

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1037
Study Protocol	Membrane RBSMT treatment study
Plant ICR Number	614
PWS Name	Brownsville Public Utilities Board
City, State, Zip	Brownsville, TX 78520

General Comments:

1. During this bench-scale study, two membranes were evaluated: the Koch-Fluid Systems TFC-SR and the FilmTec NF200. Each membrane was tested during four quarters over a one-year period; however, the dates of testing resulted in two Winter tests, one late Spring test and one Summer test for each membrane. Table 6 of the Summary Report summarizes these sampling dates, and Tables 7 and 8 summarize the experimental design.
2. During data analysis, temperatures of 23°C, 26°C, 29°C, and 26°C for Winter, Spring, Summer and Autumn, were used, 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.
3. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 7 water quality outliers were identified and removed prior to base analysis.
2. SDS conditions are summarized in Table 11 of the Summary Report. The free chlorine residual and pH were held constant over the four quarters at 1 mg/L and 8.2, respectively. The incubation temperature varied from 21°C (Winter) to 25°C (Summer). The incubation time was 72 hours during the first quarter, 24 hours during the third quarter and 48 hours during the second and fourth quarters – the utility verified that these times reflect changing conditions in the distribution system.

Productivity Comments:

1. 50 productivity outliers were identified and removed prior to base analysis.
2. Severe flux loss was observed at 90% recovery. All of the productivity outliers are associated with operation under this extreme recovery.
3. For the SR40 membrane, productivity was much higher during quarters 2 and 4 compared to quarters 1 and 3. No explanation is provided.
4. In general, the membranes were cleaned with a sodium hydroxide solution ($\text{pH} \approx 12$) at 40°C . However, during Quarter 4 of the NF200 membrane evaluation the sodium hydroxide cleaning was not effective and was followed by cleaning with a sulfuric acid solution ($\text{pH} \approx 2.5$). Additional cleaning information is provided in Section 3 of the Summary Report.

ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 2/4/98 - 2/10/98 (6 days)

Membrane Information

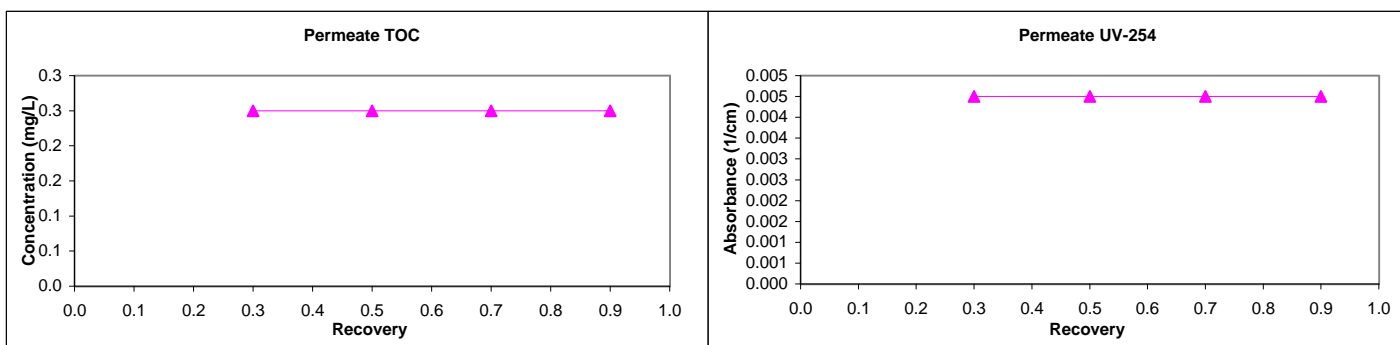
Manufacturer: Fluid Systems
 Trade Name: TFC-SR
 MWCO: 300 Daltons
 Mfr. Flux: 24.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTCw: 0.240 gfd/psi

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

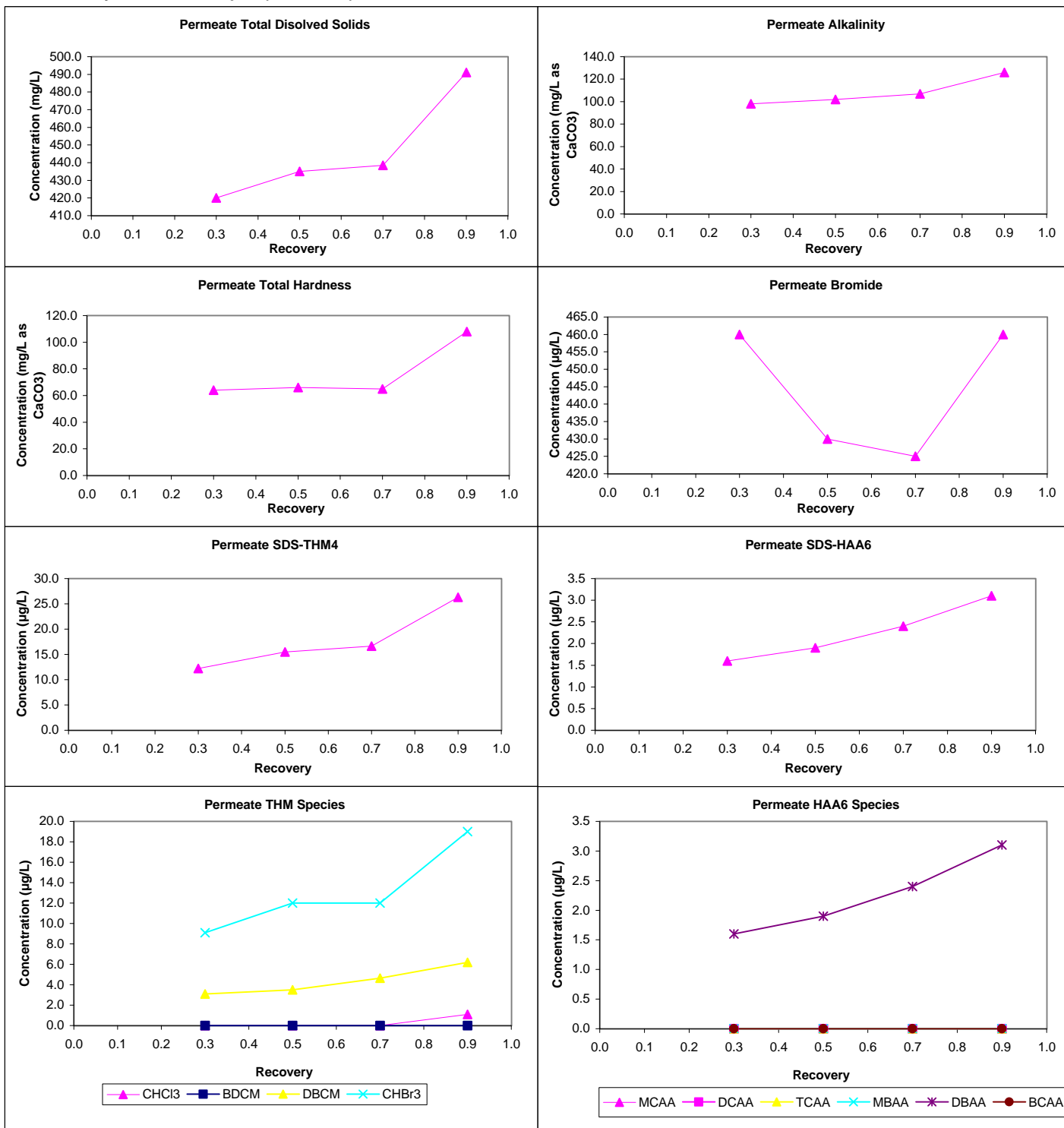
Water Quality Summary

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	8.3	0.0	8.2	8.2	8.0	8.2	8.1	8.2	8.1	8.2	TDS _{st}	26	-17	54
Temp	23.0	0.0	24.0	24.0	23.0	23.5	24.0	24.0	23.0	23.5	Alk	4	-19	16
Alk	136	0	98	102	107	126	144	158	168	162	TDS	4	-19	24
TDS	741	10	420	435	439	491	858	1045	1181	1965	TotHard	4	-6	15
TotHard	369	5	64	66	65	108	504	748	984	2164	CaHard	4	-8	13
CaHard	247	5	46	52	54	80	326	472	634	1406	Turb	4	39	79
Turb	0.24	0.00	0.11	0.17	0.22	0.31	0.23	0.28	0.55	0.85	Amm	0	n/a	n/a
Amm	0.03	0.03	0.06	0.05	0.07	0.06	NA	NA	NA	NA	TOC	0	n/a	n/a
TOC	3.1	0.1	0.3	0.3	0.3	0.3	4.3	7.0	9.9	21.0	UV254	0	n/a	n/a
UV254	0.071	0.000	0.005	0.005	0.005	0.005	0.104	0.167	0.191	0.509	Pretreatment Information			
SUVA	2.31	0.02	1.80	1.80	1.80	1.80	2.42	2.39	1.93	2.42				
Bromide	475	5	460	430	425	460	Process Description Scale							
TOX	325	5	13	25	26	34								
CHCl ₃	22.0	0.0	0.0	0.0	0.0	1.1	Coagulation aluminum sulfate (Al ₂ (SO ₄) ₃) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench							
BDCM	56.5	11.5	0.0	0.0	0.0	0.0								
DBCM	103.0	7.0	3.1	3.5	4.7	6.2								
CHBr ₃	54.0	11.0	9.1	12.0	12.0	19.0								
THM ₄	235.5	29.5	12.2	15.5	16.7	26.3	Design Parameters							
MCAA	3.3	1.1	0.0	0.0	0.0	0.0								
DCAA	12.5	1.5	0.0	0.0	0.0	0.0								
TCAA	8.5	1.5	0.0	0.0	0.0	0.0								
MBAA	4.4	0.2	0.0	0.0	0.0	0.0								
DBAA	22.0	0.0	1.6	1.9	2.4	3.1								
BCAA	21.0	1.0	0.0	0.0	0.0	0.0								
TBAA	15.0	2.0	0.0	0.0	0.0	0.0								
CDBAA	24.5	3.5	0.0	0.0	0.0	0.0								
DCBAA	20.5	4.5	0.0	0.0	0.0	0.0								
HAA ₅	50.7	4.3	1.6	1.9	2.4	3.1	Active memb area:		0.167 ft ²	ID#		Recov (dec.)	F _{W-des} (gfd)	
HAA ₆	71.7	5.3	1.6	1.9	2.4	3.1	Active width:		0.330 ft	1		0.70	15.0	
HAA ₉	131.7	11.3	1.6	1.9	2.4	3.1	Norm Temp:		24.6 °C	2		0.90	15.0	
SDS Conditions							Feed TDS:		700.0 mg/L	3		0.50	15.0	
							Manuf rep TDS rej:		50%	4		0.30	15.0	
							Temp Norm MTC-w:		0.237 gfd/psi					
							Comments:							
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.90	0.25	6	0.60 - 1.21										
Temp (°C)	21.0	0.0	6	21.0 - 21.0										
pH (unit)	8.1	0.1	6	7.9 - 8.2										
Time (hr)	72.0	0.0	6	72.0 - 72.0										

