

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1053
Study Protocol	Membrane RBSMT treatment study
Plant ICR Number	293
PWS Name	Broward County, District 2A WTP
City, State, Zip	Pompano Beach, FL 33069

General Comments:

1. During this bench-scale study, two membranes were evaluated: the Koch-Fluid Systems TFC-SR and the Hydranautics NTR7450. Each membrane was tested during four quarters over a one-year period. The sampling and testing dates are summarized in Table 5 of the Summary Report.
2. The only pretreatment applied to this groundwater (Biscayne aquifer) was cartridge filtration. Relatively loose membranes (i.e., low rejection of most inorganic salts) were used during this study. However, these membranes did reject calcium hardness in the range of 25 to 60%, and at high recoveries, this level of rejection may have resulted in concentration factors high enough to cause salt precipitation. Thus, the addition of acid or antiscalant to control inorganic scale formation may have resulted in longer cleaning intervals than those observed during this study.
3. During data analysis, a temperature of 26°C was used for productivity analysis during all four quarters. The average temperature for this source is reported as 26°C and varies between 25°C and 27°C.
4. No cost information was provided in the Summary Report.

Water Quality Comments:

1. 1 water quality outlier was identified and removed prior to base analysis.
2. Constant SDS conditions were used throughout all four quarters: incubation temperature = 25°C; pH = 9.0; incubation time = 24 hours; and free residual = 1 mg/L.

Productivity Comments:

1. 6 productivity outliers were identified and removed prior to base analysis.
2. Severe flux loss was observed at 90% recovery during the 4th quarter of the TFC SR40 run. Summary Report indicates that this could be due to inorganic scale formation.
3. The standard membrane cleaning procedure utilized a sodium hydroxide solution (pH \approx 12, at 40°C). When this cleaner was not effective, a sulfuric acid solutions (pH $>$ 2.5) was also used. Additional information on membrane cleaning is given in Section 3 of the Summary Report.

ICR Information

ID / ICR#: 4060163 / 293
 ICR Contact: Mr. Jerry Baker
 Phone No.: (954) 960-3061
 Period: 5/27/98 - 6/3/98 (7 days)

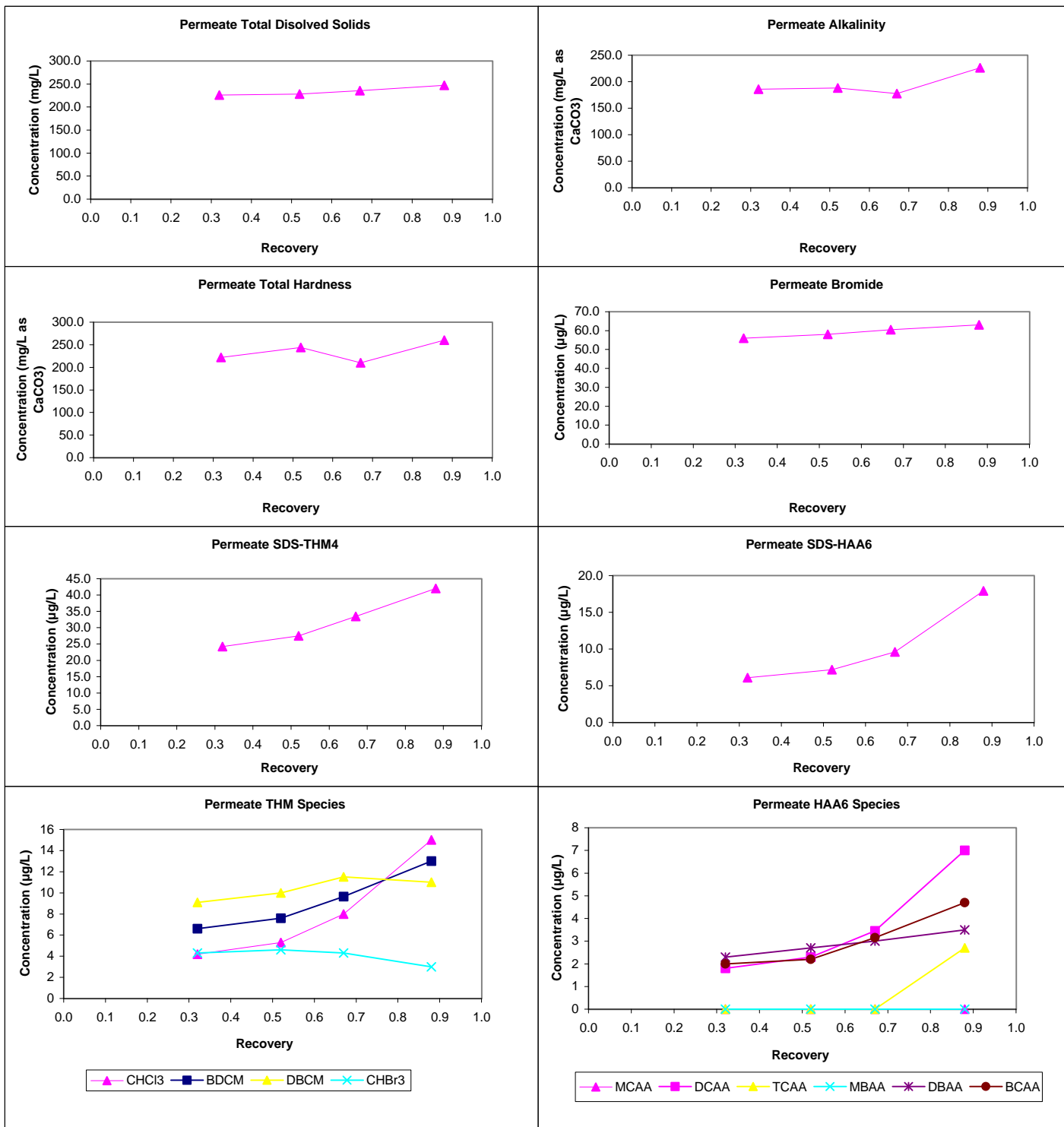
Membrane Information

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

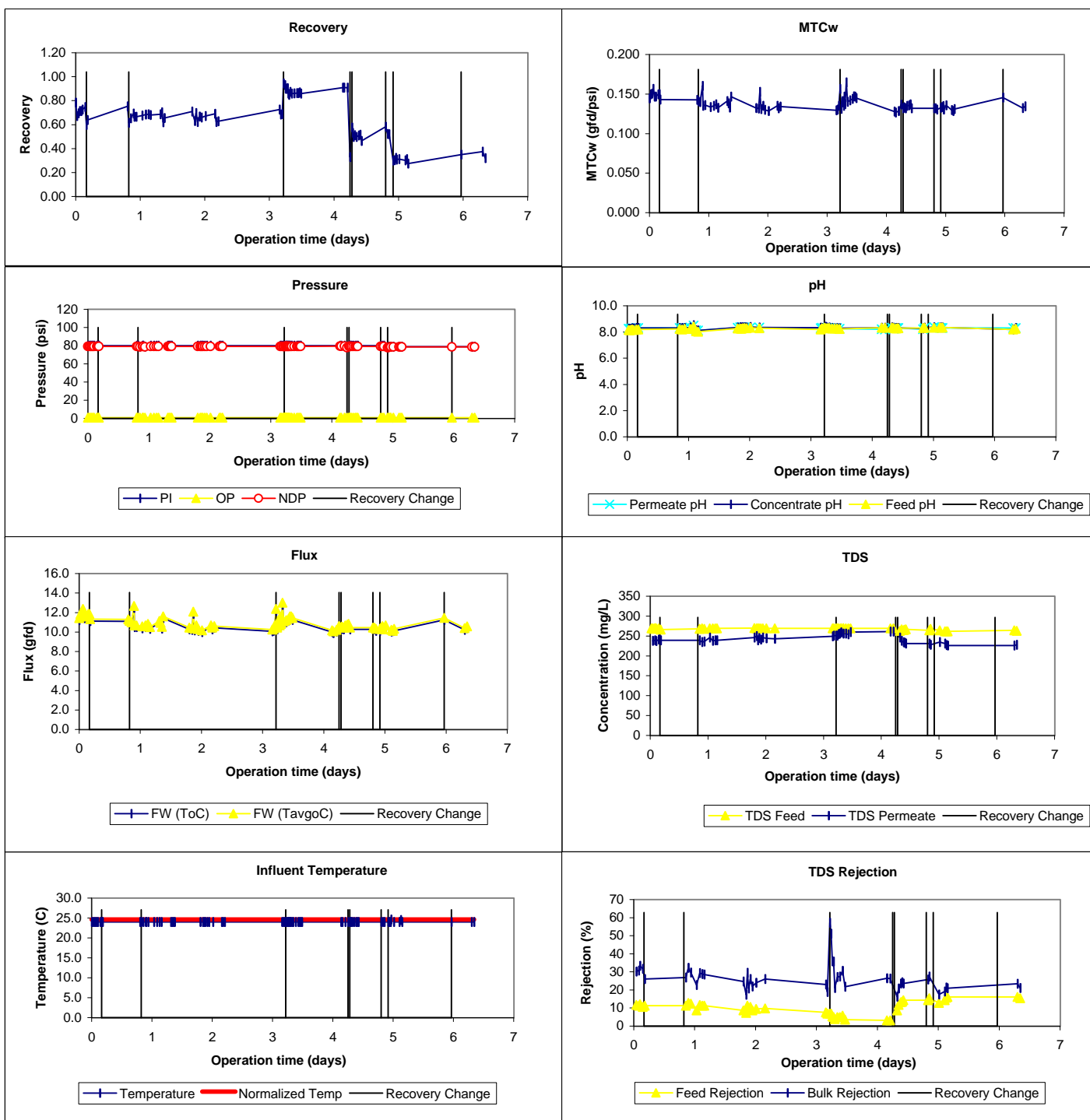
Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)								
Source ->	Feed		Permeate				Concentrate								
Recovery ->	Avg	RD	0.32	0.52	0.67	0.88	0.32	0.52	0.67	0.88	WQP	Count	Avg	SD	
pH	8.5	0.1	8.5	8.3	8.2	8.4	8.4	8.4	8.4	8.5	TDS	41	-4	11	
Temp	24.3	0.3	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5					
Alk	229	7	186	188	178	226	227	238	236	248	Alk	4	-17	17	
TDS	270	2	226	228	236	247	272	280	279	416	TDS	4	-11	8	
TotHard	291	39	222	244	210	260	282	304	300	359	TotHard	4	-31	20	
CaHard	248	12	196	204	178	238	260	273	271	305	CaHard	4	-16	19	
Turb	0.13	0.0	0.15	0.11	0.12	0.17	0.19	0.21	0.20	0.41	Turb	4	60	56	
Amm	0.03	0.03	0.00	0.00	0.00	0.09	NA	NA	NA	NA	Amm	0	n/a	n/a	
TOC	6.1	0.1	0.7	0.8	1.0	1.3	8.8	12.0	16.2	38.8	TOC	4	-1	4	
UV254	0.185	0.000	0.011	0.014	0.020	0.027	0.269	0.376	0.521	1.242	UV254	4	-1	5	
SUVA	3.03	0.05	1.57	1.75	2.11	2.08	3.06	3.13	3.22	3.20					
Bromide	62	1	56	58	61	63	Pretreatment Information								
TOX	538	38	49	67	79	105									
							Process		Description		Scale				
CHCl3	165.0	5.0	4.2	5.3	8.0	15.0	Cartridge filtration		5 micron filter		bench				
BDCM	22.0	2.0	6.6	7.6	9.7	13.0									
DBCM	3.6	0.2	9.1	10.0	11.5	11.0									
CHBr3	0.0	0.0	4.3	4.6	4.3	3.0									
THM4	190.6	6.8	24.2	27.5	33.5	42.0									
MCAA	5.4	0.9	0.0	0.0	0.0	0.0									
DCAA	47.5	3.5	1.8	2.3	3.5	7.0									
TCAA	37.5	2.5	0.0	0.0	0.0	2.7									
MBAA	0.0	0.0	0.0	0.0	0.0	0.0									
DBAA	0.5	0.5	2.3	2.7	3.0	3.5									
BCAA	7.7	0.4	2.0	2.2	3.2	4.7									
TBAA	0.0	0.0	0.0	0.0	0.0	0.0									
CDBAA	0.0	0.0	0.0	0.0	0.0	2.6									
DCBAA	7.5	0.2	1.4	1.6	1.9	2.9									
HAA5	90.9	7.3	4.1	5.0	6.5	13.2									
HAA6	98.6	7.8	6.1	7.2	9.6	17.9									
HAA9	106.0	7.6	7.5	8.8	11.5	23.4									
SDS Conditions							Design Parameters								
WQP	Avg	SD	Count	Min - Max											
Res (mg/L) (0)	1.76	0.44	6	1.43 - 2.60											
Temp (°C)	25.0	0.0	6	25.0 - 25.0											
pH (unit)	8.5	0.1	6	8.3 - 8.6											
Time (hr)	24.2	0.4	6	24.0 - 25.0											
							Active memb area:		0.167 ft ²	ID#		Recov	F _{W-de}		
							Active width:		0.330 ft			(dec.)	(gfd)		
							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:		0.316 gfd/psi	4		0.30	15.0		
							Comments:								

Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 7/16/98 - 7/22/98 (6 days)

Membrane Information

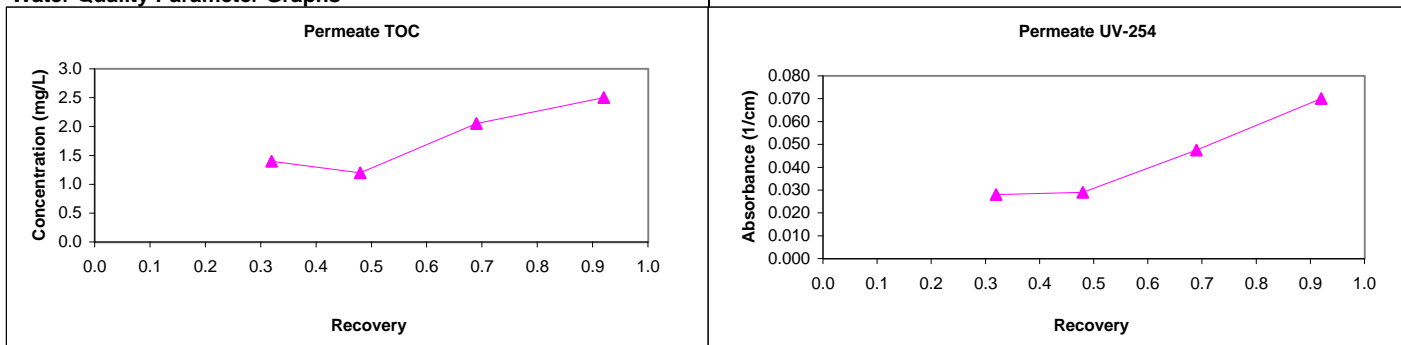
Manufacturer: Hydranautics Corp., San Diego, CA
Trade Name: NTR7450
MWCO: 1,000 Da Daltons
Mfr. Flux: 45.0 gfd
Mfr. NDP: 140.0 psi
Mfr. MTCw: 0.320 gfd/psi

Mfr. Temp: 25.0 °C
840 Element Area: 365.0 ft²
840 Purchase Price: \$800
840 Maximum Flow: 75.0 gpm
840 Minimum Flow: 25.0 gpm
840 Total Width: 64.4 ft
840 Feed Spacer Thickness: 0.0023 ft

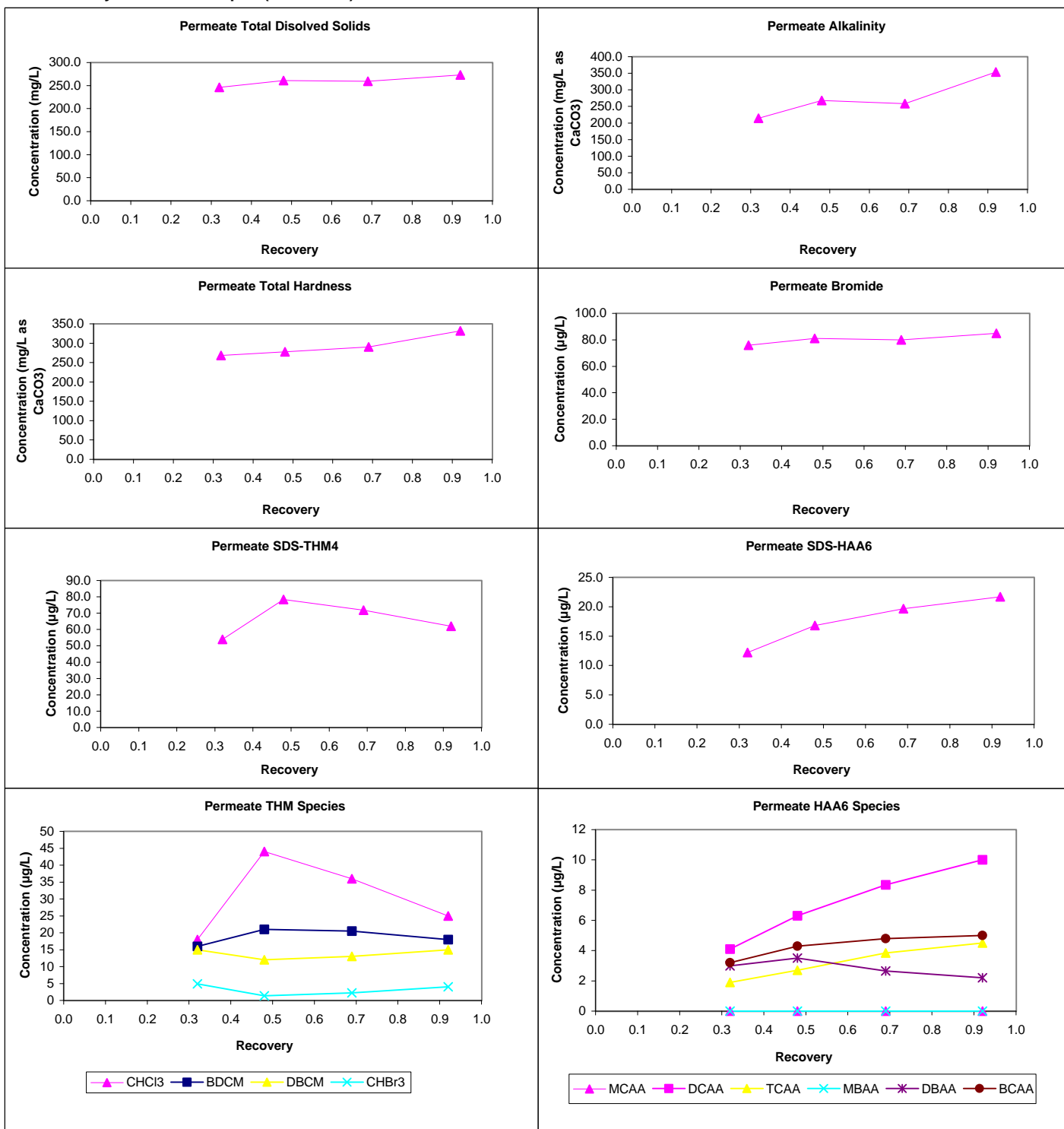
Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																																				
Recovery ->	Avg	RD	0.32	0.48	0.69	0.92	0.32	0.48	0.69	0.92	WQP	Count	Avg	SD																																	
pH	7.9	0.1	8.0	8.1	8.1	8.2	8.3	8.4	8.0	8.4	TDS	37	-5	8																																	
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	Alk	4	9	53																																	
Alk	330	4	214	268	258	354	344	366	369	398	TDS	4	-18	15																																	
TDS	286	2	246	261	260	273	285	292	281	318	TotHard	4	30	58																																	
TotHard	300	22	268	278	290	332	300	340	328	400	CaHard	4	41	88																																	
CaHard	268	4	226	236	247	314	268	302	305	354	Turb	4	-73	45																																	
Turb	0.20	0.0	0.07	0.08	0.09	0.12	0.20	0.21	0.21	0.49	Amm	0	n/a	n/a																																	
Amm	0.04	0.04	0.00	0.06	0.07	0.06	NA	NA	NA	NA	TOC	4	-49	69																																	
TOC	6.7	0.1	1.4	1.2	2.1	2.5	8.0	10.1	14.9	21.6	UV254	4	-3	8																																	
UV254	0.204	0.011	0.028	0.029	0.048	0.070	0.289	0.371	0.552	1.519	<div>Pretreatment Information</div> <table><thead><tr><th>Process</th><th>Description</th><th>Scale</th></tr></thead><tbody><tr><td>Cartridge filtration</td><td>5 micron filter</td><td>bench</td></tr></tbody></table> <div>Design Parameters</div> <table><tbody><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>0.316 gfd/psi</td><td>4</td><td>0.30</td><td>15.0</td></tr></tbody></table> <div>Comments:</div>				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:	0.316 gfd/psi	4	0.30	15.0
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Temp Norm MTC-w:	0.316 gfd/psi	4	0.30	15.0																																											
SUVA	3.06	0.10	2.00	2.42	2.32	2.80	3.61	3.67	3.70	7.03																																					
Bromide	85	2	76	81	80	85																																									
TOX	473	58	84	100	140	180																																									
CHCl3	175.0	25.0	18.0	44.0	36.0	25.0	<div>Design Parameters</div> <table><tbody><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>0.316 gfd/psi</td><td>4</td><td>0.30</td><td>15.0</td></tr></tbody></table> <div>Comments:</div>								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:	0.316 gfd/psi	4	0.30	15.0						
Active memb area:	0.167 ft ²	ID#	Recov (dec.)	F _{W-de} (gfd)																																											
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BDCM	23.0	4.0	16.0	21.0	20.5	18.0																																									
DBCM	4.2	0.3	15.0	12.0	13.0	15.0																																									
CHBr3	0.0	0.0	4.9	1.4	2.3	4.0																																									
THM4	202.2	29.3	53.9	78.4	71.8	62.0																																									
MCAA	3.4	0.1	0.0	0.0	0.0	0.0																																									
DCAA	39.5	5.5	4.1	6.3	8.4	10.0																																									
TCAA	15.2	6.9	1.9	2.7	3.9	4.5																																									
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																																									
DBAA	0.0	0.0	3.0	3.5	2.7	2.2																																									
BCAA	5.9	0.9	3.2	4.3	4.8	5.0																																									
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	2.6	1.4	1.8	2.2	2.3	2.3																																									
HAA5	58.1	12.3	9.0	12.5	14.9	16.7																																									
HAA6	63.9	13.1	12.2	16.8	19.7	21.7																																									
HAA9	66.5	14.5	14.0	19.0	22.0	24.0																																									
SDS Conditions							<div>Design Parameters</div> <table><tbody><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>0.316 gfd/psi</td><td>4</td><td>0.30</td><td>15.0</td></tr></tbody></table> <div>Comments:</div>								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:	0.316 gfd/psi	4	0.30	15.0						
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Temp Norm MTC-w:	0.316 gfd/psi	4	0.30	15.0																																											
WQP	Avg	SD	Count	Min - Max																																											
Res (mg/L) (0)	0.94	0.25	6	0.57 - 1.18																																											
Temp (°C)	25.0	0.0	6	25.0 - 25.0																																											
pH (unit)	8.8	0.2	6	8.4 - 9.0																																											
Time (hr)	24.0	0.0	6	24.0 - 24.0																																											

