

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

| | |
|---------------------------|--------------------------------------|
| Treatment Study ID | 1062 |
| Study Protocol | Membrane RBSMT treatment study |
| Plant ICR Number | 604 |
| PWS Name | Sioux Falls Water Purification Plant |
| City, State, Zip | Sioux Falls, SD 57102 |

General Comments:

1. During this bench-scale study, four membranes were evaluated: the FilmTec NF70-400, the Koch-Fluid Systems TFC-S, the FilmTec NF200B and the Hydranautics NTR7450. The NF70 was evaluated over four quarters. The TFC-S was evaluated during the Spring and Summer. The NF200 was evaluated in the Autumn and the NTR7450 was evaluated in the Winter. Table 3.8 of the Summary Report summarizes the experimental design. All quarterly experiments were conducted between 4/22/98 and 2/10/99.
2. The Sioux Falls Water Purification Plant uses a blend of surface water from the Big Sioux River and ground water from the Big Sioux Aquifer. In 1998, 41% of the flow came from the river source.
3. The plant does add chlorine prior to the filters; however, the chlorine feed was shut off prior to sampling, and measurements were made to verify that there was no detectable residual in the filter effluent. Filter media includes GAC.
4. During data analysis, temperatures of 5°C, 12°C, 20°C, and 12°C were used for Winter, Spring, Summer and Autumn, respectively. This was necessary to estimate the range of pressures required to maintain a constant production rate over the course of a calendar year. The temperatures were estimated using the range of full-scale influent water temperatures reported in the Summary Report. The temperatures in the Data Collection Spreadsheets are indicative of lab conditions.
5. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 27 water quality outliers were removed from this study for analysis.

2. SDS conditions are summarized in Table 3.11 of the Summary Report. The free chlorine residual was held constant over the four quarters at 1.5 mg/L. The target pH was 8.5 during the Spring and Summer and 8.7 during the Autumn and Winter. The incubation temperature varied from 5°C (Winter) to 20°C (Summer). The incubation time varied from 24 hours in Summer to 48 hours in Spring.
3. High mass balance closure errors were observed at the higher recoveries investigated. Based on LSI calculations for the concentrate stream, the researchers hypothesize that inorganic scaling contributed to these high errors.

Productivity Comments:

1. 5 productivity outliers were removed from this study for analysis.
2. The researchers used the measured TDS concentration in the concentrate stream to estimate osmotic pressure. The Data Collection Spreadsheets use a concentrate TDS value calculated from a mass balance. Due to the high mass balance closure errors in this study, it is more appropriate to use the measured TDS values to estimate osmotic pressure.
3. A hydrochloric acid solution (heated to 35°C) was used during membrane cleanings. Additional information about the membrane cleaning procedure is given on page 25 of the Summary Report.

ICR Information

ID / ICR#: SD4600294 / 604
ICR Contact: Mr. Timothy D. Stefanich
Phone No.: 605-367-7025
Period: 4/24/98 - 4/30/98 (6 days)

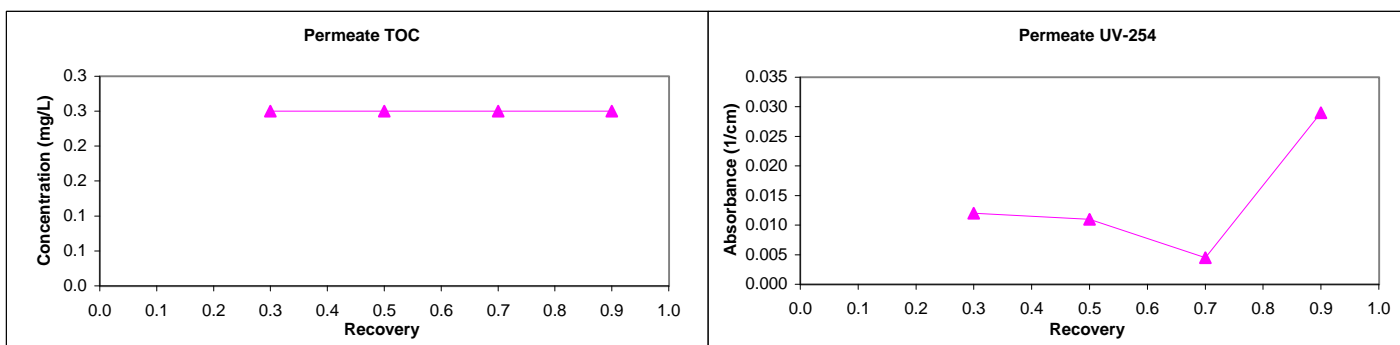
Membrane Information

Manufacturer: FILMTEC
Trade Name: NF70-400
MWCO: 200 Daltons
Mfr. Flux: 31.3 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.446 gfd/psi
Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: \$800
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 60.0 ft
840 Feed Spacer Thickness: 0.0023 ft

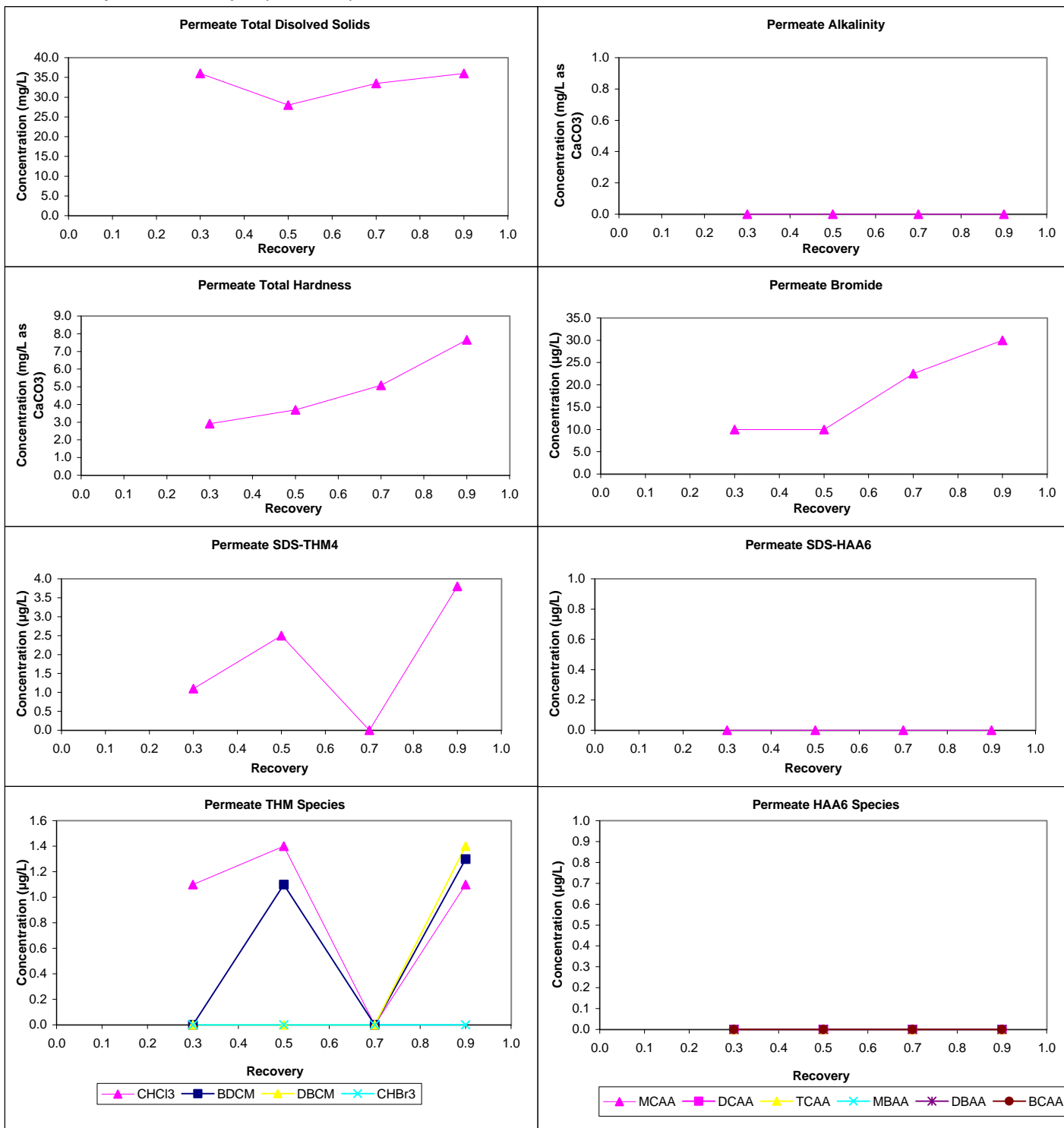
Water Quality Summary

| Source -> | | Feed | | Permeate | | | | Concentrate | | | | Mass Balance Closure Err (%) | | | | | | |
|----------------|--|-------|------|----------|-------------|-------|-----------|------------------------|-------|-----------------------------------|-------|------------------------------|--------------|--------------|-----|-------------|--|-------|
| Recovery -> | | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD | | | |
| pH | | 7.5 | 0.1 | 6.6 | 6.8 | 6.6 | 7.0 | 7.9 | 8.0 | 8.1 | 8.2 | TDS | 6 | -40 | 61 | | | |
| Temp | | 21.8 | 0.6 | 23.5 | 22.9 | 22.6 | 23.2 | 22.9 | 23.5 | 20.9 | 24.5 | Alk | 0 | n/a | n/a | | | |
| Alk | | 45 | 7 | 0 | 0 | 0 | 0 | 53 | 70 | 220 | 147 | TDS | 4 | -36 | 58 | | | |
| TDS | | 452 | 9 | 36 | 28 | 34 | 36 | 625 | 885 | 1155 | 1895 | TotHard | 4 | -64 | 73 | | | |
| TotHard | | 239 | 0 | 3 | 4 | 5 | 8 | 331 | 480 | 332 | 1059 | CaHard | 4 | -64 | 76 | | | |
| CaHard | | 88 | 0 | 1 | 1 | 2 | 3 | 124 | 179 | 120 | 392 | Turb | 0 | n/a | n/a | | | |
| Turb | | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.20 | 0.23 | 0.29 | Amm | 0 | n/a | n/a | | | |
| Amm | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a | | | |
| TOC | | 3.7 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 5.2 | 7.7 | 9.7 | 17.0 | UV254 | 3 | -30 | 37 | | | |
| UV254 | | 0.070 | NA | 0.012 | 0.011 | 0.005 | 0.029 | 0.086 | 0.121 | 0.166 | 0.255 | Pretreatment Information | | | | | | |
| SUVA | | #N/A | NA | 4.80 | 4.40 | 1.80 | 11.60 | 1.65 | 1.57 | 1.71 | 1.50 | | | | | | | |
| Bromide | | 77 | 2 | 10 | 10 | 23 | 30 | | | | | | | | | | | |
| TOX | | 420 | 40 | 13 | 13 | 13 | 13 | Process | | | | | | | | Description | | Scale |
| CHCl3 | | 33.0 | 2.0 | 1.1 | 1.4 | 0.0 | 1.1 | Solids Contact Basin | | 220 + 15 mg/L Lime | | Full-scale | | | | | | |
| BDCM | | 19.5 | 1.5 | 0.0 | 1.1 | 0.0 | 1.3 | | | +0.5 mg/L Ferric Chloride (FeCl3) | | Full-scale | | | | | | |
| DBCM | | 7.4 | 0.5 | 0.0 | 0.0 | 0.0 | 1.4 | | | 3.9 + 0.5 mg/L PAC | | Full-scale | | | | | | |
| CHBr3 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Dual media filtration | | sand / anthracite | | Full-scale | | | | | | |
| THM4 | | 59.9 | 4.0 | 1.1 | 2.5 | 0.0 | 3.8 | Sulfuric acid addition | | pH = 7.4 | | Bench-scale | | | | | | |
| MCAA | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Design Parameters | | | | | | | | | | |
| DCAA | | 19.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | |
| TCAA | | 20.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | |
| MBAA | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | |
| DBAA | | 1.6 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | |
| BCAA | | 6.5 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | |
| TBAA | | NA | NA | NA | NA | NA | NA | Active memb area: | | 0.167 ft² | | ID# | Recov (dec.) | Fw-des (gfd) | | | | |
| CDBAA | | NA | NA | NA | NA | NA | NA | Active width: | | 0.333 ft | | | | | | | | |
| DCBAA | | NA | NA | NA | NA | NA | NA | Norm Temp: | | 13.0 °C | | | | | | | | |
| HAA5 | | 40.6 | 5.3 | 0.0 | 0.0 | 0.0 | 0.0 | Feed TDS: | | 530.0 mg/L | | | | | | | | |
| HAA6 | | 47.0 | 5.9 | 0.0 | 0.0 | 0.0 | 0.0 | Manuf rep TDS rej: | | 70% | | | | | | | | |
| HAA9 | | NA | NA | NA | NA | NA | NA | Temp Norm MTC-w: | | 0.313 gfd/psi | | | | | | | | |
| SDS Conditions | | | | | | | Comments: | | | | | | | | | | | |
| WQP | | Avg | SD | Count | Min - Max | | | | | | | | | | | | | |
| Res (mg/L) (0) | | 1.72 | 0.22 | 6 | 1.44 - 2.04 | | | | | | | | | | | | | |
| Temp (°C) | | 11.9 | 0.7 | 6 | 10.8 - 12.9 | | | | | | | | | | | | | |
| pH (unit) | | 8.4 | 0.2 | 6 | 8.1 - 8.6 | | | | | | | | | | | | | |
| Time (hr) | | 47.7 | 0.8 | 6 | 46.0 - 48.0 | | | | | | | | | | | | | |

