

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

| | |
|---------------------------|---------------------------|
| Treatment Study ID | 1057 |
| Study Protocol | GAC RSSCT treatment study |
| Plant ICR Number | 597 |
| PWS Name | City of Charleston CPW |
| City, State, Zip | Charleston, SC 29402 |

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

Major comments:

None

General Comments:

1. The MRL for UV-254 is reported at 0.009 1/cm, but values as low as 0.001 1/cm are reported in the Data Collection Spreadsheets. The MRL for TOC is reported as 0.5 mg/L, but values as low as 0.25 are reported in Data Collection Spreadsheets. The MRL for TOX is reported as 25 ug/L, but values as low as 13 ug/L are reported in Data Collection Spreadsheets. It is acceptable to use these measured values below the MRL, but comments should be included that indicate these values are BMRL. Alternatively, the MRL could be revised if it was determined according to acceptable procedures.

Response: Values below the MRL in the Data Collection Spreadsheets are estimates. A comment indicating this has been added to the Data Collection Spreadsheets.

2. Section 6.6 of the Summary Report discussed the method for selecting SDS conditions. The free residual at the end of the 28 hour incubation period was based on the dose necessary to achieve a free residual of 2.8 to 3.0 mg/L after two hours, representing the end of the clearwell.
3. Seasonal variability was evaluated over four quarters; however, the plant switched to a different source water between the 2nd and 3rd sessions. During the first two sessions, the plant source water was the Edisto River. During the last two sessions, the plant source water was the Bushy Park Reservoir. Although TOC levels were lower in the Bushy Park Reservoir, bromide levels were higher in this source. This resulted in shifts in DBP species to the more brominated compounds during the 3rd and 4th quarters.

4. During the January session, actual EBCTs of 10.4 and 20.8 were simulated due to a calculation error. However, since these values were within 5% of the target values, the results from these runs will be reported as contactors with full-scale equivalent EBCTs of 10 and 20 minutes.
5. During all sessions, chlorine and ammonia feeds in the rapid mix were turned off. However, during the 2nd and 3rd session a total chlorine residual of 0.1 mg/L was detected. The influent sampled during these quarters was analyzed for instantaneous THMs and HAAs. All DBPs were found to be below the MRL.
6. Due to the low alkalinity in the influent water, there was some degree variability in the effluent pH for the GAC columns during all runs. However, the influent pH was maintained within 0.1 unit of the target value.

Response: Note that due to a systematic error, QA/QC data reported in Table 63 of the Treatment Study Summary Report were incorrect. The values have been corrected, and the updated version of Table 63 has been added to the hard copy and to the electronic version (PDF) of the report.

Outlier Data:

No outliers were removed.

Cell: A1

Comment: 1057-597_SAS.xls 2/1/00 13:03

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

1057-597_SAS.xls 2/2/00 21:15

Curve fit review updated and approved. See below for log of refit datasets.

Cell: C49

Comment: 1057-10-03 - Run 5 (CHBr3) 2/1/00 12:44

Original value (CoefA0) = -0.0821 New value = 0.0004

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

Cell: D49

Comment: 1057-10-03 - Run 5 (CHBr3) 2/1/00 12:44

Original value (CoefAf) = 12.18 New value = 8.1201

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

Cell: E49

Comment: 1057-10-03 - Run 5 (CHBr3) 2/1/00 12:44

Original value (CoefB) = 5.4089 New value = 20

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

Cell: F49

Comment: 1057-10-03 - Run 5 (CHBr3) 2/1/00 12:44

Original value (CoefD) = 0.0385 New value = 0.1045

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

Cell: J49

Comment: 1057-10-03 - Run 5 (CHBr3) 2/1/00 12:44

Original value (S) = 0 New value = -0.0349

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

Cell: C70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (CoefA0) = 0 New value = 2.2902

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: D70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (CoefAf) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: E70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (CoefB) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: F70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (CoefD) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: J70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (S) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: K70

Comment: 1057-10-04 - Run 7 (CDBAA) 2/2/00 21:08

Original value (t0) = 0 New value = 52.3476

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: C84

Comment: 1057-10-04 - Run 7 (TCAA) 2/1/00 12:47

Original value (CoefA0) = 0 New value = -1.0367

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: D84

Comment: 1057-10-04 - Run 7 (TCAA) 2/1/00 12:47

Original value (CoefAf) = 0 New value = 20.321

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: E84

Comment: 1057-10-04 - Run 7 (TCAA) 2/1/00 12:47

Original value (CoefB) = 0 New value = 45.6659

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: F84

Comment: 1057-10-04 - Run 7 (TCAA) 2/1/00 12:47

Original value (CoefD) = 0 New value = 0.0244

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: J84

Comment: 1057-10-04 - Run 7 (TCAA) 2/1/00 12:47

Original value (S) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: C136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (CoefA0) = 0 New value = 2.2644

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: D136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (CoefAf) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: E136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (CoefB) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: F136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (CoefD) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: J136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (S) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: K136

Comment: 1057-20-03 - Run 6 (CDBAA) 2/2/00 21:05

Original value (t0) = 0 New value = 203.0478

Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: C172

Comment: 1057-20-04 - Run 8 (TCAA) 2/1/00 12:57

Original value (CoefA0) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: D172

Comment: 1057-20-04 - Run 8 (TCAA) 2/1/00 12:57

Original value (CoefAf) = 0 New value = 7

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: E172

Comment: 1057-20-04 - Run 8 (TCAA) 2/1/00 12:57

Original value (CoefB) = 0 New value = 100

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: F172

Comment: 1057-20-04 - Run 8 (TCAA) 2/1/00 12:57

Original value (CoefD) = 0 New value = 0.02

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

Cell: J172

Comment: 1057-20-04 - Run 8 (TCAA) 2/1/00 12:57

Original value (S) = 0 New value = 0

Fewer than 6 points above MRL, average above 1/2 MRL. Logistic function (type 1) applied.

