

# ICR TREATMENT STUDY ANALYSIS

## Base Analysis and Data Review Comments

<b>Treatment Study ID</b>	1074
<b>Study Protocol</b>	Rapid Bench-Scale Membrane Test Study
<b>Plant ICR Number</b>	1086
<b>PWS Name</b>	Delray Beach Water Department
<b>City, State, Zip</b>	Delray Beach, FL 33444

### General Comments:

1. During this RBSMT study 4 membranes were evaluated, over a 2 ½ month period: the FilmTec NF70, the FilmTec NF200B-400, the Hydranautics ESNA1 and the Fluid Systems TFC 8921S-400. The experimental design and characteristics of the membranes evaluated during this study are shown in Tables 4 and 5, respectively, of the Summary Report.
2. Section 4.1 of the Summary Report describes some of the problems encountered during this study. For example, there was difficulty in maintaining correct concentrate flow rates during operation at 70% and 90% recovery, requiring changes in plumbing of the RBSMT system. Also, at times it was difficult to obtain a representative flat-sheet membrane sample from the membrane manufacturer.
3. Data from one of the TFC 8921S-400 runs (3/21 through 3/27/99) was not used during data analysis because the performance of this membrane during this run were very different from that observed during the other evaluation of this membrane and from the expected trends (based on the membrane specifications and other studies).
4. During data analysis, a water temperature of 25°C was used for all four quarters. Since this is a Florida groundwater source, little variability in temperature would be expected over the course of a year. It was necessary to use a temperature representative of full-scale conditions to develop estimates of pressure requirements. The temperatures reported in the Data Collection Spreadsheets are indicative of lab conditions.
5. No cost information was provided in the Summary Report.

### Water Quality Comments:

1. 39 water quality outliers were identified and removed prior to base analysis. This does include the TFC 8921S-400 run (3/21 through 3/27) which was not analyzed.

2. Feed and permeate samples were chlorinated under the following SDS conditions during this study: target free chlorine residual of 1.0 mg/L (some residuals ranged from 0.3 to 2.0 mg/L), average holding time of 24 hours (although one sample was incubated for 20 hours, and one for 29 hours), pH ranged from 7.4 to 7.6, at a constant temperature of 20 °C. Although SDS conditions are summarized on Table 9 in the Summary Report, the reported incubation time on Table 9 for Membrane B Round 1 (12.4 hours) does not match that on the Data Collection Spreadsheets, which is 24.4 hours.
3. No temperatures were recorded during the water quality sampling events at the different recoveries.

### **Productivity Comments:**

1. 0 productivity outliers were identified and removed prior to base analysis.
2. The membrane cleaning procedure included the use of a citric acid solution (pH > 2, heated to 30 – 35 °C), and a sodium hydroxide/surfactant solution (pH < 11, heated to 30 – 35 °C). It is not clear in Section 4.3.5 in the Summary Report whether both solutions were used sequentially during each cleaning event, or whether different cleaning solutions were used based on the suspected membrane foulant.

## ICR Information

ID / ICR#: FL4500351 / 1086  
 ICR Contact: n'Detenga n'Gurumo  
 Phone No.: 407 243 7318  
 Period: 3/21/99 - 3/27/99 (6 days)

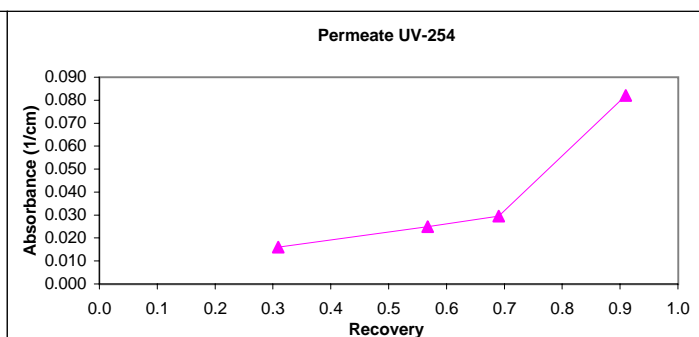
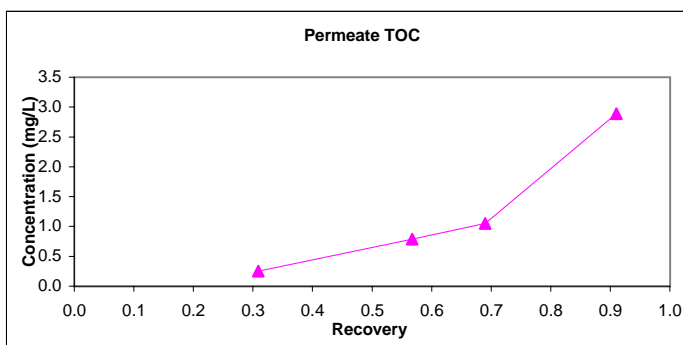
## Membrane Information

Manufacturer: Film Tec  
 Trade Name: NF70  
 MWCO: 200 Daltons  
 Mfr. Flux: 25.0 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTCw: 0.357 gfd/psi  
 Mfr. Temp: 25.0 °C  
 840 Element Area: 400.0 ft<sup>2</sup>  
 840 Purchase Price: \$600  
 840 Maximum Flow: 75.0 gpm  
 840 Minimum Flow: 24.7 gpm  
 840 Total Width: 58.7 ft  
 840 Feed Spacer Thickness: 0.0023 ft

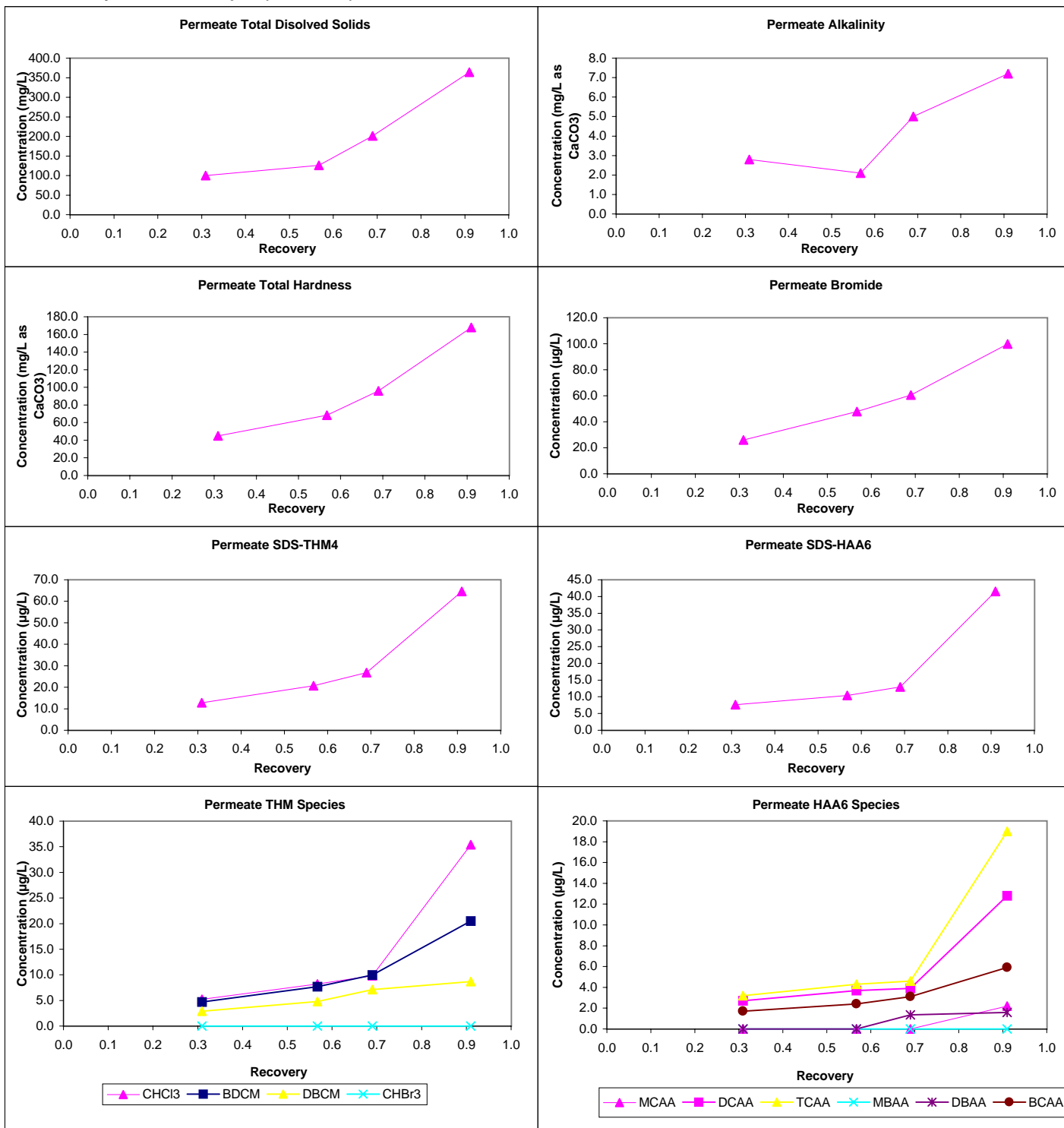
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.31	0.57	0.69	0.91	0.31	0.57	0.69	0.91	WQP	Count	Avg	SD
pH	6.6	0.3	6.8	6.9	6.2	6.3	6.6	6.7	6.7	7.4	TDS	4	9	18
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	3	-38	89
Alk	7	2	3	2	5	7	8	6	21	NR	TDS	4	6	20
TDS	468	19	100	126	202	364	678	844	992	2290	TotHard	4	8	12
TotHard	222	4	45	68	96	168	309	424	516	1030	CaHard	4	8	12
CaHard	211	4	43	65	91	160	294	404	491	981	Turb	1	-109	n/a
Turb	0.28	0.11	0.02	0.00	0.00	0.00	0.19	0.15	0.37	0.40	Amm	4	-14	44
Amm	0.42	0.02	0.18	0.18	0.17	0.36	0.51	0.63	0.56	1.45	TOC	4	6	8
TOC	10.7	0.3	0.3	0.8	1.1	2.9	15.0	24.1	35.0	107.0	UV254	4	5	5
UV254	0.334	0.004	0.016	0.025	0.030	0.082	0.478	0.757	1.110	3.200	Pretreatment Information			
SUVA	3.11	0.14	6.40	3.16	2.81	2.84	3.18	3.14	3.17	2.99				
Bromide	117	12	26	48	61	100	Process Description Scale							
TOX	940	31	41	113	83	217								
CHCl3	146.5	8.5	5.2	8.2	9.8	35.4	Acidification Hydrochloric acid to pH 6.5 Bench Antiscalant addition æ PreTreat 0100, 3 ppm by vol Bench Cartridge filtration 5 micron nominal Bench							
BDCM	25.2	2.4	4.7	7.7	10.0	20.5								
DBCM	2.7	0.1	2.9	4.8	7.1	8.7								
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0								
THM4	174.4	11.0	12.8	20.7	26.9	64.6	Design Parameters							
MCAA	6.3	0.6	0.0	0.0	0.0	2.2								
DCAA	63.0	7.5	2.7	3.7	3.9	12.8								
TCAA	128.0	10.0	3.2	4.3	4.6	19.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	0.0	0.0	0.0	0.0	1.4	1.6								
BCAA	8.1	0.5	1.7	2.4	3.1	5.9								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	197.3	18.0	5.9	8.0	9.9	35.6	Active memb area: 0.167 ft² Active width: 0.333 ft Norm Temp: 22.0 °C Feed TDS: 545.0 mg/L Manuf rep TDS rej: 70% Temp Norm MTC-w: 0.327 gfd/psi		ID#		Recov (dec.) F <sub>W-des</sub> (gfd)			
HAA6	205.4	18.5	7.6	10.4	13.0	41.5								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max			Comments:							
Res (mg/L) (0)	1.45	1.00	6	0.72 - 3.42										
Temp (°C)	20.0	0.0	6	20.0 - 20.0										
pH (unit)	7.5	0.1	6	7.4 - 7.5										
Time (hr)	24.1	1.5	6	21.6 - 25.2										

