	6,944 gpm	based on a total 10 MGD flow through the
Detention Time	1.7 min	conventional 2010 CWTP facilities
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T₁₀	1.7 min	

Unit - 2 Type: Rapid Mix Shape: Rectangular

Further Description: Rapid Mix Basin

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	27 ft	As per CT Submittal Dated April 4, 2011
Width	6 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	4 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.7 min	
Baffling Factor	0.1	Typical Baffling Factor for an "Unbaffled" Basin
		Baffling Characteristics: Unbaffled
		Approved Baffling Factor:
T₁₀	0.1 min	

Unit - 3 Type: Piping Shape: Pipe

Further Description: 30 Inch Raw Water Pipe

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	3,122 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.4 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T₁₀	0.4 min	

Unit - 4 Type: Clarifier Shape: Circular

Enclosure H1: 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: Clarifier

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	90 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	18.9 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	926,521 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	133.4 min	
Baffling Factor	0.3	Typical Baffling Factor for Clarifiers
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: <u></u>
T₁₀	40.0 min	
Unit - 5	Type: <u>Other</u>	Shape: <u>Rectangular</u>

Further Description: Recarbonation Basin

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	45.5 ft	As per CT Submittal Dated April 4, 2011
Width	32 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	16.8 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	183,003 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	26.4 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: <u></u>
T₁₀	13.2 min	
Unit - 6	Type: <u>Filter</u>	Shape: <u>Rectangular</u>

Further Description: Gravity Filters

<u>Characteristic</u>		<u>Comments</u>
Number of Units	4	To represent the City's operation with four filters always in service and the fifth filter on standby for when one the filters goes into backwash.
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011
Average Porosity	50 %	

Enclosure H1: 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)	29,088 gal	10 MGD Flow Divided Equally Between Four Filters (Filters Rated at 2.5 MGD Flow Each). Four filters must always be operated together at equal flow rates.
Flow Rate (each)	1,736 gpm	
Detention Time	16.8 min	
Baffling Factor	0.7	Typical Baffling Factor for Filters
		Baffling Characteristics: Superior
		Approved Baffling Factor:
T ₁₀	11.7 min	

D4 FLOW RATE	10.000 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
Number of Units	1	
Length	98.4 ft	As per CT Submittal Dated April 4, 2011
Width	26 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	11.3 ft	As per CT Submittal Dated April 4, 2011
Maximum Volume (each)	216,290 gal	
Minimum Operating Level	5.7 ft	
Worst Case Volume (each)	109,102 gal	
Percent of Maximum Volume	50 %	Based on the clearwell's minimum operating level, i.e., 50% of Total Volume
Worst Case Volume (each)	109,102 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	15.7 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with Two Internal Baffles 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

Enclosure H1: 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

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 a "Worst Case" operating level that is
Worst Case Volume (each)	4,987,042	gal	50% of the maximum water depth
Percent of Maximum Volume	50	%	
Worst Case Volume (each)	4,987,042	gal	
Flow Rate (each)	6,944	gpm	100% of 10 MGD Max at Cypress. All water
Detention Time	718.1	min	produced will pass through the 10 MG GST for
			the DPR Full Scale Operation
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	215.4	min	

D5 FLOW RATE	10.000	mgd
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T10 SUM FOR D5	223.3	min
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Disinfection Zone:	<u>D6</u>	Disinfectant:	<u></u>
Disinfection Zone:	<u>D7</u>	Disinfectant:	<u></u>
Disinfection Zone:	<u>D8</u>	Disinfectant:	<u></u>
Disinfection Zone:	<u>D9</u>	Disinfectant:	<u></u>
Disinfection Zone:	<u>D10</u>	Disinfectant:	<u></u>

Enclosure H1: 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)	1,859,189	7.500	1	356.964	356.96
D2	MF/RO Flocc-Clarifier (1)	3,875,583	7.500	0.3	223.234	223.23
D3	36 Inch Raw Water Pipe (1)	13,221	7.500	1	2.538	5.56
	Micro-filtration Trough (1)	5,508	7.500	0.1	0.106	
	Micro-filtration Cells (1)	9,557	3.308	0.7	2.912	
D4	36 Inch Raw Water Pipe (1)	11,634	10.000	1	1.675	67.12
	Rapid Mix Basin (1)	4,848	10.000	0.1	0.070	
	30 Inch Raw Water Pipe (1)	3,122	10.000	1	0.450	
	Clarifier (1)	926,521	10.000	0.3	40.026	
	Recarbonation Basin (1)	183,003	10.000	0.5	13.176	
D5	Gravity Filters (4)	29,088	2.500	0.7	11.728	223.30
	Clearwell/Transfer Pump Station (1)	109,102	10.000	0.5	7.855	
	10 MG Ground Storage Tank (1)	4,987,042	10.000	0.3	215.440	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