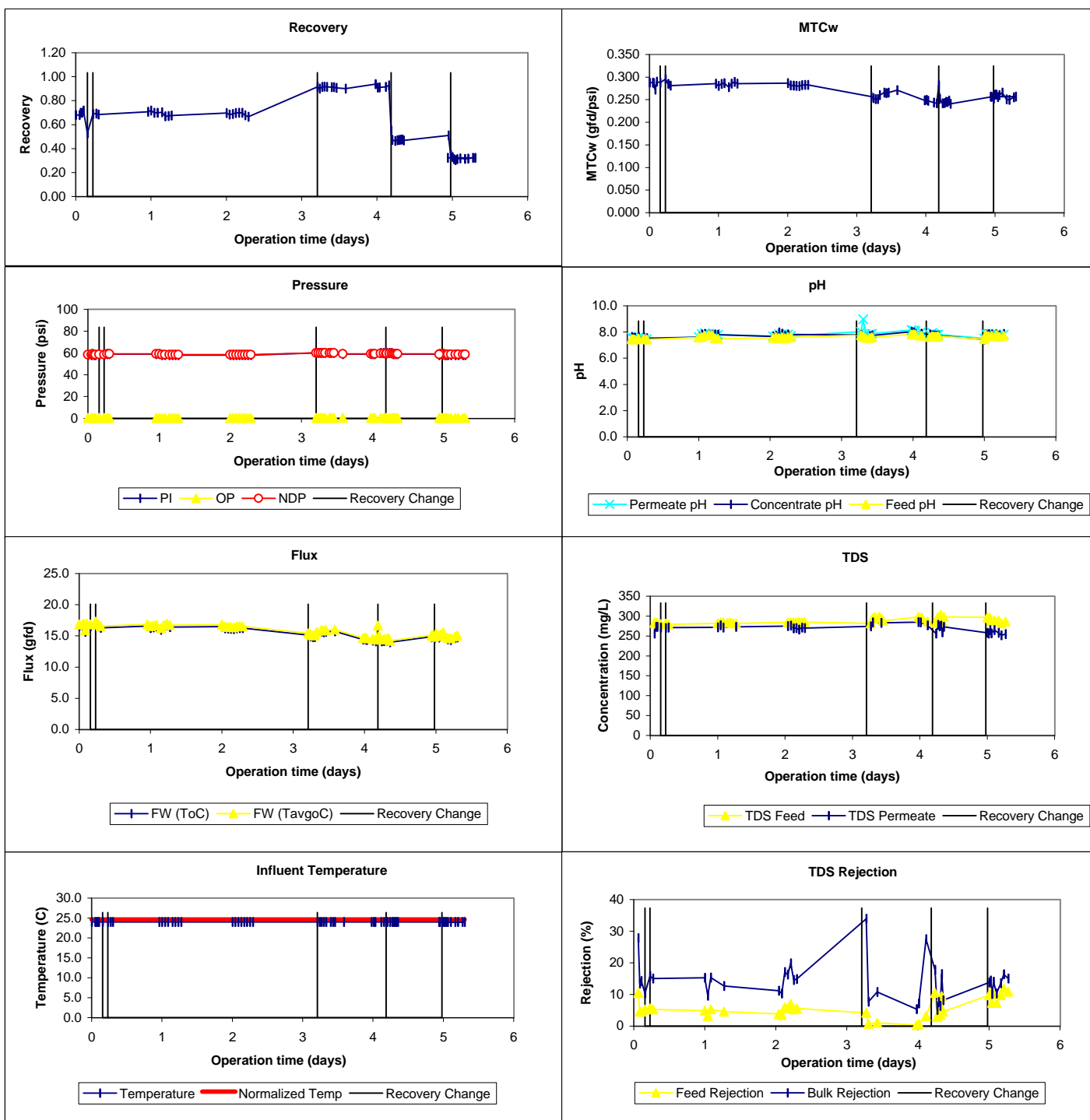
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
ICR Contact: Mr. Jerry Baker
Phone No.: (954) 960-3061
Period: 12/15/98 - 12/22 (7 days)

Membrane Information

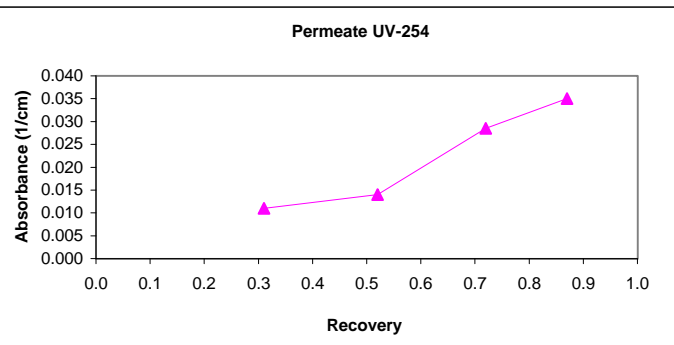
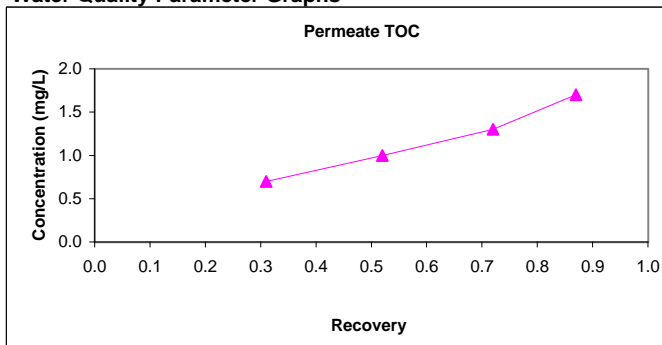
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Mfr. Temp: 25.0 °C
840 Element Area: 365.0 ft²
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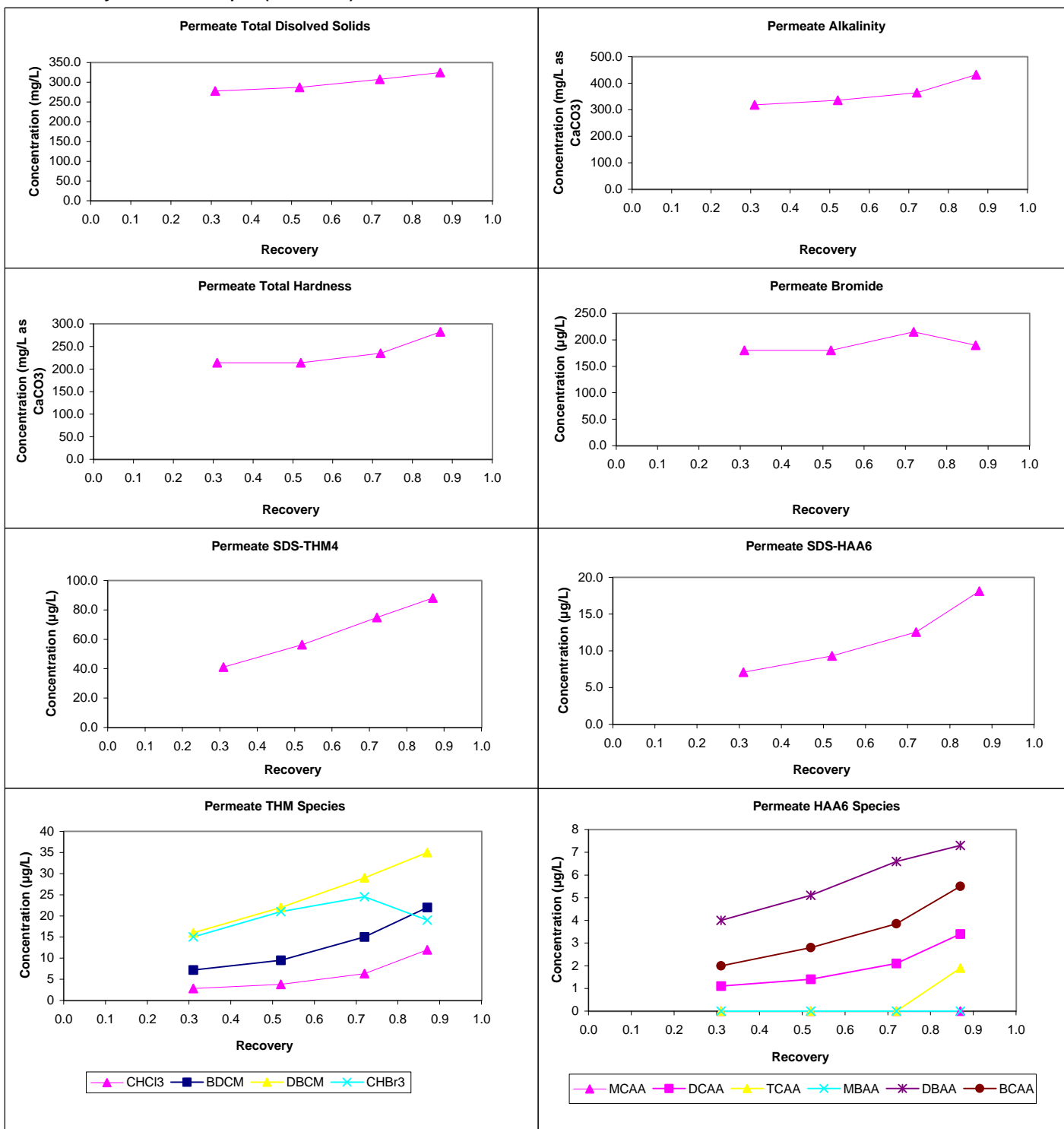
Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	RD	0.31	0.52	0.72	0.87	0.31	0.52	0.72	0.87	WQP	Count	Avg	SD
pH	7.6	0.3	7.9	8.0	8.1	8.0	7.9	8.0	8.2	8.3	TDS	42	-9	11
Temp	23.0	0.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0				
Alk	443	5	318	336	364	432	484	496	511	562	Alk	4	-9	15
TDS	333	2	278	287	308	325	339	362	375	388	TDS	4	-4	3
TotHard	286	14	214	214	235	282	300	312	320	360	TotHard	4	-10	18
CaHard	260	0	202	210	227	254	270	286	298	334	CaHard	4	-5	11
Turb	0.28	0.0	0.12	0.15	0.19	0.22	0.26	0.27	0.29	1.30	Turb	4	-28	55
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	Amm	0	n/a	n/a
TOC	6.8	0.4	0.7	1.0	1.3	1.7	8.0	11.9	16.6	49.5	TOC	4	-9	19
UV254	0.201	0.000	0.011	0.014	0.029	0.035	0.284	0.453	0.650	1.693	UV254	4	8	11
SUVA	2.99	0.15	1.57	1.40	2.19	2.06	3.55	3.81	3.92	3.42				
Bromide	190	0	180	180	215	190	Pretreatment Information							
TOX	660	40	65	83	115	125								
CHCl3	145.0	15.0	2.8	3.8	6.4	12.0	Cartridge filtration		5 micron filter		bench			
BDCM	65.5	1.5	7.2	9.5	15.0	22.0	Design Parameters							
DBCM	23.5	0.5	16.0	22.0	29.0	35.0								
CHBr3	1.8	0.0	15.0	21.0	24.5	19.0								
THM4	235.8	17.1	41.0	56.3	74.9	88.0								
MCAA	3.8	0.2	0.0	0.0	0.0	0.0								
DCAA	33.0	0.0	1.1	1.4	2.1	3.4								
TCAA	25.0	4.0	0.0	0.0	0.0	1.9								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	4.5	0.1	4.0	5.1	6.6	7.3								
BCAA	14.0	0.0	2.0	2.8	3.9	5.5								
TBAA	0.0	0.0	0.0	0.0	0.0	0.0	Active memb area:		0.167 ft ²		ID#	Recov (dec.)	F _{W-de} (gfd)	
CDBAA	3.4	0.2	2.5	3.2	3.9	5.3	Active width:		0.330 ft					
DCBAA	10.0	1.0	1.9	2.2	2.9	4.5	Norm Temp:		24.6 °C		1	0.70	15.0	
HAA5	66.3	4.1	5.1	6.5	8.7	12.6	Feed TDS:		700.0 mg/L		2	0.90	15.0	
HAA6	80.3	4.1	7.1	9.3	12.6	18.1	Manuf rep TDS rej:		50%		3	0.50	15.0	
HAA9	93.7	5.3	11.5	14.7	19.3	27.9	Temp Norm MTC-w:		0.316 gfd/psi		4	0.30	15.0	
SDS Conditions							Comments:							
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.01	0.14	6	0.75 - 1.13										
Temp (°C)	25.0	0.0	6	25.0 - 25.0										
pH (unit)	8.5	0.1	6	8.4 - 8.7										
Time (hr)	24.0	0.0	6	24.0 - 24.0										