ICR Information

ID / ICR#: SC1010001 / 597
 ICR Contact: Andrew W. Fairey
 Phone No.: (843) 727-6862
 Period: 1/29/98 - 2/14/98 (16 B-S days)

Design Information

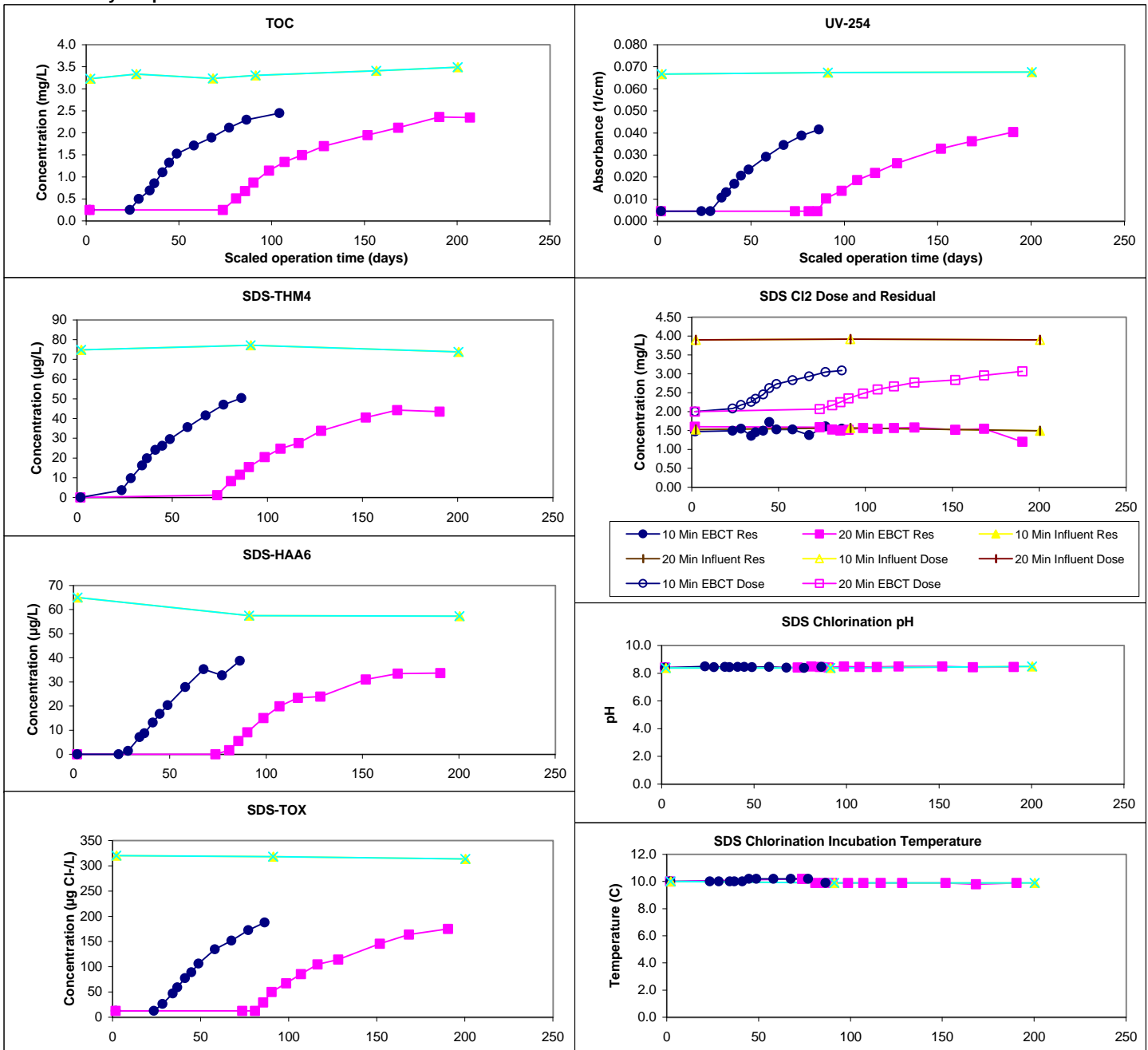
Design TOC: 3.5 mg/L
 Col Diameter: 10.0 mm
 Min Reynolds#: 0.50
 Full-Scale Temp: 10.0 C

Full-Scale GAC Size: 8x30 Bituminous
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 13.16
 Meas Dry Bed Density: 0.50 g/cm3

