

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1080
Study Protocol	Membrane RBSMT treatment study
Plant ICR Number	1095
PWS Name	Lee County Utilities
City, State, Zip	Ft Myers, FL 33901

General Comments:

1. Lee County operates two treatment plants, the Corkscrew WTP (groundwater source) and the Olga WTP (surface water source). Under the ICR, the Corkscrew plant was required to conduct a study, but EPA allowed the utility to conduct a study at the Olga WTP since other studies were conducted on the ground water source. Also, a new WTP is under contract and may use the Caloosahatchee source; thus, a study on this source would provide more useful information to the utility.
2. During this bench-scale study, three membranes were evaluated: the Koch-Fluid Systems TFC-SR, the Hydranautics NTR7450, and the FilmTec NF200. The TFC-SR membrane was evaluated over four quarters. The NTR7450 was evaluated during the first two quarters, while the NF200 was evaluated during the last two quarters.
3. The influent to the study was collected from the effluent of the coagulation / flocculation / sedimentation process, prior to the addition of chlorine and ammonia. See Figure 3-2 and the figure in Appendix A in the Summary Report.
4. In addition to the full-scale process listed above, bench-scale cartridge filtration was used as pretreatment; however, no pretreatment to control inorganic scale formation was used. The lack of a scale inhibitor prior to nanofiltration may have resulted in the short runtimes observed in this study, and the addition of acid or antiscalant to control inorganic scale formation may have resulted in longer cleaning intervals than those observed during this study.
5. An average temperature of 25°C was used to during the productivity and water quality data analysis.
6. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 19 water quality outliers were removed during analysis of this study.
2. SDS conditions are summarized in Table 3-9 of the Summary Report. The incubation temperature, pH and target free residual were held constant over the four quarters at 24°C, 8.0 and ~1 mg/L, respectively. The incubation time was varied seasonally: Winter (quarter 1), 24 hours; Spring (quarter 2), 48 hours; Summer (quarter 3), 72 hours; and Autumn (quarter 4), 48 hours.

Productivity Comments:

1. 16 productivity outliers were removed during analysis of this study.
2. The standard cleaning procedure utilized a sodium hydroxide solution ($\text{pH} \approx 12$, at 40°C). When that was not effective (i.e., NTR7450 second quarter and NF-200 fourth quarter), the membranes were also cleaned with a sulfuric acid solution ($\text{pH} > 2.5$, at 40°C). Additional information about membrane cleaning is provided in Section 3 of the Summary Report.

ICR Information

ID / ICR#: FL 536-4048 / 1095
ICR Contact: Keith Kibbey
Phone No.: (941) 278-7070
Period: 3/25/98 - 3/31/98 (6 days)

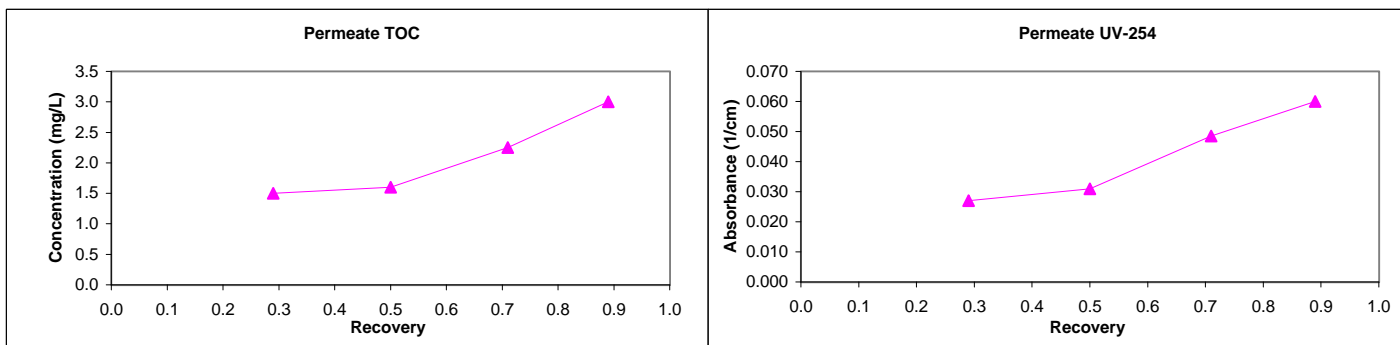
Membrane Information

Manufacturer:	Hydranautics Corp., San Diego, CA	Mfr. Temp:	25.0 °C
Trade Name:	NTR7450	840 Element Area:	365.0 ft ²
MWCO:	1,000 Da Daltons	840 Purchase Price:	\$800
Mfr. Flux:	45.0 gfd	840 Maximum Flow:	75.0 gpm
Mfr. NDP:	140.0 psi	840 Minimum Flow:	25.0 gpm
Mfr. MTCw:	0.320 gfd/psi	840 Total Width:	64.4 ft
		840 Feed Spacer Thickness:	0.0023 ft

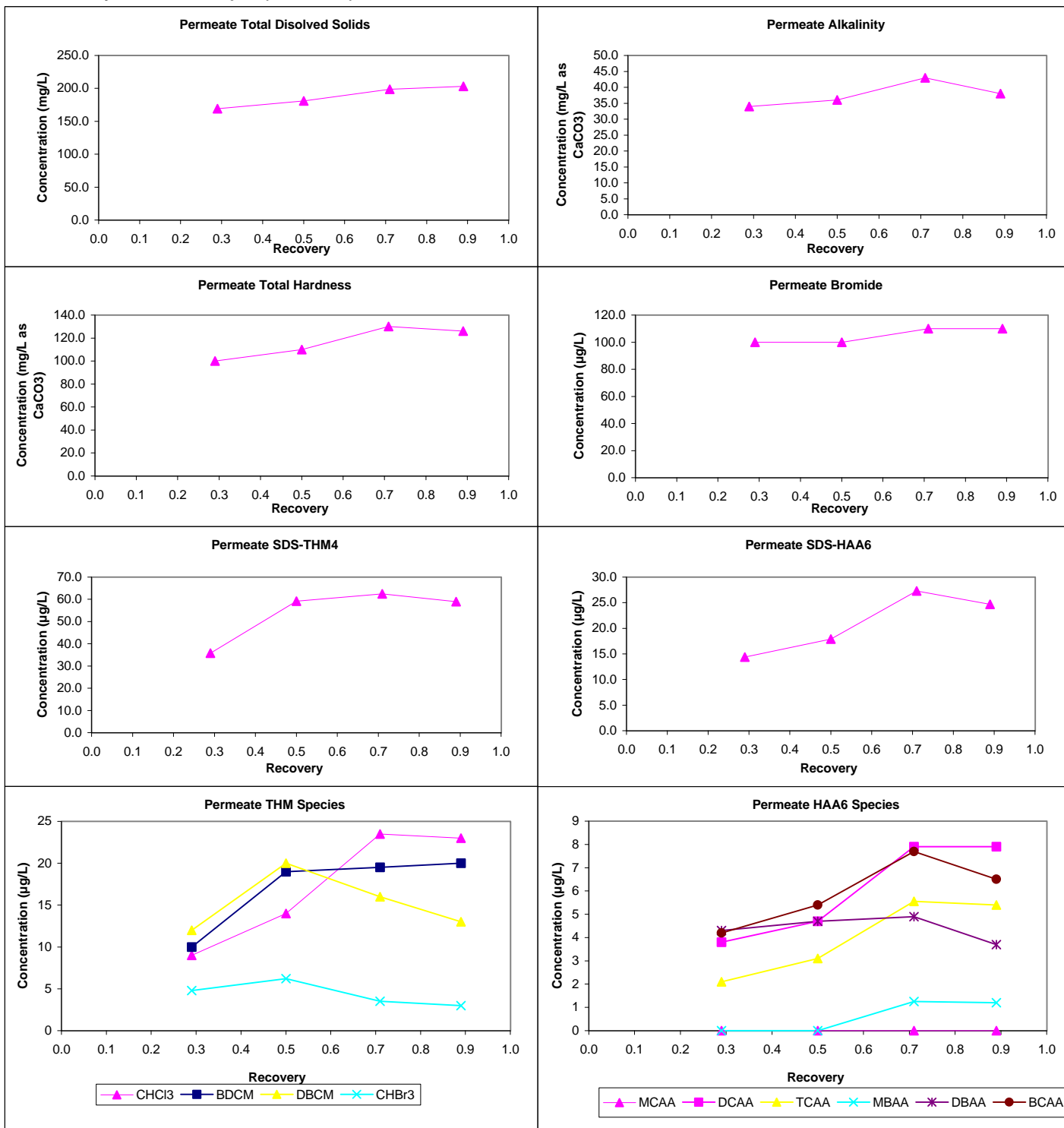
Water Quality Summary

Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.29	0.50	0.71	0.89	0.29	0.50	0.71	0.89	WQP	Count	Avg	SD
pH	7.4	0.5	7.9	7.9	7.8	7.8	7.9	7.8	7.7	7.7	TDS	17	-11	26
Temp	23.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0				
Alk	43	3	34	36	43	38	42	48	56	46	Alk	4	-18	45
TDS	215	2	169	181	199	203	229	249	250	270	TDS	4	-5	7
TotHard	141	7	100	110	130	126	154	174	177	190	TotHard	4	-9	20
CaHard	104	4	76	80	96	92	110	132	131	146	CaHard	4	-8	20
Turb	0.14	0.01	0.05	0.12	0.05	0.07	0.12	0.14	0.28	0.18	Turb	4	-96	132
Amm	0.08	0.01	0.08	0.08	0.08	0.09	NA	NA	NA	NA	Amm	0	n/a	n/a
TOC	6.3	0.1	1.5	1.6	2.3	3.0	8.2	10.7	14.3	29.1	TOC	4	-8	7
UV254	0.123	0.002	0.027	0.031	0.049	0.060	0.162	0.216	0.282	0.565	UV254	4	-5	6
SUVA	1.95	0.06	1.80	1.94	2.16	2.00	1.98	2.02	1.97	1.94				
Bromide	110	0	100	100	110	110	Pretreatment Information							
TOX	540	20	120	125	168	185								
							Process		Description		Scale			
CHCl3	77.5	3.5	9.0	14.0	23.5	23.0	PAC		3.3 mg/L		plant			
BDCM	34.0	1.0	10.0	19.0	19.5	20.0	Coagulation		aluminum sulfate (Al2(SO4)3		1 plant			
DBCM	12.0	0.0	12.0	20.0	16.0	13.0	Coagulation c		Polymer LC 214 PWG, 0.54 r		plant			
CHBr3	0.0	0.0	4.8	6.2	3.5	3.0	Cartridge filtration		5 micron filter		bench			
THM4	123.5	2.5	35.8	59.2	62.5	59.0	Design Parameters							
MCAA	5.3	0.2	0.0	0.0	0.0	0.0								
DCAA	35.5	0.5	3.8	4.7	7.9	7.9	Active memb area: 0.167 ft ²							
TCAA	45.0	3.0	2.1	3.1	5.6	5.4								
MBAA	1.9	0.1	0.0	0.0	1.3	1.2	Active width: 0.330 ft							
DBAA	3.1	0.2	4.3	4.7	4.9	3.7								
BCAA	14.0	0.0	4.2	5.4	7.7	6.5	Norm Temp: 22.0 °C							
TBAA	0.0	0.0	0.0	4.2	0.0	0.0								
CDBAA	6.1	0.3	2.9	3.2	4.0	3.1	Feed TDS: 300.0 mg/L							
DCBAA	22.5	2.5	3.0	3.5	5.7	4.6								
HAA5	90.8	2.5	10.2	12.5	19.6	18.2	Manuf rep TDS rej: 50%							
HAA6	104.8	2.6	14.4	17.9	27.3	24.7								
HAA9	133.3	5.3	20.3	28.8	37.0	32.4	Temp Norm MTC-w: 0.293 gfd/psi							
SDS Conditions														
WQP	Avg	SD	Count	Min - Max			Comments:							
Res (mg/L) (0)	0.76	0.17	6	0.48 - 0.92										
Temp (°C)	24.0	0.0	6	24.0 - 24.0										
pH (unit)	8.0	0.0	6	7.9 - 8.0										
Time (hr)	24.0	0.0	6	24.0 - 24.0										

