

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1006
Study Protocol	Three-Stage Full-Scale System
Plant ICR Number	1092
PWS Name	Collier County Water Department
City, State, Zip	Naples, FL 34112

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

General Comments:

1. This study was done at a full-scale NF plant; thus, the operational time for this study starts at 24054 hours, to reflect the operational history of these membranes. Note that the reported dates and operational times do not correspond with full-time (24 hour) operation of this plant.
2. The costs of constructing this full-scale plant were not provided in the Summary Report; however, several operational issues that arose during plant start-up are mentioned in the report.

Water Quality Comments:

1. Fifty-five water quality outliers were identified and removed prior to base analysis.
2. The target SDS conditions during this study were to dose the samples so that they had a free chlorine residual ranging from 0.5 to 1.0 mg/L after 40 to 48 hours of incubation between 21 to 25°C at a pH of 8.4. More details about their SDS procedure are given in the Summary Report.
3. The reported SDS free chlorine residuals were very erratic – possibly due to high concentrations of H₂S – and the resulting DBP and chlorine demand data should be carefully considered. All of the DBP data corresponding to chlorine residuals of either < 0.1 or > 10 mg/L were reported as NR during outlier review.
4. This water contains H₂S, which may have contributed to erratic TDS concentrations and problems during SDS chlorinations.

5. This utility reported their permeate alkalinity and bromide concentrations to be higher than the corresponding feed concentrations. This trend was also observed during an independent EPA study done with feed and permeate samples from this utility. The utility offered no reasonable explanation for this trend.

Productivity Comments:

1. Four productivity outliers were identified and removed prior to base analysis.
2. The cleaning SOP is provided in the Summary Report; however, the cleaning solution is not identified.
3. During EPA data analysis the projected cleaning interval greatly exceeded one-year. Thus, the upper-bound of 365 days was used as the cleaning interval for this membrane system. This upper-bound of one year serves as the minimum cleaning frequency necessary to mitigate problems beyond flux loss that can result from membrane fouling. The membrane plant was cleaned one time during the study and, based on the reported data, the cleaning efficiency was estimated to be 100%.

ICR Information

ID / ICR#: FL5114069 / 1092
 ICR Contact: Howard B. Brogdon
 Phone No.: (941) 352-7004
 Period: 4/6/98 - 6/13/98 (68 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: PVD 1
 Membrane Model: 8040-LSY-PVD1
 MWCO: 100-300 Daltons
 Element Size: 8" X 40"
 Element Area: 365.0 ft²
 Design Flux: 30.0 gfd
 Mfr. NDP: 125.0 psi
 Mfr. MTC_w: 0.240 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 75.0 gpm
 Minimum Flow: 72.0 gpm
 Total Width : 63.4 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 365.0 ft²
 840 Purchase Price: \$800

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.240 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 15.0 gfd
 # of Elem in P.V.: 6
 # Pres Ves in Stg 1: 36
 # Pres Ves in Stg 2: 18
 Pres Ves in Stg 3: 7
 Design Flux: 15.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 4.0 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 16.0 psi

Water Quality Summary

	Feed (System)				Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.2	0.2	5	6.1 - 6.5	6.4	0.2	5	6.2 - 6.6	6.4	0.2	5	6.2 - 6.6
Temp	25.0	0.3	5	24.5 - 25.3	24.6	0.4	5	24.3 - 25.2	24.9	0.7	5	24.1 - 25.5
Alk	108	30	4	77 - 138	135	23	5	104 - 164	257	59	5	180 - 320
TDS	535	26	4	508 - 568	270	22	5	246 - 292	3221	206	5	2988 - 3452
TotHard	300	1	4	299 - 302	146	23	5	118 - 169	1957	77	5	1890 - 2075
CaHard	237	9	4	226 - 244	113	19	5	86 - 134	1424	18	5	1400 - 1450
Turb	0.18	0.0	4	0.15 - 0.21	0.07	0.0	5	0.04 - 0.10	19.50	2.1	5	17.00 - 22.50
Amm	0.21	0.07	4	0.11 - 0.27	0.20	0.06	5	0.11 - 0.26	0.75	0.08	5	0.6 - 0.8
TOC	7.8	0.5	4	7.0 - 8.0	0.3	0.0	5	0.3 - 0.3	75.8	5.8	5	71.0 - 85.0
UV254	0.242	0.0	4	0.223 - 0.255	0.021	0.0	5	0.019 - 0.026	2.291	0.2	5	2.150 - 2.555
SUVA	NA	NA	4	NA	8.46	1.15	5	7.60 - 10.40	3.04	0.35	5	2.72 - 3.60
Bromide	138	13	4	120 - 150	154	5	5	150 - 160				
TOX	855	64	2	810 - 900	30	22	4	13 - 58				
CHCl3	170.0	56.6	2	130.0 - 210.0	1.4	1.3	4	0.0 - 3.0	Mass Balance Closure Errors (%)			
BDCM	48.5	10.6	2	41.0 - 56.0	2.6	2.6	4	0.0 - 6.0				
DBCM	16.5	0.7	2	16.0 - 17.0	7.4	7.0	4	2.0 - 17.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	2	0.0 - 0.0	4.3	4.1	4	0.0 - 9.0	Alk	4	159	64
THM4	235.0	66.5	2	188.0 - 282.0	15.6	14.7	4	4.0 - 35.0	TDS	4	14	6
MCAA	5.8	1.1	2	5.0 - 6.6	1.7	2.1	4	0.0 - 4.3	TotHard	4	19	5
DCAA	54.5	2.1	2	53.0 - 56.0	6.0	2.4	4	3.0 - 8.1	CaHard	4	11	7
TCAA	67.0	0.0	2	67.0 - 67.0	3.1	1.5	4	1.8 - 4.8	Turb	4	94	2
MBAA	0.0	0.0	2	0.0 - 0.0	0.3	0.6	4	0.0 - 1.2	Amm	4	66	17
DBAA	2.4	0.1	2	2.3 - 2.4	1.4	1.7	4	0.0 - 3.5	TOC	0	n/a	n/a
BCAA	12.0	0.0	2	12.0 - 12.0	2.2	2.8	4	0.0 - 6.3	UV254	4	11	6
TBAA	0.0	0.0	2	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	Comments:			
CDBAA	1.5	2.1	2	0.0 - 2.9	0.0	0.0	4	0.0 - 0.0				
DCBAA	17.5	0.7	2	17.0 - 18.0	1.7	1.5	4	0.0 - 3.6	TDS	68	-1	10
HAA5	129.7	3.2	2	127.4 - 131.9	12.4	5.5	4	6.9 - 19.1				
HAA6	141.7	3.2	2	139.4 - 143.9	14.6	8.1	4	6.9 - 25.4				
HAA9	160.6	4.5	2	157.4 - 163.8	16.3	9.5	4	6.9 - 29.0				
SDS Conditions				Pretreatment Information								
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	1.48	0.97	6	0.60 - 2.85	Sulfuric Acid Addition		pH adjustment to 5.8-6.0		full-scale			
Temp (°C)	23.4	0.8	6	22.4 - 24.1	Anti-Scalant Addition		Argo Scientific Hyperspearase AS120UL		full-scale			
pH (unit)	8.3	0.0	6	8.2 - 8.4	Cartridge Filtration		5 Micron		full-scale			
Time (hr)	44.0	1.3	6	42.5 - 45.5								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.2%
Sys Conc - Stg 3 Conc	0.0%	0.2%	Sys Conc - Stg 3 Conc	0.0%	0.4%	Sys Conc - Stg 3 Conc	0.1%	0.7%
Stg 1 Conc - Stg 2 Inf	0.0%	0.1%	Stg 1 Conc - Stg 2 Inf	0.0%	0.2%	Stg 1 Conc - Stg 2 Inf	0.0%	9.8%
Stg 2 Conc - Stg 3 Inf	0.0%	0.1%	Stg 2 Conc - Stg 3 Inf	-0.1%	0.3%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	22.3%	1.4%	Sys Perm - Sum Stg Per	-11.2%	0.2%	Sys Perm - Avg Stg Perm	6.5%	3.8%

Stage Summary

	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.00	5	0.60 - 0.60					
pH	6.2	6.4	6.2	0.2	5	6.1 - 6.5	6.4	6.2	0.1	5	6.0 - 6.3
Temp	25.0	24.9	25.0	0.3	5	24.5 - 25.3	24.6	24.7	0.4	5	24.4 - 25.2
Alk	108	257	108	30	4	78 - 138	135	83	14	5	62 - 100
TDS	535	3221	536	27	4	508 - 572	270	175	12	5	165 - 195
TotHard	300	1957	300	1	4	299 - 302	146	86	8	5	75 - 94
CaHard	237	1424	236	8	4	226 - 244	113	66	7	5	55 - 72
Turb	0.18	19.50	0.18	0	4	0.15 - 0.21	0.07	0.05	0.01	5	0 - 0
TOC	7.8	75.8	7.8	0.5	4	7.0 - 8.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.242	2.291	0.241	0.015	4	0.223 - 0.255	0.021	0.026	0.025	5	0.009 - 0.071
SUVA	NA	3.04	3.12	0.36	4	2.79 - 3.60	8.46	10.46	10.17	5	3.64 - 28.40

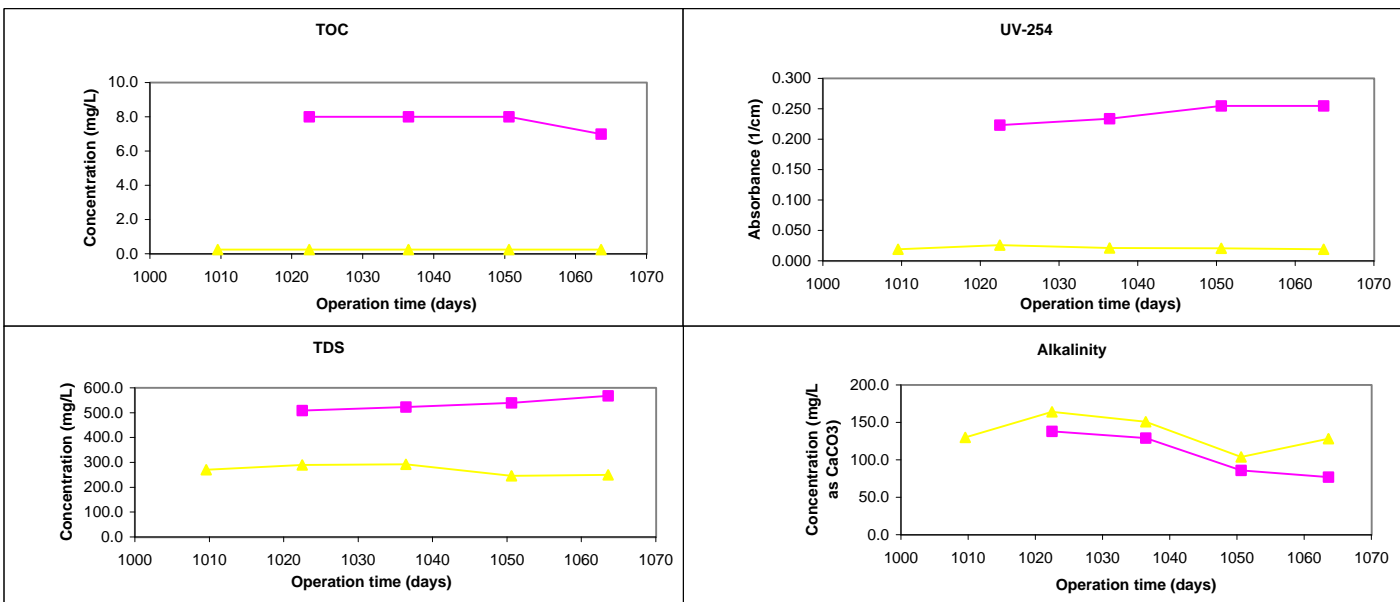
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.53	0.00	5	0.52 - 0.53					
pH	6.2	6.4	6.4	0.2	5	6.2 - 6.6	6.4	6.2	0.2	5	6.1 - 6.5
Temp	25.0	24.9	24.8	0.6	5	24.0 - 25.3	24.6	24.7	0.5	5	24.1 - 25.2
Alk	108	257	159	50	5	96 - 214	135	109	29	5	73 - 153
TDS	535	3221	1279	450	5	1032 - 2080	270	192	50	5	106 - 229
TotHard	300	1957	646	18	5	620 - 670	146	112	13	5	98 - 131
CaHard	237	1424	480	10	5	470 - 490	113	81	9	5	67 - 89
Turb	0.18	19.50	5.36	2	5	2.80 - 7.20	0.07	0.06	0.01	5	0 - 0
TOC	7.8	75.8	19.6	0.5	5	19.0 - 20.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.242	2.291	0.570	0.009	5	0.556 - 0.581	0.021	0.019	0.004	5	0.013 - 0.025
SUVA	NA	3.04	2.91	0.06	5.00	2.84 - 3.00	8.46	7.49	1.79	5.00	5.04 - 9.84