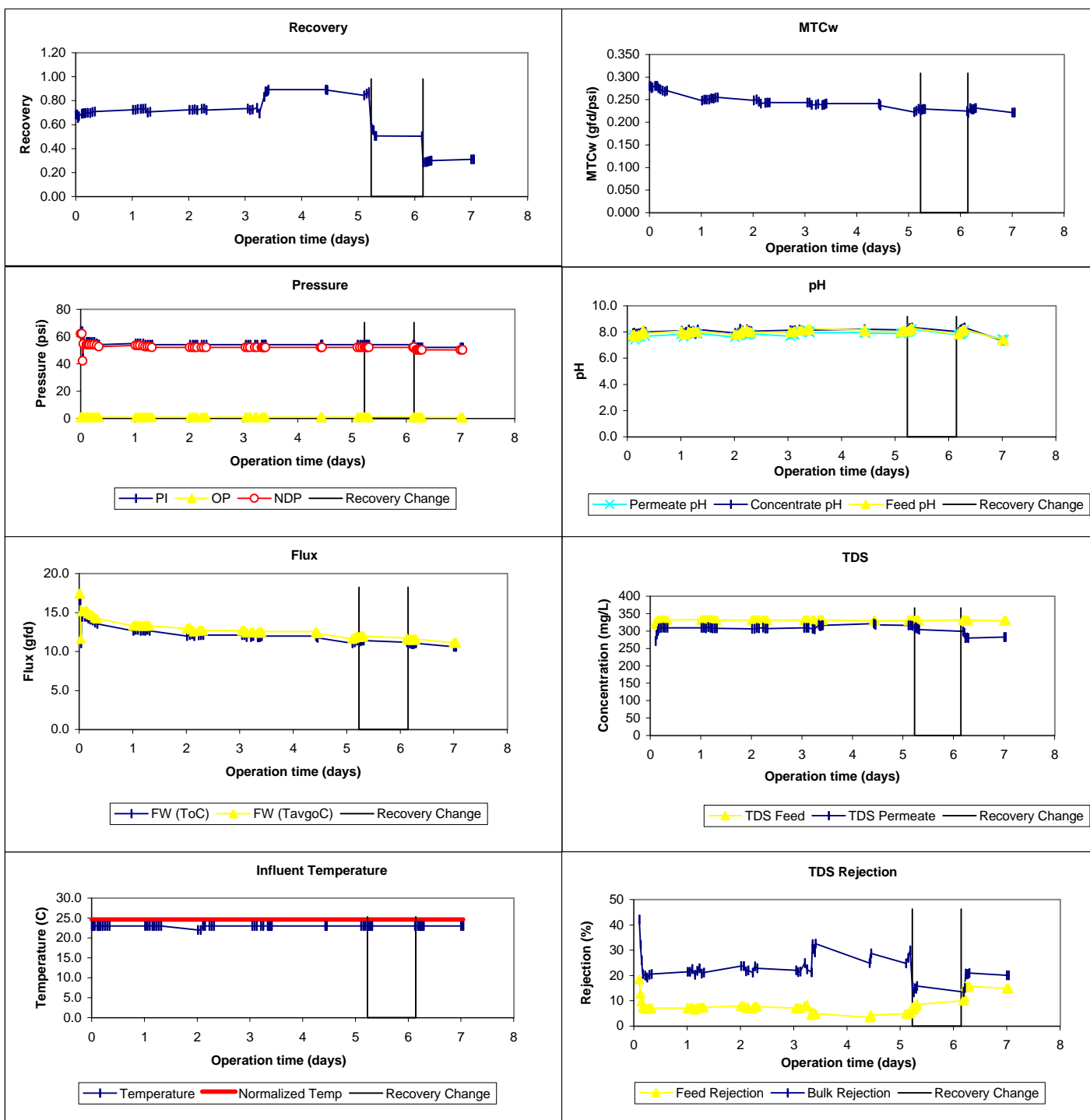
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: 4060163 / 293
 ICR Contact: Mr. Jerry Baker
 Phone No.: (954) 960-3061
 Period: 4/1/99 - 4/7/99 (6 days)