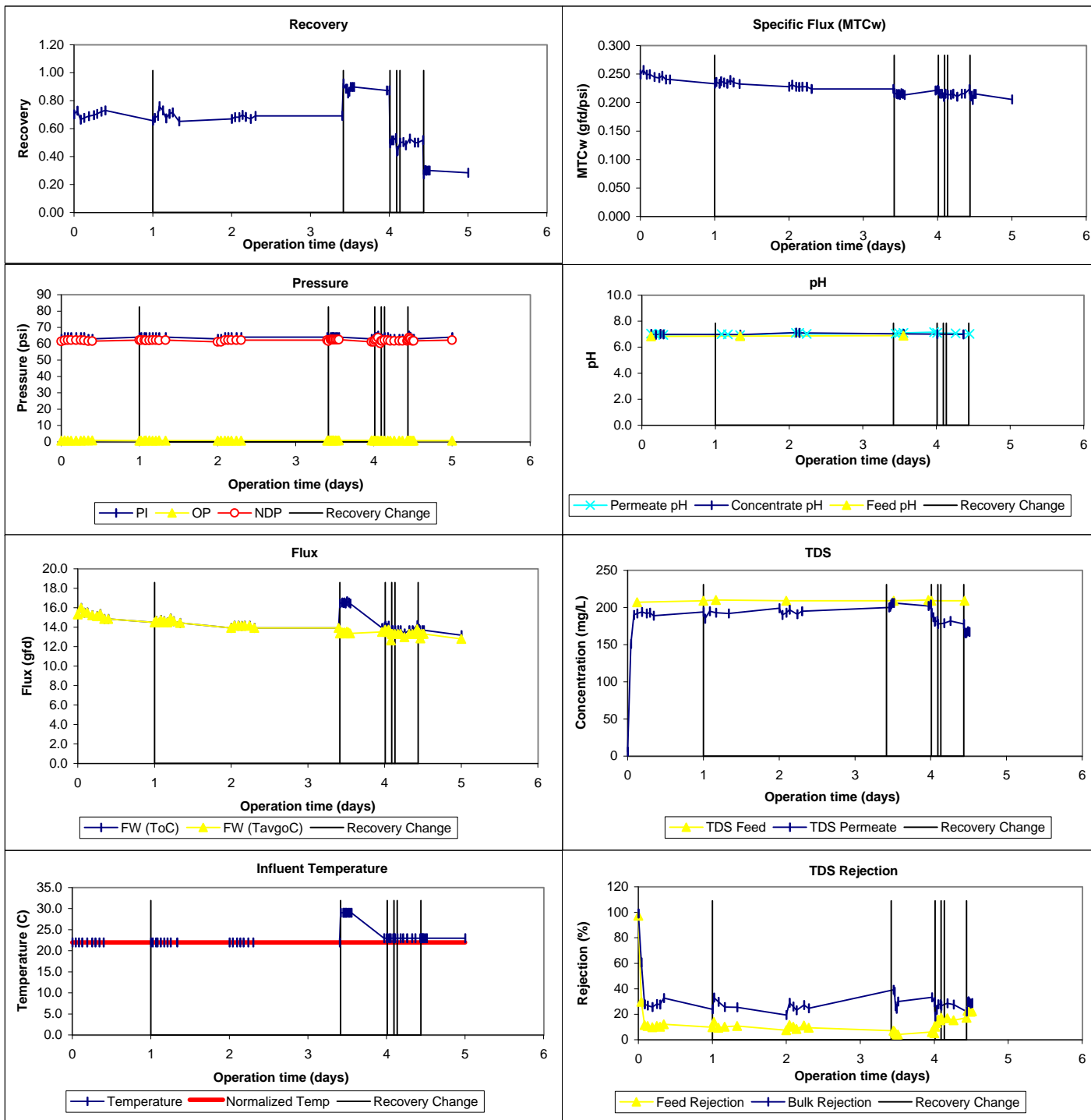
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL 536-4048 / 1095
 ICR Contact: Keith Kibbey
 Phone No.: (941) 278-7070
 Period: 7/7/98 - 7/14/98 (7 days)

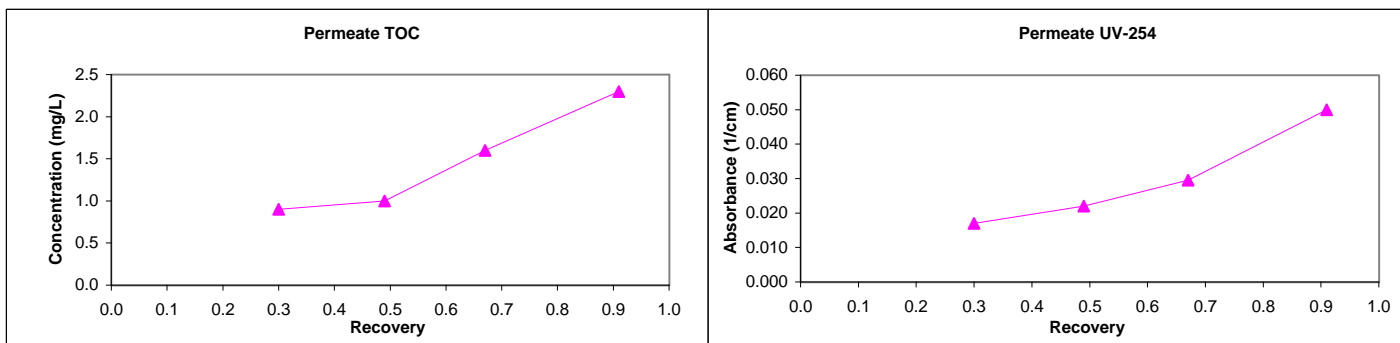
Membrane Information

Manufacturer: Hydranautics Corp., San Diego, CA Mfr. Temp: 25.0 °C
 Trade Name: NTR7450 840 Element Area: 365.0 ft²
 MWCO: 1,000 Da Daltons 840 Purchase Price: \$800
 Mfr. Flux: 45.0 gfd 840 Maximum Flow: 75.0 gpm
 Mfr. NDP: 140.0 psi 840 Minimum Flow: 25.0 gpm
 Mfr. MTCw: 0.320 gfd/psi 840 Total Width: 64.4 ft
 840 Feed Spacer Thickness: 0.0023 ft

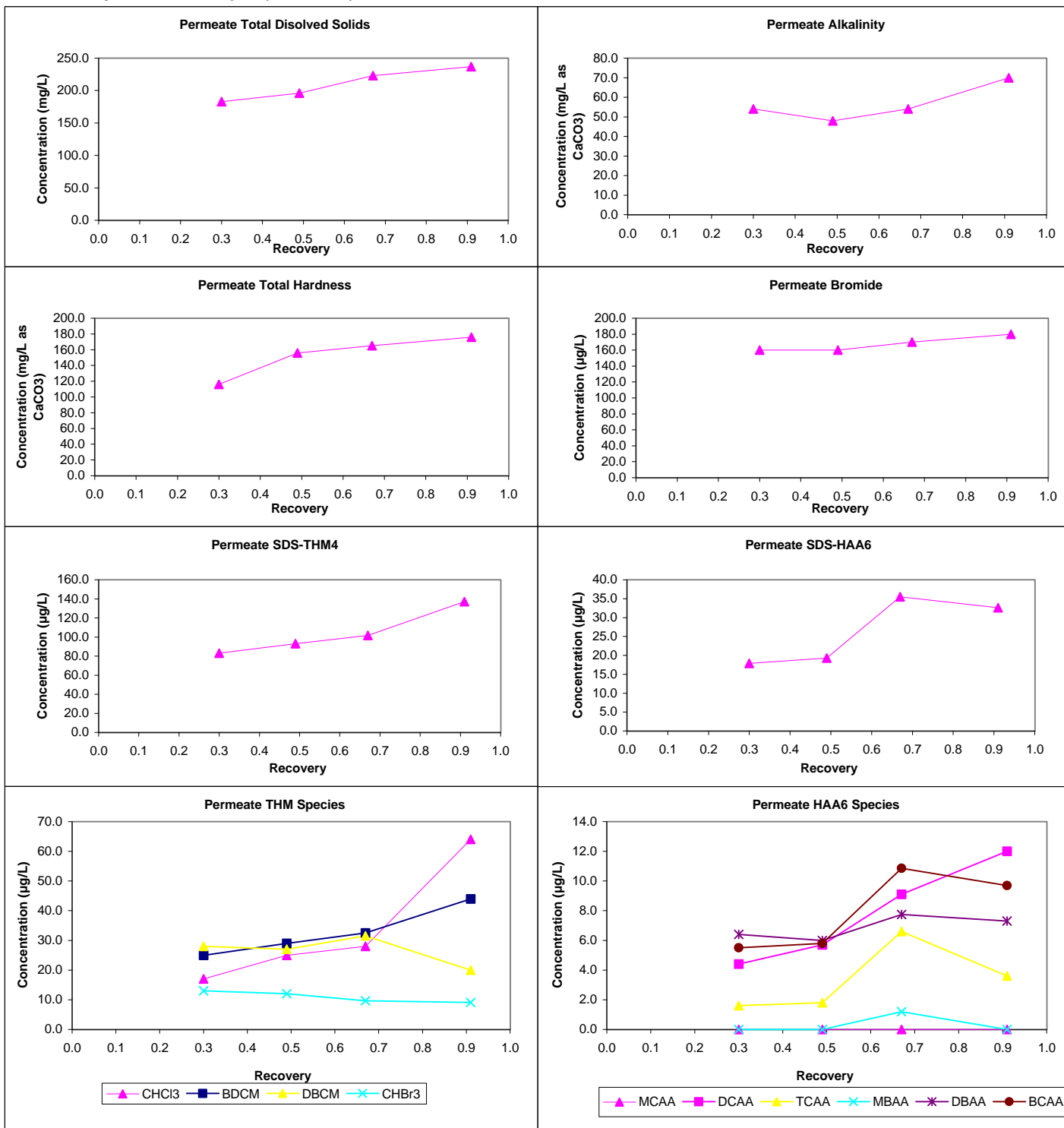
Water Quality Summary

Source ->		Feed		Permeate				Concentrate				Mass Balance Closure Error (%)							
Recovery ->		Avg	Diff	0.30	0.49	0.67	0.91	0.30	0.49	0.67	0.91	WQP	Count	Avg	SD				
pH		7.2	0.5	8.2	8.0	7.9	8.0	7.4	8.0	7.8	7.9	TDS	57	-7	9				
Temp		24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	37	72				
Alk		60	2	54	48	54	70	60	68	82	94	TDS	4	-11	11				
TDS		254	1	183	196	223	237	270	292	303	332	TotHard	4	-18	18				
TotHard		197	7	116	156	165	176	194	226	251	286	CaHard	4	16	36				
CaHard		137	9	86	96	117	142	150	156	213	256	Turb	4	-81	55				
Turb		0.20	0.01	0.09	0.09	0.08	0.10	0.17	0.20	0.27	0.47	Amm	0	n/a	n/a				
Amm		0.10	0.10	0.00	0.00	0.16	0.00	NA	NA	NA	NA	TOC	4	-5	2				
TOC		5.8	0.0	0.9	1.0	1.6	2.3	7.6	10.0	14.0	38.1	UV254	4	-3	2				
UV254		0.112	0.001	0.017	0.022	0.030	0.050	0.146	0.198	0.269	0.714	Pretreatment Information ProcessDescriptionScale PAC4.6 mg/Lplant Coagulation aluminum sulfate (Al2(SO4)3)1plant Coagulation c Polymer LC 214 PWG, 0.53 rplant Cartridge filtration5 micron filterbench							
SUVA		1.93	0.02	1.89	2.20	1.84	2.17	1.92	1.98	1.93	1.87								
Bromide		180	0	160	160	170	180	Design Parameters Active memb area:0.167 ft² Active width:0.330 ft Norm Temp:22.0 °C Feed TDS:300.0 mg/L Manuf rep TDS rej:50% Temp Norm MTC-w:0.293 gfd/psi											
TOX		545	5	125	135	185	230												
CHCl3		135.0	5.0	17.0	25.0	28.0	64.0	Design Parameters Active memb area:0.167 ft² Active width:0.330 ft Norm Temp:22.0 °C Feed TDS:300.0 mg/L Manuf rep TDS rej:50% Temp Norm MTC-w:0.293 gfd/psi											
BDCM		57.0	2.0	25.0	29.0	32.5	44.0												
DBCM		22.0	0.0	28.0	27.0	31.5	20.0												
CHBr3		2.0	0.1	13.0	12.0	9.7	9.1												
THM4		216.0	3.1	83.0	93.0	101.7	137.1												
MCAA		5.4	0.3	0.0	0.0	0.0	0.0												
DCAA		40.5	2.5	4.4	5.7	9.1	12.0												
TCAA		47.5	0.5	1.6	1.8	6.6	3.6												
MBAA		1.9	0.2	0.0	0.0	1.2	0.0												
DBAA		5.1	0.1	6.4	6.0	7.8	7.3												
BCAA		18.5	0.5	5.5	5.8	10.9	9.7												
TBAA		0.0	0.0	0.0	0.0	0.0	0.0												
CDBAA		8.0	0.6	2.8	2.1	7.5	2.3												
DCBAA		29.5	2.5	2.6	1.8	10.3	3.1												
HAA5		100.3	3.0	12.4	13.5	24.7	22.9												
HAA6		118.8	3.5	17.9	19.3	35.5	32.6												
HAA9		156.3	0.4	23.3	23.2	53.2	38.0												
SDS Conditions								Comments:											
WQP		Avg	SD	Count	Min - Max														
Res (mg/L) (0)		0.93	0.20	6	0.76 - 1.26														
Temp (°C)		24.0	0.0	6	24.0 - 24.0														
pH (unit)		8.0	0.0	6	8.0 - 8.0														
Time (hr)		48.0	0.0	6	48.0 - 48.0														