	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.44	0.01	5	0.43 - 0.44					
pH	6.2	6.4	6.4	0.2	5	6.2 - 6.6	6.4	6.4	0.2	5.0	6.2 - 6.6
Temp	25.0	24.9	24.8	0.8	5	23.7 - 25.4	24.6	24.8	0.5	5	24.2 - 25.3
Alk	108	257	217	53	5	146 - 268	135	196	37	5	140 - 234
TDS	535	3221	2247	152	5	2096 - 2424	270	377	33	5	332 - 418
TotHard	300	1957	1109	543	5	139 - 1395	146	208	30	5	167 - 243
CaHard	237	1424	1050	57	5	970 - 1100	113	156	32	5	108 - 186
Turb	0.18	19.50	17.30	3	5	13.00 - 22.00	0.07	0.16	0.20	5	0 - 1
TOC	7.8	75.8	47.0	1.2	5	45.0 - 48.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.242	2.291	1.408	0.038	5	1.345 - 1.438	0.021	0.023	0.006	5	0.015 - 0.030
SUVA	NA	3.04	3.00	0.06	5.00	2.92 - 3.06	8.46	9.26	2.24	5.00	6.12 - 11.92

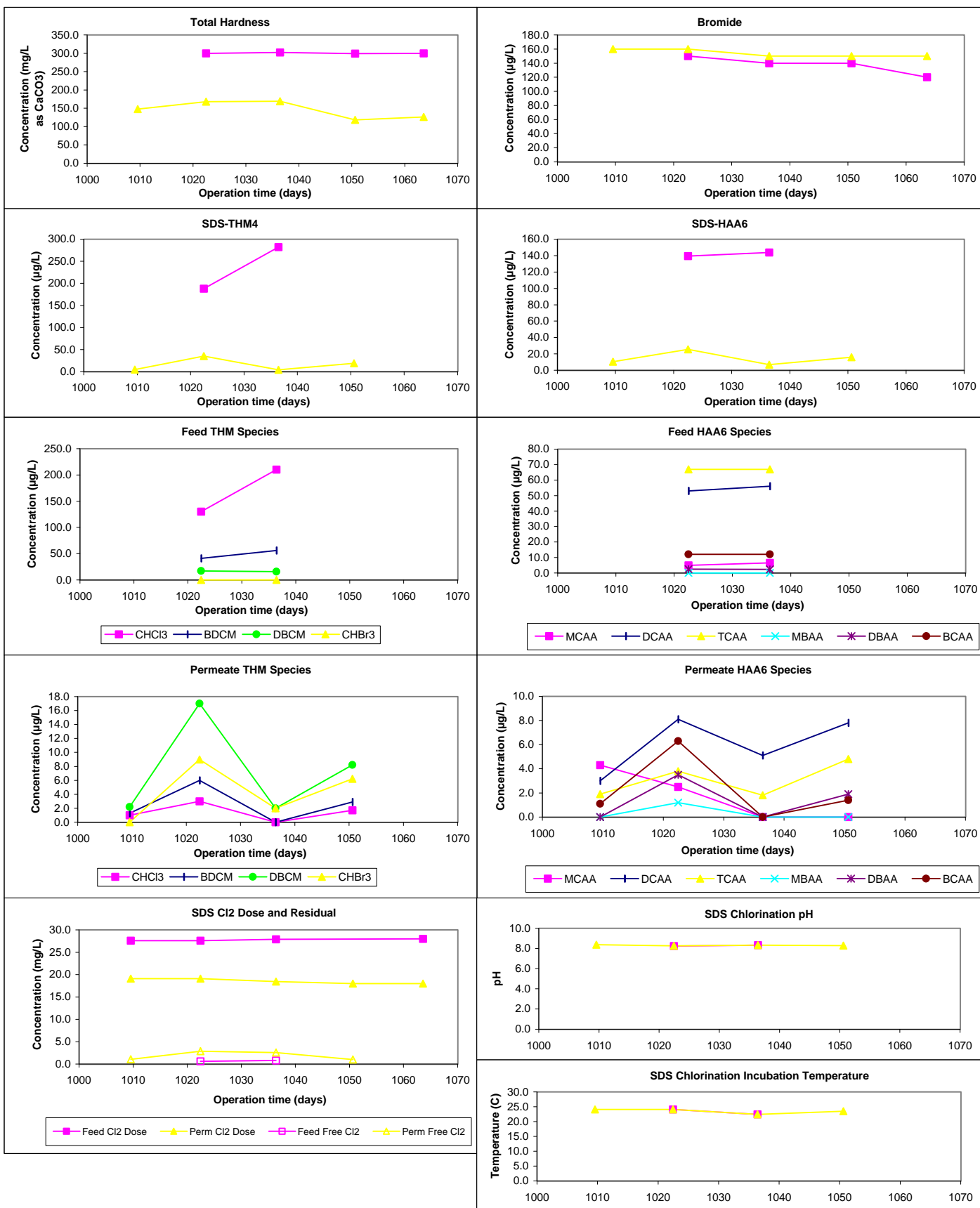
Chart Legend:

- Feed (System)
- ▲ Permeate (System)

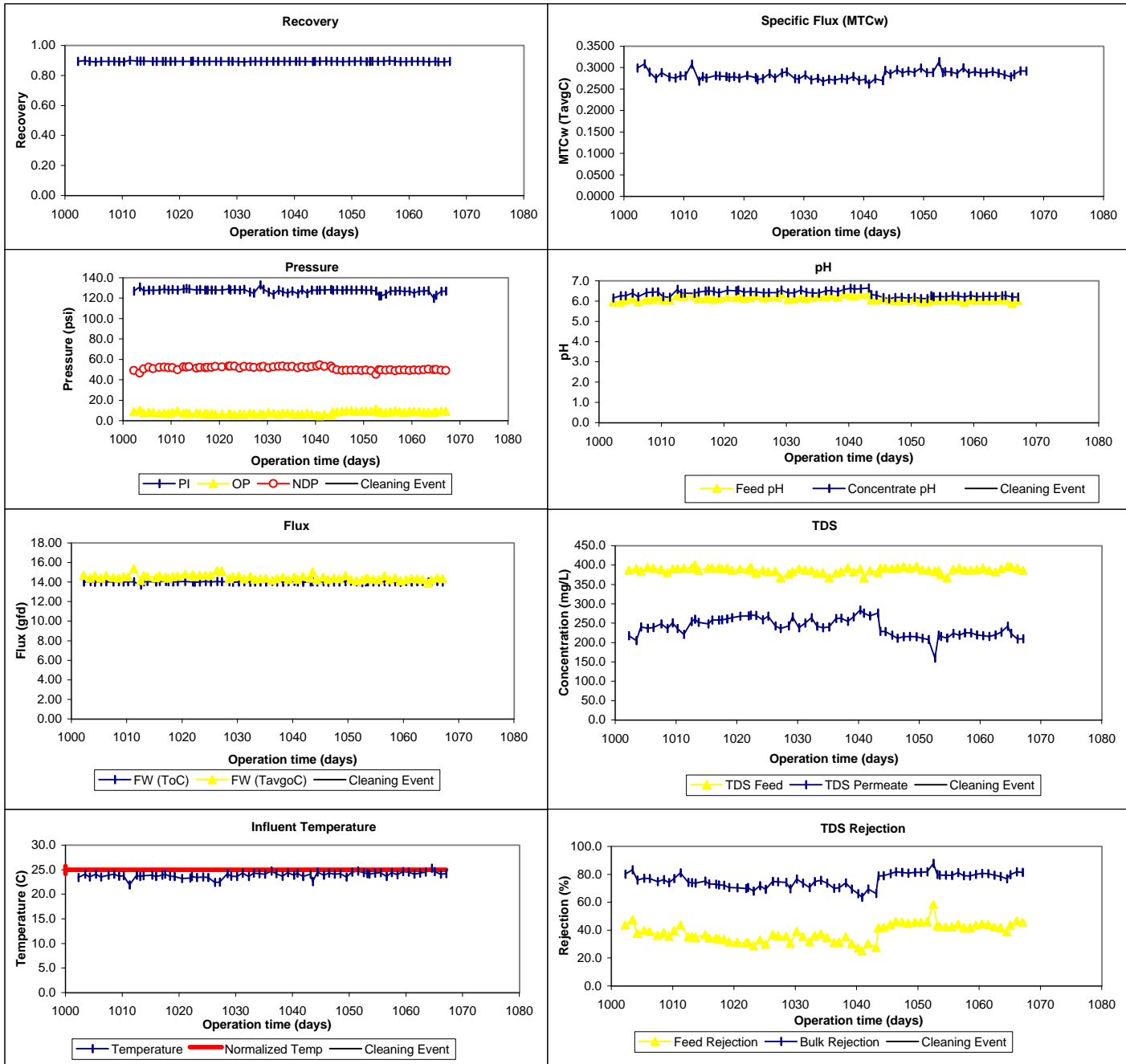
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL5114069 / 1092
 ICR Contact: Howard B. Brogdon
 Phone No.: (941) 352-7004
 Period: 6/14/98 - 8/21/98 (68 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: PVD 1
 Membrane Model: 8040-LSY-PVD1
 MWCO: 100-300 Daltons
 Element Size: 8" X 40"
 Element Area: 365.0 ft²
 Design Flux: 30.0 gfd
 Mfr. NDP: 125.0 psi
 Mfr. MTC_w: 0.240 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 75.0 gpm
 Minimum Flow: 72.0 gpm
 Total Width : 63.4 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 365.0 ft²
 840 Purchase Price: \$800

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.240 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 15.0 gfd
 # of Elem in P.V.: 6
 # Pres Ves in Stg 1: 36
 # Pres Ves in Stg 2: 18
 Pres Ves in Stg 3: 7
 Design Flux: 15.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 4.0 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 16.0 psi