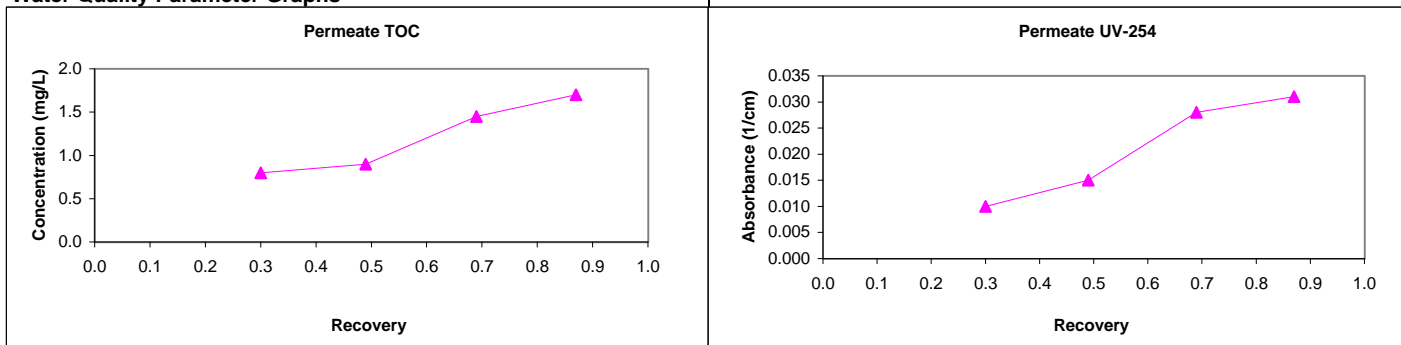
Membrane Information

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

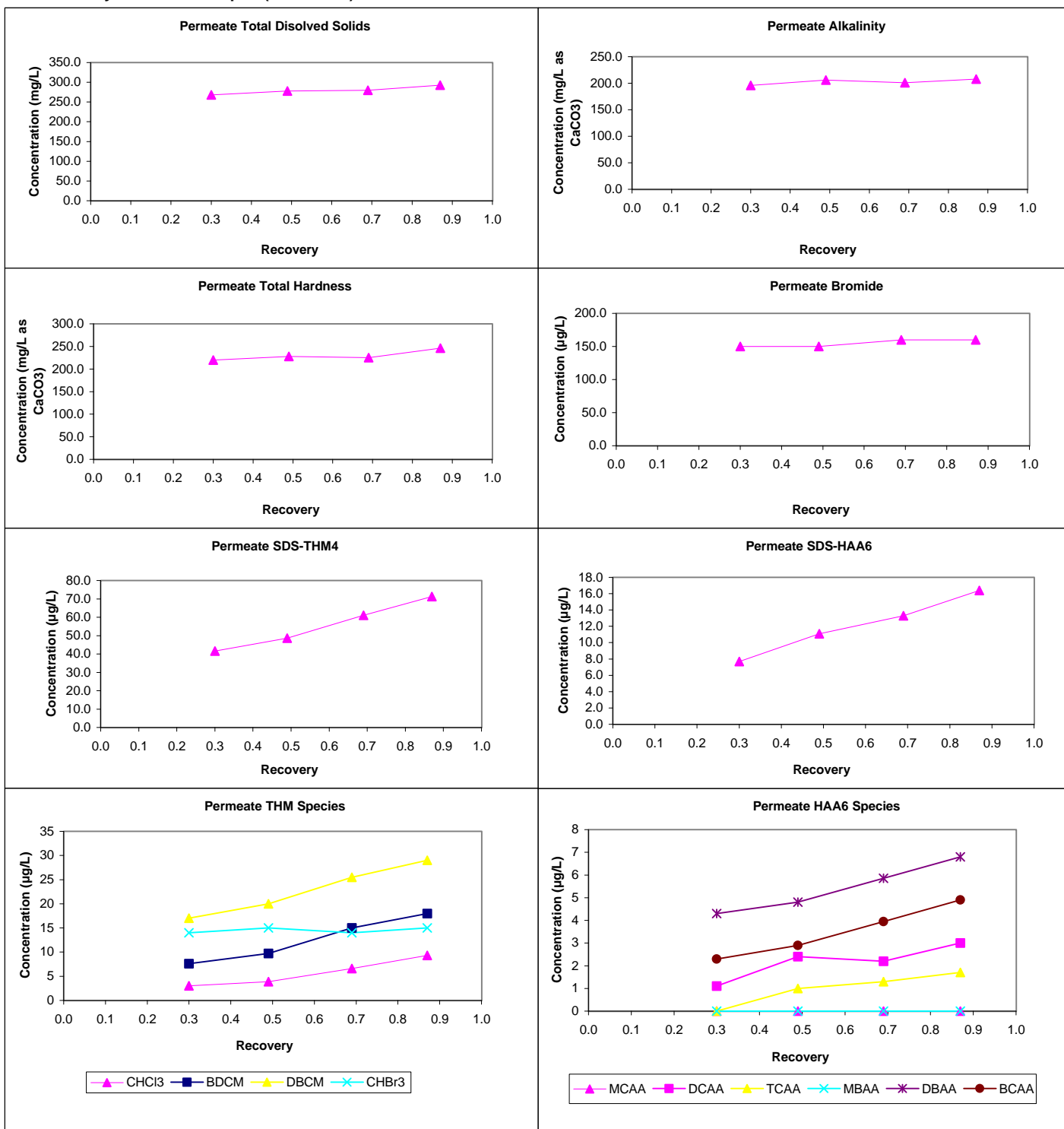
Water Quality Summary

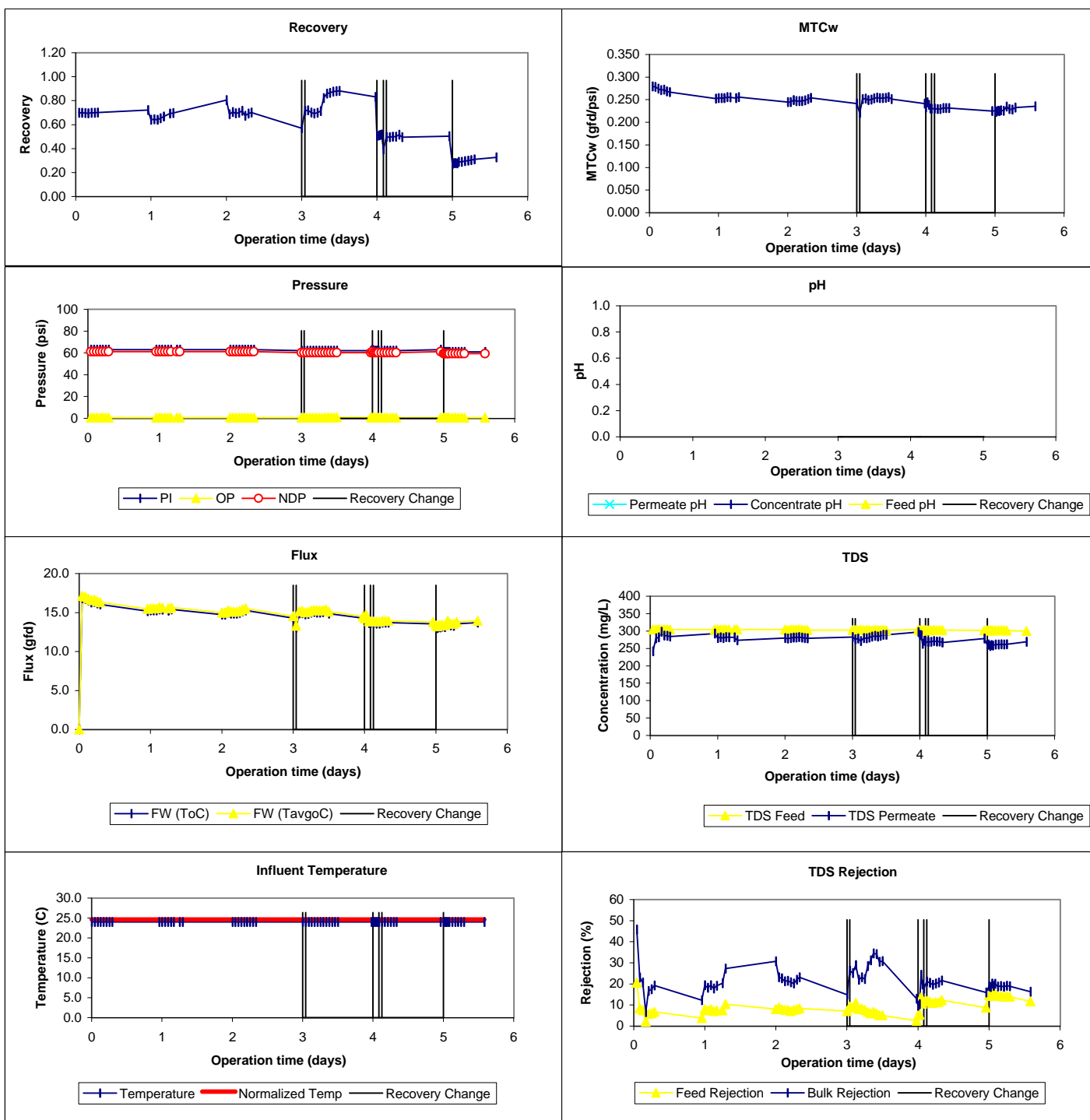
Water Quality Summary							Mass Balance Closure Err (%)															
Source ->	Feed		Permeate				Concentrate															
Recovery ->	Avg	RD	0.30	0.49	0.69	0.87	0.30	0.49	0.69	0.87	WQP	Count	Avg	SD								
pH	8.1	0.3	8.1	7.9	8.2	7.9	8.2	8.2	8.3	8.3	TDS	61	-9	10								
Temp	24.0	0.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0												
Alk	217	1	196	206	201	208	230	238	252	246	Alk	4	-2	8								
TDS	305	1	268	278	280	293	311	321	326	338	TDS	4	-7	5								
TotHard	252	2	220	228	225	246	270	274	289	318	TotHard	4	0	7								
CaHard	237	1	210	222	221	238	260	268	279	304	CaHard	4	9	10								
Turb	0.15	0.0	0.05	0.05	0.07	0.05	0.17	0.15	0.17	0.20	Turb	4	-118	124								
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	Amm	0	n/a	n/a								
TOC	5.9	0.4	0.8	0.9	1.5	1.7	6.9	9.1	12.5	25.3	TOC	4	-24	8								
UV254	0.156	0.001	0.010	0.015	0.028	0.031	0.228	0.311	0.470	0.874	UV254	4	1	10								
SUVA	2.65	0.17	1.25	1.67	1.93	1.82	3.30	3.42	3.76	3.45												
Bromide	170	0	150	150	160	160	Pretreatment Information															
TOX	505	30	64	70	91	95																
							Process		Description		Scale											
							Cartridge filtration		5 micron filter		bench											
CHCl3	125.0	15.0	3.0	3.9	6.6	9.3	Design Parameters															
BDCM	48.5	0.5	7.6	9.7	15.0	18.0																
DBCM	18.0	0.0	17.0	20.0	25.5	29.0																
CHBr3	0.0	0.0	14.0	15.0	14.0	15.0																
THM4	191.5	15.5	41.6	48.6	61.1	71.3																
MCAA	1.6	1.6	0.0	0.0	0.0	0.0																
DCAA	30.0	1.0	1.1	2.4	2.2	3.0																
TCAA	21.5	5.5	0.0	1.0	1.3	1.7																
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																
DBAA	3.1	0.0	4.3	4.8	5.9	6.8																
BCAA	11.0	0.0	2.3	2.9	4.0	4.9																
TBAA	0.0	NA	4.5	4.6	4.4	4.5																
CDBAA	2.7	0.3	3.0	3.3	3.9	4.2																
DCBAA	8.8	2.2	1.8	2.0	2.9	3.2																
HAA5	56.2	8.0	5.4	8.2	9.4	11.5																
HAA6	67.2	8.0	7.7	11.1	13.3	16.4																
HAA9	89.2	NA	17.0	21.0	24.4	28.3																
SDS Conditions															Comments:							
WQP	Avg	SD	Count	Min - Max																		
Res (mg/L) (0)	1.04	0.21	6	0.84 - 1.39																		
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

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

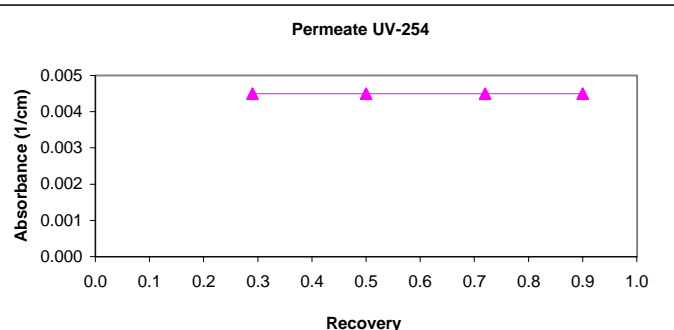
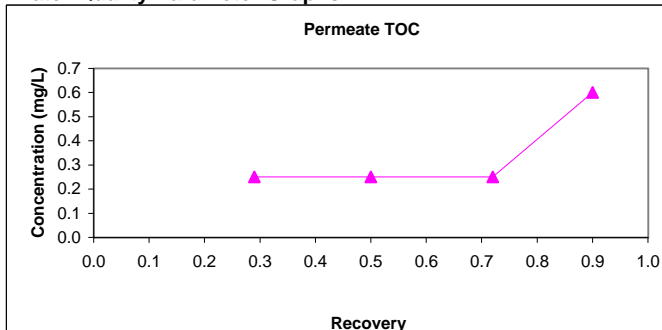
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

