

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1022
Study Protocol	GAC bench-scale treatment study
Plant ICR Number	448
PWS Name	Public Works Commission of the City of Fayetteville
City, State, Zip	Fayetteville, NC 28302

These are general comments that do not need to be responded to directly.

Major comments:

1. As explained in Section 4.1.1 of the Summary Report, due to bromide contamination from the cartridge filter used during the first two quarters of testing, bromide levels were measured at concentrations much higher than normal for this water source. Since the high bromide levels impacted DBP speciation, the DBP data for the first two quarters should not be used for further data analysis. The problem was corrected during the third and fourth quarters by using a glass fiber cartridge filter. The bromide concentration during the third and fourth quarters averaged 93 µg/L (range: 90 to 96 µg/L). During the first quarter of testing, the bromide concentration ranged from 740 to 1,500 µg/L, and during the second quarter of testing the bromide concentration ranged from 30 to 349 µg/L.

General Comments:

1. During Quarter 4, 70 percent TOC breakthrough in the 20 minute EBCT contactor was reached based on on-site TOC monitoring. However, the TOC data reported are those analyzed by an off-site ICR certified laboratory. Due to differences in analytical results, the column did not reach 70 percent TOC breakthrough based on the off-site laboratory analyses.

Outlier Data:

1. Do not curve fit quarter 1 nor quarter 2 DBP results for both columns. Per consultant, "CDM: do not use these DBP values, the results are skewed due to bromide contamination in influent." 1st and 2nd quarter DBP data changed to "NCF".
2. One outlier removed.

Cell: A1

Comment: 1022-SAS.xls 2/6/00 16:20

All curve fits reviewed and approved. See below for log of refit datasets.

Cell: C49

Comment: 1022-10-03 - Run 5 (CHBr3) 2/6/00 16:11

Original value (CoefA0) = 0 New value = -1.0808

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D49

Comment: 1022-10-03 - Run 5 (CHBr3) 2/6/00 16:11

Original value (CoefAf) = 6.5 New value = 70.3764

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E49

Comment: 1022-10-03 - Run 5 (CHBr3) 2/6/00 16:11

Original value (CoefB) = 50 New value = 88.8173

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F49

Comment: 1022-10-03 - Run 5 (CHBr3) 2/6/00 16:11

Original value (CoefD) = 0.11 New value = 0.0535

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J49

Comment: 1022-10-03 - Run 5 (CHBr3) 2/6/00 16:11

Original value (S) = 0 New value = -0.0386

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C55

Comment: 1022-10-03 - Run 5 (DCBAA) 2/6/00 16:06

Original value (CoefA0) = 0 New value = -0.1007

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

Cell: D55

Comment: 1022-10-03 - Run 5 (DCBAA) 2/6/00 16:06

Original value (CoefAf) = 0 New value = 8.3691

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

Cell: E55

Comment: 1022-10-03 - Run 5 (DCBAA) 2/6/00 16:06

Original value (CoefB) = 0 New value = 19.6536

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

Cell: F55

Comment: 1022-10-03 - Run 5 (DCBAA) 2/6/00 16:06

Original value (CoefD) = 0 New value = 0.0627

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

Cell: J55

Comment: 1022-10-03 - Run 5 (DCBAA) 2/6/00 16:06
Original value (S) = 0 New value = 0
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

Cell: C59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (CoefA0) = 0 New value = 1.1
Fewer than 6 points above MRL. Step function applied.

Cell: D59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K59

Comment: 1022-10-03 - Run 5 (MBAA) 2/6/00 13:45
Original value (t0) = 0 New value = 48.7711
Fewer than 6 points above MRL. Step function applied.

Cell: C66

Comment: 1022-10-03 - Run 5 (TSUVA) 2/6/00 16:05
Original value (CoefA0) = -1.0577 New value = -0.1062
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: D66

Comment: 1022-10-03 - Run 5 (TSUVA) 2/6/00 16:05
Original value (CoefAf) = 3.1731 New value = 1.6783
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: E66

Comment: 1022-10-03 - Run 5 (TSUVA) 2/6/00 16:05
Original value (CoefB) = 0.5571 New value = 20.7926
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: F66

Comment: 1022-10-03 - Run 5 (TSUVA) 2/6/00 16:05
Original value (CoefD) = 0.0161 New value = 1.5562
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: J66

Comment: 1022-10-03 - Run 5 (TSUVA) 2/6/00 16:05
Original value (S) = 0 New value = 0
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: C71

Comment: 1022-10-04 - Run 7 (CHBr3) 2/6/00 16:14
Original value (CoefA0) = 0.0184 New value = -0.3559
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D71

Comment: 1022-10-04 - Run 7 (CHBr3) 2/6/00 16:14
Original value (CoefAf) = 2.9114 New value = 4.3364
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E71

Comment: 1022-10-04 - Run 7 (CHBr3) 2/6/00 16:14
Original value (CoefB) = 52.3792 New value = 20.1309
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F71

Comment: 1022-10-04 - Run 7 (CHBr3) 2/6/00 16:14
Original value (CoefD) = 0.1702 New value = 0.1346
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J71

Comment: 1022-10-04 - Run 7 (CHBr3) 2/6/00 16:14
Original value (S) = -0.013 New value = -0.0159
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42
Original value (CoefA0) = 0 New value = 0.4656
Fewer than 6 points. Step function applied.

Cell: D110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points. Step function applied.

Cell: E110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42
Original value (CoefB) = 0 New value = 0
Fewer than 6 points. Step function applied.

Cell: F110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42

Original value (CoefD) = 0 New value = 0
Fewer than 6 points. Step function applied.