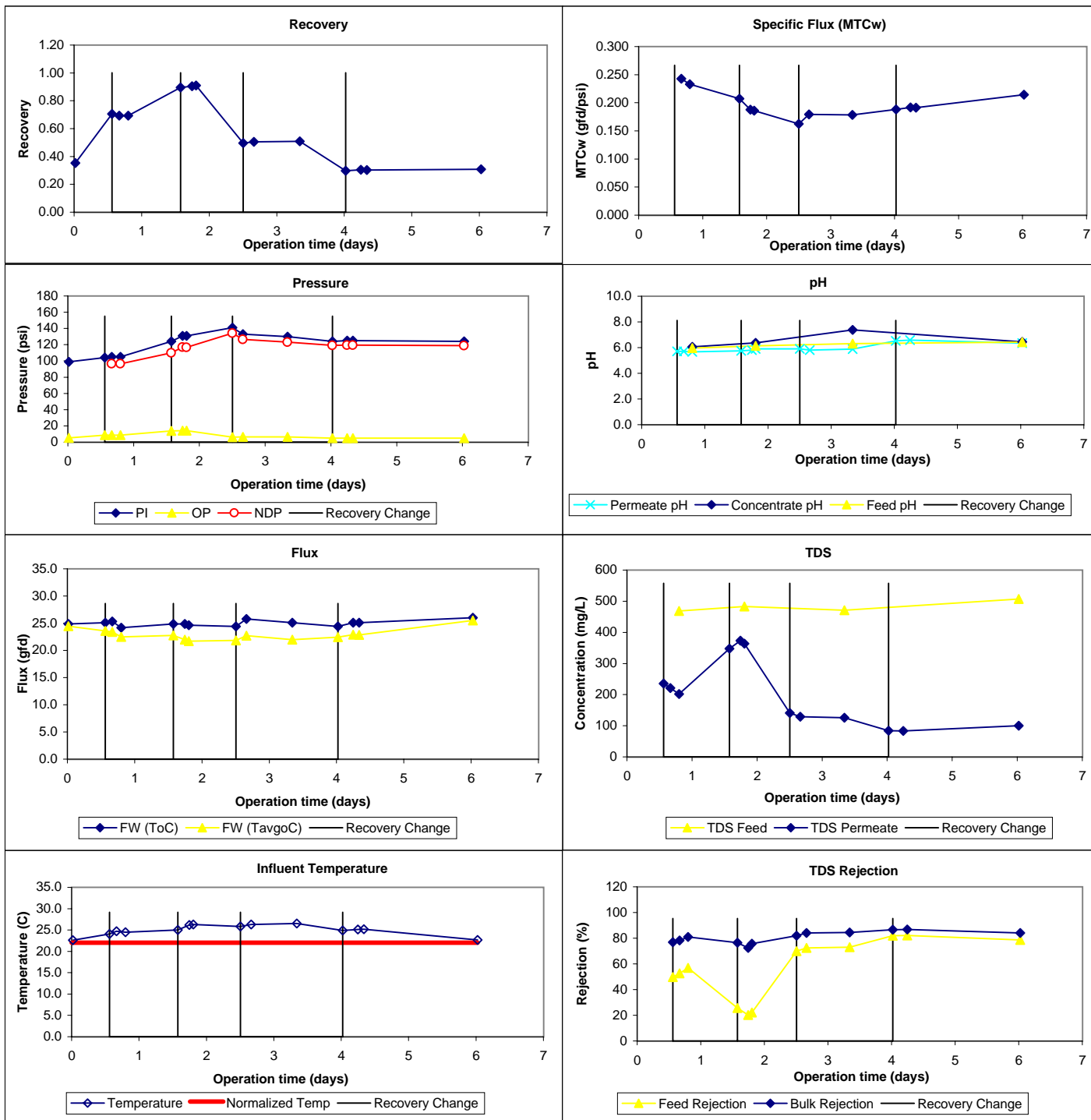
## Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500351 / 1086  
 ICR Contact: n'Detenga n'Gurumo  
 Phone No.: 407 243 7318  
 Period: 4/19/99 - 4/23/99 (4 days)

## Membrane Information

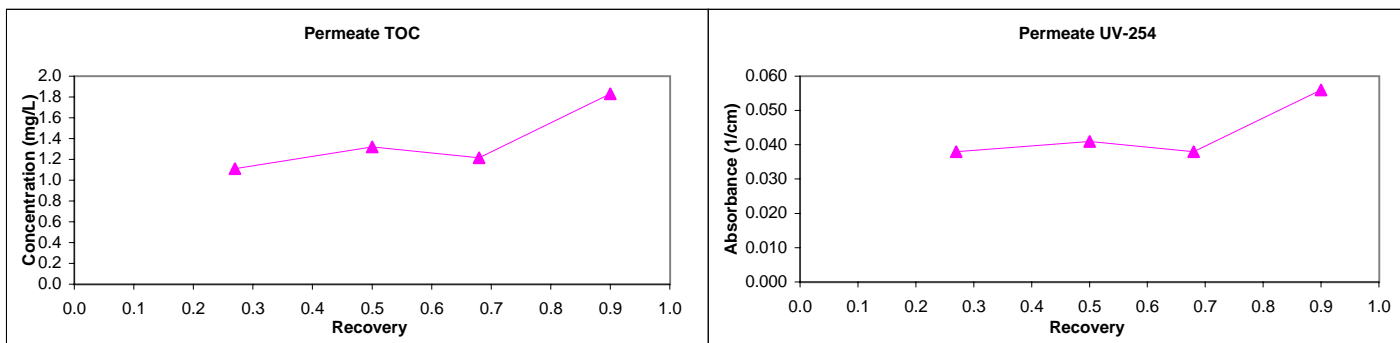
Manufacturer: Film Tec  
 Trade Name: NF200B-400  
 MWCO: 200-400 Daltons  
 Mfr. Flux: 21.1 gfd  
 Mfr. NDP: 71.0 psi  
 Mfr. MTCw: 0.284 gfd/psi

Mfr. Temp: 25.0 °C  
 840 Element Area: 400.0 ft<sup>2</sup>  
 840 Purchase Price: \$800  
 840 Maximum Flow: 70.0 gpm  
 840 Minimum Flow: 16.0 gpm  
 840 Total Width: 58.7 ft  
 840 Feed Spacer Thickness: 0.0023 ft

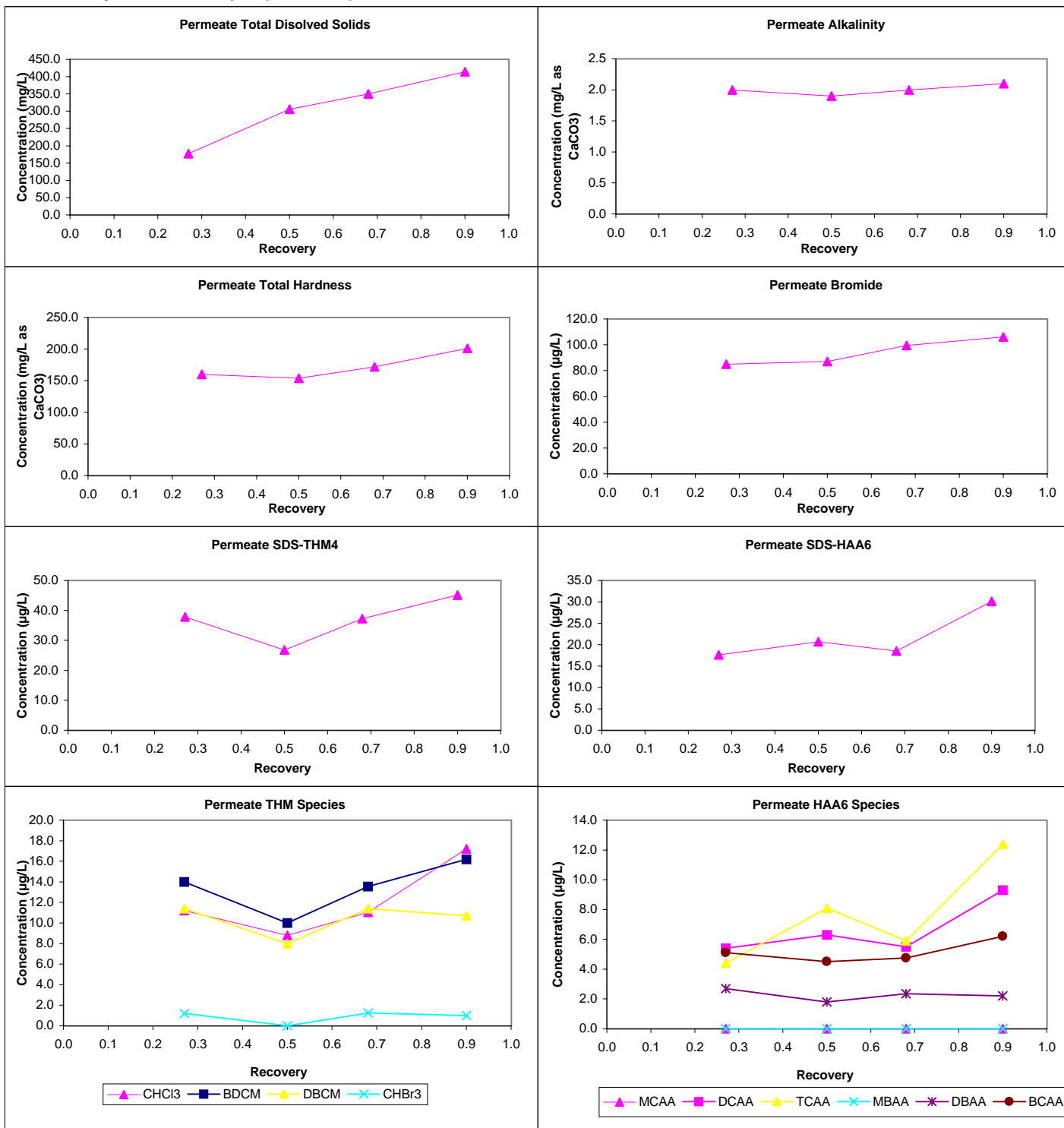
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)											
Source ->	Feed		Permeate				Concentrate											
Recovery ->	Avg	Diff	0.27	0.50	0.68	0.90	0.27	0.50	0.68	0.90	WQP	Count	Avg	SD				
pH	6.4	0.3	6.7	6.7	6.6	6.6	6.4	6.5	6.3	6.4	TDS	5	-31	23				
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	4	-2	30				
Alk	3	0	2	2	2	2	4	7	5	11	TDS	4	-33	25				
TDS	530	76	177	306	350	414	614	592	708	937	TotHard	4	-17	18				
TotHard	256	13	160	154	172	201	294	319	374	531	CaHard	4	-18	18				
CaHard	245	13	155	149	166	193	279	302	352	494	Turb	0	n/a	n/a				
Turb	0.25	0.03	0.00	0.00	0.00	0.00	0.06	0.09	0.10	0.31	Amm	4	52	30				
Amm	0.47	0.09	0.53	0.52	0.48	0.52	0.66	0.68	0.78	0.61	TOC	4	-8	15				
TOC	10.2	0.4	1.1	1.3	1.2	1.8	14.1	19.0	27.9	66.2	UV254	4	-10	16				
UV254	0.332	0.021	0.038	0.041	0.038	0.056	0.461	0.590	0.897	2.115	Pretreatment Information							
SUVA	3.26	0.32	3.42	3.11	3.13	3.06	3.27	3.11	3.22	3.19								
Bromide	109	2	85	87	100	106												
TOX	854	226	97	149	115	168												
CHCl3	137.0	6.0	11.2	8.8	11.1	17.2	Process Description Scale Acidification Hydrochloric acid to pH 6.5 Bench Antiscalant addition æ PreTreat 0100, 3 ppm by vol Bench Cartridge filtration 5 micron nominal Bench											
BDCM	25.6	1.7	14.0	10.0	13.6	16.2												
DBCM	2.9	0.0	11.4	8.0	11.4	10.7												
CHBr3	0.0	0.0	1.2	0.0	1.3	1.0												
THM4	165.5	7.7	37.8	26.8	37.3	45.1												
MCAA	7.1	0.7	0.0	0.0	0.0	0.0	Design Parameters											
DCAA	98.8	NA	5.4	6.3	5.5	9.3												
TCAA	145.0	NA	4.4	8.1	5.9	12.4												
MBAA	0.0	0.0	0.0	0.0	0.0	0.0												
DBAA	0.0	0.0	2.7	1.8	2.4	2.2	Active memb area: 0.167 ft <sup>2</sup> Active width: 0.333 ft Norm Temp: 22.0 °C Feed TDS: 545.0 mg/L Manuf rep TDS rej: 70% Temp Norm MTC-w: 0.260 gfd/psi											
BCAA	7.5	0.2	5.1	4.5	4.8	6.2												
TBAA	NA	NA	NA	NA	NA	NA												
CDBAA	NA	NA	NA	NA	NA	NA												
DCBAA	NA	NA	NA	NA	NA	NA	ID# Recov (dec.) F <sub>W-des</sub> (gfd) 1 0.70 21.1 2 0.90 21.1 3 0.50 21.1 4 0.30 21.1											
HAA5	251.6	NA	12.5	16.2	13.8	23.9												
HAA6	259.3	NA	17.6	20.7	18.5	30.1												
HAA9	NA	NA	NA	NA	NA	NA												
SDS Conditions							Comments:											
WQP	Avg	SD	Count	Min - Max														
Res (mg/L) (0)	1.41	0.36	6	1.00 - 1.93														
Temp (°C)	20.0	0.0	6	20.0 - 20.0														
pH (unit)	7.5	0.1	6	7.4 - 7.6														
Time (hr)	24.2	0.2	6	23.9 - 24.4														