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.0	0.1	5	5.9 - 6.2	6.2	0.2	5	5.9 - 6.3	5.1	2.7	5	0.3 - 6.5
Temp	25.3	0.2	5	25.0 - 25.5	24.9	0.2	5	24.5 - 25.1	25.4	0.2	5	25.2 - 25.7
Alk	96	13	5	82 - 112	113	14	5	100 - 129	216	31	5	170 - 255
TDS	559	29	5	526 - 600	256	17	5	234 - 276	3456	123	5	3272 - 3580
TotHard	310	20	5	290 - 335	128	14	5	110 - 146	2086	134	5	1880 - 2220
CaHard	240	19	5	228 - 274	97	9	5	84 - 109	1566	77	5	1460 - 1660
Turb	0.39	0.2	5	0.16 - 0.67	0.06	0.0	5	0.04 - 0.10	19.00	2.0	5	17.00 - 22.00
Amm	0.26	0.04	5	0.22 - 0.32	0.24	0.05	5	0.21 - 0.33	0.89	0.05	5	0.8 - 0.9
TOC	8.0	0.0	5	8.0 - 8.0	0.3	0.0	5	0.3 - 0.3	72.6	4.2	5	68.0 - 79.0
UV254	0.244	0.0	5	0.227 - 0.276	0.014	0.0	5	0.005 - 0.028	2.315	0.2	5	2.090 - 2.710
SUVA	3.05	0.24	5	2.83 - 3.45	5.48	3.46	5	1.80 - 11.20	3.21	0.49	5	2.65 - 3.99
Bromide	152	13	5	140 - 170	163	17	4	140 - 180				
TOX	777	86	5	635 - 860	13	0	5	13 - 13				
CHCl3	215.0	33.5	5	180.0 - 255.0	0.4	0.5	5	0.0 - 1.0	Mass Balance Closure Errors (%)			
BDCM	55.4	10.9	5	43.0 - 65.0	1.4	0.8	5	0.0 - 2.0				
DBCM	14.0	2.3	5	12.0 - 18.0	2.3	0.8	5	1.0 - 3.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	5	0.0 - 0.0	1.2	1.3	5	0.0 - 3.0	Alk	5	122	11
THM4	284.4	45.0	5	235.0 - 330.0	5.3	1.8	5	3.6 - 8.0	TDS	5	8	7
MCAA	5.1	1.0	5	3.8 - 6.3	0.0	0.0	5	0.0 - 0.0	TotHard	5	10	4
DCAA	49.8	11.8	5	32.0 - 61.0	0.2	0.5	5	0.0 - 1.1	CaHard	5	6	4
TCAA	65.8	17.5	5	38.0 - 79.0	0.0	0.0	5	0.0 - 0.0	Turb	5	84	11
MBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Amm	5	50	22
DBAA	2.1	0.2	5	1.8 - 2.3	0.0	0.0	5	0.0 - 0.0	TOC	0	n/a	n/a
BCAA	11.5	1.8	5	8.7 - 13.0	0.0	0.0	5	0.0 - 0.0	UV254	4	5	4
TBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0				
CDBAA	4.1	2.4	5	2.2 - 8.1	0.0	0.0	5	0.0 - 0.0	TDS _t	65	-2	13
DCBAA	17.8	4.3	5	11.0 - 22.0	0.2	0.5	5	0.0 - 1.2	Comments:			
HAA5	122.8	30.1	5	75.8 - 147.1	0.2	0.5	5	0.0 - 1.1				
HAA6	134.4	31.8	5	84.5 - 159.1	0.2	0.5	5	0.0 - 1.1				
HAA9	156.2	35.9	5	97.7 - 182.9	0.5	1.0	5	0.0 - 2.3				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	2.42	1.51	10	0.10 - 4.40	Sulfuric Acid Addition		pH adjustment to 5.8-6.0		full-scale			
Temp (°C)	22.8	1.4	10	21.0 - 24.5	Anti-Scalant Addition		Argo Scientific Hyperspearase AS120UL		full-scale			
pH (unit)	8.3	0.1	10	8.2 - 8.4	Cartridge Filtration		5 Micron		full-scale			
Time (hr)	44.7	2.5	10	40.3 - 47.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	0.5%	3.7%	Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	-0.2%	1.6%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	24.3%	2.0%	Sys Perm - Sum Stg Per	-11.1%	0.2%	Sys Perm - Avg Stg Perm	5.6%	7.2%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.00	5	0.60 - 0.61					
pH	6.0	5.1	6.0	0.1	5	5.9 - 6.2	6.2	127.4	271.5	5	5.8 - 613.0
Temp	25.3	25.4	25.3	0.2	5	25.0 - 25.5	24.9	25.1	0.2	5	24.8 - 25.3
Alk	96	216	96	13	5	82 - 112	113	71	7	5	61 - 78
TDS	559	3456	560	29	5	526 - 600	256	173	9	5	162 - 182
TotHard	310	2086	310	19	5	290 - 334	128	80	6	5	71 - 87
CaHard	240	1566	241	20	5	228 - 276	97	62	5	5	56 - 69
Turb	0.39	19.00	0.39	0	5	0.16 - 0.67	0.06	0.06	0.02	5	0 - 0
TOC	8.0	72.6	8.0	0.0	4	8.0 - 8.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.244	2.315	0.244	0.019	5	0.227 - 0.276	0.014	0.013	0.009	5	0.005 - 0.028
SUVA	3.05	3.21	NA	NA	4	NA	5.48	5.11	3.57	5	1.80 - 11.20

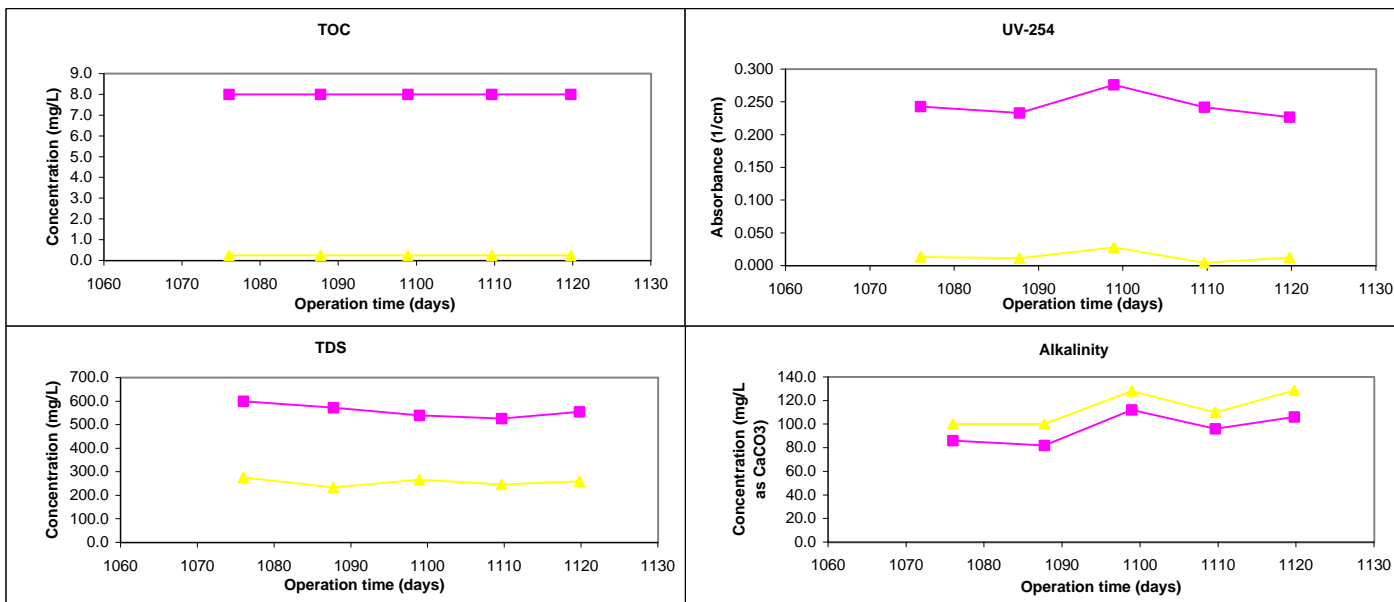
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.57	0.09	5	0.53 - 0.73					
pH	6.0	5.1	6.2	0.1	5	6.1 - 6.4	6.2	6.0	0.1	5	5.9 - 6.1
Temp	25.3	25.4	25.3	0.2	5	25.0 - 25.6	24.9	25.2	0.2	5	24.9 - 25.4
Alk	96	216	140	19	5	116 - 162	113	88	8	5	79 - 99
TDS	559	3456	1114	39	5	1076 - 1172	256	189	19	5	172 - 214
TotHard	310	2086	658	42	5	620 - 730	128	105	13	5	88 - 120
CaHard	240	1566	512	28	5	490 - 560	97	76	6	5	66 - 82
Turb	0.39	19.00	7.07	1	5	5.70 - 8.20	0.06	0.06	0.02	5	0 - 0
TOC	8.0	72.6	20.0	0.7	5	19.0 - 21.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.244	2.315	0.599	0.040	5	0.569 - 0.668	0.014	0.016	0.007	5	0.011 - 0.029
SUVA	3.05	3.21	3.01	0.30	5.00	2.71 - 3.52	5.48	6.48	2.92	5.00	4.40 - 11.60

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.44	0.01	5	0.43 - 0.46					
pH	6.0	5.1	6.2	0.1	5	6.1 - 6.4	6.2	6.2	0.1	5.0	6.1 - 6.3
Temp	25.3	25.4	25.4	0.3	5	25.0 - 25.7	24.9	25.3	0.2	5	25.1 - 25.5
Alk	96	216	177	27	5	144 - 204	113	159	20	5	134 - 184
TDS	559	3456	2408	90	5	2300 - 2528	256	350	22	5	318 - 376
TotHard	310	2086	1462	82	5	1350 - 1580	128	179	19	5	154 - 202
CaHard	240	1566	1118	82	5	1010 - 1200	97	140	11	5	126 - 157
Turb	0.39	19.00	16.70	1	5	15.50 - 17.00	0.06	0.09	0.03	5	0 - 0
TOC	8.0	72.6	48.6	0.9	5	47.0 - 49.0	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.244	2.315	1.497	0.105	5	1.382 - 1.660	0.014	0.017	0.009	5	0.010 - 0.032
SUVA	3.05	3.21	3.08	0.27	5.00	2.82 - 3.53	5.48	6.76	3.66	5.00	3.80 - 12.80

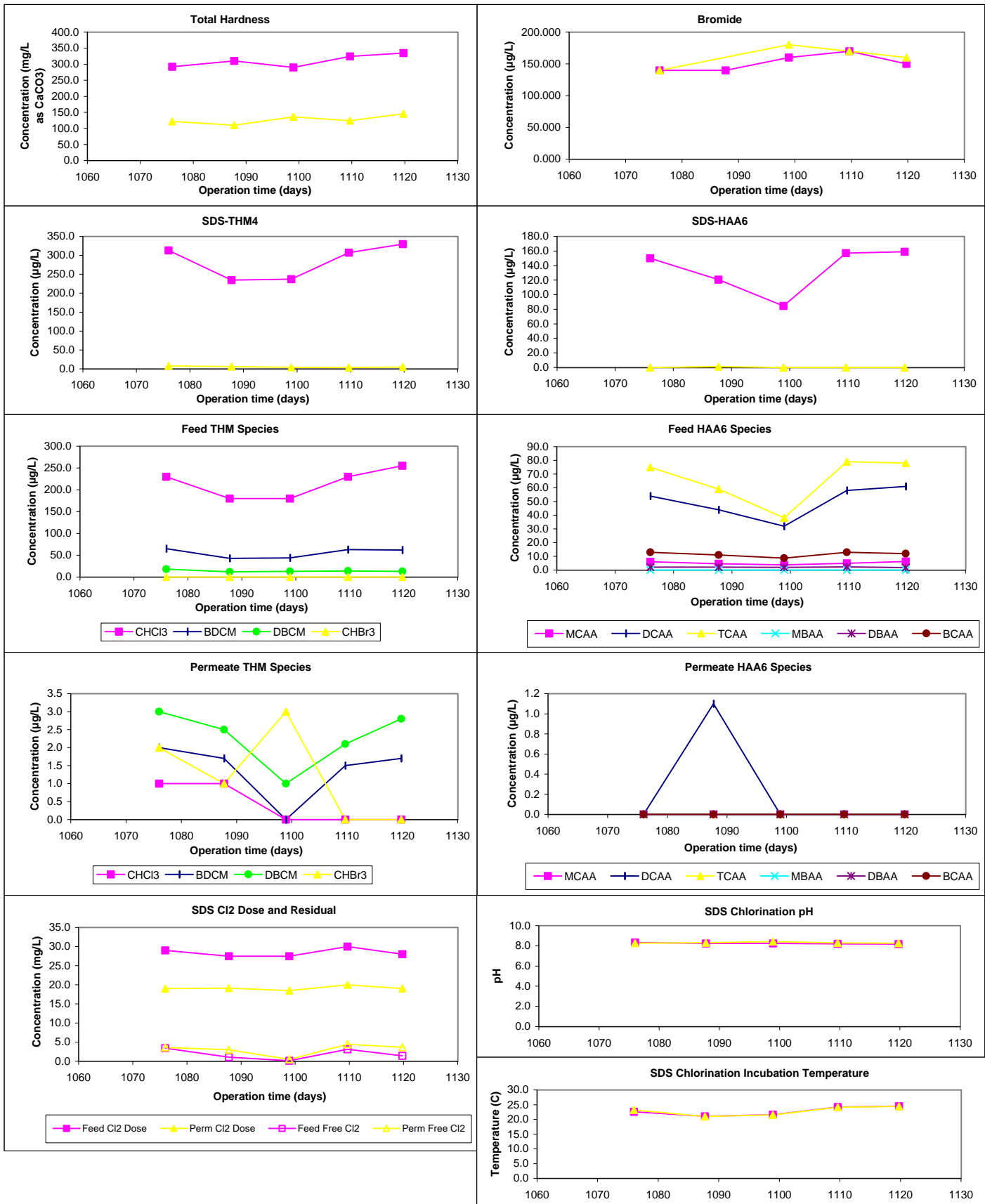
Chart Legend:

■ Feed (System)
▲ Permeate (System)

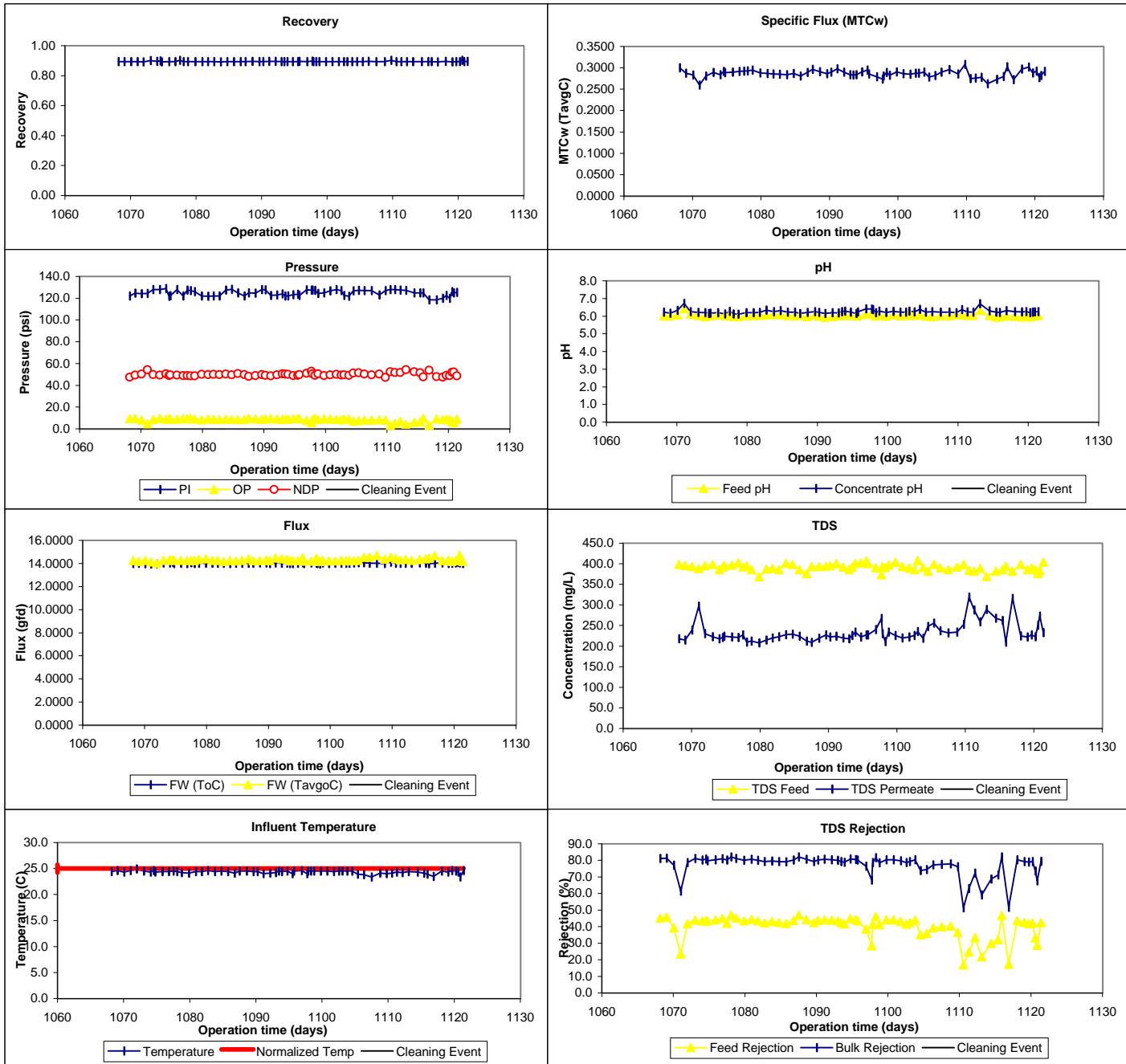
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL5114069 / 1092
 ICR Contact: Howard B. Brogdon
 Phone No.: (941) 352-7004
 Period: 9/4/98 - 10/31/98 (57 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: PVD 1
 Membrane Model: 8040-LSY-PVD1
 MWCO: 100-300 Daltons
 Element Size: 8" X 40"
 Element Area: 365.0 ft²
 Design Flux: 30.0 gfd
 Mfr. NDP: 125.0 psi
 Mfr. MTC_w: 0.240 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 75.0 gpm
 Minimum Flow: 72.0 gpm
 Total Width : 63.4 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 365.0 ft²
 840 Purchase Price: \$800

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.240 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 15.0 gfd
 # of Elem in P.V.: 6
 # Pres Ves in Stg 1: 36
 # Pres Ves in Stg 2: 18
 Pres Ves in Stg 3: 7
 Design Flux: 15.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 4.0 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 16.0 psi

Water Quality Summary

Water Quality Summary														
Summary	Feed (System)				Permeate (System)				Concentrate (System)					
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max		
pH	6.1	0.0	4	6.1 - 6.2	6.2	0.1	4	6.1 - 6.3	6.2	0.0	4	6.2 - 6.3		
Temp	25.0	0.4	4	24.5 - 25.5	25.0	0.4	4	24.8 - 25.6	25.4	0.8	4	24.5 - 26.5		
Alk	98	17	4	77 - 116	119	18	4	92 - 131	216	53	4	165 - 290		
TDS	563	28	4	536 - 600	266	34	4	222 - 304	3478	115	4	3308 - 3552		
TotHard	315	9	4	304 - 324	130	11	4	120 - 142	2060	42	4	2020 - 2110		
CaHard	231	11	4	220 - 241	94	8	4	86 - 100	1483	221	4	1160 - 1660		
Turb	0.80	0.4	4	0.26 - 1.30	0.07	0.0	4	0.05 - 0.09	19.88	0.9	4	19.00 - 21.00		
Amm	0.28	0.09	4	0.22 - 0.41	0.26	0.09	4	0.19 - 0.39	0.87	0.08	4	0.8 - 1.0		
TOC	8.8	1.0	4	8.0 - 10.0	0.3	0.0	3	0.3 - 0.3	79.5	7.2	4	74.0 - 90.0		
UV254	0.230	0.0	4	0.220 - 0.251	0.011	0.0	4	0.005 - 0.016	2.090	0.1	4	2.020 - 2.240		
SUVA	2.65	0.24	4	2.29 - 2.79	NA	NA	3	NA	2.64	0.25	4	2.29 - 2.87		
Bromide	155	6	4	150 - 160	165	6	4	160 - 170						
TOX	930	82	3	860 - 1020	21	16	4	13 - 45						
CHCl3	250.0	52.9	4	180.0 - 300.0	0.8	1.0	4	0.0 - 2.0	Mass Balance Closure Errors (%)					
BDCM	52.1	10.1	4	39.0 - 62.0	1.6	0.6	4	1.0 - 2.3						
DBCM	14.1	2.8	4	11.0 - 17.5	2.5	1.0	4	2.0 - 4.0	WQP	Count	Avg	SD/RD		
CHBr3	0.0	0.0	4	0.0 - 0.0	1.0	0.7	4	0.0 - 1.8	Alk	4	138	43		
THM4	316.3	64.4	4	232.0 - 375.0	5.9	2.3	4	4.0 - 9.1	TDS	4	15	2		
MCAA	5.6	2.7	4	2.6 - 9.1	0.0	0.0	4	0.0 - 0.0	TotHard	4	12	4		
DCAA	63.1	13.3	4	51.0 - 82.0	0.5	0.9	4	0.0 - 1.8	CaHard	4	7	16		
TCAA	78.4	8.4	4	69.0 - 86.0	0.3	0.6	4	0.0 - 1.2	Turb	4	67	18		
MBAA	0.3	0.6	4	0.0 - 1.1	0.0	0.0	4	0.0 - 0.0	Amm	4	44	23		
DBAA	2.3	0.3	4	2.0 - 2.8	0.4	0.9	4	0.0 - 1.7	TOC	0	n/a	n/a		
BCAA	13.5	2.4	4	12.0 - 17.0	0.4	0.7	4	0.0 - 1.4	UV254	3	4	0		
TBAA	0.0	0.0	4	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	TDS					
CDBAA	3.3	0.6	4	2.6 - 4.0	0.0	0.0	4	0.0 - 0.0						
DCBAA	21.1	4.1	4	17.0 - 26.0	0.6	0.7	4	0.0 - 1.3	29	9	16			
HAA5	149.7	21.8	4	127.4 - 176.0	1.2	2.4	4	0.0 - 4.7	Comments:					
HAA6	163.2	23.7	4	139.4 - 193.0	1.5	3.1	4	0.0 - 6.1						
HAA9	187.6	27.6	4	159.5 - 221.6	2.1	3.6	4	0.0 - 7.4						
SDS Conditions					Pretreatment Information									
WQP	Avg	SD	Count	Min - Max	Process		Description				Scale			
Res (0)	3.40	1.83	8	1.54 - 7.50	Sulfuric Acid Addition		pH adjustment to 5.8-6.0				full-scale			
Temp (°C)	21.8	0.5	8	21.3 - 22.5	Anti-Scalant Addition		Argo Scientific Hyperspearase AS120UL				full-scale			
pH (unit)	8.3	0.1	8	8.0 - 8.5	Cartridge Filtration		5 Micron				full-scale			
Time (hr)	45.1	2.1	8	42.0 - 47.3										

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	26.4%	3.5%	Sys Perm - Sum Stg Per	-11.2%	0.2%	Sys Perm - Avg Stg Perm	-102.1%	12.0%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.01	3	0.60 - 0.61					
pH	6.1	6.2	6.1	0.0	4	6.1 - 6.2	6.2	6.0	0.0	4	6.0 - 6.1
Temp	25.0	25.4	25.0	0.4	4	24.5 - 25.6	25.0	25.0	0.5	4	24.4 - 25.6
Alk	98	216	98	17	4	77 - 116	119	69	8	4	58 - 74
TDS	563	3478	565	27	4	536 - 600	266	174	27	4	140 - 202
TotHard	315	2060	315	9	4	304 - 324	130	77	6	4	70 - 83
CaHard	231	1483	232	11	4	220 - 242	94	59	5	4	55 - 66
Turb	0.80	19.88	0.80	0	4	0.25 - 1.30	0.07	0.06	0.01	4	0 - 0
TOC	8.8	79.5	8.8	1.0	4	8.0 - 10.0	0.3	1.7	2.9	4	0.3 - 6.0
UV254	0.230	2.090	0.230	0.014	4	0.219 - 0.251	0.011	0.006	0.003	4	0.005 - 0.010
SUVA	2.65	2.64	2.65	0.24	4	2.29 - 2.79	NA	1.39	0.82	4	0.16 - 1.80