CT STUDY

Enclosure H1: 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	3.308	10.000	10.000	1.0		5.0	
T ₁₀ (minutes)	357.0	223.2	5.6	67.1	223.3				

DISINFECTION PROCESS DATA												
INDIVIDUAL DISINFECTION ZONES										PLANT TOTAL		
Disinfectant	C (mg/L)	Flow (MGD)	Temp (°C)	pH	CT _{CALC}	Giardia CT _{REQD}	Virus CT _{REQD}	Giardia Log	Virus Log	Giardia Log	Virus Log	Inact. Ratio
CLA D1	1.0	7.500	12.0	7.5	357.0	554.0	1604.5	0.64	1.11			
CLA D2	1.0	7.500	12.0	7.5	223.2	554.0	1604.5	0.40	0.70			
CLA D3	1.0	3.308	12.0	7.5	5.6	554.0	1604.5	0.01	0.02	3.01	5.20	1.04
CLA D4	3.5	10.000	12.0	9.0	234.9	554.0	1604.5	0.42	0.73	(V)		
CLA D5	3.8	10.000	12.0	8.9	848.5	554.0	1604.5	1.53	2.64			

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

TCEQ - (05-01-13) CT STUDY

Enclosure H1: 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: 3RWWTP 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			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	Giardia Log	Virus Log	Inact. Ratio
D6												
D7												
D8												
D9												
D10												

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

TCEQ - (05-01-13)

CT STUDY

Enclosure H2: 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 City of Wichita Falls Cypress Water Treatment Plant (CWF CWTP) Temporary Reuse Project will combine the use of the Micro-filtration/Reverse Osmosis (MF/RO) treatment facilities with the conventional 2010 CWTP. This CT study takes into account the treated water pumped from the CWF River Road Waste Water Treatment Plant (RRWWTP) to the CWTP through a 30 inch raw water pipe at a flow of 7.5 million gallons per day (MGD), through the MF/RO treatment facility to a raw water lagoon where 5.0 MG will then be mixed with 5.0 MG raw surface water and treated through the conventional 2010 CWTP. The treatment process includes clarification prior to micro-filtration, reverse osmosis where the 5.0 MG permeate will be sent to a raw water lagoon, pumped back the the splitter basin and mixed with 5.0 MG of raw surface water prior to the 2010 CWTP. The 2010 CWTP consists of a rapid mix basin, a 90-foot diameter (dia.) clarifier, a re-carbonation basin, five multi-media gravity filters, a 0.20-million gallon (MG) clearwell and pump station and a 10-MG ground storage tank. Total capacity through the 2010 CWTP is 10 MGD.

The treatment processes for the water from Lake Arrowhead and Lake Kicapoo through the CWF's Secondary Reservoir must achieve a 2.0-log removal or inactivation of Cryptosporidium, a 3.0-log removal or inactivation of Giardia, and a 4.0-log removal or inactivation of viruses before water is distributed to the customers. Based on the combination of treatment processes that will be used at 2010 CWTP, the disinfection process must be able to achieve a 0.5-log inactivation of Giardia and a 2.0-log inactivation of viruses before treated water enters the distribution system.

However, it should be noted that higher levels of inactivation may be required at the 2010 CWTP so that the reuse water from the RRWWTP, which will be passing through the CWTP treatment processes, will be adequately disinfected before treatment is complete and it enters the distribution system.

The proposed disinfection protocol involves the injection of chlorine dioxide (ClO₂) downstream of the secondary reservoir, and chlorine (Cl₂) and liquid ammonia gas (NH₄) downstream of the splitter basin and upstream of the 0.20-MG clearwell and transfer pump station. Chlorine dioxide residual can be measured at three locations along the 42-inch raw water pipe at 400, 900 and 6500 linear feet downstream of the reservoir pump station, prior to entering the splitter basin. Since Cl₂ and NH₄ are added at the same location, a measureable ClO₂ residual must be maintained at the 400 ft sample tap. Chloramine residual is monitored downstream of the five multi-media gravity filters and downstream of the Cypress high service pumps, prior to entering the distribution system.