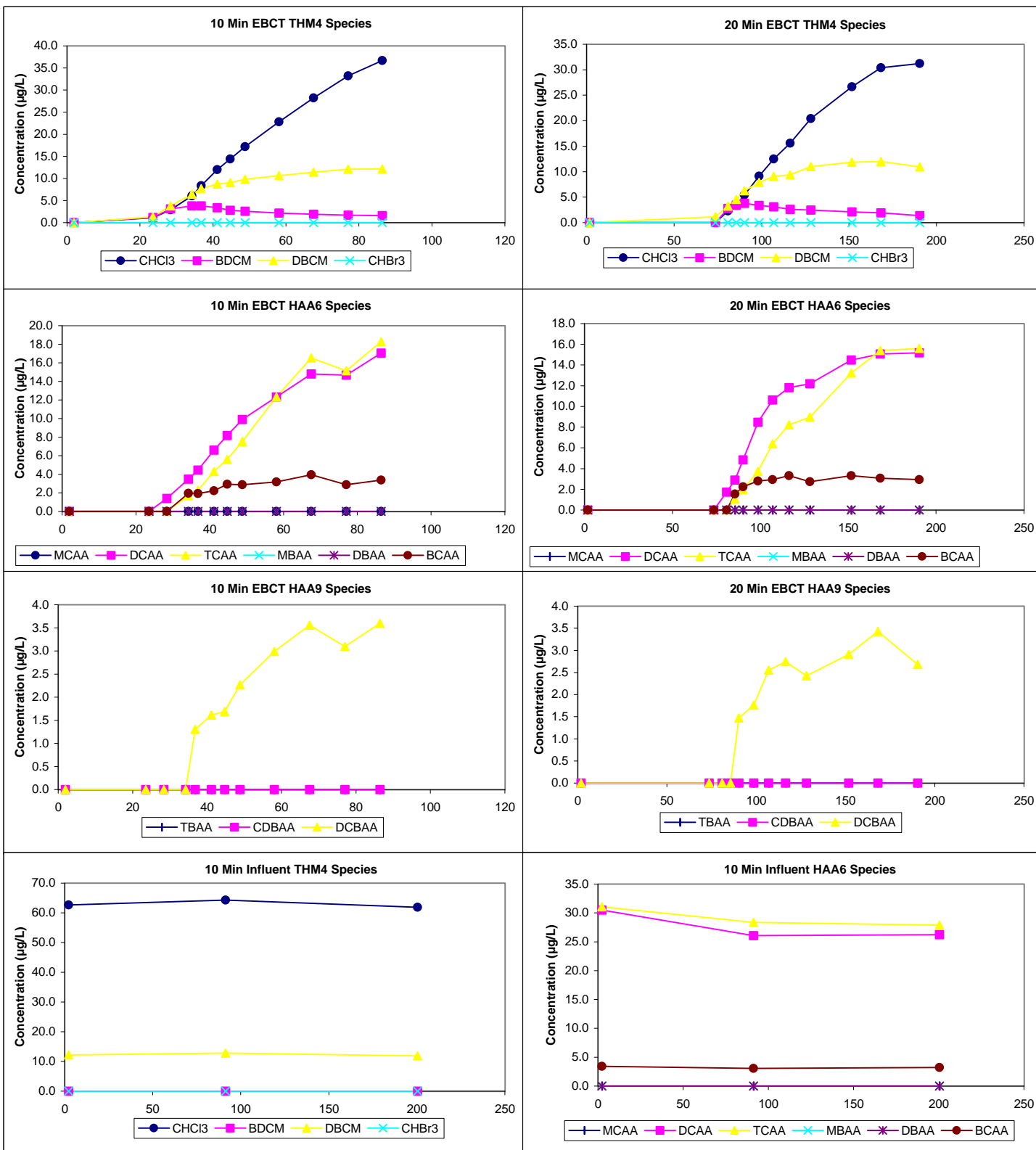
Water Quality Summary

| Influent | 10 Min Influent | | | | 20 Min Influent | | | | Cumulative SDS Conditions | | | |
|---------------|--------------------------|-------|-------|---------------|---------------------------|-------|-------|---------------|--|------|-----|-------|
| | Mean | SD/RD | Count | Min/Max | Mean | SD/RD | Count | Min/Max | Res (0) | Mean | SD | Count |
| TOC | 3.3 | 0.1 | 6 | 3.2 - 3.5 | 3.3 | 0.1 | 6 | 3.2 - 3.5 | 1.52 | 0.09 | | 30 |
| pH | 6.4 | 0.0 | 6 | 6.4 - 6.5 | 6.4 | 0.0 | 6 | 6.4 - 6.5 | Temp | 10.0 | 0.1 | 30 |
| UV254 | 0.067 | 0.000 | 3 | 0.067 - 0.068 | 0.067 | 0.000 | 3 | 0.067 - 0.068 | pH | 8.4 | 0.0 | 30 |
| SUVA | 2.01 | 0.07 | 3 | 1.94 - 2.07 | 2.01 | 0.07 | 3 | 1.94 - 2.07 | Time | 28.1 | 0.2 | 30 |
| Bromide | 17 | 14 | 2 | 10 - 24 | 17 | 14 | 2 | 10 - 24 | Comments: | | | |
| SDS-TOX | 317 | 3 | 3 | 314 - 320 | 317 | 3 | 3 | 314 - 320 | | | | |
| SDS-THM4 | 75 | 2 | 3 | 74 - 77 | 75 | 2 | 3 | 74 - 77 | Chart Legend: | | | |
| SDS-HAA6 | 60 | 4 | 3 | 57 - 65 | 60 | 4 | 3 | 57 - 65 | | | | |
| Effluent | 10 Min EBCT (8 B-S days) | | | | 20 Min EBCT (16 B-S days) | | | | 10 Min EBCT 20 Min EBCT 10 Min Influent 20 Min Influent | | | |
| Effluent pH | 7.5 | 0.3 | 13 | 7.3 - 8.3 | 7.7 | 0.9 | 13 | 6.5 - 9.2 | | | | |
| Effluent Temp | 21.4 | 0.6 | 13 | 20.4 - 22.2 | 21.8 | 0.7 | 13 | 20.4 - 22.7 | | | | |