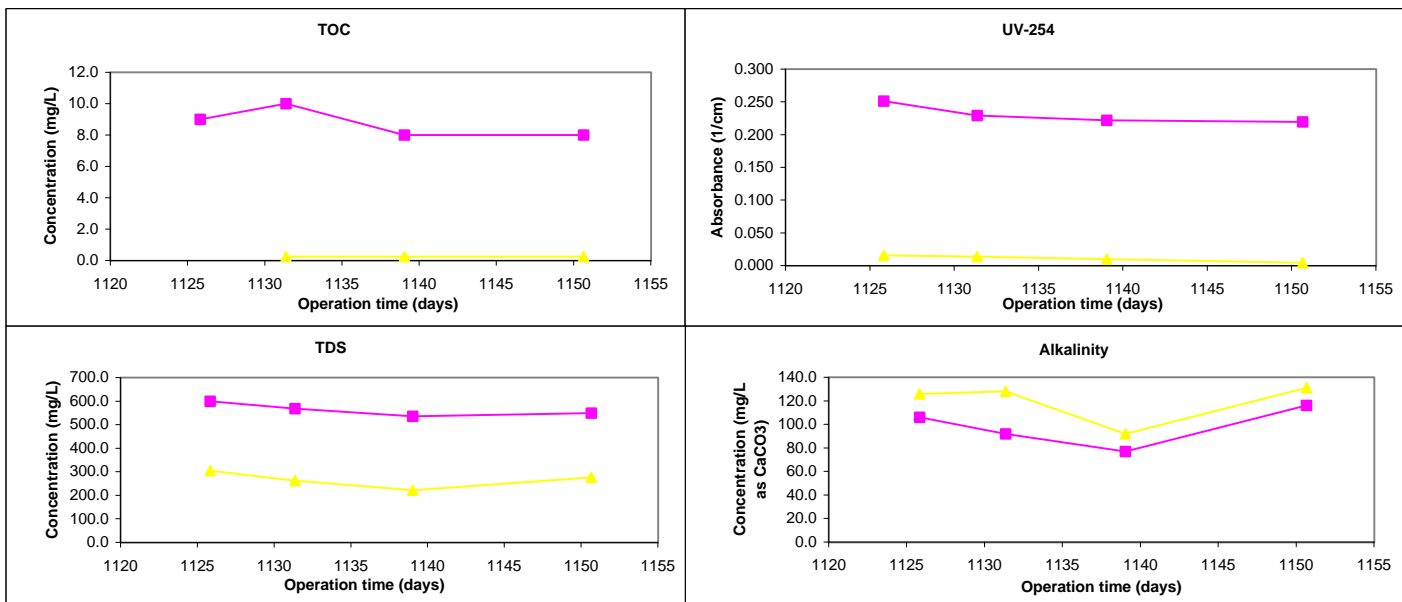
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.53	0.01	3	0.52 - 0.53					
pH	6.1	6.2	6.2	0.1	4	6.1 - 6.3	6.2	6.0	0.0	4	6.0 - 6.0
Temp	25.0	25.4	25.1	0.4	4	24.6 - 25.6	25.0	25.1	0.5	4	24.5 - 25.8
Alk	98	216	149	25	4	122 - 178	119	87	13	4	67 - 95
TDS	563	3478	876	539	4	68 - 1164	266	202	38	4	168 - 246
TotHard	315	2060	663	29	4	620 - 680	130	96	8	4	86 - 104
CaHard	231	1483	508	10	4	500 - 520	94	74	8	4	68 - 85
Turb	0.80	19.88	8.18	2	4	5.50 - 11.00	0.07	0.06	0.01	4	0 - 0
TOC	8.8	79.5	21.5	1.3	4	20.0 - 23.0	0.3	1.4	2.4	4	0.3 - 5.0
UV254	0.230	2.090	0.519	0.163	4	0.287 - 0.669	0.011	0.009	0.003	4	0.005 - 0.011
SUVA	2.65	2.64	2.44	0.81	4.00	1.25 - 3.04	NA	2.63	1.98	4.00	0.23 - 4.48

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.43	0.01	3	0.42 - 0.44					
pH	6.1	6.2	6.3	0.1	4	6.2 - 6.3	6.2	6.3	0.1	4.0	6.2 - 6.4
Temp	25.0	25.4	25.2	0.4	4	24.6 - 25.7	25.0	25.2	0.5	4	24.5 - 25.8
Alk	98	216	186	38	4	154 - 240	119	165	19	4	138 - 182
TDS	563	3478	2464	74	4	2362 - 2540	266	347	38	4	312 - 388
TotHard	315	2060	1430	16	4	1410 - 1450	130	182	19	4	164 - 206
CaHard	231	1483	1075	64	4	990 - 1140	94	134	17	4	123 - 159
Turb	0.80	19.88	17.88	1	4	17.00 - 19.00	0.07	0.13	0.08	4	0 - 0
TOC	8.8	79.5	53.5	4.1	4	50.0 - 58.0	0.3	1.7	2.9	4	0.3 - 6.0
UV254	0.230	2.090	1.437	0.124	4	1.350 - 1.620	0.011	0.013	0.007	4	0.005 - 0.020
SUVA	2.65	2.64	2.69	0.13	4.00	2.50 - 2.79	NA	3.49	2.96	4.00	0.33 - 6.80

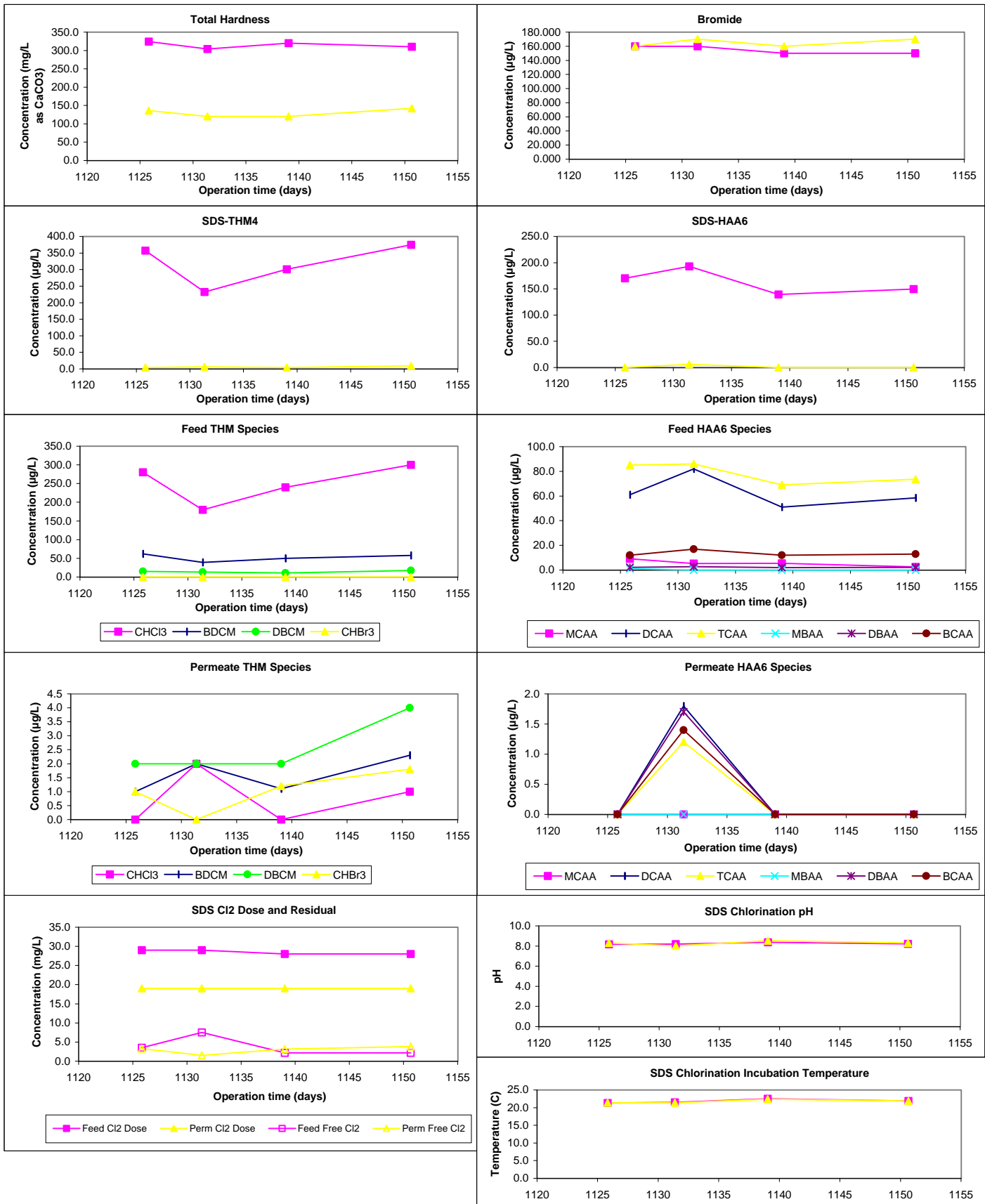
Chart Legend:

- Feed (System)
- ▲ Permeate (System)

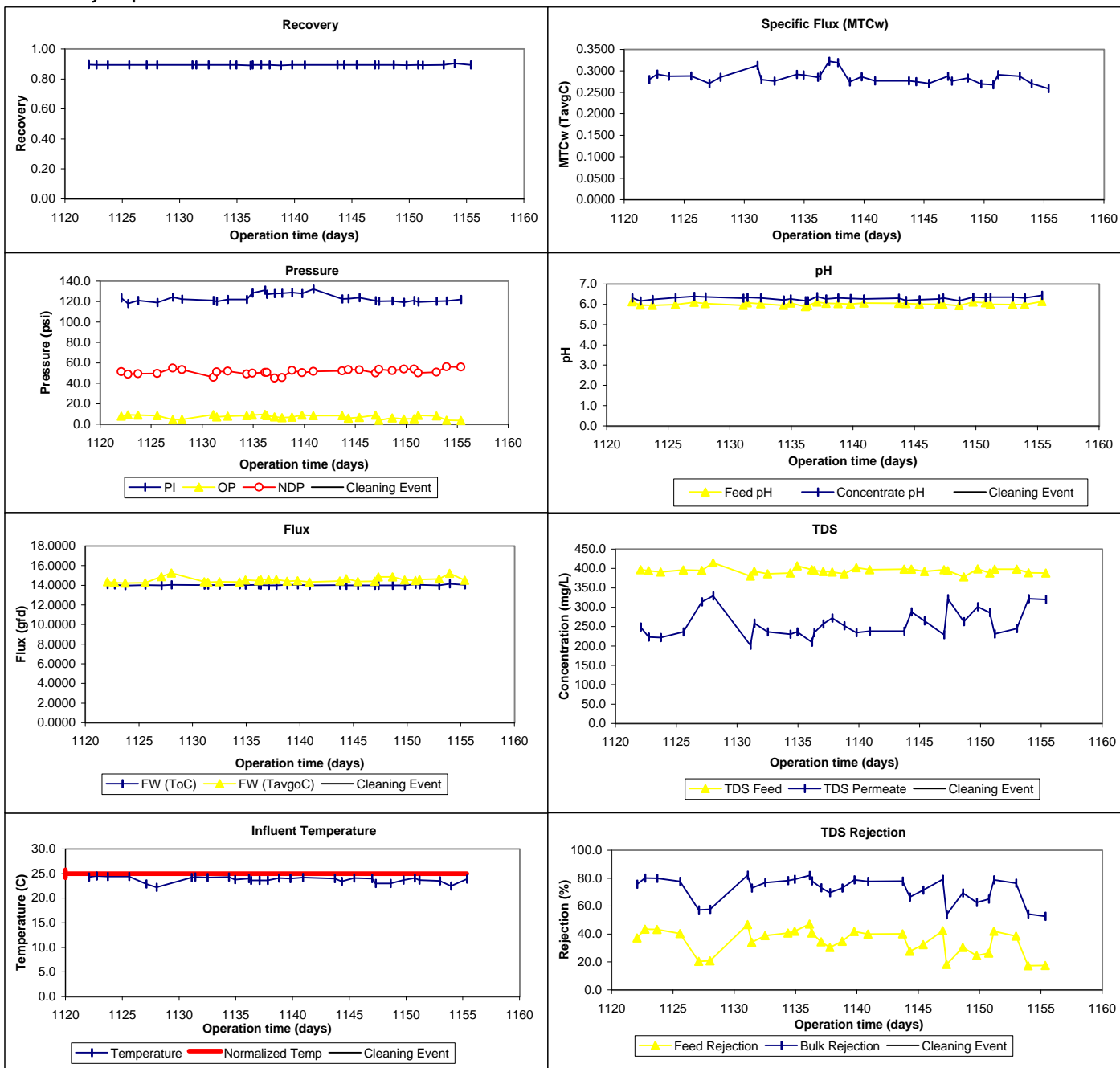
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL5114069 / 1092
 ICR Contact: Howard B. Brogdon
 Phone No.: (941) 352-7004
 Period: 11/1/98 - 1/9/99 (69 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: PVD 1
 Membrane Model: 8040-LSY-PVD1
 MWCO: 100-300 Daltons
 Element Size: 8" X 40"
 Element Area: 365.0 ft²
 Design Flux: 30.0 gfd
 Mfr. NDP: 125.0 psi
 Mfr. MTC_w: 0.240 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 75.0 gpm
 Minimum Flow: 72.0 gpm
 Total Width : 63.4 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 365.0 ft²
 840 Purchase Price: \$800