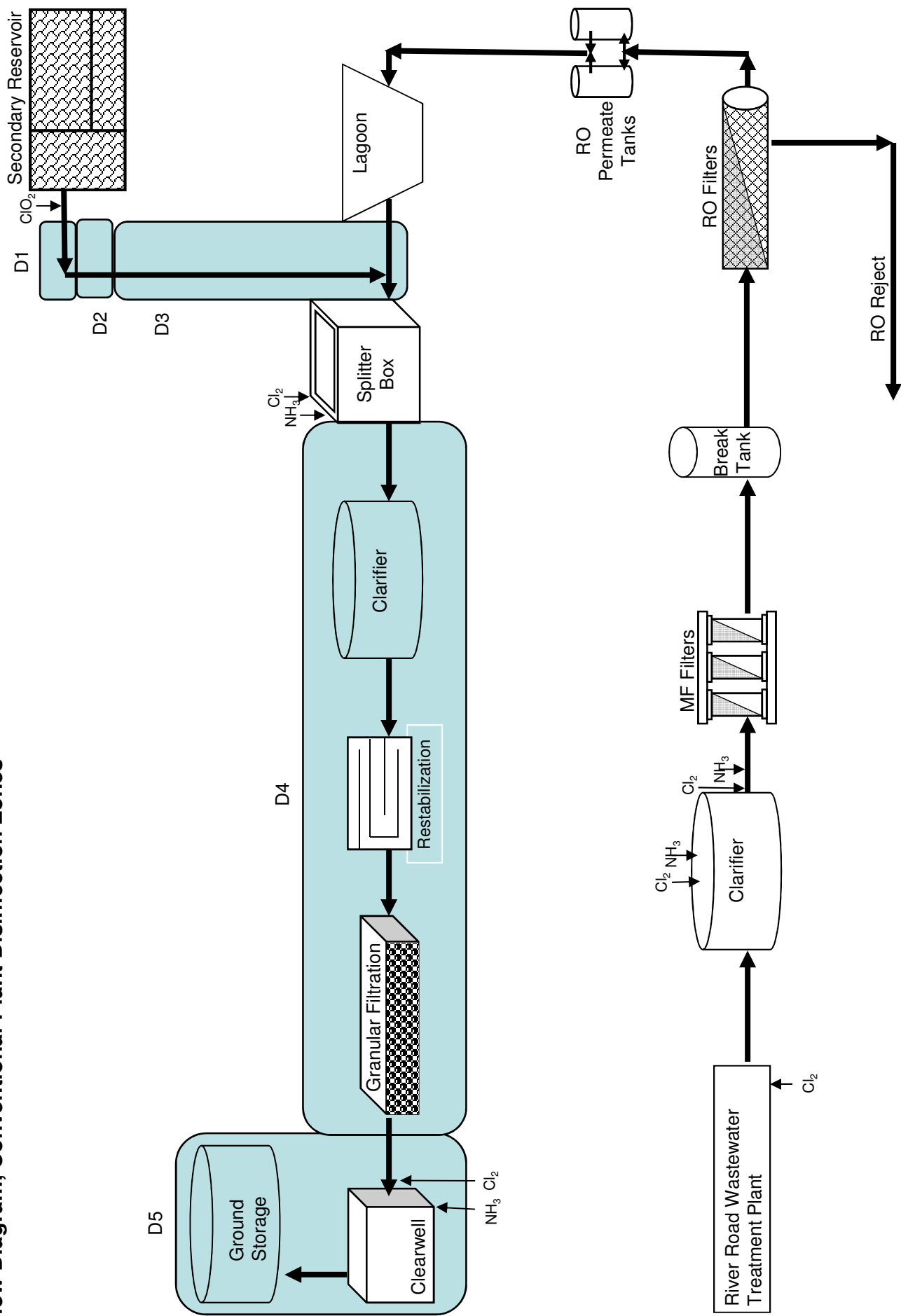
The disinfection process will utilize five disinfection zones which are summarized as follows:

- D1: The segment of the raw water pipeline from the chlorine dioxide injection point to the first monitoring point
- D2: The segment of the raw water pipeline between the first and second chlorine dioxide monitoring points
- D3: The segment of the raw water pipeline between the second and third chlorine dioxide monitoring points
- D4: The 2010 clarifier, recarbonation basin, multi-media gravity filters, and associated piping
- D5: The 2010 SWTP 0.20-MG clearwell and 10-MG ground storage tank

Submitted by: _____
Contact
Information: _____

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

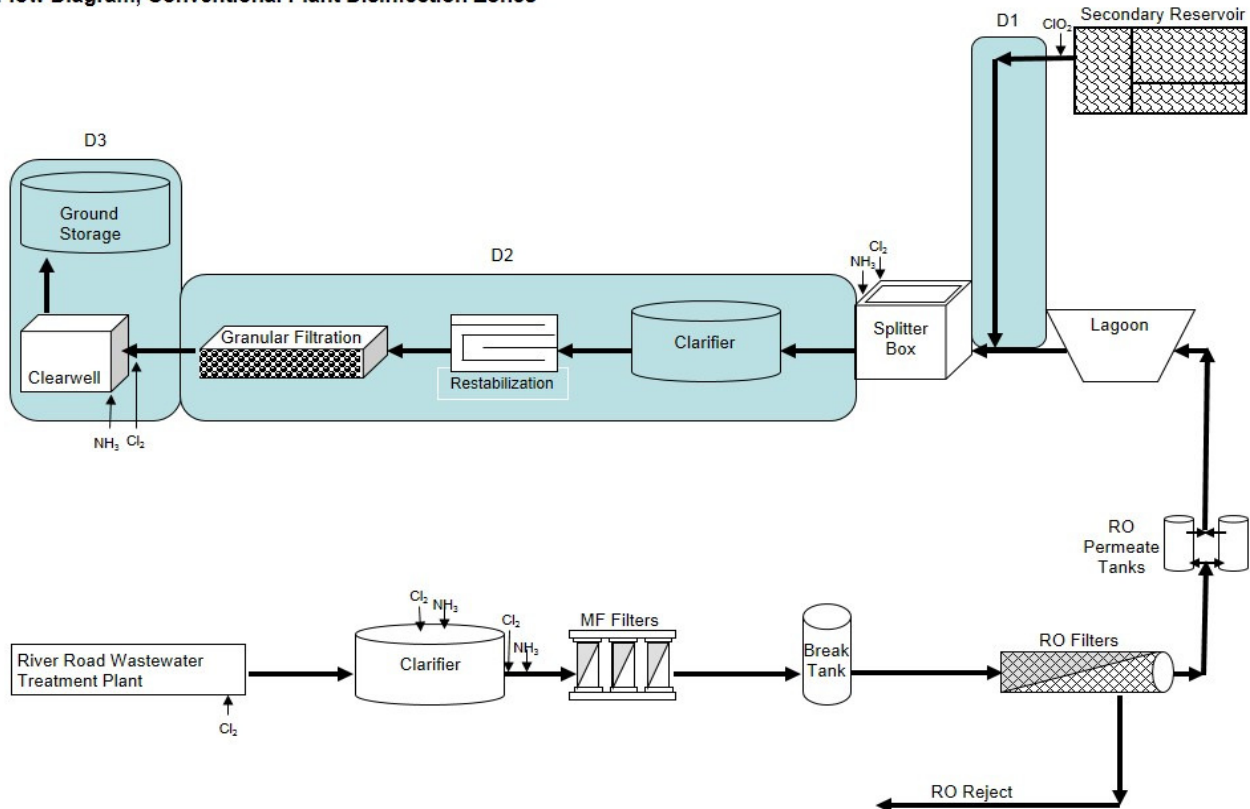
Flow Diagram, Conventional Plant Disinfection Zones



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

Secondary Res. Through Cypress Conventional

Date:



Enclosure H2: CT STUDY 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

Based on the combined flow rate from the MF/RO facilities and the secondary reservoir containing the raw water from Lake Arrowhead and Lake Kicakpoo through the Secondary Reservoir.