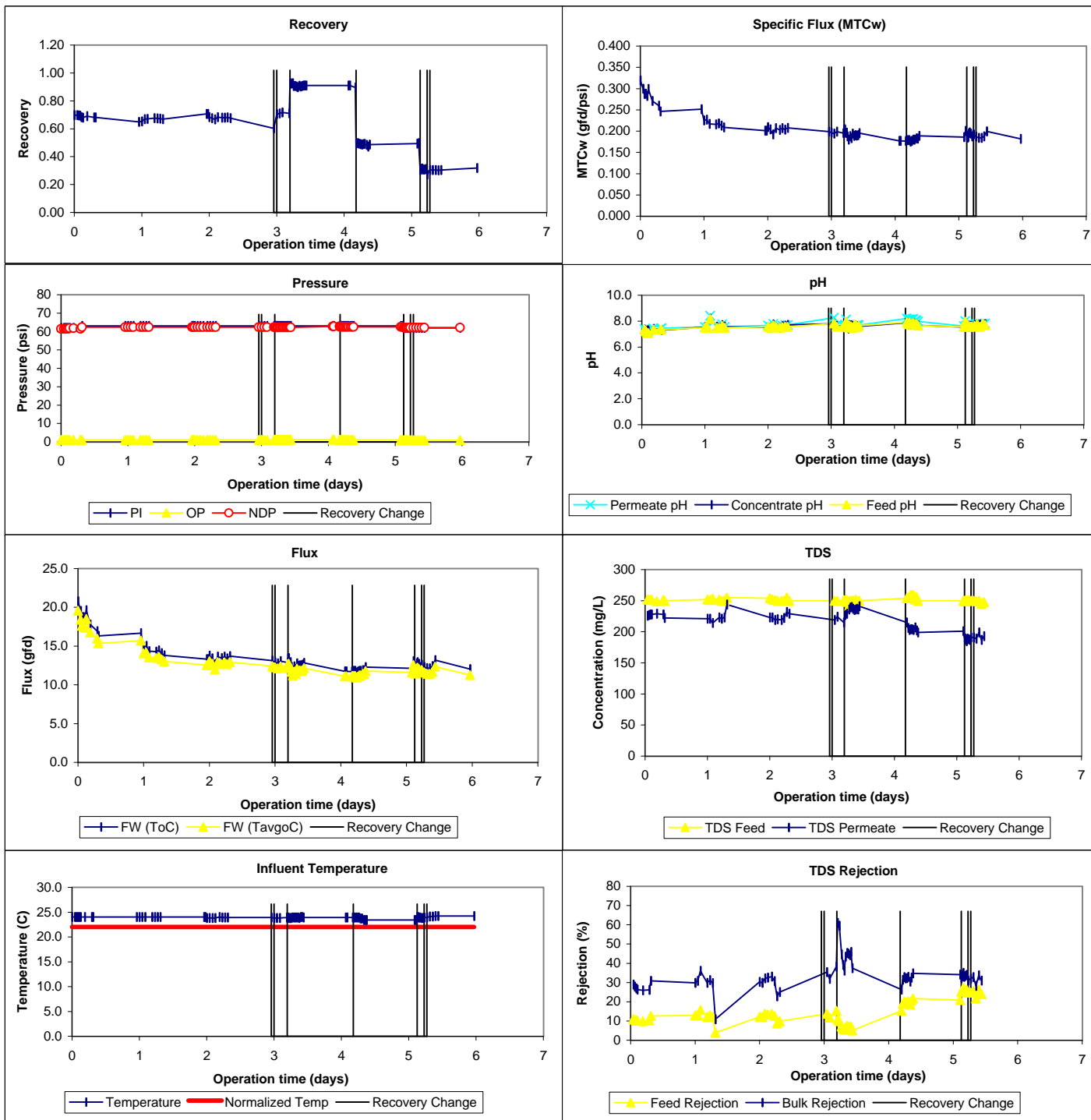
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL 536-4048 / 1095
 ICR Contact: Keith Kibbey
 Phone No.: (941) 278-7070
 Period: 9/15/98 - 9/22/98 (7 days)

Membrane Information

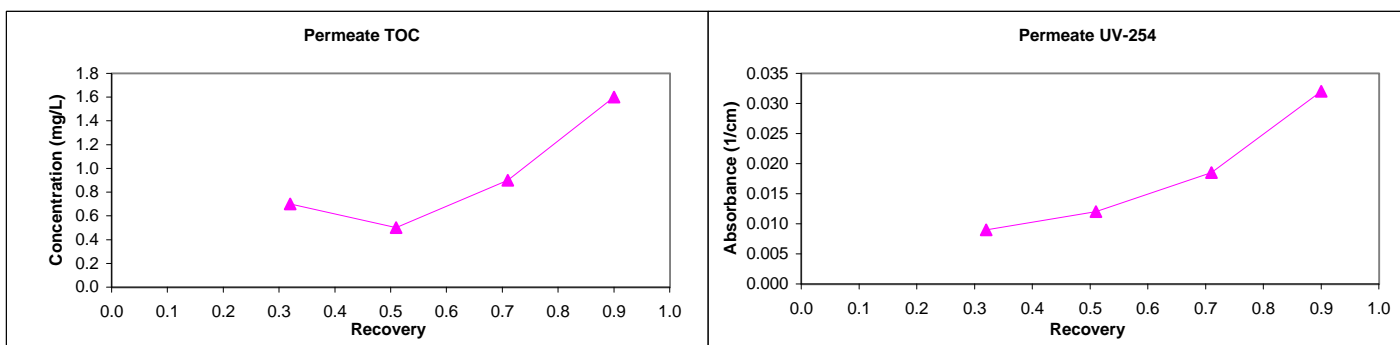
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.1 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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: 70.5 ft
 840 Feed Spacer Thickness: 0.0023 ft

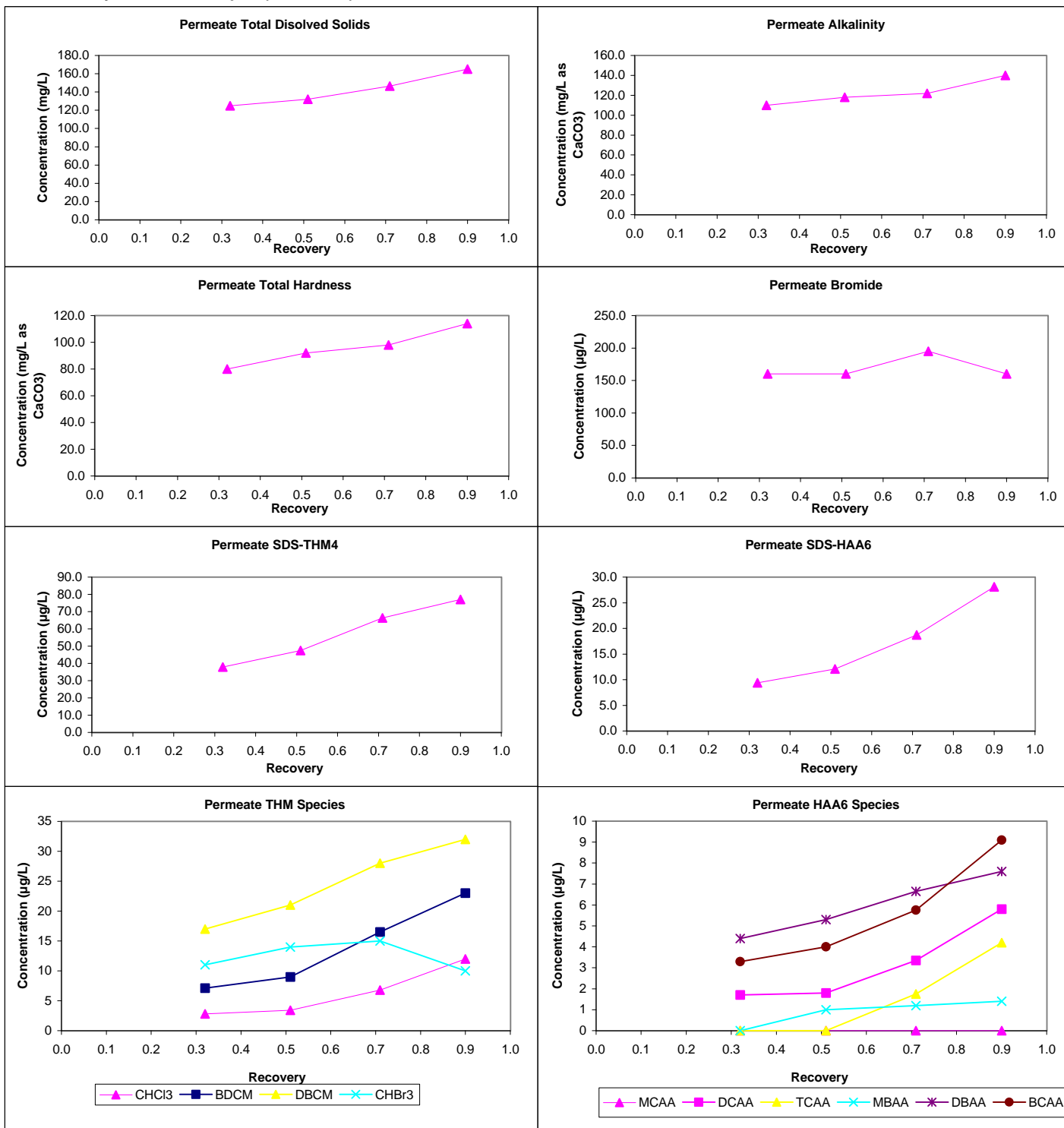
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)									
Recovery ->	Avg	Diff	0.32	0.51	0.71	0.90	0.32	0.51	0.71	0.90	WQP	Count	Avg	SD						
pH	7.9	0.0	7.9	8.0	7.9	7.8	7.8	7.8	7.5	7.6	TDS	50	-15	25						
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	3	7						
Alk	145	1	110	118	122	140	168	180	190	216	TDS	4	-16	18						
TDS	247	2	125	132	147	165	291	351	443	694	TotHard	4	-3	8						
TotHard	199	3	80	92	98	114	248	328	436	846	CaHard	4	-2	8						
CaHard	164	0	66	72	83	94	208	272	366	700	Turb	4	-43	89						
Turb	0.21	0.04	0.10	0.10	0.11	0.10	0.23	0.39	0.43	0.43	Amm	0	n/a	n/a						
Amm	0.00	0.00	0.00	0.00	0.10	0.00	NA	NA	NA	NA	TOC	4	17	43						
TOC	8.3	0.1	0.7	0.5	0.9	1.6	12.2	86.9	26.1	60.2	UV254	4	-4	10						
UV254	0.209	0.002	0.009	0.012	0.019	0.032	0.297	0.434	0.672	1.522	Pretreatment Information									
SUVA	2.52	0.05	1.29	2.40	2.06	2.00	2.43	0.50	2.57	2.53					Process Description Scale					
Bromide	150	0	160	160	195	160	Coagulation aluminum sulfate (Al2(SO4)3) 1 plant Coagulation c Polymer LC 214 PWG, 0.59 r plant Cartridge filtration 5 micron filter bench													
TOX	1580	520	54	65	108	145														
CHCl3	255.0	35.0	2.8	3.4	6.8	12.0	Design Parameters													
BDCM	71.5	7.5	7.1	9.0	16.5	23.0									Active memb area: 0.167 ft ²			ID#	Recov (dec.)	F _{w-des} (gfd)
DBCM	16.0	2.0	17.0	21.0	28.0	32.0														
CHBr3	0.0	0.0	11.0	14.0	15.0	10.0									Norm Temp: 22.0 °C					
THM4	342.5	44.5	37.9	47.4	66.3	77.0												Feed TDS: 300.0 mg/L		
MCAA	10.0	1.1	0.0	0.0	0.0	0.0									Manuf rep TDS rej: 50%					
DCAA	84.5	3.5	1.7	1.8	3.4	5.8												Temp Norm MTC-w: 0.260 gfd/psi		
TCAA	115.0	5.0	0.0	0.0	1.8	4.2									Comments:					
MBAA	2.0	0.1	0.0	1.0	1.2	1.4														
DBAA	3.4	0.2	4.4	5.3	6.7	7.6														
BCAA	22.0	1.0	3.3	4.0	5.8	9.1														
TBAA	0.0	0.0	0.0	0.0	0.0	0.0														
CDBAA	5.4	1.1	4.5	5.1	6.2	9.8														
DCBAA	38.5	9.5	2.6	2.9	4.9	11.0														
HAA5	214.8	9.5	6.1	8.1	13.0	19.0														
HAA6	236.8	10.5	9.4	12.1	18.7	28.1														
HAA9	280.7	21.1	16.5	20.1	29.8	48.9														
SDS Conditions																				
WQP	Avg	SD	Count	Min - Max																
Res (mg/L) (0)	1.16	0.32	6	0.82 - 1.63																
Temp (°C)	24.0	0.0	6	24.0 - 24.0																
pH (unit)	7.9	0.1	6	7.9 - 8.0																
Time (hr)	72.0	0.0	6	72.0 - 72.0																

