

# Control of Trihalomethanes at the 23<sup>rd</sup> Avenue WWTP Year 2016 Field Test Results



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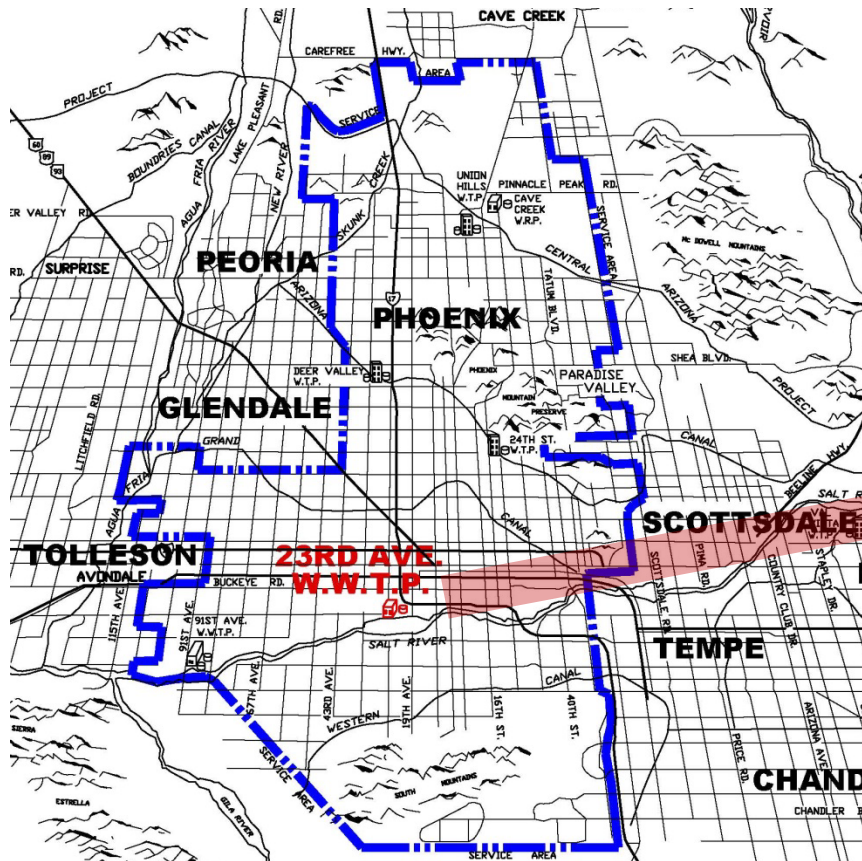
**May 4, 2017**

# Agenda

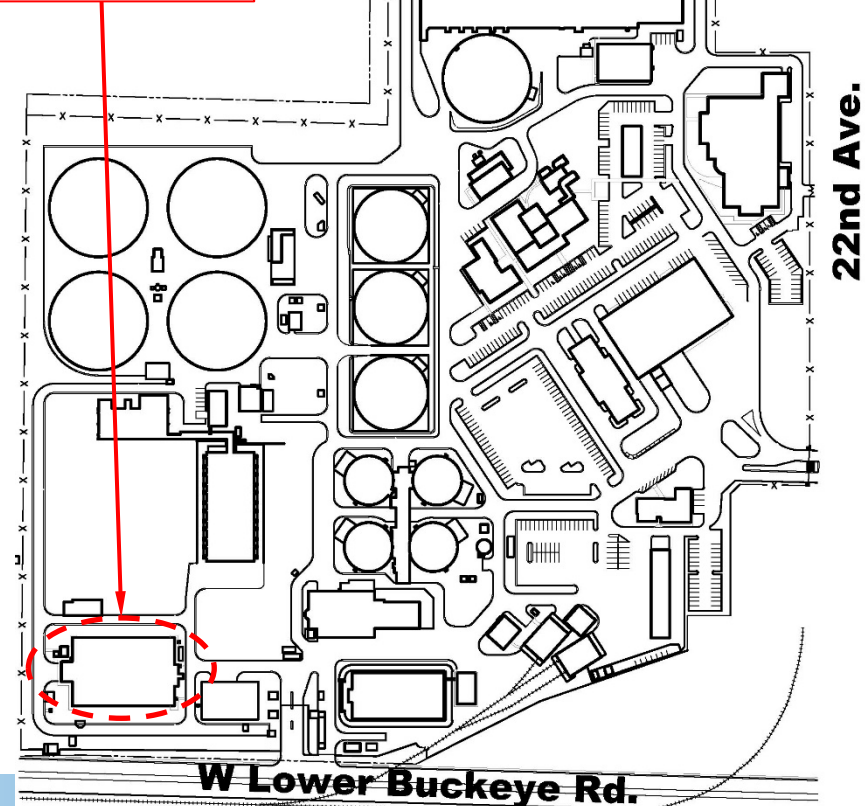
- Facility Overview
- Regulatory Requirements and Project Goals
- Understanding THM Formation
- THM and Ammonia Monitoring
- Step Feed Chlorination
- In Plant Ammonia Diversion-Chloramination
- Summary



# Location Map



**CHLORINE  
CONTACT  
BASINS**



# 23<sup>rd</sup> Avenue WWTP

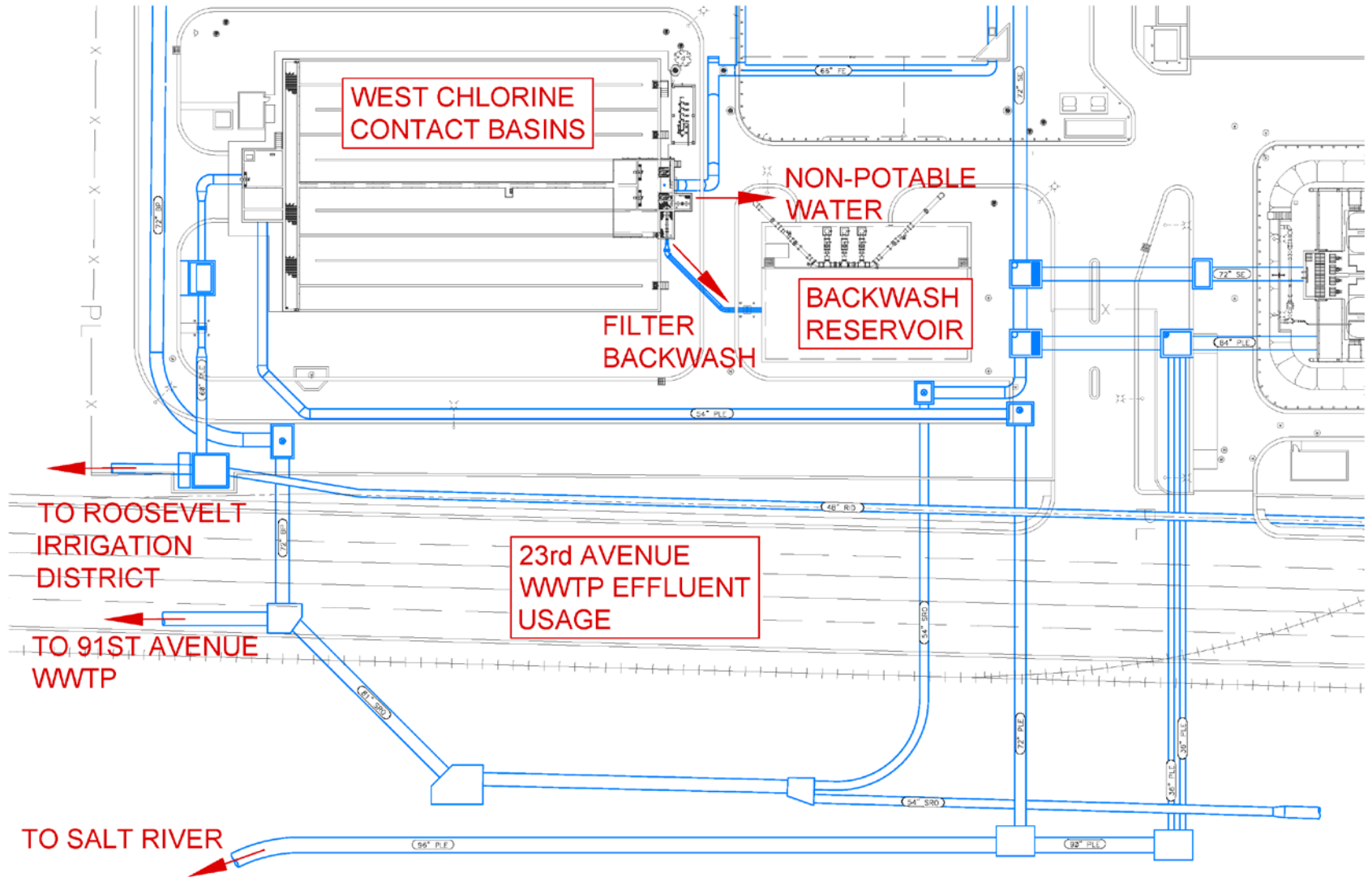
Parameter	Design Criteria		Actual 7/1/15 to 4/30/17	
	Average	Max Month	Average	Max Month
Flow (MGD)	57	63	34	37
BOD <sub>5</sub> (mg/l)	200	217	248	282
TSS (mg/l)	160	174	264	296

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# Regulatory Requirements



**23<sup>rd</sup> Ave. WWTP Process-Related Limits at Effluent Junction Box (730.30, 23 FINAL) – April 2017**

Parameter	AZ Pollutant Discharge Elimination System (AZPDES) Permit Limits				Aquifer Protection Permit (APP) Limits <sup>1</sup>		RID Agreement Limits	
	Discharging to Salt River		Not discharging to Salt River		Sampling Frequency	Limits	Sampling Frequency	Limits
	Sampling Frequency	Limits	Sampling Frequency	Limits				
<b>Bromodichloromethane</b>	Monthly	<b>17 ug/L</b> <i>Daily max<sup>2</sup></i>	Quarterly <sup>4</sup>	--		--		--
<b>Dibromochloromethane</b>	Monthly	<b>13 ug/L</b> <i>Daily max<sup>3</sup></i>	Quarterly <sup>4</sup>	--		--		--
<b>Total THM</b>		--		--	Quarterly	<b>100 ug/L</b>		--
<b>Ammonia</b>	Twice per month	<b>pH and temp. dependent</b>	Quarterly	--		--		--
<b>Chlorine</b>	Daily	<b>18.8 ug/L<sup>5</sup></b> <i>Daily max and Monthly avg.</i>	Quarterly	--		--		--
<b>Nitrate</b>	Quarterly	--	Quarterly	--	Monthly	<b>10.0 mg/L</b>		--
<b>Nitrite</b>	Quarterly	--	Quarterly	--	Monthly	<b>1.0 mg/L</b>		--
<b>Nitrogen</b> AZPDES - TKN APP - Total Nitrogen	Quarterly	--	Quarterly	--	Monthly	<b>10.0 mg/L</b>		--
<b>E. coli</b>	Daily	<b>575 CFU/100 mL</b> <i>Daily max</i>	Quarterly	--		--		--
		<b>126 CFU/100 mL</b> <i>Monthly geo. mean</i>						
<b>Fecal Coliform</b>	--	--	--	--	Daily	<b>800 MPN / 100mL</b> <i>Daily max</i>	Daily	<b>&lt;23 MPN / 100mL</b> <i>Daily max</i>
						<b>200 MPN / 100 mL</b> <b>in 4 of 7 samples</b> <i>Sunday through Saturday</i>		<b>Non-detect<sup>6</sup></b> <b>in last 4 of 7 days</b> <i>Rolling 7 days</i>
<b>Turbidity</b>	--	--	--	--		--	Daily	<b>2 NTU<sup>7</sup></b> <i>Daily max</i>

<sup>1</sup> Includes limits for reclaimed water used on site.

<sup>2</sup> Daily max = 22 ug/L, but because sampling is done once/month, the monthly average limit of 17 ug/L is the actual daily max

<sup>3</sup> Daily max = 19 ug/L, but because sampling is done once/month, the monthly average limit of 13 ug/L is the actual daily max

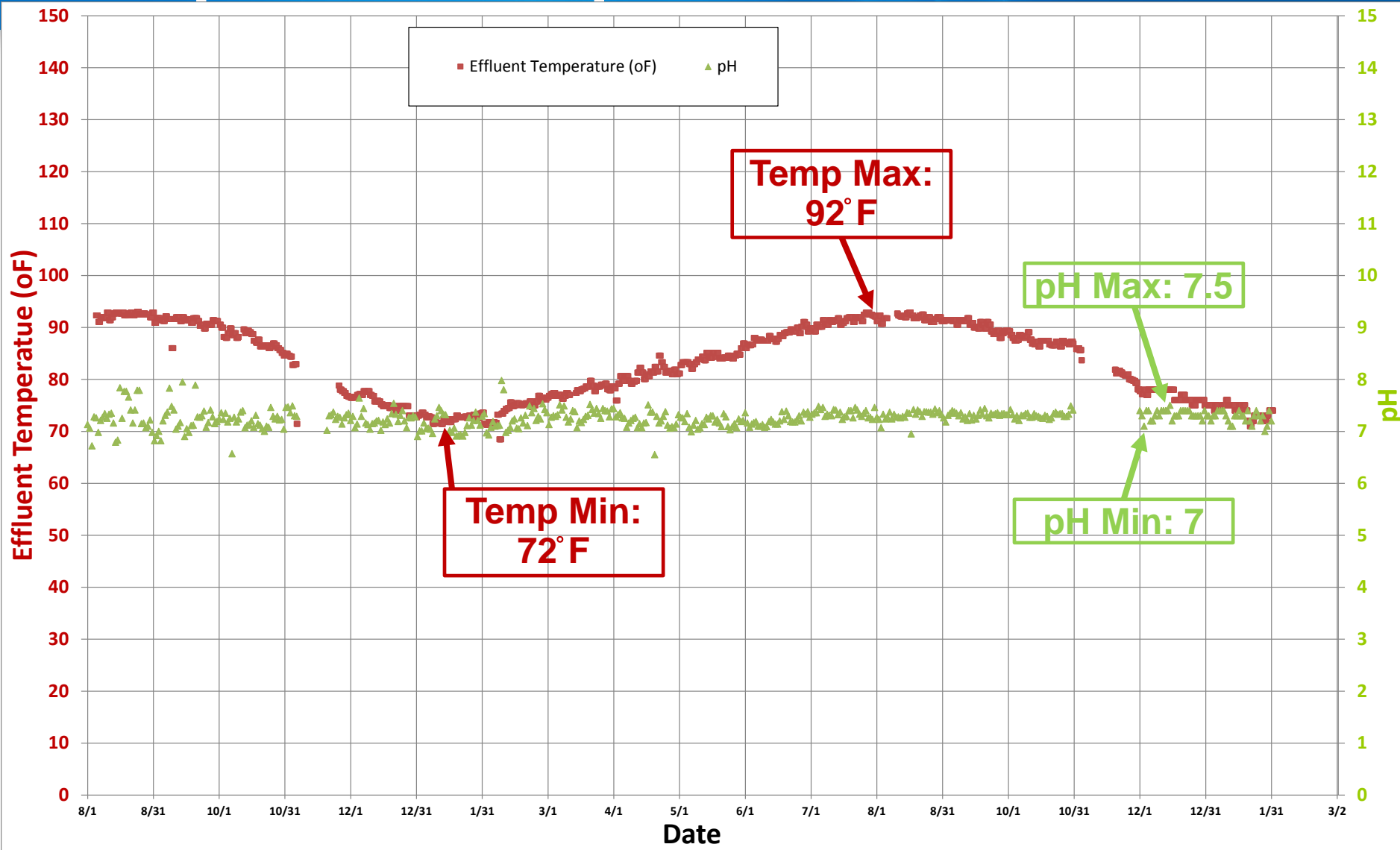
<sup>4</sup> Sampled quarterly to meet AZPDES Industrial Pretreatment Program requirements, which require quarterly sampling if detected in the annual scan. If no detect, would be required twice per year for effluent characterization.