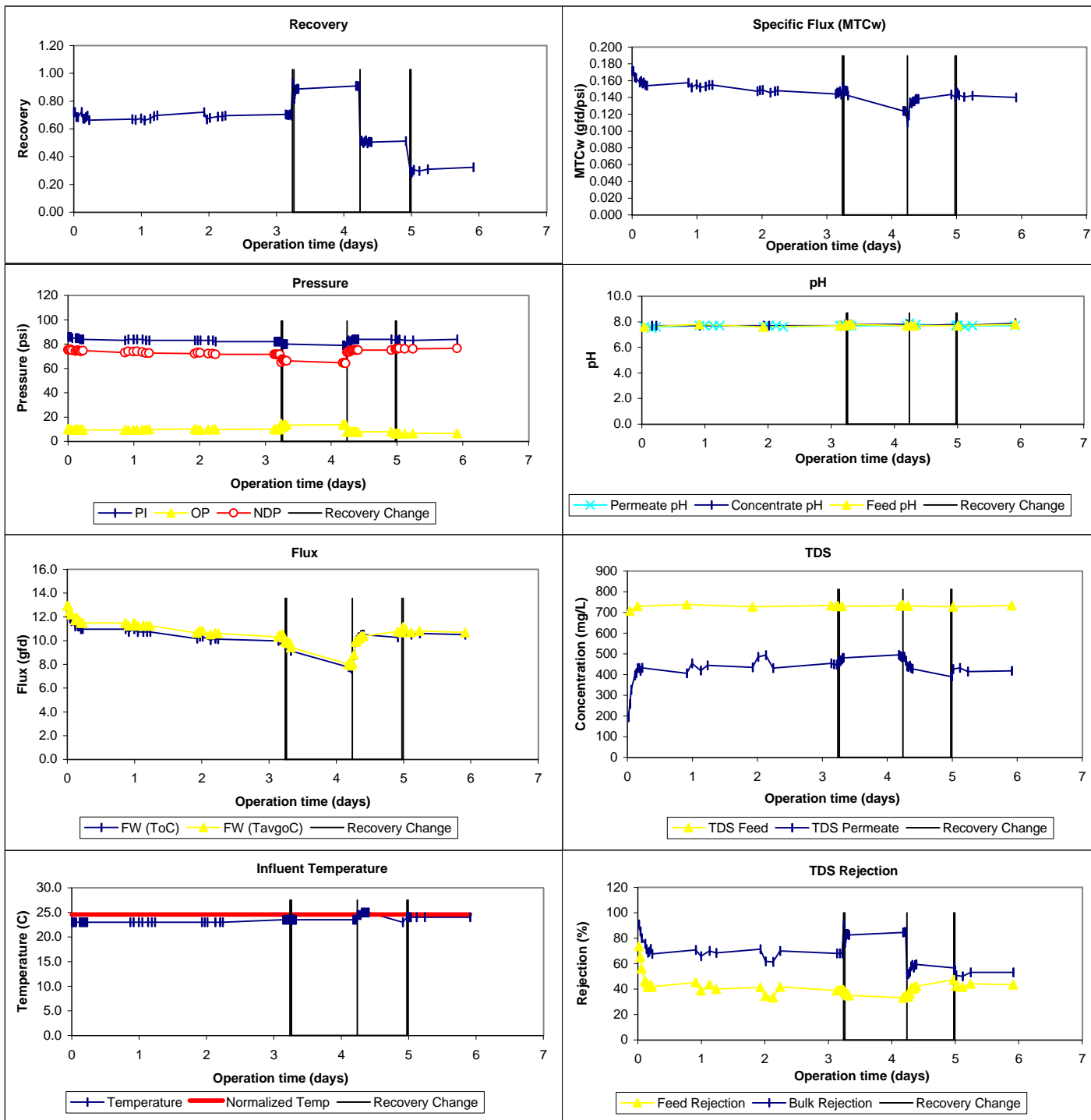
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
ICR Contact: Isidoro Urbano, Jr.
Phone No.: (956) 982-6379
Period: 5/27/98 - 6/2/98 (6 days)

Membrane Information

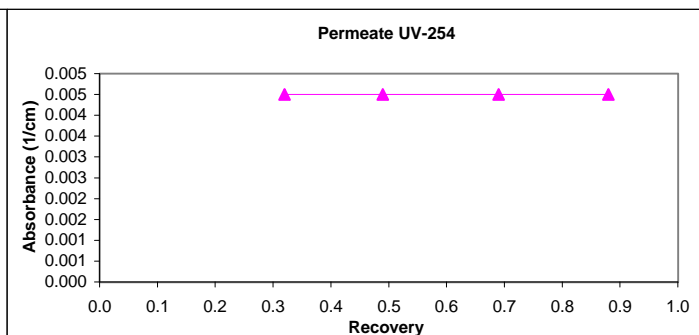
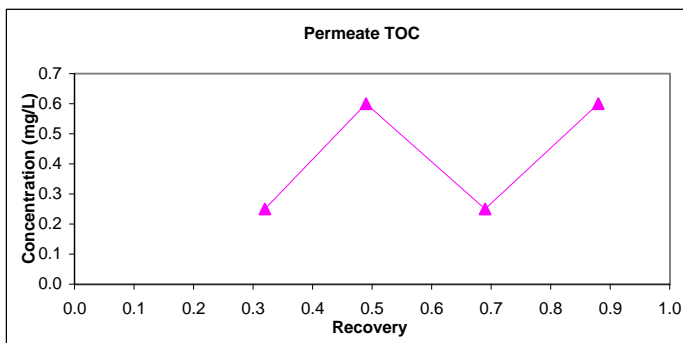
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

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

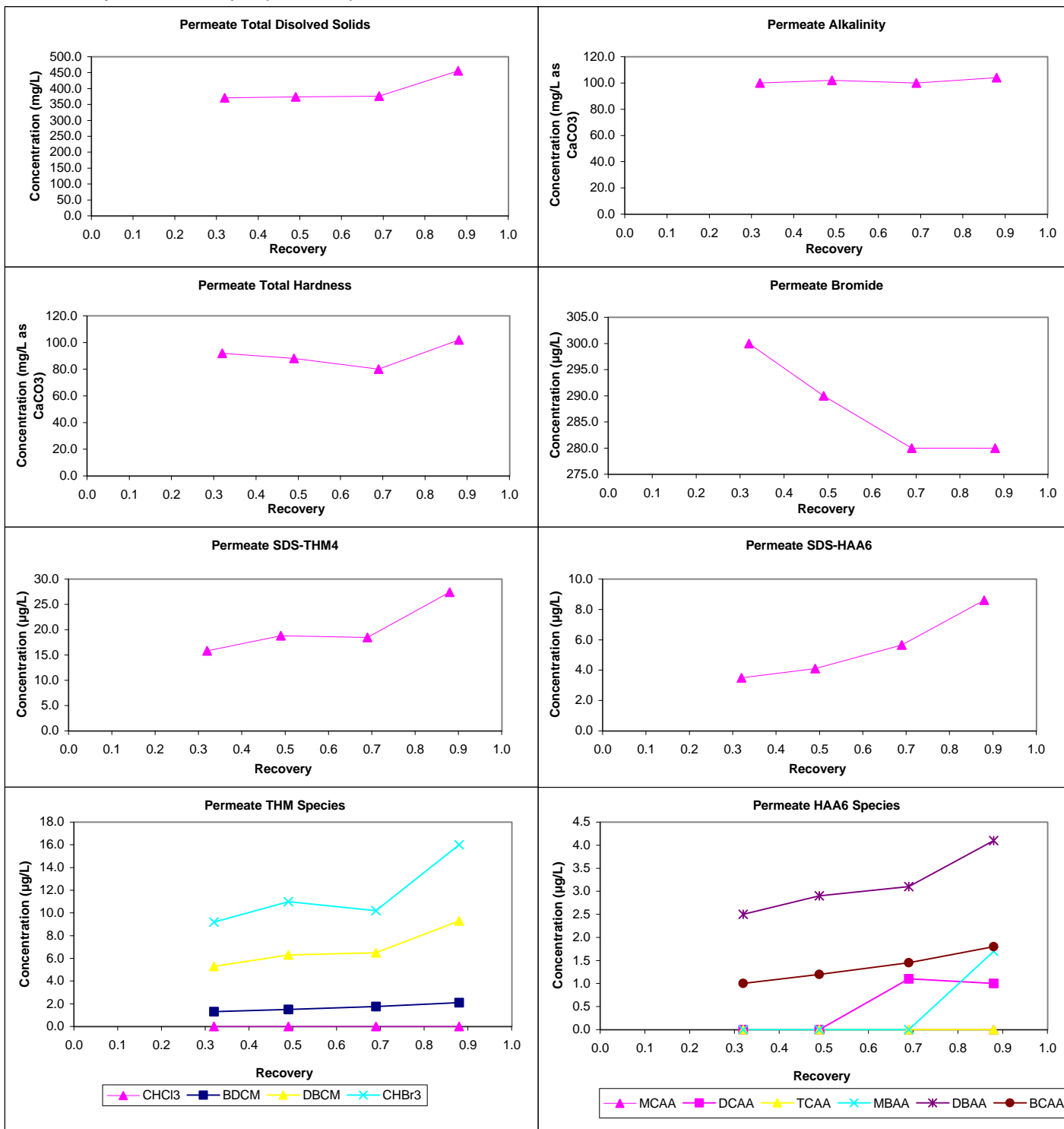
Water Quality Summary

Water Quality Summary																																									
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																														
Recovery ->	Avg	Diff	0.32	0.49	0.69	0.88	0.32	0.49	0.69	0.88	WQP	Count	Avg	SD																											
pH	7.9	0.2	8.0	7.8	7.9	7.9	7.9	8.1	8.3	8.2	TDS	47	-12	18																											
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	2	4																											
Alk	105	1	100	102	100	104	112	112	121	108	TDS	4	1	3																											
TDS	571	6	371	374	377	456	662	762	999	1484	TotHard	4	-12	7																											
TotHard	311	13	92	88	80	102	372	494	762	1522	CaHard	4	-4	9																											
CaHard	193	3	66	68	59	64	246	322	502	974	Turb	4	-86	109																											
Turb	0.17	0.02	0.05	0.06	0.07	0.05	0.24	0.14	0.31	0.31	Amm	0	n/a	n/a																											
Amm	0.00	0.00	0.00	0.06	0.13	0.00	NA	NA	NA	NA	TOC	2	7	6																											
TOC	2.7	0.2	0.3	0.6	0.3	0.6	3.8	5.3	8.3	17.9	UV254	0	n/a	n/a																											
UV254	0.060	0.001	0.005	0.005	0.005	0.005	0.086	0.113	0.176	0.359	Pretreatment Information																														
SUVA	2.27	0.17	1.80	0.75	1.80	0.75	2.26	2.13	2.12	2.01																															
Bromide	190	30	300	290	280	280	<table><tr><th>Process</th><th>Description</th><th>Scale</th></tr><tr><td>Coagulation</td><td>aluminum sulfate (Al2(SO4)3)</td><td>1 bench</td></tr><tr><td>Sedimentation</td><td>24 hours settling</td><td>bench</td></tr><tr><td>Cartridge filtration</td><td>5 micron filter</td><td>bench</td></tr></table>								Process	Description	Scale	Coagulation	aluminum sulfate (Al2(SO4)3)	1 bench	Sedimentation	24 hours settling	bench	Cartridge filtration	5 micron filter	bench															
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Coagulation	aluminum sulfate (Al2(SO4)3)	1 bench																																							
Sedimentation	24 hours settling	bench																																							
Cartridge filtration	5 micron filter	bench																																							
TOX	274	24	33	28	37	58																																			
CHCl3	29.0	3.0	0.0	0.0	0.0	0.0	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-des} (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>								Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (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
Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)																																					
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Manuf rep TDS rej:	50%	3	0.50	15.0																																					
Temp Norm MTC-w:	0.237 gfd/psi	4	0.30	15.0																																					
BDCM	44.0	2.0	1.3	1.5	1.8	2.1																																			
DBCM	57.5	5.5	5.3	6.3	6.5	9.3																																			
CHBr3	20.5	3.5	9.2	11.0	10.2	16.0																																			
THM4	151.0	8.0	15.8	18.8	18.5	27.4																																			
MCAA	2.6	NA	0.0	0.0	0.0	0.0																																			
DCAA	14.0	NA	0.0	0.0	1.1	1.0																																			
TCAA	9.0	NA	0.0	0.0	0.0	0.0																																			
MBAA	2.9	NA	0.0	0.0	0.0	1.7																																			
DBAA	14.0	NA	2.5	2.9	3.1	4.1																																			
BCAA	17.0	NA	1.0	1.2	1.5	1.8																																			
TBAA	9.7	NA	0.0	4.2	4.1	5.5																																			
CDBAA	15.0	NA	0.0	0.0	0.0	2.2																																			
DCBAA	16.0	NA	0.0	0.0	0.0	0.0																																			
HAA5	42.5	NA	2.5	2.9	4.2	6.8																																			
HAA6	59.5	NA	3.5	4.1	5.7	8.6																																			
HAA9	100.2	NA	3.5	8.3	9.8	16.3																																			
SDS Conditions							Comments:																																		
WQP	Avg	SD	Count	Min - Max																																					
Res (mg/L) (0)	0.99	0.28	6	0.64 - 1.46																																					
Temp (°C)	25.0	0.0	6	25.0 - 25.0																																					
pH (unit)	8.1	0.2	6	8.0 - 8.4																																					
Time (hr)	48.0	0.0	6	48.0 - 48.0																																					