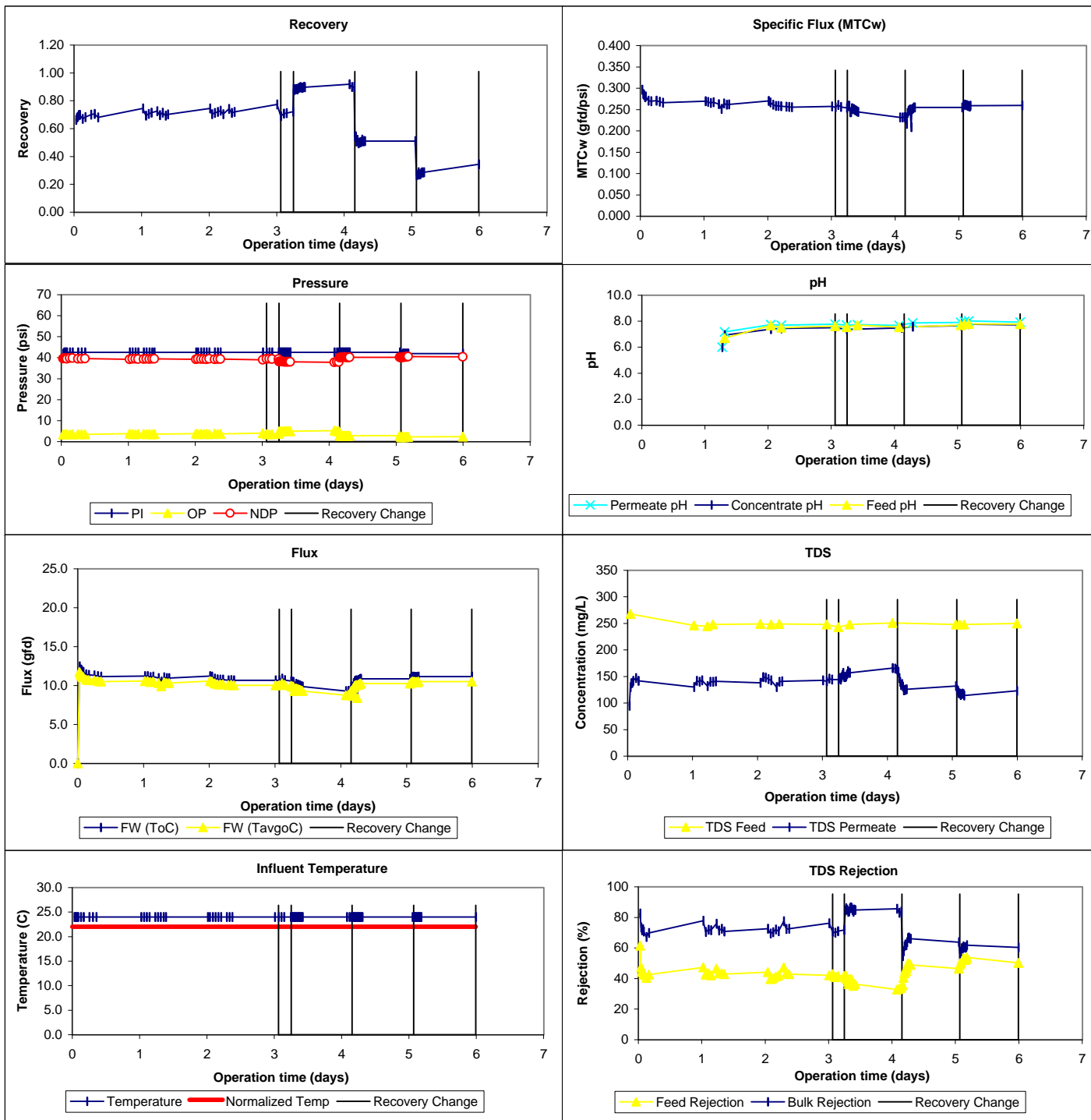
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL 536-4048 / 1095
 ICR Contact: Keith Kibbey
 Phone No.: (941) 278-7070
 Period: 3/17/99 - 3/23/99 (6 days)

Membrane Information

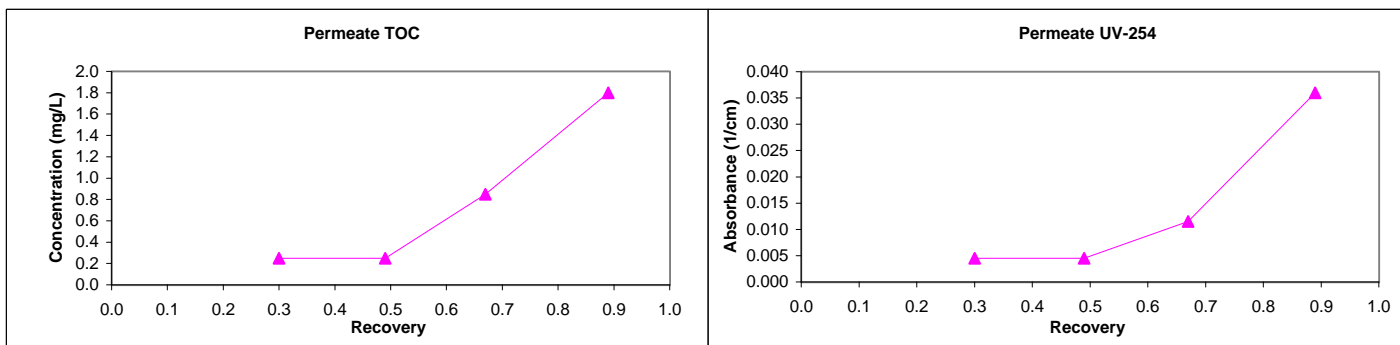
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.1 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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: 70.5 ft
 840 Feed Spacer Thickness: 0.0023 ft

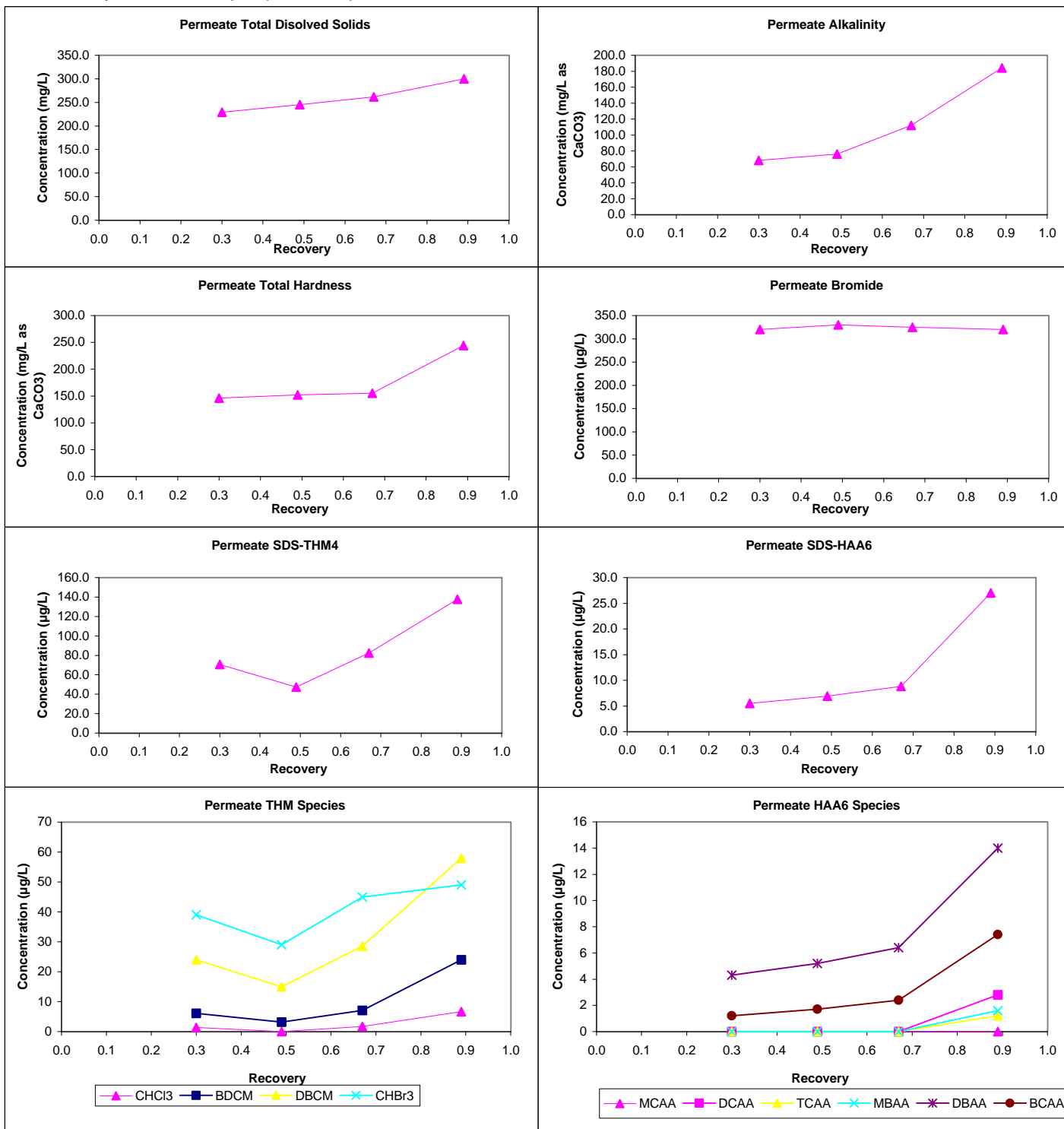
Water Quality Summary

Source ->		Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.49	0.67	0.89	0.30	0.49	0.67	0.89	WQP	Count	Avg	SD	
pH	7.6	0.0	7.8	7.8	8.0	7.9	7.9	8.0	7.9	8.0	TDS	65	-15	30	
Temp	23.8	0.3	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	-68	14	
Alk	217	1	68	76	112	184	186	190	255	292	TDS	4	4	5	
TDS	354	1	229	245	262	300	409	456	570	880	TotHard	4	7	22	
TotHard	268	0	146	152	155	244	318	356	480	772	CaHard	4	-4	14	
CaHard	225	13	88	94	115	186	266	306	400	640	Turb	4	-111	84	
Turb	0.22	0.00	0.06	0.06	0.08	0.10	0.21	0.23	0.23	0.36	Amm	0	n/a	n/a	
Amm	0.15	0.04	0.00	0.10	0.00	0.00	NA	NA	NA	NA	TOC	2	3	7	
TOC	7.8	0.3	0.3	0.3	0.9	1.8	9.4	12.7	21.0	62.1	UV254	2	14	3	
UV254	0.170	0.001	0.005	0.005	0.012	0.036	0.242	0.352	0.550	1.512	Pretreatment Information				
SUVA	2.19	0.05	1.80	1.80	1.35	2.00	2.57	2.77	2.62	2.43					
Bromide	305	5	320	330	325	320	Process Description Scale								
TOX	893	3	86	66	70	175									
CHCl3	165.0	5.0	1.4	0.0	1.7	6.7	PAC 0 mg/L plant Coagulation aluminum sulfate (Al2(SO4)3) 1 plant Coagulation c Polymer LC 214 PWG, 0.44 r plant Cartridge filtration 5 micron filter bench								
BDCM	100.0	0.0	6.1	3.2	7.1	24.0									
DBCM	54.0	1.0	24.0	15.0	28.5	58.0									
CHBr3	5.7	0.1	39.0	29.0	45.0	49.0									
THM4	324.7	4.2	70.5	47.2	82.3	137.7									
MCAA	5.9	0.5	0.0	0.0	0.0	0.0	Design Parameters								
DCAA	46.5	3.5	0.0	0.0	0.0	2.8									
TCAA	45.0	2.0	0.0	0.0	0.0	1.2									
MBAA	5.6	3.1	0.0	0.0	0.0	1.6									
DBAA	10.0	0.0	4.3	5.2	6.4	14.0									
BCAA	27.5	0.5	1.2	1.7	2.4	7.4									
TBAA	4.2	NA	5.5	6.3	6.6	9.8									
CDBAA	13.5	0.5	2.2	3.1	3.6	7.8									
DCBAA	32.0	1.0	1.1	1.5	1.8	4.4									
HAA5	112.9	2.0	4.3	5.2	6.4	19.6									
HAA6	140.4	2.5	5.5	6.9	8.8	27.0	Active memb area: 0.167 ft ² Active width: 0.330 ft Norm Temp: 22.0 °C Feed TDS: 300.0 mg/L Manuf rep TDS rej: 50% Temp Norm MTC-w: 0.260 gfd/psi								
HAA9	191.1	NA	14.3	17.8	20.8	49.0									
SDS Conditions															
WQP	Avg	SD	Count	Min - Max	Comments:										
Res (mg/L) (0)	0.94	0.11	6	0.73 - 1.03											
Temp (°C)	24.0	0.0	6	24.0 - 24.0											
pH (unit)	8.0	0.0	6	8.0 - 8.0											
Time (hr)	48.0	0.0	6	48.0 - 48.0											