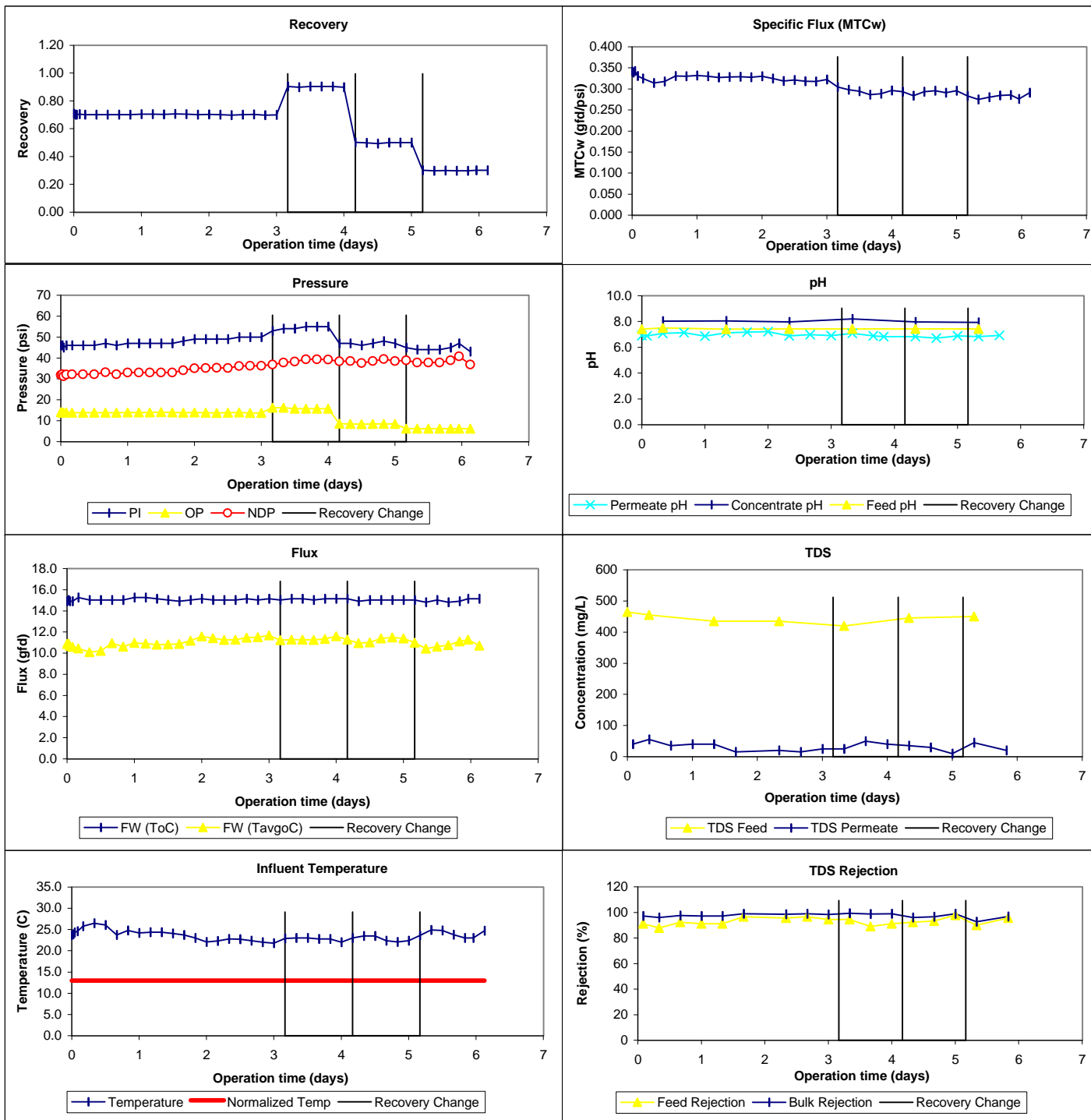
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: SD4600294 / 604
ICR Contact: Mr. Timothy D. Stefanich
Phone No.: 605-367-7025
Period: 7/17/98 - 7/23/98 (6 days)

Membrane Information

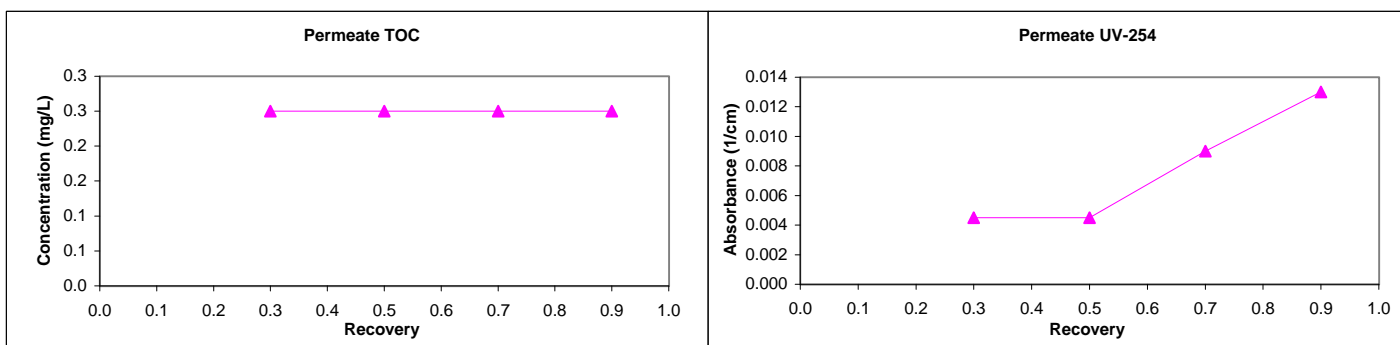
Manufacturer: FILMTEC
Trade Name: NF70-400
MWCO: 200 Daltons
Mfr. Flux: 31.3 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.446 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: \$800
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 60.0 ft
840 Feed Spacer Thickness: 0.0023 ft

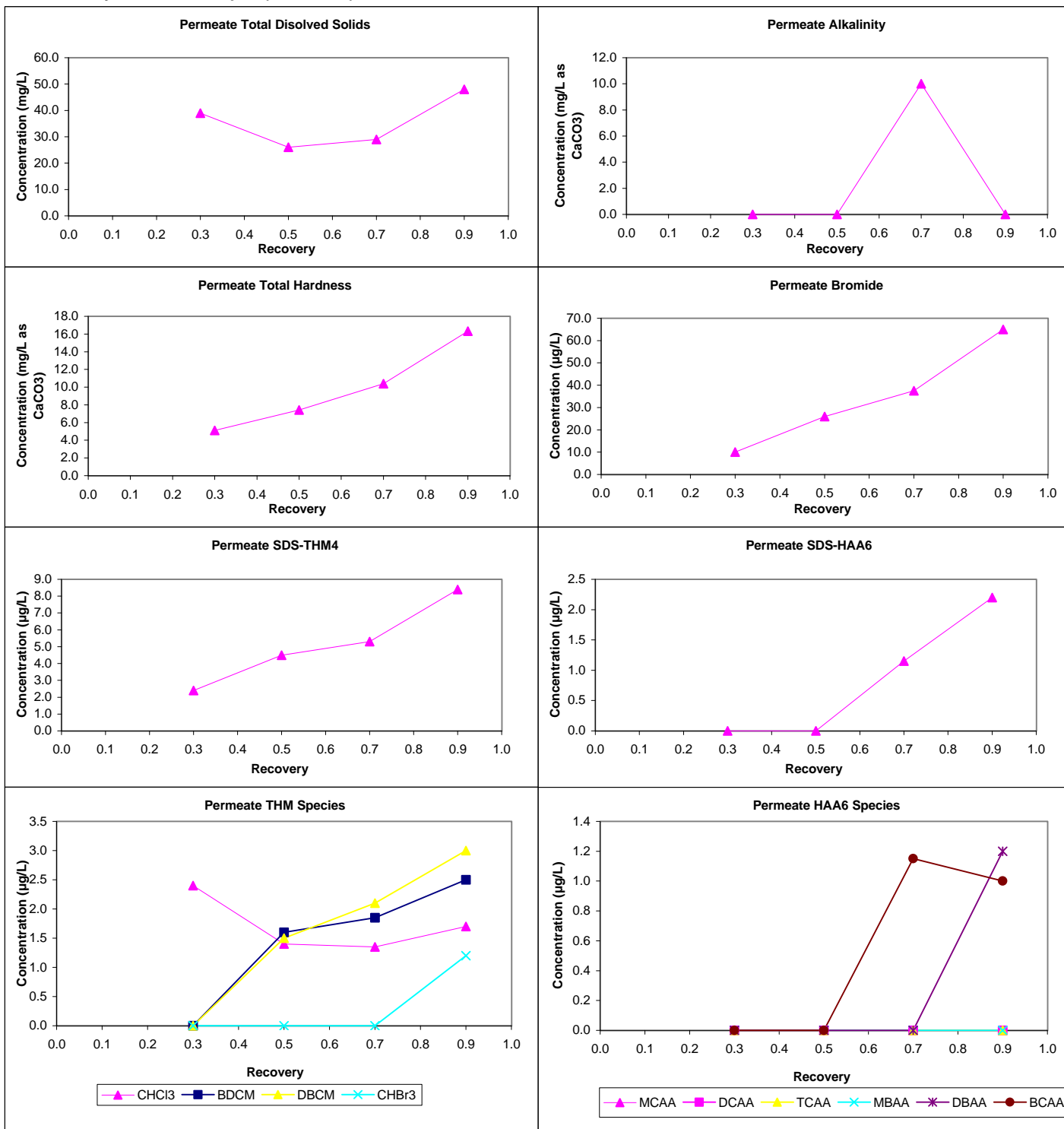
Water Quality Summary

| Water Quality Summary | | | | | | | Mass Balance Closure Error (%) | | | | | | | |
|--------------------------|-------|---------------------------------|----------|-------------|-------|--------------|--------------------------------|--------------------------|-------|-------|---------|-------|-----|-----|
| Source -> | Feed | | Permeate | | | | Concentrate | | | | | | | |
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD |
| pH | 7.4 | 0.0 | 6.5 | 6.2 | 6.5 | 6.4 | 7.7 | 7.8 | 8.1 | 8.0 | TDS | 8 | -37 | 50 |
| Temp | 20.5 | 0.6 | 21.2 | 21.0 | 21.0 | 21.9 | 21.3 | 20.9 | 21.0 | 22.0 | Alk | 1 | -19 | n/a |
| Alk | 78 | 2 | 0 | 0 | 10 | 0 | 115 | 142 | 180 | 270 | TDS | 4 | -46 | 64 |
| TDS | 525 | 10 | 39 | 26 | 29 | 48 | 699 | 956 | 1272 | 2010 | TotHard | 4 | -47 | 64 |
| TotHard | 283 | 1 | 5 | 7 | 10 | 16 | 371 | 523 | 695 | 1110 | CaHard | 4 | -48 | 67 |
| CaHard | 141 | 0 | 3 | 4 | 5 | 8 | 187 | 262 | 350 | 544 | Turb | 2 | 9 | 21 |
| Turb | 0.08 | 0.00 | 0.00 | 0.06 | 0.05 | 0.00 | 0.14 | 0.14 | 0.12 | 0.20 | Amm | 0 | n/a | n/a |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a |
| TOC | 3.6 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 4.9 | 6.8 | 9.2 | 14.5 | UV254 | 2 | -82 | 52 |
| UV254 | 0.064 | 0.003 | 0.005 | 0.005 | 0.009 | 0.013 | 0.086 | 0.110 | 0.148 | 0.224 | | | | |
| SUVA | 1.78 | 0.08 | 1.80 | 1.80 | 3.60 | 5.20 | 1.76 | 1.62 | 1.61 | 1.54 | | | | |
| Bromide | 120 | 0 | 10 | 26 | 38 | 65 | | | | | | | | |
| TOX | 410 | 20 | 44 | 32 | 29 | 35 | | | | | | | | |
| CHCl3 | 35.0 | 3.0 | 2.4 | 1.4 | 1.4 | 1.7 | | | | | | | | |
| BDCM | 23.0 | 0.0 | 0.0 | 1.6 | 1.9 | 2.5 | | | | | | | | |
| DBCM | 11.5 | 0.5 | 0.0 | 1.5 | 2.1 | 3.0 | | | | | | | | |
| CHBr3 | 1.2 | 0.1 | 0.0 | 0.0 | 0.0 | 1.2 | | | | | | | | |
| THM4 | 70.7 | 2.4 | 2.4 | 4.5 | 5.3 | 8.4 | | | | | | | | |
| MCAA | 1.2 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCAA | 15.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| TCAA | 13.5 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DBAA | 2.4 | 0.6 | 0.0 | 0.0 | 0.0 | 1.2 | | | | | | | | |
| BCAA | 7.4 | 1.4 | 0.0 | 0.0 | 1.2 | 1.0 | | | | | | | | |
| TBAA | NA | NA | NA | 0.0 | 0.0 | 0.0 | | | | | | | | |
| CDBAA | NA | NA | NA | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCBAA | NA | NA | NA | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA5 | 32.1 | 6.3 | 0.0 | 0.0 | 0.0 | 1.2 | | | | | | | | |
| HAA6 | 39.5 | 7.7 | 0.0 | 0.0 | 1.2 | 2.2 | | | | | | | | |
| HAA9 | NA | NA | NA | 0.0 | 1.2 | 2.2 | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | |
| WQP | Avg | SD | Count | Min - Max | | | | | | | | | | |
| Res (mg/L) (0) | 1.50 | 0.34 | 6 | 1.06 - 1.96 | | | | | | | | | | |
| Temp (°C) | 19.2 | 0.2 | 6 | 18.8 - 19.4 | | | | | | | | | | |
| pH (unit) | 8.5 | 0.2 | 6 | 8.2 - 8.7 | | | | | | | | | | |
| Time (hr) | 24.2 | 0.7 | 6 | 23.0 - 24.8 | | | | | | | | | | |
| Pretreatment Information | | | | | | | | | | | | | | |
| Process | | Description | | Scale | | | | | | | | | | |
| Solids Contact Basin | | 220 + 15 mg/L Lime | | Full-scale | | | | | | | | | | |
| | | +0.5 mg/L Ferric Chloride (FeCl | | Full-scale | | | | | | | | | | |
| | | 3.9 + 0.5 mg/L PAC | | Full-scale | | | | | | | | | | |
| Dual media filtration | | sand / anthracite | | Full-scale | | | | | | | | | | |
| Sulfuric acid addition | | pH = 7.4 | | Bench-scale | | | | | | | | | | |
| Design Parameters | | | | | | | | | | | | | | |
| Active memb area: | | 0.167 ft ² | | ID# | | Recov (dec.) | | F _{W-des} (gfd) | | | | | | |
| Active width: | | 0.333 ft | | 1 | | 0.70 | | 15.0 | | | | | | |
| Norm Temp: | | 13.0 °C | | 2 | | 0.90 | | 15.0 | | | | | | |
| Feed TDS: | | 530.0 mg/L | | 3 | | 0.50 | | 15.0 | | | | | | |
| Manuf rep TDS rej: | | 70% | | 4 | | 0.30 | | 15.0 | | | | | | |
| Temp Norm MTC-w: | | 0.313 gfd/psi | | | | | | | | | | | | |
| Comments: | | | | | | | | | | | | | | |