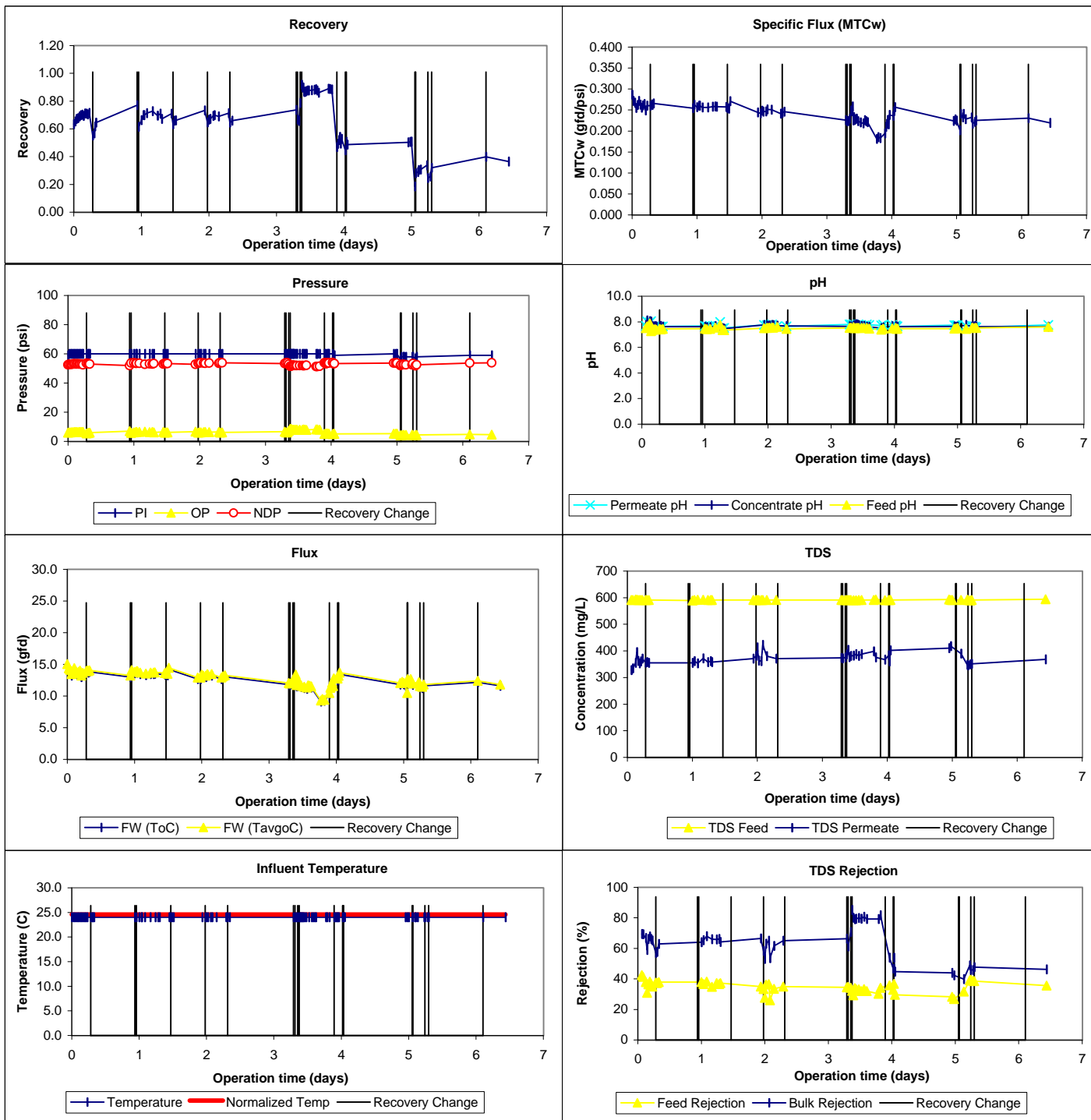
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 8/18/98 - 8/24/98 (6 days)

Membrane Information

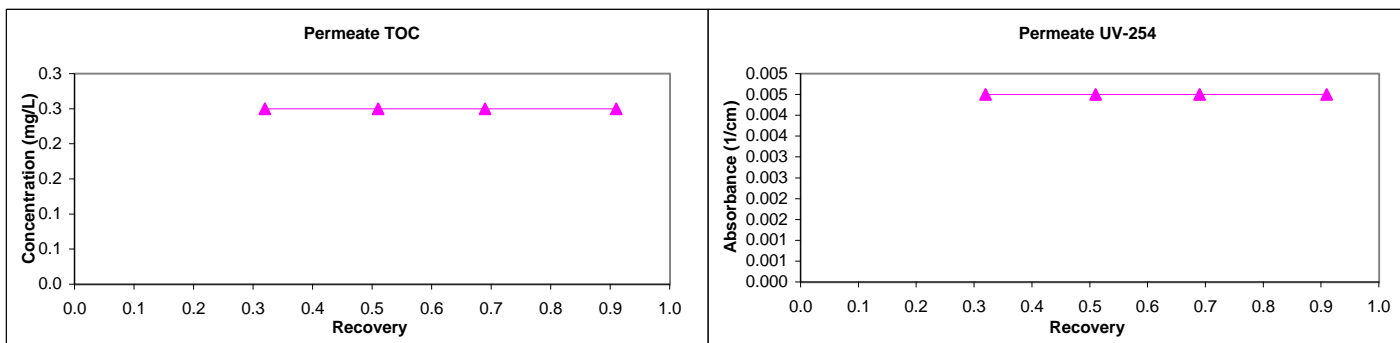
Manufacturer: Fluid Systems
 Trade Name: TFC-SR
 MWCO: 300 Daltons
 Mfr. Flux: 24.0 gfd
 Mfr. NDP: 100.0 psi
 Mfr. MTCw: 0.240 gfd/psi

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

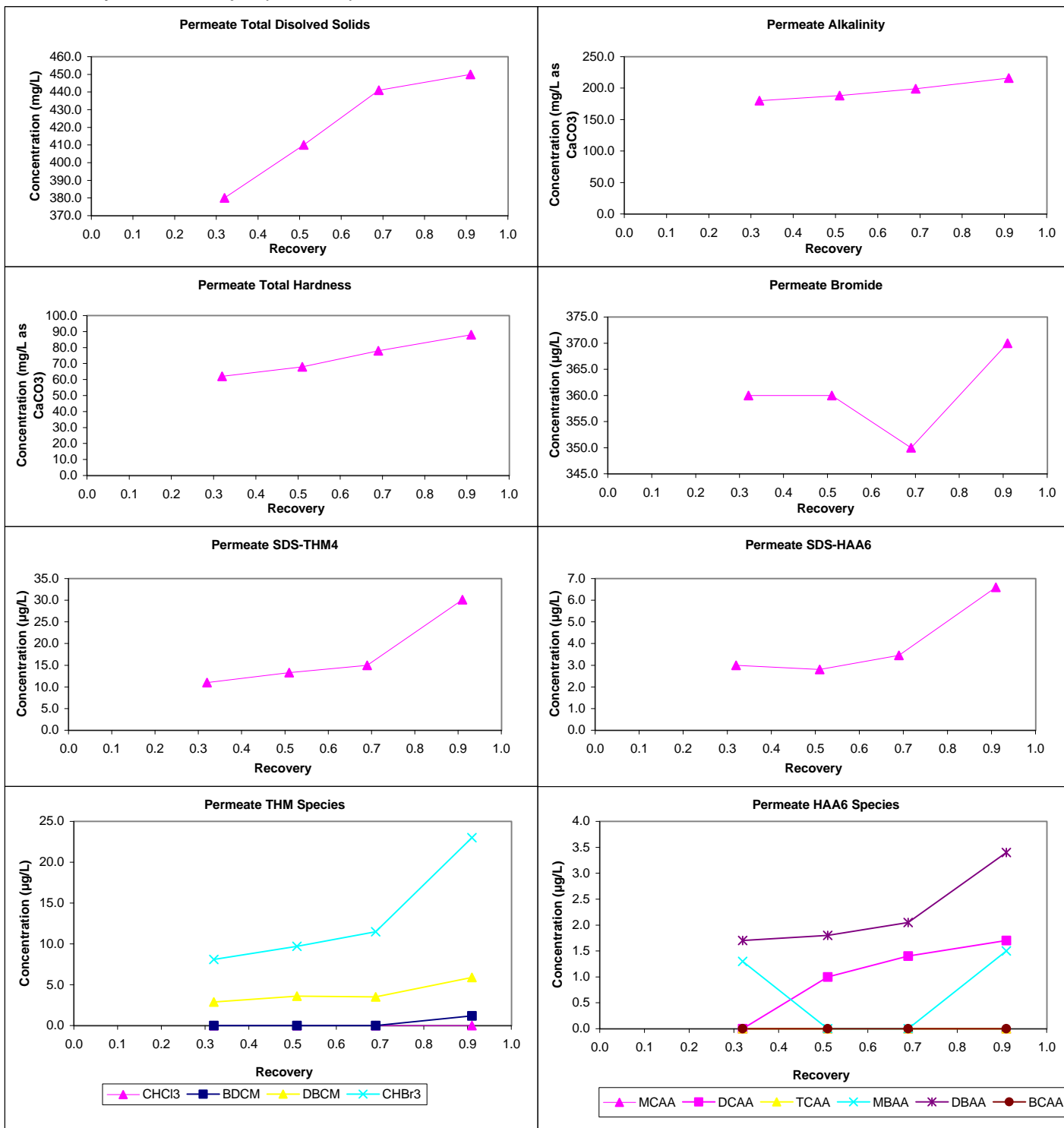
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)											
Recovery ->	Avg	Diff	0.32	0.51	0.69	0.91	0.32	0.51	0.69	0.91	WQP	Count	Avg	SD								
pH	8.1	0.1	8.5	8.5	8.2	8.3	8.1	8.1	7.8	7.5	TDS	30	2	19								
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	26	36								
Alk	210	10	180	188	199	216	234	256	266	726	TDS	4	-13	27								
TDS	638	9	380	410	441	450	745	872	1112	1654	TotHard	4	-5	13								
TotHard	329	5	62	68	78	88	434	610	950	2232	CaHard	4	-5	16								
CaHard	216	0	48	50	52	60	288	400	626	1392	Turb	4	7	2								
Turb	0.14	0.00	0.09	0.08	0.11	0.09	0.18	0.21	0.23	0.69	Amm	0	n/a	n/a								
Amm	0.00	0.00	0.00	0.14	0.03	0.00	NA	NA	NA	NA	TOC	1	19	n/a								
TOC	2.5	0.1	0.3	0.3	0.3	0.3	3.6	5.3	8.6	18.1	UV254	0	n/a	n/a								
UV254	0.060	0.001	0.005	0.005	0.005	0.005	0.086	0.116	0.204	0.463	Pretreatment Information											
SUVA	2.40	0.06	1.80	1.80	1.80	1.80	2.39	2.19	2.37	2.56					Process	Description	Scale					
Bromide	355	5	360	360	350	370	Coagulation aluminum sulfate (Al2(SO4)3) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench															
TOX	270	20	28	NR	13	37																
CHCl3	12.0	1.0	0.0	0.0	0.0	0.0																
BDCM	33.0	3.0	0.0	0.0	0.0	1.2	Design Parameters															
DBCM	74.5	6.5	2.9	3.6	3.5	5.9																
CHBr3	50.5	5.5	8.1	9.7	11.5	23.0																
THM4	170.0	16.0	11.0	13.3	15.0	30.1																
MCAA	0.0	0.0	0.0	0.0	0.0	0.0																
DCAA	6.1	0.1	0.0	1.0	1.4	1.7																
TCAA	2.3	0.0	0.0	0.0	0.0	0.0																
MBAA	2.6	0.2	1.3	0.0	0.0	1.5																
DBAA	17.0	0.0	1.7	1.8	2.1	3.4																
BCAA	12.0	0.0	0.0	0.0	0.0	0.0																
TBAA	10.2	0.8	0.0	0.0	0.0	0.0																
CDBAA	9.7	0.1	0.0	0.0	0.0	0.0																
DCBAA	6.7	0.0	0.0	0.0	0.0	0.0																
HAA5	28.0	0.2	3.0	2.8	3.5	6.6																
HAA6	40.0	0.2	3.0	2.8	3.5	6.6																
HAA9	66.5	1.1	3.0	2.8	3.5	6.6																
SDS Conditions															Active memb area: 0.167 ft² 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							
WQP	Avg	SD	Count	Min - Max																		
Res (mg/L) (0)	0.96	0.17	6	0.74 - 1.13																		
Temp (°C)	25.0	0.0	6	25.0 - 25.0																		
pH (unit)	8.0	0.2	6	7.7 - 8.2																		
Time (hr)	24.0	0.0	6	24.0 - 24.0		Comments:																