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: SC1010001 / 597
 ICR Contact: Andrew W. Fairey
 Phone No.: (843) 727-6862
 Period: 5/8/98 - 5/23/98 (14 B-S days)

Design Information

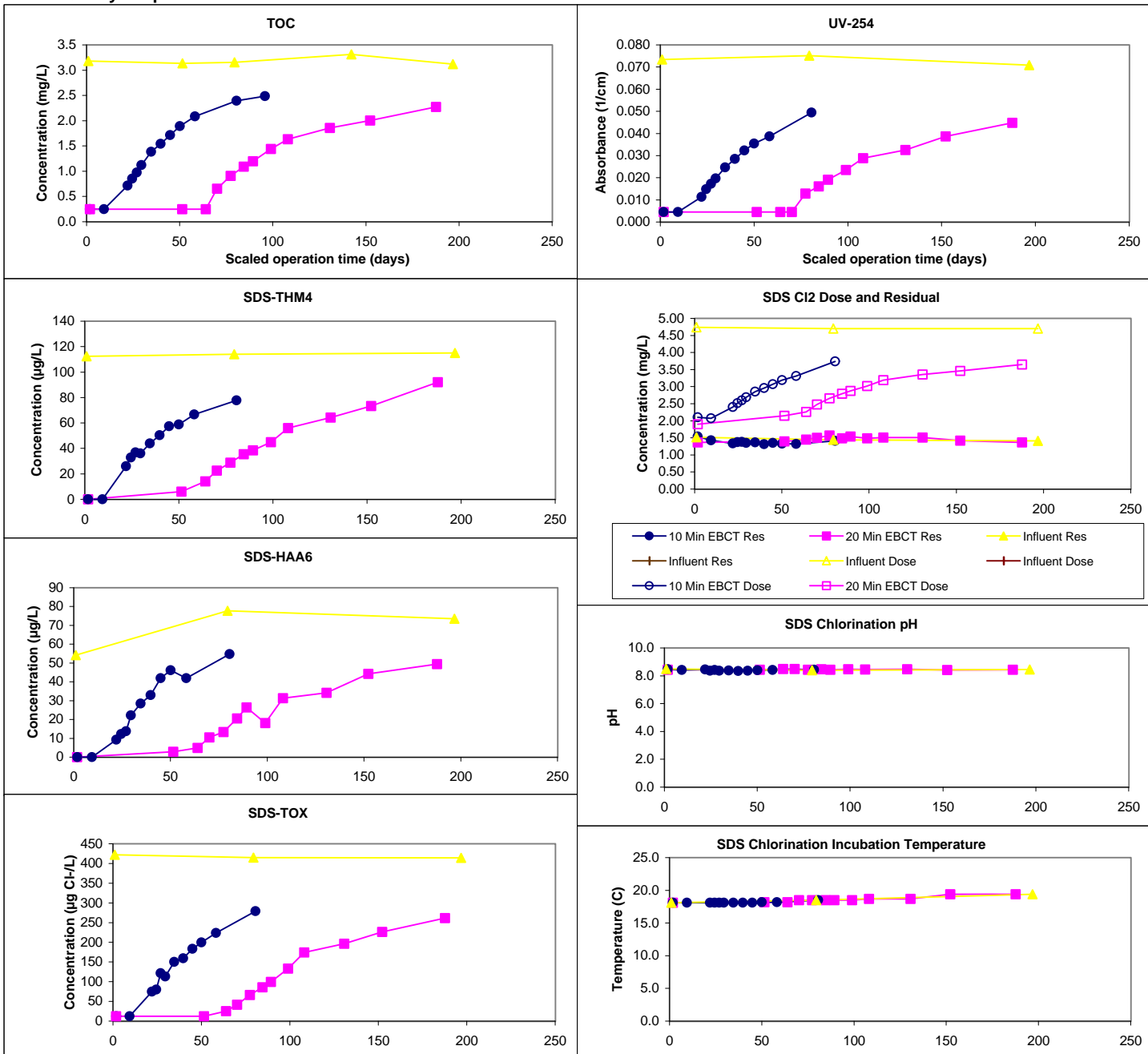
Design TOC: 3.3 mg/L
 Col Diameter: 11.0 mm
 Min Reynolds#: 0.50
 Full-Scale Temp: 20.0 C

Full-Scale GAC Size: 8x30 Bituminous
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 13.16
 Meas Dry Bed Density: 0.46 g/cm3