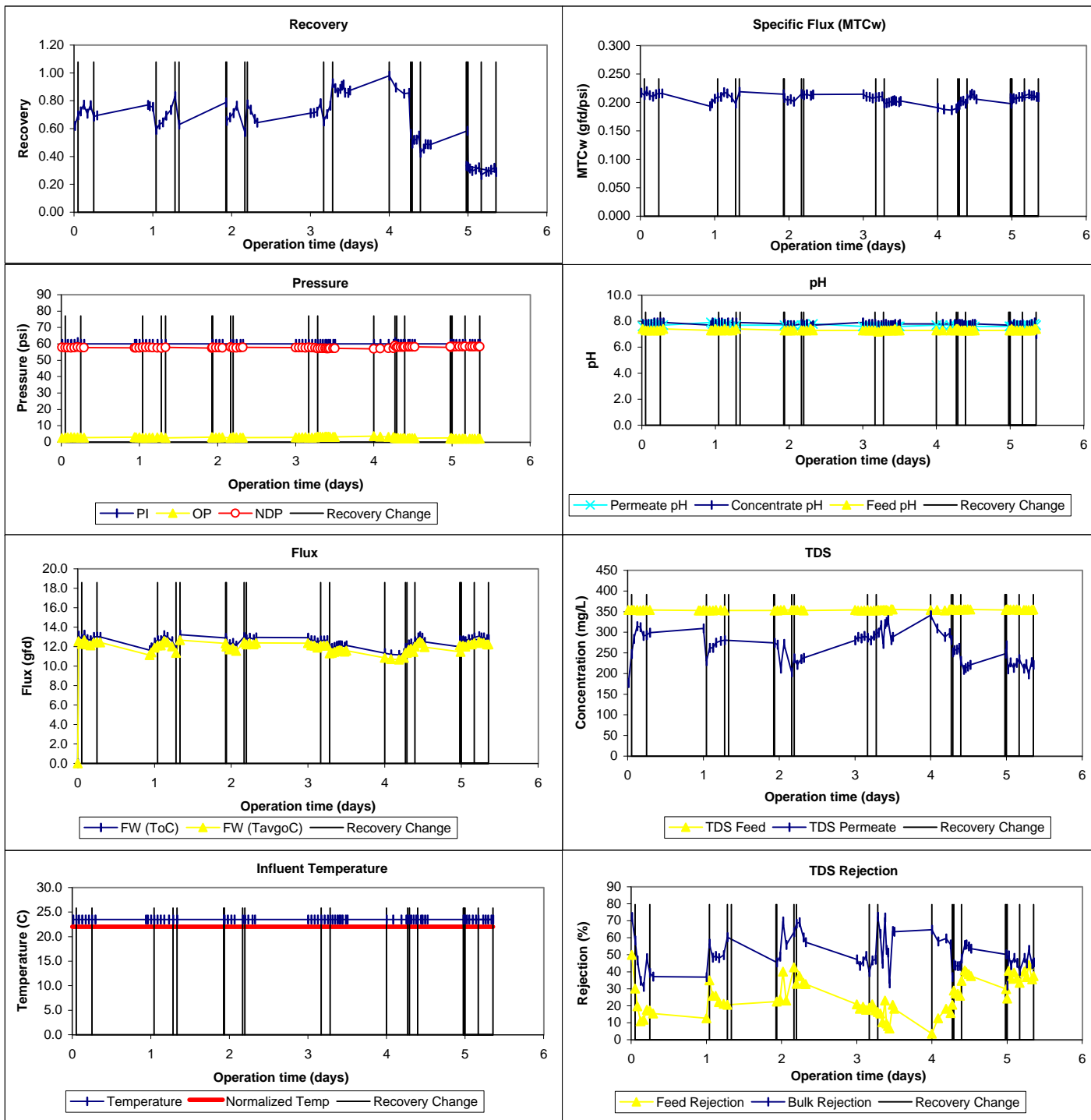
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 5/19/98 - 5/26/98 (7 days)

Membrane Information

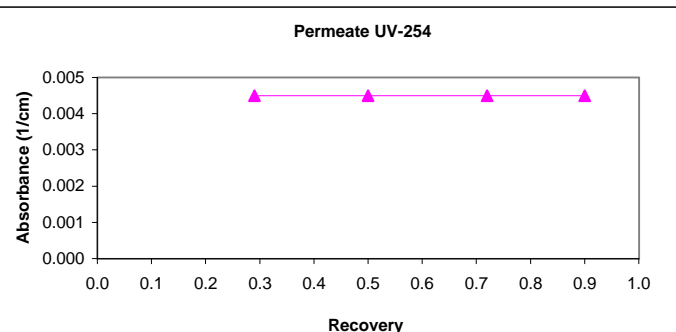
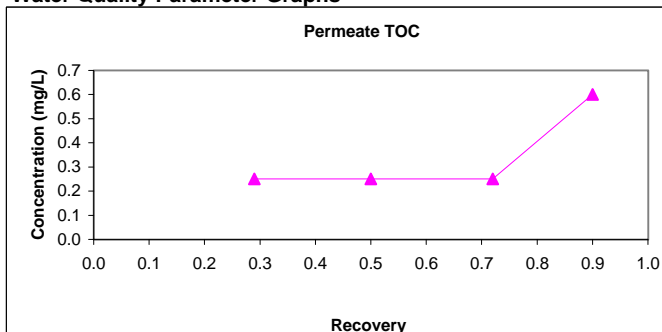
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 330.0 ft²
840 Purchase Price: N.A.
840 Maximum Flow: 80.0 gpm
840 Minimum Flow: 20.0 gpm
840 Total Width: 58.2 ft
840 Feed Spacer Thickness: 0.0026 ft

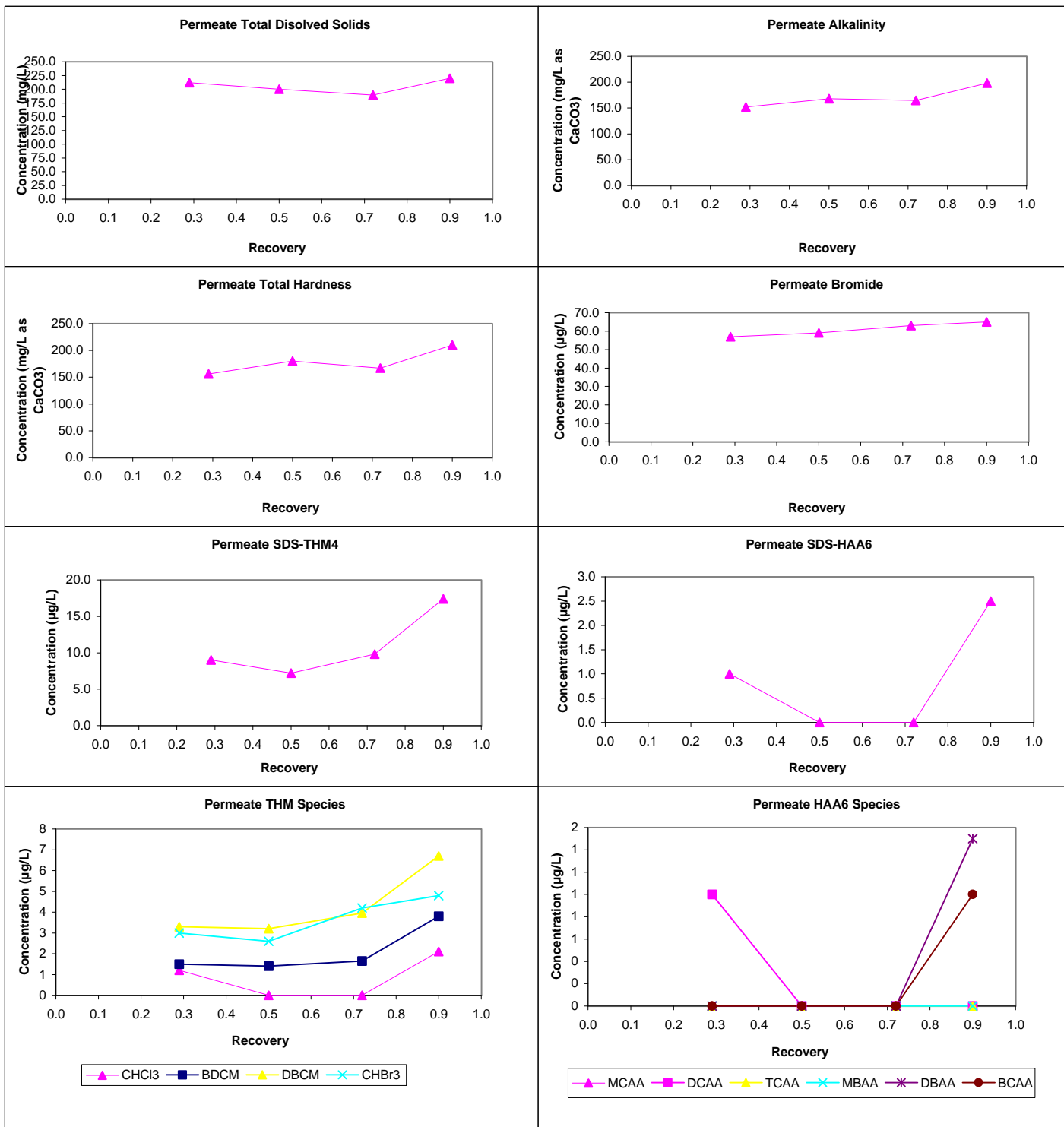
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																																				
Recovery ->	Avg	RD	0.29	0.50	0.72	0.90	0.29	0.50	0.72	0.90	WQP	Count	Avg	SD																																	
pH	8.5	0.1	8.4	8.3	8.0	8.1	8.4	8.4	8.3	8.4	TDS	58	-1	10																																	
Temp	24.3	0.3	24.0	25.0	25.0	25.0	24.0	25.0	25.0	25.0	Alk	4	-29	28																																	
Alk	229	7	152	168	165	198	244	274	275	314	TDS	4	-17	38																																	
TDS	270	2	212	200	190	220	321	416	354	442	TotHard	4	-51	39																																	
TotHard	291	39	156	180	167	210	282	342	378	504	CaHard	4	-19	20																																	
CaHard	248	12	148	162	157	198	276	336	372	496	Turb	4	-30	67																																	
Turb	0.13	0.0	0.05	0.06	0.06	0.06	0.22	0.28	0.17	0.38	Amm	0	n/a	n/a																																	
Amm	0.03	0.03	0.00	0.00	0.04	0.00	NA	NA	NA	NA	TOC	2	-9	4																																	
TOC	6.1	0.1	0.3	0.3	0.3	0.6	8.6	12.7	19.6	49.4	UV254	0	n/a	n/a																																	
UV254	0.185	0.000	0.005	0.005	0.005	0.005	0.263	0.399	0.600	1.489	Pretreatment Information <table><tr><th>Process</th><th>Description</th><th>Scale</th></tr><tr><td>Cartridge filtration</td><td>5 micron filter</td><td>bench</td></tr></table> Design Parameters <table><tr><td>Active memb area:</td><td>0.167 ft²</td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F_{W-de} (gfd)</td></tr><tr><td>Active width:</td><td>0.330 ft</td></tr><tr><td>Norm Temp:</td><td>24.6 °C</td><td>1</td><td>0.70</td><td>15.0</td></tr><tr><td>Feed TDS:</td><td>700.0 mg/L</td><td>2</td><td>0.90</td><td>15.0</td></tr><tr><td>Manuf rep TDS rej:</td><td>50%</td><td>3</td><td>0.50</td><td>15.0</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.237 gfd/psi</td><td>4</td><td>0.30</td><td>15.0</td></tr></table> Comments:				Process	Description	Scale	Cartridge filtration	5 micron filter	bench	Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-de} (gfd)	Active width:	0.330 ft	Norm Temp:	24.6 °C	1	0.70	15.0	Feed TDS:	700.0 mg/L	2	0.90	15.0	Manuf rep TDS rej:	50%	3	0.50	15.0	Temp Norm MTC-w:	0.237 gfd/psi	4	0.30	15.0
Process	Description	Scale																																													
Cartridge filtration	5 micron filter	bench																																													
Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-de} (gfd)																																											
Active width:	0.330 ft																																														
Norm Temp:	24.6 °C	1	0.70	15.0																																											
Feed TDS:	700.0 mg/L	2	0.90	15.0																																											
Manuf rep TDS rej:	50%	3	0.50	15.0																																											
Temp Norm MTC-w:	0.237 gfd/psi	4	0.30	15.0																																											
SUVA	3.03	0.05	1.80	1.80	1.80	0.75	3.06	3.14	3.06	3.01																																					
Bromide	62	1	57	59	63	65																																									
TOX	538	38	40	29	48	44																																									
CHCl3	165.0	5.0	1.2	0.0	0.0	2.1																																									
BDCM	22.0	2.0	1.5	1.4	1.7	3.8																																									
DBCM	3.6	0.2	3.3	3.2	4.0	6.7																																									
CHBr3	0.0	0.0	3.0	2.6	4.2	4.8																																									
THM4	190.6	6.8	9.0	7.2	9.8	17.4																																									
MCAA	5.4	0.9	0.0	0.0	0.0	0.0																																									
DCAA	47.5	3.5	1.0	0.0	0.0	0.0																																									
TCAA	37.5	2.5	0.0	0.0	0.0	0.0																																									
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																																									
DBAA	0.5	0.5	0.0	0.0	0.0	1.5																																									
BCAA	7.7	0.4	0.0	0.0	0.0	1.0																																									
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	7.5	0.2	0.0	0.0	0.0	0.0																																									
HAA5	90.9	7.3	1.0	0.0	0.0	1.5																																									
HAA6	98.6	7.8	1.0	0.0	0.0	2.5																																									
HAA9	106.0	7.6	1.0	0.0	0.0	2.5																																									
SDS Conditions																																															
WQP	Avg	SD	Count	Min - Max																																											
Res (mg/L) (0)	1.41	0.69	6	0.74 - 2.60																																											
Temp (°C)	25.0	0.0	6	25.0 - 25.0																																											
pH (unit)	8.5	0.1	6	8.4 - 8.6																																											
Time (hr)	24.2	0.4	6	24.0 - 25.0																																											