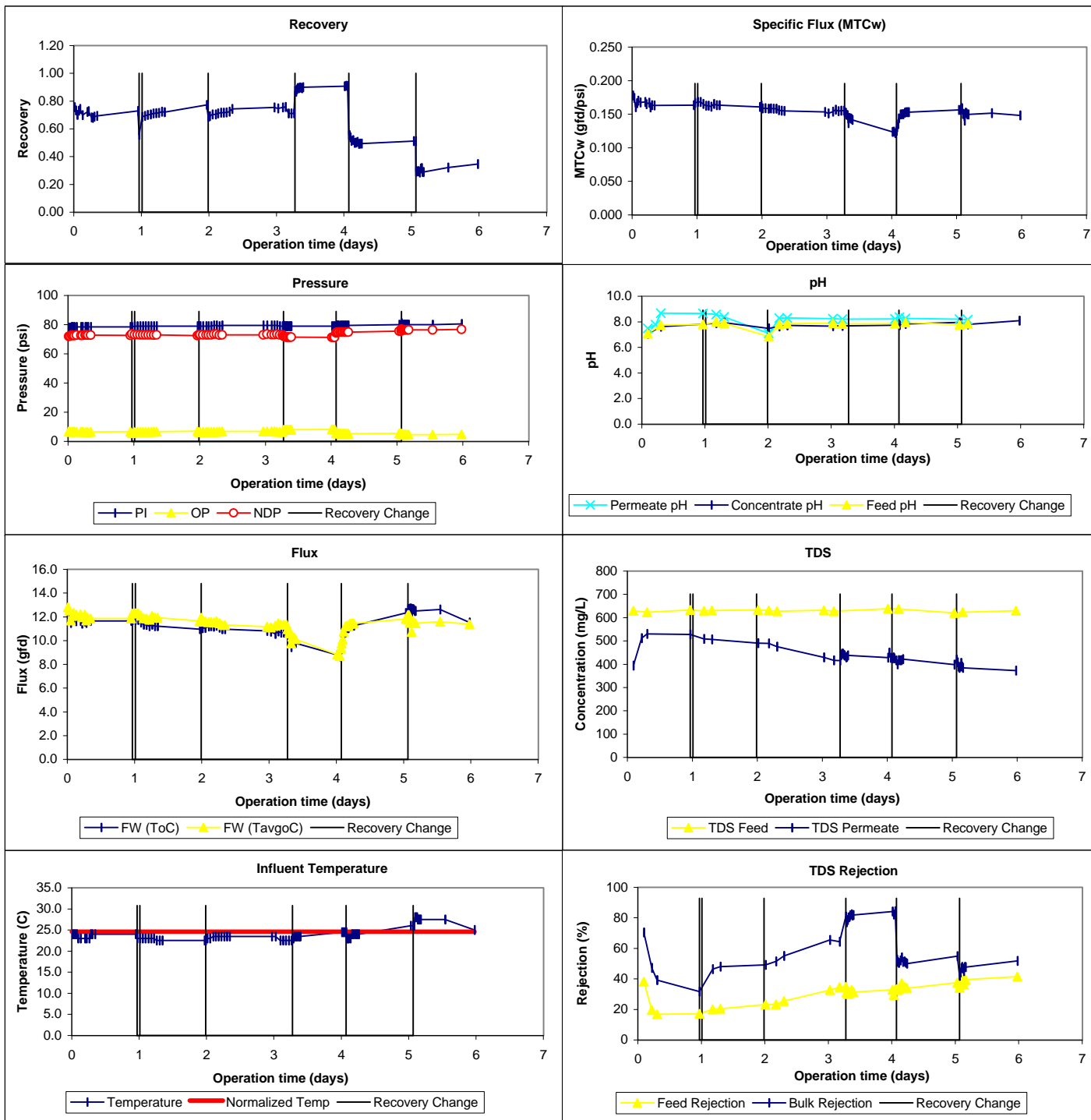
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 2/15/99 - 2/21/99 (6 days)

Membrane Information

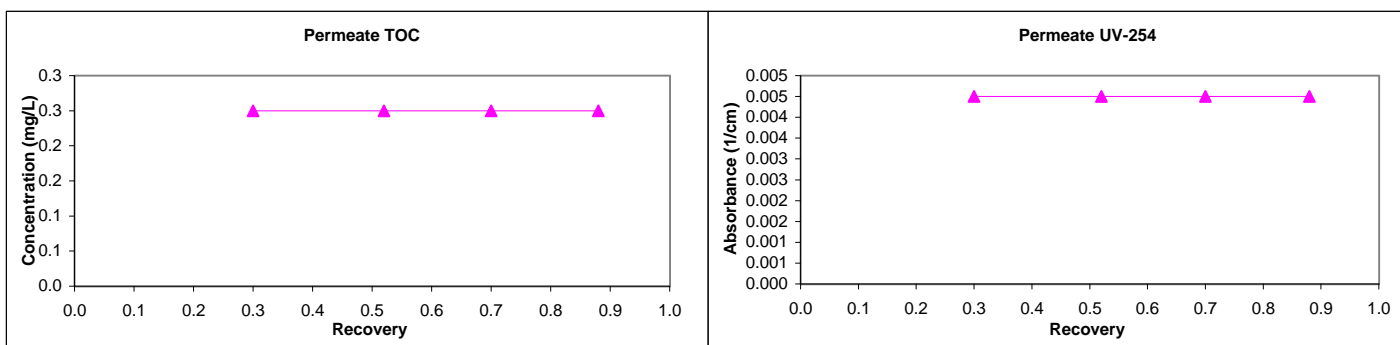
Manufacturer: Fluid Systems
 Trade Name: TFC-SR
 MWCO: 300 Daltons
 Mfr. Flux: 24.0 gfd
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Mfr. Temp: 25.0 °C
 840 Element Area: 330.0 ft²
 840 Purchase Price: N.A.
 840 Maximum Flow: 80.0 gpm
 840 Minimum Flow: 20.0 gpm
 840 Total Width: 58.2 ft
 840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

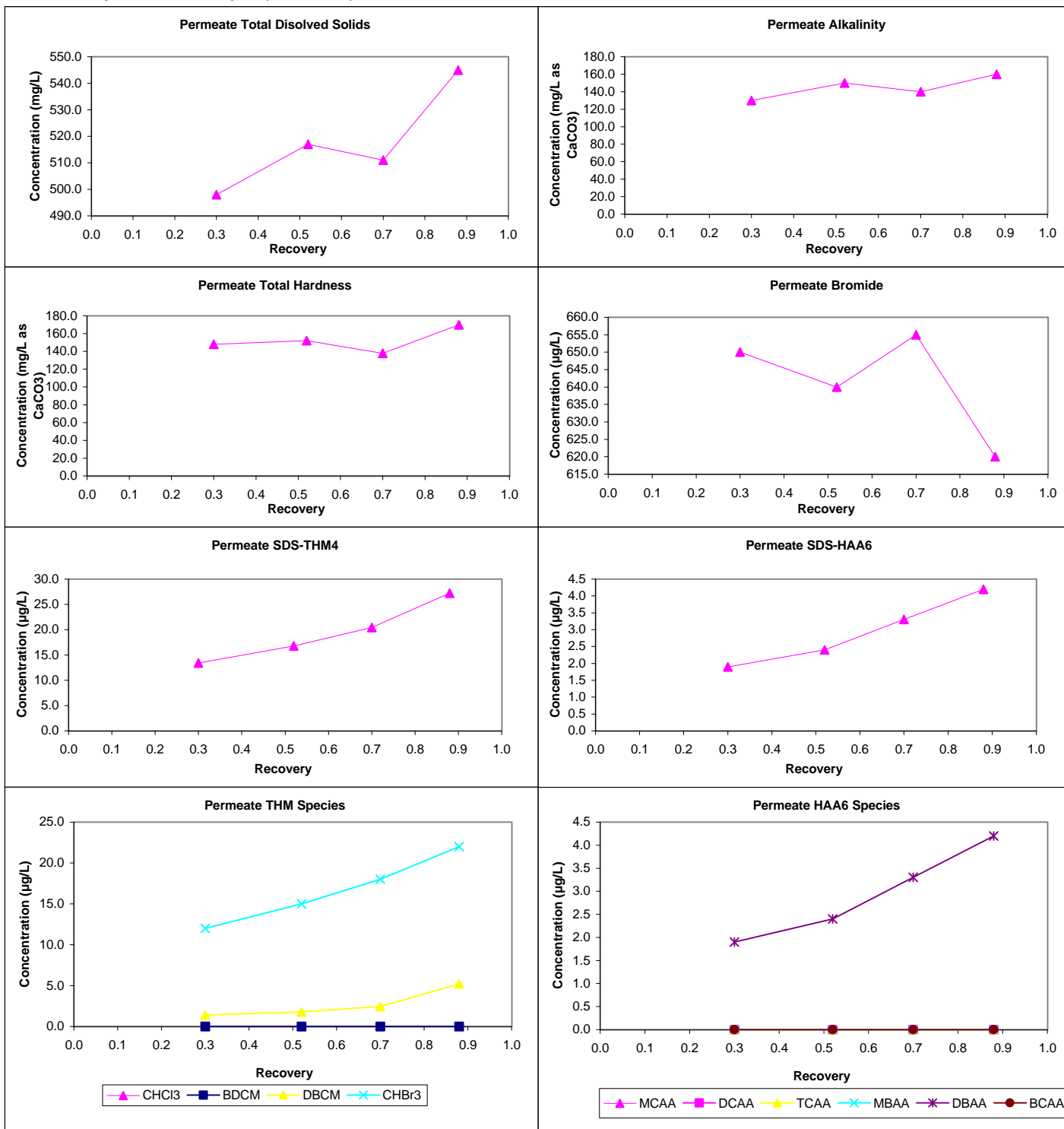
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.52	0.70	0.88	0.30	0.52	0.70	0.88	WQP	Count	Avg	SD
pH	8.2	0.1	8.4	8.4	7.9	8.4	8.4	8.4	8.2	8.3	TDS	37	-10	15
Temp	23.8	0.3	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	-12	17
Alk	167	3	130	150	140	160	182	196	184	170	TDS	4	-15	16
TDS	789	1	498	517	511	545	899	1028	1247	1884	TotHard	4	-2	9
TotHard	409	1	148	152	138	170	548	732	982	1926	CaHard	4	0	7
CaHard	293	3	116	120	106	138	386	512	714	1300	Turb	4	-45	83
Turb	0.14	0.00	0.05	0.07	0.07	0.06	0.26	0.29	0.18	0.31	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	0	n/a	n/a
TOC	3.5	0.3	0.3	0.3	0.3	0.3	3.8	6.3	2.5	18.6	UV254	0	n/a	n/a
UV254	0.075	0.000	0.005	0.005	0.005	0.005	0.111	0.164	0.233	0.492	Pretreatment Information			
SUVA	2.16	0.19	1.80	1.80	1.80	1.80	2.92	2.60	9.32	2.65				
Bromide	630	10	650	640	655	620	ProcessDescriptionScale							
TOX	348	23	13	26	29	31								
CHCl3	13.0	2.0	0.0	0.0	0.0	0.0	Coagulation aluminum sulfate (Al2(SO4)3) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench							
BDCM	51.0	9.0	0.0	0.0	0.0	0.0								
DBCM	125.0	5.0	1.4	1.8	2.5	5.2								
CHBr3	109.0	11.0	12.0	15.0	18.0	22.0								
THM4	298.0	5.0	13.4	16.8	20.5	27.2	Design Parameters							
MCAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCAA	8.1	1.9	0.0	0.0	0.0	0.0								
TCAA	2.8	0.6	0.0	0.0	0.0	0.0								
MBAA	2.2	2.2	0.0	0.0	0.0	0.0								
DBAA	32.0	4.0	1.9	2.4	3.3	4.2								
BCAA	20.0	3.0	0.0	0.0	0.0	0.0								
TBAA	18.5	0.5	0.0	0.0	0.0	0.0								
CDBAA	18.5	2.5	0.0	0.0	0.0	0.0								
DCBAA	9.8	1.2	0.0	0.0	0.0	0.0								
HAA5	45.0	4.4	1.9	2.4	3.3	4.2	Active memb area:		0.167 ft ²	ID#	Recov (dec.)	F _{W-des} (gfd)		
HAA6	65.0	7.4	1.9	2.4	3.3	4.2	Active width:		0.330 ft					
HAA9	111.8	10.6	1.9	2.4	3.3	4.2	Norm Temp:		24.6 °C					
SDS Conditions							Feed TDS:		700.0 mg/L					
WQP							Manuf rep TDS rej:		50%					
Res (mg/L) (0)	0.93	0.13	6	0.74 - 1.10			Temp Norm MTC-w:		0.237 gfd/psi	1	0.70	15.0		
Temp (°C)	24.0	0.0	6	24.0 - 24.0			Comments:							
pH (unit)	8.4	0.1	6	8.2 - 8.5										
Time (hr)	48.0	0.0	6	48.0 - 48.0										