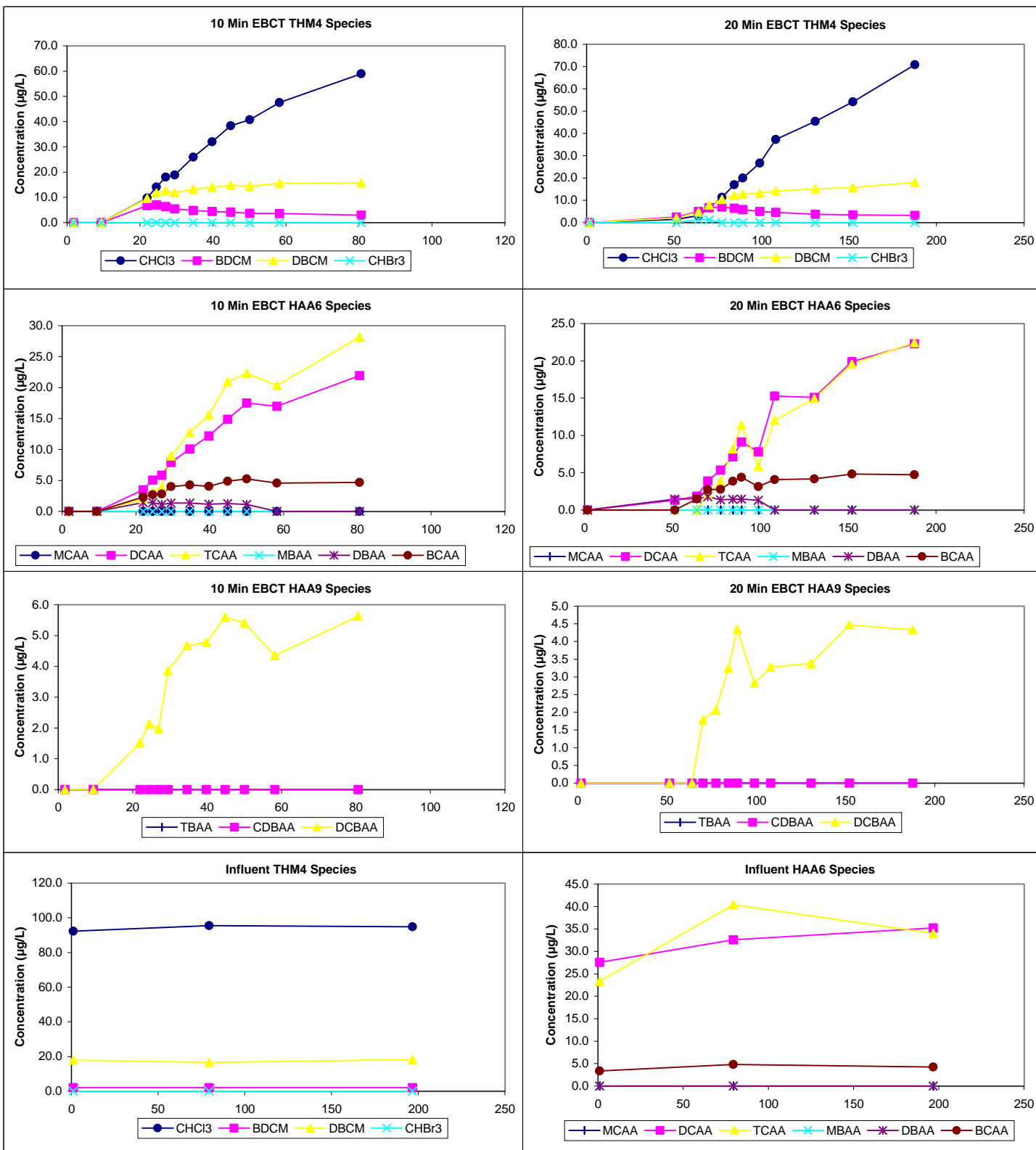
Water Quality Summary

| Influent | Influent | | | | Influent | | | | Res (0) | Mean | SD | Count | Min/Max |
|---------------|--------------------------|-------|-------|---------------|---------------------------|-------|-------|-------------|---------------|---|-----|-------|-------------|
| | Mean | SD/RD | Count | Min/Max | Mean | SD/RD | Count | Min/Max | | | | | |
| TOC | 3.2 | 0.1 | 5 | 3.1 - 3.3 | | | | | | | | | |
| pH | 6.4 | 0.0 | 5 | 6.4 - 6.5 | | | | | Temp | 18.4 | 0.4 | 27 | 18.1 - 19.4 |
| UV254 | 0.073 | 0.002 | 3 | 0.071 - 0.075 | | | | | pH | 8.4 | 0.0 | 27 | 8.3 - 8.5 |
| SUVA | 2.32 | 0.06 | 3 | 2.27 - 2.38 | | | | | Time | 27.9 | 0.1 | 27 | 27.8 - 28.2 |
| Bromide | 28 | 4 | 2 | 26 - 30 | | | | | Comments: | | | | |
| SDS-TOX | 417 | 4 | 3 | 414 - 422 | | | | | | | | | |
| SDS-THM4 | 114 | 1 | 3 | 112 - 115 | | | | | | | | | |
| SDS-HAA6 | 69 | 13 | 3 | 54 - 78 | | | | | | | | | |
| Effluent | 10 Min EBCT (7 B-S days) | | | | 20 Min EBCT (15 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 | 7.3 | 0.2 | 13 | 7.0 - 7.8 | 7.7 | 0.7 | 13 | 7.0 - 9.3 | | | | | |
| Effluent Temp | 21.3 | 0.9 | 13 | 20.5 - 23.3 | 21.1 | 0.7 | 13 | 20.3 - 22.6 | | | | | |

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: SC1010001 / 597
 ICR Contact: Andrew W. Fairey
 Phone No.: (843) 727-6862
 Period: 7/27/98 - 8/17/98 (20 B-S days)

Design Information

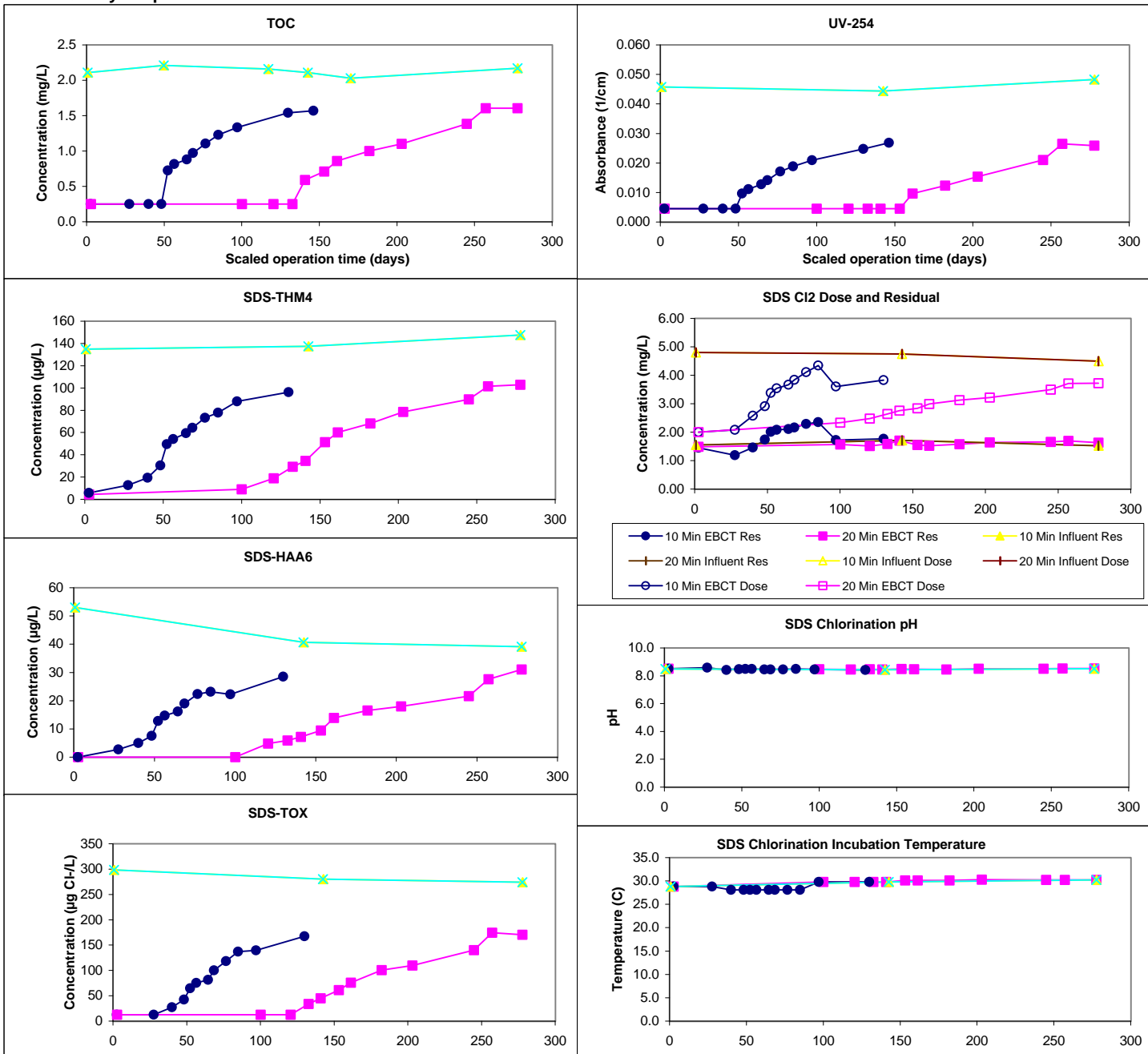
Design TOC: 2.0 mg/L
 Col Diameter: 8.0 mm
 Min Reynolds#: 0.75
 Full-Scale Temp: 30.0 C

Full-Scale GAC Size: 8x30 Bituminous
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 13.16
 Meas Dry Bed Density: 0.45 g/cm3