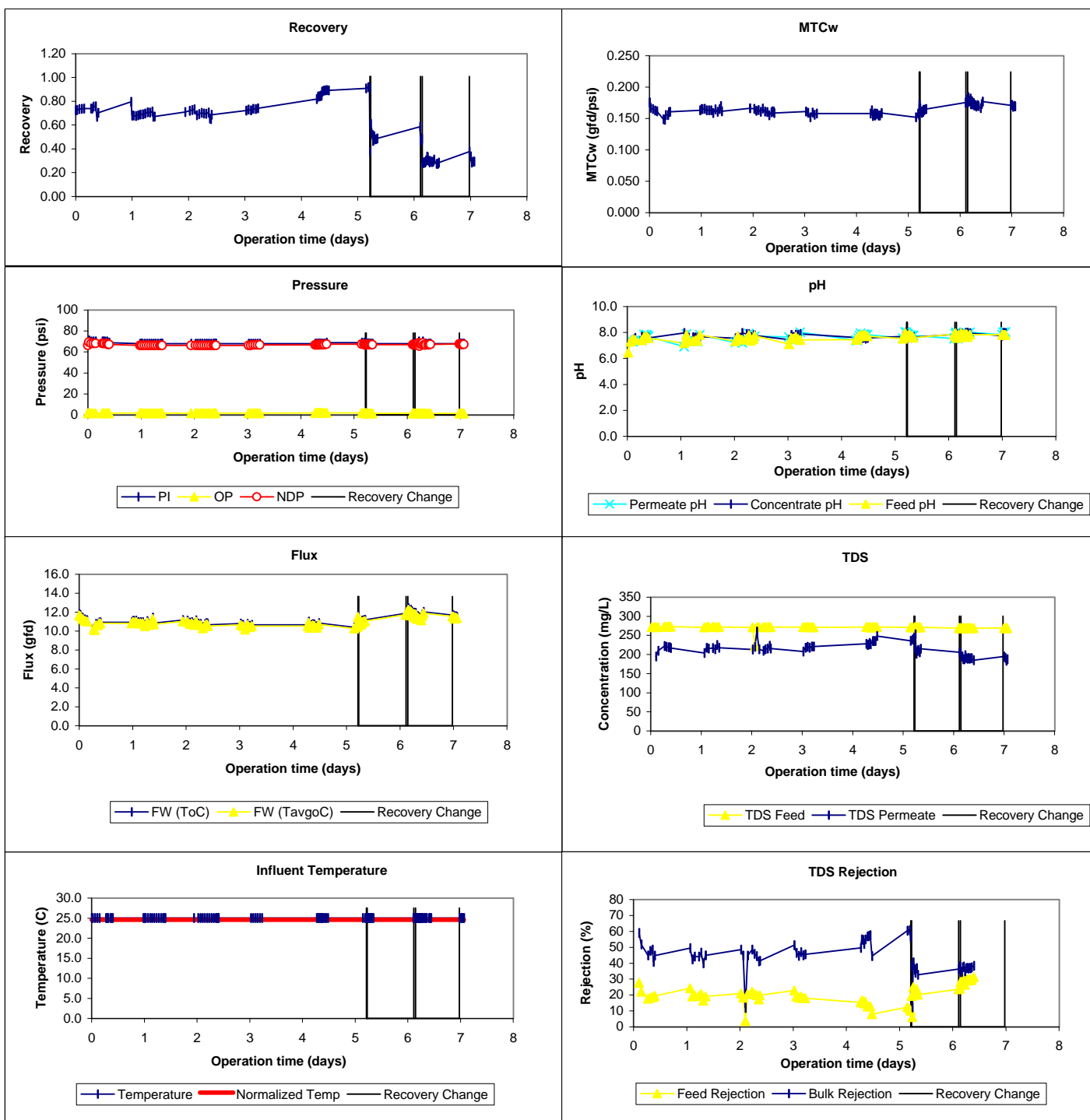
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 7/24/98 - 7/30/98 (6 days)

Membrane Information

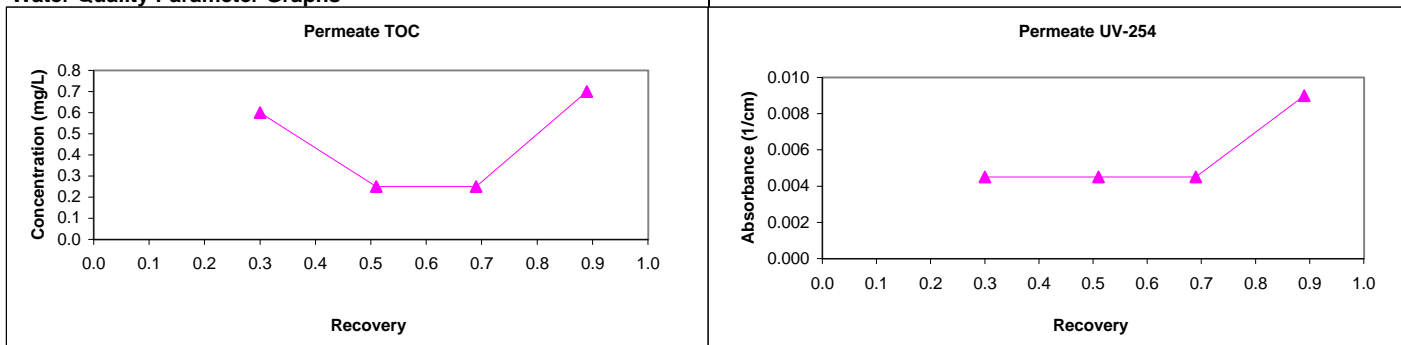
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 330.0 ft²
840 Purchase Price: N.A.
840 Maximum Flow: 80.0 gpm
840 Minimum Flow: 20.0 gpm
840 Total Width: 58.2 ft
840 Feed Spacer Thickness: 0.0026 ft

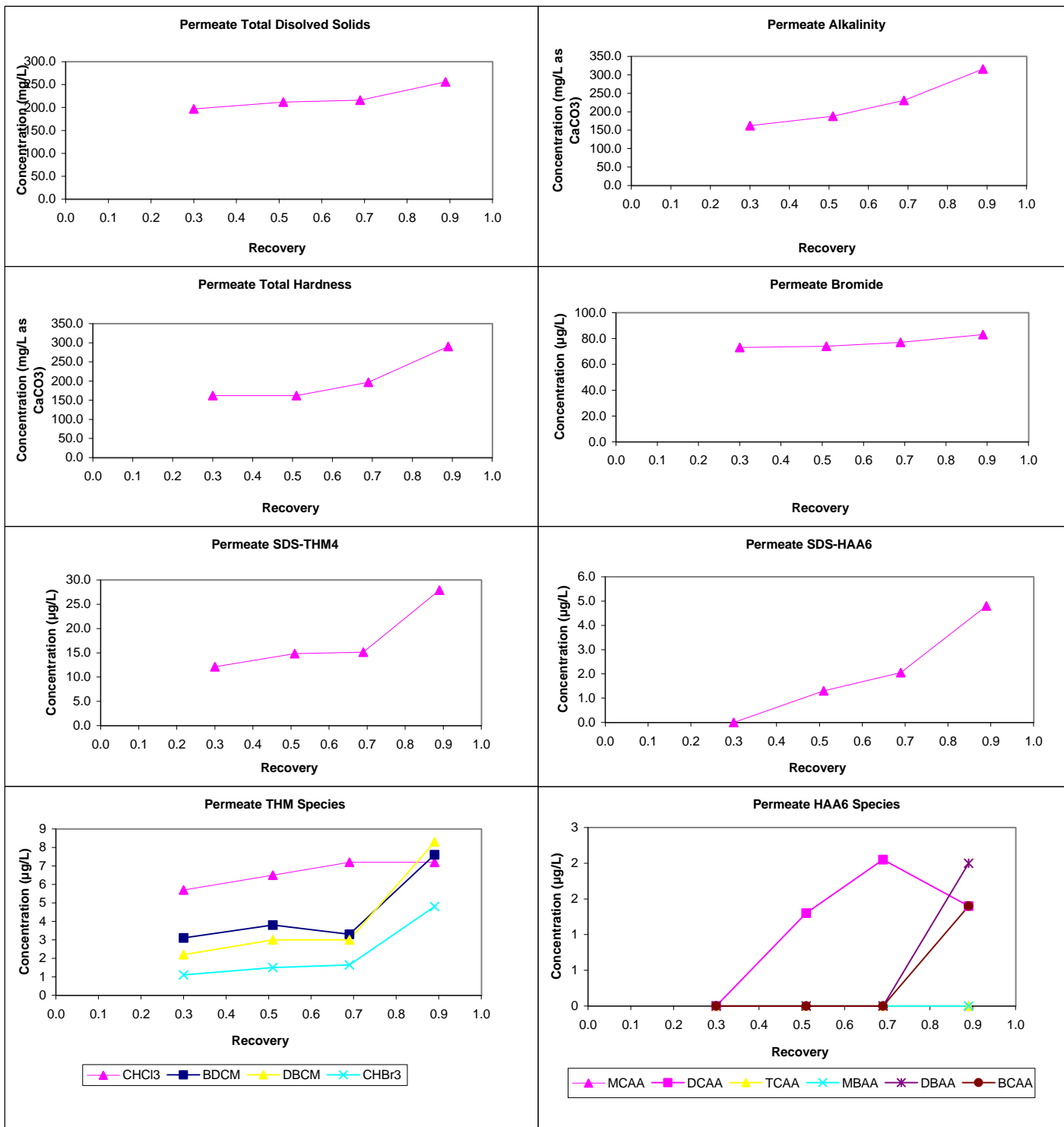
Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	RD	0.30	0.51	0.69	0.89	0.30	0.51	0.69	0.89	WQP	Count	Avg	SD
pH	7.9	0.1	7.9	7.8	7.7	7.6	8.0	7.9	7.9	8.2	TDS	50	-10	10
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0				
Alk	330	4	162	188	231	316	288	292	372	442	Alk	4	-38	27
TDS	286	2	197	212	216	256	324	357	385	458	TDS	4	-8	8
TotHard	300	22	162	162	197	290	352	384	438	698	TotHard	4	2	30
CaHard	268	4	148	134	164	268	314	340	357	618	CaHard	4	-1	42
Turb	0.20	0.0	0.05	0.07	0.07	0.06	0.18	0.26	0.25	0.43	Turb	4	-90	75
Amm	0.04	0.04	0.00	0.00	0.00	0.00	NA	NA	NA	NA	Amm	0	n/a	n/a
TOC	6.7	0.1	0.6	0.3	0.3	0.7	8.2	12.0	19.8	52.0	TOC	3	-7	5
UV254	0.204	0.011	0.005	0.005	0.005	0.009	0.280	0.395	0.628	1.593	UV254	1	-12	n/a
SUVA	3.06	0.10	0.75	1.80	1.80	1.29	3.41	3.29	3.17	3.06				
Bromide	85	2	73	74	77	83	Pretreatment Information							
TOX	473	58	13	13	13	38								
CHCl3	175.0	25.0	5.7	6.5	7.2	7.2	Cartridge filtration	5 micron filter	bench					
BDCM	23.0	4.0	3.1	3.8	3.3	7.6	Design Parameters							
DBCM	4.2	0.3	2.2	3.0	3.0	8.3								
CHBr3	0.0	0.0	1.1	1.5	1.7	4.8								
THM4	202.2	29.3	12.1	14.8	15.2	27.9								
MCAA	3.4	0.1	0.0	0.0	0.0	0.0								
DCAA	39.5	5.5	0.0	1.3	2.1	1.4								
TCAA	15.2	6.9	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	0.0	0.0	0.0	0.0	0.0	2.0								
BCAA	5.9	0.9	0.0	0.0	0.0	1.4								
TBAA	0.0	0.0	0.0	0.0	0.0	0.0	Active memb area: 0.167 ft ² Active width: 0.330 ft Norm Temp: 24.6 °C Feed TDS: 700.0 mg/L Manuf rep TDS rej: 50% Temp Norm MTC-w: 0.237 gfd/psi							
CDBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCBAA	2.6	1.4	0.0	0.0	0.0	0.0								
HAA5	58.1	12.3	0.0	1.3	2.1	3.4								
HAA6	63.9	13.1	0.0	1.3	2.1	4.8	ID# Recov (dec.) F _{W-de} (gfd)							
HAA9	66.5	14.5	0.0	1.3	2.1	4.8								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.35	0.37	6	0.70 - 1.67										
Temp (°C)	25.0	0.0	6	25.0 - 25.0										
pH (unit)	9.0	0.1	6	8.8 - 9.0										
Time (hr)	24.0	0.0	6	24.0 - 24.0										
Comments:														