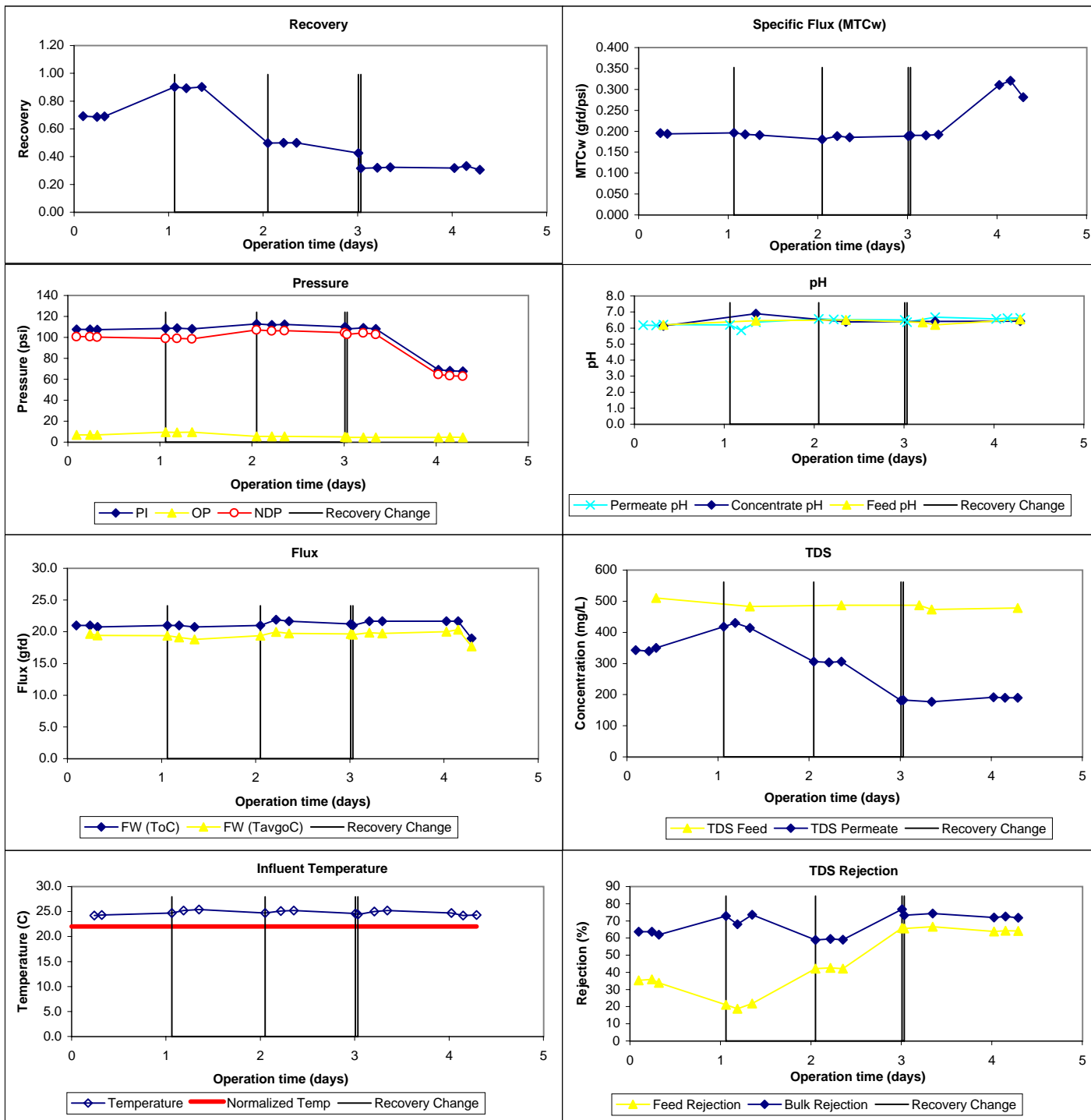
## Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



## Productivity Graphs





## ICR Information

ID / ICR#: FL4500351 / 1086  
 ICR Contact: n'Detenga n'Gurumo  
 Phone No.: 407 243 7318  
 Period: 4/19/99 - 4/23/99 (4 days)

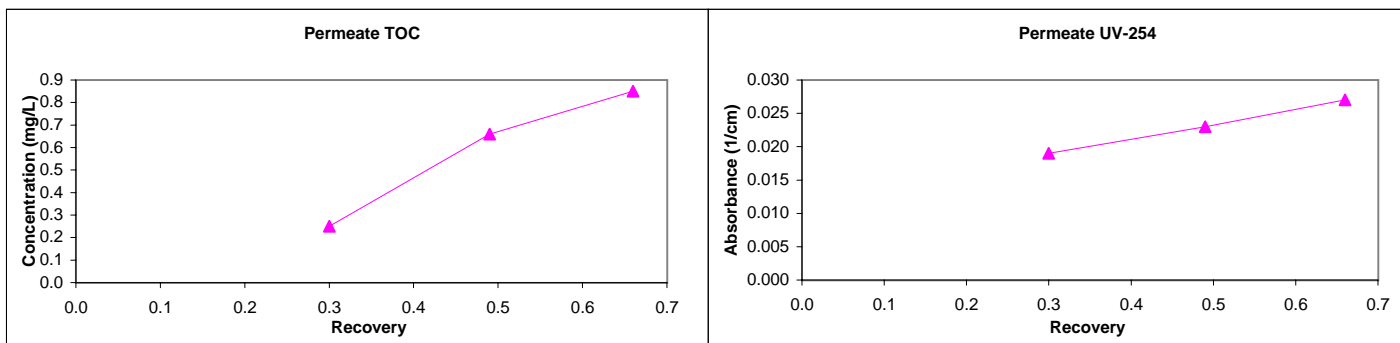
## Membrane Information

Manufacturer: Hydranautics  
 Trade Name: ESNA1  
 MWCO: 180 Daltons  
 Mfr. Flux: 27.0 gfd  
 Mfr. NDP: 68.0 psi  
 Mfr. MTCw: 0.360 gfd/psi  
 Mfr. Temp: 25.0 °C  
 840 Element Area: 400.0 ft<sup>2</sup>  
 840 Purchase Price: \$875  
 840 Maximum Flow: 75.0 gpm  
 840 Minimum Flow: 25.0 gpm  
 840 Total Width: 76.7 ft  
 840 Feed Spacer Thickness: 0.0023 ft

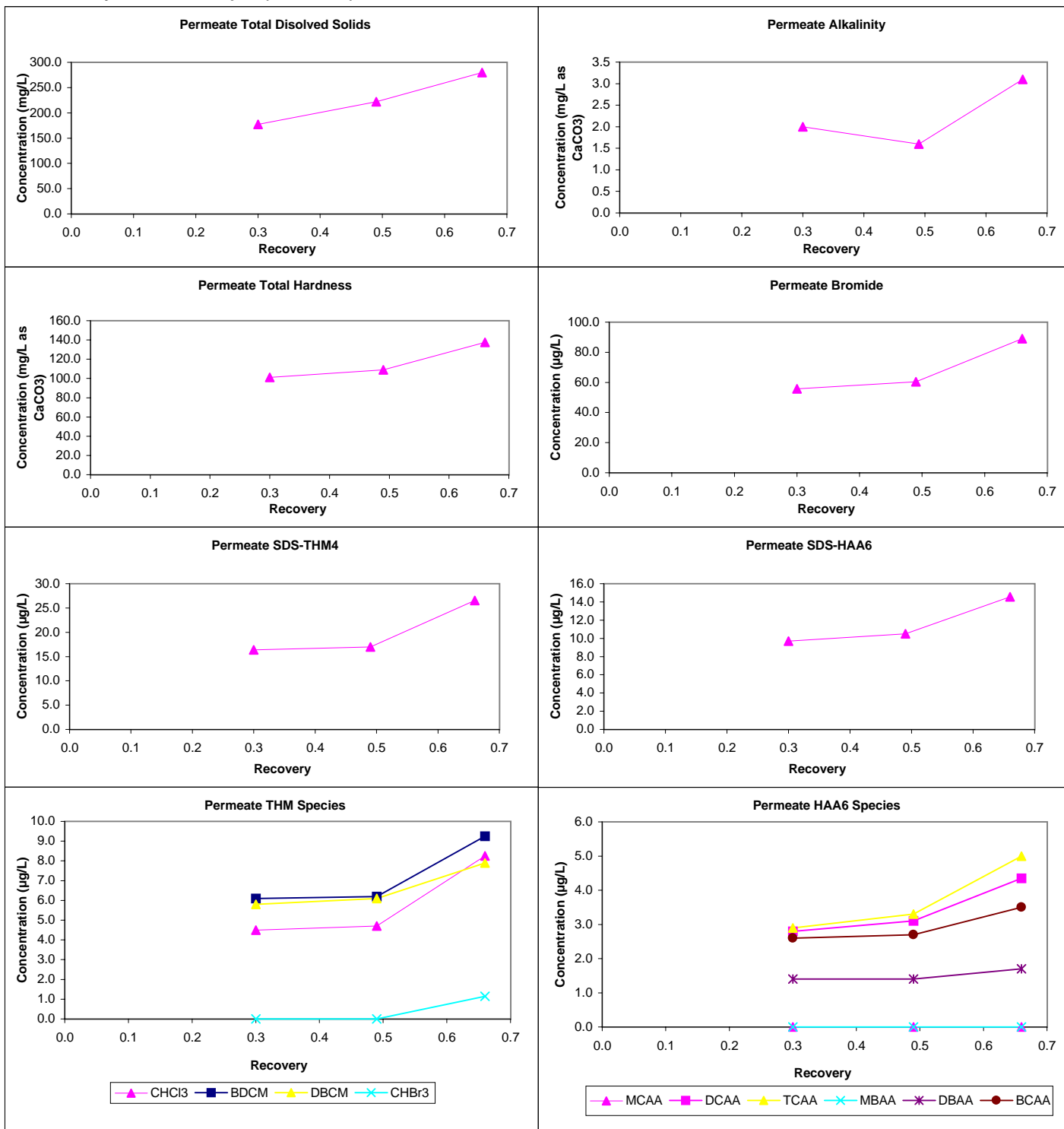
## Water Quality Summary

Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)			
Recovery ->	Avg	Diff	0.30	0.49	0.66	0.00	0.30	0.49	0.66	0.00	WQP	Count	Avg	SD
pH	6.4	0.3	6.7	6.5	7.0		6.3	6.4	6.5		TDS	5	-13	9
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	3	15	26
Alk	3	0	2	2	3		4	5	6		TDS	3	-9	3
TDS	530	76	177	222	280		645	756	909		TotHard	3	-7	5
TotHard	256	13	101	109	138		319	356	447		CaHard	3	-8	6
CaHard	245	13	96	103	131		304	339	426		Turb	1	-198	n/a
Turb	0.25	0.03	0.00	0.00	0.06		0.05	0.07	0.17		Amm	3	16	19
Amm	0.47	0.09	0.28	0.37	0.34		0.76	0.76	0.68		TOC	3	1	8
TOC	10.2	0.4	0.3	0.7	0.9		13.9	19.0	31.6		UV254	3	4	6
UV254	0.332	0.021	0.019	0.023	0.027		0.473	0.630	1.030					
SUVA	3.26	0.32	7.60	3.48	3.18	#VALUE!	3.40	3.32	3.26					
Bromide	109	2	56	61	89						Pretreatment Information			
TOX	854	226	48	62	89						Process	Description	Scale	
CHCl3	137.0	6.0	4.5	4.7	8.3						Acidification	Hydrochloric acid to pH 6.5	Bench	
BDCM	25.6	1.7	6.1	6.2	9.3						Antiscalant addition	PreTreat 0100, 3 ppm by vol	Bench	
DBCM	2.9	0.0	5.8	6.1	7.9						Cartridge filtration	5 micron nominal	Bench	
CHBr3	0.0	0.0	0.0	0.0	1.2									
THM4	165.5	7.7	16.4	17.0	26.6	0.0								
MCAA	7.1	0.7	0.0	0.0	0.0						Design Parameters			
DCAA	98.8	NA	2.8	3.1	4.4						Active memb area:	0.167 ft <sup>2</sup>		
TCAA	145.0	NA	2.9	3.3	5.0						Active width:	0.333 ft		
MBAA	0.0	0.0	0.0	0.0	0.0						Norm Temp:	22.0 °C		
DBAA	0.0	0.0	1.4	1.4	1.7						Feed TDS:	545.0 mg/L		
BCAA	7.5	0.2	2.6	2.7	3.5						Manuf rep TDS rej:	70%		
TBAA	NA	NA	NA	NA	NA	NA					Temp Norm MTC-w:	0.329 gfd/psi		
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	251.6	NA	7.1	7.8	11.1	0.0								
HAA6	259.3	NA	9.7	10.5	14.6	0.0								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.92	0.27	5	0.59 - 1.32										
Temp (°C)	20.0	0.0	5	20.0 - 20.0										
pH (unit)	7.5	0.1	5	7.4 - 7.6										
Time (hr)	24.2	0.2	5	23.9 - 24.4										