Cell: J110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42
Original value (S) = 0 New value = 0
Fewer than 6 points. Step function applied.

Cell: K110

Comment: 1022-20-01 - Run 2 (TSUVA) 2/6/00 13:42
Original value (t0) = 0 New value = 77.077
Fewer than 6 points. Step function applied.

Cell: C132

Comment: 1022-20-02 - Run 4 (TSUVA) 2/6/00 16:03
Original value (CoefA0) = -0.0274 New value = -0.1244
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D132

Comment: 1022-20-02 - Run 4 (TSUVA) 2/6/00 16:03
Original value (CoefAf) = 2.2857 New value = 2.424
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E132

Comment: 1022-20-02 - Run 4 (TSUVA) 2/6/00 16:03
Original value (CoefB) = 10 New value = 20.0008
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F132

Comment: 1022-20-02 - Run 4 (TSUVA) 2/6/00 16:03
Original value (CoefD) = 0.1585 New value = 0.5211
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J132

Comment: 1022-20-02 - Run 4 (TSUVA) 2/6/00 16:03
Original value (S) = -0.0055 New value = -0.0114
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (CoefA0) = 0 New value = 2.6
Fewer than 6 points above MRL. Step function applied.

Cell: D136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (CoefB) = 0 New value = 0

Fewer than 6 points above MRL. Step function applied.

Cell: F136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K136

Comment: 1022-20-03 - Run 6 (CDBAA) 2/6/00 13:51
Original value (t0) = 0 New value = 120.0009
Fewer than 6 points above MRL. Step function applied.

Cell: C154

Comment: 1022-20-03 - Run 6 (TSUVA) 2/6/00 16:13
Original value (CoefA0) = -0.0082 New value = -0.0181
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: D154

Comment: 1022-20-03 - Run 6 (TSUVA) 2/6/00 16:13
Original value (CoefAf) = 1.6216 New value = 1.1031
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: E154

Comment: 1022-20-03 - Run 6 (TSUVA) 2/6/00 16:13
Original value (CoefB) = 50 New value = 19.9974
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: F154

Comment: 1022-20-03 - Run 6 (TSUVA) 2/6/00 16:13
Original value (CoefD) = 0.1317 New value = 0.2337
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: J154

Comment: 1022-20-03 - Run 6 (TSUVA) 2/6/00 16:13
Original value (S) = -0.0008 New value = 0
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: C158

Comment: 1022-20-04 - Run 8 (CDBAA) 2/6/00 16:16
Original value (CoefA0) = 0 New value = -0.3407
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: D158

Comment: 1022-20-04 - Run 8 (CDBAA) 2/6/00 16:16
Original value (CoefAf) = 0 New value = 8.5342
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: E158

Comment: 1022-20-04 - Run 8 (CDBAA) 2/6/00 16:16
Original value (CoefB) = 0 New value = 29.0842
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: F158

Comment: 1022-20-04 - Run 8 (CDBAA) 2/6/00 16:16
Original value (CoefD) = 0 New value = 0.03
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: J158

Comment: 1022-20-04 - Run 8 (CDBAA) 2/6/00 16:16
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: C176

Comment: 1022-20-04 - Run 8 (TSUVA) 2/6/00 16:15
Original value (CoefA0) = -0.4344 New value = -0.1705
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: D176

Comment: 1022-20-04 - Run 8 (TSUVA) 2/6/00 16:15
Original value (CoefAf) = 3.5052 New value = 2.6078
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: E176

Comment: 1022-20-04 - Run 8 (TSUVA) 2/6/00 16:15
Original value (CoefB) = 7.3237 New value = 16.2896
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: F176

Comment: 1022-20-04 - Run 8 (TSUVA) 2/6/00 16:15
Original value (CoefD) = 0.0886 New value = 0.1383
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

Cell: J176

Comment: 1022-20-04 - Run 8 (TSUVA) 2/6/00 16:15
Original value (S) = -0.0156 New value = 0
Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

ICR Information

ID / ICR#: NC 0326010 / 448
 ICR Contact: Mr. Kevin Christmas
 Phone No.: (910)-223-4709
 Period: 3/26/98 - 4/21/98 (26 B-S days)