<sup>5</sup> Limits change based on MDL study each year.

<sup>6</sup> For MPN, <2.2 is considered non-detect.

<sup>7</sup> Daily max = 5 NTU, but because sampling is done once/day, the 24-hour average limit of 2 NTU is the actual daily max.

# Ammonia – Effluent pH and Temperature Dependent





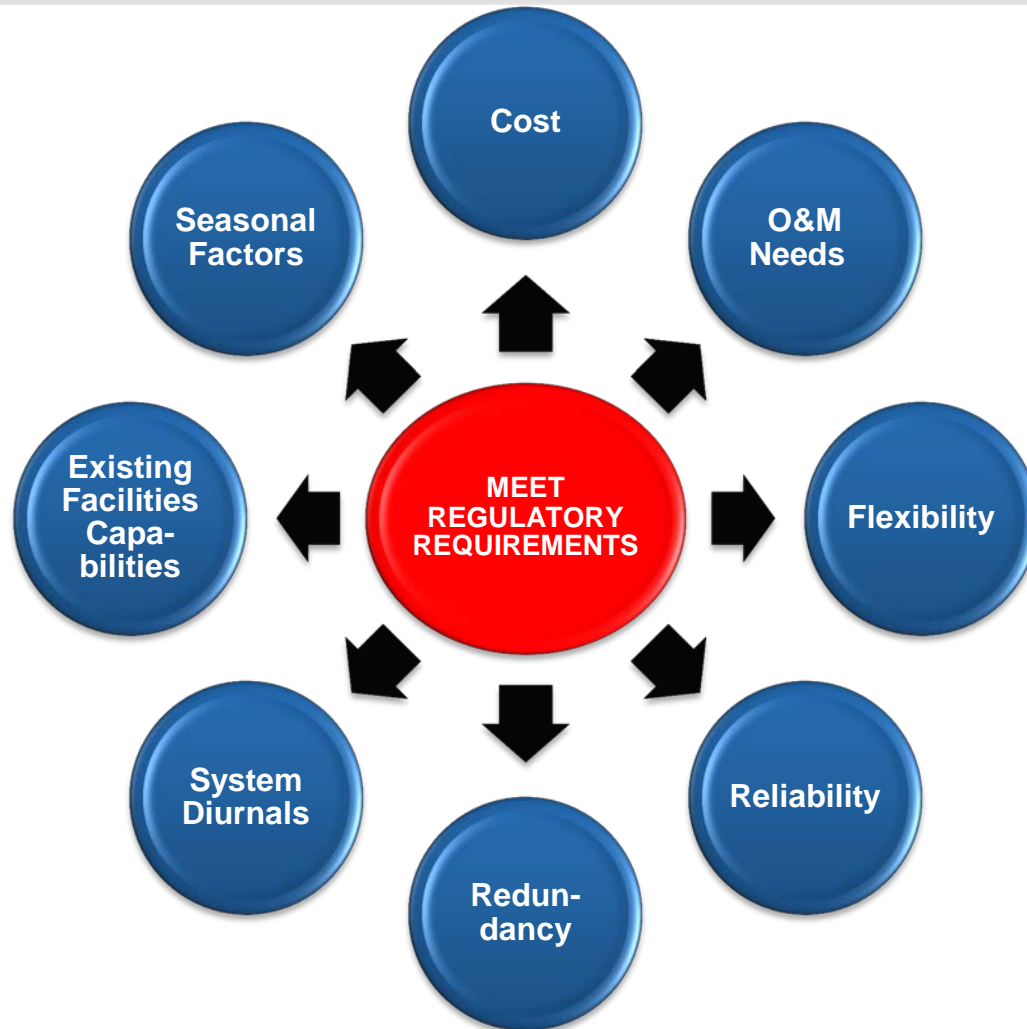
# APPENDIX C - AMMONIA SPECIAL REPORTING REQUIREMENTS

## A&W Designated Uses

**Determination of Chronic Total Ammonia Criteria as N in mg / L**  
**Based on pH and Temperature at Time of Sampling (1) (2)**

pH	Temperature, °C and°F									
	0 (32)	14 (57)	16 (61)	18 (64)	20 (68)	22 (72)	24 (75)	26 (79)	28 (82)	30 (86)
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.8	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.5	3.07	2.7	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.3	3.78	3.32	2.92	2.57	2.25
7	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.5	3.08	2.7	2.38	2.09
7.2	5.39	5.39	4.9	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.3	3.78	3.33	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.9	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	Total Ammonia Between 1.74 and 3.65 mg/l				
7.8	3.18	3.18	2.89	2.54	2.23					
7.9	2.8	2.8	2.54	2.24	1.96					
8	2.43	2.43	2.21	1.94	1.71	1.5	1.32	1.16	1.02	0.897
8.1	2.1	2.1	1.91	1.68	1.47	1.29	1.14	1	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.7	0.615	0.541	0.475
8.5	1.09	1.09	0.99	0.87	0.765	0.672	0.591	0.52	0.457	0.401
8.6	0.92	0.92	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.48	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9	0.486	0.486	0.442	0.389	0.342	0.3	0.264	0.232	0.204	0.179

# Regulatory Requirements and Project Goals



**Meet THM, BDCM and DBCM Needs At All Times**

# Agenda

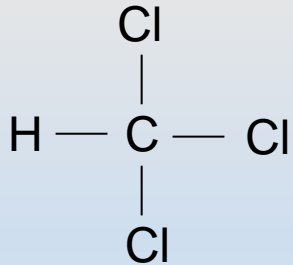
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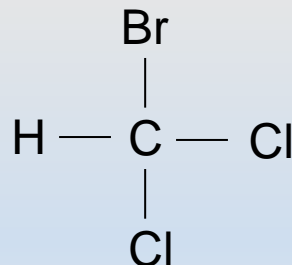
# Understanding THM Formation

- THM Profile at 23<sup>rd</sup> Avenue WWTP
- Chlorine Contact Basins

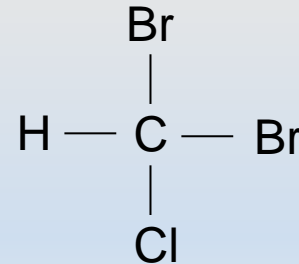
## The THM Species



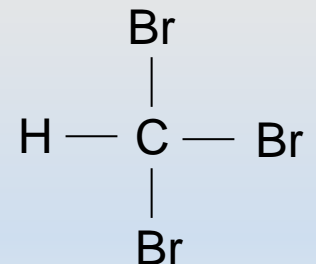
Chloroform  
 $\text{CHCl}_3$



Bromodichloromethane  
(BDCM)  
 $\text{CHBrCl}_2$

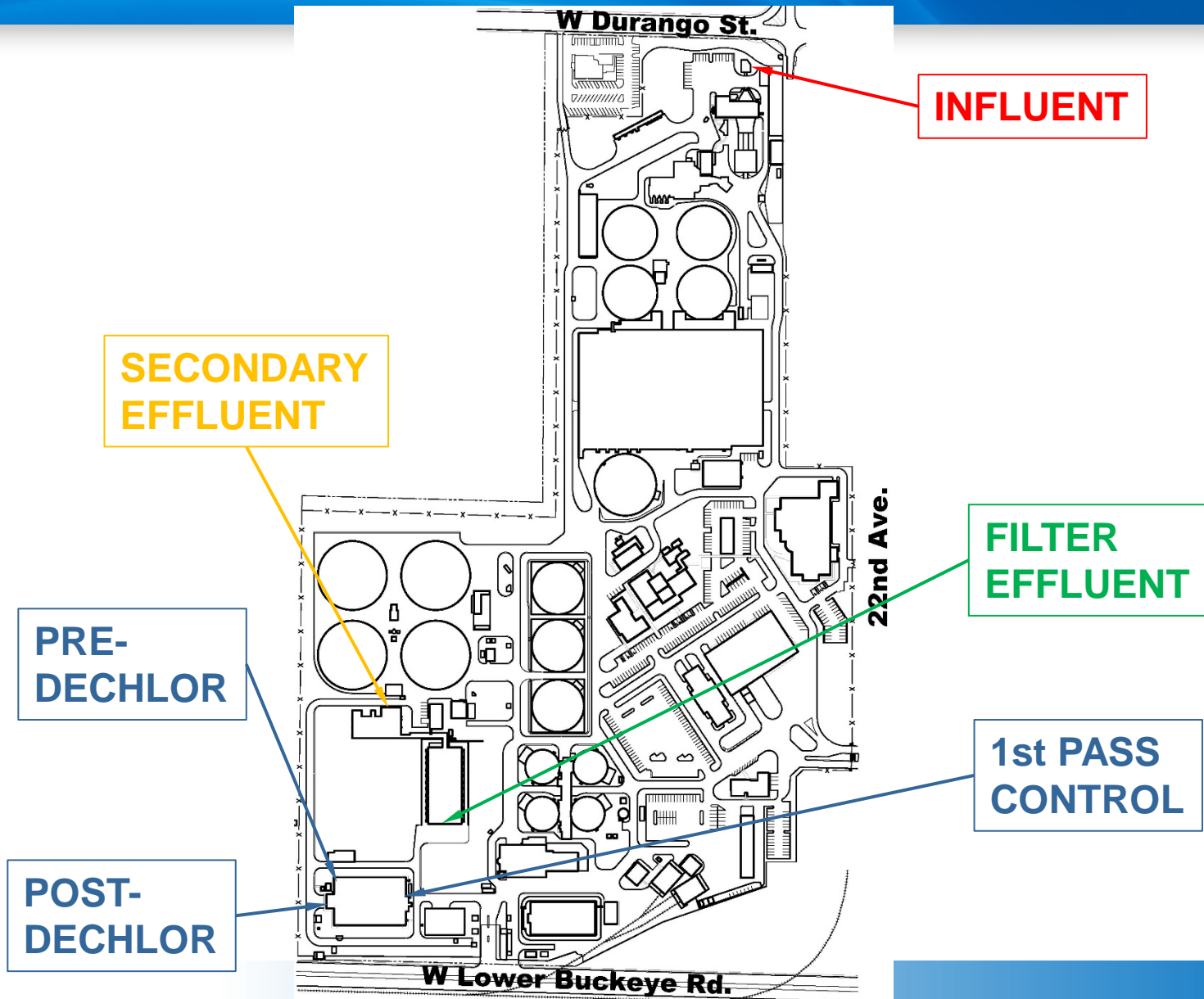


Dibromochloromethane  
(DBCM)  
 $\text{CHBr}_2\text{Cl}$



Bromoform  
 $\text{CHBr}_3$

# THM Profile at 23<sup>rd</sup> Avenue WWTP (April / May 2014)



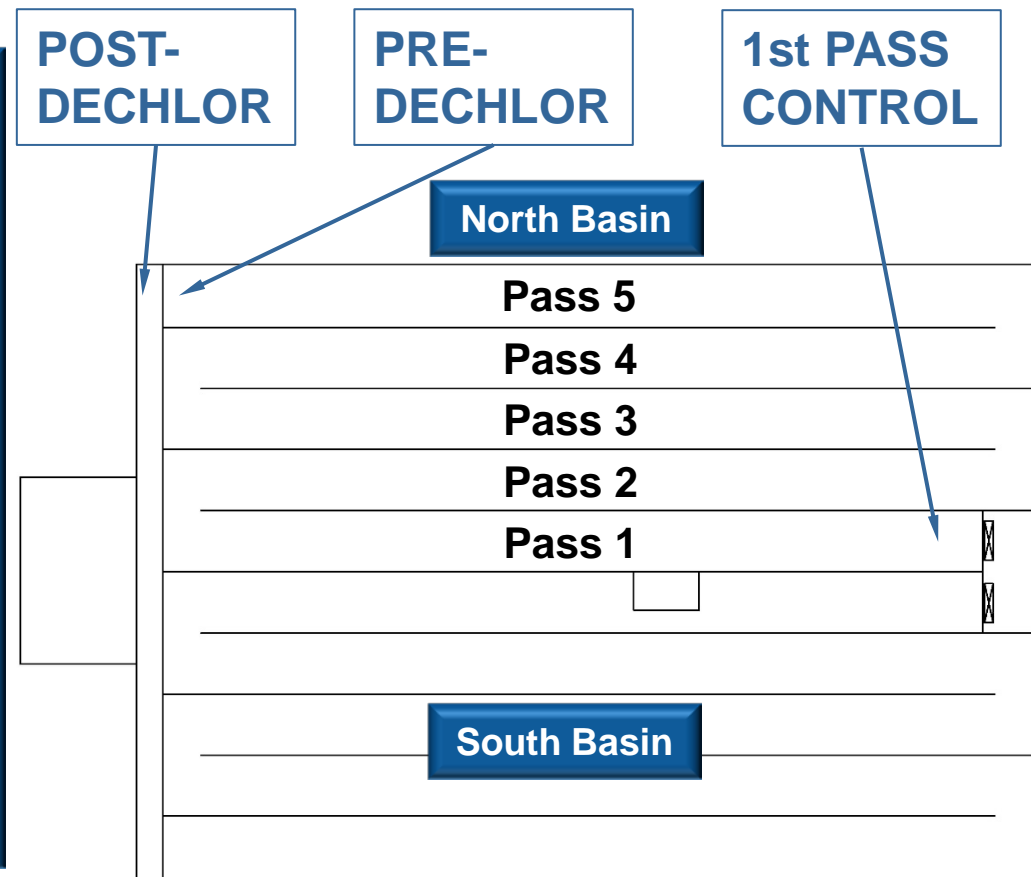
# 23<sup>rd</sup> Avenue WWTP West Chlorine Contact Basins

## Chlorine Contact Basins

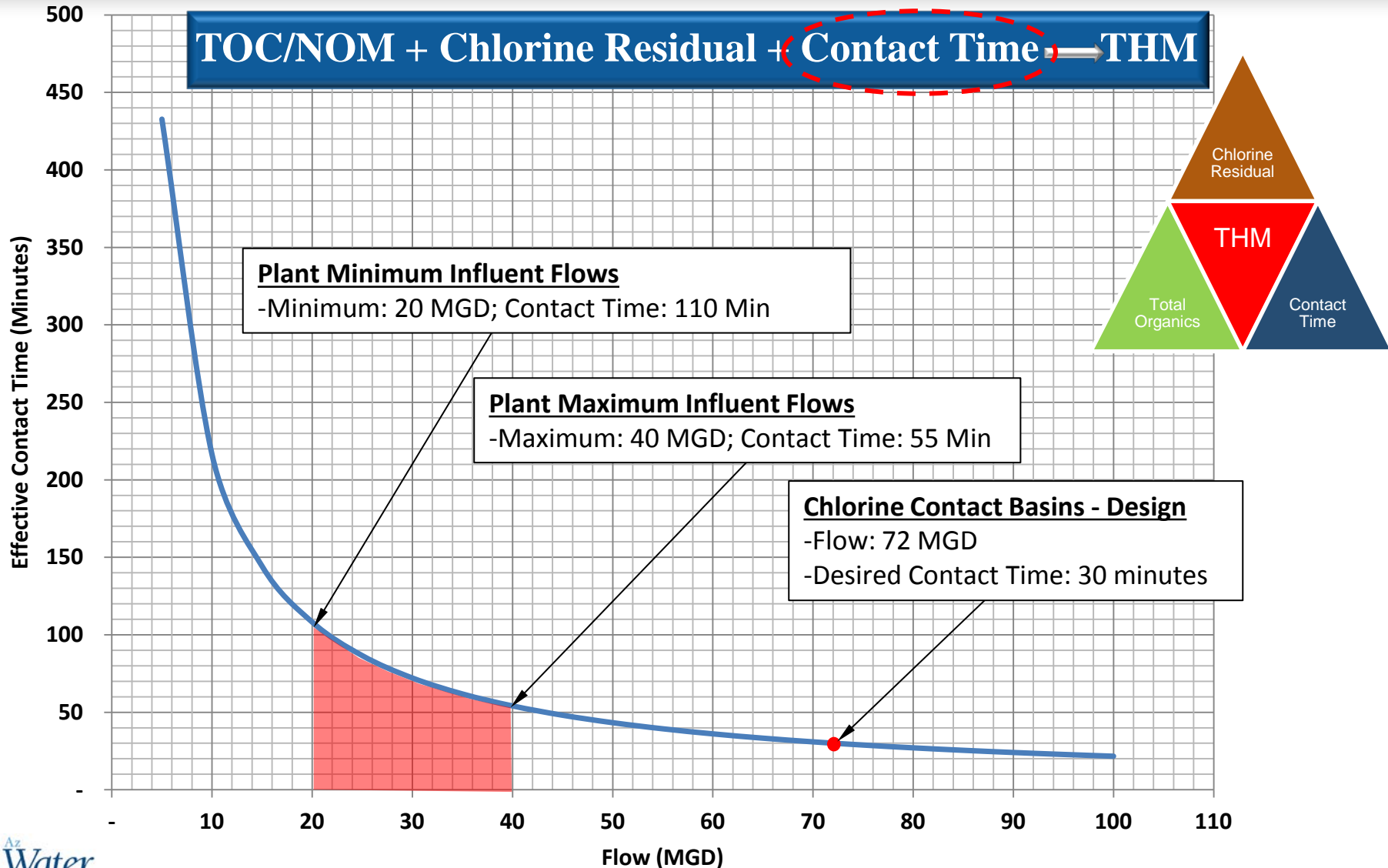
-2 Compartments

-5 Passes (each:  
186'L, 12'W, 18'D)