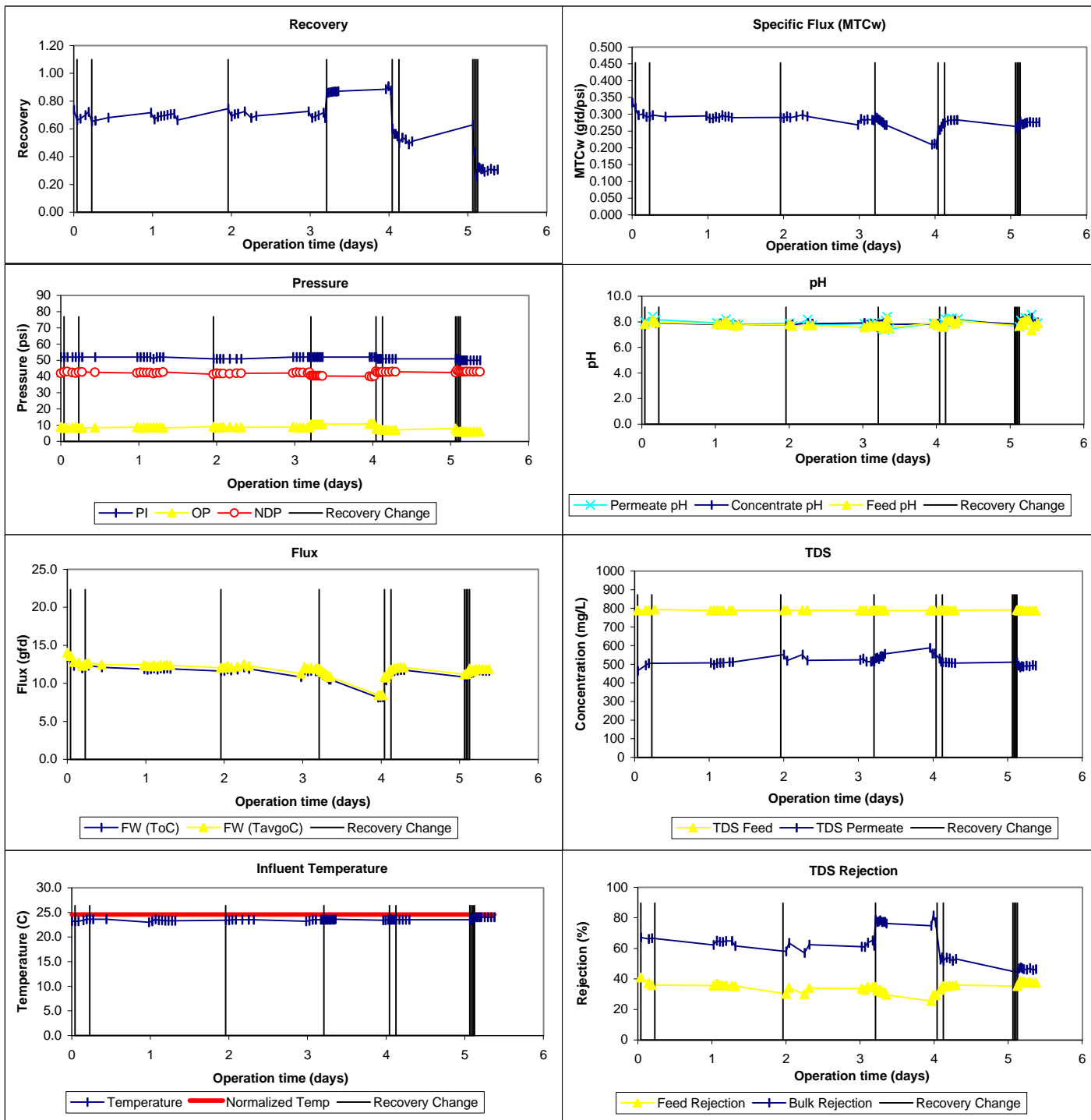
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 2/17/98 - 2/23/98 (6 days)

Membrane Information

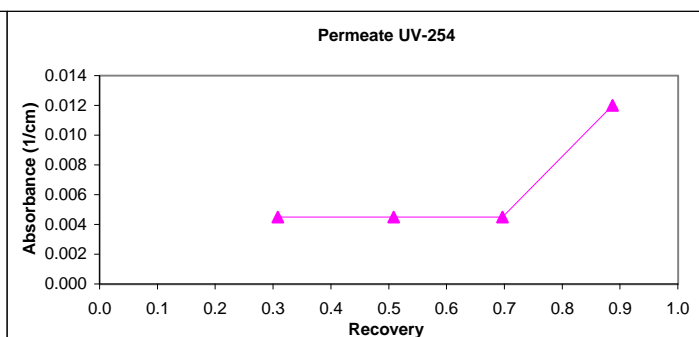
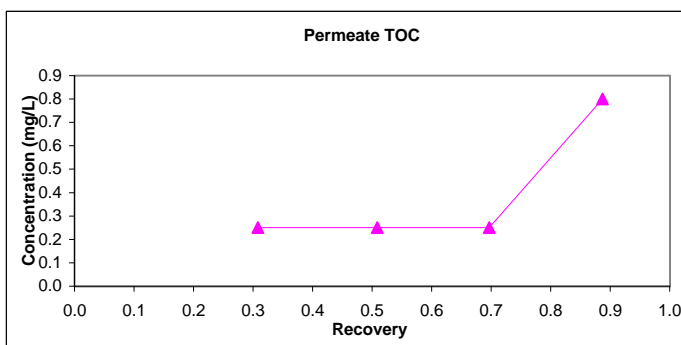
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.0 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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

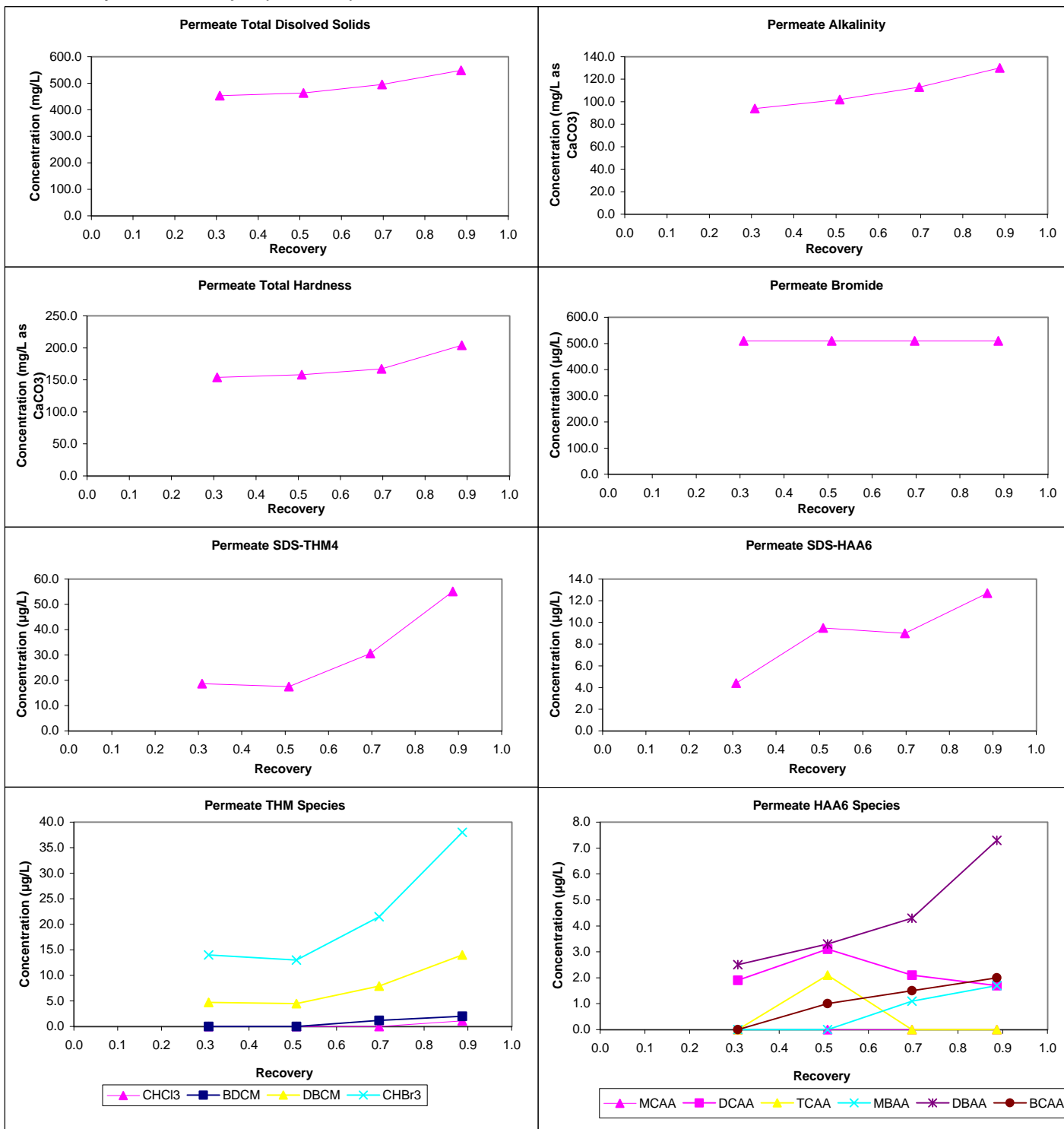
Water Quality Summary

Water Quality Summary																					
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)										
Recovery ->	Avg	Diff	0.31	0.51	0.70	0.89	0.31	0.51	0.70	0.89	WQP	Count	Avg	SD							
pH	8.3	0.0	8.3	8.3	8.2	8.3	8.4	8.4	8.4	8.3	TDS _{st}	27	-9	25							
Temp	23.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	Alk	4	-4	2							
Alk	136	0	94	102	113	130	152	168	180	172	TDS	4	-9	12							
TDS	741	10	453	463	495	549	868	1008	1208	1780	TotHard	4	4	8							
TotHard	369	5	154	158	167	204	524	604	904	1552	CaHard	4	-1	7							
CaHard	247	5	102	108	115	132	324	408	548	1040	Turb	4	-62	93							
Turb	0.24	0.00	0.04	0.04	0.05	0.04	0.15	0.17	0.73	2.52	Amm	0	n/a	n/a							
Amm	0.03	0.03	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	1	-13	n/a							
TOC	3.1	0.1	0.3	0.3	0.3	0.8	4.3	6.2	9.7	18.4	UV254	1	-15	n/a							
UV254	0.071	0.000	0.005	0.005	0.005	0.012	0.101	0.140	0.215	0.461	Pretreatment Information										
SUVA	2.31	0.02	1.80	1.80	1.80	1.50	2.35	2.26	2.23	2.51											
Bromide	475	5	510	510	510	510	Design Parameters														
TOX	325	5	13	28	36	63															
CHCl ₃	22.0	0.0	0.0	0.0	0.0	1.1	Active memb area:		0.167 ft ²		ID#	Recov (dec.)	F _{W-des} (gfd)								
BDCM	56.5	11.5	0.0	0.0	1.2	2.0															
DBCM	103.0	7.0	4.7	4.5	7.9	14.0	Norm Temp:		24.6 °C		1	0.70	15.0								
CHBr ₃	54.0	11.0	14.0	13.0	21.5	38.0					2	0.90	15.0								
THM ₄	235.5	29.5	18.7	17.5	30.6	55.1	Manuf rep TDS rej:		50%		3	0.50	15.0								
MCAA	3.3	1.1	0.0	0.0	0.0	0.0					4	0.30	15.0								
DCAA	12.5	1.5	1.9	3.1	2.1	1.7	Comments:														
TCAA	8.5	1.5	0.0	2.1	0.0	0.0															
MBAA	4.4	0.2	0.0	0.0	1.1	1.7															
DBAA	22.0	0.0	2.5	3.3	4.3	7.3															
BCAA	21.0	1.0	0.0	1.0	1.5	2.0															
TBAA	15.0	2.0	0.0	0.0	5.8	9.3															
CDBAA	24.5	3.5	0.0	0.0	2.4	3.6															
DCBAA	20.5	4.5	0.0	0.0	1.3	1.6															
HAA ₅	50.7	4.3	4.4	8.5	7.5	10.7															
HAA ₆	71.7	5.3	4.4	9.5	9.0	12.7															
HAA ₉	131.7	11.3	4.4	9.5	18.5	27.2															
SDS Conditions																					
WQP	Avg	SD	Count	Min - Max																	
Res (mg/L) (0)	1.11	0.17	6	0.80 - 1.23																	
Temp (°C)	21.0	0.0	6	21.0 - 21.0																	
pH (unit)	8.2	0.0	6	8.1 - 8.2																	
Time (hr)	72.0	0.0	6	72.0 - 72.0																	