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.240 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 15.0 gfd
 # of Elem in P.V.: 6
 # Pres Ves in Stg 1: 36
 # Pres Ves in Stg 2: 18
 Pres Ves in Stg 3: 7
 Design Flux: 15.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 4.0 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 16.0 psi

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.2	0.1	5	6.1 - 6.3	6.3	0.1	5	6.2 - 6.4	6.3	0.1	5	6.2 - 6.5
Temp	24.2	0.7	5	23.2 - 25.0	24.3	0.6	5	23.4 - 24.8	24.2	0.8	5	23.0 - 25.2
Alk	109	14	5	86 - 123	127	12	5	112 - 145	190	40	5	140 - 250
TDS	540	30	5	498 - 576	287	20	5	256 - 306	3114	103	5	2996 - 3200
TotHard	300	14	5	276 - 314	160	14	5	152 - 184	1854	43	5	1810 - 1900
CaHard	249	8	5	242 - 260	132	15	5	114 - 147	1400	51	5	1330 - 1470
Turb	0.21	0.0	5	0.18 - 0.24	0.07	0.0	5	0.05 - 0.08	20.00	2.7	5	17.00 - 24.00
Amm	0.28	0.09	5	0.18 - 0.42	0.24	0.09	5	0.16 - 0.39	0.75	0.13	5	0.6 - 0.9
TOC	8.0	0.0	5	8.0 - 8.0	0.4	0.3	5	0.3 - 1.0	48.6	32.1	5	13.0 - 76.0
UV254	0.229	0.0	5	0.220 - 0.240	0.017	0.0	5	0.005 - 0.032	2.094	0.1	5	2.010 - 2.220
SUVA	2.86	0.11	5	2.75 - 3.00	6.00	4.62	5	1.60 - 12.80	8.02	7.09	5	2.66 - 17.08
Bromide	164	9	5	160 - 180	168	8	5	160 - 180				
TOX	638	313	3	455 - 1000	53	38	3	13 - 88				
CHCl3	193.3	32.1	3	170.0 - 230.0	2.0	1.7	3	0.0 - 3.0	Mass Balance Closure Errors (%)			
BDCM	44.3	12.7	3	37.0 - 59.0	4.3	4.0	3	0.0 - 8.0				
DBCM	10.3	1.5	3	9.0 - 12.0	9.0	7.9	3	0.0 - 15.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	3	0.0 - 0.0	9.3	8.1	3	0.0 - 15.0	Alk	5	124	39
THM4	248.0	46.2	3	216.0 - 301.0	24.7	21.5	3	0.0 - 39.0	TDS	5	16	12
MCAA	3.5	3.1	3	0.0 - 6.0	0.0	0.0	3	0.0 - 0.0	TotHard	5	22	5
DCAA	59.0	15.1	3	47.0 - 76.0	0.8	0.7	3	0.0 - 1.4	CaHard	5	14	13
TCAA	64.3	13.1	3	54.0 - 79.0	0.4	0.6	3	0.0 - 1.1	Turb	5	93	1
MBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	3	0.0 - 0.0	Amm	5	8	41
DBAA	2.7	0.3	3	2.5 - 3.1	2.9	2.5	3	0.0 - 4.5	TOC	1	9	n/a
BCAA	12.7	1.5	3	11.0 - 14.0	1.4	1.2	3	0.0 - 2.4	UV254	4	8	3
TBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	3	0.0 - 0.0	Comments:			
CDBAA	9.5	10.1	3	2.3 - 21.0	1.4	1.2	3	0.0 - 2.2				
DCBAA	19.3	8.0	3	11.0 - 27.0	1.1	1.0	3	0.0 - 1.9				
HAA5	129.6	24.7	3	114.2 - 158.1	4.1	3.5	3	0.0 - 6.3				
HAA6	142.3	25.9	3	125.2 - 172.1	5.4	4.7	3	0.0 - 8.3				
HAA9	171.1	42.6	3	142.8 - 220.1	8.0	6.9	3	0.0 - 12.4				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	3.76	4.28	8	0.15 - 10.50	Sulfuric Acid Addition		pH adjustment to 5.8-6.0		full-scale			
Temp (°C)	21.7	1.2	8	20.3 - 23.4	Anti-Scalant Addition		Argo Scientific Hyperspearase AS120UL		full-scale			
pH (unit)	8.3	0.1	8	8.1 - 8.5	Cartridge Filtration		5 Micron		full-scale			
Time (hr)	45.3	1.7	8	43.5 - 47.5								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	29.2%	2.5%	Sys Perm - Sum Stg Per	-11.2%	0.2%	Sys Perm - Avg Stg Perm	9.3%	5.9%

Stage Summary

	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.00	5	0.60 - 0.60					
pH	6.2	6.3	6.2	0.1	5	6.1 - 6.3	6.3	6.1	0.1	5	6.0 - 6.2
Temp	24.2	24.2	24.2	0.7	5	23.2 - 25.0	24.3	24.0	0.7	5	23.0 - 24.8
Alk	109	190	110	15	5	86 - 126	127	79	7	5	73 - 90
TDS	540	3114	542	26	5	508 - 576	287	191	19	5	162 - 208
TotHard	300	1854	302	17	5	276 - 324	160	99	15	5	88 - 124
CaHard	249	1400	249	8	5	242 - 260	132	90	12	5	71 - 102
Turb	0.21	20.00	0.21	0	5	0.18 - 0.25	0.07	0.07	0.01	5	0 - 0
TOC	8.0	48.6	8.0	0.0	5	8.0 - 8.0	0.4	0.3	0.0	5	0.3 - 0.3
UV254	0.229	2.094	0.229	0.008	5	0.220 - 0.240	0.017	0.014	0.005	5	0.005 - 0.018
SUVA	2.86	8.02	2.86	0.11	5	2.75 - 3.00	6.00	5.52	2.17	5	1.80 - 7.20

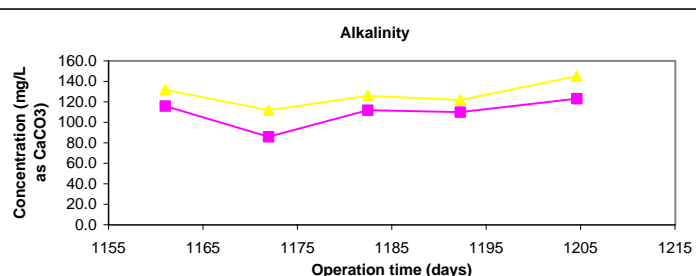
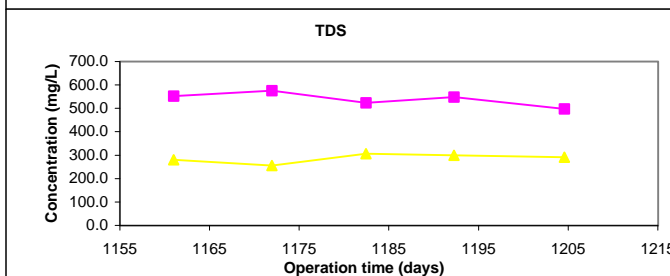
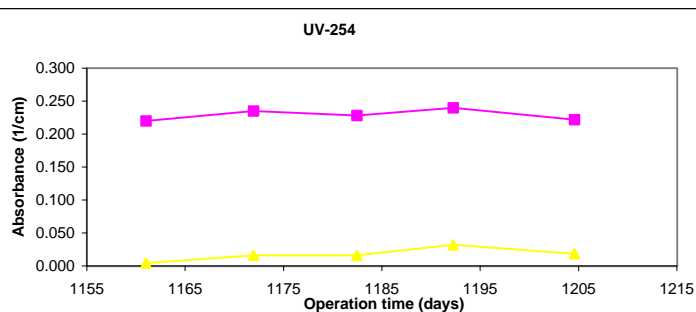
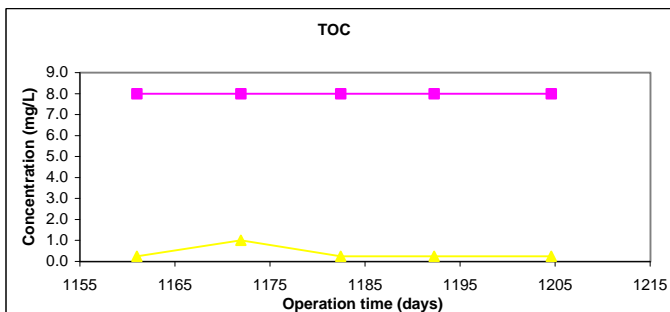
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.53	0.00	5	0.53 - 0.53					
pH	6.2	6.3	6.3	0.1	5	6.2 - 6.4	6.3	6.1	0.1	5	6.0 - 6.2
Temp	24.2	24.2	24.1	0.8	5	22.9 - 25.0	24.3	44.7	45.7	5	23.1 - 126.5
Alk	109	190	148	27	5	114 - 184	127	93	12	5	77 - 110
TDS	540	3114	1063	35	5	1024 - 1104	287	223	11	5	214 - 239
TotHard	300	1854	676	83	5	580 - 800	160	117	12	5	110 - 140
CaHard	249	1400	515	29	5	474 - 550	132	105	13	5	97 - 127
Turb	0.21	20.00	5.03	2	5	2.00 - 7.50	0.07	0.08	0.01	5	0 - 0
TOC	8.0	48.6	19.2	0.8	5	18.0 - 20.0	0.4	0.3	0.0	5	0.3 - 0.3
UV254	0.229	2.094	0.562	0.021	5	0.530 - 0.588	0.017	0.019	0.006	5	0.010 - 0.024
SUVA	2.86	8.02	2.94	0.21	5.00	2.79 - 3.27	6.00	7.64	2.26	5.00	4.00 - 9.60

	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			9.15	19.48	5	0.43 - 44.00					
pH	6.2	6.3	6.3	0.1	5	6.2 - 6.5	6.3	6.3	0.1	5.0	6.2 - 6.4
Temp	24.2	24.2	24.1	0.9	5	22.8 - 25.1	24.3	24.1	0.9	5	22.9 - 25.1
Alk	109	190	176	35	5	142 - 232	127	171	21	5	150 - 198
TDS	540	3114	2210	58	5	2156 - 2296	287	398	24	5	360 - 420
TotHard	300	1854	1314	70	5	1230 - 1420	160	213	24	5	184 - 249
CaHard	249	1400	1062	50	5	1010 - 1120	132	174	11	5	160 - 190
Turb	0.21	20.00	16.80	4	5	14.00 - 24.00	0.07	0.12	0.04	5	0 - 0
TOC	8.0	48.6	33.0	21.5	5	9.0 - 50.0	0.4	0.4	0.3	5	0.3 - 1.0
UV254	0.229	2.094	1.412	0.041	5	1.360 - 1.470	0.017	0.021	0.007	5	0.015 - 0.031
SUVA	2.86	8.02	7.77	6.76	5.00	2.78 - 16.33	6.00	7.42	4.26	5.00	1.70 - 12.40