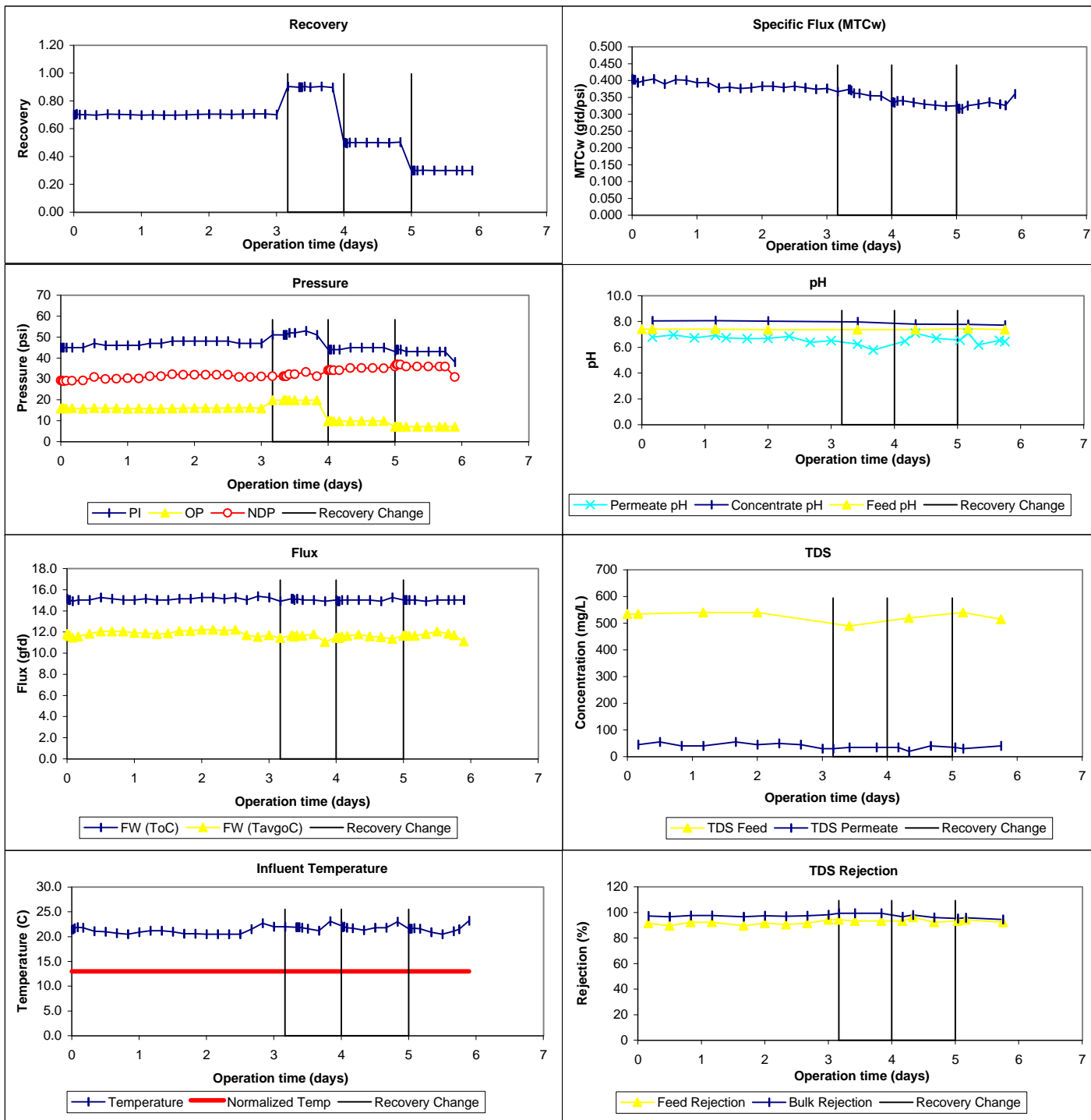
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



Membrane Information

| | | | |
|--|----------------------------------|-----------------------------------|-----------------------|
| ICR Information: | Manufacturer Information: | | |
| ID / ICR#: SD4600294 / 604 | Manufacturer: FILMTEC | Mfr. Temp: | 25.0 °C |
| ICR Contact: Mr. Timothy D. Stefanich | Trade Name: NF70-400 | 840 Element Area: | 400.0 ft ² |
| Phone No.: 605-367-7025 | MWCO: 200 Daltons | 840 Purchase Price: | \$800 |
| Period: 10/23/98 - 10/30 (7 days) | Mfr. Flux: 31.3 gfd | 840 Maximum Flow: | 70.0 gpm |
| | Mfr. NDP: 70.0 psi | 840 Minimum Flow: | 16.0 gpm |
| | Mfr. MTCw: 0.446 gfd/psi | 840 Total Width: | 60.0 ft |
| | | 840 Feed Spacer Thickness: | 0.0023 ft |

Mass Balance Closure Err (%)

| Water Quality Summary | | | | | | | Mass Balance Closure 2H (%) | | | | | | | |
|-----------------------|-------|-------|----------|-------------|-------|-------|-----------------------------|---------------|-------|-------|--|-------------|-----|-----|
| Source -> | Feed | | Permeate | | | | Concentrate | | | | | | | |
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD |
| pH | 7.4 | 0.1 | 6.2 | 6.3 | 6.3 | 6.9 | 7.7 | 7.7 | 7.8 | 8.2 | TDS _{st} | 7 | -42 | 60 |
| Temp | 20.7 | 1.3 | 23.1 | 24.7 | 25.4 | 23.9 | 22.9 | 24.7 | 25.5 | 24.8 | Alk | 0 | n/a | n/a |
| Alk | 26 | 0 | 0 | 0 | 0 | 0 | 35 | 46 | 66 | 102 | TDS | 4 | -47 | 59 |
| TDS | 538 | 3 | 19 | 17 | 15 | 43 | 719 | 929 | 1294 | 2130 | TotHard | 4 | -58 | 64 |
| TotHard | 280 | 0 | 2 | 3 | 4 | 7 | 338 | 464 | 649 | 1088 | CaHard | 4 | -66 | 62 |
| CaHard | 143 | 0 | 1 | 2 | 2 | 3 | 160 | 222 | 320 | 544 | Turb | 0 | n/a | n/a |
| Turb | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.08 | 0.06 | 0.10 | Amm | 0 | n/a | n/a |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a |
| TOC | 3.1 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 4.0 | 5.2 | 6.9 | 9.4 | UV254 | 1 | -5 | n/a |
| UV254 | 0.053 | 0.000 | 0.005 | 0.005 | 0.005 | 0.005 | 0.075 | 0.099 | 0.139 | 0.219 | SUVA | | | |
| SUVA | 1.74 | 0.09 | 1.80 | 1.80 | 1.80 | 1.80 | 1.88 | 1.90 | 2.01 | 2.33 | Pretreatment Information | | | |
| Bromide | 75 | 19 | 10 | 10 | 23 | 32 | Process | | | | | | | |
| TOX | 198 | 8 | 13 | 13 | 13 | 13 | Solids Contact Basin | | | | 220 + 15 mg/L Lime | Full-scale | | |
| CHCl3 | 19.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | Dual media filtration | | | | +0.5 mg/L Ferric Chloride (FeCl ₃) | Full-scale | | |
| BDCM | 15.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | 3.9 + 0.5 mg/L PAC | Full-scale | | |
| DBCM | 8.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | Sulfuric acid addition | | | | sand / anthracite | Full-scale | | |
| CHBr3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | pH = 7.4 | Bench-scale | | |
| THM4 | 42.5 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | Design Parameters | | | | | | | |
| MCAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCAA | 15.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | Active width: | 0.333 ft | | | | | | |
| TCAA | 13.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | Norm Temp: | 13.0 °C | 1 | 0.70 | 15.0 | | | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Feed TDS: | 530.0 mg/L | 2 | 0.90 | 15.0 | | | |
| DBAA | 2.5 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | Manuf rep TDS rej: | 70% | 3 | 0.50 | 15.0 | | | |
| BCAA | 7.7 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | Temp Norm MTC-w: | 0.313 gfd/psi | 4 | 0.30 | 15.0 | | | |
| TBAA | NA | NA | NA | NA | NA | NA | Comments: | | | | | | | |
| CDBAA | NA | NA | NA | NA | NA | NA | | | | | | | | |
| DCBAA | NA | NA | NA | NA | NA | NA | | | | | | | | |
| HAA5 | 30.5 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA6 | 38.2 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA9 | NA | NA | NA | NA | NA | NA | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | |
| WQP | Avg | SD | Count | Min - Max | | | | | | | | | | |
| Res (mg/L) (0) | 1.41 | 0.10 | 6 | 1.32 - 1.60 | | | | | | | | | | |
| Temp (°C) | 11.8 | 0.6 | 6 | 11.2 - 12.5 | | | | | | | | | | |
| pH (unit) | 8.5 | 0.2 | 6 | 8.3 - 8.7 | | | | | | | | | | |
| Time (hr) | 29.8 | 0.7 | 6 | 29.0 - 30.5 | | | | | | | | | | |

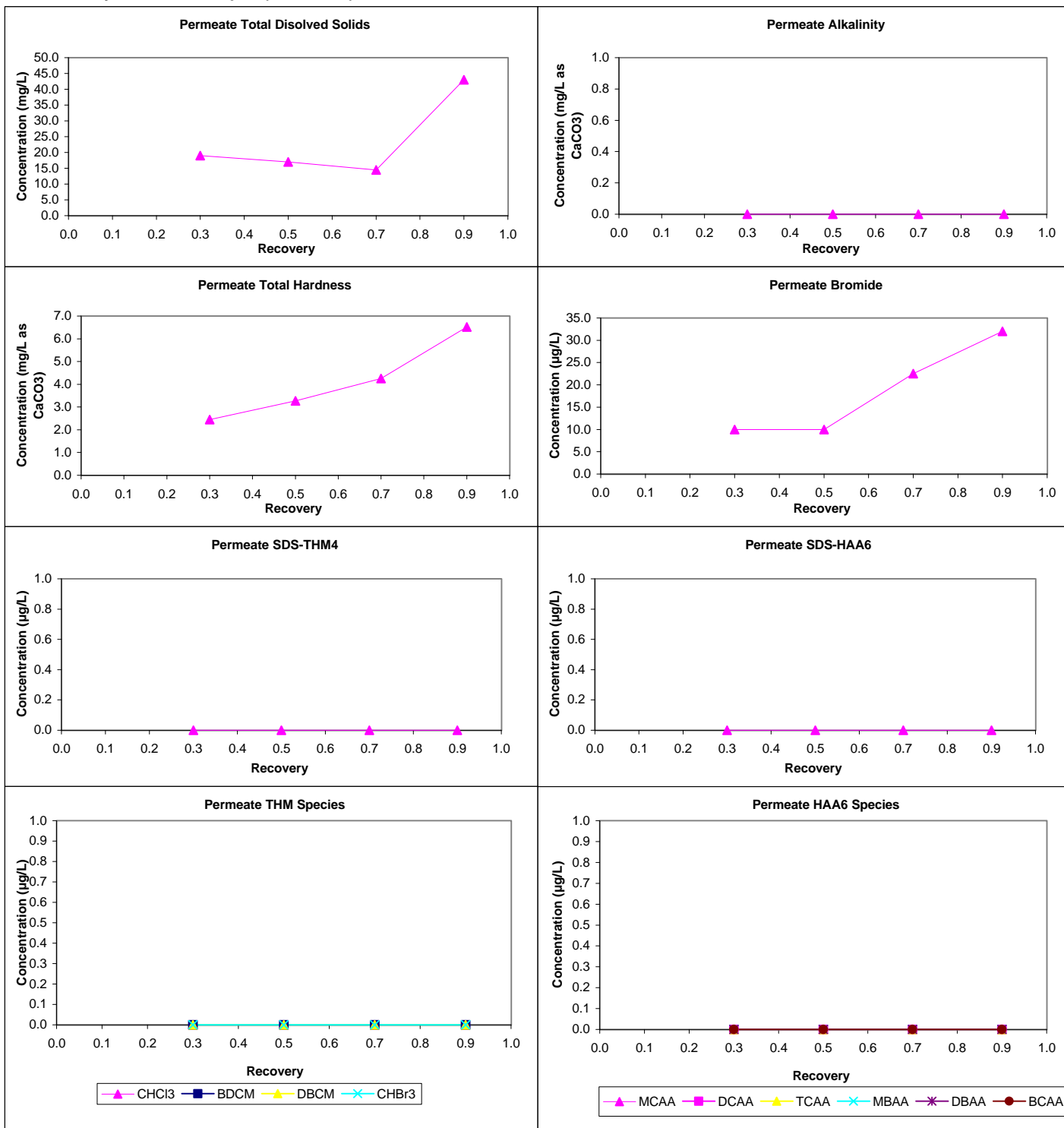
Permeate TOC

| Recovery | Concentration (mg/L) |
|----------|----------------------|
| 0.3 | 0.28 |
| 0.5 | 0.28 |
| 0.7 | 0.28 |
| 0.9 | 0.28 |