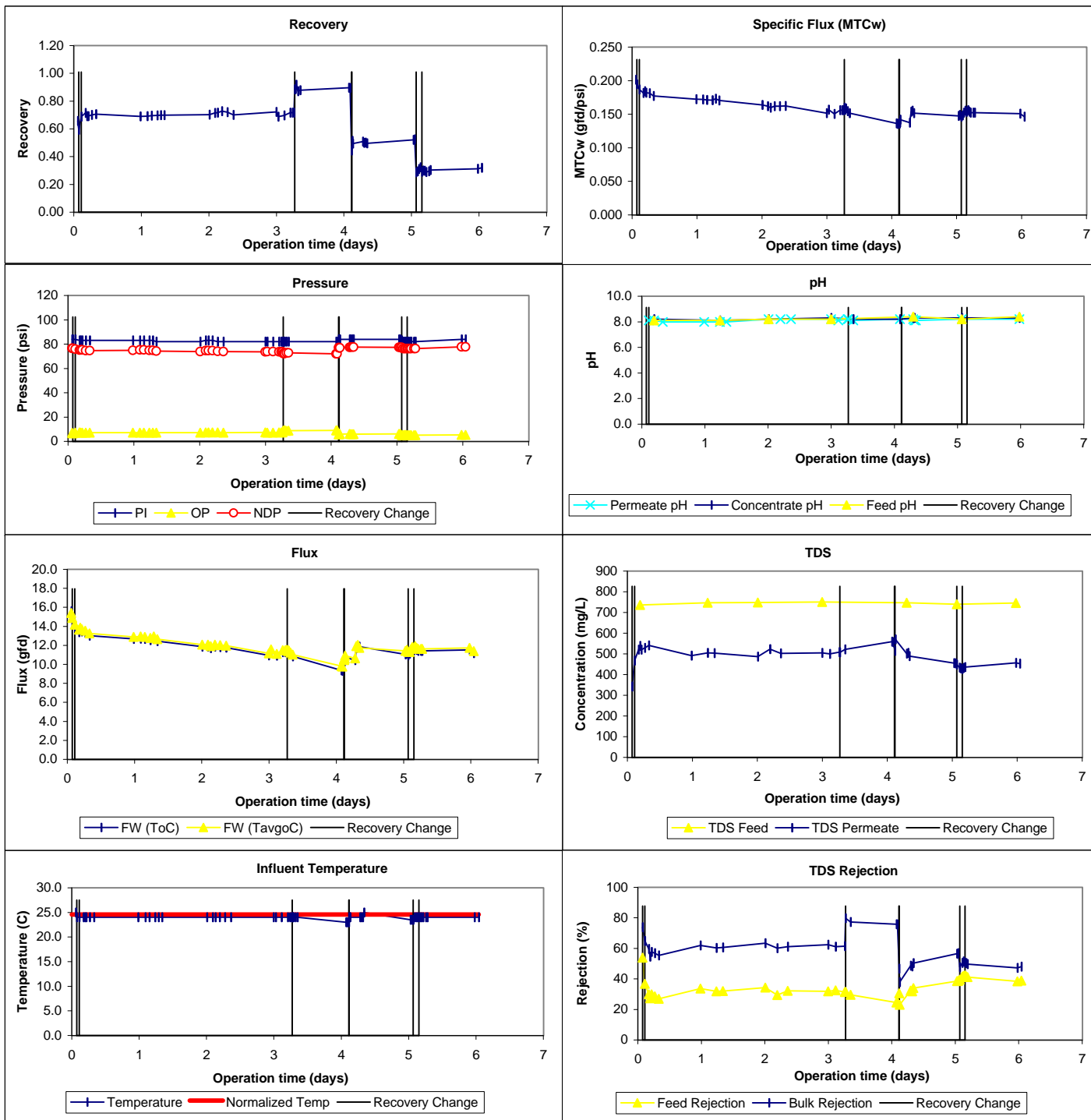
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 6/4/98 - 6/10/98 (6 days)

Membrane Information

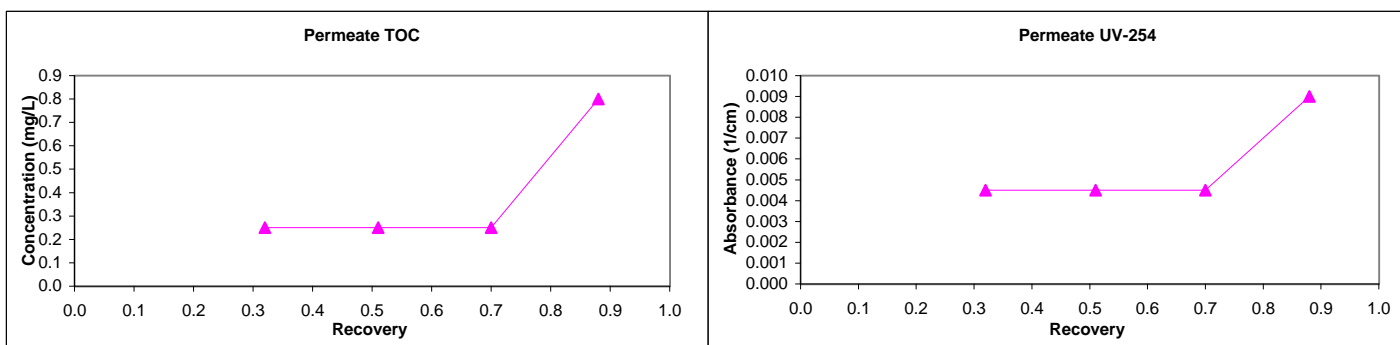
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.0 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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

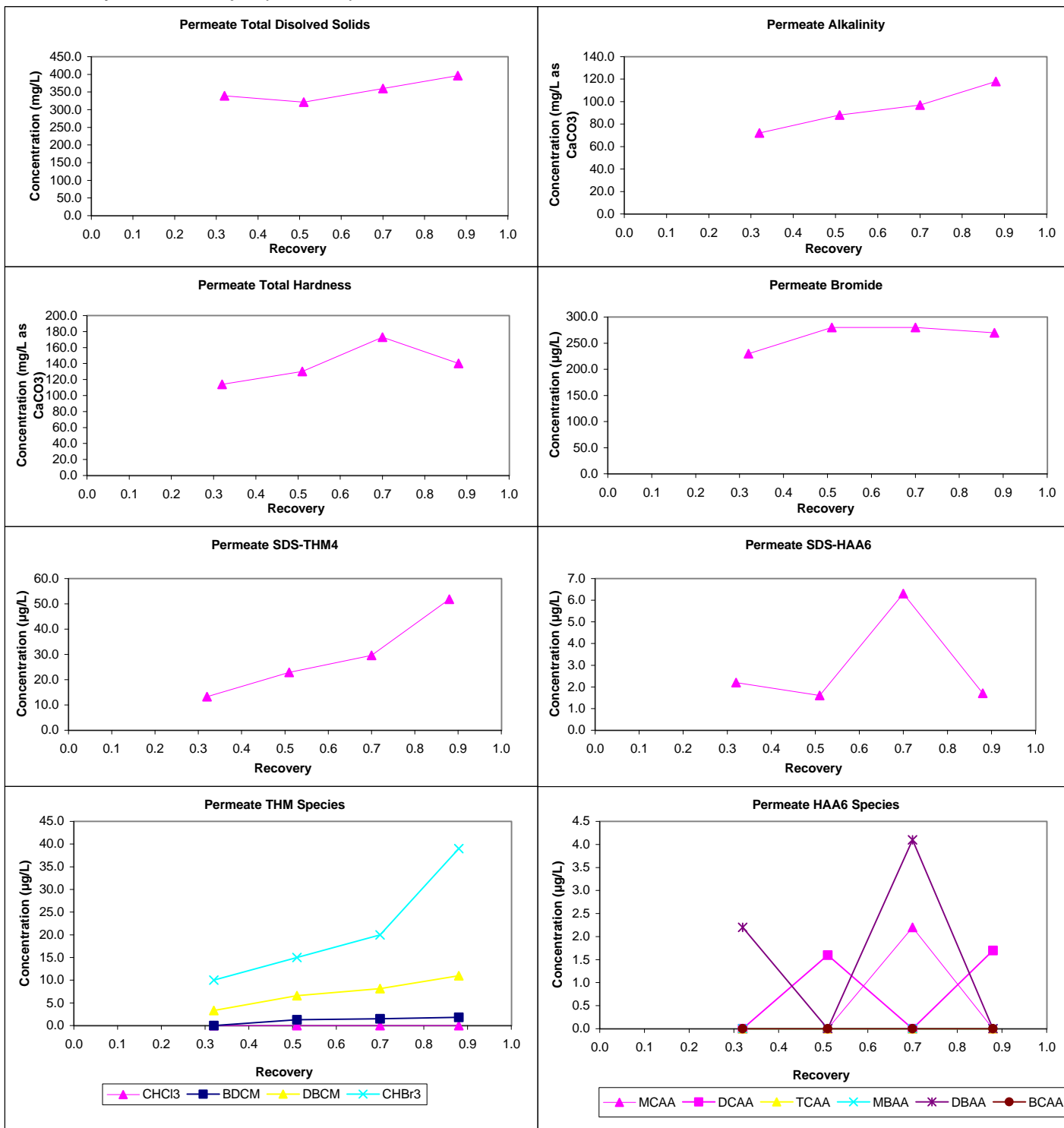
Water Quality Summary

Water Quality Summary															Mass Balance Closure Err (%)		
Source ->	Feed		Permeate				Concentrate										
Recovery ->	Avg	Diff	0.32	0.51	0.70	0.88	0.32	0.51	0.70	0.88	WQP	Count	Avg	SD			
pH	7.9	0.2	8.2	8.3	8.3	8.2	8.3	8.3	8.3	8.3	TDS	43	-18	39			
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	36	41			
Alk	105	1	72	88	97	118	124	178	144	204	TDS	4	-7	7			
TDS	571	6	339	321	360	396	677	788	998	1588	TotHard	4	-2	10			
TotHard	311	13	114	130	173	140	372	466	723	1486	CaHard	4	9	8			
CaHard	193	3	76	84	89	102	246	328	499	1062	Turb	4	-61	73			
Turb	0.17	0.02	0.04	0.04	0.06	0.08	0.25	0.27	0.18	0.40	Amm	0	n/a	n/a			
Amm	0.00	0.00	0.05	0.00	0.04	0.18	NA	NA	NA	NA	TOC	1	19	n/a			
TOC	2.7	0.2	0.3	0.3	0.3	0.8	3.6	5.2	8.6	20.0	UV254	1	0	n/a			
UV254	0.060	0.001	0.005	0.005	0.005	0.009	0.082	0.130	0.183	0.433	Pretreatment Information						
SUVA	2.27	0.17	1.80	1.80	1.80	1.13	2.28	2.50	2.13	2.17							
Bromide	190	30	230	280	280	270	Process Description Scale										
TOX	274	24	13	34	38	53											
CHCl3	29.0	3.0	0.0	0.0	0.0	0.0	Coagulation aluminum sulfate (Al2(SO4)3) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench										
BDCM	44.0	2.0	0.0	1.3	1.5	1.8											
DBCM	57.5	5.5	3.3	6.6	8.2	11.0											
CHBr3	20.5	3.5	10.0	15.0	20.0	39.0											
THM4	151.0	8.0	13.3	22.9	29.7	51.8	Design Parameters										
MCAA	2.6	NA	0.0	0.0	2.2	0.0											
DCAA	14.0	NA	0.0	1.6	0.0	1.7											
TCAA	9.0	NA	0.0	0.0	0.0	0.0											
MBAA	2.9	NA	0.0	0.0	0.0	0.0											
DBAA	14.0	NA	2.2	0.0	4.1	0.0											
BCAA	17.0	NA	0.0	0.0	0.0	0.0											
TBAA	9.7	NA	NA	NA	NA	NA											
CDBAA	15.0	NA	NA	NA	NA	NA											
DCBAA	16.0	NA	NA	NA	NA	NA											
HAA5	42.5	NA	2.2	1.6	6.3	1.7	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: 0.281 gfd/psi										
HAA6	59.5	NA	2.2	1.6	6.3	1.7											
HAA9	100.2	NA	NA	NA	NA	NA											
SDS Conditions							Comments:										
WQP	Avg	SD	Count	Min - Max													
Res (mg/L) (0)	0.90	0.39	6	0.39 - 1.46													
Temp (°C)	25.0	0.0	6	25.0 - 25.0													
pH (unit)	8.2	0.1	6	8.0 - 8.4													
Time (hr)	48.0	0.0	6	48.0 - 48.0													