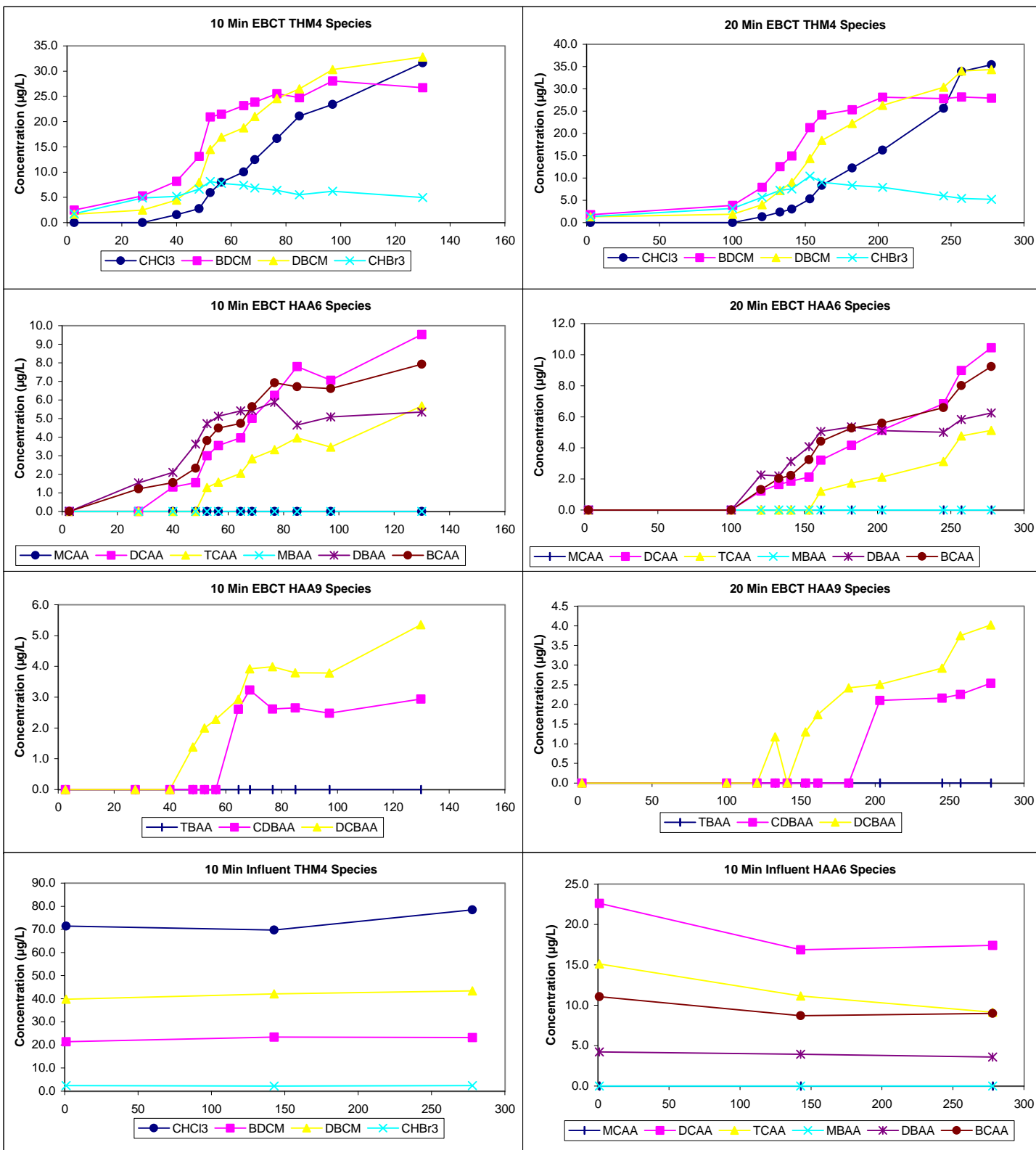
Water Quality Summary

| Influent | 10 Min Influent | | | | 20 Min Influent | | | | Res (0) | Mean | SD | Count | Min/Max |
|---------------|---------------------------|-------|-------|---------------|---------------------------|-------|-------|---------------|---------------|------|-----|-------|-------------|
| | Mean | SD/RD | Count | Min/Max | Mean | SD/RD | Count | Min/Max | | | | | |
| TOC | 2.1 | 0.1 | 6 | 2.0 - 2.2 | 2.1 | 0.1 | 6 | 2.0 - 2.2 | | | | | |
| pH | 6.2 | 0.1 | 6 | 6.1 - 6.4 | 6.2 | 0.1 | 6 | 6.1 - 6.4 | Temp | 29.3 | 0.9 | 30 | 28.1 - 30.3 |
| UV254 | 0.046 | 0.002 | 3 | 0.044 - 0.048 | 0.046 | 0.002 | 3 | 0.044 - 0.048 | pH | 8.5 | 0.0 | 30 | 8.4 - 8.6 |
| SUVA | 2.17 | 0.06 | 3 | 2.10 - 2.22 | 2.17 | 0.06 | 3 | 2.10 - 2.22 | Time | 28.0 | 0.3 | 30 | 27.3 - 28.4 |
| Bromide | 96 | 1 | 2 | 95 - 96 | 96 | 1 | 2 | 95 - 96 | Comments: | | | | |
| SDS-TOX | 284 | 13 | 3 | 274 - 298 | 284 | 13 | 3 | 274 - 298 | | | | | |
| SDS-THM4 | 140 | 7 | 3 | 135 - 148 | 140 | 7 | 3 | 135 - 148 | | | | | |
| SDS-HAA6 | 44 | 8 | 3 | 39 - 53 | 44 | 8 | 3 | 39 - 53 | | | | | |
| Effluent | 10 Min EBCT (11 B-S days) | | | | 20 Min EBCT (21 B-S days) | | | | Chart Legend: | | | | |
| Effluent pH | 7.0 | 0.2 | 13 | 6.8 - 7.5 | 7.1 | 0.3 | 12 | 6.8 - 8.0 | | | | | |
| Effluent Temp | 22.8 | 0.3 | 13 | 22.3 - 23.5 | 22.5 | 0.6 | 12 | 21.9 - 23.8 | | | | | |

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: SC1010001 / 597
 ICR Contact: Andrew W. Fairey
 Phone No.: (843) 727-6862
 Period: 10/16/98 - 11/6/98 (20 B-S days)

Design Information

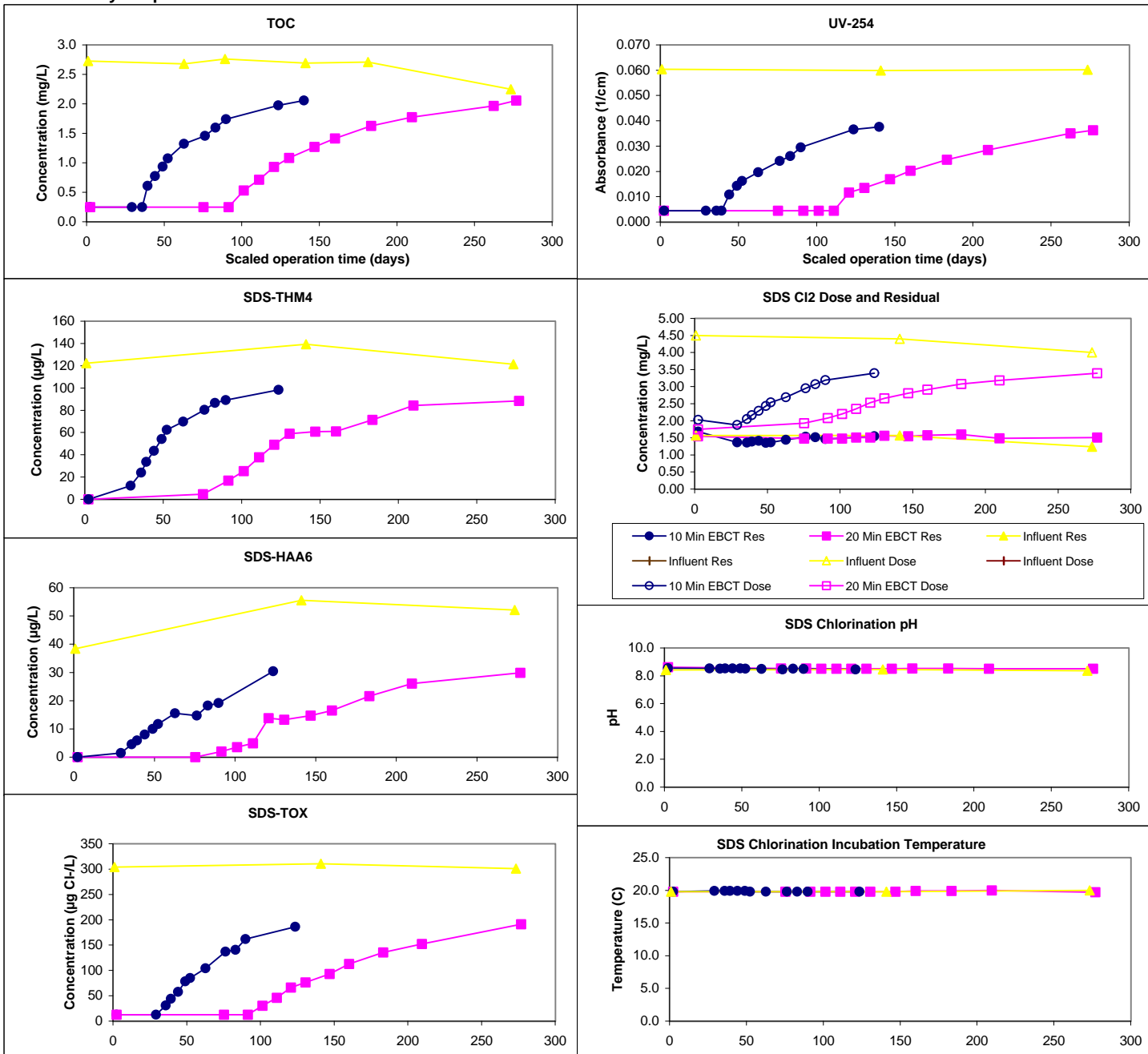
Design TOC: 2.6 mg/L
 Col Diameter: 10.0 mm
 Min Reynolds#: 0.50
 Full-Scale Temp: 20.0 C

Full-Scale GAC Size: 8x30 Bituminous
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 13.16
 Meas Dry Bed Density: 0.47 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 | 2.6 | 0.2 | 6 | 2.3 - 2.8 | | | | | | | | | |
| pH | 6.4 | 0.2 | 6 | 6.2 - 6.7 | | | | | Temp | 19.8 | 0.1 | 27 | 19.7 - 20.0 |
| UV254 | 0.060 | 0.000 | 3 | 0.060 - 0.060 | | | | | pH | 8.5 | 0.0 | 27 | 8.4 - 8.6 |
| SUVA | 2.37 | 0.26 | 3 | 2.22 - 2.67 | | | | | Time | 27.9 | 0.8 | 27 | 25.0 - 28.4 |
| Bromide | 140 | 0 | 2 | 140 - 140 | | | | | Comments: | | | | |
| SDS-TOX | 305 | 5 | 3 | 301 - 311 | | | | | | | | | |
| SDS-THM4 | 128 | 10 | 3 | 121 - 139 | | | | | | | | | |
| SDS-HAA6 | 49 | 9 | 3 | 38 - 56 | | | | | | | | | |
| Effluent | 10 Min EBCT (11 B-S days) | | | | 20 Min EBCT (21 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 | 7.0 | 0.2 | 13 | 6.6 - 7.4 | 6.9 | 0.4 | 13 | 6.7 - 8.3 | | | | | |
| Effluent Temp | 20.6 | 0.8 | 13 | 19.3 - 21.8 | 20.9 | 1.2 | 13 | 18.7 - 22.3 | | | | | |

Water Quality Graphs



Water Quality Graphs (Continued)