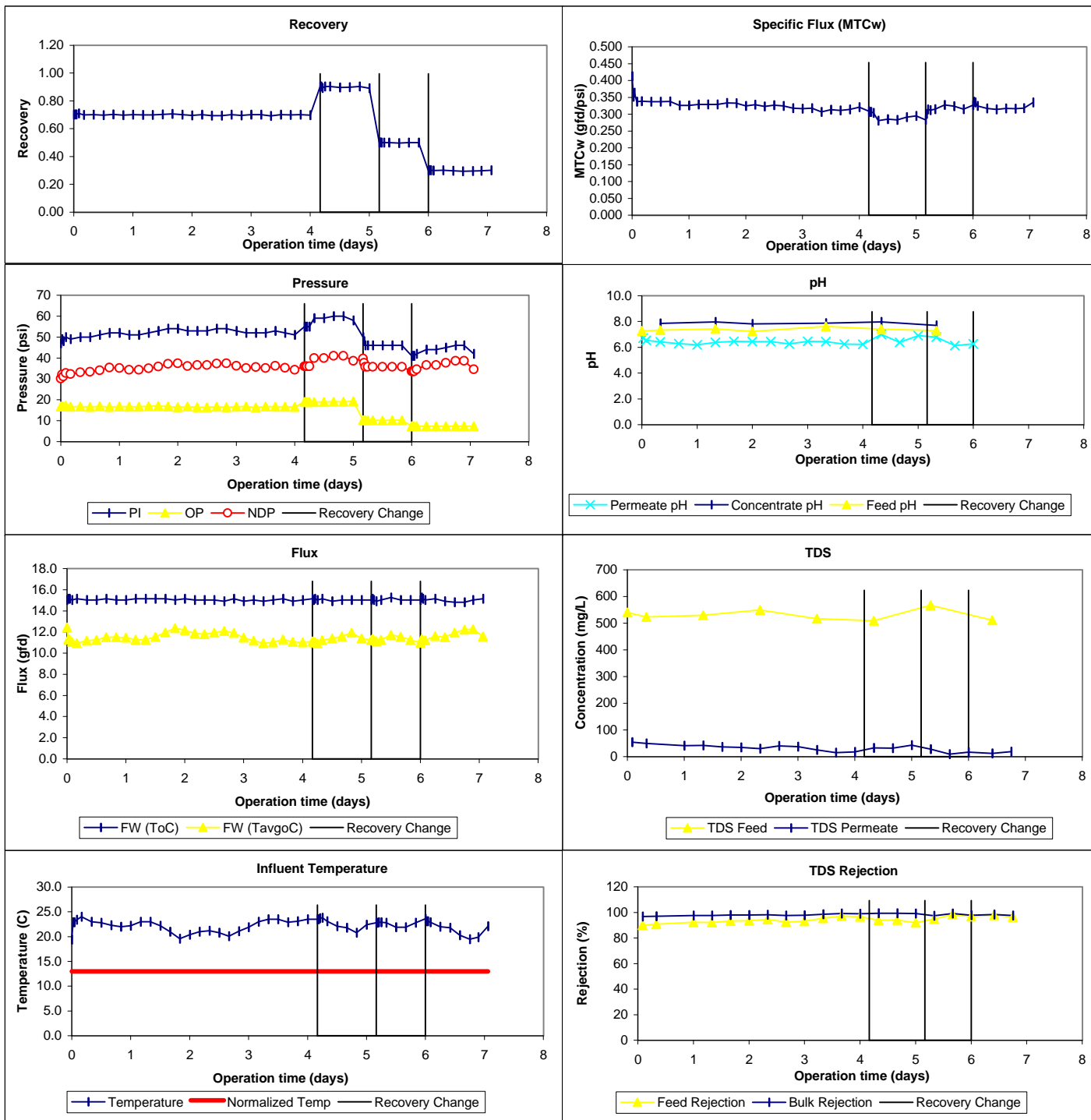
Permeate UV-254

| Recovery | Absorbance (1/cm) |
|----------|-------------------|
| 0.3 | 0.0048 |
| 0.5 | 0.0048 |
| 0.7 | 0.0048 |
| 0.9 | 0.0048 |

Water Quality Parameter Graphs (Continued)



Productivity Graphs

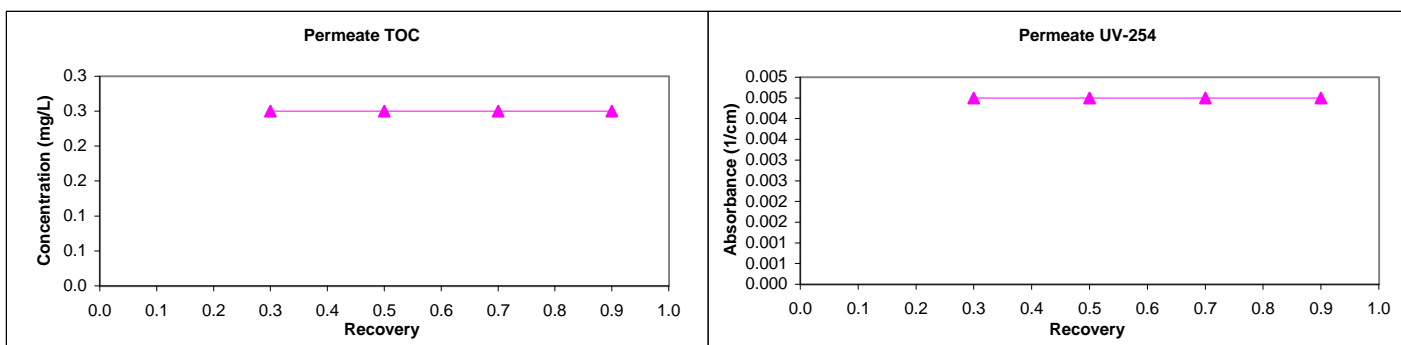


Membrane Information

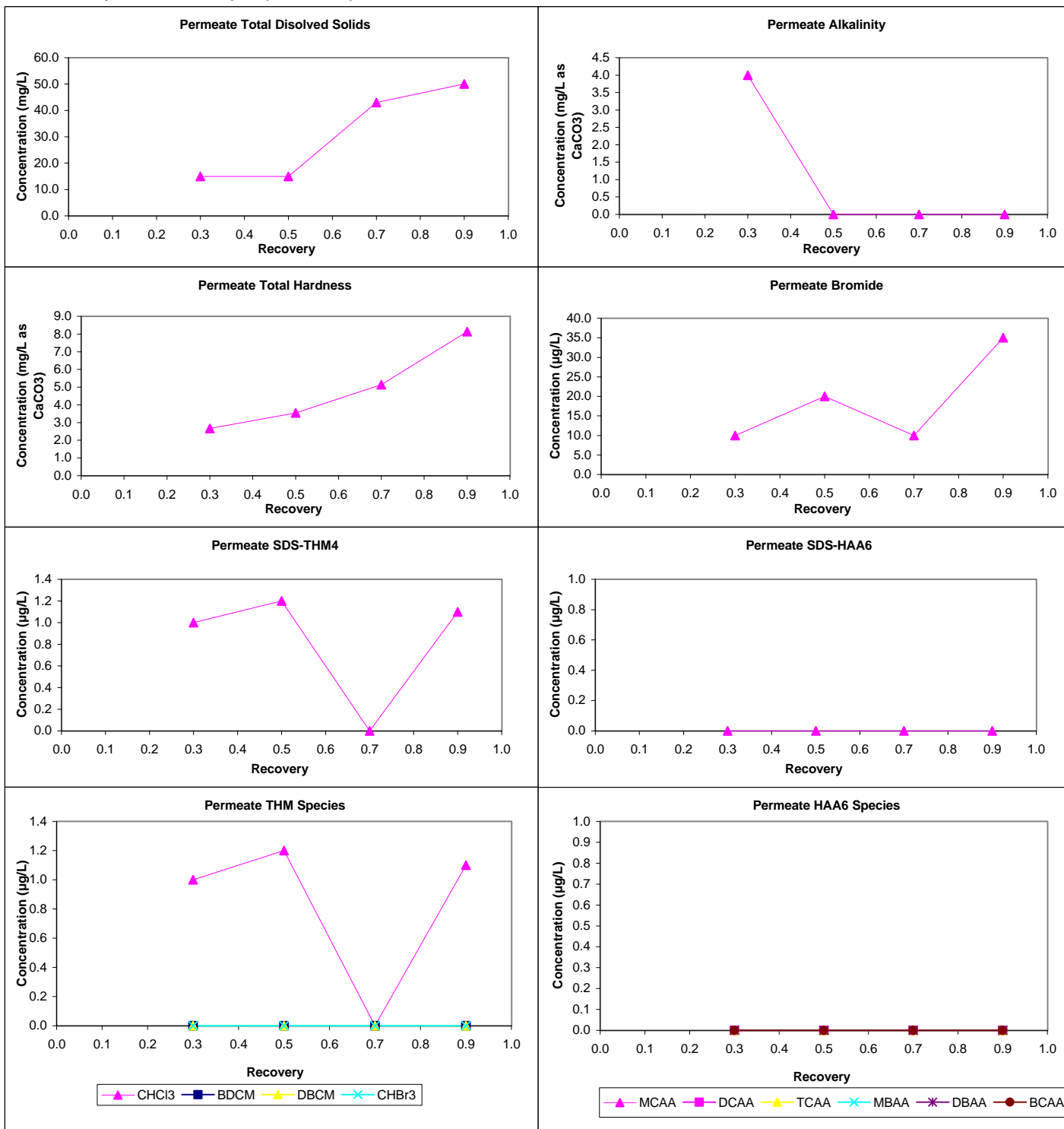
| | | |
|--|----------------------------------|--|
| ICR Information: | Manufacturer Information: | |
| ID / ICR#: SD4600294 / 604 | Manufacturer: FILMTEC | Mfr. Temp: 25.0 °C |
| ICR Contact: Mr. Timothy D. Stefanich | Trade Name: NF70-400 | 840 Element Area: 400.0 ft ² |
| Phone No.: 605-367-7025 | MWCO: 200 Daltons | 840 Purchase Price: \$800 |
| Period: 1/22/99 - 1/28/99 (6 days) | Mfr. Flux: 31.3 gfd | 840 Maximum Flow: 70.0 gpm |
| | Mfr. NDP: 70.0 psi | 840 Minimum Flow: 16.0 gpm |
| | Mfr. MTCw: 0.446 gfd/psi | 840 Total Width: 60.0 ft |
| | | 840 Feed Spacer Thickness: 0.0023 ft |

Mass Balance Closure Err (%)

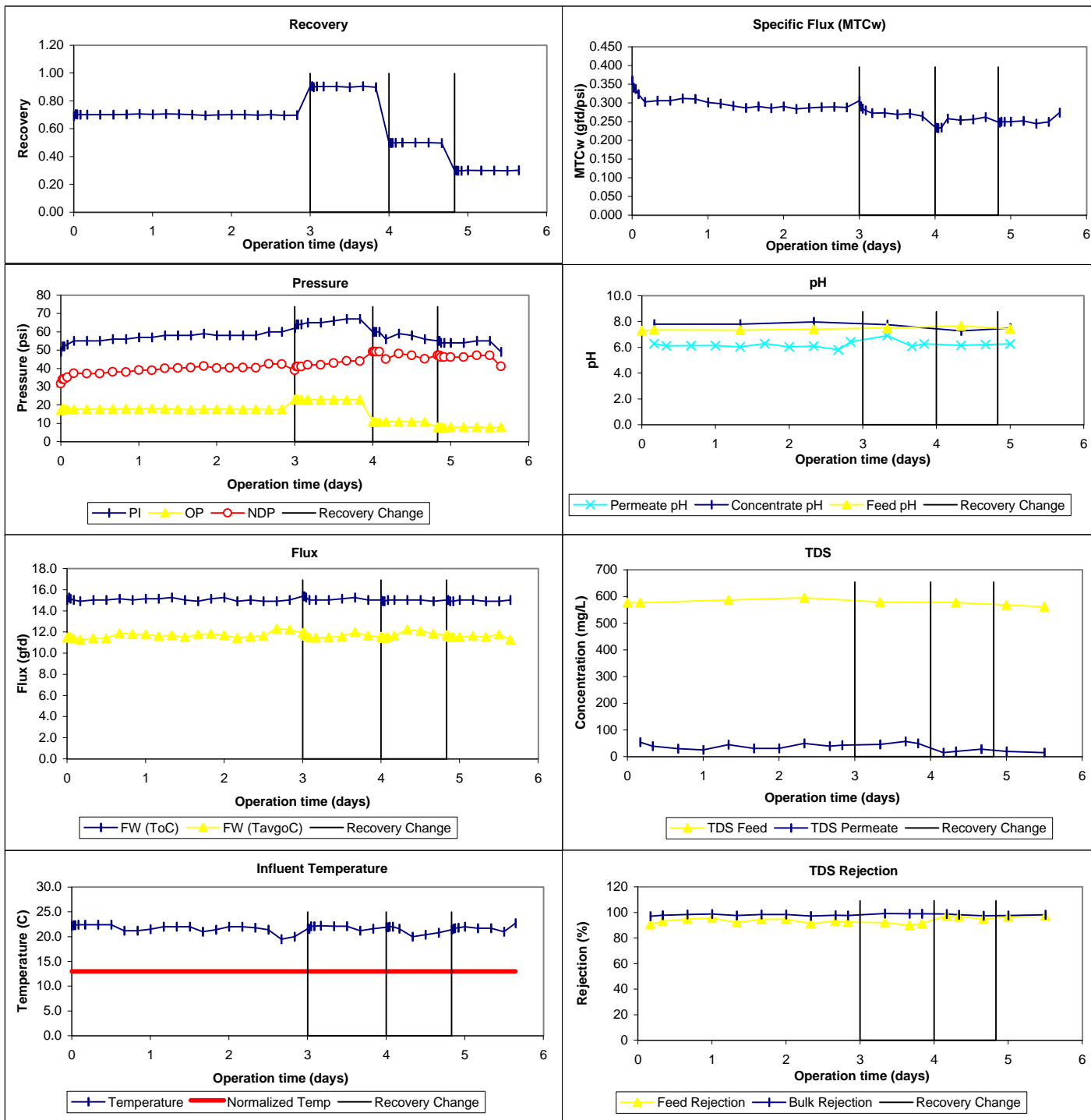
| Water Quality Summary | | | | | | | Mass Balance Closure 2H (%) | | | | | | | | | |
|-----------------------|-------|-------|----------|-------------|-------|-------|-----------------------------|-------|-----------------------------------|-------|-------------------|-------|--------|------|-------------------|--|
| Source -> | Feed | | Permeate | | | | Concentrate | | | | Process | | | | | |
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD | | |
| pH | 7.3 | 0.0 | 6.3 | 6.4 | 6.4 | 6.3 | 7.5 | 7.8 | 8.0 | 8.2 | TDS _{st} | 7 | -29 | 48 | | |
| Temp | 19.7 | 0.2 | 20.4 | 20.2 | 20.4 | 20.7 | 20.4 | 20.3 | 20.4 | 20.8 | Alk | 1 | 0 | n/a | | |
| Alk | 46 | 2 | 4 | 0 | 0 | 0 | 64 | 88 | 120 | 175 | TDS | 4 | -37 | 55 | | |
| TDS | 570 | 8 | 15 | 15 | 43 | 50 | 772 | 1095 | 1451 | 2404 | TotHard | 4 | -65 | 92 | | |
| TotHard | 323 | 2 | 3 | 4 | 5 | 8 | 443 | 591 | 723 | 1051 | CaHard | 4 | -39 | 59 | | |
| CaHard | 125 | 0 | 1 | 1 | 2 | 3 | 176 | 247 | 320 | 542 | Turb | 1 | -40 | n/a | | |
| Turb | 0.07 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.06 | 0.07 | 0.13 | 0.16 | Amm | 0 | n/a | n/a | | |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.40 | TOC | 0 | n/a | n/a | | |
| TOC | 3.7 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 5.2 | 7.1 | 9.5 | 15.0 | UV254 | 0 | n/a | n/a | | |
| UV254 | 0.062 | 0.001 | 0.005 | 0.005 | 0.005 | 0.005 | 0.087 | 0.118 | 0.157 | 0.261 | SUVA | 1.68 | 0.03 | 1.80 | | |
| SUVA | 1.68 | 0.03 | 1.80 | 1.80 | 1.80 | 1.80 | 1.67 | 1.66 | 1.65 | 1.74 | Bromide | 98 | 2 | 10 | | |
| Bromide | 98 | 2 | 10 | 20 | 10 | 35 | Pretreatment Information | | | | | | | | | |
| TOX | 205 | 45 | 56 | 13 | 31 | 13 | | | | | | | | | Process | |
| CHCl3 | 17.0 | 1.0 | 1.0 | 1.2 | 0.0 | 1.1 | Solids Contact Basin | | 220 + 15 mg/L Lime | | Full-scale | | | | | |
| BDCM | 15.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | +0.5 mg/L Ferric Chloride (FeCl3) | | Full-scale | | | | | |
| DBCM | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | 3.9 + 0.5 mg/L PAC | | Full-scale | | | | | |
| CHBr3 | 0.6 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | Dual media filtration | | sand / anthracite | | Full-scale | | | | | |
| THM4 | 41.0 | 0.3 | 1.0 | 1.2 | 0.0 | 1.1 | Sulfuric acid addition | | pH = 7.4 | | Bench-scale | | | | | |
| MCAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Design Parameters | | | | | | | | | |
| DCAA | 13.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | Active memb area: | |
| TCAA | 10.7 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | Active width: | | 0.333 ft | | ID# | | (dec.) | | (gfd) | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Norm Temp: | | 13.0 °C | | 1 | | 0.70 | | 15.0 | |
| DBAA | 2.6 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | Feed TDS: | | 530.0 mg/L | | 2 | | 0.90 | | 15.0 | |
| BCAA | 7.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | Manuf rep TDS rej: | | 70% | | 3 | | 0.50 | | 15.0 | |
| TBAA | 0.0 | 0.0 | NA | NA | NA | NA | Temp Norm MTC-w: | | 0.313 gfd/psi | | 4 | | 0.30 | | 15.0 | |
| CDBAA | 0.0 | 0.0 | NA | NA | NA | NA | Comments: | | | | | | | | | |
| DCBAA | 0.0 | 0.0 | NA | NA | NA | NA | | | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | | | |
| WQP | Avg | SD | Count | Min - Max | | | | | | | | | | | | |
| Res (mg/L) (0) | 1.44 | 0.12 | 6 | 1.27 - 1.63 | | | | | | | | | | | | |
| Temp (°C) | 5.2 | 0.3 | 6 | 4.8 - 5.6 | | | | | | | | | | | | |
| pH (unit) | 8.6 | 0.3 | 6 | 8.2 - 8.9 | | | | | | | | | | | | |
| Time (hr) | 30.7 | 1.0 | 6 | 30.0 - 32.0 | | | | | | | | | | | | |