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

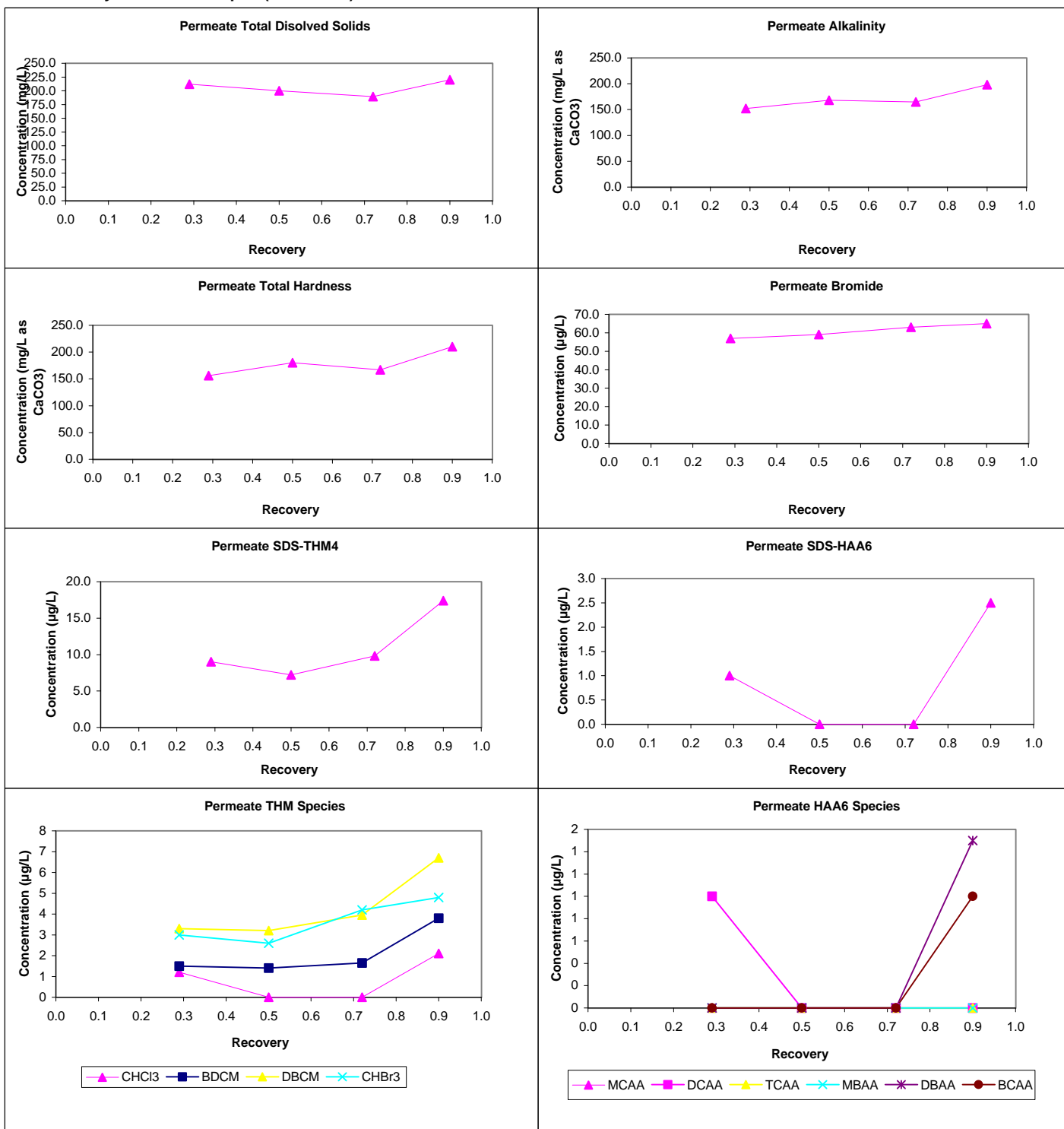
Water Quality Summary

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																																											

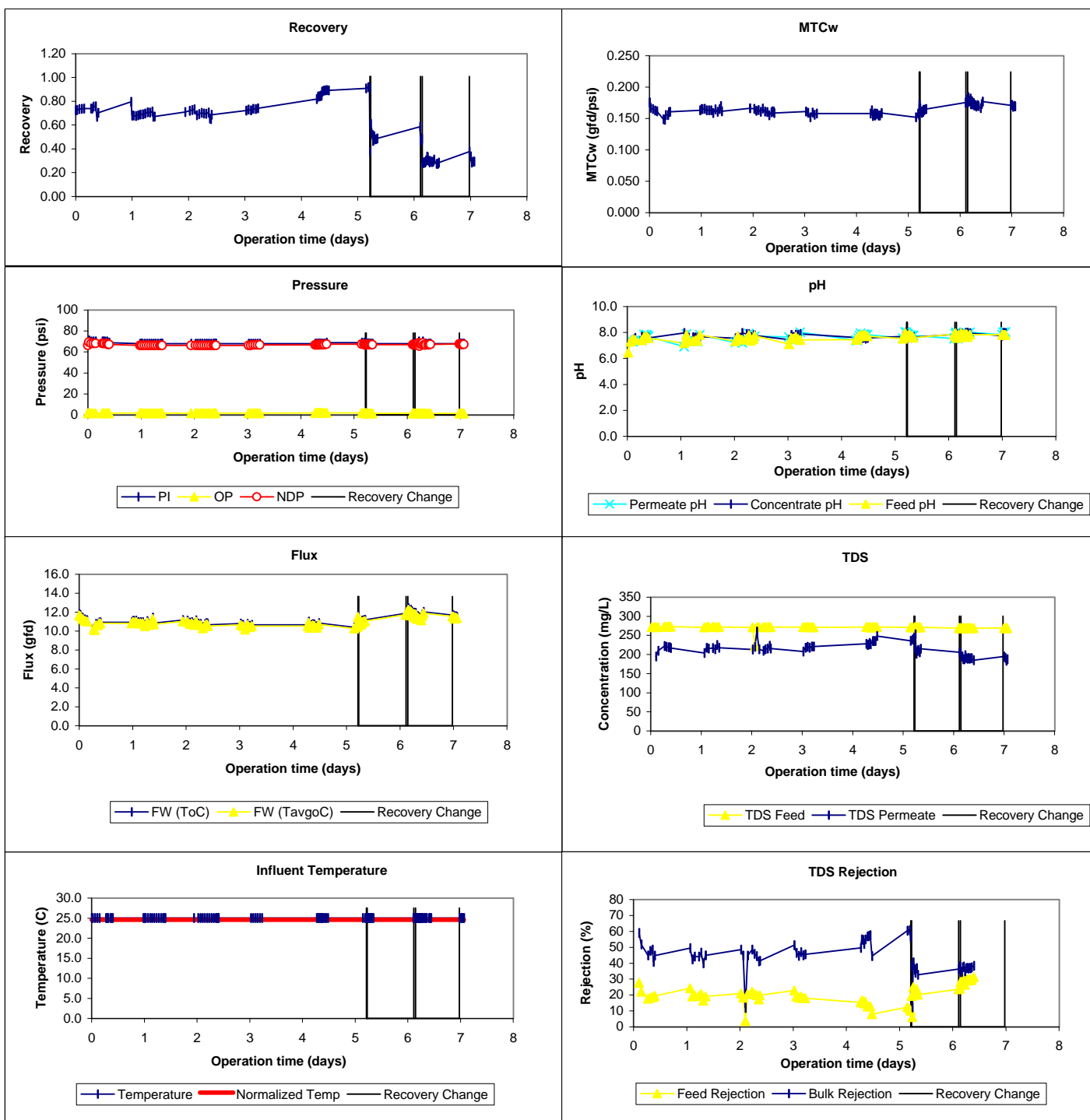
Water Quality Parameter Graphs



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

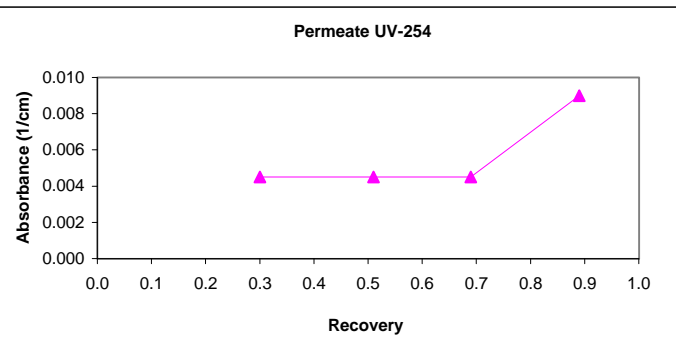
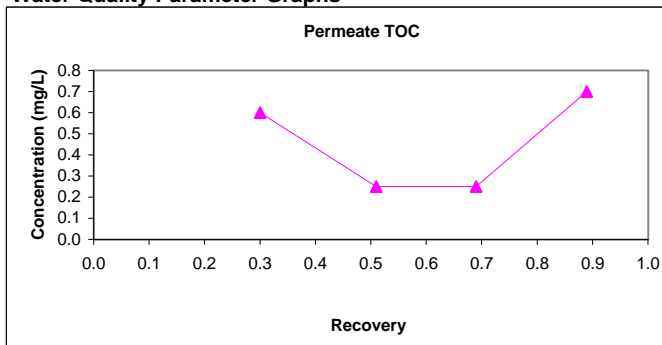
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

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

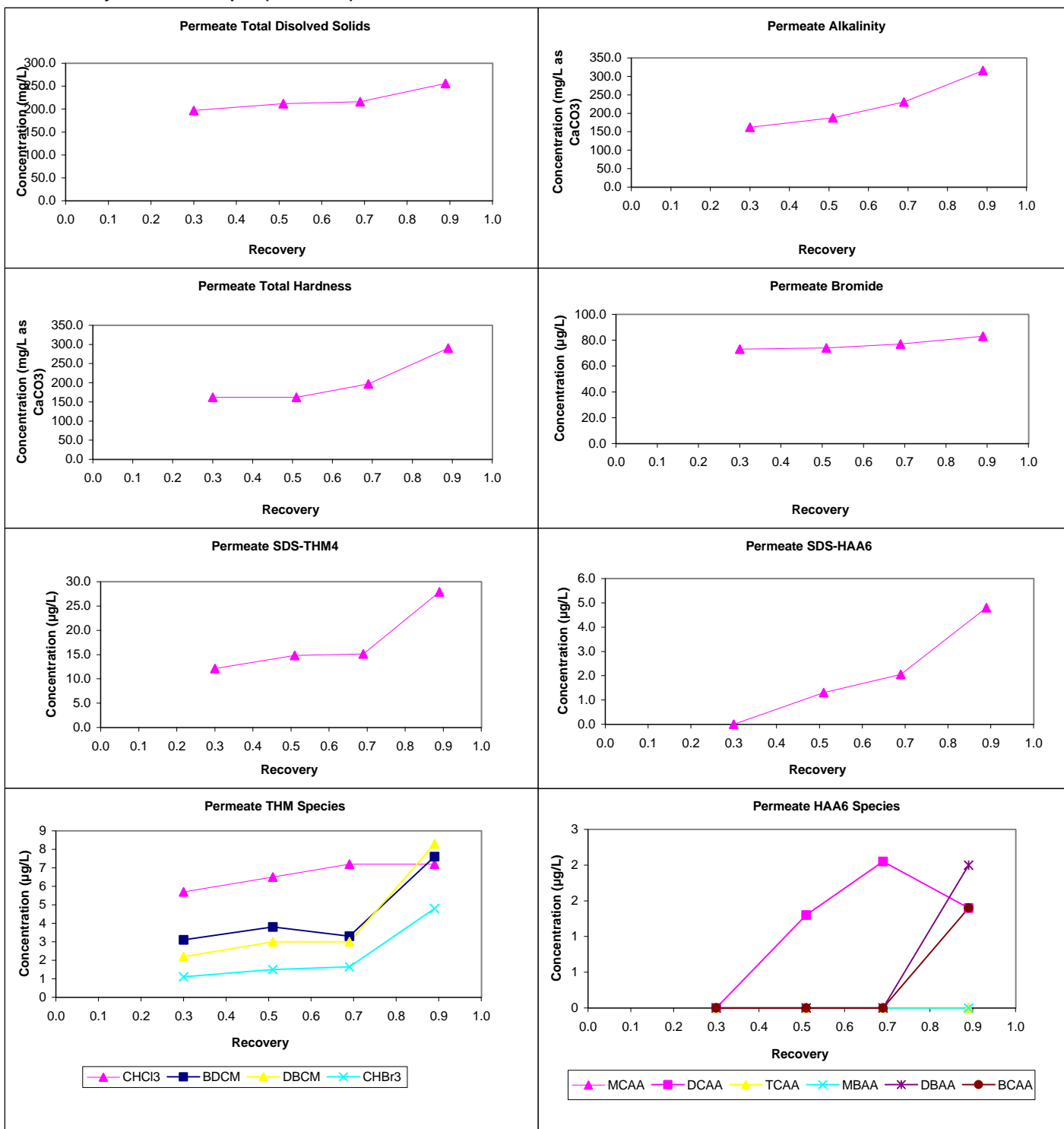
Water Quality Summary

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	4	-38	27
Alk	330	4	162	188	231	316	288	292	372	442	TDS	4	-8	8
TDS	286	2	197	212	216	256	324	357	385	458	TotHard	4	2	30
TotHard	300	22	162	162	197	290	352	384	438	698	CaHard	4	-1	42
CaHard	268	4	148	134	164	268	314	340	357	618	Turb	4	-90	75
Turb	0.20	0.0	0.05	0.07	0.07	0.06	0.18	0.26	0.25	0.43	Amm	0	n/a	n/a
Amm	0.04	0.04	0.00	0.00	0.00	0.00	NA	NA	NA	NA	TOC	3	-7	5
TOC	6.7	0.1	0.6	0.3	0.3	0.7	8.2	12.0	19.8	52.0	UV254	1	-12	n/a
UV254	0.204	0.011	0.005	0.005	0.005	0.009	0.280	0.395	0.628	1.593	Pretreatment Information			
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	Process Cartridge filtration							
TOX	473	58	13	13	13	38								
CHCl3	175.0	25.0	5.7	6.5	7.2	7.2	Scale bench							
BDCM	23.0	4.0	3.1	3.8	3.3	7.6								
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								
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								
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										
							Active memb area:		0.167 ft ²			Recov	F_{W-de}	
							Active width:		0.330 ft			ID#	(dec.)	(gfd)
							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
							Comments:							