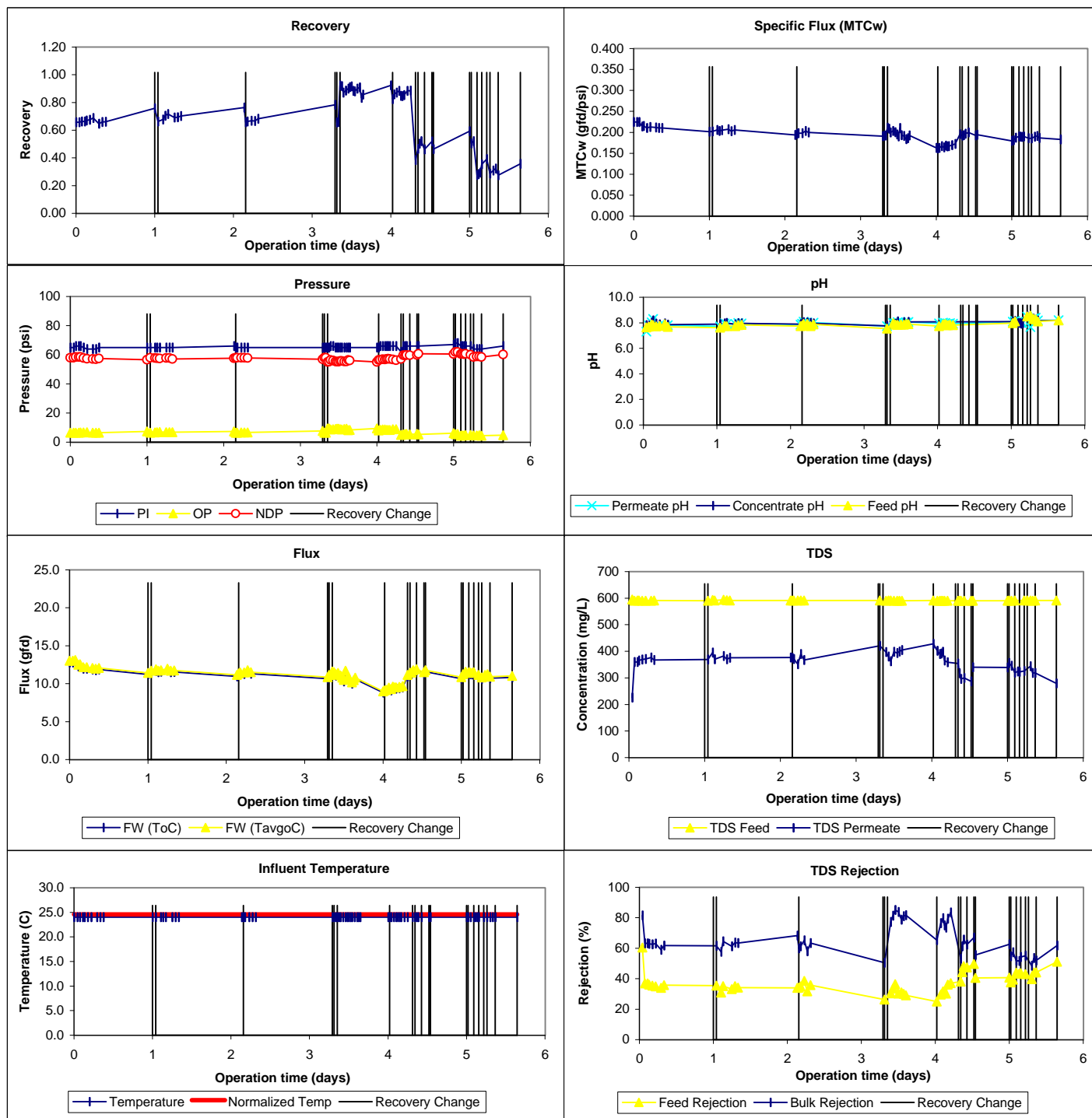
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 9/1/98 - 9/8/98 (7 days)

Membrane Information

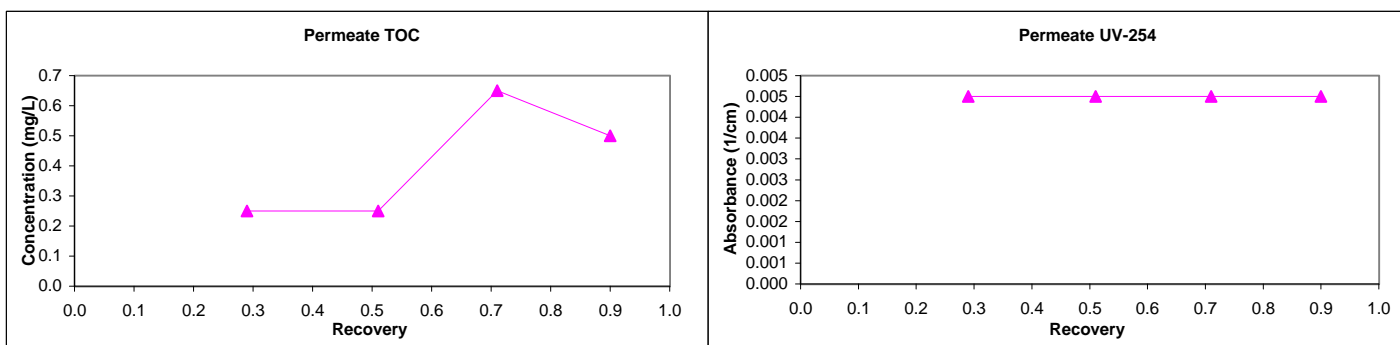
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.0 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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

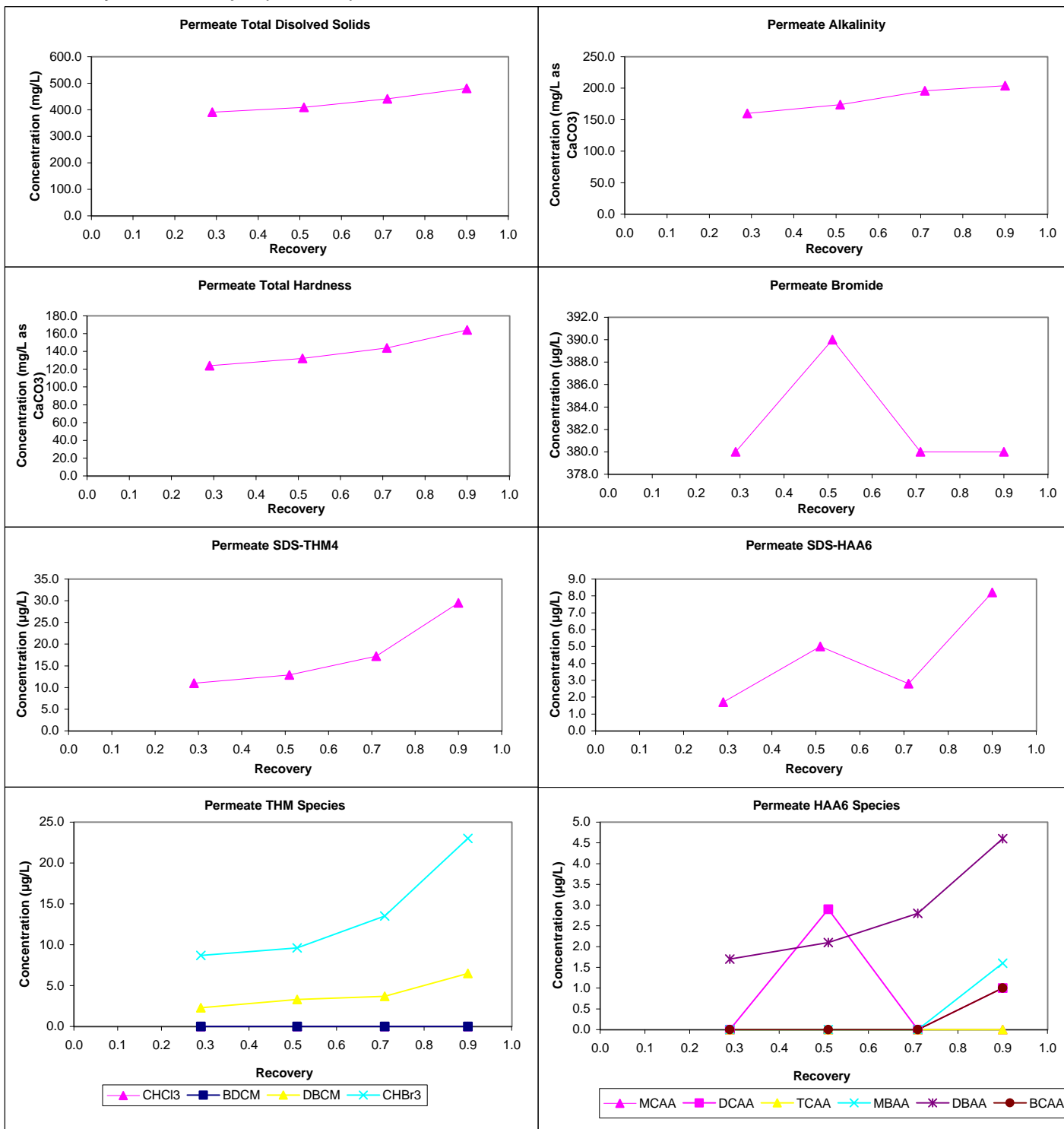
Water Quality Summary

Water Quality Summary														
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.29	0.51	0.71	0.90	0.29	0.51	0.71	0.90	WQP	Count	Avg	SD
pH	8.1	0.1	8.4	8.3	8.3	8.3	8.1	8.0	7.9	7.9	TDS _{St}	47	-7	11
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	4	3
Alk	210	10	160	174	196	204	246	254	258	264	TDS	4	-16	20
TDS	638	9	391	409	441	481	717	824	1021	1401	TotHard	4	-6	8
TotHard	329	5	124	132	144	164	412	522	760	1536	CaHard	4	-5	15
CaHard	216	0	82	88	96	104	298	352	492	964	Turb	4	-33	31
Turb	0.14	0.00	0.06	0.07	0.09	0.09	0.16	0.17	0.21	0.35	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	2	-1	16
TOC	2.5	0.1	0.3	0.3	0.7	0.5	3.8	5.4	8.3	17.5	UV254	0	n/a	n/a
UV254	0.060	0.001	0.005	0.005	0.005	0.005	0.085	0.118	0.192	0.412	Pretreatment Information			
SUVA	2.40	0.06	1.80	1.80	0.69	0.90	2.24	2.19	2.31	2.35				
Bromide	355	5	380	390	380	380	Coagulation aluminum sulfate (Al ₂ (SO ₄) ₃) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench							
TOX	270	20	35	13	37	53								
CHCl ₃	12.0	1.0	0.0	0.0	0.0	0.0	Design Parameters							
BDCM	33.0	3.0	0.0	0.0	0.0	0.0								
DBCM	74.5	6.5	2.3	3.3	3.7	6.5	Active width:	0.330 ft						
CHBr ₃	50.5	5.5	8.7	9.6	13.5	23.0	Norm Temp:	24.6 °C	1	0.70	15.0			
THM ₄	170.0	16.0	11.0	12.9	17.2	29.5	Feed TDS:	700.0 mg/L	2	0.90	15.0			
MCAA	0.0	0.0	0.0	0.0	0.0	0.0	Manuf rep TDS rej:	50%	3	0.50	15.0			
DCAA	6.1	0.1	0.0	2.9	0.0	1.0	Temp Norm MTC-w:	0.281 gfd/psi	4	0.30	15.0			
TCAA	2.3	0.0	0.0	0.0	0.0	0.0	Comments:							
MBAA	2.6	0.2	0.0	0.0	0.0	1.6								
DBAA	17.0	0.0	1.7	2.1	2.8	4.6								
BCAA	12.0	0.0	0.0	0.0	0.0	1.0								
TBAA	10.2	0.8	0.0	0.0	4.8	7.0								
CDBAA	9.7	0.1	0.0	0.0	0.0	0.0								
DCBAA	6.7	0.0	0.0	0.0	0.0	0.0								
HAA ₅	28.0	0.2	1.7	5.0	2.8	7.2								
HAA ₆	40.0	0.2	1.7	5.0	2.8	8.2								
HAA ₉	66.5	1.1	1.7	5.0	7.6	15.2								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.93	0.17	6	0.74 - 1.17										
Temp (°C)	25.0	0.0	6	25.0 - 25.0										
pH (unit)	8.2	0.2	6	7.8 - 8.3										
Time (hr)	24.0	0.0	6	24.0 - 24.0										