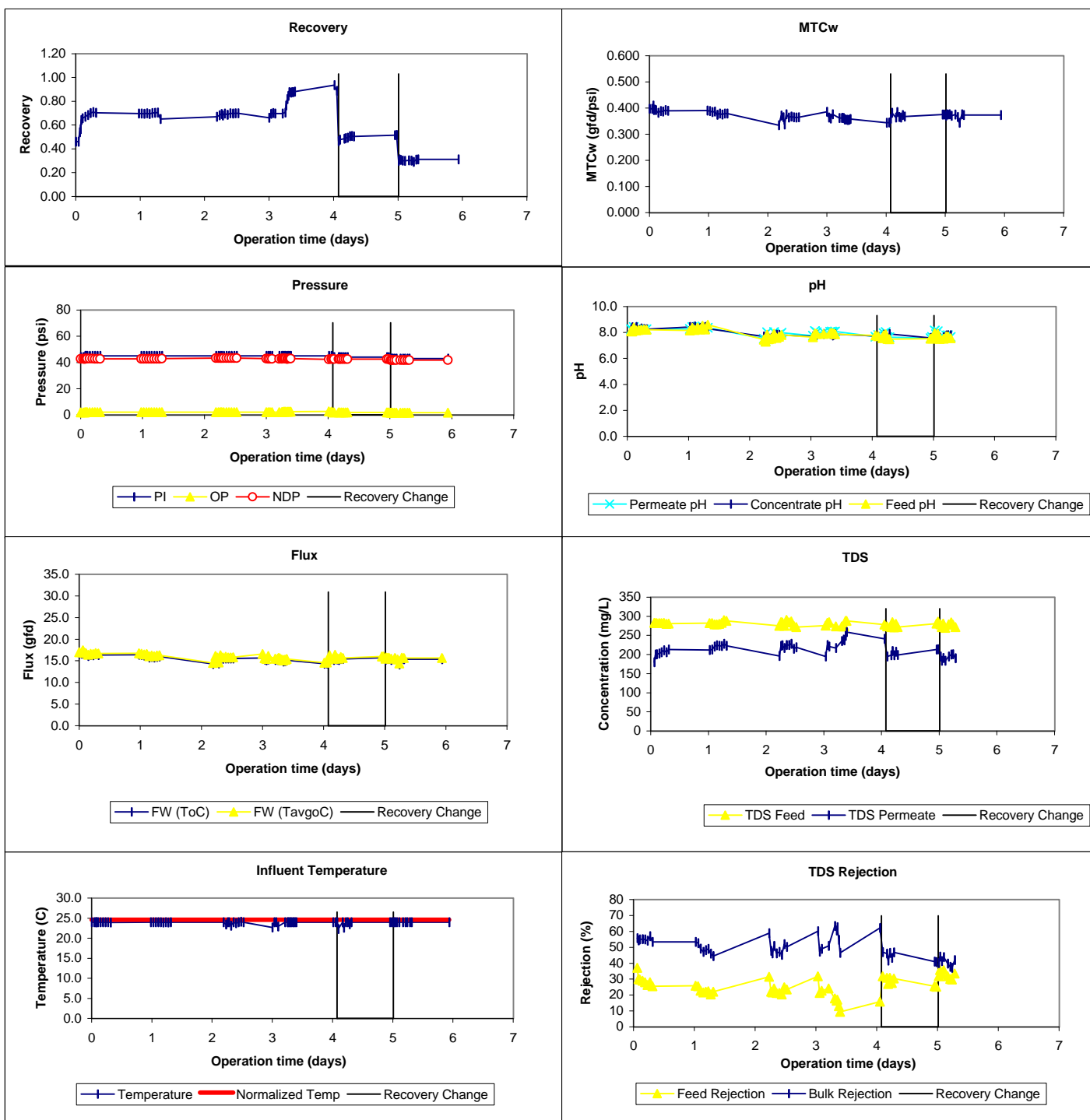
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 12/1/98 - 12/9/98 (8 days)

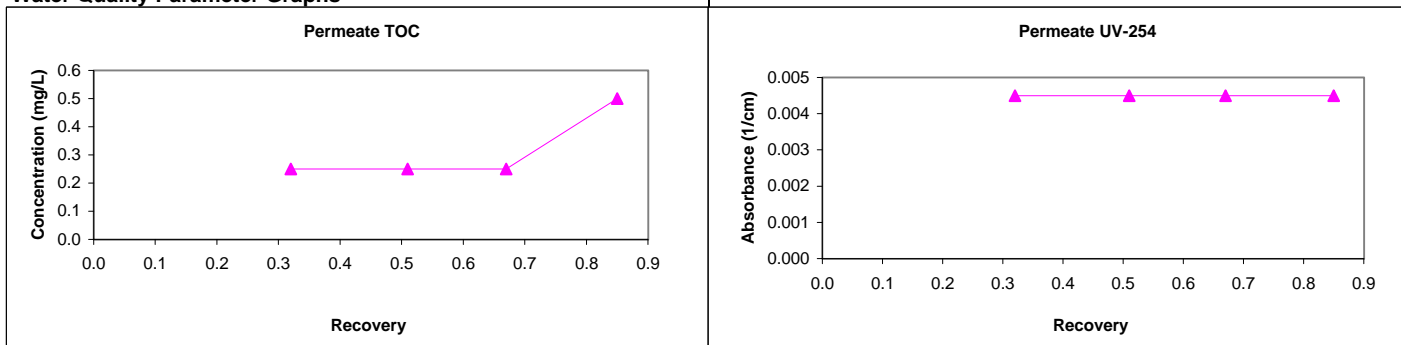
Membrane Information

Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi
Mfr. Temp: 25.0 °C
840 Element Area: 330.0 ft²
840 Purchase Price: N.A.
840 Maximum Flow: 80.0 gpm
840 Minimum Flow: 20.0 gpm
840 Total Width: 58.2 ft
840 Feed Spacer Thickness: 0.0026 ft

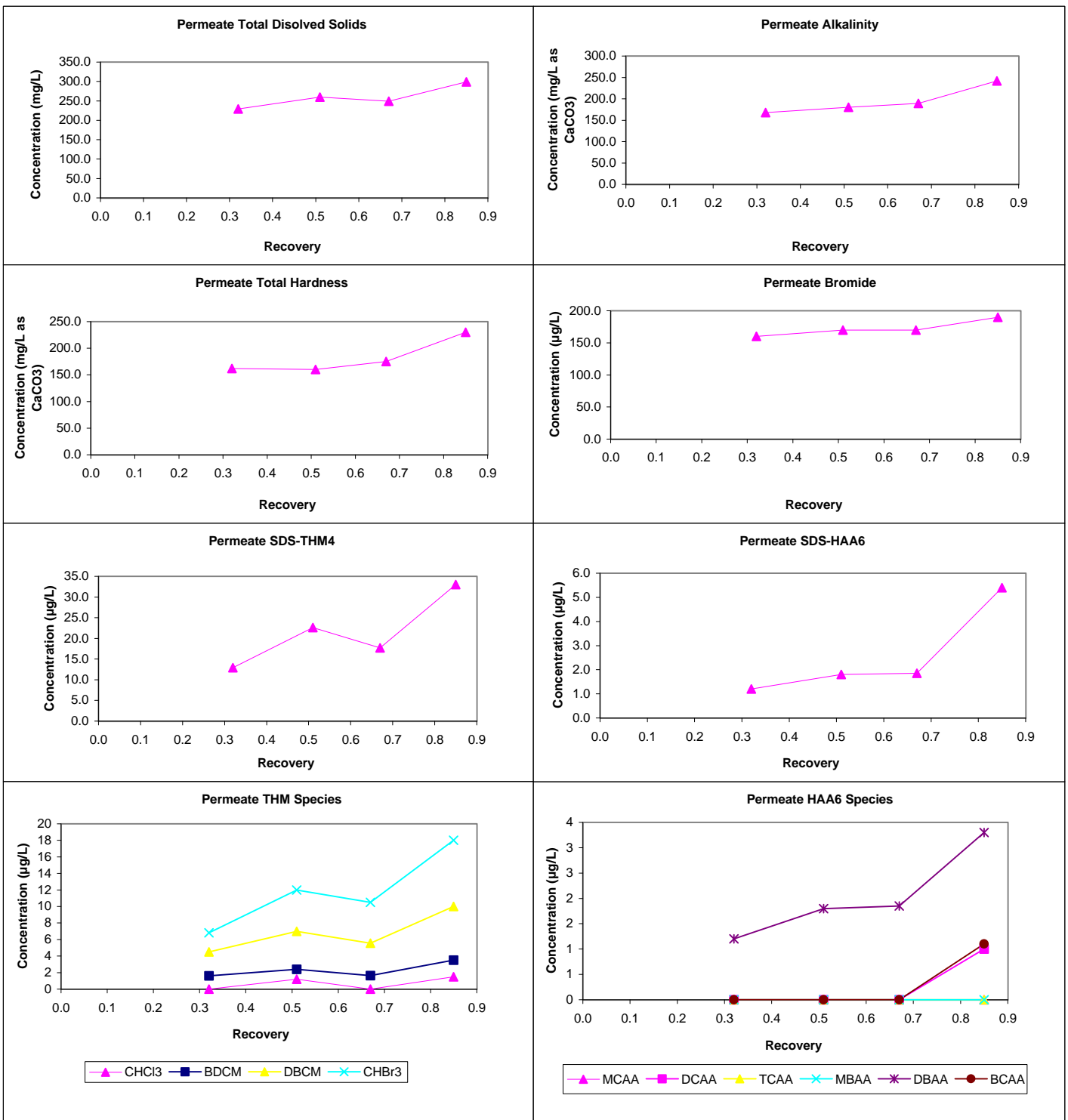
Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	RD	0.32	0.51	0.67	0.85	0.32	0.51	0.67	0.85	WQP	Count	Avg	SD
pH	7.6	0.3	7.8	7.8	7.9	7.9	7.8	7.9	7.8	7.9	TDS	45	-38	210
Temp	23.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	Alk	4	-55	52
Alk	443	5	168	180	189	242	530	562	610	696	TDS	4	1	13
TDS	333	2	229	260	249	299	370	380	476	665	TotHard	4	-17	17
TotHard	286	14	162	160	175	230	336	380	363	524	CaHard	4	-11	15
CaHard	260	0	140	154	125	220	302	342	404	500	Turb	4	-4	36
Turb	0.28	0.0	0.17	0.23	0.21	0.26	0.24	0.29	0.36	0.67	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	1	35	n/a
TOC	6.8	0.4	0.3	0.3	0.3	0.5	8.3	11.7	16.6	65.0	UV254	0	n/a	n/a
UV254	0.201	0.000	0.005	0.005	0.005	0.005	0.300	0.411	0.595	2.108	Pretreatment Information			
SUVA	2.99	0.15	1.80	1.80	1.80	0.90	3.61	3.51	3.58	3.24				
Bromide	190	0	160	170	170	190	Process				Description			
TOX	660	40	26	32	26	37								
CHCl3	145.0	15.0	0.0	1.2	0.0	1.5	Cartridge filtration				5 micron filter			
BDCM	65.5	1.5	1.6	2.4	1.7	3.5								
DBCM	23.5	0.5	4.5	7.0	5.6	10.0	Design Parameters							
CHBr3	1.8	0.0	6.8	12.0	10.5	18.0					Active memb area: 0.167 ft ²			
THM4	235.8	17.1	12.9	22.6	17.7	33.0								
MCAA	3.8	0.2	0.0	0.0	0.0	0.0	Norm Temp: 24.6 °C							
DCAA	33.0	0.0	0.0	0.0	0.0	1.0					Feed TDS: 700.0 mg/L			
TCAA	25.0	4.0	0.0	0.0	0.0	0.0	Manuf rep TDS rej: 50%							
MBAA	0.0	0.0	0.0	0.0	0.0	0.0					Temp Norm MTC-w: 0.237 gfd/psi			
DBAA	4.5	0.1	1.2	1.8	1.9	3.3	ID#							
BCAA	14.0	0.0	0.0	0.0	0.0	1.1					Recov (dec.)			
TBAA	0.0	0.0	0.0	0.0	0.0	0.0	F _{W-de} (gfd)							
CDBAA	3.4	0.2	0.0	0.0	0.0	0.0					1			
DCBAA	10.0	1.0	0.0	0.0	0.0	1.3	2							
HAA5	66.3	4.1	1.2	1.8	1.9	4.3					3			
HAA6	80.3	4.1	1.2	1.8	1.9	5.4	0.70							
HAA9	93.7	5.3	1.2	1.8	1.9	6.7					0.90			
SDS Conditions							Comments:							
WQP	Avg	SD	Count	Min - Max							0.50			
Res (mg/L) (0)	1.06	0.27	6	0.75 - 1.44										
Temp (°C)	25.0	0.0	6	25.0 - 25.0							15.0			
pH (unit)	8.8	0.3	6	8.5 - 9.3										
Time (hr)	24.0	0.0	6	24.0 - 24.0							15.0			