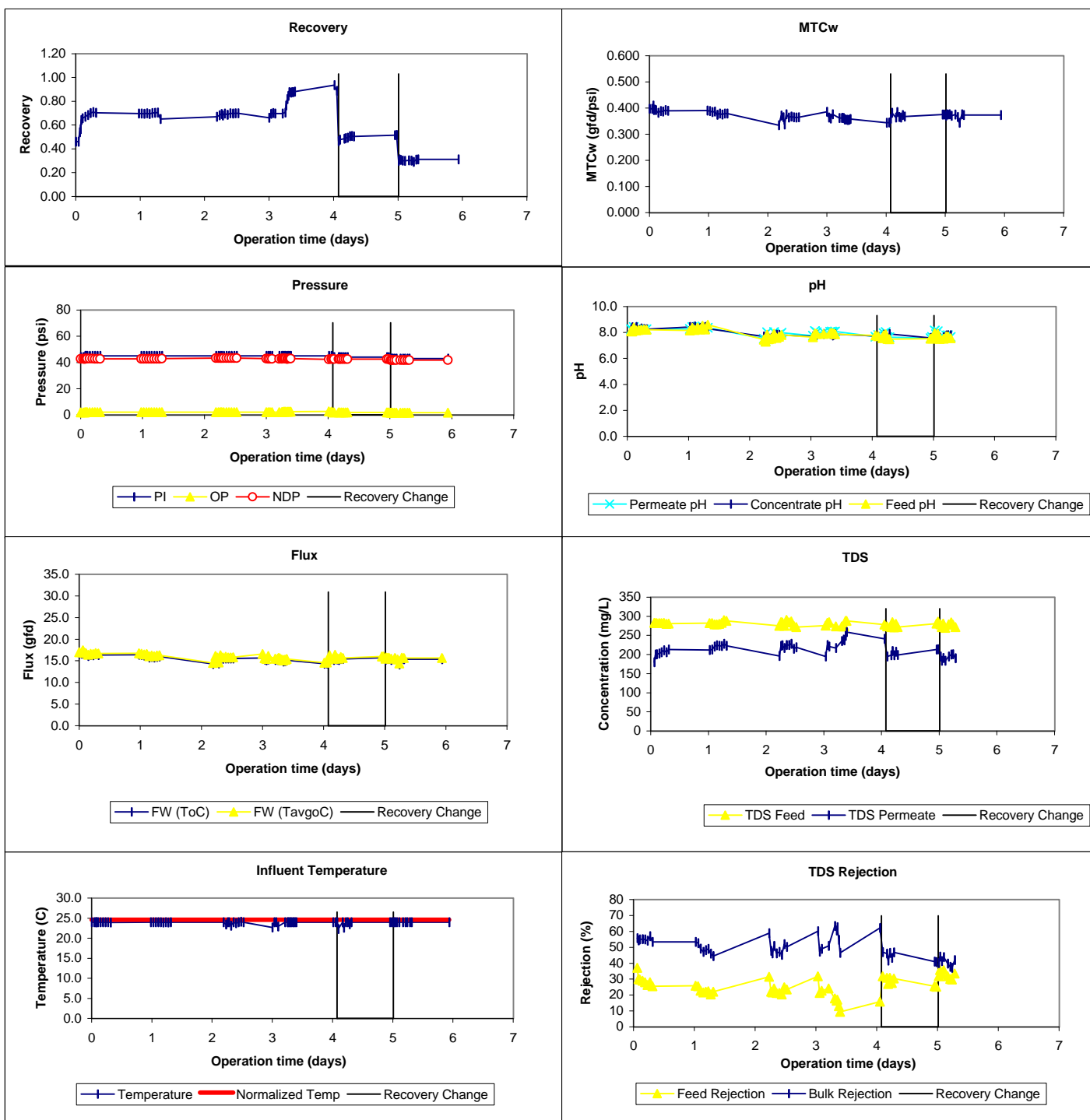
Water Quality Parameter Graphs



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)

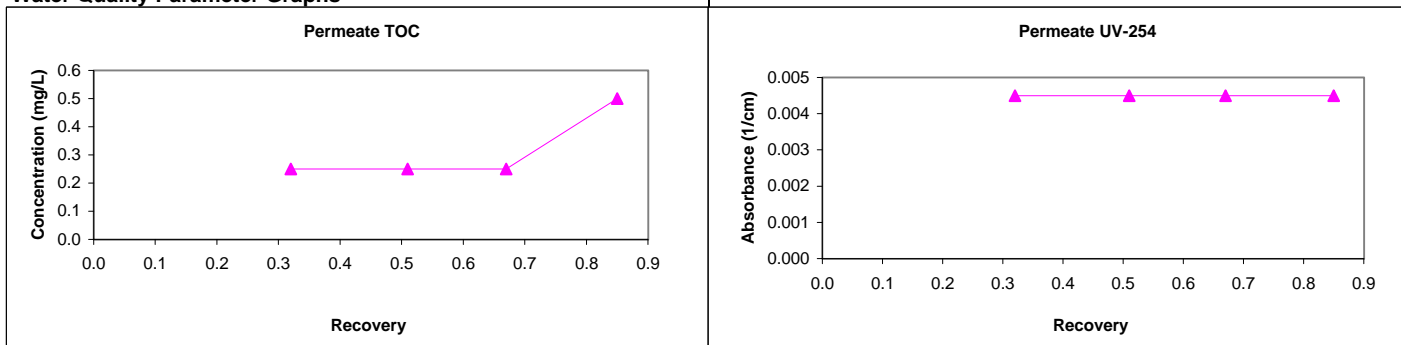
Membrane Information

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

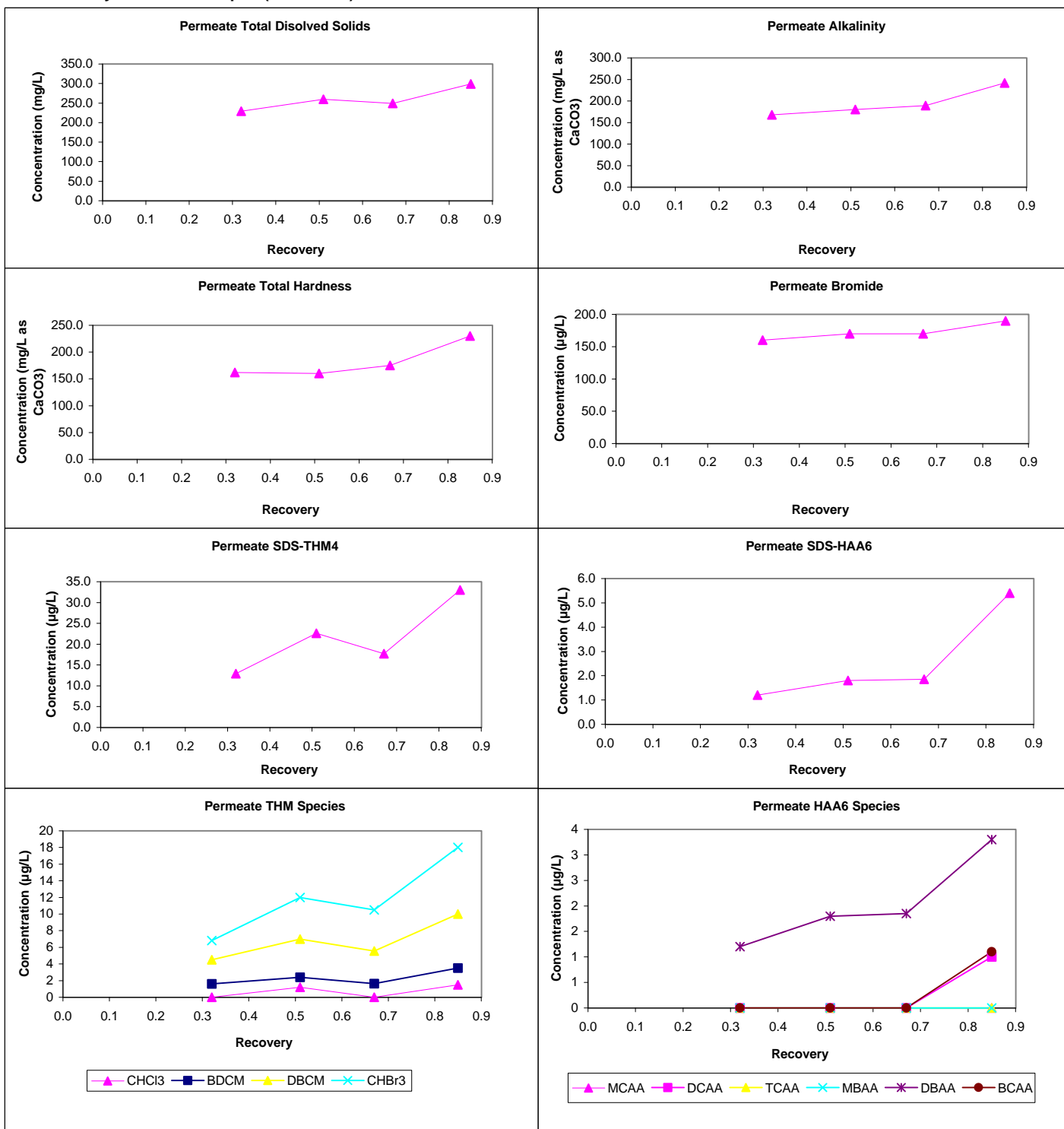
Water Quality Summary

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	443	5	168	180	189	242	530	562	610	696	Alk	4	-55	52
TDS	333	2	229	260	249	299	370	380	476	665	TDS	4	1	13
TotHard	286	14	162	160	175	230	336	380	363	524	TotHard	4	-17	17
CaHard	260	0	140	154	125	220	302	342	404	500	CaHard	4	-11	15
Turb	0.28	0.0	0.17	0.23	0.21	0.26	0.24	0.29	0.36	0.67	Turb	4	-4	36
Amm	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	Amm	0	n/a	n/a
TOC	6.8	0.4	0.3	0.3	0.3	0.5	8.3	11.7	16.6	65.0	TOC	1	35	n/a
UV254	0.201	0.000	0.005	0.005	0.005	0.005	0.300	0.411	0.595	2.108	UV254	0	n/a	n/a
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	Pretreatment Information							
TOX	660	40	26	32	26	37								
							Process		Description		Scale			
							Cartridge filtration		5 micron filter		bench			
CHCl3	145.0	15.0	0.0	1.2	0.0	1.5	Design Parameters							
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								
CHBr3	1.8	0.0	6.8	12.0	10.5	18.0								
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								
DCAA	33.0	0.0	0.0	0.0	0.0	1.0								
TCAA	25.0	4.0	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	4.5	0.1	1.2	1.8	1.9	3.3								
BCAA	14.0	0.0	0.0	0.0	0.0	1.1								
TBAA	0.0	0.0	0.0	0.0	0.0	0.0								
CDBAA	3.4	0.2	0.0	0.0	0.0	0.0								
DCBAA	10.0	1.0	0.0	0.0	0.0	1.3								
HAA5	66.3	4.1	1.2	1.8	1.9	4.3	Active memb area:		0.167 ft ²		ID#	Recov	F _{W-de}	
HAA6	80.3	4.1	1.2	1.8	1.9	5.4	Active width:		0.330 ft			(dec.)	(gfd)	
HAA9	93.7	5.3	1.2	1.8	1.9	6.7	Norm Temp:		24.6 °C		1	0.70	15.0	
SDS Conditions							Feed TDS:		700.0 mg/L		2	0.90	15.0	
							Manuf rep TDS rej:		50%		3	0.50	15.0	
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.06	0.27	6	0.75 - 1.44										
Temp (°C)	25.0	0.0	6	25.0 - 25.0										
pH (unit)	8.8	0.3	6	8.5 - 9.3										
Time (hr)	24.0	0.0	6	24.0 - 24.0										
Comments:														