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: SD4600294 / 604
ICR Contact: Mr. Timothy D. Stefanich
Phone No.: 605-367-7025
Period: 5/2/98 - 5/8/98 (6 days)

Membrane Information

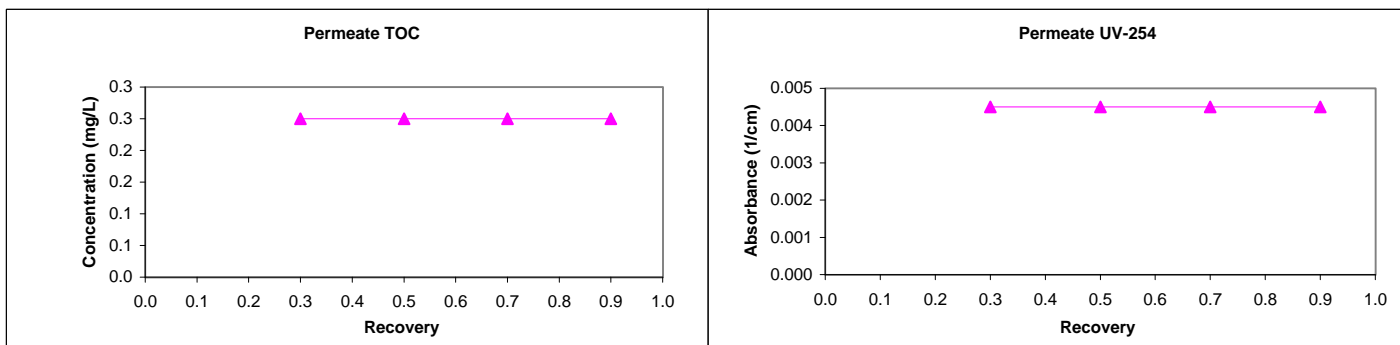
Manufacturer: Fluid Systems
Trade Name: TFC-S
MWCO: 300 Daltons
Mfr. Flux: 28.0 gfd
Mfr. NDP: 95.0 psi
Mfr. MTCw: 0.295 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 336.0 ft²
840 Purchase Price: \$1,200
840 Maximum Flow: NA gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 60.0 ft
840 Feed Spacer Thickness: 0.0026 ft

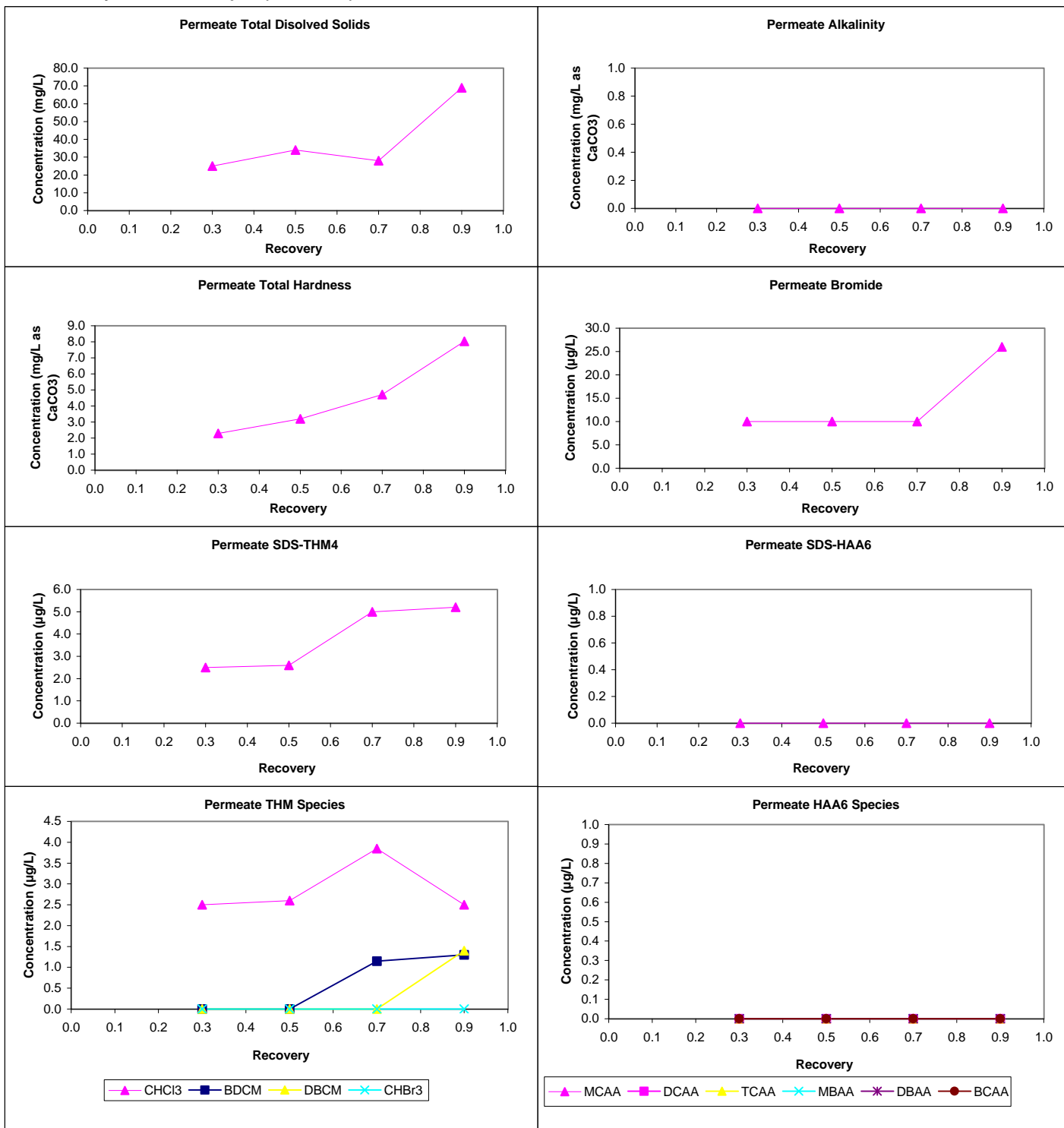
Water Quality Summary

| Source -> | | Feed | | Permeate | | | | Concentrate | | | | Mass Balance Closure Err (%) | | | |
|----------------|--|-------------------------|-------|----------|-------------|-------|-------|--------------------------|-------|---------------------------------|-------|------------------------------|-------|-----|-----|
| Recovery -> | | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD |
| pH | | 7.5 | 0.0 | 6.6 | 7.0 | 6.9 | 6.9 | 7.9 | 8.0 | 8.2 | 8.3 | TDS | 6 | -39 | 43 |
| Temp | | 21.6 | 1.6 | 21.6 | 22.6 | 26.0 | 25.0 | 22.0 | 23.9 | 25.4 | 26.8 | Alk | 0 | n/a | n/a |
| Alk | | 40 | 2 | 0 | 0 | 0 | 0 | 53 | 69 | 89 | 178 | TDS | 4 | -28 | 45 |
| TDS | | 439 | 4 | 25 | 34 | 28 | 69 | 651 | 855 | 1090 | 1970 | TotHard | 4 | -27 | 62 |
| TotHard | | 240 | 0 | 2 | 3 | 5 | 8 | 519 | 462 | 615 | 1103 | CaHard | 4 | -35 | 52 |
| CaHard | | 89 | 1 | 1 | 1 | 2 | 3 | 127 | 172 | 231 | 409 | Turb | 0 | n/a | n/a |
| Turb | | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.20 | 0.11 | 0.32 | Amm | 0 | n/a | n/a |
| Amm | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a |
| TOC | | 3.6 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 5.2 | 7.4 | 9.8 | 18.0 | UV254 | 1 | -11 | n/a |
| UV254 | | 0.064 | 0.003 | 0.005 | 0.005 | 0.005 | 0.005 | 0.085 | 0.123 | 0.163 | 0.294 | | | | |
| SUVA | | 1.76 | 0.07 | 1.80 | 1.80 | 1.80 | 1.80 | 1.63 | 1.66 | 1.66 | 1.63 | | | | |
| Bromide | | 73 | 5 | 10 | 10 | 10 | 26 | Pretreatment Information | | | | | | | |
| TOX | | 418 | 23 | 28 | 190 | 13 | 49 | | | | | | | | |
| | | ProcessDescriptionScale | | | | | | | | | | | | | |
| CHCl3 | | 36.5 | 0.5 | 2.5 | 2.6 | 3.9 | 2.5 | Solids Contact Basin | | 220 + 15 mg/L Lime | | Full-scale | | | |
| BDCM | | 21.5 | 0.5 | 0.0 | 0.0 | 1.2 | 1.3 | | | +0.5 mg/L Ferric Chloride (FeCl | | Full-scale | | | |
| DBCM | | 8.2 | 0.3 | 0.0 | 0.0 | 0.0 | 1.4 | | | 3.9 + 0.5 mg/L PAC | | Full-scale | | | |
| CHBr3 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Dual media filtration | | sand / anthracite | | Full-scale | | | |
| THM4 | | 66.2 | 1.3 | 2.5 | 2.6 | 5.0 | 5.2 | Sulfuric acid addition | | pH = 7.4 | | Bench-scale | | | |
| MCAA | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Design Parameters | | | | | | | |
| DCAA | | 20.0 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| TCAA | | 22.5 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| MBAA | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DBAA | | 1.6 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| BCAA | | 6.3 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| TBAA | | NA | NA | NA | NA | NA | NA | | | | | | | | |
| CDBAA | | NA | NA | NA | NA | NA | NA | | | | | | | | |
| DCBAA | | NA | NA | NA | NA | NA | NA | | | | | | | | |
| HAA5 | | 44.1 | 5.8 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA6 | | 50.3 | 6.8 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA9 | | NA | NA | NA | NA | NA | NA | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | | |
| WQP | | Avg | SD | Count | Min - Max | | | | | | | | | | |
| Res (mg/L) (0) | | 1.63 | 0.13 | 6 | 1.45 - 1.84 | | | | | | | | | | |
| Temp (°C) | | 11.9 | 0.5 | 6 | 11.1 - 12.4 | | | | | | | | | | |
| pH (unit) | | 8.4 | 0.2 | 6 | 8.1 - 8.5 | | | | | | | | | | |
| Time (hr) | | 47.7 | 0.4 | 6 | 47.0 - 48.0 | | | | | | | | | | |
| Comments: | | | | | | | | | | | | | | | |