Design Information

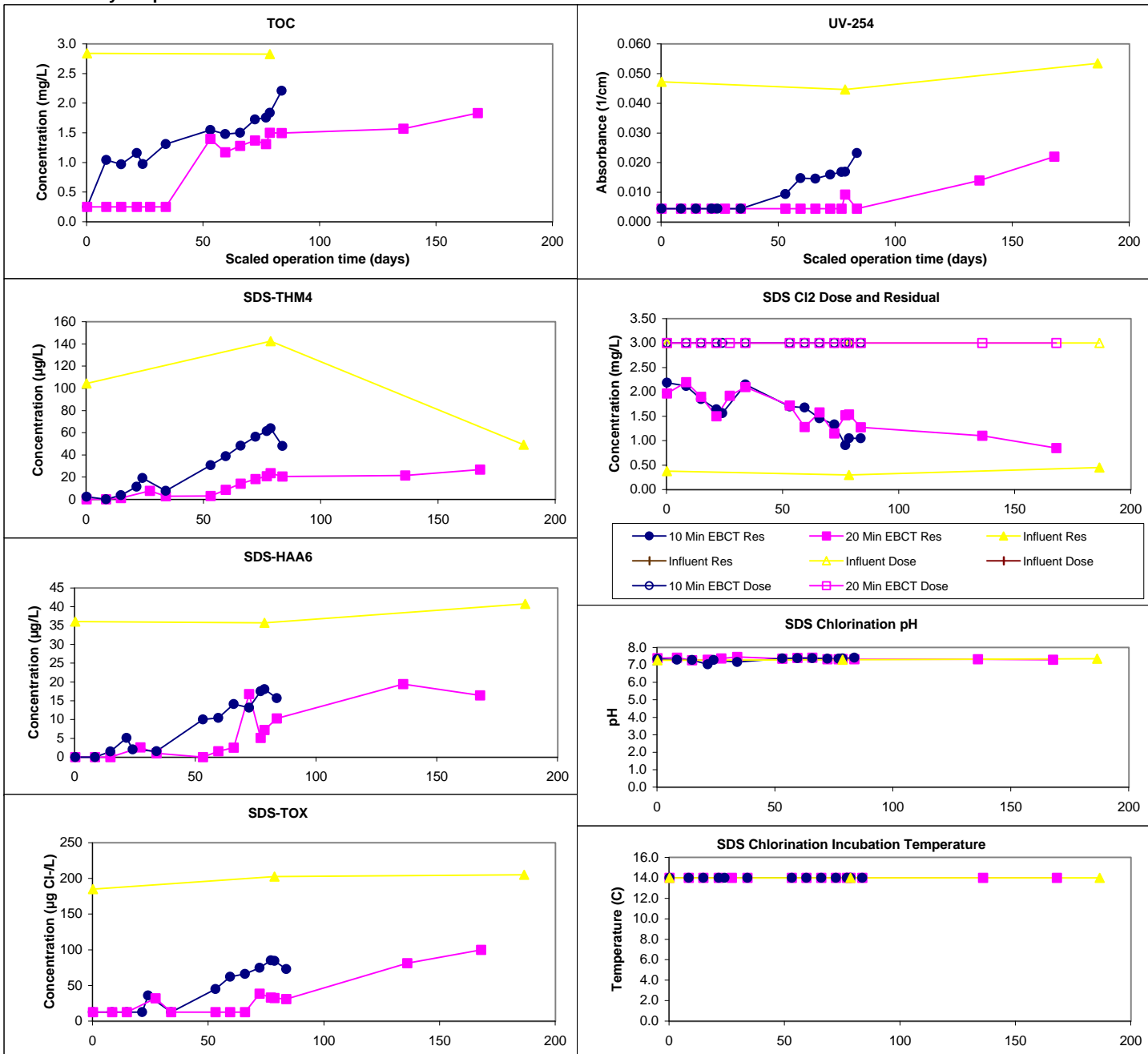
Design TOC: 2.8 mg/L
 Col Diameter: 15.0 mm
 Min Reynolds#: 0.20
 Full-Scale Temp: 11.1 C

Full-Scale GAC Size: 12x40 Bituminous
 Bench-Scale GAC Size: 80x100
 Scaling Factor: 6.38
 Meas Dry Bed Density: 0.46 g/cm3