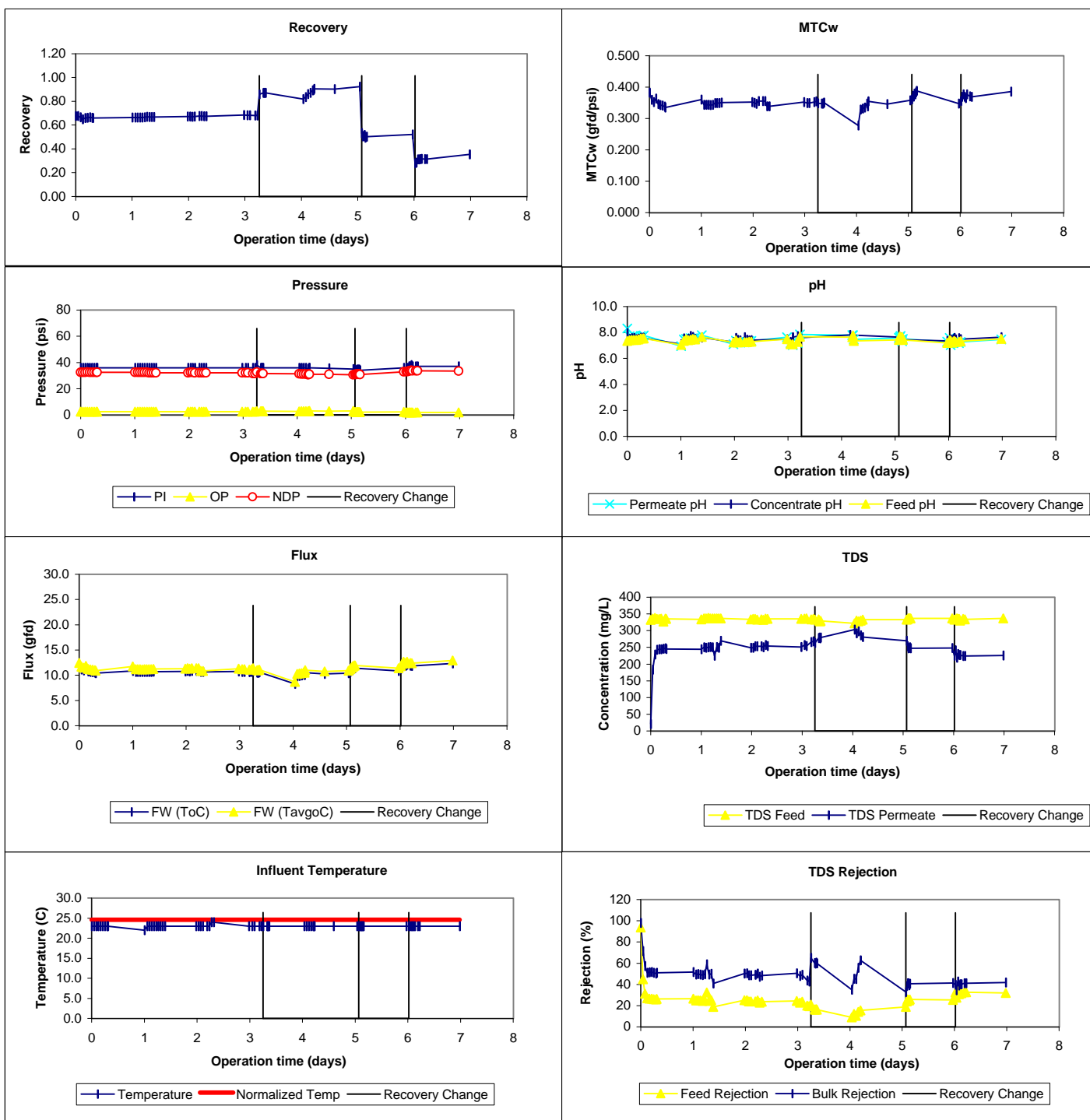
Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs



ICR Information

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

Membrane Information

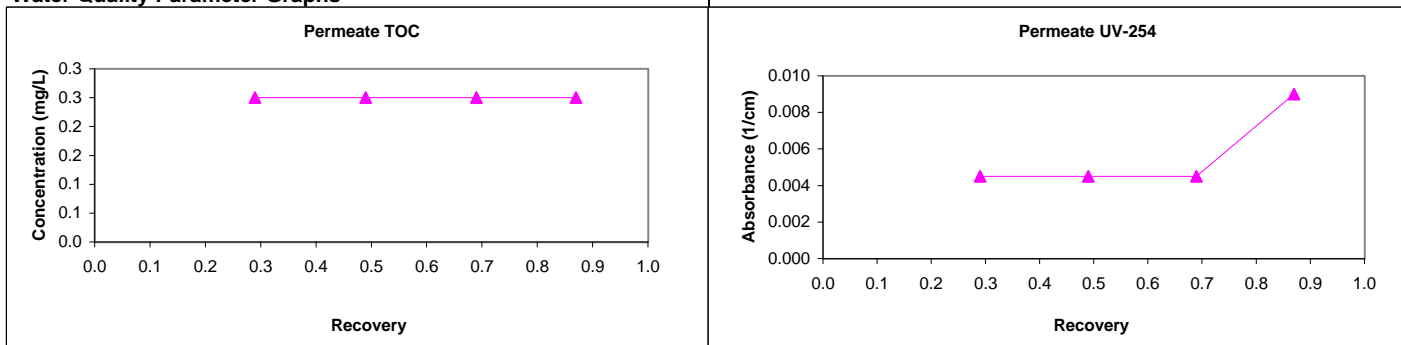
Manufacturer: Fluid Systems
Trade Name: TFC-SR
MWCO: 300 Daltons
Mfr. Flux: 24.0 gfd
Mfr. NDP: 100.0 psi
Mfr. MTCw: 0.240 gfd/psi

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

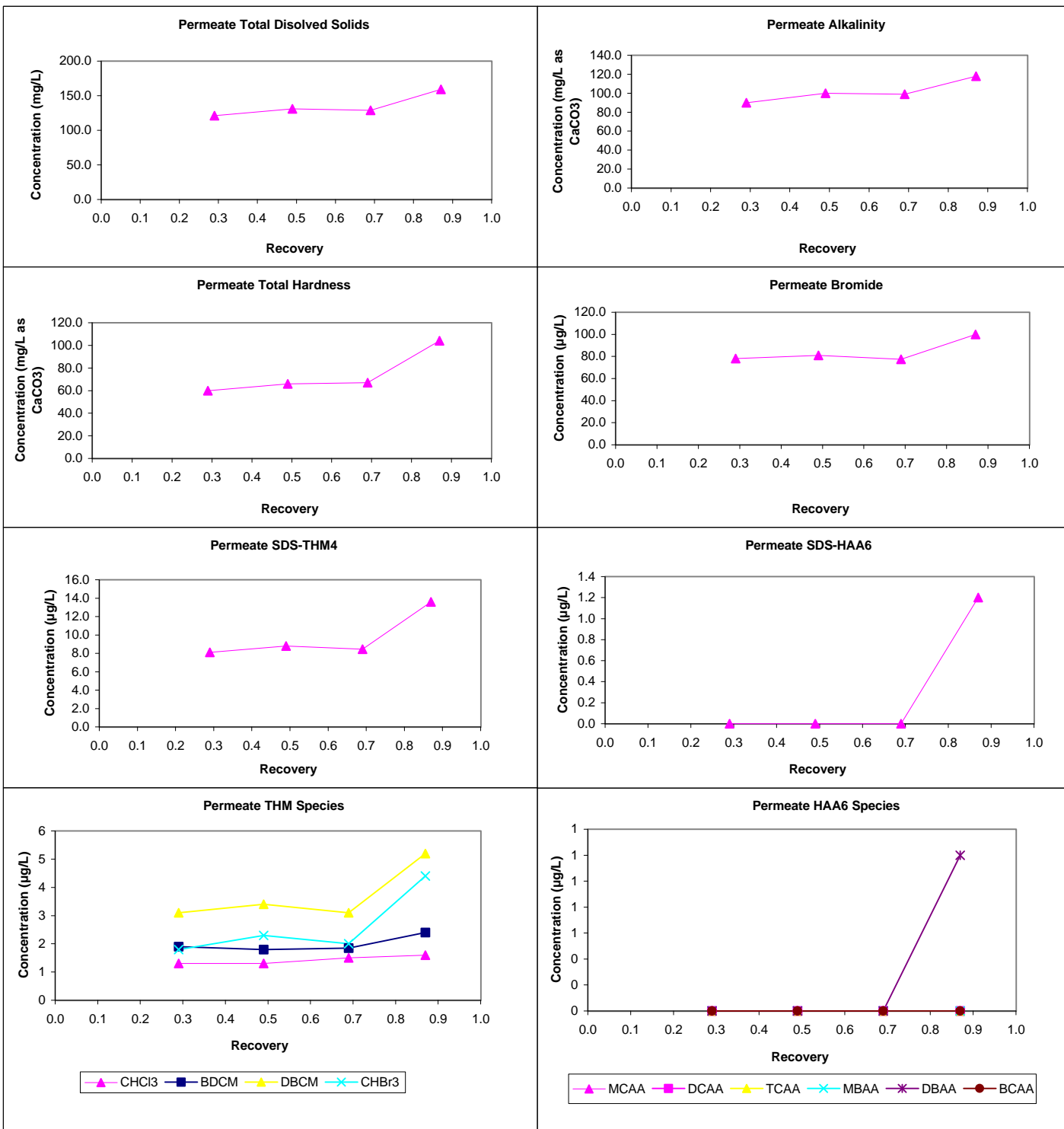
Water Quality Summary

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

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



Productivity Graphs