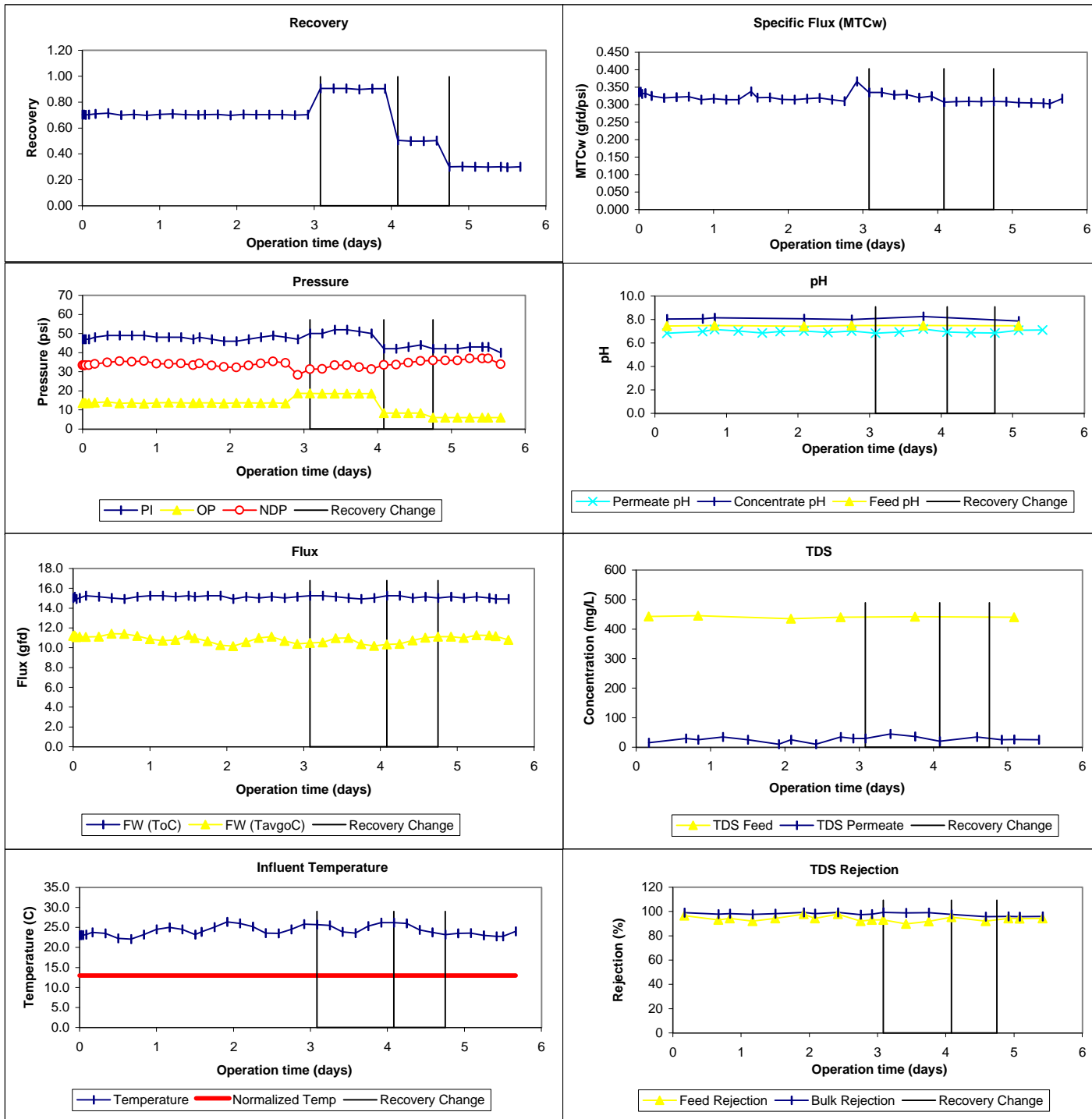
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: SD4600294 / 604
ICR Contact: Mr. Timothy D. Stefanich
Phone No.: 605-367-7025
Period: 7/25/98 - 7/31/98 (6 days)

Membrane Information

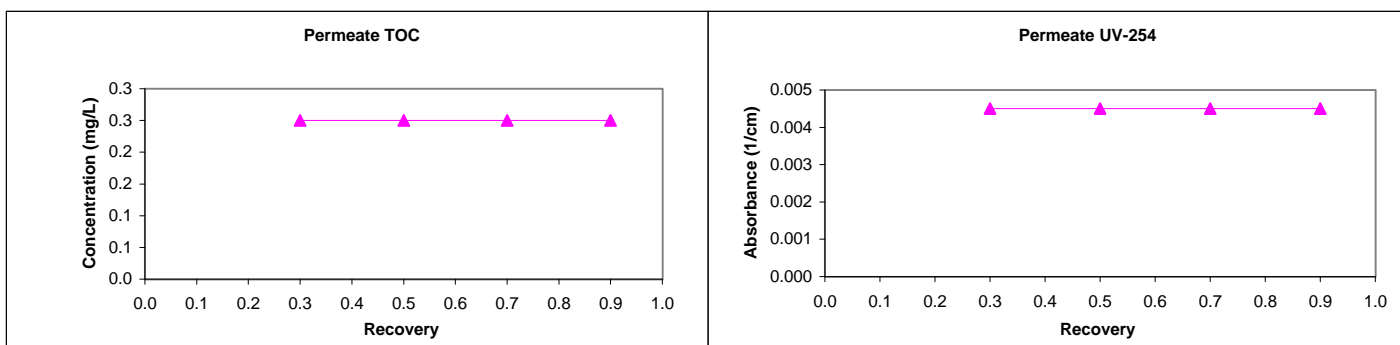
Manufacturer: Fluid Systems
Trade Name: TFC-S
MWCO: 300 Daltons
Mfr. Flux: 28.0 gfd
Mfr. NDP: 95.0 psi
Mfr. MTCw: 0.295 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 336.0 ft²
840 Purchase Price: \$1,200
840 Maximum Flow: NA gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 60.0 ft
840 Feed Spacer Thickness: 0.0026 ft

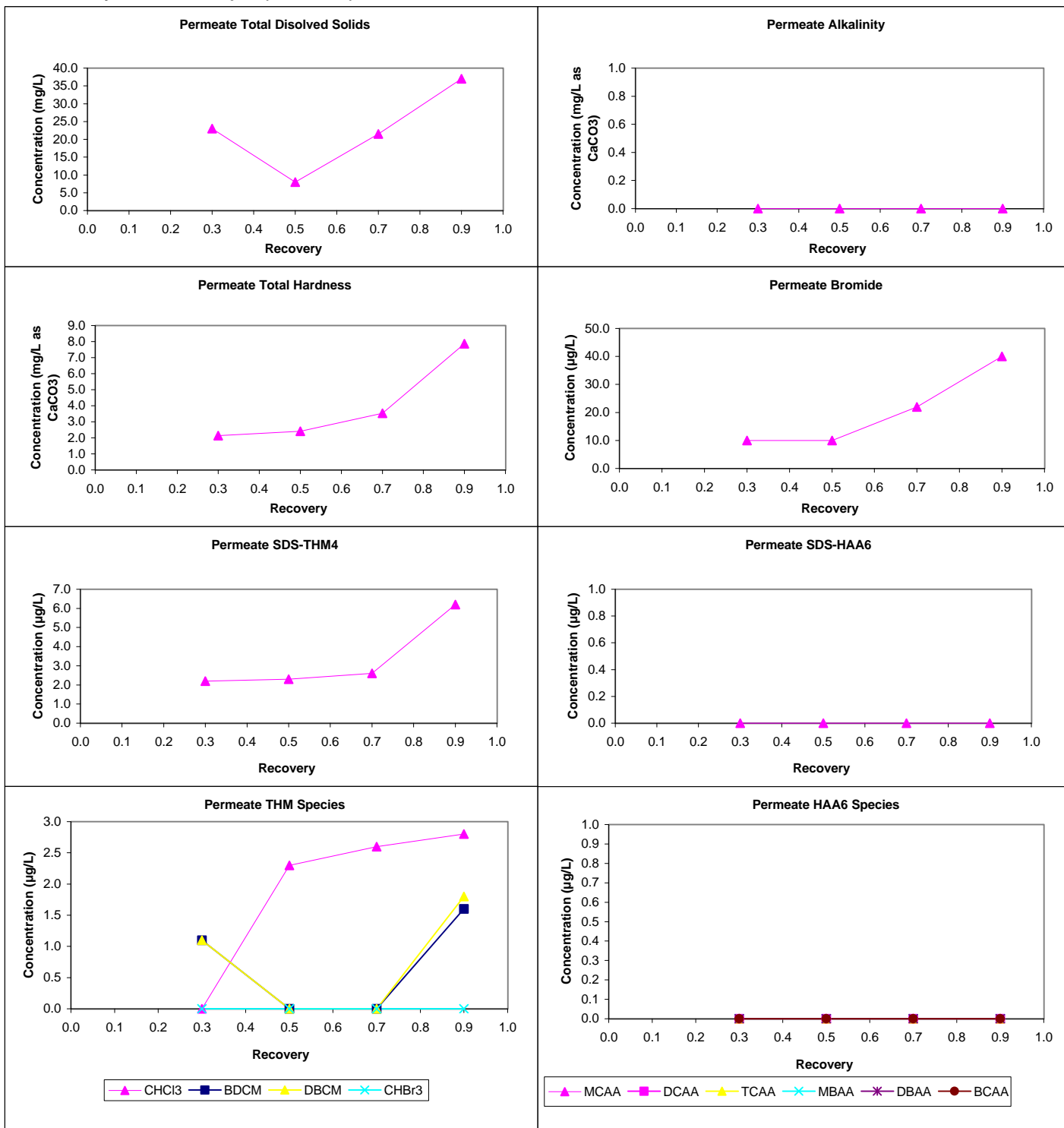
Water Quality Summary

| Water Quality Summary | | | | | | | Mass Balance Closure Error (%) | | | | | | | |
|-----------------------|-------|-------|----------|-------------|-------|-------|--------------------------------|-------|-------|-------|---------|-------|-----|-----|
| Source -> | Feed | | Permeate | | | | Concentrate | | | | | | | |
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD |
| pH | 7.4 | 0.0 | 6.3 | 6.4 | 6.4 | 6.3 | 7.6 | 7.9 | 8.0 | 8.1 | TDS | 5 | -36 | 50 |
| Temp | 17.7 | 0.7 | 19.6 | 18.6 | 20.3 | 21.9 | 19.9 | 19.0 | 20.5 | 21.8 | Alk | 0 | n/a | n/a |
| Alk | 82 | 8 | 0 | 0 | 0 | 0 | 112 | 148 | 194 | 296 | TDS | 4 | -44 | 62 |
| TDS | 530 | 10 | 23 | 8 | 22 | 37 | 716 | 979 | 1324 | 2112 | TotHard | 4 | -46 | 63 |
| TotHard | 293 | 10 | 2 | 2 | 4 | 8 | 403 | 540 | 724 | 1199 | CaHard | 4 | -45 | 66 |
| CaHard | 147 | 5 | 1 | 1 | 2 | 4 | 210 | 275 | 365 | 594 | Turb | 0 | n/a | n/a |
| Turb | 0.09 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.12 | 0.10 | 0.13 | Amm | 0 | n/a | n/a |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a |
| TOC | 3.8 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 5.1 | 7.2 | 9.6 | 15.0 | UV254 | 0 | n/a | n/a |
| UV254 | 0.062 | 0.000 | 0.005 | 0.005 | 0.005 | 0.005 | 0.085 | 0.109 | 0.155 | 0.243 | | | | |
| SUVA | 1.65 | 0.00 | 1.80 | 1.80 | 1.80 | 1.80 | 1.67 | 1.51 | 1.61 | 1.62 | | | | |
| Bromide | 130 | 10 | 10 | 10 | 22 | 40 | | | | | | | | |
| TOX | 408 | 13 | 37 | 13 | 13 | 13 | | | | | | | | |
| CHCl3 | 34.0 | 1.0 | 0.0 | 2.3 | 2.6 | 2.8 | | | | | | | | |
| BDCM | 23.0 | 1.0 | 1.1 | 0.0 | 0.0 | 1.6 | | | | | | | | |
| DBCM | 12.0 | 1.0 | 1.1 | 0.0 | 0.0 | 1.8 | | | | | | | | |
| CHBr3 | 1.5 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| THM4 | 70.5 | 3.2 | 2.2 | 2.3 | 2.6 | 6.2 | | | | | | | | |
| MCAA | 1.1 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCAA | 15.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| TCAA | 12.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DBAA | 2.8 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| BCAA | 7.8 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| TBAA | NA | NA | NA | NA | NA | NA | | | | | | | | |
| CDBAA | NA | NA | NA | NA | NA | NA | | | | | | | | |
| DCBAA | NA | NA | NA | NA | NA | NA | | | | | | | | |
| HAA5 | 30.9 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA6 | 38.7 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA9 | NA | NA | NA | NA | NA | NA | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | |
| WQP | Avg | SD | Count | Min - Max | | | | | | | | | | |
| Res (mg/L) (0) | 1.42 | 0.19 | 6 | 1.16 - 1.64 | | | | | | | | | | |
| Temp (°C) | 18.9 | 0.5 | 6 | 18.3 - 19.3 | | | | | | | | | | |
| pH (unit) | 8.4 | 0.1 | 6 | 8.2 - 8.5 | | | | | | | | | | |
| Time (hr) | 24.0 | 0.8 | 6 | 23.0 - 24.8 | | | | | | | | | | |
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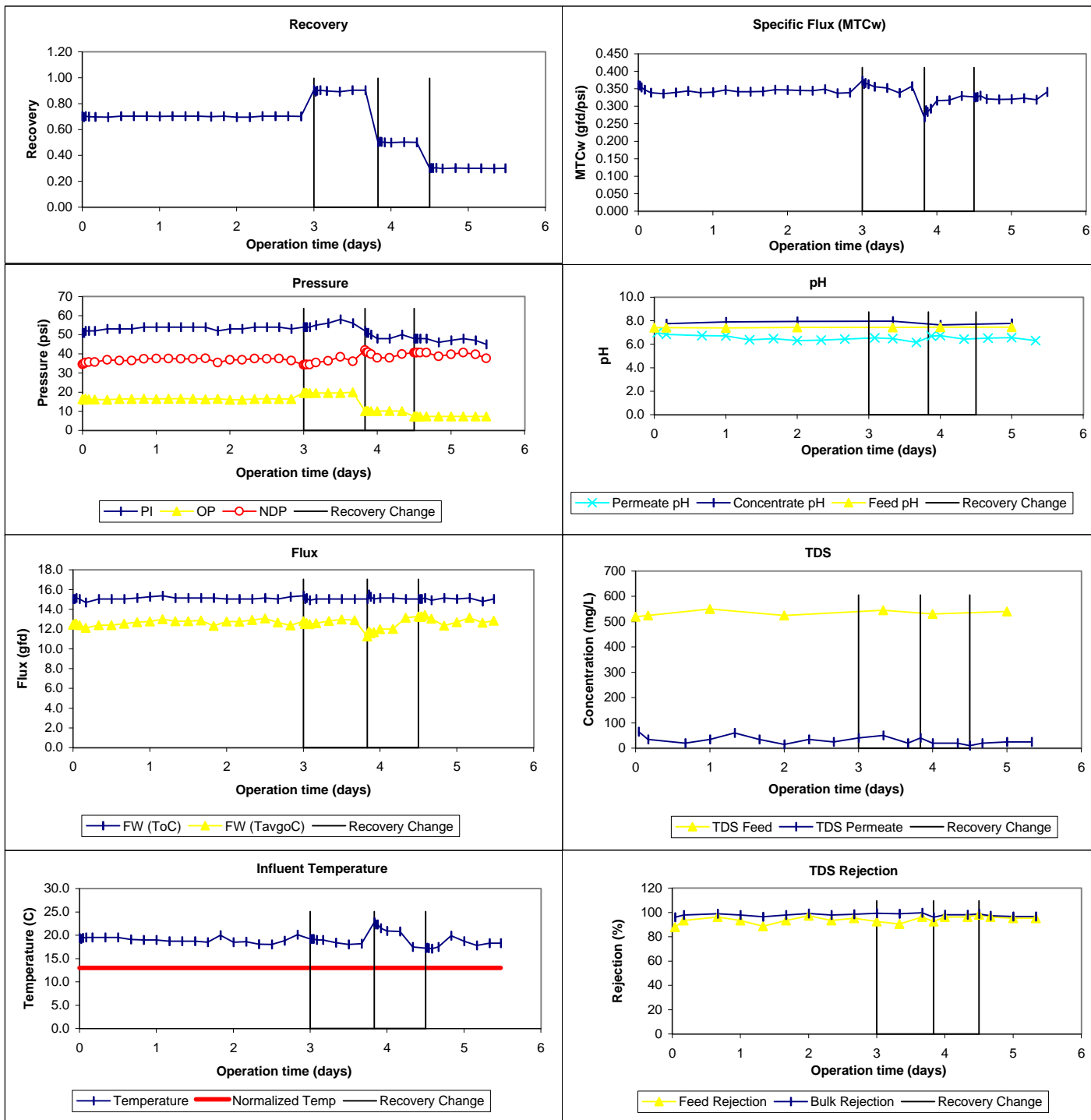
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: SD4600294 / 604
ICR Contact: Mr. Timothy D. Stefanich
Phone No.: 605-367-7025
Period: 11/1/98 - 11/6/98 (5 days)

Membrane Information

Manufacturer: Film - Tec
Trade Name: NF200B - 400
MWCO: NA Daltons
Mfr. Flux: 18.3 gfd
Mfr. NDP: 70.0 psi
Mfr. MTCw: 0.261 gfd/psi

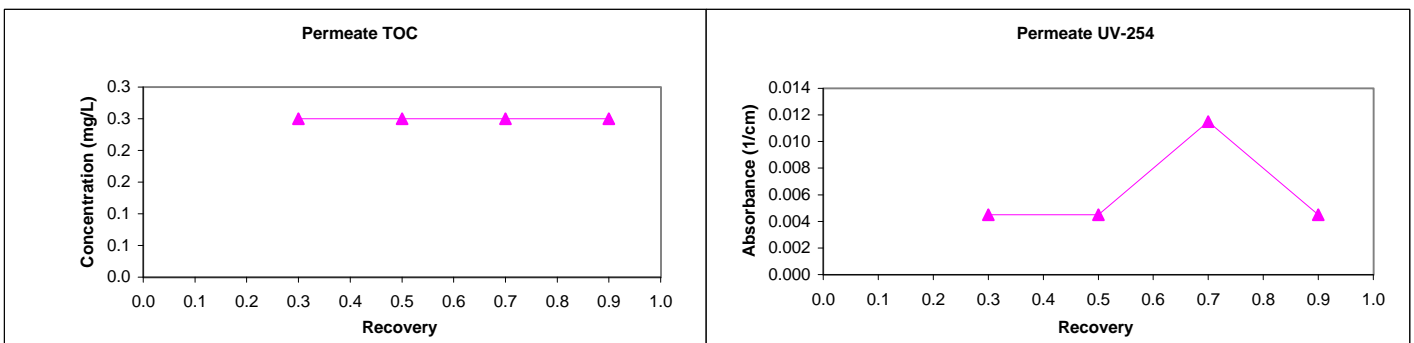
Mfr. Temp: 25.0 °C
840 Element Area: 400.0 ft²
840 Purchase Price: \$1,000
840 Maximum Flow: 70.0 gpm
840 Minimum Flow: 16.0 gpm
840 Total Width: 60.0 ft
840 Feed Spacer Thickness: 0.0023 ft

Water Quality Summary

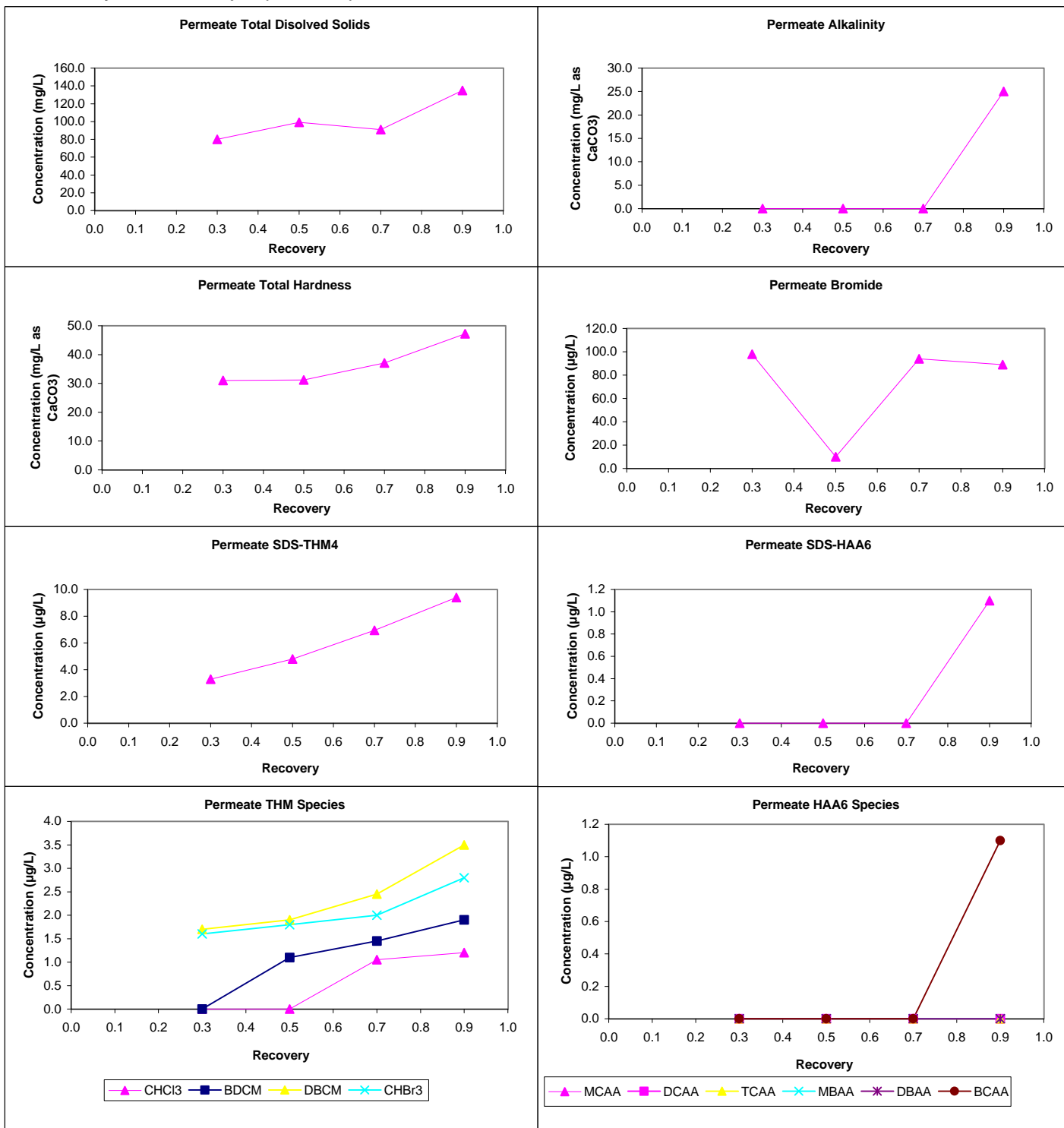
| Source -> | Feed | | Permeate | | | | Concentrate | | | | Mass Balance Closure Err (%) | | | | | | | | | | | | | | | | | | | | | |
|------------------------|--|-------------|-----------------|-----------------------------|-------|-------|--|-------|-------|-------|---|-------|-----|-----|-------------------|-----------------------|-------|----------------------|-----------------------------|---------------|----------|--|------------|-----------|--------------------|--------------------|-----------------------|-------------------|---------------|------------------------|----------|-------------|
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD | | | | | | | | | | | | | | | | | | |
| pH | 7.4 | 0.0 | 6.8 | 7.2 | 6.9 | 6.0 | 7.4 | 7.6 | 7.8 | 7.8 | TDS | 6 | -34 | 56 | | | | | | | | | | | | | | | | | | |
| Temp | 19.6 | 3.0 | 22.0 | 21.3 | 21.3 | 21.8 | 22.5 | 20.7 | 21.7 | 22.3 | Alk | 1 | 6 | n/a | | | | | | | | | | | | | | | | | | |
| Alk | 28 | 1 | 0 | 0 | 0 | 25 | 34 | 40 | 45 | 53 | TDS | 4 | -29 | 42 | | | | | | | | | | | | | | | | | | |
| TDS | 516 | 6 | 80 | 99 | 91 | 135 | 685 | 914 | 1254 | 2073 | TotHard | 4 | -43 | 53 | | | | | | | | | | | | | | | | | | |
| TotHard | 280 | 0 | 31 | 31 | 37 | 47 | 361 | 467 | 648 | 1077 | CaHard | 4 | -46 | 52 | | | | | | | | | | | | | | | | | | |
| CaHard | 144 | 1 | 15 | 17 | 19 | 24 | 180 | 232 | 327 | 552 | Turb | 0 | n/a | n/a | | | | | | | | | | | | | | | | | | |
| Turb | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.09 | 0.09 | 0.12 | Amm | 0 | n/a | n/a | | | | | | | | | | | | | | | | | | |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 0 | n/a | n/a | | | | | | | | | | | | | | | | | | |
| TOC | 3.0 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 4.3 | 5.7 | 8.0 | 14.0 | UV254 | 1 | -18 | n/a | | | | | | | | | | | | | | | | | | |
| UV254 | 0.059 | NA | 0.005 | 0.005 | 0.012 | 0.005 | 0.074 | 0.102 | 0.144 | 0.244 | <div>Pretreatment Information</div> <table><thead><tr><th>Process</th><th>Description</th><th>Scale</th></tr></thead><tbody><tr><td>Solids Contact Basin</td><td>220 + 15 mg/L Lime</td><td>Full-scale</td></tr><tr><td></td><td>+0.5 mg/L Ferric Chloride (FeCl₃)</td><td>Full-scale</td></tr><tr><td></td><td>3.9 + 0.5 mg/L PAC</td><td>Full-scale</td></tr><tr><td>Dual media filtration</td><td>sand / anthracite</td><td>Full-scale</td></tr><tr><td>Sulfuric acid addition</td><td>pH = 7.4</td><td>Bench-scale</td></tr></tbody></table> | | | | Process | Description | Scale | Solids Contact Basin | 220 + 15 mg/L Lime | Full-scale | | +0.5 mg/L Ferric Chloride (FeCl ₃) | Full-scale | | 3.9 + 0.5 mg/L PAC | Full-scale | Dual media filtration | sand / anthracite | Full-scale | Sulfuric acid addition | pH = 7.4 | Bench-scale |
| Process | Description | Scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solids Contact Basin | 220 + 15 mg/L Lime | Full-scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | +0.5 mg/L Ferric Chloride (FeCl ₃) | Full-scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 3.9 + 0.5 mg/L PAC | Full-scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dual media filtration | sand / anthracite | Full-scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sulfuric acid addition | pH = 7.4 | Bench-scale | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SUVA | #N/A | NA | 1.80 | 1.80 | 4.60 | 1.80 | 1.72 | 1.79 | 1.80 | 1.74 | | | | | | | | | | | | | | | | | | | | | | |
| Bromide | 74 | 19 | 98 | 10 | 94 | 89 | <div>Design Parameters</div> <table><tbody><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="6">ID#</td><td rowspan="6">Recov (dec.)</td><td rowspan="6">F_{W-des} (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>13.0 °C</td></tr><tr><td>Feed TDS:</td><td>530.0 mg/L</td></tr><tr><td>Manuf rep TDS rej:</td><td>45%</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.183 gfd/psi</td></tr></tbody></table> | | | | | | | | Active memb area: | 0.167 ft ² | ID# | Recov (dec.) | F _{W-des} (gfd) | Active width: | 0.333 ft | Norm Temp: | 13.0 °C | Feed TDS: | 530.0 mg/L | Manuf rep TDS rej: | 45% | Temp Norm MTC-w: | 0.183 gfd/psi | | | |
| Active memb area: | 0.167 ft ² | ID# | Recov (dec.) | F _{W-des} (gfd) | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Active width: | 0.333 ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Norm Temp: | 13.0 °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Feed TDS: | 530.0 mg/L | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Manuf rep TDS rej: | 45% | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temp Norm MTC-w: | 0.183 gfd/psi | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOX | 205 | 15 | 13 | 13 | 26 | 13 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHCl ₃ | 19.5 | 0.5 | 0.0 | 0.0 | 1.1 | 1.2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BDCM | 15.5 | 0.5 | 0.0 | 1.1 | 1.5 | 1.9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DBCM | 8.3 | 0.2 | 1.7 | 1.9 | 2.5 | 3.5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CHBr ₃ | 0.0 | 0.0 | 1.6 | 1.8 | 2.0 | 2.8 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| THM4 | 43.3 | 1.2 | 3.3 | 4.8 | 7.0 | 9.4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MCAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DCAA | 13.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TCAA | 9.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DBAA | 2.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BCAA | 5.6 | 0.1 | 0.0 | 0.0 | 0.0 | 1.1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TBAA | NA | NA | NA | NA | NA | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CDBAA | NA | NA | NA | NA | NA | NA | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DCBAA | NA | NA | NA | NA | NA | NA | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HAA5 | 24.6 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HAA6 | 30.2 | 0.8 | 0.0 | 0.0 | 0.0 | 1.1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HAA9 | NA | NA | NA | NA | NA | NA | | | | | | | | | | | | | | | | | | | | | | | | | | |

| SDS Conditions | | | | |
|----------------|------|------|-------|-------------|
| WQP | Avg | SD | Count | Min - Max |
| Res (mg/L) (0) | 1.47 | 0.08 | 6 | 1.36 - 1.56 |
| Temp (°C) | 12.3 | 0.7 | 6 | 11.2 - 13.2 |
| pH (unit) | 8.5 | 0.1 | 6 | 8.4 - 8.7 |
| Time (hr) | 29.8 | 0.3 | 6 | 29.5 - 30.0 |