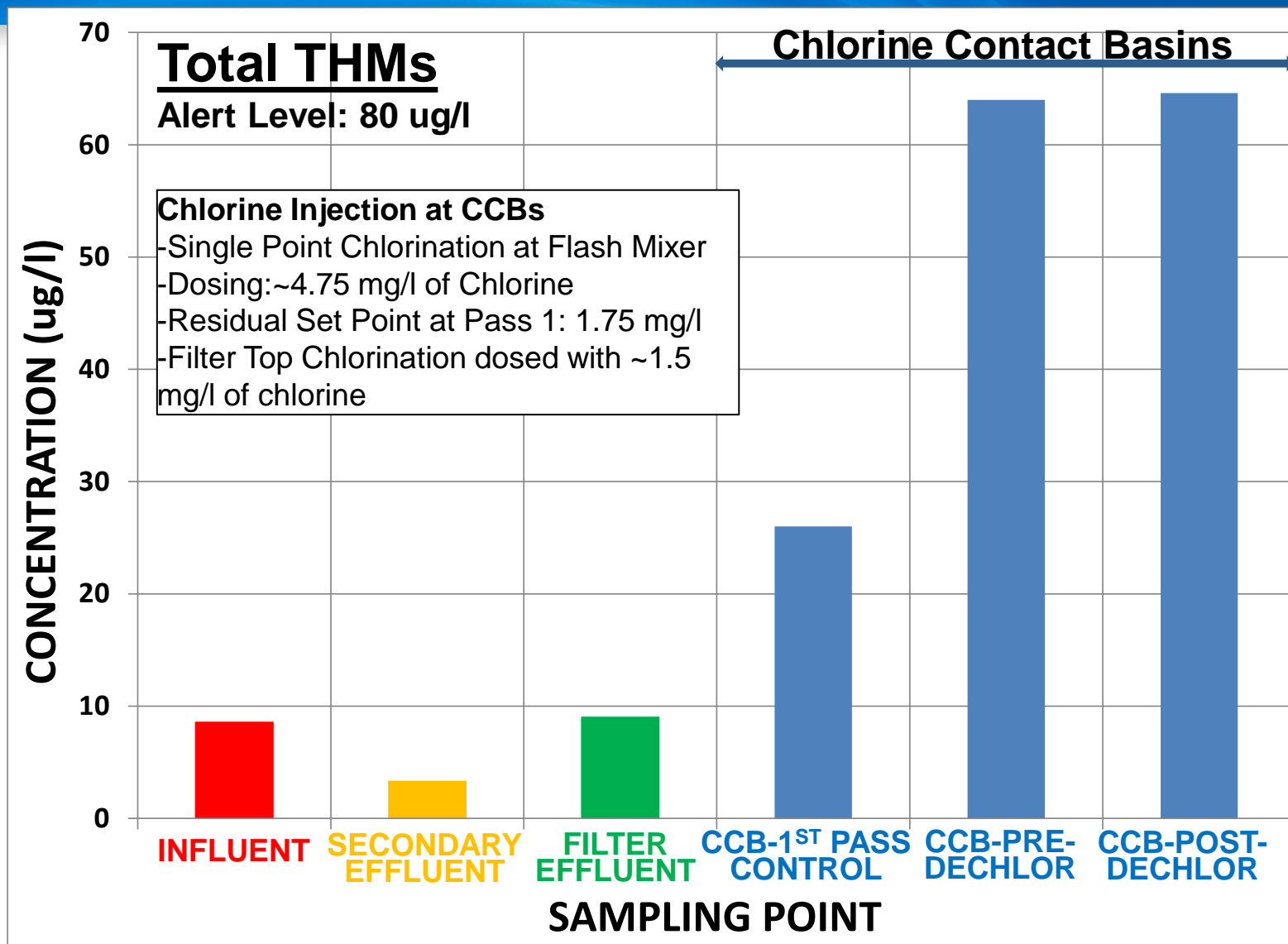
-Total Tank Volume: 3  
MG



# West Chlorine Contact Basins Existing Conditions (5 Passes)

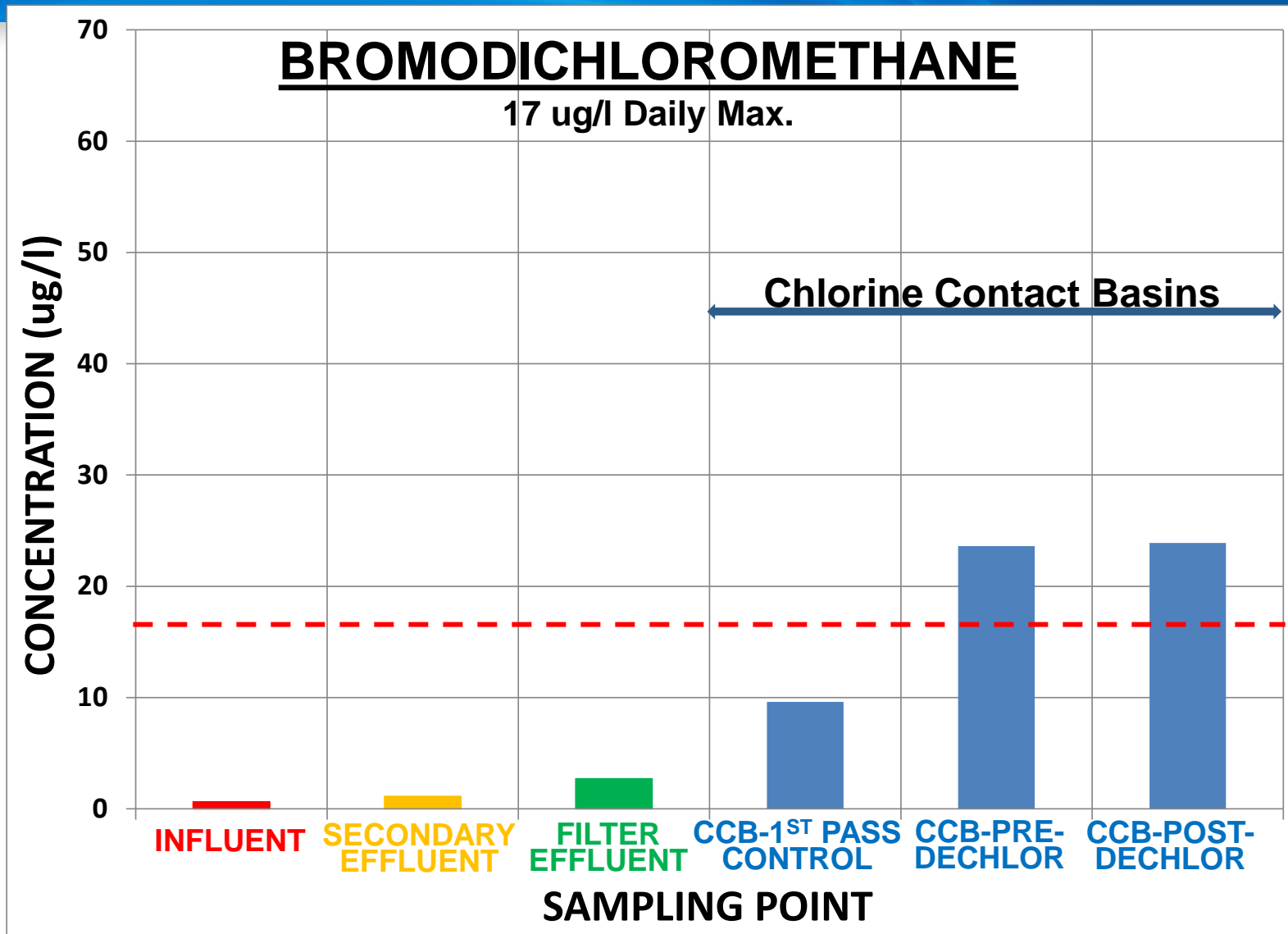


# THM Profile at 23<sup>rd</sup> Avenue WWTP (April/May 2014)

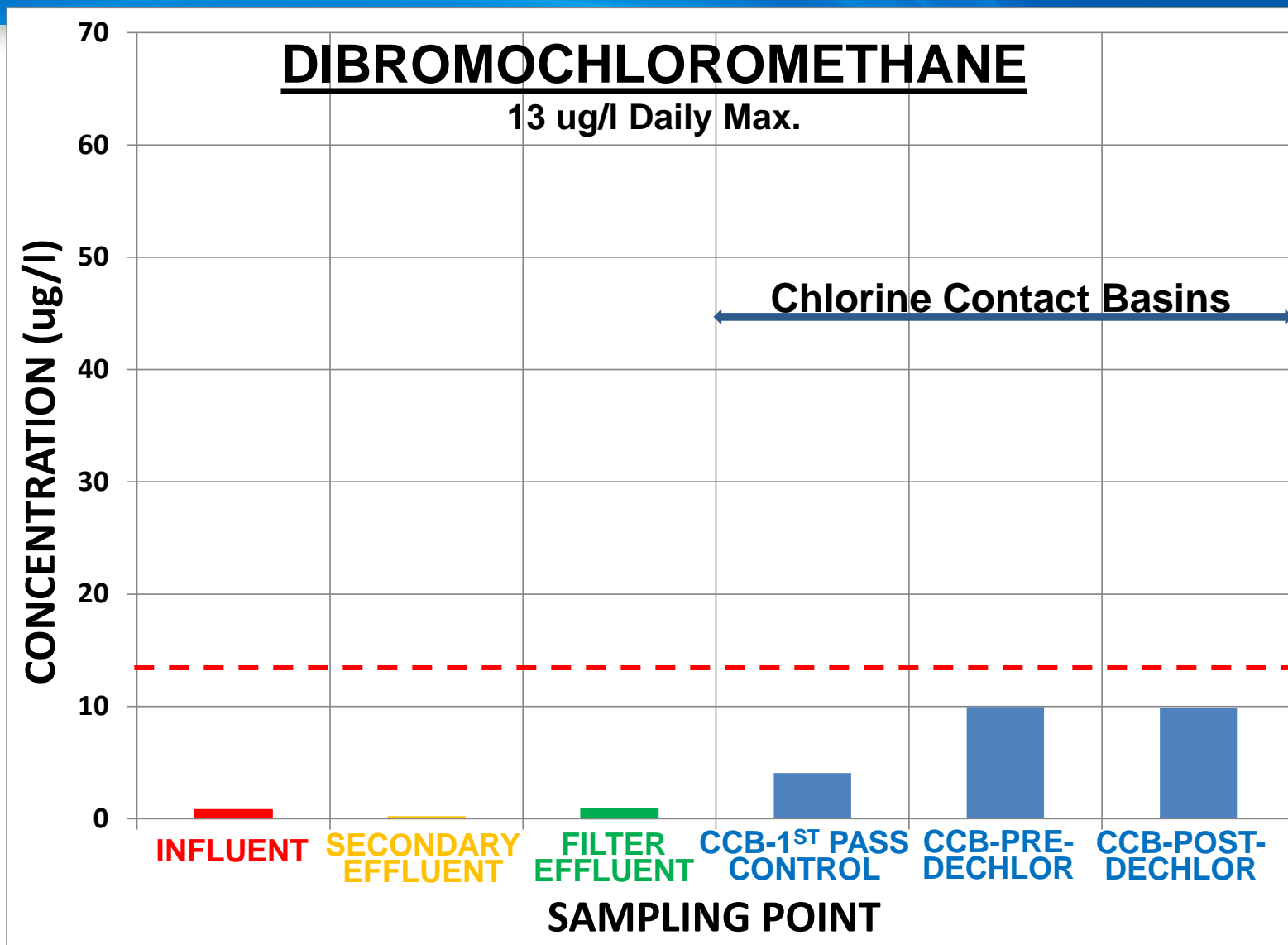




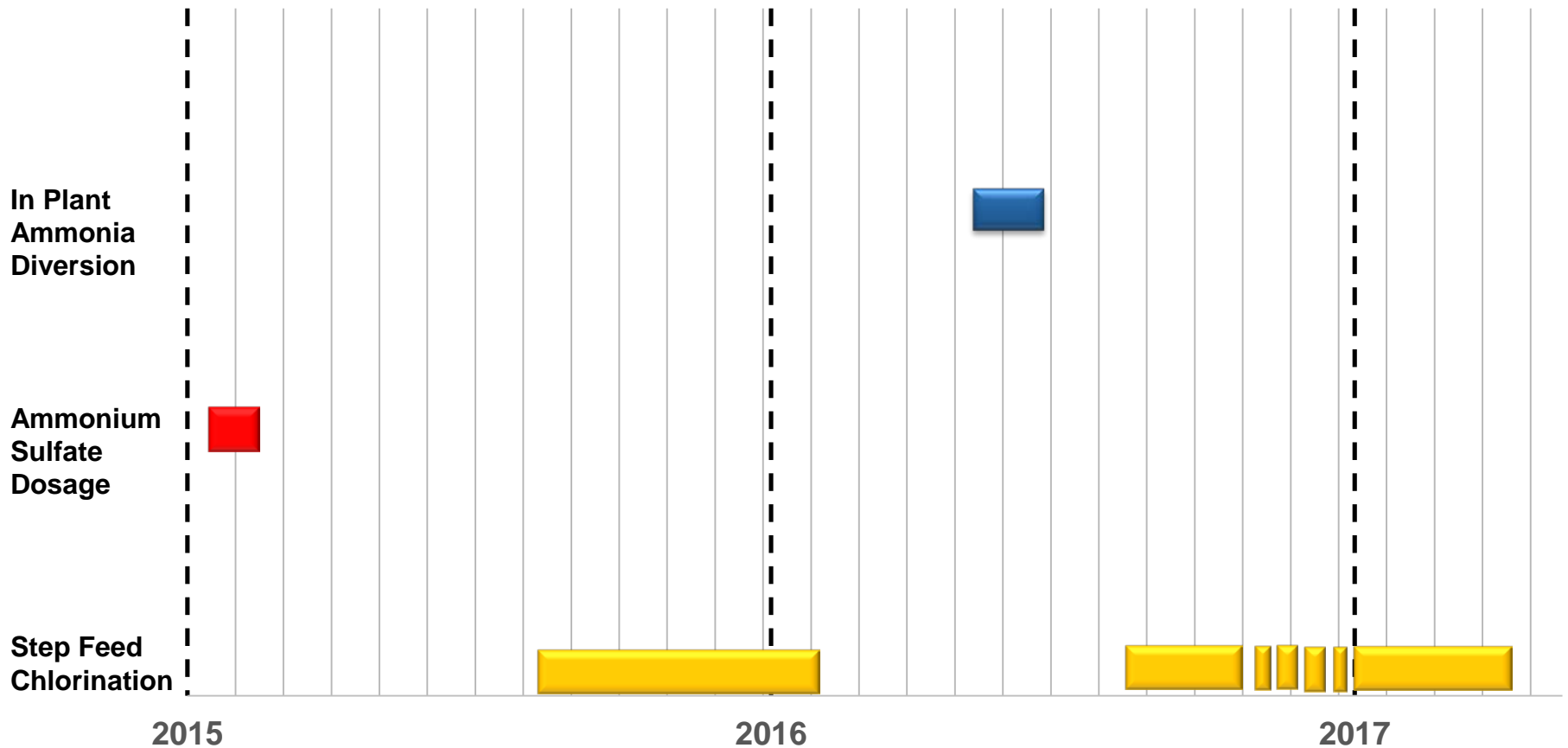
# THM Profile at 23<sup>rd</sup> Avenue WWTP (April/May 2014)



# THM Profile at 23<sup>rd</sup> Avenue WWTP (April/May 2014)



# Testing Approaches For Meeting Total THM BDCM and DBCM



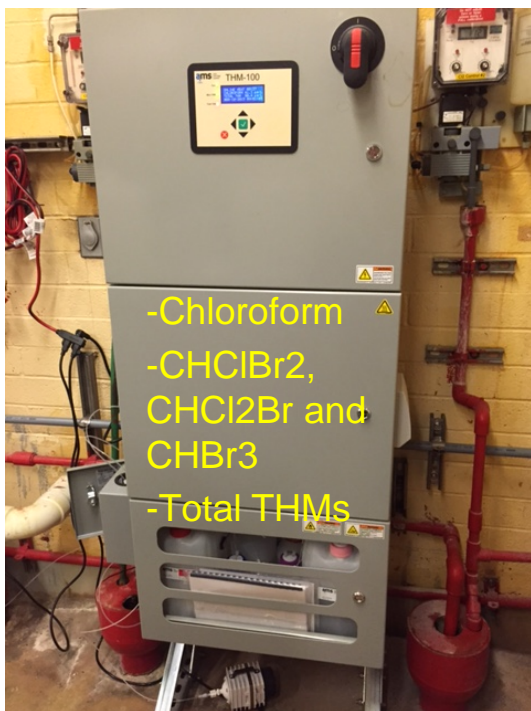
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# THM and Ammonia Monitoring Equipment

THM-100 Online Analyzer



Effluent Box

5500sc Ammonia Monochloramine Analyzer



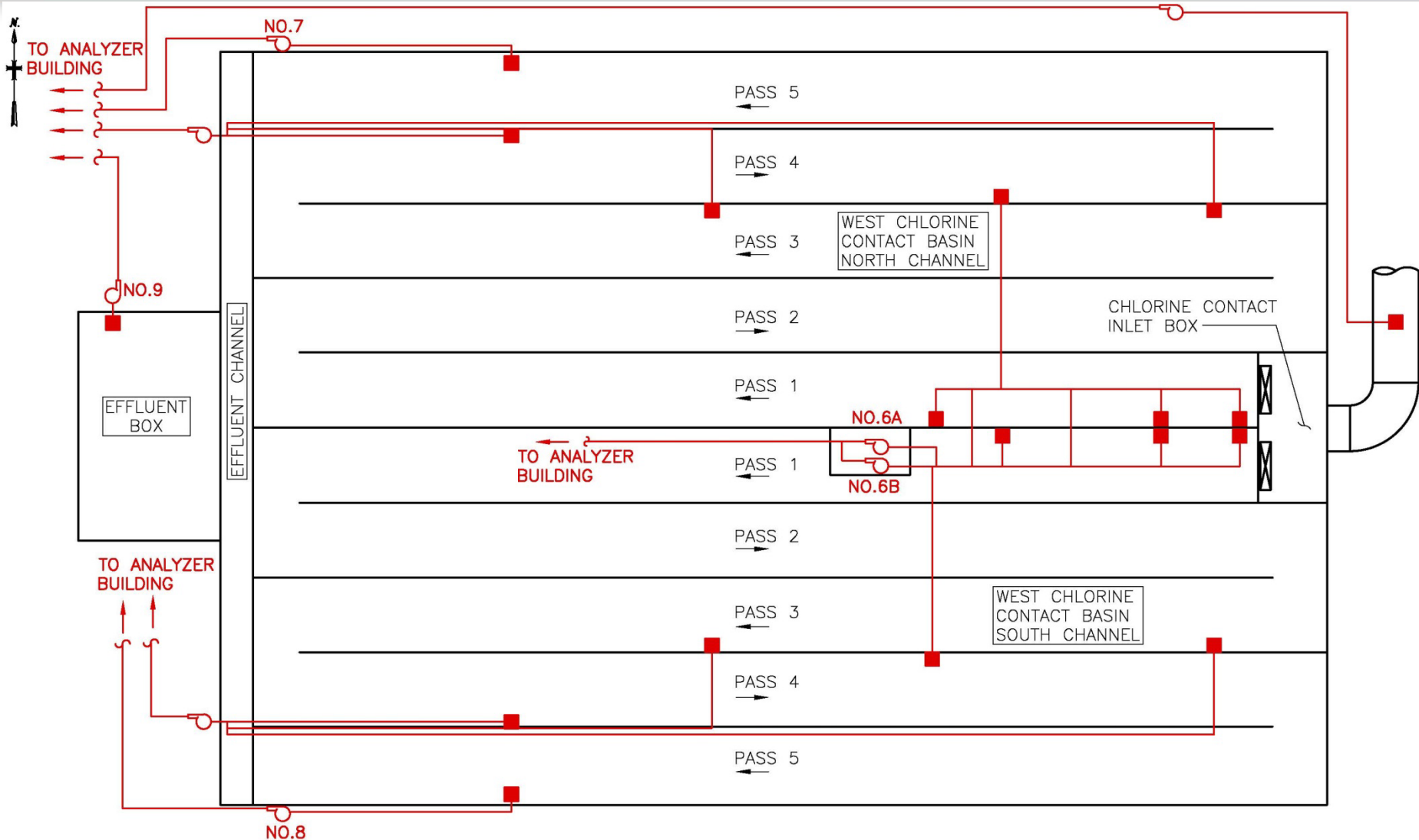
66" Influent Pipe  
CCB's Pass 1  
Effluent Box

AMTAX sc Ammonium Analyzer

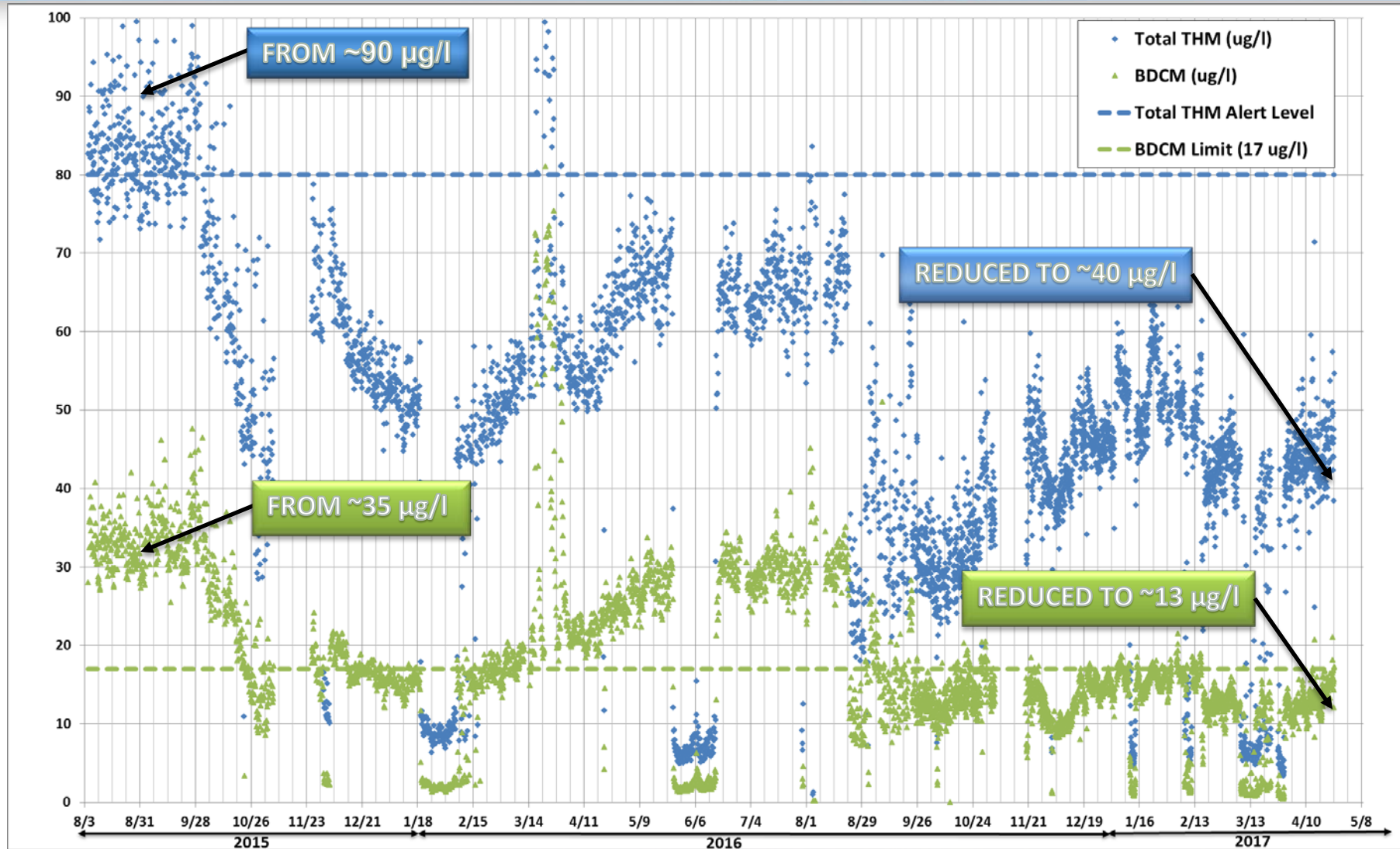


Primary Effluent Flows

# Sampling Points, THM and Ammonia Monitoring Equipment



# Effluent THM and BDCM Trending



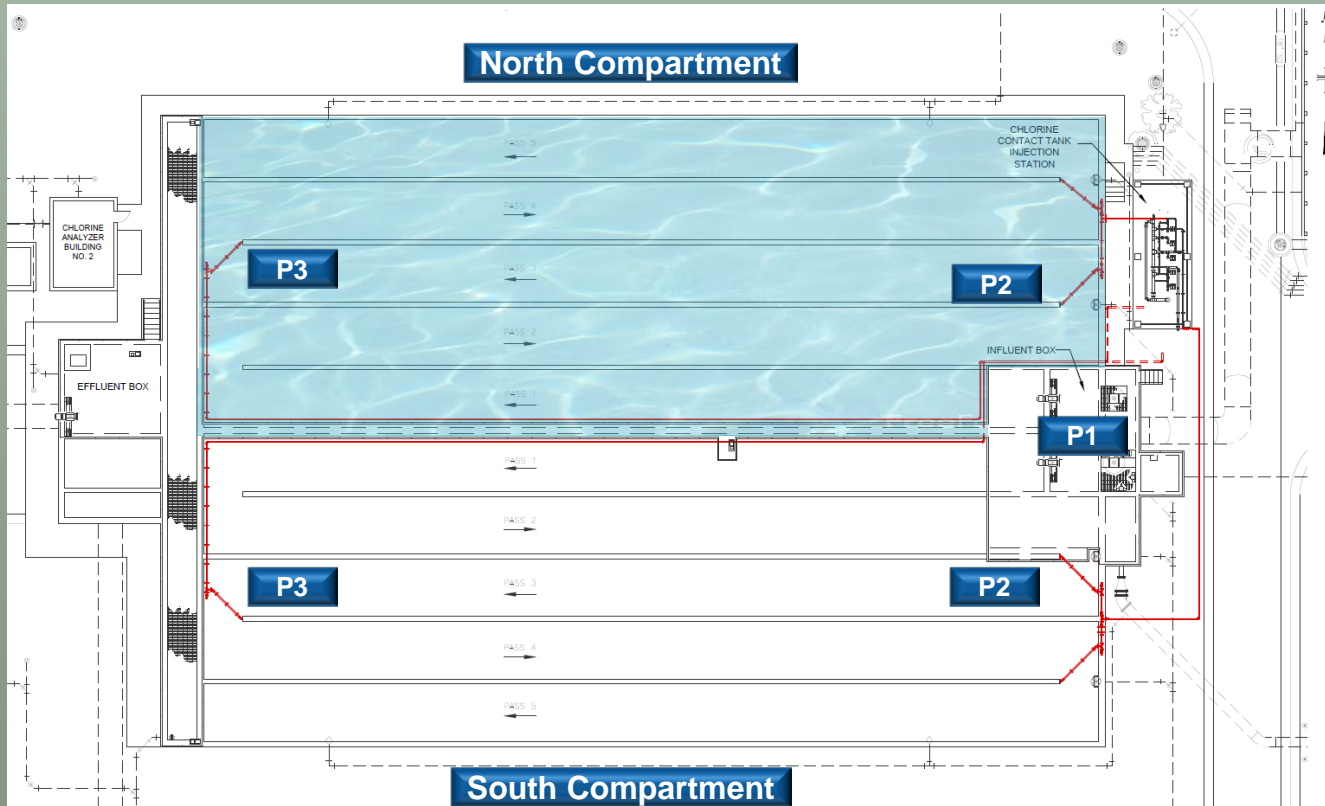
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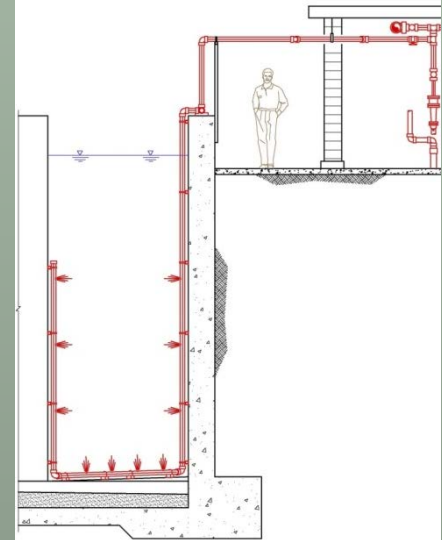