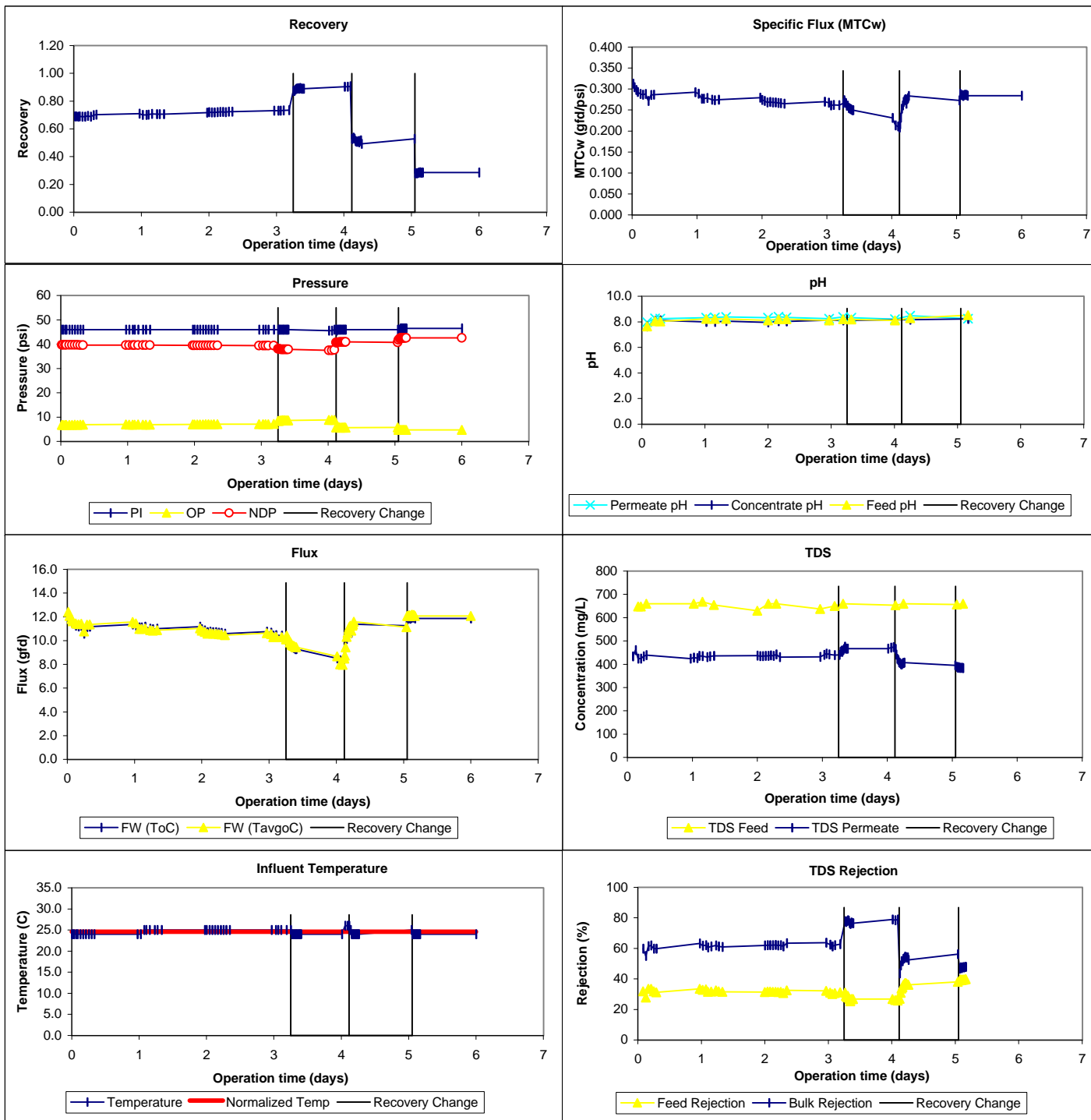
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: TX0310001 / 614
 ICR Contact: Isidoro Urbano, Jr.
 Phone No.: (956) 982-6379
 Period: 2/6/99 - 2/12/99 (6 days)

Membrane Information

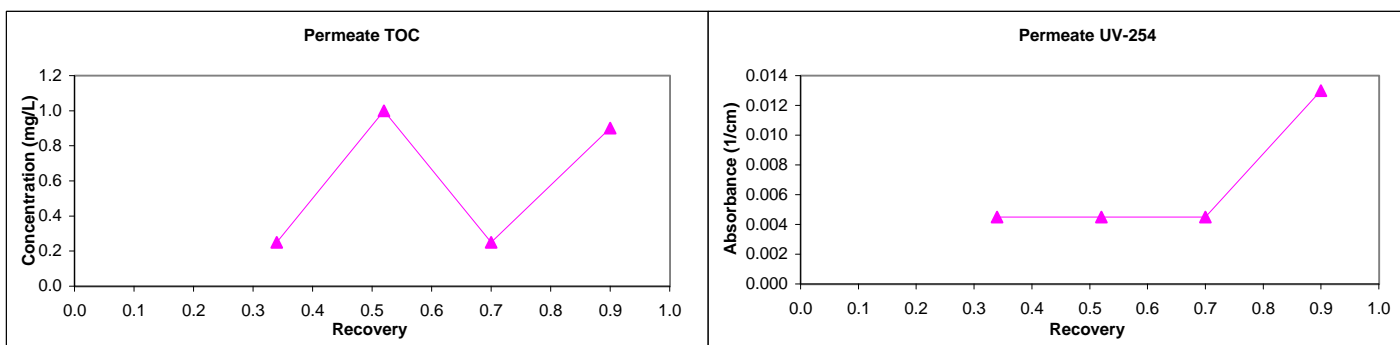
Manufacturer: FilmTec Corporation
 Trade Name: NF200B-400
 MWCO: 200-400 Daltons
 Mfr. Flux: 21.0 gfd
 Mfr. NDP: 71.0 psi
 Mfr. MTCw: 0.284 gfd/psi

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

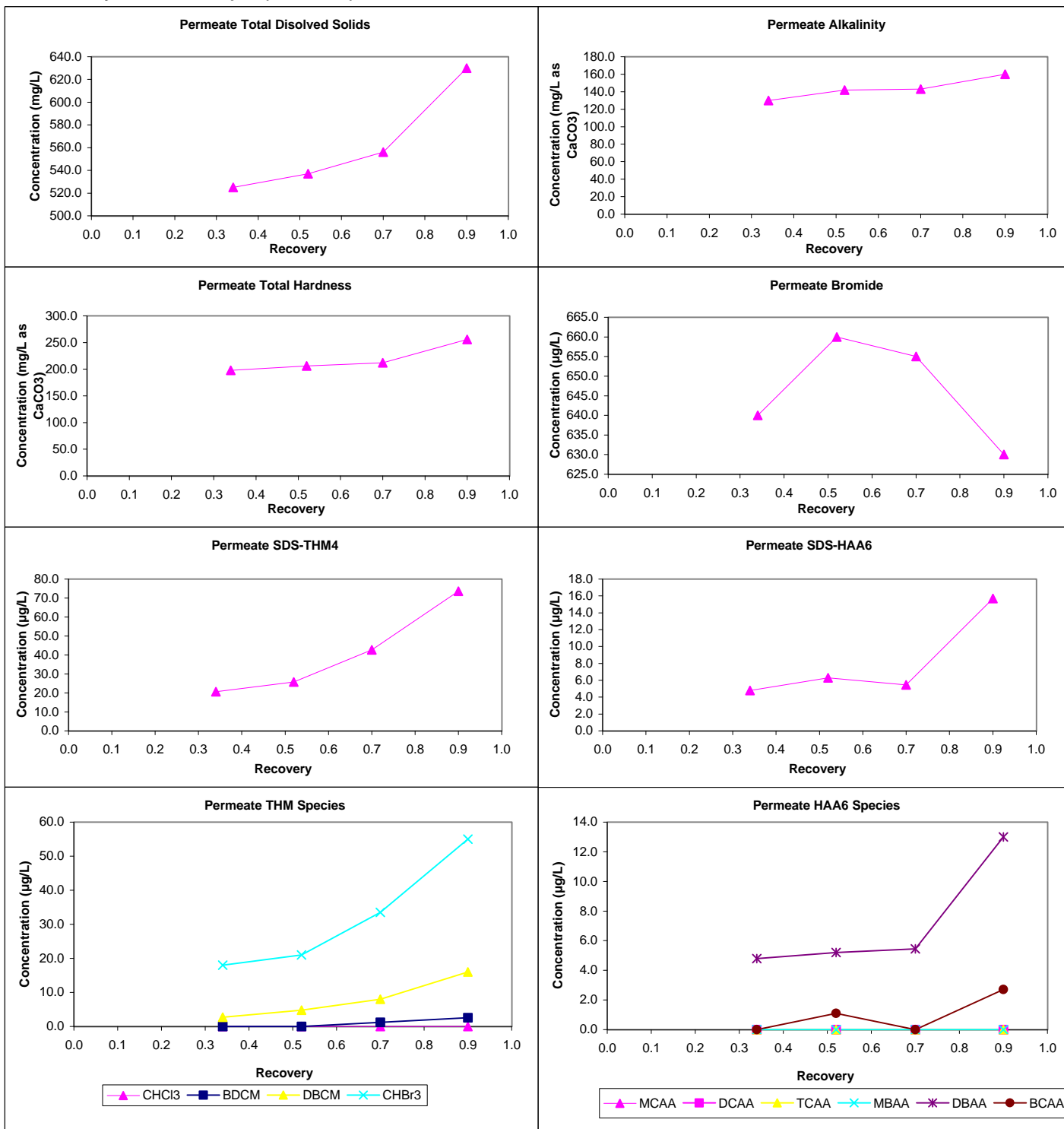
Water Quality Summary

Water Quality Summary														
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.34	0.52	0.70	0.90	0.34	0.52	0.70	0.90	WQP	Count	Avg	SD
pH	8.2	0.1	8.2	8.1	8.1	8.2	8.3	8.2	8.2	8.2	TDS	43	-23	50
Temp	23.8	0.3	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	Alk	4	-1	7
Alk	167	3	130	142	143	160	190	188	202	246	TDS	4	-11	11
TDS	789	1	525	537	556	630	908	1000	1201	1750	TotHard	4	-5	7
TotHard	409	1	198	206	212	256	528	628	818	1558	CaHard	4	-11	9
CaHard	293	3	138	148	148	198	362	434	558	938	Turb	4	-75	76
Turb	0.14	0.00	0.06	0.06	0.07	0.08	0.17	0.21	0.16	0.26	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	3	-9	17
TOC	3.5	0.3	0.3	1.0	0.3	0.9	4.6	6.8	9.4	21.7	UV254	1	-27	n/a
UV254	0.075	0.000	0.005	0.005	0.005	0.013	0.111	0.151	0.225	0.498	Pretreatment Information			
SUVA	2.16	0.19	1.80	0.45	1.80	1.44	2.41	2.22	2.39	2.29				
Bromide	630	10	640	660	655	630	Coagulation aluminum sulfate (Al2(SO4)3) 1 bench Sedimentation 24 hours settling bench Cartridge filtration 5 micron filter bench							
TOX	348	23	32	27	44	71								
CHCl3	13.0	2.0	0.0	0.0	0.0	0.0								
BDCM	51.0	9.0	0.0	0.0	1.3	2.6	Design Parameters							
DBCM	125.0	5.0	2.7	4.8	8.0	16.0								
CHBr3	109.0	11.0	18.0	21.0	33.5	55.0								
THM4	298.0	5.0	20.7	25.8	42.8	73.6								
MCAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCAA	8.1	1.9	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: 0.281 gfd/psi							
TCAA	2.8	0.6	0.0	0.0	0.0	0.0								
MBAA	2.2	2.2	0.0	0.0	0.0	0.0								
DBAA	32.0	4.0	4.8	5.2	5.5	13.0								
BCAA	20.0	3.0	0.0	1.1	0.0	2.7								
TBAA	18.5	0.5	0.0	0.0	0.0	7.0	ID# Recov (dec.) F _{W-des} (gfd) 1 0.70 15.0 2 0.90 15.0 3 0.50 15.0 4 0.30 15.0							
CDBAA	18.5	2.5	0.0	0.0	0.0	3.0								
DCBAA	9.8	1.2	0.0	1.1	0.0	1.2								
HAA5	45.0	4.4	4.8	5.2	5.5	13.0								
HAA6	65.0	7.4	4.8	6.3	5.5	15.7								
HAA9	111.8	10.6	4.8	7.4	5.5	26.9	Comments:							
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.99	0.17	6	0.82 - 1.30										
Temp (°C)	24.0	0.0	6	24.0 - 24.0										
pH (unit)	8.3	0.1	6	8.2 - 8.5										
Time (hr)	48.0	0.0	6	48.0 - 48.0										

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs