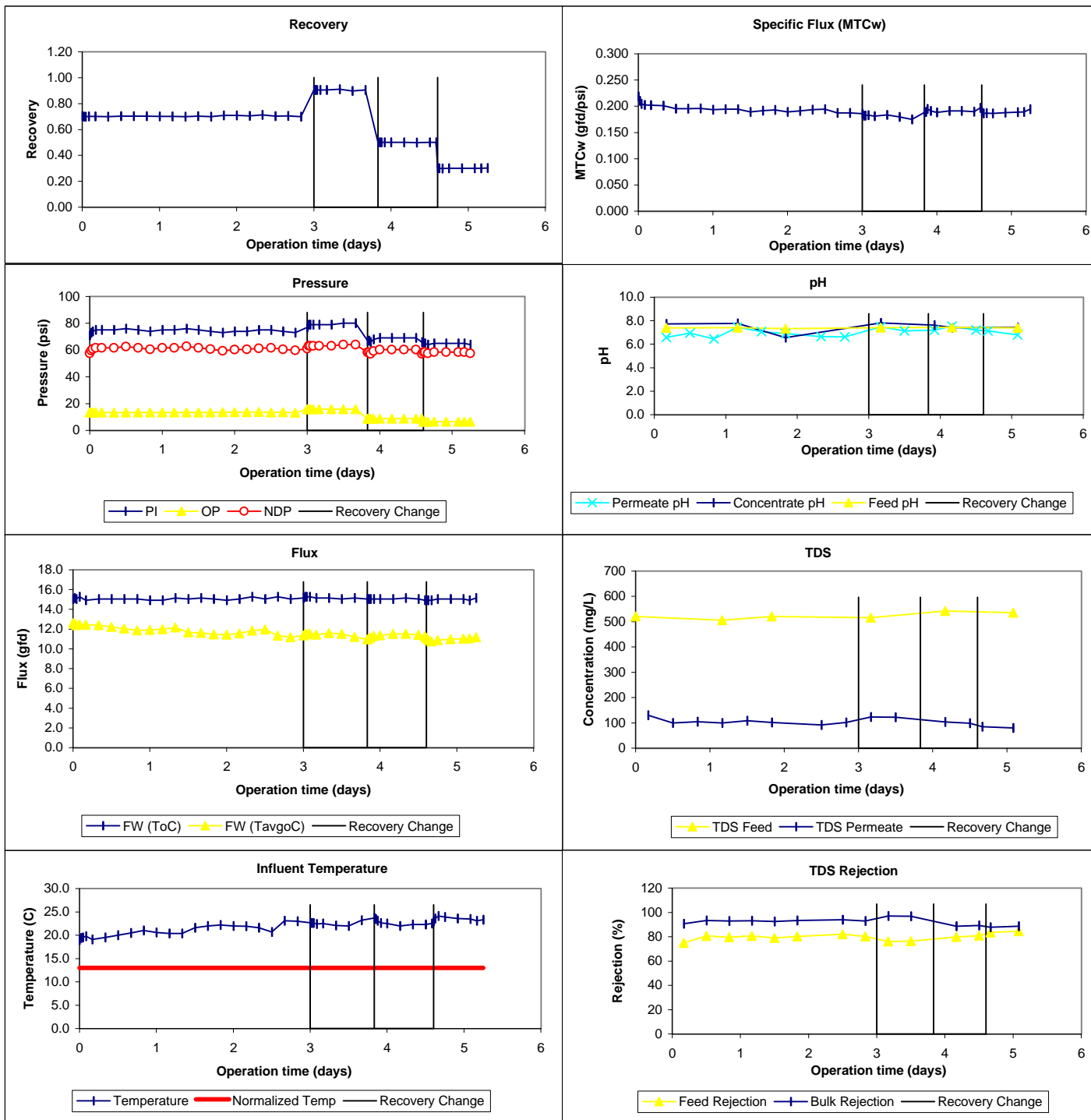
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: SD4600294 / 604
 ICR Contact: Mr. Timothy D. Stefanich
 Phone No.: 605-367-7025
 Period: 2/4/99 - 2/9/99 (5 days)

Membrane Information

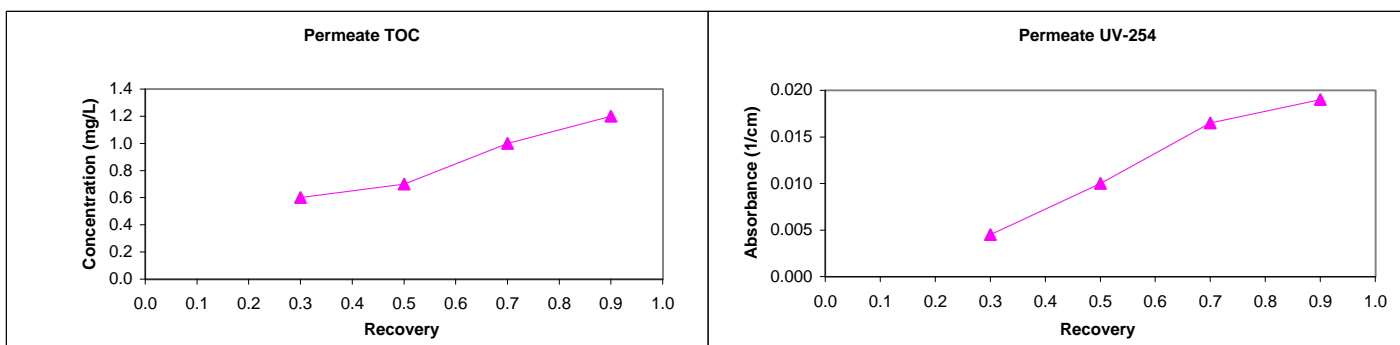
Manufacturer: Hydranautics
 Trade Name: NTR7450
 MWCO: NA Daltons
 Mfr. Flux: 57.1 gfd
 Mfr. NDP: 150.0 psi
 Mfr. MTCw: 0.381 gfd/psi

Mfr. Temp: 25.0 °C
 840 Element Area: 315.0 ft²
 840 Purchase Price: NA
 840 Maximum Flow: 85.0 gpm
 840 Minimum Flow: 14.0 gpm
 840 Total Width: 47.3 ft
 840 Feed Spacer Thickness: 0.0023 ft

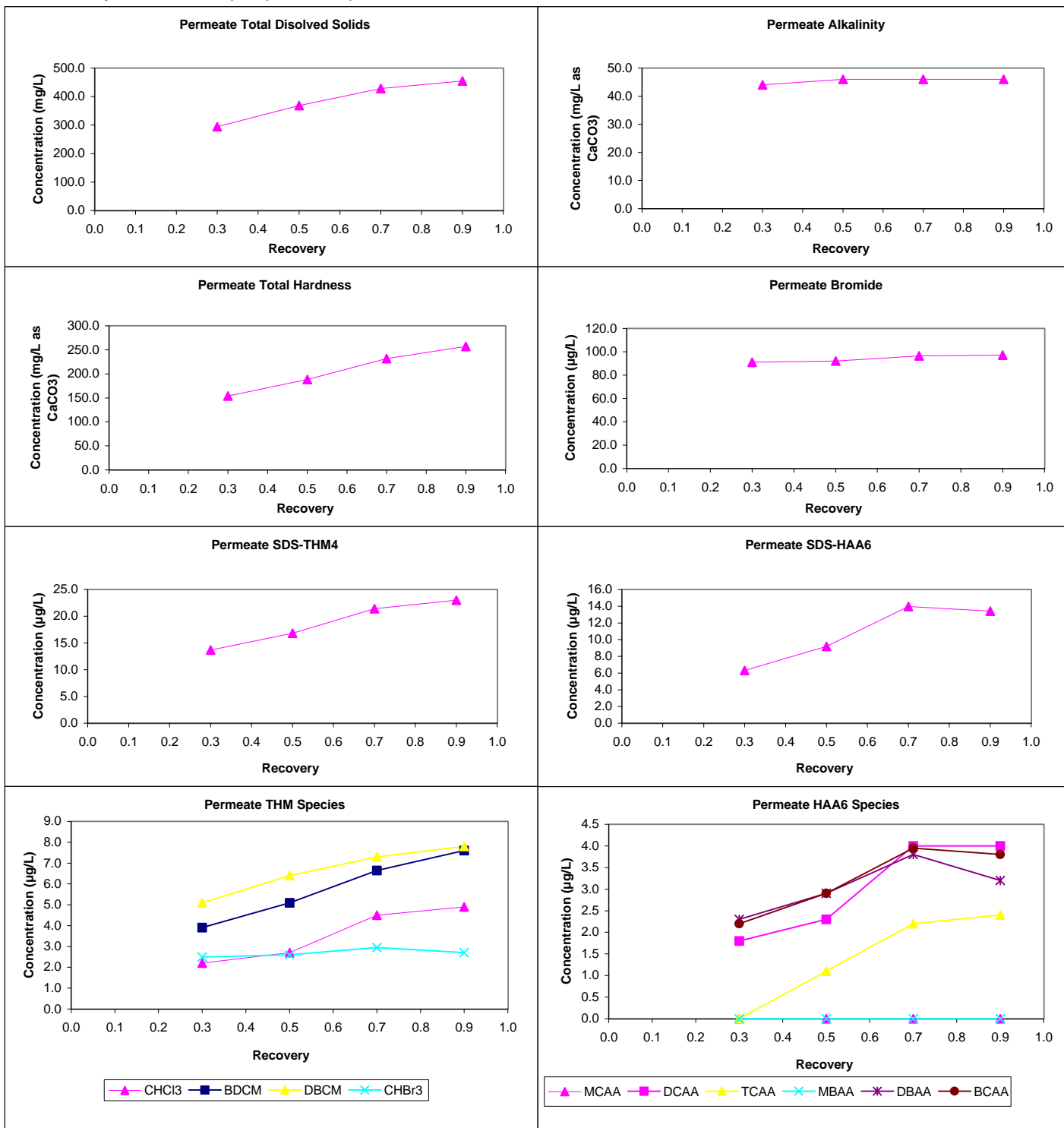
Water Quality Summary

| Water Quality Summary | | | | | | | Mass Balance Closure Err (%) | | | | | | | |
|-----------------------|-------|-------|----------|-------------|-------|-------|---|-------|-------|-------|--------------------------|-------|-----|-----|
| Source -> | Feed | | Permeate | | | | Concentrate | | | | | | | |
| Recovery -> | Avg | Diff | 0.30 | 0.50 | 0.70 | 0.90 | 0.30 | 0.50 | 0.70 | 0.90 | WQP | Count | Avg | SD |
| pH | 7.4 | 0.0 | 7.4 | 7.4 | 7.4 | 7.4 | 7.5 | 7.5 | 7.9 | 8.0 | TDS | 6 | -4 | 16 |
| Temp | 20.6 | 0.6 | 21.3 | 21.0 | 20.6 | 20.3 | 21.1 | 20.7 | 20.7 | 20.4 | Alk | 4 | 17 | 11 |
| Alk | 45 | 3 | 44 | 46 | 46 | 46 | 50 | 50 | 50 | 54 | TDS | 4 | -6 | 23 |
| TDS | 540 | 21 | 294 | 369 | 428 | 455 | 690 | 780 | 799 | 922 | TotHard | 4 | -27 | 37 |
| TotHard | 326 | 2 | 154 | 188 | 232 | 257 | 395 | 439 | 456 | 524 | CaHard | 4 | -28 | 40 |
| CaHard | 128 | 1 | 59 | 72 | 88 | 97 | 156 | 175 | 184 | 216 | Turb | 0 | n/a | n/a |
| Turb | 0.06 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.05 | 0.09 | Amm | 0 | n/a | n/a |
| Amm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | TOC | 4 | -33 | 52 |
| TOC | 3.6 | 0.0 | 0.6 | 0.7 | 1.0 | 1.2 | 4.9 | 6.5 | 7.8 | 12.0 | UV254 | 3 | -51 | 61 |
| UV254 | 0.061 | 0.002 | 0.005 | 0.010 | 0.017 | 0.019 | 0.080 | 0.106 | 0.131 | 0.199 | Pretreatment Information | | | |
| SUVA | 1.69 | 0.06 | 0.75 | 1.43 | 1.65 | 1.58 | 1.63 | 1.63 | 1.68 | 1.66 | | | | |
| Bromide | 100 | 1 | 91 | 92 | 97 | 97 | ProcessDescriptionScale | | | | | | | |
| TOX | 165 | 5 | 31 | 44 | 51 | 70 | | | | | | | | |
| CHCl3 | 17.5 | 1.5 | 2.2 | 2.7 | 4.5 | 4.9 | | | | | | | | |
| BDCM | 15.5 | 0.5 | 3.9 | 5.1 | 6.7 | 7.6 | | | | | | | | |
| DBCM | 8.9 | 0.4 | 5.1 | 6.4 | 7.3 | 7.8 | | | | | | | | |
| CHBr3 | 1.4 | NA | 2.5 | 2.6 | 3.0 | 2.7 | Dual media filtrationsand / anthraciteFull-scaleSulfuric acid additionpH = 7.4Bench-scale | | | | | | | |
| THM4 | 42.6 | 3.1 | 13.7 | 16.8 | 21.4 | 23.0 | | | | | | | | |
| MCAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCAA | 12.0 | 0.0 | 1.8 | 2.3 | 4.0 | 4.0 | | | | | | | | |
| TCAA | 8.9 | 0.5 | 0.0 | 1.1 | 2.2 | 2.4 | | | | | | | | |
| MBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | Design Parameters | | | | | | | |
| DBAA | 2.9 | 0.2 | 2.3 | 2.9 | 3.8 | 3.2 | | | | | | | | |
| BCAA | 6.9 | 0.2 | 2.2 | 2.9 | 4.0 | 3.8 | | | | | | | | |
| TBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| CDBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| DCBAA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | | |
| HAA5 | 23.8 | 0.8 | 4.1 | 6.3 | 10.0 | 9.6 | | | | | | | | |
| HAA6 | 30.7 | 1.0 | 6.3 | 9.2 | 14.0 | 13.4 | | | | | | | | |
| HAA9 | 30.7 | 1.0 | 6.3 | 9.2 | 14.0 | 13.4 | | | | | | | | |
| SDS Conditions | | | | | | | | | | | | | | |
| WQP | Avg | SD | Count | Min - Max | | | | | | | | | | |
| Res (mg/L) (0) | 1.48 | 0.11 | 6 | 1.39 - 1.68 | | | | | | | | | | |
| Temp (°C) | 5.6 | 0.3 | 6 | 5.2 - 6.0 | | | | | | | | | | |
| pH (unit) | 8.3 | 0.0 | 6 | 8.3 - 8.4 | | | | | | | | | | |
| Time (hr) | 30.4 | 0.8 | 6 | 30.0 - 32.0 | | | | | | | | | | |
| | | | | | | | Comments: | | | | | | | |

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs