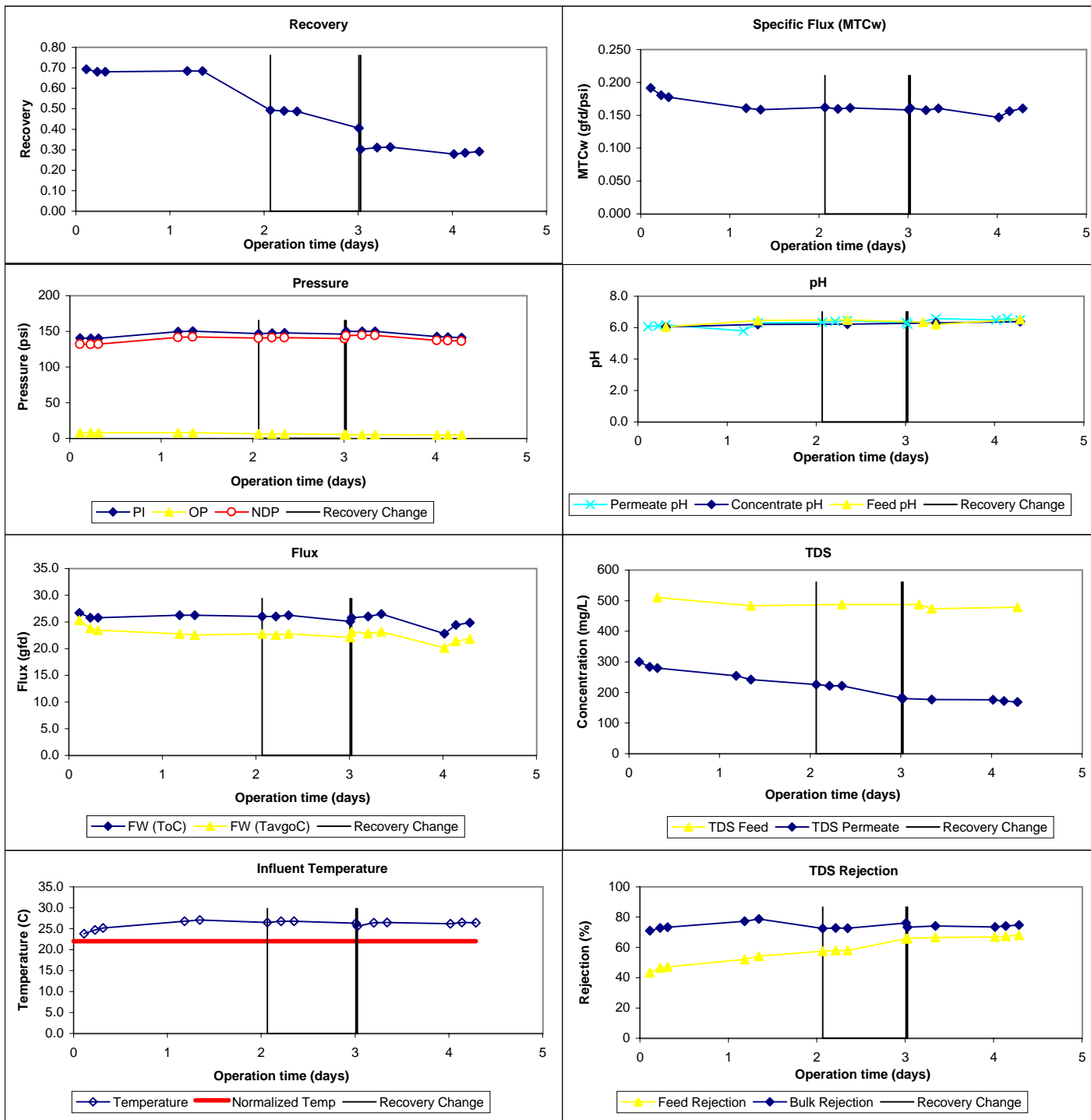
## Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



## Productivity Graphs



## ICR Information

**ID / ICR#:** FL4500351 / 1086  
**ICR Contact:** n'Detenga n'Gurumo  
**Phone No.:** 407 243 7318  
**Period:** 3/21/99 - 3/27/99 (6 days)

## Membrane Information

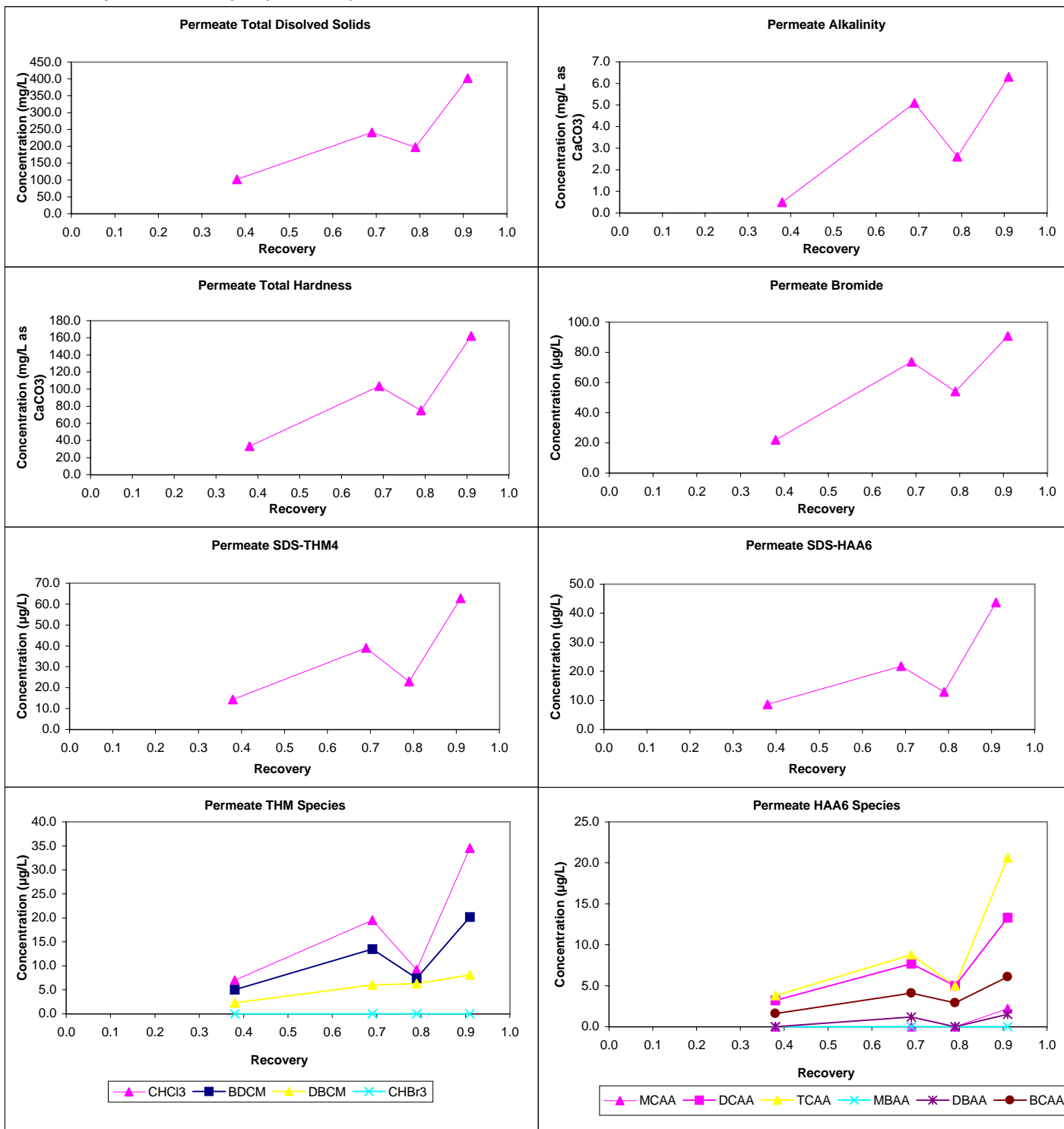
**Manufacturer:** Fluid Systems  
**Trade Name:** TFC 8921S-400  
**MWCO:** 200 Daltons  
**Mfr. Flux:** 15.0 gfd  
**Mfr. NDP:** 56.5 psi  
**Mfr. MTCw:** 0.265 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$846  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 15.0 gpm  
**840 Total Width:** 63.2 ft  
**840 Feed Spacer Thickness:** 0.0022 ft

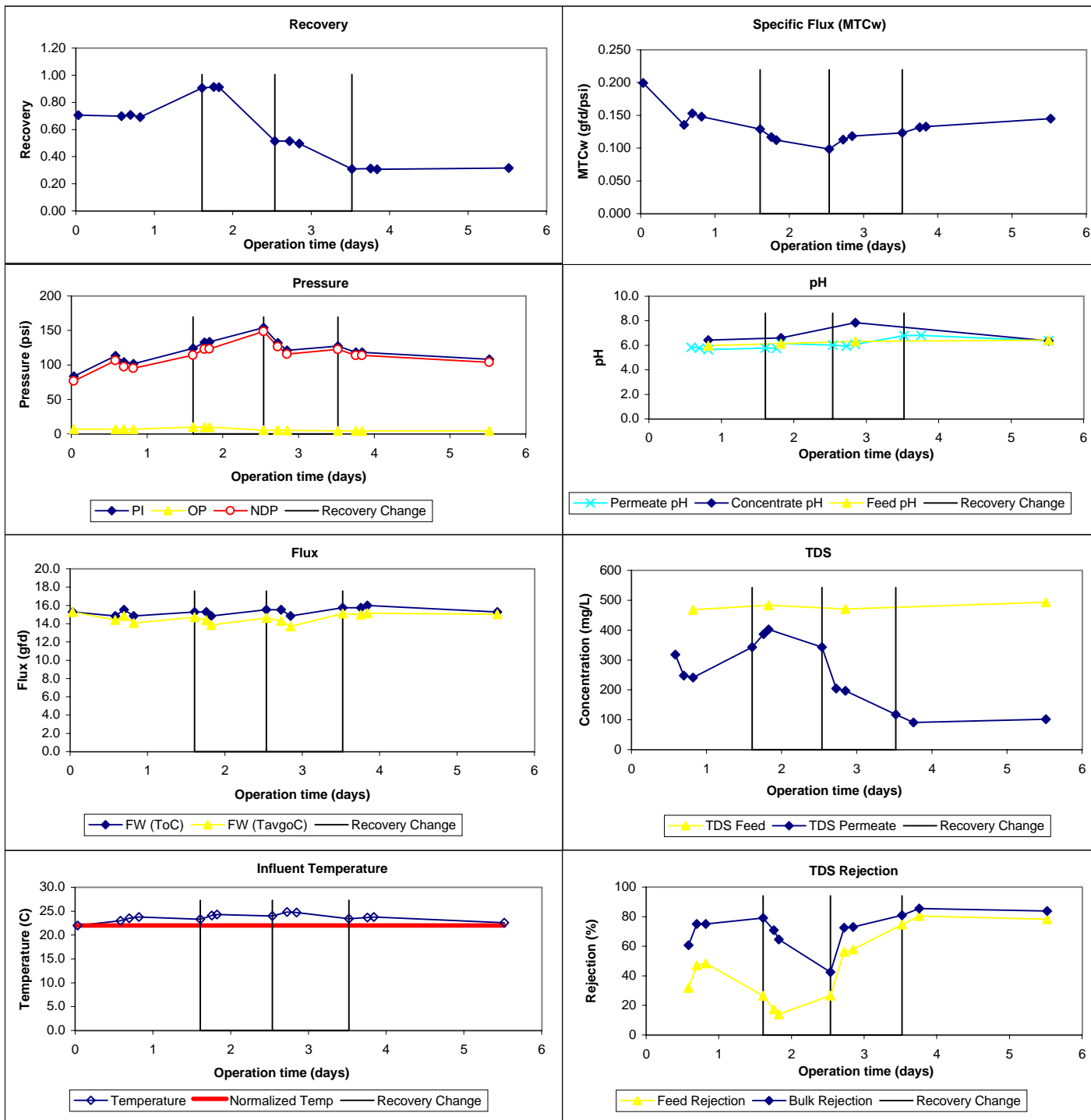
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)											
Source ->	Feed		Permeate				Concentrate											
Recovery ->	Avg	Diff	0.38	0.69	0.79	0.91	0.38	0.69	0.79	0.91	WQP	Count	Avg	SD				
pH	6.6	0.3	6.7	6.3	6.9	6.4	6.5	7.3	7.0	8.3	TDS	4	37	24				
Temp	NA	NA	NR	NA	NR	NR	NR	NR	NR	NR	Alk	3	-197	271				
Alk	7	2	1	5	3	6	2	30	10	NR	TDS	4	20	36				
TDS	468	19	102	241	197	402	659	1660	1280	2820	TotHard	4	14	29				
TotHard	222	4	33	104	75	162	332	765	653	1390	CaHard	4	15	29				
CaHard	211	4	33	99	72	155	317	729	621	1320	Turb	0	n/a	n/a				
Turb	0.28	0.11	0.00	0.00	0.00	0.00	0.24	0.30	0.20	1.11	Amm	3	-4	14				
Amm	0.42	0.02	0.18	0.25	0.28	0.60	0.63	0.68	0.87	NR	TOC	4	13	21				
TOC	10.7	0.3	0.6	1.7	1.1	2.8	16.2	48.2	44.6	122.7	UV254	4	10	22				
UV254	0.334	0.004	0.018	0.052	0.037	0.081	0.516	1.510	1.280	3.610	Pretreatment Information  ProcessDescriptionScale  AcidificationHydrochloric acid to pH 6.5Bench Antiscalant additionæ PreTreat 0100, 3 ppm by volBench Cartridge filtration5 micron nominalBench							
SUVA	3.11	0.14	2.95	2.95	3.27	2.88	3.18	3.13	2.87	2.94								
Bromide	117	12	22	74	54	91												
TOX	940	31	47	134	104	211												
CHCl3	146.5	8.5	7.0	19.5	9.2	34.5												
BDCM	25.2	2.4	5.0	13.5	7.4	20.2												
DBCM	2.7	0.1	2.3	6.1	6.3	8.1												
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0												
THM4	174.4	11.0	14.3	39.1	22.9	62.8												
MCAA	6.3	0.6	0.0	0.0	0.0	2.2												
DCAA	63.0	7.5	3.2	7.7	5.0	13.3												
TCAA	128.0	10.0	3.8	8.8	5.0	20.6												
MBAA	0.0	0.0	0.0	0.0	0.0	0.0												
DBAA	0.0	0.0	0.0	1.2	0.0	1.5												
BCAA	8.1	0.5	1.6	4.1	2.9	6.1												
TBAA	NA	NA	NA	NA	NA	NA												
CDBAA	NA	NA	NA	NA	NA	NA												
DCBAA	NA	NA	NA	NA	NA	NA												
HAA5	197.3	18.0	7.0	17.7	10.0	37.6												
HAA6	205.4	18.5	8.6	21.8	12.9	43.7												
HAA9	NA	NA	NA	NA	NA	NA												
SDS Conditions							Design Parameters  Active memb area:0.167 ft² Active width:0.333 ft Norm Temp:22.0 °C Feed TDS:545.0 mg/L Manuf rep TDS rej:70% Temp Norm MTC-w:0.243 gfd/psi											
WQP	Avg	SD	Count	Min - Max														
Res (mg/L) (0)	1.37	1.07	6	0.37 - 3.42														
Temp (°C)	20.0	0.0	6	20.0 - 20.0														
pH (unit)	7.5	0.1	6	7.4 - 7.6														
Time (hr)	23.5	1.5	6	21.6 - 24.9		Comments:												

## Water Quality Parameter Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500351 / 1086  
 ICR Contact: n'Detenga n'Gurumo  
 Phone No.: 407 243 7318  
 Period: 5/10/99 - 5/15/99 (5 days)

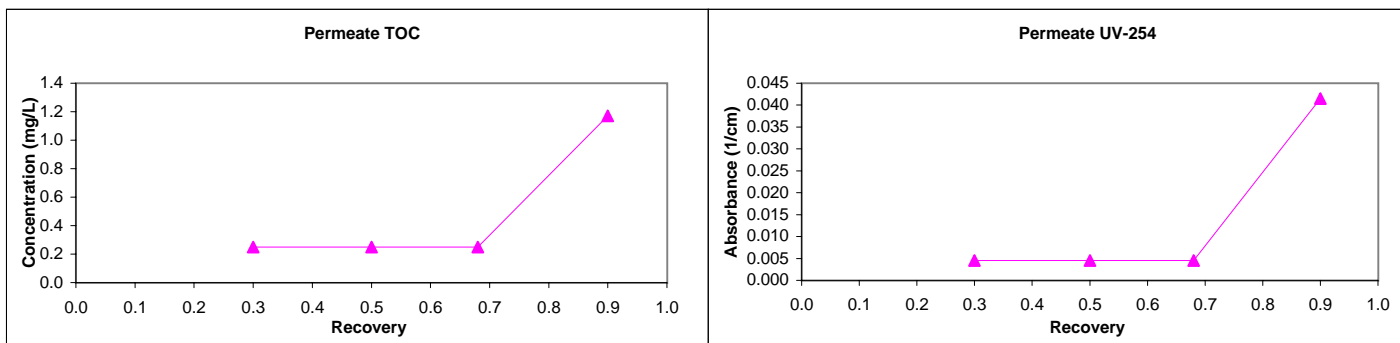
## Membrane Information

Manufacturer: Film Tec  
 Trade Name: NF70  
 MWCO: 200 Daltons  
 Mfr. Flux: 25.0 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTCw: 0.357 gfd/psi  
 Mfr. Temp: 25.0 °C  
 840 Element Area: 400.0 ft<sup>2</sup>  
 840 Purchase Price: \$600  
 840 Maximum Flow: 75.0 gpm  
 840 Minimum Flow: 24.7 gpm  
 840 Total Width: 58.7 ft  
 840 Feed Spacer Thickness: 0.0023 ft

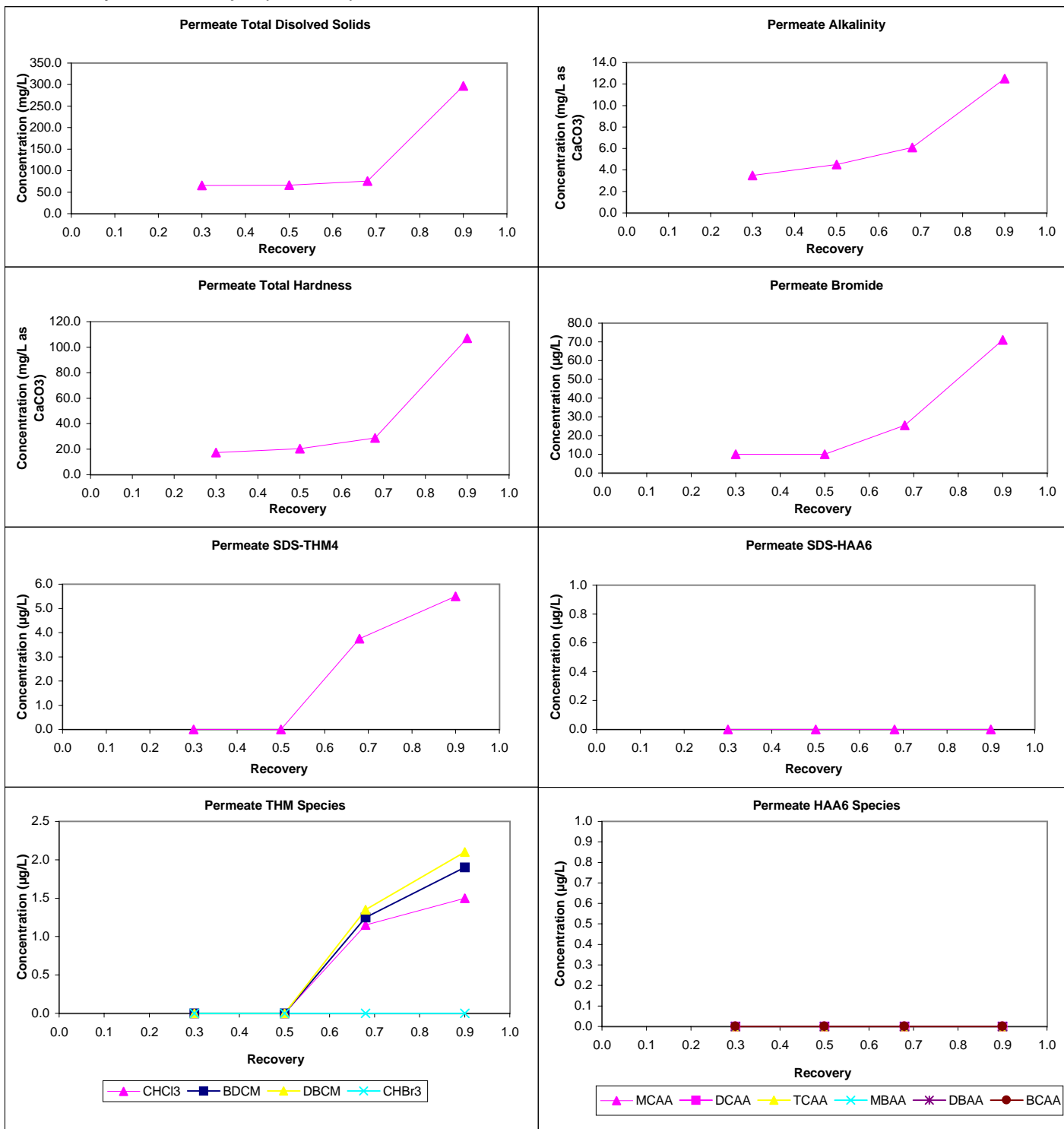
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Error (%)																							
Source ->	Feed		Permeate				Concentrate																							
Recovery ->	Avg	Diff	0.30	0.50	0.68	0.90	0.30	0.50	0.68	0.90	WQP	Count	Avg	SD																
pH	6.2	0.0	5.7	5.9	6.1	6.1	6.4	6.6	6.8	7.3	TDS	3	4	11																
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	4	0	4																
Alk	25	0	4	5	6	13	35	47	67	130	TDS	4	2	10																
<b>TDS</b>	<b>471</b>	<b>16</b>	<b>66</b>	<b>66</b>	<b>76</b>	<b>297</b>	<b>752</b>	<b>817</b>	<b>1237</b>	<b>2184</b>	TotHard	4	-8	17																
TotHard	245	7	17	21	29	107	334	488	691	1110	CaHard	4	-8	17																
CaHard	232	6	17	21	29	102	317	464	656	1050	Turb	0	n/a	n/a																
Turb	0.05	0.01	0.00	0.00	0.00	0.00	0.10	0.07	0.12	0.63	Amm	4	-26	29																
Amm	0.58	0.01	0.41	0.44	0.43	0.43	0.63	0.70	0.66	1.19	TOC	1	-22	n/a																
<b>TOC</b>	<b>11.1</b>	<b>0.4</b>	<b>0.3</b>	<b>0.3</b>	<b>0.3</b>	<b>1.2</b>	<b>13.4</b>	<b>21.1</b>	<b>33.1</b>	<b>82.2</b>	UV254	1	-1	n/a																
UV254	0.359	0.009	0.005	0.005	0.005	0.042	0.542	0.153	1.163	3.188																				
SUVA	3.25	0.06	1.80	1.80	1.80	3.55	4.04	0.73	3.51	3.88																				
<b>Bromide</b>	<b>130</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>26</b>	<b>71</b>	<b>Pretreatment Information</b>																							
<b>TOX</b>	<b>1059</b>	<b>1</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>13</b>									<b>Process Description Scale</b>															
CHCl3	194.0	17.0	0.0	0.0	1.2	1.5	Aeration Bubble diffuser in barrel overni Bench Acidification Hydrochloric acid to pH 6.5 Bench Antiscalant addition PreTreat 0100, 3 ppm by vol Bench Membrane Filtration 1 micron Pall Microza cartridge Bench																							
BDCM	36.6	0.1	0.0	0.0	1.3	1.9																								
DBCM	3.7	0.1	0.0	0.0	1.4	2.1																								
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0																								
<b>THM4</b>	<b>234.3</b>	<b>16.8</b>	<b>0.0</b>	<b>0.0</b>	<b>3.8</b>	<b>5.5</b>																								
MCAA	7.1	0.1	0.0	0.0	0.0	0.0	<b>Design Parameters</b>																							
DCAA	52.8	0.5	0.0	0.0	0.0	0.0																								
TCAA	122.5	1.5	0.0	0.0	0.0	0.0																								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																								
DBAA	0.0	0.0	0.0	0.0	0.0	0.0																								
BCAA	7.9	0.4	0.0	0.0	0.0	0.0																								
TBAA	NA	NA	NA	NA	NA	NA																								
CDBAA	NA	NA	NA	NA	NA	NA																								
DCBAA	NA	NA	NA	NA	NA	NA																								
<b>HAA5</b>	<b>182.4</b>	<b>1.9</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>																								
<b>HAA6</b>	<b>190.3</b>	<b>1.5</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>																								
<b>HAA9</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>																								
<b>SDS Conditions</b>															<b>Active memb area:</b> 0.167 ft <sup>2</sup> <b>Active width:</b> 0.333 ft <b>Norm Temp:</b> 22.0 °C <b>Feed TDS:</b> 545.0 mg/L <b>Manuf rep TDS rej:</b> 70% <b>Temp Norm MTC-w:</b> 0.327 gfd/psi															
<b>WQP</b>	<b>Avg</b>	<b>SD</b>	<b>Count</b>	<b>Min - Max</b>																										
Res (mg/L) (0)	0.76	0.29	6	0.46 - 1.19																										
Temp (°C)	20.0	0.0	6	20.0 - 20.0																										
pH (unit)	7.5	0.0	6	7.5 - 7.6																										
Time (hr)	24.0	0.3	6	23.6 - 24.4																										
							<b>Comments:</b>																							

## Water Quality Parameter Graphs

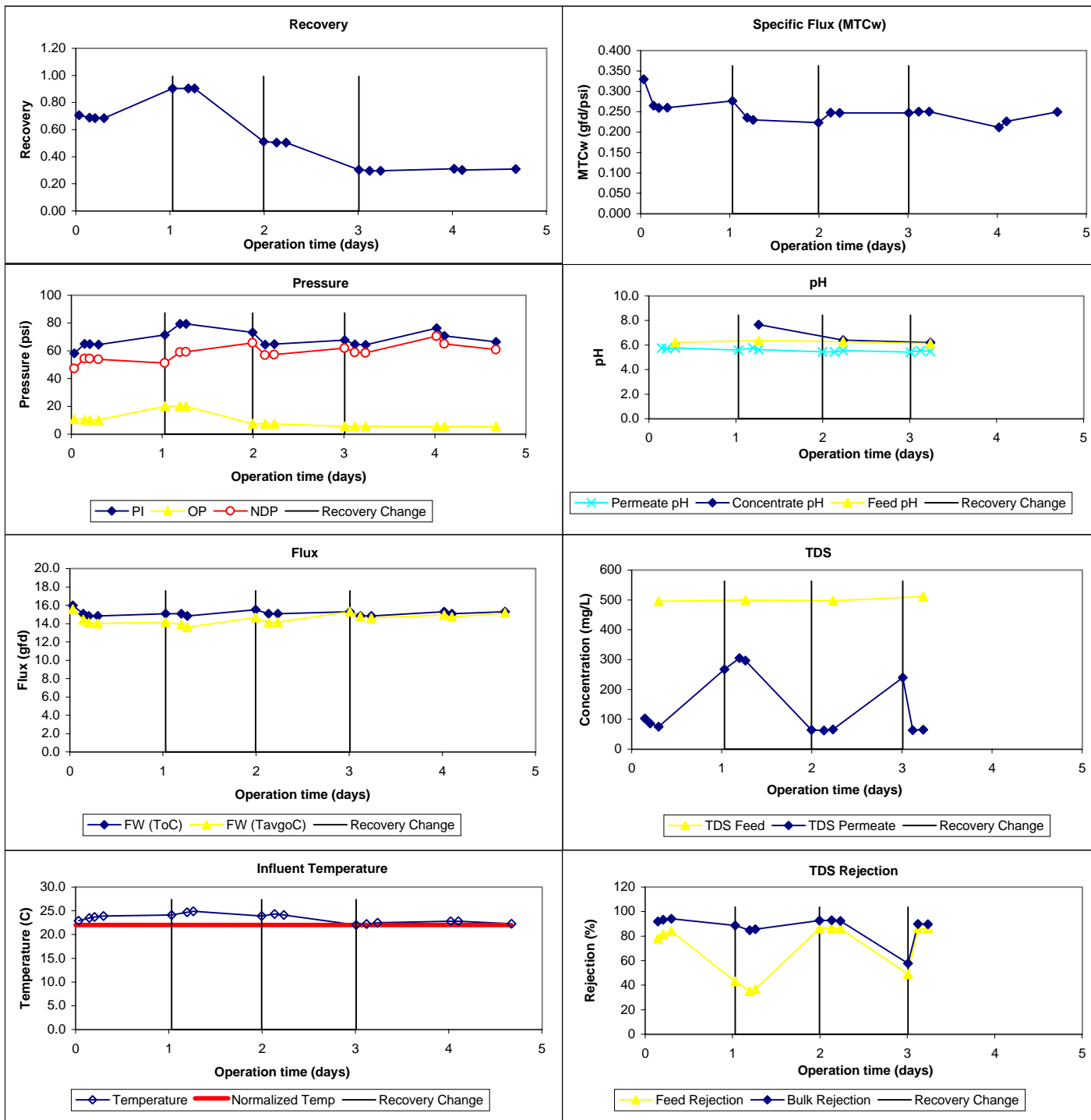


## Water Quality Parameter Graphs (Continued)





## Productivity Graphs



## ICR Information

ID / ICR#: FL4500351 / 1086  
 ICR Contact: n'Detenga n'Gurumo  
 Phone No.: 407 243 7318  
 Period: 5/17/99 - 5/22/99 (5 days)

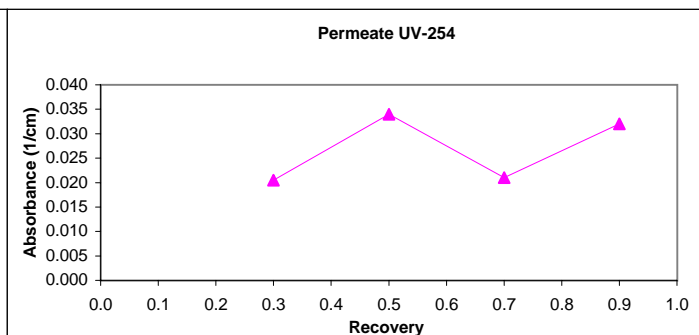
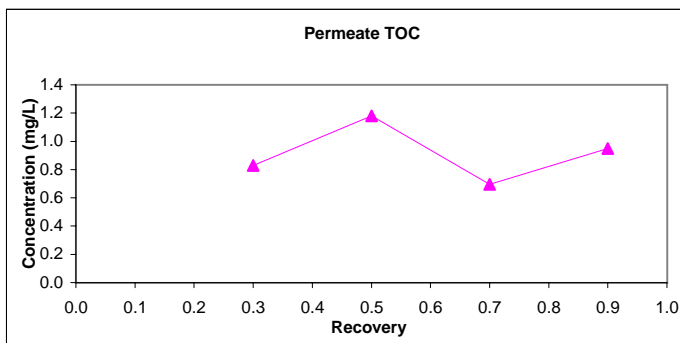
## Membrane Information

Manufacturer: Film Tec  
 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 ft<sup>2</sup>  
 840 Purchase Price: \$800  
 840 Maximum Flow: 70.0 gpm  
 840 Minimum Flow: 16.0 gpm  
 840 Total Width: 58.7 ft  
 840 Feed Spacer Thickness: 0.0023 ft

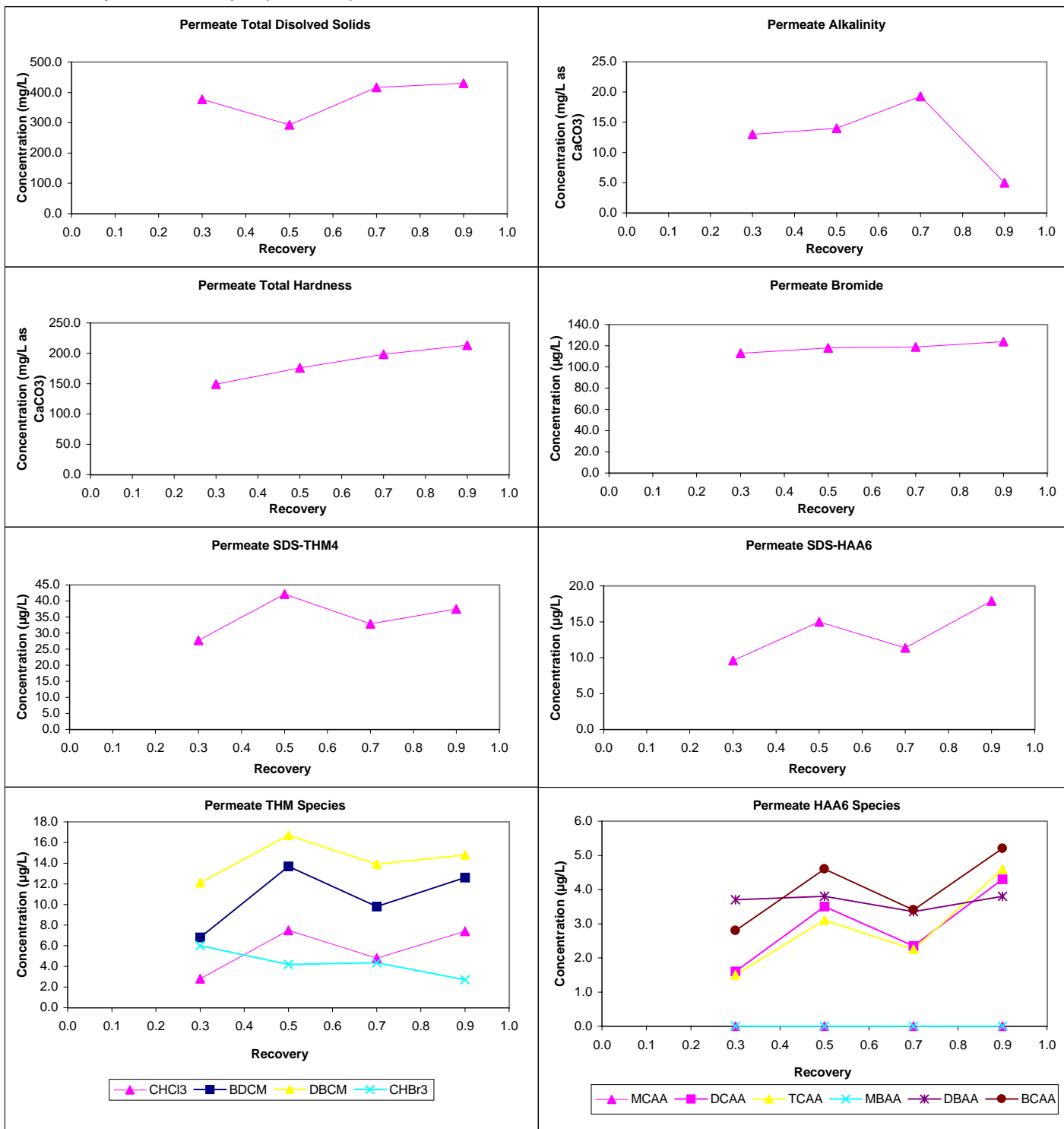
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Error (%)												
Source ->	Feed		Permeate				Concentrate												
Recovery ->	Avg	Diff	0.30	0.50	0.70	0.90	0.30	0.50	0.70	0.90	WQP	Count	Avg	SD					
pH	6.2	0.2	6.0	6.2	6.6	6.3	6.3	6.4	6.7	6.6	TDS <sub>st</sub>	5	-14	6					
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	4	-91	250					
Alk	19	7	13	14	19	5	31	31	41	26	TDS	4	-6	14					
TDS	480	59	378	293	417	430	455	558	712	908	TotHard	4	5	8					
TotHard	233	14	149	176	199	213	253	312	353	445	CaHard	4	6	8					
CaHard	221	13	143	168	191	203	239	294	332	414	Turb	4	-325	352					
Turb	0.26	0.05	0.19	0.04	0.11	0.02	0.13	0.15	0.27	0.25	Amm	4	17	48					
Amm	0.48	0.11	0.28	0.47	0.51	0.50	0.37	0.66	0.67	0.67	TOC	4	-3	18					
TOC	9.7	0.0	0.8	1.2	0.7	1.0	14.1	21.1	29.7	69.1	UV254	4	-15	25					
UV254	0.380	0.008	0.021	0.034	0.021	0.032	0.593	0.693	1.031	2.360	Pretreatment Information								
SUVA	3.92	0.10	2.47	2.88	3.02	3.37	4.20	3.28	3.47	3.42					Process	Description	Scale		
Bromide	191	53	113	118	119	124	Aeration Bubble diffuser in barrel overn Bench Acidification Hydrochloric acid to pH 6.5 Bench Antiscalant addition PreTreat 0100, 3 ppm by vol Bench Membrane Filtration 1 micron Pall Microza cartridge Bench												
TOX	1001	114	54	101	67	98													
CHCl3	206.0	10.0	2.8	7.5	4.8	7.4													
BDCM	36.0	2.4	6.8	13.7	9.8	12.6													
DBCM	3.7	0.2	12.1	16.7	13.9	14.8													
CHBr3	0.0	0.0	6.0	4.2	4.4	2.7													
THM4	245.7	12.7	27.7	42.1	32.9	37.5													
MCAA	2.9	2.9	0.0	0.0	0.0	0.0													
DCAA	60.0	8.0	1.6	3.5	2.4	4.3													
TCAA	116.0	0.0	1.5	3.1	2.3	4.6													
MBAA	0.0	0.0	0.0	0.0	0.0	0.0													
DBAA	0.7	0.7	3.7	3.8	3.4	3.8													
BCAA	9.1	1.0	2.8	4.6	3.4	5.2													
TBAA	NA	NA	NA	NA	NA	NA													
CDBAA	NA	NA	NA	NA	NA	NA													
DCBAA	NA	NA	NA	NA	NA	NA													
HAA5	179.5	11.5	6.8	10.4	8.0	12.7													
HAA6	188.6	12.5	9.6	15.0	11.4	17.9													
HAA9	NA	NA	NA	NA	NA	NA													
SDS Conditions							Design Parameters												
WQP	Avg	SD	Count	Min - Max											Active memb area:	0.167 ft <sup>2</sup>	ID#	Recov (dec.)	F <sub>w-des</sub> (gfd)
Res (mg/L) (0)	0.76	0.28	6	0.31 - 1.15											Active width:	0.333 ft	1	0.70	21.1
Temp (°C)	20.0	0.0	6	20.0 - 20.0											Norm Temp:	22.0 °C	2	0.90	21.1
pH (unit)	7.5	0.1	6	7.4 - 7.6											Feed TDS:	545.0 mg/L	3	0.50	21.1
Time (hr)	24.3	0.5	6	23.5 - 24.8											Manuf rep TDS rej:	70%	4	0.30	21.1
							Temp Norm MTC-w: 0.260 gfd/psi												
Comments:																			

