TABLE 1

CONDITIONS DURING
LARGER ULTRAFILTRATION UNIT OPERATION

Time Period (Year 2000)	Threshold Pressure Setting (bar)	Threshold Pressure Setting (psi)	Set Flow Rate GPM	Set Flow Rate m^3/hr
February 1 – February 29	1.8	26	10.6	2.4
March 3 – March 22	2	29	14.2	3.2
March 28 – April 3	2	29	8.8	2.0
April 3 – April 28	2	29	10.6	2.4

TABLE 2

ANALYTICAL MONITORING PROGRAM
FOR UF PROJECT

Parameter	***EPA Analytical Method***	***Location***	***Frequency (during flow)***
Total Dissolved Solids	160.1	1,3	Three times per week
Conductivity	120.1	1,3	Once per week
Total Solids	160.3	1,3	Three times per week
Total Suspended Solids	160.2	1,2,3,4	Three times per week
Total Phosphorus	365.1	1,2,3,4	Daily
Total Dissolved Phosphorus	365.1	1,2,3,4	Daily
Soluble Reactive Phosphorus	365.1	1,2,3,4	Daily
Temperature	Field	2,3	Three times per week
pH	Lab	1,2,3,4	Three times per week
Color	110.2	1,3	Three times per week
Total Organic Carbon	415.1	1,3	Three times per week
Alkalinity	310.1	1,3	Three times per week
Iron	6010	1,3,5	Three times per week
Sulfate	375.4	1,3,4,5	Once per week
Reactive Silica	370.1	1,3,4,5	Once per week
Calcium	6010	1,3,4,5	Once per week
Magnesium	6010	1,3,4,5	Once per week
Zinc	6010	1,3,4,5	Once per week
Molybdenum	6010	1,3,4,5	Once per week
Aluminum	6010	1,3,4,5	Once per week
Manganese	6010	1,3,4,5	Once per week
Chloride	325.2	1,3,4,5	Once per week
Sodium	60.0	1,3,4,5	Once per week
Potassium	60.0	1,3,4,5	Once per week
Mercury	7470	1,3,4,5	Every other week
TKN	351.2	1,3,4,5	Every other week
Ammonia	350.1	1,3,4,5	Every other week
Nitrate-Nitrite	353.2	1,3,4,5	Every other week
Ametryn	8141	1,3	Monthly
2,4-D	8150	1,3	Monthly
Marsh Readiness Testing		1,3,4	Once at end of testing
Mercury		1,3,4	Once during testing

Location Code (*see* **FIGURE 1**):

1 = Pre-Screened Influent
2 = Screened Influent
3 = UF Permeate
4 = UF Concentrate
5 = Spent Chemical Cleaning Solutions

TABLE 3

TOTAL PHOSPHORUS CONCENTRATIONS FOR SMALL UF PILOT UNIT

Date (1999)	Total P Concentration (µg/L)	
	UF Influent	UF Effluent
13-Oct	14	7
19-Oct	21	8
20-Oct	19	8
27-Oct	18	5
28-Oct	11	4
29-Oct	17	6
7-Dec	16	5

TABLE 4

PHOSPHORUS FORMS FOR LARGER UF PILOT UNIT
(February 7, 2000 to April 28, 2000)

Date (year 2000)	Raw Water (µg/L)			UF Influent (µg/L)			UF effluent (µg/L)		
	SRP	TDP	TP	SRP	TDP	TP	SRP	TDP	TP
FEBRUARY									
7	13	25	28	-	-	33	-	-	27
8	-	-	-	-	-	35	-	-	32
11	-	-	-	-	-	32	-	-	29
14	-	23	29	-	-	27	-	-	27
15	-	26	30	-	-	31	-	-	19
16	11	27	32	-	-	33	-	-	28
17	-	-	-	-	-	31	-	-	21
18	-	-	-	-	-	31	-	-	21
21	16	35	40	-	-	-	-	-	-
22	-	-	-	-	-	37	-	-	24
23	-	-	-	-	-	34	-	-	24
24	-	-	-	-	-	36	-	-	21
25	-	-	-	-	-	33	-	-	19
28	12	35	38	-	-	-	-	-	-
MARCH									
7	11	30	45	12	26	39	12	22	31
13	-	24	37	-	-	-	-	-	-
14	12	36	42	-	-	-	-	-	-
15	-	33	34	-	-	-	-	-	-
20	10	22	30	-	-	-	-	-	-
27	3	15	33	-	-	-	-	-	-
28	-	-	-	6	18	31	-	-	-
29	-	-	-	4	17	47	4	12	11
31	-	-	-	4	2	29	4	10	10
APRIL			-						
4	-	-	-	2	22	25	18	10	33
6	5	23	50	4	20	43	2	16	14
7	4	14	31	4	17	26	2	10	8
10	2	13	28	2	13	25	2	8	7
13	8	17	28	2	10	24	4	11	10
20	-	-	-	2	11	36	2	8	7
21	-	-	-	2	11	34	2	8	27
24	-	-	-	2	14	25	18	16	17
25	-	-	-	2	11	30	2	7	10
27	-	-	-	2.5	13.5	34	2	8	10
28	-	-	-	2	15	33	3	10	10

*NOTE: Phosphorus analytical data provided by DB Environmental Laboratories (See **FIGURE 1** for sampling locations).*

TABLE 5

AVERAGE PHOSPHORUS SPECIES - ULTRAFILTRATION

PILOT UNIT	SAMPLE LOCATION		TP (ug/L)	TDP (ug/L)	SRP (ug/L)
Smaller Unit	Influent	average	17	11.8	3
		n	8	5	1
		std	3.3	1.6	
	Effluent	average	6.4	5.5	2
		n	8	6	2
		std	1.6	3.2	0
Larger Unit (Feb 7 - Apr 1)	Influent	average	33.2	26.1	10
		n	13	15	11
		std	3.1	6.7	4
	Effluent	average	24.9	22	12
		n	13	1	1
		std	14.5		
Larger Unit (Apr 2 - Apr 28)	Influent	average	30.3	14.2	3.1
		n	12	16	16
		std	5.8	5.1	1.7
	Effluent	average	13.6	10.2	2.5
		n	12	12	10
		std	8.3	3	0.9
Larger Unit Overall	Influent	average	31.8	14.7	3.5
		n	25	15	15
		std	4.7	5.7	2.7
	Effluent	average	19.4	11.1	3.4
		n	25	13	11
		std	8.7	4.4	3

NOTE: *n = Number of Samples*
std = Standard Deviation

TABLE 6
RESULTS OF OTHER WATER QUALITY PARAMETERS

Parameter	Influent	Effluent	Concentrate	Cleaning
Aluminum, ug/L				
Mean	70	82	79	530
Max	120	100	100	530
Min	23	35	36	530
N	9	7	6	1
S.D	35	27	28	---
Alkalinity (as $CaCO_3$), mg/L				
Mean	189	195	196	---
Max	240	240	270	---
Min	150	170	170	---
N	11	8	7	---
S.D	29	26	35	---
Ammonia Nitrogen (as N), mg/L				
Mean	0.112	0.079	0.098	0.085
Max	0.200	0.150	0.170	0.085
Min	0.066	0.050	0.072	0.085
N	7.000	6.000	5.000	1.000
S.D	0.060	0.037	0.041	---
Calcium, ug/L				
Mean	64	61	65	220
Max	76	75	79	220
Min	59	56	61	220
N	9	7	6	1
S.D	6.8	6.5	7.0	---
Chloride, mg/L				
Mean	146	141	146	---
Max	160	160	160	---
Min	120	120	120	---
N	9	7	5	---
S.D	17	17	17	---
Color, PCU				
Mean	119	109	109	---
Max	140	120	140	---
Min	70	70	50	---
N	11	8	7	---
S.D	22	18	30	---
Dissolved Silica, mg/L				
Mean	15	14	15	---
Max	20	20	20	---
Min	9.0	8.0	13	---
N	9	7	6	---
S.D	3.5	3.6	2.9	---

TABLE 6
RESULTS OF OTHER WATER QUALITY PARAMETERS

Parameter	Influent	Effluent	Concentrate	Cleaning
Iron, ug/L				
Mean	41	40	34	---
Max	53	40	40	---
Min	38	40	20	---
N	8	6	6	---
S.D	4.7	0.0	10	---
Magnesium, mg/L				
Mean	20	19	21	21
Max	23	23	24	21
Min	17	16	17	21
N	9	7	6	1
S.D	2.0	2.4	2.3	---
Manganese, ug/L				
Mean	13	6.6	11	4400
Max	28	23	29	4400
Min	3.6	0.59	5.2	4400
N	9	7	6	1
S.D	8.1	8.9	8.7	---
Mercury, ug/L				
Mean	0.15	0.12	0.16	0.10
Max	0.20	0.20	0.20	0.10
Min	0.04	0.03	0.03	0.10
N	9	7	6	1
S.D	0.06	0.08	0.07	---
Molybdenum, ug/L				
Mean	8.3	10	10	10
Max	10	10	10	10
Min	2.4	10	10	10
N	9	7	6	1
S.D	3.3	0.0	0.0	---
Nitrate Nitrogen (as N), mg/L				
Mean	0.09	0.07	0.08	---
Max	0.25	0.25	0.25	---
Min	0.02	0.01	0.05	---
N	9	7	6	---
S.D	0.09	0.08	0.08	---
Potassium, mg/L				
Mean	8.1	7.8	8.2	9.4
Max	8.8	8.7	9.1	9.4
Min	7.4	7.2	7.7	9.4
N	9	7	6	1
S.D	0.5	0.5	0.5	---

TABLE 6
RESULTS OF OTHER WATER QUALITY PARAMETERS

Parameter	Influent	Effluent	Concentrate	Cleaning
Sodium, mg/L				
Mean	100	99	104	99
Max	110	110	120	99
Min	83	83	85	99
N	9	7	6	1
S.D	9.0	9.3	12	---
Specific Conductance, umho/cm				
Mean	946	933	963	---
Max	1110	1100	1110	---
Min	781	808	875	---
N	11	8	7	---
S.D	101	92	81	---
Sulfate, mg/L				
Mean	52	53	56	---
Max	59	60	63	---
Min	49	47	51	---
N	4	3	3	---
S.D	4.8	6.6	6.2	---
Total Dissolved Solids (TDS)				
Mean	633	583	586	---
Max	995	960	1000	---
Min	430	430	450	---
N	11	8	7	---
S.D	163	160	187	---
Total Kjeldahl Nitrogen (TKN), mg/L				
Mean	1.8	1.6	2.0	2.6
Max	2.0	1.9	2.1	2.6
Min	1.4	1.3	1.7	2.6
N	7	6	5	1
S.D	0.21	0.20	0.15	---
Total Organic Carbon (TOC), mg/L				
Mean	22	24	24	740
Max	30	30	32	740
Min	11	12	13	740
N	9	7	6	1
S.D	8.1	6.2	8.6	---
Total Solids, mg/L				
Mean	597	574	584	---
Max	670	700	690	---
Min	500	490	480	---
N	11	8	7	---
S.D	52	59	64	---

TABLE 6
RESULTS OF OTHER WATER QUALITY PARAMETERS

Parameter	Influent	Effluent	Concentrate	Cleaning
Total Suspended Solids (TSS), mg/L				
Mean	1.9	1.9	1.6	---
Max	5.8	5.8	3.5	---
Min	1.0	1.0	1.0	---
N	11	8	7	---
S.D	1.7	1.8	1.0	---
Zinc, mg/L				
Mean	11	9.8	10	96
Max	20	20	20	96
Min	2.1	4.1	2.7	96
N	9	7	6	1
S.D	8.3	6.8	7.9	---

TABLE 7

TOXICITY AND AGP TESTING SUMMARY

Process	Test Date	Laboratory	Sample ID	Algal Growth Potential	Chronic Tests		
					fish	waterflea	algae
UF (ROCHEM)	4/4/00	Hydrosphere	UF Influent	no effect	significantly reduced survival	no effect	no effect
			UF Effluent	no effect	no effect	no effect	no effect

TABLE 8

CONCEPTUAL DESIGN CRITERIA
FOR FULL-SCALE ULTRAFILTRATION SYSTEM

Site		**Post-STA**
Blended Effluent TP Concentration (ppb)		20
Diversion of 10-yr POR Flow Volume		20%
Treatment Plant Design Average Daily Flow (mgd)		**95**
Feed Characteristics	**Units**	
Peak Hydraulic Loading	mgd	143
Average Total Phosphorus Concentration	ug/L	65
Liquid Phase Temperature Range	degree F	68 - 77
Flow Equalization		
Surface Area	acres	1500
Usable Depth	feet	4
Usable Volume	acre-feet	6000
Membrane Systems		
Operation mode	---	dead-end
Permeate yield	%	90-95
Membrane area	square feet	1753970
Nominal Pore Size	Dalton	50,000
Membrane cleaning		
No. of days operating per year	days	215
No. of membrane cleanings (1 clean per 21 days)	---	11
No. of cleaning using citric acid (1-reuse)	---	6
No. of cleaning using sodium hydroxide	---	11

TABLE 9
TREATMENT PLANT OPERATION SUMMARY

Treatment Plant Size (mgd)	% of Time Operational During 10-yr POR	% Operating Time at Peak Design Flow Rate	Average Depth in FEB (feet)	FEB Depth > 4.0 feet (days/yr)
95	59%	54%	2.1	887

TABLE 10
WATER BALANCE SUMMARY

Site	Blended Effluent Total Phosphorus Concentration (ppb)	Diversion of 10-year Period of Record Flow Volume	Treatment Plant Design Average Daily Flow (mgd)	Total Inflow Qin		Total Inflow Phosphorus (Pin)		Treated Flow		Phosphorus Removed During 10-year POR		Untreated for Blending			
												Stormwater		Phosphorus	
				(acre-ft)	(mgal)	(kg)	(lb)	(acre-ft)	(mgal)	(kg)	(lb)	(acre-ft)	(mgal)	(kg)	(lb)
Post-STA	20	20%	95	1226612	399665	93536	206247	776308	252943	63103	138827	450304	146722	20859	45994

TABLE 11

FULL-SCALE TREATMENT FACILITY COST ESTIMATE SUMMARY

Including STA Costs[1]

Blended effluent TP concentration (ppb)		
Diversion of 10-YR POR Flow Volume		20%
Treatment plant design average daily flow (mgd)		95
50-YEAR PRESENT WORTH		
Capital Cost	$	165,228,968
Operating Cost	$	125,534,568
Demolition/Replacement Cost	$	58,103,557
Salveage Cost	$	(4,208,390)
Lump Sum Cost	$	700,000
TOTAL	$	345,358,703
$/Million gallons treated	$	273
$/Pound P removed	$	498

Excluding STA Costs[1]

Blended effluent TP concentration (ppb)		
Diversion of 10-YR POR Flow Volume		20%
Treatment plant design average daily flow (mgd)		95
50-YEAR PRESENT WORTH		
Capital Cost	$	74,575,413
Operating Cost	$	121,112,853
Demolition/Replacement Cost	$	22,546,236
Salveage Cost	$	-
Lump Sum Cost	$	700,000
TOTAL	$	218,934,501
$/Million gallons treated	$	173
$/Pound P removed	$	315

[1] "STA Costs" include costs associated with the STA-2 influent, effluent, and seepage pumping stations, and the STA-2 treatment works (6430-acres of land, canals, and levees).

TABLE 12

TREATMENT PLANT EQUIPMENT, TANKAGE, AND PIPING CAPITAL COST SUMMARY

Blended Effluent TP Concentration (ppb)	20
Diversion of 10-yr POR Flow Volume	20%
Treatment Plant Design Average Daily Flow (MGD)	95
Capital Cost:	
Membrane Equipment[1] (ROCHEM quotation -see **APPENDIX D**)	$ 42,500,000
Strainer/screen system	$ 475,000
Excavation ($1.85/yd^3)	$ 4,625
Piping ($ per linear feet for various pipe sizes)	$ 177,000
Trench for pipe ($3.38/lienar foot)	$ 10,140
TOTAL:	$ 43,166,765

Notes:

1 Equipment = Capital costs asssociated with membranes, membrane tanks, permeate pumps, backpulse pumps, air scour blowers, PLCs and MCC, permeate and air scour headers, and backpulse chemical feed system.

TABLE 13

ESTIMATED ANNUAL OPERATING COSTS FOR FULL-SCALE UF SYSTEM

Item	95 mgd Post-STA
Labor	$561,600
Maintenance (Mechanical, Levee)	$999,335
Chemicals	$154,043
Energy (Electric, Diesel)	$2,223,839
Sampling and Monitoring	$500,000
Membrane Replacement	$1,400,000
TOTAL:	$5,838,817

TABLE 14

50-YEAR PRESENT WORTH ANALYSIS FOR FULL-SCALE UF SYSTEM

Site	Blended Effluent Total P Concentration (ppb)	Diversion of 10-Year POR Flow Volume	Treatment Plant Design Average Daily Flow (mgd)	Present Worth ($/million gallons treated)	Present Worth ($/pound phosphorus removed)
Post-STA	20	20%	95	$ 273	$ 498

Blended effluent TP concentration (ppb)		20
Diversion of 10-YR POR Flow Volume		20%
Treatment plant design average daily flow (mgd)		95
50-YEAR PRESENT WORTH		
Capital Cost	$	165,228,968
Operating Cost	$	125,534,568
Demolition/Replacement Cost	$	58,103,557
Salveage Cost	$	(4,208,390)
Lump Sum Cost	$	700,000
TOTAL	$	345,358,703
$ of capital cost/gallon of capacity[1]	$	1.74
$ of annual operating cost/million gallons treated[2]	$	230.83

Notes:

[1] *cost based on nominal treatment plant size*

[2] *cost based on actual volume of treated water*