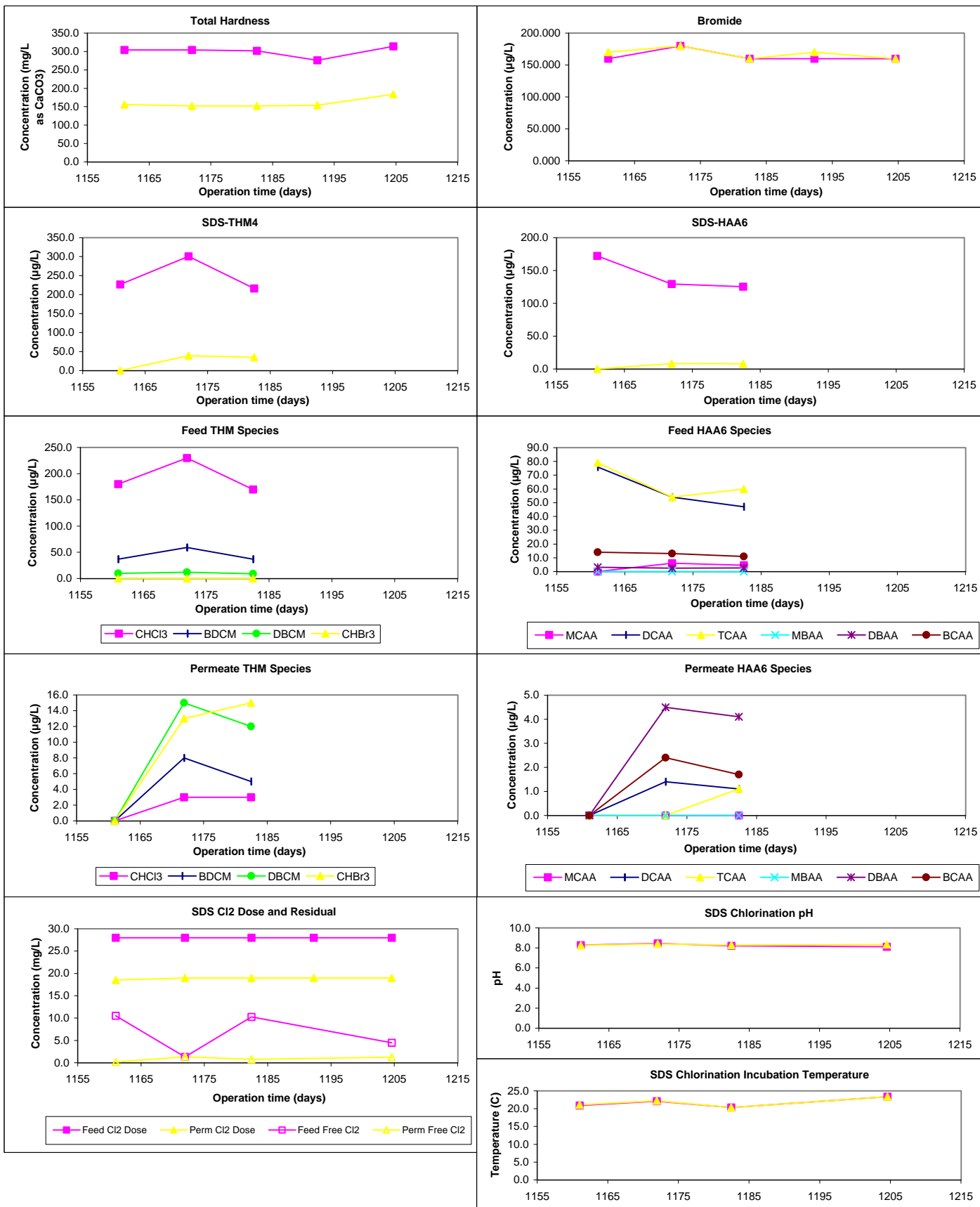
Chart Legend:

- Feed (System)
- ▲ Permeate (System)

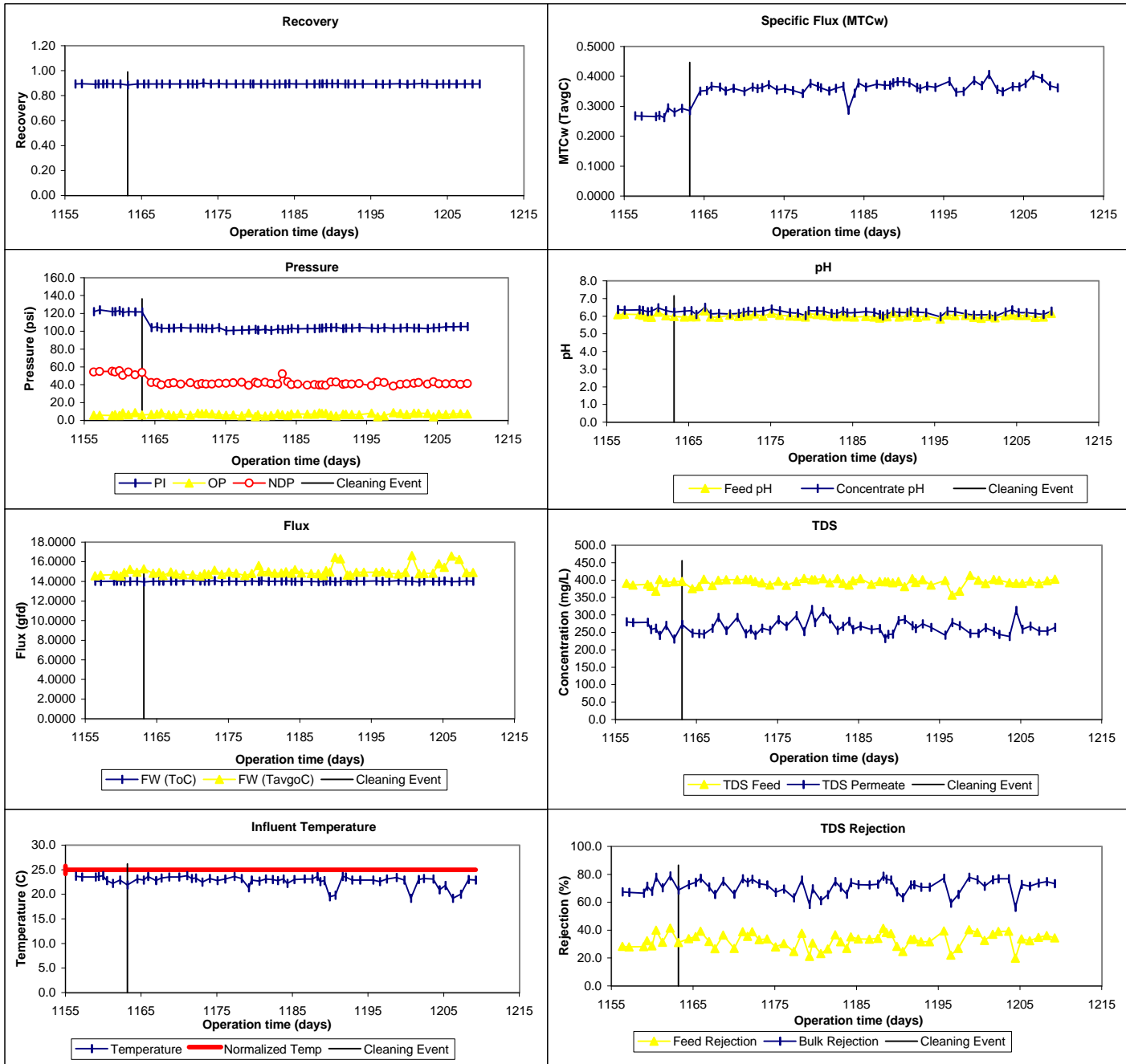
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL5114069 / 1092
 ICR Contact: Howard B. Brogdon
 Phone No.: (941) 352-7004
 Period: 1/10/99 - 3/20/99 (69 days)

Membrane Information

Manufacturer: Hydranautics
 Trade Name: PVD 1
 Membrane Model: 8040-LSY-PVD1
 MWCO: 100-300 Daltons
 Element Size: 8" X 40"
 Element Area: 365.0 ft²
 Design Flux: 30.0 gfd
 Mfr. NDP: 125.0 psi
 Mfr. MTC_w: 0.240 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 75.0 gpm
 Minimum Flow: 72.0 gpm
 Total Width : 63.4 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 365.0 ft²
 840 Purchase Price: \$800

Design Parameters

Norm Temp: 25.0 °C
 Temp Norm MTC-w: 0.240 TavGC
 Design Recovery: 0.90
 Avg Sys Flux F_w: 15.0 gfd
 # of Elem in P.V.: 6
 # Pres Ves in Stg 1: 36
 # Pres Ves in Stg 2: 18
 Pres Ves in Stg 3: 7
 Design Flux: 15.0 gfd
 Recycle Ratio: 0.00
 Osmotic P Stage 1: 4.0 psi
 Osmotic P Stage 2: 9.0 psi
 Osmotic P Stage 3: 16.0 psi

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.1	0.1	5	6.0 - 6.2	6.2	0.1	5	6.1 - 6.3	6.2	0.1	5	6.1 - 6.3
Temp	23.7	0.5	5	23.0 - 24.3	23.9	0.5	5	23.0 - 24.4	23.4	0.7	5	22.6 - 24.4
Alk	89	8	5	78 - 98	114	15	5	100 - 138	100	60	5	36 - 160
TDS	543	31	5	500 - 572	276	9	5	268 - 290	3283	117	5	3148 - 3436
TotHard	301	4	5	296 - 306	143	14	5	130 - 164	1892	50	5	1820 - 1940
CaHard	248	9	5	234 - 260	120	10	5	106 - 128	1500	70	5	1390 - 1550
Turb	0.22	0.0	5	0.21 - 0.25	0.08	0.0	5	0.06 - 0.11	19.00	2.3	5	17.00 - 23.00
Amm	0.25	0.05	5	0.19 - 0.32	0.25	0.07	5	0.15 - 0.32	0.78	0.13	5	0.6 - 0.9
TOC	7.6	0.5	5	7.0 - 8.0	0.6	0.4	5	0.3 - 1.0	72.4	5.3	5	68.0 - 81.0
UV254	0.230	0.0	5	0.225 - 0.248	0.028	0.0	5	0.026 - 0.030	2.104	0.1	5	2.030 - 2.190
SUVA	3.03	0.20	5	2.81 - 3.21	6.52	4.52	5	2.60 - 12.00	2.91	0.13	5	2.70 - 3.04
Bromide	159	7	5	150 - 170	164	5	5	160 - 170				
TOX	773	75	3	695 - 845	46	22	4	13 - 60				
CHCl3	233.3	35.1	3	200.0 - 270.0	3.8	1.1	4	2.4 - 5.0	Mass Balance			
BDCM	68.8	9.3	3	59.0 - 77.5	8.5	2.8	4	4.6 - 11.0	Closure Errors (%)			
DBCM	18.7	3.1	3	16.0 - 22.0	18.3	4.1	4	13.0 - 23.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	3	0.0 - 0.0	13.3	6.2	4	7.0 - 20.0	Alk	5	358	408
THM4	320.8	47.3	3	275.0 - 369.5	43.8	5.7	4	40.0 - 52.3	TDS	5	16	9
MCAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	TotHard	5	15	7
DCAA	53.8	3.8	3	49.5 - 56.0	1.0	1.1	4	0.0 - 2.2	CaHard	5	13	6
TCAA	69.5	4.8	3	64.5 - 74.0	1.1	0.8	4	0.0 - 2.0	Turb	5	93	1
MBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	Amm	5	61	27
DBAA	2.6	0.1	3	2.5 - 2.6	4.1	0.6	4	3.5 - 4.8	TOC	3	15	8
BCAA	13.0	0.0	3	13.0 - 13.0	2.5	0.5	4	1.9 - 2.9	UV254	5	10	3
TBAA	0.0	0.0	3	0.0 - 0.0	0.0	0.0	4	0.0 - 0.0	TDS	60	4	10
CDBAA	3.2	0.8	3	2.4 - 4.0	2.3	1.5	4	0.0 - 3.2	Comments:			
DCBAA	18.0	1.0	3	17.0 - 19.0	2.0	1.4	4	0.0 - 3.0				
HAA5	125.9	8.4	3	116.5 - 132.6	6.2	1.3	4	4.8 - 7.7				
HAA6	138.9	8.4	3	129.5 - 145.6	8.6	1.8	4	6.7 - 10.6				
HAA9	160.1	10.1	3	148.9 - 168.6	12.9	4.4	4	6.7 - 16.8				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description	Scale					
Res (0)	4.51	4.21	9	0.10 - 15.00	Sulfuric Acid Addition	pH adjustment to 5.8-6.0	full-scale					
Temp (°C)	23.2	0.5	9	22.5 - 23.7	Anti-Scalant Addition	Argo Scientific Hyperspearase AS120UL	full-scale					
pH (unit)	8.3	0.1	9	8.2 - 8.5	Cartridge Filtration	5 Micron	full-scale					
Time (hr)	44.0	1.6	9	41.5 - 46.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	-0.1%	0.9%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%	Sys Conc - Stg 3 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Stg 2 Conc - Stg 3 Inf	0.0%	0.0%	Stg 2 Conc - Stg 3 Inf	0.5%	4.0%	Stg 2 Conc - Stg 3 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	29.9%	1.1%	Sys Perm - Sum Stg Per	-11.1%	0.3%	Sys Perm - Avg Stg Perm	11.0%	5.8%

Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.00	5	0.60 - 0.60					
pH	6.1	6.2	6.1	0.1	5	6.0 - 6.2	6.2	6.1	0.1	5	6.0 - 6.1
Temp	23.7	23.4	23.7	0.5	5	23.0 - 24.3	23.9	23.6	0.7	5	23.0 - 24.6
Alk	89	100	88	8	5	78 - 98	114	73	7	5	65 - 83
TDS	543	3283	544	29	5	504 - 572	276	187	5	5	180 - 194
TotHard	301	1892	301	4	5	296 - 306	143	89	6	5	83 - 98
CaHard	248	1500	247	9	5	234 - 260	120	78	6	5	72 - 85
Turb	0.22	19.00	0.22	0	5	0.21 - 0.25	0.08	0.10	0.05	5	0 - 0
TOC	7.6	72.4	7.6	0.5	5	7.0 - 8.0	0.6	0.3	0.0	5	0.3 - 0.3
UV254	0.230	2.104	0.230	0.010	5	0.223 - 0.248	0.028	0.014	0.002	5	0.012 - 0.017
SUVA	3.03	2.91	3.03	0.19	5	2.81 - 3.21	6.52	5.48	0.77	5	4.80 - 6.80

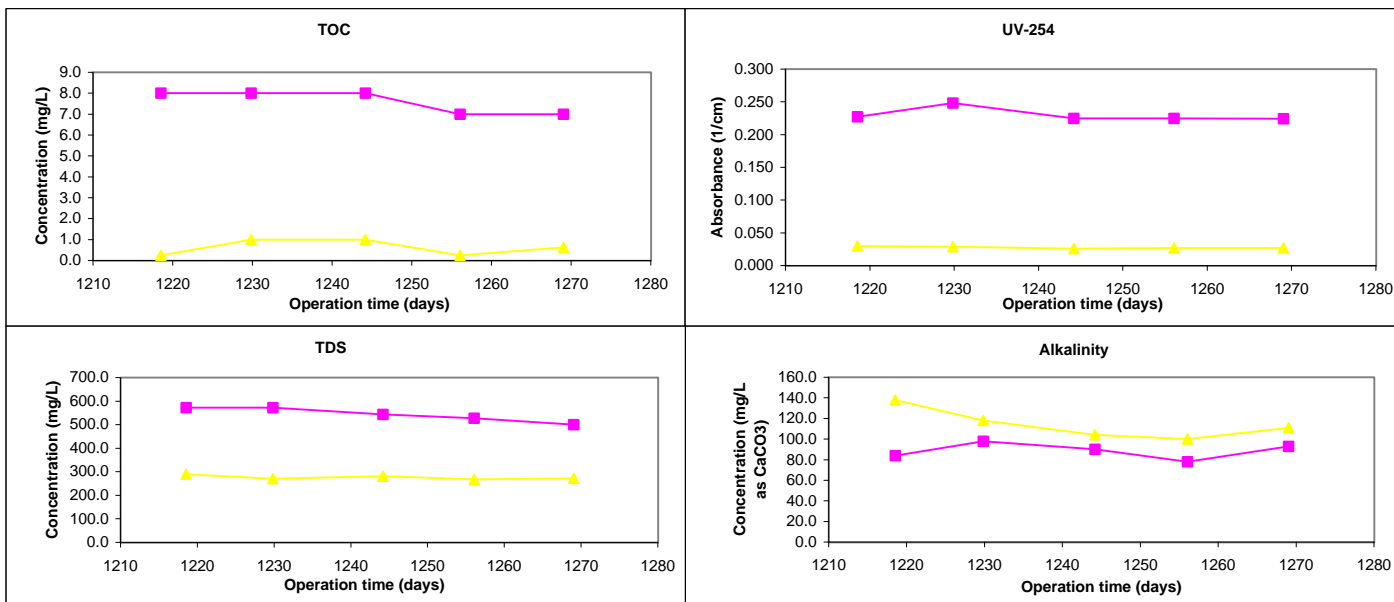
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.53	0.01	5	0.52 - 0.54					
pH	6.1	6.2	6.2	0.1	5	6.0 - 6.3	6.2	6.0	0.0	5	6.0 - 6.0
Temp	23.7	23.4	65.3	93.2	5	23.0 - 232.0	23.9	23.5	0.6	5	22.8 - 24.3
Alk	89	100	122	12	5	110 - 136	114	83	10	5	71 - 93
TDS	543	3283	1082	31	5	1040 - 1116	276	214	13	5	196 - 228
TotHard	301	1892	648	38	5	602 - 690	143	109	7	5	100 - 118
CaHard	248	1500	524	29	5	500 - 570	120	95	7	5	88 - 102
Turb	0.22	19.00	2.50	1	5	1.40 - 4.00	0.08	0.09	0.06	5	0 - 0
TOC	7.6	72.4	19.2	0.8	5	18.0 - 20.0	0.6	0.3	0.0	5	0.3 - 0.3
UV254	0.230	2.104	0.567	0.015	5	0.560 - 0.594	0.028	0.020	0.002	5	0.018 - 0.023
SUVA	3.03	2.91	2.96	0.11	5.00	2.80 - 3.11	6.52	7.81	0.71	5.00	7.20 - 9.04

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.44	0.01	5	0.43 - 0.46					
pH	6.1	6.2	6.2	0.1	5	6.1 - 6.3	6.2	6.2	0.0	5.0	6.2 - 6.3
Temp	23.7	23.4	23.6	0.5	5	23.0 - 24.4	23.9	23.6	0.7	5	22.8 - 24.6
Alk	89	100	141	9	5	130 - 152	114	139	14	5	124 - 152
TDS	543	3283	2339	48	5	2272 - 2400	276	366	10	5	354 - 376
TotHard	301	1892	1368	63	5	1290 - 1430	143	186	8	5	178 - 198
CaHard	248	1500	1102	41	5	1040 - 1150	120	153	14	5	138 - 168
Turb	0.22	19.00	15.46	4	5	10.30 - 21.00	0.08	0.18	0.08	5	0 - 0
TOC	7.6	72.4	47.8	1.9	5	45.0 - 50.0	0.6	0.4	0.3	5	0.3 - 1.0
UV254	0.230	2.104	1.433	0.029	5	1.410 - 1.480	0.028	0.025	0.002	5	0.022 - 0.028
SUVA	3.03	2.91	3.00	0.10	5.00	2.90 - 3.13	6.52	8.47	3.56	5.00	2.30 - 11.04

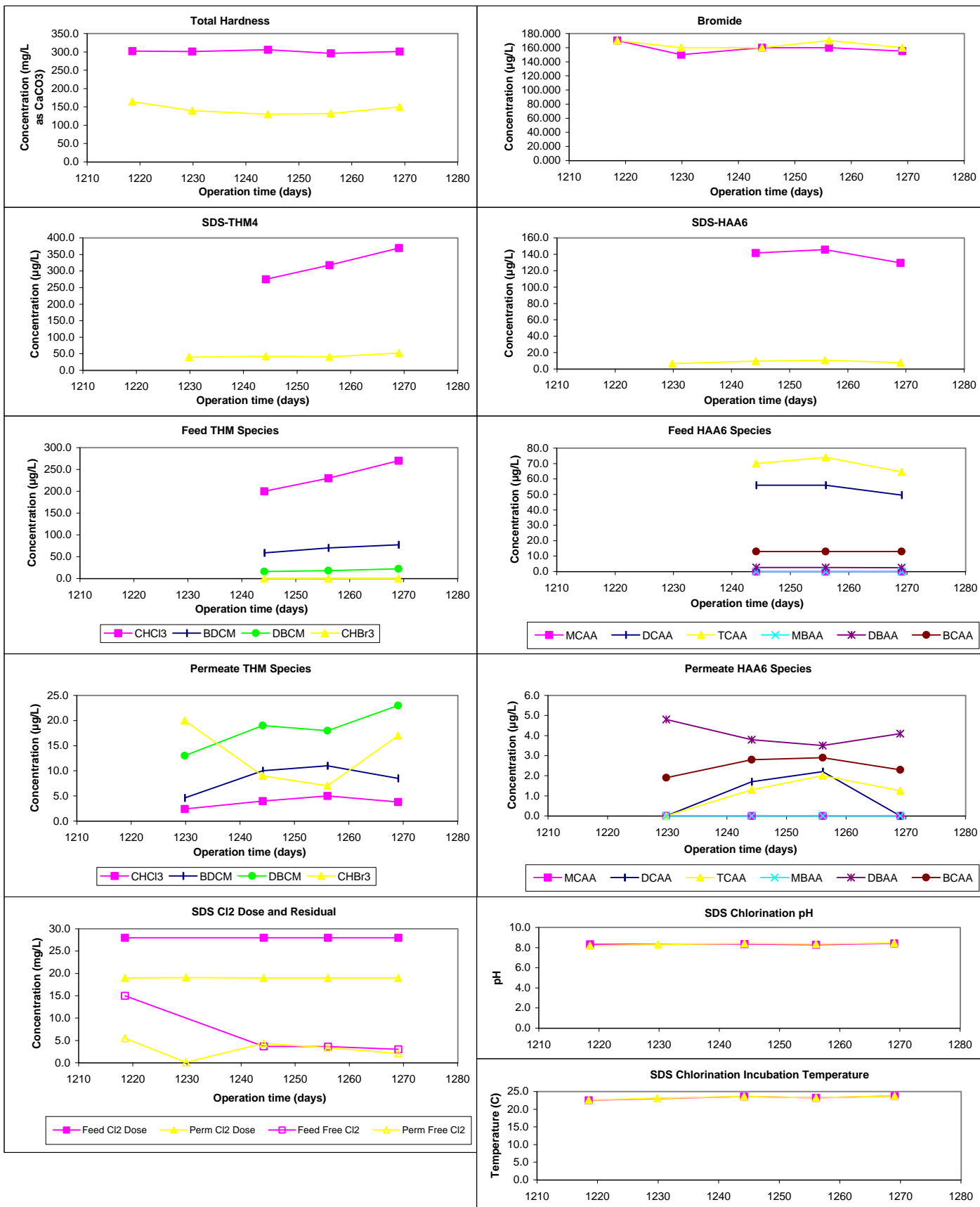
Chart Legend:

- Feed (System)
- ▲ Permeate (System)

Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs