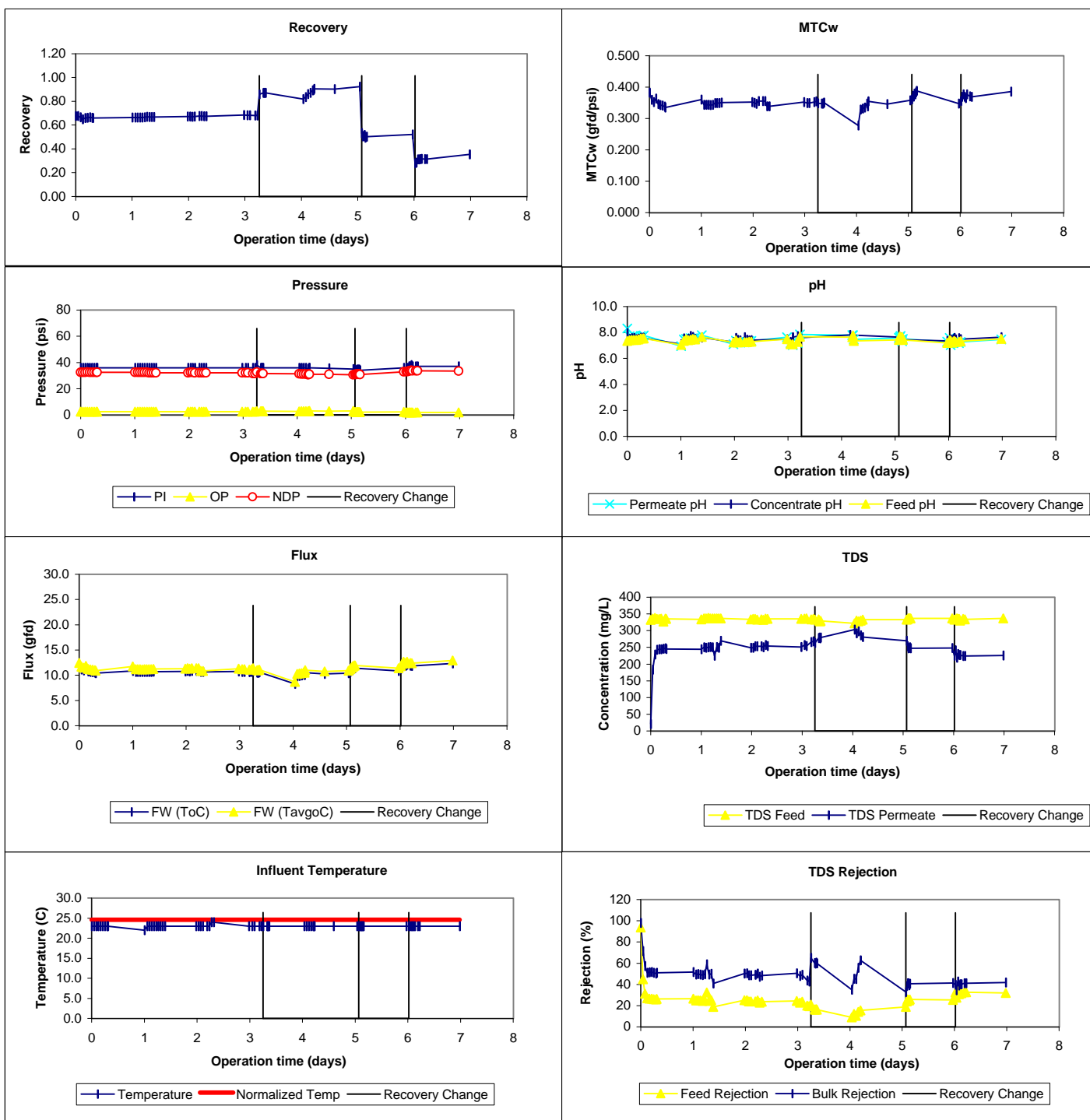
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 3/24/99 - 3/30/99 (6 days)

Membrane Information

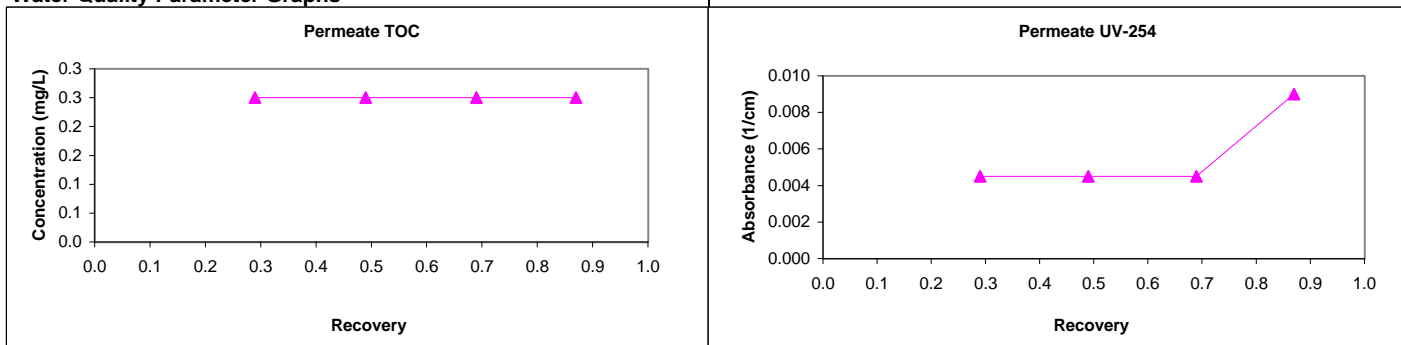
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 330.0 ft²
840 Purchase Price: N.A.
840 Maximum Flow: 80.0 gpm
840 Minimum Flow: 20.0 gpm
840 Total Width: 58.2 ft
840 Feed Spacer Thickness: 0.0026 ft

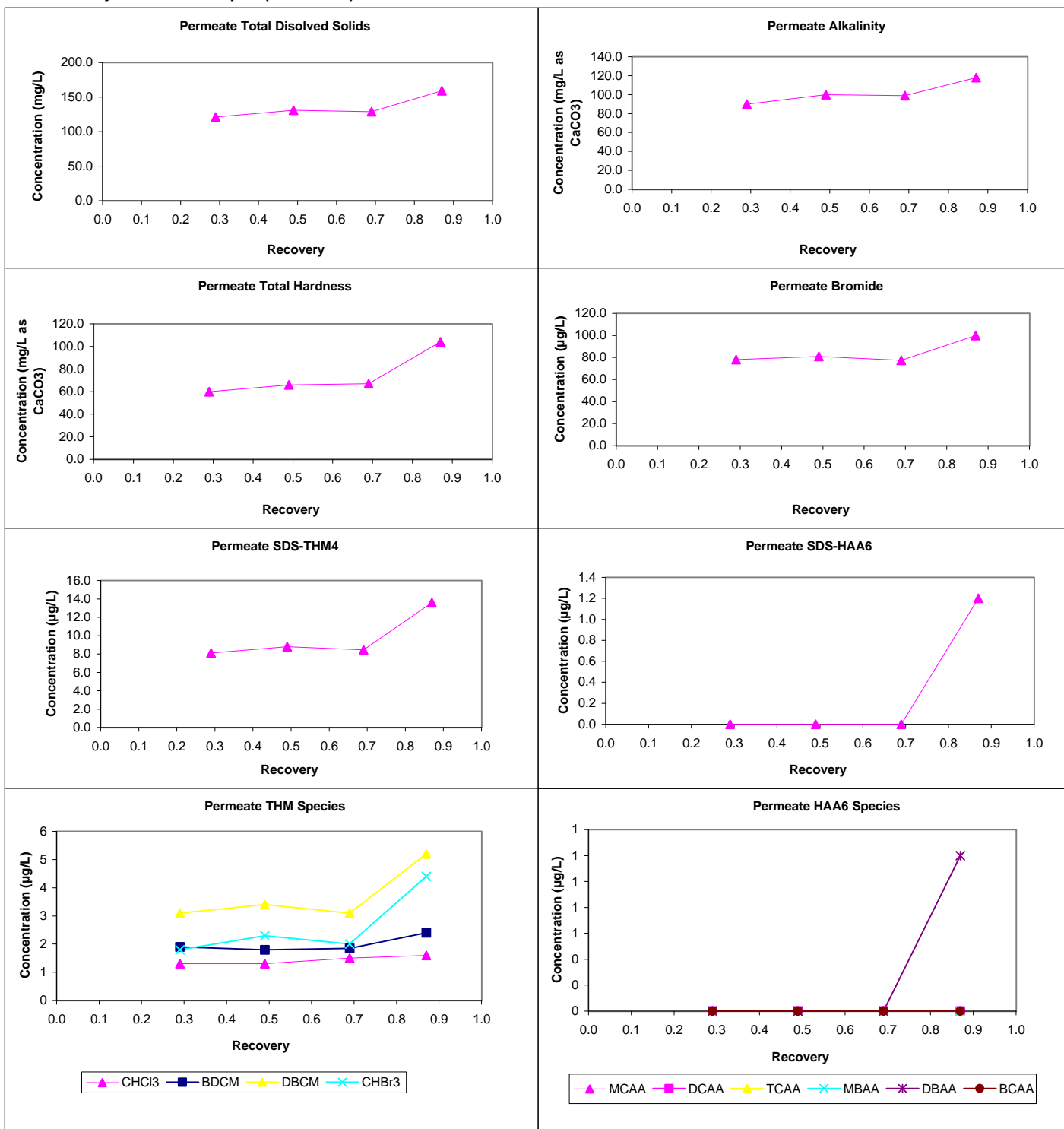
Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)															
Source ->	Feed		Permeate				Concentrate															
Recovery ->	Avg	RD	0.29	0.49	0.69	0.87	0.29	0.49	0.69	0.87	WQP	Count	Avg	SD								
pH	8.1	0.3	8.8	8.8	8.6	8.8	8.5	8.4	8.0	8.5	TDS	71	-43	143								
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0												
Alk	217	1	90	100	99	118	266	338	413	266	Alk	4	-61	113								
TDS	305	1	121	131	129	159	368	455	595	656	TDS	4	-30	44								
TotHard	252	2	60	66	67	104	356	454	623	696	TotHard	4	-18	41								
CaHard	237	1	52	60	58	96	324	414	581	604	CaHard	4	-25	47								
Turb	0.15	0.0	0.07	0.06	0.08	0.06	0.17	0.19	0.15	0.20	Turb	4	-107	126								
Amm	0.00	0.00	0.12	0.18	0.23	0.15	NA	NA	NA	NA	Amm	0	n/a	n/a								
TOC	5.9	0.4	0.3	0.3	0.3	0.3	6.7	9.4	14.5	31.0	TOC	0	n/a	n/a								
UV254	0.156	0.001	0.005	0.005	0.005	0.009	0.237	0.316	0.469	0.954	UV254	1	-19	n/a								
SUVA	2.65	0.17	1.80	1.80	1.80	3.60	3.54	3.36	3.23	3.08												
Bromide	170	0	78	81	78	100	Pretreatment Information															
TOX	505	30	13	13	13	13									Process	Description	Scale					
CHCl3	125.0	15.0	1.3	1.3	1.5	1.6	Cartridge filtration	5 micron filter	bench													
BDCM	48.5	0.5	1.9	1.8	1.9	2.4	Design Parameters															
DBCM	18.0	0.0	3.1	3.4	3.1	5.2									Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-de} (gfd)			
CHBr3	0.0	0.0	1.8	2.3	2.0	4.4									Active width:	0.330 ft	1	0.70	15.0			
THM4	191.5	15.5	8.1	8.8	8.5	13.6									Norm Temp:	24.6 °C	2	0.90	15.0			
MCAA	1.6	1.6	0.0	0.0	0.0	0.0									Feed TDS:	700.0 mg/L	3	0.50	15.0			
DCAA	30.0	1.0	0.0	0.0	0.0	0.0									Manuf rep TDS rej:	50%	4	0.30	15.0			
TCAA	21.5	5.5	0.0	0.0	0.0	0.0									Temp Norm MTC-w:	0.237 gfd/psi						
MBAA	0.0	0.0	0.0	0.0	0.0	0.0									Comments:							
DBAA	3.1	0.0	0.0	0.0	0.0	1.2																
BCAA	11.0	0.0	0.0	0.0	0.0	0.0																
TBAA	0.0	NA	NR	NR	NA	0.0																
CDBAA	2.7	0.3	0.0	0.0	0.0	0.0																
DCBAA	8.8	2.2	0.0	0.0	0.0	0.0																
HAA5	56.2	8.0	0.0	0.0	0.0	1.2																
HAA6	67.2	8.0	0.0	0.0	0.0	1.2																
HAA9	89.2	NA	NR	NR	NA	1.2																
SDS Conditions																						
WQP	Avg	SD	Count	Min - Max																		
Res (mg/L) (0)	1.22	0.33	6	0.84 - 1.60																		
Temp (°C)	24.0	0.0	6	24.0 - 24.0																		
pH (unit)	9.0	0.0	6	9.0 - 9.0																		
Time (hr)	24.0	0.0	6	24.0 - 24.0																		

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs