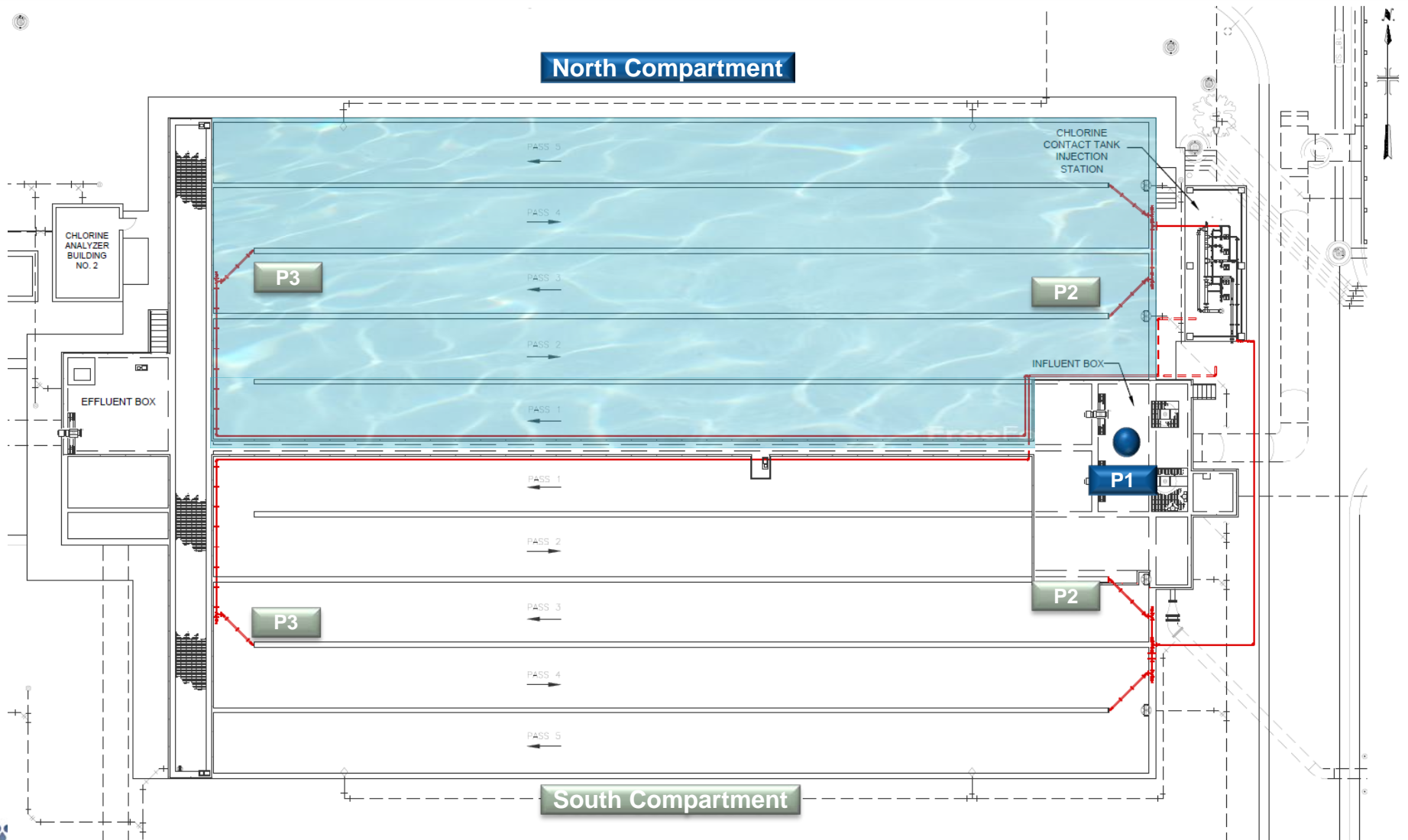
# Step Feed Chlorination



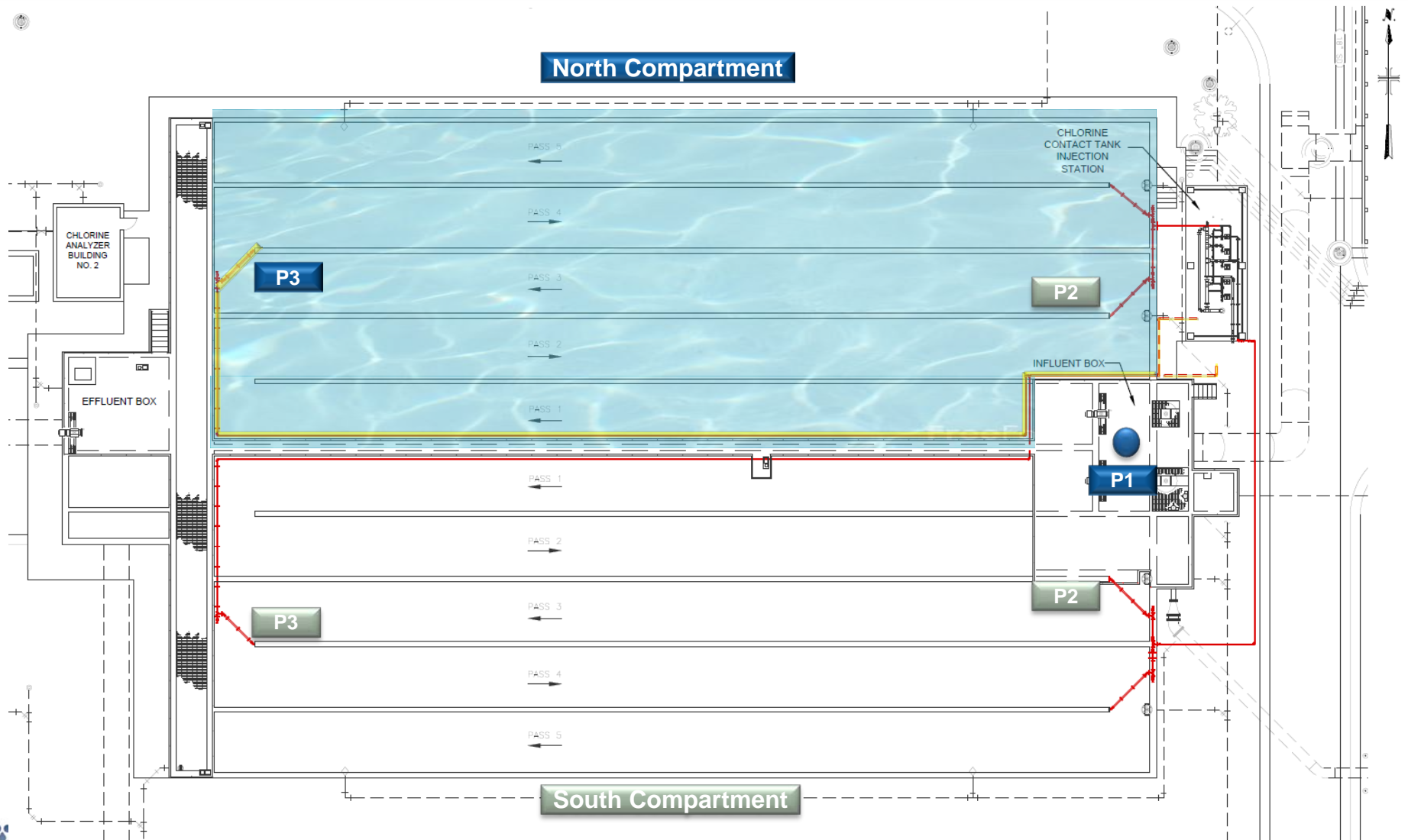
Typical Step Feed Injection Point



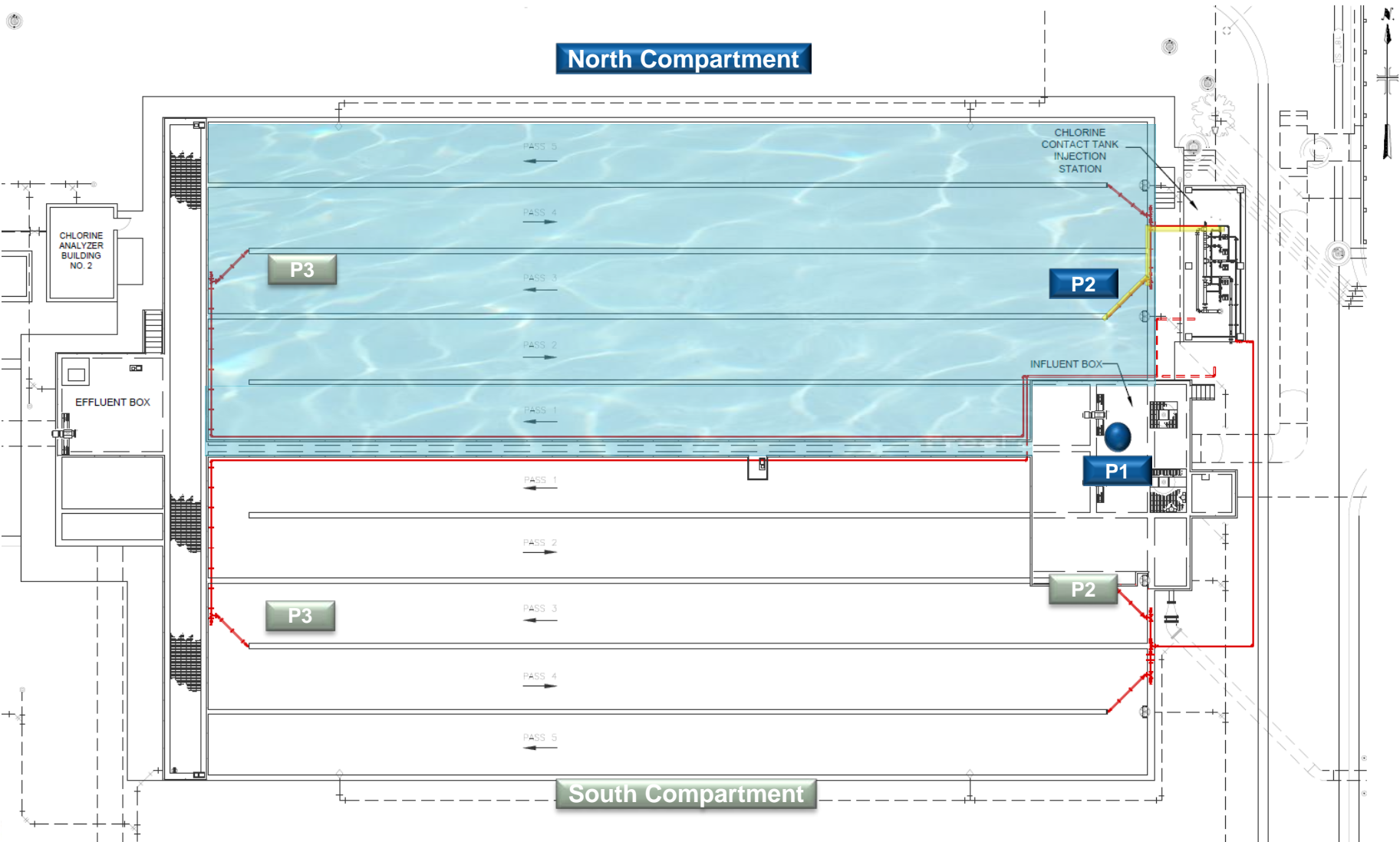
# Step Feed Chlorination at P1



# Step Feed Chlorination at P1 and P3 (North)



# Step Feed Chlorination at P1 and P2 (North)

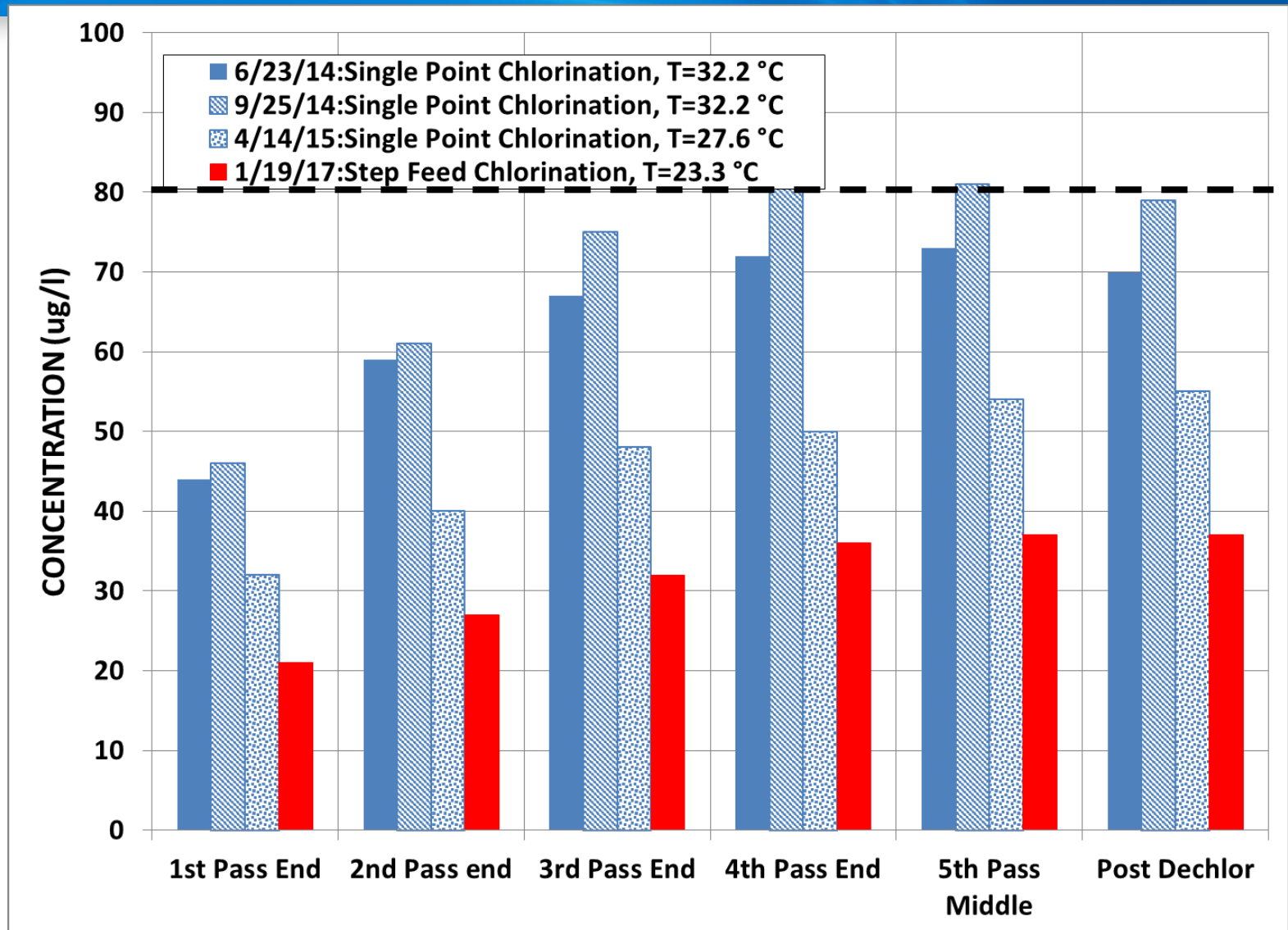


# 23<sup>rd</sup> Avenue WWTP

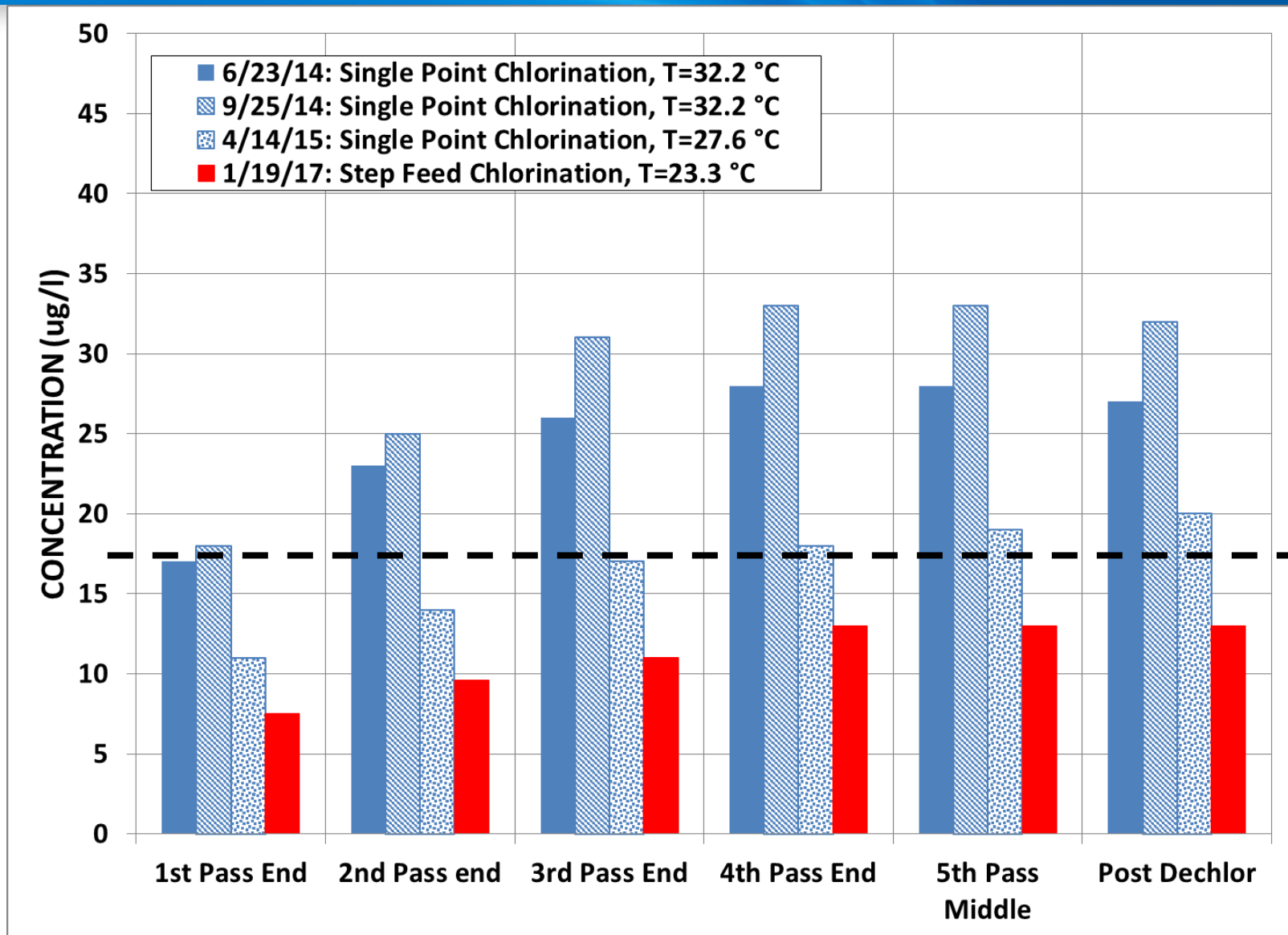
## Chlorine Contact Basins Profile

Date	Profile	Chlorination	Temp (°C)	Comments
6/24/14	Complete	Single Point	32.2	<u>Above BDCM limit</u> but achieved Non-Detect in Fecal Coliform
9/25/14	Complete	Single Point	32.2	<u>Above BDCM limit</u> but achieved Non-Detect in Fecal Coliform
4/14/15	Complete	Single Point	27.6	<u>Above BDCM limit</u> but achieved Non-Detect in Fecal Coliform
1/19/17	Complete	Step Feed	23.3	Met BDCM limit <u>but Inconclusive in Fecal Coliform Inactivation</u>
9/7/16, 9/9/16, 9/12/16, 9/14/16	Partial	Step Feed	32.0	Below BDCM limit and achieved Non-Detect in Fecal Coliform
3/7/17	Partial	Step Feed	24.2	Below BDCM limit and achieved Non-Detect in Fecal Coliform

# 23<sup>rd</sup> Avenue WWT – Complete Chlorine Contact Basins Profile - THMs



# 23<sup>rd</sup> Avenue WWT – Complete Chlorine Contact Basins Profile - BDCMs

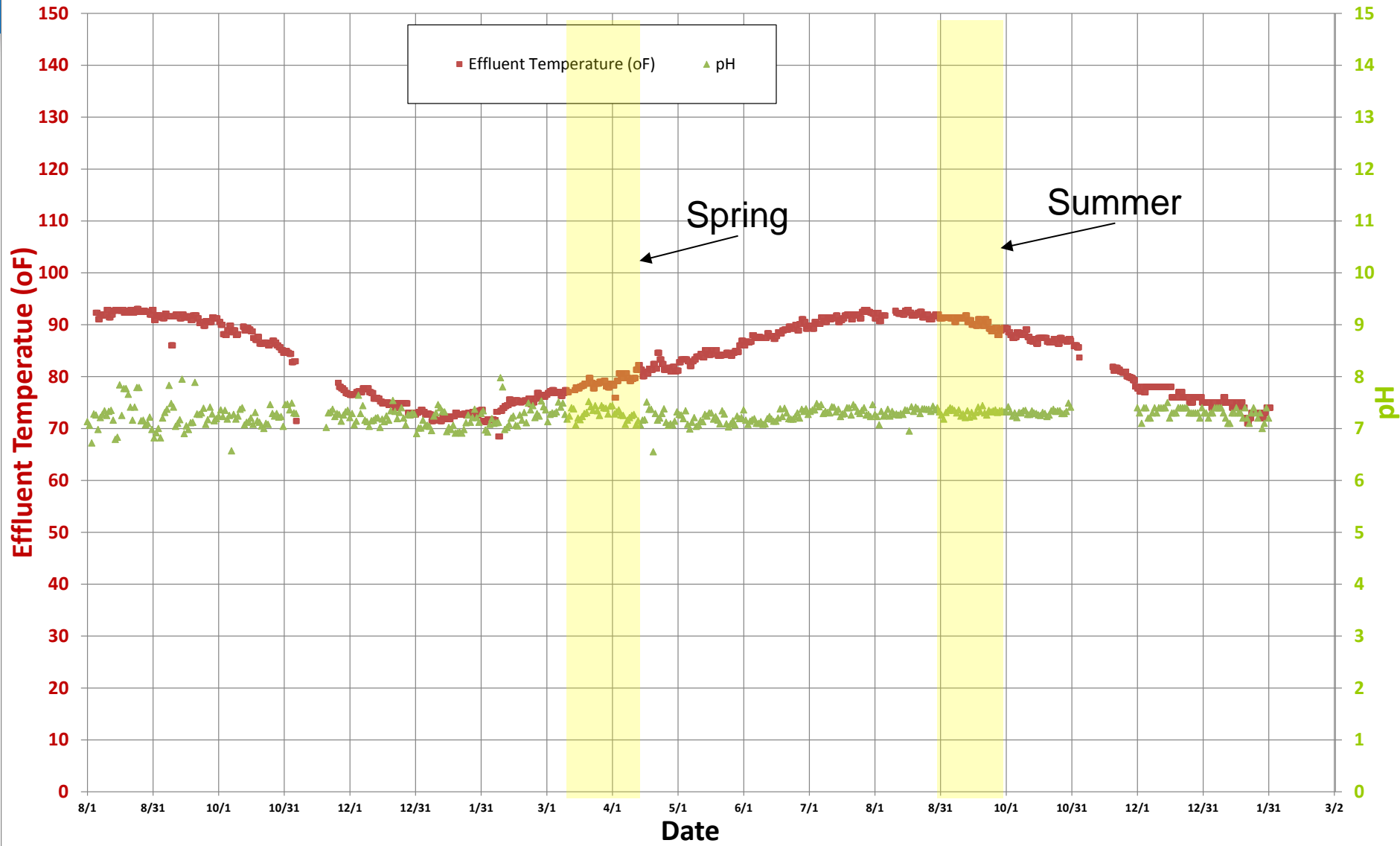


# 23<sup>rd</sup> Avenue WWTP Chlorine Contact Basins Profile

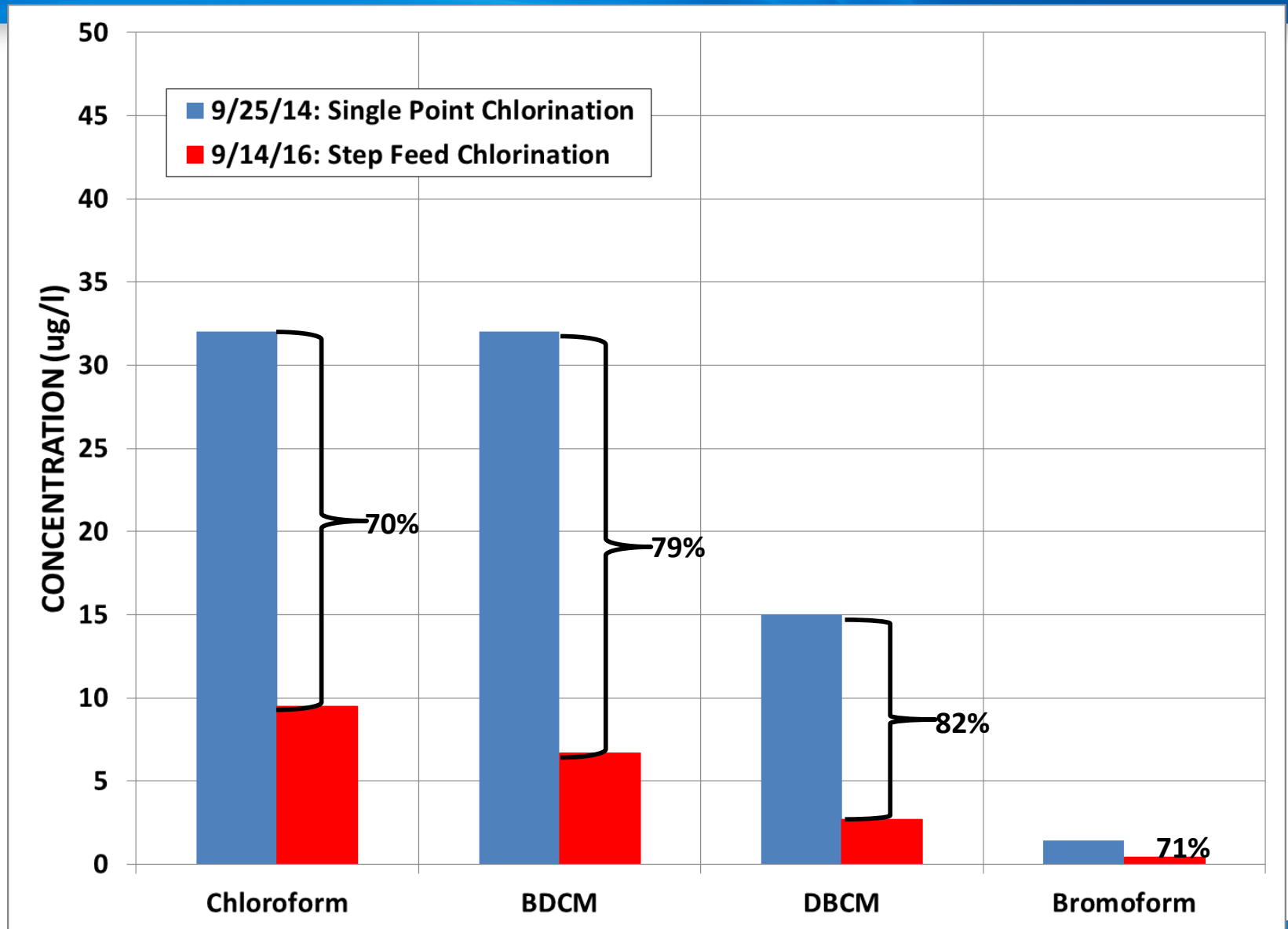
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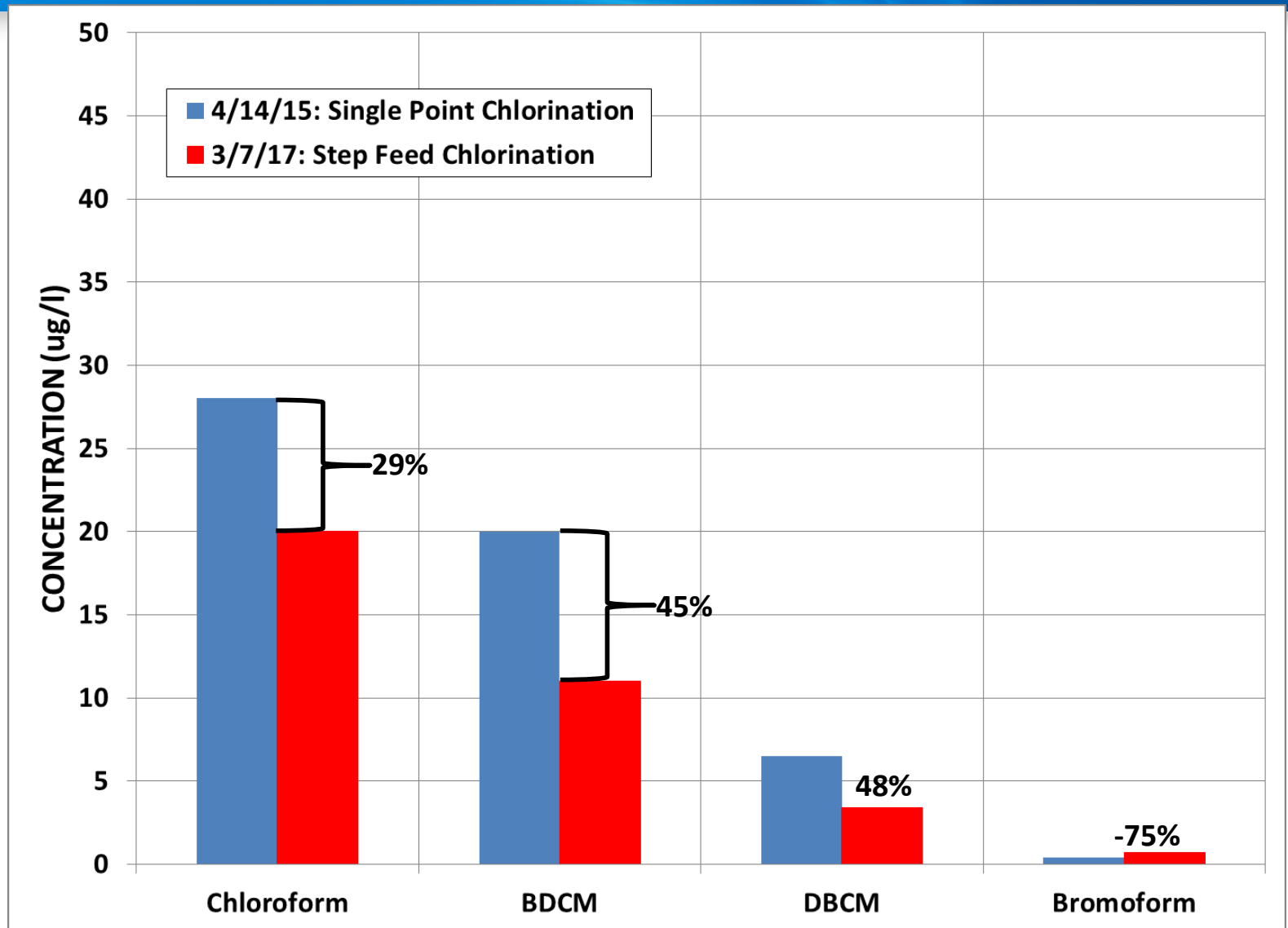
# Step Feed Chlorination Efficiency



# Step Feed Chlorination Summer - Plant Effluent THM



# Step Feed Chlorination Spring - Plant Effluent THM

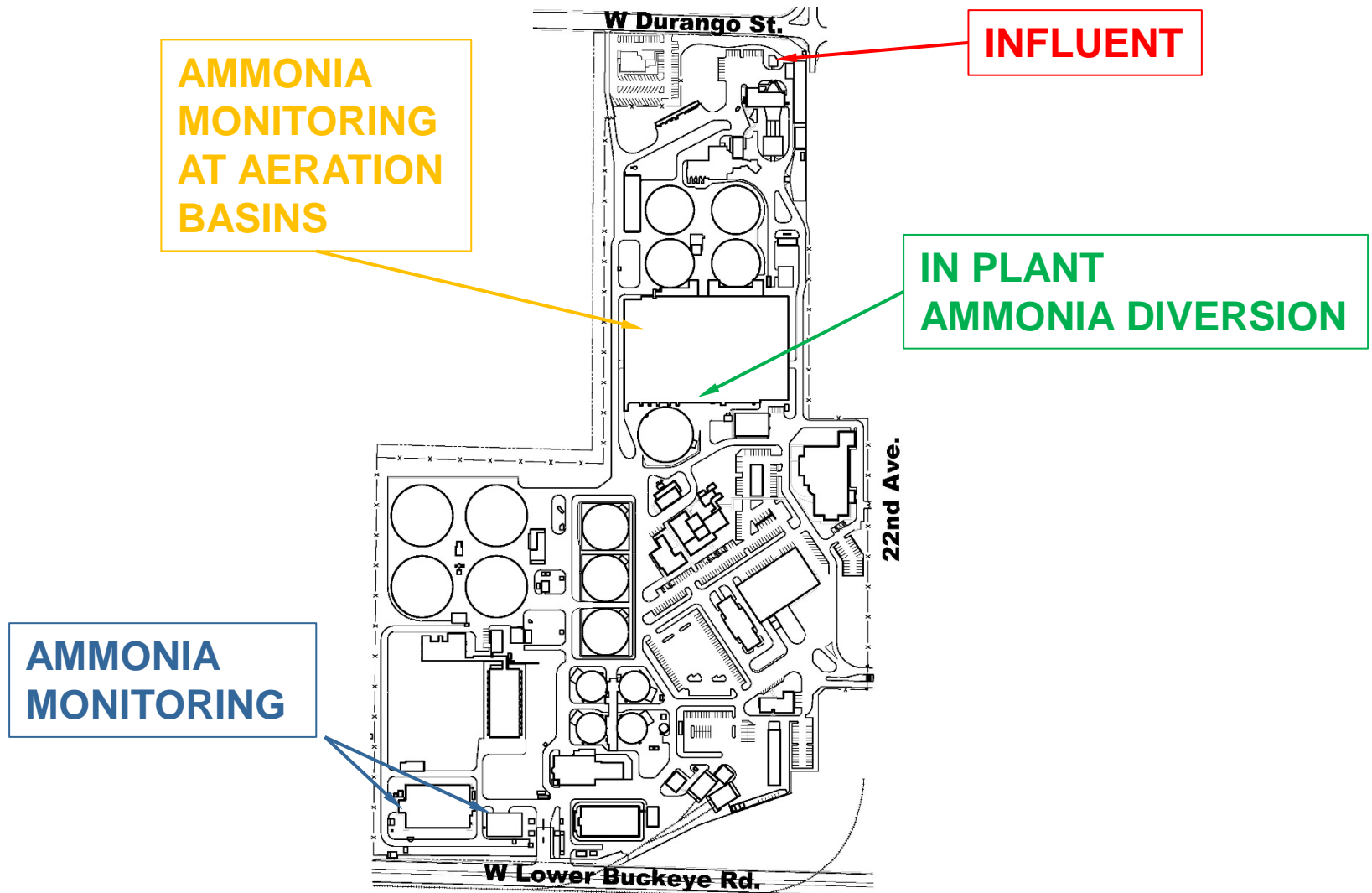


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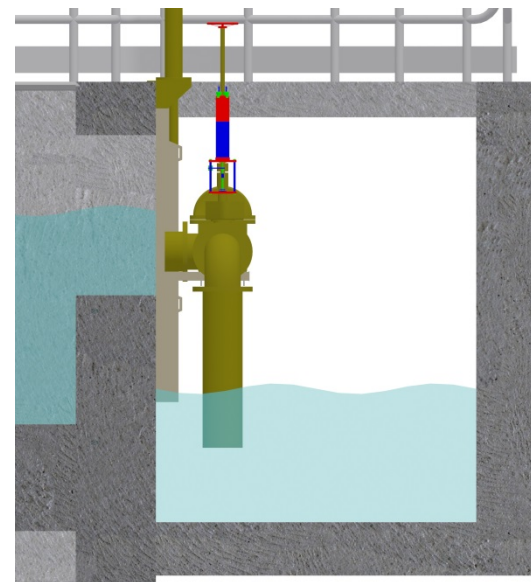
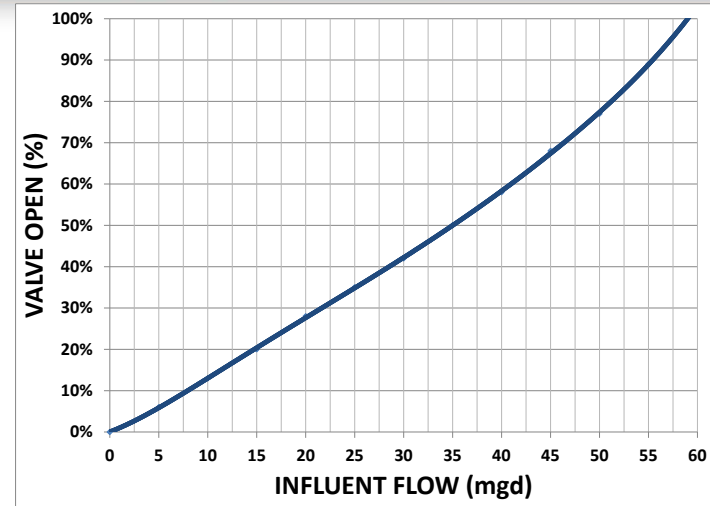
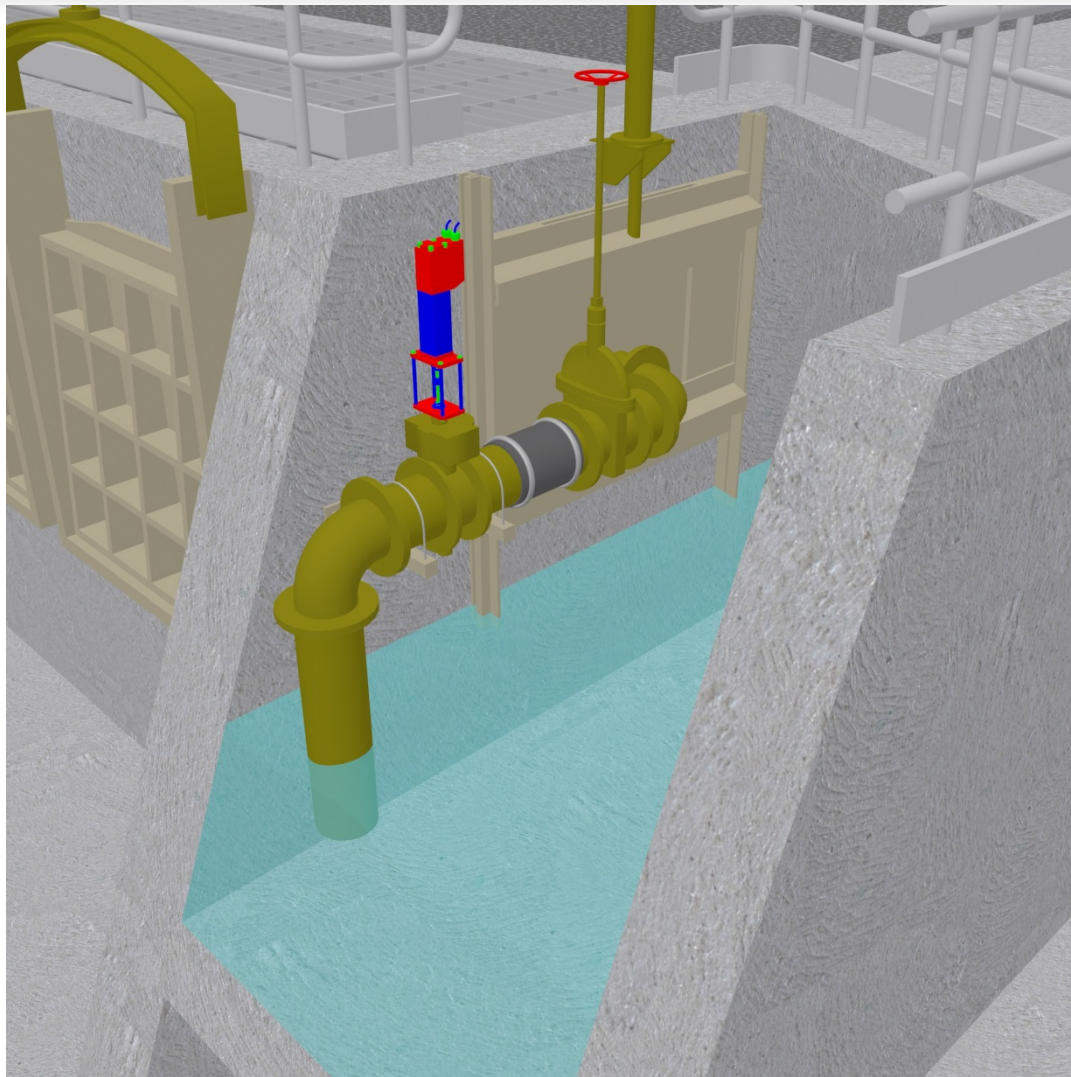
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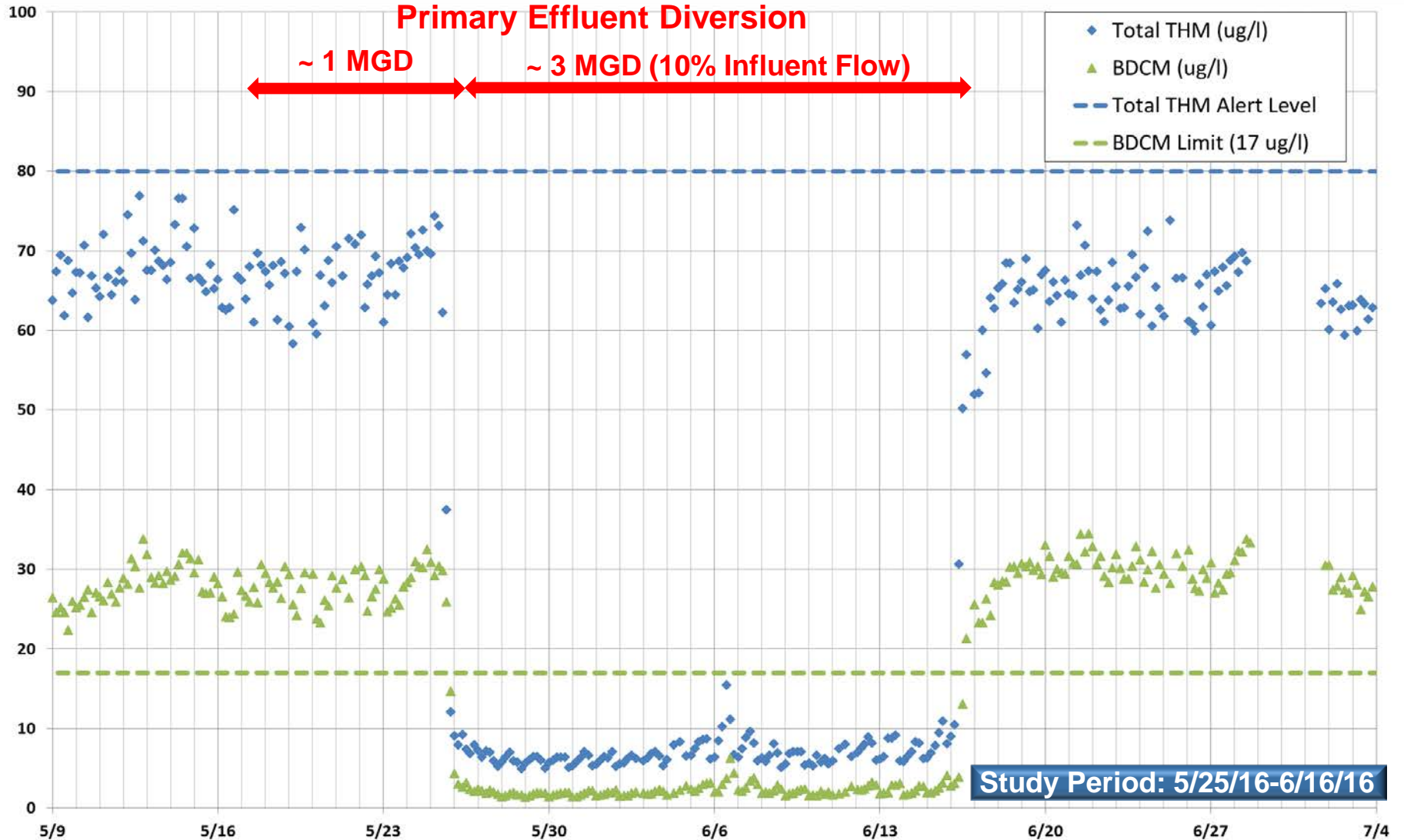
# In-Plant Ammonia Diversion Chloramination



# In-Plant Ammonia Diversion Chloramination

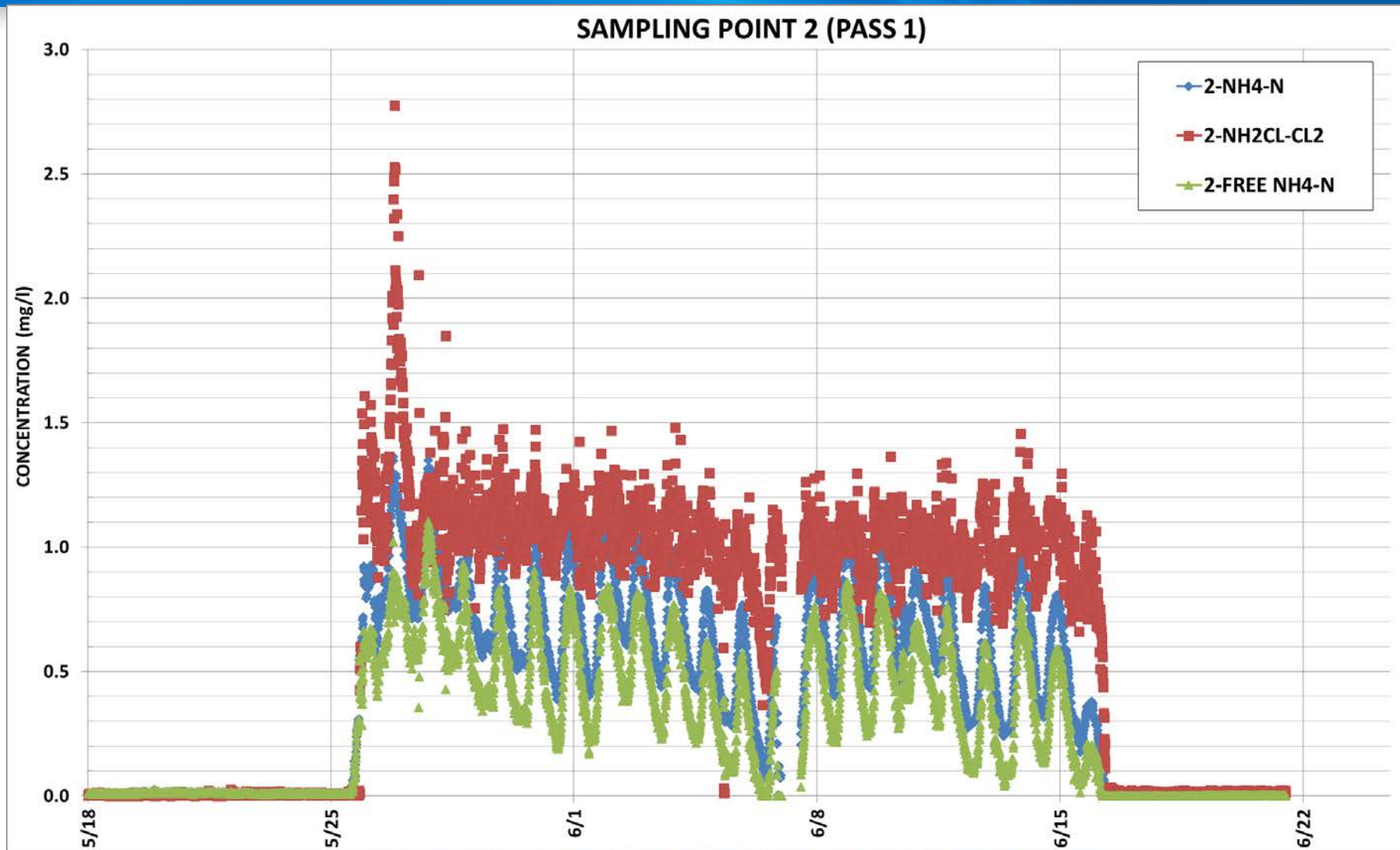


# In Plant Ammonia Diversion THM Monitoring



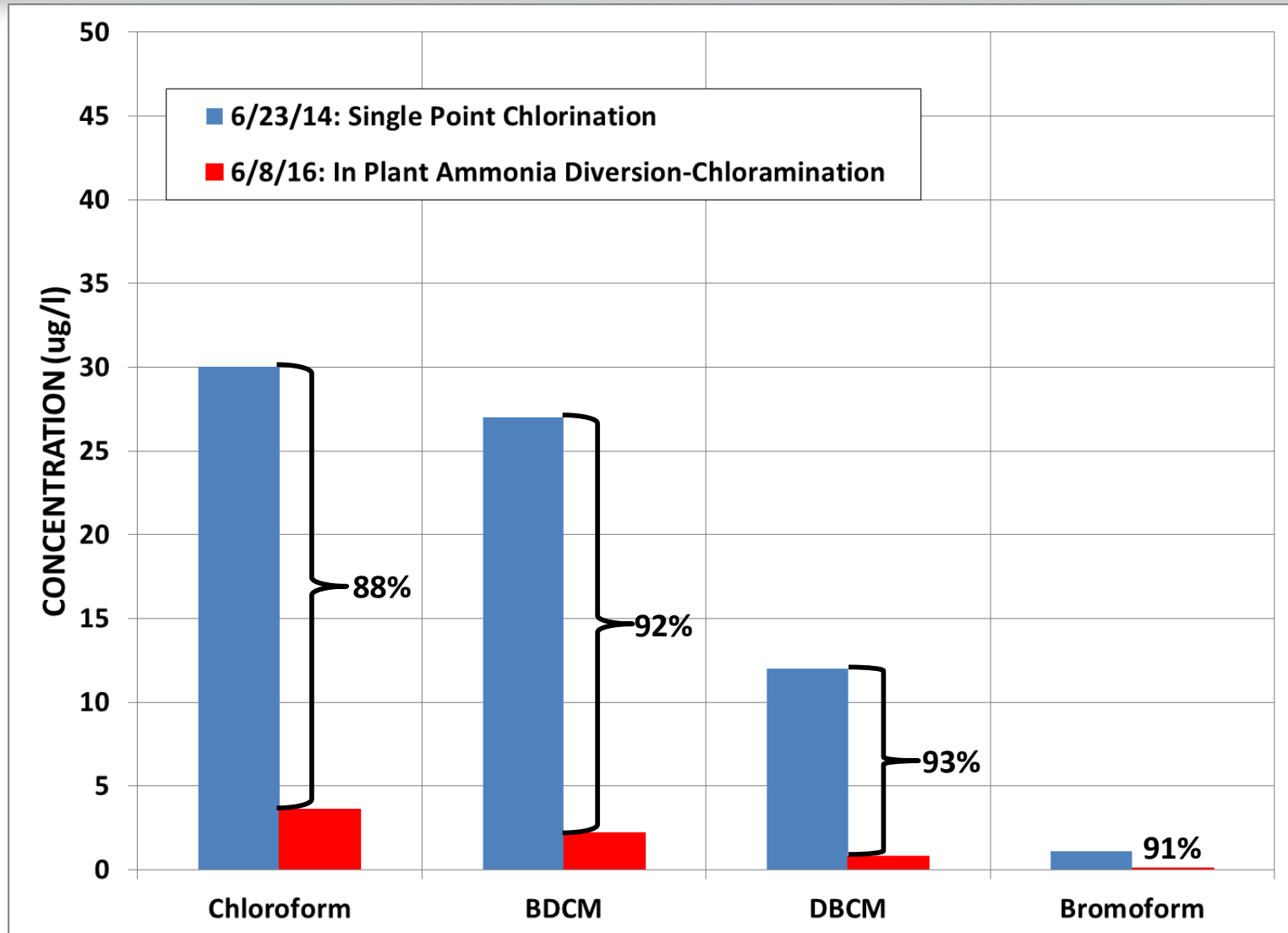
Study Period: 5/25/16-6/16/16

# In Plant Ammonia Diversion Ammonia Monitoring





# In Plant Ammonia Diversion Chloramination



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# Step Feed Chlorination and Seasonal Chloramination Approach

Period	Water Temperature (°F)	In Plant Ammonia Diversion Chlorine/Ammonia Dosing (mg/l)	Step Feed	
			P1 Dose (mg/l)	P3 Residual (mg/l)
April - August	81-93 <sup>0</sup> F	None	1.30 - 1.00	1.75 - 1.20
August - Mid October	86-91 <sup>0</sup> F	None	1.00	1.20
Mid October - Mid February	72-86 <sup>0</sup> F	Chloramination if Step Feed failed: 1.6 - 2.4 ppm Cl <sub>2</sub> /0.8 ppm Ammonia	1.00 - 1.50	1.20 - 1.75
Mid February April	73-81 <sup>0</sup> F	None	1.50 - 1.30	1.75



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## Questions?

Michael Nunez, City of Phoenix  
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# AZ Water Release



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“Statements of fact and opinion expressed are those of the author(s) / presenter(s).

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# Understanding THM Formation Findings

- THMs Formed at Chlorine Contact Basins
- Actual Contact Time Varies Between 55 to 110 Minutes Depending of Plant Influent Flows
  - Desired Contact Time: 30 Minutes
- Plant Staff Indicated of the Potential to Reduce Chlorine Residuals

# Step Feed Chlorination Summary

- Less Use of Chlorine and Sodium Bisulfate
- Meet Regulatory Requirements
  - Reliable Control of THMs (<50 ug/l)
  - BDCM Consistently Below Daily Max Limit (<17 ug/l), at all Times
- It Requires Monthly Exchange of Chlorine Contact Basins for Algae Control

# In Plant Ammonia Diversion Summary

- Total THMS below 10 mg/l
  - No generation of THM's in Chlorine Contact Basins
- Ammonia Efficient Concentrations Below 0.8 mg/l
  - System Program to Maintain this limit