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

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
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	Based on a 5 MGD Flow Rate of raw water from Lake Arrowhead
Detention Time	8.3 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: <u>Perfect</u>
		Approved Baffling Factor: _____
T ₁₀	8.3 min	

D1 FLOW RATE	5.000 mgd
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T10 SUM FOR D1	8.3 min
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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

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	42 in	As per CT Submittal Dated April 4, 2011
Length	500 ft	As per CT Submittal Dated April 4, 2011

Enclosure H2: CT STUDY

T10 Details Worksheet

Volume (each)	35,990	gal	
Flow Rate (each)	3,472	gpm	Based on a 5 MGD Flow Rate of raw water from Lake Arrowhead
Detention Time	10.4	min	
Baffling Factor	1.0		Typical Baffling Factor for Pipe
			Baffling Characteristics: Perfect
			Approved Baffling Factor:
T ₁₀	10.4	min	

D2 FLOW RATE	5.000	mgd
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T10 SUM FOR D2	10.4	min
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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

<u>Characteristic</u>	<u>Comments</u>
Number of Units	1
Diameter	42 in
Length	5600 ft

Volume (each)	403,091	gal	
Flow Rate (each)	3,472	gpm	Based on a 5 MGD Flow Rate of raw water from Lake Arrowhead
Detention Time	116.1	min	
Baffling Factor	1.0		Typical Baffling Factor for Pipe
			Baffling Characteristics: Perfect
			Approved Baffling Factor:
T ₁₀	116.1	min	

D3 FLOW RATE	5.000	mgd
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T10 SUM FOR D3	116.1	min
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Disinfection Zone: D4 Disinfectant: Chloramines

Unit - 1 Type: Piping Shape: Pipe

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

Enclosure H2: CT STUDY

T10 Details Worksheet

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Splitter Box to Rapid Mix
Diameter	36 in	As per CT Submittal Dated April 4, 2011
Length	220 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	11,634 gal	
Flow Rate (each)	6,944 gpm	10 MGD, the combined flow rate from the MF/RO facilities and the secondary reservoir containing raw water from Lake Arrowhead
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

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	27 ft	As per CT Submittal Dated April 4, 2011
Width	6 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	4 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	4,848 gal	
Flow Rate (each)	6,944 gpm	based on a total 10 MGD flow through the conventional 2010 CWTP facilities
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

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	Rapid Mix to Clarifier
Diameter	30 in	As per CT Submittal Dated April 4, 2011
Length	85 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	3,122 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	0.4 min	
Baffling Factor	1.0	Typical Baffling Factor for Pipe
		Baffling Characteristics: Perfect
		Approved Baffling Factor:
T₁₀	0.4 min	

Enclosure H2: CT STUDY

T10 Details Worksheet

Unit - 4 Type: Clarifier Shape: Circular

Further Description: 2010 Plant Clarifier

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Diameter	90 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	18.9 ft	As per CT Submittal Dated April 4, 2011
Center Water Depth	20.6 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	926,521 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	133.4 min	
Baffling Factor	0.3	Typical Baffling Factor for Clarifiers
		Baffling Characteristics: <u>Poor</u>
		Approved Baffling Factor: _____
T₁₀	40.0 min	

Unit - 5 Type: Other Shape: Rectangular

Further Description: Recarbonation Basin

<u>Characteristic</u>		<u>Comments</u>
Number of Units	1	
Length	45.5 ft	As per CT Submittal Dated April 4, 2011
Width	32 ft	As per CT Submittal Dated April 4, 2011
Side Water Depth	16.8 ft	As per CT Submittal Dated April 4, 2011
Volume (each)	183,003 gal	
Flow Rate (each)	6,944 gpm	10 MGD Flow
Detention Time	26.4 min	
Baffling Factor	0.5	Typical Baffling Factor for Basins with 4 Internal Baffles and Length to Width (40:1)
		Baffling Characteristics: <u>Average</u>
		Approved Baffling Factor: _____
T₁₀	13.2 min	

Unit - 6 Type: Filter Shape: Rectangular

Further Description: 2010 Plant Gravity Filters

<u>Characteristic</u>		<u>Comments</u>
Number of Units	4	To represent the City's operation with four filters always in service and the fifth filter on standby for when one the filters goes into backwash.
Length	24 ft	As per CT Submittal Dated April 4, 2011
Width	15 ft	As per CT Submittal Dated April 4, 2011
Media Depth	6 ft	As per CT Submittal Dated April 4, 2011
Underdrain Depth	1 ft	As per CT Submittal Dated April 4, 2011
Minimum Water Depth Over Media	6.8 ft	As per CT Submittal Dated April 4, 2011

Enclosure H2: CT STUDY

T10 Details Worksheet

Average Porosity	50	%	
Volume (each)	29,088	gal	10 MGD Flow divided equally between four filters. Each filter is rated at 2.5 MGD. Four filters must always me operated together at equal flow rates.
Flow Rate (each)	1,736	gpm	
Detention Time	16.8	min	
Baffling Factor	0.7		Typical Baffling Factor for Filters Baffling Characteristics: <u>Superior</u> Approved Baffling Factor: <u> </u>
T ₁₀	11.7	min	

D4 FLOW RATE	10.000	mgd	
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T10 SUM FOR D4	67.1	min	
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Disinfection Zone:	D5	Disinfectant:	Chloramines
Unit - 1	Type: <u>Clearwell</u>	Shape:	<u>Rectangular</u>

Further Description: 2010 Plant Clearwell/Transfer Pump Station

<u>Characteristic</u>			<u>Comments</u>
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: <u>Average</u> Approved Baffling Factor: <u> </u>
T ₁₀	7.9	min	

Unit - 2	Type: Clearwell	Shape: Circular	
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Further Description: 10 MG Ground Storage Tank

<u>Characteristic</u>			<u>Comments</u>
Number of Units	1		

Enclosure H2: CT STUDY

T10 Details Worksheet

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	
Flow Rate (each)	6,944	gpm	100% of 10 MGD Max at Cypress. All water produced during the DPR Full Scale Operation will pass through the 10 MG GST.
Detention Time	718.1	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	215.4	min	

D5 FLOW RATE	10.000	mgd
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T10 SUM FOR D5	223.3	min
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Disinfection Zone:	D6	Disinfectant:	
Disinfection Zone:	D7	Disinfectant:	
Disinfection Zone:	D8	Disinfectant:	
Disinfection Zone:	D9	Disinfectant:	
Disinfection Zone:	D10	Disinfectant:	

Enclosure H2: 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	8.292	8.29
D2	Raw Water Line From Secondary Reservoir to Cypress	35,990	5.000	1	10.365	10.37
D3	Raw Water Line From Secondary Reservoir to Cypress	403,091	5.000	1	116.090	116.09
D4	Raw Water Pipe from Splitter Box to Rapid Mix (1)	11,634	10.000	1	1.675	67.12
	Rapid Mix Basin (1)	4,848	10.000	0.1	0.070	
	30 Inch Pipe from Rapid Mix to Clarifier (1)	3,122	10.000	1	0.450	
	2010 Plant Clarifier (1)	926,521	10.000	0.3	40.026	
	Recarbonation Basin (1)	183,003	10.000	0.5	13.176	
	2010 Plant Gravity Filters (4)	29,088	2.500	0.7	11.728	
D5	2010 Plant Clearwell/Transfer Pump Station (7)	109,102	10.000	0.5	7.855	223.30
	10 MG Ground Storage Tank (1)	4,987,042	10.000	0.3	215.440	

* These values are calculated on the T10 Details Sheet

TCEQ - (05-01-13)

CT STUDY

Enclosure H2: 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	10.000	10.000	0.5			2.0		
T ₁₀ (minutes)	8.3	10.4	116.1	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
CLO2 D1	0.05	5.000	5.0	8.2	0.4	4.5	5.7	0.05	0.14			
CLO2 D2	0.0	5.000	5.0	8.2	0.0	NA	NA	0.00	0.00			
CLO2 D3	0.0	5.000	5.0	8.2	0.0	NA	NA	0.00	0.00	1.56	2.67	1.34
CLA D4	3.5	10.000	5.0	9.0	234.9	357.5	857.0	0.33	0.55	(V)		
CLA D5	3.8	10.000	5.0	8.9	848.5	357.5	857.0	1.19	1.98			

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

TCEQ - (05-01-13)

CT STUDY

Enclosure H2: 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					
	D6	D7	D8	D9	D10	Giardia lamblia Cysts			Viruses		
Flow Rate (MGD)						0.5			2.0		
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	Giardia Log	Virus Log	Inact. Ratio
D6												
D7												
D8												
D9												
D10												

SUBMITTED BY: _____

Certificate No.
and Grade: _____ Date: _____

TCEQ - (05-01-13)

CT STUDY