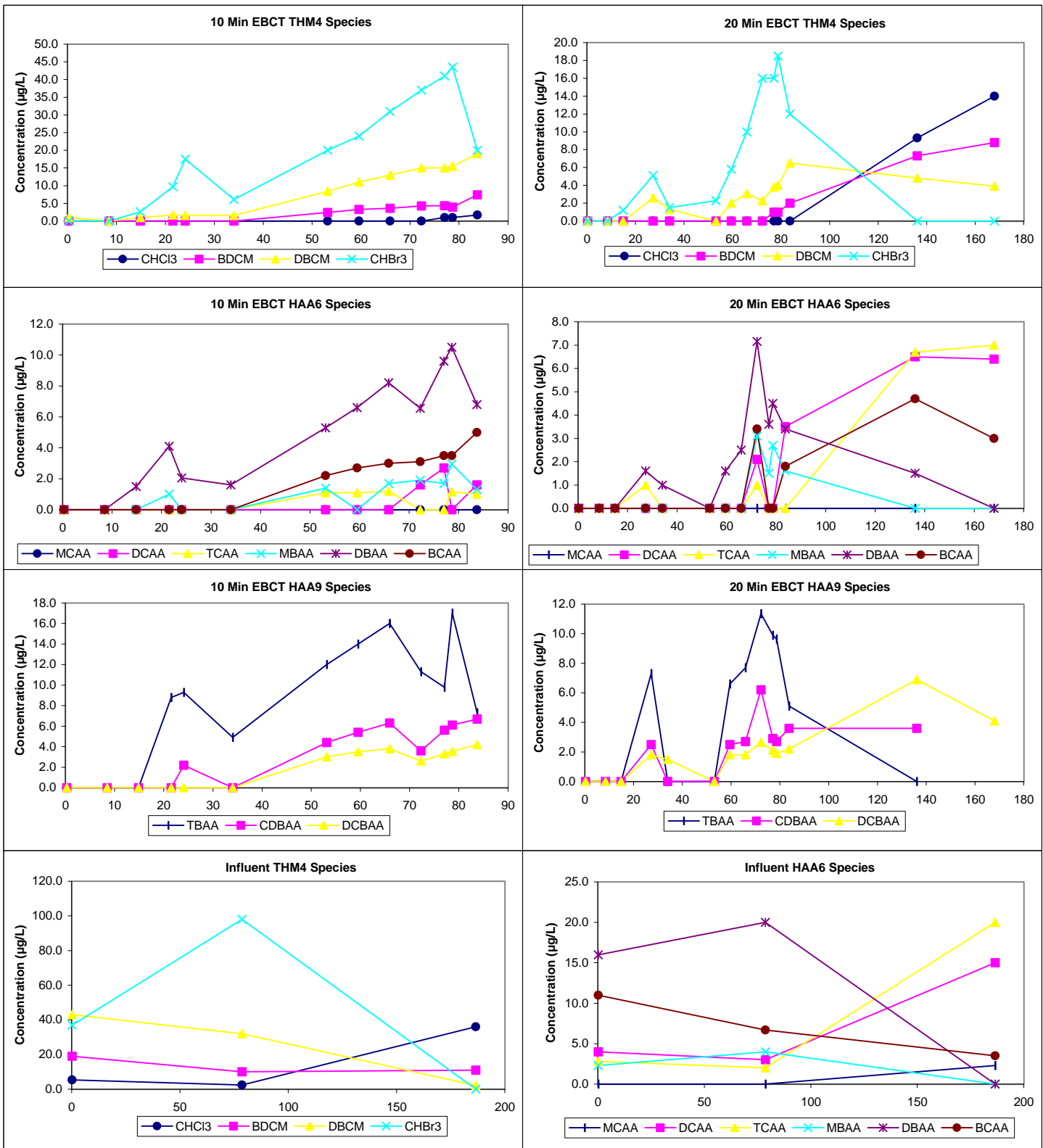
Water Quality Summary

Influent	Influent				Influent				Res (0)	Mean	SD	Count	Min/Max
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max					
TOC	2.8	0.0	2	2.8 - 2.8									
pH	6.3	0.0	3	6.3 - 6.3					Temp	14.0	0.0	31	14.0 - 14.0
UV254	0.048	0.005	3	0.045 - 0.053					pH	7.3	0.1	31	7.0 - 7.5
SUVA	1.62	0.08	2	1.58 - 1.66					Time	48.0	0.0	31	48.0 - 48.0
Bromide	1120	760	2	740 - 1500					Comments:				
SDS-TOX	198	11	3	185 - 205									
SDS-THM4	99	47	3	49 - 142									
SDS-HAA6	38	3	3	36 - 41									
Effluent	10 Min EBCT (13 B-S days)				20 Min EBCT (26 B-S days)				Chart Legend:	<div><div><div></div><div>10 Min EBCT</div></div><div><div></div><div>20 Min EBCT</div></div><div><div></div><div>Influent</div></div><div><div></div><div>Influent</div></div></div>			
Effluent pH	6.3	0.1	13	6.2 - 6.5	6.3	0.1	15	6.2 - 6.5					
Effluent Temp	19.2	0.7	13	18.0 - 20.0	19.1	0.7	15	18.0 - 20.0					

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: NC 0326010 / 448
 ICR Contact: Mr. Kevin Christmas
 Phone No.: (910)-223-4709
 Period: 6/3/98 - 6/29/98 (25 B-S days)

Design Information

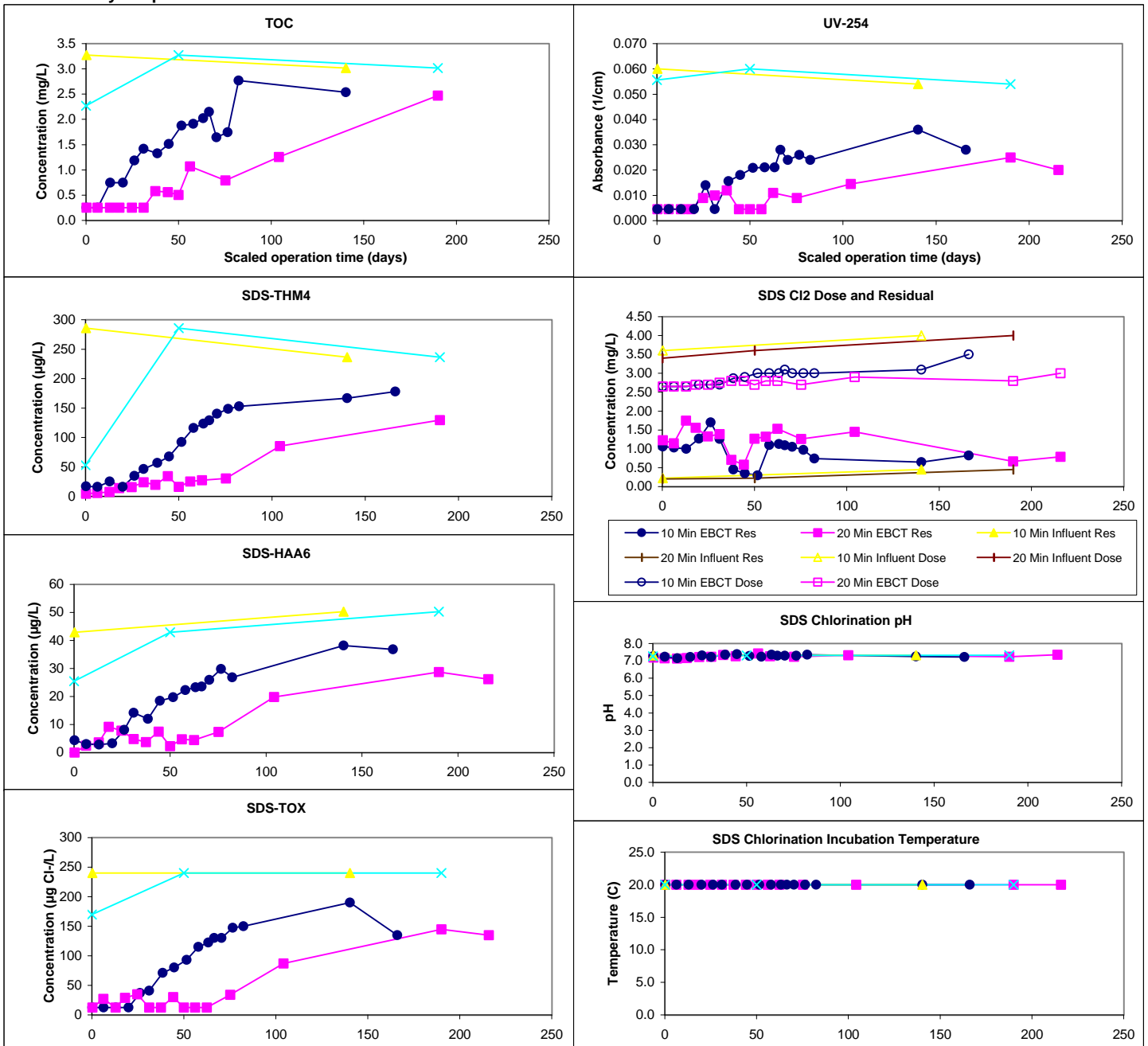
Design TOC: 2.8 mg/L
 Col Diameter: 15.0 mm
 Min Reynolds#: 0.20
 Full-Scale Temp: 23.5 C

Full-Scale GAC Size: 12x40 Bituminous
 Bench-Scale GAC Size: 80x100
 Scaling Factor: 6.38
 Meas Dry Bed Density: 0.46 g/cm3

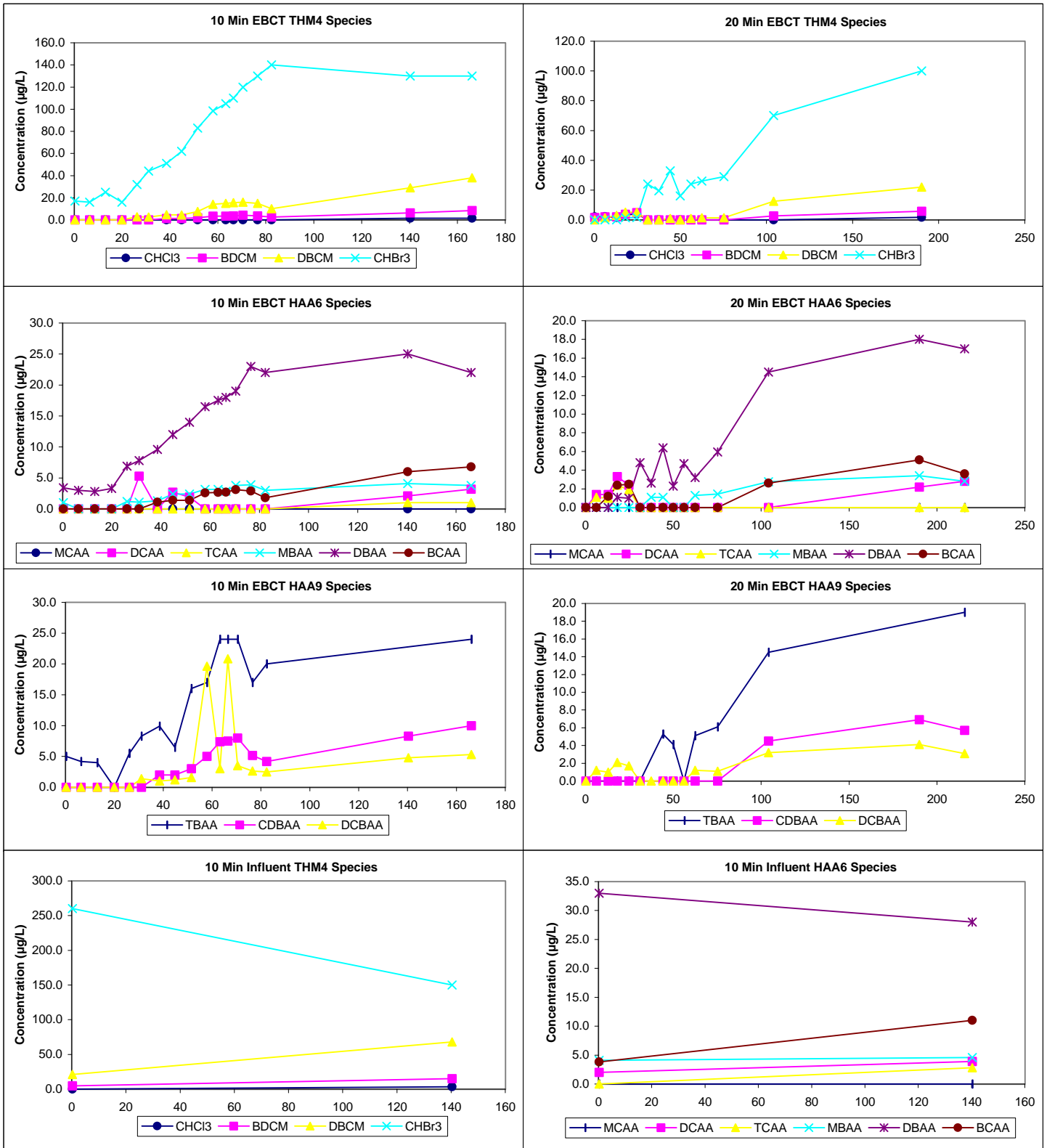
Water Quality Summary

	10 Min Influent				20 Min Influent								
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	3.1	0.3	2	3.0 - 3.3	2.9	0.5	3	2.3 - 3.3	Res (0)	0.96	0.44	37	0.20 - 1.75
pH	6.2	0.1	2	6.2 - 6.2	6.1	0.1	3	6.1 - 6.2	Temp	20.0	0.0	37	20.0 - 20.0
UV254	0.057	0.006	2	0.054 - 0.060	0.057	0.003	3	0.054 - 0.060	pH	7.3	0.1	36	7.1 - 7.4
SUVA	1.81	0.04	2	1.79 - 1.83	2.02	0.37	3	1.79 - 2.45	Time	48.0	0.0	37	48.0 - 48.0
Bromide	190	319	2	30 - 349	200	298	2	51 - 349	Comments:				
SDS-TOX	240	0	2	240 - 240	217	40	3	170 - 240					
SDS-THM4	261	50	2	236 - 286	192	123	3	53 - 286	Chart Legend: <div><div>● 10 Min EBCT</div><div>■ 20 Min EBCT</div><div>▲ 10 Min Influent</div><div>✕ 20 Min Influent</div></div>				
SDS-HAA6	47	7	2	43 - 50	40	13	3	26 - 50					
Effluent	10 Min EBCT (26 B-S days)				20 Min EBCT (34 B-S days)								
Effluent pH	6.4	0.3	17	5.8 - 7.1	6.5	0.3	15	6.2 - 7.1					
Effluent Temp	23.3	0.7	17	22.0 - 24.0	23.1	0.8	15	22.0 - 24.0					

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: NC 0326010 / 448
ICR Contact: Mr. Kevin Christmas
Phone No.: (910)-223-4709
Period: 8/25/98 - 9/28/98 (33 B-S days)

Design Information

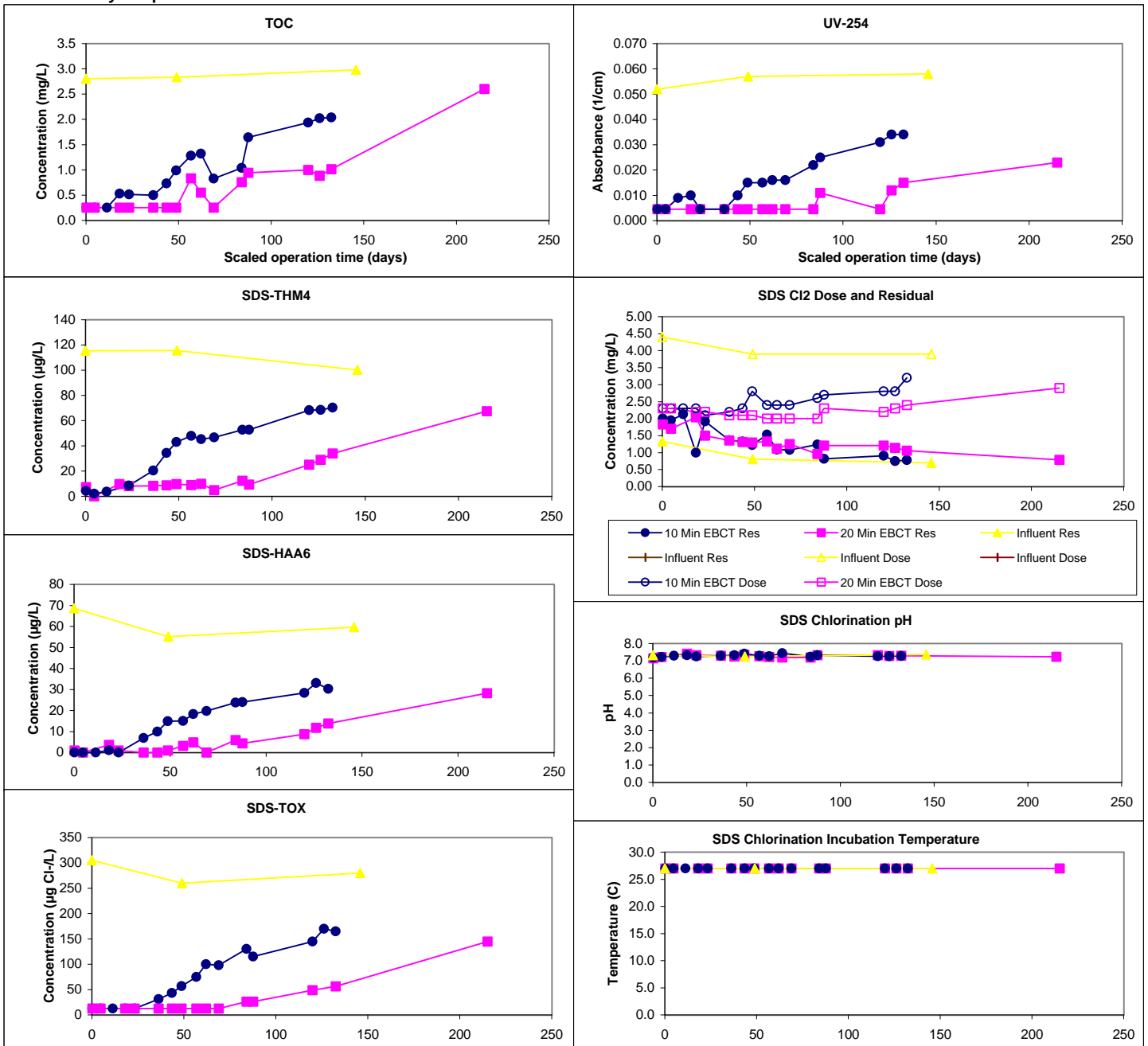
Design TOC: 2.8 mg/L
Col Diameter: 15.0 mm
Min Reynolds#: 0.20
Full-Scale Temp: 29.8 C

Full-Scale GAC Size: 12x40 Bituminous
Bench-Scale GAC Size: 80x100
Scaling Factor: 6.38
Meas Dry Bed Density: 0.46 g/cm3

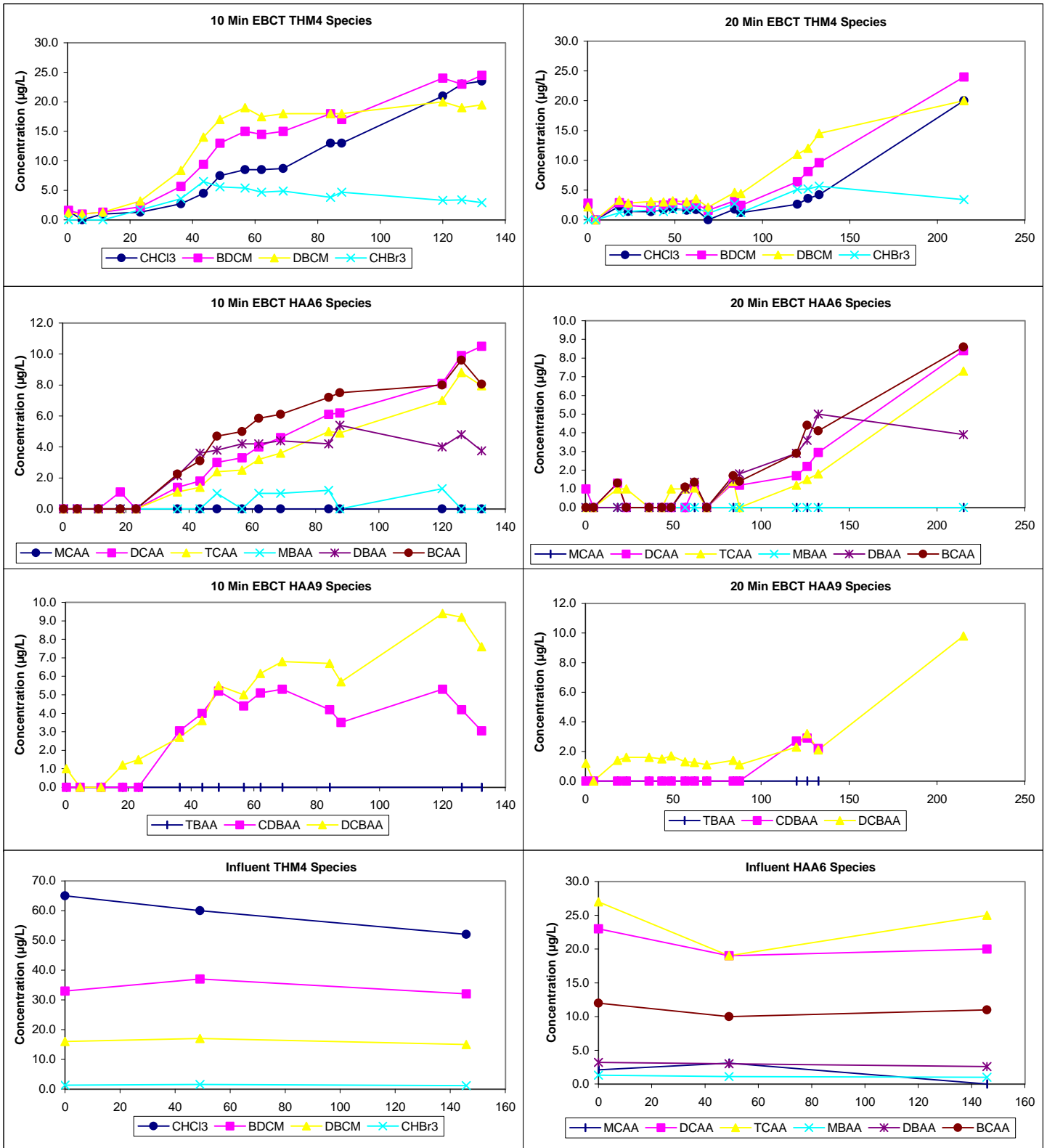
Water Quality Summary

	Influent				Influent								
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	2.9	0.1	3	2.8 - 3.0					Res (0)	1.29	0.40	35	0.70 - 2.13
pH	6.9	0.1	3	6.8 - 7.0					Temp	27.0	0.0	35	27.0 - 27.0
UV254	0.056	0.003	3	0.052 - 0.058					pH	7.3	0.1	35	7.2 - 7.4
SUVA	1.94	0.08	3	1.85 - 2.01					Time	48.0	0.0	35	48.0 - 48.0
Bromide	91	2	2	90 - 92					Comments:				
SDS-TOX	282	23	3	260 - 305									
SDS-THM4	110	9	3	100 - 116									
SDS-HAA6	61	7	3	55 - 69					<div><div><div></div><div>10 Min EBCT</div></div><div><div></div><div>20 Min EBCT</div></div><div><div></div><div>Influent</div></div><div><div></div><div>Influent</div></div></div> <div>Chart Legend:</div>				
Effluent	10 Min EBCT (21 B-S days)				20 Min EBCT (34 B-S days)								
Effluent pH	7.2	0.1	16	7.0 - 7.5	7.1	0.2	16	6.8 - 7.4					
Effluent Temp	20.6	0.7	16	20.0 - 22.0	20.9	0.6	16	20.0 - 22.0					

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: NC 0326010 / 448
ICR Contact: Mr. Kevin Christmas
Phone No.: (910)-223-4709
Period: 11/20/98 - 12/14/98 (24 B-S days)

Design Information

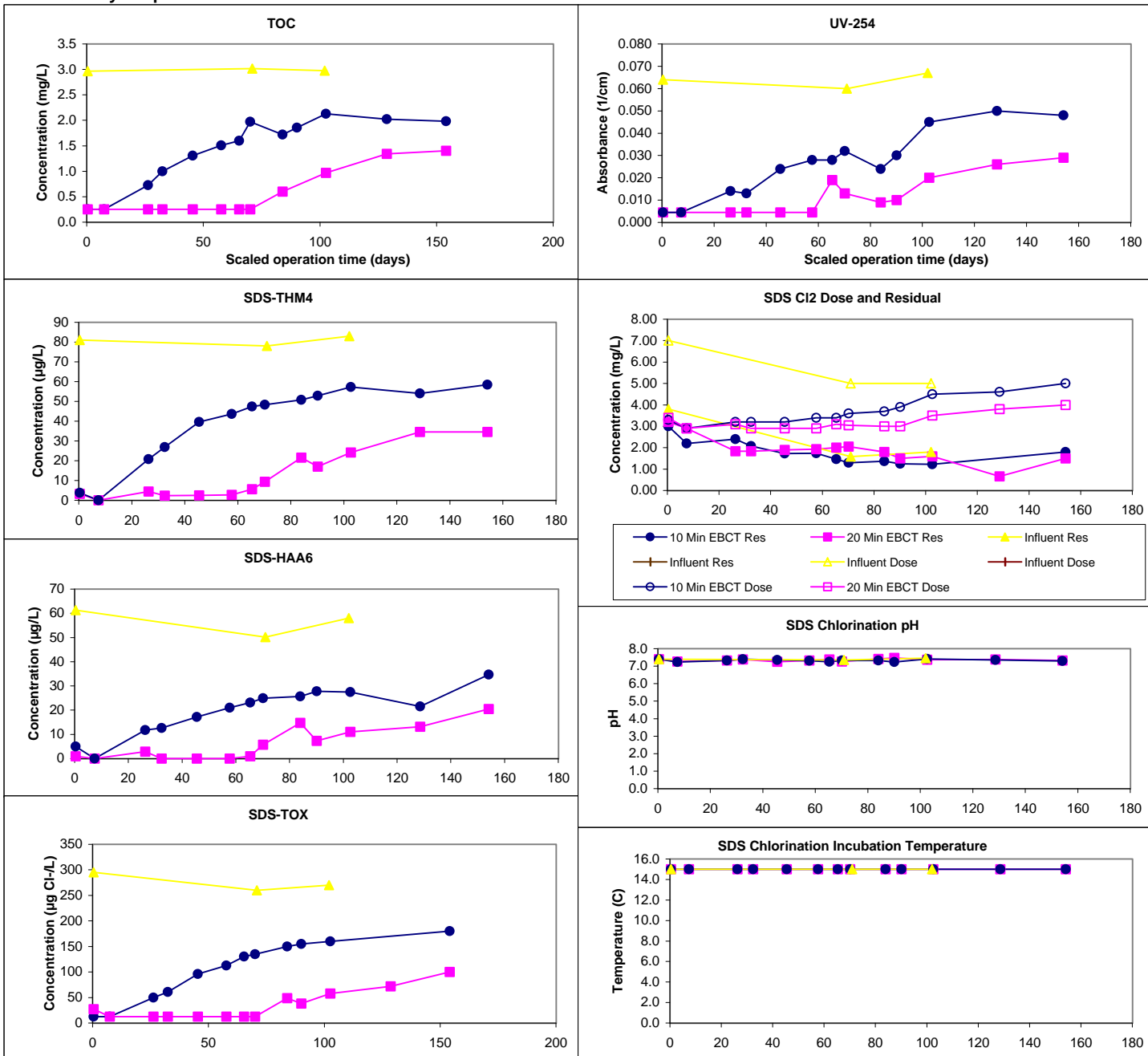
Design TOC: 2.8 mg/L
Col Diameter: 15.0 mm
Min Reynolds#: 0.20
Full-Scale Temp: 18.1 C

Full-Scale GAC Size: 12x40 Bituminous
Bench-Scale GAC Size: 80x100
Scaling Factor: 6.38
Meas Dry Bed Density: 0.46 g/cm3

Water Quality Summary

Influent	Influent				Influent	Influent				Res (0)	Mean	SD	Count	Min/Max					
	Mean	SD/RD	Count	Min/Max		Mean	SD/RD	Count	Min/Max										
TOC	3.0	0.0	3	3.0 - 3.0															
pH	6.8	0.1	3	6.7 - 6.8											Temp	15.0	0.0	29	15.0 - 15.0
UV254	0.064	0.004	3	0.060 - 0.067											pH	7.3	0.1	29	7.2 - 7.5
SUVA	2.13	0.13	3	1.99 - 2.25											Time	48.0	0.0	29	48.0 - 48.0
Bromide	94	4	2	92 - 96											Comments:				
SDS-TOX	275	18	3	260 - 295															
SDS-THM4	81	3	3	78 - 83															
SDS-HAA6	57	6	3	50 - 61															
Effluent		10 Min EBCT (24 B-S days)													20 Min EBCT (24 B-S days)				Chart Legend:
Effluent pH		7.1	0.3	13	6.2 - 7.8	7.1	0.3	13	6.6 - 7.8										
Effluent Temp		23.0	1.2	13	22.0 - 25.0	23.0	1.2	13	22.0 - 25.0										

Water Quality Graphs



Water Quality Graphs (Continued)