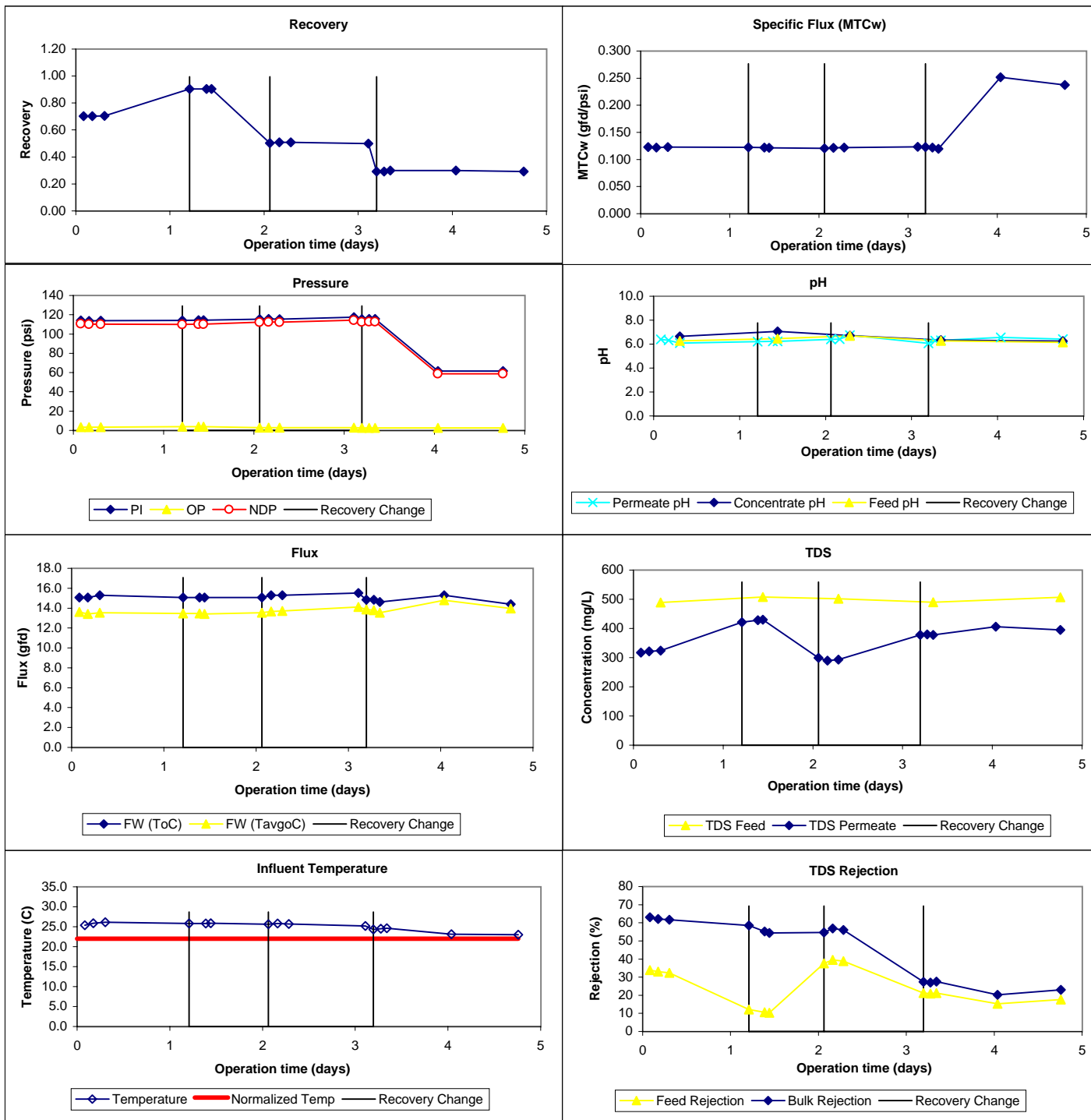
## Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500351 / 1086

**ICR Contact:** n'Detenga n'Gurumo

**Phone No.:** 407 243 7318

**Period:** 5/24/99 - 5/29/99 (5 days)

### Membrane Information

**Manufacturer:** Hydranautics

**Trade Name:** ESNA1

**MWCO:** 180 Daltons

**Mfr. Flux:** 27.0 gfd

Mfr. NDP: 68.0 psi

**Mfr. MTCw:** 0.360 gfd/psi

Mfr. Temp: 25.0 °C

**840 Element Area:** 400.0 ft<sup>2</sup>

**840 Purchase Price:** \$875

**840 Maximum Flow:** 75.0 gpm

**840 Minimum Flow:** 25.0 gpm

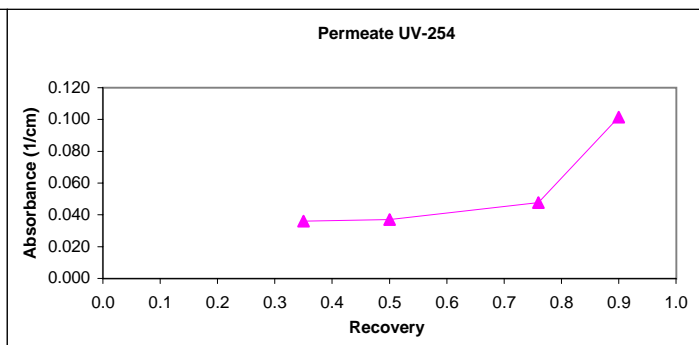
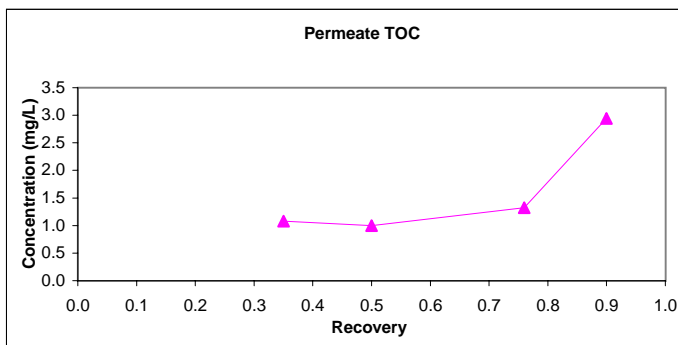
**840 Total Width:** 76.7 ft

**840 Feed Spacer Thickness:** 0.0023 ft

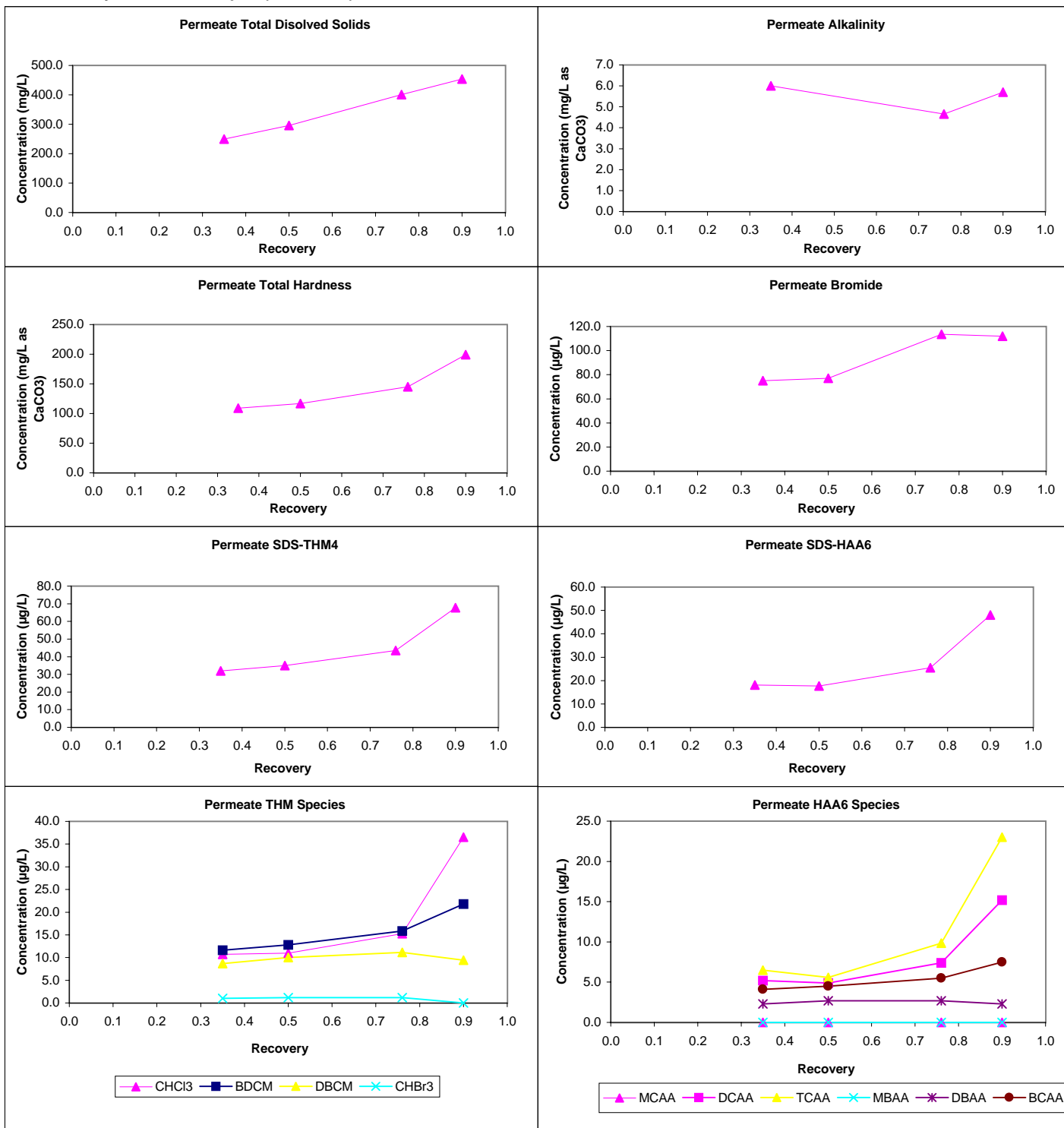
## Water Quality Summary

[illegible]

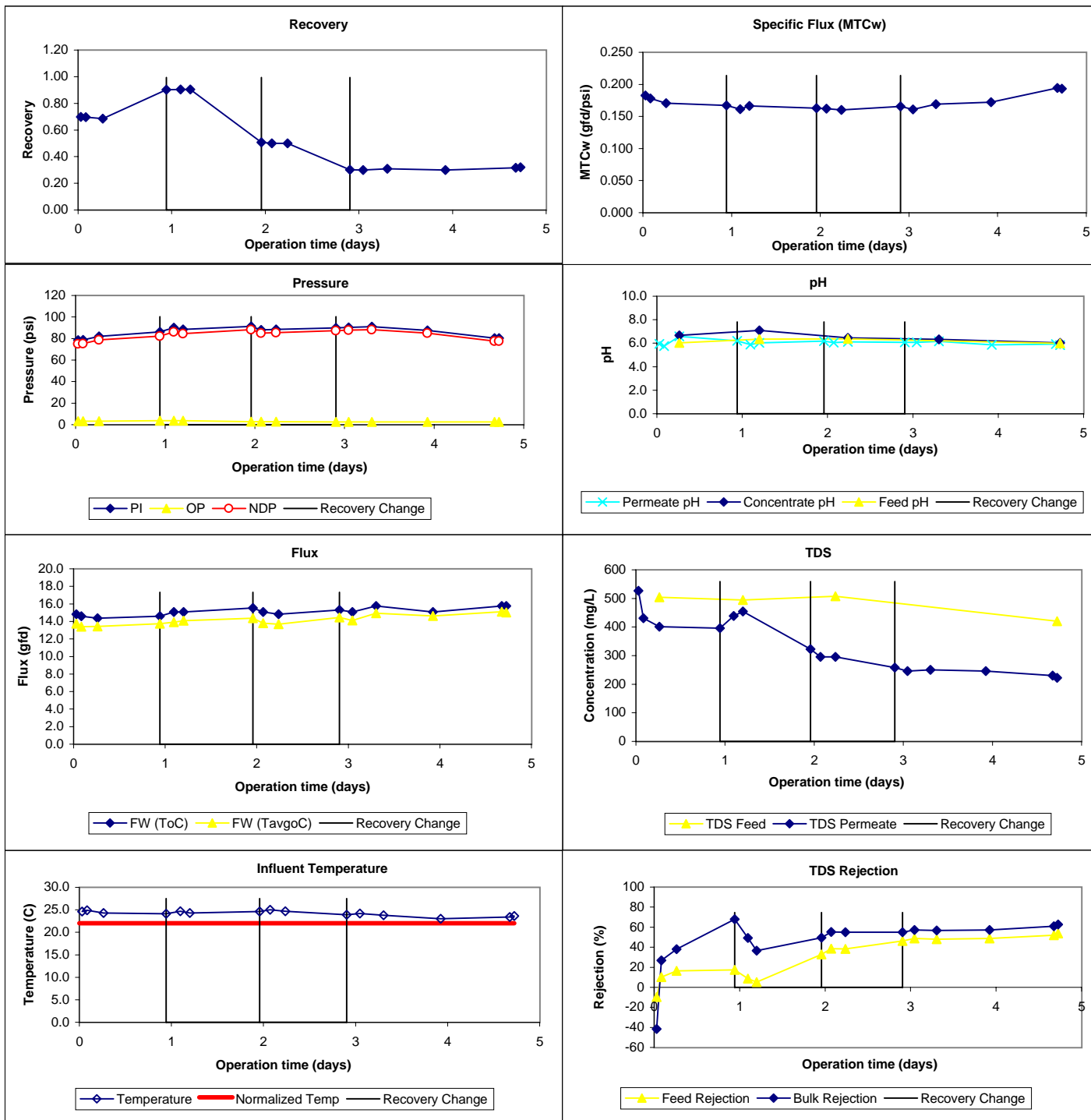
### Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



## Productivity Graphs



## ICR Information

**ID / ICR#:** FL4500351 / 1086  
**ICR Contact:** n'Detenga n'Gurumo  
**Phone No.:** 407 243 7318  
**Period:** 5/10/99 - 5/15/99 (5 days)

## Membrane Information

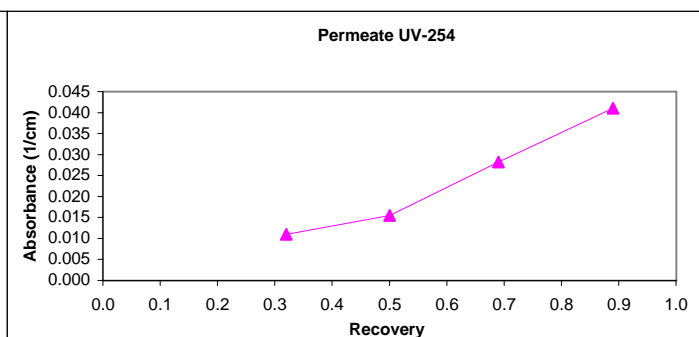
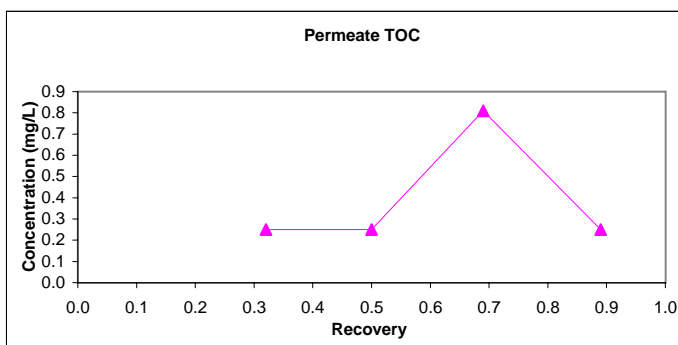
**Manufacturer:** Fluid Systems  
**Trade Name:** TFC 8921S-400  
**MWCO:** 200 Daltons  
**Mfr. Flux:** 15.0 gfd  
**Mfr. NDP:** 56.5 psi  
**Mfr. MTCw:** 0.265 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$846  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 15.0 gpm  
**840 Total Width:** 63.2 ft  
**840 Feed Spacer Thickness:** 0.0022 ft

## Water Quality Summary

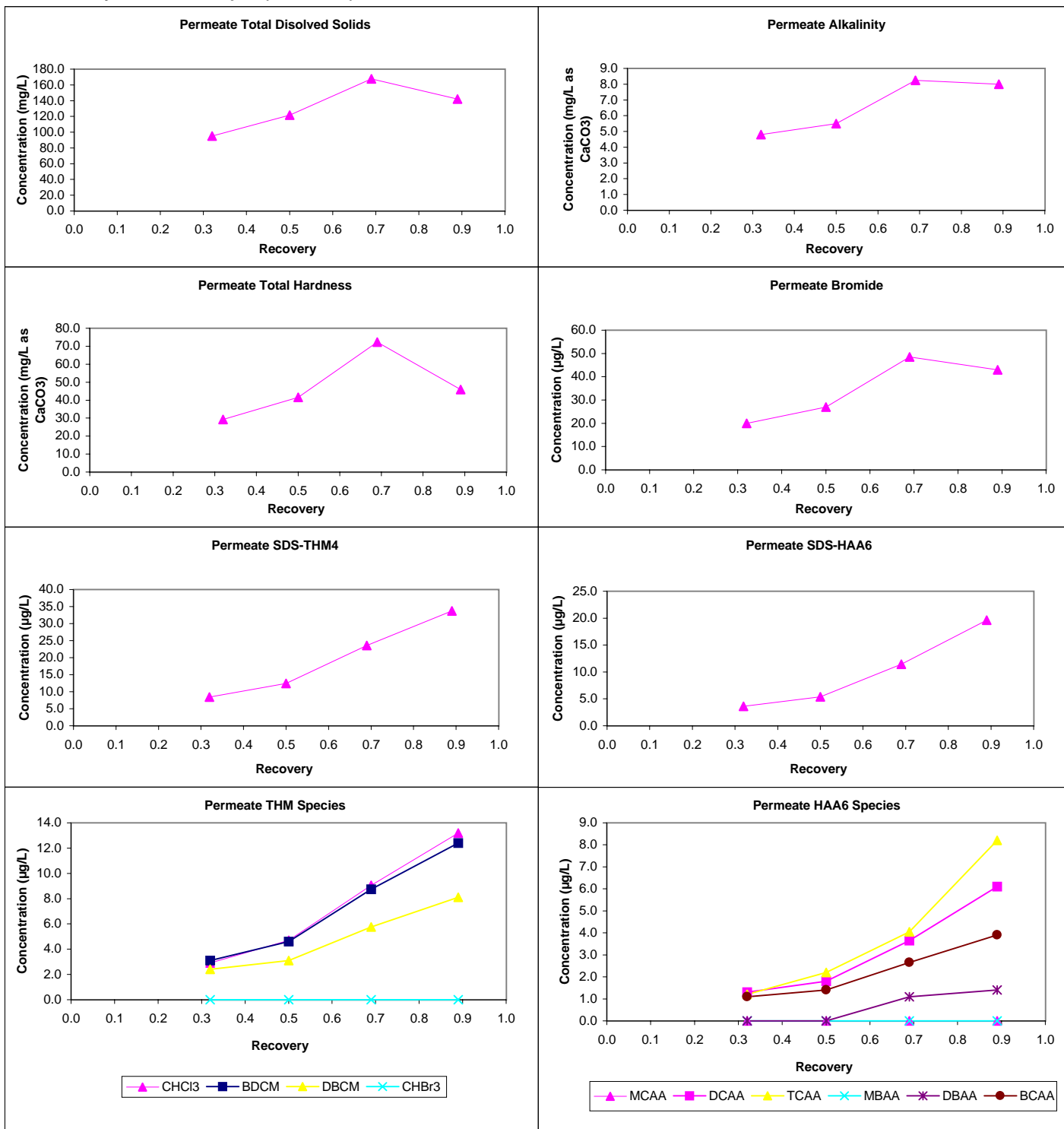
Water Quality Summary							Mass Balance Closure Error (%)										
Source ->	Feed		Permeate				Concentrate										
Recovery ->	Avg	Diff	0.32	0.50	0.69	0.89	0.32	0.50	0.69	0.89	WQP	Count	Avg	SD			
pH	6.2	0.0	0.1	5.9	6.2	6.0	6.5	6.8	6.8	7.6	TDS	4	-1	11			
Temp	NA	NA	NR	NR	NA	NR	NR	NR	NR	NR	Alk	4	3	2			
Alk	25	0	5	6	8	8	36	47	62	170	TDS	4	2	11			
<b>TDS</b>	<b>471</b>	<b>16</b>	<b>95</b>	<b>122</b>	<b>168</b>	<b>142</b>	<b>645</b>	<b>909</b>	<b>1018</b>	<b>3526</b>	TotHard	4	-5	3			
TotHard	245	7	29	42	72	46	329	441	609	1690	CaHard	4	-4	3			
CaHard	232	6	29	39	69	46	312	419	579	1600	Turb	0	n/a	n/a			
Turb	0.05	0.01	0.00	0.00	0.00	0.00	0.15	0.11	0.18	1.38	Amm	4	9	16			
Amm	0.58	0.01	0.22	0.30	0.40	0.60	0.76	0.88	0.99	0.63	TOC	2	-11	1			
<b>TOC</b>	<b>11.1</b>	<b>0.4</b>	<b>0.3</b>	<b>0.3</b>	<b>0.8</b>	<b>0.3</b>	<b>14.2</b>	<b>19.7</b>	<b>30.0</b>	<b>101.0</b>	UV254	4	-1	8			
UV254	0.359	0.009	0.011	0.016	0.028	0.041	0.577	0.696	0.987	2.919							
SUVA	3.25	0.06	4.40	6.20	3.49	16.40	4.06	3.53	3.29	2.89							
<b>Bromide</b>	<b>130</b>	<b>8</b>	<b>20</b>	<b>27</b>	<b>49</b>	<b>43</b>	<b>Pretreatment Information</b>										
<b>TOX</b>	<b>1059</b>	<b>1</b>	<b>28</b>	<b>53</b>	<b>74</b>	<b>140</b>									<b>Process</b>	<b>Description</b>	<b>Scale</b>
CHCl3	194.0	17.0	2.9	4.7	9.1	13.2	Aeration Bubble diffuser in barrel overni Bench Acidification Hydrochloric acid to pH 6.5 Bench Antiscalant addition PreTreat 0100, 3 ppm by vol Bench Membrane Filtration 1 micron Pall Microza cartridge Bench										
BDCM	36.6	0.1	3.1	4.6	8.8	12.4											
DBCM	3.7	0.1	2.4	3.1	5.8	8.1											
CHBr3	0.0	0.0	0.0	0.0	0.0	0.0											
<b>THM4</b>	<b>234.3</b>	<b>16.8</b>	<b>8.4</b>	<b>12.4</b>	<b>23.6</b>	<b>33.7</b>											
MCAA	7.1	0.1	0.0	0.0	0.0	0.0	<b>Design Parameters</b>										
DCAA	52.8	0.5	1.3	1.8	3.7	6.1											
TCAA	122.5	1.5	1.2	2.2	4.1	8.2											
MBAA	0.0	0.0	0.0	0.0	0.0	0.0											
DBAA	0.0	0.0	0.0	0.0	1.1	1.4											
BCAA	7.9	0.4	1.1	1.4	2.7	3.9											
TBAA	NA	NA	NA	NA	NA	NA											
CDBAA	NA	NA	NA	NA	NA	NA											
DCBAA	NA	NA	NA	NA	NA	NA											
<b>HAA5</b>	<b>182.4</b>	<b>1.9</b>	<b>2.5</b>	<b>4.0</b>	<b>8.8</b>	<b>15.7</b>											
<b>HAA6</b>	<b>190.3</b>	<b>1.5</b>	<b>3.6</b>	<b>5.4</b>	<b>11.5</b>	<b>19.6</b>											
<b>HAA9</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>											
<b>SDS Conditions</b>							<b>Active memb area:</b> 0.167 ft <sup>2</sup> <b>Active width:</b> 0.333 ft <b>Norm Temp:</b> 22.0 °C <b>Feed TDS:</b> 545.0 mg/L <b>Manuf rep TDS rej:</b> 70% <b>Temp Norm MTC-w:</b> 0.243 gfd/psi										
<b>WQP</b>	<b>Avg</b>	<b>SD</b>	<b>Count</b>	<b>Min - Max</b>											<b>ID#</b>	<b>Recov (dec.)</b>	<b>F<sub>w-des</sub> (gfd)</b>
Res (mg/L) (0)	0.96	0.40	6	0.60 - 1.67											1	0.70	15.0
Temp (°C)	20.0	0.0	6	20.0 - 20.0											2	0.90	15.0
pH (unit)	7.5	0.0	6	7.5 - 7.6											3	0.50	15.0
Time (hr)	24.2	1.0	6	23.3 - 26.0											4	0.30	15.0
<b>Comments:</b>																	

## Water Quality Parameter Graphs





## Water Quality Parameter Graphs (Continued)



## Productivity Graphs

