APPENDIX A

LAKE HANCOCK WATER QUALITY DATA FOR TOTAL NITROGEN AND TOTAL PHOSPHORUS FROM STORET, POLK COUNTY, AND USGS

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Storet Data for Lake Hancock Total Nitrogen and Total Phosphorus from 1984 to 2004

Date	CENTER HANCOCK		Hancock H-11	Hancock H-22	Hancock H-24	Hancock H-29	Hancock H-3	Hancock H-31	Hancock H-32
	Total N (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)
7/31/84	3.490	0.650							
8/29/84	5.790	1.010							
9/26/84	8.290	1.650							
10/24/84	10.040	1.180							
5/23/85	15.630	2.870							
2/18/88	2.280	0.154							
3/16/88	1.510	0.424							
8/18/88	6.440	0.704							
4/10/89	6.530	0.576							
10/11/89	4.480	0.423							
5/23/90	6.830	0.429							
10/4/90	9.730	0.879							
4/8/91	12.550	0.548							
10/3/91	9.870	0.534							
4/9/92	11.220	0.944							
10/7/92	4.070	0.366							
3/31/93	12.030	0.712							
10/7/93	2.040	0.198							
12/6/93	4.020	0.170							
12/20/93	4.300	0.201							
4/12/94	4.870	0.468							
10/5/94	1.710	0.355							
4/5/95	3.130	0.420							
11/8/95	2.560	0.487							
5/8/96	4.990	0.509							
11/13/96	4.420	0.415							
5/7/97	4.630	0.426							
10/30/97	1.980	0.105							
5/7/98	1.890	0.535							
11/9/98	5.150	0.487							
5/11/99	9.800	0.745							
11/9/99	5.489	0.529							
5/3/00	4.110	0.364							
11/16/00	5.570	0.231							
11/20/01	2.760	0.767							
1/16/02									
2/5/02									
3/7/02									
8/22/02									
11/18/02									
2/4/03									
2/13/03				0.591		0.617			
4/22/03									
5/20/03					0.946			0.953	0.886
8/20/03					0.544				
11/18/03			0.459	0.519			0.500	0.458	

Storet Data for Lake Hancock Total Nitrogen and Total Phosphorus from 1984 to 2004

Date	Hancock H-34	Hancock H-38	Hancock H-39	Hancock H-41	Hancock H-43	Hancock H-45	Hancock H-47	Hancock H-48	Hancock H-49
	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)
7/31/84									
8/29/84									
9/26/84									
10/24/84									
5/23/85									
2/18/88									
3/16/88									
8/18/88									
4/10/89									
10/11/89									
5/23/90									
10/4/90									
4/8/91									
10/3/91									
4/9/92									
10/7/92									
3/31/93									
10/7/93									
12/6/93									
12/20/93									
4/12/94									
10/5/94									
4/5/95									
11/8/95									
5/8/96									
11/13/96									
5/7/97									
10/30/97									
5/7/98									
11/9/98									
5/11/99									
11/9/99									
5/3/00									
11/16/00									
11/20/01									
1/16/02									
2/5/02									
3/7/02									
8/22/02									
11/18/02									
2/4/03									
2/13/03				0.418		0.575	0.464		
4/22/03									
5/20/03		0.868					0.670		
8/20/03		0.397	1.093				0.382	0.333	
11/18/03	0.422				0.446			1.040	0.398

Storet Data for Lake Hancock Total Nitrogen and Total Phosphorus from 1984 to 2004

Date	Hancock H-51	Hancock H-54	Hancock H-56	Hancock H-61	L50S2 - Lake Hancock	Lake Hancock		NE quadrant of the lake	
	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)
7/31/84									
8/29/84									
9/26/84									
10/24/84									
5/23/85									
2/18/88									
3/16/88									
8/18/88									
4/10/89									
10/11/89									
5/23/90									
10/4/90									
4/8/91									
10/3/91									
4/9/92									
10/7/92									
3/31/93									
10/7/93									
12/6/93									
12/20/93									
4/12/94									
10/5/94									
4/5/95									
11/8/95									
5/8/96									
11/13/96									
5/7/97									
10/30/97									
5/7/98									
11/9/98									
5/11/99									
11/9/99									
5/3/00									
11/16/00									
11/20/01									
1/16/02								2.998	0.969
2/5/02								2.856	1.009
3/7/02								4.540	0.804
8/22/02						49.040	5.111		
11/18/02							6.556		
2/4/03					0.430				
2/13/03							4.564		
4/22/03					0.680				
5/20/03			0.662				5.829		
8/20/03	0.360			0.490			2.076		
11/18/03		0.399					1.516		

Storet Data for Lake Hancock Total Nitrogen and Total Phosphorus from 1984 to 2004

Date	NW quadrant of the lake		SE quadrant of the lake		SW quadrant of the lake		Mean	
	Total N (mg/l)	**Total P (mg/l)**	**Total N (mg/l)**	**Total P (mg/l)**	**Total N (mg/l)**	**Total P (mg/l)**	**Total N (mg/l)**	**Total P (mg/l)**
7/31/84							3.490	0.650
8/29/84							5.790	1.010
9/26/84							8.290	1.650
10/24/84							10.040	1.180
5/23/85							15.630	2.870
2/18/88							2.280	0.154
3/16/88							1.510	0.424
8/18/88							6.440	0.704
4/10/89							6.530	0.576
10/11/89							4.480	0.423
5/23/90							6.830	0.429
10/4/90							9.730	0.879
4/8/91							12.550	0.548
10/3/91							9.870	0.534
4/9/92							11.220	0.944
10/7/92							4.070	0.366
3/31/93							12.030	0.712
10/7/93							2.040	0.198
12/6/93							4.020	0.170
12/20/93							4.300	0.201
4/12/94							4.870	0.468
10/5/94							1.710	0.355
4/5/95							3.130	0.420
11/8/95							2.560	0.487
5/8/96							4.990	0.509
11/13/96							4.420	0.415
5/7/97							4.630	0.426
10/30/97							1.980	0.105
5/7/98							1.890	0.535
11/9/98							5.150	0.487
5/11/99							9.800	0.745
11/9/99							5.489	0.529
5/3/00							4.110	0.364
11/16/00							5.570	0.231
11/20/01							2.760	0.767
1/16/02	4.243	0.760	3.004	0.727	4.191	0.739	3.609	0.799
2/5/02	5.581	0.808	4.154	0.729	5.108	0.758	4.425	0.826
3/7/02	7.930	0.823	4.600	0.705	8.060	0.818	6.283	0.788
8/22/02							3.772	0.393
11/18/02								0.273
2/4/03								0.430
2/13/03								0.556
4/22/03								0.680
5/20/03								0.832
8/20/03								0.437
11/18/03								0.474

Storet Data for Lake Hancock Total Nitrogen and Total Phosphorus from 1973 to 1998

Date	W SIDE		CENTER		E SHORE		LAKE HANCOCK		OPEN WATER		N SHORE		SW SHORE		Mean	
	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)
3/14/73								0.547								0.547
9/4/73								0.608								0.608
11/6/73								0.923								0.923
2/17/76		0.350														0.350
9/1/76		0.020														0.020
6/13/78		0.550														0.550
12/12/78		0.760														0.760
10/25/79		0.670														0.670
11/18/80		1.530														1.530
7/31/84				0.650		1.430								0.850		0.977
8/29/84				1.010		0.960								0.980		0.983
9/26/84				1.650		1.290								1.270		1.403
10/24/84				1.180		0.790								0.680		0.883
5/23/85				2.870		2.200								2.940		2.670
2/18/88			2.280	0.154	2.660	0.195									2.470	0.175
3/16/88			1.510	0.424	3.470	0.519							4.080	0.518	3.020	0.487
8/18/88			6.440	0.704	6.950	0.788									6.695	0.746
4/10/89			6.530	0.576	4.360	0.376									5.445	0.476
10/11/89			4.480	0.423	5.030	0.462									4.755	0.443
5/23/90			6.830	0.429	6.450	0.529									6.640	0.479
10/4/90			9.730	0.879							9.390	0.685			9.560	0.782
4/8/91			12.550	0.548											12.550	0.548
10/3/91			9.870	0.534											9.870	0.534
4/9/92			11.220	0.944											11.220	0.944
10/7/92			4.070	0.366											4.070	0.366
3/31/93			12.030	0.712											12.030	0.712
10/7/93			2.040	0.198											2.040	0.198
12/6/93			4.020	0.170											4.020	0.170
12/20/93			4.300	0.201											4.300	0.201
4/12/94			4.870	0.468											4.870	0.468
10/5/94			1.710	0.355											1.710	0.355
4/5/95			3.130	0.420											3.130	0.420
11/8/95			2.560	0.487											2.560	0.487
5/8/96			4.990	0.509											4.990	0.509
8/1/96									4.820	0.037					4.820	0.037
11/13/96			4.420	0.415											4.420	0.415
1/13/97										0.239						0.239
5/7/97			4.630	0.426											4.630	0.426
10/30/97			1.980	0.105											1.980	0.105
5/7/98			1.890	0.535											1.890	0.535
11/9/98			5.150	0.487											5.150	0.487

Polk County Total Nitrogen and Total Phosphours Data

Date Collected	Center Of Lake		Eastern Shore		Lake Hancock		NE quadrant		Northern Shore		NW quadrant		SE quadrant		SW Shore		SW quadrant		Unidentified		Mean Concentration	
	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)	Total N (mg/l)	Total P (mg/l)
5/23/85	15.630	2.870	10.830	2.200											15.190	2.940					13.883	2.670
2/18/88	2.280	0.154	2.660	0.195																	2.470	0.175
3/16/88	1.510	0.424	3.470	0.519											4.080	0.518					3.020	0.487
8/18/88	6.440	0.704	6.950	0.788																	6.695	0.746
4/10/89	6.530	0.576	4.360	0.376																	5.445	0.476
10/11/89	4.480	0.423	5.030	0.462																	4.755	0.443
5/23/90	6.830	0.429	6.450	0.529																	6.640	0.479
10/4/90	9.730	0.879							9.390	0.685											9.560	0.782
4/8/91	12.550	0.548																			12.550	0.548
10/3/91	9.870	0.534																			9.870	0.534
4/9/92	11.220	0.944																			11.220	0.944
10/7/92	4.070	0.366																			4.070	0.366
3/31/93	12.030	0.712																			12.030	0.712
10/7/93	2.040	0.198																			2.040	0.198
12/6/93	4.020	0.170																			4.020	0.170
12/20/93	4.300	0.201																			4.300	0.201
4/12/94	4.870	0.468																			4.870	0.468
10/5/94	1.710	0.355																			1.710	0.355
4/5/95	3.130	0.420																			3.130	0.420
11/8/95	2.560	0.487																			2.560	0.487
5/8/96	4.990	0.509																			4.990	0.509
11/13/96	4.420	0.415																			4.420	0.415
5/7/97	4.630	0.426																			4.630	0.426
10/30/97	1.980	0.105																			1.980	0.105
5/7/98	1.890	0.535																			1.890	0.535
11/9/98	5.150	0.487																			5.150	0.487
5/11/99	9.800	0.745																			9.800	0.745
11/9/99	5.489	0.529																			5.489	0.529
5/3/00	4.110	0.364																			4.110	0.364
11/16/00	5.570	0.231																			5.570	0.231
11/20/01	2.760	0.767																			2.760	0.767
1/16/02							2.998	0.969			4.243	0.760	3.004	0.727			4.191	0.739			3.609	0.799
2/5/02							2.856	1.009			5.581	0.808	4.154	0.729			5.108	0.758			4.425	0.826
3/7/02							4.540	0.804			7.930	0.823	4.600	0.705			8.060	0.818			6.283	0.788
5/28/02																			8.346	0.729	8.346	0.729
5/29/02																			9.382	0.680	9.382	0.680
8/22/02					3.772	0.393															3.772	0.393
11/18/02					3.269	0.390													3.980	0.420	3.324	0.393
2/13/03					3.224	0.571															3.224	0.571
5/20/03					6.377	0.833															6.377	0.833
8/20/03					3.136	0.415															3.136	0.415
11/18/03					5.226	0.505															5.226	0.505
2/19/04					4.645	0.376															4.645	0.376
5/5/04					6.459	0.542															6.459	0.542
8/18/04					3.622	0.252															3.622	0.252
11/9/04					3.193	0.675															3.193	0.675

Storet Structure P-11 Total N and Total P Data

Date	NO_x (mg/l)	TKN (mg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)
8/4/97	0.020	3.700	3.720	0.390
9/10/97	0.004	2.100	2.104	0.150
10/6/97	0.004	4.100	4.104	0.390
11/3/97	0.004	3.400	3.404	0.450
2/2/98	0.001	3.500	3.501	0.549
3/2/98	0.005	3.680	3.685	0.651
4/6/98	0.051	2.880	2.931	0.510
5/4/98	0.001	4.040	4.041	0.600
6/1/98	0.058	4.920	4.978	0.395
7/6/98	0.001	6.080	6.081	0.710
8/3/98	0.003	6.540	6.543	0.581
9/8/98	0.001	6.210	6.211	0.596
10/7/98			0.890	0.308
11/9/98			1.200	0.294
12/17/98			0.390	0.244

USGS Structure P-11 Total N and Total P Data

Date	TKN (mg/l)	NO_x (mg/l)	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)
8/16/82	5.00	0.00	5.00	0.36
11/30/82	3.50	0.36	3.86	0.76
2/15/83	3.70	0.01	3.71	0.65
5/24/83	2.70	0.01	2.71	0.48
10/4/83	2.60	0.01	2.61	1.10
12/13/83	5.20	0.02	5.22	0.63
2/14/84	4.20	0.02	4.22	0.54
3/26/84	5.60	0.32	5.92	1.10
6/5/84	7.40	0.02	7.42	0.66
8/9/84	8.20	0.02	8.22	0.83
10/9/84	7.00	0.01	7.01	0.88
2/11/86	6.40	0.01	6.41	0.53
4/22/86	3.50	0.01	3.51	0.38
7/9/86	5.40	0.01	5.41	4.40
8/14/86	12.00	0.03	12.03	1.30
10/7/86	5.70	0.02	5.72	1.40
2/3/87	6.40	0.02	6.42	0.62
3/31/87	1.30	0.02	1.32	0.74
6/2/87	7.40	0.02	7.42	0.51
8/13/87	26.00	0.02	26.02	1.50
10/1/87	6.40	0.02	6.42	0.15
12/3/87	5.50	0.02	5.52	0.44
2/11/88	5.40	0.02	5.42	0.31
4/14/88	4.90	0.02	4.92	0.45
6/7/88	2.90	0.02	2.92	1.60
8/11/88	8.60	0.02	8.62	0.32
10/17/88	3.80	0.16	3.96	1.00
12/15/88	4.30	0.02	4.32	0.52
2/15/89	5.10	0.02	5.12	0.46
4/7/89	6.20	0.02	6.22	0.72
6/8/89	9.70	0.03	9.73	1.50
10/5/89	3.90	0.05	3.95	0.21
12/7/89	2.60	0.02	2.62	0.17
2/8/90	3.40	0.03	3.43	0.38
4/13/90	3.90	0.02	3.92	0.38
5/7/90	3.70	0.02	3.72	0.68
6/21/90	5.00	0.02	5.02	0.64
11/5/90	5.90	0.02	5.92	0.75
7/11/91	5.80	0.02	5.82	0.41
8/21/91	3.30	0.02	3.32	0.30
8/21/92	6.40	0.02	6.42	0.42
9/25/92	2.50	0.02	2.52	0.17
10/29/92	5.20	0.18	5.38	0.76
4/16/93	5.50	0.02	5.52	0.47
7/9/93	14.00	0.02	14.02	1.10
9/23/93	2.90	0.02	2.92	0.35
10/13/93	5.10	0.02	5.12	0.30
2/9/94	3.70	0.02	3.72	0.24
7/14/94	8.20	0.02	8.22	0.20
8/9/94	6.40	0.02	6.42	0.15
8/23/94	5.30	0.02	5.32	0.33

APPENDIX B

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK DURING 2004

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RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 17, 2004 (Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.93	6.57	6.31	5.93	6.69	6.69
Conductivity	µmho/cm	185	193	207	211	196	196
NH_3	µg/l	958	685	797	753	902	789
NO_x	µg/l	14	< 5	< 5	< 5	11	< 5
Organic N	µg/l	2532	566	411	265	413	427
Total N	µg/l	3504	1254	1211	1011	1326	1219
SRP	µg/l	117	2	4	1	11	1
Total P	µg/l	383	32	16	5	36	23
Turbidity	NTU	20.6	1.0	0.6	0.6	0.6	0.5

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 17, 2004 (Settled - 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.93	6.88	6.70	6.41	7.25	7.27
Conductivity	µmho/cm	185	189	198	210	193	195
Alkalinity	mg/l	58.2	45.5	36.0	26.3	57.8	56.6
NH_3	µg/l	958	1050	850	714	747	752
NO_x	µg/l	14	< 5	< 5	< 5	9	< 5
Diss. Organic N	µg/l	209	238	233	321	358	379
Particulate N	µg/l	2323	993	176	40	141	167
Total N	µg/l	3504	2284	1262	1078	1255	1301
SRP	µg/l	117	3	< 1	< 1	9	2
Diss. Organic P	µg/l	20	16	10	9	8	11
Particulate P	µg/l	246	80	22	4	28	32
Total P	µg/l	383	99	33	14	45	45
Turbidity	NTU	20.6	4.7	1.2	0.2	1.0	1.2
TSS	mg/l	37.4	20.0	5.0	1.5	2.0	4.0
BOD	mg/l	14.3	8.7	2.8	2.5	3.7	3.0
Color	Pt-Co	59	31	14	7	17	16
Chlorophyll-a	mg/m^3	112	20.8	3.7	0.2	2.9	3.7
Calcium	mg/l	23.6	20.9	22.3	22.4	22.4	21.2
Chloride	mg/l	11.2	14.6	13.9	13.6	18.2	19.7
Sulfate	mg/l	7	22	30	45	8	6
Diss. Aluminum	µg/l	46	170	84	61	28	69

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 17, 2004 (Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.93	7.38	7.19	6.93	7.30	7.48
Conductivity	µmho/cm	185	198	203	214	200	200
Alkalinity	mg/l	58.2	48.9	38.4	27.5	61.0	55.2
NH_3	µg/l	958	665	690	787	716	666
NO_x	µg/l	14	55	97	93	48	72
Diss. Organic N	µg/l	209	544	412	195	448	315
Particulate N	µg/l	2323	174	139	43	207	198
Total N	µg/l	3504	1438	1338	1118	1419	1251
SRP	µg/l	117	1	1	1	1	1
Diss. Organic P	µg/l	20	14	8	8	13	14
Particulate P	µg/l	246	72	24	4	19	12
Total P	µg/l	383	87	33	13	33	27
Turbidity	NTU	20.6	2.4	1.1	0.2	1.9	0.7
TSS	mg/l	37.4	14.0	7.0	1.0	8.0	2.5
BOD	mg/l	14.3	3.5	4.6	4.8	4.8	4.5
Color	Pt-Co	59	35	19	11	20	20
Chlorophyll-a	mg/m^3	112	4.1	1.4	< 0.1	6.6	0.9
Calcium	mg/l	23.6	22.9	22.9	23.4	22.0	23.3
Chloride	mg/l	11.2	14.5	15.1	14.4	19.4	20.5
Sulfate	mg/l	7	21	36	42	15	7
Diss. Aluminum	µg/l	46	157	168	80	35	40

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 17, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.93	7.15	7.21	7.02	7.31	7.34
Conductivity	µmho/cm	185	201	209	216	202	204
NH_3	µg/l	958	985	935	950	1152	687
NO_x	µg/l	14	552	596	402	60	283
Organic N	µg/l	2532	569	417	412	1147	705
Total N	µg/l	3504	2106	1948	1764	2359	1675
SRP	µg/l	117	4	< 1	1	2	4
Total P	µg/l	383	36	14	14	18	20
Turbidity	NTU	20.6	0.9	0.6	0.6	0.6	3.3

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 28, 2004 (Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.42	7.26	7.08	6.55	7.19	6.90
Conductivity	µmho/cm	150	161	170	175	157	158
NH_3	µg/l	78	88	86	65	188	405
NO_x	µg/l	1442	478	146	125	607	218
Organic N	µg/l	3125	3313	3238	2554	2476	3033
Total N	µg/l	4645	3879	3470	2744	3271	3956
SRP	µg/l	357	32	3	1	194	181
Total P	µg/l	792	100	17	11	207	156
Turbidity	NTU	34.1	--	--	--	--	--

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 28, 2004 (Settled - 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.42	6.69	6.48	5.89	6.87	6.99
Conductivity	μmho/cm	150	162	172	179	159	161
Alkalinity	mg/l	43.4	32.7	22.0	10.9	24.2	40.8
NH_3	μg/l	78	65	48	69	65	63
NO_x	μg/l	177	67	51	32	82	571
Diss. Organic N	μg/l	3125	3136	3079	3001	3006	3253
Particulate N	μg/l	1265	555	239	165	76	83
Total N	μg/l	4645	3823	3417	3267	3229	3970
SRP	μg/l	357	32	1	1	172	91
Diss. Organic P	μg/l	41	97	13	9	30	60
Particulate P	μg/l	394	296	124	24	75	92
Total P	μg/l	792	425	138	34	277	243
Turbidity	NTU	34.1	6.7	1.8	0.9	1.7	1.9
TSS	mg/l	63.0	14.7	10.4	4.0	7.3	6.7
BOD	mg/l	12.0	3.4	< 2.0	< 2.0	< 2.0	2.3
Color	Pt-Co	93	55	13	5	25	25
Chlorophyll-a	mg/m^3	109	31.9	3.8	0.4	7.3	8.6
Calcium	mg/l	24.2	17.6	17.6	17.8	19.2	19.2
Chloride	mg/l	10.4	10.3	10.5	10.7	14.2	20.8
Sulfate	mg/l	10	9	20	33	44	7
Diss. Aluminum	μg/l	--	848	91	33	65	107

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 28, 2004
(Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.42	7.04	6.90	6.24	7.00	7.24
Conductivity	µmho/cm	150	156	170	176	155	157
Alkalinity	mg/l	43.4	34.1	21.2	10.3	41.4	41.0
NH_3	µg/l	78	71	69	49	54	63
NO_x	µg/l	177	168	93	133	65	156
Diss. Organic N	µg/l	3125	3113	3166	3079	3105	3077
Particulate N	µg/l	1265	308	276	205	100	95
Total N	µg/l	4645	3660	3604	3466	3324	3391
SRP	µg/l	357	46	1	< 1	151	102
Diss. Organic P	µg/l	41	101	12	12	34	32
Particulate P	µg/l	394	274	55	6	63	67
Total P	µg/l	792	421	68	19	248	201
Turbidity	NTU	34.1	5.6	1.1	0.6	1.4	1.5
TSS	mg/l	63.0	8.7	3.4	2.7	5.7	4.0
BOD	mg/l	12.0	4.1	< 2.0	2.2	< 2.0	< 2.0
Color	Pt-Co	93	61	15	7	24	24
Chlorophyll-a	mg/m^3	109	12.4	0.7	0.4	1.4	1.8
Calcium	mg/l	24.2	17.8	18.0	20.5	20.8	20.9
Chloride	mg/l	10.4	10.0	9.7	9.4	14.2	15.6
Sulfate	mg/l	10	11	32	46	6	7
Diss. Aluminum	µg/l	--	818	168	35	77	97

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON SEPTEMBER 28, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS/ FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.42	7.23	6.80	6.48	6.60	7.05
Conductivity	µmho/cm	150	158	166	173	155	156
NH_3	µg/l	78	80	60	70	256	205
NO_x	µg/l	1442	272	231	860	692	966
Organic N	µg/l	3125	3290	3411	2726	2575	2364
Total N	µg/l	4645	3642	3702	3656	3523	3535
SRP	µg/l	357	46	1	2	182	127
Total P	µg/l	792	114	15	15	201	148
Turbidity	NTU	34.1	0.8	0.4	0.3	0.6	0.6

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON OCTOBER 25, 2004
(Settled - 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	9.49	7.41	7.10	6.52	7.41	7.41
Conductivity	µmho/cm	158	166	179	190	167	166
Alkalinity	mg/l	50.3	42.6	28.1	15.6	47.5	47.7
NH_3	µg/l	192	600	605	601	618	599
NO_x	µg/l	< 5	28	36	23	47	37
Diss. Organic N	µg/l	551	530	280	194	303	372
Particulate N	µg/l	2442	601	562	466	452	431
Total N	µg/l	3188	1759	1483	1284	1420	1439
SRP	µg/l	316	107	9	< 1	183	141
Diss. Organic P	µg/l	49	33	14	4	3	4
Particulate P	µg/l	224	277	123	27	139	189
Total P	µg/l	589	417	146	32	325	334
Turbidity	NTU	19.6	5.9	4.5	0.8	3.0	3.5
TSS	mg/l	18.3	13.3	16.0	4.7	12.0	15.3
BOD	mg/l	6.5	3.8	< 2.0	< 2.0	< 2.0	3.6
Color	Pt-Co	135	97	24	8	40	39
Chlorophyll-a	mg/m^3	103	25.3	7.4	0.8	5.8	7.0
Calcium	mg/l	22.3	17.9	16.8	18.8	17.3	17.8
Chloride	mg/l	12.4	12.2	12.3	11.8	15.4	14.6
Sulfate	mg/l	14	21	32	44	8	7
Diss. Aluminum	µg/l	--	118	78	53	33	55

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON OCTOBER 25, 2004 (Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	9.49	8.18	7.65	6.61	9.23	8.86
Conductivity	µmho/cm	158	158	169	175	151	152
NH_3	µg/l	192	61	122	128	131	185
NO_x	µg/l	< 5	< 5	77	24	< 5	194
Organic N	µg/l	2993	2373	2231	2204	2470	2431
Total N	µg/l	3188	2437	2430	2356	2604	2422
SRP	µg/l	316	45	5	2	128	93
Total P	µg/l	589	117	17	6	181	160
Turbidity	NTU	19.6	0.5	0.4	0.1	0.4	0.4

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON OCTOBER 25, 2004
(Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	9.49	7.15	7.17	7.02	7.43	7.58
Conductivity	µmho/cm	158	168	177	182	162	163
Alkalinity	mg/l	50.3	39.2	26.3	14.9	45.9	46.3
NH_3	µg/l	192	106	46	46	47	46
NO_x	µg/l	< 5	< 5	< 5	8	< 5	< 5
Diss. Organic N	µg/l	551	579	483	333	563	561
Particulate N	µg/l	2442	632	477	320	830	547
Total N	µg/l	3188	1320	1009	707	1443	1157
SRP	µg/l	316	80	10	7	73	61
Diss. Organic P	µg/l	49	26	22	0	33	35
Particulate P	µg/l	224	140	107	85	277	207
Total P	µg/l	589	246	139	92	383	303
Turbidity	NTU	19.6	9.3	6.5	1.0	7.3	7.1
TSS	mg/l	18.3	11.0	16.2	3.3	10.3	15.5
BOD	mg/l	6.5	4.4	4.5	4.2	4.7	4.9
Color	Pt-Co	135	99	38	13	58	56
Chlorophyll-a	mg/m^3	103	65.3	28.3	2.9	40.5	42.5
Calcium	mg/l	22.3	17.5	18.3	18.3	17.6	16.8
Chloride	mg/l	12.4	15.9	11.6	11.7	15.9	17.8
Sulfate	mg/l	14	22	40	51	8	9
Diss. Aluminum	µg/l	--	177	92	88	51	45

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE P-11 ON OCTOBER 25, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	9.49	6.86	6.76	6.63	7.03	7.12
Conductivity	µmho/cm	158	168	175	182	162	164
NH_3	µg/l	192	180	136	172	213	352
NO_x	µg/l	< 5	42	39	21	48	32
Organic N	µg/l	2993	1265	801	420	825	767
Total N	µg/l	3188	1487	976	613	1086	1151
SRP	µg/l	316	62	12	1	34	31
Total P	µg/l	589	277	52	4	68	67
Turbidity	NTU	19.6	1.6	0.9	0.3	0.8	1.0

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 17, 2004
(Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.04	6.87	6.51	6.15	6.91	6.99
Conductivity	µmho/cm	190	201	211	217	198	194
NH_3	µg/l	1037	886	715	716	636	665
NO_x	µg/l	21	< 5	< 5	< 5	< 5	< 5
Organic N	µg/l	3949	720	613	452	742	760
Total N	µg/l	5007	1609	1331	1171	1381	1428
SRP	µg/l	38	4	2	1	2	2
Total P	µg/l	402	33	16	11	19	15
Turbidity	NTU	23.8	1.6	0.6	0.6	0.8	0.6

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 17, 2004 (Settled for 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.04	7.26	6.97	6.74	7.44	7.48
Conductivity	µmho/cm	190	198	207	214	196	199
Alkalinity	mg/l	58.4	20.1	38.4	27.5	60.8	57.4
NH_3	µg/l	1037	652	729	754	693	695
NO_x	µg/l	21	< 5	< 5	< 5	< 5	< 5
Diss. Organic N	µg/l	172	620	516	346	595	624
Particulate N	µg/l	3777	989	113	64	103	154
Total N	µg/l	5007	2264	1361	1167	1394	1476
SRP	µg/l	38	2	1	1	1	1
Diss. Organic P	µg/l	44	7	1	5	5	6
Particulate P	µg/l	320	129	29	4	22	25
Total P	µg/l	402	138	31	10	28	32
Turbidity	NTU	23.8	8.2	1.2	0.3	1.6	1.7
TSS	mg/l	33.2	32.0	6.0	1.0	5.5	21.5
BOD	mg/l	11.7	10.4	3.1	3.8	3.3	2.9
Color	Pt-Co	51	27	12	6	17	16
Chlorophyll-a	mg/m^3	56.3	59.2	7.2	0.5	9.2	10.4
Calcium	mg/l	21.7	21.8	21.0	22.3	22.3	21.6
Chloride	mg/l	11.8	15.3	14.5	24.7	19.5	19.6
Sulfate	mg/l	9	20	34	45	6	8
Diss. Aluminum	µg/l	70	145	138	96	45	49

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 17, 2004 (Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.04	7.36	7.09	6.88	7.29	7.43
Conductivity	µmho/cm	190	201	213	221	198	199
Alkalinity	mg/l	58.4	51.9	39.4	27.7	57.6	57.2
NH_3	µg/l	1037	686	754	818	190	659
NO_x	µg/l	21	6	14	10	37	451
Diss. Organic N	µg/l	172	570	354	251	897	38
Particulate N	µg/l	3777	429	150	26	98	23
Total N	µg/l	5007	1691	1272	1105	1222	1171
SRP	µg/l	38	1	1	1	< 1	2
Diss. Organic P	µg/l	44	10	10	9	9	9
Particulate P	µg/l	320	46	10	2	24	12
Total P	µg/l	402	57	21	12	34	23
Turbidity	NTU	23.8	3.0	0.9	0.4	1.1	1.0
TSS	mg/l	33.2	13.0	4.0	1.0	6.5	2.0
BOD	mg/l	11.7	5.8	4.3	4.6	5.0	5.2
Color	Pt-Co	51	31	17	11	20	20
Chlorophyll-a	mg/m^3	56.3	12.4	1.7	0.6	2.3	2.8
Calcium	mg/l	21.7	22.4	23.9	24.0	22.6	23.0
Chloride	mg/l	11.8	15.4	14.9	15.5	19.2	20.6
Sulfate	mg/l	9	50	35	50	6	8
Diss. Aluminum	µg/l	70	172	122	73	32	94

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 17, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.04	7.12	7.11	6.98	7.20	7.34
Conductivity	µmho/cm	190	201	212	220	199	203
NH_3	µg/l	1037	770	812	799	347	753
NO_x	µg/l	21	60	29	19	42	41
Organic N	µg/l	3949	741	504	99	731	439
Total N	µg/l	5007	1571	1345	935	1120	1233
SRP	µg/l	38	3	2	3	3	3
Total P	µg/l	402	21	14	18	17	16
Turbidity	NTU	23.8	0.9	0.7	3.2	0.7	0.7

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 28, 2004 (Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.72	6.80	6.62	6.69	6.68	6.71
Conductivity	µmho/cm	153	166	172	179	164	161
NH_3	µg/l	66	12	28	< 5	611	244
NO_x	µg/l	350	352	348	276	646	507
Organic N	µg/l	3108	3206	2855	3193	3089	3330
Total N	µg/l	3978	3570	3472	3231	4346	4081
SRP	µg/l	329	23	3	50	74	133
Total P	µg/l	542	104	75	112	138	172
Turbidity	NTU	19.9	0.4	0.2	0.1	0.3	0.3

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 28, 2004
(Settled - 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.72	6.79	6.27	5.81	6.73	6.87
Conductivity	µmho/cm	153	164	172	178	160	161
Alkalinity	mg/l	39	27.7	17.8	6.3	36.4	35.4
NH_3	µg/l	66	11	14	23	12	17
NO_x	µg/l	350	92	152	308	263	320
Diss. Organic N	µg/l	3108	3079	3051	3139	3055	3133
Particulate N	µg/l	454	711	386	209	591	532
Total N	µg/l	3978	3893	3603	3679	3921	4002
SRP	µg/l	329	30	1	1	110	96
Diss. Organic P	µg/l	40	41	20	16	46	8
Particulate P	µg/l	173	27	14	9	116	77
Total P	µg/l	542	98	35	26	272	181
Turbidity	NTU	19.9	8.4	2.2	0.5	3.5	3.6
TSS	mg/l	32.0	14.7	3.0	3.0	11.3	10.7
BOD	mg/l	11.4	7.8	< 2	< 2	< 2	< 2
Color	Pt-Co	94	58	14	7	29	28
Chlorophyll-a	mg/m^3	68.4	35.7	7.4	1.1	12.5	11.9
Calcium	mg/l	22.4	17.5	18.0	19.7	19.4	19.2
Chloride	mg/l	11.3	11.4	11.2	10.8	15.1	16.4
Sulfate	mg/l	11	22	31	45	8	7
Diss. Aluminum	µg/l	27	724	177	27	49	139

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 28, 2004 (Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.72	6.97	6.84	6.36	6.95	7.14
Conductivity	µmho/cm	153	164	173	182	161	162
Alkalinity	mg/l	39	29.3	19.2	8.3	39.0	38.6
NH_3	µg/l	66	10	< 5	28	< 5	8
NO_x	µg/l	350	106	122	101	267	126
Diss. Organic N	µg/l	3108	3163	3188	3147	3298	3091
Particulate N	µg/l	454	203	141	52	54	411
Total N	µg/l	3978	3482	3454	3328	3622	3636
SRP	µg/l	329	39	1	< 1	123	59
Diss. Organic P	µg/l	40	32	3	3	29	40
Particulate P	µg/l	173	81	34	24	86	69
Total P	µg/l	542	152	38	28	238	168
Turbidity	NTU	19.9	7.7	1.6	0.4	2.4	2.3
TSS	mg/l	32.0	15.0	4.7	< 0.7	4.4	4.7
BOD	mg/l	11.4	2.9	< 2.0	< 2.0	2.7	< 2.0
Color	Pt-Co	94	64	15	7	27	26
Chlorophyll-a	mg/m^3	68.4	25.6	8.6	1.9	13.1	12.3
Calcium	mg/l	22.4	17.6	18.3	20.4	21.6	20.0
Chloride	mg/l	11.3	11.7	11.1	10.4	15.3	15.9
Sulfate	mg/l	11	20	33	44	5	7
Diss. Aluminum	µg/l	27	658	151	52	74	122

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON SEPTEMBER 28, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	6.72	6.74	6.31	6.18	6.72	6.62
Conductivity	µmho/cm	153	166	177	184	164	164
NH_3	µg/l	66	30	20	29	150	185
NO_x	µg/l	804	797	1024	1111	1024	960
Organic N	µg/l	3108	3064	2795	2704	2910	2802
Total N	µg/l	3978	3891	3839	3844	4084	3947
SRP	µg/l	329	41	2	1	116	84
Total P	µg/l	542	105	6	2	146	98
Turbidity	NTU	19.9	0.7	0.3	0.3	0.5	0.6

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON OCTOBER 25, 2004 (Settled - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.10	7.45	7.10	7.00	7.25	7.19
Conductivity	µmho/cm	169	175	185	194	173	176
Alkalinity	mg/l	55.4	44.9	31.5	19.8	51.9	47.5
NH_3	µg/l	1176	1158	1115	1114	1072	1067
NO_x	µg/l	18	20	21	13	11	14
Diss. Organic N	µg/l	725	333	463	314	190	237
Particulate N	µg/l	996	786	375	117	528	486
Total N	µg/l	2915	2297	1974	1558	1801	1804
SRP	µg/l	349	57	2	< 1	54	34
Diss. Organic P	µg/l	86	68	22	5	0	0
Particulate P	µg/l	191	123	70	40	122	130
Total P	µg/l	626	248	94	46	176	164
Turbidity	NTU	8.5	2.9	3.3	1.2	1.3	1.7
TSS	mg/l	13.2	14.0	18.7	6.0	11.3	11.3
BOD	mg/l	9.2	7.8	7.1	6.5	8.4	8.3
Color	Pt-Co	101	68	25	6	19	19
Chlorophyll-a	mg/m^3	53.5	7.0	3.5	0.6	2.1	2.1
Calcium	mg/l	21.0	18.6	18.4	19.6	18.0	18.4
Chloride	mg/l	11.3	11.7	10.6	11.6	17.7	19.3
Sulfate	mg/l	9	22	32	46	8	8
Diss. Aluminum	µg/l	38	667	183	32	62	118

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON OCTOBER 25, 2004
(Settled - 3 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 3 HOURS (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.10	7.28	6.81	6.45	7.05	7.16
Conductivity	µmho/cm	169	171	186	195	171	172
Alkalinity	mg/l	55.4	44.6	32.9	21.2	51.3	50.9
NH_3	µg/l	1176	1217	1195	1204	1194	1205
NO_x	µg/l	18	19	21	10	21	56
Diss. Organic N	µg/l	725	611	450	292	783	348
Particulate N	µg/l	996	583	371	76	55	394
Total N	µg/l	2915	2430	2037	1582	2053	2003
SRP	µg/l	349	79	< 1	< 1	144	90
Diss. Organic P	µg/l	86	144	14	4	33	20
Particulate P	µg/l	191	115	60	25	170	216
Total P	µg/l	626	338	75	30	347	326
Turbidity	NTU	8.5	5.3	3.5	0.8	2.9	2.7
TSS	mg/l	13.2	11.3	15.3	4.0	13.3	14.0
BOD	mg/l	9.2	4.8	2.9	2.7	3.8	3.4
Color	Pt-Co	101	74	18	6	35	30
Chlorophyll-a	mg/m^3	53.5	27.6	4.7	0.4	8.9	7.1
Calcium	mg/l	21.0	19.1	18.1	18.8	18.6	17.5
Chloride	mg/l	11.3	11.8	11.4	15.4	15.4	16.9
Sulfate	mg/l	9	20	33	49	11	8
Diss. Aluminum	µg/l	38	122	118	35	52	111

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON OCTOBER 25, 2004 (Filtered - 5 minutes)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 5 MINUTES / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.10	7.37	7.38	6.97	7.44	7.44
Conductivity	µmho/cm	169	163	174	188	164	164
NH_3	µg/l	1176	1049	1079	1046	1097	1132
NO_x	µg/l	18	56	78	47	154	143
Organic N	µg/l	1721	669	892	170	1304	765
Total N	µg/l	2915	2049	1774	1263	2555	2040
SRP	µg/l	349	39	< 1	< 1	151	102
Total P	µg/l	626	143	15	7	228	153
Turbidity	NTU	8.5	0.7	0.3	0.2	0.5	0.6

RESULTS OF LABORATORY JAR TESTS CONDUCTED ON WATER SAMPLES COLLECTED FROM LAKE HANCOCK SITE 2 ON OCTOBER 25, 2004 (Filtered - 24 hours)

PARAMETER	UNITS	RAW	ALUM TREATED AND SETTLED FOR 24 HOURS / FILTERED (Dose in mg Al/liter)				
			2.5 mg/l	5.0 mg/l	7.5 mg/l	5.0 mg/l + 1090 Polymer	5.0 mg/l + 4090 Polymer
pH	s.u.	7.10	7.57	7.50	7.38	7.71	7.72
Conductivity	µmho/cm	169	164	175	189	169	170
NH_3	µg/l	1176	1141	1199	1121	1430	1451
NO_x	µg/l	18	20	68	76	149	36
Organic N	µg/l	1721	1210	967	688	802	981
Total N	µg/l	2915	2371	2234	1885	2381	2468
SRP	µg/l	349	36	< 1	< 1	22	10
Total P	µg/l	626	145	19	7	68	55
Turbidity	NTU	8.5	1.5	0.2	0.3	0.5	0.3

APPENDIX C

BUDGETARY COST ESTIMATE WORKSHEETS
FOR SURFACE FLOW CONSTRUCTED WETLANDS CONCEPTUAL PLAN

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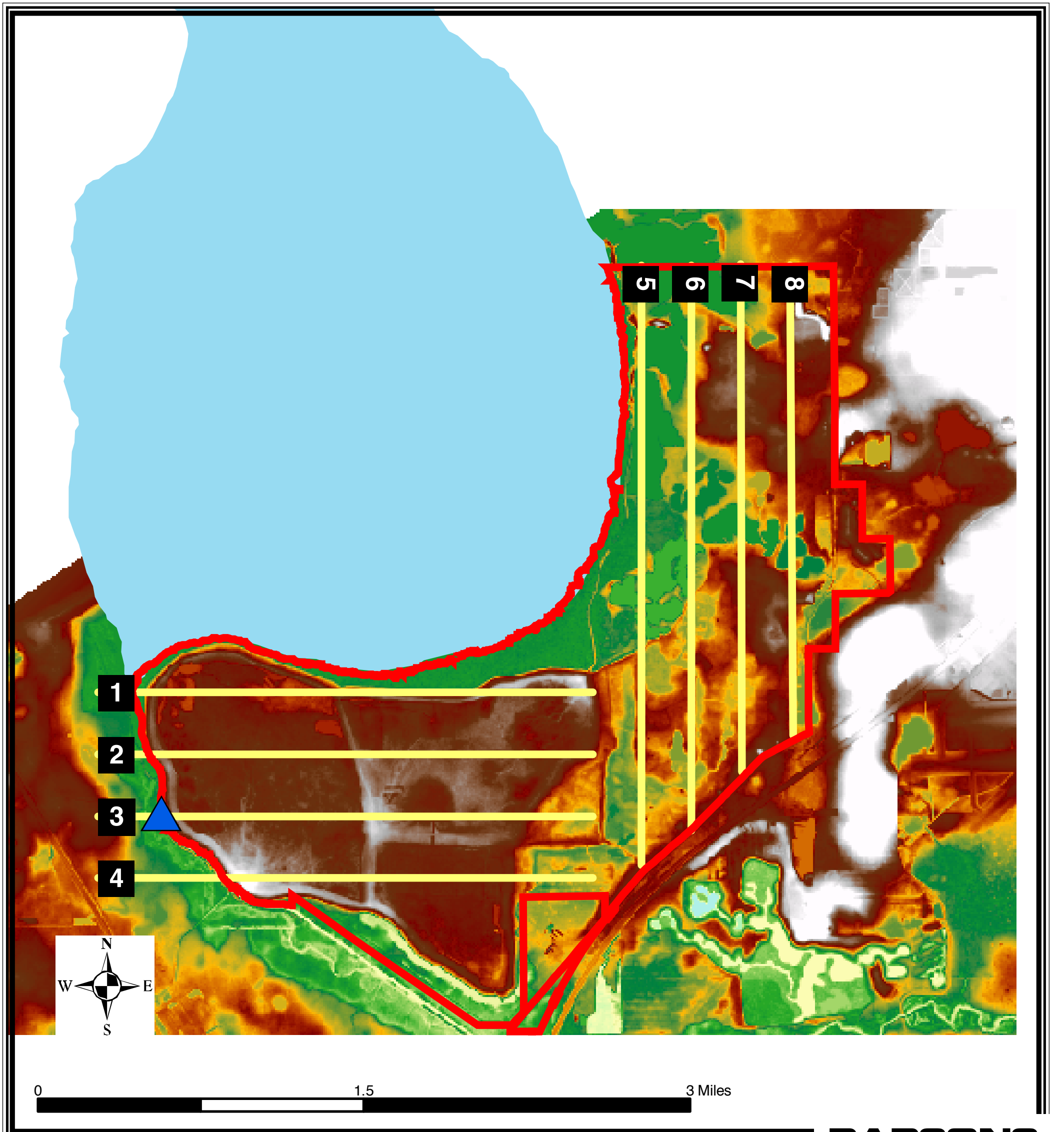

PARSONS

Lake Hancock
Outfall Treatment Project

Figure C1

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Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 1

Figure C2

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 2

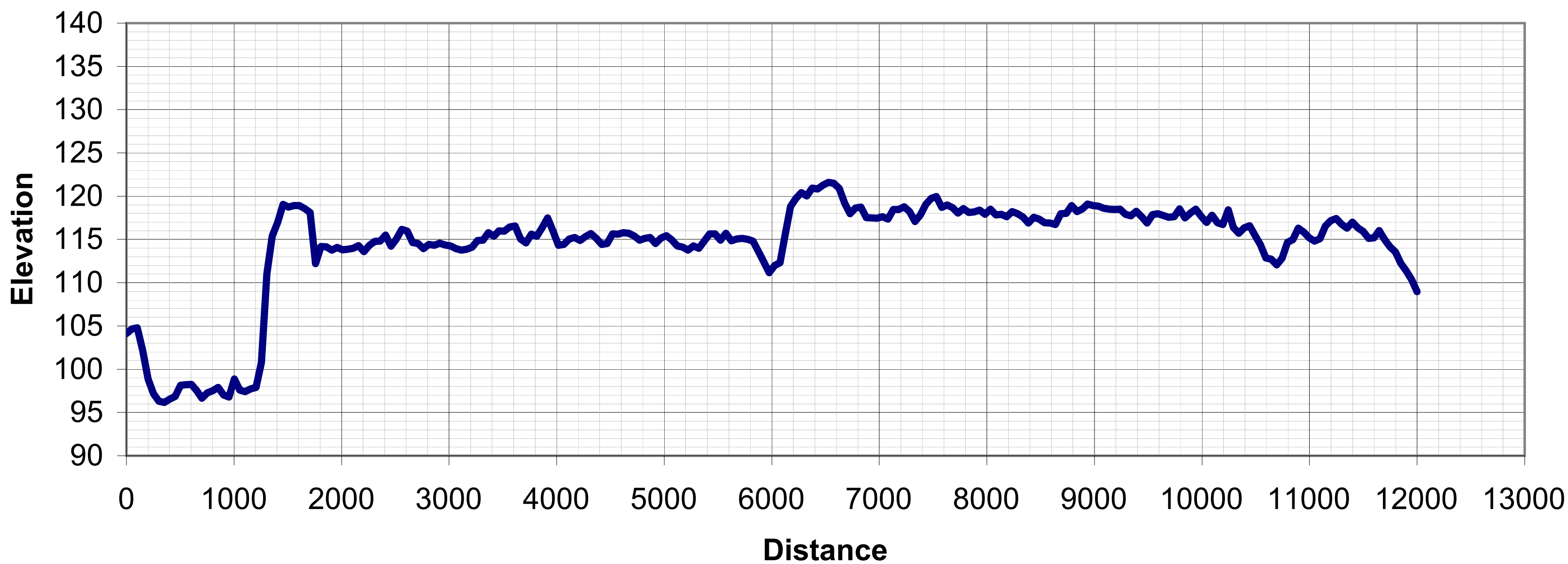


Figure C3

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 3

Figure C4

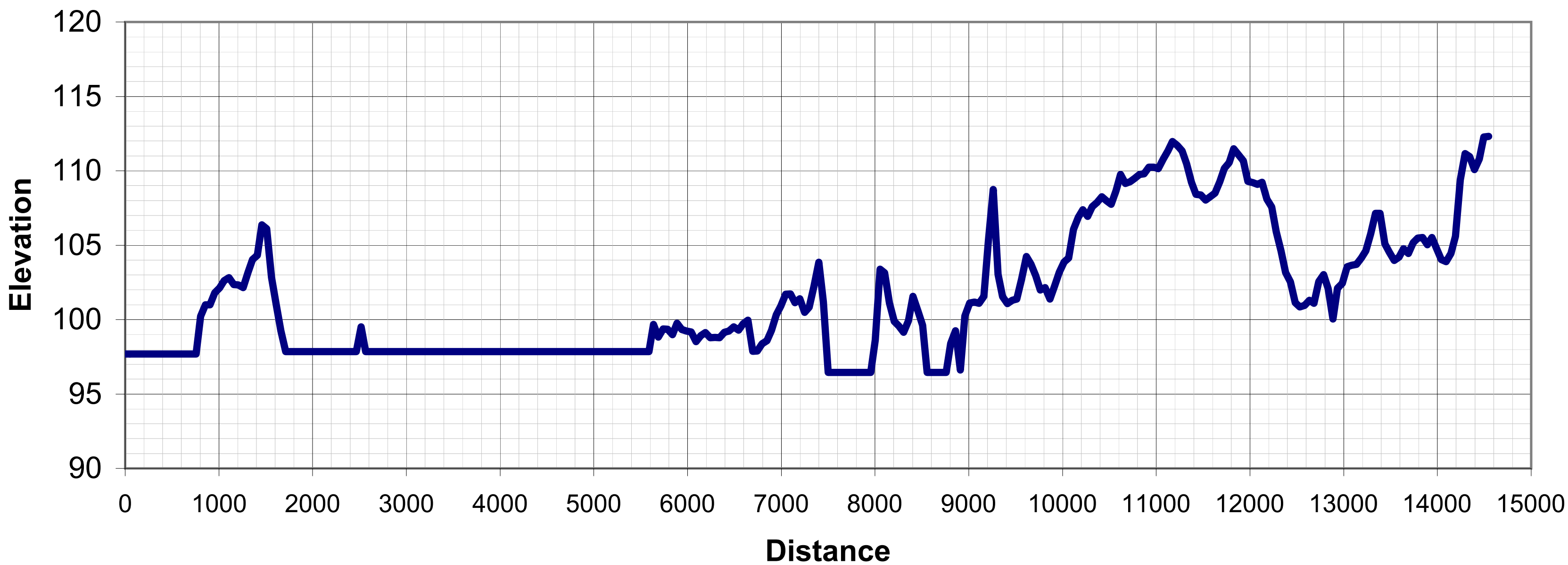
Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 4

Figure C5

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 5



Copy of Lake Hancock Profiles 2 v0 (2).xls 5 Chart

Figure C6

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 6

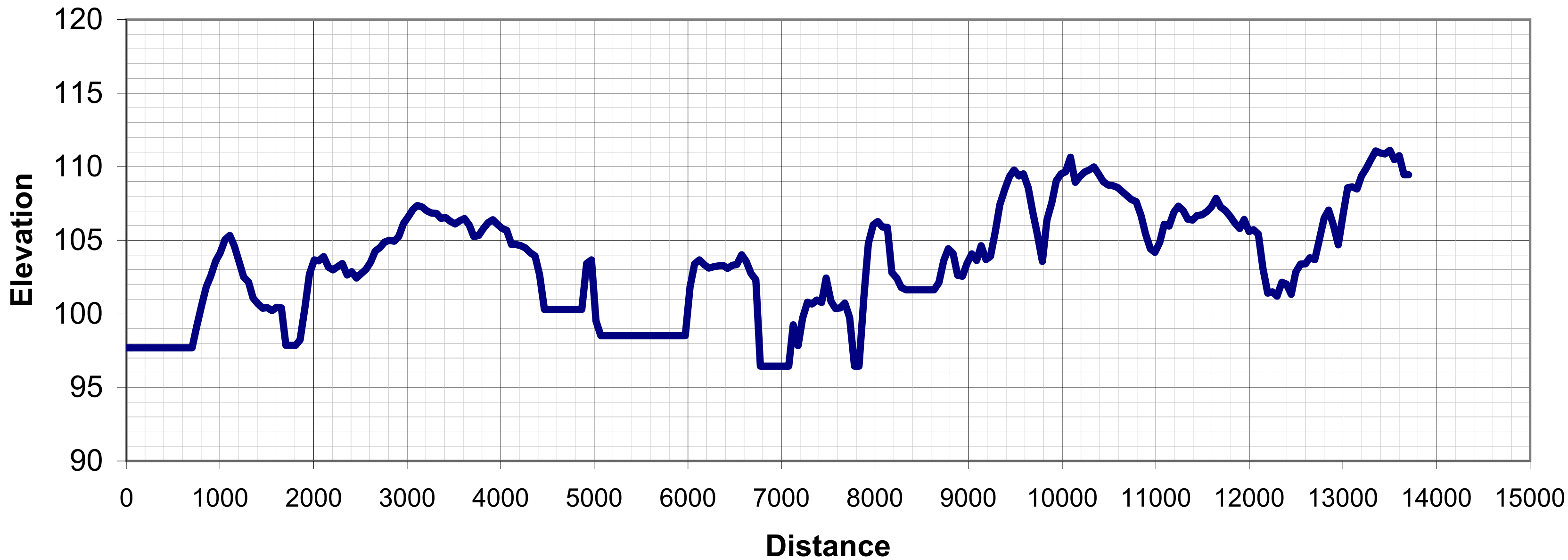


Figure C7

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 7

Figure C8

Cross Section Profiles
Old Florida Plantation Site
from Lidar DTM provided by SWFWMD (NADD 88)

Profile 8

Figure C9

Table 1 Itemized construction and annual operations and maintenance (O&M) costs for 2540 Acre surface flow wetlantds needed to reduce total nitrogen load by 45%.

FILE NAME:|2540Ac Construction Costs

PARSONS Budgetary Cost Estimate
ENGINEER ESTIMATE WORKSHEET

JOB NO.: 743785 | M.T.O. BY: WSI/Parsons | DATE: 09/13/04 | EST DATE:
PROJECT: Lake Hancock Outfall Treatment Project | Project Description | PRICED BY: WSI/Parsons | DATE: 09/13/04 | PRINT DATE: 01/17/07
CLIENT: | Estimate Type: | CHECKED BY: H. Snow | DATE: 05/27/05 | REV. 1:

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES: MATERIAL/ EQUIPMENT	UNIT RATES: LABOR M/H	UNIT RATES: LABOR P.F.	UNIT RATES: LABOR RATE	UNIT RATES: CONST. EQUIPMENT	UNIT RATES: SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST	
1.00	**Clearing and Grubbing**															
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	2,667	AC		40	1.00	29.00	1,200.00		$ -	$ 3,093,720	$ 3,200,400	$ -	$ 2,360.00	$ 6,294,120	
1.02	Tree Removal (Larger then 12" dia.)	0	Ea		6.6	1.00	29.00	124.00		$ -	$ -	$ -	$ -	$ 315.40	$ -	
															SUBTOTAL	$ 6,294,120
2.00	**Earth Work And General Site Preparation**															
1.03	Earth Work (excavation and grading)	1,902,000	Cy		0.02	1.50	32.00	1.76		$ -	$ 1,825,920	$ 3,347,520	$ -	$ 2.72	$ 5,173,440	
1.04	Tree Protection	-	Lf	$ 0.50	0.01	1.00	26.00	1.00		$ -	$ -	$ -	$ -	1.76	$ -	
1.05	Stripping Top Soil	83,000	Cy		0.01	1.00	29.00	0.45		$ -	$ 24,070	$ 37,350	$ -	$ 0.74	$ 61,420	
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts onsite soils)	5,780,000	Cy		0.04	1.00	32.00	2.93		$ -	$ 7,398,400	$ 16,935,400	$ -	$ 4.21	$ 24,333,800	
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)		Cy	$ 2.40	0.035	1.00	32.00	3.09		$ -	$ -	$ -	$ -	6.61	$ -	
1.08	Final Grading	13,197	Sy		0.009	1.00	28.00	0.35		$ -	$ 3,326	$ 4,619	$ -	$ 0.60	$ 7,945	
1.09	Exterior Berms, Maintenance Road (12" consolidated stone)	-	Cy	$ 8.00	0.005	1.00	32.00	1.75		$ -	$ -	$ -	$ -	9.91	$ -	
1.10	Pump Station Road, 3" Asphalt Conc. Pavement	13,197	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 46,190	$ 8,446	$ 52,788	$ -	$ 8.14	$ 107,424	
1.11	Pump Station Roadk, 12" Compacted Limerock Base	13,197	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 171,561	$ 8,446	$ 16,496	$ -	$ 14.89	$ 196,503	
1.12	12" Stabilized Subbase	-	Cy	$ 4.00	0.025	1.00	32.00	1.00		$ -	$ -	$ -	$ -	5.8	$ -	
1.14	12" Compacted Crushed Concrete	-	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ -	$ -	$ -	$ -	14.89	$ -	
1.15	Replace topsoil, grade, seed & mulch (see note a)	624,822	SY	$ 1.72	included	1.00	36.00	included		$ 1,074,694	$ -	$ -	$ -	$ 1.72	$ 1,074,694	
															SUBTOTAL	$ 30,955,226
7.00	**Piping**															
7.01	48' CMP	6,000	Lf	$ 69.00	0.7	1.00	32.00	9.00		$ 414,000	$ 134,400	$ 54,000	$ -	$ 100.40	$ 602,400.00	
																$ 602,400.0
8.00	**Water Control Structures**															
8.01	Weir structures, slab on grade	69	CY	$ 203.00	6.00	1.00	36.00			$ 14,075	$ 14,976	$ -	$ -	$ 419.00	$ 29,051	
8.02	Weir Structures, conventional walls	231	CY	$ 371.00	6.00	1.00	36.00			$ 85,742	$ 49,920	$ -	$ -	$ 587.00	$ 135,662	
8.03	Elevated Work	-	CY	$ 473.00	8.00	1.00	36.00			$ -	$ -	$ -	$ -	$ 761.00	$ -	
8.04	Columns	-	CY	$ 486.00	8.00	1.00	36.00			$ -	$ -	$ -	$ -	$ 774.00	$ -	
8.05	12" Structural Fill (57 stone or crushed conc.)	308	CY	$ 12.00	0.17	1.00	25.00	5.00		$ 3,698	$ 1,310	$ 1,541	$ -	$ 21.25	$ 6,548	
8.06	Inlet grates	26	EA	$ 1,000.00	Included	1.00	25.00			$ 26,000	$ -	$ -	$ -	$ 1,000	$ 26,000	
8.07	10' weir	26	EA	$ 10,000.00	Included	1.00	25.00			$ 260,000	$ -	$ -	$ -	$ 10,000	$ 260,000	
8.08	Aerated Discharge structure, including piping	1	EA	$ 671,000.00	Included	1.00	25.00			$ 335,500	$ -	$ -	$ -	$ 671,000	$ 671,000	
															SUBTOTAL	$ 1,128,261
9.00	**Instrumentaion**															
9.01	Instrumention, allowance	1	LS	180,500.00	Included					180,500	-	-	-	180,500.00	180,500	
															SUBTOTAL	$ 180,500
	TOTAL CONSTRUCTION															39,160,507
	Contingency 20%														7,832,101	
	Mob/Demob 5%														1,958,025	
	Permits 1%														391,605	
	Bonds 1%														391,605	
	Insurance 1%														391,605	
	Sales Tax								Equipment & Materials		$ 2,611,960					182,837	
															SUBTOTAL	$ 11,147,778
3.00	**Intake & Pump Station**	See Intake Pump 71-mgd spreadsheet - Table 2														
															See Intake Pump 71-mgd spreadsheet - Table 2	1,912,713
4.00	**Inflow Transmission Main**	See Intake Pump 71-mgd spreadsheet - Table 2														
															See Intake Pump 71-mgd spreadsheet - Table 2	462,840
5.00	**Intermeadiate Station**	See Intermeadiate Pump 71-mgd spreadsheet - Table 3														
															See Intermeadiate Pump 71-mgd spreadsheet - Table 3	1,912,713
6.00	**Intermeadiate Trasmission Main**	See Intermeadiate Pump 71-mgd spreadsheet - Table 3														
															See Intermeadiate Pump 71-mgd spreadsheet - Table 3	231,420
	Total Construction Costs															54,827,971

(a) Review of unit costs against national average quoted for seed & mulch does not account for screening, load, haul and place topsoil, finegrading, (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for City of Tampa to include screening, load, haul & placement of topsoil, finegrading & hydroseed/mulch

Table 2a Cost Assumptions for 2450 Acre Surface Flow Wetlands

CAPITAL COSTS						
Clear and Grub						
Clear and grub entire site plus 5%. Bulldoze trees, pile, burn in place. Do not remove root balls.	2667	Acres				
Earthwork						
Cut (inside cells)	1,902,000	CY	Earthwork volumes calculated using composite/grid volumes, Autodesk Land Desktop 2005			
Fill (berm construction)	5,780,000	CY	Earthwork volumes calculated using composite/grid volumes, Autodesk Land Desktop 2005			
			Assume suitable fill available onsite			
Roads/ berms						
Berm length, exterior	50,773	LF	20' wide	no road base, final grading only		
berm length, interior	436,697	LF	20' wide	no road base, final grading only		
final grading, road	13,197	SY	20' wide			
road to pump statuion, 12' consolidated stone	9,776	CY	20' wide			
road to pump station from access gate	13,197	SY	20' wide			
erosion control: final grading, apply topsoil, hydroseed	624,822	SY	sides of berms and areas of no road base requireerosion control measures			
topsoil for erosion control;	83000	CY	need to be stockpiled, assume 20% retained while screening			
Piping						
48" dia CMP	6000	LF	passes 52 cfs per pipe (min 2 per cell) at 4.1 ft/s with 0.20 ft/100 ft head loss			
			assume 200 feet per structure per barrel			
Water Control Structures						
Weir structures						
concrete, per structure						
slab, conc	69.3	CY	12'x6x1', 26 ea			
walls, conc	231.1	CY	(12'+6'+6')x10'x1', 26 ea			
gravel	308.1	CY	16'x10'x2', 26 ea			
Grate, 5'x10'	26	EA	$1000 allowance per WSI			
Weir, 10 ft	26	EA	$10,0000 allowance per WSI			
Outlet structure						
concrete aeration structure	1	EA	$671,000 allowance base on S. Cross construction cost of similar facility			
Instrumentation						
2 water level recorders per cell + 1 in buffer			17	$ 1,500.00	$ 25,500.00	
pump station discharge flow meter/totalizer			1	$ 5,000.00	$ 5,000.00	
RTU system			1	$ 150,000.00	$ 150,000.00	
Total	1	LS	$ 180,500.00			
OPERATIONS AND MAINTENANCE						
Routine Maintenance	433849.7	$ 10,846.24	quarterly, round to $10000			
Mowing	4	$ 10,000.00	$ 40,000.00	mow berms quarterly with equipment trailered from Bartow Office		
Misc	1	$ 120,000.00	$ 120,000.00	allowance: includes meter repair, structure clean out, trash removal, etc.		
			$ 160,000.00			
Routine Operations						
Operators (3)	6240	$ 35.00	$ 218,400.00	3 full-time operators, includes labor for WQ sampling and vegetation assessments		
Operational WQ Monitoring						
Lab Costs	$ 200,000.00	allowance				

Table 2b - Cost Assumptions for 2450 Acre Surface Flow Wetlands

Stratum: proposed 45 existing 45
Site: Lake Hancock Earthwork
Site Volume Table: Unadjusted

	CUT (CY)	FILL (CY)	NET (CY)	RESULT (CUT OR FILL)	METHOD
OVERALL	2,449,074.59	21,589,785.45	19,140,710.86	(F)	Grid
CELL 1-2	915,379.32	3,270,926.86	2,355,547.54	(F)	Grid
CELL 3-4	732,955.39	2,034,611.99	1,301,656.60	(F)	Grid
CELL 5-6	101,052.88	7,237,781.57	7,136,728.69	(F)	Grid
CELL 7-8	136,298.75	1,799,181.77	1,662,883.02		
BUFFER	15,936.62	1,467,715.90	1,451,779.28	(F)	Grid
TOTALS	**1,901,622.97**	**5,779,567.35**	**3,877,944.38**		
only include cut within cel	1,901,623				
available for use in berms	1,648,335				
Fill on berms only, subtract fill inside cells from ov		5,779,567			
Net, needed from other sources			4,131,233		

Calculation Method:
Contours from Digital Topographic Map (BCI, 2004) in NVGD was converted into TIN in Autodesk Land Development 2005. Existing surface was built from TIN. Proposed Surface was built using Land Development Terrain Tools. Volume calculated using Grid Volume method.

Table 2c Sitework Calculations for 2540 Acre Surface Flow Wetlands

BERM LENGTH (LINEAR FEET)	Length			final grading		hydroseed		mowing	
	from Cadd	perimeter	interior	perimeter	interior	perimeter	interior	perimeter	interior
BUFFER CELL	7446.69	7446.69		105514		74,111		33,096	
CELL 1-2	17537.63		9110		77,861		52,254		40488.89
CELL 3-4	28938		7560		64,614		43,363		33600
CELL 5-6	26790		11524		98,493		66,100		51217.78
CELL 7-8	23003		4604		39,349		26,408		20462.22
EXTERIOR BERM		50773		433,946		362,586		225658	
ROAD TO PUMP STATION (1)	500	13197		94,244				29327	
TOTAL BERM LENGTH	**104215.32**	71417	32798	633703.1	280317	436697	188125	288,081	145,769

(1) estimated from main road

Average berm characteristics	top width	ratio x:1	base width	height1	height2	slope1, ft	slope2, L	volume, cy	perimeter
volume, per linear foot	20	3	74	9	9	28.5	28.5	15.7	8.5
for buffer cell berm, exterior	20	3	122	17	17	53.8	53.8	44.7	14.2
for buffer cell berm, interior	20	3	98	9	17	28.5	53.8	19.7	11.4
slope area for grading to toe of slope	20	3	74	9	9	28.5	28.5		8.5
slope area to edge of water (4' water depth	20	3	50	5	9	15.8	28.5		7.1
slope area to edge of water (4' water depth	20	3	50	5	5	15.8	15.8		5.7
slope area to edge of water (4' water depth	20	3	50	5	17	15.8	53.8		10.0

mowing	sy/lf
top & 10' slope each side, with roads	2.2
top & 10' each side, 9' berms	4.4

Table 3 Itemized construction and annual operations and maintenance (O&M) costs for 110 CFS (71-MGD) inflow intake and pump station.

110 CUBIC FEET PER SECOND INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	$/ft [1]	Escalated Cost
Transmission Main											
Single Pipeline	71.00	49345	52.0	Steel	110	1000	7.45	0.3762	3.8	380.00	$ 380,000
Dual Pipeline	0.00	0	48.0	Steel	110	0	0.00	0.0000	0.0	0.00	$ -
Total	**71.00**	**49,345**							**3.76**		**$ 380,000**
										Inflated to 2004	**$ 462,840**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs		110	
Construction Cost $	$	870,170	(Footnote 2)
Telemetry	$	100,000	(Footnote 2)
3-Phase Power	$	625,000	(Footnote 2)
Electrical Service	$	100,000	
Inflation (Construction Materials)	$	217,543	Increased by 25% due to recent increases in concrete and steel costs this year
Total	**$**	**1,912,713**	

Lake Hancock Pump Station

Capacity - mgd	71	(110 cfs)
Hf	3.8	
Static Head+PS Loss	22.0	Assume lake intake is at 95, top of buffer cell berm is 117
TDH	25.8	
Pump Efficiency	0.80	
Break HP	401.8	
Motor Efficiency	0.95	
Maximum Annual kwh	2,762,874	
Average Annual kwh	1,105,150	Based on annual average flow 44 cfs or 28 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**77,360**	Assumes operation at 44 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	$ 1,912,713	$ 19,127	$ 76,509	$ 77,360	$ 172,996
Transmission Main	$ 462,840	$ 4,628			$ 4,628
Total Intake, pump station and transmission main	**$ 2,375,553**	**$ 23,756**	**$ 76,509**	**$ 77,360**	$ 177,625

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of cost

Annual O&M Equipment @ 4% of cost

Table 4 Itemized construction and annual operations and maintenance (O&M) costs for 110 CFS (71-MGD) intermediate pump station.

110 CUBIC FEET PER SECOND INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	$/ft (1)	Escalated Cost
Transmission Main											
Single Pipeline	71.00	49345	52.0	Steel	110	500	7.45	0.3762	1.9	380.00	$ 190,000
Dual Pipeline	0.00	0	48.0	Steel	110	0	0.00	0.0000	0.0	0.00	$ -
Total	**71.00**	**49,345**							**1.88**		**$ 190,000**
										Inflated to 2004	**$ 231,420**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs	110	
Construction Cost $	$ 870,170	(Footnote 2)
Telemetry	$ 100,000	(Footnote 2)
3-Phase Power	$ 625,000	(Footnote 2)
Electrical Service	$ 100,000	
Inflation (Construction Materials)	$ 217,543	Increased by 25% due to recent increases in concrete and steel costs this year
Total	**$ 1,912,713**	

Lake Hancock Pump Station

Capacity - mgd	71	(110 cfs)
Hf	1.9	
Static Head+PS Loss	7.0	Assume intake is 1' above bottom of deep zone of cells 3 &4 at 117
TDH	8.9	Assume berm is 124
Pump Efficiency	0.80	
Break HP	138.5	
Motor Efficiency	0.95	
Maximum Annual kwh	952,450	
Average Annual kwh	380,980	Based on annual average flow 44 cfs or 28 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**26,669**	Assumes operation at 44 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	$ 1,912,713	$ 19,127	$ 76,509	$ 26,669	$ 122,304
Transmission Main	$ 231,420	$ 2,314			$ 2,314
Total Intake, pump station and transmission main	**$ 2,144,133**	**$ 21,441**	**$ 76,509**	**$ 26,669**	$ 124,618

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of cost

Annual O&M Equipment @ 4% of cost

PARSONS

Table 5 Itemized construction and annual operations and maintenance (O&M) costs for 1095 Acre surface flow wetlantds needed to reduce total nitrogen load by 27%

FILE NAME: .xls]1095Ac Construction C

PARSONS Budgetary Cost Estimate

ENGINEER ESTIMATE WORKSHEET

JOB NO.:	743785		M.T.O. BY:	WSI/Parsons	DATE:	05/12/05	EST DATE:	08/18/05
PROJECT:	Lake Hancock Outfall Treatment Project	Project Description	PRICED BY:	WSI/Parsons	DATE:	05/12/05	PRINT DATE:	01/17/07
CLIENT:		Estimate Type:	CHECKED BY:	H. Snow	DATE:	05/27/05	REV. 1	

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES: MATERIAL/ EQUIPMENT	LABOR M/H	LABOR P.F.	LABOR RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR HOURS	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST	
1.00	**Clearing and Grubbing**																
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	1,150	AC		40	1.00	29.00	1,200.00		$ -	46,000.00	$ 1,334,000	$ 1,380,000	$ -	$ 2,360.00	$ 2,714,000	
1.02	Tree Removal (Larger then 12" dia.)	-	Ea		6.6	1.00	29.00	124.00		$ -	-	$ -	$ -	$ -	315.4	$ -	
																SUBTOTAL	$ 2,714,000
2.00	**Earth Work And General Site Preparation**																
1.03	Earth Work (excavation of unsuitable plastic clay material for deepen areas)	401,000	Cy		0.02	1.50	32.00	1.76		$ -	12,030.00	$ 384,960	$ 705,760	$ -	$ 2.72	$ 1,090,720	
1.04	Tree Protection	-	Lf	$ 0.50	0.01	1.00	26.00	1.00		$ -	-	$ -	$ -	$ -	1.76	$ -	
1.05	Stripping Top Soil		Cy		0.01	1.00	29.00	0.45		$ -	-	$ -	$ -	$ -	$ 0.74	$ -	
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts onsite soils)	1,098,000	Cy		0.035	1.00	32.00	3.09		$ -	38,430.00	$ 1,229,760	$ 3,392,820	$ -	$ 4.21	$ 4,622,580	
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	-	Cy	$ 2.40	0.035	1.00	32.00	3.09		$ -	-	$ -	$ -	$ -	6.61	$ -	
1.08	Final Grading	-	Sy		0.009	1.00	28.00	0.35		$ -	-	$ -	$ -	$ -	0.6		
1.09	Exterior Berms, Maintenance Road (12" consolidated stone)	-	Cy	$ 8.00	0.005	1.00	32.00	1.75		$ -	-	$ -	$ -	$ -	9.91	$ -	
1.10	Pump Station Road, 3" Asphalt Conc. Pavement	12,836	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 44,924	256.71	$ 8,215	$ 51,342	$ -	$ 8.14	$ 104,481	
1.11	Pump Station Roadk, 12" Compacted Limerock Base	12,836	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 166,862	256.71	$ 8,215	$ 16,044	$ -	$ 14.89	$ 191,121	
1.12	12" Stabilized Subbase	-	Cy	$ 4.00	0.025	1.00	32.00	1.00		$ -	-	$ -	$ -	$ -	5.8	$ -	
1.14	12" Compacted Crushed Concrete	-	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ -	-	$ -	$ -	$ -	14.89	$ -	
1.15	Replace topsoil, grade, seed & mulch (see note h)	321,967	SY	$ 1.72	included	1.00	36.00	included		$ 553,782	0.0	$ -	$ -	$ -	$ 1.72	$ 553,782	
																SUBTOTAL	$ 6,562,685
5.00	**Piping**																
1.13	48' CMP	3,200	Lf	$ 69.00	0.7	1.00	32.00	9.00		$ 220,800.00	2,240.00	$ 71,680.00	$ 28,800.00	$ -	$ 100.40	$ 321,280	$ 321,280
6.00	**Water Control Structures**																
6.01	Weir structures, slab on grade	21	CY	$ 203.00	6.00	1.00	36.00			$ 4,331	128.00	$ 4,608	$ -	$ -	$ 419.00	$ 8,939	
6.02	Weir Structures, conventional walls	71	CY	$ 371.00	6.00	1.00	36.00			$ 26,382	426.67	$ 15,360	$ -	$ -	$ 587.00	$ 41,742	
6.03	Elevated Work	-	CY	$ 473.00	8.00	1.00	36.00			$ -	-	$ -	$ -	$ -	$ 761.00	$ -	
6.04	Columns	-	CY	$ 486.00	8.00	1.00	36.00			$ -	-	$ -	$ -	$ -	$ 774.00	$ -	
6.05	12" Structural Fill (57 stone or crushed conc.)	95	CY	$ 12.00	0.17	1.00	25.00	5.00		$ 1,138	16.12	$ 403	$ 474	$ -	$ 21.25	$ 2,015	
6.06	Inlet grates	8	EA	$ 1,000.00	Included	1.00	25.00			$ 8,000	-	$ -	$ -	$ -	$ 1,000.00	$ 8,000	
6.07	10' weir	8	EA	$ 10,000.00	Included	1.00	25.00			$ 80,000	-	$ -	$ -	$ -	$ 10,000	$ 80,000	
6.08	Aerated Discharge structure, including piping	1	EA	$ 450,000.00	Included	1.00	25.00			$ 225,000	-	$ -	$ -	$ -	$ 450,000	$ 450,000	
																SUBTOTAL	$ 590,696
7.00	**Instrumentaion**																
7.01	Instrumention, allowance	1	LS	150,000.00	Included					150,000	-	-	-	-	150,000.00	150,000	$ 150,000.00
	TOTAL CONSTRUCTION																$ 10,338,661
	General Conditions																
	Contingency 20%															$ 2,067,732	
	Mob/Demob 5%															$ 516,933	
	Permits 1%															$ 103,387	
	Bonds 1%															$ 103,387	
	Insurance 1%															$ 103,387	
	Sales Tax								Equipment & Materials	$ 1,331,220						$ 93,185	
																SUBTOTAL	$ 2,988,011
3.00	**Intake & Pump Station**	See Intake Pump 33-mgd spreadsheet - Table 5															
																See Intake Pump 33-mgd spreadsheet - Table 5	$ 1,342,378
4.00	**Inflow Transmission Main**	See Intake Pump 33-mgd spreadsheet - Table 5															
																See Intake Pump 33-mgd spreadsheet - Table 5	$ 2,339,565
	Total Construction Costs																$ 17,008,614

Table 6a Cost Assumptions for 1095 Acre Surface Flow Wetlands

Item	Quant	Unit	Unit Cost	Cost	Notes
CAPITAL COSTS					
Clear and Grub					
Clear and grub entire site plus 5%. Bulldoze trees, pile, burn in place. Do not remc	1150	Acres			
Earthwork					
Cut (inside cells), assume not usable for berms	401,000	CY			Earthwork volumes calculated using composite/grid volumes, Autodesk Land Desktop 2005
Embankment fill (berm construction)	1,098,000	CY			Earthwork volumes calculated using composite/grid volumes, Autodesk Land Desktop 2005
					See figures 1 & 2 for plan and sample cross sections
Roads					
Berm length, exterior	34,147	LF			20' wide 12' road base
berm length, interior	12,356	LF			20' wide no road base, final grading only
final grading, maintenance road areas along exterior berms	12,836	SY			top of exterior berms receiving road base only
road, 20' paved to pump station	5,651	LF			assume 500' from end of wetland area to gate
road, 20' paved, sy + 50'x50' area by pump station	12,836	SY			
maintenance road along exterior berm, 20' wide, consolidated stone	-	CY			
erosion control, fine grading, screen, load, haul & place topsoil, hydroseed	321,967	SY			sides of berms and areas of no road base require final grading prior to applying erosion control measures
stripping and stockpile topsoil, assume 20% retained on screener	43,000	CY			
Piping					
48" dia CMP	3200	LF			passes 52 cfs per pipe (min 2 per cell) at 4.1 ft/s with 0.20 ft/100 ft head loss
					assume 200 feet per structure per barrel
Water control Structures					
Weir structures					8 structures
slab, conc	21.3	CY			12'x6x1', 8 ea
walls, conc	71.1	CY			(12'+6'+6')x10'x1', 8 ea
gravel	94.8	CY			16'x10'x2', 8 ea
Grate, 5'x10'	8	EA			$1000 allowance per WSI
Weir, 10 ft	8	EA			$10,0000 allowance per WSI
Outlet structure					
concrete aeration structure	1	LS			$450,000 allowance base on S. Cross construction cost of similar facility
					based on cost for 33 MGD structure for South Cross brought to 2004 dollars
Instrumentation					
Item	Quant		Unit Cost	Cost	
2 water level recorders per cell + 1 in buffer	7		$ 5,000.00	$ 35,000.00	
pump station discharge flow meter/totalizer	3		$ 5,000.00	$ 15,000.00	installed on stubs to Cells 2 and 3 as well
RTU system	1		$ 100,000.00	$ 100,000.00	
				$ 150,000.00	
OPERATIONS AND MAINTENANCE					
Routine Maintenance					
Mowing, assume mowing with tractor & 5' cutter mowing only top and first 10' on s	195,233		$ 0.03	$ 4,880.83	quarterly, round up to $5000
	4		$ 5,000.00	$ 20,000.00	mow berms quarterly with equipment trailered from Bartow Office
Misc	1		$ 80,000.00	$ 80,000.00	allowance: includes meter repair, structure clean out, trash removal, etc.
				$ 100,000.00	
Routine Operations					
Operators (3)	6240		$ 35.00	$ 218,400.00	3 full-time operators, includes labor for WQ sampling and vegetation assessments
Operational WQ Monitoring					
Lab Costs				$ 100,000.00	allowance

Table 6b Earthwork Summary for 1095 Acre Surface Flow Wetlands

Stratum: proposed 27 existing 27
Site: Lake Hancock Earthwork
Site Volume Table: Unadjusted

	CUT (CY)	FILL (CY)	NET (CY)	RESULT (CUT OR FILL)	METHOD
	648,467.00	4,539,376.00	3,890,910.00	(F)	Grid
CELL 1	45,860.84	1,238,372.53	1,192,511.69	(F)	Grid
CELL 2	179,128.38	227,837.83	48,709.44	(F)	Grid
CELL 3	175,624.87	1,346,162.61	1,170,537.74	(F)	Grid
BUFFER	-	629,483.54	629,483.54	(F)	Grid
TOTALS	**400,614.09**	**1,097,519.50**	**1,498,133.59**		
cut only in cell areas	400,614.09				
fill only in berm areas		1,097,519.50			
net			696,905.40		

material excavated is from within cells of existing reclaimed phosphatic clays and may not be suitable for berms
for purpose of this conceptual plan it assumed that borrow material will be needed from other parts of the OFP site

Table 6c Sitework Calculations for 1095 Acre Surface Flow Wetlands

BERM LENGTHS (LINEAR FEET)	Length			final grading		hydro seed		mowing	
	exterior	interior	Total	exposed berm slope		exposed berm slope		top & 10' of side slope	
CELL 3	13630	0	13630	116,493	-	97,336	-	60,578	
CELL 2	7643	0	7643	65,323	-	54,581	-	33,969	
CELL 1	7962	0	7962	68,049	-	56,859	-	35,387	
BUFFER CELL	4912	0	4912	69,596	-	35,078	-	21,831	-
BERM BETWEEN CELL 1 & 2	0	3490	3490	-	29,828	-	20,018		15,511
BERM BETWEEN CELL 1 & 3 (to pump station)	0	3544	3544	-	30,290	-	25,309		7,876
BERM BETWEEN CELL 3 & 2 (to pump station)	0	1607	1607	-	13,735	-	11,476		3,571
BERM BETWEEN CELL 1 & BUFFER)	0	3715	3715	-	42,194	-	21,309		16,511
TOTAL BERM LENGTH	34147	12356	**46503**	319,461	116,047	243,855	78,112	151,764	43,469

Average berm characteristics	top width	ratio x:1	base width	height1	height2	slope1, ft	slope2, L	volume, cy	perimeter
volume, per linear foot	20	3	74	9	9	28.5	28.5	15.7	8.5
for buffer cell berm, exterior	20	3	122	17	17	53.8	53.8	44.7	14.2
for buffer cell berm, interior	20	3	98	9	17	28.5	53.8	19.7	11.4
grading, slope area to edge of water (4' water depth), ir	20	3	50	5	9	15.8	28.5		7.1
grading, slope area to edge of water (4' water depth), e	20	3	50	5	5	15.8	15.8		5.7
mowing area of exterior berms	20	3	50	5	9	15.8	28.5		7.1

mowing	sy/lf
10' slope each side, with roads	2.2
top & 10' each side, interior berms	4.4

Table 7 Itemized construction and annual operations and maintenance (O&M) costs for 52 CFS (33-MGD) inflow intake and pump station.

LAKE HANCOCK OUTFALL TREATMENT PROJECT

52 CUBIC FEET PER SECOND INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	\$/ft [(1)]	Escalated Cost
Transmission Main											
Single Pipeline	33.47	23263	36.0	Steel	110	7500	7.33	0.5601	42.0	256.11	\$ 1,920,825
Dual Pipeline	0.00	0	48.0	Steel	110	0	0.00	0.0000	0.0	0.00	\$ -
Total	**33.47**	**23,263**							**42.01**		**\$ 1,920,825**
										Inflated to 2004	**\$ 2,339,565**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs		52	
Capacity - MGD		33	
Construction Cost \$	\$	413,902	(Footnote 2)
Telemetry	\$	100,000	(Footnote 2)
3-Phase Power	\$	625,000	(Footnote 2)
Electrical Service	\$	100,000	
Inflation (Construction Materials)	\$	103,476	Increased by 25% due to recent increases in concrete and steel costs this year
Total	**\$**	**1,342,378**	

Lake Hancock Pump Station

Capacity - mgd	33	
Hf	42.0	
Static Head+PS Loss	30.0	Assume lake level intake at 95, top of buffer cell berm is 125
TDH	72.0	
Pump Efficiency	0.80	
Break HP	528.7	
Motor Efficiency	0.95	
Maximum Annual kwh	3,635,639	
Average Annual kwh	2,035,884	Based on annual average flow 29 cfs or 19 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**142,512**	Assumes operation at 29 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	\$ 1,342,378	\$ 13,424	\$ 53,695	\$ 142,512	\$ 209,631
Transmission Main	\$ 2,339,565	\$ 23,396			\$ 23,396
Total Intake, pump station and transmission main	**\$ 3,681,942**	**\$ 36,819**	**\$ 53,695**	**\$ 142,512**	\$ 233,026

Power cost \$0.07 & 95% motor efficiency
Annual O&M Structures @ 1% of cost
Annual O&M Equipment @ 4% of cost

Table 8   2450 Acre Surface Flow Wetland, Nitrogen Removal Model

Global Parameters

Wetland Area =	2540	ac
Minimum Pumping Capacity =	0	cfs
Maximum Pumping Capacity =	110	cfs
Number of Tanks in Series (N) =	6	
TN Load Reduction Goal =	30	% of Average Annual Total
Average Annual TN Load Available =	289714	kg/yr
Average Annual TN Load to Wetland =	216394	kg/yr
Average Annual TN Load Reduced by Wetland	130377	kg/yr
Wetland TN Treatment Efficiency =	60	% of Load Applied to Wetland
Overall TN Removal Efficiency =	45.0	% of Available Load
Flow Captured =	75%	% of Total Flow

	BOD	TSS	TON	NH_3-N	NO_3-N	TN	TP
k (m/yr)	34	100	17	40	75	22	10
C* (mg/L)	2.0	2.0	1.0	0	0.005	1.0	0.01
θ	1.00	1.00	1.00	1.04	1.04	1.05	1.00

							Inflow Concentrations (mg/L)							Inflow Mass Loading Rates (kg/ha/d)							Outflow Concentrations (mg/L)						
Date	Pumped Flow (cfs)	Untreated Flow (cfs)	Cumul. Flow Treated (cfs-q)	Cumul. Total Flow (cfs-q)	%of Flow Treated	Water Temp (°C)	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP
Average--->	44	15				20	18	115	5.50	0.02	0.02	5.53	0.60	1.88	11.99	0.57	0.00	0.00	0.58	0.06	2.27	2.07	1.29	0.18	0.11	1.58	0.09
Maximum--->	110	429				20	18	115	5.50	0.02	0.02	5.53	0.60	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
Minimum--->	0	0				20	18	115	5.50	0.02	0.02	5.53	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
Standard Deviation--->	40	55				0	0	0	0.00	0.00	0.00	0.00	0.00	1.70	10.85	0.52	0.00	0.00	0.52	0.06	0.40	0.11	0.39	0.23	0.14	0.75	0.09
1/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
4/1/1975	10	0	10	10	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.41	2.61	0.13	0.00	0.00	0.13	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1976	1	0	11	11	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.04	0.27	0.01	0.00	0.00	0.01	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
2/1/1976	0	0	11	11	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/1976	20	0	31	31	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.87	5.53	0.26	0.00	0.00	0.27	0.03	2.00	2.00	1.01	0.01	0.01	1.03	0.02
4/1/1976	8	0	39	39	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.36	2.30	0.11	0.00	0.00	0.11	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1977	11	0	50	50	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.49	3.10	0.15	0.00	0.00	0.15	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
2/1/1977	10	0	61	61	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.45	2.86	0.14	0.00	0.00	0.14	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1977	7	0	67	67	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.28	1.79	0.09	0.00	0.00	0.09	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
4/1/1977	16	0	84	84	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.70	4.45	0.21	0.00	0.00	0.21	0.02	2.00	2.00	1.01	0.00	0.00	1.01	0.02
1/1/1978	27	0	111	111	2%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.17	7.48	0.36	0.00	0.00	0.36	0.04	2.01	2.00	1.04	0.03	0.02	1.09	0.03
2/1/1978	9	0	120	120	2%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.37	2.39	0.11	0.00	0.00	0.11	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1978	67	0	187	187	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.86	18.29	0.87	0.00	0.00	0.88	0.10	2.27	2.03	1.41	0.27	0.17	1.86	0.14
4/1/1978	12	0	198	198	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.50	3.22	0.15	0.00	0.00	0.15	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1979	20	0	219	219	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.88	5.60	0.27	0.00	0.00	0.27	0.03	2.00	2.00	1.01	0.01	0.01	1.03	0.02
2/1/1979	103	0	322	322	5%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.43	28.32	1.35	0.00	0.00	1.36	0.15	2.85	2.21	1.87	0.52	0.32	2.71	0.22
3/1/1979	110	51	432	483	6%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1979	110	0	542	593	8%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.70	30.01	1.44	0.00	0.00	1.44	0.16	2.97	2.26	1.94	0.56	0.33	2.84	0.24
1/1/1980	39	0	581	632	9%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.67	10.69	0.51	0.00	0.00	0.51	0.06	2.04	2.00	1.12	0.08	0.05	1.25	0.06
2/1/1980	26	0	607	658	9%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.10	7.02	0.34	0.00	0.00	0.34	0.04	2.01	2.00	1.03	0.02	0.02	1.07	0.03
3/1/1980	32	0	639	690	9%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.37	8.75	0.42	0.00	0.00	0.42	0.05	2.02	2.00	1.07	0.05	0.03	1.14	0.05
4/1/1980	22	0	661	712	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.94	6.03	0.29	0.00	0.00	0.29	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
1/1/1981	18	0	678	729	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.75	4.79	0.23	0.00	0.00	0.23	0.03	2.00	2.00	1.01	0.01	0.00	1.02	0.02
2/1/1981	3	0	681	732	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.14	0.87	0.04	0.00	0.00	0.04	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1981	18	0	699	750	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.76	4.85	0.23	0.00	0.00	0.23	0.03	2.00	2.00	1.01	0.01	0.00	1.02	0.02
4/1/1981	22	0	721	772	11%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.93	5.94	0.28	0.00	0.00	0.29	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
1/1/1982	6	0	727	778	11%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.25	1.61	0.08	0.00	0.00	0.08	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
2/1/1982	50	0	777	828	11%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.14	13.67	0.65	0.00	0.00	0.66	0.07	2.11	2.01	1.22	0.15	0.10	1.47	0.09
3/1/1982	110	75	887	1013	13%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1982	108	0	995	1120	15%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.62	29.55	1.41	0.00	0.00	1.42	0.15	2.94	2.25	1.92	0.55	0.33	2.80	0.23
1/1/1983	110	91	1105	1321	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
2/1/1983	110	10	1215	1441	18%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
3/1/1983	110	20	1325	1571	19%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1983	65	0	1390	1636	20%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.80	17.88	0.86	0.00	0.00	0.86	0.09	2.25	2.03	1.40	0.26	0.17	1.83	0.14
1/1/1984	110	24	1500	1771	22%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
2/1/1984	35	0	1535	1806	23%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.51	9.66	0.46	0.00	0.00	0.46	0.05	2.03	2.00	1.09	0.06	0.04	1.19	0.05
3/1/1984	74	0	1609	1880	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.17	20.27	0.97	0.00	0.00	0.97	0.11	2.36	2.05	1.50	0.33	0.21	2.04	0.16
4/1/1984	16	0	1625	1896	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.68	4.31	0.21	0.00	0.00	0.21	0.02	2.00	2.00	1.01	0.00	0.00	1.01	0.01
1/1/1985	30	0	1655	1926	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.29	8.26	0.39	0.00	0.00	0.40	0.04	2.02	2.00	1.06	0.04	0.03	1.12	0.04
2/1/1985	5	0	1660	1930	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.20	1.28	0.06	0.00	0.00	0.06	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1985	16	0	1676	1947	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.70	4.50	0.22	0.00	0.00	0.22	0.02	2.00	2.00	1.01	0.00	0.00	1.01	0.02
4/1/1985	4	0	1681	1951	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.18	1.17	0.06	0.00	0.00	0.06	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1986	14	0	1695	1965	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.61	3.89	0.19	0.00	0.00	0.19	0.02	2.00	2.00	1.00	0.00	0.00	1.01	0.01
2/1/1986	5	0	1700	1971	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.23	1.49	0.07	0.00	0.00	0.07	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1986	21	0	1722	1992	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.92	5.85	0.28	0.00	0.00	0.28	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
4/1/1986	13	0	1734	2005	26%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.54	3.44	0.16	0.00	0.00	0.17	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1987	24	0	1758	2029	26%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.03	6.59	0.32	0.00	0.00	0.32	0.03	2.01	2.00	1.03	0.02	0.01	1.06	0.03
2/1/1987	48	0	1807	2077	27%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.08	13.27	0.63	0.00	0.00	0.64	0.07	2.10	2.01	1.21	0.14	0.09	1.44	0.09
3/1/1987	31	0	1838	2108	27%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.33	8.50	0.41	0.00	0.00	0.41	0.04	2.02	2.00	1.06	0.04	0.03	1.13	0.04
4/1/1987	36	0	1874	2144	28%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.54	9.84	0.47	0.00	0.00	0.47	0.05	2.03	2.00	1.09	0.07	0.04	1.20	0.06
1/1/1988	41	0	1914	2185	28%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.74	11.13	0.53	0.00	0.00	0.54	0.06	2.05	2.00	1.13	0.09	0.06	1.28	0.07
2/1/1988	15	0	1929	2200	28%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.63	4.03	0.19	0.00	0.00	0.19	0.02	2.00	2.00	1.00	0.00	0.00	1.01	0.01
3/1/1988	110	52	2039	2362	30%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1988	53	0	2092	2415	31%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.26	14.44	0.69	0.00	0.00	0.69	0.08	2.13	2.01	1.25	0.17	0.11	1.53	0.10
1/1/1989	26	0	2118	2441	31%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.11	7.12	0.34	0.00	0.00	0.34	0.04	2.01	2.00	1.03	0.02	0.02	1.08	0.03
2/1/1989	21	0	2139	2462	31%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.92	5.87	0.28	0.00	0.00	0.28	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
3/1/1989	23	0	2162	2485	32%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.99	6.32	0.30	0.00	0.00	0.30	0.03	2.01	2.00	1.02	0.02	0.01	1.05	0.03
4/1/1989	19	0	2182	2504	32%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.83	5.28	0.25	0.00	0.00	0.25	0.03	2.00	2.00	1.01	0.01	0.01	1.03	0.02
1/1/1990	17	0	2199	2522	32%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.74	4.70	0.22	0.00	0.00	0.23	0.02	2.00	2.00	1.01	0.01	0.00	1.02	0.02
2/1/1990	16	0	2215	2537	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.68	4.34	0.21	0.00	0.00	0.21	0.02	2.00	2.00	1.01	0.00	0.00	1.01	0.02
3/1/1990	35	0	2250	2573	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.52	9.68	0.46	0.00	0.00	0.47	0.05	2.03	2.00	1.09	0.06	0.04	1.19	0.05
4/1/1990	18	0	2268	2591	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.76	4.87	0.23	0.00	0.00	0.23	0.03	2.00	2.00	1.01	0.01	0.00	1.02	0.02
1/1/1991	0	0	2268	2591	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/1991	5	0	2273	2596	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.22	1.37	0.07	0.00	0.00	0.07	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1991	110	34	2383	2739	35%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1991	18	0	2401	2757	35%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.76	4.85	0.23	0.00	0.00	0.23	0.03	2.00	2.00	1.01	0.01	0.00	1.02	0.02
1/1/1992	12	0	2413	2769	35%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.52	3.30	0.16	0.00	0.00	0.16	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01

Table 8 2450 Acre Surface Flow Wetland, Nitrogen Removal Model

							Inflow Concentrations (mg/L)							Inflow Mass Loading Rates (kg/ha/d)							Outflow Concentrations (mg/L)						
Date	Pumped Flow (cfs)	Untreated Flow (cfs)	Cumul. Flow Treated (cfs-q)	Cumul. Total Flow (cfs-q)	%of Flow Treated	Water Temp (^oC)	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP
Average--->	44	15				20	18	115	5.50	0.02	0.02	5.53	0.60	1.88	11.99	0.57	0.00	0.00	0.58	0.06	2.27	2.07	1.29	0.18	0.11	1.58	0.09
Maximum--->	110	429				20	18	115	5.50	0.02	0.02	5.53	0.60	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
Minimum--->	0	0				20	18	115	5.50	0.02	0.02	5.53	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
Standard Deviation--->	40	55				0	0	0	0.00	0.00	0.00	0.00	0.00	1.70	10.85	0.52	0.00	0.00	0.52	0.06	0.40	0.11	0.39	0.23	0.14	0.75	0.09
2/1/1992	16	0	2429	2785	36%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.70	4.45	0.21	0.00	0.00	0.21	0.02	2.00	2.00	1.01	0.00	0.00	1.01	0.02
3/1/1992	100	0	2529	2885	37%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.28	27.37	1.31	0.00	0.00	1.32	0.14	2.79	2.18	1.83	0.50	0.30	2.63	0.22
4/1/1992	9	0	2538	2895	37%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.40	2.59	0.12	0.00	0.00	0.12	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1993	91	0	2630	2986	39%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.92	25.01	1.20	0.00	0.00	1.20	0.13	2.63	2.13	1.72	0.45	0.28	2.44	0.20
2/1/1993	60	0	2690	3046	40%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.57	16.42	0.79	0.00	0.00	0.79	0.09	2.19	2.02	1.33	0.22	0.14	1.70	0.12
3/1/1993	27	0	2717	3073	40%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.16	7.40	0.35	0.00	0.00	0.36	0.04	2.01	2.00	1.04	0.03	0.02	1.09	0.03
4/1/1993	24	0	2741	3097	40%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.03	6.55	0.31	0.00	0.00	0.32	0.03	2.01	2.00	1.03	0.02	0.01	1.06	0.03
1/1/1994	24	0	2764	3121	41%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.02	6.53	0.31	0.00	0.00	0.31	0.03	2.01	2.00	1.03	0.02	0.01	1.06	0.03
2/1/1994	24	0	2788	3145	41%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.02	6.50	0.31	0.00	0.00	0.31	0.03	2.01	2.00	1.03	0.02	0.01	1.06	0.03
3/1/1994	110	32	2898	3287	43%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1994	110	56	3008	3453	44%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
1/1/1995	45	0	3054	3498	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.95	12.43	0.59	0.00	0.00	0.60	0.07	2.08	2.01	1.17	0.12	0.08	1.37	0.08
2/1/1995	37	0	3091	3535	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.60	10.20	0.49	0.00	0.00	0.49	0.05	2.04	2.00	1.10	0.07	0.05	1.22	0.06
3/1/1995	110	322	3201	3967	47%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1995	110	12	3311	4089	49%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
1/1/1996	110	25	3421	4224	50%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
2/1/1996	66	0	3487	4290	51%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.82	18.00	0.86	0.00	0.00	0.87	0.09	2.26	2.03	1.40	0.26	0.17	1.84	0.14
3/1/1996	110	24	3597	4424	53%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/1996	56	0	3653	4480	54%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.40	15.31	0.73	0.00	0.00	0.74	0.08	2.15	2.01	1.29	0.19	0.13	1.60	0.11
1/1/1997	23	0	3676	4503	54%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.99	6.33	0.30	0.00	0.00	0.30	0.03	2.01	2.00	1.02	0.02	0.01	1.05	0.03
2/1/1997	34	0	3710	4537	55%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.47	9.41	0.45	0.00	0.00	0.45	0.05	2.03	2.00	1.08	0.06	0.04	1.18	0.05
3/1/1997	86	0	3796	4623	56%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.68	23.49	1.12	0.00	0.00	1.13	0.12	2.54	2.10	1.65	0.41	0.25	2.32	0.19
4/1/1997	110	128	3906	4861	57%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
1/1/1998	110	429	4016	5400	59%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
2/1/1998	92	0	4107	5492	60%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.92	25.07	1.20	0.00	0.00	1.21	0.13	2.63	2.13	1.72	0.45	0.28	2.45	0.20
3/1/1998	75	0	4182	5567	62%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.21	20.49	0.98	0.00	0.00	0.99	0.11	2.37	2.06	1.51	0.33	0.21	2.06	0.16
4/1/1998	93	0	4276	5660	63%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.00	25.52	1.22	0.00	0.00	1.23	0.13	2.66	2.14	1.74	0.46	0.28	2.49	0.20
1/1/1999	19	0	4294	5679	63%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.80	5.09	0.24	0.00	0.00	0.24	0.03	2.00	2.00	1.01	0.01	0.01	1.02	0.02
2/1/1999	39	0	4333	5717	64%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.66	10.63	0.51	0.00	0.00	0.51	0.06	2.04	2.00	1.12	0.08	0.05	1.25	0.06
3/1/1999	28	0	4361	5746	64%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.21	7.75	0.37	0.00	0.00	0.37	0.04	2.01	2.00	1.05	0.03	0.02	1.10	0.04
4/1/1999	26	0	4387	5771	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.10	7.05	0.34	0.00	0.00	0.34	0.04	2.01	2.00	1.03	0.02	0.02	1.07	0.03
1/1/2000	23	0	4410	5795	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.00	6.37	0.30	0.00	0.00	0.31	0.03	2.01	2.00	1.02	0.02	0.01	1.05	0.03
2/1/2000	8	0	4418	5803	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.35	2.22	0.11	0.00	0.00	0.11	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/2000	5	0	4423	5808	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.21	1.37	0.07	0.00	0.00	0.07	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
4/1/2000	3	0	4426	5810	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.11	0.70	0.03	0.00	0.00	0.03	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/2001	0	0	4426	5810	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/2001	0	0	4426	5810	65%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/2001	28	0	4454	5839	66%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.22	7.79	0.37	0.00	0.00	0.37	0.04	2.01	2.00	1.05	0.03	0.02	1.10	0.04
4/1/2001	15	0	4469	5854	66%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.63	4.05	0.19	0.00	0.00	0.19	0.02	2.00	2.00	1.00	0.00	0.00	1.01	0.01
1/1/2002	27	0	4496	5880	66%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.14	7.30	0.35	0.00	0.00	0.35	0.04	2.01	2.00	1.04	0.03	0.02	1.08	0.03
2/1/2002	8	0	4504	5888	66%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.34	2.15	0.10	0.00	0.00	0.10	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/2002	106	0	4610	5994	68%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.54	29.01	1.39	0.00	0.00	1.40	0.15	2.90	2.23	1.90	0.54	0.32	2.76	0.23
4/1/2002	110	108	4720	6213	69%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
1/1/2003	110	168	4830	6491	71%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
2/1/2003	106	0	4935	6596	73%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.52	28.91	1.38	0.00	0.00	1.39	0.15	2.89	2.23	1.90	0.54	0.32	2.75	0.23
3/1/2003	110	54	5045	6760	74%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.71	30.11	1.44	0.00	0.00	1.45	0.16	2.98	2.26	1.95	0.56	0.33	2.84	0.24
4/1/2003	38	0	5083	6797	75%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.62	10.32	0.49	0.00	0.00	0.50	0.05	2.04	2.00	1.11	0.07	0.05	1.23	0.06

Table 8 2450 Acre Surface Flow Wetland, Nitrogen Removal Model

	Outflow Mass Loading Rates (kg/ha/d)							TN Loads (kg/d)			TN Removal Efficiency (%)		Calculations							kg/d removed					
Date	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	Total	Pumped to Wetland	Removed by Wetland	Wetland	Total	q (m/yr)	$(1+k_{TON}/(Nq))^{-N}$	$(1+k_{NH3}/(Nq))^{-N}$	$(1+k_{NO3}/(Nq))^{-N}$	$k_{TON}/(k_{NH3}-k_{TON})$	$k_{NH3}/(k_{NO3}-k_{NH3})$	$k_{NH3}/(k_{NO3}-k_{TON})$	BOD	TSS	NH3	NO3	TP	
Average--->	0.29	0.24	0.18	0.04	0.02	0.24	0.02	289378	216394	130377	60%	45%								603,007	4,415,941	-13,797	-8,096	17,163	kg/yr
Maximum--->	0.78	0.59	0.51	0.15	0.09	0.74	0.06	8368961	6258232	3770560															
Minimum--->	0.00	0.00	0.00	0.00	0.00	0.00	0.00	288585	215801	130019															
Standard Deviation--->	0.29	0.21	0.19	0.06	0.04	0.29	0.03																		
1/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
4/1/1975	0.05	0.05	0.02	0.00	0.00	0.02	0.00	129.19	129.19	105.80	82%	82%	0.83	0.000	0.000	0.000	0.7	1.1	0.7	374	2,640	0.340	0.343	13.8	
1/1/1976	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.35	13.35	10.93	82%	82%	0.09	0.000	0.000	0.000	0.7	1.1	0.7	38.6	273	0.036	0.036	1.43	
2/1/1976	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/1976	0.10	0.10	0.05	0.00	0.00	0.05	0.00	273.57	273.57	222.56	81%	81%	1.76	0.003	0.000	0.000	0.7	1.1	0.7	791	5,590	0.24	0.40	28.8	
4/1/1976	0.04	0.04	0.02	0.00	0.00	0.02	0.00	113.65	113.65	93.08	82%	82%	0.73	0.000	0.000	0.000	0.7	1.1	0.7	329	2,322	0.303	0.305	12.2	
1/1/1977	0.05	0.05	0.03	0.00	0.00	0.03	0.00	153.31	153.31	125.51	82%	82%	0.98	0.000	0.000	0.000	0.7	1.1	0.7	444	3,133	0.389	0.398	16.4	
2/1/1977	0.05	0.05	0.02	0.00	0.00	0.02	0.00	141.22	141.22	115.63	82%	82%	0.91	0.000	0.000	0.000	0.7	1.1	0.7	409	2,886	0.366	0.371	15.1	
3/1/1977	0.03	0.03	0.02	0.00	0.00	0.02	0.00	88.33	88.33	72.35	82%	82%	0.57	0.000	0.000	0.000	0.7	1.1	0.7	256	1,805	0.238	0.239	9.47	
4/1/1977	0.08	0.08	0.04	0.00	0.00	0.04	0.00	219.98	219.98	179.66	82%	82%	1.41	0.001	0.000	0.000	0.7	1.1	0.7	636	4,495	0.42	0.48	23.4	
1/1/1978	0.13	0.13	0.07	0.00	0.00	0.07	0.00	369.83	369.83	297.02	80%	80%	2.37	0.009	0.000	0.000	0.7	1.1	0.7	1,069	7,557	-0.9	-0.29	38.0	
2/1/1978	0.04	0.04	0.02	0.00	0.00	0.02	0.00	117.92	117.92	96.57	82%	82%	0.76	0.000	0.000	0.000	0.7	1.1	0.7	341	2,409	0.314	0.316	12.6	
3/1/1978	0.36	0.32	0.22	0.04	0.03	0.30	0.02	903.95	903.95	599.72	66%	66%	5.80	0.092	0.010	0.001	0.7	1.1	0.7	2,572	18,466	-42.1	-26.0	75.6	
4/1/1978	0.06	0.06	0.03	0.00	0.00	0.03	0.00	159.22	159.22	130.33	82%	82%	1.02	0.000	0.000	0.000	0.7	1.1	0.7	461	3,253	0.399	0.410	17.0	
1/1/1979	0.10	0.10	0.05	0.00	0.00	0.05	0.00	276.86	276.86	225.16	81%	81%	1.78	0.003	0.000	0.000	0.7	1.1	0.7	801	5,657	0.22	0.39	29.1	
2/1/1979	0.70	0.54	0.46	0.13	0.08	0.67	0.06	1400.02	1400.02	714.11	51%	51%	8.99	0.193	0.036	0.005	0.7	1.1	0.7	3,835	28,555	-128.9	-76.1	96.0	
3/1/1979	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2178.42	1488.26	722.77	49%	33%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1979	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1483.56	1483.56	722.38	49%	49%	9.53	0.210	0.041	0.007	0.7	1.1	0.7	4,032	30,245	-146.2	-85.5	98.6	
1/1/1980	0.19	0.19	0.10	0.01	0.01	0.12	0.01	528.38	528.38	408.50	77%	77%	3.39	0.026	0.001	0.000	0.7	1.1	0.7	1,525	10,797	-6.4	-3.8	51.5	
2/1/1980	0.12	0.12	0.06	0.00	0.00	0.07	0.00	347.09	347.09	279.81	81%	81%	2.23	0.007	0.000	0.000	0.7	1.1	0.7	1004	7,092	-0.5	-0.05	35.9	
3/1/1980	0.15	0.15	0.08	0.00	0.00	0.09	0.00	432.35	432.35	342.90	79%	79%	2.78	0.015	0.001	0.000	0.7	1.1	0.7	1,249	8,835	-2.5	-1.3	43.6	
4/1/1980	0.11	0.10	0.05	0.00	0.00	0.05	0.00	298.22	298.22	241.99	81%	81%	1.91	0.004	0.000	0.000	0.7	1.1	0.7	863	6,094	0.06	0.30	31.2	
1/1/1981	0.08	0.08	0.04	0.00	0.00	0.04	0.00	236.98	236.98	193.35	82%	82%	1.52	0.002	0.000	0.000	0.7	1.1	0.7	686	4,843	0.39	0.47	25.1	
2/1/1981	0.02	0.02	0.01	0.00	0.00	0.01	0.00	43.09	43.09	35.30	82%	82%	0.28	0.000	0.000	0.000	0.7	1.1	0.7	125	881	0.117	0.117	4.62	
3/1/1981	0.08	0.08	0.04	0.00	0.00	0.04	0.00	239.51	239.51	195.38	82%	82%	1.54	0.002	0.000	0.000	0.7	1.1	0.7	693	4,894	0.38	0.47	25.4	
4/1/1981	0.10	0.10	0.05	0.00	0.00	0.05	0.00	293.68	293.68	238.43	81%	81%	1.89	0.004	0.000	0.000	0.7	1.1	0.7	849	6,001	0.10	0.32	30.8	
1/1/1982	0.03	0.03	0.01	0.00	0.00	0.01	0.00	79.59	79.59	65.20	82%	82%	0.51	0.000	0.000	0.000	0.7	1.1	0.7	230	1,626	0.215	0.215	8.53	
2/1/1982	0.25	0.24	0.15	0.02	0.01	0.17	0.01	675.63	675.63	496.08	73%	73%	4.34	0.049	0.004	0.000	0.7	1.1	0.7	1,942	13,805	-16.6	-10.2	62.1	
3/1/1982	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2502.52	1488.26	722.77	49%	29%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1982	0.76	0.58	0.49	0.14	0.08	0.72	0.06	1460.51	1460.51	720.34	49%	49%	9.38	0.205	0.040	0.006	0.7	1.1	0.7	3,978	29,779	-141.4	-82.9	97.9	
1/1/1983	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2713.09	1488.26	722.77	49%	27%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
2/1/1983	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1626.27	1488.26	722.77	49%	44%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
3/1/1983	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1752.26	1488.26	722.77	49%	41%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1983	0.35	0.32	0.22	0.04	0.03	0.28	0.02	884.03	884.03	592.17	67%	67%	5.68	0.088	0.009	0.001	0.7	1.1	0.7	2,518	18,059	-39.4	-24.4	74.6	
1/1/1984	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1818.77	1488.26	722.77	49%	40%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
2/1/1984	0.17	0.17	0.09	0.01	0.00	0.10	0.00	477.71	477.71	374.67	78%	78%	3.07	0.020	0.001	0.000	0.7	1.1	0.7	1,380	9,761	-4.1	-2.3	47.4	
3/1/1984	0.42	0.36	0.27	0.06	0.04	0.36	0.03	1002.09	1002.09	633.13	63%	63%	6.43	0.112	0.014	0.002	0.7	1.1	0.7	2,834	20,467	-56.4	-34.6	80.5	
4/1/1984	0.08	0.08	0.04	0.00	0.00	0.04	0.00	213.25	213.25	174.23	82%	82%	1.37	0.001	0.000	0.000	0.7	1.1	0.7	617	4,358	0.43	0.48	22.7	
1/1/1985	0.14	0.14	0.08	0.00	0.00	0.08	0.00	408.18	408.18	325.44	80%	80%	2.62	0.012	0.001	0.000	0.7	1.1	0.7	1,180	8,341	-1.8	-0.8	41.5	
2/1/1985	0.02	0.02	0.01	0.00	0.00	0.01	0.00	63.22	63.22	51.79	82%	82%	0.41	0.000	0.000	0.000	0.7	1.1	0.7	183	1,292	0.171	0.171	6.78	
3/1/1985	0.08	0.08	0.04	0.00	0.00	0.04	0.00	222.22	222.22	181.47	82%	82%	1.43	0.001	0.000	0.000	0.7	1.1	0.7	643	4,541	0.42	0.48	23.6	
4/1/1985	0.02	0.02	0.01	0.00	0.00	0.01	0.00	57.84	57.84	47.38	82%	82%	0.37	0.000	0.000	0.000	0.7	1.1	0.7	167	1,182	0.157	0.157	6.20	
1/1/1986	0.07	0.07	0.03	0.00	0.00	0.03	0.00	192.08	192.08	157.08	82%	82%	1.23	0.001	0.000	0.000	0.7	1.1	0.7	556	3,925	0.43	0.461	20.5	
2/1/1986	0.03	0.03	0.01	0.00	0.00	0.01	0.00	73.71	73.71	60.38	82%	82%	0.47	0.000	0.000	0.000	0.7	1.1	0.7	213	1,506	0.200	0.200	7.90	
3/1/1986	0.10	0.10	0.05	0.00	0.00	0.05	0.00	289.28	289.28	234.97	81%	81%	1.86	0.004	0.000	0.000	0.7	1.1	0.7	837	5,911	0.13	0.34	30.4	
4/1/1986	0.06	0.06	0.03	0.00	0.00	0.03	0.00	169.96	169.96	139.08	82%	82%	1.09	0.000	0.000	0.000	0.7	1.1	0.7	492	3,473	0.415	0.429	18.2	
1/1/1987	0.11	0.11	0.06	0.00	0.00	0.06	0.00	325.59	325.59	263.30	81%	81%	2.09	0.006	0.000	0.000	0.7	1.1	0.7	942	6,653	-0.2	0.13	33.9	
2/1/1987	0.24	0.23	0.14	0.02	0.01	0.17	0.01	655.88	655.88	485.28	74%	74%	4.21	0.046	0.003	0.000	0.7	1.1	0.7	1,886	13,401	-14.9	-9.2	60.8	
3/1/1987	0.15	0.15	0.08	0.00	0.00	0.08	0.00	420.17	420.17	334.14	80%	80%	2.70	0.013	0.001	0.000	0.7	1.1	0.7	1,214	8,586	-2.1	-1.0	42.5	
4/1/1987	0.17	0.17	0.09	0.01	0.00	0.10	0.00	486.28	486.28	380.52	78%	78%	3.12	0.021	0.001	0.000	0.7	1.1	0.7	1,404	9,936	-4.4	-2.5	48.1	
1/1/1988	0.20	0.19	0.11	0.01	0.01	0.12	0.01	549.99	549.99	422.37	77%	77%	3.53	0.029	0.002	0.000	0.7	1.1	0.7	1,586	11,238	-7.6	-4.5	53.2	
2/1/1988	0.07	0.07	0.04	0.00	0.00	0.04	0.00	199.19	199.19	162.84	82%	82%	1.28	0.001	0.000	0.000	0.7	1.1	0.7	576	4,070	0.43	0.468	21.2	
3/1/1988	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2192.96	1488.26	722.77	49%	33%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1988	0.27	0.25	0.16	0.02	0.01	0.19	0.01	713.78	713.78	516.07	72%	72%	4.58	0.056	0.005	0.000	0.7	1.1	0.7	2,049	14,584	-20.0	-12.4	64.6	
1/1/1989	0.12	0.12	0.06	0.00	0.00	0.07	0.00	351.84	351.84	283.42	81%	81%	2.26	0.008	0.000	0.000	0.7	1.1	0.7	1,017	7,189	-0.6	-0.10	36.4	
2/1/1989	0.10	0.10	0.05	0.00	0.00	0.05	0.00	289.91	289.91	235.47	81%	81%	1.86	0.004	0.000	0.000	0.7	1.1	0.7	839	5,924	0.13	0.34	30.4	
3/1/1989	0.11	0.11	0.06	0.00	0.00	0.06	0.00	312.33	312.33	253.02	81%	81%	2.01	0.005	0.000	0.000	0.7	1.1	0.7	903	6,382	-0.08	0.22	32.6	
4/1/1989	0.09	0.09	0.05	0.00	0.00	0.05	0.00	261.05	261.05	212.60	81%	81%	1.68	0.003	0.000	0.000	0.7	1.1	0.7	755	5,334	0.30	0.43	27.5	
1/1/1990	0.08	0.08	0.04	0.00	0.00	0.04	0.00	232.14	232.14	189.46	82%	82%	1.49	0.002	0.000	0.000	0.7	1.1	0.7	672	4,744	0.40	0.47	24.6	
2/1/1990	0.08	0.08	0.04	0.00	0.00	0.04	0.00	214.33	214.33	175.10	82%	82%	1.38	0.001	0.000	0.000	0.7	1.1	0.7	620	4,380	0.43	0.48	22.8	
3/1/1990	0.17	0.17	0.09	0.01	0.00	0.10	0.00	478.61	478.61	375.29	78%	78%	3.07	0.020	0.001	0.000	0.7	1.1	0.7	1,382	9,780	-4.1	-2.3	47.5	
4/1/1990	0.08	0.08	0.04	0.00	0.00	0.04	0.00	240.67	240.67	196.32	82%	82%	1.55	0.002	0.000	0.000	0.7	1.1	0.7	696	4,918	0.38	0.47	25.5	
1/1/1991	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/1991	0.02	0.02	0.01	0.00	0.00	0.01	0.00	67.95	67.95	55.66	82%	82%	0.44	0.000	0.000	0.000	0.7	1.1	0.7	197	1,388	0.184	0.184	7.29	
3/1/1991	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1942.67	1488.26	722.77	49%	37%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1991	0.08	0.08	0.04	0.00	0.00	0.04	0.00	239.61	239.61	195.46	82%	82%	1.54	0.002	0.000	0.000	0.7	1.1	0.7	693	4,896	0.38	0.47	25.4	
1/1/1992	0.06	0.06	0.03	0.00	0.00	0.03	0.00	162.97	162.97	133.38	82%	82%	1.05	0.000	0.000	0.000	0.7	1.1	0.7	472	3,330	0.405	0.417	17.4	

Table 8 2450 Acre Surface Flow Wetland, Nitrogen Removal Model

	Outflow Mass Loading Rates (kg/ha/d)							TN Loads (kg/d)			TN Removal Efficiency (%)		Calculations							kg/d removed					
Date	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	Total	Pumped to Wetland	Removed by Wetland	Wetland	Total	q (m/yr)	$(1+k_{TON}/(Nq))^{-N}$	$(1+k_{NH3}/(Nq))^{-N}$	$(1+k_{NO3}/(Nq))^{-N}$	$k_{TON}/(k_{NH3}-k_{TON})$	$k_{NH3}/(k_{NO3}-k_{NH3})$	$k_{NH3}/(k_{NO3}-k_{TON})$	BOD	TSS	NH3	NO3	TP	
Average--->	0.29	0.24	0.18	0.04	0.02	0.24	0.02	289378	216394	130377	60%	45%								603,007	4,415,941	-13,797	-8,096	17,163	kg/yr
Maximum--->	0.78	0.59	0.51	0.15	0.09	0.74	0.06	8368961	6258232	3770560															
Minimum--->	0.00	0.00	0.00	0.00	0.00	0.00	0.00	288585	215801	130019															
Standard Deviation--->	0.29	0.21	0.19	0.06	0.04	0.29	0.03																		
2/1/1992	0.08	0.08	0.04	0.00	0.00	0.04	0.00	219.75	219.75	179.47	82%	82%	1.41	0.001	0.000	0.000	0.7	1.1	0.7	636	4,490	0.42	0.48	23.3	
3/1/1992	0.66	0.52	0.43	0.12	0.07	0.63	0.05	1352.76	1352.76	708.30	52%	52%	8.69	0.184	0.033	0.005	0.7	1.1	0.7	3,722	27,598	-119.3	-70.9	94.5	
4/1/1992	0.04	0.04	0.02	0.00	0.00	0.02	0.00	127.79	127.79	104.65	82%	82%	0.82	0.000	0.000	0.000	0.7	1.1	0.7	370	2,611	0.337	0.340	13.7	
1/1/1993	0.57	0.46	0.37	0.10	0.06	0.53	0.04	1236.42	1236.42	690.06	56%	56%	7.94	0.160	0.026	0.003	0.7	1.1	0.7	3,436	25,237	-96.7	-58.2	90.3	
2/1/1993	0.31	0.29	0.19	0.03	0.02	0.24	0.02	811.49	811.49	562.32	69%	69%	5.21	0.074	0.007	0.001	0.7	1.1	0.7	2,320	16,579	-30.4	-18.9	70.6	
3/1/1993	0.13	0.13	0.07	0.00	0.00	0.07	0.00	365.97	365.97	294.12	80%	80%	2.35	0.009	0.000	0.000	0.7	1.1	0.7	1,058	7,478	-0.8	-0.25	37.7	
4/1/1993	0.11	0.11	0.06	0.00	0.00	0.06	0.00	323.93	323.93	262.01	81%	81%	2.08	0.006	0.000	0.000	0.7	1.1	0.7	937	6,619	-0.2	0.14	33.7	
1/1/1994	0.11	0.11	0.06	0.00	0.00	0.06	0.00	322.75	322.75	261.10	81%	81%	2.07	0.006	0.000	0.000	0.7	1.1	0.7	933	6,595	-0.2	0.15	33.6	
2/1/1994	0.11	0.11	0.06	0.00	0.00	0.06	0.00	321.25	321.25	259.94	81%	81%	2.06	0.006	0.000	0.000	0.7	1.1	0.7	929	6,565	-0.18	0.16	33.5	
3/1/1994	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1923.43	1488.26	722.77	49%	38%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1994	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2246.36	1488.26	722.77	49%	32%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
1/1/1995	0.22	0.22	0.13	0.01	0.01	0.15	0.01	614.28	614.28	461.58	75%	75%	3.94	0.039	0.003	0.000	0.7	1.1	0.7	1,769	12,552	-11.7	-7.2	57.9	
2/1/1995	0.18	0.18	0.10	0.01	0.00	0.11	0.01	504.41	504.41	392.72	78%	78%	3.24	0.023	0.001	0.000	0.7	1.1	0.7	1,456	10,307	-5.2	-3.0	49.6	
3/1/1995	0.78	0.59	0.51	0.15	0.09	0.74	0.06	5845.57	1488.26	722.77	49%	12%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1995	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1647.58	1488.26	722.77	49%	44%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
1/1/1996	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1829.47	1488.26	722.77	49%	40%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
2/1/1996	0.35	0.32	0.22	0.04	0.03	0.29	0.02	889.58	889.58	594.30	67%	67%	5.71	0.089	0.010	0.001	0.7	1.1	0.7	2,533	18,173	-40.2	-24.9	74.9	
3/1/1996	0.78	0.59	0.51	0.15	0.09	0.74	0.06	1810.20	1488.26	722.77	49%	40%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/1996	0.29	0.27	0.17	0.03	0.02	0.21	0.01	756.58	756.58	537.21	71%	71%	4.86	0.063	0.006	0.000	0.7	1.1	0.7	2,168	15,458	-24.3	-15.1	67.3	
1/1/1997	0.11	0.11	0.06	0.00	0.00	0.06	0.00	312.89	312.89	253.45	81%	81%	2.01	0.005	0.000	0.000	0.7	1.1	0.7	905	6,394	-0.08	0.22	32.7	
2/1/1997	0.17	0.16	0.09	0.00	0.00	0.10	0.00	465.06	465.06	365.94	79%	79%	2.99	0.018	0.001	0.000	0.7	1.1	0.7	1,343	9,503	-3.6	-2.0	46.4	
3/1/1997	0.52	0.43	0.34	0.08	0.05	0.47	0.04	1160.94	1160.94	674.91	58%	58%	7.45	0.145	0.022	0.003	0.7	1.1	0.7	3,246	23,702	-82.9	-50.2	87.4	
4/1/1997	0.78	0.59	0.51	0.15	0.09	0.74	0.06	3222.89	1488.26	722.77	49%	22%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
1/1/1998	0.78	0.59	0.51	0.15	0.09	0.74	0.06	7290.73	1488.26	722.77	49%	10%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
2/1/1998	0.57	0.46	0.38	0.10	0.06	0.53	0.04	1239.02	1239.02	690.53	56%	56%	7.96	0.161	0.026	0.003	0.7	1.1	0.7	3,443	25,289	-97.2	-58.4	90.4	
3/1/1998	0.42	0.37	0.27	0.06	0.04	0.37	0.03	1012.85	1012.85	636.42	63%	63%	6.50	0.114	0.014	0.002	0.7	1.1	0.7	2,862	20,686	-58.0	-35.6	81.0	
4/1/1998	0.59	0.47	0.39	0.10	0.06	0.55	0.05	1261.65	1261.65	694.52	55%	55%	8.10	0.165	0.027	0.004	0.7	1.1	0.7	3,499	25,749	-101.5	-60.9	91.3	
1/1/1999	0.09	0.09	0.04	0.00	0.00	0.05	0.00	251.43	251.43	204.93	82%	82%	1.61	0.002	0.000	0.000	0.7	1.1	0.7	727	5,138	0.34	0.45	26.6	
2/1/1999	0.19	0.19	0.10	0.01	0.00	0.12	0.01	525.50	525.50	406.63	77%	77%	3.37	0.026	0.001	0.000	0.7	1.1	0.7	1,516	10,738	-6.3	-3.7	51.3	
3/1/1999	0.14	0.13	0.07	0.00	0.00	0.07	0.00	382.98	382.98	306.86	80%	80%	2.46	0.010	0.000	0.000	0.7	1.1	0.7	1,107	7,826	-1.2	-0.5	39.2	
4/1/1999	0.12	0.12	0.06	0.00	0.00	0.07	0.00	348.70	348.70	281.04	81%	81%	2.24	0.007	0.000	0.000	0.7	1.1	0.7	1008	7,125	-0.6	-0.06	36.1	
1/1/2000	0.11	0.11	0.06	0.00	0.00	0.06	0.00	314.90	314.90	255.01	81%	81%	2.02	0.005	0.000	0.000	0.7	1.1	0.7	911	6,435	-0.10	0.21	32.9	
2/1/2000	0.04	0.04	0.02	0.00	0.00	0.02	0.00	109.91	109.91	90.03	82%	82%	0.71	0.000	0.000	0.000	0.7	1.1	0.7	318	2,246	0.294	0.295	11.8	
3/1/2000	0.02	0.02	0.01	0.00	0.00	0.01	0.00	67.55	67.55	55.33	82%	82%	0.43	0.000	0.000	0.000	0.7	1.1	0.7	195	1,380	0.183	0.183	7.24	
4/1/2000	0.01	0.01	0.01	0.00	0.00	0.01	0.00	34.51	34.51	28.27	82%	82%	0.22	0.000	0.000	0.000	0.7	1.1	0.7	99.9	705	0.094	0.094	3.70	
1/1/2001	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/2001	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/2001	0.14	0.14	0.07	0.00	0.00	0.07	0.00	385.04	385.04	308.39	80%	80%	2.47	0.010	0.000	0.000	0.7	1.1	0.7	1,113	7,868	-1.2	-0.5	39.4	
4/1/2001	0.07	0.07	0.04	0.00	0.00	0.04	0.00	200.31	200.31	163.75	82%	82%	1.29	0.001	0.000	0.000	0.7	1.1	0.7	580	4,093	0.43	0.469	21.3	
1/1/2002	0.13	0.13	0.07	0.00	0.00	0.07	0.00	360.65	360.65	290.11	80%	80%	2.32	0.008	0.000	0.000	0.7	1.1	0.7	1,043	7,370	-0.8	-0.19	37.2	
2/1/2002	0.04	0.04	0.02	0.00	0.00	0.02	0.00	106.23	106.23	87.01	82%	82%	0.68	0.000	0.000	0.000	0.7	1.1	0.7	307	2,171	0.285	0.286	11.4	
3/1/2002	0.73	0.56	0.48	0.14	0.08	0.70	0.06	1433.97	1433.97	717.77	50%	50%	9.21	0.200	0.038	0.006	0.7	1.1	0.7	3,915	29,242	-135.9	-79.9	97.1	
4/1/2002	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2954.62	1488.26	722.77	49%	24%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
1/1/2003	0.78	0.59	0.51	0.15	0.09	0.74	0.06	3761.22	1488.26	722.77	49%	19%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
2/1/2003	0.73	0.56	0.48	0.13	0.08	0.69	0.06	1428.77	1428.77	717.24	50%	50%	9.17	0.199	0.038	0.006	0.7	1.1	0.7	3,903	29,137	-134.8	-79.4	96.9	
3/1/2003	0.78	0.59	0.51	0.15	0.09	0.74	0.06	2212.71	1488.26	722.77	49%	33%	9.56	0.211	0.042	0.007	0.7	1.1	0.7	4,042	30,340	-147.2	-86.1	98.8	
4/1/2003	0.18	0.18	0.10	0.01	0.00	0.11	0.01	510.17	510.17	396.55	78%	78%	3.28	0.024	0.001	0.000	0.7	1.1	0.7	1,473	10,425	-5.5	-3.2	50.1	

Table 9 1095 Acre Surface Flow Wetlands, Nitrogen Removal Model

Global Parameters

Wetland Area =	1095	ac
Minimum Pumping Capacity =	0	cfs
Maximum Pumping Capacity =	52	cfs
Number of Tanks in Series (N) =	6	
TN Load Reduction Goal =	30	% of Average Annual Total
Average Annual TN Load Available =	289714	kg/yr
Average Annual TN Load to Wetland =	145037	kg/yr
Average Annual TN Load Reduced by Wetland	79246	kg/yr
Wetland TN Treatment Efficiency =	55	% of Load Applied to Wetland
Overall TN Removal Efficiency =	27.4	% of Available Load
Flow Captured =	50%	% of Total Flow

	BOD	TSS	TON	NH_3-N	NO_3-N	TN	TP
k (m/yr)	34	100	17	40	75	22	10
C* (mg/L)	2.0	2.0	1.0	0	0.005	1.0	0.01
θ	1.00	1.00	1.00	1.04	1.04	1.05	1.00

Date	Pumped Flow (cfs)	Untreated Flow (cfs)	Cumul. Flow Treated (cfs-q)	Cumul. Total Flow (cfs-q)	%of Flow Treated	Water Temp (°C)	Inflow Concentrations (mg/L)							Inflow Mass Loading Rates (kg/ha/d)							Outflow Concentrations (mg/L)						
							BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP
Average--->	29	29				20	18	115	5.50	0.02	0.02	5.53	0.60	2.92	18.65	0.89	0.00	0.00	0.90	0.10	2.53	2.15	1.53	0.32	0.19	2.04	0.15
Maximum--->	52	487				20	18	115	5.50	0.02	0.02	5.53	0.60	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
Minimum--->	0	0				20	18	115	5.50	0.02	0.02	5.53	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
Standard Deviation--->	19	70				0	0	0	0.00	0.00	0.00	0.00	0.00	1.86	11.87	0.57	0.00	0.00	0.57	0.06	0.52	0.17	0.44	0.25	0.15	0.84	0.09
1/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/1975	0	0	0	0	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
4/1/1975	10	0	10	10	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.95	6.06	0.29	0.00	0.00	0.29	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
1/1/1976	1	0	11	11	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.10	0.63	0.03	0.00	0.00	0.03	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
2/1/1976	0	0	11	11	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/1976	20	0	31	31	0%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.01	12.84	0.61	0.00	0.00	0.62	0.07	2.09	2.01	1.19	0.13	0.09	1.41	0.09
4/1/1976	8	0	39	39	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.83	5.33	0.26	0.00	0.00	0.26	0.03	2.00	2.00	1.01	0.01	0.01	1.03	0.02
1/1/1977	11	0	50	50	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.13	7.19	0.34	0.00	0.00	0.35	0.04	2.01	2.00	1.04	0.03	0.02	1.08	0.03
2/1/1977	10	0	61	61	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.04	6.63	0.32	0.00	0.00	0.32	0.03	2.01	2.00	1.03	0.02	0.01	1.06	0.03
3/1/1977	7	0	67	67	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.65	4.14	0.20	0.00	0.00	0.20	0.02	2.00	2.00	1.00	0.00	0.00	1.01	0.01
4/1/1977	16	0	84	84	1%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.62	10.32	0.49	0.00	0.00	0.50	0.05	2.04	2.00	1.11	0.07	0.05	1.23	0.06
1/1/1978	27	0	111	111	2%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.72	17.36	0.83	0.00	0.00	0.83	0.09	2.23	2.03	1.37	0.25	0.16	1.78	0.13
2/1/1978	9	0	120	120	2%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.87	5.53	0.26	0.00	0.00	0.27	0.03	2.00	2.00	1.01	0.01	0.01	1.03	0.02
3/1/1978	52	15	172	187	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1978	12	0	184	198	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.17	7.47	0.36	0.00	0.00	0.36	0.04	2.01	2.00	1.04	0.03	0.02	1.09	0.03
1/1/1979	20	0	204	219	3%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.03	12.99	0.62	0.00	0.00	0.62	0.07	2.09	2.01	1.20	0.13	0.09	1.42	0.09
2/1/1979	52	51	256	322	4%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/1979	52	109	308	483	5%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1979	52	58	360	593	5%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1980	39	0	399	632	6%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.88	24.80	1.19	0.00	0.00	1.19	0.13	2.62	2.12	1.71	0.44	0.27	2.43	0.20
2/1/1980	26	0	425	658	6%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.55	16.29	0.78	0.00	0.00	0.78	0.09	2.19	2.02	1.33	0.22	0.14	1.69	0.12
3/1/1980	32	0	457	690	7%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.18	20.29	0.97	0.00	0.00	0.98	0.11	2.36	2.05	1.50	0.33	0.21	2.04	0.16
4/1/1980	22	0	479	712	7%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.19	13.99	0.67	0.00	0.00	0.67	0.07	2.12	2.01	1.23	0.16	0.10	1.50	0.10
1/1/1981	18	0	496	729	7%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.74	11.12	0.53	0.00	0.00	0.53	0.06	2.05	2.00	1.13	0.09	0.06	1.28	0.07
2/1/1981	3	0	499	732	7%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.32	2.02	0.10	0.00	0.00	0.10	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1981	18	0	517	750	8%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.76	11.24	0.54	0.00	0.00	0.54	0.06	2.05	2.00	1.13	0.09	0.06	1.29	0.07
4/1/1981	22	0	539	772	8%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.16	13.78	0.66	0.00	0.00	0.66	0.07	2.11	2.01	1.22	0.15	0.10	1.48	0.10
1/1/1982	6	0	545	778	8%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.58	3.74	0.18	0.00	0.00	0.18	0.02	2.00	2.00	1.00	0.00	0.00	1.01	0.01
2/1/1982	50	0	595	828	9%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.96	31.71	1.52	0.00	0.00	1.52	0.17	3.10	2.32	2.02	0.59	0.35	2.96	0.25
3/1/1982	52	133	647	1013	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1982	52	56	699	1120	10%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1983	52	149	751	1321	11%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/1983	52	68	803	1441	12%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/1983	52	78	855	1571	13%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1983	52	13	907	1636	13%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1984	52	82	959	1771	14%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/1984	35	0	994	1806	15%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.51	22.42	1.07	0.00	0.00	1.08	0.12	2.48	2.08	1.60	0.38	0.24	2.22	0.18
3/1/1984	52	22	1046	1880	15%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1984	16	0	1062	1896	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.57	10.01	0.48	0.00	0.00	0.48	0.05	2.03	2.00	1.10	0.07	0.05	1.21	0.06
1/1/1985	30	0	1092	1926	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.00	19.16	0.92	0.00	0.00	0.92	0.10	2.31	2.04	1.45	0.30	0.19	1.94	0.15
2/1/1985	5	0	1097	1930	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.46	2.97	0.14	0.00	0.00	0.14	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1985	16	0	1113	1947	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.63	10.43	0.50	0.00	0.00	0.50	0.05	2.04	2.00	1.11	0.08	0.05	1.24	0.06
4/1/1985	4	0	1117	1951	16%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.42	2.71	0.13	0.00	0.00	0.13	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/1986	14	0	1131	1965	17%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.41	9.01	0.43	0.00	0.00	0.43	0.05	2.02	2.00	1.07	0.05	0.03	1.16	0.05
2/1/1986	5	0	1137	1971	17%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.54	3.46	0.17	0.00	0.00	0.17	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1986	21	0	1158	1992	17%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.12	13.58	0.65	0.00	0.00	0.65	0.07	2.10	2.01	1.22	0.15	0.10	1.46	0.09
4/1/1986	13	0	1171	2005	17%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.25	7.98	0.38	0.00	0.00	0.38	0.04	2.01	2.00	1.05	0.04	0.02	1.11	0.04
1/1/1987	24	0	1195	2029	18%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.39	15.28	0.73	0.00	0.00	0.73	0.08	2.15	2.01	1.28	0.19	0.12	1.60	0.11
2/1/1987	48	0	1243	2077	18%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.82	30.78	1.47	0.00	0.00	1.48	0.16	3.03	2.29	1.98	0.58	0.34	2.89	0.24
3/1/1987	31	0	1274	2108	19%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.09	19.72	0.94	0.00	0.00	0.95	0.10	2.33	2.05	1.48	0.31	0.20	1.99	0.15
4/1/1987	36	0	1310	2144	19%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.57	22.82	1.09	0.00	0.00	1.10	0.12	2.50	2.09	1.62	0.39	0.24	2.26	0.18
1/1/1988	41	0	1351	2185	20%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.04	25.81	1.23	0.00	0.00	1.24	0.14	2.68	2.14	1.76	0.47	0.29	2.51	0.21
2/1/1988	15	0	1366	2200	20%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.46	9.35	0.45	0.00	0.00	0.45	0.05	2.03	2.00	1.08	0.06	0.04	1.18	0.05
3/1/1988	52	110	1418	2362	21%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1988	52	1	1470	2415	22%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1989	26	0	1496	2441	22%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.58	16.51	0.79	0.00	0.00	0.79	0.09	2.20	2.02	1.34	0.22	0.15	1.71	0.12
2/1/1989	21	0	1517	2462	22%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.13	13.61	0.65	0.00	0.00	0.65	0.07	2.10	2.01	1.22	0.15	0.10	1.46	0.09
3/1/1989	23	0	1540	2485	23%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.29	14.66	0.70	0.00	0.00	0.70	0.08	2.13	2.01	1.26	0.18	0.11	1.55	0.10
4/1/1989	19	0	1560	2504	23%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.92	12.25	0.59	0.00	0.00	0.59	0.06	2.07	2.01	1.17	0.12	0.08	1.36	0.08
1/1/1990	17	0	1577	2522	23%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.71	10.89	0.52	0.00	0.00	0.52	0.06	2.05	2.00	1.12	0.09	0.06	1.27	0.07
2/1/1990	16	0	1593	2537	23%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.57	10.06	0.48	0.00	0.00	0.48	0.05	2.04	2.00	1.10	0.07	0.05	1.22	0.06
3/1/1990	35	0	1628	2573	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.52	22.46	1.07	0.00	0.00	1.08	0.12	2.48	2.08	1.60	0.38	0.24	2.23	0.18
4/1/1990	18	0	1646	2591	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.77	11.29	0.54	0.00	0.00	0.54	0.06	2.05	2.00	1.14	0.09	0.06	1.29	0.07
1/1/1991	0	0	1646	2591	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/1991	5	0	1651	2596	24%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.50	3.19	0.15	0.00	0.00	0.15	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
3/1/1991	52	92	1703	2739	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1991	18	0	1720	2757	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.76	11.24	0.54	0.00	0.00	0.54	0.06	2.05	2.00	1.14	0.09	0.06	1.29	0.07
1/1/1992	12	0	1732	2769	25%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.20	7.65	0.37	0.00	0.00	0.37	0.04	2.01	2.00	1.04	0.03	0.02	1.10	0.04

Table 9 1095 Acre Surface Flow Wetlands, Nitrogen Removal Model

Date	Pumped Flow (cfs)	Untreated Flow (cfs)	Cumul. Flow Treated (cfs-q)	Cumul. Total Flow (cfs-q)	%of Flow Treated	Water Temp (°C)	Inflow Concentrations (mg/L) BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	Inflow Mass Loading Rates (kg/ha/d) BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	Outflow Concentrations (mg/L) BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP
Average--->	29	29				20	18	115	5.50	0.02	0.02	5.53	0.60	2.92	18.65	0.89	0.00	0.00	0.90	0.10	2.53	2.15	1.53	0.32	0.19	2.04	0.15
Maximum--->	52	487				20	18	115	5.50	0.02	0.02	5.53	0.60	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
Minimum--->	0	0				20	18	115	5.50	0.02	0.02	5.53	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	2.00	1.00	0.00	0.00	1.00	0.01
Standard Deviation--->	19	70				0	0	0	0.00	0.00	0.00	0.00	0.00	1.86	11.87	0.57	0.00	0.00	0.57	0.06	0.52	0.17	0.44	0.25	0.15	0.84	0.09
2/1/1992	16	0	1749	2785	26%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.61	10.31	0.49	0.00	0.00	0.50	0.05	2.04	2.00	1.11	0.07	0.05	1.23	0.06
3/1/1992	52	48	1801	2885	26%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1992	9	0	1810	2895	27%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.94	6.00	0.29	0.00	0.00	0.29	0.03	2.00	2.00	1.02	0.01	0.01	1.04	0.02
1/1/1993	52	39	1862	2986	27%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/1993	52	8	1914	3046	28%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/1993	27	0	1941	3073	29%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.69	17.17	0.82	0.00	0.00	0.83	0.09	2.22	2.03	1.37	0.24	0.16	1.76	0.13
4/1/1993	24	0	1965	3097	29%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.38	15.20	0.73	0.00	0.00	0.73	0.08	2.15	2.01	1.28	0.19	0.12	1.59	0.11
1/1/1994	24	0	1989	3121	29%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.37	15.15	0.72	0.00	0.00	0.73	0.08	2.15	2.01	1.28	0.19	0.12	1.59	0.11
2/1/1994	24	0	2013	3145	30%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.36	15.08	0.72	0.00	0.00	0.72	0.08	2.15	2.01	1.28	0.19	0.12	1.58	0.11
3/1/1994	52	90	2065	3287	30%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1994	52	114	2117	3453	31%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1995	45	0	2162	3498	32%	20	18	115	5.50	0.015	0.015	5.53	0.603	4.51	28.83	1.38	0.00	0.00	1.39	0.15	2.89	2.22	1.89	0.53	0.32	2.75	0.23
2/1/1995	37	0	2199	3535	32%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.70	23.67	1.13	0.00	0.00	1.14	0.12	2.55	2.10	1.66	0.41	0.26	2.33	0.19
3/1/1995	52	380	2251	3967	33%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1995	52	70	2303	4089	34%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1996	52	83	2355	4224	35%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/1996	52	14	2407	4290	35%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/1996	52	82	2459	4424	36%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1996	52	4	2511	4480	37%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1997	23	0	2535	4503	37%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.30	14.68	0.70	0.00	0.00	0.71	0.08	2.14	2.01	1.26	0.18	0.11	1.55	0.10
2/1/1997	34	0	2569	4537	38%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.42	21.82	1.04	0.00	0.00	1.05	0.11	2.44	2.07	1.57	0.37	0.23	2.17	0.17
3/1/1997	52	34	2621	4623	39%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1997	52	186	2673	4861	39%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1998	52	487	2725	5400	40%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/1998	52	40	2777	5492	41%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/1998	52	23	2829	5567	42%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/1998	52	41	2881	5660	42%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/1999	19	0	2900	5679	43%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.85	11.80	0.56	0.00	0.00	0.57	0.06	2.06	2.00	1.15	0.11	0.07	1.33	0.08
2/1/1999	39	0	2938	5717	43%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.86	24.66	1.18	0.00	0.00	1.19	0.13	2.61	2.12	1.70	0.44	0.27	2.41	0.20
3/1/1999	28	0	2967	5746	44%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.81	17.97	0.86	0.00	0.00	0.86	0.09	2.25	2.03	1.40	0.26	0.17	1.83	0.14
4/1/1999	26	0	2992	5771	44%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.56	16.36	0.78	0.00	0.00	0.79	0.09	2.19	2.02	1.33	0.22	0.14	1.69	0.12
1/1/2000	23	0	3016	5795	44%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.31	14.78	0.71	0.00	0.00	0.71	0.08	2.14	2.01	1.26	0.18	0.12	1.56	0.11
2/1/2000	8	0	3024	5803	44%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.81	5.16	0.25	0.00	0.00	0.25	0.03	2.00	2.00	1.01	0.01	0.01	1.02	0.02
3/1/2000	5	0	3029	5808	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.50	3.17	0.15	0.00	0.00	0.15	0.02	2.00	2.00	1.00	0.00	0.00	1.00	0.01
4/1/2000	3	0	3031	5810	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.25	1.62	0.08	0.00	0.00	0.08	0.01	2.00	2.00	1.00	0.00	0.00	1.00	0.01
1/1/2001	0	0	3031	5810	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
2/1/2001	0	0	3031	5810	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.00	0.00	0.00	0.00	0.00	0.00	0.00	no flow	no flow	no flow	no flow	no flow	no flow	no flow
3/1/2001	28	0	3060	5839	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.83	18.07	0.86	0.00	0.00	0.87	0.09	2.26	2.03	1.40	0.27	0.17	1.84	0.14
4/1/2001	15	0	3075	5854	45%	20	18	115	5.50	0.015	0.015	5.53	0.603	1.47	9.40	0.45	0.00	0.00	0.45	0.05	2.03	2.00	1.08	0.06	0.04	1.18	0.05
1/1/2002	27	0	3101	5880	46%	20	18	115	5.50	0.015	0.015	5.53	0.603	2.65	16.92	0.81	0.00	0.00	0.81	0.09	2.21	2.02	1.35	0.24	0.15	1.74	0.13
2/1/2002	8	0	3109	5888	46%	20	18	115	5.50	0.015	0.015	5.53	0.603	0.78	4.98	0.24	0.00	0.00	0.24	0.03	2.00	2.00	1.01	0.01	0.00	1.02	0.02
3/1/2002	52	54	3161	5994	47%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/2002	52	166	3213	6213	47%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
1/1/2003	52	226	3265	6491	48%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
2/1/2003	52	54	3317	6596	49%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
3/1/2003	52	112	3369	6760	50%	20	18	115	5.50	0.015	0.015	5.53	0.603	5.17	33.02	1.58	0.00	0.00	1.59	0.17	3.20	2.37	2.07	0.62	0.36	3.05	0.25
4/1/2003	38	0	3407	6797	50%	20	18	115	5.50	0.015	0.015	5.53	0.603	3.75	23.94	1.15	0.00	0.00	1.15	0.13	2.57	2.11	1.67	0.42	0.26	2.35	0.19

Table 9   1095 Acre Surface Flow Wetlands, Nitrogen Removal Model

Date	Outflow Mass Loading Rates (kg/ha/d) BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	TN Loads (kg/d) Total	Pumped to Wetland	Removed by Wetland	TN Removal Efficiency (%) Wetland	Total
Average--->	0.48	0.39	0.31	0.08	0.05	0.43	0.03	289378	145037	79246	55%	27%
Maximum--->	0.92	0.68	0.59	0.18	0.10	0.88	0.07	8368961	4194544	2291837		
Minimum--->	0.01	0.01	0.01	0.00	0.00	0.01	0.00	288585	144639	79029		
Standard Deviation--->	0.35	0.24	0.23	0.08	0.04	0.35	0.03					
1/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
2/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
3/1/1975	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
4/1/1975	0.11	0.11	0.05	0.00	0.00	0.06	0.00	129.19	129.19	104.82	81%	81%
1/1/1976	0.01	0.01	0.01	0.00	0.00	0.01	0.00	13.35	13.35	10.93	82%	82%
2/1/1976	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
3/1/1976	0.23	0.22	0.13	0.01	0.01	0.16	0.01	273.57	273.57	204.05	75%	75%
4/1/1976	0.09	0.09	0.05	0.00	0.00	0.05	0.00	113.65	113.65	92.54	81%	81%
1/1/1977	0.13	0.13	0.06	0.00	0.00	0.07	0.00	153.31	153.31	123.43	81%	81%
2/1/1977	0.12	0.12	0.06	0.00	0.00	0.06	0.00	141.22	141.22	114.17	81%	81%
3/1/1977	0.07	0.07	0.04	0.00	0.00	0.04	0.00	88.33	88.33	72.19	82%	82%
4/1/1977	0.18	0.18	0.10	0.01	0.00	0.11	0.01	219.98	219.98	170.98	78%	78%
1/1/1978	0.34	0.31	0.21	0.04	0.02	0.27	0.02	369.83	369.83	250.83	68%	68%
2/1/1978	0.10	0.10	0.05	0.00	0.00	0.05	0.00	117.92	117.92	95.93	81%	81%
3/1/1978	0.92	0.68	0.59	0.18	0.10	0.88	0.07	903.95	703.54	315.36	45%	35%
4/1/1978	0.13	0.13	0.07	0.00	0.00	0.07	0.00	159.22	159.22	127.89	80%	80%
1/1/1979	0.24	0.23	0.14	0.02	0.01	0.16	0.01	276.86	276.86	205.91	74%	74%
2/1/1979	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1400.02	703.54	315.36	45%	23%
3/1/1979	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2178.42	703.54	315.36	45%	14%
4/1/1979	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1483.56	703.54	315.36	45%	21%
1/1/1980	0.56	0.46	0.37	0.10	0.06	0.52	0.04	528.38	528.38	296.63	56%	56%
2/1/1980	0.31	0.29	0.19	0.03	0.02	0.24	0.02	347.09	347.09	241.21	69%	69%
3/1/1980	0.42	0.36	0.27	0.06	0.04	0.36	0.03	432.35	432.35	273.05	63%	63%
4/1/1980	0.26	0.24	0.15	0.02	0.01	0.18	0.01	298.22	298.22	217.56	73%	73%
1/1/1981	0.20	0.19	0.11	0.01	0.01	0.12	0.01	236.98	236.98	182.01	77%	77%
2/1/1981	0.04	0.04	0.02	0.00	0.00	0.02	0.00	43.09	43.09	35.30	82%	82%
3/1/1981	0.20	0.20	0.11	0.01	0.01	0.13	0.01	239.51	239.51	183.61	77%	77%
4/1/1981	0.25	0.24	0.15	0.02	0.01	0.18	0.01	293.68	293.68	215.15	73%	73%
1/1/1982	0.06	0.06	0.03	0.00	0.00	0.03	0.00	79.59	79.59	65.10	82%	82%
2/1/1982	0.85	0.64	0.56	0.16	0.10	0.82	0.07	675.63	675.63	313.99	46%	46%
3/1/1982	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2502.52	703.54	315.36	45%	13%
4/1/1982	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1460.51	703.54	315.36	45%	22%
1/1/1983	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2713.09	703.54	315.36	45%	12%
2/1/1983	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1626.27	703.54	315.36	45%	19%
3/1/1983	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1752.26	703.54	315.36	45%	18%
4/1/1983	0.92	0.68	0.59	0.18	0.10	0.88	0.07	884.03	703.54	315.36	45%	36%
1/1/1984	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1818.77	703.54	315.36	45%	17%
2/1/1984	0.48	0.41	0.31	0.07	0.05	0.43	0.03	477.71	477.71	285.64	60%	60%
3/1/1984	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1002.09	703.54	315.36	45%	31%
4/1/1984	0.18	0.17	0.10	0.01	0.00	0.11	0.00	213.25	213.25	166.49	78%	78%
1/1/1985	0.38	0.34	0.24	0.05	0.03	0.32	0.02	408.18	408.18	265.17	65%	65%
2/1/1985	0.05	0.05	0.03	0.00	0.00	0.03	0.00	63.22	63.22	51.76	82%	82%
3/1/1985	0.19	0.18	0.10	0.01	0.00	0.11	0.01	222.22	222.22	172.46	78%	78%
4/1/1985	0.05	0.05	0.02	0.00	0.00	0.02	0.00	57.84	57.84	47.36	82%	82%
1/1/1986	0.16	0.16	0.08	0.00	0.00	0.09	0.00	192.08	192.08	151.87	79%	79%
2/1/1986	0.06	0.06	0.03	0.00	0.00	0.03	0.00	73.71	73.71	60.32	82%	82%
3/1/1986	0.25	0.24	0.14	0.02	0.01	0.17	0.01	289.28	289.28	212.79	74%	74%
4/1/1986	0.14	0.14	0.07	0.00	0.00	0.08	0.00	169.96	169.96	135.88	80%	80%
1/1/1987	0.29	0.27	0.17	0.03	0.02	0.21	0.01	325.59	325.59	231.32	71%	71%
2/1/1987	0.81	0.61	0.53	0.15	0.09	0.77	0.06	655.88	655.88	312.70	48%	48%
3/1/1987	0.40	0.35	0.25	0.05	0.03	0.34	0.03	420.17	420.17	269.18	64%	64%
4/1/1987	0.50	0.41	0.32	0.08	0.05	0.45	0.04	486.28	486.28	287.71	59%	59%
1/1/1988	0.60	0.48	0.39	0.10	0.06	0.56	0.05	549.99	549.99	300.43	55%	55%
2/1/1988	0.16	0.16	0.09	0.00	0.00	0.10	0.00	199.19	199.19	156.85	79%	79%
3/1/1988	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2192.96	703.54	315.36	45%	14%
4/1/1988	0.92	0.68	0.59	0.18	0.10	0.88	0.07	713.78	703.54	315.36	45%	44%
1/1/1989	0.32	0.29	0.19	0.03	0.02	0.24	0.02	351.84	351.84	243.29	69%	69%
2/1/1989	0.25	0.24	0.14	0.02	0.01	0.17	0.01	289.91	289.91	213.13	74%	74%
3/1/1989	0.27	0.26	0.16	0.02	0.01	0.20	0.01	312.33	312.33	224.82	72%	72%
4/1/1989	0.22	0.21	0.12	0.01	0.01	0.15	0.01	261.05	261.05	196.77	75%	75%
1/1/1990	0.19	0.19	0.11	0.01	0.01	0.12	0.01	232.14	232.14	178.92	77%	77%
2/1/1990	0.18	0.18	0.10	0.01	0.00	0.11	0.01	214.33	214.33	167.21	78%	78%
3/1/1990	0.48	0.41	0.31	0.07	0.05	0.43	0.03	478.61	478.61	285.86	60%	60%
4/1/1990	0.20	0.20	0.11	0.01	0.01	0.13	0.01	240.67	240.67	184.34	77%	77%
1/1/1991	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
2/1/1991	0.06	0.06	0.03	0.00	0.00	0.03	0.00	67.95	67.95	55.62	82%	82%
3/1/1991	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1942.67	703.54	315.36	45%	16%
4/1/1991	0.20	0.20	0.11	0.01	0.01	0.13	0.01	239.61	239.61	183.67	77%	77%
1/1/1992	0.13	0.13	0.07	0.00	0.00	0.07	0.00	162.97	162.97	130.70	80%	80%

Date	Calculations q (m/yr)	$(1+k_{TON}/(Nq))^{-N}$	$(1+k_{NH3}/(Nq))^{-N}$	$(1+k_{NO3}/(Nq))^{-N}$	$k_{TON}/(k_{NH3}-k_{TON})$	$k_{NH3}/(k_{NO3}-k_{NH3})$	$k_{NH3}/(k_{NO3}-k_{TON})$	kg/d removed BOD	TSS	NH3	NO3	TP	
Average--->								398,409	2,957,462	-11,641	-6,764	10,595	kg/yr
Maximum--->													
Minimum--->													
Standard Deviation--->													
1/1/1975	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/1975	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/1975	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
4/1/1975	1.92	0.004	0.000	0.000	0.7	1.1	0.7	374	2,640	0.020	0.127	13.5	
1/1/1976	0.20	0.000	0.000	0.000	0.7	1.1	0.7	38.6	273	0.036	0.036	1.43	
2/1/1976	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/1976	4.07	0.042	0.003	0.000	0.7	1.1	0.7	787	5,590	-5.70	-3.50	25.6	
4/1/1976	1.69	0.003	0.000	0.000	0.7	1.1	0.7	329	2,322	0.126	0.185	12.0	
1/1/1977	2.28	0.008	0.000	0.000	0.7	1.1	0.7	443	3,133	-0.287	-0.058	15.8	
2/1/1977	2.10	0.006	0.000	0.000	0.7	1.1	0.7	408	2,886	-0.109	0.051	14.7	
3/1/1977	1.32	0.001	0.000	0.000	0.7	1.1	0.7	256	1,805	0.187	0.204	9.40	
4/1/1977	3.28	0.024	0.001	0.000	0.7	1.1	0.7	635	4,495	-2.38	-1.39	21.6	
1/1/1978	5.51	0.083	0.009	0.001	0.7	1.1	0.7	1,055	7,555	-15.5	-9.63	31.5	
2/1/1978	1.76	0.003	0.000	0.000	0.7	1.1	0.7	341	2,409	0.103	0.173	12.4	
3/1/1978	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1978	2.37	0.009	0.000	0.000	0.7	1.1	0.7	460	3,253	-0.394	-0.124	16.4	
1/1/1979	4.12	0.043	0.003	0.000	0.7	1.1	0.7	797	5,657	-5.95	-3.66	25.8	
2/1/1979	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/1979	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1979	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1980	7.87	0.158	0.025	0.003	0.7	1.1	0.7	1,470	10,785	-40.8	-24.6	38.8	
2/1/1980	5.17	0.073	0.007	0.001	0.7	1.1	0.7	992	7,091	-12.8	-7.93	30.3	
3/1/1980	6.44	0.112	0.014	0.002	0.7	1.1	0.7	1,223	8,831	-24.4	-15.0	34.7	
4/1/1980	4.44	0.052	0.004	0.000	0.7	1.1	0.7	857	6,093	-7.75	-4.79	27.3	
1/1/1981	3.53	0.029	0.002	0.000	0.7	1.1	0.7	683	4,842	-3.27	-1.95	22.9	
2/1/1981	0.64	0.000	0.000	0.000	0.7	1.1	0.7	125	881	0.116	0.116	4.62	
3/1/1981	3.57	0.030	0.002	0.000	0.7	1.1	0.7	691	4,894	-3.41	-2.04	23.1	
4/1/1981	4.37	0.050	0.004	0.000	0.7	1.1	0.7	844	6,001	-7.35	-4.54	27.0	
1/1/1982	1.19	0.001	0.000	0.000	0.7	1.1	0.7	230	1,626	0.185	0.195	8.49	
2/1/1982	10.06	0.226	0.047	0.008	0.7	1.1	0.7	1,821	13,767	-70.7	-41.0	43.6	
3/1/1982	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1982	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1983	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/1983	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/1983	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1983	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1984	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/1984	7.12	0.134	0.019	0.002	0.7	1.1	0.7	1,341	9,755	-31.7	-19.3	36.7	
3/1/1984	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1984	3.18	0.022	0.001	0.000	0.7	1.1	0.7	616	4,357	-2.07	-1.19	21.0	
1/1/1985	6.08	0.101	0.012	0.001	0.7	1.1	0.7	1,158	8,338	-20.7	-12.8	33.5	
2/1/1985	0.94	0.000	0.000	0.000	0.7	1.1	0.7	183	1,292	0.162	0.165	6.76	
3/1/1985	3.31	0.024	0.001	0.000	0.7	1.1	0.7	641	4,541	-2.49	-1.45	21.8	
4/1/1985	0.86	0.000	0.000	0.000	0.7	1.1	0.7	167	1,182	0.151	0.153	6.19	
1/1/1986	2.86	0.016	0.001	0.000	0.7	1.1	0.7	555	3,925	-1.25	-0.666	19.3	
2/1/1986	1.10	0.000	0.000	0.000	0.7	1.1	0.7	213	1,506	0.179	0.186	7.87	
3/1/1986	4.31	0.048	0.004	0.000	0.7	1.1	0.7	832	5,911	-6.97	-4.30	26.7	
4/1/1986	2.53	0.011	0.000	0.000	0.7	1.1	0.7	491	3,473	-0.623	-0.268	17.3	
1/1/1987	4.85	0.063	0.006	0.000	0.7	1.1	0.7	933	6,652	-10.4	-6.46	29.0	
2/1/1987	9.77	0.217	0.044	0.007	0.7	1.1	0.7	1,776	13,368	-66.5	-38.7	43.0	
3/1/1987	6.26	0.106	0.013	0.001	0.7	1.1	0.7	1,190	8,582	-22.5	-13.9	34.1	
4/1/1987	7.24	0.138	0.020	0.002	0.7	1.1	0.7	1,363	9,929	-33.2	-20.2	37.1	
1/1/1988	8.19	0.168	0.028	0.004	0.7	1.1	0.7	1,523	11,224	-44.9	-26.9	39.6	
2/1/1988	2.97	0.018	0.001	0.000	0.7	1.1	0.7	575	4,070	-1.50	-0.826	19.9	
3/1/1988	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1988	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1989	5.24	0.075	0.007	0.001	0.7	1.1	0.7	1,005	7,188	-13.3	-8.27	30.5	
2/1/1989	4.32	0.048	0.004	0.000	0.7	1.1	0.7	833	5,924	-7.02	-4.33	26.7	
3/1/1989	4.65	0.058	0.005	0.000	0.7	1.1	0.7	896	6,382	-9.08	-5.62	28.2	
4/1/1989	3.89	0.037	0.002	0.000	0.7	1.1	0.7	752	5,334	-4.78	-2.92	24.7	
1/1/1990	3.46	0.028	0.002	0.000	0.7	1.1	0.7	670	4,743	-3.00	-1.78	22.5	
2/1/1990	3.19	0.022	0.001	0.000	0.7	1.1	0.7	619	4,379	-2.12	-1.22	21.1	
3/1/1990	7.13	0.134	0.019	0.002	0.7	1.1	0.7	1,343	9,773	-31.9	-19.4	36.8	
4/1/1990	3.58	0.030	0.002	0.000	0.7	1.1	0.7	694	4,918	-3.48	-2.08	23.2	
1/1/1991	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/1991	1.01	0.000	0.000	0.000	0.7	1.1	0.7	197	1,388	0.171	0.175	7.27	
3/1/1991	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1991	3.57	0.030	0.002	0.000	0.7	1.1	0.7	691	4,896	-3.42	-2.05	23.1	
1/1/1992	2.43	0.010	0.000	0.000	0.7	1.1	0.7	471	3,330	-0.468	-0.171	16.7	

Table 9 1095 Acre Surface Flow Wetlands, Nitrogen Removal Model

Date	Outflow Mass Loading Rates (kg/ha/d) BOD	TSS	TON	NH_4-N	NO_3-N	TN	TP	TN Loads (kg/d) Total	Pumped to Wetland	Removed by Wetland	TN Removal Efficiency (%) Wetland	Total
Average--->	0.48	0.39	0.31	0.08	0.05	0.43	0.03	289378	145037	79246	55%	27%
Maximum--->	0.92	0.68	0.59	0.18	0.10	0.88	0.07	8368961	4194544	2291837		
Minimum--->	0.01	0.01	0.01	0.00	0.00	0.01	0.00	288585	144639	79029		
Standard Deviation--->	0.35	0.24	0.23	0.08	0.04	0.35	0.03					
2/1/1992	0.18	0.18	0.10	0.01	0.00	0.11	0.01	219.75	219.75	170.83	78%	78%
3/1/1992	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1352.76	703.54	315.36	45%	23%
4/1/1992	0.10	0.10	0.05	0.00	0.00	0.05	0.00	127.79	127.79	103.72	81%	81%
1/1/1993	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1236.42	703.54	315.36	45%	26%
2/1/1993	0.92	0.68	0.59	0.18	0.10	0.88	0.07	811.49	703.54	315.36	45%	39%
3/1/1993	0.33	0.30	0.20	0.04	0.02	0.26	0.02	365.97	365.97	249.26	68%	68%
4/1/1993	0.28	0.27	0.17	0.03	0.02	0.21	0.01	323.93	323.93	230.52	71%	71%
1/1/1994	0.28	0.27	0.17	0.02	0.02	0.21	0.01	322.75	322.75	229.95	71%	71%
2/1/1994	0.28	0.26	0.17	0.02	0.02	0.21	0.01	321.25	321.25	229.22	71%	71%
3/1/1994	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1923.43	703.54	315.36	45%	16%
4/1/1994	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2246.36	703.54	315.36	45%	14%
1/1/1995	0.72	0.56	0.47	0.13	0.08	0.69	0.06	614.28	614.28	309.03	50%	50%
2/1/1995	0.52	0.43	0.34	0.09	0.05	0.48	0.04	504.41	504.41	291.81	58%	58%
3/1/1995	0.92	0.68	0.59	0.18	0.10	0.88	0.07	5845.57	703.54	315.36	45%	5%
4/1/1995	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1647.58	703.54	315.36	45%	19%
1/1/1996	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1829.47	703.54	315.36	45%	17%
2/1/1996	0.92	0.68	0.59	0.18	0.10	0.88	0.07	889.58	703.54	315.36	45%	35%
3/1/1996	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1810.20	703.54	315.36	45%	17%
4/1/1996	0.92	0.68	0.59	0.18	0.10	0.88	0.07	756.58	703.54	315.36	45%	42%
1/1/1997	0.27	0.26	0.16	0.02	0.01	0.20	0.01	312.89	312.89	225.10	72%	72%
2/1/1997	0.46	0.39	0.30	0.07	0.04	0.41	0.03	465.06	465.06	282.40	61%	61%
3/1/1997	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1160.94	703.54	315.36	45%	27%
4/1/1997	0.92	0.68	0.59	0.18	0.10	0.88	0.07	3222.89	703.54	315.36	45%	10%
1/1/1998	0.92	0.68	0.59	0.18	0.10	0.88	0.07	7290.73	703.54	315.36	45%	4%
2/1/1998	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1239.02	703.54	315.36	45%	25%
3/1/1998	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1012.85	703.54	315.36	45%	31%
4/1/1998	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1261.65	703.54	315.36	45%	25%
1/1/1999	0.21	0.21	0.12	0.01	0.01	0.14	0.01	251.43	251.43	190.99	76%	76%
2/1/1999	0.56	0.45	0.37	0.09	0.06	0.52	0.04	525.50	525.50	296.08	56%	56%
3/1/1999	0.35	0.32	0.22	0.04	0.03	0.29	0.02	382.98	382.98	256.01	67%	67%
4/1/1999	0.31	0.29	0.19	0.03	0.02	0.24	0.02	348.70	348.70	241.92	69%	69%
1/1/2000	0.27	0.26	0.16	0.02	0.01	0.20	0.01	314.90	314.90	226.10	72%	72%
2/1/2000	0.09	0.09	0.05	0.00	0.00	0.05	0.00	109.91	109.91	89.56	81%	81%
3/1/2000	0.06	0.06	0.03	0.00	0.00	0.03	0.00	67.55	67.55	55.30	82%	82%
4/1/2000	0.03	0.03	0.01	0.00	0.00	0.01	0.00	34.51	34.51	28.27	82%	82%
1/1/2001	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
2/1/2001	no flow	no flow	no flow	no flow	no flow	no flow	no flow	0.00	0.00	0.00	no flow	no flow
3/1/2001	0.35	0.32	0.22	0.04	0.03	0.29	0.02	385.04	385.04	256.79	67%	67%
4/1/2001	0.17	0.16	0.09	0.00	0.00	0.10	0.00	200.31	200.31	157.63	79%	79%
1/1/2002	0.33	0.30	0.20	0.03	0.02	0.26	0.02	360.65	360.65	247.05	69%	69%
2/1/2002	0.09	0.09	0.04	0.00	0.00	0.04	0.00	106.23	106.23	86.61	82%	82%
3/1/2002	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1433.97	703.54	315.36	45%	22%
4/1/2002	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2954.62	703.54	315.36	45%	11%
1/1/2003	0.92	0.68	0.59	0.18	0.10	0.88	0.07	3761.22	703.54	315.36	45%	8%
2/1/2003	0.92	0.68	0.59	0.18	0.10	0.88	0.07	1428.77	703.54	315.36	45%	22%
3/1/2003	0.92	0.68	0.59	0.18	0.10	0.88	0.07	2212.71	703.54	315.36	45%	14%
4/1/2003	0.53	0.44	0.35	0.09	0.05	0.49	0.04	510.17	510.17	293.02	57%	57%

Date	Calculations q (m/yr)	$(1+k_{TON}/(Nq))^{-N}$	$(1+k_{NH3}/(Nq))^{-N}$	$(1+k_{NO3}/(Nq))^{-N}$	$k_{TON}/(k_{NH3}-k_{TON})$	$k_{NH3}/(k_{NO3}-k_{NH3})$	$k_{NH3}/(k_{NO3}-k_{TON})$	kg/d removed BOD	TSS	NH3	NO3	TP	
Average--->								398,409	2,957,462	-11,641	-6,764	10,595	kg/yr
Maximum--->													
Minimum--->													
Standard Deviation--->													
2/1/1992	3.27	0.024	0.001	0.000	0.7	1.1	0.7	634	4,490	-2.37	-1.38	21.6	
3/1/1992	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1992	1.90	0.004	0.000	0.000	0.7	1.1	0.7	370	2,611	0.032	0.134	13.4	
1/1/1993	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/1993	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/1993	5.45	0.081	0.008	0.001	0.7	1.1	0.7	1,044	7,477	-15.1	-9.33	31.3	
4/1/1993	4.82	0.063	0.005	0.000	0.7	1.1	0.7	928	6,618	-10.2	-6.35	28.9	
1/1/1994	4.81	0.062	0.005	0.000	0.7	1.1	0.7	925	6,594	-10.1	-6.27	28.8	
2/1/1994	4.78	0.061	0.005	0.000	0.7	1.1	0.7	921	6,564	-9.97	-6.18	28.7	
3/1/1994	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1994	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1995	9.15	0.198	0.037	0.006	0.7	1.1	0.7	1,679	12,527	-57.8	-34.0	41.7	
2/1/1995	7.51	0.147	0.022	0.003	0.7	1.1	0.7	1,409	10,298	-36.4	-22.1	37.8	
3/1/1995	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1995	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1996	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/1996	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/1996	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1996	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1997	4.66	0.058	0.005	0.000	0.7	1.1	0.7	898	6,393	-9.13	-5.66	28.2	
2/1/1997	6.93	0.128	0.018	0.002	0.7	1.1	0.7	1,308	9,497	-29.6	-18.1	36.2	
3/1/1997	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1997	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1998	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/1998	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/1998	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/1998	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/1999	3.74	0.034	0.002	0.000	0.7	1.1	0.7	725	5,138	-4.14	-2.51	24.0	
2/1/1999	7.83	0.157	0.025	0.003	0.7	1.1	0.7	1,463	10,727	-40.3	-24.3	38.7	
3/1/1999	5.70	0.089	0.010	0.001	0.7	1.1	0.7	1,090	7,824	-17.2	-10.7	32.2	
4/1/1999	5.19	0.073	0.007	0.001	0.7	1.1	0.7	997	7,124	-13.0	-8.04	30.4	
1/1/2000	4.69	0.059	0.005	0.000	0.7	1.1	0.7	903	6,434	-9.33	-5.78	28.3	
2/1/2000	1.64	0.002	0.000	0.000	0.7	1.1	0.7	318	2,246	0.143	0.193	11.6	
3/1/2000	1.01	0.000	0.000	0.000	0.7	1.1	0.7	195	1,380	0.170	0.174	7.22	
4/1/2000	0.51	0.000	0.000	0.000	0.7	1.1	0.7	99.9	705	0.093	0.093	3.70	
1/1/2001	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
2/1/2001	0.00	no flow	no flow	no flow	0.7	1.1	0.7	0.00	0.00	0.00	0.00	0.00	
3/1/2001	5.73	0.090	0.010	0.001	0.7	1.1	0.7	1,096	7,866	-17.5	-10.8	32.4	
4/1/2001	2.98	0.018	0.001	0.000	0.7	1.1	0.7	579	4,093	-1.55	-0.852	20.0	
1/1/2002	5.37	0.079	0.008	0.001	0.7	1.1	0.7	1,030	7,368	-14.4	-8.92	31.0	
2/1/2002	1.58	0.002	0.000	0.000	0.7	1.1	0.7	307	2,171	0.156	0.198	11.2	
3/1/2002	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/2002	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
1/1/2003	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
2/1/2003	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
3/1/2003	10.48	0.238	0.052	0.009	0.7	1.1	0.7	1,883	14,329	-76.8	-44.1	44.3	
4/1/2003	7.60	0.149	0.023	0.003	0.7	1.1	0.7	1,424	10,415	-37.5	-22.7	38.1	

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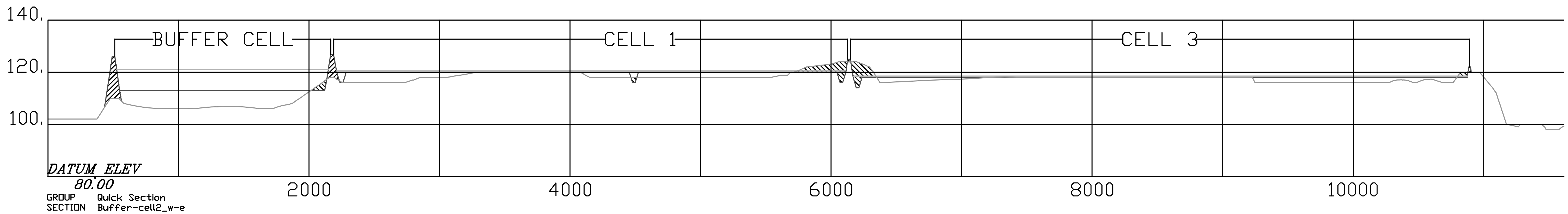
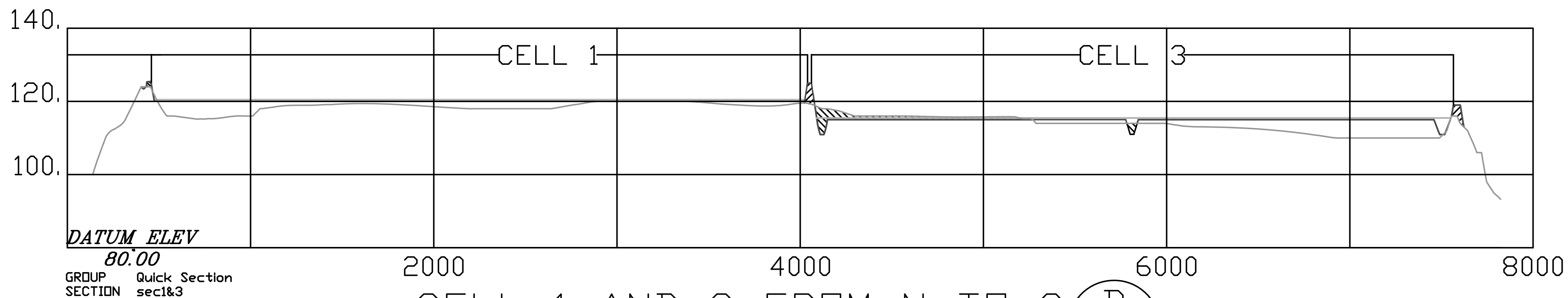
CONCEPTUAL



BUFFER CELL, CELL 1 AND 3, FROM E to W (A / A-2.0)

SCALE:1:800



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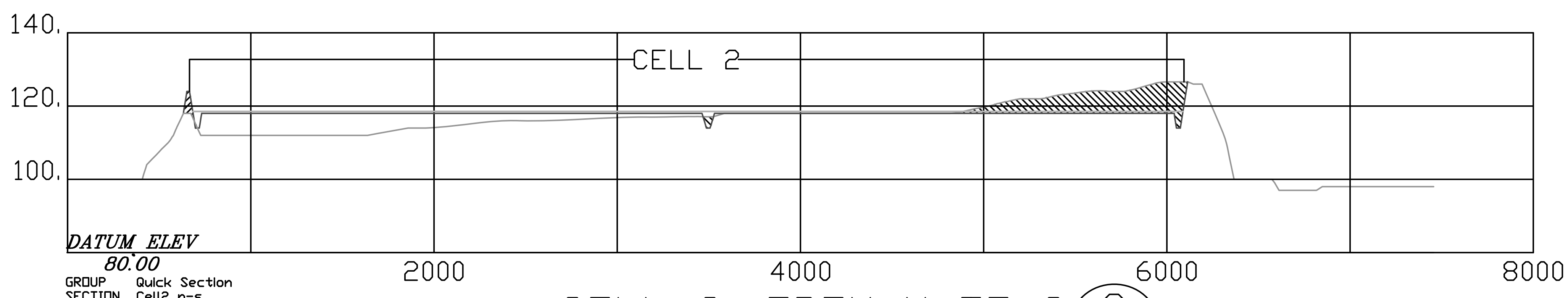


CELL 2, FROM N TO S (C / A-2.0)

SCALE:1:800

LEGEND

- FILL
- CUT
- EXISTING GROUND
- PROPOSED BOTTOM OF CELL
- WATER SURFACE

NOT FOR BIDDING OR CONSTRUCTION

NO.	DATE	REVISIONS	BY

PROJECT NO. 743785
DESIGNED BY HS
DRAWN BY FD
CHECKED BY TC
ENGINEER
REGISTRATION NO. 63756 DATE 10/06

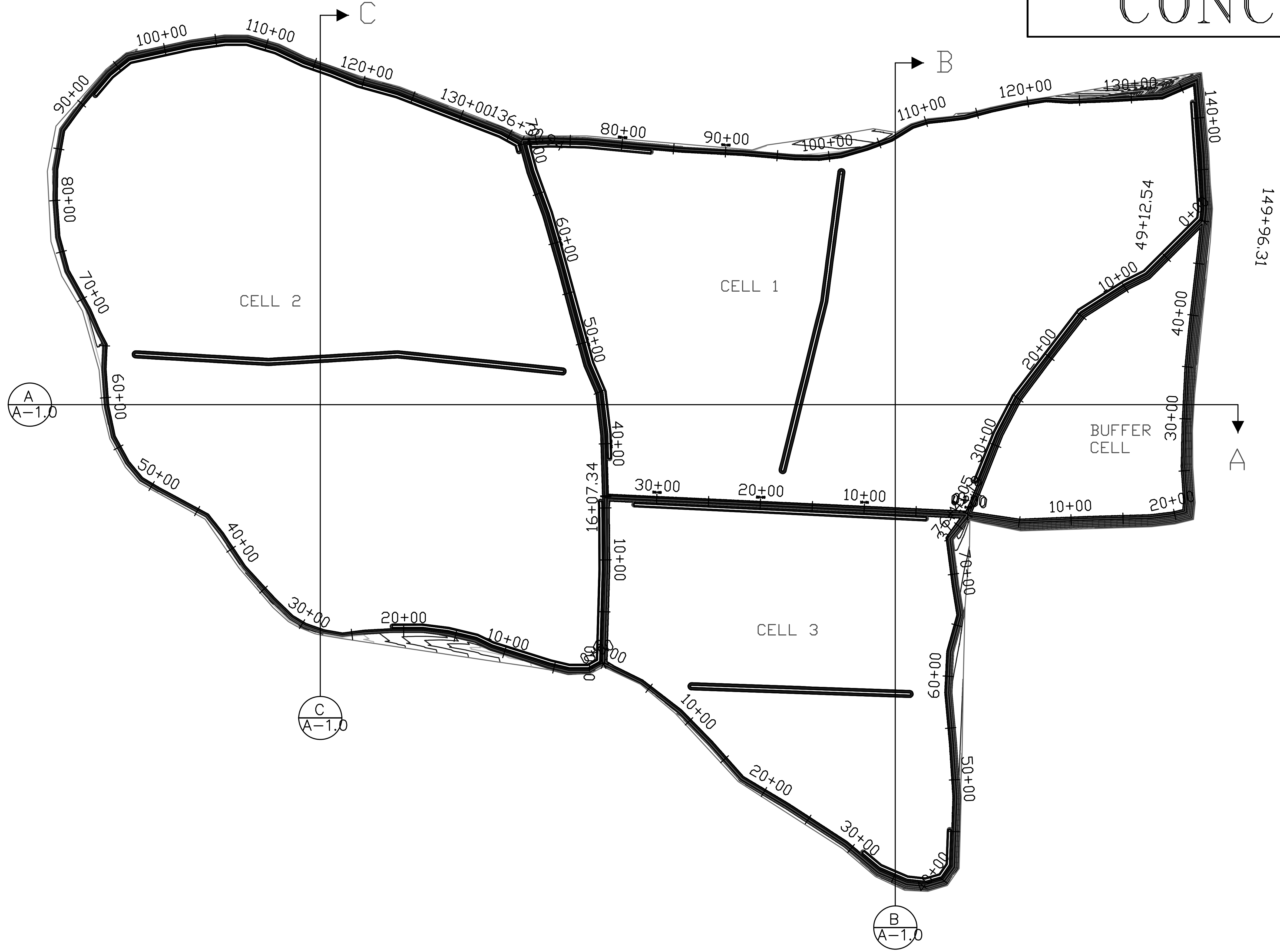
PARSONS
PARSONS WATER & INFRASTRUCTURE INC.
3450 BUSCHWOOD PARK DRIVE, SUITE 345 TAMPA, FLORIDA 33618
PH: (813) 933-4650 FAX: (813) 930-7332
CERTIFICATE No. 9834

SWFWMD
LAKE HANCOCK OUTFALL PROJECT
Bartow Florida

SWFWMD
27% WETLANDS CONCEPT PLAN
TYPICAL SAMPLE SECTIONS

SCALE 1:800
SHEET NO. A-1.0
FILE NO.

CONCEPTUAL



NOT FOR BIDDING OR CONSTRUCTION

NO.	DATE	REVISIONS	BY

PROJECT NO. 743785
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PARSONS WATER & INFRASTRUCTURE INC.
3450 BUSCHWOOD PARK DRIVE, SUITE 345 TAMPA, FLORIDA 33618
PH: (813) 933-4650 FAX: (813) 930-7332
CERTIFICATE No. 9834

SWFWMD
LAKE HANCOCK OUTFALL PROJECT
BARTOW, FLORIDA

PROPOSED 27% TN GOAL WETLANDS PLAN VIEW

SCALE 1:1000
SHEET NO. A-2.0
FILE NO.

Appendix D1
Lake Hancock Outfall
MAPS Nutrient Recovery Facility
Conceptual Plan

Single Stage WHS™ Facility
Revision 2 – February 2005

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Lake Hancock Outfall

MAPS Nutrient Recovery Facility Conceptual Plan

Single Stage WHS™ Facility

Revision 2 – February 2005

Vendor Proposal Prepared for:

Wetland Solutions Inc. / Parsons

Southwest Florida Water Management District

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Table of Contents

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1.0 PROPOSAL SUMMARY

Provided is a proposal for a Lake Hancock Water Hyacinth Scrubber (WHS™) Nutrient Recovery Facility to annually remove 132,108 kilograms of nitrogen from the Lake Hancock Outfall upstream of the P-11 structure within Saddle Creek.

This proposed WHS™ Nutrient Recovery Facility represents two levels of revisions. The first revision, submitted January 2005, was developed to accommodate updated design conditions, the most relevant being the need to manage fluctuating flows at the P-11 outfall. This second revision is an elaboration upon the January submittal, which includes technical and costing updates which evolved from a series of comments from Dr. Tory Champlin after review of the January submittal, and a resulting discussion between HydroMentia, Parsons, and Southwest Florida Water Management District (SWFWMD) staff in Tampa on February 14, 2005. The submitted comments are included in this document as Appendix A, and are addressed within this text. As appropriate, the comments will be referenced throughout the document at the point of reply.

The proposed WHS™ Nutrient Recovery Facility will be constructed on 338 acres of the approximately 3,400 acres of land purchased by the SWFWMD adjacent to the eastern and southern shores of Lake Hancock. The facility will remove 132,108 kg of nitrogen per year from the incoming flows, or 45.7% of Lake Hancock nitrogen discharges.

WHS™ CAPITAL CONSTRUCTION COSTS

- Capital costs for the proposed WHS™ Nutrient Recovery Facility are $12,299,000 with design revisions as requested by Parsons, to include the use of imported fill for facility construction.

WHS™ ANNUAL OPERATING COSTS

“Best-Case” Scenario

- Annual operating costs of $711,000 are projected for the “Best-Case” scenario, which includes $179,000 in revenue from the sale of processed compost/organic fertilizer.

- At a discount rate of 5.625%, an inflation rate of 3%, and exclusion of lands costs, the 50-year estimated total “Present Worth” cost per mass unit removal for the subject facility for the “best-case” scenario is <u>$3.34 per pound of nitrogen removed</u> and $29.13 per pound of phosphorus removed.

“Worst-Case” Scenario

- Annual operating costs of $1,118,000 are projected for the “Worst-Case” scenario, which includes $228,000 in costs to landfill the processed compost/organic fertilizer.

- At a discount rate of 5.625%, an inflation rate of 3%, and exclusion of lands costs, the 50-year estimated total “Present Worth” cost per mass unit removal for the subject facility for the “best-case” scenario is <u>$4.15 per pound of nitrogen removed</u> and $36.21 per pound of phosphorus removed.

> Note: Because the small footprint of the WHS™ Treatment Facility takes up only 338 acres, estimated revenues from the sale of surplus lands thus not required to be used for water treatment can be used to offset the cost of construction and some years of operation of the WHS™ Treatment Facility.

Annual operating costs within this proposal are based on a maximum flow of 300 cfs (194 MGD); with an average daily flow (ADF) of about 49.70 cfs (32.12 MGD). It should be noted that operational costs for the WHS treatment system are not fixed, but fluctuate with actual treatment system flows and pollutant recovery rates.

The WHS™ was originally offered as an alternative to a two-stage WHS™-ATS™ (Algal Turf Scrubber®) system, and was developed in response to information provided by Robert Knight, PhD, of Wetland Solutions Inc. (WSI), and later revised in response to information provided by Dr. Champlin of Parsons. The preparation and submission of this single-stage WHS™ proposal should in no way be interpreted as a change in HydroMentia's original recommendation for a WHS™ - ATS™ integrated system. However, after being provided clarification in the nature of sequencing of hydraulic loads, HydroMentia does, under these provisions, recommend a single-stage WHS™ as the preferred managed aquatic plant system (MAPS) approach for meeting the water quality requirements associated with the present scenario associated with the Lake Hancock Outfall Nutrient Recovery Program.

2.0 INTRODUCTION

COMPANY AND TECHNOLOGY

HydroMentia Inc., (www.hydromentia.com) is a water pollution control company specializing in the design and operation of advanced water treatment technologies in which treatment is performed and pollutants are recovered within proprietary MAPS. The HydroMentia Team pioneered and has dedicated its efforts for nearly three decades to the development of its Algal Turf Scrubber® (ATS™) and Water Hyacinth Scrubber (WHS™) treatment technologies. HydroMentia staff, with nearly 75 years combined experience, includes several of the nation's leading experts in the design and operation of commercial scale MAPS.

HydroMentia has developed and refined specific equipment for harvesting and processing of water hyacinths. General descriptions and specifications are provided as Appendix B (see Comments 11 and 12 within Appendix A). HydroMentia also has experience in the utilization and processing of water hyacinths and water hyacinth residuals, both as compost (mesophilic/thermophilic aerobic windrows process) and as cattle feed ingredient, both as a green chop product and as a dried product. During the course of a recent project done jointly with the South Florida Water Management District (SFWMD), the Florida department of Environmental Protection (FDEP and the Florida Department of Agriculture and Consumer Services (FDACS)—Grant No. C-13933—HydroMentia designed, constructed, and has operated for over two years, a prototype facility near the City of Okeechobee. This facility is referenced throughout this document as the S-154 MAPS prototype, or simply the S-154 facility. During the course of operations of this facility, HydroMentia delivered over 600 wet tons of chopped water hyacinths to a local dairy—McArthur Farms—where it was blended with other feed ingredients and fed to dairy cattle. In addition, during the course of operation of the S-154 facility, HydroMentia composted harvested and processed water hyacinths, and other residuals, included sediments associated with the WHS™ units.

REQUEST FOR QUOTE

On September 1, 2004 HydroMentia received a memorandum from Robert L. Knight PhD of Wetlands Solutions, Inc. (WSI) entitled **Lake Hancock Alternative Conceptual Treatment System Plan Foundation—Request for Harvested Aquatic Plant Based System for Nutrient Removal**, which included a request for a comprehensive quote for application of HydroMentia's Managed Aquatic Plant Systems (MAPS) as a method of nitrogen reduction within waters discharged into the Peace River from Lake Hancock, located in Polk County, Florida. Summarized within this memorandum were design conditions and treatment requirements associated with the planned program. Lake Hancock is identified as a large (4,500 acre) hypereutrophic lake, which releases highly nutritive waters into the

Peace River—a major tributary to the protected estuarine waters of Charlotte Harbor on Florida's gulf coast. (The Peace River also serves as a drinking water source for a significant segment of Southwest Florida's population.)

In response to the request, HydroMentia prepared and submitted a comprehensive document entitled Lake Hancock Outfall MAPS Nutrient Recovery Conceptual Plan September 2004. Comments subsequent to that submittal, made on September 30, 2004, and as generated following a meeting between HydroMentia and WSI on September 30, 2004, in HydroMentia's office in Ocala, Florida, are summarized as follows:

- WSI staff expressed concern related to the significant reliance upon ATS™, and offered a suggestion "that you [HydroMentia] also outline the sizing, estimated performance, and associated costs of a water hyacinth nitrogen removal system".
- Include greater detail about the deposition of solid by-products, and
- Evaluate the system on a 50 year rather than 20 year basis, to include replacement costs.

An alternate proposal was prepared and submitted in response to these comments. In addition, the original proposal was adjusted, and submitted a second time as an upgraded quote intended to address the issues of concern as listed.

Both proposals were prepared and offered to provide information needed to initiate an objective comparison of various technologies and process configurations. The process scenario as outlined within these documents included 1) The use of an initial WHS™ treatment, followed by an ATS™ process for final treatment and 2) the sole application of the WHS™ technology, which serves as a settling and nutrient uptake unit. Nutrient removal is largely by direct plant uptake and subsequent harvesting, with the smaller percentage of removal to be through sedimentation of sloughed solids, denitrification, ecological dynamics, and other processes. It is important to recognize that this process arrangement is but one possible application of the MAPS technologies, and that various alternative arrangements in coordination with other unit processes, such as filtration, chemical enhanced settling, and marsh floway or treatment wetlands may be considered.
.
Subsequent to these submittals, the documents were reviewed by Tory Champlin, PhD, P.E., the senior project manager for Parsons of Tampa, Florida—the engineering group serving through contract with the South West Florida Water Management District (SWFWMD) to develop the Lake Hancock project. In a discussion with Dr. Champlin and his staff, revisions were made to the design conditions, and on January 5, 2005 a request was made to modify the two proposals to include adjustments associated with these new conditions.

The most important and influential of these new conditions, in terms of facility sizing, was the need to accommodate the historical fluctuations in flows from Lake Hancock, into Saddle Creek (and eventually into the Peace River) while ensuring the systems provide 45% reduction of annual total nitrogen loads associated with these flows. This is a significant deviation from the conditions used in the previous proposals, in which flows were assumed to be maintained at a rather constant rate by a pumping system that withdrew water upstream of the Saddle Creek control structure, P-11. In other words, in the first set of proposals, it was assumed that Lake Hancock could serve as an equalization basin, while in the new set, the use of the lake in this capacity is not considered, and treatment must be provided as flow is discharged from the lake. This requires a much more extensive review of historical flow patterns, which is discussed in detail within this proposal.

3.0 SYSTEM DESIGN PROVISIONS AND ASSUMPTIONS

In addition to the conditions included within the original request for quote, HydroMentia was provided further clarification by Dr. Champlin regarding other items related to cost and technical issues via a series of emails from 1/5/05 through 1/7/05. These items included adjusted water quality provisions, as well as engineering and economic conditions and aerials of the potential sites.

The following provisions and assumptions are applied throughout this document:

1. Water to be treated is the controlled discharge from Lake Hancock at or near the structure identified as P-11.

2. Discharged water shall be delivered to the proposed MAPS facility via a pump station to be constructed owned and operated by the SWFWMD.

3. The proposer shall determine the capacity and flow rates of this pumping station based upon historical flow conditions at P-11 as provided within a data set delivered by Dr. Champlin.

4. The average total nitrogen concentration, calculated as the sum of nitrate-nitrogen and nitrite-nitrogen (NO_x-N) and total Kjeldahl nitrogen (TKN), which is the sum of total organic nitrogen (TON) and ammonia-nitrogen, is 5.53 mg/l.

5. The removal requirement for nitrogen is reduction of this load by 45% as a minimum on an annual basis, or a total annual reduction of nitrogen of no less than 130,200 kg, which represents 45% of the average annual total nitrogen load of 289,300 kg, when it is assumed that there is no discernible relationship between the rate of flow delivery and total nitrogen concentration, and that the rate of change in loads parallels the rate of change in flows delivered.

6. Of the total nitrogen load, 72% is in particulate form, with this particulate form being essentially all TON. This particulate TON annual load is therefore assumed to be about 208,300 kg. The remaining nitrogen load is largely dissolved TON, with a small percentage (<1.0%) as ammonia-N and NO_x-N.

7. Total phosphorus concentration averages 0.603 mg/l or 603 ppb, with 92% of the total phosphorus load as particulate phosphorus with only 2.2% of the total phosphorus as ortho-phosphorus.

8. There is no numerical reduction target for total phosphorus, but it is identified as an element of concern and projected reductions will be provided.

9. Total suspended solids appear to have increased significantly over recent times, with the most recent data indicating an average of 115 mg/l, as compared to modern STORET data indicating an average of 70 mg/l. For purposes of this submittal, the average value of 115 mg/l will be used.

10. There is no numerical reduction target for total suspended solids, but it is identified as a parameter of concern and projected reductions will be provided.

11. Discount rate used for “present worth” analysis is 5.625% per Section 80 of PL 93-251. The life period for the “present worth” analysis shall be 50 years, based upon 2004 dollars.

12. Inflation rate has been assigned as 3% annually per Dr. Champlin.

13. The site to be selected shall have a mean high groundwater no less than 3 feet below ground surface, and shall contain no existing wetlands or other environmentally sensitive features.

14. Costs exclude any additional expenditures which might be associated with extensive demucking and removal of buried organic debris, or unsuitable subsurface condition e.g. sink holes, unconsolidated clays, etc.; any toxic, hazardous or dangerous materials that may have been deposited on or near the site; presence of threatened, endangered or species of special concern; prolonged public opposition to the siting; or Acts of God or other activities beyond the control of HydroMentia. However, based upon discussions on February 14, 2005 with Dr. Champlin et al., this second revision includes consideration of the WHS™ unit berms to be constructed of imported material. The reason for these considerations is related to the presence of phosphatic clays near the ground surface, and the concerns related to interruption of these clays during pond construction; their behavior in terms of potential release of colloidal solids should they be exposed directly to the water column within the ponds; the difficulties in excavating and compacting these clays should they be used in pond bottom and berm construction; the question of the actual depth of overburden over these clays; and the issue of possible release of other pollutants from disturbed clays.

15. Replacement of equipment and material items shall be twenty years for tractors, loaders, conveyors, choppers and mixers; geotech matrix; pumps; automatic rakes and fifty years for HDPE (High Density Polyethylene) geomembrane.

16. Construction contingency shall be 20% of equipment, labor and material costs associated with construction. Mobilization/Demobilization shall be 5%; Construction Permits 1%; Bonding 1%; and Insurance 1% of these same costs.

17. Sales tax shall be 7% of the equipment and material costs associated with construction.

18. Engineering and design costs shall be 25% of the total construction costs, which is the sum of equipment, materials, labor, contingency, mobilization/demobilization, construction permit costs, bonding, insurance and sales taxes.

19. "Present worth" shall mean the long term total cost of the project as the sum of all initial capital costs excluding land costs; annual operating costs adjusted for 50 continuous years to represent one present cost investment required at the selected interest rate to ensure sufficient funds are available for each annual period; replacement costs to represent one present cost investment required at the selected interest rate to ensure sufficient funds are available at the time replacement is needed; demolition costs at the end of the 50 year period to represent one present cost investment required at the selected discount rate to ensure sufficient funds are available at the end of the project; land salvage at the end of the project to represent monies as one present cost income equivalent to the represented funds related to the land sale at the selected interest rate, with land prices unchanged from initial purchase price. (**Note: HydroMentia has been instructed within the revised proposal to exclude land purchase and demolition costs, as well as land salvage costs from the present worth calculation. By eliminating land costs and other factors the present worth analysis is not consistent with Federal guidelines as delineated within Circular A-94**[1] **and the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*.**[2] **Therefore, this economic review as modified, may be more correctly defined as a customized long-term economic analysis, rather than a true present worth analysis. However, to avoid confusion within the text, the term present worth or present value will be applied, but will be in quotation marks.**)

20. The "present worth" cost-effectiveness shall be based upon $/lb-N removed (or phosphorus), and shall be the total 50 year "present worth" cost divided by the total lb of nitrogen (or phosphorus) projected to be removed over that 50 year period. This "present worth" cost-effectiveness unit shall not be interpreted as a proposed fee for

implementation of the process.

21. Fees, profits and licenses for all proprietary technologies for the subject facility are included in the quote, and are appropriately identified, as requested (see Comment A8(n) of Appendix A).

22. Dr. Champlin has provided specific unit costs to be applied to the project, including a cost per linear foot for the planned WHS™ berms, soil cement, etc. which are included in the cost details provided in Appendix C (Comment A8(b) of Appendix A.)

4.0 TECHNICAL REVIEW AND FACILITY SIZING AND LAYOUT

ASSESSMENT OF WATER QUALITY

Based upon initial information submitted by WSI, and subsequent data provided by Parsons through Dr. Champlin, and from existing water quality information such as the ERD Report entitled **Lake Hancock Water and Nutrient Budget and Water Quality Improvement Project** (2000), the water associated with Lake Hancock may be described as a soft, low alkalinity, nutrient laden water characterized by extensive, quasi-continuous blooms of phytoplankton resulting in reduced light penetration, diurnal fluctuations in pH and dissolved oxygen attendant with high levels of photosynthesis, followed by nocturnal periods of high respiratory demands. The mass ratio of total nitrogen to total phosphorus oscillates around 9.2:1, indicating a biologically acceptable balance in terms of capability to support active productivity. The alkalinity is comparatively low, typically around 55-65 mg/l as $CaCO_3$, indicating rather limited buffering capability and modest levels of available carbon within the water column. Therefore, pH levels are noted to be quite high in the afternoon as carbon dioxide, bicarbonate and even carbonate are consumed by the primary producers within the water column, resulting in a shift towards increased hydroxide alkalinity. At night this shift is driven towards a lower pH as carbon dioxide is released during respiration.

As noted, most of the nitrogen and phosphorus are present in particulate form. Accordingly, the suspended solids are quite high, now averaging about 115 mg/l. With the average total nitrogen at 5.53 mg/l, and the particulate nitrogen at about 3.97 mg/l, it is noted that the suspended solids average about 3.46% total nitrogen. Accordingly, the total particulate phosphorus (mostly organic) is about 0.55 mg/l, indicating the suspended solids are about 0.5% phosphorus. These percentages are within the ranges expected for plant tissue within moderately high nutritive conditions, indicating the suspended solids component is mostly composed of phytoplankton, which was also noted by ERD in their 2000 report.

HydroMentia staff reviewed STORET data for Lake Hancock related to calcium, magnesium and potassium, which are essential to the support of highly productive plant crops such as water hyacinths and periphytic algae. The average concentration of calcium, magnesium and potassium were about 26, 8 and 2.5 mg/l, respectively. These are acceptable levels to ensure sufficiency for the working standing crops. Iron, another essential element was not represented within the STORET data, but it would be expected that it would be available in sufficient quantities. It is recommended that a pilot study be conducted to establish the specific performance of water hyacinths when this particular water source serves as a feed source. More detail related to such a study is included in subsequent sections within this quote.

It has been HydroMentia's experience in dealing with such hypereutrophic waters that a major portion of phytoplankton under certain conditions, will settle, and accordingly deteriorate (lyse), thereby releasing intercellular material, including nitrogen and phosphorus to the water column. Similar observations were noted by Gopal et al. (1984)[3], who found significant reductions in phytoplankton within hypereutrophic waters as they were introduced into water hyacinth lagoons. Fisher and Reddy (1987)[4] also documented extensive reduction in phytoplankton within waters associated with Lake Apopka in Florida, noting that within harvested hyacinth systems, with a hydraulic retention time of 1.5

days the nitrogen removal was 54% of the incoming load, as opposed to 39% for a system with no hyacinths. Within the harvested system, they documented about 30% of the removed nitrogen as being contained within new plant tissue, with 61% in the sediments, and the remaining 9% unaccounted for, likely associated with denitrification, ammonia volatilization and larval emergence.

Within this proposal plant uptake is assigned a greater role in the reduction of nitrogen—about 78% of the removed nitrogen, with 22% as sedimentation. The ensures a conservative assessment of operational costs, as it can be expected that somewhat greater efforts may be associated with the harvesting and processing of water hyacinths, as compared to sediments. The proposed pilot study will allow documentation of these ratios—plant uptake Vs. sedimentation—within the specific conditions associated with the Lake Hancock feedwater. The Lake Hancock nutrient loads, while particulate, are expected to be labile and rendered biologically available once the integrity of the phytoplankton biomass is challenged.

In their recent studies on Lake Hancock, ERD found a significant reduction (circa 50%) of nitrogen and even greater reduction in Chlorophyll-a with 9 hours of detention within a settling lagoon under shaded conditions. This is similar to the behavior of hypereutrophic waters within WHS™ systems noted by HydroMentia's staff, as well as by Fisher and Reddy (1987) and others.

WHS™ systems have been documented throughout the literature as promoting significant reduction of total suspended solids (TSS) as well as 5-day biochemical demand (BOD_5). Dinges (1979)[5] found both TSS and BOD_5 reductions to exceed 80% when hyacinth lagoons were used for treating primary domestic wastewater effluents. McDonald and Wolverton (1980)[6] found similar performances, with TSS reductions at 100% plant coverage amounting to 95%, with influent concentrations at 125 mg/l and effluent concentrations at 6 mg/l. In this same system BOD_5 was reduced from 161 mg/l to 23 mg/l or 86% removal. Hayes et. al (1987)[7] working with hyacinth lagoons in Orlando, Florida, found a correlation between BOD_5 areal loading with areal removal, with loadings of about 350 lb/acre-day resulting in a removal of approximately 267 lb/acre-day, or 76% removal. They also developed a linear equation for the reduction of total suspended solids within these hyacinth systems, $y = 0.645t+10.75$, where t is hydraulic retention time in days, and y is the effluent TSS concentration in mg/l.

One of the most effective means, therefore, of challenging the integrity of extensive phytoplankton production is through a combination of shading and intra-specific competition. Both can be provided by a number of vascular aquatic plants, with water hyacinths, a floating aquatic, perhaps the most studied and effective. Within the presence of an established water hyacinth crop, phytoplankton will be effectively attenuated, largely through shading, but also through competition for nutrients and perhaps through allelopathic responses.

Attendant with the large suspended solids load is a moderate BOD_5 load, with an average BOD_5 of about 18 mg/l. From review of some of the more recent STORET data, it is estimated that the TOC averages close to 20 mg/l, indicating relatively labile organic carbon, as might be expected with the predominance of phytoplankton. However, the TSS:BOD ratio indicates about 6.5 pounds of solids to yield 1 pound of BOD, which implies some recalcitrant organic compounds; a low carbon content within the suspended solids; or a significant nitrogenous or 28-day carbonaceous demand—the later being perhaps the most likely. Similarly, from the STORET data, it appears COD averages about 150 mg/l, indicating a BOD:COD ratio of close to 9:1, again indicating some recalcitrance, perhaps associated with the high nitrogenous demand and resistant organic carbonaceous compounds An extended BOD test period will provide better insight into the extent of the oxygen demand associated with nitrogenous and recalcitrant compounds within this water source.

ESTABLISHING DESIGN FLOWS AND LOADS

As noted, HydroMentia was provided a data set by Dr. Champlin, in which were listed dates and flows, identified to be from the P-11 structure, representing discharges from Lake Hancock to Saddle Creek. The data set is from the time period 1/1/75 through 12/31/03. In an initial, somewhat cursory review of the data, HydroMentia developed the loading ranges for the 29-year period as noted in Table 1. Shown in Appendix D are the individual monthly composite distribution of flow rates and loading rates as calculated by HydroMentia. In the February 14, 2005 meeting with Dr. Champlin et al., it was noted that there were some differences between the HydroMentia averages, and those developed by Parsons. The difference, for example, for the average daily flow was 37.9 MGD (Parsons) as compared to 40.4 MGD HydroMentia, and 289,300 kg/yr annual nitrogen load (Parsons), as compared to 308,690 kg/yr (HydroMentia.) In the meeting is was recognized that the discrepancies are likely related to minor mathematical adjustments (such as rounding), and that it would be in the best interest of the evaluation process to adjust to the Parson values (see initial statement in Appendix A.). Consequently, the design parameters have been adjusted accordingly, through interpolation and are shown as Table 2. Included in Table 2 are the design parameters based upon a strategy to capture all flows at or below 300 cfs or 194 MGD. For all flows greater than 300 cfs, that portion greater than 300 cfs would be by-passed. As noted, this strategy results in the capture of about 85% of the flows and loads. The captured nitrogen load is estimated at 245,607 kg/yr. If the removal requirement of 130,200 kg/yr is to be satisfied, at least 53% removal of the captured nitrogen is necessary.

Table 1: Twenty-nine year (1975 through 2003) flow and loading trends as calculated by HydroMentia

n=10592
TN = 5.53 mg/l
TP = 0.603 mg/l

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg
0-2.5	6009	3,274	0.25%	0.25%	22,339	292
2.6-5	344	2,430	0.19%	0.43%	16,580	217
5.1-7.5	231	2,852	0.22%	0.65%	19,463	254
7.6-10	162	2,824	0.22%	0.87%	19,270	252
10.1-15	147	3,847	0.29%	1.16%	26,251	343
15.1-20	160	5,926	0.45%	1.61%	40,434	529
20.1-25	155	7,184	0.55%	2.16%	49,017	641
25.1-30	86	4,743	0.36%	2.52%	32,366	423
30.1-35	67	4,404	0.34%	2.86%	30,047	393
35.1-40	66	5,010	0.38%	3.24%	34,183	447
40.1-50	142	8,159	0.62%	3.86%	55,674	728
50.1-100	771	114,481	8.72%	12.58%	781,136	10,213
100.1-200	1043	292,397	22.27%	34.85%	1,995,110	26,085
200.1-300	576	279,043	21.25%	56.11%	1,903,992	24,894
300.1-400	286	193,853	14.77%	70.87%	1,322,720	17,294
400.1-500	163	144,978	11.04%	81.91%	989,230	12,934
500.1-600	77	84,313	6.42%	88.34%	575,292	7,522
600.1-700	45	57,551	4.38%	92.72%	392,690	5,134
700.1-800	42	61,860	4.71%	97.43%	422,086	5,519
800.1-900	15	24,512	1.87%	99.299%	167,254	2,187
900.1-1000	5	9,205	0.70%	100.000%	62,807	821
	TOTALS	1,312,845			8,957,940	117,121

AVERAGES	
Flow acre-ft/yr	45,241
Flow MGD	40.39
Total Nitrogen kg/yr	308,690
Total Phosphorus kg/yr	4,036

Table 2: Summary of 29-year monthly flow and load averages, and projected system capture adjusted to conform with values provided by Dr. Tory Champlin of Parsons.

Month	Average Total Monthly Flow MGD	Average Captured Monthly Flow MGD	Maximum Influent Flow Rate MGD (cfs)	Days at Maximum Flow Rate	% Flow Capture	Total Monthly Nitrogen Load kg	Captured Monthly Nitrogen Load kg
January	42.17	30.90	194 (300)	2.51	73.29%	27,278	20,034
February	31.83	27.25	194 (300)	1.48	85.62%	18,580	15,957
March	38.73	30.54	194 (300)	1.74	78.85%	25,049	19,796
April	30.35	27.15	194 (300)	1.50	89.46%	18,981	17,032
May	11.84	10.71	194 (300)	0.37	90.46%	7,617	6,943
June	22.13	21.11	194 (300)	0.82	95.38%	13,825	13,242
July	48.50	45.12	194 (300)	1.86	93.03%	31,387	29,253
August	68.89	58.26	194 (300)	3.24	84.56%	44,605	37,767
September	66.75	56.32	194 (300)	3.92	84.37%	41,823	35,335
October	44.47	38.96	194 (300)	2.34	87.63%	28,769	25,261
November	17.66	16.98	194 (300)	0.34	96.14%	11,023	10,654
December	31.50	22.11	194 (300)	1.64	70.19%	20,361	14,332
Summary	37.90	32.12		21.76	84.74%	289,300	245,607

WHS™ UNIT SIZING AND CONCEPTUAL DESIGN

HydroMentia proposes a single stage WHS™ system as one of two alternative Lake Hancock MAPS Nutrient Control System. The single-stage WHS™ system as proposed will provide the following benefits:

1. The WHS™ provides a means for attenuating the phytoplankton load through shading, settling and interspecific competition. The high nitrogen load solicits high levels of water hyacinth productivity and accordingly, relatively high rates of removal.

2. The WHS™ conditions the water quality by :

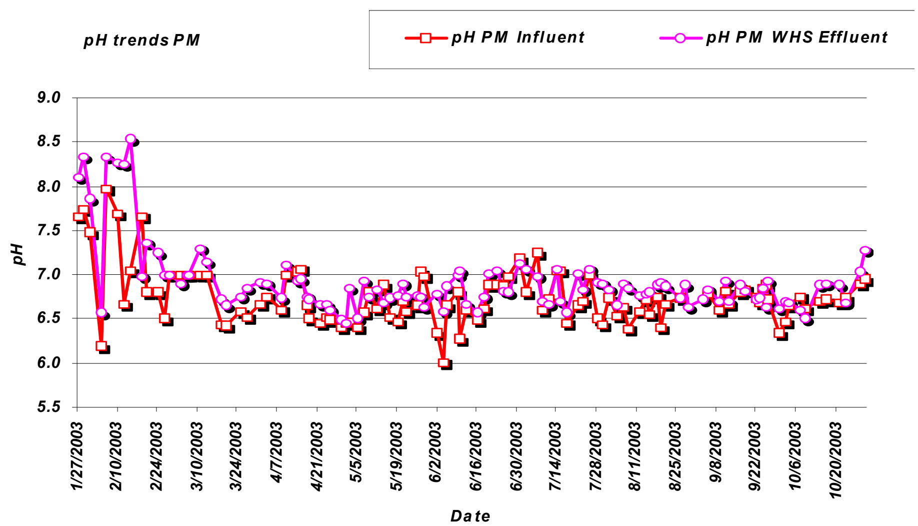
    a. Reducing the organic solids loads and facilitating conversion of organic nitrogen to more available forms, largely through lysing of the algal cells associated with the heavy phytoplankton load.

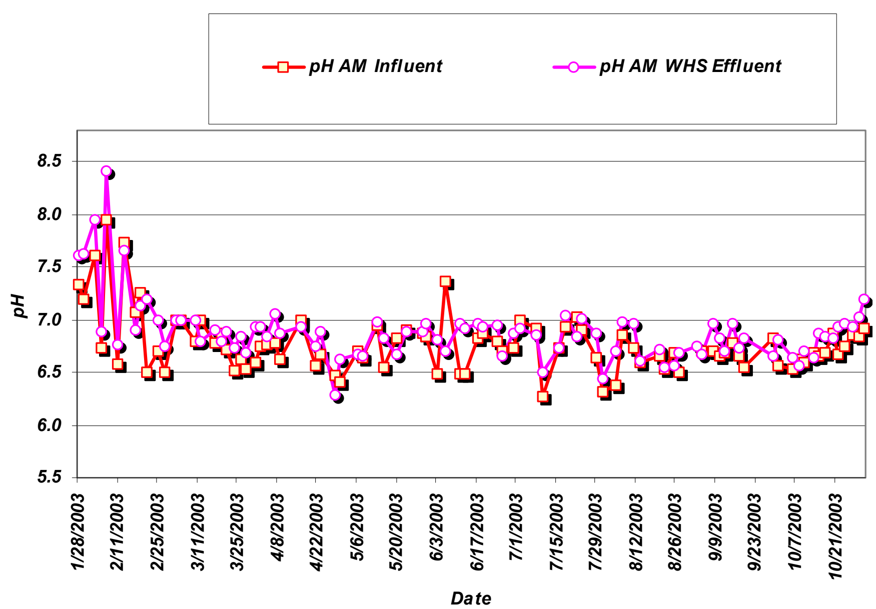
    b. Direct plant uptake of the nutrients nitrogen and phosphorus, and the subsequent recovery of these nutrients through crop harvesting and processing into fertilizer/compost products. These by-products can then be removed from the watershed, thereby avoiding extensive storage within the Lake Hancock watershed, or substituted for imported fertilizer products, thereby reducing nutrient imports into the basin.

    c. Reducing biodegradable organic loads, as well as reduction of metals and synthetic organic pollutants.

    d. Modulating pH fluctuations by transferring primary productivity from phytoplankton to water hyacinths. High pH levels attendant with low alkalinities and high phytoplankton blooms can be deleterious to certain aquatic communities. Within the hyacinth system CO_2 is generated through heterotrophic activity within the root zone and the sediments. This typically reduces pH to between 5.5-7.0 and attenuates the diurnal variability of the pH, and eliminates high pH (>9.5) peaks. Based upon its experience of WHS™ facilities, HydroMentia has noted hyacinth effluents to be at or just below neutral (7.0) in pH, and low in dissolved oxygen. The effluents are often very low in suspended solids. A typical trend for pH, for example is noted as Figure A, in which the AM and PM pH trends for influent and effluent associated with the WHS™ system are noted.

Figure A: WHS™ influent and effluent pH trends S-154 MAPS prototype.





e. Modulating water temperature by providing insulation, which levels out fluctuations both in the summer and winter.

f. Sustaining an active, viable biomass during extended periods of no flow. The WHS™ system requires no recycle flow during down times, as the lagoons, through the use of risers can be set at a minimum depth, thereby assuring the ponds retain water even during extended periods of no flow. The hyacinth crop itself can be maintained without input flows for long periods, as they will access nutrients held within the sediments. While some physiological and morphological changes may eventually occur after long-term periods of no inflow (> 8 weeks), the crop will remain viable, and be capable of uptaking nutrients as they are introduced into the system. For example, at the S-154 MAPS prototype, HydroMentia has maintained one off-line WHS™ treatment unit for over 8 months, without continuous flow. The crop remains healthy, and the system functional (Comment 1 of Appendix A)

g. The proposed WHS™ will be designed to protect from release of viable hyacinth tissue into Saddle Creek. To cultivate water hyacinth an Aquatic Plant Permit is required from FDEP. For example, HydroMentia presently holds such a permit for the S-154 MAPS facility. This permit is issued with general and special conditions that address the issue of escape, and the attendant responsibilities. Such a permit would be required for the proposed Lake Hancock WHS™ facility.

   The issue of release of tissue is addressed as part of the Aquatic Plant Permit application. The elimination of direct releases is facilitated through use of multi level exclusion barriers constructed in conjunction with outflow structures. (Figure B).

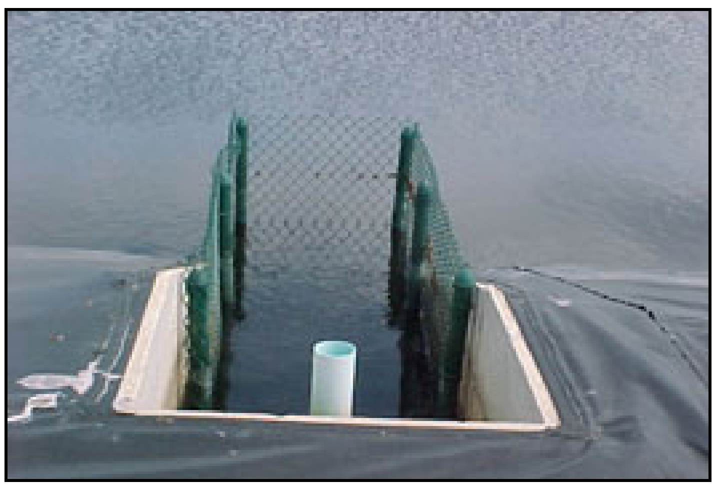


Figure B: Typical WHS™ effluent screen and riser.

Direct releases of hyacinth biomass would not be problematic unless a serious breech of system integrity was to occur—i.e. berm collapse. Measures will be taken to avoid such events from occurring, and this relies upon sound engineering practices, and common sense operational provisions.

Due to the small controlled size of the WHS™ unit, plant tissue releases often are more effectively accomplished within MAPS systems than can be accomplished within larger treatment wetland systems. (Comment 2 of Appendix A). Provisions for screening tissue associated with exotic aquatic vegetation also needs to be provided in treatment wetland system, which unavoidably are invaded by exotics such as hyacinths, alligator weed, hydrilla, and torpedo grass, all of which could escape into the receiving waters. The following citation by Goforth, 2005[8] describes the magnitude of these issues with the large treatment wetland systems developed to reduce pollutants to the Everglades Protection Area.

> *Through 2002 no large-scale herbicide applications were utilized in Cell 5. However, by late 2002, it was clear that the large floating aquatic vegetation (FAV) was creating performance problems, so over 1000 acres were treated with herbicide, resulting in effective control. A lesson learned from this experience (along with similar occurrence in STA-5) is to stay ahead of the FAV growth by actively controlling its growth with herbicide.*
>
> *To minimize the disruption of outflow pump G-310 caused by the discharge of floating SAV fragments, a vegetation control plan was developed for G-308 and G-309. This consisted of periodic gate openings to release any SAV material that may have lodged against the gate, thereby preventing a buildup of SAV mats at the structure that could move downstream and clog the trash racks at G-310.*

It should be noted that 100% exclusion of nuisance vegetation from discharges is not possible in either WHS™ or treatment wetlands systems.

From an indirect hyacinth and other nuisance species control perspective, the fact that the proposed WHS™ would reduce nitrogen levels within Lake Hancock discharges by 45% would influence the rate of growth and expansion of any hyacinths that presently exist downstream in Saddle Creek. Using the Monod relationship, for example, and the HYADEM model, suppose that there is an existing stand of water hyacinths in 100 acres of Saddle Creek of 599 wet tons, at a density of 5.50 wet lbs/ft^2. Noted in Figure C and D are the HYADEM printouts at the existing total nitrogen concentration of 5.53 mg/l and the proposed average treated concentration of about 3.04 mg/l, using an average flow of 37.9 MGD. As noted, over a 100-day period, the creek standing crop has increased to 3,078 wet tons, or 30.7% coverage without treatment, as compared to only 1,613 wet tons and 18.5 % coverage with treatment. (These numbers are provided only for comparative purposes only, in an effort to demonstrate the general influence of this indirect control phenomenon.)

HYADEM Before WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	37.9
Days	365
Average Total Nitrogen (mg/l)	5.53
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**5.53**
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	599
Field Water Hyacinth Growth Rate (1/day)	0.018
100 day Growth (Wet Tons)	**3,078**
Coverage after 100 days	**30.7%**

Figure C: Projected Hyacinth Growth Saddle Creek Prior to WHS™ treatment

HYADEM After WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	37.9
Days	365
Average Total Nitrogen (mg/l)	3.04
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**3.04**
Influent Total Nitrogen including Supplementation mg/l	3.04
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	599
Field Water Hyacinth Growth Rate (1/day)	0.013
100 Day Growth (Wet Tons)	**1,613**
Average Daily Growth (Dry Tons)	**18.5%**

Figure D: Projected Hyacinth Growth Saddle Creek After WHS™ treatment

This control strategy in not unique, for it is the same strategy used in controlled heterotrophic systems (e.g. activated sludge) in which the pollutant impacts are contained within a “controlled vessel”, so they do not manifest themselves within the receiving water. In other words a colony of facultative bacteria and rotifers are used to metabolize waste prior to its release, thereby avoiding a colony of facultative bacteria and rotifers performing the same task within a more expansive, protected ecosystem, e.g. a stream, lake or estuary. Water hyacinths used within a “controlled vessel”—i.e. a WHS™ unit—help ensure hyacinth growth does not become problematic within the receiving water.

h. Because the WHS™ system will typically reduce dissolved oxygen levels to below 5 mg/l, post-treatment aeration will be provided. This will be done within a final stage basin in conjunction with paddlewheel aerators.

Considering the flow patterns as previously presented, the system requires a maximum flow capacity of 300 cfs. A working depth of 4.0 feet is suggested to provide adequate space for sediment accumulation and to ensure that at maximum flow at least one day of hydraulic retention is provided. Considering this, model runs can be done on each month, based upon the average air temperature [9] as shown in Table 3. Incidental nitrogen removal (C_n) is set at 0.30 to account for heavy sedimentation and sloughing (Stewart et al., 1987[10]; Fisher and Reddy, 1987[11]). Also, when the model projects a total nitrogen concentration of less than 1.25 mg/l and a total phosphorus concentration of less than 0.05 mg/l the model defaults to a minimum total nitrogen concentration of 1.25 mg/l and a total phosphorus concentration of 0.05 mg/l, as these are reasonably conservative achievement limits, based upon work done in waters of similar quality. A typical model run (July) is shown as Table 4. The runs for each month are presented in Appendix B.

Table 3: Mean Air Temperatures for the Lake Hancock Region

	Winter Haven	Bartow	Lakeland		
	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (C)
Jan	62.3	62.5	59.8	62.5	16.94
Feb	63.7	64.2	61.7	64.4	18.00
Mar	68.3	68.6	66.6	69.1	20.61
Apr	72	72.6	70.8	73.2	22.89
May	77.5	78.1	76.5	78.9	26.06
Jun	81	81.8	80.8	82.7	28.17
Jul	82.3	82.9	82.3	84	28.89
Aug	82.6	83.1	82.2	84.1	28.94
Sep	81.1	81.6	80.3	82.6	28.11
Oct	75.5	75.7	74.4	76.6	24.78
Nov	69.2	69.7	68.1	69.9	21.06
Dec	63.7	64.1	61.6	63.9	17.72
Annual	73.3	73.7	72.1	74.3	23.50

Table 4: Typical HYADEM run for flow and load conditions (July)

HYADEM July 300 cfs (194 MGD)		**HYADEM July (35.62 MGD)**	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.62
Days	1.86	Days	29.14
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.49
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.89	Average Air Temperature (degrees C)	28.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	200.00
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	17,642
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	7.32
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	16.66
Mean Plant Age days	49.78	Mean Plant Age days	60.87
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	292.2
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	14.6
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	169.7
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	11.0
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	70.7
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.5
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.44**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.190**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	551.92
Nitrogen Removal kg/period	1,320	Nitrogen Removal kg/period	16,083
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	6.08
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	249
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	56
Phosphorus Removal kg/period	133	Phosphorus Removal kg/period	1,624
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.61
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	25.12

Total Nitrogen Removed kg/month	17,403
Total Phosphorus Removed kg/month	1,757

WHS™ PERFORMANCE PROJECTIONS

A summarization of the modeling results are noted in Tables 5 and 6. The annual projected nitrogen removal is 132,108 kg/yr, which is somewhat greater than the required 130,200 kg/yr. Based upon these results, it is proposed that the WHS™ area required to reduce the annual incoming nitrogen load by 45% would be 210 acres, with a maximum flow capacity of 300 cfs. This determination is made through application of the Monod based HYADEM model (Stewart et. al 1984)[12], and since refined by HydroMentia, [HydroMentia (2004)][13].

Table 5: Summary of Modeled Monthly Performance

Month	kg-N removed	kg-P removed
January	8,797	1,104
February	8,434	1,069
March	10,832	1,201
April	9,407	1,189
May	4,480	571
June	8,268	1,052
July	17,403	1,757
August	18,884	1,907
September	17,702	1,787
October	13,781	1,703
November	7,378	948
December	6,741	849
Totals	132,108	15,138

Shown as Figures E, F and G are the general nitrogen reduction performances of a number of WHS™ systems with which HydroMentia has been involved. The projected performance data point for the proposed Lake Hancock process acres, WHS™ Nutrient Recovery Facility is also noted in each of these figures, and as noted, lays within the general data clusters within the scattergrams. The individual WHS™ facilities are summarized within Table 7. This list is just a representative sample of the literature, which is quite extensive (Gopal; 1987)[14].

The initial sizing calculations then include a WHS™ system of 210 acres. In addition a reaeration lagoon is provided. HydroMentia has extensive experience with paddlewheel aeration systems, which have generally been found to be a most efficient method of increasing dissolved oxygen within shallow, surface water impoundments (Boyd, 1990)[16]. If it assumed that the summer months represent the worst case during high daily temperatures (36^{o} C), and that at this time the effluent has a dissolved oxygen of 0.00 mg/l, then it can be projected that at max flow of 300 cfs, about 337 lbs or 153 kg of oxygen are required per hour, the required lagoon size can be determined for a given Standard Aeration Efficiency (SAE) for a paddlwheel aerator. Boyd (1990)[15] indicates paddlewheel aerators average about 2.2 Kg O_2 /kwh. This SAE value would be adjusted to an actual rate of about 1.30 kg O_2 /kwh (Boyd, 1990). Therefore, about 118 kwh would be required to provide the required oxygen during the maximum flow in the summer, or about 165-188 hp of aerators. The aeration lagoon would need to provide no less than one hour's detention, or a volume of 8.08 million gallons, or at a 4 ft depth, about 6.2 acres. The lagoon needs to be dimensioned to ensure adequate mixing, and would be lined with 40 mil HDPE to prevent scouring. A typical dimension at water surface would be 200 ft wide and 1350 ft long and 4 ft deep, with 1 ft freeboard. A workable design would involve 20-10 HP paddlewheels, about 12 ft in length, placed in a staggered manner along the long axis of the pond.

Table 6: Performance projection WHS™ system

Parameter	WHS™
Process Acres	210
Average Hydraulic Retention Time days	8.52
Minimum Hydraulic Retention Time days (@194 MGD)	1.41
Average Hydraulic Loading Rate cm/day	14.31
Nitrogen Removal kg/yr	132,108
Average Nitrogen Effluent Concentration mg/l	2.56
Nitrogen Areal Removal Rate g/m^2-yr	155
Phosphorus Removal kg/yr	15,138
Phosphorus Effluent Concentration mg/l	0.262
Phosphorus Areal Removal Rate g/m^2-yr	17.8
TSS Areal Loading Rate g/m^2-yr	6,005
TSS Areal Removal Rate g/m^2-yr	5.404
TSS Effluent Concentration mg/l	<12
Wet/Dry Biomass Harvest tons/yr	52,756 / 3,429
WHS™ Wet/Dry Sediment Harvest tons/yr	26.680 / 1,334
Wet/Dry Growth tons/yr (see Comment 6 Appendix A)	95,260 / 4,763
Annual Compost Production tons/yr	8,931
Annual Compost Production cy/yr	14,884

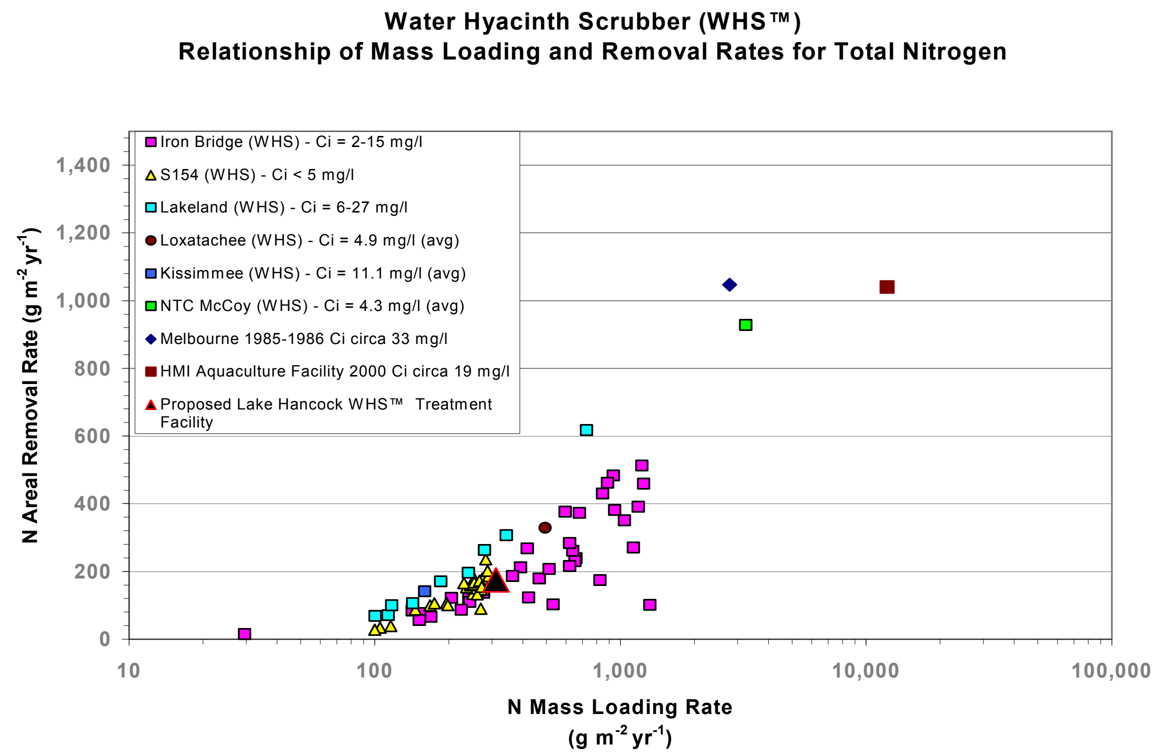


Figure E: Water Hyacinth Scrubber nitrogen removal performance

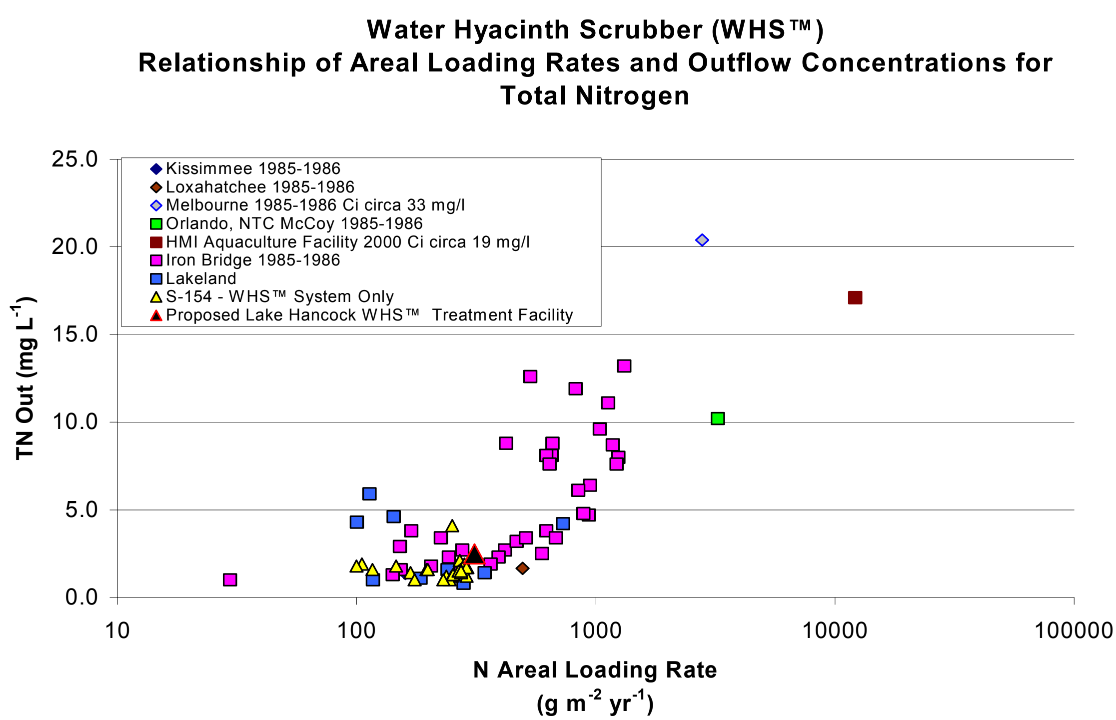


Figure F: Water Hyacinth Scrubber nitrogen loading compared to effluent concentration

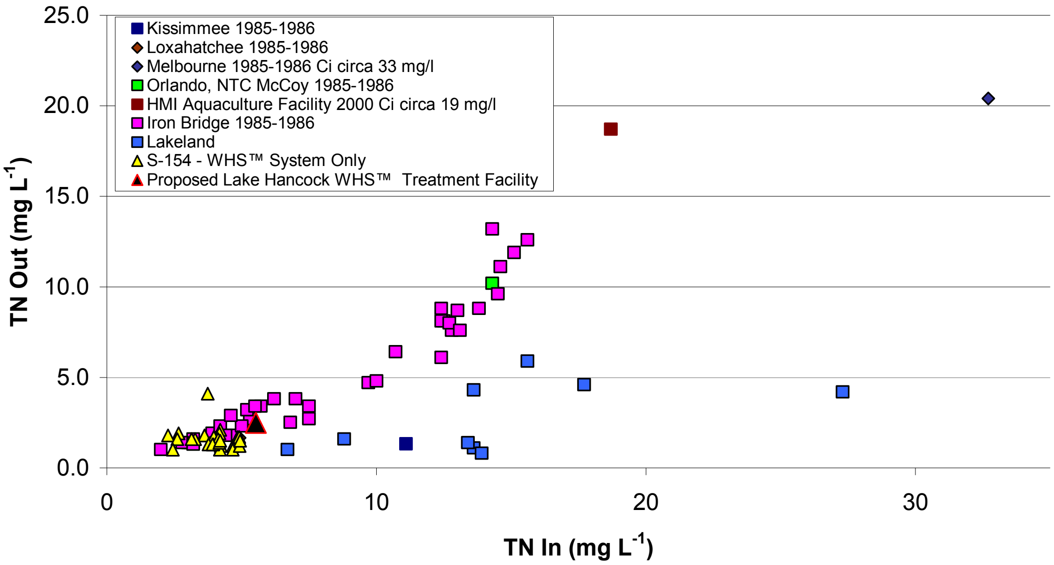


Figure G: WHS™ nitrogen influent concentration compared to effluent concentration

Table 7: Summary of Performance WHS™ projects

Facility	Operational		Total Phosphorus mg/l		Total Nitrogen		Total Nitrogen Loading Rate g/m²-yr	Total Nitrogen Removal Rate g/m²-yr	Hydraulic loading Rate cm/day	References
	Flow mgd	**acres**	**In**	**Out**	**In**	**Out**				
WHS™ Lakeland (1978-79)	0.15	3.0	4.10	2.19	14.51	2.76	250	211	4.7	Stewart (1979)
WHS™ Iron Bridge (1985-1988)	5.87	32	0.40	0.21	8.31	5.07	556	221	14.8	Performance reports to City of Orlando Stewart et al. (1987)
WHS™ Melbourne (1985-1986)	2.99	12	4.33	3.70	32.70	20.40	2,784	1,047	0.76	Stewart et al. (1987)
WHS™ Kissimmee (1985-1986)	0.15	3.7	1.46	0.12	11.1	1.32	160	141	3.81	Stewart et al. (1987)
WHS™ Loxahatchee (1985-1986)	2.49	8.50	1.06	0.55	4.93	1.65	494	329	30	Stewart et al. (1987)
WHS™ NTC Orlando (1983-1986)	1.00	1.51	1.97	0.62	14.30	10.20	3,234	927	62	Stewart et al. (1987)
WHS™ HMI Aquaculture (2000-2001)	21.50	11.33	8.64	8.59	18.70	17.10	12,157	1,040	178	Stewart (2001)
WHS™ S-154 (January through September 2003)	0.41	2.50	0.495	0.183	3.92	1.58	219	131	15.3	HydroMentia (2004a)

A general layout and flow schematic is presented as Figure H. A generalized layout over a site aerial is presented as Figure I. The WHS™ system will receive flows from the District's pumping station to be located on Saddle Creek, just north of P-11. Flows will be delivered at a maximum rate of 300 cfs (194 MGD), with the capability of modulating flows to match discharges from P-11. As noted in the modeling, the maximum flow will occur only about 22 days of the year. The annual average flow to the system is projected at 32.12 MGD. The modeling was done at two levels—one set at maximum flow for the days expected, the other at the average daily flow for flows below 300 cfs.

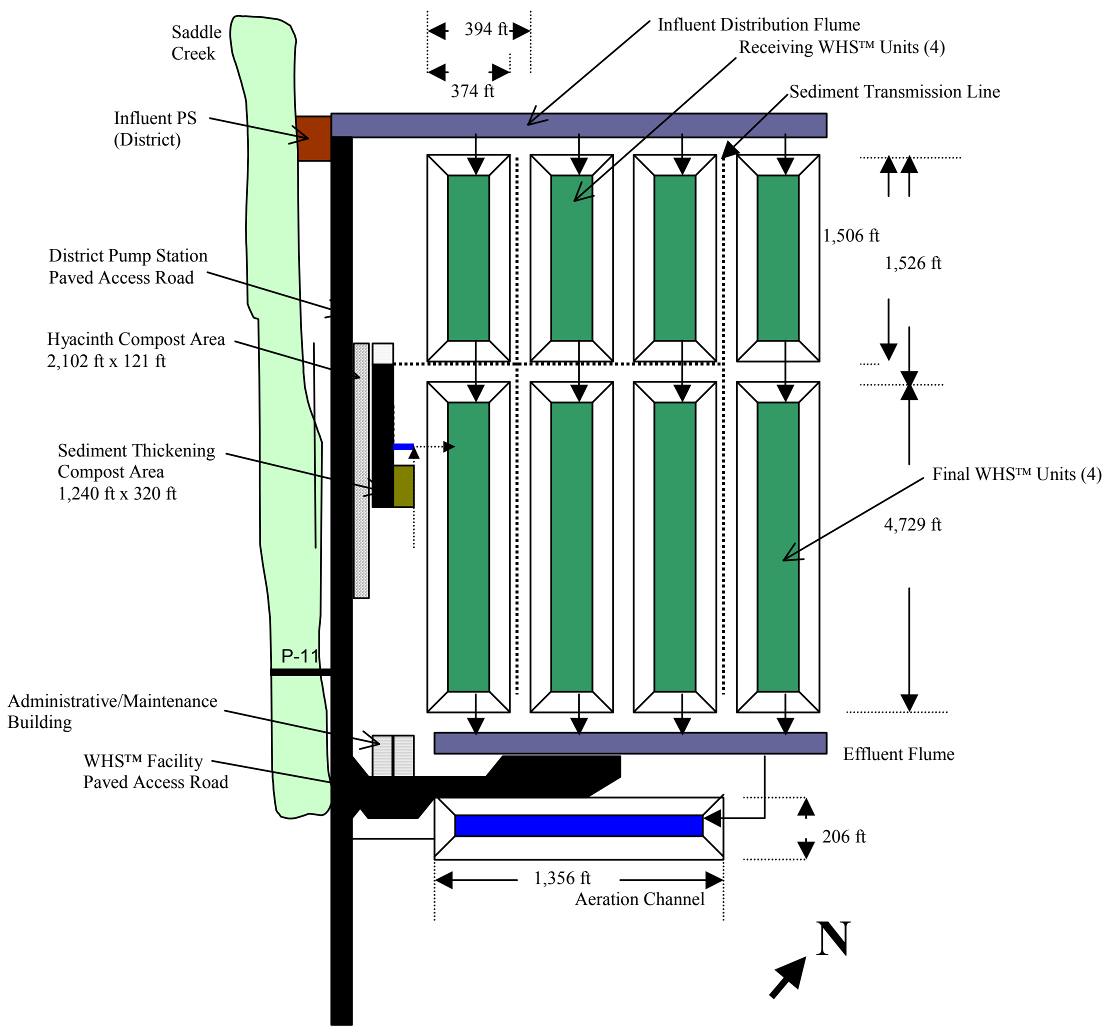


Figure H: General layout proposed Lake Hancock WHS™ Nutrient Recovery Facility: Drawing not to scale (nts)

Flow conveyance to the WHS™ unit will be through a trapezoidal conveyance flume, lined with 40 mil HDPE. Lining the flume will permit more effective flow and seepage control. Individual 8-10 inch laterals would deliver flow to the four parallel WHS™ units along the width (368 ft each). Control of flow would be through low-pressure in-line valves, such as those manufactured by Pond Dam Piping, LTD.

Operation of the four WHS™ units (2 in series and 4 in parallel) would be segregated into smaller 100-150 ft long growing units separated with 6" floating boom. This prevents excessive compression of the hyacinth crop, and facilitates healthy production. The initial receiving units will serve to a greater extent to settle and transform the heavy solids loads. Each parallel WHS™ train includes this receiving unit (1500 ft x 368 ft) and a final unit (4,723 ft x 368 ft). The units will be provided with 1 foot of freeboard. Water would be transferred through adjustable overflow weirs, thereby facilitating effective settling within the first unit. Effluent discharge from the final WHS™ units will also be through a series of overflow weirs. The effluent will be directed to the effluent and harvest flume, which eventually delivers the flow to the reaeration chamber. The WHS™ units will be bordered by a 20 ft compacted limestone or shell harvest road to permit access by the integrated harvesting/processing system (Comment A6 in Appendix A).

Harvesting of the WHS™ unit will be via HydroMentia's Model 101-G WHS™ harvest grapple used in tandem with a mobile version of a Model 401-P biomass processor, as developed by HydroMentia, and as shown in Appendix B, to include cross and vertical conveyors as necessary. (The use of conveyance flumes in this system is not considered cost effective because of the distances involved.) Drive will be by a tractor PTO. The harvest grapple will transfer harvested biomass (300-450 lbs per grapple) into the processor, and the chopped product will be then delivered into a transfer trailer (Miller Series 5300 or equivalent), which when loaded, will transfer the chopped biomass to the compost area. The harvest rate will be about 20 TPH. With an average daily harvest requirement estimated at 142 wet tons (July), one harvest unit will require seven operational hours daily. During peak harvest periods, when rates could be as high as 231 wet tons/day, limited overtime may be required (Comment 13 Appendix A). Harvesting, including chopping and processing and transport, will be done typically by two persons. The recovered hyacinth biomass once delivered to the compost area will be spread into a windrow.

As noted, there is a sloughing component associated with the water hyacinth crop. This represents sloughed tissue and sediments not captured through routine biomass recovery. Sloughed material, represented as organic sediment, as well as phytoplankton and solids from the source water, is scheduled for periodic recovery, thereby assuring long-term performance of the system. The cost for solids recovery, are included within scheduled operational costs.

It is expected that even though there is a considerable phytoplankton and solids load being introduced to the WHS™ process, the cells will lyse, and their protoplasm will be released into the water column. Therefore, to a large extent, the algae solids will be converted to hyacinth biomass. To sufficiently quantify this phenomenon, it is recommended that a pilot study be conducted. It is noteworthy, that if a greater accumulation of algal solids occurs within the WHS™ sediments, there will be a greater reduction of nitrogen through these units, and while removal of WHS™ sediments would have to be increased, the overall size of the WHS™ units could be downsized accordingly. The proposed pilot study is presented as part of this quote. It is proposed that the management of the WHS™ sediment will be on a quarterly basis using a hydraulic dredge and a transmission piping network in conjunction with thickening basins, which will also serve as a composting platform. , Dredging can be conducted without interrupting normal WHS™ operations. Flows from the final WHS™ will be delivered to an effluent flume, from which flows will be directed to the final aeration channel. After aeration, flows will be directed for release into designated receiving waters.

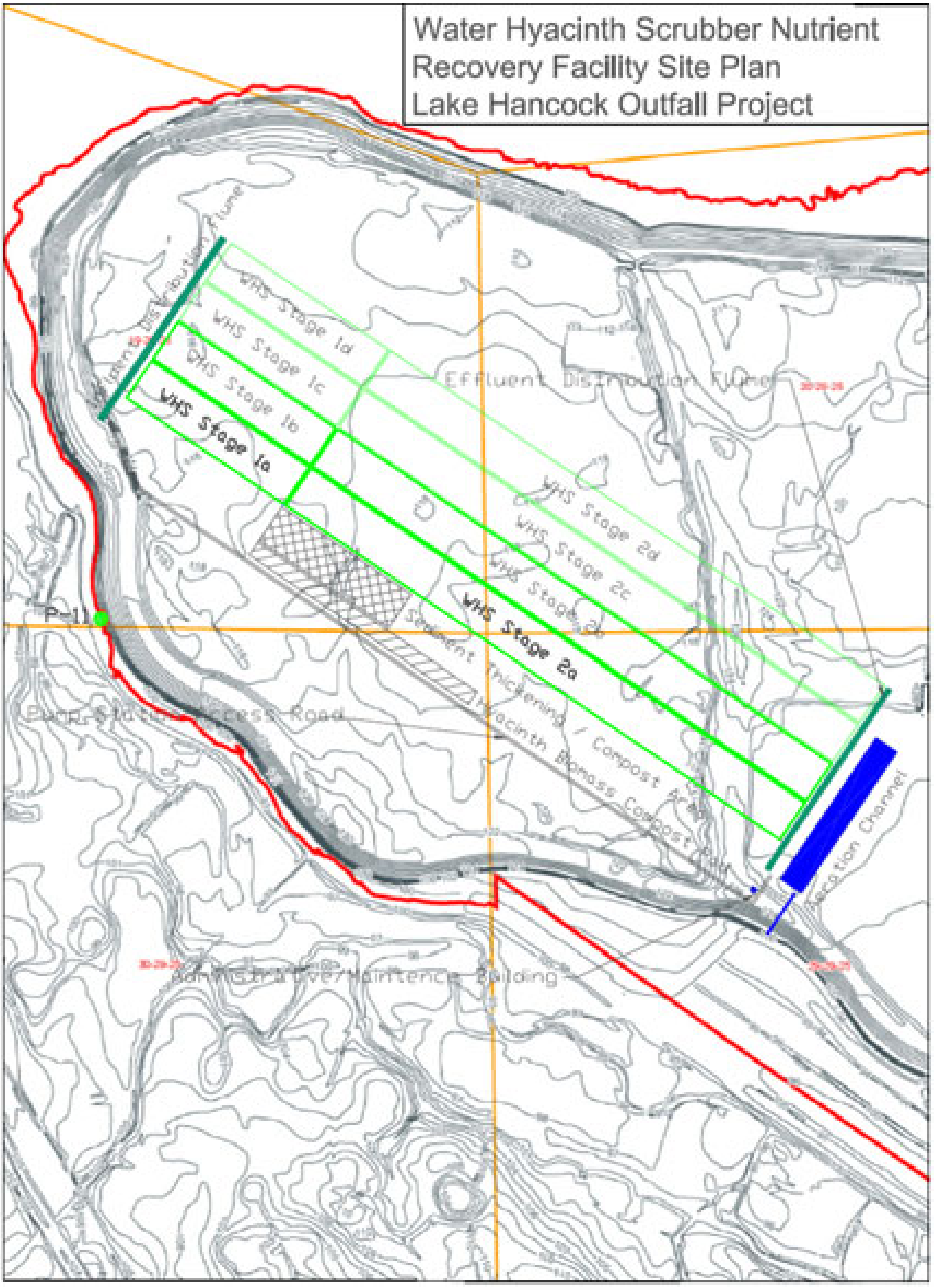


Figure I: Proposed General Facility Location and Layout

RESIDUAL MANAGEMENT

Biological (Treatment Wetlands, MAPS) and chemical treatment (alum, ferric chloride, etc.) systems are designed to recover pollutants in the form of organic biomass or precipitated sediments. MAPS and chemical treatment systems operational protocol call for the routine recovery of organic biomass and/or sediments, which facilitates consistent long-term operational performance. Due to the much larger facility footprint of treatment wetlands, management of accrued biomass and sediments occurs at a reduced frequency, with isolated biomass and sediment management occurring ever several years and large-scale sediment management scheduled less frequently – 15 to20 years for large-scale treatment wetland systems in Florida with relatively low nutrient loading rates.[16 17]

For the proposed WHS™ Nutrient Recovery Facility there are two sources of residuals requiring management—recovered hyacinth biomass and accumulated WHS™ sediment. The relative proportions of these, as noted in Table 6, are projected to be 52,756 wet tons at 6.5% solids/yr or 3,429 dry tons/yr water hyacinth biomass and 26,680 at 5% solids wet tons/yr or 1,294 dry tons/yr sediment. It is intended that both solids sources be managed through windrow composting.

The use of windrow composting to reduce and stabilize organic solids is a well-established process, with numerous large-scale facilities located throughout Florida and the United States. Design of these systems is thoroughly discussed within available literature. HydroMentia developed and implemented a design mix using the methodology developed by Haug (1993) [18]. This strategy was applied to the S-154 WHS™-ATS™ MAPS prototype, and resulted in a stable, high quality organic fertilizer/compost, the composition and dynamic changes of which are noted in Table 8.

Table 8: Compost characteristics S-154 MAPS 2004

Content	Beginning Batch #2		Finished Batch #2	
	%	Total Pounds	%	Total Pounds
Total Weight pounds	-	52,883	-	6,589
Moisture	91	48,111	45.2	2,978
Total Dry Weight	-	4,772	-	3,611
Phosphorus dw	0.26	12.2	0.36	12.9
Nitrogen dw	2.30	110	3.21	116
Ash	-		60.2	2,174
Potassium dw	-		1.11	40
Sulfur dw	-		0.33	12
Calcium dw	-		3.72	134
Magnesium dw	-		0.55	20
Sodium dw	-		0.18	6
Iron dw	-		0.70	25
Copper dw	-		0.0013	0.005
Manganese dw	-		0.040	1
Zinc dw	-		0.011	0.40
PH units	-		8.0	-

As shown, the composting process results in a reduction of moisture to 40-45%, with a solids reduction of about 25%. The source material, composed of chopped hyacinths, algae and hay, achieved internal temperatures of about 55 ^{O}C during composting, resulting in a total weight loss of about 88%. The initial composting process to reduce volume by about 60% lasted approximately 35 days, after which the material was stockpiled and cured for 60 additional days. This material is high in nitrogen content (3.21%), which provides for a high quality organic fertilizer.

Best and Worse Case Scenarios

The “most-likely” scenario for processed compost/organic fertilizer produced from the facility is that said product will be sold in bulk, or should market conditions so warrant, as packaged product. For market reference purposes, the volume of finished compost product produced from the WHS™ facility (14,884 cy/yr) represents less than 2% of annual sales for a large soil amendment distributor operating in Orlando, Florida since 1974.

A “worst case” scenario for compost/organic fertilizer is also provided. As directed, costs are provided whereby processed compost is transported to a landfill for disposal.

Within the present analysis, the “best case” scenario considers finished compost/organic fertilizer being sold at the rate of $20/ton FOB the facility.

For the “worst case” scenario, finished compost/organic fertilizer is transported to a local landfill at a rate of $5.00/ton hauling cost plus a landfill tipping fee of $20.50/ton.

Recovered Hyacinth Biomass

To size the proposed recovered hyacinth biomass composting facility, consider the material balance as noted in Figure J for the hyacinth harvest. Finished compost in this case is used as a bulking agent to bring the initial mix to 75% moisture.

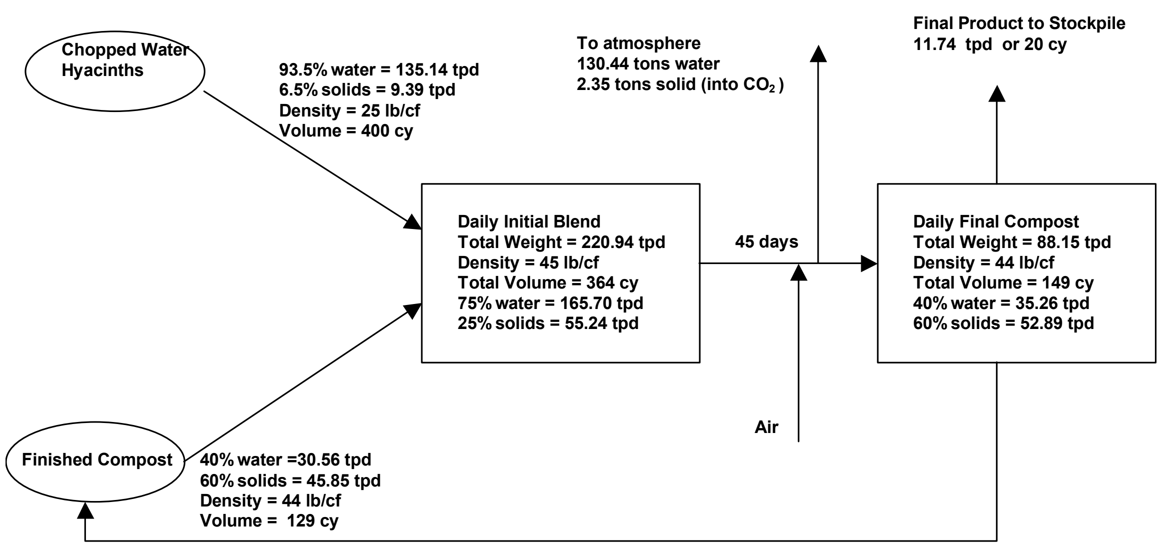


Figure J: Compost material balance hyacinth harvest proposed WHS™ Nutrient Recovery Facility

The process time as shown is set at 45 days. During process the material is mixed daily during the first five days, and then less frequently thereafter. Windrow mixing and finished product loading is accomplished via a Valtra Model T170 (170 hp) with a Brown Bear PTOPA35C-10.5 Mixer at a rate of 2880 cubic yards per hour. Mixing is needed to ensure aerobic conditions and to facilitate release of water vapor. Temperatures within the compost can be expected to be sustained around 50-55^{O} C during the active period of processing. When these internal temperatures fall, the process is considered near completion. After this initial compost, the product is stockpiled for typically 60 days for a final cure. After this curing, it is ready for market, or further refined processing, such as screening, enhancement, blending etc.

The area required for the compost rows may be calculated by considering the volumes as noted in Figure J. The average volume of one batch during the 45-day process is about 256 cy or nearly 6,926 cf. If the average rows are 4 ft high, with an angle of repose of 1.3:1, then the cross sectional area is 20.8 sf, and the footprint is 10.4sf/lf. Therefore, considering the volume capacity of 20.8 cf per linear foot of row, or 2.00 cf per square foot of pad area, it is calculated that one daily batch will require an average of 3,463 sf of area for each batch, or about 332 linear feet. Considering a 45-day process time, then the total area required just for rows is 5.71 acres. There needs to be one extra row to accommodate the lateral displacement during mixing, and about 3 feet between rows for vehicle wheels. If the compost pad is 2,000 feet long, and an average row is 1,900 ft, then eight rows would be required, plus a ninth row space, plus 27 ft for vehicle tire allowance, or a total width of 121 ft, and an area of 5.6 acres. In addition, considering a 60-day volume of product of about 1,200 cy, and a stockpile 10 ft high, and 3:1 angle of repose, the stockpiled row would be about 110 ft long, and require a footprint of 6,600 sf, or 0.15 acres. To accommodate access, consider the stockpile area to be 0.24 acres. Therefore, for composting the recovered hyacinth biomass, about 5.84 acres are required.

WHS™ Sediments

The next residual management process relates to sediments recovered within the WHS™ unit. The projected accumulation rate is 26,680 (5% moisture) wet tons/yr or 1,334 dry tons/year. The strategy for collecting this material will be to collect sediments on a quarterly basis, thus one-fourth of the annual deposition is removed and processed every 91 days.

WHS™ sediment processing shall include the following steps:

1. Pump sediment at 3% solids via a 500 gpm hydraulic dredge into a thickening pond via an 8” piping network. One fourth of the annual deposition amounts to 333.5 tons dry, or 2.97 million gallons at 3% moisture. At 500 gpm this will take about 12 days.
2. Once the thickening pond is loaded, let the sediment settle and draw off supernatant using a telescoping valve, until the solids content increases to 5% solids. The thickening pond to accommodate this volume, at a depth of 1.0 ft average, would need to have a surface area at water level of 9.1 acres. It is expected that the thickening process will take about 5 days, this being based upon HydroMentia’s experience with WHS™ sediment. Once thickened the material depth would decrease from 1.0 ft to about 0.6 ft.
3. Mix finished compost into the thickened sediment such that the solids content is increased to 25%. The annual mix is as noted in Figure K. The quarterly finished compost requirement is 6,420 cy. It is expected that this will be moved via 20 yd transport trailers, with the material being retrieved from a storage pad contiguous to the pond. About 2,000 cy as a minimum can be loaded daily (4 loads/hr, for three trailers). Therefore about 4 workdays will be required to load and mix the compost blend.
4. After mixing, establish the blend into windrows. These windrows will be as previously described, with 20.8 cf/lf, and 2.0 cf/sf. Therefore, with a total blend of 14,931 cy or 403,137 cf, the area just for the initial rows is 4.6 acres, with 19,381 ft of rows. If each row is 1,000 feet long, this means 20 rows will be established, plus an eleventh displacement row, and 63 ft for vehicle tire allowance, or a total width of 301 feet, and the total required composting area is 6.9 acres. There is ample space therefore in the thickening pond of 9.1 acres to accommodate these composting rows.
5. The material will be mixed/composted in windrows for 60 days, during which time it is reduced to about 7,119 cy. It will be transported to the storage pad in about 4 days. Therefore the total cycle time is about 85 days.

The thickening pond will include the following components:

1. A concrete entrance ramp for moving materials and vehicles into and out of the pond, with a contiguous finished compost storage pad.
2. A telescoping valve and associated piping to a small submersible or self-priming centrifugal pumping station for removal of supernatant.
3. A 10" soil sediment base (17,319 sy), sloped to a terminal sump at 1.5 ft over 2,175 ft
4. A terminal drainage sump for recovery and distribution of runoff via a culvert to a peripheral stormwater pond. This pond will have a bottom set at 2 ft below the internal sump, with an adjustable riser for distribution of flows to the supernatant pump station, for return to the WHS™ units.
5. A typical layout for the thickening pond is presented as Figure L.

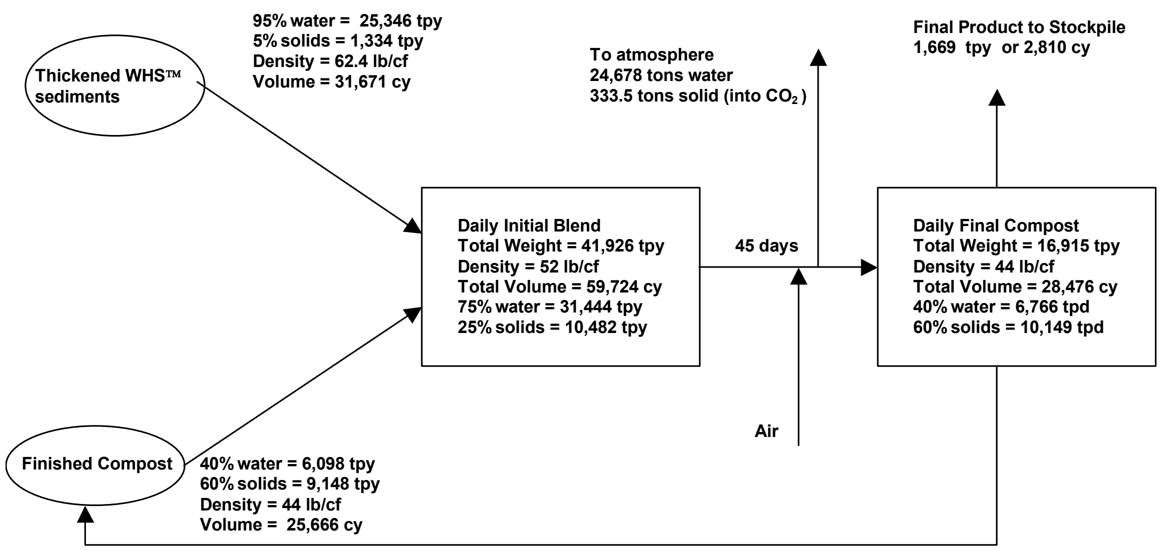


Figure K: Compost material balance hyacinth sediment proposed WHS™-ATS™ Facility

The sizing of the thickening will be 9.1 acres, with an average depth of 1 foot, with a length of 1,240 feet and a width of 320 feet at fill level. The top of berm dimensions, with one foot of freeboard, and 3:1 slopes will be 1,246 feet x 326 feet, with 3,144 feet of berm length.

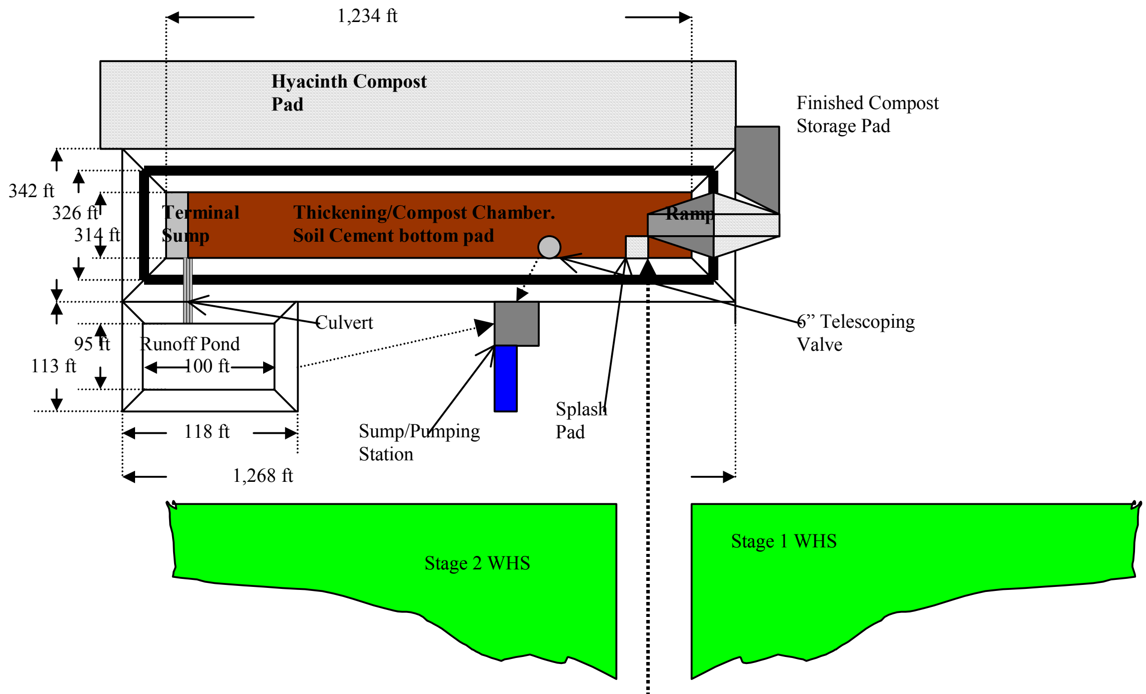


Figure L: Typical Thickening Pond NTS

Residual Processing Cost Savings

A worst-case residuals processing scenario has been developed to produce a conservative cost estimate. While both biosolids and alum residuals are routinely reduced from 5% solids to less than 50% solids without blending in Florida operations using equipment planned for the WHS™ Facility (Appendix F), costs within this analysis are calculated based on blending of low moisture finished compost to produce an initial product with 25% solids.

An additional cost savings protocol, thermophilic bacteria inoculation has proven in large-scale commercial operations to reduce windrow-mixing demands by 90%, drastically reducing composting costs. Application and investigation of these cost savings approaches would be investigated in a pilot study.

5.0 CAPITAL AND ANNUAL OPERATING COSTS

CAPITAL ITEMS AND QUOTE

The conceptual design presented represents an initial engineering assessment of project needs and intent, and is subject to revisions as required to ensure the final product best accommodates the actual needs of the client.

The proposed Lake Hancock WHS™ Nutrient Recovery Facility includes the following units:

1. An Influent Manifold Flume, trapezoidal cross section, lined with HDPE geomembrane for conveying flows of up to 300 cfs from the District's lift station near P-11 to the influent devices into the receiving WHS™ units.

2. Four parallel WHS™ units each composed of two, in series WHS™ units, of 5 foot working depth, 1.0-foot freeboard. The receiving units will each be of an approximate dimension of 374 ft x 1,506 ft, or 12.9 acres each. The final units will be of an approximate dimension of 374 ft x 4,729 ft, or 40.6 acres each. The acreage of each unit then is 53.5 acres, or a total of 214 acres including freeboard, or 210 acres of process area, excluding freeboard. Interior slopes shall be 3:1. Construction will be done by cut-fill balance, with excavated dirt being used for berm construction.

3. Influent and effluent structures associated with the WHS™ to include 180 (45 per unit) 8" equally spaced pipes with low pressure butterfly in-line valves and HDPE boots for withdrawal from the Influent Manifold Flume; 180 (45 per unit) equally spaced intermediate effluent boxes, and 180 (45 per unit) equally spaced final effluent boxes, each identical in dimension and function, with screening and overflow weirs, and effluent piping.

4. A network of 20 ft wide limerock base Harvest Roads will run the length of the WHS™ units on both sides, as well as at the terminus of each unit sufficient for turnaround by the tandem harvesting/processing unit. The road network shall serve to facilitate management and harvesting of the hyacinth crop.

5. Effluent from the WHS™ units shall enter the effluent flume at the terminus of the final stage WHS™ units. It shall be approximately 1,484 feet long, and shall be of similar construction as the Influent Flume.

6. An aeration channel shall receive flows from the Effluent Flume via underground piping. The channel shall be approximately 206 ft wide and 1,356 ft long, with a working depth of 4 ft, and 1 ft freeboard. It shall be lined with 40 mil HDPE, and shall be serviced by a series of paddlewheel aerators capable of transferring 337 lb-DO/hr. Units will be House Model DDA or equivalent, total expected power is 175 HP.

7. A composting pad with a 10" soil cement base of approximately 5.8 acres (121 ft x 2100 ft) located contiguous to the sediment thickening and compost unit upon which harvested biomass will be processed and stockpiled through windrowing.

8. A sediment thickening and compost pad with a 10" soil cement base of approximately 9.1 acres (320 ft x 1240 ft) located contiguous to the WHS™ unit upon which recovered organic sediments be processed and stockpiled through windrowing.

9. A paved access road from US 17 to the facility, to include a security gate.

10. Harvesting, processing and transport equipment to include specialized equipment for harvesting and chopping water hyacinths (HMI Model 401-P) as well as mowers, loaders, tractors, mixers, wagons, trucks, and tanks as needed to ensure efficient operations of the facility.

11. Grassing, erosion control and stormwater management, to include a perimeter swale.

12. A perimeter security fence.

13. Fuel and material storage facilities

14. Electrical distribution and controls

15. Tools and small engine items as required for system operations and maintenance.

16. All elements as deemed necessary to meet applicable health and safety standards

17. Calculations associated with the estimated quantities for this project are presented in Appendix C.

18. Fees, profits and licenses for all proprietary technologies for the subject facility are included in quote (See Appendix G for a list of MAPS related HydroMentia patents)

HydroMentia, Inc will provide items 1 through 18, to include engineering; bringing the project to final completion; training of District Personnel and, exclusive of land, and those applicable issues listed under "Design Provisions and Assumptions" within this report, for a lump sum amount of:

Twelve million, two hundred and ninety-nine thousand, dollars
($12,299,000)

This is a good faith budgetary cost estimate based upon the conceptual plan presented herein, to be adjusted to site-specific conditions, final engineering plans and cost adjustment factors applicable at the time of construction.

OPERATING COSTS

It is assumed that the single stage WHS™ Treatment Facility will be operated by the Southwest Florida Water Management District or its agent with training provided by HydroMentia Inc. Calculations are presented within Appendix F, including cost summaries. The costs included in the estimate included below are:

1. All labor required to operate the facility as described, including all components identified within the "Capital Items and Quote".

2. All energy costs, including electricity and fuels as required to operate necessary equipment, excluding the District's Influent Lift Station.

3. All costs associated with the management, transport and landfilling of the residual solids as the "worst case" scenario, and a net sales, after loading and transport, of $20/ton as a "best case" scenario.

4. All expendables including chemicals, biological control agents, etc. as may be required to

facilitate system performance, and the proper management of these agents.

5. All equipment maintenance and replacement of damaged or expended equipment, and maintenance of necessary tools and spare parts to ensure expeditious repair of critical items.

Estimated annual cost of Single Stage WHS™ System operations:

"Best Case": Five hundred and thirty-five thousand dollars ($711,00)

"Worst Case": Nine-hundred and forty-two thousand dollars ($1,118,000)

6.0 50-YEAR "PRESENT WORTH" ANALYSIS

"Present worth" costs at a discount rate of 5.625%, over a fifty-year period are shown within Table 9 and Table 10, using the procedure and format provided by Dr. Champlin.

Table 9: 50-Year "Present Worth" Costs for the proposed Lake Hancock WHS™ MAPS Nutrient Recovery Facility Best Case conditions.

Capital and Operating costs for Single Stage WHS™ Best Case Scenario - Sale of Compost/Organic Fertilizer			
System	Capital Costs ($)	Annual Operating Costs ($)	Equipment Replacement Costs (1) ($)
Intake and Inflow Pump Station	$ 3,732,000	$ 300,000	$ 2,463,000
Inflow Transmission Main	$ 383,000	$ 4,000	$ 253,000
Pump Station Access Road	$ 818,000	$ -	$ -
Single Stage WHS Facility	$ 10,442,000	$ 744,000	$ 900,000
Residuals disposal	$ -	$ (179,000)	$ -
Instrumentation and Telemetry(2)	$ -	$ -	$ -
Land Acquisition (3)	$ -	$ -	$ -
Subtotal	$ 15,374,000	$ 869,000	$ 3,615,000
Engineering, Overhead & Legal (4)	$ 2,800,000	$ -	$ -
Technology Preformance Fee (5)	$ 291,000	$ 146,000	
Total	$ 18,464,000	$ 1,014,000	$ 3,615,000
Present Worth Cost (5)	$ 18,464,000	$ 26,872,000	$ 3,254,000
Total Present Worth Cost	$48,590,000		
Per Pound Nitrogen Removed (6)	$3.34		

(1) Replacement of equipment and material items every 20 years.
(2) Telemetry not required, except for PS which is included in PS spreadsheet
(3) Cost for land acquisition were not included as requested by the SWFWMD.
(4) Estimated as 25% of capital costs for Intake and Inflow Pump Station, Inflow Tranmission Main and Instrumentation and Telemetry plus 15% of capital costs for single Stage WHS Facility.
(5) Technology Performance Fee. ($0.50 per lb of nitrogen removed) payable annually during years 1-18, Years 19 and 20 payable in advance based on performance estimate. 3% Inflation rate not applied to Technology Fee
(6) Estimated at 5.625% for a 50-year period. Annual O&M costs were inflated at 3% per year. Salvage of equipment purchased at 40 years estimated at 1/3 the purchased value at the end of 50 years.
(7) Listed cost based on estimated per pound nitrogen removed by flow through constructed wetlands over a 50-year period.

Table 10: 50-Year "Present Worth" Costs for the proposed Lake Hancock WHS™ MAPS Nutrient Recovery Facility Worst Case conditions.

Capital and Operating costs for Single Stage WHS™ Worst-Case Scenario - Landfill Disposal of Compost/Organic Fertilizer			
System	Capital Costs ($)	Annual Operating Costs ($)	Equipment Replacement Costs (1) ($)
Intake and Inflow Pump Station	$ 3,732,000	$ 300,000	$ 2,463,000
Inflow Transmission Main	$ 383,000	$ 4,000	$ 253,000
Pump Station Access Road	$ 818,000	$ -	$ -
Single Stage WHS Facility	$ 10,442,000	$ 744,000	$ 900,000
Residuals disposal	$ -	$ 228,000	$ -
Instrumentation and Telemetry(2)	$ -	$ -	$ -
Land Acquisition (3)	$ -	$ -	$ -
Subtotal	$ 15,374,000	$ 1,275,000	$ 3,615,000
Engineering, Overhead & Legal (4)	$ 2,800,000	$ -	$ -
Technology Performance Fee (5)	$ 291,000	$ 146,000	
Total	$ 18,464,000	$ 1,420,000	$ 3,615,000
Present Worth Cost (5)	$ 18,464,000	$ 38,693,000	$ 3,254,000
Total Present Worth Cost	$60,411,000		
Per Pound Nitrogen Removed (6)	$4.15		

(1) Replacement of equipment and material items every 20 years.
(2) Telemetry not required, except for PS which is included in PS spreadsheet
(3) Cost for land acquisition were not included as requested by the SWFWMD.
(4) Estimated as 25% of capital costs for Intake and Inflow Pump Station, Inflow Tranmission Main and Instrumentation and Telemetry plus 15% of capital costs for Two Stage WHS-ATS Facility.
(5) Technology Performance Fee. ($0.50 per lb of nitrogen removed) payable annually during years 1-18, Years 19 and 20 payable in advance based on performance estimate. 3% Inflation rate not applied to Technology Fee
(6) Estimated at 5.625% for a 50-year period. Annual O&M costs were inflated at 3% per year. Salvage of equipment purchased at 40 years estimated at 1/3 the purchased value at the end of 50 years.
(7) Listed cost based on estimated per pound nitrogen removed by flow through constructed wetlands over a 50-year period.

7.0 PROPOSED PILOT STUDY

It is proposed that prior to initiation of full scale implementation of the Lake Hancock WHS™ Nutrient Recovery Facility that a pilot study be conducted to determine the following:

1. The behavior of the algal (phytoplankton) solids associated with the feedwater within the units, with particular consideration on settling and decomposition rate within the two WHS™ stages, and the rate of nutrient release and net sediment accumulation.
2. Behavior of the process at flow fluctuations emulative of the proposed full scale system
3. To determine if any micro-element deficiencies exist, and to determine the nature and extent of such deficiencies, and the respective corrective measures required to optimize treatment performance.
4. To verify growth and productivity rates for hyacinths under seasonal and other environmental variations.
5. To establish the plant tissue nutrient content associated with production within the design feed water.
6. To determine the rate of solids and BOD_5 reduction, and the diurnal variations of pH, T and dissolved oxygen within the effluent.

7. To investigation the general response of the system to this particular feedwater

Findings from the pilot study shall be used in refining design criteria and final unit sizing. It is proposed and included within the present pilot study proposal that the investigation period include both cool weather and warm weather conditions for a period of 6 months. The system would be modestly sized, but of sufficient dimension to provide meaningful similitude. The layout and suggested sizing is noted in Figure M.r

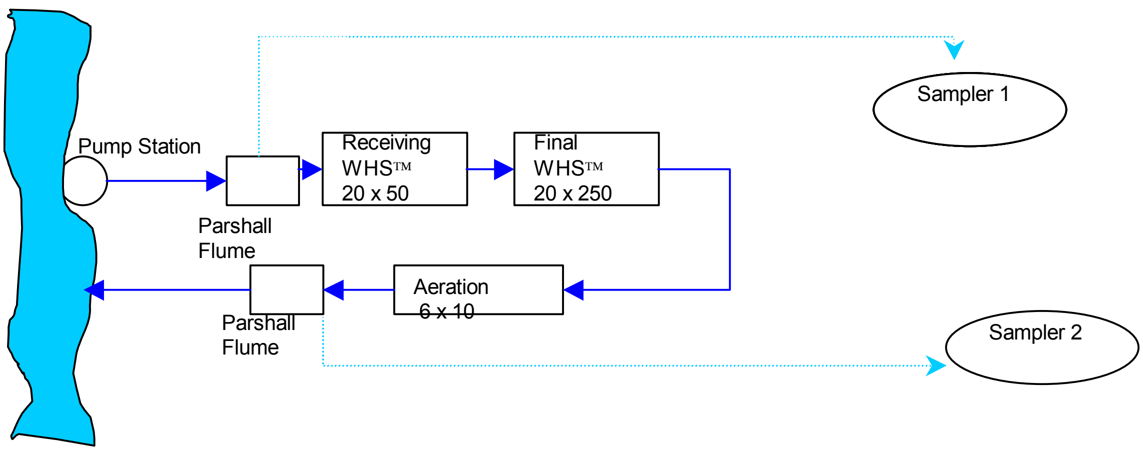


Figure M. Proposed flow and process schematic WHS™ bench-scale investigation.

As noted, flow will be delivered to the system from Lake Hancock, near but upstream of P-11. A self-priming pumping system is suggested (Gorman-Rupp or equivalent) skid mounted with two pumps. Flow will be modulated using diversion piping and a throttling valve. Flows will be monitored through an influent Parshall Flume, or similar open channel flow monitoring device before discharging into the two WHS™ units. These will be lined with 40mil HDPE, and sized as noted in Figure H. Flows, pH, DO and temperature will be continually monitored at the influent and the effluent Parshall Flumes. Water sampling will be conducted through refrigerated automatic samplers (Sigma or equivalent), which will be flow sequenced for collecting composite samples. Sampling will be done over a two-week period during a designed flow regime intended to emulate the expected flow fluctuations. Samples for the first 13 days will be collected in 6 bottles, so the more labile parameters, such as Nitrite-N, Ammonia-N, Ortho-P and BOD_5 will not fall out of hold time allowance for the seventh sample. The previous 13 days samples will be composited, so for each sampling period there are two composite samples for each of the five stations—one representing days 1-13, and one representing day 14.

In addition to the nitrogen and phosphorus series, samples will be tested for Ca, Mg, BOD_5, TOC, TSS, TVSS, TDS, Alkalinity and Total Iron. At the beginning of the project and at the end of the project the six-day composite sample will be analyzed for K, Cl, Na, Zn, B, Mn, Cu, Cd, Cr, Hg, As, Pb and Se.

Biomass testing will be done monthly. Samples of harvested material will be composited and dehydrated in accordance with appropriate approved procedures, and then sent to Mid-West Laboratory in Omaha, Nebraska and tested for nitrogen, phosphorus, moisture, protein, fiber, K, Mg, Ca, Na, Fe, Mn, Cu, and Zn. Biomass production will be determined through weekly harvests, which because of the small size of the bench system, will be by hand. The harvest wet weight will be documented, and then the moisture content determined through sample preparation.

In addition to biomass sampling, sediment chambers will be placed in both WHS™ units. These will be collected bi-monthly, the rate of accumulation determined, as well as the moisture content of the sediment. A sediment sample will then be prepared and delivered monthly to Mid-West Laboratories and tested as with the plant samples.

Within the WHS™ system, standing crop samples will be taken monthly to establish density and standing crop biomass. This will allow estimation of specific growth rate.

HydroMentia personnel will visit the site bi-weekly during the course of the pilot study—at the same time samples are picked up by the independent laboratory. At this time field monitoring at key locations within the process will be tested for pH, temperature, DO, conductivity, and sechi depth as appropriate. In addition a subjective crop status assessment will be made.

At the end of three months operation, an interim report will be completed that provides general assessment of system performance, crop productivity and health, and suggested refinements of design criteria. A presentation of the report will be made. A final report will be submitted after project termination, and will include firm recommendations regarding full-scale system design, and refinements to operational strategy and performance expectations.

Two hundred and thirty four thousand, five hundred and fifty one dollars
($234,551)

Total cost for the proposed pilot study exclusive of land costs is $234,551, composed of $100,000 in fees and operating costs to HydroMentia (Table 11), $12,990 of laboratory fees (Table 12) and $121,561 of Capital Costs (Table 13). This is offered only as an estimate, with the understanding that actual costs may vary from this estimate based on design parameters selected by the client.

Table 11: HydroMentia Services for Proposed Pilot Study

Task	Description
Site Selection	Review potential sites as offered by client and offer ranking, after detailed review of the site, and examination of topographical and soils data.
Conceptual layout and design	Provide a recommended layout of unit processes, to include general elevation, sections, and technical specifications for pumps, samplers, flumes, and liner
Review of design	Once system design is 75% complete, HydroMentia shall review drawings and specifications and offer edits and comments. The same shall be provided for final design
Assist in Bidding	HydroMentia shall attend a pre-bid conference and the bid opening, and assist the client in addressing contractor's questions as appropriate.
Assist in Construction Management	HydroMentia shall assist in review of shop drawings, change order request, and interim field inspections as requested by the client, but shall not serve as the engineer or resident engineer.
Final Inspection and Facility Acceptance	HydroMentia shall be in attendance of the substantial completion and final completion inspections, and shall provide the client written acceptance of the facility prior to issuance of notice of final completion.
Permitting	HydroMentia shall be responsible for procurement of the aquatic plant permit associated with the transport and cultivation of water hyacinths.
Start-up	HydroMentia shall complete start-up, which shall include confirmation of operability of equipment, crop seeding and maintenance and programming of samplers and calibrating field elements.
Operations	Hydromentia shall manage and operate the system in accordance with an operations and monitoring plan as prepared and submitted to the client, and as approved by the client. This shall include all provisions associated with personnel and pubic health and safety, and protection of property and environment. HydroMentia shall procure and maintain sufficient insurance as required by the client during the full course of operations.
Interim report	An interim report shall be provided as described in this section and presented to the client.
Final Report	A final report, to include recommended full-scale design parameters, shall be provided as described in this section and presented to the client, and all questions and issues offered by the client upon review shall be addressed as part of the final submittal.
	TOTAL PROPOSED FEE: $100,000

Table 12: Projected Laboratory Costs for Proposed Pilot Study

Series	Sample Type	Media	Parameters	Cost/sample	Number	Project Cost
1	13 day composite	water	Mg, Ca, Fe TSS,TVSS, Alkalinity, TOC,TON,TKN Nitrate-N,TP,TDS	$230	26	$5,980
2	1 day composite	water	BOD 5, Ammonia-N, TKN,Nitrite-N,Nitrate-N, TON TP, OP-filtered	$140	26	$3,640
4	13 day composite	water	Mg, Ca, Fe TSS,TVSS, F10Alkalinity, TOC,TON,TKN Nitrate-N,TP, Cu,Zn,B,Hg,Pb, As,Cr,Cd,Se	$380	2	$760
5	composite	biomass	Protein, Fiber, Ash, Moisture, Nitrogen, Phosphorus, Potassium, Zinc, Copper	$80	6	$480
6	composite	sediment	Ash, Moisture, Nitrogen, Phosphorus, Potassium, Zinc, Copper	$60	3	$180
	Sample Pick-up	water		$150	13	$1,950
					TOTAL	**$12,990**

Table 13: Projected Capital Costs for Proposed Pilot Study

Item	Cost
Mobilization	
Excavation/Grading	
Grid/HDPE with entrenchment	
Refrigerated Samplers	
Feed and ATS Lift Pump Skid set-ups	
Piping/Valving	
Office Trailer with field lab equipment	
Parshall Flumes	
Grassing/Fencing	
Subtotal	
Contingency 25%	
Engineering 15%	
Total Construction Cost	**$121,561**

8.0 OTHER CONSIDERATIONS

ADDITIONAL WATER QUALITY ISSUES

The WHS™ system as proposed would be expected to render water quality in compliance with Class III requirements, with a tendency to modulate diurnal fluctuations in pH and dissolved oxygen. Specific benefits will be attributable to the maintenance of high dissolved oxygen levels and the attendant elimination of the dissolved oxygen sag during the early morning hours. Regarding pH, the WHS™ system provides reduction and stabilization of pH, when compared to the feed water.

The reduction of both BOD_5 and suspended solids is expected to be significant through the system. Typically, as previously noted, WHS™ units will provide BOD_5 removal at rates approaching 250 lb/acre-day (Hayes et al. 1987; Wolverton, 1976). [19] [20]As the daily loading is projected to be about 5,750 lb/day, then the removal over the 200 acres of WHS™ would be expected to reduce essentially all but the most recalcitrant BOD_5 , with over 90% reduction expected, except during maximum flow periods. It is not unreasonable to expect BOD_5 reductions to 5-7 mg/l through the system. This will be investigated during the proposed pilot study.

Total suspended solids (TSS) removal will occur largely through settling and resolubilization within the WHS™ units, as discussed previously The extent to which algal solids will lyse and release available nutrients needs to be established during the proposed pilot study. As noted, with a hydraulic detention time of 9 hours under shaded conditions, the algal solids reduction (as measured as Chlorophyll-a) was 78%. With chemical aided settling, it was projected at 90% reduction. These are similar to numbers cited previously for WHS™ systems. The reduction through the WHS™ unit with over 5 days retention at ADF and 1.6 days at maximum flow, is projected to reduce TSS significantly, approaching 90%. The overall TSS removal therefore is expected to be about 33,100 lb/day (16.55 tons). It is projected that many of these solids will be biologically converted to CO_2 and other gases, or released as soluble or colloidal components into the water column, from where they will be incorporated into hyacinth biomass, which will be harvested on a regular basis. It is the primary intent of the proposed pilot study to determine the dynamics of these phytoplankton-associated solids as they are processed through the WHS™ units. It should be noted, that if the extent of solids accumulation is higher within the WHS™ than expected, then nitrogen and phosphorus reduction will also be higher than expected, and the design strategy could be shifted towards greater removal of WHS™ sediments and a reduction in the required process area. Consequently, it would be expected that capital costs might be reduced, with greater operational attention given to the processing of accumulated sediments within the WHS™ units.

Another water quality benefit, which is expected to be associated with the proposed system, is the significant reduction or elimination of cyanobacteria (blue-green algae). This will be done within the WHS™ were shading significantly inhibits phytoplankton production. Elimination of cyanobacteria is of importance because i) several species produce toxins which can impair, injure or kill other aquatic organisms and ii) several species release geosmin and other taste causing chemical which can be problematic for drinking water systems.

As with other biological systems, the WHS™ can be expected to provide additional polishing in terms of metals and organic toxins (pesticides, fungicides etc.). This will render the water of higher quality, and more amenable for downstream uses. In addition, because of the highly oxidized conditions, and the relatively short detention times, WHS™ and ATS™ units have been found to inhibit the development of methyl-mercury—an important concern relating to the ecological health of downstream systems. (Bonzongo, 2004, personal communication). Also, because the hyacinths are harvested regularly from the WHS™, development of *Mansonia sp* mosquitoes, as well species such as *Coquillettidia sp,* which are associated with cattails and other emergent vascular plants, will be sufficiently repressed (O'Meara, 2004, personal communication).

CHEMICAL AND POWER REQUIREMENTS

Based upon the review of the existing water quality, it is not expected that any nutritional supplementation will be required to sustain the proposed system. As noted, data on iron content is not available, so the need for iron addition will be determined during the proposed pilot study. If iron addition is required, it will be done through supplementation with ferrous sulfate. The quantities needed would likely not exceed 500 lbs/day, and could be done through a volumetric feeder, or simply by hand. The chemical would be stored in bags, and is not dangerous or particularly corrosive, nor would it impose any degradation of water quality upon the effluent.

It may also be necessary to treat the water hyacinth standing crop on occasion with nematodes to control weevil larvae. This has been done extensively at the S-154 MAPS prototype, and these activities have been coordinated closely with the University of Florida Institute of Food and Agricultural Sciences (IFAS). The nematodes used are indigenous and require no special permitting. Distribution is done through a spraying program over the crop. Treatments may be done 4-6 times annually. These treatments will have no water quality impacts.

Power requirements are associated mostly with the paddlewheel aerators intended to oxygenate the effluent. It is expected that about 175 HP are required during the summer daytime hours, with less at night, and considerably less in the cooler months. On an annual basis, it is projected that about 1/3 of the total available power will be used, or about 385,000 kwh/yr.

All other equipment will be diesel or gasoline driven. The fuel need, considering equipment for harvesting, chopping, mixing, and transport of solids, as well as transportation and ground maintenance is projected at about 61,000 gallons per year.

Regulatory requirements for the system will be modest. An aquatic plant permit will be required from the FDEP for the cultivation of water hyacinths. HydroMentia already holds one such permit, and has familiarity with the FDEP staff involved in developing these permits. It is not anticipated that any additional regulatory demands would be associated with the management of residual solids, other than demonstrating the absence of viable hyacinth tissue within the final product (compost). The compost product is not expected to contain sufficient quantities of heavy metals or other regulated materials that would restrict its distribution and use. Permitting prior to construction would be as expected for any water treatment project.

OTHER SYSTEM BENEFITS

Several ancillary benefits would be associated with the proposed facility. The most evident is its sustainability. Through continual harvesting and processing of the solids, accumulation of sediment is eliminated, and the system retains its full capabilities independent of time. In addition, it is quite possible that costs savings could be realized in the future by enhancing product value. For example, it would be practical to begin product distribution through bulk sales. However, as users became familiar with the product, and as the market trends become clearer, it may be cost effective to package the system for retail sales, resulting in higher returns, and lower overall treatment costs. The impact of product sales is noted in the difference between the “worst case” and “best case” scenarios as shown in Tables 9 and 10.

While the proposed system does not require extensive labor for operations, the jobs it creates are meaningful. It needs to be realized also that the MAPS technology has a real potential as a means of long-term lake restoration and protection with modest land requirements, and without the use of large mounts of chemicals. MAPS systems are presently being considered by Orange County, and others as a means of restoring lakes.

MAPS systems are durable, as demonstrated recently with the exposure of the two-stage S-154 MAPS facility to two Category 2 hurricanes within 3 weeks in September 2004 (Frances and Jeanne). In both cases, there was no damage to the facility. While power outage resulted in a seventeen-day shut down, the system, once brought back into operation, recovered full treatment capabilities within one week. The WHS™ component commenced system performance immediately.

The proposed system does not require any complex instrumentation loops to sustain operational effectiveness, nor is complicated equipment required or any telemetry needed. The equipment that is used is agricultural in nature, and can be easily operated and maintained by personnel who are aware and mature, but who do not require extensive specialized training. As noted, should the system be shut down because of power failure, it can be easily brought back into full operation with introduction of flow.

APPENDIX A. PARSONS REVIEW WHS™ NUTRIENT RECOVERY FACILITY (REV01)

Project: Lake Hancock Outfall Treatment Project
Report: Technical Memorandum: Alternative Treatment Technologies Evaluations.
Section: Appendix H – MAPS Nutrient Recovery Facility Conceptual Plan.
Reviewer: T. L. Champlin

REPORTED VALUES:

Although the values reported in your proposal are not significantly different than those being reported in other portions of the report, the following values have been provided for reference:

Annual Average Flow: Based on Mike Taylor's analysis as discussed in Section 2 of the report, annual average discharge is estimated at 58.65-cfs (37.9-mgd).

Nitrogen Load Discharge: Based on 5.53 mg/L of TN, average annual load is 289,300 kg/yr.

Nitrogen Load Reduction: Average annual load reduction is 130,200 kg/yr.

Particulate Form Nitrogen: Average annual particulate form nitrogen is 208,300 kg/yr.

Comments:

1. Appendix D and E: FYI, Appendix D and E were missing from my review copy. Although the few others that I looked through had them. It may have been an isolated case.

2. Inflow Flowrate: There is no mention of a recycle or a minimum recycle flowrate to sustain MAPS during the dry season or when there is no discharge from the lake. The design would require a discharge channel return back to the Lake if needed.

3. Limiting Water Hyacinth Growth: What measures do you provide in your system to prevent water hyacinth, which is known to be an aggressive species, from discharging biological matter that could lead to growth of water hyacinths downstream in receiving bodies (i.e., Saddle Creek and the Peace River)?

4. Page 5, Item 18: Engineering and "project contingency" costs shall be estimated at 25% of …. The line item in the spreadsheet I provided you was mislabeled.

5. Page 10, Item 2, Part d: There is mention of a pH reduction between 5.5 to 7.0 SU. What is the minimum pH that we could expect discharging from the MAPS system?

6. Page 11, Table 4: How can the harvesting rate be less than the production rate (i.e., 60% of the growth rate)? In other words, shouldn't the harvesting rate be either the same as the production rate or slightly more?

7. Page 13, Table 6, Performance: Based on projected effluent concentration, treatment efficiency is estimated at 46.47% using an influent concentration of 5.53 mg/L. This does not achieve the 55% removal efficiency stated at the bottom of page 8 needed for treatment of 85% of the discharged flow.

8. Page 15, Table 7: Need to provide complete listing of all citations, preferably in a reference section in your proposal.

9. Page 16, first paragraph: The annual average flow projected as 39.89-mgd seems high given 85% removal efficiency. This may be related to initial values used for annual average discharge from lake which we estimated to be 58.65 cfs (37.9-mgd). Based on my calculations, I estimate the annual average flow to be 32.2-mgd.

10. Page 16, Figure D: There is an unlabeled arrow on the left side of figure pointing to left WHS cell in the second stage.

11. Page 17, Second Paragraph, Photographs: Need to provide complete photographs of all harvesting equipment. I checked the HydroMentia website and did not see photographs of Tractor PTO, tandem harvest grapple/process unit, and transfer trailer. The only photograph I could find related to project was one of the grapple arm.

12. Page 17, Second Paragraph, Grapple Arm: Is the grapple arm able to reach the estimated 183 feet needed to retrieve water hyacinth in the middle of the cells? I would like to see the specifications for the proposed equipment.

13. Page 17, Second Paragraph, Harvest Requirements: An additional statement needs to be added that states the projected daily labor requirements at maximum daily harvesting.

14. Page 18, Figure E: It would be helpful from a conceptual level design effort if the locations of administration building and maintenance buildings be shown in the provided figure along with the access road and parking lot.

15. Page 21, Second Paragraph Composting of Dredged Solids: Disposal of dredged solids needs to be thought-out more thoroughly. Composting of 5% solids is not realistic. Dredged solids will need to be dewatered first to raise solids content to at least 20-25% solids before adding them to finished compost for composting. Also it is important to determine the level of inert solids, which if high enough, it may be more cost effective to dispose dewatered solids directly to landfill.

Given the size of system, dredging operations would need a net work of pipes with connections to follow along each basin for transfer to a holding tank/gravity thickener, mechanical dewatering of solids using a belt filter press, transfer of dewatered sludge by front end loader to sludge drying beds, transfer of dried sludge to trucks and disposal to landfill. If inert matter is low enough, dewatered sludge could be composted. Transferring of solids by tanker truck is unrealistic given it would take approximately 990 trips with a 6000 gallon tanker truck at the estimated 5.9 million gallons to transfer the solids to the holding tank.

16. Page 22, Item 7: Composting pad made of compacted soil is not realistic. Composting pad should be constructed with 1 foot of stabilized subbase and 1 foot of crushed concrete at $6.90 SY.

17. Page 22, Item 9: List of equipment does not include Tractor PTO, tandem harvesting Grapple/Process Unit, Transfer Trailer, front end loaders for turning windrow piles, etc.

18. Page 24, Estimated annual cost of Single Stage WHS™ System Operation: List price for "Best Case" is missing a zero.

19. Page 24, Table 9, Title: Table should be relabeled as "Capital and operating costs for MAPS Nutrient Recovery Facility". Currently mislabeled as surface-flow constructed wetlands.

20. Page 24, Table 9, Inflow Transmission Main Costs: Costs listed for capital and annual operating are low for 300-cfs (194-mgd) transmission main. See revised excel spreadsheet with updated costs.

21. Page 24, Table 9, Costs: Costs listed for capital and annual operating do not match those provided in text.

22. Page 24, Table 9, Footnote 4: As a point of clarification, it is assumed that Hydromentia engineering costs are included in the capital costs listed for Single Stage WHS Facility. The costs for Engineering and Project Contingency (mislabeled as Engineering, Overhead and Legal) are consultant engineering costs.

23. Page 25, Table 10, Issues: Same issues as described for items 18 through 21.

24. Page 25, Section 7.0, Item 2: Behavior is misspelled.

25. Page 25, Section 7.0, Item 6: "T" should be identified. It is assumed to be temperature.

26. Page 26, Figure H: "bench" should be replaced with "pilot"

APPENDICES

A1 Appendix C, Earthwork Calculations: Confusing.

A2 Appendix C, Fine Grading: As a point of clarification, 9000 SY of paved road is sufficient to provide 1.30-miles of 12 feet wide (i.e., single lane) access road. Access road should be two lane (i.e., 24 feet wide) and distance from US-17 to P-11 is 14,400 ft (2.7 miles) following along existing dirt road. Total pavement required is 38,400 SY at a cost of $15.03 SY, total estimated cost is $577,000.

A3 Appendix C, Influent and Effluent Laterals: 10" SDR 35 PVC pipe material cost is $15 LF uninstalled (Means 2005). Installation will add $30 LF.

A4 Appendix C, Influent and Effluent Laterals: Costs for boot and values appear to be for materials only and do not include installation. Installation costs need to be considered.

A5 Appendix C, Influent and Effluent Laterals: Cost for screening, piping and grating for effluent riser of $478 (i.e., $4000 - $3,528) is not sufficient for materials and installation. The unit price of $587/cy for CIP includes both materials and installation. To combines these with costs for screening, piping and grating requires both materials and installation costs be considered.

A6 Appendix C, Roads: Compacted soil is not sufficient for routine transportation of heavy equipment (tractor PTO, tandem harvest grapple/processor unit, transfer trailer and front end loaders. All maintenance roads will be constructed with 1 foot of crushed limestone.

A7 Appendix C, Discharge Piping: 48-inch culvert unit price for materials and installation is $112.50 LF (Means, 2005) or $114 LF (FDOT, 2002 inflated to January, 2005). Use $112.50 LF.

A8 Appendix C, Construction Cost Estimate: See listed Items below:

(a) In general, it is wise to provide one column for material unit costs. another for installation unit costs and third column for total unit costs. This makes it easier to understand cost estimates and insures installation costs are not missing which is the most common mistake. In the case where unit costs include both materials and installation, "included" is listed in unit material and unit installation cost columns and the listed unit cost that includes both is provided in the total unit costs. Please be aware that installation costs include cost of labor and cost of equipment use. In a design level cost estimate, both of these would be considered separately as shown in the unit cost spreadsheet. For a conceptual design level cost estimate, this is not necessary.

(b) Earthwork: Estimation for excavation, grading and compaction which appears to include the costs of constructing levees around MAPS WHS™ cells is not representative of actual costs. Standard levee unit construction costs was provided at $148.58 LF. This includes the costs of Earthwork for constructing the levee, costs for constructing the sloped embankments and the 12-inch of consolidated stone for a maintenance road. This cost is comparable with average district levee construction quoted at $155.17 LF. Based on the need for approximately 40,000 feet of levees, estimated construction costs is $6 million (only for levees). This does not include the other costs considered in the $2.7 million listed in the table. Granted proposed levee design is different from district standard design, but not substantially different to justify a $3.3 million savings. Given the higher angle slope on the interior side, it would not be surprising if the proposed levee design wouldn't cost more, but given the accuracy of this estimate, the cost for a standard levee design is probably sufficient.

(c) Hydraulic Structures, Influent Structures: Combining materials and installation costs, estimate should be closer to $500k. See A3 and A4 for details.

(d) Hydraulic Structures, Effluent Structures: Unit costs are not sufficient for materials and installation. See A5 for details.

(e) Hydraulic Structures, Discharge Piping and Structure: Unit costs are not sufficient for materials and installation. See A7 for details.

(f) Equipment: As a point of verification, all major equipment for biomass recovery and residuals management needs to be individually listed and priced out to ensure nothing is missing.

(g) Buildings, Administrative: Average cost is $180/sf.

(h) Buildings, Maintenance: Average cost is $130/sf.

(i) Buildings, Well Drinking Water: Allowance $30,000.

(j) Buildings, Sanitary System (Septic Tank): Allowance $30,000.

(k) Site Landscaping & Maintenance, Fencing: Unit price is $14.50 LF

(l) Site Landscaping & Maintenance, Sod: Unit price is $0.22 SF

(m) Electrical, Site Lighting: Include allowance for $50,000.

(n) Patent Use Fees: Will there be patent use fees? If one time fee, than cost of fee should be listed under capital costs. If annual fee, than costs should be listed in annual costs. Patent duration and payment schedule should also be provided.

A8 Appendix E, Operating Cost Calculations: See listed Items below:

(a) Removal of solids from WHS™ unit: Solids handling needs to be more thoroughly thought-out. See Item 15 for details. Dredging costs at $2.00 cy is not realistic and does not include processing costs.

(b) What is the provided statement in the narrative referencing to???: "Conservatively, about 100 gallons/day is projected, or about 37,000 gallons/yr. This is set at 50,000 gallons/year."

(c) Laboratory Costs: Increase allowance to $30,000 per year.

(d) Annual costs do not include patent use fees: Will these be charged annually or one-time fee. If one time fee, than costs need to be listed individually and provided in capital costs. Patent duration and payment schedule should also be provided.

APPENDIX B. HMI EQUIPMENT SPECIFICATIONS

Model 401-P HYACINTH PROCESSOR

HydroMentia's Model 401 Processor is unchallenged in the aquatic plant management industry with its economical and mobile design and engineering. Developed for efficient and cost effective processing of large volumes of harvested plant biomass, the Model 401-P combines a century of land based forage system design with over two decades of floating aquatic plant system processing.

HydroMentia processing equipment, patented for its innovative approach are well suited for both perimeter and centralized biomass recovery and processing facilities.

The Model 401 Processor is designed to be used with HydroMentia's Model 101-G Grapple. Biomass recovered via the grapple system is directly introduced into the Model 401-P, or recovered biomass may be transported via HydroMentia's patented conveyance system to a central biomass processing system. At the central processing facility a traveling screen separates the recovered biomass from the conveyance

water, introducing the plant material to the Model 401-P.

The design features maximize accessibility to all components to facilitate and minimize equipment maintenance and repairs.

The HydroMentia Model 301 Processor is designed and manufactured to provide the latest advances in processing technologies, combined with quality workmanship, for a system that is fully warranted for complete customer satisfaction

Upper Photo

Model 101-G Grapple Recovering Plant Biomass From a WHS™ Treatment Unit

Lower Photo

HydroMentia Model 401-P Processor

MODEL 301 HAYCINTH PROCESSOR

Specifications:

GENERAL DESCRIPTION AND FUNCTION

The Model 401-P Processor is a trailer mounted, floating aquatic plant biomass processing unit which can be supplied as a mobile unit, or as a stationary unit, and which can be equipped with interface with a standard PTO, or direct drive from diesel, gasoline, or electrical power units. The processor is designed specifically for conditioning, chopping and conveying the floating aquatic plant, the water hyacinth (*Eichhornia crassipes [Mart] solms)*, with a field verified capability of not less than 40 wet tons per hour.

The Model 401 Processor reduces plant material into a chopped product, with a significant percentage of the particles between 0.25-1.00 in^2 in size. The final chopped hyacinth product has a typical a density, as delivered, of 20-45 lb/ft^3, with the final density dependent upon the initial morphology of the harvested plant material.

MECHANICAL COMPONENTS

The Model 401 Processor is of sturdy steel construction, with materials and coating selected to suit the applied environment. Stainless steel and aluminum may be used when applicable and practical.

Mechanical components include:

A mounting trailer with associated power units, including the option to be a self- driven unit.

A receiving box of a size capable of capturing released loads of harvested plants, and containing this load as plant material is captured by the header.

A header unit composed of two counter-rotating screws designed to capture plant material as they contact the screws, and quickly compress and convey the plants into the forage chopper unit.

A forage chopper with mounting and speed modified to accommodate wet plant material, with the chopper being a standard unit as manufactured by John Deere, and others.

An enclosed screw conveyor, which collects and transports chopped material from the forage chopper to an external delivery site.

Other input and output conveyance systems as required to accommodate the operational strategy for a specific application.

POWER AND CONTROL

The Processing unit uses chain drives, with associated gearing as required to maintain required RPM for each unit. Chain systems are be labeled and contained within a safety shroud. The primary power can be through PTO, direct diesel or gasoline engine, or even electrical motor when placement is stationary. Power transfer is through direct drive, with transfer to the drive chains. The p be design to facilitate ready access to bearings and grease ports.

MANUFACTURER

The Model 401-P is designed and fabricated by HydroMentia, Inc. of Ocala, Florida. All units are provided with start-up and field verification services by HydroMentia, and shall be warranted for workmanship for a period of one-year from purchase.

HydroMentia, Inc.
3233 SW 33rd Street
Ocala, FL 34474
(352) 237-6145

The Leader in cost-effective, sustainable nutrient pollution control technologies

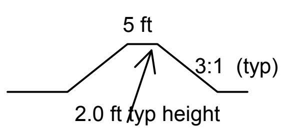
APPENDIX C. CAPITAL COSTS QUANTITY ESTIMATES

1. Facility Total Acreage
    a. Facility dimensions approximately 2,200 ft x 6,700 ft or 338 acres.

2. Perimeter Fencing
    a. 5-Strand Barbed Wire—17,800 ft
    b. Chain Link 900 ft around maintenance/admin area.

3. Roads
    a. A paved road will be required for the entrance, and this will terminate at the southern end of the compost area and the operations building. All other roads will be compacted soil, which is ample for accommodating farm equipment needed for operations.
    b. Pump Station P-11 paved access road 37,000 sy
    c. WHS™ Access Road equals 1000 ft x 100 ft = 100,000 sf or 11,111 sy

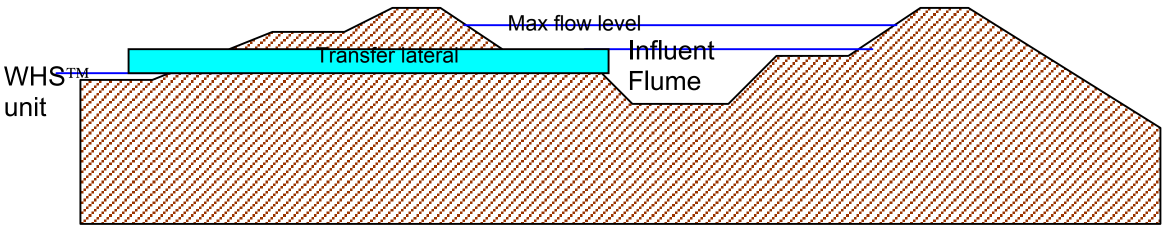
4. Sitework
    a. Imported fill for WHS™ typical berm: Total berm length is (6,235 ft x 5) + (1,576ft x 3) = 35,903. Add flumes and reaeration flumes another 10,000 lf. Total berm length therefore equal to 46,000 lf.
    b. Berm from imported fill around thickening pond. Cross sectional area 22 sf or 0.815 cy/lf at $11.39/cy (No road) or $9.28/lf.



Length 4,906 x $9.28 = $45,527

    c. Stormwater lagoon associated with thickening pond, about $17.72/lf (3 ft high). 500 ft x $17.72 = $8,860
    d. Topsoil Stripping 6” over 260 acres = 210,000 cy
    e. 10” Soil cement Compost Pad = 3,123 x 166 = 518,418 sf or 57,600 sy. Thickening Pad 215 x 2,175 = 467,625 sf or 51,960 sy. Add 8,000 cy for storage pads. Total 117,560 sy.
    f. Concrete Ramp Thickening Pad: 1’ thick x 60 ft x 20ft = 1,200 cf or 44 cy
    g. 8” Sediment FM. Total Length about 14,000 ft. Fittings and valves. Four 250 psi NRS 8” Gate Valve for Buried Service. Four 8” air relief devices. Two 8” crosses. 40-8” flanged connection with wye fitting.

5. Flumes
    a. Now consider the influent and effluent flumes. It is desired to generate some velocity in these flumes, particularly the effluent flume, at ADF (about 62 cfs), while ensuring it can handle the max flow at 300 cfs. A 3 ft depth at 10 ft wide would provide close to 2 fps at ADF, at least in the up front sections. In the end sections, it can be anticipated that some settling may occur, and this will need to be considered in the design phase—perhaps by altering the cross sectional area in the distal sections, or perhaps just establishing a periodic maintenance regime. At max flow, a cross sectional area of about 150 sf would be required to maintain 2 fps. This suggests an influent design cross section as shown below:



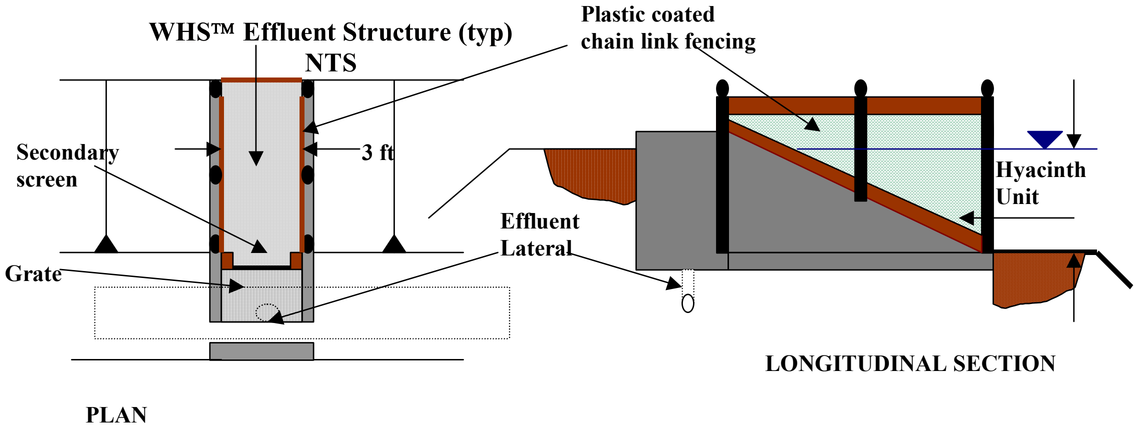
6. Fine Grading
    a. Fine grading would typically apply to subbase for concrete pad or paved road.

7. HDPE Liner
    a. Liner is required for the influent and effluent flumes and the reaeration basin. The influent flume has a wetted perimeter of about 130 ft on the cross section, over 1575 ft, this amounts to 205,000 sf. Add 20% for burial and corners, or 246,000 sf. The effluent flume may be considered about the same. The reaeration lagoon has a wetted perimeter of about 230 ft, therefore considering the length of 1357 ft, and adding 20%, the liner area is estimated at 375,000

        Influent Flume----246,000 sf
        Effluent Flume----246,000 sf
        Reaeration Lagoon----375,000 sf
        i. TOTAL LINER 40 mil HDPE 867,000 sf

8. Influent and Effluent Laterals
    a. There is anticipated to be 130 transfer pipes. These will be 10" SDR 35 PVC, with low-pressure butterfly valves (Pond Dam Piping type), booted into the HDPE. Each boot costs $100. Each pipe length will be about 60 ft, installed at perhaps $10/ft. The installed valves cost $275 each. The total unit cost then is estimated at $875 or a total of $113,750

       Effluent riser: There will be 130 of these. 65 transfer from Stage 1 to Stage 2, 65 from stage 2 to the effluent flume. They will consist of a concrete entrance box as shown below. The estimated cy of CIP for the box is 6 cy, or at $587/cy about $3,522 each. Including the screening and piping and grating, consider each unit at $4,000, or a total of $520,000.



9. Land area estimates, grassing

    a. Seed and mulch areas will be all back slopes associated with the units, or about 500,000 sf, plus interim areas. The estimate is about 700,000 sf or 16 acres, considering a 20% contingency, total grassing area is estimated at 840,000 sf

10. Discharge Piping

    a. Four 48" culverts will be required to handle the effluent flows. These will come from the reparation lagoon, and transverse perhaps 200 ft, to a discharge area. The outfall will need to be fortified with riprap, or preferably fabriform. A sump will be required at the aeration lagoon for the entrance. The sump and the fabriform spillway can be estimated at about $100,000. The piping, considering the unit prices provided would be 800 ft at $100.40.ft or $80,320. Therefore, discharge piping and support is estimated at $180, 320. Unit costs for 48" CMP (Item No. 1.13) was provided by Parsons at an installed cost of $100.40/lf.

Following are the Capital Cost Estimate Worksheets for the WHS™ Nutrient Recovery Facility:

Worksheet 1 of 3

FILE NAME: 1 Earth & Site Work (WHS)

HydroMentia, Inc.

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.:			M.T.O. BY:	DATE:	
PROJECT:	Lake Hancock Outfall Treatment Project	Project Description	PRICED BY: Mark Zivojnovict	DATE:	02/18/05
CLIENT:	SWFWMD	Estimate Type:	CHECKED BY: Allen Stewart	DATE:	02/19/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**								
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	304	Ac	$ -	$ 2,360.00	$ -	$ 717,440.00	$ 2,360.00	$ 717,440
1.02	Tree Removal (Larger then 12" dia.)	0	Ea	$ -	$ 315.40	$ -	$ -	$ 315.40	$ -
1.03	Earth Work (excavation and grading)	0	Cy	$ -	$ 7.44	$ -	$ -	$ 7.44	$ -
1.04	Tree Protection	0	Lf	$ 0.50	$ 1.26	$ -	$ -	$ 1.76	$ -
1.05	Stripping Top Soil	210,000	Cy	$ -	$ 0.74	$ -	$ 155,400.00	$ 0.74	$ 155,400
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts imported soils)	0	Cy	$ 9.00	$ 2.39	$ -	$ -	$ 11.39	$ -
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	0	Cy	$ -	$ 3.03	$ -	$ -	$ 3.03	$ -
1.08	Final Grading	11,111	Sy	$ -	$ 3.44	$ -	$ 38,221.84	$ 3.44	$ 38,222
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	0	Cy	$ 8.00	$ 1.91	$ -	$ -	$ 9.91	$ -
1.10a	3" Asphalt Conc. Pavement - WHS™ Access	11,111	Sy	$ 3.50	$ 4.64	$ 38,889	$ 51,555.04	$ 8.14	$ 90,444
1.11a	12" Compacted Limerock Base - WHS™ Access Road	3,704	Cy	$ 13.00	$ 1.89	$ 48,152	$ 7,000.56	$ 14.89	$ 55,153
1.12	12" Stabilized Subbase	0	Cy	$ 4.00	$ 1.80	$ -	$ -	$ 5.80	$ -
1.13	48' CMP	0	Lf	$ 69.00	$ 31.40	$ -	$ -	$ 100.40	$ -
1.14	Construction of WHS™ Berm	46,000	Lf	$ 72.72	Inlcuded	$ 3,345,120	$ -	$ 72.72	$ 3,345,120
1.15	10" Soil Cement - Compost and Sediment Dewatering Pads	72,309	Sy	$ 8.00	Inlcuded	$ 578,472	$ -	$ 8.00	$ 578,472
1.16	Construction of Berm for Thickening Pond	3,997	Cy	$ 9.00	$ 2.39	$ 35,973	$ 9,552.83	$ 11.39	$ 45,526
1.17	Construction of Berm for Thickening Pond Stormwater Treatment	778	Cy	$ 9.00	$ 2.39	$ 7,002	$ 1,859.42	$ 11.39	$ 8,861
2.00	**Concrete**								
2.01	Slab on grade	44	Cy	$ 203.00	$ -	8,932.00	$ -	$ 203.00	$ 8,932
2.02	Conventional walls	0	Cy	$ 371.00	$ -	0.00	$ -	$ 371.00	$ -
2.03	Elevated Work	0	Cy	$ 473.00	$ -	0.00	$ -	$ 473.00	$ -
2.04	Columns	0	Cy	$ 486.00	$ -	0.00	$ -	$ 486.00	$ -
3.00	**Geomembrane**								
3.01	HDPE Liner	867,000	Sf	$ 0.193	$ 0.120	$ 167,331	$ 104,040	$ 0.313	$ 271,371
3.02	Liner Entrenchment	20,000	Lf	$ -	$ 3.15	$ -	$ 63,000	$ 3.15	$ 63,000
3.03	Floating Boom	77,520	Lf	$ 4.50	$ 0.07	$ 348,840	$ 5,116	$ 4.57	$ 353,956
3.04	Floating Boom & Dredge Anchors	290	Each	$ 11.20	$ 4.20	$ 3,248	$ 1,218	$ 15.40	$ 4,466
4.00	**Hydraulic Structures**								
4.01	Influent Structures	130	Each	$ 855.00	Included	$ 111,150	$ -	$ 855.00	$ 111,150
4.02	Effluent Structures	130	Each	$ 4,000.00	Included	$ 520,000	$ -	$ 4,000.00	$ 520,000
4.03	Discharge Piping Structure	1	Each	$ 180,320.00	Included	$ 180,320	$ -	$ 180,320.00	$ 180,320
4.04	Stormwater Culverts	1	Lump Sum	$ 20,000.00	Included	$ 20,000	$ -	$ 20,000.00	$ 20,000
4.05	Dredge PVC Distribution Line - 8"	14,000	Lf	$ 3.25	$ 11.00	$ 45,500	$ 154,000	$ 14.25	$ 199,500
4.06	Dredge Distribution Line GateValves - 8"	4	Each	$ 300.00	$ 200.00	$ 1,200	$ 800	$ 500.00	$ 2,000
4.07	Dredge Distribution Line Air Relief Valves - 8"	4	Each	$ 300.00	$ 200.00	$ 1,200	$ 800	$ 500.00	$ 2,000
4.08	Miscellaneous Piping	1	Lump Sum	$ 15,000.00	Included	$ 15,000	$ -	$ 15,000.00	$ 15,000

Worksheet 2 of 3

5.00	**Buildings**								
5.01	Maintenance & Equipment Storage	2,500	Sf	$ 15.00	Included	$ 37,500	$ -	$ 15.00	$ 37,500
5.02	Adminstrative & Staff Facilities	600	Sf	$ 60.00	Included	$ 36,000	$ -	$ 60.00	$ 36,000
5.03	Well, Drinking Water	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
5.04	Sanitary Facilties, Septic	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
5.05	Fuel Storage	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
6.00	**Site Landscaping & Maintenance**								
6.01	Fence - Chain Link	900	Lf	$ 14.50	Included	$ 13,050	$ -	$ 14.50	$ 13,050
6.02	Fence - 5-Strand Barbed Wire	17,800	Sf	$ 1.75	Included	$ 31,150	$ -	$ 1.75	$ 31,150
6.03	Seed & Mulch	840,000	Lump Sum	$ 0.0266	Included	$ 22,344	$ -	$ 0.027	$ 22,344
6.04	Sod	10,000	Sf	$ 0.22	Included	$ 2,200	$ -	$ 0.220	$ 2,200
7.00	**Equipment**								
7.01	Valtra Model T170 with Brown Bear PTOPA- 10.5 Compost Aerator	1	Each	$ 128,000.00	NA	$ 128,000	$ -	$ 128,000.00	$ 128,000
7.02	John Deere Model 7420 - 115 hp	2	Each	$ 80,000.00	NA	$ 160,000	$ -	$ 80,000.00	$ 160,000
7.03	John Deere Model 7420 - 115 hp - with Loader	1	Each	$ 86,000.00	NA	$ 86,000	$ -	$ 86,000.00	$ 86,000
7.04	HMI Model 101-G Grapple	2	Each	$ 42,000.00	NA	$ 84,000	$ -	$ 42,000.000	$ 84,000
7.05	HMI Model 401-P Processor	2	Each	$ 98,000.00	NA	$ 196,000	$ -	$ 98,000.000	$ 196,000
7.06	Miller Model 5300 Series Forage Wagon	3	Each	$ 18,200.00	NA	$ 54,600	$ -	$ 18,200.000	$ 54,600
7.08	60" Dixie Chopper Mower	1	Each	$ 8,900.00	NA	$ 8,900	$ -	$ 8,900.000	$ 8,900
7.09	Trimmers & Misc Lawn Equipment	1	Lump Sum	$ 2,000.00	NA	$ 2,000	$ -	$ 2,000.000	$ 2,000
7.10	All Terrain Vehicles	2	Each	$ 3,000.00	NA	$ 6,000	$ -	$ 3,000.000	$ 6,000
7.11	Tools & Incidental Equipment	1	Lump Sum	$ 5,000.00	NA	$ 5,000	$ -	$ 5,000.000	$ 5,000
7.12	House Model HDC 181A153 Aerators	8	Each	$ 8,100.00	$ 100.00	$ 64,800	$ 800	$ 8,200.000	$ 65,600
7.13	Sigma 900 Autosamplers with Housing	2	Each	$ 4,500.00	$ 500.00	$ 9,000	$ 1,000	$ 5,000.000	$ 10,000
7.14	LWT Model RCLPES Hydraulic Dredge - 600 gpm	1	Each	$ 100,000.00	Included	$ 100,000	$ -	$ 100,000.000	$ 100,000
7.15	Supernatant Pump Station	1	Lump Sum	$ 40,000.00	Included	$ 40,000	$ -	$ 40,000.000	$ 40,000
7.15	6" Telescoping Valve	1	Each	$ 1,200.00	$ 100.00	$ 1,200	$ 100	$ 1,300.000	$ 1,300
8.00	**Electrical**								
8.01	Electrical Equipment & Installation	1	Lump Sum	$ 50,000.00	NA	$ 50,000	$ -	$ 50,000.00	$ 50,000

TOTAL CONSTRUCTION			$ 8,015,977
Contingency 20%			$ 1,603,195
Mob/Demob 5%			$ 400,799
Permits 1%			$ 80,160
Bonds 1%			$ 80,160
Insurance 1%			$ 80,160
Sales Tax	Equipment & Materials	$2,591,533	$ 181,407
Total Construction Costs			$ 10,441,857
Engineering & Overhead (15%)			$ 1,566,279
TOTAL CAPITAL COSTS			$ 12,008,136

Worksheet 3 of 3

Items Required for Levee Construction (Footnote 1):

1.03	Earth Work (excavation and soils removal)	$60.00	LF
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	$25.00	LF
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	$86.00	LF
	Total = Lf of Levee	$171.00	LF

Footnote 1 - Complete construction of STA levee includes items 1.03, 1.07 and 1.09 from above
Typical perimeter levee cross section is 168 ft base, 14 ft top, 9 ft high, 3:1 slope

1.14 Construction of WHS™ Berm, Costs provided by Parson, Feb 2005
1.15 10" Soil Cement - Compost and Sediment Pads, Costs provided by Parson, Feb 2005
3.01 HDPE Liner, Comanco 2002 Costs adj to 2005
3.02 Liner Entrenchment, Comanco 2002 Costs adj to 2005
3.03 Floating Boom, Feb 2005 Price Quote from American Marine, Cocoa, FL
4.05 Dredge PVC Distribution Line - 8", Feb 2005 Price quote for Material from Summers Irrigation, Sebring, FL
5.01 Maintenance & Equipment Storage, Metal Structure with Concrete Slab, Feb 2005 Price Quote Provided by G.M. Worley Construction, Okeechobee, FL
5.02 Adminstrative Building, 2 Offices, restroom and break room located inside Maintenace & Equipment Stoarge Buliding - Feb 2005 Price Quote from G.M. Worley Construction, Okeechobee, FL
5.03 Well, Drinking Water Facilties Allowance provided by Parsons - Feb 2005
5.04 Sanitary Facilties, Septic Allowance provided by Parsons - Feb 2006
6.01 Fence, Chain Link costs provided by Parsons -Feb 2005
6.02 Fence - 5-Strand Barbed Wire, 3.5-4" Post at 14' centers - Feb 2005 Price Quote from R&R Fencing, Webster, Florida (Material and Labor Included)
6.03 Seed & Mulch - DOT Spec - Feb 2005 Proce Quote from Bennett Grasssing, Tampa, FL (Materials & Labor Included)
6.04 Sod cost provided by Parsons - Feb 2005
7.01 Valtra Model T-170 (170 hp) with Brown Bear Aerator, High Capacity Bucket, Feb 2005 Price Quote, Suwannee Equipment, Live Oak, FL
7.02 John Deere Model 7420 - 115 hp - -Feb 2005 Price Quote from Everglades Tractor, Okeechobee, FL
7.04 HMI Model 101-G Grapple, Feb 2005 HMI Quote
7.05 HMI Model 401-P Processor, Feb 2005 HMI Quote
7.06 Miller Model 5300 Series Forage Wagon - Feb 2005 Proce quote from Miller-St. Nazianz, Inc., St. Nazianz, Inc.
7.07 Brown Bear PTOP A35C-10.5 Mixer - Feb 2005 Brown Bear Corp, Corning, IA
7.08 60" Dixie Chopper Mower, Nov 2004 Price Quote from Lawn Tamer Equipment, Okeechobee, FL
7.12 House Model HDC 181A153 Aerators, Oct 2004 Price Quote from House Manufacturing, Cherry Valley, AR
7.13 Sigma 900 Autosamplers with Housing
7.14 LWT Model RCLPES Hydraulic Dredge - 600 gpm, Feb 2005 Quote from LWT Inc, Somerset WI

Following are the Capital Cost Estimate Worksheets for the Pump Station Access Road:

Worksheet 1 of 1

FILE NAME: n & Site Work (Pump Road)

HydroMentia, Inc.

ENGINEER ESTIMATE WORKSHEET | Budgetary Cost Estimate

JOB NO.:			M.T.O. BY:		DATE:
PROJECT:	Lake Hancock Outfall Treatment Project	Project Description	PRICED BY:	Mark Zivojnovicł	DATE: 02/18/05
CLIENT:	SWFWMD	Estimate Type:	CHECKED BY:	Allen Stewart	DATE: 02/19/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**								
1.08	Final Grading	37,000	Sy	$ -	$ 3.44	0.00	$ 127,280.00	$ 3.44	$ 127,280
1.10b	3" Asphalt Conc. Pavement - Pump Station Access	37,000	Sy	$ 3.50	$ 4.64	129,500.00	$ 171,680.00	$ 8.14	$ 301,180
1.11b	12" Compacted Limerock Base - Pump Station Access	12,333	Cy	$ 13.00	$ 1.89	160,329.00	$ 23,309.37	$ 14.89	$ 183,638
	TOTAL CONSTRUCTION								$ 612,098
	Contingency 20%								$ 122,420
	Mob/Demob 5%								$ 30,605
	Permits 1%								$ 6,121
	Bonds 1%								$ 6,121
	Insurance 1%								$ 6,121
	Sales Tax	Equipment & Materials		$484,818					$ 33,937
	Total Construction Costs								$ 817,423
	Engineering & Overhead (25%)								$ 204,356
	TOTAL CAPITAL COSTS								$ 1,021,779

APPENDIX D. 29-YEAR MONTHLY FLOWS AND LOAD AVERAGES AND PROPOSED FLOW RECOVERY STRATEGY

TN = 5.53 mg/l
TP = 0.603 mg/l

January

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	579	244	0.20%	0.20%	1,666	182	244
2.6-5	11	79	0.06%	0.26%	540	59	79
5.1-7.5	8	95	0.08%	0.34%	648	71	95
7.6-10	9	167	0.14%	0.48%	1,137	124	167
10.1-15	10	262	0.21%	0.69%	1,786	195	262
15.1-20	10	369	0.30%	0.99%	2,517	274	369
20.1-25	7	393	0.32%	1.31%	2,682	292	393
25.1-30	9	474	0.39%	1.70%	3,235	353	474
30.1-35	4	264	0.22%	1.92%	1,800	196	264
35.1-40	7	534	0.44%	2.35%	3,641	397	534
40.1-50	13	1,186	0.97%	3.32%	8,093	882	1,186
50.1-100	57	8,265	6.75%	10.07%	56,395	6,149	8,265
100.1-200	75	20,991	17.14%	27.21%	143,228	15,618	20,991
200.1-300	29	13,855	11.32%	38.53%	94,534	10,308	13,855
300.1-400	29	19,498	15.92%	54.45%	133,037	14,507	
400.1-500	10	8,795	7.18%	61.64%	60,009	6,543	
500.1-600	8	8,745	7.14%	68.78%	59,671	6,507	
600.1-700	8	8,955	7.31%	76.09%	61,105	6,663	
700.1-800	9	13,420	10.96%	87.05%	91,570	9,985	
800.1-900	4	6,666	5.44%	92.497%	45,487	4,960	
900.1-1000	5	9,187	7.50%	100.000%	62,689	6,836	
	TOTALS	122,444			835,470	91,101	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,222
Total Flow MGD	44.38
Flow at or below 300 cfs MGD	18.93
Total Nitrogen kg	28,809
Total Phosphorus kg	3,141

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	74.01%
Total Nitrogen Captured Annually kg	21,320
Percentage of the time at maximum flow	8.10%
Percentage of Nitrogen at maximum flow	47.94%

TN = 5.53 mg/l
TP = 0.603 mg/l

February

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	515	233	0.19%	0.19%	1,588	173	233
2.6-5	7	49	0.04%	0.23%	334	36	49
5.1-7.5	6	66	0.05%	0.28%	449	49	66
7.6-10	2	34	0.03%	0.31%	233	25	34
10.1-15	8	214	0.17%	0.49%	1,462	159	214
15.1-20	24	902	0.74%	1.22%	6,158	671	902
20.1-25	19	863	0.70%	1.93%	5,887	642	863
25.1-30	15	845	0.69%	2.62%	5,765	629	845
30.1-35	12	778	0.64%	3.25%	5,305	578	778
35.1-40	4	313	0.26%	3.51%	2,138	233	313
40.1-50	10	895	0.73%	4.24%	6,104	666	895
50.1-100	63	9,233	7.54%	11.78%	63,000	6,870	9,233
100.1-200	72	18,774	15.33%	27.11%	128,098	13,968	18,774
200.1-300	39	19,741	16.12%	43.24%	134,702	14,688	19,741
300.1-400	22	14,206	11.60%	54.84%	96,929	10,569	
400.1-500	10	8,922	7.29%	62.12%	60,875	6,638	
500.1-600	2	2,158	1.76%	63.89%	14,725	1,606	
600.1-700	1	1,307	1.07%	64.95%	8,919	973	
700.1-800	9	12,873	10.51%	75.47%	87,834	9,578	
800.1-900							
900.1-1000							
	TOTALS	92,405			630,506	68,751	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,186
Total Flow MGD	33.50
Flow at or below 300 cfs MGD	21.25
Total Nitrogen kg	21,742
Total Phosphorus kg	2,371

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	85.62%
Total Nitrogen Captured Annually kg	18,616
Percentage of the time at maximum flow	5.24%
Percentage of Nitrogen at maximum flow	33.09%

TN = 5.53 mg/l
TP = 0.603 mg/l

March

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	538	246	0.22%	0.22%	1,682	183	246
2.6-5	18	140	0.12%	0.34%	955	104	140
5.1-7.5	9	112	0.10%	0.44%	765	83	112
7.6-10	9	157	0.14%	0.58%	1,073	117	157
10.1-15	9	248	0.22%	0.80%	1,692	184	248
15.1-20	21	791	0.70%	1.51%	5,400	589	791
20.1-25	18	827	0.74%	2.24%	5,644	615	827
25.1-30	6	319	0.28%	2.53%	2,179	238	319
30.1-35	5	315	0.28%	2.81%	2,152	235	315
35.1-40	1	79	0.07%	2.88%	541	59	79
40.1-50	13	1,210	1.08%	3.95%	8,256	900	1,210
50.1-100	62	8,983	7.99%	11.94%	61,295	6,684	8,983
100.1-200	85	23,853	21.21%	33.16%	162,758	17,747	23,853
200.1-300	44	21,624	19.23%	52.39%	147,546	16,089	21,624
300.1-400	17	12,169	10.82%	63.21%	83,030	9,054	
400.1-500	4	3,485	3.10%	66.31%	23,779	2,593	
500.1-600	6	6,454	5.74%	72.05%	44,039	4,802	
600.1-700	13	16,683	14.84%	86.88%	113,833	12,413	
700.1-800	10	14,749	13.12%	100.00%	100,637	10,974	
800.1-900	0	0	0.00%	100.000%	0	0	
900.1-1000	0	0	0.00%	100.000%	0	0	
	TOTALS	112,446			767,255	83,663	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,877
Total Flow MGD	40.76
Flow at or below 300 cfs MGD	22.83
Total Nitrogen kg	26,457
Total Phosphorus kg	2,885

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	78.85%
Total Nitrogen Captured Annually kg	20,860
Percentage of Time at Maximum Flow	5.63%
Percentage of Nitrogen at Maximum Flow	33.56%

TN = 5.53 mg/l
TP = 0.603 mg/l

April

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	488	230	0.26%	0.26%	1,570	171	230
2.6-5	15	115	0.13%	0.39%	785	86	115
5.1-7.5	28	351	0.40%	0.79%	2,394	261	351
7.6-10	13	222	0.25%	1.04%	1,513	165	222
10.1-15	37	956	1.09%	2.13%	6,523	711	956
15.1-20	8	264	0.30%	2.43%	1,800	196	264
20.1-25	16	734	0.83%	3.26%	5,008	546	734
25.1-30	16	902	1.02%	4.28%	6,158	671	902
30.1-35	4	258	0.29%	4.58%	1,759	192	258
35.1-40	12	912	1.04%	5.61%	6,226	679	912
40.1-50	10	897	1.02%	6.63%	6,117	667	897
50.1-100	61	8,884	10.08%	16.71%	60,618	6,610	8,884
100.1-200	95	26,769	30.38%	47.10%	182,652	19,917	26,769
200.1-300	25	12,329	13.99%	61.09%	84,126	9,173	12,329
300.1-400	20	14,106	16.01%	77.10%	96,253	10,496	
400.1-500	11	9,221	10.47%	87.57%	62,919	6,861	
500.1-600	11	10,951	12.43%	100.00%	74,720	8,148	
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	88,101			601,141	65,549	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,038
Total Flow MGD	31.94
Flow at or below 300 cfs MGD	20.86
Total Nitrogen kg	20,729
Total Phosphorus kg	2,260

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	89.46%
Total Nitrogen Captured Annually kg	18,544
Percentage of the time at maximum flow	4.83%
Percentage of Nitrogen at maximum flow	31.71%

TN = 5.53 mg/l
TP = 0.603 mg/l

May

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	690	379	1.10%	1.10%	2,585	282	379
2.6-5	42	326	0.95%	2.05%	2,225	243	326
5.1-7.5	41	514	1.50%	3.55%	3,508	383	514
7.6-10	19	329	0.96%	4.50%	2,243	245	329
10.1-15	5	139	0.40%	4.91%	947	103	139
15.1-20	4	149	0.43%	5.34%	1,015	111	149
20.1-25	2	87	0.25%	5.60%	595	65	87
25.1-30	1	52	0.15%	5.75%	352	38	52
30.1-35	1	69	0.20%	5.95%	474	52	69
35.1-40	2	149	0.43%	6.38%	1,015	111	149
40.1-50	5	470	1.37%	7.75%	3,208	350	470
50.1-100	33	5,576	16.23%	23.97%	38,044	4,148	5,576
100.1-200	33	8,688	25.28%	49.26%	59,278	6,464	8,688
200.1-300	11	7,615	22.16%	71.42%	51,956	5,665	7,615
300.1-400	11	9,822	28.58%	100.00%	67,019	7,308	
400.1-500							
500.1-600							
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	34,362			234,464	25,566	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	1,185
Total Flow MGD	12.46
Flow at or below 300 cfs MGD	9.51
Total Nitrogen kg	8,085
Total Phosphorus kg	882

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	90.46%
Total Nitrogen Captured Annually kg	7,314
Percentage of the time at maximum flow	1.22%
Percentage of Nitrogen at maximum flow	21.06%

TN = 5.53 mg/l
TP = 0.603 mg/l

June

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg
0-2.5	601	242	0.38%	0.38%	1,652	180
2.6-5	16	114	0.18%	0.55%	775	85
5.1-7.5	18	229	0.36%	0.91%	1,560	170
7.6-10	6	94	0.15%	1.06%	640	70
10.1-15	2	52	0.08%	1.14%	352	38
15.1-20	2	69	0.11%	1.24%	474	52
20.1-25	2	83	0.13%	1.37%	568	62
25.1-30	5	282	0.44%	1.81%	1,922	210
30.1-35	14	938	1.46%	3.27%	6,401	698
35.1-40	4	296	0.46%	3.73%	2,017	220
40.1-50	6	559	0.87%	4.60%	3,817	416
50.1-100	37	5,607	8.73%	13.33%	38,260	4,172
100.1-200	64	18,726	29.15%	42.48%	127,773	13,933
200.1-300	42	20,301	31.60%	74.08%	138,519	15,104
300.1-400	19	12,643	19.68%	93.76%	86,265	9,406
400.1-500	2	1,805	2.81%	96.57%	12,316	1,343
500.1-600	2	2,204	3.43%	100.00%	15,036	1,640
600.1-700						
700.1-800						
800.1-900						
900.1-1000						
	TOTALS	64,243			438,346	47,798

MONTHLY AVERAGES	
Flow acre-ft	2,215
Total Flow MGD	23.29
Flow at or below 300 cfs MGD	18.44
Total Nitrogen kg	15,115
Total Phosphorus kg	1,648

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	95.38%
Total Nitrogen Captured Annually kg	14,418
Percentage of the time at maximum flow	2.73%
Percentage of Nitrogen at maximum flow	22.33%

TN = 5.53 mg/l
TP = 0.603 mg/l

July

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	420	180.9	0.13%	0.13%	1,234	135	181
2.6-5	20	142.2	0.10%	0.23%	970	106	142
5.1-7.5	5	60.7	0.04%	0.27%	414	45	61
7.6-10	1	18.6	0.01%	0.29%	127	14	19
10.1-15	2	55.5	0.04%	0.33%	379	41	56
15.1-20	4	144.8	0.10%	0.43%	988	108	145
20.1-25	1	49.6	0.04%	0.46%	338	37	50
25.1-30	2	113.1	0.08%	0.54%	771	84	113
30.1-35	2	123.0	0.09%	0.63%	839	91	123
35.1-40	9	686.3	0.49%	1.12%	4,683	511	686
40.1-50	26	2382.1	1.69%	2.81%	16,254	1,772	2,382
50.1-100	107	15939.2	11.32%	14.13%	108,758	11,859	15,939
100.1-200	186	50386.1	35.78%	49.90%	343,800	37,488	50,386
200.1-300	63	30985.8	22.00%	71.90%	211,425	23,054	30,986
300.1-400	47	31204.0	22.16%	94.06%	212,914	23,216	
400.1-500	0	0	0.00%	94.06%	0	0	
500.1-600	3	3367.9	2.39%	96.45%	22,980	2,506	
600.1-700	4	5000.3	3.55%	100.00%			
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	140,840			926,876	101,068	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,857
Total Flow MGD	51.05
Flow at or below 300 cfs MGD	39.24
Total Nitrogen kg	31,961
Total Phosphorus kg	3,485

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	93.03%
Total Nitrogen Captured Annually kg	29,733
Percentage of the time at maximum flow	5.99%
Percentage of Nitrogen at maximum flow	22.71%

TN = 5.53 mg/l
TP = 0.603 mg/l

August

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	369	317	0.16%	0.16%	2,166	236	317
2.6-5	24	157	0.08%	0.24%	1,071	117	157
5.1-7.5	15	191	0.10%	0.33%	1,302	142	191
7.6-10	11	189	0.09%	0.43%	1,292	141	189
10.1-15	8	204	0.10%	0.53%	1,394	152	204
15.1-20	3	105	0.05%	0.58%	717	78	105
20.1-25	12	538	0.27%	0.85%	3,668	400	538
25.1-30	7	369	0.18%	1.04%	2,517	274	369
30.1-35	2	135	0.07%	1.10%	920	100	135
35.1-40	4	290	0.14%	1.25%	1,976	215	290
40.1-50	17	1,511	0.76%	2.00%	10,313	1,125	1,511
50.1-100	77	11,966	5.98%	7.98%	81,650	8,903	11,966
100.1-200	130	37,468	18.73%	26.72%	255,654	27,877	37,468
200.1-300	126	59,784	29.89%	56.60%	407,923	44,481	59,784
300.1-400	48	31,410	15.70%	72.30%	214,322	23,370	
400.1-500	15	12,768	6.38%	78.69%	87,117	9,499	
500.1-600	10	11,060	5.53%	84.22%	75,465	8,229	
600.1-700	4	5,054	2.53%	86.74%	34,484	3,760	
700.1-800	8	11,954	5.98%	92.72%	81,568	8,894	
800.1-900	9	14,567	7.28%	100.000%	99,392	10,838	
900.1-1000							
	TOTALS	200,037			1,364,911	148,832	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	6,898
Total Flow MGD	72.51
Flow at or below 300 cfs MGD	45.44
Total Nitrogen kg	47,066
Total Phosphorus kg	5,132

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	84.56%
Total Nitrogen Captured Annually kg	39,801
Percentage of Time at Maximum Flow	10.46%
Percentage of Nitrogen at Maximum Flow	33.07%

TN = 5.53 mg/l
TP = 0.603 mg/l

September

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	275	172	0.09%	0.09%	1,171	128	172
2.6-5	48	345	0.18%	0.27%	2,356	257	345
5.1-7.5	27	341	0.18%	0.44%	2,328	254	341
7.6-10	44	768	0.40%	0.84%	5,243	572	768
10.1-15	17	444	0.23%	1.07%	3,032	331	444
15.1-20	15	541	0.28%	1.35%	3,695	403	541
20.1-25	14	649	0.33%	1.68%	4,426	483	649
25.1-30	11	607	0.31%	2.00%	4,141	452	607
30.1-35	7	470	0.24%	2.24%	3,208	350	470
35.1-40	4	307	0.16%	2.40%	2,098	229	307
40.1-50	15	1,416	0.73%	3.13%	9,663	1,054	1,416
50.1-100	62	9,072	4.68%	7.81%	61,904	6,750	9,072
100.1-200	121	34,883	18.00%	25.80%	238,019	25,954	34,883
200.1-300	100	48,069	24.80%	50.60%	327,992	35,765	48,069
300.1-400	36	24,343	12.56%	63.16%	166,101	18,112	
400.1-500	49	44,608	23.01%	86.17%	304,376	33,190	
500.1-600	22	23,096	11.91%	98.09%	157,588	17,184	
600.1-700	3	3,707	1.91%	100.00%	25,295	2,758	
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	193,841			1,322,634	144,222	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	6,684
Total Flow MGD	70.26
Flow at or below 300 cfs MGD	42.39
Total Nitrogen kg	45,608
Total Phosphorus kg	4,973

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	84.37%
Total Nitrogen Captured Annually kg	38,479
Percentage of Time at Maximum Flow	12.64%
Percentage of Nitrogen at Maximum Flow	40.02%

TN = 5.53 mg/l
TP = 0.603 mg/l

October

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	362	233	0.18%	0.18%	1,588	173	233
2.6-5	60	409	0.32%	0.50%	2,788	304	409
5.1-7.5	38	449	0.35%	0.84%	3,061	334	449
7.6-10	13	230	0.18%	1.02%	1,571	171	230
10.1-15	26	668	0.52%	1.54%	4,561	497	668
15.1-20	16	553	0.43%	1.97%	3,776	412	553
20.1-25	14	643	0.50%	2.47%	4,385	478	643
25.1-30	5	284	0.22%	2.69%	1,935	211	284
30.1-35	11	706	0.55%	3.23%	4,818	525	706
35.1-40	10	756	0.59%	3.82%	5,156	562	756
40.1-50	12	1,073	0.83%	4.65%	7,322	798	1,073
50.1-100	115	16,802	13.01%	17.66%	114,645	12,501	16,802
100.1-200	104	28,606	22.16%	39.82%	195,185	21,283	28,606
200.1-300	45	21,269	16.47%	56.29%	145,123	15,824	21,269
300.1-400	28	19,666	15.23%	71.53%	134,188	14,632	
400.1-500	33	28,774	22.29%	93.81%	196,335	21,409	
500.1-600	5	5,536	4.29%	98.10%	37,773	4,119	
600.1-700	2	2,454	1.90%	100.00%	16,741	1,826	
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	129,109			880,952	96,060	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,452
Total Flow MGD	46.80
Flow at or below 300 cfs MGD	29.17
Total Nitrogen kg	30,378
Total Phosphorus kg	3,312

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	87.63%
Total Nitrogen Captured Annually kg	26,621
Percentage of Time at Maximum Flow	7.56%
Percentage of Nitrogen at Maximum Flow	35.76%

TN = 5.53 mg/l
TP = 0.603 mg/l

November

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	563	430.2	0.84%	0.84%	2,935	320	430
2.6-5	60	391.9	0.76%	1.60%	2,674	292	392
5.1-7.5	22	271.1	0.53%	2.13%	1,850	202	271
7.6-10	26	450.2	0.88%	3.01%	3,072	335	450
10.1-15	11	277.7	0.54%	3.55%	1,895	207	278
15.1-20	22	839.0	1.64%	5.19%	5,725	624	839
20.1-25	15	698.2	1.36%	6.55%	4,764	519	698
25.1-30	11	579.2	1.13%	7.68%	3,952	431	579
30.1-35	6	398.7	0.78%	8.46%	2,720	297	399
35.1-40	8	599.0	1.17%	9.62%	4,087	446	599
40.1-50	5	432.4	0.84%	10.47%	2,950	322	432
50.1-100	29	4316.0	8.42%	18.88%	29,450	3,211	4,316
100.1-200	46	13920.0	27.14%	46.02%	94,980	10,357	13,920
200.1-300	41	19749.4	38.51%	84.53%	134,756	14,694	19,749
300.1-400	4	2638.0	5.14%	89.68%	18,000	1,963	
400.1-500	6	5293.9	10.32%	100.00%	36,122	3,939	
500.1-600							
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	51,285			349,933	38,157	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	1,768
Total Flow MGD	18.59
Flow at or below 300 cfs MGD	16.80
Total Nitrogen kg	12,067
Total Phosphorus kg	1,316

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	96.14%
Total Nitrogen Captured Annually kg	11,600
Percentage of Time at Maximum Flow	1.14%
Percentage of Nitrogen at Maximum Flow	12.07%

TN = 5.53 mg/l TP = 0.603 mg/l	December						
Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	587	350	0.38%	0.38%	2,387	260	350
2.6-5	27	179	0.20%	0.58%	1,220	133	179
5.1-7.5	14	170	0.19%	0.76%	1,161	127	170
7.6-10	9	160	0.17%	0.94%	1,092	119	160
10.1-15	13	340	0.37%	1.31%	2,319	253	340
15.1-20	33	1,258	1.38%	2.69%	8,583	936	1,258
20.1-25	36	1,717	1.88%	4.56%	11,715	1,277	1,717
25.1-30	1	58	0.06%	4.63%	393	43	58
30.1-35	0	0	0.00%	4.63%	0	0	0
35.1-40	2	149	0.16%	4.79%	1,017	111	149
40.1-50	11	1,037	1.13%	5.92%	7,078	772	1,037
50.1-100	68	9,640	10.54%	16.46%	65,776	7,172	9,640
100.1-200	37	10,564	11.55%	28.01%	72,081	7,860	10,564
200.1-300	20	10,017	10.95%	38.97%	68,352	7,453	10,017
300.1-400	7	5,193	5.68%	44.64%	35,430	3,863	
400.1-500	4	3,591	3.93%	48.57%	24,502	2,672	
500.1-600	16	18,246	19.95%	68.52%	124,501	13,576	
600.1-700	12	15,299	16.73%	85.25%	104,393	11,383	
700.1-800	7	10,256	11.21%	96.46%	69,979	7,631	
800.1-900	2	3,239	3.54%	100.000%	22,102	2,410	
900.1-1000							
	TOTALS	91,463			624,081	68,051	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,154
Total Flow MGD	33.15
Flow at or below 300 cfs MGD	13.81
Total Nitrogen kg	21,520
Total Phosphorus kg	2,347

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	70.19%
Total Nitrogen Captured Annually kg	15,106
Percentage of Time at Maximum Flow	5.30%
Percentage of Nitrogen at Maximum Flow	44.49%

APPENDIX E. MONTHLY HYADEM RESULTS

HYADEM February 300 cfs (194 MGD)		HYADEM February (17.95 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	17.95
Days	1.48	Days	26.52
Average Total Nitrogen (mg/l)	5.20	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	18.00	Average Air Temperature (degrees C)	18.00
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.014	Field Water Hyacinth Growth Rate (1/day)	0.011
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.010	Net Specific Growth Rate (1/day)	0.007
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	15.25
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	7.99
Mean Plant Age days	72.45	Mean Plant Age days	91.41
Average Daily Growth (Wet Tons)	257.4	Average Daily Growth (Wet Tons)	203.7
Average Daily Growth (Dry Tons)	12.9	Average Daily Growth (Dry Tons)	10.2
Average Daily Harvest (Wet Tons)	140.4	Average Daily Harvest (Wet Tons)	99.2
Average Daily Harvest (Dry Tons)	9.1	Average Daily Harvest (Dry Tons)	6.4
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.87**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.536**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.050**
Nitrogen Removal kg/day	486.22	Nitrogen Removal kg/day	290.88
Nitrogen Removal kg/period	720	Nitrogen Removal kg/period	7,714
Nitrogen Removal Rate lb/acre-day	5.10	Nitrogen Removal Rate lb/acre-day	3.05
Nitrogen Removal Rate gm/sm-yr	209	Nitrogen Removal Rate gm/sm-yr	125
Phosphorus Removal kg/day	49	Phosphorus Removal kg/day	38
Phosphorus Removal kg/period	73	Phosphorus Removal kg/period	997
Phosphorus Removal Rate lb/acre-day	0.51	Phosphorus Removal Rate lb/acre-day	0.39
Phosphorus Removal Rate gm/sm-yr	21.08	Phosphorus Removal Rate gm/sm-yr	16.14

Total Nitrogen Removed kg/month	8,434
Total Phosphorus Removed kg/month	1,069

HYADEM March 300 cfs (194 MGD)		HYADEM March (23.20 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	23.20
Days	1.74	Days	26.26
Average Total Nitrogen (mg/l)	5.16	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	20.61	Average Air Temperature (degrees C)	20.61
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210.00	Growing Area (acres)	200.00
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	17,642
Field Water Hyacinth Growth Rate (1/day)	0.016	Field Water Hyacinth Growth Rate (1/day)	0.012
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.012	Net Specific Growth Rate (1/day)	0.008
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	11.23
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	10.85
Mean Plant Age days	64.06	Mean Plant Age days	80.48
Average Daily Growth (Wet Tons)	291.4	Average Daily Growth (Wet Tons)	220.6
Average Daily Growth (Dry Tons)	14.6	Average Daily Growth (Dry Tons)	11.0
Average Daily Harvest (Wet Tons)	166.4	Average Daily Harvest (Wet Tons)	114.8
Average Daily Harvest (Dry Tons)	10.8	Average Daily Harvest (Dry Tons)	7.5
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	70.7
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.5
WHS™ Effluent Total Nitrogen (mg/l)	**4.78**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.527**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.124**
Nitrogen Removal kg/day	550.39	Nitrogen Removal kg/day	376.04
Nitrogen Removal kg/period	958	Nitrogen Removal kg/period	9,875
Nitrogen Removal Rate lb/acre-day	5.77	Nitrogen Removal Rate lb/acre-day	4.14
Nitrogen Removal Rate gm/sm-yr	236	Nitrogen Removal Rate gm/sm-yr	170
Phosphorus Removal kg/day	56	Phosphorus Removal kg/day	42
Phosphorus Removal kg/period	97	Phosphorus Removal kg/period	1,104
Phosphorus Removal Rate lb/acre-day	0.58	Phosphorus Removal Rate lb/acre-day	0.46
Phosphorus Removal Rate gm/sm-yr	23.86	Phosphorus Removal Rate gm/sm-yr	18.96

Total Nitrogen Removed kg/month	10,832
Total Phosphorus Removed kg/month	1,201

HYADEM April 300 cfs (194 MGD)		HYADEM April (18.37 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	18.37
Days	1.50	Days	28.50
Average Total Nitrogen (mg/l)	5.13	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	22.89	Average Air Temperature (degrees C)	22.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.017	Field Water Hyacinth Growth Rate (1/day)	0.014
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.013	Net Specific Growth Rate (1/day)	0.010
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	14.90
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	8.18
Mean Plant Age days	57.46	Mean Plant Age days	72.01
Average Daily Growth (Wet Tons)	325.2	Average Daily Growth (Wet Tons)	259.0
Average Daily Growth (Dry Tons)	16.3	Average Daily Growth (Dry Tons)	13.0
Average Daily Harvest (Wet Tons)	192.3	Average Daily Harvest (Wet Tons)	141.6
Average Daily Harvest (Dry Tons)	12.5	Average Daily Harvest (Dry Tons)	9.2
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.69**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.519**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.050**
Nitrogen Removal kg/day	614.24	Nitrogen Removal kg/day	297.75
Nitrogen Removal kg/period	921	Nitrogen Removal kg/period	8,486
Nitrogen Removal Rate lb/acre-day	6.44	Nitrogen Removal Rate lb/acre-day	3.12
Nitrogen Removal Rate gm/sm-yr	264	Nitrogen Removal Rate gm/sm-yr	128
Phosphorus Removal kg/day	62	Phosphorus Removal kg/day	38
Phosphorus Removal kg/period	93	Phosphorus Removal kg/period	1,096
Phosphorus Removal Rate lb/acre-day	0.65	Phosphorus Removal Rate lb/acre-day	0.40
Phosphorus Removal Rate gm/sm-yr	26.62	Phosphorus Removal Rate gm/sm-yr	16.52

Total Nitrogen Removed kg/month	**9,407**
Total Phosphorus Removed kg/month	**1,189**

HYADEM May 300 cfs (194 MGD)		HYADEM May (8.50 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	8.50
Days	0.37	Days	30.63
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	26.06	Average Air Temperature (degrees C)	26.06
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	32.22
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	3.78
Mean Plant Age days	49.78	Mean Plant Age days	61.87
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	301.8
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	15.1
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	174.4
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	11.3
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.050**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	137.70
Nitrogen Removal kg/period	263	Nitrogen Removal kg/period	4,218
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	1.44
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	59
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	18
Phosphorus Removal kg/period	27	Phosphorus Removal kg/period	545
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.19
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	7.64

Total Nitrogen Removed kg/month	**4,480**
Total Phosphorus Removed kg/month	**571**

HYADEM June 300 cfs (194 MGD)		HYADEM June (16.25 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	16.25
Days	0.82	Days	29.18
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.17	Average Air Temperature (degrees C)	28.17
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	16.84
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	7.24
Mean Plant Age days	49.78	Mean Plant Age days	61.87
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	301.8
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	15.1
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	174.4
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	11.3
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.050**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	263.41
Nitrogen Removal kg/period	582	Nitrogen Removal kg/period	7,686
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	2.76
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	113
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	34
Phosphorus Removal kg/period	59	Phosphorus Removal kg/period	993
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.36
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	14.61

Total Nitrogen Removed kg/month	8,268
Total Phosphorus Removed kg/month	1,052

HYADEM July 300 cfs (194 MGD)		HYADEM July (35.62 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.62
Days	1.86	Days	29.14
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.49
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.89	Average Air Temperature (degrees C)	28.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	200.00
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	17,642
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	7.32
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	16.66
Mean Plant Age days	49.78	Mean Plant Age days	60.87
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	292.2
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	14.6
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	169.7
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	11.0
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	70.7
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.5
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.44**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.190**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	551.92
Nitrogen Removal kg/period	1,320	Nitrogen Removal kg/period	16,083
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	6.08
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	249
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	56
Phosphorus Removal kg/period	133	Phosphorus Removal kg/period	1,624
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.61
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	25.12

Total Nitrogen Removed kg/month	17,403
Total Phosphorus Removed kg/month	1,757

HYADEM August 300 cfs (194 MGD)		HYADEM August (42.43 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	42.43
Days	3.24	Days	27.76
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.67
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.94	Average Air Temperature (degrees C)	28.94
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.017
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.013
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	6.45
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	18.90
Mean Plant Age days	49.78	Mean Plant Age days	59.06
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	316.3
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	15.8
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	185.5
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	12.1
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.81**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.228**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	597.41
Nitrogen Removal kg/period	2,300	Nitrogen Removal kg/period	16,584
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	6.27
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	256
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	60
Phosphorus Removal kg/period	232	Phosphorus Removal kg/period	1,674
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.63
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	25.90

Total Nitrogen Removed kg/month	18,884
Total Phosphorus Removed kg/month	1,907

HYADEM September 300 cfs (194 MGD)		HYADEM September (35.64 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.64
Days	3.92	Days	26.08
Average Total Nitrogen (mg/l)	5.05	Average Total Nitrogen (mg/l)	3.41
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.11	Average Air Temperature (degrees C)	28.11
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.020	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.016	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	7.68
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	15.87
Mean Plant Age days	49.78	Mean Plant Age days	61.66
Average Daily Growth (Wet Tons)	375.9	Average Daily Growth (Wet Tons)	302.9
Average Daily Growth (Dry Tons)	18.8	Average Daily Growth (Dry Tons)	15.1
Average Daily Harvest (Wet Tons)	231.1	Average Daily Harvest (Wet Tons)	175.2
Average Daily Harvest (Dry Tons)	15.0	Average Daily Harvest (Dry Tons)	11.4
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.56**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.29**
WHS™ Effluent Total Phosphorus (mg/l)	**0.505**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.175**
Nitrogen Removal kg/day	709.94	Nitrogen Removal kg/day	572.04
Nitrogen Removal kg/period	2,783	Nitrogen Removal kg/period	14,919
Nitrogen Removal Rate lb/acre-day	7.45	Nitrogen Removal Rate lb/acre-day	6.00
Nitrogen Removal Rate gm/sm-yr	305	Nitrogen Removal Rate gm/sm-yr	246
Phosphorus Removal kg/day	72	Phosphorus Removal kg/day	58
Phosphorus Removal kg/period	281	Phosphorus Removal kg/period	1,506
Phosphorus Removal Rate lb/acre-day	0.75	Phosphorus Removal Rate lb/acre-day	0.61
Phosphorus Removal Rate gm/sm-yr	30.77	Phosphorus Removal Rate gm/sm-yr	24.80

Total Nitrogen Removed kg/month	17,702
Total Phosphorus Removed kg/month	1,787

HYADEM October 300 cfs (194 MGD)		HYADEM October (26.31 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	26.31
Days	2.34	Days	28.66
Average Total Nitrogen (mg/l)	5.08	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	24.68	Average Air Temperature (degrees C)	24.68
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.019	Field Water Hyacinth Growth Rate (1/day)	0.015
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.015	Net Specific Growth Rate (1/day)	0.011
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41	Hydraulic retention time (days)	10.40
Hydraulic Loading Rate (cm/day)	86.37	Hydraulic Loading Rate (cm/day)	11.72
Mean Plant Age days	52.93	Mean Plant Age days	65.99
Average Daily Growth (Wet Tons)	353.3	Average Daily Growth (Wet Tons)	282.8
Average Daily Growth (Dry Tons)	17.7	Average Daily Growth (Dry Tons)	14.1
Average Daily Harvest (Wet Tons)	213.8	Average Daily Harvest (Wet Tons)	159.8
Average Daily Harvest (Dry Tons)	13.9	Average Daily Harvest (Dry Tons)	10.4
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.62**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.511**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.062**
Nitrogen Removal kg/day	667.22	Nitrogen Removal kg/day	426.35
Nitrogen Removal kg/period	1,561	Nitrogen Removal kg/period	12,219
Nitrogen Removal Rate lb/acre-day	7.00	Nitrogen Removal Rate lb/acre-day	4.47
Nitrogen Removal Rate gm/sm-yr	286	Nitrogen Removal Rate gm/sm-yr	183
Phosphorus Removal kg/day	67	Phosphorus Removal kg/day	54
Phosphorus Removal kg/period	158	Phosphorus Removal kg/period	1,546
Phosphorus Removal Rate lb/acre-day	0.71	Phosphorus Removal Rate lb/acre-day	0.57
Phosphorus Removal Rate gm/sm-yr	28.92	Phosphorus Removal Rate gm/sm-yr	23.16

Total Nitrogen Removed kg/month	13,781
Total Phosphorus Removed kg/month	1,703

HYADEM November 300 cfs (194 MGD)	
INPUTS	
Influent Average Daily Flow (mgd)	193.91
Days	0.34
Average Total Nitrogen (mg/l)	5.15
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	21.06
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	1.41
Hydraulic Loading Rate (cm/day)	86.37
Mean Plant Age days	62.73
Average Daily Growth (Wet Tons)	297.7
Average Daily Growth (Dry Tons)	14.9
Average Daily Harvest (Wet Tons)	171.2
Average Daily Harvest (Dry Tons)	11.1
Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**4.76**
WHS™ Effluent Total Phosphorus (mg/l)	**0.526**
Nitrogen Removal kg/day	562.17
Nitrogen Removal kg/period	191
Nitrogen Removal Rate lb/acre-day	5.90
Nitrogen Removal Rate gm/sm-yr	241
Phosphorus Removal kg/day	57
Phosphorus Removal kg/period	19
Phosphorus Removal Rate lb/acre-day	0.60
Phosphorus Removal Rate gm/sm-yr	24.37

HYADEM November (14.95 MGD)	
INPUTS	
Influent Average Daily Flow (mgd)	14.95
Days	29.66
Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	21.06
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.013
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.009
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	18.31
Hydraulic Loading Rate (cm/day)	6.66
Mean Plant Age days	78.74
Average Daily Growth (Wet Tons)	236.8
Average Daily Growth (Dry Tons)	11.8
Average Daily Harvest (Wet Tons)	124.5
Average Daily Harvest (Dry Tons)	8.1
Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.050**
Nitrogen Removal kg/day	242.30
Nitrogen Removal kg/period	7,187
Nitrogen Removal Rate lb/acre-day	2.54
Nitrogen Removal Rate gm/sm-yr	104
Phosphorus Removal kg/day	31
Phosphorus Removal kg/period	929
Phosphorus Removal Rate lb/acre-day	0.33
Phosphorus Removal Rate gm/sm-yr	13.44

Total Nitrogen Removed kg/month	7,378
Total Phosphorus Removed kg/month	948

HYADEM December 300 cfs (194 MGD)		HYADEM December (12.51 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	32.12	Influent Average Daily Flow (mgd)	21.55
Days	1.64	Days	29.36
Average Total Nitrogen (mg/l)	5.21	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	17.72	Average Air Temperature (degrees C)	17.72
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	210	Growing Area (acres)	210
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	18,524	Standing Crop (Wet Tons)	18,524
Field Water Hyacinth Growth Rate (1/day)	0.014	Field Water Hyacinth Growth Rate (1/day)	0.011
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.010	Net Specific Growth Rate (1/day)	0.007
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	8.52	Hydraulic retention time (days)	12.70
Hydraulic Loading Rate (cm/day)	14.31	Hydraulic Loading Rate (cm/day)	9.60
Mean Plant Age days	73.41	Mean Plant Age days	92.67
Average Daily Growth (Wet Tons)	254.0	Average Daily Growth (Wet Tons)	201.0
Average Daily Growth (Dry Tons)	12.7	Average Daily Growth (Dry Tons)	10.0
Average Daily Harvest (Wet Tons)	137.8	Average Daily Harvest (Wet Tons)	97.1
Average Daily Harvest (Dry Tons)	9.0	Average Daily Harvest (Dry Tons)	6.3
Average Daily Sloughing (Wet Tons)	74.2	Average Daily Sloughing (Wet Tons)	74.2
Average Daily Sloughing (Dry Tons)	3.7	Average Daily Sloughing (Dry Tons)	3.7
WHS™ Effluent Total Nitrogen (mg/l)	**1.58**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.205**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.133**
Nitrogen Removal kg/day	479.80	Nitrogen Removal kg/day	349.25
Nitrogen Removal kg/period	787	Nitrogen Removal kg/period	10,254
Nitrogen Removal Rate lb/acre-day	5.03	Nitrogen Removal Rate lb/acre-day	3.66
Nitrogen Removal Rate gm/sm-yr	206	Nitrogen Removal Rate gm/sm-yr	150
Phosphorus Removal kg/day	48	Phosphorus Removal kg/day	38
Phosphorus Removal kg/period	79	Phosphorus Removal kg/period	1,125
Phosphorus Removal Rate lb/acre-day	0.51	Phosphorus Removal Rate lb/acre-day	0.40
Phosphorus Removal Rate gm/sm-yr	20.80	Phosphorus Removal Rate gm/sm-yr	16.45

Total Nitrogen Removed kg/month	11,041
Total Phosphorus Removed kg/month	1,205

APPENDIX F. SLUDGE DRYING OF WASTE WATER & POTABLE WATER - BROWN BEAR EQUIPMENT

Dade County Municipal WWTP - Miami, FL

With an in-flow rate of 200 plus million gallons per day, this WWTP had to find an effective method for sludge disposal, and it has with four Brown Bear paddle aerators. Each aerator unit breaks up and turns up to 3,000 cubic yards of windrowed sludge per hour, greatly reducing drying time over other handling methods. The 66 tons of dried sludge produced daily has been approved by the Florida Dept. of Agriculture as a soil conditioner.

The Bears are used to aerate and dry sludge from 20% solids to 85% solids in about a week's time during hot summer months.

In order to cease occasional odor complaints, two Bears with liquid application systems apply an oxidizer – potassium permanganate – directly to the biosolids as they are aerated.

Municipal WWTP - Phoenix, AZ

Keith Greenberg, assistant WWTP supervisor for the city of Phoenix states, "Bed space is always limited. We needed to dry our sludge to 40% solids to meet our contract with the sludge haulers for easier spreadability." The dried sludge is applied to cotton fields as fertilizer. The city is paying this contractor a hauling fee of $14 per dry ton; significant savings compared to the $100/ton landfill dumping fees found in Phoenix.

Denver Water Company - Denver, CO

Denver Water Company trucks a Brown Bear Model 400 aerator between two of their potable water plants, utilizing it to speed air drying of alum sludge in the summer and to facilitate freeze drying of the alum sludge in the winter. It is possible to take the alum sludge from a solids content of less than 10% to a solids content of over 70% in only a few days using the freeze dry method and the Brown Bear paddle aerator.

Manatee County Public Service – Bradenton, FL

The Manatee County Public Service Dept. operates the potable water plant, serving the city of Bradenton, Florida and all of Manatee County. Alum sludge is a residual material left from the water treatment process and is a problem for most potable plants to dispose of. In the past, landfills would accept the wet alum sludge, but due to landfill space confinements wet sludges are no longer acceptable in most landfills. Additionally, the cost of transportation of wet sludge is very substantial. Manatee's potable water plant was experiencing problems in drying the alum sludge to a landfill acceptable state. The potable water plant now utilizes a Brown Bear Model SC4912 paddle auger which is mounted on a JD 644E articulating front-end loader. The aerator is used to accelerate the drying process, as much as four times faster than non aerated drying, drying the alum sludge to 70% solids. Transportation costs to the landfill are substantially reduced and the dried material is used as daily cover at the landfill.

APPENDIX G. HYDROMENTIA PATENTS

Algal Turf Scrubber® (ATS™)

Patent No. 4,333,263 – Algal Turf Scrubber®

Patent No. 4,966,096 - Water Purification System and Apparatus

Patent No. 5,097,795 - Water Purification System and Apparatus

Patent No. 5,527,456 - Apparatus for Water Purification by Culturing and Harvesting Attached Algal Communities (License Rights Granted to ABES)

Patent No. 5,573,669 - Method and System for Water Purification by Culturing and Harvesting Attached Algal Communities (License Rights Granted to ABES)

Patent No. 5,715,774 - Animal feedstocks comprising harvested algal turf and a method of preparing and using the same

Patent No. 5,778,823 - Method of raising fish by use of algal turf

Patent No. 5,851,398 – Algal turf water purification method

Patent No. 6,572,770 – Apparatus and Method for Harvesting and Collecting Attached Algal Communities

Water Hyacinth Scrubber (WHS™)

Patent No. 5,811,007 - Vascular Plant Aquaculture and Bioremediation System and Method

Patent No. 5,820,759 – Integrated aquaculture and bioremediation system and method

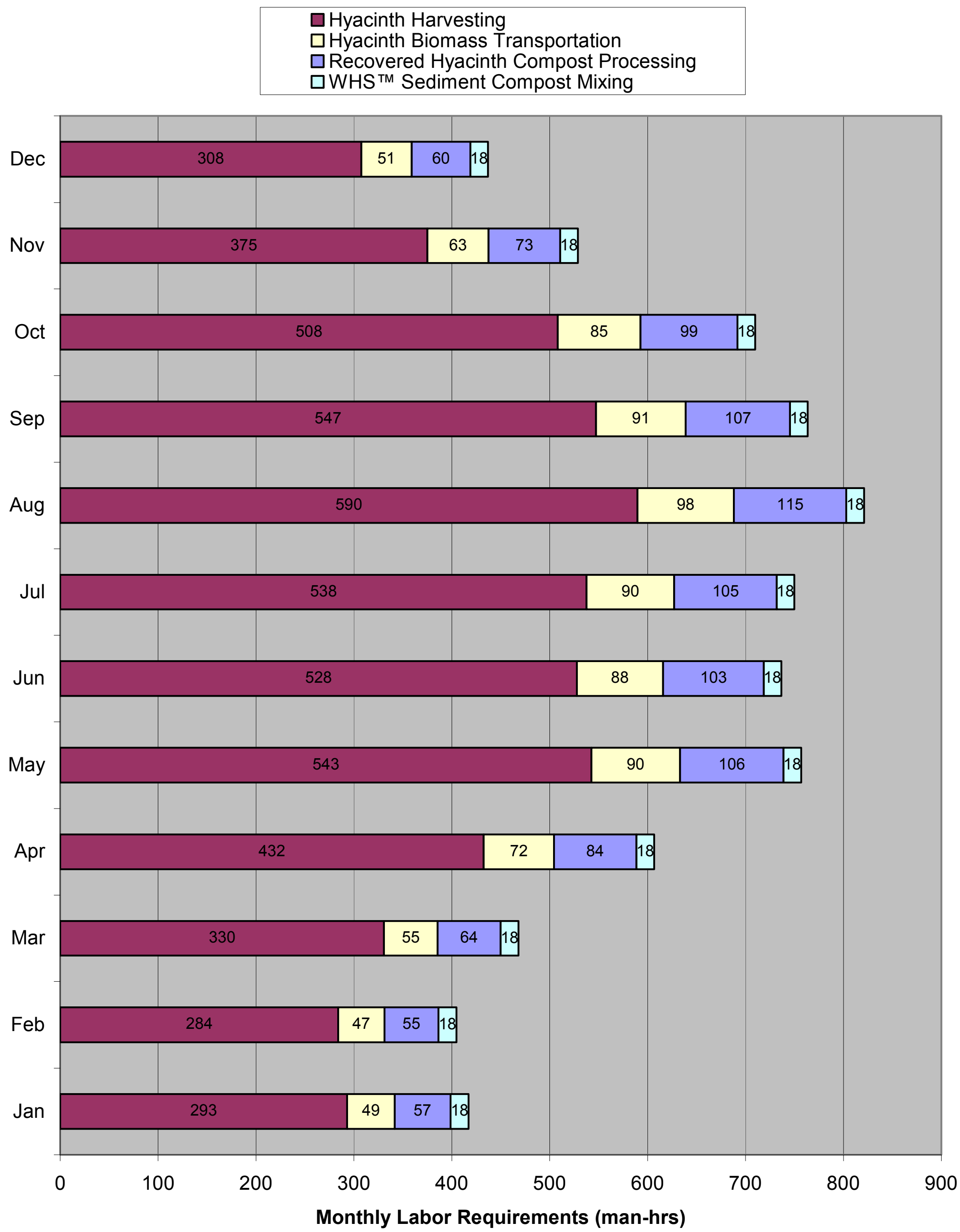
Patent No. 6,393,812 – Method and apparatus for gathering, transporting and processing aquatic plants.

Patent No. 6,732,499 – Method and apparatus for gathering, transporting and processing aquatic plants.

APPENDIX F. OPERATING COST CALCULATIONS

Labor:
It is projected that the project can be operated by a lead operator and four field operators, excluding maintenance of the District's Pump Station. All five would be full time.

Labor distribution for WHS™ facility operation for primary operational tasks are provided below:



Equipment Maintenance:

The projected equipment maintenance is 2% of the equipment costs, with equipment cost projected at $899,300.

Road maintenance will involve grading and fill supplementation of the compacted dirt roads, as well as maintenance of the paved entrance road.
This is projected at $40,000/year, which would cover a grader and operator on site biweekly.

Building maintenance is set at $6,000/year.

Nematodes for control of the hyacinth weevil requires about $500/acre-yr.

Within the present analysis, the "Best Case" scenario considers finished compost/organic fertilizer being sold at the rate of $20/ton FOB the facility.

For the "Worst Case" scenario, finished compost/organic fertilizer is transported to a local landfill at a rate of $5.00/ton hauling cost plus a landfill tipping fee of $20.50/ton.

Removal of solids from the WHS™ unit will be performed quarterly. Costs provided include mobile dredging unit diesel power.

Fuel usage estimates for the WHS™ Facility are as provided below:

Category	Equip	Hp	Fuel Usage (gal/hr)	No of Units	Total Fuel Usage Per Hour	Annual Usage (hrs)	Total Fuel Usage (gals)
Hyacinth Harvest [1]	John Deere 7420	120	3.4272	2	6.8544	5,276	36,161
Hyacinth Transportation	John Deere 7420	120	5.712	1	5.712	879	5,022
Compost Mixing	Valtra 170	170	8.092	1	8.092	1,028	8,315
Sediment Mixing	Valtra 170	170	8.092	1	8.092	217	1,757
							51,256
					20% Misc (Loading Etc.)		10,251
							61,507

NOTES:
1. Hourly fuel consumption rate for hyacinth harvest reduced as equipment operating at near idle speeds.
2. For fuel usage multiply hp by 0.0476 gal/hp-hr. Grisso, R.D., M.F. Kocher and D.H. Vaughan. 2004. Predicting Tractor Fuel Consumption. Applied Engineering in Agriculture. Volume 20(5)

Electrical energy will be associated with the 175 hp of aerators. These will run typically at about 1/3 of capacity during the year, with the heaviest use in the hottest summer days. The kwh/yr is estimated at about 400,000.

Total Annual Operating Costs therefore are as follows:

The “Best case” projection is $565,166/yr
The “Worst case” projection is $971,527/yr

The table attached below shows these costs.

ANNUAL O&M COSTS

		Unit	Rate	Quantity	Cost	Total Category Cost
Labor						
Sitework						
Field Operator		hrs	$ 35.00	8,320	$ 291,200	
Lead Operator		hrs	$ 60.00	2,080	$ 124,800	
						$ 416,000
Maintenance						
Equipment						
Equipment	2% of Equipment Costs	2% EC	2%	899,300	$ 17,986	
Site						
Building		per unit	$ 6,000	1	$ 6,000	
Road Maintenance		lump sum	$ 40,000	1	$ 40,000	
						$ 63,986
Chemicals and Pest Control						
Pest Control						
Nematodes		$/acre-yr	$ 500	200	$ 100,000	
						$ 100,000
Laboratory Costs (ATS™ & WHS™ Systems Only)						
WHS™						
Laboratory Costs (Per Parsons)		lump sum	$ 30,000	1	$ 30,000	
Misc Samples		lump sum	$ 1,000	1	$ 1,000	
						$ 31,000
Energy						
Electricity						
Aeration, Pumps and Building		kwh	$ 0.08	430,000	$ 34,400	
Fuel						
Diesel		gallons	$ 1.60	61,500	$ 98,400	
Gasoline						
						$ 132,800
						$ 743,786
Residual Management						
Compost/Organic Fertilizer Disposal "Worst Case"						
Compost Transportation		tons	$ 5.00	8,931	$ 44,655	
Compost Disposal (Tipping Fee)		$/ton	$ 20.50	8,931	$ 183,086	
						$ 227,741
Compost/Organic Fertilizer Disposal "Best Case"						
Sales From Composting		$/ton	$ (20.00)	8,931	$ (178,620)	
						$ (178,620)
				Best Case		$ 565,166
				Worst Case		$ 971,527

APPENDIX H. REFERENCES

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Appendix D2
Lake Hancock Outfall
MAPS Nutrient Recovery Facility
Conceptual Plan

Single Stage WHS™ Facility
Revision 3 - May 2005

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Lake Hancock Outfall

MAPS Nutrient Recovery Facility Conceptual Plan

Single Stage WHS™ Facility

Revision 3 – May 2005

Vendor Proposal Prepared for:

Wetland Solutions Inc. / Parsons

Southwest Florida Water Management District

HydroMentia

HMI Water Treatment Technologies

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Table of Contents

1.0 PROPOSAL SUMMARY

Provided is a proposal for a Lake Hancock Water Hyacinth Scrubber (WHS™) Nutrient Recovery Facility to annually remove 80,801 kilograms of nitrogen from the Lake Hancock Outfall upstream of the P-11 structure within Saddle Creek.

This proposed WHS™ Nutrient Recovery Facility represents two levels of revisions. The first revision, submitted January 2005, was developed to accommodate updated design conditions, the most relevant being the need to manage fluctuating flows at the P-11 outfall. This second revision is an elaboration upon the January submittal, which includes technical and costing updates which evolved from a series of comments from Dr. Tory Champlin after review of the January submittal, and a resulting discussion between HydroMentia, Parsons, and Southwest Florida Water Management District (SWFWMD) staff in Tampa on February 14, 2005. The submitted comments are included in this document as Appendix A, and are addressed within this text. As appropriate, the comments will be referenced throughout the document at the point of reply.

The proposed WHS™ Nutrient Recovery Facility will be constructed on 151 acres of the approximately 3,400 acres of land purchased by the SWFWMD adjacent to the eastern and southern shores of Lake Hancock. The facility will remove 80,801 kg of nitrogen per year from the incoming flows, or 27.9% of Lake Hancock nitrogen discharges.

WHS™ CAPITAL CONSTRUCTION COSTS

- Capital costs for the proposed WHS™ Nutrient Recovery Facility are $9,022,000 with design revisions as requested by Parsons, to include the use of imported fill for facility construction.

WHS™ ANNUAL OPERATING COSTS

“Best-Case” Scenario

- Annual operating costs of $526,000 are projected for the “Best-Case” scenario, which includes $56,000 in revenue from the sale of processed compost/organic fertilizer.
- At a discount rate of 5.625%, an inflation rate of 3%, and exclusion of lands costs, the 50-year estimated total “Present Worth” cost per mass unit removal for the subject facility for the “best-case” scenario is <u>$4.98 per pound of nitrogen removed</u>.

“Worst-Case” Scenario

- Annual operating costs of $653,000 are projected for the “Worst-Case” scenario, which includes $71,000 in costs to landfill the processed compost/organic fertilizer.
- At a discount rate of 5.625%, an inflation rate of 3%, and exclusion of lands costs, the 50-year estimated total “Present Worth” cost per mass unit removal for the subject facility for the “best-case” scenario is <u>$5.41 per pound of nitrogen removed</u>.

> Note: Because the small footprint of the WHS™ Treatment Facility takes up only 151 acres, estimated revenues from the sale of surplus lands thus not required to be used for water treatment can be used to offset the cost of construction and some years of operation of the WHS™ Treatment Facility.

Annual operating costs within this proposal are based on a maximum flow of 300 cfs (194 MGD); with an average daily flow (ADF) of about 49.70 cfs (32.12 MGD). It should be noted that operational costs for the WHS treatment system are not fixed, but fluctuate with actual treatment system flows and pollutant recovery rates.

The WHS™ was originally offered as an alternative to a two-stage WHS™-ATS™ (Algal Turf Scrubber®) system, and was developed in response to information provided by Robert Knight, PhD, of Wetland Solutions Inc. (WSI), and later revised in response to information provided by Dr. Champlin of Parsons. The preparation and submission of this single-stage WHS™ proposal should in no way be interpreted as a change in HydroMentia's original recommendation for a WHS™ - ATS™ integrated system. However, after being provided clarification in the nature of sequencing of hydraulic loads, HydroMentia does, under these provisions, recommend a single-stage WHS™ as the preferred managed aquatic plant system (MAPS) approach for meeting the water quality requirements associated with the present scenario associated with the Lake Hancock Outfall Nutrient Recovery Program.

2.0 INTRODUCTION

COMPANY AND TECHNOLOGY

HydroMentia Inc., (www.hydromentia.com) is a water pollution control company specializing in the design and operation of advanced water treatment technologies in which treatment is performed and pollutants are recovered within proprietary MAPS. The HydroMentia Team pioneered and has dedicated its efforts for nearly three decades to the development of its Algal Turf Scrubber® (ATS™) and Water Hyacinth Scrubber (WHS™) treatment technologies. HydroMentia staff, with nearly 75 years combined experience, includes several of the nation's leading experts in the design and operation of commercial scale MAPS.

HydroMentia has developed and refined specific equipment for harvesting and processing of water hyacinths. General descriptions and specifications are provided as Appendix B (see Comments 11 and 12 within Appendix A). HydroMentia also has experience in the utilization and processing of water hyacinths and water hyacinth residuals, both as compost (mesophilic/thermophilic aerobic windrows process) and as cattle feed ingredient, both as a green chop product and as a dried product. During the course of a recent project done jointly with the South Florida Water Management District (SFWMD), the Florida department of Environmental Protection (FDEP and the Florida Department of Agriculture and Consumer Services (FDACS)—Grant No. C-13933—HydroMentia designed, constructed, and operated for over two years, a prototype facility near the City of Okeechobee. This facility is referenced throughout this document as the S-154 MAPS prototype, or simply the S-154 facility. During the course of operations of this facility, HydroMentia delivered over 600 wet tons of chopped water hyacinths to a local dairy—McArthur Farms—where it was blended with other feed ingredients and fed to dairy cattle. In addition, during the course of operation of the S-154 facility, HydroMentia composted harvested and processed water hyacinths, and other residuals, included sediments associated with the WHS™ units.

REQUEST FOR QUOTE

On September 1, 2004 HydroMentia received a memorandum from Robert L. Knight PhD of Wetlands Solutions, Inc. (WSI) entitled **Lake Hancock Alternative Conceptual Treatment System Plan Foundation—Request for Harvested Aquatic Plant Based System for Nutrient Removal**, which included a request for a comprehensive quote for application of HydroMentia's Managed Aquatic Plant Systems (MAPS) as a method of nitrogen reduction within waters discharged into the Peace River from Lake Hancock, located in Polk County, Florida. Summarized within this memorandum were design conditions and treatment requirements associated with the planned program. Lake Hancock is identified as a large (4,500 acre) hypereutrophic lake, which releases highly nutritive waters into the Peace River—a major tributary to the protected estuarine waters of Charlotte Harbor on Florida's gulf coast. (The Peace River also serves as a drinking water source for a significant segment of Southwest Florida's population.)

In response to the request, HydroMentia prepared and submitted a comprehensive document entitled Lake Hancock Outfall MAPS Nutrient Recovery Conceptual Plan September 2004. Comments subsequent to that submittal, made on September 30, 2004, and as generated following a meeting between HydroMentia and WSI on September 30, 2004, in HydroMentia's office in Ocala, Florida, are summarized as follows:

- WSI staff expressed concern related to the significant reliance upon ATS™, and offered a suggestion "that you [HydroMentia] also outline the sizing, estimated performance, and associated costs of a water hyacinth nitrogen removal system".
- Include greater detail about the deposition of solid by-products, and
- Evaluate the system on a 50 year rather than 20 year basis, to include replacement costs.

An alternate proposal was prepared and submitted in response to these comments. In addition, the original proposal was adjusted, and submitted a second time as an upgraded quote intended to address the issues of concern as listed.

Both proposals were prepared and offered to provide information needed to initiate an objective comparison of various technologies and process configurations. The process scenario as outlined within these documents included 1) The use of an initial WHS™ treatment, followed by an ATS™ process for final treatment and 2) the sole application of the WHS™ technology, which serves as a settling and nutrient uptake unit. Nutrient removal is largely by direct plant uptake and subsequent harvesting, with the smaller percentage of removal to be through sedimentation of sloughed solids, denitrification, ecological dynamics, and other processes. It is important to recognize that this process arrangement is but one possible application of the MAPS technologies, and that various alternative arrangements in coordination with other unit processes, such as filtration, chemical enhanced settling, and marsh floway or treatment wetlands may be considered.
.
Subsequent to these submittals, the documents were reviewed by Tory Champlin, PhD, P.E., the senior project manager for Parsons of Tampa, Florida—the engineering group serving through contract with the South West Florida Water Management District (SWFWMD) to develop the Lake Hancock project. In a discussion with Dr. Champlin and his staff, revisions were made to the design conditions, and on January 5, 2005 a request was made to modify the two proposals to include adjustments associated with these new conditions.

The most important and influential of these new conditions, in terms of facility sizing, was the need to accommodate the historical fluctuations in flows from Lake Hancock, into Saddle Creek (and eventually into the Peace River) while ensuring the systems provide 45% reduction of annual total nitrogen loads associated with these flows. This is a significant deviation from the conditions used in the previous proposals, in which flows were assumed to be maintained at a rather constant rate by a pumping system that withdrew water upstream of the Saddle Creek control structure, P-11. In other words, in the first set of proposals, it was assumed that Lake Hancock could serve as an equalization basin, while in the new set, the use of the lake in this capacity is not considered, and treatment must be provided as flow is discharged from the lake. This requires a much more extensive review of historical flow patterns, which is discussed in detail within this proposal.

The revised proposal (Revision 2) was submitted to Parsons in February, 2005. On May 3, 2005, Dr. Champlin, contacted HydroMentia with a request to revise the prior proposal to include adjustment of facility sizing to accommodate a 27% annual total nitrogen removal from the same influent scenario. This third revision proposal was prepared to address these new conditions.

3.0 SYSTEM DESIGN PROVISIONS AND ASSUMPTIONS

In addition to the conditions included within the original request for quote, HydroMentia was provided further clarification by Dr. Champlin regarding other items related to cost and technical issues via a series of emails from 1/5/05 through 1/7/05, and the recent telephone communication of 5/03/05 related to the percent nitrogen removal adjustment. These items included adjusted water quality provisions, as well as engineering and economic conditions and aerials of the potential sites.

The following provisions and assumptions are applied throughout this document:

1. Water to be treated is the controlled discharge from Lake Hancock at or near the structure identified as P-11.

2. Discharged water shall be delivered to the proposed MAPS facility via a pump station to be constructed owned and operated by the SWFWMD.

3. The proposer shall determine the capacity and flow rates of this pumping station based upon historical flow conditions at P-11 as provided within a data set delivered by Dr. Champlin.

4. The average total nitrogen concentration, calculated as the sum of nitrate-nitrogen and nitrite-nitrogen (NO_x-N) and total Kjeldahl nitrogen (TKN), which is the sum of total organic nitrogen (TON) and ammonia-nitrogen, is 5.53 mg/l.

5. The removal requirement for nitrogen is reduction of this load by 27% as a minimum on an annual basis, or a total annual reduction of nitrogen of no less than 80,541 kg, which represents 27% of the average annual total nitrogen load of 289,300 kg, when it is assumed that there is no discernible relationship between the rate of flow delivery and total nitrogen concentration, and that the rate of change in loads parallels the rate of change in flows delivered.

6. Of the total nitrogen load, 72% is in particulate form, with this particulate form being essentially all TON. This particulate TON annual load is therefore assumed to be about 208,300 kg. The remaining nitrogen load is largely dissolved TON, with a small percentage (<1.0%) as ammonia-N and NO_x-N.

7. Total phosphorus concentration averages 0.603 mg/l or 603 ppb, with 92% of the total phosphorus load as particulate phosphorus with only 2.2% of the total phosphorus as ortho-phosphorus.

8. There is no numerical reduction target for total phosphorus, but it is identified as an element of concern and projected reductions will be provided.

9. Total suspended solids appear to have increased significantly over recent times, with the most recent data indicating an average of 115 mg/l, as compared to modern STORET data indicating an average of 70 mg/l. For purposes of this submittal, the average value of 115 mg/l will be used.

10. There is no numerical reduction target for total suspended solids, but it is identified as a parameter of concern and projected reductions will be provided.

11. Discount rate used for “present worth” analysis is 5.625% per Section 80 of PL 93-251. The life period for the “present worth” analysis shall be 50 years, based upon 2004 dollars.

12. Inflation rate has been assigned as 3% annually per Dr. Champlin.

13. The site to be selected shall have a mean high groundwater no less than 3 feet below ground surface, and shall contain no existing wetlands or other environmentally sensitive features.

14. Costs exclude any additional expenditures which might be associated with extensive demucking and removal of buried organic debris, or unsuitable subsurface condition e.g. sink holes, unconsolidated clays, etc.; any toxic, hazardous or dangerous materials that may have been deposited on or near the site; presence of threatened, endangered or species of special concern; prolonged public opposition to the siting; or Acts of God or other activities beyond the control of HydroMentia. However, based upon discussions on February 14, 2005 with Dr. Champlin et al., the second and third revision include consideration of the WHS™ unit berms to be constructed of imported material. The reason for these considerations is related to the presence of phosphatic clays near the ground surface, and the concerns related to interruption of these clays during pond construction; their behavior in terms of potential release of colloidal solids should they be exposed directly to the water column within the ponds; the difficulties in excavating and compacting these clays should they be used in pond bottom and berm construction; the question of the actual depth of overburden over these clays; and the issue of possible release of other pollutants from disturbed clays.

15. Replacement of equipment and material items shall be twenty years for tractors, loaders, conveyors, choppers and mixers; geotech matrix; pumps; automatic rakes and fifty years for HDPE (High Density Polyethylene) geomembrane.

16. Construction contingency shall be 20% of equipment, labor and material costs associated with construction. Mobilization/Demobilization shall be 5%; Construction Permits 1%; Bonding 1%; and Insurance 1% of these same costs.

17. Sales tax shall be 7% of the equipment and material costs associated with construction.

18. Engineering and design costs shall be 25% of the total construction costs, which is the sum of equipment, materials, labor, contingency, mobilization/demobilization, construction permit costs, bonding, insurance and sales taxes.

19. "Present worth" shall mean the long term total cost of the project as the sum of all initial capital costs <u>excluding</u> land costs; annual operating costs adjusted for 50 continuous years to represent one present cost investment required at the selected interest rate to ensure sufficient funds are available for each annual period; replacement costs to represent one present cost investment required at the selected interest rate to ensure sufficient funds are available at the time replacement is needed; demolition costs at the end of the 50 year period to represent one present cost investment required at the selected discount rate to ensure sufficient funds are available at the end of the project; land salvage at the end of the project to represent monies as one present cost income equivalent to the represented funds related to the land sale at the selected interest rate, with land prices unchanged from initial purchase price. (**Note: HydroMentia has been instructed within the revised proposal to exclude land purchase and demolition costs, as well as land salvage costs from the present worth calculation. By eliminating land costs and other factors the present worth analysis is not consistent with Federal guidelines as delineated within Circular A-94**[1] **and the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*.**[2] **Therefore, this economic review as modified, may be more correctly defined as a customized long-term economic analysis, rather than a true present worth analysis. However, to avoid confusion within the text, the term present worth or present value will be applied, but will be in quotation marks.**)

20. The "present worth" cost-effectiveness shall be based upon $/lb-N removed (or phosphorus), and shall be the total 50 year "present worth" cost divided by the total lb of nitrogen (or phosphorus) projected to be removed over that 50 year period. This "present worth" cost-effectiveness unit shall not be interpreted as a proposed fee for implementation of the process.

21. Fees, profits and licenses for all proprietary technologies for the subject facility are included in the quote, and are appropriately identified, as requested (see Comment A8(n) of Appendix A).

22. Dr. Champlin has provided specific unit costs to be applied to the project, including a cost per linear foot for the planned WHS™ berms, soil cement, etc. which are included in the cost details provided in Appendix C (Comment A8(b) of Appendix A.)

4.0 TECHNICAL REVIEW AND FACILITY SIZING AND LAYOUT

ASSESSMENT OF WATER QUALITY

Based upon initial information submitted by WSI, and subsequent data provided by Parsons through Dr. Champlin, and from existing water quality information such as the ERD Report entitled **Lake Hancock Water and Nutrient Budget and Water Quality Improvement Project** (2000), the water associated with Lake Hancock may be described as a soft, low alkalinity, nutrient laden water characterized by extensive, quasi-continuous blooms of phytoplankton resulting in reduced light penetration, diurnal fluctuations in pH and dissolved oxygen attendant with high levels of photosynthesis, followed by nocturnal periods of high respiratory demands. The mass ratio of total nitrogen to total phosphorus oscillates around 9.2:1, indicating a biologically acceptable balance in terms of capability to support active productivity. The alkalinity is comparatively low, typically around 55-65 mg/l as $CaCO_3$, indicating rather limited buffering capability and modest levels of available carbon within the water column. Therefore, pH levels are noted to be quite high in the afternoon as carbon dioxide, bicarbonate and even carbonate are consumed by the primary producers within the water column, resulting in a shift towards increased hydroxide alkalinity. At night this shift is driven towards a lower pH as carbon dioxide is released during respiration.

As noted, most of the nitrogen and phosphorus are present in particulate form. Accordingly, the suspended solids are quite high, now averaging about 115 mg/l. With the average total nitrogen at 5.53 mg/l, and the particulate nitrogen at about 3.97 mg/l, it is noted that the suspended solids average about 3.46% total nitrogen. Accordingly, the total particulate phosphorus (mostly organic) is about 0.55 mg/l, indicating the suspended solids are about 0.5% phosphorus. These percentages are within the ranges expected for plant tissue within moderately high nutritive conditions, indicating the suspended solids component is mostly composed of phytoplankton, which was also noted by ERD in their 2000 report.

HydroMentia staff reviewed STORET data for Lake Hancock related to calcium, magnesium and potassium, which are essential to the support of highly productive plant crops such as water hyacinths and periphytic algae. The average concentration of calcium, magnesium and potassium were about 26, 8 and 2.5 mg/l, respectively. These are acceptable levels to ensure sufficiency for the working standing crops. Iron, another essential element was not represented within the STORET data, but it would be expected that it would be available in sufficient quantities. It is recommended that a pilot study be conducted to establish the specific performance of water hyacinths when this particular water source serves as a feed source. More detail related to such a study is included in subsequent sections within this quote.

It has been HydroMentia's experience in dealing with such hypereutrophic waters that a major portion of phytoplankton under certain conditions, will settle, and accordingly deteriorate (lyse), thereby releasing intercellular material, including nitrogen and phosphorus to the water column. Similar observations were noted by Gopal et al. (1984)[3], who found significant reductions in phytoplankton within hypereutrophic waters as they were introduced into water hyacinth lagoons. Fisher and Reddy (1987)[4] also documented extensive reduction in phytoplankton within waters associated with Lake Apopka in Florida, noting that within harvested hyacinth systems, with a hydraulic retention time of 1.5 days the nitrogen removal was 54% of the incoming load, as opposed to 39% for a system with no hyacinths. Within the harvested system, they documented about 30% of the removed nitrogen as being contained within new plant tissue, with 61% in the sediments, and the remaining 9% unaccounted for, likely associated with denitrification, ammonia volatilization and larval emergence.

Within this proposal plant uptake is assigned a greater role in the reduction of nitrogen—about 78% of the removed nitrogen, with 22% as sedimentation. This ensures a conservative assessment of operational costs, as it can be expected that somewhat greater efforts may be associated with the harvesting and processing of water hyacinths, as compared to management of the sediments. The proposed pilot study will allow documentation of these ratios—plant uptake Vs. sedimentation—within the specific conditions associated with the Lake Hancock feedwater. The Lake Hancock nutrient loads, while particulate, are expected to be labile and rendered biologically available once the integrity of the phytoplankton biomass is challenged.

In their recent studies on Lake Hancock, ERD found a significant reduction (circa 50%) of nitrogen and even greater reduction in Chlorophyll-a with 9 hours of detention within a settling lagoon under shaded conditions. This is similar to the behavior of hypereutrophic waters within WHS™ systems noted by HydroMentia's staff, as well as by Fisher and Reddy (1987) and others.

WHS™ systems have been documented throughout the literature as promoting significant reduction of total suspended solids (TSS) as well as 5-day biochemical demand (BOD_5). Dinges (1979)[5] found both TSS and BOD_5 reductions to exceed 80% when hyacinth lagoons were used for treating primary domestic wastewater effluents. McDonald and Wolverton (1980)[6] found similar performances, with TSS reductions at 100% plant coverage amounting to 95%, with influent concentrations at 125 mg/l and effluent concentrations at 6 mg/l. In this same system BOD_5 was reduced from 161 mg/l to 23 mg/l or 86% removal. Hayes et. al (1987)[7] working with hyacinth lagoons in Orlando, Florida, found a correlation between BOD_5 areal loading with areal removal, with loadings of about 350 lb/acre-day resulting in a removal of approximately 267 lb/acre-day, or 76% removal. They also developed a linear equation for the reduction of total suspended solids within these hyacinth systems, $y = 0.645t+10.75$, where t is hydraulic retention time in days, and y is the effluent TSS concentration in mg/l.

One of the most effective means, therefore, of challenging the integrity of extensive phytoplankton production is through a combination of shading and intra-specific competition. Both can be provided by a number of vascular aquatic plants, with water hyacinths, a floating aquatic, perhaps the most studied and effective. Within the presence of an established water hyacinth crop, phytoplankton will be effectively attenuated, largely through shading, but also through competition for nutrients and perhaps through allelopathic responses.

Attendant with the large suspended solids load associated with the Lake Hancock outfall, is a moderate BOD_5 load, with an average BOD_5 of about 18 mg/l. From review of some of the more recent STORET data, it is estimated that the TOC averages close to 20 mg/l, indicating relatively labile organic carbon, as might be expected with the predominance of phytoplankton. However, the TSS:BOD ratio indicates about 6.5 pounds of solids to yield 1 pound of BOD, which implies some recalcitrant organic compounds; a low carbon content within the suspended solids; or a significant nitrogenous or 28-day carbonaceous demand—the later being perhaps the most likely. Similarly, from the STORET data, it appears COD averages about 150 mg/l, indicating a BOD:COD ratio of close to 9:1, again indicating some recalcitrance, perhaps associated with the high nitrogenous demand and resistant organic carbonaceous compounds An extended BOD test period will provide better insight into the extent of the oxygen demand associated with nitrogenous and recalcitrant compounds within this water source.

ESTABLISHING DESIGN FLOWS AND LOADS

As noted, HydroMentia was provided a data set by Dr. Champlin, in which were listed dates and flows, identified to be from the P-11 structure, representing discharges from Lake Hancock to Saddle Creek. The data set is from the time period 1/1/75 through 12/31/03. In an initial, somewhat cursory review of the data, HydroMentia developed the loading ranges for the 29-year period as noted in Table 1. Shown in Appendix D are the individual monthly composite distribution of flow rates and loading rates as calculated by HydroMentia. In the February 14, 2005 meeting with Dr. Champlin et al., it was noted that there were some differences between the HydroMentia averages, and those developed by Parsons. The difference, for example, for the average daily flow was 37.9 MGD (Parsons) as compared to 40.4 MGD HydroMentia, and 289,300 kg/yr annual nitrogen load (Parsons), as compared to 308,690 kg/yr (HydroMentia.) In the meeting is was recognized that the discrepancies are likely related to minor mathematical adjustments (such as rounding), and that it would be in the best interest of the evaluation process to adjust to the Parson values (see initial statement in Appendix A.). Consequently, the design parameters have been adjusted accordingly, through interpolation and are shown as Table 2. Included in Table 2 are the design parameters based upon a strategy to capture all flows at or below 300 cfs or 194 MGD. For all flows greater than 300 cfs, that portion greater than 300 cfs would be by-passed. As noted, this strategy results in the capture of about 85% of the flows and loads. The captured nitrogen load is estimated at 245,607 kg/yr. If the removal requirement of 80,541 kg/yr is to be satisfied, at least 32.8% removal of the captured nitrogen is necessary.

Table 1: Twenty-nine year (1975 through 2003) flow and loading trends as calculated by HydroMentia

n=10592
TN = 5.53 mg/l
TP = 0.603 mg/l

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg
0-2.5	6009	3,274	0.25%	0.25%	22,339	292
2.6-5	344	2,430	0.19%	0.43%	16,580	217
5.1-7.5	231	2,852	0.22%	0.65%	19,463	254
7.6-10	162	2,824	0.22%	0.87%	19,270	252
10.1-15	147	3,847	0.29%	1.16%	26,251	343
15.1-20	160	5,926	0.45%	1.61%	40,434	529
20.1-25	155	7,184	0.55%	2.16%	49,017	641
25.1-30	86	4,743	0.36%	2.52%	32,366	423
30.1-35	67	4,404	0.34%	2.86%	30,047	393
35.1-40	66	5,010	0.38%	3.24%	34,183	447
40.1-50	142	8,159	0.62%	3.86%	55,674	728
50.1-100	771	114,481	8.72%	12.58%	781,136	10,213
100.1-200	1043	292,397	22.27%	34.85%	1,995,110	26,085
200.1-300	576	279,043	21.25%	56.11%	1,903,992	24,894
300.1-400	286	193,853	14.77%	70.87%	1,322,720	17,294
400.1-500	163	144,978	11.04%	81.91%	989,230	12,934
500.1-600	77	84,313	6.42%	88.34%	575,292	7,522
600.1-700	45	57,551	4.38%	92.72%	392,690	5,134
700.1-800	42	61,860	4.71%	97.43%	422,086	5,519
800.1-900	15	24,512	1.87%	99.299%	167,254	2,187
900.1-1000	5	9,205	0.70%	100.000%	62,807	821
	TOTALS	**1,312,845**			**8,957,940**	**117,121**

AVERAGES	
Flow acre-ft/yr	**45,241**
Flow MGD	**40.39**
Total Nitrogen kg/yr	**308,690**
Total Phosphorus kg/yr	**4,036**

Table 2: Summary of 29-year monthly flow and load averages, and projected system capture adjusted to conform with values provided by Dr. Tory Champlin of Parsons.

Month	Average Total Monthly Flow MGD	Average Captured Monthly Flow MGD	Maximum Influent Flow Rate MGD (cfs)	Days at Maximum Flow Rate	% Flow Capture	Total Monthly Nitrogen Load kg	Captured Monthly Nitrogen Load kg
January	42.17	30.90	194 (300)	2.51	73.29%	27,278	20,034
February	31.83	27.25	194 (300)	1.48	85.62%	18,580	15,957
March	38.73	30.54	194 (300)	1.74	78.85%	25,049	19,796
April	30.35	27.15	194 (300)	1.50	89.46%	18,981	17,032
May	11.84	10.71	194 (300)	0.37	90.46%	7,617	6,943
June	22.13	21.11	194 (300)	0.82	95.38%	13,825	13,242
July	48.50	45.12	194 (300)	1.86	93.03%	31,387	29,253
August	68.89	58.26	194 (300)	3.24	84.56%	44,605	37,767
September	66.75	56.32	194 (300)	3.92	84.37%	41,823	35,335
October	44.47	38.96	194 (300)	2.34	87.63%	28,769	25,261
November	17.66	16.98	194 (300)	0.34	96.14%	11,023	10,654
December	31.50	22.11	194 (300)	1.64	70.19%	20,361	14,332
Summary	37.90	32.12		21.76	84.74%	289,300	245,607

WHS™ UNIT SIZING AND CONCEPTUAL DESIGN

HydroMentia proposes a single stage WHS™ system as a Lake Hancock MAPS Nutrient Control System. The single-stage WHS™ system as proposed will provide the following benefits:

1. The WHS™ provides a means for attenuating the phytoplankton load through shading, settling and interspecific competition. The high nitrogen load solicits high levels of water hyacinth productivity and accordingly, relatively high rates of removal.

2. The WHS™ conditions the water quality by :

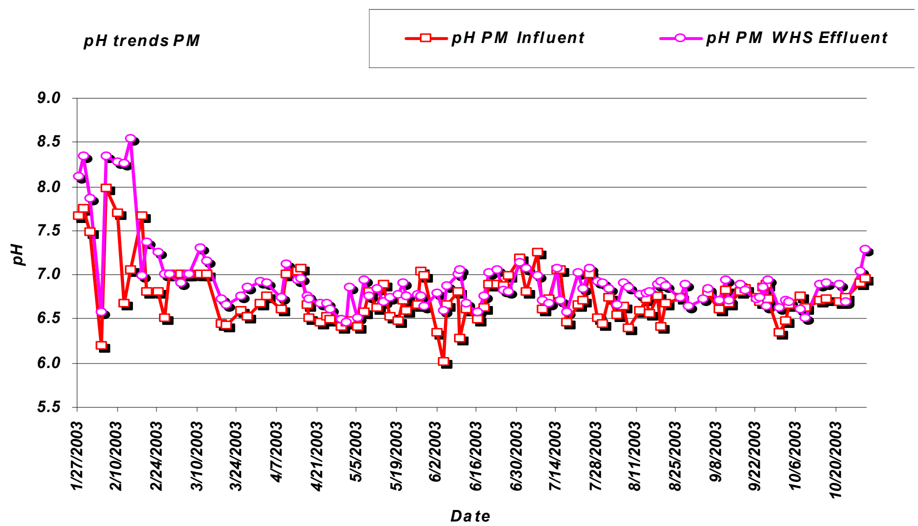
    a. Reducing the organic solids loads and facilitating conversion of organic nitrogen to more available forms, largely through lysing of the algal cells associated with the heavy phytoplankton load.

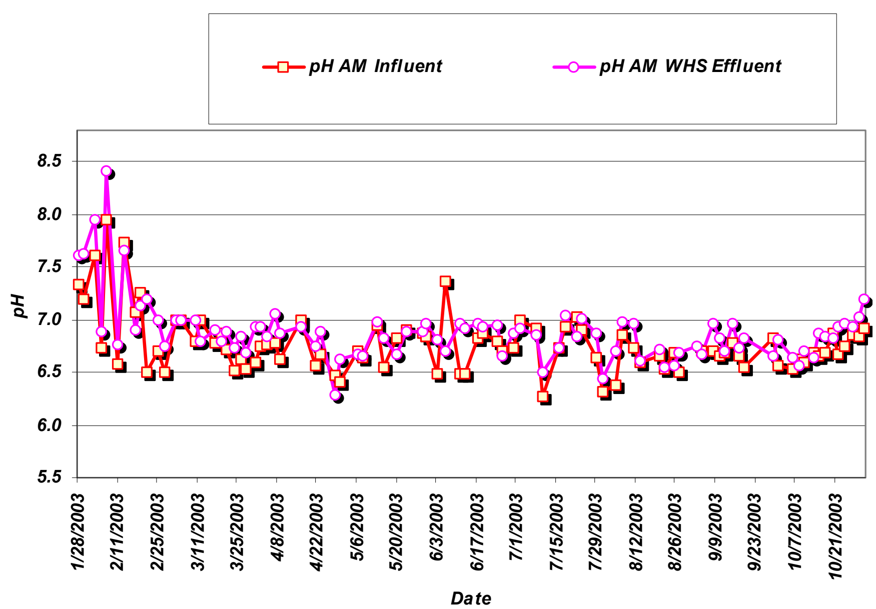
    b. Direct plant uptake of the nutrients nitrogen and phosphorus, and the subsequent recovery of these nutrients through crop harvesting and processing into fertilizer/compost products. These by-products can then be removed from the watershed, thereby avoiding extensive storage within the Lake Hancock watershed, or substituted for imported fertilizer products, thereby reducing nutrient imports into the basin.

    c. Reducing biodegradable organic loads, as well as reduction of metals and synthetic organic pollutants.

    d. Modulating pH fluctuations by transferring primary productivity from phytoplankton to water hyacinths. High pH levels attendant with low alkalinities and high phytoplankton blooms can be deleterious to certain aquatic communities. Within the hyacinth system CO_2 is generated through heterotrophic activity within the root zone and the sediments. This typically reduces pH to between 5.5-7.0 and attenuates the diurnal variability of the pH, and eliminates high pH (>9.5) peaks. Based upon its experience of WHS™ facilities, HydroMentia has noted hyacinth effluents to be at or just below neutral (7.0) in pH, and low in dissolved oxygen. The effluents are often very low in suspended solids. A typical trend for pH, for example is noted as Figure A, in which the AM and PM pH trends for influent and effluent associated with the WHS™ system are noted.

Figure A: WHS™ influent and effluent pH trends S-154 MAPS prototype.





e. Modulating water temperature by providing insulation, which levels out fluctuations both in the summer and winter.

f. Sustaining an active, viable biomass during extended periods of no flow. The WHS™ system requires no recycle flow during down times, as the lagoons, through the use of risers can be set at a minimum depth, thereby assuring the ponds retain water even during extended periods of no flow. The hyacinth crop itself can be maintained without input flows for long periods, as they will access nutrients held within the sediments. While some physiological and morphological changes may eventually occur after long-term periods of no inflow (> 8 weeks), the crop will remain viable, and be capable of uptaking nutrients as they are introduced into the system. For example, at the S-154 MAPS prototype, HydroMentia maintained one off-line WHS™ treatment unit for over 8 months, without continuous flow. The crop during this period remained healthy, and the system functional (Comment 1 of Appendix A)

g. The proposed WHS™ will be designed to prevent the extensive release of viable hyacinth tissue into Saddle Creek. To cultivate water hyacinth an Aquatic Plant Permit is required from FDEP. For example, HydroMentia presently holds such a permit for the S-154 MAPS facility. This permit is issued with general and special conditions that address the issue of escape, and the attendant responsibilities. Such a permit would be required for the proposed Lake Hancock WHS™ facility.

The issue of release of tissue is addressed as part of the Aquatic Plant Permit application. The elimination of direct releases is facilitated through use of multi level exclusion barriers constructed in conjunction with outflow structures. (Figure B).

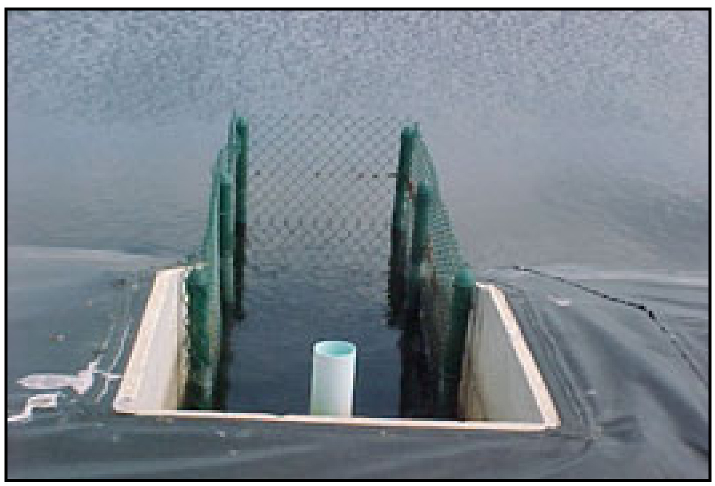


Figure B: Typical WHS™ effluent screen and riser.

Direct releases of hyacinth biomass would not be problematic unless a serious breech of system integrity was to occur—i.e. berm collapse. Measures will be taken to avoid such events from occurring, and this relies upon sound engineering practices, and common sense operational provisions.

Due to the small controlled size of the WHS™ unit, plant tissue releases often are more effectively accomplished within MAPS systems than can be accomplished within larger treatment wetland systems. (Comment 2 of Appendix A). Provisions for screening tissue associated with exotic aquatic vegetation also needs to be provided in treatment wetland system, which unavoidably are invaded by exotics such as hyacinths, alligator weed, hydrilla, and torpedo grass, all of which could escape into the receiving waters. The following citation by Goforth, 2005[8] describes the magnitude of these issues with the large treatment wetland systems developed to reduce pollutants to the Everglades Protection Area.

> *Through 2002 no large-scale herbicide applications were utilized in Cell 5. However, by late 2002, it was clear that the large floating aquatic vegetation (FAV) was creating performance problems, so over 1000 acres were treated with herbicide, resulting in effective control. A lesson learned from this experience (along with similar occurrence in STA-5) is to stay ahead of the FAV growth by actively controlling its growth with herbicide.*
>
> *To minimize the disruption of outflow pump G-310 caused by the discharge of floating SAV fragments, a vegetation control plan was developed for G-308 and G-309. This consisted of periodic gate openings to release any SAV material that may have lodged against the gate, thereby preventing a buildup of SAV mats at the structure that could move downstream and clog the trash racks at G-310.*

It should be noted that 100% exclusion of nuisance vegetation from discharges is not possible in either WHS™ or treatment wetlands systems.

From an indirect hyacinth and other nuisance species control perspective, the fact that the proposed WHS™ would reduce nitrogen levels within Lake Hancock discharges would influence the rate of growth and expansion of any hyacinths that presently exist downstream in Saddle Creek. Using the Monod relationship, for example, and the HYADEM model, suppose that there is an existing stand of water hyacinths in 100 acres of Saddle Creek of 599 wet tons, at a density of 5.50 wet lbs/ft^2. Noted in Figure C and D are the HYADEM printouts at the existing total nitrogen concentration of 5.53 mg/l and an average treated concentration of about 3.04 mg/l (this being at 45% removal), using an average flow of 37.9 MGD. As noted, over a 100-day period, the creek standing crop has increased to 3,078 wet tons, or 30.7% coverage without treatment, as compared to only 1,613 wet tons and 18.5 % coverage with treatment. (These numbers are provided only for comparative purposes only, in an effort to demonstrate the general influence of this indirect control phenomenon. A similar, but not as dramatic benefit would be expected at 27% nitrogen reduction)

HYADEM Before WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	37.9
Days	365
Average Total Nitrogen (mg/l)	5.53
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**5.53**
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	599
Field Water Hyacinth Growth Rate (1/day)	0.018
100 day Growth (Wet Tons)	**3,078**
Coverage after 100 days	**30.7%**

Figure C: Projected Hyacinth Growth Saddle Creek Prior to WHS™ treatment

HYADEM After WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	37.9
Days	365
Average Total Nitrogen (mg/l)	3.04
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**3.04**
Influent Total Nitrogen including Supplementation mg/l	3.04
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	599
Field Water Hyacinth Growth Rate (1/day)	0.013
100 Day Growth (Wet Tons)	**1,613**
Average Daily Growth (Dry Tons)	**18.5%**

Figure D: Projected Hyacinth Growth Saddle Creek After WHS™ treatment (45% TN removal)

This control strategy in not unique, for it is the same strategy used in controlled heterotrophic systems (e.g. activated sludge) in which the pollutant impacts are contained within a "controlled vessel", so they do not manifest themselves within the receiving water. In other words a colony of facultative bacteria and rotifers are used to metabolize waste prior to its release, thereby avoiding a colony of facultative bacteria and rotifers performing the same task within a more expansive, protected ecosystem, e.g. a stream, lake or estuary. Water hyacinths used within a "controlled vessel"—i.e. a WHS™ unit—help ensure hyacinth growth does not become problematic within the receiving water.

h. Because the WHS™ system will typically reduce dissolved oxygen levels to below 5 mg/l, post-treatment aeration will be provided. This will be done within a final stage basin in conjunction with paddlewheel aerators.

Considering the flow patterns as previously presented, the system requires a maximum flow capacity of 300 cfs. A working depth of 4.0 feet is suggested to provide adequate space for sediment accumulation, and to provide reasonable hydraulic retention. Considering this, model runs can be done on each month, based upon the average air temperature [9] as shown in Table 3. Incidental nitrogen removal (C_n) is set at 0.30 to account for heavy sedimentation and sloughing (Stewart et al., 1987[10]; Fisher and Reddy, 1987[11]). Also, when the model projects a total nitrogen concentration of less than 1.25 mg/l and a total phosphorus concentration of less than 0.05 mg/l the model defaults to a minimum total nitrogen concentration of 1.25 mg/l and a total phosphorus concentration of 0.05 mg/l, as these are reasonably conservative achievement limits, based upon work done in waters of similar quality. A typical model run (July) is shown as Table 4. The runs for each month are presented in Appendix B.

Table 3: Mean Air Temperatures for the Lake Hancock Region

	Winter Haven	Bartow	Lakeland		
	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (F)	Mean Temperature (C)
Jan	62.3	62.5	59.8	62.5	16.94
Feb	63.7	64.2	61.7	64.4	18.00
Mar	68.3	68.6	66.6	69.1	20.61
Apr	72	72.6	70.8	73.2	22.89
May	77.5	78.1	76.5	78.9	26.06
Jun	81	81.8	80.8	82.7	28.17
Jul	82.3	82.9	82.3	84	28.89
Aug	82.6	83.1	82.2	84.1	28.94
Sep	81.1	81.6	80.3	82.6	28.11
Oct	75.5	75.7	74.4	76.6	24.78
Nov	69.2	69.7	68.1	69.9	21.06
Dec	63.7	64.1	61.6	63.9	17.72
Annual	73.3	73.7	72.1	74.3	23.50

Table 4: Typical HYADEM run for flow and load conditions (July)

HYADEM July 300 cfs (194 MGD)		HYADEM July (35.62 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.62
Days	1.86	Days	29.14
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	4.49
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.89	Average Air Temperature (degrees C)	28.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.019
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.015
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	3.22
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	37.86
Mean Plant Age days	48.50	Mean Plant Age days	52.84
Average Daily Growth (Wet Tons)	161.7	Average Daily Growth (Wet Tons)	148.3
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	7.4
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	89.8
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	5.8
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**3.45**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.393**
Nitrogen Removal kg/day	305.44	Nitrogen Removal kg/day	280.09
Nitrogen Removal kg/period	568	Nitrogen Removal kg/period	8,162
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	7.01
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	287
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	28
Phosphorus Removal kg/period	57	Phosphorus Removal kg/period	824
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.71
Phosphorus Removal Rate gm/sm-yr	31.59	Phosphorus Removal Rate gm/sm-yr	28.97

Total Nitrogen Removed kg/month	8,730
Total Phosphorus Removed kg/month	881

WHS™ PERFORMANCE PROJECTIONS

A summarization of the modeling results are noted in Tables 5 and 6. The annual projected nitrogen removal is 80,801 kg/yr, which is somewhat greater than the required 80,541 kg/yr. Based upon these results, it is proposed that the WHS™ area required to reduce the annual incoming nitrogen load by 27% would be 88 acres, with a maximum flow capacity of 300 cfs. This determination is made through application of the Monod based HYADEM model (Stewart et. al 1984)[12], and since refined by HydroMentia, [HydroMentia (2004)][13].

Table 5: Summary of Modeled Monthly Performance

Month	kg-N removed	kg-P removed
January	5,396	545
February	5,136	519
March	5,943	600
April	6,757	682
May	4,331	556
June	7,403	747
July	8,730	881
August	8,903	899
September	8,502	858
October	7,974	805
November	5,997	605
December	5,729	578
Totals	80,801	8,277

Shown as Figures E, F and G are the general nitrogen reduction performances of a number of WHS™ systems with which HydroMentia has been involved. The projected performance data point for the proposed Lake Hancock process acres, WHS™ Nutrient Recovery Facility is also noted in each of these figures, and as noted, lays within the general data clusters within the scattergrams. The individual WHS™ facilities are summarized within Table 7. This list is just a representative sample of the literature, which is quite extensive (Gopal; 1987)[14].

The initial sizing calculations then include a WHS™ system of 88 acres. In addition a reaeration lagoon is provided. HydroMentia has extensive experience with paddlewheel aeration systems, which have generally been found to be a most efficient method of increasing dissolved oxygen within shallow, surface water impoundments (Boyd, 1990)[16]. If it assumed that the summer months represent the worst case during high daily temperatures (36^{o} C), and that at this time the effluent has a dissolved oxygen of 0.00 mg/l, then it can be projected that at max flow of 300 cfs, about 337 lbs or 153 kg of oxygen are required per hour, the required lagoon size can be determined for a given Standard Aeration Efficiency (SAE) for a paddlwheel aerator. Boyd (1990)[15] indicates paddlewheel aerators average about 2.2 Kg O_2 /kwh. This SAE value would be adjusted to an actual rate of about 1.30 kg O_2 /kwh (Boyd, 1990). Therefore, about 118 kwh would be required to provide the required oxygen during the maximum flow in the summer, or about 165-188 hp of aerators. The aeration lagoon would need to provide no less than one hour's detention, or a volume of 8.08 million gallons, or at a 4 ft depth, about 6.2 acres. The lagoon needs to be dimensioned to ensure adequate mixing, and would be lined with 40 mil HDPE to prevent scouring. A typical dimension at water surface would be 200 ft wide and 1350 ft long and 4 ft deep, with 1 ft freeboard. A workable design would involve 20-10 HP paddlewheels, about 12 ft in length, placed in a staggered manner along the long axis of the pond.

Table 6: Performance projection WHS™ system

Parameter	WHS™
Process Acres	88
Average Hydraulic Retention Time days	3.57
Minimum Hydraulic Retention Time days (@194 MGD)	0.59
Average Hydraulic Loading Rate cm/day	6.00
Nitrogen Removal kg/yr	80,801
Average Nitrogen Effluent Concentration mg/l	3.71
Nitrogen Areal Removal Rate g/m^2-yr	227
Phosphorus Removal kg/yr	8,277
Phosphorus Effluent Concentration mg/l	0.418
Phosphorus Areal Removal Rate g/m^2-yr	23.2
TSS Areal Loading Rate g/m^2-yr	14,330
TSS Areal Removal Rate g/m^2-yr	12,897
TSS Effluent Concentration mg/l	<12
Wet/Dry Biomass Harvest tons/yr	25,407 / 1,651
WHS™ Wet/Dry Sediment Harvest tons/yr	11,262 / 563
Wet/Dry Growth tons/yr (see Comment 6 Appendix A)	44,290 / 2,215
Annual Compost Production tons/yr	2,769
Annual Compost Production cy/yr	4,602

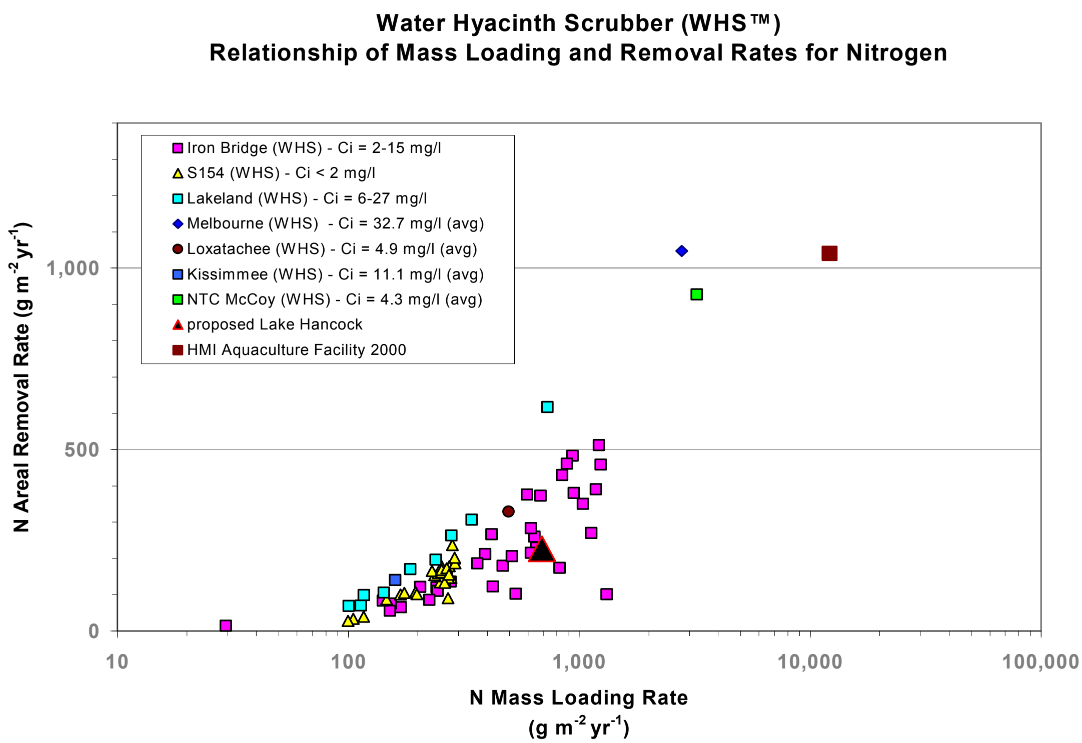


Figure E: Water Hyacinth Scrubber nitrogen removal performance

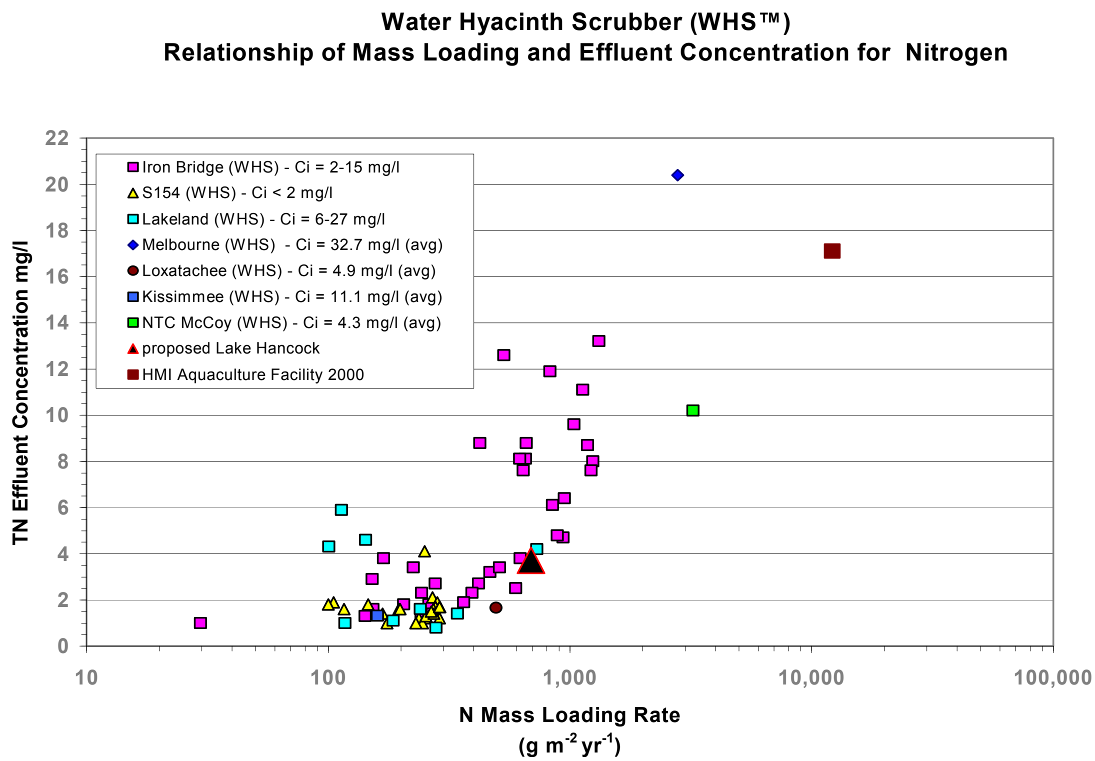


Figure F: Water Hyacinth Scrubber nitrogen loading compared to effluent concentration

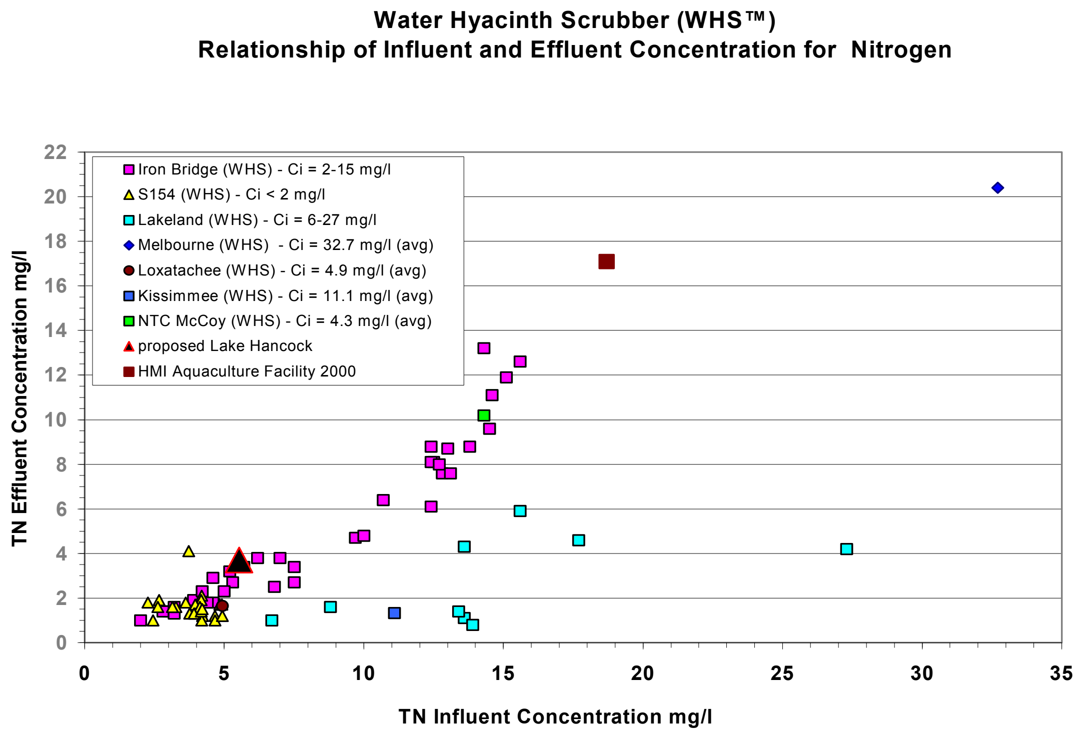


Figure G: WHS™ nitrogen influent concentration compared to effluent concentration

Table 7: Summary of Performance WHS™ projects

Facility	Operational		Total Phosphorus mg/l		Total Nitrogen		Total Nitrogen Loading Rate g/m²-yr	Total Nitrogen Removal Rate g/m²-yr	Hydraulic loading Rate cm/day	References
	Flow mgd	**acres**	**In**	**Out**	**In**	**Out**				
WHS™ Lakeland (1978-79)	0.15	3.0	4.10	2.19	14.51	2.76	250	211	4.7	Stewart (1979)
WHS™ Iron Bridge (1985-1988)	5.87	32	0.40	0.21	8.31	5.07	556	221	14.8	Performance reports to City of Orlando Stewart et al. (1987)
WHS™ Melbourne (1985-1986)	2.99	12	4.33	3.70	32.70	20.40	2,784	1,047	0.76	Stewart et al. (1987)
WHS™ Kissimmee (1985-1986)	0.15	3.7	1.46	0.12	11.1	1.32	160	141	3.81	Stewart et al. (1987)
WHS™ Loxahatchee (1985-1986)	2.49	8.50	1.06	0.55	4.93	1.65	494	329	30	Stewart et al. (1987)
WHS™ NTC Orlando (1983-1986)	1.00	1.51	1.97	0.62	14.30	10.20	3,234	927	62	Stewart et al. (1987)
WHS™ HMI Aquaculture (2000-2001)	21.50	11.33	8.64	8.59	18.70	17.10	12,157	1,040	178	Stewart (2001)
WHS™ S-154 (January through September 2003)	0.41	2.50	0.495	0.183	3.92	1.58	219	131	15.3	HydroMentia (2004a)

A general layout and flow schematic is presented as Figure H. A generalized layout over a site aerial is presented as Figure I. The WHS™ system will receive flows from the District's pumping station to be located on Saddle Creek, just north of P-11. Flows will be delivered at a maximum rate of 300 cfs (194 MGD), with the capability of modulating flows to match discharges from P-11. As noted in the modeling, the maximum flow will occur only about 22 days of the year. The annual average flow to the system is projected at 32.12 MGD. The modeling was done at two levels—one set at maximum flow for the days expected, the other at the average daily flow for flows below 300 cfs.

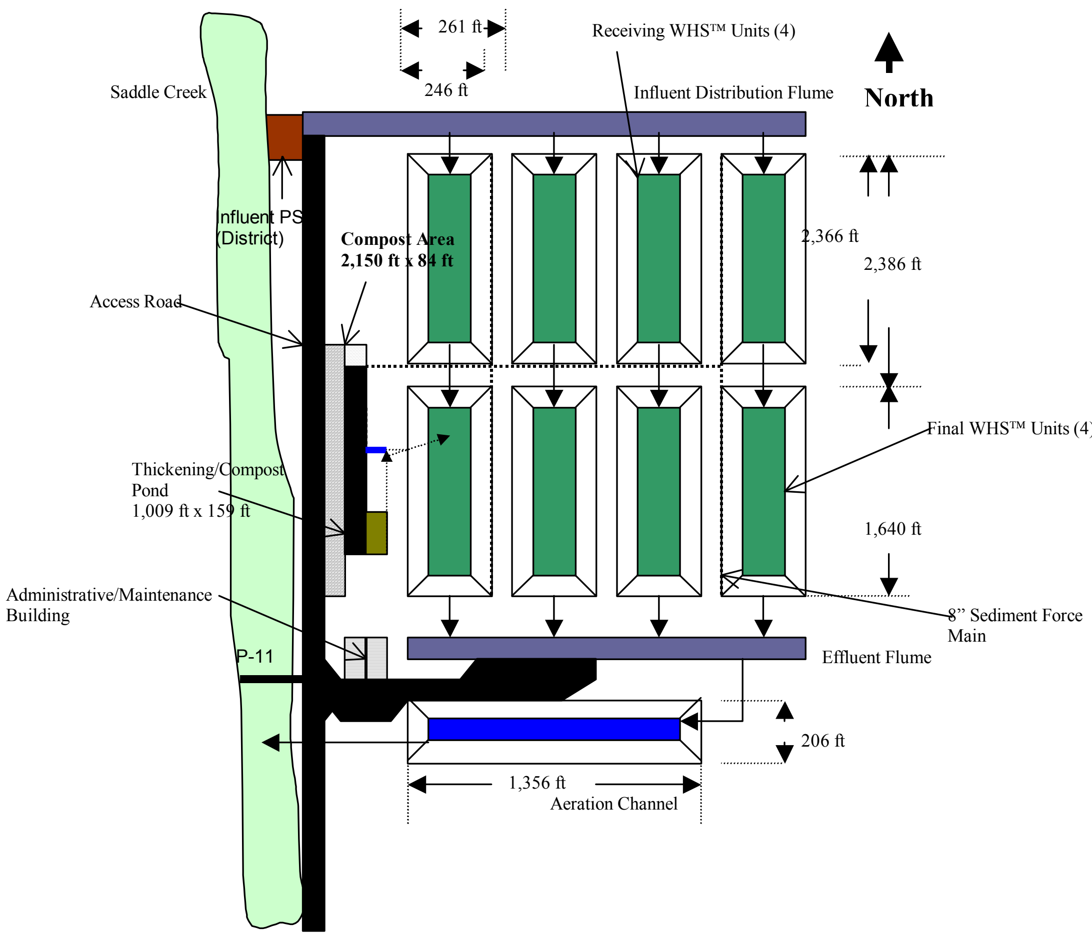


Figure H: General layout proposed Lake Hancock WHS™ Nutrient Recovery Facility: Drawing not to scale (nts)

Flow conveyance to the WHS™ unit will be through a trapezoidal conveyance flume, lined with 40 mil HDPE. Lining the flume will permit more effective flow and seepage control. Individual 8-10 inch laterals would deliver flow to the four parallel WHS™ units along the width (240 ft each). Control of flow would be through low-pressure in-line valves, such as those manufactured by Pond Dam Piping, LTD.

Operation of the four WHS™ units (2 in series and 4 in parallel) would be segregated into smaller 100-150 ft long growing units separated with 6" floating boom. This prevents excessive compression of the hyacinth crop, and facilitates healthy production. The initial receiving units will serve to a greater extent to settle and transform the heavy solids loads. Each parallel WHS™ train includes this receiving unit (2,366 ft x 246 ft) and a final unit (1,640 ft x 246 ft). The units will be provided with 1 foot of freeboard. Water would be transferred through adjustable overflow weirs, thereby facilitating effective settling within the first unit. Effluent discharge from the final WHS™ units will also be through a series of overflow weirs. The effluent will be directed to the effluent and harvest flume, which eventually delivers the flow to the reaeration chamber. The WHS™ units will be bordered by a 20 ft compacted limestone or shell harvest road to permit access by the integrated harvesting/processing system (Comment A6 in Appendix A).

Harvesting of the WHS™ unit will be via HydroMentia's Model 101-G WHS™ harvest grapple used in tandem with a mobile version of a Model 401-P biomass processor, as developed by HydroMentia, and as shown in Appendix B, to include cross and vertical conveyors as necessary. (The use of conveyance flumes in this system is not considered cost effective because of the distances involved.) Drive will be by a tractor PTO. The harvest grapple will transfer harvested biomass (300-450 lbs per grapple) into the processor, and the chopped product will be then delivered into a transfer trailer (Miller Series 5300 or equivalent), which when loaded, will transfer the chopped biomass to the compost area. The harvest rate will be about 20 TPH. With an average daily harvest requirement estimated at 98 wet tons, based upon a five day work week, one harvest unit will require less than five operational hours daily. During peak harvest periods, when rates might be as high as 180 wet tons/day, limited overtime may be required (Comment 13 Appendix A). Harvesting, including chopping and processing and transport, will be done typically by two persons. The recovered hyacinth biomass once delivered to the compost area will be spread into a windrow.

As noted, there is a sloughing component associated with the water hyacinth crop. This represents sloughed tissue and sediments not captured through routine biomass recovery. Sloughed material, represented as organic sediment, as well as phytoplankton and solids from the source water, is scheduled for periodic recovery, thereby assuring long-term performance of the system. The cost for solids recovery, are included within scheduled operational costs.

It is expected that even though there is a considerable phytoplankton and solids load being introduced to the WHS™ process, the cells will lyse, and their protoplasm will be released into the water column. Therefore, to a large extent, the algae solids will be converted to hyacinth biomass. To sufficiently quantify this phenomenon, it is recommended that a pilot study be conducted. It is noteworthy, that if a greater accumulation of algal solids occurs within the WHS™ sediments, there will be a greater reduction of nitrogen through these units, and while removal of WHS™ sediments would have to be increased, the overall size of the WHS™ units could be downsized accordingly. The proposed pilot study is presented as part of this quote. It is proposed that the management of the WHS™ sediment will be on a quarterly basis using a hydraulic dredge and a transmission piping network in conjunction with thickening basins, which will also serve as a composting platform. , Dredging can be conducted without interrupting normal WHS™ operations. Flows from the final WHS™ will be delivered to an effluent flume, from which flows will be directed to the final aeration channel. After aeration, flows will be directed for release into designated receiving waters.

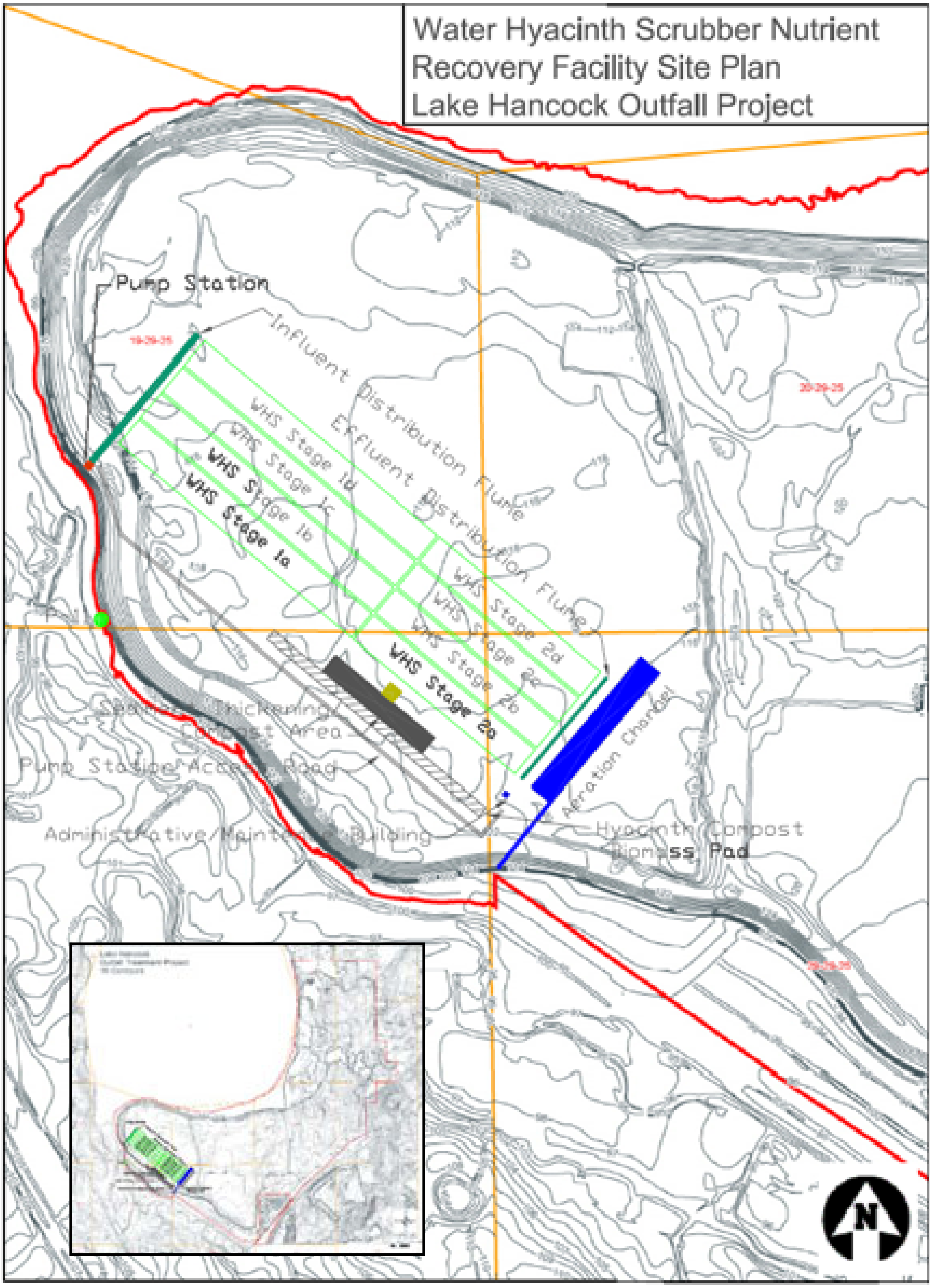


Figure I: Proposed General Facility Location and Layout

RESIDUAL MANAGEMENT

Biological (Treatment Wetlands, MAPS) and chemical treatment (alum, ferric chloride, etc.) systems are designed to recover pollutants in the form of organic biomass or precipitated sediments. MAPS and chemical treatment systems operational protocol call for the routine recovery of organic biomass and/or sediments, which facilitates consistent long-term operational performance. Due to the much larger facility footprint of treatment wetlands, management of accrued biomass and sediments occurs at a reduced frequency, with isolated biomass and sediment management occurring ever several years and large-scale sediment management scheduled less frequently – 15 to20 years for large-scale treatment wetland systems in Florida with relatively low nutrient loading rates.[16 17]

For the proposed WHS™ Nutrient Recovery Facility there are two sources of residuals requiring management—recovered hyacinth biomass and accumulated WHS™ sediment. The relative proportions of these, as noted in Table 6, are projected to be 25,407wet tons at 6.5% solids/yr or 1,651 dry tons/yr water hyacinth biomass and 11,262 at 5% solids wet tons/yr or 563 dry tons/yr sediment. It is intended that both solids sources be managed through windrow composting.

The use of windrow composting to reduce and stabilize organic solids is a well-established process, with numerous large-scale facilities located throughout Florida and the United States. Design of these systems is thoroughly discussed within available literature. HydroMentia developed and implemented a design mix using the methodology developed by Haug (1993) [18]. This strategy was applied to the S-154 WHS™-ATS™ MAPS prototype, and resulted in a stable, high quality organic fertilizer/compost, the composition and dynamic changes of which are noted in Table 8.

Table 8: Compost characteristics S-154 MAPS 2004

Content	Beginning Batch #2		Finished Batch #2	
	%	Total Pounds	%	Total Pounds
Total Weight pounds	-	52,883	-	6,589
Moisture	91	48,111	45.2	2,978
Total Dry Weight	-	4,772	-	3,611
Phosphorus dw	0.26	12.2	0.36	12.9
Nitrogen dw	2.30	110	3.21	116
Ash	-		60.2	2,174
Potassium dw	-		1.11	40
Sulfur dw	-		0.33	12
Calcium dw	-		3.72	134
Magnesium dw	-		0.55	20
Sodium dw	-		0.18	6
Iron dw	-		0.70	25
Copper dw	-		0.0013	0.005
Manganese dw	-		0.040	1
Zinc dw	-		0.011	0.40
PH units	-		8.0	-

As shown, the composting process results in a reduction of moisture to 40-45%, with a solids reduction of about 25%. The source material, composed of chopped hyacinths, algae and hay, achieved internal temperatures of about 55 ^{O}C during composting, resulting in a total weight loss of about 88%. The initial composting process to reduce volume by about 60% lasted approximately 35 days, after which the material was stockpiled and cured for 60 additional days. This material, as shown in Figure J, is high in nitrogen content (3.21%), which provides for a high quality organic fertilizer.

Figure J: Finished compost from harvested MAPS biomass

During the course of the S-154 operation, it was discovered that because of the low bulk density, and high air volume within the chopped water hyacinths, that additives (hay) were not needed to reduce water content. By placement of the chopped material in a wind row, the moisture content was found to reduce from about 93.5% to 75% in just a few days with periodic mixing. This allowed the material to commence with mesophilic composting, with 60% volume reduction in about 40 days. Over 360,000 pounds of wet chopped hyacinths, as noted in Figure K, has been windrowed and composted in this manner. This material produced no noxious odors or showed signs of anaerobiosis or putrefication.

Figure K: Chopped hyacinth compost windrow with no additive mixing.

Best and Worse Case Scenarios

The "most-likely" scenario for processed compost/organic fertilizer produced from the facility is that said product will be sold in bulk, or should market conditions so warrant, as packaged product. For market reference purposes, the volume of finished compost product produced from the WHS™ facility (4,602 cy/yr) represents less than 1% of annual sales for a large soil amendment distributor operating in Orlando, Florida since 1974.

A "worst case" scenario for compost/organic fertilizer is also provided. As directed, costs are provided whereby processed compost is transported to a landfill for disposal.

Within the present analysis, the "best case" scenario considers finished compost/organic fertilizer being sold at the rate of $20/ton FOB the facility. For the "worst case" scenario, finished compost/organic fertilizer is transported to a local landfill at a rate of $5.00/ton hauling cost plus a landfill tipping fee of $20.50/ton.

Recovered Hyacinth Biomass

To size the proposed recovered hyacinth biomass composting facility, consider the material balance as noted in Figure L for the hyacinth harvest. No bulking agent is added to the mix.

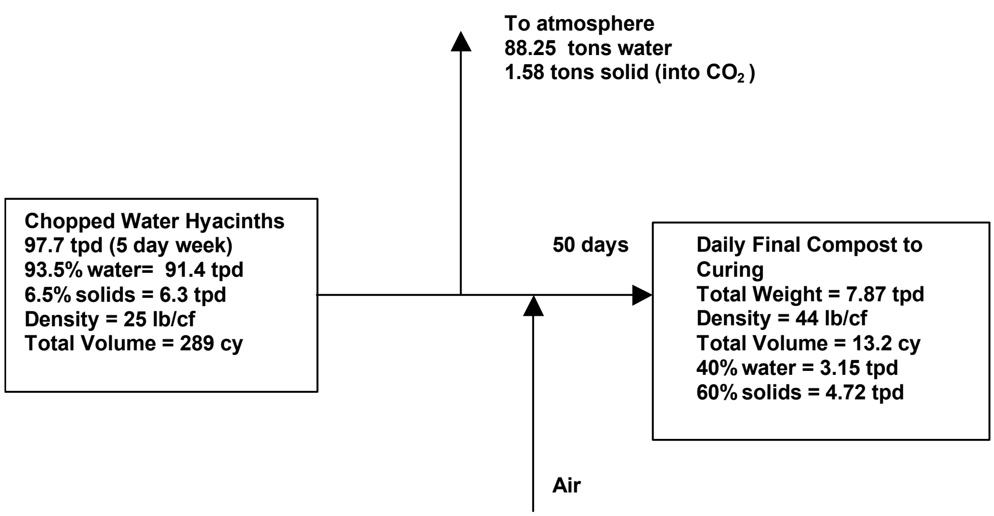


Figure L: Compost material balance hyacinth harvest proposed WHS™ Nutrient Recovery Facility

The process time as shown is set at 50 days. During processing the material is mixed as required to maintain aerobic conditions and to facilitate release of water vapor. Windrow mixing and finished product loading is accomplished via a Valtra Model T170 (170 hp) with a Brown Bear PTOPA35C-10.5 Mixer at a rate of 2880 cubic yards per hour. Temperatures within the compost can be expected to be sustained around 50-55^{O} C during the active period of processing. When these internal temperatures fall, the process is considered near completion. After this initial compost, the product is stockpiled for typically 60 days for a final cure. After this curing, it is ready for market, or further refined processing, such as screening, enhancement, blending etc.

The area required for the compost rows may be calculated by considering the volumes as noted in Figure L. The average volume of one batch during the 50-day process is about 151 cy or nearly 4,080 cf. If the average rows are 4 ft high, with an angle of repose of 1.3:1, then the cross sectional area is 20.8 sf, and the footprint is 10.4sf/lf. Therefore, considering the volume capacity of 20.8 cf per linear foot of row, or 2.00 cf per square foot of pad area, it is calculated that one daily batch will require an average of 2,040 sf of area for each batch, or about 196 linear feet. Considering a 50-day process time, then the total area required just for rows would be no more than 2.34 acres. As there needs to be one extra row to accommodate the lateral displacement during mixing, and about 3 feet between rows for vehicle wheels, then if the compost pad is 2,060 feet long, and an average row is 1,960 ft, then five rows would be required, plus a sixth row space, plus 21 ft for vehicle tire allowance, or a total width of 84 ft, and an area of about 4.0 acres. In addition, considering a 60-day volume of product of about 792cy, and a stockpile 10 ft high, and 3:1 angle of repose, the stockpiled row would be about 72 ft long, and require a footprint of 4,320 sf, or 0.10 acres. To accommodate access, consider the stockpile area to be 0.15 acres. Therefore, for composting the recovered hyacinth biomass, about 4.15 acres are required.

WHS™ Sediments

The next residual management process relates to sediments recovered within the WHS™ unit. The projected accumulation rate is 11,262 (5% moisture) wet tons/yr or 563 dry tons/year. The strategy for collecting this material will be to collect sediments on a quarterly basis, thus one-fourth of the annual deposition is removed and processed every 91 days.

WHS™ sediment processing shall include the following steps:

1. Pump sediment at 3% solids via a 500 gpm hydraulic dredge into a thickening pond via an 8" piping network. One fourth of the annual deposition amounts to 140.8 tons dry, or 1.13 million gallons at 3% solids. At 500 gpm this will take less than 2 days.
2. Once the thickening pond is loaded, let the sediment settle and draw off supernatant using a telescoping valve, until the solids content increases to 5% solids. The thickening pond to accommodate this volume, at a depth of 1.0 ft average, would need to have a surface area at water level of 3.5 acres. It is expected that the thickening process will take about 5 days, this being based upon HydroMentia's experience with WHS™ sediment. Once thickened the material depth would decrease from 1.0 ft to about 0.6 ft.
3. Mix finished compost into the thickened sediment such that the solids content is increased to 25%. The annual mix is as noted in Figure M. The quarterly finished compost requirement is 2,710 cy. It is expected that this will be moved via 20 yd transport trailers, with the material being retrieved from a storage pad contiguous to the pond. About 2,000 cy as a minimum can be loaded daily (4 loads/hr, for three trailers). Therefore about 2 workdays or less will be required to load and mix the compost blend.
4. After mixing, establish the blend into windrows. These windrows will be as previously described, with 20.8 cf/lf, and 2.0 cf/sf. Therefore, with a total blend of 6,304 cy or 170,201 cf, the area just for the initial rows is 2.0 acres, with 8,183 ft of rows. If each row is 818 feet long, this means 10 rows will be established, plus an eleventh displacement row, and 33 ft for vehicle tire allowance, or a total width of 148 feet, and the total required composting area is 2.8 acres. There is ample space therefore in the thickening pond of 3.5 acres to accommodate these composting rows.
5. The material will be mixed/composted in windrows for 60 days, during which time it is reduced to about 3.006 cy. It will be transported to the storage pad in about 2 days. Therefore the total cycle time is about 71 days.

The thickening pond will include the following components:

1. A concrete entrance ramp for moving materials and vehicles into and out of the pond, with a contiguous finished compost storage pad.
2. A telescoping valve and associated piping to a small submersible or self-priming centrifugal pumping station for removal of supernatant.
3. A 10" soil sediment base (4,706 sy), sloped to a terminal sump at 1.5 ft over 1000 ft
4. A terminal drainage sump for recovery and distribution of runoff via a culvert to a peripheral stormwater pond. This pond will have a bottom set at 2 ft below the internal sump, with an adjustable riser for distribution of flows to the supernatant pump station, for return to the WHS™ units.
5. A typical layout for the thickening pond is presented as Figure N.

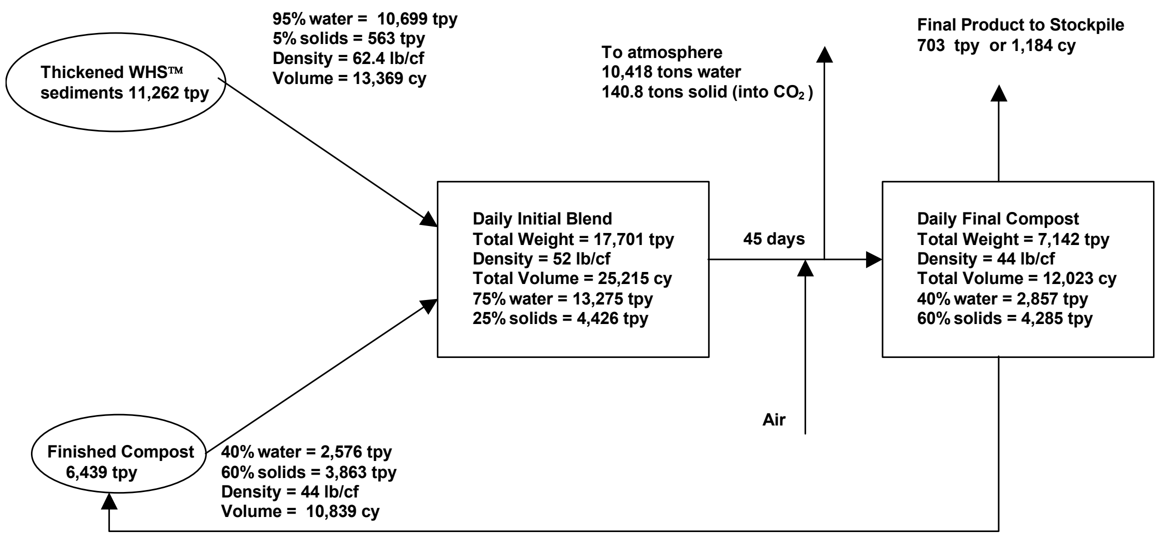


Figure M: Compost material balance hyacinth sediment proposed WHS™-ATS™ Facility

The sizing of the thickening unit will be 3.5 acres, with an average depth of 1 foot, with a length of 1,000 feet and a width of 153 feet at fill level. The top of berm dimensions, with one foot of freeboard, and 3:1 slopes will be 1,006 feet x 159 feet, with 2,330 feet of berm length.

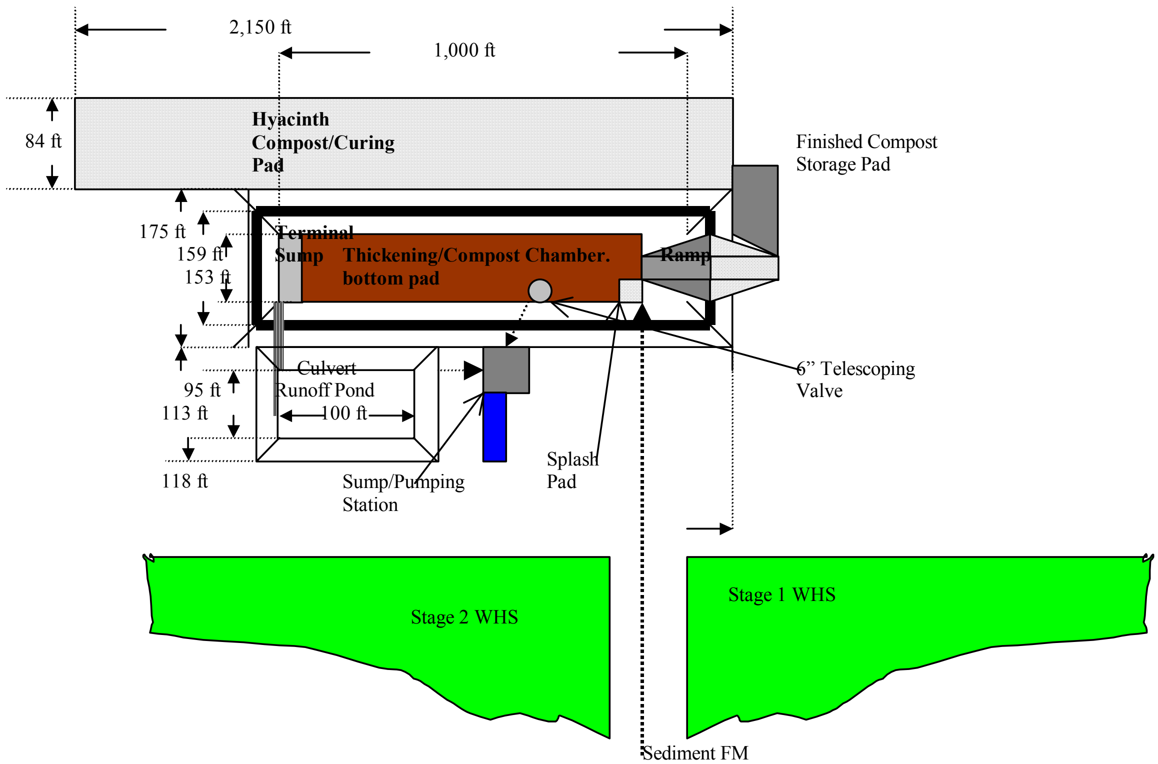


Figure N: Typical Thickening Pond NTS

Residual Processing Cost Savings

A worst-case residuals processing scenario has been developed to produce a conservative cost estimate. While both biosolids and alum residuals are routinely reduced from 5% solids to less than 50% solids without blending in Florida operations using equipment planned for the WHS™ Facility (Appendix F), costs within this analysis are calculated based on blending of low moisture finished compost to produce an initial product with 25% solids.

An additional cost savings protocol, thermophilic bacteria inoculation has proven in large-scale commercial operations to reduce windrow-mixing demands by 90%, drastically reducing composting costs. Application and investigation of these cost savings approaches would be investigated in a pilot study.

5.0 CAPITAL AND ANNUAL OPERATING COSTS

CAPITAL ITEMS AND QUOTE

The conceptual design presented represents an initial engineering assessment of project needs and intent, and is subject to revisions as required to ensure the final product best accommodates the actual needs of the client.

The proposed Lake Hancock WHS™ Nutrient Recovery Facility includes the following units:

1. An Influent Manifold Flume, trapezoidal cross section, lined with HDPE geomembrane for conveying flows of up to 300 cfs from the District's lift station near P-11 to the influent devices into the receiving WHS™ units.

2. Four parallel WHS™ units each composed of two, in series WHS™ units, of 4 foot working depth, 1.0-foot freeboard. The receiving units will each be of an approximate Top of Berm (TOB) dimension of 246 ft x 2,366 ft, or 13.4 acres each. The final units will be of an approximate TOB dimension of 246 ft x 1,640 ft, or 9.3 acres each. The acreage of each unit at TOB then is 22.7 acres, or a total of 90.8 acres including freeboard, or 88 acres of process area, excluding freeboard. Interior slopes shall be 3:1. Construction will be done with imported fill to create the berms.

3. Influent and effluent structures associated with the WHS™ to include 60 (15 per unit) 8" equally spaced pipes with low pressure butterfly in-line valves and HDPE boots for withdrawal from the Influent Manifold Flume; 40 (10 per unit) equally spaced intermediate effluent boxes, and 40 (10 per unit) equally spaced final effluent boxes, each identical in dimension and function, with screening and overflow weirs, and effluent piping.

4. A network of 20 ft wide limerock base Harvest Roads will run the length of the WHS™ units on both sides, as well as at the terminus of each unit sufficient for turnaround by the tandem harvesting/processing unit. The road network shall serve to facilitate management and harvesting of the hyacinth crop.

5. Effluent from the WHS™ units shall enter the effluent flume at the terminus of the final stage WHS™ units. It shall be approximately 1,044 feet long, and shall be of similar construction as the Influent Flume.

6. An aeration channel shall receive flows from the Effluent Flume via underground piping. The channel shall be approximately 206 ft wide and 1,356 ft long, with a working depth of 4 ft, and 1 ft freeboard. It shall be lined with 40 mil HDPE, and shall be serviced by a series of paddlewheel aerators capable of transferring 337 lb-DO/hr. Units will be House Model DDA or equivalent, total expected power is 175 HP.

7. A composting pad with a 10" soil cement base of approximately 4.15 acres (84 ft x 2150 ft) located contiguous to the sediment thickening and compost unit upon which harvested biomass will be processed and stockpiled through windrowing.

8. A sediment thickening and compost pad with a 10" soil cement base of approximately 3.5 acres (153 ft x 1,000 ft) located contiguous to the WHS™ unit upon which recovered organic sediments be processed and stockpiled through windrowing.

9. A paved access road from US 17 to the facility, to include a security gate.

10. Harvesting, processing and transport equipment to include specialized equipment for harvesting and chopping water hyacinths (HMI Model 401-P) as well as mowers, loaders, tractors, mixers, wagons, trucks, and tanks as needed to ensure efficient operations of the facility.

11. Grassing, erosion control and stormwater management, to include a perimeter swale.

12. A perimeter security fence.

13. Fuel and material storage facilities

14. Electrical distribution and controls

15. Tools and small engine items as required for system operations and maintenance.

16. All elements as deemed necessary to meet applicable health and safety standards

17. Calculations associated with the estimated quantities for this project are presented in Appendix C.

18. Fees, profits and licenses for all proprietary technologies for the subject facility are included in quote (See Appendix G for a list of MAPS related HydroMentia patents)

HydroMentia, Inc will provide items 1 through 18, to include engineering; bringing the project to final completion; exclusive of land, and those applicable issues listed under "Design Provisions and Assumptions" within this report, for a lump sum amount of:

Nine million, twenty-two thousand dollars
($9,022,000)

This is a good faith budgetary cost estimate based upon the conceptual plan presented herein, to be adjusted to site-specific conditions, final engineering plans and cost adjustment factors applicable at the time of construction.

OPERATING COSTS

It is assumed that the single stage WHS™ Treatment Facility will be operated by HydroMentia Inc. Calculations are presented within Appendix H, including cost summaries. The costs included in the estimate included below are:

1. All administrative and operation labor required to operate the facility as described, including all components identified within the "Capital Items and Quote".

2. All energy costs, including electricity and fuels as required to operate necessary equipment, excluding the District's Influent Lift Station.

3. All costs associated with the management, transport and landfilling of the residual solids as the "worst case" scenario, and a net sales, after loading and transport, of $20/ton as a "best case" scenario.

4. All expendables including chemicals, biological control agents, etc. as may be required to facilitate system performance, and the proper management of these agents.

5. All equipment maintenance and replacement of damaged or expended equipment, and maintenance of necessary tools and spare parts to ensure expeditious repair of critical items.

Estimated annual cost of Single Stage WHS™ System operations:

"Best Case": Five hundred and twenty six thousand dollars ($526,000)

"Worst Case": Six hundred and fifty three thousand dollars ($653,000)

6.0 50-YEAR "PRESENT WORTH" ANALYSIS

"Present worth" costs at a discount rate of 5.625%, over a fifty-year period are shown within Table 9 and Table 10, using the procedure and format provided by Dr. Champlin.

Table 9: 50-Year "Present Worth" Costs for the proposed Lake Hancock WHS™ MAPS Nutrient Recovery Facility Best Case conditions.

Capital and Operating costs for Single Stage WHS™ Best Case Scenario - Sale of Compost/Organic Fertilizer			
System	Capital Costs ($)	Annual Operating Costs ($)	Equipment Replacement Costs (1) ($)
Intake and Inflow Pump Station	$ 3,732,000	$ 355,000	$ 2,463,000
Inflow Transmission Main	$ 383,000	$ 4,000	$ 253,000
Pump Station Access Road	$ 818,000	$ -	$ -
Single Stage WHS Facility	$ 6,958,000	$ 582,000	$ 701,000
Residuals disposal	$ -	$ (56,000)	$ -
Instrumentation and Telemetry(2)	$ -	$ -	$ -
Land Acquisition (3)	$ -	$ -	$ -
Subtotal	$ 11,889,000	$ 885,000	$ 3,416,000
Engineering, Overhead & Legal (4)	$ 2,277,000	$ -	$ -
Technology Performance Fee (5)	$ 445,000	$ 89,000	
Total	$ 14,611,000	$ 974,000	$ 3,416,000
Present Worth Cost (5)	$ 14,611,000	$ 26,611,000	$ 3,075,000
Total Present Worth Cost	$44,295,000		
Per Pound Nitrogen Removed (6)	$4.98		

(1) Replacement of equipment and material items every 20 years.

(2) Telemetry not required, except for PS which is included in PS spreadsheet

(3) Cost for land acquisition were not included as requested by the SWFWMD.

(4) Estimated as 25% of capital costs for Intake and Inflow Pump Station, Inflow Tranmission Main and Instrumentation and Telemetry plus 15% of capital costs for single Stage WHS Facility.

(5) Technology Performance Fee. Initial Technology fee of $445,000. Thereafter a technology fee of $89,00 ($0.50 per lb of nitrogen removed) payable annually during years 1-15. 3% Inflation rate not applied to Technology Fee

(6) Estimated at 5.625% for a 50-year period. Annual O&M costs were inflated at 3% per year. Salvage of equipment purchased at 40 years estimated at 1/3 the purchased value at the end of 50 years.

(7) Listed cost based on estimated per pound nitrogen removed by flow through constructed wetlands over a 50-year period.

Table 10: 50-Year "Present Worth" Costs for the proposed Lake Hancock WHS™ MAPS Nutrient Recovery Facility Worst Case conditions.

Capital and Operating costs for Single Stage WHS™ Worst-Case Scenario - Landfill Disposal of Compost/Organic Fertilizer			
System	Capital Costs ($)	Annual Operating Costs ($)	Equipment Replacement Costs (1) ($)
Intake and Inflow Pump Station	$ 3,732,000	$ 355,000	$ 2,463,000
Inflow Transmission Main	$ 383,000	$ 4,000	$ 253,000
Pump Station Access Road	$ 818,000	$ -	$ -
Single Stage WHS Facility	$ 6,958,000	$ 582,000	$ 900,000
Residuals disposal	$ -	$ 71,000	$ -
Instrumentation and Telemetry(2)	$ -	$ -	$ -
Land Acquisition (3)	$ -	$ -	$ -
Subtotal	$ 11,889,000	$ 1,011,000	$ 3,615,000
Engineering, Overhead & Legal (4)	$ 2,277,000	$ -	$ -
Technology Performance Fee (5)	$ 445,000	$ 89,000	
Total	$ 14,611,000	$ 1,100,000	$ 3,615,000
Present Worth Cost (5)	$ 14,611,000	$ 30,276,000	$ 3,254,000
Total Present Worth Cost	$48,140,000		
Per Pound Nitrogen Removed (6)	$5.41		

(1) Replacement of equipment and material items every 20 years.
(2) Telemetry not required, except for PS which is included in PS spreadsheet
(3) Cost for land acquisition were not included as requested by the SWFWMD.
(4) Estimated as 25% of capital costs for Intake and Inflow Pump Station, Inflow Tranmission Main and Instrumentation and Telemetry plus 15% of capital costs for Two Stage WHS-ATS Facility.
(5) Technology Performance Fee. Initial Technology fee of $445,000. Thereafter a technology fee of $89,00 ($0.50 per lb of nitrogen removed) payable annually during years 1-15. 3% Inflation rate not applied to Technology Fee
(6) Estimated at 5.625% for a 50-year period. Annual O&M costs were inflated at 3% per year. Salvage of equipment purchased at 40 years estimated at 1/3 the purchased value at the end of 50 years.
(7) Listed cost based on estimated per pound nitrogen removed by flow through constructed wetlands over a 50-year period.

7.0 PROPOSED PILOT STUDY

It is proposed that prior to initiation of full scale implementation of the Lake Hancock WHS™ Nutrient Recovery Facility that a pilot study be conducted to determine the following:

1. The behavior of the algal (phytoplankton) solids associated with the feedwater within the units, with particular consideration on settling and decomposition rate within the two WHS™ stages, and the rate of nutrient release and net sediment accumulation.

2. Behavior of the process at flow fluctuations emulative of the proposed full scale system

3. To determine if any micro-element deficiencies exist, and to determine the nature and extent of such deficiencies, and the respective corrective measures required to optimize treatment performance.

4. To verify growth and productivity rates for hyacinths under seasonal and other environmental variations.

5. To establish the plant tissue nutrient content associated with production within the design feed water.

6. To determine the rate of solids and BOD_5 reduction, and the diurnal variations of pH, T and dissolved oxygen within the effluent.

7. To investigation the general response of the system to this particular feedwater

Findings from the pilot study shall be used in refining design criteria and final unit sizing. It is proposed and included within the present pilot study proposal that the investigation period include both cool weather and warm weather conditions for a period of 6 months. The system would be modestly sized, but of sufficient dimension to provide meaningful similitude. The layout and suggested sizing is noted in Figure O

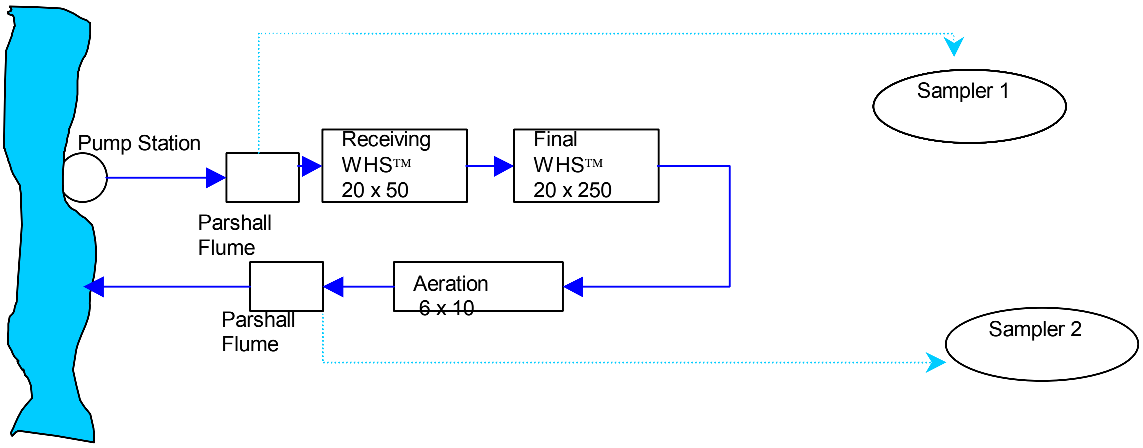


Figure O. Proposed flow and process schematic WHS™ bench-scale investigation.

As noted, flow will be delivered to the system from Lake Hancock, near but upstream of P-11. A self-priming pumping system is suggested (Gorman-Rupp or equivalent) skid mounted with two pumps. Flow will be modulated using diversion piping and a throttling valve. Flows will be monitored through an influent Parshall Flume, or similar open channel flow monitoring device before discharging into the two WHS™ units. These will be lined with 40mil HDPE, and sized as noted in Figure H. Flows, pH, DO and temperature will be continually monitored at the influent and the effluent Parshall Flumes. Water sampling will be conducted through refrigerated automatic samplers (Sigma or equivalent), which will be flow sequenced for collecting composite samples. Sampling will be done over a two-week period during a designed flow regime intended to emulate the expected flow fluctuations. Samples for the first 13 days will be collected in 6 bottles, so the more labile parameters, such as Nitrite-N, Ammonia-N, Ortho-P and BOD_5 will not fall out of hold time allowance for the seventh sample. The previous 13 days samples will be composited, so for each sampling period there are two composite samples for each of the five stations—one representing days 1-13, and one representing day 14.

In addition to the nitrogen and phosphorus series, samples will be tested for Ca, Mg, BOD_5, TOC, TSS, TVSS, TDS, Alkalinity and Total Iron. At the beginning of the project and at the end of the project the six-day composite sample will be analyzed for K, Cl, Na, Zn, B, Mn, Cu, Cd, Cr, Hg, As, Pb and Se.

Biomass testing will be done monthly. Samples of harvested material will be composited and dehydrated in accordance with appropriate approved procedures, and then sent to Mid-West Laboratory in Omaha, Nebraska and tested for nitrogen, phosphorus, moisture, protein, fiber, K, Mg, Ca, Na, Fe, Mn, Cu, and Zn. Biomass production will be determined through weekly harvests, which because of the small size of the bench system, will be by hand. The harvest wet weight will be documented, and then the moisture content determined through sample preparation.

In addition to biomass sampling, sediment chambers will be placed in both WHS™ units. These will be collected bi-monthly, the rate of accumulation determined, as well as the moisture content of the sediment. A sediment sample will then be prepared and delivered monthly to Mid-West Laboratories and tested as with the plant samples.

Within the WHS™ system, standing crop samples will be taken monthly to establish density and standing crop biomass. This will allow estimation of specific growth rate.

HydroMentia personnel will visit the site bi-weekly during the course of the pilot study—at the same time samples are picked up by the independent laboratory. At this time field monitoring at key locations within the process will be tested for pH, temperature, DO, conductivity, and sechhi depth as appropriate. In addition a subjective crop status assessment will be made.

At the end of three months operation, an interim report will be completed that provides general assessment of system performance, crop productivity and health, and suggested refinements of design criteria. A presentation of the report will be made. A final report will be submitted after project termination, and will include firm recommendations regarding full-scale system design, and refinements to operational strategy and performance expectations.

Two hundred and thirty four thousand, five hundred and fifty one dollars
($234,551)

Total cost for the proposed pilot study exclusive of land costs is $234,551, composed of $100,000 in fees and operating costs to HydroMentia (Table 11), $12,990 of laboratory fees (Table 12) and $121,561 of Capital Costs (Table 13). This is offered only as an estimate, with the understanding that actual costs may vary from this estimate based on design parameters selected by the client.

Table 11: HydroMentia Services for Proposed Pilot Study

Task	Description
Site Selection	Review potential sites as offered by client and offer ranking, after detailed review of the site, and examination of topographical and soils data.
Conceptual layout and design	Provide a recommended layout of unit processes, to include general elevation, l sections, and technical specifications for pumps, samplers, flumes, and liner
Review of design	Once system design is 75% complete, HydroMentia shall review drawings and specifications and offer edits and comments. The same shall be provided for final design
Assist in Bidding	HydroMentia shall attend a pre-bid conference and the bid opening, and assist the client in addressing contractor's questions as appropriate.
Assist in Construction Management	HydroMentia shall assist in review of shop drawings, change order request, and interim field inspections as requested by the client, but shall not serve as the engineer or resident engineer.
Final Inspection and Facility Acceptance	HydroMentia shall be in attendance of the substantial completion and final completion inspections, and shall provide the client written acceptance of the facility prior to issuance of notice of final completion.
Permitting	HydroMentia shall be responsible for procurement of the aquatic plant permit associated with the transport and cultivation of water hyacinths.
Start-up	HydroMentia shall complete start-up, which shall include confirmation of operability of equipment, crop seeding and maintenance and programming of samplers and calibrating field elements.
Operations	Hydromentia shall manage and operate the system in accordance with an operations and monitoring plan as prepared and submitted to the client, and as approved by the client. This shall include all provisions associated with personnel and pubic health and safety, and protection of property and environment. HydroMentia shall procure and maintain sufficient insurance as required by the client during the full course of operations.
Interim report	An interim report shall be provided as described in this section and presented to the client.
Final Report	A final report, to include recommended full-scale design parameters, shall be provided as described in this section and presented to the client, and all questions and issues offered by the client upon review shall be addressed as part of the final submittal.
	TOTAL PROPOSED FEE: $100,000

Table 12: Projected Laboratory Costs for Proposed Pilot Study

Series	Sample Type	Media	Parameters	Cost/sample	Number	Project Cost
1	13 day composite	water	Mg, Ca, Fe TSS,TVSS, Alkalinity, TOC,TON,TKN Nitrate-N,TP,TDS	$230	26	$5,980
2	1 day composite	water	BOD 5, Ammonia-N, TKN,Nitrite-N,Nitrate-N, TON TP, OP-filtered	$140	26	$3,640
4	13 day composite	water	Mg, Ca, Fe TSS,TVSS, F10Alkalinity, TOC,TON,TKN Nitrate-N,TP, Cu,Zn,B,Hg,Pb, As,Cr,Cd,Se	$380	2	$760
5	composite	biomass	Protein, Fiber, Ash, Moisture, Nitrogen, Phosphorus, Potassium, Zinc, Copper	$80	6	$480
6	composite	sediment	Ash, Moisture, Nitrogen, Phosphorus, Potassium, Zinc, Copper	$60	3	$180
	Sample Pick-up	water		$150	13	$1,950
					TOTAL	**$12,990**

Table 13: Projected Capital Costs for Proposed Pilot Study

Item	Cost
Mobilization	
Excavation/Grading	
Grid/HDPE with entrenchment	
Refrigerated Samplers	
Feed and ATS Lift Pump Skid set-ups	
Piping/Valving	
Office Trailer with field lab equipment	
Parshall Flumes	
Grassing/Fencing	
Subtotal	
Contingency 25%	
Engineering 15%	
Total Construction Cost	**$121,561**

8.0 OTHER CONSIDERATIONS

ADDITIONAL WATER QUALITY ISSUES

The WHS™ system as proposed would be expected to render water quality in compliance with Class III requirements, with a tendency to modulate diurnal fluctuations in pH and dissolved oxygen. Specific benefits will be attributable to the maintenance of high dissolved oxygen levels and the attendant elimination of the dissolved oxygen sag during the early morning hours. Regarding pH, the WHS™ system provides reduction and stabilization of pH, when compared to the feed water.

The reduction of both BOD_5 and suspended solids is expected to be significant through the system. Typically, as previously noted, WHS™ units will provide BOD_5 removal at rates approaching 250 lb/acre-day (Hayes et al. 1987; Wolverton, 1976). [19] [20]As the daily loading is projected to be about 5,750 lb/day, then the removal over the 88 acres of WHS™ would be expected to reduce essentially all but the most recalcitrant BOD_5, with over 90% reduction expected, except during maximum flow periods. It is not unreasonable to expect BOD_5 reductions to 5-7 mg/l through the system. This will be investigated during the proposed pilot study.

Total suspended solids (TSS) removal will occur largely through settling and resolubilization within the WHS™ units, as discussed previously. The extent to which algal solids will lyse and release available nutrients needs to be established during the proposed pilot study. As noted, with a hydraulic detention time of 9 hours under shaded conditions, the algal solids reduction (as measured as Chlorophyll-a) was 78%. With chemical aided settling, it was projected at 90% reduction. These are similar to numbers cited previously for WHS™ systems. The reduction through the WHS™ unit with 3.6 days retention at ADF and 0.6 days at maximum flow is projected to reduce TSS significantly, approaching 90%. The overall TSS removal therefore is expected to be about 33,100 lb/day (16.55 tons). It is projected that many of these solids will be biologically converted to CO_2 and other gases, or released as soluble or colloidal components into the water column, from where they will be incorporated into hyacinth biomass, which will be harvested on a regular basis. It is the primary intent of the proposed pilot study to determine the dynamics of these phytoplankton-associated solids as they are processed through the WHS™ units. It should be noted, that if the extent of solids accumulation is higher within the WHS™ than expected, then nitrogen and phosphorus reduction will also be higher than expected, and the design strategy could be shifted towards greater removal of WHS™ sediments and a reduction in the required process area. Consequently, it would be expected that capital costs might be reduced, with greater operational attention given to the processing of accumulated sediments within the WHS™ units.

Another water quality benefit, which is expected to be associated with the proposed system, is the significant reduction or elimination of cyanobacteria (blue-green algae). This will be done within the WHS™ were shading significantly inhibits phytoplankton production. Elimination of cyanobacteria is of importance because i) several species produce toxins which can impair, injure or kill other aquatic organisms and ii) several species release geosmin and other taste causing chemical which can be problematic for drinking water systems.

As with other biological systems, the WHS™ can be expected to provide additional polishing in terms of metals and organic toxins (pesticides, fungicides etc.). This will render the water of higher quality, and more amenable for downstream uses. In addition, because of the highly oxidized conditions, and the relatively short detention times, WHS™ and ATS™ units have been found to inhibit the development of methyl-mercury—an important concern relating to the ecological health of downstream systems. (Bonzongo, 2004, personal communication). Also, because the hyacinths are harvested regularly from the WHS™, development of *Mansonia sp* mosquitoes, as well species such as *Coquillettidia sp,* which are associated with cattails and other emergent vascular plants, will be sufficiently repressed (O'Meara, 2004, personal communication).

CHEMICAL AND POWER REQUIREMENTS

Based upon the review of the existing water quality, it is not expected that any nutritional supplementation will be required to sustain the proposed system. As noted, data on iron content is not available, so the need for iron addition will be determined during the proposed pilot study. If iron addition is required, it will be done through supplementation with ferrous sulfate. The quantities needed would likely not exceed 500 lbs/day, and could be done through a volumetric feeder, or simply by hand. The chemical would be stored in bags, and is not dangerous or particularly corrosive, nor would it impose any degradation of water quality upon the effluent.

It may also be necessary to treat the water hyacinth standing crop on occasion with nematodes to control weevil larvae. This has been done extensively at the S-154 MAPS prototype, and these activities have been coordinated closely with the University of Florida Institute of Food and Agricultural Sciences (IFAS). The nematodes used are indigenous and require no special permitting. Distribution is done through a spraying program over the crop. Treatments may be done 4-6 times annually. These treatments will have no water quality impacts.

Power requirements are associated mostly with the paddlewheel aerators intended to oxygenate the effluent. It is expected that about 175 HP are required during the summer daytime hours, with less at night, and considerably less in the cooler months. On an annual basis, it is projected that about 1/3 of the total available power will be used, or about 385,000 kwh/yr.

All other equipment will be diesel or gasoline driven. The fuel need, considering equipment for harvesting, chopping, mixing, and transport of solids, as well as transportation and ground maintenance is projected at about 61,000 gallons per year.

Regulatory requirements for the system will be modest. An aquatic plant permit will be required from the FDEP for the cultivation of water hyacinths. HydroMentia already holds one such permit, and has familiarity with the FDEP staff involved in developing these permits. It is not anticipated that any additional regulatory demands would be associated with the management of residual solids, other than demonstrating the absence of viable hyacinth tissue within the final product (compost). The compost product is not expected to contain sufficient quantities of heavy metals or other regulated materials that would restrict its distribution and use. Permitting prior to construction would be as expected for any water treatment project.

OTHER SYSTEM BENEFITS

Several ancillary benefits would be associated with the proposed facility. The most evident is its sustainability. Through continual harvesting and processing of the solids, accumulation of sediment is eliminated, and the system retains its full capabilities independent of time. In addition, it is quite possible that costs savings could be realized in the future by enhancing product value. For example, it would be practical to begin product distribution through bulk sales. However, as users became familiar with the product, and as the market trends become clearer, it may be cost effective to package the system for retail sales, resulting in higher returns, and lower overall treatment costs. The impact of product sales is noted in the difference between the “worst case” and “best case” scenarios as shown in Tables 9 and 10.

While the proposed system does not require extensive labor for operations, the jobs it creates are meaningful. It needs to be realized also that the MAPS technology has a real potential as a means of long-term lake restoration and protection with modest land requirements, and without the use of large amounts of chemicals. MAPS systems are presently being considered by Orange County, and others as a means of restoring lakes.

MAPS systems are durable, as demonstrated recently with the exposure of the two-stage S-154 MAPS facility to two Category 2 hurricanes within 3 weeks in September 2004 (Frances and Jeanne). In both cases, there was no damage to the facility. While power outage resulted in a seventeen-day shut down, the system, once brought back into operation, recovered full treatment capabilities within one week. The WHS™ component commenced system performance immediately.

The proposed system does not require any complex instrumentation loops to sustain operational effectiveness, nor is complicated equipment required or any telemetry needed. The equipment that is used is agricultural in nature, and can be easily operated and maintained by personnel who are aware and mature, but who do not require extensive specialized training. As noted, should the system be shut down because of power failure, it can be easily brought back into full operation with introduction of flow.

APPENDIX A. PARSONS REVIEW WHS™ NUTRIENT RECOVERY FACILITY (REV01)

Project: Lake Hancock Outfall Treatment Project
Report: Technical Memorandum: Alternative Treatment Technologies Evaluations.
Section: Appendix H – MAPS Nutrient Recovery Facility Conceptual Plan.
Reviewer: T. L. Champlin

REPORTED VALUES:

Although the values reported in your proposal are not significantly different than those being reported in other portions of the report, the following values have been provided for reference:

Annual Average Flow: Based on Mike Taylor's analysis as discussed in Section 2 of the report, annual average discharge is estimated at 58.65-cfs (37.9-mgd).

Nitrogen Load Discharge: Based on 5.53 mg/L of TN, average annual load is 289,300 kg/yr.

Nitrogen Load Reduction: Average annual load reduction is 130,200 kg/yr.

Particulate Form Nitrogen: Average annual particulate form nitrogen is 208,300 kg/yr.

Comments:

Note: Appendix D and E: Appendix D and E were missing from my review copy. Although the few others that I looked through had them. It may have been an isolated case.

Comment 1: Inflow Flowrate: *There is no mention of a recycle or a minimum recycle flowrate to sustain MAPS during the dry season or when there is no discharge from the lake. The design would require a discharge channel return back to the Lake if needed.*

Reply 1: The WHS™ system requires no recycle flow during down times, as the lagoons, through the use of risers can be set at a minimum depth, thereby assuring the ponds retain water even during extensive periods of no flow. The hyacinth crop itself can be maintained without input flows for an extended time, as they will access nutrients held within the sediments. While some physiological and morphological changes may eventually occur after long-term periods of no inflow (> 8 weeks), the crop will remain viable, and be capable of uptaking nutrients as they are introduced into the system. For example, at the S-154 MAPS prototype, we have maintained one off-line WHS™ treatment unit for over 8 months, without continuous flow. The crop remains healthy, and the system functional.

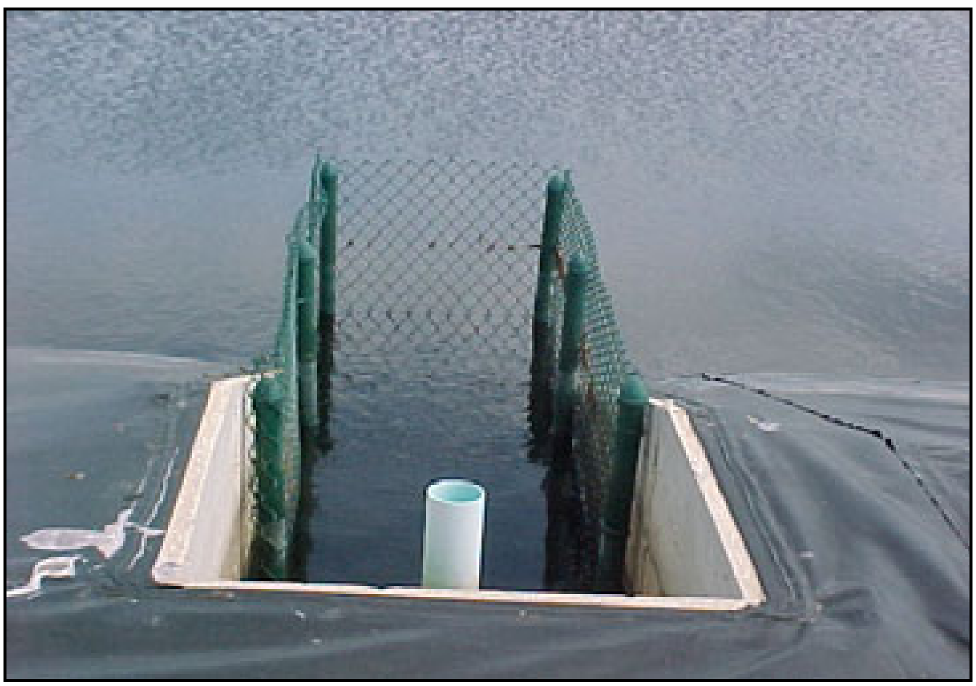
Comment 2: Limiting Water Hyacinth Growth: *What measures do you provide in your system to prevent water hyacinth, which is known to be an aggressive species, from discharging biological matter that could lead to growth of water hyacinths downstream in receiving bodies (i.e., Saddle Creek and the Peace River)?*

Reply 2: To cultivate water hyacinth an Aquatic Plant Permit is required from FDEP. For example, HydroMentia presently holds such a permit for the S-154 MAPS facility in Okeechobee. This permit is issued with general and special conditions that address the issue of escape, and the attendant responsibilities. Such a permit would be required for the proposed Lake Hancock WHS™ facility. From a practical perspective, the fact that the proposed WHS™ would reduce nitrogen levels by 55% would influence the rate of growth and expansion of any hyacinths that presently exist downstream in Saddle Creek. Using the Monod relationship for example, and our HYADEM model, suppose that there is an existing standing crop of water hyacinth in 100 acres of Saddle Creek of 545 tons, at a density of 5.50 wet lbs/ft^2 . Noted in Figure R-2a and R-2b are the HYADEM printouts at the existing total nitrogen concentration of 5.53 mg/l and the proposed average treated concentration of about 2.70 mg/l, using an average flow of 39 MGD. As noted, over a 100-day period, the creek yields 2,534 wet tons, or 28.3% coverage without treatment, as compared to only 1,154 wet tons and 15.6 % coverage with treatment. (These numbers are provided only for comparative purposes only, in an effort to demonstrate the general influence of this phenomenon.)

This is not surprising, for it is the same strategy used in controlled heterotrophic systems (e.g. activated sludge) in which the pollutant impacts are contained within a vessel, so they do not manifest themselves within the receiving water. In other words a colony of facultative bacteria and rotifers are used to metabolize waste prior to its release, thereby avoiding a colony of facultative bacteria and rotifers performing the same task within a more expansive, protected ecosystem, e.g. a stream, lake or estuary. We use hyacinths within a controlled vessel—i.e. a WHS™ unit—so hyacinth growth does not become problematic within the receiving water.

The issue of release of tissue is addressed as part of the Aquatic Plant Permit application. The elimination of releases is facilitated through use of multi level exclusion barriers constructed in conjunction with outflow structures. (See Image Below as Figure R-2). A release would not be problematic unless a serious breech of system integrity were to occur—i.e. berm collapse.

Figure R-2: Typical WHS™ effluent screen and riser.



Measures need to be taken of course to avoid such events from occurring, and this relies upon sound engineering practices, and common sense operational provisions. Due to the small controlled size of the WHS™ unit, plant tissue releases often are more effectively accomplished within MAPS systems than can be accomplished within larger treatment wetland systems. Provisions must also be provided in treatment wetland system, which unavoidably are invaded by exotics such as hyacinths, alligator weed, hydrilla, and torpedo grass, all of which could escape into the receiving waters. The following citation by Goforth, 2005 describes the magnitude of these issues with the large treatment wetland systems developed to reduce pollutants to the Everglades Protection Area. 1

> *Through 2002 no large-scale herbicide applications were utilized in Cell 5. However, by late 2002, it was clear that the large floating aquatic vegetation (FAV) was creating performance problems, so over 1000 acres were treated with herbicide, resulting in effective control. A lesson learned from this experience (along with similar occurrence in STA-5) is to stay ahead of the FAV growth by actively controlling its growth with herbicide.*
>
> *To minimize the disruption of outflow pump G-310 caused by the discharge of floating SAV fragments, a vegetation control plan was developed for G-308 and G-309. This consisted of periodic gate openings to release any SAV material that may have lodged against the gate, thereby preventing a buildup of SAV mats at the structure that could move downstream and clog the trash racks at G-310.*

Figure R-2a: Projected Hyacinth Growth in Saddle Creek without WHS™ upstream treatment

HYADEM Before WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	39
Days	365
Average Total Nitrogen (mg/l)	5.53
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**5.53**
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.00
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.50
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	545
Field Water Hyacinth Growth Rate (1/day)	0.017
100 day Growth (Wet Tons)	**2,534**
Coverage after 100 days	**28.3%**

1 Goforth. 2005. Summary of STA Vegetation Management Practices. South Florida Water Management District

Figure R-2b: Projected Hyacinth in Saddle Creek growth with upstream WHS™ treatment

HYADEM After WHS Treatment Saddle Creek	
INPUTS	
Influent Average Daily Flow (mgd)	39
Days	365
Average Total Nitrogen (mg/l)	2.70
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	**2.70**
Influent Total Nitrogen including Supplementation mg/l	2.70
Influent Total Phosphorus (mg/l)	0.30
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	23.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	5.00
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.50
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	100.00
Percent Coverage	5.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	545
Field Water Hyacinth Growth Rate (1/day)	0.011
100 Day Growth (Wet Tons)	**1,154**
Average Daily Growth (Dry Tons)	**15.6%**

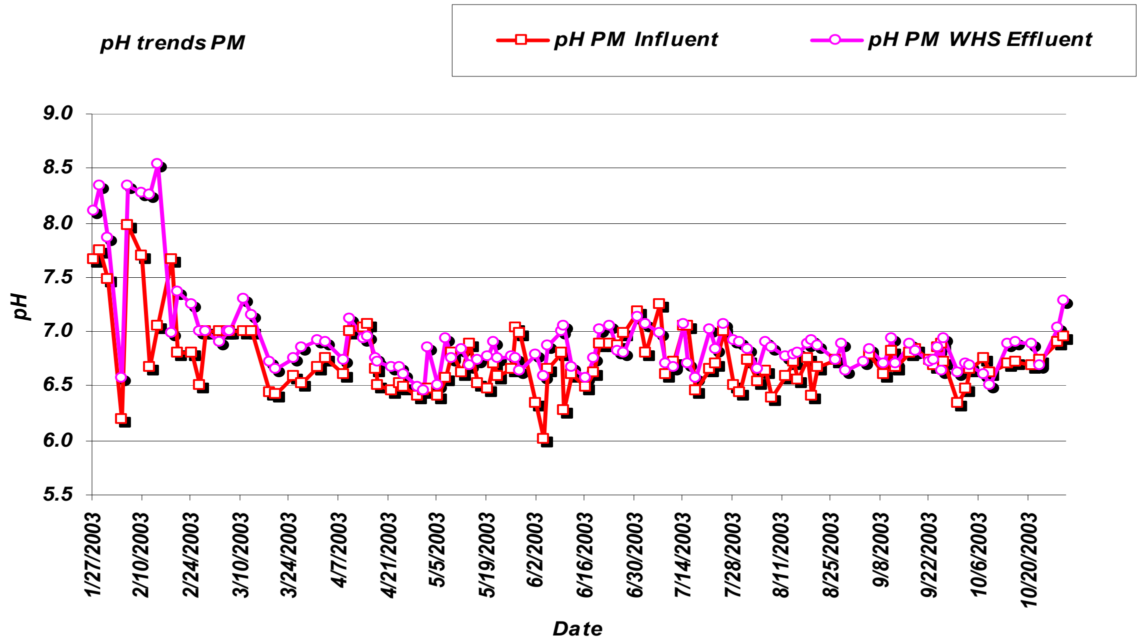
Comment 4. Page 5, Item 18: *Engineering and "project contingency" costs shall be estimated at 25% of …. The line item in the spreadsheet I provided you was mislabeled.*

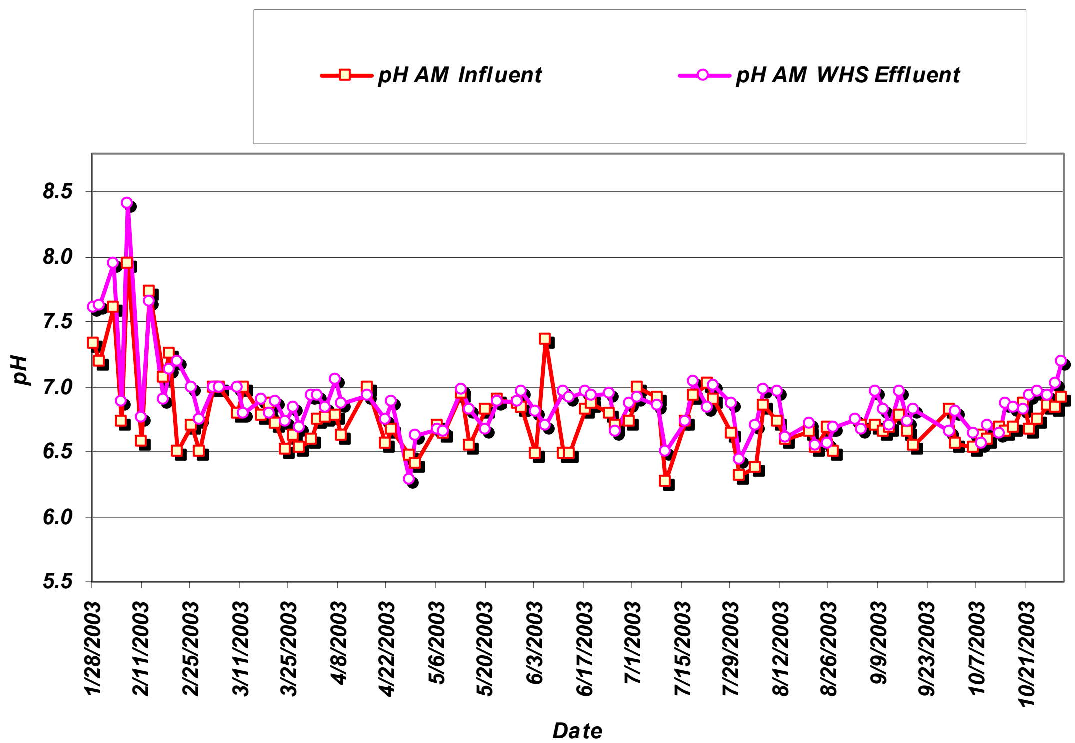
Reply 4: So noted

Comment 5: Page 10, Item 2, Part d: *There is mention of a pH reduction between 5.5 to 7.0 SU. What is the minimum pH that we could expect discharging from the MAPS system? 5.5, and more likely 6.0. The S-154 discharge from the WHS™ has never been below 6.0 over nearly two years.*

Reply 5: Typically WHS™ treatment units produce effluent levels between 6.0 and 7.0 . For example, at the S-154 project, it can be seen from the attached graphs as Figure R-5, that there is no dramatic decline in pH from the influent, although the WHS™ can be expected to reduce pH somewhat. This data is consistent with previous commercial scale WHS™ systems operated in Florida. There is no reason to expect a departure from this trend. This would be verified through the proposed "pilot" unit at Lake Hancock.

Figure R-5: Typical pH trends WHS™ effluent





Comment 6. Page 11, Table 4: *How can the harvesting rate be less than the production rate (i.e., 60% of the growth rate)? In other words, shouldn't the harvesting rate be either the same as the production rate or slightly more?*

Reply 6: It is important to look at percent moisture, and more importantly, to do the balance on dry weight. Note, for example, that the average daily growth from the Table 4 at 194 MGD is 17.9

tons/day, which balances with the dry harvest at 14.4 tons/day and sloughed production at 3.5 tons/day. Production goes to both standing crop, which is harvested, and sloughed biomass, which is removed periodically from as WHS™ sediments. Please note that the percent solids of the harvest is higher than the standing crop on the water, largely because much of the free water drains during harvest, and the fact that the harvest is chopped, and in the course of chopping, some water is lost through draining and evaporation.

Comment 8: ***Page 15, Table 7:*** *Need to provide complete listing of all citations, preferably in a reference section in your proposal.*

Reply 8: The citations are provided as footnotes. These will be compiled in a reference sheet, as requested.

Comment 7. ***Page 13, Table 6, Performance:*** *Based on projected effluent concentration, treatment efficiency is estimated at 46.47% using an influent concentration of 5.53 mg/L. This does not achieve the 55% removal efficiency stated at the bottom of page 8 needed for treatment of 85% of the discharged flow.*

Comment 9: ***Page 16, first paragraph:*** *The annual average flow projected as 39.89-mgd seems high given 85% removal efficiency. This may be related to initial values used for annual average discharge from lake, which we estimated to be 58.65 cfs (37.9-mgd). Based on my calculations, I estimate the annual average flow to be 32.2-mgd.*

Reply 7/9: In reviewing the model calculation, it was noted that the 2.96 mg/l more closely represents the concentration of the nitrogen removed. The effluent concentration, based upon the composite results of the 12 model runs is projected at about 2.70 mg/l total nitrogen, with the average flow at about 36.3 MGD and the captured nitrogen at 277,495 kg/yr—slightly higher than the 252,412 kg/yr cited in the report. The removed load is estimated at 141,840, about 8% above the required removal. Much of the difference is related to inherent error, as input data is rounded. Note, that to be conservative, and to account for such errors, which can be anticipated early in conceptual planning, we used a base minimum effluent concentration of 1.25 mg/l, even though we have documented much lower levels within hyacinth systems. We can try to fine-tune some of these numbers, but generally it does not appear that there will be much change (<+/-10%).

Comment 10: ***Page 16, Figure D:*** *There is an unlabeled arrow on the left side of figure pointing to left WHS cell in the second stage.*

Reply 10: The arrows refer to the WHS™ units themselves—both first stage and second stage. This can be corrected.

Comment 11: ***Page 17, Second Paragraph, Photographs:*** *Need to provide complete photographs of all harvesting equipment. I checked the HydroMentia website and did not see photographs of Tractor PTO, tandem harvest grapple/process unit, and transfer trailer. The only photograph I could find related to project was one of the grapple arm.*

Reply 11: These will be provided

Comment 12: ***Page 17, Second Paragraph, Grapple Arm:*** *Is the grapple arm able to reach the estimated 183 feet needed to retrieve water hyacinth in the middle of the cells? I would like to see the specifications for the proposed equipment.*

Reply 12 : The system works by traveling a perimeter road, therefore there is no need to reach across the entire pond width. Wind movement, combined with controlled open water to allow random crop movement, ensures that the crop moves in a manner that permits adequate access from the perimeter road. Remember, only a small fraction is harvested with each event. This biomass operational management procedure has been demonstrated to work efficiently, with crop health maintained (as measured by % viable tissue). Just as activated sludge is wasted (harvested) assuming complete mix, we assume a complete mix of the hyacinth crop when we harvest. Using booms to further isolate standing crop segments also aids in ensuring a controlled “mean plant age”.

Comment 13: Page 17, Second Paragraph, Harvest Requirements: *An additional statement needs to be added that states the projected daily labor requirements at maximum daily harvesting.*

Reply 13: The maximum daily harvest expected is about 220 wet tons/day. This will require two grapples, one chopper and one transport, with three operators, about 5-6 hours. The plan calls for 4 full time operators, so sufficient manpower is available to meet these peak periods.

Comment 14: Page 18, Figure E: *It would be helpful from a conceptual level design effort if the locations of administration building and maintenance buildings be shown in the provided figure along with the access road and parking lot.*

Reply 14: This will be done.

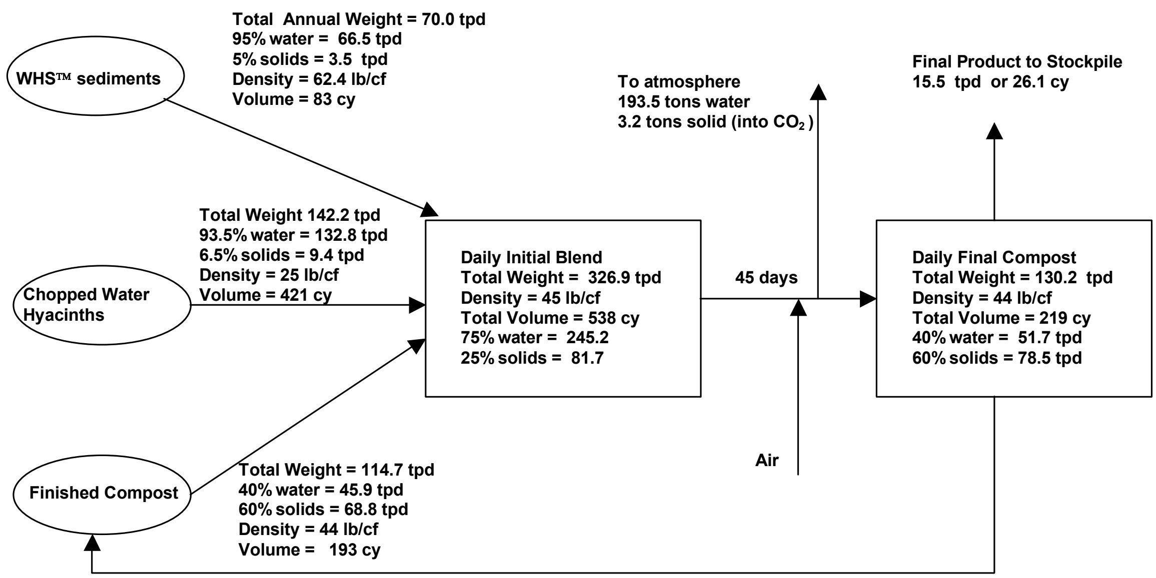
Comment 15. Page 21, Second Paragraph Composting of Dredged Solids: *Disposal of dredged solids needs to be thought-out more thoroughly. Composting of 5% solids is not realistic. Dredged solids will need to be dewatered first to raise solids content to at least 20-25% solids before adding them to finished compost for composting. Also it is important to determine the level of inert solids, which if high enough, it may be more cost effective to dispose dewatered solids directly to landfill.*

Given the size of system, dredging operations would need a net work of pipes with connections to follow along each basin for transfer to a holding tank/gravity thickener, mechanical dewatering of solids using a belt filter press, transfer of dewatered sludge by front end loader to sludge drying beds, transfer of dried sludge to trucks and disposal to landfill. If inert matter is low enough, dewatered sludge could be composted. Transferring of solids by tanker truck is unrealistic given it would take approximately 990 trips with a 6000 gallon tanker truck at the estimated 5.9 million gallons to transfer the solids to the holding tank.

Reply 15: The intent is to blend the 5% solids sludge directly with 40% moisture compost, and possibly the water hyacinth harvest to yield a composting blend at 25% solids, as noted in Figure G of the proposal. At the S-154 prototype we have been able to apply wet sludges and harvested materials (circa 4-6% solids) generated by the system, directly to the compost windrows. The intent, as noted, is to bring the compost mix to the desired 25% solids. In the proposal we suggested doing this with recycled compost. It could also be done using chopped hay, sawdust, cardboard, wood chips, etc. The frequency dredging is needed, and the time period for dredging will determine the design and operational approach. For example, if dredging is required more frequently, it may be cost effective to purchase a dredge, and associated piping. The time dedicated to dredging will determine the design of the receiving facilities.

One feasible scenario would be to build two receiving ponds, one on either side of the long axis of the WHS™ units. If we deliver the 1,294 dry pounds of sediment annually at 3% solids, then the annual volume is projected at almost 10 million gallons. This could be stored at a depth of three feet within 10 acres of settling and storage lagoon, or 5 acres on either side, with dimensions of 6,250 ft x 50 ft. The lagoons then could be filled once, no more frequently than once annually, in about 15 days with a 1,500 gpm dredge, and then allowed to settle and thicken. HDPE, 12” flexible piping, which could be heat welded, would be used, and because the receiving pond would run the length of the long axis, piping distances would be relatively short—no more than 600 ft. The storage lagoons would need to be equipped with an adjustable weir to permit decanting of supernatant, which will be returned to the WHS™ units. This supernatant will provide some nutrients for the standing crop during extended periods of no influent. The material now stored in the lagoons can be used to supplement the composting process throughout the remainder of the year. HydroMentia’s experience with WHS™ sediments have shown the material is readily composted. The thickened sludge would be removed daily simply by using the hydraulic dredge, which would deliver the material to a 2,000 gallon transfer wagon. With the thickened sediments at 5% moisture, and conducting this operation 250 days/year, would require about 12 wagon loads/day, or 24,000 gallons, or about 3.5 tons of dry sediment per day for a 365 day period. The material balance then for incorporating both chopped hyacinths, and thickened sediment would be as noted in Figure R-15.

Figure R-15 Material Balance for Composting WHS™ harvest and thickened sediments.



Comment 16: Page 22, Item 7: *Composting pad made of compacted soil is not realistic. Composting pad should be constructed with 1 foot of stabilized subbase and 1 foot of crushed concrete at $6.90 SY.*

Reply 16: Clay, or sand/clay mix is used commonly as a compost subbase. Crushed concrete is not recommended as it will contaminate the product. It is likely that the existing soils are a sand clay blend, suitable for a compost pad. If the soils are too sandy, they can be stabilized with soil cement or clay additives.

Comment 17: Page 22, Item 9: *List of equipment does not include Tractor PTO, tandem harvesting Grapple/Process Unit, Transfer Trailer, front end loaders for turning windrow piles, etc.*

Reply 17: Tractors are mentioned—all but the smallest tractors come with PTO. The harvesting, processing and transport equipment mentioned include the tandem harvesting Grapple/Process Unit, as well as the transport trailer. Loaders are also listed, as are mixers, which are attachments to the loaders. These mixers (Brown Bear) will be used to turn the compost piles.

Comment 18: Page 24, Estimated annual cost of Single Stage WHS™ System Operation: *List price for "Best Case" is missing a zero*

Reply 18: This will be corrected.

Comment 19: Page 24, Table 9, Title: *Table should be relabeled as "Capital and operating costs for MAPS Nutrient Recovery Facility". Currently mislabeled as surface-flow constructed wetlands.*

Reply 19: This will be corrected.

Comment 20: Page 24, Table 9, Inflow Transmission Main Costs: *Costs listed for capital and annual operating are low for 300-cfs (194-mgd) transmission main. See revised excel spreadsheet with updated costs.*

Reply 20: Transmission Line costs can be adjusted to $645,540 capital and $6,455/yr O&M **.**

Comment 21: Page 24, Table 9, Costs: *Costs listed for capital and annual operating do not match those provided in text.*

Reply 21: Section 5 costs are presented as a proposed fee, i.e. the fee HydroMentia would require to conduct the project as a design-build-operate (DBO) project. They do not include the Influent pump station or transmission line, but do include engineering.

Comment 22: Page 24, Table 9, Footnote 4: *As a point of clarification, it is assumed that Hydromentia engineering costs are included in the capital costs listed for Single Stage WHS Facility. The costs for Engineering and Project Contingency (mislabeled as Engineering, Overhead and Legal) are consultant engineering costs.*

Reply 22: This issue needs to be clarified during our upcoming discussion.

Comment 23: Page 25, Table 10, Issues: *Same issues as described for items 18 through 21.*

Reply 23: Same as for Table 9

Comment 24: Page 25, Section 7.0, Item 2: *Behavior is misspelled.*

Reply 24: Typo missed by spell check, or more likely, person using spell check. This will be corrected.

Comment 25: Page 25, Section 7.0, Item 6: *"T" should be identified. It is assumed to be temperature.*

Reply 25: "T" is for temperature. This will be corrected.

Comment 26: Page 26, Figure H: *"bench" should be replaced with "pilot"*

Reply 26: We can make this change. However, to us pilot implies testing of a new technology. What we will be doing is verifying design parameters for an established technology, hence the concept of a "bench" rather than "pilot". Perhaps "test unit" would work.

APPENDICES

Comment A1: Appendix C, Earthwork Calculations*: Confusing.*

Reply A1: Will clarify during our upcoming discussions. The concept is to build the berms from the pond cut, so there is a balance.

Comment A2: Appendix C, Fine Grading: *As a point of clarification, 9000 SY of paved road is sufficient to provide 1.30-miles of 12 feet wide (i.e., single lane) access road. Access road should be two lane (i.e., 24 feet wide) and distance from US-17 to P-11 is 14,400 ft (2.7 miles) following along existing dirt road. Total pavement required is 38,400 SY at a cost of $15.03 SY, total estimated cost is $577,000.*

Reply A2: Is it required to have the entire length paved?? We will discuss this during our upcoming discussion.

Comment A3: Appendix C, Influent and Effluent Laterals: *10" SDR 35 PVC pipe material cost is $15 LF uninstalled (Means 2005). Installation will add $30 LF*.

Reply A3: Attached as Table R-A2 are some rather recent quotes for SDR 35 Bell & Spigot, water tight low pressure HDPE, and Sch 40 PVC pipe from local suppliers. These quotes may be 2-3 years old, so we understand there would be likely have been an increase. The installation of this pipe, within a shallow trench (3-4 ft) for gravity flow is comparatively inexpensive—remember these are just transfer pipes, and installation can be done quickly using 2-3 men and a backhoe. Our contractors at Okeechobee, for example, recently installed approximately 1,200 ft 6" SDR 35 PVC low-pressure force main, at the rate of 500 ft/day. Considering labor and equipment, a backhoe and a 3-man crew might cost $1,500/day, or $3.00/ft. If the system needed deep burial, or extensive infrastructure interference, or involved extensive pressure, or dewatering and problem soils were an issue, the higher pricing may be applicable. This is a matter that needs to be discussed further during our discussion.

PIPING S-154 APBWT Prototype

				SOMERS IRRIGATION		HUGHES	
				Material	Total	Material	Total
			length	Price	Material	Price	Material
Size	**Material**	**Style**	**ft**	**$/ft**	**$$**	**$/ft**	**$$**
1"	PVC	Sch 40 Solvent Weld	300	$0.75	$225.00	$0.13	$39.00
1.5"	PVC	Sch 40 Solvent Weld	200	$0.20	$40.00	$0.21	$42.00
2"	PVC	Sch 40 Solvent Weld	100	$0.28	$28.00	$0.27	$27.00
3"	PVC	Sch 40 Solvent Weld	620	$0.54	$334.80	$0.56	$347.20
4"	ADS	Sock Drain	1000	$0.31	$310.00	$0.44	$440.00
4"	PVC	SDR 35 B&S	1300	$0.47	$611.00	$0.81	$1,053.00
6"	PVC	SDR 35 B&S	2405	$1.02	$2,453.10	$1.26	$3,030.30
8"	PVC	SDR 35 B&S	663	$1.84	$1,219.92	$2.17	$1,438.71
10"	PVC	SDR 35 B&S	2106	$2.90	$6,107.40	$3.42	$7,202.52
12"	PVC	SDR 35 B&S	611	$4.16	$2,541.76	$4.89	$2,987.79
18"	PVC	SDR 35 B&S	1300	$10.40	$13,520.00	$11.37	$14,781.00
24"	HDPE	Water Tight Joint (ADS)	1360	$9.26	$12,593.60	$10.00	$13,600.00

Comment A4 :Appendix C, Influent and Effluent Laterals: *Costs for boot and valves appear to be for materials only and do not include installation. Installation costs need to be considered. Includes both.*

Reply A4: The boot costs include installation—as the material costs are very minimal—a few sf of HDPE liner. Most of the cost is in extrusion welding. The valves are very low-tech as used in the Aquaculture industry. Installation typically can be done by one person in about 30 minutes.

Comment A5: Appendix C, Influent and Effluent Laterals: *Cost for screening, piping and grating for effluent riser of $478 (i.e., $4000 - $3,528) is not sufficient for materials and installation. The unit price of $587/cy for CIP includes both materials and installation. To combines these with costs for screening, piping and grating requires both materials and installation costs be considered*.

Reply A5: The screening is 4-5 ft plastic coated chain link type as noted in Figure R-2, and requires about 20 ft per unit, including 4 posts, which are placed in the slab. The effluent riser is a small stick (2-4 ft) of PVC SDR 35. The walkway would likely be about 6 sf of fibergrate, secured to the concrete. The total cost of purchasing and installing these items at $478 is reasonable.

Comment A6: Appendix C, Roads: *Compacted soil is not sufficient for routine transportation of heavy equipment (tractor PTO, tandem harvest grapple/processor unit, transfer trailer and front end loaders. All maintenance roads will be constructed with 1 foot of crushed limestone.*

Reply A6: It is our opinion that compacted soil roads are suitable for typical farming equipment. However, we admit that for long term, crushed shell or limestone (6” should be sufficient) would provide a superior surface. This can be discussed during our upcoming discussion.

Comment A7: Appendix C, Discharge Piping: *48-inch culvert unit price for materials and installation is $112.50 LF (Means, 2005) or $114 LF (FDOT, 2002 inflated to January, 2005). Use $112.50 LF.*

Reply A7: This adjustment can be made.

Comment A8: Appendix C, Construction Cost Estimate: *See listed Items below:*

(a) *In general, it is wise to provide one column for material unit costs, another for installation unit costs and third column for total unit costs. This makes it easier to understand cost estimates and insures installation costs are not missing, which is the most common mistake. In the case where unit costs include both materials and installation, “included” is listed in unit material and unit installation cost columns and the listed unit cost that includes both is provided in the total unit costs. Please be aware that installation costs include cost of labor and cost of equipment use. In a design level cost estimate, both of these would be considered separately as shown in the unit cost spreadsheet. For a conceptual design level cost estimate, this is not necessary.*

Reply A8(a): You may note that for major items, such as HDPE geomembrane, we segregate material from installation. We are aware that the installation includes both labor and equipment. In the case of the geomembrane the unit costs are from recent contractor quotes, and are very reliable. Most of the costs with earthwork, in this case, involve very little material costs. Most of the equipment is “drive on” type equipment, such as harvesters, mixers, choppers, etc and require little actual installation, outside of the manufacturer’s start-up and check-out. We will attempt to provide a more detailed spreadsheet following our upcoming discussions, to ensure that all involved costs are included.

(b) Earthwork: Estimation for excavation, grading and compaction, which appears to include the costs of constructing levees around MAPS WHS™™ cells is not representative of actual costs. Standard levee unit construction costs was provided at $148.58 LF. This includes the costs of Earthwork for constructing the levee, costs for constructing the sloped embankments and the 12-inch of consolidated stone for a maintenance road. This cost is comparable with average district levee construction quoted at $155.17 LF. Based on the need for approximately 40,000 feet of levees, estimated construction costs is $6 million (only for levees). This does not include the other costs considered in the $2.7 million listed in the table. Granted proposed levee design is different from district standard design, but not substantially different to justify a $3.3 million savings. Given the higher angle slope on the interior side, it would not be surprising if the proposed levee design wouldn’t cost more, but given the accuracy of this estimate, the cost for a standard levee design is probably sufficient.

Reply A8(b): We do not consider the berms around the WHS™™ to be a typical levee, which we feel represents a ground-up enclosure to isolate an expansive area, and generally requires the development of a rim canal or a borrow pit, from which soil will be transported. Also, the vision of a levee is more formidable in terms of height and base width than what we envision for the berms. As opposed to levees, berms are the result of a cut-fill balance with a pond excavation, and involves a dozer pushing dirt as the pond is shaped to the periphery, where the berm is then shaped, an compacted in lifts. We used the excavating and grading costs provided by your office of $7.44/cy, which is considerably higher than what we have paid for similar earthwork. We did not add the 12” of limerock as discussed earlier. At $14.89/cy, for 40,000 ft of 20 ft wide road, this would add about $447,000. If we also included the $3.03/cy for construction of sloped embankments, this would add an additional $1.13 million if we apply this to the entire soil volume, bringing the total after topsoil removal, to $4.36 million, or $108/lf. This is the same methodology your office used in developing the unit levee costs based upon items 1.03, 1,07 and 1.09 of your unit cost sheet for project identified as #743785. While we believe the project can be done for considerable less than this, we will adjust our costs accordingly.

(c) Hydraulic Structures, Influent Structures: Combining materials and installation costs, estimate should be closer to $500k. See A3 and A4 for details.

Reply A8(c): Please note our responses to A3 and A4, as why we believe these are reasonable costs.

(d) Hydraulic Structures, Effluent Structures: Unit costs are not sufficient for materials and installation. See A5 for details.

Reply A8(d): Please note our responses to A5, as why we believe these are reasonable costs.

(e) Hydraulic Structures, Discharge Piping and Structure: Unit costs are not sufficient for materials and installation. See A7 for details.

Reply A8(e): Please note our responses to A7.

(f) Equipment: As a point of verification, all major equipment for biomass recovery and residuals management needs to be individually listed and priced out to ensure nothing is missing.

Reply A8(f): We will discuss this issue in our upcoming discussions.

(g) Buildings, Administrative: Average cost is $180/sf.

Reply A8(g): We envision an administrative building as a mobile or modular building, which costs far less than $180/sf.

Buildings, Maintenance: Average cost is $130/sf.

Reply A8(h): We envision a maintenance "building" to be pole barn type structure with an earthen floor used mostly for vehicle storage.

Buildings, Well Drinking Water: Allowance $30,000.

Reply A8(i): We will adjust accordingly.

Buildings, Sanitary System (Septic Tank): Allowance $30,000.

Reply A8(j): We will adjust accordingly.

(h) Site Landscaping & Maintenance, Fencing: Unit price is $14.50 LF

Reply A8(k): We will adjust accordingly.

(i) Site Landscaping & Maintenance, Sod: Unit price is $0.22 SF

Reply A8(l): We will adjust accordingly.

(j) Electrical, Site Lighting: Include allowance for $50,000.

Reply A8(m): We will adjust accordingly.

(k) Patent Use Fees: Will there be patent use fees? If one time fee, than cost of fee should be listed under capital costs. If annual fee, than costs should be listed in annual costs. Patent duration and payment schedule should also be provided.

Reply A8(n): We will discuss this during our upcoming discussions

Comment A9: Appendix E, Operating Cost Calculations: *See listed Items below:*

(a) Removal of solids from WHS™ unit: Solids handling needs to be more thoroughly thought-out. See Item 15 for details. Dredging costs at $2.00 cy is not realistic and does not include processing costs.

Reply A9(a): Please see Reply 15

What is the provided statement in the narrative referencing to???: "Conservatively, about 100 gallons/day is projected, or about 37,000 gallons/yr. This is set at 50,000 gallons/year."

Reply A9(b): A reference indicator should have been included. This refers to fuel consumption.

(b) Laboratory Costs: Increase allowance to $30,000 per year.

Reply A9(c): This will be adjusted.

(c) Annual costs do not include patent use fees: Will these be charged annually or one-time fee? If one time fee, than costs need to be listed individually and provided in capital costs? Patent duration and payment schedule should also be provided.

Reply A9(d): This item needs to be discussed during our upcoming discussion.

APPENDIX B. HMI EQUIPMENT SPECIFICATIONS

Model 401-P HYACINTH PROCESSOR

HydroMentia's Model 401 Processor is unchallenged in the aquatic plant management industry with its economical and mobile design and engineering. Developed for efficient and cost effective processing of large volumes of harvested plant biomass, the Model 401-P combines a century of land based forage system design with over two decades of floating aquatic plant system processing.

HydroMentia processing equipment, patented for its innovative approach are well suited for both perimeter and centralized biomass recovery and processing facilities.

The Model 401 Processor is designed to be used with HydroMentia's Model 101-G Grapple. Biomass recovered via the grapple system is directly introduced into the Model 401-P, or recovered biomass may be transported via HydroMentia's patented conveyance system to a central biomass processing system. At the central processing facility a traveling screen separates the recovered biomass from the conveyance

water, introducing the plant material to the Model 401-P.

The design features maximize accessibility to all components to facilitate and minimize equipment maintenance and repairs.

The HydroMentia Model 301 Processor is designed and manufactured to provide the latest advances in processing technologies, combined with quality workmanship, for a system that is fully warranted for complete customer satisfaction

Upper Photo

Model 101-G Grapple Recovering Plant Biomass From a WHS™ Treatment Unit

Lower Photo

HydroMentia Model 401-P Processor

MODEL 301 HAYCINTH PROCESSOR

Specifications:

GENERAL DESCRIPTION AND FUNCTION

The Model 401-P Processor is a trailer mounted, floating aquatic plant biomass processing unit which can be supplied as a mobile unit, or as a stationary unit, and which can be equipped with interface with a standard PTO, or direct drive from diesel, gasoline, or electrical power units. The processor is designed specifically for conditioning, chopping and conveying the floating aquatic plant, the water hyacinth (*Eichhornia crassipes* [Mart] *solms)*, with a field verified capability of not less than 40 wet tons per hour.

The Model 401 Processor reduces plant material into a chopped product, with a significant percentage of the particles between 0.25-1.00 in^2 in size. The final chopped hyacinth product has a typical a density, as delivered, of 20-45 lb/ft^3, with the final density dependent upon the initial morphology of the harvested plant material.

MECHANICAL COMPONENTS

The Model 401 Processor is of sturdy steel construction, with materials and coating selected to suit the applied environment. Stainless steel and aluminum may be used when applicable and practical.

Mechanical components include:

A mounting trailer with associated power units, including the option to be a self- driven unit.

A receiving box of a size capable of capturing released loads of harvested plants, and containing this load as plant material is captured by the header.

A header unit composed of two counter-rotating screws designed to capture plant material as they contact the screws, and quickly compress and convey the plants into the forage chopper unit.

A forage chopper with mounting and speed modified to accommodate wet plant material, with the chopper being a standard unit as manufactured by John Deere, and others.

An enclosed screw conveyor, which collects and transports chopped material from the forage chopper to an external delivery site.

Other input and output conveyance systems as required to accommodate the operational strategy for a specific application.

POWER AND CONTROL

The Processing unit uses chain drives, with associated gearing as required to maintain required RPM for each unit. Chain systems are be labeled and contained within a safety shroud. The primary power can be through PTO, direct diesel or gasoline engine, or even electrical motor when placement is stationary. Power transfer is through direct drive, with transfer to the drive chains. The p be design to facilitate ready access to bearings and grease ports.

MANUFACTURER

The Model 401-P is designed and fabricated by HydroMentia, Inc. of Ocala, Florida. All units are provided with start-up and field verification services by HydroMentia, and shall be warranted for workmanship for a period of one-year from purchase.

HydroMentia, Inc.
3233 SW 33rd Street
Ocala, FL 34474
(352) 237-6145

The Leader in cost-effective, sustainable nutrient pollution control technologies

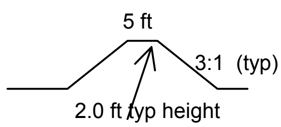
APPENDIX C. CAPITAL COSTS QUANTITY ESTIMATES

1. Facility Total Acreage
    a. Facility dimensions approximately 1,460 ft x 4,500 ft or 151 acres.

2. Perimeter Fencing
    a. 5-Strand Barbed Wire—12,000 ft
    b. Chain Link 900 ft around maintenance/admin area.

3. Roads
    a. A paved road will be required for the entrance, and this will terminate at the southern end of the compost area and the operations building. All other roads will be compacted soil, which is ample for accommodating farm equipment needed for operations.
    b. Pump Station P-11 paved access road 37,000 sy
    c. WHS™ Access Road equals 1000 ft x 100 ft = 100,000 sf or 11,111 sy

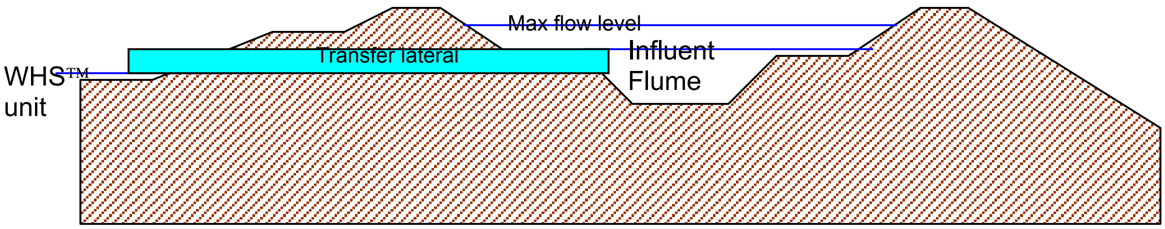
4. Sitework
    a. Imported fill for WHS™ typical berm: Total berm length is (4,026 ft x 5) + (1,064ft x 3) = 23,322. Add flumes and reaeration lagoon another 8,000 lf. Total berm length therefore equal to 31,322 lf.
    b. Berm from imported fill around thickening pond. Cross sectional area 22 sf or 0.815 cy/lf at $11.39/cy (No road) or $9.28/lf.



Length 2,318 x $9.28 = $21,511 (1,889 cy)

    c. Stormwater lagoon associated with thickening pond, about $17.72/lf (3 ft high). 500 ft x $17.72 = $8,860
    d. Topsoil Stripping 6” over 105 acres = 84,700 cy
    e. 10” Soil cement Compost Pad = 2,150 x 84 = 180,600 sf or 20,067 sy. Thickening Pad 153 x 1,000 = 153,000 sf or 17,000 sy. Add 6,000 cy for storage pads. Total 43,067 sy.
    f. Concrete Ramp Thickening Pad: 1’ thick x 60 ft x 20ft = 1,200 cf or 44 cy
    g. 8” Sediment FM. Total Length about 9,000 ft. Fittings and valves. Four 250 psi NRS 8” Gate Valve for Buried Service. Four 8” air relief devices. Two 8” crosses. 40-8” flanged connection with wye fitting.

5. Flumes
    a. Now consider the influent and effluent flumes. It is desired to generate some velocity in these flumes, particularly the effluent flume, at ADF (about 62 cfs), while ensuring it can handle the max flow at 300 cfs. A 3 ft depth at 10 ft wide would provide close to 2 fps at ADF, at least in the up front sections. In the end sections, it can be anticipated that some settling may occur, and this will need to be considered in the design phase—perhaps by altering the cross sectional area in the distal sections, or perhaps just establishing a periodic maintenance regime. At max flow, a cross sectional area of about 150 sf would be required to maintain 2 fps. This suggests an influent design cross section as shown below:



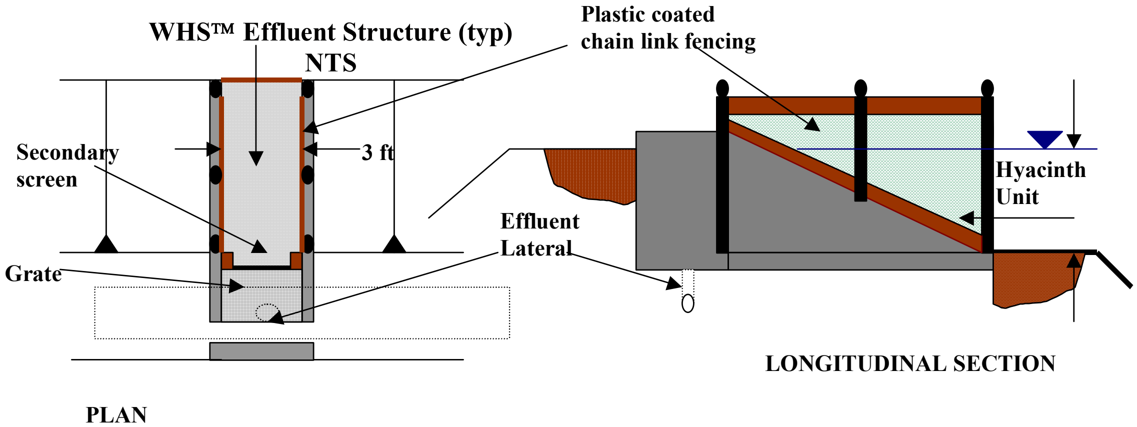
6. Fine Grading
   a. Fine grading would typically apply to subbase for concrete pad or paved road.

7. HDPE Liner
   a. Liner is required for the influent and effluent flumes and the reaeration basin. The influent flume has a wetted perimeter of about 130 ft on the cross section, over 1,200 ft, this amounts to 156,000 sf. Add 20% for burial and corners, or 187,200 sf. The effluent flume may be considered about the same. The reaeration lagoon has a wetted perimeter of about 230 ft, therefore considering the length of 1357 ft, and adding 20%, the liner area is estimated at 375,000

      Influent Flume----187,200 sf
      Effluent Flume----187,200 sf
      Reaeration Lagoon----375,000 sf
      i. TOTAL LINER 40 mil HDPE 749,400 sf

8. Influent and Effluent Laterals
   a. There is anticipated to be 60 influent transfer pipes. These will be 10" SDR 35 PVC, with low-pressure butterfly valves (Pond Dam Piping type), booted into the HDPE. Each boot costs $100. Each pipe length will be about 60 ft, installed at perhaps $10/ft. The installed valves cost $275 each. The total unit cost then is estimated at $875 or a total of $ 52,500

      Effluent riser: There will be 80 of these. 40transfer from Stage 1 to Stage 2, 40 from stage 2 to the effluent flume. They will consist of a concrete entrance box as shown below. The estimated cy of CIP for the box is 6 cy, or at $587/cy about $3,522 each. Including the screening and piping and grating, consider each unit at $4,000, or a total of $320,000.



9. Land area estimates, grassing

    a. Seed and mulch areas will be all back slopes associated with the units, or about 225,000 sf, plus interim areas. The estimate is about 300,000 sf or 6.9 acres, considering a 20% contingency, total grassing area is estimated at 360,000 sf

10. Discharge Piping

    a. Four 48" culverts will be required to handle the effluent flows. These will come from the rearation lagoon, and will transverse perhaps 200 ft, to a discharge area. The outfall will need to be fortified with riprap, or preferably fabriform. A sump will be required at the aeration lagoon for the entrance. The sump and the fabriform spillway can be estimated at about $100,000. The piping, considering the unit prices provided would be 800 ft at $100.40.ft or $80,320. Therefore, discharge piping and support is estimated at $180, 320. Unit costs for 48" CMP (Item No. 1.13) was provided by Parsons at an installed cost of $100.40/lf.

Following are the Capital Cost Estimate Worksheets for the WHS™ Nutrient Recovery Facility:

Worksheet 1 of 3

FILE NAME: Lake Hnck Capital Costs Rev 3

HydroMentia, Inc.

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.: — M.T.O. BY: — DATE:

PROJECT: Lake Hancock Outfall Treatment Project Rev 3 — **Project Description** — PRICED BY: Mark Zivojnovict — DATE: 05/08/05

CLIENT: SWFWMD — **Estimate Type**: — CHECKED BY: Allen Stewart — DATE: 05/08/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**								
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	130	Ac	$ -	$ 2,360.00	$ -	$ 306,800.00	$ 2,360.00	$ 306,800
1.02	Tree Removal (Larger then 12" dia.)	0	Ea	$ -	$ 315.40	$ -	$ -	$ 315.40	$ -
1.03	Earth Work (excavation and grading)	0	Cy	$ -	$ 7.44	$ -	$ -	$ 7.44	$ -
1.04	Tree Protection	0	Lf	$ 0.50	$ 1.26	$ -	$ -	$ 1.76	$ -
1.05	Stripping Top Soil	84,700	Cy	$ -	$ 0.74	$ -	$ 62,678.00	$ 0.74	$ 62,678
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts imported soils)	0	Cy	$ 9.00	$ 2.39	$ -	$ -	$ 11.39	$ -
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	0	Cy	$ -	$ 3.03	$ -	$ -	$ 3.03	$ -
1.08	Final Grading	11,111	Sy	$ -	$ 3.44	$ -	$ 38,221.84	$ 3.44	$ 38,222
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	0	Cy	$ 8.00	$ 1.91	$ -	$ -	$ 9.91	$ -
1.10a	3" Asphalt Conc. Pavement - WHS™ Access	11,111	Sy	$ 3.50	$ 4.64	$ 38,889	$ 51,555.04	$ 8.14	$ 90,444
1.11a	12" Compacted Limerock Base - WHS™ Access Road	3,704	Cy	$ 13.00	$ 1.89	$ 48,152	$ 7,000.56	$ 14.89	$ 55,153
1.12	12" Stabilized Subbase	0	Cy	$ 4.00	$ 1.80	$ -	$ -	$ 5.80	$ -
1.13	48' CMP	0	Lf	$ 69.00	$ 31.40	$ -	$ -	$ 100.40	$ -
1.14	Construction of WHS™ Berm	31,322	Lf	$ 72.72	Inlcuded	$ 2,277,736	$ -	$ 72.72	$ 2,277,736
1.15	10" Soil Cement - Compost and Sediment Dewatering Pads	43,067	Sy	$ 8.00	Inlcuded	$ 344,536	$ -	$ 8.00	$ 344,536
1.16	Construction of Berm for Thickening Pond	1,889	Cy	$ 9.00	$ 2.39	$ 17,001	$ 4,514.71	$ 11.39	$ 21,516
1.17	Construction of Berm for Thickening Pond Stormwater Treatment	778	Cy	$ 9.00	$ 2.39	$ 7,002	$ 1,859.42	$ 11.39	$ 8,861
2.00	**Concrete**								
2.01	Slab on grade	44	Cy	$ 203.00	$ -	8,932.00	$ -	$ 203.00	$ 8,932
2.02	Conventional walls	0	Cy	$ 371.00	$ -	0.00	$ -	$ 371.00	$ -
2.03	Elevated Work	0	Cy	$ 473.00	$ -	0.00	$ -	$ 473.00	$ -
2.04	Columns	0	Cy	$ 486.00	$ -	0.00	$ -	$ 486.00	$ -
3.00	**Geomembrane**								
3.01	HDPE Liner	749,400	Sf	$ 0.193	$ 0.120	$ 144,634	$ 89,928	$ 0.313	$ 234,562
3.02	Liner Entrenchment	10,000	Lf	$ -	$ 3.15	$ -	$ 31,500	$ 3.15	$ 31,500
3.03	Floating Boom	29,000	Lf	$ 4.50	$ 0.07	$ 130,500	$ 1,914	$ 4.57	$ 132,414
3.04	Floating Boom & Dredge Anchors	290	Each	$ 11.20	$ 4.20	$ 3,248	$ 1,218	$ 15.40	$ 4,466
4.00	**Hydraulic Structures**								
4.01	Influent Structures	60	Each	$ 875.00	Included	$ 52,500	$ -	$ 875.00	$ 52,500
4.02	Effluent Structures	80	Each	$ 4,000.00	Included	$ 320,000	$ -	$ 4,000.00	$ 320,000
4.03	Discharge Piping Structure	1	Each	$ 180,320.00	Included	$ 180,320	$ -	$ 180,320.00	$ 180,320
4.04	Stormwater Culverts	1	Lump Sum	$ 12,000.00	Included	$ 12,000	$ -	$ 12,000.00	$ 12,000
4.05	Dredge PVC Distribution Line - 8"	9,000	Lf	$ 3.25	$ 11.00	$ 29,250	$ 99,000	$ 14.25	$ 128,250
4.06	Dredge Distribution Line GateValves - 8"	4	Each	$ 300.00	$ 200.00	$ 1,200	$ 800	$ 500.00	$ 2,000
4.07	Dredge Distribution Line Air Relief Valves - 8"	4	Each	$ 300.00	$ 200.00	$ 1,200	$ 800	$ 500.00	$ 2,000
4.08	Miscellaneous Piping	1	Lump Sum	$ 12,000.00	Included	$ 12,000	$ -	$ 12,000.00	$ 12,000

Worksheet 2 of 3

FILE NAME: Lake Hnck Capital Costs Rev 3

HydroMentia, Inc.

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.:			M.T.O. BY:		DATE:
PROJECT:	Lake Hancock Outfall Treatment Project Rev 3	Project Description	PRICED BY: Mark Zivojnovich		DATE: 05/08/05
CLIENT:	SWFWMD	Estimate Type:	CHECKED BY: Allen Stewart		DATE: 05/08/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
5.00	**Buildings**								
5.01	Maintenance & Equipment Storage	2,500	Sf	$ 15.00	Included	$ 37,500	$ -	$ 15.00	$ 37,500
5.02	Adminstrative & Staff Facilities	600	Sf	$ 60.00	Included	$ 36,000	$ -	$ 60.00	$ 36,000
5.03	Well, Drinking Water	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
5.04	Sanitary Facilties, Septic	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
5.05	Fuel Storage	1	Lump Sum	$ 30,000.00	Included	$ 30,000	$ -	$ 30,000.00	$ 30,000
6.00	**Site Landscaping & Maintenance**								
6.01	Fence - Chain Link	900	Lf	$ 14.50	Included	$ 13,050	$ -	$ 14.50	$ 13,050
6.02	Fence - 5-Strand Barbed Wire	12,000	Sf	$ 1.75	Included	$ 21,000	$ -	$ 1.75	$ 21,000
6.03	Seed & Mulch	360,000	sf	$ 0.0266	Included	$ 9,576	$ -	$ 0.027	$ 9,576
6.04	Sod	10,000	Sf	$ 0.22	Included	$ 2,200	$ -	$ 0.220	$ 2,200
7.00	**Equipment**								
7.01	Valtra Model T170 with Brown Bear PTOPA- 10.5 Compost Aerator	1	Each	$ 128,000.00	NA	$ 128,000	$ -	$ 128,000.00	$ 128,000
7.02	John Deere Model 7420 - 115 hp	1	Each	$ 80,000.00	NA	$ 80,000	$ -	$ 80,000.00	$ 80,000
7.03	John Deere Model 7420 - 115 hp - with Loader	1	Each	$ 86,000.00	NA	$ 86,000	$ -	$ 86,000.00	$ 86,000
7.04	HMI Model 101-G Grapple	2	Each	$ 42,000.00	NA	$ 84,000	$ -	$ 42,000.000	$ 84,000
7.05	HMI Model 401-P Processor	1	Each	$ 98,000.00	NA	$ 98,000	$ -	$ 98,000.000	$ 98,000
7.06	Miller Model 5300 Series Forage Wagon	2	Each	$ 18,200.00	NA	$ 36,400	$ -	$ 18,200.000	$ 36,400
7.08	60" Dixie Chopper Mower	1	Each	$ 8,900.00	NA	$ 8,900	$ -	$ 8,900.000	$ 8,900
7.09	Trimmers & Misc Lawn Equipment	1	Lump Sum	$ 2,000.00	NA	$ 2,000	$ -	$ 2,000.000	$ 2,000
7.10	All Terrain Vehicles	1	Each	$ 3,000.00	NA	$ 3,000	$ -	$ 3,000.000	$ 3,000
7.11	Tools & Incidental Equipment	1	Lump Sum	$ 5,000.00	NA	$ 5,000	$ -	$ 5,000.000	$ 5,000
7.12	House Model HDC 181A153 Aerators	8	Each	$ 8,100.00	$ 100.00	$ 64,800	$ 800	$ 8,200.000	$ 65,600
7.13	Sigma 900 Autosamplers with Housing	2	Each	$ 4,500.00	$ 500.00	$ 9,000	$ 1,000	$ 5,000.000	$ 10,000
7.14	LWT Model RCLPES Hydraulic Dredge - 600 gpm	1	Each	$ 100,000.00	Included	$ 100,000	$ -	$ 100,000.000	$ 100,000
7.15	Supernatant Pump Station	1	Lump Sum	$ 40,000.00	Included	$ 40,000	$ -	$ 40,000.000	$ 40,000
7.15	6" Telescoping Valve	1	Each	$ 1,200.00	$ 100.00	$ 1,200	$ 100	$ 1,300.000	$ 1,300
8.00	**Electrical**								
8.01	Electrical Equipment & Installation	1	Lump Sum	$ 50,000.00	NA	$ 50,000	$ -	$ 50,000.00	$ 50,000
	TOTAL CONSTRUCTION								$ 5,334,415
	Contingency 20%								$ 1,066,883
	Mob/Demob 5%								$ 266,721
	Permits 1%								$ 53,344
	Bonds 1%								$ 53,344
	Insurance 1%								$ 53,344
	Sales Tax	Equipment & Materials		$1,842,478					$ 128,973
	Total Construction Costs								$ 6,957,025
	Engineering & Overhead (15%)								$ 1,043,554
	TOTAL CAPITAL COSTS								$ 8,000,579

Worksheet 3 of 3

FILE NAME: Lake Hnck Capital Costs Rev 3

HydroMentia, Inc.

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.:			M.T.O. BY:		DATE:
PROJECT:	Lake Hancock Outfall Treatment Project Rev 3	Project Description	PRICED BY: Mark Zivojnovich		DATE: 05/08/05
CLIENT:	SWFWMD	Estimate Type:	CHECKED BY: Allen Stewart		DATE: 05/08/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
	Items Required for Levee Construction (Footnote 1):								
1.03	Earth Work (excavation and soils removal)	$60.00	LF						
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	$25.00	LF						
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	$86.00	LF						
	Total = Lf of Levee	$171.00	LF						

Footnote 1 - Complete construction of STA levee includes items 1.03, 1.07 and 1.09 from above
Typical perimeter levee cross section is 168 ft base, 14 ft top, 9 ft high, 3:1 slope

1.14 Construction of WHS™ Berm, Costs provided by Parson, Feb 2005
1.15 10" Soil Cement - Compost and Sediment Pads, Costs provided by Parson, Feb 2005
3.01 HDPE Liner, Comanco 2002 Costs adj to 2005
3.02 Liner Entrenchment, Comanco 2002 Costs adj to 2005
3.03 Floating Boom, Feb 2005 Price Quote from American Marine, Cocoa, FL
4.05 Dredge PVC Distribution Line - 8", Feb 2005 Price quote for Material from Summers Irrigation, Sebring, FL
5.01 Maintenance & Equipment Storage, Metal Structure with Concrete Slab, Feb 2005 Price Quote Provided by G.M. Worley Construction, Okeechobee, FL
5.02 Adminstrative Building, 2 Offices, restroom and break room located inside Maintenace & Equipment Stoarge Buliding - Feb 2005 Price Quote from G.M. Worley Construction, Okeechobee, FL
5.03 Well, Drinking Water Facilties Allowance provided by Parsons - Feb 2005
5.04 Sanitary Facilties, Septic Allowance provided by Parsons - Feb 2006
6.01 Fence, Chain Link costs provided by Parsons -Feb 2005
6.02 Fence - 5-Strand Barbed Wire, 3.5-4" Post at 14' centers - Feb 2005 Price Quote from R&R Fencing, Webster, Florida (Material and Labor Included)
6.03 Seed & Mulch - DOT Spec - Feb 2005 Proce Quote from Bennett Grasssing, Tampa, FL (Materials & Labor Included)
6.04 Sod cost provided by Parsons - Feb 2005
7.01 Valtra Model T-170 (170 hp) with Brown Bear Aerator, High Capacity Bucket, Feb 2005 Price Quote, Suwannee Equipment, Live Oak, FL
7.02 John Deere Model 7420 - 115 hp - -Feb 2005 Price Quote from Everglades Tractor, Okeechobee, FL
7.04 HMI Model 101-G Grapple, Feb 2005 HMI Quote
7.05 HMI Model 401-P Processor, Feb 2005 HMI Quote
7.06 Miller Model 5300 Series Forage Wagon - Feb 2005 Proce quote from Miller-St. Nazianz, Inc., St. Nazianz, Inc.
7.07 Brown Bear PTOP A35C-10.5 Mixer - Feb 2005 Brown Bear Corp, Corning, IA
7.08 60" Dixie Chopper Mower, Nov 2004 Price Quote from Lawn Tamer Equipment, Okeechobee, FL
7.12 House Model HDC 181A153 Aerators, Oct 2004 Price Quote from House Manufacturing, Cherry Valley, AR
7.13 Sigma 900 Autosamplers with Housing
7.14 LWT Model RCLPES Hydraulic Dredge - 600 gpm, Feb 2005 Quote from LWT Inc, Somerset WI

Following are the Capital Cost Estimate Worksheets for the Pump Station Access Road:

Worksheet 1 of 1

FILE NAME: n & Site Work (Pump Road)

HydroMentia, Inc.

	ENGINEER ESTIMATE WORKSHEET	Budgetary Cost Estimate			
JOB NO.:			M.T.O. BY:	DATE:	
PROJECT:	Lake Hancock Outfall Treatment Project	Project Description	PRICED BY: Mark Zivojnovich	DATE:	02/18/05
CLIENT:	SWFWMD	Estimate Type:	CHECKED BY: Allen Stewart	DATE:	02/19/05

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	UNIT RATES INSTALLATION	MATERIAL/ EQUIPMENT COST	INSTALLATION COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**								
1.08	Final Grading	37,000	Sy	$ -	$ 3.44	0.00	$ 127,280.00	$ 3.44	$ 127,280
1.10b	3" Asphalt Conc. Pavement - Pump Station Access	37,000	Sy	$ 3.50	$ 4.64	129,500.00	$ 171,680.00	$ 8.14	$ 301,180
1.11b	12" Compacted Limerock Base - Pump Station Access	12,333	Cy	$ 13.00	$ 1.89	160,329.00	$ 23,309.37	$ 14.89	$ 183,638
	TOTAL CONSTRUCTION								$ 612,098
	Contingency 20%								$ 122,420
	Mob/Demob 5%								$ 30,605
	Permits 1%								$ 6,121
	Bonds 1%								$ 6,121
	Insurance 1%								$ 6,121
	Sales Tax	Equipment & Materials		$484,818					$ 33,937
	Total Construction Costs								$ 817,423
	Engineering & Overhead (25%)								$ 204,356
	TOTAL CAPITAL COSTS								$ 1,021,779

APPENDIX D. 29-YEAR MONTHLY FLOWS AND LOAD AVERAGES AND PROPOSED FLOW RECOVERY STRATEGY

TN = 5.53 mg/l
TP = 0.603 mg/l

January

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	579	244	0.20%	0.20%	1,666	182	244
2.6-5	11	79	0.06%	0.26%	540	59	79
5.1-7.5	8	95	0.08%	0.34%	648	71	95
7.6-10	9	167	0.14%	0.48%	1,137	124	167
10.1-15	10	262	0.21%	0.69%	1,786	195	262
15.1-20	10	369	0.30%	0.99%	2,517	274	369
20.1-25	7	393	0.32%	1.31%	2,682	292	393
25.1-30	9	474	0.39%	1.70%	3,235	353	474
30.1-35	4	264	0.22%	1.92%	1,800	196	264
35.1-40	7	534	0.44%	2.35%	3,641	397	534
40.1-50	13	1,186	0.97%	3.32%	8,093	882	1,186
50.1-100	57	8,265	6.75%	10.07%	56,395	6,149	8,265
100.1-200	75	20,991	17.14%	27.21%	143,228	15,618	20,991
200.1-300	29	13,855	11.32%	38.53%	94,534	10,308	13,855
300.1-400	29	19,498	15.92%	54.45%	133,037	14,507	
400.1-500	10	8,795	7.18%	61.64%	60,009	6,543	
500.1-600	8	8,745	7.14%	68.78%	59,671	6,507	
600.1-700	8	8,955	7.31%	76.09%	61,105	6,663	
700.1-800	9	13,420	10.96%	87.05%	91,570	9,985	
800.1-900	4	6,666	5.44%	92.497%	45,487	4,960	
900.1-1000	5	9,187	7.50%	100.000%	62,689	6,836	
	TOTALS	122,444			835,470	91,101	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,222
Total Flow MGD	44.38
Flow at or below 300 cfs MGD	18.93
Total Nitrogen kg	28,809
Total Phosphorus kg	3,141

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	74.01%
Total Nitrogen Captured Annually kg	21,320
Percentage of the time at maximum flow	8.10%
Percentage of Nitrogen at maximum flow	47.94%

TN = 5.53 mg/l
TP = 0.603 mg/l

February

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	515	233	0.19%	0.19%	1,588	173	233
2.6-5	7	49	0.04%	0.23%	334	36	49
5.1-7.5	6	66	0.05%	0.28%	449	49	66
7.6-10	2	34	0.03%	0.31%	233	25	34
10.1-15	8	214	0.17%	0.49%	1,462	159	214
15.1-20	24	902	0.74%	1.22%	6,158	671	902
20.1-25	19	863	0.70%	1.93%	5,887	642	863
25.1-30	15	845	0.69%	2.62%	5,765	629	845
30.1-35	12	778	0.64%	3.25%	5,305	578	778
35.1-40	4	313	0.26%	3.51%	2,138	233	313
40.1-50	10	895	0.73%	4.24%	6,104	666	895
50.1-100	63	9,233	7.54%	11.78%	63,000	6,870	9,233
100.1-200	72	18,774	15.33%	27.11%	128,098	13,968	18,774
200.1-300	39	19,741	16.12%	43.24%	134,702	14,688	19,741
300.1-400	22	14,206	11.60%	54.84%	96,929	10,569	
400.1-500	10	8,922	7.29%	62.12%	60,875	6,638	
500.1-600	2	2,158	1.76%	63.89%	14,725	1,606	
600.1-700	1	1,307	1.07%	64.95%	8,919	973	
700.1-800	9	12,873	10.51%	75.47%	87,834	9,578	
800.1-900							
900.1-1000							
	TOTALS	92,405			630,506	68,751	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,186
Total Flow MGD	33.50
Flow at or below 300 cfs MGD	21.25
Total Nitrogen kg	21,742
Total Phosphorus kg	2,371

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	85.62%
Total Nitrogen Captured Annually kg	18,616
Percentage of the time at maximum flow	5.24%
Percentage of Nitrogen at maximum flow	33.09%

TN = 5.53 mg/l
TP = 0.603 mg/l

March

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	538	246	0.22%	0.22%	1,682	183	246
2.6-5	18	140	0.12%	0.34%	955	104	140
5.1-7.5	9	112	0.10%	0.44%	765	83	112
7.6-10	9	157	0.14%	0.58%	1,073	117	157
10.1-15	9	248	0.22%	0.80%	1,692	184	248
15.1-20	21	791	0.70%	1.51%	5,400	589	791
20.1-25	18	827	0.74%	2.24%	5,644	615	827
25.1-30	6	319	0.28%	2.53%	2,179	238	319
30.1-35	5	315	0.28%	2.81%	2,152	235	315
35.1-40	1	79	0.07%	2.88%	541	59	79
40.1-50	13	1,210	1.08%	3.95%	8,256	900	1,210
50.1-100	62	8,983	7.99%	11.94%	61,295	6,684	8,983
100.1-200	85	23,853	21.21%	33.16%	162,758	17,747	23,853
200.1-300	44	21,624	19.23%	52.39%	147,546	16,089	21,624
300.1-400	17	12,169	10.82%	63.21%	83,030	9,054	
400.1-500	4	3,485	3.10%	66.31%	23,779	2,593	
500.1-600	6	6,454	5.74%	72.05%	44,039	4,802	
600.1-700	13	16,683	14.84%	86.88%	113,833	12,413	
700.1-800	10	14,749	13.12%	100.00%	100,637	10,974	
800.1-900	0	0	0.00%	100.000%	0	0	
900.1-1000	0	0	0.00%	100.000%	0	0	
	TOTALS	112,446			767,255	83,663	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,877
Total Flow MGD	40.76
Flow at or below 300 cfs MGD	22.83
Total Nitrogen kg	26,457
Total Phosphorus kg	2,885

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	78.85%
Total Nitrogen Captured Annually kg	20,860
Percentage of Time at Maximum Flow	5.63%
Percentage of Nitrogen at Maximum Flow	33.56%

TN = 5.53 mg/l
TP = 0.603 mg/l

April

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	488	230	0.26%	0.26%	1,570	171	230
2.6-5	15	115	0.13%	0.39%	785	86	115
5.1-7.5	28	351	0.40%	0.79%	2,394	261	351
7.6-10	13	222	0.25%	1.04%	1,513	165	222
10.1-15	37	956	1.09%	2.13%	6,523	711	956
15.1-20	8	264	0.30%	2.43%	1,800	196	264
20.1-25	16	734	0.83%	3.26%	5,008	546	734
25.1-30	16	902	1.02%	4.28%	6,158	671	902
30.1-35	4	258	0.29%	4.58%	1,759	192	258
35.1-40	12	912	1.04%	5.61%	6,226	679	912
40.1-50	10	897	1.02%	6.63%	6,117	667	897
50.1-100	61	8,884	10.08%	16.71%	60,618	6,610	8,884
100.1-200	95	26,769	30.38%	47.10%	182,652	19,917	26,769
200.1-300	25	12,329	13.99%	61.09%	84,126	9,173	12,329
300.1-400	20	14,106	16.01%	77.10%	96,253	10,496	
400.1-500	11	9,221	10.47%	87.57%	62,919	6,861	
500.1-600	11	10,951	12.43%	100.00%	74,720	8,148	
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	88,101			601,141	65,549	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,038
Total Flow MGD	31.94
Flow at or below 300 cfs MGD	20.86
Total Nitrogen kg	20,729
Total Phosphorus kg	2,260

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	89.46%
Total Nitrogen Captured Annually kg	18,544
Percentage of the time at maximum flow	4.83%
Percentage of Nitrogen at maximum flow	31.71%

TN = 5.53 mg/l
TP = 0.603 mg/l

May

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	690	379	1.10%	1.10%	2,585	282	379
2.6-5	42	326	0.95%	2.05%	2,225	243	326
5.1-7.5	41	514	1.50%	3.55%	3,508	383	514
7.6-10	19	329	0.96%	4.50%	2,243	245	329
10.1-15	5	139	0.40%	4.91%	947	103	139
15.1-20	4	149	0.43%	5.34%	1,015	111	149
20.1-25	2	87	0.25%	5.60%	595	65	87
25.1-30	1	52	0.15%	5.75%	352	38	52
30.1-35	1	69	0.20%	5.95%	474	52	69
35.1-40	2	149	0.43%	6.38%	1,015	111	149
40.1-50	5	470	1.37%	7.75%	3,208	350	470
50.1-100	33	5,576	16.23%	23.97%	38,044	4,148	5,576
100.1-200	33	8,688	25.28%	49.26%	59,278	6,464	8,688
200.1-300	11	7,615	22.16%	71.42%	51,956	5,665	7,615
300.1-400	11	9,822	28.58%	100.00%	67,019	7,308	
400.1-500							
500.1-600							
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	34,362			234,464	25,566	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	1,185
Total Flow MGD	12.46
Flow at or below 300 cfs MGD	9.51
Total Nitrogen kg	8,085
Total Phosphorus kg	882

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	90.46%
Total Nitrogen Captured Annually kg	7,314
Percentage of the time at maximum flow	1.22%
Percentage of Nitrogen at maximum flow	21.06%

TN = 5.53 mg/l
TP = 0.603 mg/l

June

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg
0-2.5	601	242	0.38%	0.38%	1,652	180
2.6-5	16	114	0.18%	0.55%	775	85
5.1-7.5	18	229	0.36%	0.91%	1,560	170
7.6-10	6	94	0.15%	1.06%	640	70
10.1-15	2	52	0.08%	1.14%	352	38
15.1-20	2	69	0.11%	1.24%	474	52
20.1-25	2	83	0.13%	1.37%	568	62
25.1-30	5	282	0.44%	1.81%	1,922	210
30.1-35	14	938	1.46%	3.27%	6,401	698
35.1-40	4	296	0.46%	3.73%	2,017	220
40.1-50	6	559	0.87%	4.60%	3,817	416
50.1-100	37	5,607	8.73%	13.33%	38,260	4,172
100.1-200	64	18,726	29.15%	42.48%	127,773	13,933
200.1-300	42	20,301	31.60%	74.08%	138,519	15,104
300.1-400	19	12,643	19.68%	93.76%	86,265	9,406
400.1-500	2	1,805	2.81%	96.57%	12,316	1,343
500.1-600	2	2,204	3.43%	100.00%	15,036	1,640
600.1-700						
700.1-800						
800.1-900						
900.1-1000						
	TOTALS	64,243			438,346	47,798

MONTHLY AVERAGES	
Flow acre-ft	2,215
Total Flow MGD	23.29
Flow at or below 300 cfs MGD	18.44
Total Nitrogen kg	15,115
Total Phosphorus kg	1,648

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	95.38%
Total Nitrogen Captured Annually kg	14,418
Percentage of the time at maximum flow	2.73%
Percentage of Nitrogen at maximum flow	22.33%

TN = 5.53 mg/l
TP = 0.603 mg/l

July

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	420	180.9	0.13%	0.13%	1,234	135	181
2.6-5	20	142.2	0.10%	0.23%	970	106	142
5.1-7.5	5	60.7	0.04%	0.27%	414	45	61
7.6-10	1	18.6	0.01%	0.29%	127	14	19
10.1-15	2	55.5	0.04%	0.33%	379	41	56
15.1-20	4	144.8	0.10%	0.43%	988	108	145
20.1-25	1	49.6	0.04%	0.46%	338	37	50
25.1-30	2	113.1	0.08%	0.54%	771	84	113
30.1-35	2	123.0	0.09%	0.63%	839	91	123
35.1-40	9	686.3	0.49%	1.12%	4,683	511	686
40.1-50	26	2382.1	1.69%	2.81%	16,254	1,772	2,382
50.1-100	107	15939.2	11.32%	14.13%	108,758	11,859	15,939
100.1-200	186	50386.1	35.78%	49.90%	343,800	37,488	50,386
200.1-300	63	30985.8	22.00%	71.90%	211,425	23,054	30,986
300.1-400	47	31204.0	22.16%	94.06%	212,914	23,216	
400.1-500	0	0	0.00%	94.06%	0	0	
500.1-600	3	3367.9	2.39%	96.45%	22,980	2,506	
600.1-700	4	5000.3	3.55%	100.00%			
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	140,840			926,876	101,068	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,857
Total Flow MGD	51.05
Flow at or below 300 cfs MGD	39.24
Total Nitrogen kg	31,961
Total Phosphorus kg	3,485

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Total Flow Captured Annually	93.03%
Total Nitrogen Captured Annually kg	29,733
Percentage of the time at maximum flow	5.99%
Percentage of Nitrogen at maximum flow	22.71%

TN = 5.53 mg/l
TP = 0.603 mg/l

August

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	369	317	0.16%	0.16%	2,166	236	317
2.6-5	24	157	0.08%	0.24%	1,071	117	157
5.1-7.5	15	191	0.10%	0.33%	1,302	142	191
7.6-10	11	189	0.09%	0.43%	1,292	141	189
10.1-15	8	204	0.10%	0.53%	1,394	152	204
15.1-20	3	105	0.05%	0.58%	717	78	105
20.1-25	12	538	0.27%	0.85%	3,668	400	538
25.1-30	7	369	0.18%	1.04%	2,517	274	369
30.1-35	2	135	0.07%	1.10%	920	100	135
35.1-40	4	290	0.14%	1.25%	1,976	215	290
40.1-50	17	1,511	0.76%	2.00%	10,313	1,125	1,511
50.1-100	77	11,966	5.98%	7.98%	81,650	8,903	11,966
100.1-200	130	37,468	18.73%	26.72%	255,654	27,877	37,468
200.1-300	126	59,784	29.89%	56.60%	407,923	44,481	59,784
300.1-400	48	31,410	15.70%	72.30%	214,322	23,370	
400.1-500	15	12,768	6.38%	78.69%	87,117	9,499	
500.1-600	10	11,060	5.53%	84.22%	75,465	8,229	
600.1-700	4	5,054	2.53%	86.74%	34,484	3,760	
700.1-800	8	11,954	5.98%	92.72%	81,568	8,894	
800.1-900	9	14,567	7.28%	100.000%	99,392	10,838	
900.1-1000							
	TOTALS	200,037			1,364,911	148,832	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	6,898
Total Flow MGD	72.51
Flow at or below 300 cfs MGD	45.44
Total Nitrogen kg	47,066
Total Phosphorus kg	5,132

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	84.56%
Total Nitrogen Captured Annually kg	39,801
Percentage of Time at Maximum Flow	10.46%
Percentage of Nitrogen at Maximum Flow	33.07%

TN = 5.53 mg/l
TP = 0.603 mg/l

September

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	275	172	0.09%	0.09%	1,171	128	172
2.6-5	48	345	0.18%	0.27%	2,356	257	345
5.1-7.5	27	341	0.18%	0.44%	2,328	254	341
7.6-10	44	768	0.40%	0.84%	5,243	572	768
10.1-15	17	444	0.23%	1.07%	3,032	331	444
15.1-20	15	541	0.28%	1.35%	3,695	403	541
20.1-25	14	649	0.33%	1.68%	4,426	483	649
25.1-30	11	607	0.31%	2.00%	4,141	452	607
30.1-35	7	470	0.24%	2.24%	3,208	350	470
35.1-40	4	307	0.16%	2.40%	2,098	229	307
40.1-50	15	1,416	0.73%	3.13%	9,663	1,054	1,416
50.1-100	62	9,072	4.68%	7.81%	61,904	6,750	9,072
100.1-200	121	34,883	18.00%	25.80%	238,019	25,954	34,883
200.1-300	100	48,069	24.80%	50.60%	327,992	35,765	48,069
300.1-400	36	24,343	12.56%	63.16%	166,101	18,112	
400.1-500	49	44,608	23.01%	86.17%	304,376	33,190	
500.1-600	22	23,096	11.91%	98.09%	157,588	17,184	
600.1-700	3	3,707	1.91%	100.00%	25,295	2,758	
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	193,841			1,322,634	144,222	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	6,684
Total Flow MGD	70.26
Flow at or below 300 cfs MGD	42.39
Total Nitrogen kg	45,608
Total Phosphorus kg	4,973

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	84.37%
Total Nitrogen Captured Annually kg	38,479
Percentage of Time at Maximum Flow	12.64%
Percentage of Nitrogen at Maximum Flow	40.02%

TN = 5.53 mg/l
TP = 0.603 mg/l

October

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	362	233	0.18%	0.18%	1,588	173	233
2.6-5	60	409	0.32%	0.50%	2,788	304	409
5.1-7.5	38	449	0.35%	0.84%	3,061	334	449
7.6-10	13	230	0.18%	1.02%	1,571	171	230
10.1-15	26	668	0.52%	1.54%	4,561	497	668
15.1-20	16	553	0.43%	1.97%	3,776	412	553
20.1-25	14	643	0.50%	2.47%	4,385	478	643
25.1-30	5	284	0.22%	2.69%	1,935	211	284
30.1-35	11	706	0.55%	3.23%	4,818	525	706
35.1-40	10	756	0.59%	3.82%	5,156	562	756
40.1-50	12	1,073	0.83%	4.65%	7,322	798	1,073
50.1-100	115	16,802	13.01%	17.66%	114,645	12,501	16,802
100.1-200	104	28,606	22.16%	39.82%	195,185	21,283	28,606
200.1-300	45	21,269	16.47%	56.29%	145,123	15,824	21,269
300.1-400	28	19,666	15.23%	71.53%	134,188	14,632	
400.1-500	33	28,774	22.29%	93.81%	196,335	21,409	
500.1-600	5	5,536	4.29%	98.10%	37,773	4,119	
600.1-700	2	2,454	1.90%	100.00%	16,741	1,826	
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	129,109			880,952	96,060	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	4,452
Total Flow MGD	46.80
Flow at or below 300 cfs MGD	29.17
Total Nitrogen kg	30,378
Total Phosphorus kg	3,312

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	87.63%
Total Nitrogen Captured Annually kg	26,621
Percentage of Time at Maximum Flow	7.56%
Percentage of Nitrogen at Maximum Flow	35.76%

TN = 5.53 mg/l
TP = 0.603 mg/l

November

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	563	430.2	0.84%	0.84%	2,935	320	430
2.6-5	60	391.9	0.76%	1.60%	2,674	292	392
5.1-7.5	22	271.1	0.53%	2.13%	1,850	202	271
7.6-10	26	450.2	0.88%	3.01%	3,072	335	450
10.1-15	11	277.7	0.54%	3.55%	1,895	207	278
15.1-20	22	839.0	1.64%	5.19%	5,725	624	839
20.1-25	15	698.2	1.36%	6.55%	4,764	519	698
25.1-30	11	579.2	1.13%	7.68%	3,952	431	579
30.1-35	6	398.7	0.78%	8.46%	2,720	297	399
35.1-40	8	599.0	1.17%	9.62%	4,087	446	599
40.1-50	5	432.4	0.84%	10.47%	2,950	322	432
50.1-100	29	4316.0	8.42%	18.88%	29,450	3,211	4,316
100.1-200	46	13920.0	27.14%	46.02%	94,980	10,357	13,920
200.1-300	41	19749.4	38.51%	84.53%	134,756	14,694	19,749
300.1-400	4	2638.0	5.14%	89.68%	18,000	1,963	
400.1-500	6	5293.9	10.32%	100.00%	36,122	3,939	
500.1-600							
600.1-700							
700.1-800							
800.1-900							
900.1-1000							
	TOTALS	51,285			349,933	38,157	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	1,768
Total Flow MGD	18.59
Flow at or below 300 cfs MGD	16.80
Total Nitrogen kg	12,067
Total Phosphorus kg	1,316

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	96.14%
Total Nitrogen Captured Annually kg	11,600
Percentage of Time at Maximum Flow	1.14%
Percentage of Nitrogen at Maximum Flow	12.07%

TN = 5.53 mg/l
TP = 0.603 mg/l

December

Discharge (cfs)	# daily events	total discharge (ac-ft)	% of total discharge	Cumulative (%)	Nitrogen Load kg	Phosphorus Load kg	acre-ft influent at or below 300 cfs
0-2.5	587	350	0.38%	0.38%	2,387	260	350
2.6-5	27	179	0.20%	0.58%	1,220	133	179
5.1-7.5	14	170	0.19%	0.76%	1,161	127	170
7.6-10	9	160	0.17%	0.94%	1,092	119	160
10.1-15	13	340	0.37%	1.31%	2,319	253	340
15.1-20	33	1,258	1.38%	2.69%	8,583	936	1,258
20.1-25	36	1,717	1.88%	4.56%	11,715	1,277	1,717
25.1-30	1	58	0.06%	4.63%	393	43	58
30.1-35	0	0	0.00%	4.63%	0	0	0
35.1-40	2	149	0.16%	4.79%	1,017	111	149
40.1-50	11	1,037	1.13%	5.92%	7,078	772	1,037
50.1-100	68	9,640	10.54%	16.46%	65,776	7,172	9,640
100.1-200	37	10,564	11.55%	28.01%	72,081	7,860	10,564
200.1-300	20	10,017	10.95%	38.97%	68,352	7,453	10,017
300.1-400	7	5,193	5.68%	44.64%	35,430	3,863	
400.1-500	4	3,591	3.93%	48.57%	24,502	2,672	
500.1-600	16	18,246	19.95%	68.52%	124,501	13,576	
600.1-700	12	15,299	16.73%	85.25%	104,393	11,383	
700.1-800	7	10,256	11.21%	96.46%	69,979	7,631	
800.1-900	2	3,239	3.54%	100.000%	22,102	2,410	
900.1-1000							
	TOTALS	91,463			624,081	68,051	Total Capture Acre-ft

MONTHLY AVERAGES	
Flow acre-ft	3,154
Total Flow MGD	33.15
Flow at or below 300 cfs MGD	13.81
Total Nitrogen kg	21,520
Total Phosphorus kg	2,347

MONTHLY TOTALS	
Maximum Capture Rate cfs	300
Percentage Total Flow Captured Annually	70.19%
Total Nitrogen Captured Annually kg	15,106
Percentage of Time at Maximum Flow	5.30%
Percentage of Nitrogen at Maximum Flow	44.49%

APPENDIX E. MONTHLY HYADEM RESULTS

HYADEM January 300 cfs (194 MGD)		HYADEM January (16.54 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	16.54
Days	2.51	Days	28.49
Average Total Nitrogen (mg/l)	5.40	Average Total Nitrogen (mg/l)	4.16
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	16.94	Average Air Temperature (degrees C)	16.94
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.013	Field Water Hyacinth Growth Rate (1/day)	0.012
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.009	Net Specific Growth Rate (1/day)	0.008
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	6.94
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	17.58
Mean Plant Age days	74.95	Mean Plant Age days	85.70
Average Daily Growth (Wet Tons)	104.3	Average Daily Growth (Wet Tons)	91.1
Average Daily Growth (Dry Tons)	5.2	Average Daily Growth (Dry Tons)	4.6
Average Daily Harvest (Wet Tons)	56.0	Average Daily Harvest (Wet Tons)	46.0
Average Daily Harvest (Dry Tons)	3.6	Average Daily Harvest (Dry Tons)	3.0
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.26**	**WHS™ Effluent Total Nitrogen (mg/l)**	**2.78**
WHS™ Effluent Total Phosphorus (mg/l)	**0.576**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.326**
Nitrogen Removal kg/day	196.92	Nitrogen Removal kg/day	172.06
Nitrogen Removal kg/period	494	Nitrogen Removal kg/period	4,902
Nitrogen Removal Rate lb/acre-day	4.93	Nitrogen Removal Rate lb/acre-day	4.31
Nitrogen Removal Rate gm/sm-yr	202	Nitrogen Removal Rate gm/sm-yr	176
Phosphorus Removal kg/day	20	Phosphorus Removal kg/day	17
Phosphorus Removal kg/period	50	Phosphorus Removal kg/period	495
Phosphorus Removal Rate lb/acre-day	0.50	Phosphorus Removal Rate lb/acre-day	0.43
Phosphorus Removal Rate gm/sm-yr	20.37	Phosphorus Removal Rate gm/sm-yr	17.80

Total Nitrogen Removed kg/month	**5,396**
Total Phosphorus Removed kg/month	**545**

HYADEM February 300 cfs (194 MGD)

INPUTS	
Influent Average Daily Flow (mgd)	193.91
Days	1.48
Average Total Nitrogen (mg/l)	5.39
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	18.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.014
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.010
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59
Hydraulic Loading Rate (cm/day)	206.10
Mean Plant Age days	71.20
Average Daily Growth (Wet Tons)	109.8
Average Daily Growth (Dry Tons)	5.5
Average Daily Harvest (Wet Tons)	60.3
Average Daily Harvest (Dry Tons)	3.9
Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.574**
Nitrogen Removal kg/day	207.36
Nitrogen Removal kg/period	307
Nitrogen Removal Rate lb/acre-day	5.19
Nitrogen Removal Rate gm/sm-yr	212
Phosphorus Removal kg/day	21
Phosphorus Removal kg/period	31
Phosphorus Removal Rate lb/acre-day	0.52
Phosphorus Removal Rate gm/sm-yr	21.45

HYADEM February (17.95 MGD)

INPUTS	
Influent Average Daily Flow (mgd)	17.95
Days	26.52
Average Total Nitrogen (mg/l)	4.19
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	18.00
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.012
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.008
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	6.39
Hydraulic Loading Rate (cm/day)	19.08
Mean Plant Age days	81.01
Average Daily Growth (Wet Tons)	96.4
Average Daily Growth (Dry Tons)	4.8
Average Daily Harvest (Wet Tons)	50.0
Average Daily Harvest (Dry Tons)	3.3
Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**2.85**
WHS™ Effluent Total Phosphorus (mg/l)	**0.333**
Nitrogen Removal kg/day	182.08
Nitrogen Removal kg/period	4,829
Nitrogen Removal Rate lb/acre-day	4.56
Nitrogen Removal Rate gm/sm-yr	187
Phosphorus Removal kg/day	18
Phosphorus Removal kg/period	488
Phosphorus Removal Rate lb/acre-day	0.46
Phosphorus Removal Rate gm/sm-yr	18.83

Total Nitrogen Removed kg/month	5,136
Total Phosphorus Removed kg/month	519

HYADEM March 300 cfs (194 MGD)		HYADEM March (23.20 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	23.20
Days	1.74	Days	26.26
Average Total Nitrogen (mg/l)	5.37	Average Total Nitrogen (mg/l)	4.33
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	20.61	Average Air Temperature (degrees C)	20.61
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.016	Field Water Hyacinth Growth Rate (1/day)	0.014
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.012	Net Specific Growth Rate (1/day)	0.010
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	4.94
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	24.66
Mean Plant Age days	62.80	Mean Plant Age days	70.07
Average Daily Growth (Wet Tons)	124.6	Average Daily Growth (Wet Tons)	111.6
Average Daily Growth (Dry Tons)	6.2	Average Daily Growth (Dry Tons)	5.6
Average Daily Harvest (Wet Tons)	71.6	Average Daily Harvest (Wet Tons)	61.6
Average Daily Harvest (Dry Tons)	4.7	Average Daily Harvest (Dry Tons)	4.0
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.21**	**WHS™ Effluent Total Nitrogen (mg/l)**	**3.13**
WHS™ Effluent Total Phosphorus (mg/l)	**0.571**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.361**
Nitrogen Removal kg/day	235.32	Nitrogen Removal kg/day	210.72
Nitrogen Removal kg/period	409	Nitrogen Removal kg/period	5,533
Nitrogen Removal Rate lb/acre-day	5.89	Nitrogen Removal Rate lb/acre-day	5.27
Nitrogen Removal Rate gm/sm-yr	241	Nitrogen Removal Rate gm/sm-yr	216
Phosphorus Removal kg/day	24	Phosphorus Removal kg/day	21
Phosphorus Removal kg/period	41	Phosphorus Removal kg/period	559
Phosphorus Removal Rate lb/acre-day	0.59	Phosphorus Removal Rate lb/acre-day	0.53
Phosphorus Removal Rate gm/sm-yr	24.34	Phosphorus Removal Rate gm/sm-yr	21.80

Total Nitrogen Removed kg/month	5,943
Total Phosphorus Removed kg/month	600

HYADEM April 300 cfs (194 MGD)		**HYADEM April (18.37 MGD)**	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	18.37
Days	1.50	Days	28.50
Average Total Nitrogen (mg/l)	5.35	Average Total Nitrogen (mg/l)	3.93
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	22.89	Average Air Temperature (degrees C)	22.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.018	Field Water Hyacinth Growth Rate (1/day)	0.015
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.014	Net Specific Growth Rate (1/day)	0.011
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	6.24
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	19.53
Mean Plant Age days	56.29	Mean Plant Age days	66.16
Average Daily Growth (Wet Tons)	139.1	Average Daily Growth (Wet Tons)	118.2
Average Daily Growth (Dry Tons)	7.0	Average Daily Growth (Dry Tons)	5.9
Average Daily Harvest (Wet Tons)	82.8	Average Daily Harvest (Wet Tons)	66.7
Average Daily Harvest (Dry Tons)	5.4	Average Daily Harvest (Dry Tons)	4.3
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.17**	**WHS™ Effluent Total Nitrogen (mg/l)**	**2.32**
WHS™ Effluent Total Phosphorus (mg/l)	**0.567**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.279**
Nitrogen Removal kg/day	262.77	Nitrogen Removal kg/day	223.27
Nitrogen Removal kg/period	394	Nitrogen Removal kg/period	6,363
Nitrogen Removal Rate lb/acre-day	6.58	Nitrogen Removal Rate lb/acre-day	5.59
Nitrogen Removal Rate gm/sm-yr	269	Nitrogen Removal Rate gm/sm-yr	229
Phosphorus Removal kg/day	27	Phosphorus Removal kg/day	23
Phosphorus Removal kg/period	40	Phosphorus Removal kg/period	642
Phosphorus Removal Rate lb/acre-day	0.66	Phosphorus Removal Rate lb/acre-day	0.56
Phosphorus Removal Rate gm/sm-yr	27.18	Phosphorus Removal Rate gm/sm-yr	23.09

Total Nitrogen Removed kg/month	**6,757**
Total Phosphorus Removed kg/month	**682**

HYADEM May 300 cfs (194 MGD)		HYADEM May (8.50 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	8.50
Days	0.37	Days	30.63
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	3.39
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	26.06	Average Air Temperature (degrees C)	26.06
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.016
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.012
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	13.50
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	9.03
Mean Plant Age days	48.50	Mean Plant Age days	61.87
Average Daily Growth (Wet Tons)	161.7	Average Daily Growth (Wet Tons)	126.5
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	6.3
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	73.1
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	4.7
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.25**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.050**
Nitrogen Removal kg/day	305.44	Nitrogen Removal kg/day	137.70
Nitrogen Removal kg/period	113	Nitrogen Removal kg/period	4,218
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	3.45
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	141
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	18
Phosphorus Removal kg/period	11	Phosphorus Removal kg/period	545
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.45
Phosphorus Removal Rate gm/sm-yr	31.59	Phosphorus Removal Rate gm/sm-yr	18.23

Total Nitrogen Removed kg/month	**4,331**
Total Phosphorus Removed kg/month	**556**

HYADEM June 300 cfs (194 MGD)		HYADEM June (16.25 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	16.25
Days	0.82	Days	29.18
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	3.54
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.17	Average Air Temperature (degrees C)	28.17
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.017
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.013
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	7.06
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	17.28
Mean Plant Age days	48.49	Mean Plant Age days	60.31
Average Daily Growth (Wet Tons)	161.8	Average Daily Growth (Wet Tons)	129.8
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	6.5
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	75.6
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	4.9
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**1.55**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.201**
Nitrogen Removal kg/day	305.49	Nitrogen Removal kg/day	245.11
Nitrogen Removal kg/period	251	Nitrogen Removal kg/period	7,152
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	6.14
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	251
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	25
Phosphorus Removal kg/period	25	Phosphorus Removal kg/period	722
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.62
Phosphorus Removal Rate gm/sm-yr	31.60	Phosphorus Removal Rate gm/sm-yr	25.35

Total Nitrogen Removed kg/month	7,403
Total Phosphorus Removed kg/month	747

HYADEM July 300 cfs (194 MGD)		HYADEM July (35.62 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.62
Days	1.86	Days	29.14
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	4.49
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.89	Average Air Temperature (degrees C)	28.89
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.019
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.015
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	3.22
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	37.86
Mean Plant Age days	48.50	Mean Plant Age days	52.84
Average Daily Growth (Wet Tons)	161.7	Average Daily Growth (Wet Tons)	148.3
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	7.4
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	89.8
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	5.8
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**3.45**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.393**
Nitrogen Removal kg/day	305.44	Nitrogen Removal kg/day	280.09
Nitrogen Removal kg/period	568	Nitrogen Removal kg/period	8,162
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	7.01
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	287
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	28
Phosphorus Removal kg/period	57	Phosphorus Removal kg/period	824
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.71
Phosphorus Removal Rate gm/sm-yr	31.59	Phosphorus Removal Rate gm/sm-yr	28.97

Total Nitrogen Removed kg/month	8,730
Total Phosphorus Removed kg/month	881

HYADEM August 300 cfs (194 MGD)		HYADEM August (42.43 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	42.43
Days	3.24	Days	27.76
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	4.64
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.94	Average Air Temperature (degrees C)	28.94
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.019
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.015
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	2.70
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	45.10
Mean Plant Age days	48.50	Mean Plant Age days	51.92
Average Daily Growth (Wet Tons)	161.7	Average Daily Growth (Wet Tons)	150.9
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	7.5
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	91.8
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	6.0
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**3.76**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.424**
Nitrogen Removal kg/day	305.44	Nitrogen Removal kg/day	285.09
Nitrogen Removal kg/period	990	Nitrogen Removal kg/period	7,914
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	7.14
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	292
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	29
Phosphorus Removal kg/period	100	Phosphorus Removal kg/period	799
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.72
Phosphorus Removal Rate gm/sm-yr	31.59	Phosphorus Removal Rate gm/sm-yr	29.49

Total Nitrogen Removed kg/month	8,904
Total Phosphorus Removed kg/month	899

HYADEM September 300 cfs (194 MGD)		HYADEM September (35.64 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	35.64
Days	3.92	Days	26.08
Average Total Nitrogen (mg/l)	5.32	Average Total Nitrogen (mg/l)	4.49
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	28.11	Average Air Temperature (degrees C)	28.11
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.021	Field Water Hyacinth Growth Rate (1/day)	0.019
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.017	Net Specific Growth Rate (1/day)	0.015
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	3.22
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	37.88
Mean Plant Age days	48.50	Mean Plant Age days	52.84
Average Daily Growth (Wet Tons)	161.7	Average Daily Growth (Wet Tons)	148.3
Average Daily Growth (Dry Tons)	8.1	Average Daily Growth (Dry Tons)	7.4
Average Daily Harvest (Wet Tons)	100.1	Average Daily Harvest (Wet Tons)	89.8
Average Daily Harvest (Dry Tons)	6.5	Average Daily Harvest (Dry Tons)	5.8
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.11**	**WHS™ Effluent Total Nitrogen (mg/l)**	**3.45**
WHS™ Effluent Total Phosphorus (mg/l)	**0.561**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.393**
Nitrogen Removal kg/day	305.44	Nitrogen Removal kg/day	280.09
Nitrogen Removal kg/period	1,197	Nitrogen Removal kg/period	7,305
Nitrogen Removal Rate lb/acre-day	7.65	Nitrogen Removal Rate lb/acre-day	7.01
Nitrogen Removal Rate gm/sm-yr	313	Nitrogen Removal Rate gm/sm-yr	287
Phosphorus Removal kg/day	31	Phosphorus Removal kg/day	28
Phosphorus Removal kg/period	121	Phosphorus Removal kg/period	738
Phosphorus Removal Rate lb/acre-day	0.77	Phosphorus Removal Rate lb/acre-day	0.71
Phosphorus Removal Rate gm/sm-yr	31.59	Phosphorus Removal Rate gm/sm-yr	28.97

Total Nitrogen Removed kg/month	8,502
Total Phosphorus Removed kg/month	858

HYADEM October 300 cfs (194 MGD)		HYADEM October (26.31 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	26.31
Days	2.34	Days	28.66
Average Total Nitrogen (mg/l)	5.34	Average Total Nitrogen (mg/l)	4.25
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	24.68	Average Air Temperature (degrees C)	24.68
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.019	Field Water Hyacinth Growth Rate (1/day)	0.017
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.015	Net Specific Growth Rate (1/day)	0.013
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	4.36
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	27.96
Mean Plant Age days	51.65	Mean Plant Age days	58.03
Average Daily Growth (Wet Tons)	151.7	Average Daily Growth (Wet Tons)	134.9
Average Daily Growth (Dry Tons)	7.6	Average Daily Growth (Dry Tons)	6.7
Average Daily Harvest (Wet Tons)	92.4	Average Daily Harvest (Wet Tons)	79.5
Average Daily Harvest (Dry Tons)	6.0	Average Daily Harvest (Dry Tons)	5.2
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.14**	**WHS™ Effluent Total Nitrogen (mg/l)**	**2.97**
WHS™ Effluent Total Phosphorus (mg/l)	**0.564**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.345**
Nitrogen Removal kg/day	286.60	Nitrogen Removal kg/day	254.82
Nitrogen Removal kg/period	671	Nitrogen Removal kg/period	7,303
Nitrogen Removal Rate lb/acre-day	7.17	Nitrogen Removal Rate lb/acre-day	6.38
Nitrogen Removal Rate gm/sm-yr	294	Nitrogen Removal Rate gm/sm-yr	261
Phosphorus Removal kg/day	29	Phosphorus Removal kg/day	26
Phosphorus Removal kg/period	68	Phosphorus Removal kg/period	737
Phosphorus Removal Rate lb/acre-day	0.72	Phosphorus Removal Rate lb/acre-day	0.64
Phosphorus Removal Rate gm/sm-yr	29.65	Phosphorus Removal Rate gm/sm-yr	26.36

Total Nitrogen Removed kg/month	7,974
Total Phosphorus Removed kg/month	805

HYADEM November 300 cfs (194 MGD)		HYADEM November (14.95 MGD)	
INPUTS		INPUTS	
Influent Average Daily Flow (mgd)	193.91	Influent Average Daily Flow (mgd)	14.95
Days	0.34	Days	29.66
Average Total Nitrogen (mg/l)	5.37	Average Total Nitrogen (mg/l)	3.77
Daily Nitrogen Supplementation lb	0.00	Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53	Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53	Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60	Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05	V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	21.06	Average Air Temperature (degrees C)	21.06
Maximium Specific Growth Rate (1/day)	0.040	Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50	Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00	Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00	Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30	Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88	Growing Area (acres)	88
Percent Coverage	90.00%	Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%	Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%	Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%	Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%	In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS		OUTPUTS	
Standing Crop (Wet Tons)	7,762	Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.016	Field Water Hyacinth Growth Rate (1/day)	0.014
Sloughing Rate (1/day)	0.004	Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.012	Net Specific Growth Rate (1/day)	0.010
Average Pond Depth (ft)	4.00	Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	0.59	Hydraulic retention time (days)	7.67
Hydraulic Loading Rate (cm/day)	206.10	Hydraulic Loading Rate (cm/day)	15.89
Mean Plant Age days	61.46	Mean Plant Age days	74.01
Average Daily Growth (Wet Tons)	127.3	Average Daily Growth (Wet Tons)	105.6
Average Daily Growth (Dry Tons)	6.4	Average Daily Growth (Dry Tons)	5.3
Average Daily Harvest (Wet Tons)	73.7	Average Daily Harvest (Wet Tons)	57.1
Average Daily Harvest (Dry Tons)	4.8	Average Daily Harvest (Dry Tons)	3.7
Average Daily Sloughing (Wet Tons)	31.1	Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6	Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**5.20**	**WHS™ Effluent Total Nitrogen (mg/l)**	**2.01**
WHS™ Effluent Total Phosphorus (mg/l)	**0.570**	**WHS™ Effluent Total Phosphorus (mg/l)**	**0.247**
Nitrogen Removal kg/day	240.47	Nitrogen Removal kg/day	199.44
Nitrogen Removal kg/period	82	Nitrogen Removal kg/period	5,915
Nitrogen Removal Rate lb/acre-day	6.02	Nitrogen Removal Rate lb/acre-day	4.99
Nitrogen Removal Rate gm/sm-yr	246	Nitrogen Removal Rate gm/sm-yr	204
Phosphorus Removal kg/day	24	Phosphorus Removal kg/day	20
Phosphorus Removal kg/period	8	Phosphorus Removal kg/period	597
Phosphorus Removal Rate lb/acre-day	0.61	Phosphorus Removal Rate lb/acre-day	0.50
Phosphorus Removal Rate gm/sm-yr	24.87	Phosphorus Removal Rate gm/sm-yr	20.63

Total Nitrogen Removed kg/month	5,997
Total Phosphorus Removed kg/month	605

HYADEM December 300 cfs (194 MGD)

INPUTS	
Influent Average Daily Flow (mgd)	32.12
Days	1.64
Average Total Nitrogen (mg/l)	4.74
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	17.72
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.013
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.009
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	3.57
Hydraulic Loading Rate (cm/day)	34.14
Mean Plant Age days	76.94
Average Daily Growth (Wet Tons)	101.5
Average Daily Growth (Dry Tons)	5.1
Average Daily Harvest (Wet Tons)	54.0
Average Daily Harvest (Dry Tons)	3.5
Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**3.95**
WHS™ Effluent Total Phosphorus (mg/l)	**0.444**
Nitrogen Removal kg/day	191.78
Nitrogen Removal kg/period	315
Nitrogen Removal Rate lb/acre-day	4.80
Nitrogen Removal Rate gm/sm-yr	196
Phosphorus Removal kg/day	19
Phosphorus Removal kg/period	32
Phosphorus Removal Rate lb/acre-day	0.48
Phosphorus Removal Rate gm/sm-yr	19.84

HYADEM December (12.51 MGD)

INPUTS	
Influent Average Daily Flow (mgd)	21.55
Days	29.36
Average Total Nitrogen (mg/l)	4.40
Daily Nitrogen Supplementation lb	0.00
Influent Total Nitrogen (mg/l)	5.53
Influent Total Nitrogen including Supplementation mg/l	5.53
Influent Total Phosphorus (mg/l)	0.60
V'ant Hoff Arrhenius Coefficient	1.05
Average Air Temperature (degrees C)	17.72
Maximium Specific Growth Rate (1/day)	0.040
Wet Crop Density (lb/sf)	4.50
Density Adjustment Factor	1.00
Half Rate Concentration (mg/l TN)	5.00
Incidental Nitrogen Loss C_n	0.30
Growing Area (acres)	88
Percent Coverage	90.00%
Plant Nitrogen Content (% dry weight)	3.20%
Plant Phosphorus Content (% dry weight)	0.42%
Percent Solids Harvest	6.50%
In-Pond and sloughed Plant percent solids	5.00%
OUTPUTS	
Standing Crop (Wet Tons)	7,762
Field Water Hyacinth Growth Rate (1/day)	0.013
Sloughing Rate (1/day)	0.004
Net Specific Growth Rate (1/day)	0.009
Average Pond Depth (ft)	4.00
Hydraulic retention time (days)	5.32
Hydraulic Loading Rate (cm/day)	22.91
Mean Plant Age days	79.99
Average Daily Growth (Wet Tons)	97.6
Average Daily Growth (Dry Tons)	4.9
Average Daily Harvest (Wet Tons)	51.0
Average Daily Harvest (Dry Tons)	3.3
Average Daily Sloughing (Wet Tons)	31.1
Average Daily Sloughing (Dry Tons)	1.6
WHS™ Effluent Total Nitrogen (mg/l)	**3.27**
WHS™ Effluent Total Phosphorus (mg/l)	**0.375**
Nitrogen Removal kg/day	184.42
Nitrogen Removal kg/period	5,414
Nitrogen Removal Rate lb/acre-day	4.62
Nitrogen Removal Rate gm/sm-yr	189
Phosphorus Removal kg/day	19
Phosphorus Removal kg/period	547
Phosphorus Removal Rate lb/acre-day	0.47
Phosphorus Removal Rate gm/sm-yr	19.08

Total Nitrogen Removed kg/month	5,729
Total Phosphorus Removed kg/month	578

APPENDIX F. SLUDGE DRYING OF WASTE WATER & POTABLE WATER - BROWN BEAR EQUIPMENT

Dade County Municipal WWTP - Miami, FL

With an in-flow rate of 200 plus million gallons per day, this WWTP had to find an effective method for sludge disposal, and it has with four Brown Bear paddle aerators. Each aerator unit breaks up and turns up to 3,000 cubic yards of windrowed sludge per hour, greatly reducing drying time over other handling methods. The 66 tons of dried sludge produced daily has been approved by the Florida Dept. of Agriculture as a soil conditioner.

The Bears are used to aerate and dry sludge from 20% solids to 85% solids in about a week's time during hot summer months.

In order to cease occasional odor complaints, two Bears with liquid application systems apply an oxidizer – potassium permanganate – directly to the biosolids as they are aerated.

Municipal WWTP - Phoenix, AZ

Keith Greenberg, assistant WWTP supervisor for the city of Phoenix states, "Bed space is always limited. We needed to dry our sludge to 40% solids to meet our contract with the sludge haulers for easier spreadability." The dried sludge is applied to cotton fields as fertilizer. The city is paying this contractor a hauling fee of $14 per dry ton; significant savings compared to the $100/ton landfill dumping fees found in Phoenix.

Denver Water Company - Denver, CO

Denver Water Company trucks a Brown Bear Model 400 aerator between two of their potable water plants, utilizing it to speed air drying of alum sludge in the summer and to facilitate freeze drying of the alum sludge in the winter. It is possible to take the alum sludge from a solids content of less than 10% to a solids content of over 70% in only a few days using the freeze dry method and the Brown Bear paddle aerator.

Manatee County Public Service – Bradenton, FL

The Manatee County Public Service Dept. operates the potable water plant, serving the city of Bradenton, Florida and all of Manatee County. Alum sludge is a residual material left from the water treatment process and is a problem for most potable plants to dispose of. In the past, landfills would accept the wet alum sludge, but due to landfill space confinements wet sludges are no longer acceptable in most landfills. Additionally, the cost of transportation of wet sludge is very substantial. Manatee's potable water plant was experiencing problems in drying the alum sludge to a landfill acceptable state. The potable water plant now utilizes a Brown Bear Model SC4912 paddle auger which is mounted on a JD 644E articulating front-end loader. The aerator is used to accelerate the drying process, as much as four times faster than non aerated drying, drying the alum sludge to 70% solids. Transportation costs to the landfill are substantially reduced and the dried material is used as daily cover at the landfill.

APPENDIX G. HYDROMENTIA PATENTS

Algal Turf Scrubber® (ATS™)

Patent No. 4,333,263 – Algal Turf Scrubber®

Patent No. 4,966,096 - Water Purification System and Apparatus

Patent No. 5,097,795 - Water Purification System and Apparatus

Patent No. 5,527,456 - Apparatus for Water Purification by Culturing and Harvesting Attached Algal Communities (License Rights Granted to ABES)

Patent No. 5,573,669 - Method and System for Water Purification by Culturing and Harvesting Attached Algal Communities (License Rights Granted to ABES)

Patent No. 5,715,774 - Animal feedstocks comprising harvested algal turf and a method of preparing and using the same

Patent No. 5,778,823 - Method of raising fish by use of algal turf

Patent No. 5,851,398 – Algal turf water purification method

Patent No. 6,572,770 – Apparatus and Method for Harvesting and Collecting Attached Algal Communities

Water Hyacinth Scrubber (WHS™)

Patent No. 5,811,007 - Vascular Plant Aquaculture and Bioremediation System and Method

Patent No. 5,820,759 – Integrated aquaculture and bioremediation system and method

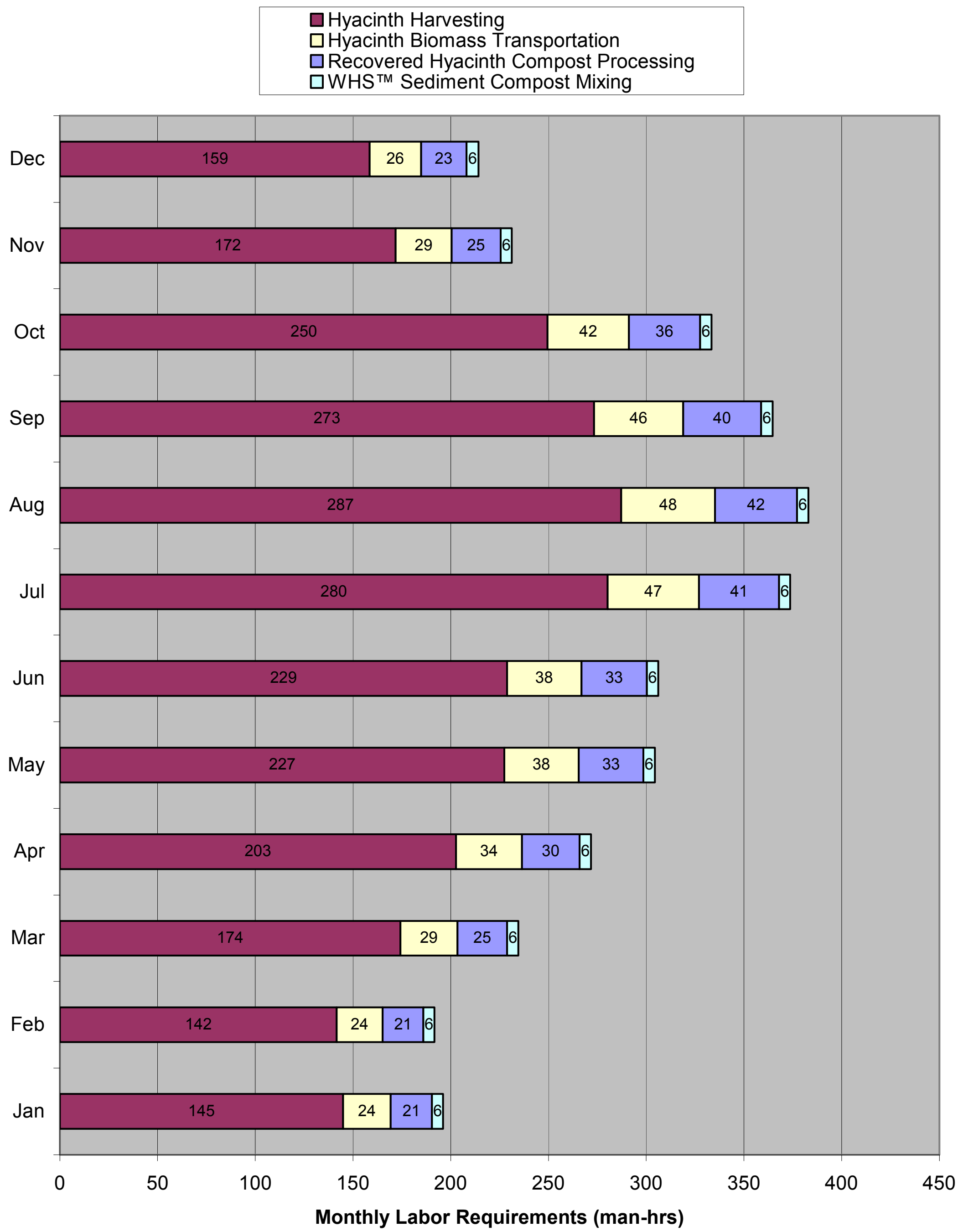
Patent No. 6,393,812 – Method and apparatus for gathering, transporting and processing aquatic plants.

Patent No. 6,732,499 – Method and apparatus for gathering, transporting and processing aquatic plants.

APPENDIX H. OPERATING COST CALCULATIONS

Labor:
It is projected that the project can be operated by a part-time lead operator and two field operators, excluding maintenance of the District's Pump Station..

Labor distribution for WHS™ facility operation for primary operational tasks are provided below:



Equipment Maintenance:

The projected equipment maintenance is 2% of the equipment costs, with equipment cost projected at $899,300.

Road maintenance will involve grading and fill supplementation of the compacted dirt roads, as well as maintenance of the paved entrance road. This is projected at $20,000/year, which would cover a grader and operator on site biweekly.

Building maintenance is set at $6,000/year.

Biological control (Nematodes) for control of the hyacinth weevil is included at a rate of $500/acre-yr.

Within the present analysis, the “Best Case” scenario considers finished compost/organic fertilizer being sold at the rate of $20/ton FOB the facility.

For the “Worst Case” scenario, finished compost/organic fertilizer is transported to a local landfill at a rate of $5.00/ton hauling cost plus a landfill tipping fee of $20.50/ton.

Removal of solids from the WHS™ unit will be performed quarterly. Costs provided include mobile dredging unit diesel power.

Fuel usage estimates for the WHS™ Facility are as provided below:

Category	Equip	Hp	Fuel Usage (gal/hr)	No of Units	Total Fuel Usage Per Hour	Annual Usage (hrs)	Total Fuel Usage (gals)
Hyacinth Harvest [1]	John Deere 7420	120	3.4272	2	6.8544	2,541	17,415
Hyacinth Transportation	John Deere 7420	120	5.712	1	5.712	423	2,419
Compost Mixing	Valtra 170	170	8.092	1	8.092	371	3,003
Sediment Mixing	Valtra 170	170	8.092	1	8.092	69	560
							23,397
					20% Misc (Loading Etc.)		4,679
							28,076

NOTES:
1. Hourly fuel consumption rate for hyacinth harvest reduced as equipment operating at near idle speeds.
2. For fuel usage multiply hp by 0.0476 gal/hp-hr. Grisso, R.D., M.F. Kocher and D.H. Vaughan. 2004. Predicting Tractor Fuel Consumption. Applied Engineering in Agriculture. Volume 20(5)

Electrical energy will be associated with the 175 hp of aerators. These will run typically at about 1/3 of capacity during the year, with the heaviest use in the hottest summer days. The kwh/yr is estimated at 430,000.

Total Annual Operating Costs therefore are as follows:

The “Best case” projection is $525,789/yr
The “Worst case” projection is $651,778/yr

The table attached below shows these costs.

ANNUAL O&M COSTS

Category	Unit	Rate	Quantity	Cost	Total Category Cost
Labor					
Facility Operations					
Field Technician II	hr	$ 45	4,160	$ 187,200	
Operations Manager	hr	$ 85	832	$ 70,720	
Administrative Assistant	hr	$ 35	80	$ 2,800	
Facility Administration and Technical Oversight					
Senior Biologist	hr	$ 110	20	$ 2,200	
Project Engineer	hr	$ 135	16	$ 2,160	
Operations Manager	hr	$ 85	200	$ 17,000	
Administrative Assistant	hr	$ 35	20	$ 700	
					$ 282,780
Travel Costs					
Travel	$/mile	$ 0.42	12,000	$ 5,040	
Hotel	nights	$ 45.00	52	$ 2,340	
					$ 7,380
Maintenance					
Equipment					
Equipment (5% of Equipment Costs)	$/yr	5%	899,300	$ 44,965	
Site					
Building	per unit	$ 6,000	1	$ 6,000	
Road Maintenance	lump sum	$ 20,000	1	$ 20,000	
					$ 70,965
Chemicals and Pest Control					
Pest Control					
Nematodes	$/acre-yr	$ 500	88	$ 44,000	
					$ 44,000
Laboratory Costs (ATS™ & WHS™ Systems Only)					
WHS™					
Laboratory Costs (Per Parsons)	lump sum	$ 30,000	1	$ 30,000	
Misc Samples (HMI Plant and Water)	lump sum	$ 1,000	1	$ 1,000	
					$ 31,000
Energy					
Electricity					
Aeration, Pumps and Building	kwh	$ 0.08	430,000	$ 34,400	
Fuel					
Diesel	gallons	$ 2.00	28,905	$ 57,810	
Gasoline					
					$ 92,210
Contingency					
Contingency (10%)					$ 52,834
					$ 581,169
Residual Management					
Compost/Organic Fertilizer Disposal "Worst Case"					
Compost Transportation	tons	$ 5.00	2,769	$ 13,845	
Compost Disposal (Tipping Fee)	$/ton	$ 20.50	2,769	$ 56,765	
					$ 70,610
Compost/Organic Fertilizer Disposal "Best Case"					
Sales From Composting	$/ton	$ (20.00)	2,769	$ (55,380)	
					$ (55,380)
				Best Case	$ 525,789
				Worst Case	$ 651,778

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Appendix D3
Lake Hancock Outfall
Reviewed & Adjusted
Construction Costs
for
WHS™ MAPS
Treatment Alternatives

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Table 1 - Construction costs for 45% TN Reduction target, 210 Acre WHS™

PARSONS
ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.: 743785
PROJECT: Lake Hancock Outfall Treatment Project — Project Description
CLIENT: South West Florida Water Management District — Estimate Type:

M.T.O. BY: HydroMentia — DATE: 02/18/05 — EST DATE: 8/18/05
PRICED BY: H. Snow — DATE: 05/26/05 — PRINT DATE: 8/18/05
CHECKED BY: T. Champlin — DATE: 05/31/05 — REV. 2:

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	LABOR M/H	LABOR P.F.	LABOR RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST	DIVISION SUBTOTALS
1.00	**Earth Work And General Site Preparation**															
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	304	AC		40	1.00	29.00	1,200.00		$ -	$ 352,640.00	$ 364,800.00	$ -	$ 2,360.00	$ 717,440.00	
1.02	Tree Removal (Larger then 12" dia.)	0	Ea		6.6	1.00	29.00	124.00		$ -	$ -	$ -	$ -	$ 315.40	$ -	
1.03	Earth Work (excavation and grading), allowance for grading of cell bottoms (see note a)	135,520	Cy		0.02	1.50	32.00	1.76		$ -	$ 130,099.20	$ 238,515.20	$ -	$ 2.72	$ 368,614.00	
1.04	Tree Protection	0	Lf	$ 0.50	0.01	1.00	26.00	1.00		$ -	$ -	$ -	$ -	$ 1.76	$ -	
1.05	Stripping Top Soil	0	Cy		0.01	1.00	29.00	0.45		$ -	$ -	$ -	$ -	$ 0.74	$ -	
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts onsite soils)		Cy		0.035	1.00	32.00	3.09		$ -	$ -	$ -	$ -	$ 4.21	$ -	
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)		Cy	$ 2.40	0.035	1.00	32.00	3.09		$ -	$ -	$ -	$ -	$ 6.61	$ -	
1.08	Final Grading	0	Sy		0.02	1.00	32.00	2.80		$ -	$ -	$ -	$ -	$ 6.61	$ -	
1.08a	DELETE Final Grading for roads only at 3.44/SY (see note b)	(11,111)	Sy		0.02	1.00	32.00	2.80		$ -	$ (7,111.04)	$ (31,110.80)	$ -	$ 3.44	$ (38,222.00)	
1.08b	Add: Final Grading for roads -WHS site (see note b)	11,111	Sy		0.009	1.00	28.00	0.35		$ -	$ 2,799.97	$ 3,888.85	$ -	$ 0.60	$ 6,689.00	
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	0	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ -	$ -	$ -	$ -	$ 14.89	$ -	
1.10a	3" Asphalt Conc. Pavement- WHS™ Access Road	11,111	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 38,888.50	$ 7,111.04	$ 44,444.00	$ -	$ 8.14	$ 90,444.00	
1.11a	12" Compacted Limerock Base - WHS™ Access Road	3,704	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 48,152.00	$ 2,370.56	$ 4,630.00	$ -	$ 14.89	$ 55,153.00	
1.12	12" Stabilized Subbase		Cy	$ 4.00	0.025	1.00	32.00	1.00		$ -	$ -	$ -	$ -	$ 5.80	$ -	
1.13	48' CMP	0	Lf	$ 69.00	0.7	1.00	32.00	9.00		$ -	$ -	$ -	$ -	$ 100.40	$ -	
1.14	Construction of WHS™ Berm	46,000	Lf	$ 72.72	Inlcuded			Inlcuded		$ 3,345,120.00	$ -	$ -	$ -	$ 72.72	$ 3,345,120.00	
1.14a	DELETE: Item 1.14, Construction of WHS™ Berm at 7.44/CY (see note c)	(46,000)	Lf	$ 72.72	Inlcuded			Inlcuded		$ (3,345,120.00)	$ -	$ -	$ -	$ 72.72	$ (3,345,120.00)	
1.14b	ADD: Berm, of imported fillw with 12' consolidated stone access road (see note c)	46,000	Lf	$ 63.23	Inlcuded			Inlcuded		$ 2,908,746.96	$ -	$ -	$ -	$ 63.23	$ 2,908,747.00	
1.15	10" Soil Cement - Compost and Sediment Dewatering Pads	117,560	Sy	$ 8.00	Inlcuded			Inlcuded		$ 940,480.00	$ -	$ -	$ -	$ 8.00	$ 940,480.00	
1.16	Construction of Berm for Thickening Pond	3,997	Cy	$ 9.00	0.02	1.00	32.00	1.75		$ 35,973.00	$ 2,558.08	$ 6,994.75	$ -	$ 11.39	$ 45,526.00	
1.17	Construction of Berm for Thickening Pond Stormwater Treatment	778	Cy	$ 9.00	0.02	1.00	32.00	1.75		$ 7,002.00	$ 497.92	$ 1,361.50	$ -	$ 11.39	$ 8,861.00	
1.18	12" Compacted Crushed Concrete	0	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ -	$ -	$ -	$ -	$ 14.89	$ -	
																$ 5,103,732.00
2.00	**Concrete**															
2.01	Slab on grade -per WHS™	44	CY	$ 203.00	0.00	1.00	36.00	included		$ 8,932.00	$ -	$ -	$ -	$ 203.00	$ 8,932.00	
2.01a	DELETE: Slab on grade -per WHS™ (see note d)	(44)	CY	$ 203.00	0.00	1.00	36.00	included		$ (8,932.00)	$ -	$ -	$ -	$ 203.00	$ (8,932.00)	
2.01b	ADD: Slab on grade , including labor (see note d)	44	CY	$ 203.00	6.00	1.00	36.00	included		$ 8,932.00	$ 9,504.00	$ -	$ -	$ 419.00	$ 18,436.00	
2.02	Conventional walls	0	CY	$ 371.00	6.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 587.00	$ -	
2.03	Elevated Work	0	CY	$ 473.00	8.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 761.00	$ -	
2.04	Columns	0	CY	$ 486.00	8.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 774.00	$ -	
2.04	12" Structural Fill (57 stone or crushed conc.)	0	Cy	$ 12.00	0.17	1.00	25.00	5.00		$ -	$ -	$ -	$ -	$ 21.25	$ -	
																$ 18,436.00
3.00	**Geomembrane**															
3.01	HDPE Liner	867,000	Sf	$ 0.19	0.003	1.00	36.00			$ 167,331.00	$ 104,039.99	$ -	$ -	$ 0.313	$ 271,371.00	
3.01a	DELETE: HDPE Liner (see note e)	(867,000)	Sf	$ 0.19	0.003	1.00	36.00			$ (167,331.00)	$ (104,039.99)	$ -	$ -	$ 0.313	$ (271,371.00)	
3.01b	HDPE Liner (see note e)	867,000	Sf	$ 0.44	0.015	1.00	36.00			$ 381,480.00	$ 468,180.00	$ -	$ -	$ 0.980	$ 849,660.00	
3.02	Liner Entrenchment	20,000	Lf	$ -	included	1.00	36.00	3.15		$ -	$ -	$ 63,000.00	$ -	$ 3.15	$ 63,000.00	
3.03	Foating Boom	77,520	Ff	$ 4.50	included	1.00	36.00	0.07		$ 348,840.00	$ -	$ 5,116.32	$ -	$ 4.57	$ 353,956.00	
3.04	Floating Boom & Dredge Anchors	290	Ea	$ 11.20	included	1.00	36.00	4.20		$ 3,248.00	$ -	$ 1,218.00	$ -	$ 15.40	$ 4,466.00	
																$ 1,271,082.00
4.00	**Hydraulic Structures**															
4.01	Influent Structures	130	Ea	$ 875.00	included	1.00	36.00	included		$ 113,750.00	$ -	$ -	$ -	$ 875.00	$ 113,750.00	
4.02	Effluent Structures	130	Ea	$ 4,000.00	included	1.00	36.00	included		$ 520,000.00	$ -	$ -	$ -	$ 4,000.00	$ 520,000.00	
4.03	Discharge Piping Structure	1	Ea	$ 180,320.00	included	1.00	36.00	included		$ 180,320.00	$ -	$ -	$ -	$ 180,320.00	$ 180,320.00	
4.04	Stormwater Culverts	1	LS	$ 20,000.00	included	1.00	36.00	included		$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ 20,000.00	
4.05	Dredge PVC Distribution Line -8"	14,000	Lf	$ 3.25	included	1.00	36.00	11.00		$ 45,500.00	$ -	$ 154,000.00	$ -	$ 14.25	$ 199,500.00	
4.06	Dredge Distribution line GateValve -8"	4	Ea	$ 300.00	included	1.00	36.00	200.00		$ 1,200.00	$ -	$ 800.00	$ -	$ 500.00	$ 2,000.00	
4.07	Dredge Distribution line Air ReliefValve -8"	4	Ea	$ 300.00	included			200.00		$ 1,200.00	$ -	$ 800.00	$ -	$ 500.00	$ 2,000.00	
4.08	Miscellaneous Piping	1	LS	$ 15,000.00	included			included		15,000	$ -	$ -	$ -	$ 15,000.00	$ 15,000.00	
																1,052,570.00
5.00	**Buildings**															
5.01	Maintenance & Equipment Storage per HydroMentia proposal	2,500	Sf	$ 15.00	included	1.00	36.00	included		$ 37,500.00	$ -	$ -	$ -	$ 15.00	$ 37,500.00	
5.01a	Maintenance & Equipment Storage per HydroMentia proposal (see note f)	(2,500)	Sf	$ 15.00	included	1.00	36.00	included		$ (37,500.00)	$ -	$ -	$ -	$ 15.00	$ (37,500.00)	
5.01b	Maintenance & Equipment Storage allowance per Parsons (see note f)	2,500	Sf	$ 130.00	included	1.00	36.00	included		$ 325,000.00	$ -	$ -	$ -	$ 130.00	$ 325,000.00	
5.02	Administrative & Staff Facilities - per WHS proposal	600	Sf	$ 60.00	included	1.00	36.00	included		$ 36,000.00	$ -	$ -	$ -	$ 60.00	$ 36,000.00	
5.02a	Administrative & Staff Facilities - per HydorMentia proposal (see note g)	(600)	Sf	$ 60.00	included	1.00	36.00	included		$ (36,000.00)	$ -	$ -	$ -	$ 60.00	$ (36,000.00)	
5.02b	Administrative & Staff Facilities, allowance per Parsons (see note g)	600	Sf	$ 180.00	included	1.00	36.00	included		$ 108,000.00	$ -	$ -	$ -	$ 180.00	$ 108,000.00	
5.03	Well, Drinking Water	1	Ls	$ 30,000.00	included	1.00	36.00	included		$ 30,000.00	$ -	$ -	$ -	$ 30,000.00	$ 30,000.00	
5.04	Sanitary Facilites, Septic	1	Ls	$ 30,000.00	included	1.00	36.00	included		$ 30,000.00	$ -	$ -	$ -	$ 30,000.00	$ 30,000.00	
5.05	Fuel Storage	1	Ls	$ 30,000.00	included	1.00	25.00	included		$ 30,000.00	$ -	$ -	$ -	$ 30,000.00	$ 30,000.00	
																$ 523,000.00
6.00	**Site Landscaping & Maintenance**															
6.01	Fence - Chain Link per HydroMentia Proposal	900	Lf	$ 14.50	included	1.00	36.00	included		$ 13,050.00	$ -	$ -	$ -	$ 14.50	$ 13,050.00	
6.01a	DELETE:Fence - Chain Link per HydroMentia Proposal (see note h)	(900)	Lf	$ 14.50	included	1.00	36.00	included		$ (13,050.00)	$ -	$ -	$ -	$ 14.50	$ (13,050.00)	
6.01b	ADD: Fence - Chain Liink, sch 40 galv. 2" posts @10'OC (see note h)	900	Lf	$ 24.30	0.07	1.00	36.00	0.56		$ 21,869.82	$ 2,365.20	$ 504.00	$ -	$ 27.49	$ 24,739.00	

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ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	LABOR M/H	LABOR P.F.	LABOR RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST	DIVISION SUBTOTALS
6.01c	Gate - Chain Link, 20 ' opening (see note i)	1	ea	$ 1,957.00	18.60	1.00	36.00	390.00		$ 1,957.00	$ 669.60	$ 390.00	$ -	$ 3,017.00	$ 3,017.00	
6.02	Fence - 5 strand Barbed Wire per HydroMentia proposal	17,800	Lf	$ 1.75	included	1.00	36.00	included		$ 31,150.00	$ -	$ -	$ -	$ 1.75	$ 31,150.00	
6.02	Fence - 5 strand Barbed Wire per HydroMentia proposal (see note j)	(17,800)	Lf	$ 1.75	included	1.00	36.00	included		$ (31,150.00)	$ -	$ -	$ -	$ 1.75	$ (31,150.00)	
6.02	Fence - 5 strand Barbed Wire (see note j)	17,800	Lf	$ 0.60	0.05	1.00	36.00	0.49		$ 10,680.00	$ 32,040.00	$ 8,722.00	$ -	$ 2.89	$ 51,442.00	
6.03	Seed & Mulch	840,000	Sf	$ 0.02	included	1.00	36.00	included		$ 19,572.00	$ -	$ -	$ -	$ 0.02	$ 19,572.00	
2.04	Sod	10,000	Sf	$ 0.22	included	1.00	36.00	included		$ 2,200.00	$ -	$ -	$ -	$ 0.22	$ 2,200.00	
6.03	Seed & Mulch (see note k)	(840,000)	Sf	$ 0.02	included	1.00	36.00	included		$ (19,572.00)	$ -	$ -	$ -	$ 0.02	$ (19,572.00)	
2.04	Sod (see note l)	(10,000)	Sf	$ 0.22	included	1.00	36.00	included		$ (2,200.00)	$ -	$ -	$ -	$ 0.22	$ (2,200.00)	
6.03	Seed & Mulch (see note k)	840,000	Sf	$ 1.72	included	1.00	36.00	included		$ 1,444,800.00	$ -	$ -	$ -	$ 1.72	$ 1,444,800.00	
2.04	Sod (see note l)	10,000	Sf	$ 1.00	included	1.00	36.00	included		$ 10,000.00	$ -	$ -	$ -	$ 1.00	$ 10,000.00	
																1,533,998.00
7.00	**Equipment**															
7.01	Valtr Model T170 with Brown Bear PTOPA-10.5 Compost Aerator	1	Ea	$ 128,000.00	NA	1.00	36.00	included		$ 128,000.00	$ -	$ -	$ -	$ 128,000.00	$ 128,000.00	
7.02	John Deere Model 7420 -115 hp	2	Ea	$ 80,000.00	NA	1.00	36.00	included		$ 160,000.00	$ -	$ -	$ -	$ 80,000.00	$ 160,000.00	
7.03	John Deere Model 7420 -115 hp - Loader	1	Ea	$ 86,000.00	NA	1.00	36.00	included		$ 86,000.00	$ -	$ -	$ -	$ 86,000.00	$ 86,000.00	
7.04	HMI Model 101-P Grapple	2	Ea	$ 42,000.00	NA	1.00	36.00	included		$ 84,000.00	$ -	$ -	$ -	$ 42,000.00	$ 84,000.00	
7.05	HMI Model 401-P Processor	2	Ea	$ 98,000.00	NA	1.00	36.00	included		$ 196,000.00	$ -	$ -	$ -	$ 98,000.00	$ 196,000.00	
7.06	Miller Model 5300 Series Forage Wagon	3	Ea	$ 18,200.00	NA	1.00	36.00	included		$ 54,600.00	$ -	$ -	$ -	$ 18,200.00	$ 54,600.00	
7.08	60" Dixie Chopper Mower	1	Ea	$ 8,900.00	NA	1.00	36.00	included		$ 8,900.00	$ -	$ -	$ -	$ 8,900.00	$ 8,900.00	
7.09	Trimmers & Misc Lawn Equipment	1	Ea	$ 2,000.00	NA	1.00	36.00	included		$ 2,000.00	$ -	$ -	$ -	$ 2,000.00	$ 2,000.00	
7.10	All Terrain Vehicles	2	Ea	$ 3,000.00	NA	1.00	36.00	included		$ 6,000.00	$ -	$ -	$ -	$ 3,000.00	$ 6,000.00	
7.11	Tools & Incidental Equipment	1	Ls	$ 5,000.00	NA	1.00	36.00	included		$ 5,000.00	$ -	$ -	$ -	$ 5,000.00	$ 5,000.00	
7.12	House Model HDC 18A153 Aerators	8	Ea	$ 8,100.00	included	1.00	36.00	100.00		$ 64,800.00	$ -	$ 800.00	$ -	$ 8,200.00	$ 65,600.00	
7.13	Sigma 900 Autosamplers with housing	2	Ea	$ 4,500.00	included			500.00		$ 9,000.00	$ -	$ 1,000.00	$ -	$ 5,000.00	$ 10,000.00	
7.14	LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	$ 100,000.00	included			included		$ 100,000.00	$ -	$ -	$ -	$ 100,000.00	$ 100,000.00	
7.14a	DELETE: LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	$ (100,000.00)	included			included		$ (100,000.00)	$ -	$ -	$ -	$ (100,000.00)	$ (100,000.00)	
7.14b	ADD: LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	$ 250,000.00	included			included		$ 250,000.00	$ -	$ -	$ -	$ 250,000.00	$ 250,000.00	
7.15	Supernatant Pump Station	1	Ls	$ 40,000.00	included			included		$ 40,000.00	$ -	$ -	$ -	$ 40,000.00	$ 40,000.00	
7.16	6" Telescoping Valve	1	Ea	$ 1,200.00	included			100.00		$ 1,200.00	$ -	$ 100.00	$ -	$ 1,300.00	$ 1,300.00	
7.16a	ADD: 6" Telescoping Valve	5	Ea	$ 1,200.00	included			100.00		$ 6,000.00	$ -	$ 500.00	$ -	$ 1,300.00	$ 6,500.00	
															$ -	$ 1,103,900.00
8.00	**Electrical**															
8.01	Electrical Equipment & Installation	1	Ls	$ 50,000.00	NA	1.00	36.00	included		$ 50,000.00	$ -	$ -	$ -	$ 50,000.00	$ 50,000.00	
																50,000.00
	TOTAL CONSTRUCTION															10,656,718.00
General Conditions																
	Contingency 20%														$ 2,131,344.00	
	Mob/Demob 5%														$ 532,835.90	
	Permits 1%														$ 106,567.00	
	Bonds 1%														$ 106,567.00	
	Insurance 1%														$ 106,567.00	
	Sales Tax							Equipment & Materials		$ 3,197,015	estimated at 1/3 total construction cost				$ 223,791.00	$ 3,207,671.90
	Total Construction Costs															
	Enginering & Overhead (15%)														$ 2,079,658.49	
	TOTAL CAPITAL COSTS														2,079,658.49	13,864,389.90

NOTES:

(a) Allowance for grading of cell bottoms made, assumed 40 percent of area requiring 1 cuft moved.

(b) Unit cost for fine grading listed was for small areas, unit cost revised to reflect fine grading of roads prior paving

(c) Berms for WHS are located within an area of reclaimed waste phosphatic clays. Assume soils within the clay settling areas are unsuitable for construction of berms, but suitable soil is available elsewhere within the site limits.

Items Required for Levee Construction (Footnote c):

1.03	Earth Work (excavation and soils removal)	$0.00
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts imported borrow soils) based on a unit cost of $4.21/cy.	$52.20
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	$11.03
	Total = Lf of Levee	$63.23

Footnote 1 - Complete construction of STA levee includes items 1.03, 1.07 and 1.09 from above.
Typical WHS- berm cross section is 76 ft base, 20 ft top, 7 ft high, 4:1 slope
Average district cost per linear foot of levee is $155.17/LF for 14' wide, 9 ft tall (HDR, November 2004)

(d) Labor costs were not included in HydroMentia's proposal for this item. Unit cost adjusted to include labor

(e) Review of HDPE liner unit costs quoted for 40 mil HDPE is 1/3 less than national average bare costs for 30 mil HDPE (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for city of Tampa

(f) Maintenance & Equipment storage buildings. Parsons provided unit cost allowance for this item of $130.00/sf

(g) Adminstrative and staff facilities buildings. Parsons provided unit cost allowance for this item of $180.00/sf

(h) Review of unit costs quoted for chain link fence is 40% less than national average bare costs for galv steel chain link fence suitable for industrial use (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL

(i) Cost for gate was omited from quote.

(j) Review of unit costs quoted for barbed wire fence is 40% less than national average bare costs for barbed wire fence (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL

(k) Review of unit costs against national average quoted for seed & mulch does not account for screening, load, haul and place topsoil, finegrading, (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL to include screening, load, haul & placement of topsoil, fine grading & hydroseed/mulch

(l) Review of unit costs quoted for sod is 65% less than national average bare costs for sod and did not include topsoil or fine grading (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for city of Tampa to include screening, load, haul & placement of topsoil, finegrading & sod (bent grass)

(m) Unit cost of $100,000 represents minimally equiped dredge (Telecommunications with LWT). Costs were increased to $250,000 to be consistent with unit costs listed for Sedimentation ponds.

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Table 2 - Unit construction costs for Pump Station Access Road

PARSONS

ENGINEER ESTIMATE WORKSHEET | Budgetary Cost Estimate

JOB NO.:	743785		**M.T.O. BY:** HydroMentia	**DATE:**	09/13/04	**EST DATE:**	5/26/05
PROJECT:	Lake Hancock Outfall Treatment Project- WHS ™ for 45% TN Reduction	**Project Description**	**PRICED BY:** HydroMentia /Pa	**DATE:**	09/13/04	**PRINT DATE:**	8/18/05
CLIENT:	South West Florida Water Management District	**Estimate Type:**	**CHECKED BY:** H. Snow	**DATE:**	09/13/04	**REV. 1:**	

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	**UNIT RATES** MATERIAL/ EQUIPMENT	LABOR M/H	LABOR P.F.	LABOR RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST
1.10	3" Asphalt Conc. Pavement - P11 Pump Station access road	37,000	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 129,500.00	$ 23,680.00	$ 148,000.00	$ -	$ 8.14	$ 301,180.00
1.08	Final Grading	37,000	Sy		0.02	1.00	32.00	2.80		$ -	$ 23,680.00	$ 103,600.00	$ -	$ 3.44	$ 127,280.00
1.08 d	DELETE: Final Grading for roads Pump Staton P-11 Access @ 3.44 (see note a)	(37,000)	Sy		0.02	1.00	32.00	2.80		$ -	$ (23,680.00)	$ (103,600.00)	$ -	$ 3.44	$ (127,280.00)
1.08 d	ADD: Final Grading for roads Pump Staton P-11 Access @ .63/SY (see note a)	37,000	Sy		0.009	1.00	28.00	0.35		$ -	$ 9,324.00	$ 12,950.00	$ -	$ 0.60	$ 22,274.00
1.11	12" Compacted Limerock Base	12,333	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 160,329.00	$ 7,893.12	$ 15,416.25	$ -	$ 14.89	$ 183,638.00
	TOTAL CONSTRUCTION														**507,092.00**
	Contingency 20%														101,418.00
	Mob/Demob 5%														25,354.60
	Permits 1%														5,071.00
	Bonds 1%														5,071.00
	Insurance 1%														5,071.00
	Sales Tax	Equipment & Materials								$ 152,128	estimated at 30% of total construction costs				10,649.00
	Total Construction Costs														659,726.60

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Table 3 Itemized construction and annual operations and maintenance (O&M) costs for 300 CFS (194-MGD) inflow intake and pump station.

LAKE HANCOCK OUTFALL TREATMENT PROJECT

300 CUBIC FEET PER SECOND (130-MGD) INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	$/ft [1]	Escalated Cost
Transmission Main											
Dual Pipeline	97.00	67415	64.0	Steel	110	300	6.72	0.2440	0.7	380.00	$ 228,000
Dual Pipeline	97.00	67415	64.0	Steel	110	300	6.72	0.2440	0.7	380.00	$ 138,852
Total	**194.00**	**134,830**							**1.46**		**$ 366,852**
										Inflated to 2004	**$ 446,826**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	length of pipeline taken from Figure I,
December 2004 ENR Construction Index:	7308	provided by HydroMentia Feb. 2005
Inflation from 1999 to present:	21.800 %	
Average Inflation per year:	4.360 %	
Escalation Factor	1.218	

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs	300	
Construction Cost $	$ 2,325,021	(Footnote 2)
Telemetry	$ 100,000	(Footnote 2)
3-Phase Power	$ 625,000	(Footnote 2)
Electrical Service	$ 100,000	
Inflation (Contingency)	$ 581,255	Increased by 25% due to recent increases in concrete, steel and construction costs this year
Total	**$ 3,731,276**	

Lake Hancock Pump Station

Capacity - mgd	194	
Hf	1.5	
Static Head+PS Loss	27.0	Assume intake at pump station 95, top of exising berm 122
TDH	28.5	
Pump Efficiency	0.80	
Break HP	1,211.4	
Motor Efficiency	0.95	
Maximum Annual kwh	8,329,896	
Average Annual kwh	1,051,779	Based on annual average flow 37.90 cfs or 24 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**73,625**	Assumes operation at 51 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	$ 3,731,276	$ 37,313	$ 149,251	$ 73,625	$ 260,188
Transmission Main	$ 446,826	$ 4,468			$ 4,468
Total Intake, pump station and transmission main	**$ 4,178,102**	**$ 41,781**	**$ 149,251**	**$ 73,625**	$ 264,657

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of capital cost

Annual O&M Equipment @ 4% of capital cost

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Table 4 - Adjusted annual operations and maintenance (O&M) costs for 45% TN reduction target, 210 acre WHS.

HydroMentia, Inc. (Proposal, February 2005, Rev02)

Annual O & M costs

Category	Unit	Rate	Quantity	Cost	Total Category Cost
Labor					
Facility Operations					
Field Technician		35	8320	$ 291,200.00	
Lead Operator		60	2080	$ 124,800.00	
Field Technician II	hr		0	$ -	
Operations Manager			0	$ -	
Administrative Assistant			0	$ -	
Facility Administration and Technical Oversight					
Senior Biologist			0	$ -	
Project Engineer			0	$ -	
Operations Manager			0	$ -	
Administrative Assistant			0	$ -	
					$ 416,000
Travel Costs					
Travel	$/mile		0	$ -	
Hotel	nights		0	$ -	
					$ -
Maintenance					
Equipment					
Equipment (2% of Equipment Cost)	$/yr	2%	899300	$ 17,986.00	
Site					
Building	per unit	6000	1	$ 6,000.00	
Road Maintenance	lump sum	40000	1	$ 40,000.00	
					$ 63,986
Chemicals and Pest Control					
Pest Control					
Nematodes	$/acre-yea	$500	200	$ 100,000.00	
Supplemental Nutrients Allowance	lump sum				
					$ 100,000
Laboratory Costs (ATS & WHS Systems Only					
WHS					
Laboratory Costs (per parsons)	lump sum	30000	1	$ 30,000.00	
Misc Samples (HMI Plant and Water	lump sum	1000	1	$ 1,000.00	
					$ 31,000
Energy					
Electricity					
Aeration, pumps and Building	kwh	0.08	430000	$ 34,400.00	
Fuel					
Diesel	gallons	$ 1.60	61500	$ 98,400.00	
Gasoline					
					$ 132,800
Contingency					
Contingency (10%)		0%			
					$ 743,786
Residual Management					
Compost/Organic Fertilizer Disposal "Worst Case"					
Compost Transportation	tons	5	8931	$ 44,655.00	
Compost Disposal	$/ton	20.5	8931	$ 183,085.50	
					$ 227,741
			Worst Case		$ 971,527

Parsons Adjustments

Annual O & M costs

Category	Unit	Rate	Quantity	Revised Cost	Total Category Cost
Labor					
Facility Operations					
Field Technician		35	0	$ -	
Lead Operator		60	0	$ -	
Field Technician II	hr	45	10400	$ 468,000	
Operations Manager		85	1980	$ 168,300	
Administrative Assistant		35	190	$ 6,650	
Facility Administration and Technical Oversight					
Senior Biologist		110	48	$ 5,280	
Project Engineer		135	38	$ 5,130	
Operations Manager		85	476	$ 40,460	
Administrative Assistant		35	48	$ 1,680	
					$ 695,500
Travel Costs					
Travel	$/mile	0.42	28560	$ 11,995	
Hotel	nights	45	124	$ 5,580	
				$ -	$ 17,575
Maintenance				$ -	
Equipment				$ -	
Equipment (5% of Equipment Cost)	$/yr	5%	1,103,900	$ 55,195	
Site				$ -	
Building	per unit	6000	1	$ 6,000	
Road Maintenance	lump sum	40000	1	$ 40,000	
				$ -	$ 101,195
				$ -	
Chemicals and Pest Control				$ -	
Pest Control				$ -	
Nematodes	$/acre-yea	$500	200	$ 100,000	
Supplemental Nutrients Allowance	lump sum			$ 50,000	
				$ -	$ 150,000
Laboratory Costs (ATS & WHS Systems Only				$ -	
WHS				$ -	
Laboratory Costs (per parsons)	lump sum	30000	1	$ 30,000	
Misc Samples (HMI Plant and Water	lump sum	1000	1	$ 1,000	
				$ -	$ 31,000
Energy				$ -	
Electricity				$ -	
Aeration, pumps and Building	kwh	0.08	430000	$ 34,400	
Fuel				$ -	
Diesel	gallons	$ 2.00	61500	$ 123,000	
Gasoline					
					$ 157,400
Contingency					
Contingency (10%)		10%			$ 115,267
					$ 1,267,937
Residual Management					
Compost/Organic Fertilizer Disposal "Worst Case"					
Compost Transportation	tons	5	8931	$ 44,655	
Compost Disposal	$/ton	20.5	8931	$ 183,086	
					$ 227,741
			Worst Case		$ 1,495,678

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PARSONS

Table 5 - Construction costs for 27% TN Reduction target, 88 Acre WHS™

PARSONS

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.:	743785		M.T.O. BY: HydroMentia	DATE:	05/06/05	EST DATE:	05/26/05
PROJECT:	Lake Hancock Outfall Treatment Project	Project Description	PRICED BY: H. Snow	DATE:	05/26/05	PRINT DATE:	02/14/06
CLIENT:	`	Estimate Type:	CHECKED BY: T. Champlin	DATE:	05/31/05	REV. 0:	

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES: MATERIAL/ EQUIPMENT	LABOR: M/H	LABOR: P.F.	LABOR: RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**														
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	130	AC		40	1.00	29.00	1,200.00		$ -	$ 150,800	$ 156,000	$ -	$ 2,360.00	$ 306,800
1.02	Tree Removal (Larger then 12" dia.)	0	Ea		6.6	1.00	29.00	124.00		$ -	$ -	$ -	$ -	$ 315.40	$ -
1.03	Earth Work (excavation and grading), allowance for grading of cell bottoms (see note a)	56,789	Cy		0.02	1.50	32.00	1.76		$ -	$ 54,518	$ 99,949	$ -	$ 2.72	$ 154,467
1.04	Tree Protection	0	Lf	$ 0.50	0.01	1.00	26.00	1.00		$ -	$ -	$ -	$ -	$ 1.76	$ -
1.05	Stripping Top Soil		Cy		0.01	Length	29.00	0.45		$ -	$ -	$ -	$ -	$ 0.45	$ -
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts onsite soils)		Cy		0.035	1.00	32.00	3.09		$ -	$ -	$ -	$ -	$ 4.21	$ -
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)		Cy	$ 2.40	0.035	1.00	32.00	3.09		$ -	$ -	$ -	$ -	$ 6.61	$ -
1.08	Final Grading	0	Sy		0.02	1.00	32.00	2.80		$ -	$ -	$ -	$ -	$ 3.44	$ -
1.08a	DELETE Final Grading for roads only at 3.44/SY (see note b)	(11,111)	Sy		0.02	1.00	32.00	2.80		$ -	$ (7,111)	$ (31,111)	$ -	$ 3.44	$ (38,222)
1.08b	ADD: Final Grading for roads -WHS site (see note b)	11,111	Sy		0.009	1.00	28.00	0.35		$ -	$ 2,800	$ 3,889	$ -	$ 0.60	$ 6,689
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	0	Cy	$ 8.00	0.005	1.00	32.00	1.75		$ -	$ -	$ -	$ -	$ 9.91	$ -
1.10a	3" Asphalt Conc. Pavement- WHS™Access Road	11,111	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 38,889	$ 7,111	$ 44,444	$ -	$ 8.14	$ 90,444
1.11a	12" Compacted Limerock Base - WHS™ Access Road	3,704	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 48,152	$ 2,371	$ 4,630	$ -	$ 14.89	$ 55,153
1.12	12" Stabilized Subbase	0	Cy	$ 4.00	0.025	1.00	32.00	1.00		$ -	$ -	$ -	$ -	$ 5.80	$ -
1.13	48' CMP	0	Lf	$ 69.00	0.7	1.00	32.00	9.00		$ -	$ -	$ -	$ -	$ 100.40	$ -
1.14	Construction of WHS™ Berm	31,322	Lf	$ 72.72	Inlcuded					$ 2,277,736	$ -	$ -	$ -	$ 72.72	$ 2,277,736
1.14a	DELETE: Item 1.14, Construction of WHS™Berm at 7.44/CY (see note c)	(31,322)	Lf	$ 72.72	Inlcuded					$ (2,277,736)	$ -	$ -	$ -	$ 72.72	$ (2,277,736)
1.14b	ADD: Berm, 46,000 Lf x 9.77 sf/lf (see note c)	31,322	Lf	$ 63.23	Inlcuded			Inlcuded		$ 1,980,490	$ -	$ -	$ -	$ 63.23	$ 1,980,490
1.15	10" Soil Cement - Compost and Sediment Dewatering Pads	43,067	Sy	$ 8.00	Inlcuded					$ 344,536	$ -	$ -	$ -	$ 8.00	$ 344,536
1.16	Construction of Berm for Thickening Pond	3,997	Cy	$ 9.00	0.02	1.00	32.00	1.75		$ 35,973	$ 2,558	$ 6,995	$ -	$ 11.39	$ 45,526
1.17	Construction of Berm for Thickening Pond Storwater Treatment	778	Cy	$ 9.00	0.02	1.00	32.00	1.75		$ 7,002	$ 498	$ 1,362	$ -	$ 11.39	$ 8,861
1.18	12" Compacted Crushed Concrete	0	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ -	$ -	$ -	$ -	$ 14.89	$ -
2.00	**Concrete**														
2.01	Slab on grade -per WHS™	44	CY	$ 203.00	0.00	1.00	36.00	included		$ 8,932	$ -	$ -	$ -	$ 203.00	$ 8,932
2.01a	DELETE: Slab on grade -per WHS™ (see note d)	(44)	CY	$ 203.00	0.00	1.00	36.00	included		$ (8,932)	$ -	$ -	$ -	$ 203.00	$ (8,932)
2.01b	ADD: Slab on grade , including labor (see note d)	44	CY	$ 203.00	6.00	1.00	36.00	included		$ 8,932	$ 9,504	$ -	$ -	$ 419.00	$ 18,436
2.02	Conventional walls	0	CY	$ 371.00	6.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 587.00	$ -
2.03	Elevated Work	0	CY	$ 473.00	8.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 761.00	$ -
2.04	Columns	0	CY	37.90	8.00	1.00	36.00	included		$ -	$ -	$ -	$ -	$ 325.90	$ -
2.04	12" Structural Fill (57 stone or crushed conc.)	0	Cy	12.00	0.17	1.00	25.00	5.00		$ -	$ -	$ -	$ -	$ 21.25	$ -
3.00	**Geomembrane**														
3.01	HDPE Liner	749,000	Sf	$ 0.19	0.003	1.00	36.00			$ 144,557	$ 89,880	$ -	$ -	$ 0.313	$ 234,437
3.01a	DELETE: HDPE Liner (see note e)	(749,000)	Sf	$ 0.19	0.003	1.00	36.00			$ (144,557)	$ (89,880)	$ -	$ -	$ 0.313	$ (234,437)
3.01b	HDPE Liner (see note e)	749,000	Sf	$ 0.44	0.015	1.00	36.00			$ 329,560	$ 404,460	$ -	$ -	$ 0.980	$ 734,020
3.02	Liner Entrenchment	10,000	Lf	$ -	include	1.00	36.00	3.15		$ -	$ -	$ 31,500	$ -	$ 3.15	$ 31,500
3.03	Foating Boom	29,000	Ff	$ 4.50	include	1.00	36.00	0.07		$ 130,500	$ -	$ 1,914	$ -	$ 4.57	$ 132,414
3.04	Floating Boom & Dredge Anchors	290	Ea	$ 11.20	include	1.00	36.00	4.20		$ 3,248	$ -	$ 1,218	$ -	$ 15.40	$ 4,466
4.00	**Hydraulic Structures**														
4.01	Influent Structures	60	Ea	$ 855.00	included	1.00	36.00	included		$ 51,300	$ -	$ -	$ -	$ 855.00	$ 51,300
4.02	Effluent Structures	80	Ea	$ 4,000.00	included	1.00	36.00	included		$ 320,000	$ -	$ -	$ -	$ 4,000.00	$ 320,000
4.03	Discharge Piping Structure	1	Ea	$ 180,320.00	included	1.00	36.00	included		$ 180,320	$ -	$ -	$ -	$ 180,320.00	$ 180,320
4.04	Stormwater Culverts	1	LS	$ 20,000.00	included	1.00	36.00	included		$ 20,000	$ -	$ -	$ -	$ 20,000.00	$ 20,000
4.05	Dredge PVC Distribution Line -8"	9,000	Lf	3.25	included	1.00	36.00	11.00		$ 29,250	$ -	$ 99,000.00	$ -	$ 14.25	$ 128,250
4.06	Dredge Distribution line GateValve -8"	4	Ea	300.00	included	1.00	36.00	200.00		$ 1,200	$ -	$ 800.00	$ -	$ 500.00	$ 2,000
4.07	Dredge Distribution line Air ReliefValve -8"	4	Ea	300.00	included			200.00		$ 1,200	$ -	$ 800.00	$ -	$ 500.00	$ 2,000
4.08	Miscellaneous Piping	1	LS	15,000.00	included			included		$ 15,000	$ -	$ -	$ -	$ 15,000.00	$ 15,000
5.00	**Buildings**														
5.01	Maintenance & Equipment Storage per HydroMentia proposal	2,500	Sf	$ 15.00	included	1.00	36.00	included		$ 37,500	$ -	$ -	$ -	$ 15.00	$ 37,500
5.01a	Maintenance & Equipment Storage per HydroMentia proposal (see note f)	(2,500)	Sf	$ 15.00	included	1.00	36.00	included		$ (37,500)	$ -	$ -	$ -	$ 15.00	$ (37,500)
5.01b	Maintenance & Equipment Storage allowance per Parsons (see note f)	2,500	Sf	$ 130.00	included	1.00	36.00	included		$ 325,000	$ -	$ -	$ -	$ 130.00	$ 325,000
5.02	Administrative & Staff Facilities - per WHS proposal	600	Sf	$ 60.00	included	1.00	36.00	included		$ 36,000	$ -	$ -	$ -	$ 60.00	$ 36,000
5.02a	Administrative & Staff Facilities - per HydorMentia proposal (see note g)	(600)	Sf	$ 60.00	included	1.00	36.00	included		$ (36,000)	$ -	$ -	$ -	$ 60.00	$ (36,000)
5.02b	Administrative & Staff Facilities, allowance per Parsons (see note g)	600	Sf	$ 180.00	included	1.00	36.00	included		$ 108,000	$ -	$ -	$ -	$ 180.00	$ 108,000
5.03	Well, Drinking Water	1	Ls	$ 30,000.00	included	1.00	36.00	included		$ 30,000	$ -	$ -	$ -	$ 30,000	$ 30,000
5.04	Sanitary Facilites, Septic	1	Ls	$ 30,000.00	included	1.00	36.00	included		$ 30,000	$ -	$ -	$ -	$ 30,000	$ 30,000
5.05	Fuel Storage	1	Ls	30,000.00	included	1.00	25.00	included		$ 30,000	$ -	$ -	$ -	$ 30,000	$ 30,000
6.00	**Site Landscaping & Maintenance**														
6.01	Fence - Chain Link per HydroMentia Proposal	900	Lf	$ 14.50	included	1.00	36.00	included		$ 13,050	$ -	$ -	$ -	$ 14.50	$ 13,050
6.01a	DELETE:Fence - Chain Link per HydroMentia Proposal (see note h)	(900)	Lf	$ 14.50	included	1.00	36.00	included		$ (13,050)	$ -	$ -	$ -	$ 14.50	$ (13,050)
6.01b	ADD: Fence - Chain Liink, sch 40 galv. 2" posts @10'OC (see note h)	900	Lf	$ 24.30	0.07	1.00	36.00	0.56		$ 21,870	$ 2,365	$ 504	$ -	$ 27.49	$ 24,739
6.01c	ADD: Gate - Chain Link, 20 ' opening (see note i)	1	ea	$ 1,957.00	18.60	1.00	36.00	390.00		$ 1,957	$ 670	$ 390	$ -	$ 3,017.00	$ 3,017

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ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES: MATERIAL/ EQUIPMENT	LABOR: M/H	LABOR: P.F.	LABOR: RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST
6.02	Fence - 5 strand Barbed Wire per HydroMentia proposal	12,000	Lf	$ 1.75	included	1.00	36.00	included		$ 21,000	$ -	$ -	$ -	$ 1.75	$ 21,000
6.02a	Fence - 5 strand Barbed Wire per HydroMentia proposal (see note j)	(12,000)	Lf	$ 1.75	included	1.00	36.00	included		$ (21,000)	$ -	$ -	$ -	$ 1.75	$ (21,000)
6.02b	Fence - 5 strand Barbed Wire (see note j)	12,000	Lf	$ 0.60	0.05	1.00	36.00	0.49		$ 7,200	$ 21,600	$ 5,880	$ -	$ 2.89	$ 34,680
6.03	Seed & Mulch	360,000	Sf	$ 0.02	included	1.00	36.00	included		$ 8,388	$ -	$ -	$ -	$ 0.02	$ 8,388
6.04	Sod	10,000	Sf	$ 0.22	included	1.00	36.00	included		$ 2,200	$ -	$ -	$ -	$ 0.22	$ 2,200
6.03a	DELETE: Seed & Mulch (see note k)	(360,000)	Sf	$ 0.02	included	1.00	36.00	included		$ (8,388)	$ -	$ -	$ -	$ 0.02	$ (8,388)
6.04a	DELETE: Sod (see note l)	(10,000)	Sf	$ 0.22	included	1.00	36.00	included		$ (2,200)	$ -	$ -	$ -	$ 0.22	$ (2,200)
6.03b	ADD: Replace Topsoil, Seed & Mulch (see note k)	360,000	Sf	$ 1.72	included	1.00	36.00	included		$ 619,200	$ -	$ -	$ -	$ 1.72	$ 619,200
6.04b	ADD: Sod (see note l)	10,000	Sf	$ 1.00	included	1.00	36.00	included		$ 10,000	$ -	$ -	$ -	$ 1.00	$ 10,000
7.00	**Equipment**														
7.01	Valtr Model T170 with Brown Bear PTOPA-10.5 Compost Aerator	1	Ea	$ 128,000.00	NA	1.00	36.00	included		$ 128,000	$ -	$ -	$ -	$ 128,000	$ 128,000
7.02	John Deere Model 7420 -115 hp	1	Ea	$ 80,000.00	NA	1.00	36.00	included		$ 80,000	$ -	$ -	$ -	$ 80,000	$ 80,000
7.03	John Deere Model 7420 -115 hp - Loader	1	Ea	$ 86,000.00	NA	1.00	36.00	included		$ 86,000	$ -	$ -	$ -	$ 86,000	$ 86,000
7.04	HMI Model 101-P Grapple	2	Ea	$ 42,000.00	NA	1.00	36.00	included		$ 84,000	$ -	$ -	$ -	$ 42,000	$ 84,000
7.05	HMI Model 401-P Processor	1	Ea	98,000.00	NA	1.00	36.00	included		$ 98,000	$ -	$ -	$ -	$ 98,000	$ 98,000
7.06	Miller Model 5300 Series Forage Wagon	4	Ea	18,200.00	NA	1.00	36.00	included		$ 72,800	$ -	$ -	$ -	$ 18,200	$ 72,800
7.08	60" Dixie Chopper Mower	1	Ea	8,900.00	NA	1.00	36.00	included		$ 8,900	$ -	$ -	$ -	$ 8,900	$ 8,900
7.09	Trimmers & Misc Lawn Equipment	1	Ea	2,000.00	NA	1.00	36.00	included		$ 2,000	$ -	$ -	$ -	$ 2,000	$ 2,000
7.10	All Terrain Vehicles	1	Ea	3,000.00	NA	1.00	36.00	included		$ 3,000	$ -	$ -	$ -	$ 3,000	$ 3,000
7.11	Tooles & Incidental Equipment	1	Ls	5,000.00	NA	1.00	36.00	included		$ 5,000	$ -	$ -	$ -	$ 5,000	$ 5,000
7.12	House Model HDC 18A153 Aerators	8	Ea	8,100.00	included	1.00	36.00	100.00		$ 64,800	$ -	$ 800	$ -	$ 8,200	$ 65,600
7.13	Sigma 900 Autosamplers with housing	2	Ea	4,500.00	included			500.00		$ 9,000	$ -	$ 1,000	$ -	$ 5,000	$ 10,000
7.14	LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	100,000.00	included			included		$ 100,000	$ -	$ -	$ -	$ 350,000	$ 100,000
7.14a	DELETE: LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	-100,000.00	included			included		$ (100,000)	$ -	$ -	$ -	$ 350,000	$ (100,000)
7.14b	ADD: LWT Model RCLPES Hydaulic Dredge -600 gpm (see note m)	1	Ea	250,000.00	included			included		$ 250,000	$ -	$ -	$ -	$ 350,000	$ 250,000
7.15	Supernatant Pump Station	1	Ls	40,000.00	included			included		$ 40,000	$ -	$ -	$ -	$ 40,000	$ 40,000
7.16	6" Telescoping Valve	1	Ea	1,200.00	included			100.00		$ 1,200	$ -	$ 100	$ -	$ 1,300	$ 1,300
7.16a	ADD: 6" Telescoping Valve	3	Ea	1,200.00	included			100.00		$ 3,600	$ -	$ 300	$ -	$ 1,300	$ 3,900
															$ -
8.00	**Electrical**														
8.01	Electrical Equipment & Installation	1	Ls	$ 50,000.00	NA	1.00	36.00	included		$ 50,000	$ -	$ -	$ -	$ 50,000	$ 50,000
	TOTAL CONSTRUCTION														$ 6,797,586
	Contingency 20%														$ 1,359,517
	Mob/Demob 5%														$ 339,879
	Permits 1%														$ 67,976
	Bonds 1%														$ 67,976
	Insurance 1%														$ 67,976
	Sales Tax								Equipment & Materials	$ 2,039,276	estimated at 1/3 total construction cost				$ 142,749
	Total Construction Costs														$ 8,843,659
	Enginering & Overhead (15%)														$ 1,326,549
	TOTAL CAPITAL COSTS														$ 10,170,208

NOTES:
(a) Allowance for grading of cell bottoms made, assumed 40 percent of area requiring 1 cuft moved.
(b) Unit cost for fine grading listed was for small areas, unit cost revised to reflect fine grading of roads prior paving
(c) Berms for WHS are located within an area of reclaimed waste phosphatic clays. Assume berms will be constructed of embankment material or areas within the site limits

Items Required for Levee Construction (Footnote c):

1.03	Earth Work (excavation and soils removal)	$0.00
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts imported borrow soils) based on a unit cost of $4.21/cy.	$52.20
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	$11.03
	Total = Lf of Levee	$63.23

Footnote 1 - Complete construction of STA levee includes items 1.03, 1.07 and 1.09 from above.
Typical WHS- berm cross section is 76 ft base, 20 ft top, 6 ft high, 4:1 slope
Average district cost per linear foot of levee is $155.17/LF for 14' wide, 9 ft tall (HDR, November 2004)

(d) Labor costs were not included in HydroMentia's proposal for this item. Unit cost adjusted to include labor
(e) Review of HDPE liner unit costs quoted for 40 mil HDPE is 1/3 less than national average bare costs for 30 mil HDPE (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for city of Tampa
(f) Maintenance & Equipment storage buildings. Parsons provided unit cost allowance for this item of $130.00/sf
(g) Adminstrative and staff facilities buildings. Parsons provided unit cost allowance for this item of $180.00/sf
(h) Review of unit costs quoted for chain link fence is 40% less than national average bare costs for galv steel chain link fence suitable for industrial use (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL
(i) Cost for gate was omited from quote.
(j) Review of unit costs quoted for barbed wire fence is 40% less than national average bare costs for barbed wire fence (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL
(k) Review of unit costs against national average quoted for seed & mulch does not account for screening, load, haul and place topsoil, finegrading, (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for Tampa, FL to include screening, load, haul & placement of topsoil, fine grading & hydroseed/mulch
(l) Review of unit costs quoted for sod is 65% less than national average bare costs for sod and did not include topsoil or fine grading (RSMeans, 2005 Site Work & Landscape Data,2005)
Unit cost was adjusted to Means cost, 2004 dollars for city of Tampa to include screening, load, haul & placement of topsoil, finegrading & sod (bent grass
(m) Unit cost of $100,000 represents minimally equiped dredge (Telecommunications with LWT). Costs were increased to $250,000 to be consistent with unit costs listed for Sedimentation ponds

Table 6 - Unit construction costs for Pump Station Access Road

PARSONS

ENGINEER ESTIMATE WORKSHEET — Budgetary Cost Estimate

JOB NO.:	743785		**M.T.O. BY:**	HydroMentia	**DATE:**	09/13/04	**EST DATE:**	5/26/05
PROJECT:	Lake Hancock Outfall Treatment Project- WHS™ for 45% TN Reduction	**Project Description**	**PRICED BY:**	HydroMentia	**DATE:**	09/13/04	**PRINT DATE:**	2/14/06
CLIENT:	South West Florida Water Management District	**Estimate Type:**	**CHECKED BY:**	H. Snow	**DATE:**	09/13/04	**REV. 1:**	

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES: MATERIAL/ EQUIPMENT	UNIT RATES: LABOR M/H	UNIT RATES: LABOR P.F.	UNIT RATES: LABOR RATE	UNIT RATES: CONST. EQUIPMENT	UNIT RATES: SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST
1.10	3" Asphalt Conc. Pavement - P11 Pump Station access road	37,000	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 129,500.00	$ 23,680.00	$ 148,000.00	$ -	$ 8.14	$ 301,180.00
1.08	Final Grading	37,000	Sy		0.02	1.00	32.00	2.80		$ -	$ 23,680.00	$ 103,600.00	$ -	$ 3.44	$ 127,280.00
1.08a	DELETE: Final Grading for roads Pump Staton P-11 Access @ 3.44 (see note a)	(37,000)	Sy		0.02	1.00	32.00	2.80		$ -	$ (23,680.00)	$ (103,600.00)	$ -	$ 3.44	$ (127,280.00)
1.08b	ADD: Final Grading for roads Pump Staton P-11 Access @ .63/SY (see note a)	37,000	Sy		0.009	1.00	28.00	0.35		$ -	$ 9,324.00	$ 12,950.00	$ -	$ 0.60	$ 22,274.00
1.11	12" Compacted Limerock Base	12,333	Cy	$ 13.00	0.02	Length	32.00	1.25		$ 160,329.00	$ -	$ 15,416.25	$ -	$ 14.25	$ 175,745.00
	TOTAL CONSTRUCTION														**499,199.00**
	Contingency 20%														99,840.00
	Mob/Demob 5%														24,959.95
	Permits 1%														4,992.00
	Bonds 1%														4,992.00
	Insurance 1%														4,992.00
	Sales Tax	Equipment & Materials								$ 149,760	estimated at 30% of total costs				10,483.00
	Total Construction Costs														**649,457.95**

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Table 7 Itemized construction and annual operations and maintenance (O&M) costs for 300 CFS (194-MGD) inflow intake and pump station.

LAKE HANCOCK OUTFALL TREATMENT PROJECT

300 CUBIC FEET PER SECOND (130-MGD) INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	$/ft (1)	Escalated Cost
Transmission Main											
Dual Pipeline	97.00	67415	64.0	Steel	110	300	6.72	0.2440	0.7	380.00	$ 228,000
Dual Pipeline	97.00	67415	64.0	Steel	110	300	6.72	0.2440	0.7	380.00	$ 138,852
Total	**194.00**	**134,830**							**1.46**		**$ 366,852**
										Inflated to 2004	**$ 446,826**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

Length of pipeline taken from Figure I, provided by HydroMentia Feb. 2005

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs	300	
Construction Cost $	$ 2,325,021	(Footnote 2)
Telemetry	$ 100,000	(Footnote 2)
3-Phase Power	$ 625,000	(Footnote 2)
Electrical Service	$ 100,000	
Inflation (Contingency)	$ 581,255	Increased by 25% due to recent increases in concrete, steel and construction costs this year
Total	**$ 3,731,276**	

Lake Hancock Pump Station

Capacity - mgd	194	
Hf	1.5	
Static Head+PS Loss	27.0	Assume intake at pump station 95, top of exising berm 122
TDH	28.5	
Pump Efficiency	0.80	
Break HP	1,211.4	
Motor Efficiency	0.95	
Maximum Annual kwh	8,329,896	
Average Annual kwh	1,051,779	Based on annual average flow 37.90 cfs or 24 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**73,625**	Assumes operation at 51 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	$ 3,731,276	$ 37,313	$ 149,251	$ 73,625	$ 260,188
Transmission Main	$ 446,826	$ 4,468			$ 4,468
Total Intake, pump station and transmission main	**$ 4,178,102**	**$ 41,781**	**$ 149,251**	**$ 73,625**	$ 264,657

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of capital cost

Annual O&M Equipment @ 4% of capital cost

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Table 8 Adjusted annual operations and maintenance costs for 27% TN reduction target, 88 acre WHS.

HydroMentia (Proposal, May 2005, Rev03)

Annual O & M costs

Category	Unit	Rate	Quantity	Cost	Total Category Cost
Labor					
Facility Operations					
Field Technician	hr	35	0	$ -	
Lead Operator	hr	60	0	$ -	
Field Technician II	hr	45	4160	$ 187,200.00	
Operations Manager		85	832	$ 70,720.00	
Administrative Assistant		35	80	$ 2,800.00	
Facility Administration and Technical Oversight					
Senior Biologist		110	20	$ 2,200.00	
Project Engineer		135	16	$ 2,160.00	
Operations Manager		85	200	$ 17,000.00	
Administrative Assistant		35	20	$ 700.00	
					$ 282,780.00
Travel Costs					
Travel	$/mile	0.42	12000	$ 5,040.00	
Hotel	nights	45	52	$ 2,340.00	
					$ 7,380.00
Maintenance					
Equipment					
Equipment (5% of Equipment Cost)	$/yr	5%	899300	$ 44,965.00	
Site					
Building	per unit	6000	1	$ 6,000.00	
Road Maintenance	lump sum	20000	1	$ 20,000.00	
					$ 70,965.00
Chemicals and Pest Control					
Pest Control					
Nematodes	$/acre-yea	$500	88	$ 44,000.00	
Supplemental Nutrients Allowance	lump sum			$ -	
					$ 44,000.00
Laboratory Costs (ATS & WHS Systems Only					
WHS					
Laboratory Costs (per parsons)	lump sum	30000	1	$ 30,000.00	
Misc Samples (HMI Plant and Water	lump sum	1000	37.90	$ 37,900.00	
					$ 67,900.00
Energy					
Electricity					
Aeration, pumps and Building	kwh	0.08	430000	$ 34,400.00	
Fuel					
Diesel	gallons	2	28905	$ 57,810.00	
Gasoline					
					$ 92,210.00
Contingency					
Contingency (10%)					$ 56,523.50
					$ 621,758.50
Residual Management					
Compost/Organic Fertilizer Disposal "Worst Case"					
Compost Transportation	tons	5	2769	$ 13,845.00	
Compost Disposal	$/ton	20.5	2769	$ 56,764.50	
					$ 70,609.50
			Worst Case		$ 692,368.00

Parsons Adjustments

Annual O & M costs

Category	Unit	Rate	Quantity	Revised cost	Total Category Cost
Labor					
Facility Operations					
Field Technician	hr	35	0	$ -	
Lead Operator	hr	60	0	$ -	
Field Technician II	hr	45	4160	$ 187,200.00	
Operations Manager		85	832	$ 70,720.00	
Administrative Assistant		35	80	$ 2,800.00	
				$ -	
Facility Administration and Technical Oversight				$ -	
Senior Biologist		110	20	$ 2,200.00	
Project Engineer		135	16	$ 2,160.00	
Operations Manager		85	200	$ 17,000.00	
Administrative Assistant		35	20	$ 700.00	
					$ 282,780.00
Travel Costs					
Travel	$/mile	0.42	12000	$ 5,040.00	
Hotel	nights	45	52	$ 2,340.00	
					$ 7,380.00
Maintenance					
Equipment					
Equipment (5% of Equipment Cost)	$/yr	5%	934600	$ 46,730.00	
Site					
Building	per unit	6000	1	$ 6,000.00	
Road Maintenance	lump sum	20000	1	$ 20,000.00	
					$ 72,730.00
Chemicals and Pest Control					
Pest Control					
Nematodes	$/acre-yea	$500	88	$ 44,000.00	
Supplemental Nutrients Allowance	lump sum			$ 50,000.00	
					$ 94,000.00
Laboratory Costs (ATS & WHS Systems Only					
WHS					
Laboratory Costs (per parsons)	lump sum	30000	1	$ 30,000.00	
Misc Samples (HMI Plant and Water	lump sum	1000	1	$ 37,900.00	
					$ 67,900.00
Energy					
Electricity					
Aeration, pumps and Building	kwh	0.08	430000	$ 34,400.00	
Fuel					
Diesel	gallons	2	28905	$ 57,810.00	
Gasoline					
					$ 92,210.00
Contingency					
Contingency (10%)					$ 61,700.00
					$ 678,700.00
Residual Management					
Compost/Organic Fertilizer Disposal "Worst Case"					
Compost Transportation	tons	5	2769	$ 13,845.00	
Compost Disposal	$/ton	20.5	2769	$ 56,764.50	
					$ 70,609.50
			Worst Case		$ 749,309.50

APPENDIX E

THE APPLICATION OF ALUM RESIDUAL AS A PHOSPHORUS ABATEMENT TOOL WITHIN THE LAKE APOPKA RESTORATION AREA

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Presented at the WEF/AWWA/CWEA Joint Residual and Biosolids Management Conference and Exhibition: Partnering for a safe, sustainable environment. February 19-22, 2003. Baltimore, Md.

THE APPLICATION OF ALUM RESIDUAL AS A PHOSPHORUS ABATEMENT TOOL WITHIN THE LAKE APOPKA RESTORATION AREA

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ABSTRACT

Lake Apopka, the fourth largest lake in Florida, is considered one of the most severely polluted lakes in the state. As part of the Lake Apopka restoration program, approximately 13,000 acres of muck (organic soil) farmland within the North Shore Restoration Area (NSRA) are being restored to marsh habitat to reduce external phosphorus (P) loading to Lake Apopka. In addition, the first 650 acres of the Lake Apopka Marsh Flow-Way (MFW), designed to filter particulate nutrients from Lake Apopka, has been constructed. The treatment wetland will be 3,400 acres when completed.

High phosphorus flux from the soil is expected to occur during initial reflooding of the highly organic soils of the NSRA and MFW. Although chemical treatment has been successful in lake restoration programs, large-scale soil amendment application in wetlands for phosphorus immobilization has not been done. If successful, the initial efficiency of wetland treatment of polluted waters will be greatly improved.

The St. Johns River Water Management District evaluated various chemical compounds and other materials for their ability to reduce P flux from the sediments and thus reducing water column P concentration. A variety of materials were tested in laboratory and small plot experiments. Based on these results a field scale experiment (three two-acre plots) was used to evaluate the effectiveness of calcium hydroxide ($Ca(OH)_2$), gypsum ($CaSO_4$), and alum residual from a potable water treatment plant (WTR) to reduce soil P flux. The amendments were surface-applied to hydrologically isolated cells. After soil treatment, the enclosures were shallowly flooded and maintained at a water depth of approximately 25 cm. WTR strongly reduced TP levels in the floodwater compared to the control cell. Gypsum and lime were not as effective in reducing TP concentrations in the water column. WTR was selected as the most cost-effective soil amendment for large-scale application. WTR was subjected to extensive tests including P adsorption capacity, Toxicity Characteristic Leaching Procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP), chemical characterization, and biological assays prior to use.

Approximately 52,610 wet tons of WTR were hauled (100 miles one-way) from Melbourne FL to the application site just north of Orlando, FL between March and May

of 1999. Another 13,500 tons were hauled in 2002. Approximately 2,000 acres were amended at a rate of 6.5 wet tons per acre between March and June of 1999. During the summer of 2000, 650 acres in the Marsh Flow-Way were amended at a rate of 10 wet tons per acre. Approximately 57,000 tons are currently stockpiled on site. The total cost for hauling and spreading alum residual up to this point has been $ 1.7 million. Initial reflooding began on a small area of the NSRA in 2002. The 650 acres of the MFW will be flooded in early 2003.

KEYWORDS

water treatment residual, alum residual, beneficial use, land application, phosphorus, pollution abatement, non-point source pollution, Lake Apopka, phosphorus adsorption capacity, treatment wetland

INTRODUCTION

Lake Apopka, the fourth largest lake in Florida, is considered one of the most severely polluted lakes in the state (EPA 1979). As part of the Lake Apopka restoration program, approximately 13,000 acres of muck farmland has been purchased by the St. Johns River Water Management District (SJRWMD) and is being restored to marsh habitat within the North Shore Restoration Area (NSRA) to reduce phosphorus importation to Lake Apopka. The marshes were drained in the 1940s and farmed until 1998.
In addition, the Lake Apopka Marsh Flow-Way (MFW), a 3,400-acre surface flow treatment wetland, is being constructed on some of the farmland to filter particulate nutrients from Lake Apopka. At this time, Phase I of the Flow-Way, including four cells with a total wetland area of 650 acres, has been completed. Reflooding is anticipated in early 2003.

During initial marsh restoration flooding, high soil phosphorus flux is expected to occur, and water column phosphorus concentrations may remain high for long periods. Previous studies found large pools of labile (available) phosphorus in the organic soils in the MFW (Ann 1996, 2001). The condition of the MFW soils is very similar to that of the soils throughout the NSRA. During the MFW Demonstration Project, the soluble reactive phosphorus (SRP) pool in the soil after initial flooding was approximately 3 g P/m^2 (Coveney et al. 2002). Optimization of the MFW for P removal will require the reduction of this P flux from previously farmed soils and newly formed soils. This, and the need to minimize the discharge of phosphorus from the NSRA to Lake Apopka led SJRWMD to evaluate a variety of materials for their ability to reduce phosphorus flux from organic soils. These tests resulted in a large-scale application to enhance the restoration of the Lake Apopka Ecosystem.

Chemical treatment has been used successfully to treat P flux from lake sediments. Large-scale soil amendment for phosphorus immobilization in wetlands is unproven. The purpose of this paper is to report a large-scale field application of alum residual as a soil amendment for phosphorus immobilization, describe chemical characteristics of the amendment, and to provide a synopsis of the work leading to this application.

SOIL AMENDMENT LABORATORY AND FIELD STUDIES

The field scale application effort was the culmination of a series of field and laboratory studies designed to identify the best material to cost-effectively reduce phosphorus flux from the organic Lake Apopka muck soils. Laboratory evaluations to test P sequestration and P flux reduction were followed by field tests that focused on water column and soil nutrient levels.

Materials Tested

A number of materials have the potential to sequester soluble phosphorus. Tested materials included pure chemicals, industrial byproducts, and byproducts of potable water treatment processes:

- Lime $Ca(OH)_2$
- Calcium carbonate $CaCO_3$
- Dolomite $CaMg(CO_3)_2$ (a naturally occurring rock material)
- Alum $Al_2(SO_4)_3$
- Ferric Chloride $FeCl_3$
- Alum residual from the Melbourne FL potable water plant (WTR)
- Gypsum – a waste product from the production of sheetrock

Laboratory Experiments

The University of Florida Wetland Soils Laboratory conducted three batch experiments (Reddy et al. 1996, Ann et al 2000a, Ann et al 2000b) under contract to SJRWMD. These experiments were designed to:

- Determine the effect of various chemical amendments on P flux between the soil and floodwater.
- Study P distribution in chemically-amended soils.
- Evaluate P solubility in chemically-amended soils.

Floodwater SRP concentration in the unamended soil increased from 0.15 mg P/L to about 1.0 mg P/L. At rates of 102 g $CaCO_3$/kg of soil, about 70 percent of the water soluble P was removed from solution. Soils treated with 36 g/kg $Ca(OH)_2$ (calcium hydroxide) decreased the water soluble P by 95 percent. Soils treated with $CaMg(CO_3)_2$ (dolomite) actually released P during the experiment. Removal of more than 80 percent of water soluble P required $Al_2(SO_4)_3$ (alum) and $FeCl_3$ (ferric chloride) rates higher than 14.4 and 7.1 g/kg, respectively. Based on P flux calculations and the floodwater concentrations during the entire incubation period, the effectiveness of chemical amendments were as follows: $FeCl_3$ > Alum > $Ca(OH)_2$ > $Ca(CO)_3$ > Dolomite (Reddy et al. 1996).

Mesocosm Experiment

To expand the scope of the laboratory work, SJRWMD and the University of Florida (Reddy et al. 1998) conducted a field experiment. The experiments were conducted in relatively shallow organic soils in the northwestern corner of the agricultural area. The organic soil layer (1- 2 feet in depth) was underlain with a marl horizon.

Five treatments (control, alum, alum residual (WTR), calcium carbonate residual from a water softening process, and calcium hydroxide) were replicated three times in15 isolated enclosures (10m x 10m each). The amendments were surface-applied and not incorporated into the soil column. Three weeks following the soil treatment and flooding, pore water equilibrators were installed to a depth of about 30 cm to obtain dissolved nutrient concentrations in the soil-water column of each enclosure.

The water depth was maintained at approximately 50 cm. Water column pH, dissolved oxygen (halfway down water column and sediment surface), turbidity, alkalinity, total suspended solids, total P, total dissolved P, soluble reactive P, dissolved calcium, total silicon, total aluminum and dissolved aluminum were measured weekly or more frequently during the experimental period.

Water column P concentrations were lowest in mesocosms treated with WTR and alum. Concentrations of P in calcium carbonate-treated mesocosms were not greatly different from those of the untreated mesocosms. None of the amendments influenced the development of P gradients in the soil column. The low water column P concentrations in enclosures with alum and WTR suggested that these applications created a chemical barrier to P flux at the soil surface.

Plant growth and animal activity in marshes disturb and mix surface soils, which over time will reduce the benefits of the application. Key conclusions of these experiments were that the first flush of P will be best treated with alum or WTR and application rates should be the highest that are economically feasible in order to maintain reduced P water column concentrations while long-term biological mechanisms of P storage develop.

Field Scale Experiment

Based on the results of laboratory and mesocosm experiments, a field experiment was conducted in 1998 at another site in the NSRA with deep organic soils. The area had recently been farmed with sweet corn and harvested. Four two-acre plots were isolated hydrologically with soil berms. Treatments included alum residual, calcium hydroxide (lime as $Ca(OH)_2$), gypsum, and a control.

Soil cores were taken within each cell prior to the soil amendment application. The samples were evaluated for soil pH, water content, ash free dry weight, TOC, P and N species and metals. A 5-cubic yard manure spreader applied approximately 10-wet tons/acre of alum residual. Gypsum was applied at a rate of 4.5-wet tons per acre. Approximately 2 dry tons per acre of lime was applied as slurry (33 % solid).

After soil treatment, the enclosures were shallowly flooded to a depth of approximately 25 cm with water from the irrigation canal system. Water was periodically let into the enclosures to maintain the depth and to compensate for evapotranspiration and seepage. Samples for nutrient analyses were taken in each treatment area and the inflow for 16 weeks.

Total phosphorus (TP) in enclosure water either came in during initial flooding or with make-up water, or came from phosphorus released from the soils. However, nutrient-rich water from irrigation ditches was let into all the enclosures more-or-less equally. Therefore, the difference between TP levels in a treated enclosure and levels in the control enclosure was attributed to the soil treatment.

For both the lime and gypsum treatments, the differences in TP levels among treatment and control enclosures varied around zero throughout the experiment (Figure 1). In contrast, TP levels in the alum residual treatment cell remained significantly lower (0.6 to 0.9 mg/L less) than TP levels in the control enclosures throughout the experiment. These results indicated that the alum residual material prevented wholly, or in part, the net release of TP from the soil during the experiment.

Based on the results of laboratory and field experiments, a thorough review of the scientific literature on the use and potential hazards of the material, and a cost analysis, alum residual was selected for large-scale application.

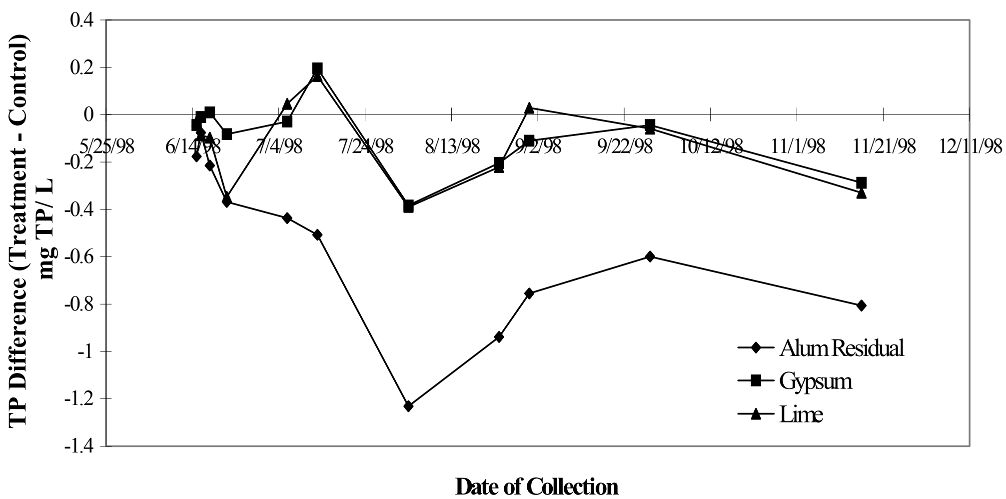

Figure 1. Effect of soil treatment on floodwater TP. All values in mg/L

WATER TREATMENT RESIDUAL (WTR) CHARACTERISTICS

WTR Production and Storage

Alum water treatment residual from the Lake Washington Water Treatment Plant in Melbourne, FL was selected as the soil amendment for the NSRA and the Lake Apopka Marsh Flow-Way. The plant, about 100 miles from the application site, was the nearest source of the material. Available literature on the material was reviewed (Hoge 2001). Other more distant sites were identified as potential sources, but these residuals did not sequester phosphorus as effectively as the Melbourne source material and so were not further pursued.

The Lake Washington Water Treatment Plant used aluminum sulfate, (alum [$(Al_2(SO_4)_3(14H_2O)$]) as the primary coagulant in a potable water treatment chain. Other materials added during the treatment process that were also part of the WTR included powdered, activated carbon (PAC), quicklime (CaO), and acrylamide and sodium acrylate copolymers. All additives used meet current potable water quality assurance and safety standards. To dewater the floc material, a belt filter press was used to compress the material between two belts of decreasing diameter rolls, which left the material at approximately 20 percent total solids.

To produce approximately 9.5 MGD of treated drinking water at the Lake Washington plant during July 1997, the plant used 14,250 pounds of alum ($AlSO_4$), 2,850 pounds of PAC, 3,000 pounds of quick lime (CaO), and minor quantities of copolymer materials daily (City of Melbourne 1997). The process produced approximately 10,000 cubic yards of WTR annually. Stockpiling of WTR adjacent to the plant began in 1988. Between 85,000 and100,000 cubic yards of total stockpiled material was available at that site in 1998 .

Physical Characteristics

The Melbourne alum residual physically resembled a black greasy loam soil. The material was slippery and could become brick-like upon drying. It did not have an odor and crumbled easily while moist. When dried and pulverized, it became a fine powdery dust, with the potential for handling problems. The bulk density varied between 1200 – 1500 lbs./cubic yard. Sand particles could be felt and seen upon close inspection.

Pesticide Scan

A full pesticide scan of samples from all ages of material was negative (below limits of detection) for both registered and unregistered pesticides.

Biological Analysis

The Florida Department of Environmental Protection conducted acute toxicity tests on biological assays of the Melbourne Water Treatment Plant residual using *Ceriodaphnia dubia* (daphnia) and *Cypreinella leedsi* (banner fin shinners) in March 1999. The "pass test" is a mortality less than 50% in a 96-hour test. *Daphnia* are used because of their sensitivity to pesticides, metals, and disturbances of the ionic composition of their environment. No mortality was observed in 100 percent elutriate or dilutions.

Chemical Characteristics

A thorough sampling of the stockpiled residuals at the Lake Washington Water Treatment Plant was first conducted in June 1997 (Table 2). The samples ranged in age from fresh material to material covered with small pine trees and dense vegetation (approximately 10 years of age). Chemical tests included elemental analysis, Toxicity Characteristic Leaching Procedure (TCLP) Synthetic Precipitation Leaching Procedure (SPLP), a comprehensive pesticide scan, and biological assays for toxicity.

Based on sediment guidelines for the State of Florida, only arsenic was present in levels that presented a potential environmental hazard. The arsenic concentration of the WTR was slightly higher but not significantly different from the arsenic content of the surface sediments of the former farm fields on the north shore of Lake Apopka. The proposed application did not significantly change the soil concentration in the top 6 cm. Soil sampling results showed no significant difference between applied and unapplied sites within the NSRA. The average concentration (n=12) of WTR was 5.9 mg As/kg. The average (n=50) soil arsenic concentration on the treatment sites was 2.6 mg As/kg. Therefore, the contribution of arsenic by the WTR was calculated to be approximately 0.8% of the existing burden within the top 6 cm of soil even at the highest application rate of 10 wet tons/acre. A statewide survey by Chen et al. (2002) showed that the highest arsenic concentrations are found in wetland soils, such as saprists (0.25-11.7 mg As/kg). The organic soils on the north shore of Lake Apopka are primarily saprists, which are predominantly decomposed organic soils.

Leaching test methods are used to determine if a material should be classified as hazardous waste. The Toxicity Characteristic Leaching Procedure (TCLP) analysis revealed very low, if any, potential for heavy metal leaching (Table 3). Therefore, this material is not considered a hazardous material according to 40 CFR 268.41.

A Synthetic Precipitation Leaching Procedure (SPLP) was conducted by the Florida Department of Environmental Protection (FDEP) (Table 4). The SPLP was developed to simulate leaching under acid rain conditions. The extraction fluid has a pH of 4.20 to evaluate the potential for leaching metals into ground and surface waters (EPA 6010 mod.).

In a series of batch experiments using the Melbourne WTR material of four different ages (one week, one month, one year, and greater than five years), SJRWMD attempted to determine the maximum sorption capacity using the Freundlich isotherm. However, even in solutions containing up to 500 mg P/L, the P was completely removed from the solution by the WTR. The experiment was repeated using increased levels of phosphorus (up to 3000 mg P/L). As in the first test, the asymptotic relationship between equilibrium P concentrations and amount of P adsorbed was never attained and the results did not conform to classical adsorption isotherms. The explanation for this discrepancy could be a chemical fixation process, such as a chemical precipitation or chemisorption. Therefore, the maximum “fixation capacity” was estimated to be greater than 60 mg/g (DB Environmental Laboratories, Inc. 1998, 1999).

The equilibrium phosphorus concentration (EPC), the phosphorus concentration at which adsorption and desorption are equal, was also defined (DB Environmental Laboratories, Inc. 1999). This value can be used to predict phosphorus movement at the sediment-water interface. The typical range of EPC values for optimal agricultural production is 50 to 200 µg/L EPC_o. The EPC for the WTR was near zero, indicating “little to no desorption capacity” (DB Environmental Laboratories, Inc 1998, 1999). Although the WTR contained 600 to 1000 mg TP/kg the high bonding energies of the material essentially prohibited desorption of P.

Based on the results above, an application rate of 10 wet tons residual/acre could capture 33.60 g P/m^2 assuming an adsorption capacity of 60 mg P/g dry residual. Coveney et al. (2002) found that the average total pool of soluble P released after flooding in the Marsh Flow-Way Demonstration Project was approximately 3.0 g P/m^2.

Table 2. Analysis of eight Lake Washington alum residual samples taken June 1997. (All values in mg/kg on a dry weight basis unless otherwise noted).

	1	2	3	4	5	6	7	8	Avg.
% solids	21.5	21.5	23.4	26.2	21.6	27.0	42.0	33.6	22.9
PH	5.91	5.63	5.57	5.59	5.96	6.13	5.73	4.68	5.65
Bulk den. (lbs/ft^3)	44.91	47.36	44.61	50.27	52.49	46.92	46.22	44.43	47.15
Al	82,000	99,000	90,000	69,000	87,000	95,000	70,000	83,000	84,375
Sb	0.52	0.59	0.43U	0.42	4.2	0.43U	0.21U	0.67	1.28
As	6.0	6.5	5.6	2.7	6.4	4.3	3.7	3.2	4.8
Ba	16	19	13	24	12	34	23	8.7	19
Be	0.37	0.29	0.28	0.29	0.42	1.2	1.2	0.23	0.54
Cd	0.089U	0.10U	0.076U	0.074U	0.081U	0.075U	0.038U	0.049U	
Ca	2,000	2,200	1,500	2,200	1,400	3,000	2,100	390	1,849
Cr	8.8	4.2	3.9	71	5.2	48	52	99	37
Cu	7.5	6.8	5.8	10	6.9	13	14	5.5	8.7
Fe	1,600	1,600	1,600	3,300	1,600	4,600	4,400	3,700	2,800
Mg	330	280	220	340	190	510	400	33	288
Mn	33	45	39	41	24	35	22	12	31
Ni	13	10	9.4	6.8	12	8.5	8.1	2.9	8.8
K	95	91	84	120	81	8.5	8.1	2.9	8.8
Se	1.3	0.89	1.0	1.6	1.8	1.6	1.1	1.4	1.3
Ag	0.13U	0.15U	0.11U	0.11U	0.12U	0.11U	0.054U	0.90	
Na	180	140	180	150	240	54U	53	35U	
Tl	2.2U	2.5U	1.8U	1.9	2.0U	1.8	0.91U	1.2U	
Sn	6.3	33	6.3	7.5	5.7	2.0	1.2	51	14
V	27	28	26	35	27	44	52	40	35
Zn	19	16	13	11	12	21	21	3.3	15
Hg	0.055	0.054	0.055	0.049	0.029	0.036	0.042	0.061	0.048

U - The compound was analyzed for but not detected
V - Indicates that the analyte was detected in both the sample and the associated blank.

Table 3. TCLP analysis of eight alum residual samples taken June 1997 (all values in mg/L)

	1	2	3	4	5	6	7	8
As	0.0032U	0.0032U	0.0032U	0.0032U	0.0032U	0.0032U	0.0032U	0.0032U
Ba	0.077V	0.087V	0.069V	0.12V	0.067V	0.11V	0.10V	0.056V
Cd	0.0007U	0.0007U	0.0007U	0.0007U	0.00070U	0.0007U	0.0007U	0.0007U
Cr	0.0018	0.0018	0.0018	0.0080	0.0018	0.0054	0.0050	0.0087
Pb	0.0030U	0.0030U	0.0030U	0.0030U	0.0030U	0.0030U	0.0030U	0.0030U
Se	0.0027V	0.0038V	0.0022V	0.0045V	0.0033V	0.0061V	0.0021V	0.0043V
Ag	0.0010U	0.0010U	0.0010U	0.0010U	0.0010U	0.0010U	0.0010U	0.0010U
Hg	0.00006 U	0.00006 U	0.00006 U	0.00006 U	0.000062 U	0.00006 U	0.00006 U	0.00006 U

U - The compound was analyzed for but not detected
V - Indicates that the analyte was detected in both the sample and the associated blank. The TCLP blank contained barium at 0.0049 mg/L, selenium at 0.0046 mg/L, and mercury at 0.00014 mg/L.

Table 4. SPLP analysis of six alum residual samples taken in March 1999 and conducted by FDEP (all values in µg/L unless otherwise noted).

Parameter	1	2	3	4	5	6
Aluminum_308	4400	706A	855	859	865	779
Arsenic	2.5U	2.5U	5.0U	5.0U	5.0U	5.0U
Antimony	2.5U	2.5U	2.5U	2.5U	2.5U	2.5U
Barium	307	219A	235	260	227	203
Beryllium	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Boron	271	140A	149	183	159	155
Cadmium	0.25U	0.25U	0.25U	0.25U	0.25U	0.25U
Calcium (mg/L)	30.9	32.8A	33.3	41.8	38.1	39.3
Chromium	8.7	2.0U	2.6I	7.8I	2.0U	2.0U
Cobalt	0.50U	0.50U	0.50U	0.51I	0.50U	0.050U
Copper	7.7	3.6I	3.7I	2.8I	4.0	1.9I
Iron_259	141	26I	31I	47	21I	34I
Lead	1.5I	1.5U	1.5U	1.5U	1.5U	1.5U
Magnesium (mg/L)	2.86	3.13A	3.02	2.91	3.40	2.86
Manganese	7.51	5.47A	5.72	5.92	5.08	6.51
Molybdenum	1.0I	0.70U	0.70U	0.86I	0.70U	0.70U
Nickel	6.9	1.6I	3.1I	5.6I	2.7I	1.5U
Potassium (mg/L)	1.04	0.757A	0.762	0.701	0.733	0.638
Selenium	2.0U	2.0U	2.0U	2.0U	4U	2.0U
Sodium (mg/L)	4.6	2.9A	2.9	3.0	3.0	2.5
Strontium	164	172A	169	195	201	182
Thallium	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U
Tin	10U	10U	10U	10U	10U	10U
Titanium	1.8I	0.40U	0.51I	0.43I	0.40U	0.40U
Vanadium	4.2	3.3A	1.3I	1.7	1.7	2.1
Zinc	417	200A	195	193	219	158
Silver	0.050U	0.050U	0.050U	0.050U	0.050	0.050U

A – Value reported is the mean of two or more determinations
I – The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
U – Material was analyzed for but not detected; The value reported is the minimum detection limit.

LARGE SCALE APPLICATION

Between March and May of 1999, 52,610 wet tons of WTR were hauled (100 miles one-way) from Melbourne. Another 13,500 tons were hauled in 2002. All trucks, which made 2 to 3 round trips per day, were weighed on State of Florida certified scales to obtain a net weight. The WTR hauled in 1999 was contaminated with construction debris and vegetation. After hauling from Melbourne it was passed through a shaker screen located near the application site loaded on small dump trucks and hauled to stockpiles located around the project area. The residual hauled in 2002 was free of contamination and stockpiled at one site on a concrete pad within the NSRA.

About 2,000 acres of the NSRA were amended at a rate of 6.5 wet tons per acre between March and June of 1999. Approximately 100 acres that could be hydrologically isolated were not treated so that they could serve as a control site for performance monitoring. About 650 acres in Phase I of the MFW were amended over a 13-week period during the summer of 2000 at a rate of 10 wet tons per acre. Due to low lake levels and pesticide residuals in the soil, initial reflooding was not begun until mid 2002. Approximately 60,000 tons of alum residual are currently stockpiled for application to other areas in the NSRA.

The total cost to date of hauling and spreading WTR is $1.7 million. The cost per acre for loading, hauling, screening, unloading, and spreading ranged from $190/acre at Duda Jem Farm (6.5 wet tons/ac) to $384/ac on the Marsh Flow-Way (10 wet tons/ac). Much of the increase was due to the cost of spreading per acre ($32/ac vs. $131/ac). The MFW cost is a more accurate reflection of expected costs to do this work. The per acre cost for NSRA treatment did not cover all the contractor's activities due to the novel material and job characteristics. The MFW was bid after the NSRA work and correctly accounted for the all contractor expenses.

Following flooding in late August 2002, water quality and macroinvertebrate monitoring was initiated.

DISCUSSION

Several lessons were learned during the large-scale application. The proper equipment and material management techniques were essential to effective and efficient spreading over the large area. There was a distinct learning period at the beginning of the large-scale application that slowed the work. This may be unavoidable when novel materials are used and the site requires intensive management in order to maintain appropriate access conditions.

In order to reach all areas of the fields, balloon-type tires were used on the spreaders. Wet conditions impeded the ability of typical farm machinery to operate. A clear field was also essential. Vegetation on the site (primarily weeds, but with some woody vegetation) was disked, chopped or removed to allow an even distribution of WTR.

Several alterations were made to the equipment to improve spreading efficiency. During application, the spreaders were only filled two-thirds full to reduce the strain on the spreader chain mechanism, which was subject to breaking under a full load. The spreaders were also completely emptied at the end of each day because the WTR cemented if allowed to remain in the spreaders overnight.

Calibration of each spreader was conducted each morning by running the spreader over a 9' x 6' tarp to test weight and coverage of the residual distribution. If the material weight was not within a 10 percent weight threshold, the spreader mechanism was adjusted. If the coverage of the distributed material was uneven, the auger was checked for obstructions. During the day, calibrations were performed with small plastic containers and a small postage scale. Loads per field were tallied to double check proper application rates Supervision of the spreading operation was continuous to ensure that even coverage was attained. The spreading rate became much more consistent as the operators gained experience with the material.

CONCLUSION

The restoration of former agricultural lands is a complex and lengthy process. Water treatment residuals can be used to cost-effectively reduce the influence of impacted areas on the surrounding ecosystem and shorten the restoration timeline. For example, the use of alum residual to reduce the movement of phosphorus from the farmland to Lake Apopka cost approximately 0.059 cents per gram of phosphorus removed. In contrast, mechanical harvest of hydrilla from a large shallow lake was estimated to cost approximately 2 cents per gram of phosphorus removed in a South Florida scenario (Harvey and Havens, 1999). The decrease in phosphorus discharged to Lake Apopka from the soils will benefit the lake ecosystem and downstream waters.

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APPENDIX F

BUDGETARY COST ESTIMATE WORKSHEETS
FOR PHYSICAL TREATMENT TECHNOLOGIES CONCEPTUAL PLANS

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Table 1 Itemized construction and annual operations and maintenance (O&M) costs for 190 CFS (123-MGD) inflow intake and pump station needed to achieve 45% total nitrogen reduction goal using physical treatment.

LAKE HANCOCK OUTFALL TREATMENT PROJECT											
190 CUBIC FEET PER SECOND (123-MGD) INTAKE, PUMP STATION AND TRANSMISSION MAIN											
Transmission and Pipelines	**Flow-mgd**	**Flow-gpm**	**Dia.-in**	**Material**	**C Coff**	**Length-ft**	**Vel. Fps**	**Hf/100**	**Hf**	**$/ft [1]**	**Escalated Cost**
Transmission Main											
Single Pipeline	123.00	85485	64.0	Steel	110	2800	8.53	0.3786	10.6	524.00	$ 1,467,200
Dual Pipeline	0.00	0	48.0	Steel	110	0	0.00	0.0000	0.0	0.00	$ -
Total	**123.00**	**85,485**							**10.60**		**$ 1,467,200**
										Inflated to 2004	**$ 1,787,050**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs	190	
Construction Cost $	$ 1,490,176	(Footnote 2)
Telemetry	$ 100,000	(Footnote 2)
3-Phase Power	$ 625,000	(Footnote 2)
Electrical Service	$ 100,000	
Inflation (Construction Materials)	$ 372,544	Increased by 25% due to recent increases in concrete and steel costs this year
Total	**$ 2,687,720**	

Lake Hancock Pump Station

Capacity - mgd	123	
Hf	10.6	
Static Head+PS Loss	30.0	
TDH	40.6	
Pump Efficiency	0.80	
Break HP	1,093.8	
Motor Efficiency	0.95	
Maximum Annual kwh	7,520,896	
Average Annual kwh	1,764,244	Based on annual average flow 44.57 cfs or 29 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**123,497**	Assumes operation at 44.57 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY					
Item	**Capital Cost**	**Annual O&M Structures**	**Annual O&M Equipment**	**Annual Power**	**Total Annual**
Lake Intake & Pump Station	$ 2,687,720	$ 26,877	$ 107,509	$ 123,497	$ 257,883
Transmission Main	$ 1,787,050	$ 17,870			$ 17,870
Total Intake, pump station and transmission main	**$ 4,474,769**	**$ 44,748**	**$ 107,509**	**$ 123,497**	$ 275,754

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of cost

Annual O&M Equipment @ 4% of cost

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Table 2 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs sedimentation ponds needed to achieve 45% total nitrogen reduction goal.

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power	Annual Alum	Annual Disposal	Total Annual
	Construction Costs									Annual Costs (i)					
Clearing and Grubbing	100	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 236,000		$ 302,080						$ -
Earthwork															$ -
Excavation/Grading	146,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 397,120		$ 508,314						
Levees	8,100	LF				$ 13.95	$ 112,995		$ 144,634						
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - Table 1					$ 257,883
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - Table 1						$ -		$ 1,787,050	See Intake Pump 123-mgd spreadsheet - Table 1					$ 17,870
Sedimentation Ponds															
Floating Turbidity Barrier	500	LF		Included	Included	$ 10.00	$ 5,000		$ 6,400						
Staked Silt Fence	11,000	LF		Included	Included	$ 2.00	$ 22,000		$ 28,160						
Sodding	35,000	SY		Included	Included	$ 2.50	$ 87,500		$ 112,000						
Seed/Mulch	35,000	SY		Included	Included	$ 1.00	$ 35,000		$ 44,800						
Concrete Rubble Rip-Rap	3,055	CY		Included	Included	$ 50.00	$ 152,750		$ 195,520						
6-ft x 5-ft Concrete Box Culvert	250	LF		Included	Included	$ 400.00	$ 100,000		$ 128,000						
Concrete Endwall	9	EA		Included	Included	$ 7,500.00	$ 67,500		$ 86,400						
Outfall Structure	3	EA		Included	Included	$ 10.00	$ 10,000		$ 12,800						
Inflow Valves	3	EA		Included	Included	$ 10.00	$ 20,000		$ 25,600						
Weir Gate	3	EA		Included	Included	$ 10.00	$ 30,000		$ 38,400						
Two Dredges/Accessories	1	LS		Included	Included	$ 10.00	$ 500,000		$ 640,000						
Sub-total									$ 1,318,080	$ 292,000	$ 7,500	$ 10,000			$ 309,500
Discharge Channel	1,600	LF				$ 578.00	$ 924,800		$ 1,183,744	$ 11,837					$ 11,837
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 1,935,000	$ 19,350	$ 77,400	$ 4,225			$ 100,975
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	74,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 1,101,860		$ 1,477,721						
12" Stabilized Sub base	74,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 429,200		$ 570,096						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 2,045,560		$ 2,653,877	$ 26,539	$ -			$ 596,000	$ 622,539
Operations and Maintenance Bldg	20,000	SF				$ 180.00		f	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 780,000		$ 859,841
Access Road and Parking															
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600		$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350		$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000		$ 115,560						
Sub-Total							$ 635,950		$ 841,666	$ 8,417	$ -				$ 8,417
Totals									$ 27,482,163	$ 499,343	$ 505,700	$ 55,194	$ 780,000	$ 596,000	$2,711,991

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 2.0 MG. Result = $1,588,400. Inflated (footnote b) to December 2004 cost = $1,935,000.
(e) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(f) Average building cost = $180 per square foot of constructed building
(g) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(h) Materials and equipment assumed to be 30% of total costs
(i) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 3 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs sedimentation basins needed to achieve 45% total nitrogen reduction goal.

Construction Costs										Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	60	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 141,600		$ 181,248						$ -
Earthwork	60,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 163,200		$ 208,896						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 235,841
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 638,232	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 6,382
Sedimentation Basins	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 10,350,000	$ 103,500	$ 414,000	$ 22,598			$ 540,098
Discharge Channel	1,400	LF				$ 578.00	$ 809,200		$ 1,035,776	$ 10,358					$ 10,358
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 1,935,000	$ 19,350	$ 77,400	$ 4,225			$ 100,975
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	74,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 1,101,860		$ 1,477,721						
12" Stabilized Sub base	74,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 429,200		$ 570,096						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 2,045,560		$ 2,653,877	$ 26,539	$ -			$ 596,000	$ 622,539
Operations and Maintenance Bldg	20,000	SF				$ 180.00		g	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,h	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 780,000		$ 859,841
Access Road and Parking															
3" Asphalt Conc. Pavement	60,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 488,400		$ 639,852						
12" Compacted Limerock Base	20,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 297,800		$ 399,384						
12" Stabilized Sub base	20,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 116,000		$ 154,080						
Sub-Total							$ 902,200		$ 1,193,316	$ 11,933	$ -				$ 11,933
Totals										$ 312,880	$ 912,200	$ 67,793	$ 780,000	$ 596,000	$2,911,096

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
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Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(12.754+0.750^2/2)*D^0.608 where D = 123 mgd. Result = $8,500,000. Inflated (footnote b) to December 2004 cost = $10,350,000
(e) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 2.0 MG. Result = $1,588,400. Inflated (footnote b) to December 2004 cost = $1,935,000.
(f) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(g) Average building cost = $180 per square foot of constructed building
(h) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(i) Materials and equipment assumed to be 30% of total costs
(j) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 4 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs sedimentation followed by filtration needed to achieve 45% total nitrogen reduction goal

	Construction Costs									Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	60	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 141,600		$ 181,248						$ -
Earthwork	80,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 217,600		$ 278,528						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 235,841
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 638,232	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 6,382
Sedimentation Basins	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 10,350,000	$ 103,500	$ 414,000	$ 22,598			$ 540,098
Filtration	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 32,400,000	$ 324,000	$ 1,296,000	$ 70,742			$ 1,690,742
Discharge Channel	1,400	LF				$ 578.00	$ 809,200		$ 1,035,776	$ 10,358					$ 10,358
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 1,935,000	$ 19,350	$ 77,400	$ 4,225			$ 100,975
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	74,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 1,101,860		$ 1,477,721						
12" Stabilized Sub base	74,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 429,200		$ 570,096						
Front End Loader	2	EA	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 2,045,560		$ 2,653,877	$ 26,539	$ -			$ 596,000	$ 622,539
Operations and Maintenance Bldg	20,000	SF				$ 180.00		h	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,i	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 780,000		$ 859,841
Access Road and Parking															
3" Asphalt Conc. Pavement	60,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 488,400		$ 639,852						
12" Compacted Limerock Base	20,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 297,800		$ 399,384						
12" Stabilized Sub base	20,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 116,000		$ 154,080						
Sub-Total							$ 902,200		$ 1,193,316	$ 11,933	$ -				$ 11,933
Totals										$ 636,880	$ 2,208,200	$ 138,535	$ 780,000	$ 596,000	$ 4,601,838

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

(d) Cost equation: e^(12.754+0.750^2/2)*D^0.608 where D = 123 mgd. Result = $8,500,000. Inflated (footnote b) to December 2004 cost = $10,350,000
(e) Cost equation: e^(12.634+0.957^2/2)*D^0.832 where D = 123 mgd. Result = $26,580,000. Inflated (footnote b) to December 2004 cost = $32,400,000
(f) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 2.0 MG. Result = $1,588,400. Inflated (footnote b) to December 2004 cost = $1,935,000.
(g) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(h) Average building cost = $180 per square foot of constructed building
(i) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(j) Materials and equipment assumed to be 30% of total costs
(k) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 5 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs Aqua DAF High-Rate Clarification needed to achieve 45% total nitrogen reduction goal.

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Construction Costs										**Annual Costs**					
Clearing and Grubbing	60	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 141,600		$ 181,248						$ -
Earthwork	60,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 163,200		$ 208,896						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 235,841
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 638,232	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 6,382
Aqua DAF															
Equipment (Infilco Degremont)	1	LS	$ 4,300,000	$ 215,000	$ 107,500	$ 4,622,500.00	$ 4,622,500		$ 6,217,800						
Structural Fill	1,000	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 21,250		$ 28,040						
Concrete (slab on grade)	800	CY	$ 203	$ 6		$ 209.00	$ 167,200		$ 225,384						
Concrete (Walls)	2,315	CY	$ 371	$ 6		$ 377.00	$ 872,755		$ 1,177,247						
Additional Equipment (Allowance)	1	LS	$ 1,075,000	$ 53,750	$ 26,875	$ 1,155,625.00	$ 1,155,625		$ 1,554,450						
Electrical (Allowance)	1	LS	$ 430,000	$ 21,500	$ 10,750	$ 462,250.00	$ 462,250		$ 621,780						
Sub-total							$ 7,301,580		$ 9,824,701	$ 98,247	$ 392,988	$ 21,451			$ 512,686
Discharge Channel	1,400	LF				$ 578.00	$ 809,200		$ 1,035,776	$ 10,358					$ 10,358
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 1,935,000	$ 19,350	$ 77,400	$ 4,225			$ 100,975
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	74,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 1,101,860		$ 1,477,721						
12" Stabilized Sub base	74,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 429,200		$ 570,096						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 2,045,560		$ 2,653,877	$ 26,539	$ -			$ 596,000	$ 622,539
Operations and Maintenance Bldg	20,000	SF				$ 180.00		f	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 780,000		$ 859,841
Access Road and Parking															
3" Asphalt Conc. Pavement	60,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 488,400		$ 639,852						
12" Compacted Limerock Base	20,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 297,800		$ 399,384						
12" Stabilized Sub base	20,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 116,000		$ 154,080						
Sub-Total							$ 902,200		$ 1,193,316	$ 11,933	$ -				$ 11,933
Totals										$ 307,627	$ 891,188	$ 66,646	$ 780,000	$ 596,000	$2,883,684

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 2.0 MG. Result = $1,588,400. Inflated (footnote b) to December 2004 cost = $1,935,000.
(e) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(f) Average building cost = $180 per square foot of constructed building
(g) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(h) Materials and equipment assumed to be 30% of total costs
(i) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 6 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs Aqua DAF High-Rate Clarification followed by filtration needed to achieve 45% total nitrogen reduction goa

Construction Costs										Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	60	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 141,600		$ 181,248						$ -
Earthwork	80,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 217,600		$ 278,528						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 235,841
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 638,232	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 6,382
Aqua DAF															
Equipment (Infilco Degremont)	1	LS	$ 4,300,000	$ 215,000	$ 107,500	$ 4,622,500.00	$ 4,622,500		$ 6,217,800						
Structural Fill	1,000	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 21,250		$ 28,040						
Concrete (slab on grade)	800	CY	$ 203	$ 6		$ 209.00	$ 167,200		$ 225,384						
Concrete (Walls)	2,315	CY	$ 371	$ 6		$ 377.00	$ 872,755		$ 1,177,247						
Additional Equipment (Allowance)	1	LS	$ 1,075,000	$ 53,750	$ 26,875	$ 1,155,625.00	$ 1,155,625		$ 1,554,450						
Electrical (Allowance)	1	LS	$ 430,000	$ 21,500	$ 10,750	$ 462,250.00	$ 462,250		$ 621,780						
Sub-total							$ 7,301,580		$ 9,824,701	$ 98,247	$ 392,988	$ 21,451			$ 512,686
Filtration	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 32,400,000	$ 324,000	$ 1,296,000	$ 70,742			$ 1,690,742
Discharge Channel	1,400	LF				$ 578.00	$ 809,200		$ 1,035,776	$ 10,358					$ 10,358
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 1,935,000	$ 19,350	$ 77,400	$ 4,225			$ 100,975
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	74,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 1,101,860		$ 1,477,721						
12" Stabilized Sub base	74,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 429,200		$ 570,096						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 2,045,560		$ 2,653,877	$ 26,539	$ -			$ 596,000	$ 622,539
Operations and Maintenance Bldg	20,000	SF				$ 180.00		g	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,h	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 780,000		$ 859,841
Access Road and Parking															
3" Asphalt Conc. Pavement	60,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 488,400		$ 639,852						
12" Compacted Limerock Base	20,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 297,800		$ 399,384						
12" Stabilized Sub base	20,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 116,000		$ 154,080						
Sub-Total							$ 902,200		$ 1,193,316	$ 11,933	$ -				$ 11,933
Totals										$ 631,627	$ 2,187,188	$ 137,388	$ 780,000	$ 596,000	$ 4,574,426

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(12.634+0.957^2/2)*D^0.832 where D = 123 mgd. Result = $26,580,000. Inflated (footnote b) to December 2004 cost = $32,400,000
(e) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 2.0 MG. Result = $1,588,400. Inflated (footnote b) to December 2004 cost = $1,935,000.
(f) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(g) Average building cost = $180 per square foot of constructed building
(h) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(i) Materials and equipment assumed to be 30% of total costs
(j) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 7 Itemized construction and annual operations and maintenance (O&M) costs for 190-cfs Microscreen filtration needed to achieve 45% total nitrogen reduction goal.

	Construction Costs									Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (i)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	40	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 94,400		$ 120,832						$ -
Earthwork	40,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 108,800		$ 139,264						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 2,687,720	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 235,841
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 1						$ -		$ 638,232	See Intake Pump 123-mgd spreadsheet - See Table 1					$ 6,382
Discfilter															
Equipment (Kruger)	1	LS	$ 5,500,000	$ 275,000	$ 137,500	$ 5,912,500.00	$ 5,912,500		$ 7,953,000						
Structural Fill	600	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 12,750		$ 16,824						
Concrete (slab on grade)	600	CY	$ 203	$ 6		$ 209.00	$ 125,400		$ 169,038						
Concrete (Walls)	2,315	CY	$ 371	$ 6		$ 377.00	$ 872,755		$ 1,177,247						
Additional Equipment (Allowance)	1	LS	$ 1,375,000	$ 68,750	$ 34,375	$ 1,478,125.00	$ 1,478,125		$ 1,988,250						
Electrical (Allowance)	1	LS	$ 550,000	$ 27,500	$ 13,750	$ 591,250.00	$ 591,250		$ 795,300						
Sub-total							$ 8,992,780		$ 12,099,659	$ 120,997	$ 483,986	$ 26,418	$ 30,000		$ 661,401
Discharge Channel	1,400	LF				$ 578.00	$ 809,200		$ 1,035,776	$ 10,358					$ 10,358
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 1,657,000	$ 16,570	$ 66,280	$ 3,618			$ 86,468
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 8,990,000	$ 89,900	$ 359,600	$ 19,629			$ 469,129
Sludge Drying Beds															
6" Diameter Pipe	5,000	LF				$ 52.90	$ 264,500		$ 338,560						
12" Crushed Concrete	45,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 670,050		$ 898,614						
12" Stabilized Sub base	45,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 261,000		$ 346,680						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 1,445,550		$ 1,851,354	$ 18,514	$ -			$614,000	$ 632,514
Operations and Maintenance Bldg	20,000	SF				$ 180.00		f	$ 3,600,000	$ 36,000	$ -	$ 18,000			$ 54,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 1,530,000	$ 15,300	$ 61,200	$ 3,341	$ 257,000		$ 336,841
Access Road and Parking															
3" Asphalt Conc. Pavement	60,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 488,400		$ 639,852						
12" Compacted Limerock Base	20,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 297,800		$ 399,384						
12" Stabilized Sub base	20,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 116,000		$ 154,080						
Sub-Total							$ 902,200		$ 1,193,316	$ 11,933	$ -				$ 11,933
Totals										$ 319,571	$ 971,066	$ 71,006	$ 287,000	$614,000	$2,504,867

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.6 MG. Result = $1,360,000. Inflated (footnote b) to December 2004 cost = $1,657,000.
(e) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(f) Average building cost = $180 per square foot of constructed building
(g) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(h) Materials and equipment assumed to be 30% of total costs
(i) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

Table 8 Itemized construction and annual operations and maintenance (O&M) costs for 68 CFS (44-MGD) inflow intake and pump station needed to achieve 27% total nitrogen reduction goal using physical treatment.

LAKE HANCOCK OUTFALL TREATMENT PROJECT

68 CUBIC FEET PER SECOND (44-MGD) INTAKE, PUMP STATION AND TRANSMISSION MAIN

Transmission and Pipelines	Flow-mgd	Flow-gpm	Dia.-in	Material	C Coff	Length-ft	Vel. Fps	Hf/100	Hf	$/ft [1]	Escalated Cost
Transmission Main											
Single Pipeline	44.00	30580	42.0	Steel	110	2800	7.08	0.4388	12.3	354.08	$ 991,424
Dual Pipeline	0.00	0	48.0	Steel	110	0	0.00	0.0000	0.0	0.00	$ -
Total	**44.00**	**30,580**							**12.29**		**$ 991,424**
										Inflated to 2004	**$ 1,207,554**

(1) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

Lake Hancock Intake and Pump Station

Construction costs = Q(cfs)*[Q(cfs)*(-0.8451) + 8003.6] (Footnote 2)

Capacity - cfs	68	
Construction Cost $	$ 540,337	(Footnote 2)
Telemetry	$ 100,000	(Footnote 2)
3-Phase Power	$ 625,000	(Footnote 2)
Electrical Service	$ 100,000	
Inflation (Construction Materials)	$ 135,084	Increased by 25% due to recent increases in concrete and steel costs this year
Total	**$ 1,500,421**	

Lake Hancock Pump Station

Capacity - mgd	44	
Hf	12.3	
Static Head+PS Loss	30.0	
TDH	42.3	
Pump Efficiency	0.80	
Break HP	407.7	
Motor Efficiency	0.95	
Maximum Annual kwh	2,803,480	
Average Annual kwh	1,111,910	Based on annual average flow 26.97 cfs or 17 mgd
Power Cost/ Kwhr	0.07	
Annual Power Cost	**77,834**	Assumes operation at 26.97 cfs 24 hours/day 365 days/year

Footnote 1 - Costs determined from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrustructure, EPA 816-R-01-005, February, 2001.

Footnote 2 - Costs determined from equation provided in HDR (2004), Nubbin Slough STA Enhancement Study, Prepared for SFWMD by HDR Engineering, Inc. November 2004.

COST SUMMARY

Item	Capital Cost	Annual O&M Structures	Annual O&M Equipment	Annual Power	Total Annual
Lake Intake & Pump Station	$ 1,500,421	$ 15,004	$ 60,017	$ 77,834	$ 152,855
Transmission Main	$ 1,207,554	$ 12,076			$ 12,076
Total Intake, pump station and transmission main	**$ 2,707,976**	**$ 27,080**	**$ 60,017**	**$ 77,834**	$ 164,930

Power cost $0.07 & 95% motor efficiency

Annual O&M Structures @ 1% of cost

Annual O&M Equipment @ 4% of cost

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Table 9 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs sedimentation ponds needed to achieve 27% total nitrogen reduction goal.

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power	Annual Alum	Annual Disposal	Total Annual
	Construction Costs									Annual Costs (i)					
Clearing and Grubbing	40	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 94,400		$ 120,832						$ -
Earthwork															$ -
Excavation/Grading	58,400	CY		$ 0.96	$ 1.76	$ 2.72	$ 158,848		$ 203,325						
Levees	5,000	LF				$ 19.56	$ 97,800		$ 125,184						
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - Table 8						$ -		$ 1,500,421	See Intake Pump 123-mgd spreadsheet - Table 8					$ 152,855
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - Table 8						$ -		$ 1,207,554	See Intake Pump 123-mgd spreadsheet - Table 8					$ 12,076
Sedimentation Ponds															
Floating Turbidity Barrier	200	LF		Included	Included	$ 10.00	$ 2,000		$ 2,560						
Staked Silt Fence	5,000	LF		Included	Included	$ 2.00	$ 10,000		$ 12,800						
Sodding	15,000	SY		Included	Included	$ 2.50	$ 37,500		$ 48,000						
Seed/Mulch	15,000	SY		Included	Included	$ 1.00	$ 15,000		$ 19,200						
Concrete Rubble Rip-Rap	2,000	CY		Included	Included	$ 50.00	$ 100,000		$ 128,000						
6-ft x 5-ft Concrete Box Culvert	180	LF		Included	Included	$ 400.00	$ 72,000		$ 92,160						
Concrete Endwall	9	EA		Included	Included	$ 7,500.00	$ 67,500		$ 86,400						
Outfall Structure	3	EA		Included	Included	$ -	$ 10,000		$ 12,800						
Inflow Valves	3	EA		Included	Included	$ -	$ 20,000		$ 25,600						
Weir Gate	3	EA		Included	Included	$ -	$ 30,000		$ 38,400						
Two Dredges/Accessories	2	EA		Included	Included	$ -	$ 500,000		$ 640,000						
Sub-total									$ 1,105,920	$ 292,000	$ 7,500	$ 10,000			$ 309,500
Discharge Channel	1,600	LF				$ 410.00	$ 656,000		$ 839,680	$ 8,397					$ 8,397
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Sludge Drying Beds															
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800		$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700		$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000		$ 231,120						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 976,500		$ 1,233,120	$ 12,331	$ -			$ 372,000	$ 384,331
Operations and Maintenance Bldg	10,000	SF				$ 180.00		f	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 472,000		$ 513,225
Access Road and Parking															
3" Asphalt Conc. Pavement	30,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 244,200		$ 319,926						
12" Compacted Limerock Base	10,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 148,900		$ 199,692						
12" Stabilized Sub base	10,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 58,000		$ 77,040						
Sub-Total							$ 451,100		$ 596,658	$ 5,967	$ -				$ 5,967
Totals									$ 16,222,695	$ 411,595	$ 307,100	$ 35,354	$ 472,000	$ 372,000	$ 1,762,979

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.0 MG. Result = $1,000,000. Inflated (footnote b) to December 2004 cost = $1,200,000.
(e) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(f) Average building cost = $180 per square foot of constructed building
(g) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 44 mgd. Result = $650,000. Inflated (footnote b) to December 2004 cost = $790,000
(h) Materials and equipment assumed to be 30% of total costs
(i) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 10 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs sedimentation basins needed to achieve 27% total nitrogen reduction goal.

	Construction Costs									Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	20	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 47,200		$ 60,416						$ -
Earthwork	20,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 54,400		$ 69,632						$ -
Intake & Pump Station	See Intake Pump 123-mgd spreadsheet - See Table 8						$ -		$ 1,500,421	See Intake Pump 123-mgd spreadsheet - See Table 8					$ 138,387
Inflow Transmission Main	See Intake Pump 123-mgd spreadsheet - See Table 8						$ -		$ 431,269	See Intake Pump 123-mgd spreadsheet - See Table 8					$ 4,313
Sedimentation Basins	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Discharge Channel	1,400	LF				$ 410.00	$ 574,000		$ 734,720	$ 7,347					$ 7,347
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Sludge Drying Beds															
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800		$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700		$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000		$ 231,120						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 976,500		$ 1,233,120	$ 12,331	$ -			$ 372,000	$ 384,331
Operations and Maintenance Bldg	10,000	SF				$ 180.00		g	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,h	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 472,000		$ 513,225
Access Road and Parking															
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600		$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350		$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000		$ 115,560						
Sub-Total							$ 635,950		$ 841,666	$ 8,417	$ -				$ 8,417
Totals										$ 175,995	$ 519,600	$ 37,362	$ 472,000	$ 372,000	$ 1,719,658

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(12.754+0.750^2/2)*D^0.608 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(e) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.0 MG. Result = $1,000,000. Inflated (footnote b) to December 2004 cost = $1,200,000.
(f) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(g) Average building cost = $180 per square foot of constructed building
(h) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 44 mgd. Result = $650,000. Inflated (footnote b) to December 2004 cost = $790,000
(i) Materials and equipment assumed to be 30% of total costs
(j) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 11 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs sedimentation followed by filtration needed to achieve 27% total nitrogen reduction goal

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
	Construction Costs									Annual Costs					
Clearing and Grubbing	30	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 70,800		$ 90,624						$ -
Earthwork	30,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 81,600		$ 104,448						$ -
Intake & Pump Station	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 1,500,421	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 138,387
Inflow Transmission Main	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 431,269	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 4,313
Sedimentation Basins	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Filtration	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 13,700,000	$ 137,000	$ 548,000	$ 29,913			$ 714,913
Discharge Channel	1,400	LF				$ 410.00	$ 574,000		$ 734,720	$ 7,347					$ 7,347
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Sludge Drying Beds															
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800		$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700		$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000		$ 231,120						
Front End Loader	2	EA	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 976,500		$ 1,233,120	$ 12,331	$ -			$ 372,000	$ 384,331
Operations and Maintenance Bldg	10,000	SF				$ 180.00		h	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,i	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 472,000		$ 513,225
Access Road and Parking															
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600		$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350		$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000		$ 115,560						
Sub-Total							$ 635,950		$ 841,666	$ 8,417	$ -				$ 8,417
Totals										$ 312,995	$ 1,067,600	$ 67,275	$ 472,000	$ 372,000	$ 2,434,570

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

(d) Cost equation: e^(12.754+0.750^2/2)*D^0.608 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(e) Cost equation: e^(12.634+0.957^2/2)*D^0.832 where D = 44 mgd. Result = $11,300,000. Inflated (footnote b) to December 2004 cost = $13,700,000
(f) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.0 MG. Result = $1,000,000. Inflated (footnote b) to December 2004 cost = $1,200,000.
(g) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(h) Average building cost = $180 per square foot of constructed building
(i) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 44 mgd. Result = $650,000. Inflated (footnote b) to December 2004 cost = $790,000
(j) Materials and equipment assumed to be 30% of total costs
(k) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 12 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs Aqua DAF High-Rate Clarification needed to achieve 27% total nitrogen reduction goal.

	Construction Costs								Annual Costs					
Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost	Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
Clearing and Grubbing	20	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 47,200	$ 60,416						$ -
Earthwork	20,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 54,400	$ 69,632						$ -
Intake & Pump Station	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -	$ 1,500,421	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 138,387
Inflow Transmission Main	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -	$ 431,269	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 4,313
Aqua DAF														
Equipment (Infilco Degremont)	1	LS	$ 1,800,000	$ 90,000	$ 45,000	$ 1,935,000.00	$ 1,935,000	$ 2,602,800						
Structural Fill	500	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 10,625	$ 14,020						
Concrete (slab on grade)	400	CY	$ 203	$ 6		$ 209.00	$ 83,600	$ 112,692						
Concrete (Walls)	1,160	CY	$ 371	$ 6		$ 377.00	$ 437,320	$ 589,895						
Additional Equipment (Allowance)	1	LS	$ 450,000	$ 22,500	$ 11,250	$ 483,750.00	$ 483,750	$ 650,700						
Electrical (Allowance)	1	LS	$ 180,000	$ 9,000	$ 4,500	$ 193,500.00	$ 193,500	$ 260,280						
Sub-total							$ 3,143,795	$ 4,230,387	$ 42,304	$ 169,215	$ 9,237			$ 220,756
Discharge Channel	1,400	LF				$ 410.00	$ 574,000	$ 734,720	$ 7,347					$ 7,347
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure						b,c,d	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure						b,c,e	$ 6,500,000	$ 65,000	$ 260,000	$ 14,192			$ 339,192
Sludge Drying Beds														
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800	$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700	$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000	$ 231,120						
Front End Loader	2	Ea	$ 125,000				$ 250,000	$ 267,500						
Sub-total							$ 976,500	$ 1,233,120	$ 12,331	$ -			$372,000	$ 384,331
Operations and Maintenance Bldg	10,000	SF				$ 180.00	f	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure						b,c,g	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 472,000		$ 513,225
Access Road and Parking														
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600	$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350	$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000	$ 115,560						
Sub-Total							$ 635,950	$ 841,666	$ 8,417	$ -				$ 8,417
Totals									$ 173,299	$ 508,815	$ 36,774	$ 472,000	$372,000	$1,705,588

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(12.754+0.750^2/2)*D^0.608 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(e) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.0 MG. Result = $1,000,000. Inflated (footnote b) to December 2004 cost = $1,200,000.
(f) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(g) Average building cost = $180 per square foot of constructed building
(h) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 44 mgd. Result = $650,000. Inflated (footnote b) to December 2004 cost = $790,000
(i) Materials and equipment assumed to be 30% of total costs
(j) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 13 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs Aqua DAF High-Rate Clarification followed by filtration needed to achieve 27% total nitrogen reduction goal.

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (j)	Annual Alum	Annual Disposal	Total Annual
	Construction Costs									Annual Costs					
Clearing and Grubbing	30	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 70,800		$ 90,624						$ -
Earthwork	30,000	CY		$ 0.96	$ 1.76	$ 2.72	$ 81,600		$ 104,448						$ -
Intake & Pump Station	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 1,500,421	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 138,387
Inflow Transmission Main	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 431,269	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 4,313
Aqua DAF															
Equipment (Infilco Degremont)	1	LS	$ 1,800,000	$ 90,000	$ 45,000	$ 1,935,000.00	$ 1,935,000		$ 2,602,800						
Structural Fill	500	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 10,625		$ 14,020						
Concrete (slab on grade)	400	CY	$ 203	$ 6		$ 209.00	$ 83,600		$ 112,692						
Concrete (Walls)	1,160	CY	$ 371	$ 6		$ 377.00	$ 437,320		$ 589,895						
Additional Equipment (Allowance)	1	LS	$ 450,000	$ 22,500	$ 11,250	$ 483,750.00	$ 483,750		$ 650,700						
Electrical (Allowance)	1	LS	$ 180,000	$ 9,000	$ 4,500	$ 193,500.00	$ 193,500		$ 260,280						
Sub-total							$ 3,143,795		$ 4,230,387	$ 42,304	$ 169,215	$ 9,237			$ 220,756
Filtration	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 13,700,000	$ 137,000	$ 548,000	$ 29,913			$ 714,913
Discharge Channel	1,400	LF				$ 410.00	$ 574,000		$ 734,720	$ 7,347					$ 7,347
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,f	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Sludge Drying Beds															
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800		$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700		$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000		$ 231,120						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 976,500		$ 1,233,120	$ 12,331	$ -			$ 372,000	$ 384,331
Operations and Maintenance Bldg	10,000	SF				$ 180.00		g	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,h	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 472,000		$ 513,225
Access Road and Parking															
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600		$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350		$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000		$ 115,560						
Sub-Total							$ 635,950		$ 841,666	$ 8,417	$ -				$ 8,417
Totals										$ 300,299	$ 1,016,815	$ 64,503	$ 472,000	$ 372,000	$ 2,368,318

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00
December 2004 ENR Construction Index:	7308
Inflation from 1999 to present:	21.800 %
Average Inflation per year:	4.360 %
Escalation Factor	1.218

(d) Cost equation: e^(12.634+0.957^2/2)*D^0.832 where D = 44 mgd. Result = $11,300,000. Inflated (footnote b) to December 2004 cost = $13,700,000
(e) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.0 MG. Result = $1,000,000. Inflated (footnote b) to December 2004 cost = $1,200,000.
(f) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 44 mgd. Result = $4,500,000. Inflated (footnote b) to December 2004 cost = $5,500,000
(g) Average building cost = $180 per square foot of constructed building
(h) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 44 mgd. Result = $650,000. Inflated (footnote b) to December 2004 cost = $790,000
(i) Materials and equipment assumed to be 30% of total costs
(j) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

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Table 14 Itemized construction and annual operations and maintenance (O&M) costs for 68-cfs Microscreen filtration needed to achieve 27% total nitrogen reduction goal.

Item	Quantity	Unit	Materials	Construction Labor	Construction Equipment	Unit Price/Item	Total Materials, Labor Const Equip Cost		Total Construction Costs (a)	Annual O&M Structures	Annual O&M Equipment	Annual Power (i)	Annual Alum	Annual Disposal	Total Annual
Construction Costs										Annual Costs					
Clearing and Grubbing	20	Acre	$ -	$ 1,160	$ 1,200	$ 2,360.00	$ 47,200		$ 60,416						$ -
Earthwork	20,000	CY		$ 0.96	$ 2.44	$ 3.40	$ 68,000		$ 87,040						$ -
Intake & Pump Station	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 1,500,421	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 138,387
Inflow Transmission Main	See Intake Pump 44-mgd spreadsheet - See Table 8						$ -		$ 431,269	See Intake Pump 44-mgd spreadsheet - See Table 8					$ 4,313
Discfilter															
Equipment (Kruger)	1	LS	$ 2,500,000	$ 125,000	$ 62,500	$ 2,687,500.00	$ 2,687,500		$ 3,615,000						
Structural Fill	400	CY	$ 12.00	$ 4.25	$ 5.00	$ 21.25	$ 8,500		$ 11,216						
Concrete (slab on grade)	400	CY	$ 203	$ 6		$ 209.00	$ 83,600		$ 112,692						
Concrete (Walls)	1,800	CY	$ 371	$ 6		$ 377.00	$ 678,600		$ 915,354						
Additional Equipment (Allowance)	1	LS	$ 625,000	$ 31,250	$ 15,625	$ 671,875.00	$ 671,875		$ 903,750						
Electrical (Allowance)	1	LS	$ 250,000	$ 12,500	$ 6,250	$ 268,750.00	$ 268,750		$ 361,500						
Sub-total							$ 4,398,825		$ 5,919,512	$ 59,195	$ 236,780	$ 12,925	$ 10,000		$ 318,900
Discharge Channel	1,400	LF				$ 410.00	$ 574,000		$ 734,720	$ 7,347					$ 7,347
Gravity Thickening	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,d	$ 1,200,000	$ 12,000	$ 48,000	$ 2,620			$ 62,620
Mechanical Dewatering	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,e	$ 5,500,000	$ 55,000	$ 220,000	$ 12,009			$ 287,009
Sludge Drying Beds															
6" Diameter Pipe	2,000	LF				$ 52.90	$ 105,800		$ 135,424						
12" Crushed Concrete	30,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 446,700		$ 599,076						
12" Stabilized Sub base	30,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 174,000		$ 231,120						
Front End Loader	2	Ea	$ 125,000				$ 250,000		$ 267,500						
Sub-total							$ 976,500		$ 1,233,120	$ 12,331	$ -			$ 398,671	$ 411,002
Operations and Maintenance Bldg	10,000	SF				$ 180.00		f	$ 1,800,000	$ 18,000	$ -	$ 9,000			$ 27,000
Alum Metering & Storage	Based on USEPA Survey Modeling the Cost of Infrastructure							b,c,g	$ 790,000	$ 7,900	$ 31,600	$ 1,725	$ 158,000		$ 199,225
Access Road and Parking															
3" Asphalt Conc. Pavement	40,000	SY	$ 3.50	$ 0.64	$ 4.00	$ 8.14	$ 325,600		$ 426,568						
12" Compacted Limerock Base	15,000	CY	$ 13.00	$ 0.64	$ 1.25	$ 14.89	$ 223,350		$ 299,538						
12" Stabilized Sub base	15,000	CY	$ 4.00	$ 0.80	$ 1.00	$ 5.80	$ 87,000		$ 115,560						
Sub-Total							$ 635,950		$ 841,666	$ 8,417	$ -				$ 8,417
Totals										$ 180,190	$ 536,380	$ 38,278	$ 168,000	$ 398,671	$ 1,464,220

(a) Construction costs include: construction contingency (20%), Mobilization/Demobilization (5%), Construction Permits (1%), Bonding (1%), Insurance (1%) and sales tax (7% of materials).
(b) Costs from USEPA 1999 Drinking Water Infrastructure Needs Survey Modeling the Cost of Infrastructure, EPA 816-R-01-005, February, 2001.
(c) Engineering News Record (ENR) Cost Indexes

January 1999 ENR Construction Index:	6000.00	
December 2004 ENR Construction Index:	7308	
Inflation from 1999 to present:	21.800	%
Average Inflation per year:	4.360	%
Escalation Factor	1.218	

(d) Cost equation: e^(13.641+0.559^2/2)*D^0.694 where D = 1.6 MG. Result = $1,360,000. Inflated (footnote b) to December 2004 cost = $1,657,000.
(e) Cost equation: e^(12.752+1.179^2/2)*D^0.494 where D = 123 mgd. Result = $7,380,000. Inflated (footnote b) to December 2004 cost = $8,990,000
(f) Average building cost = $180 per square foot of constructed building
(g) Cost equation: e^(10.298+1.102^2/2)*D^0.652 where D = 123 mgd. Result = $1,260,000. Inflated (footnote b) to December 2004 cost = $1,530,000
(h) Materials and equipment assumed to be 30% of total costs
(i) Annual costs include: annual O&M structures (1% of Const. Costs), annual O&M equipment (4% of Const. Costs), annual power (1% of Const. Costs) and annual labor (1% of Const. Costs).

Table 15 - Unit construction costs for civil site work, levees, and concrete structures.

PARSONS

ENGINEER ESTIMATE WORKSHEET

JOB NO.:	743785			**M.T.O. BY:** O. Serrano	**DATE:** 09/13/04	**EST DATE:**	09/13/04
PROJECT:	Lake Hancock Outfall Treatment Project	**Project Description**		**PRICED BY:**	**DATE:** 09/13/04	**PRINT DATE:**	01/17/07
CLIENT:		**Estimate Type:**	Budgetary Cost Estimate	**CHECKED BY:** M Taylor	**DATE:** 09/13/04	**REV. 1:**	

ACCT NUMBER	DESCRIPTION	QUANTITY	UNIT	UNIT RATES MATERIAL/ EQUIPMENT	LABOR M/H	LABOR P.F.	LABOR RATE	CONST. EQUIPMENT	SUB CONTRACT	MATERIAL/ EQUIPMENT COST	LABOR HOURS	LABOR COST	CONST. EQUIPMENT COST	SUB CONTRACT COST	UNIT PRICE / ITEM	TOTAL COST
1.00	**Earth Work And General Site Preparation**															
1.01	Clearing & Grubbing (including trees smaller then 12" dia.)	1.00	AC		40	1.00	29.00	1,200.00		$ -	$ 40.00	$ 1,160.00	$ 1,200.00	$ -	$ 2,360.00	$ 2,360.00
1.02	Tree Removal (Larger then 12" dia.)	1.00	Ea		6.6	1.00	29.00	124.00		$ -	$ 6.60	$ 191.40	$ 124.00	$ -	$ 315.40	$ 315.40
1.03	Earth Work (excavation and grading)	1.00	Cy		0.03	1.00	32.00	1.76		$ -	$ 0.03	$ 0.96	$ 1.76	$ -	$ 2.72	$ 2.72
1.04	Tree Protection	1.00	Lf	$ 0.50	0.01	1.00	26.00	1.00		$ 0.50	$ 0.01	$ 0.26	$ 1.00	$ -	$ 1.76	$ 1.76
1.05	Stripping Top Soil	1.00	Cy		0.01	1.00	29.00	0.45		$ -	$ 0.01	$ 0.29	$ 0.45	$ -	$ 0.74	$ 0.74
1.06	Construction of Sloped Embankments (compacted levee fill in 16" lifts imported soils)	1.00	Cy	$ -	0.04	1.00	32.00	2.93		$ -	$ 0.04	$ 1.28	$ 2.93	$ -	$ 4.21	$ 4.21
1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	1.00	Cy	$ 2.40	0.035	1.00	32.00	3.09		$ 2.40	$ 0.04	$ 1.12	$ 3.09	$ -	$ 6.61	$ 6.61
1.08	Final Grading	1.00	Sy		0.02	1.00	32.00	2.80		$ -	$ 0.02	$ 0.64	$ 2.80	$ -	$ 3.44	$ 3.44
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	1.00	Cy	$ 8.00	0.005	1.00	32.00	1.75		$ 8.00	$ 0.01	$ 0.16	$ 1.75	$ -	$ 9.91	$ 9.91
1.10	3" Asphalt Conc. Pavement	1.00	Sy	$ 3.50	0.020	1.00	32.00	4.00		$ 3.50	$ 0.02	$ 0.64	$ 4.00	$ -	$ 8.14	$ 8.14
1.11	12" Compacted Limerock Base	1.00	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 13.00	$ 0.02	$ 0.64	$ 1.25	$ -	$ 14.89	$ 14.89
1.12	12" Stabilized Subbase	1.00	Cy	$ 4.00	0.025	1.00	32.00	1.00		$ 4.00	$ 0.03	$ 0.80	$ 1.00	$ -	$ 5.80	$ 5.80
1.13	48' CMP	1.00	Lf	$ 69.00	0.7	1.00	32.00	9.00		$ 69.00	$ 0.70	$ 22.40	$ 9.00	$ -	$ 100.40	$ 100.40
1.14	12" Compacted Crushed Concrete	1.00	Cy	$ 13.00	0.02	1.00	32.00	1.25		$ 13.00	$ 0.02	$ 0.64	$ 1.25	$ -	$ 14.89	$ 14.89
2.00	**Concrete**															
2.01	Slab on grade	1.00	CY	$ 203.00	6.00	1.00	36.00			$ 203.00	$ 6.00	$ 216.00	$ -	$ -	$ 419.00	$ 419.00
2.02	Conventional walls	1.00	CY	$ 371.00	6.00	1.00	36.00			$ 371.00	$ 6.00	$ 216.00	$ -	$ -	$ 587.00	$ 587.00
2.03	Elevated Work	1.00	CY	$ 473.00	8.00	1.00	36.00			$ 473.00	$ 8.00	$ 288.00	$ -	$ -	$ 761.00	$ 761.00
2.04	Columns	1.00	CY	$ 486.00	8.00	1.00	36.00			$ 486.00	$ 8.00	$ 288.00	$ -	$ -	$ 774.00	$ 774.00
2.04	12" Structural Fill (57 stone or crushed conc.)	1.00	Cy	12.00	0.17	1.00	25.00	5.00		$ 12.00	$ 0.17	$ 4.25	$ 5.00	$ -	$ 21.25	$ 21.25

Items Required for Sedimentation Pond Levee Construction (Footnote 1):

1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	$6.61 LF
1.09	Sloped Embankments Maintenance Road (12" consolidated stone)	$7.34 LF
	Total = Lf of Levee	$13.95 LF

Items Required for asphalt road and parking lot construction:

1.10	3" Asphalt Conc. Pavement	$8.14 SY
1.11	12" Compacted Limerock Base	$4.96 SY
1.12	12" Stabilized Subbase	$1.93 SY
	Total	$15.03 SY

Items Required for discharge channel construction at 190 cfs flow:

1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	$ 159.00 LF
2.01	Slab on grade	$419.00 LF
	Total	$578.00 LF

Items Required for discharge channel construction at 68 cfs flow:

1.07	Construction of Sloped Embankments (levee compacted fill in 16" lifts borrow soils)	$ 100.00 LF
2.01	Slab on grade	$310.00 LF
	Total	$410.00 LF

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APPENDIX G

LAKE HANCOCK PROJECT BUDGET PROPOSAL
AQUADAF™ HIGH-RATE DAF CLARIFIER

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Lake Hancock Project
Budget Proposal

AquaDAF™
High-Rate DAF Clarifier

Attn: Mr. Tory Champlin, Ph.D, P.E.
Engineer: Parsons
DATE: January 12, 2005

Infilco Degremont

SUEZ

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Infilco Degremont, Inc.

PO Box 71390
Richmond, VA 23255-1390

8007 Discovery Drive
Richmond, VA 23229

Tel: (804) 756-7600
Fax: (804) 756-7643
Idi.info@infilcodegremont.com
www.infilcodegremont.com

January 12, 2005

Attn: Mr. Tory Champlin, Ph.D, P.E.
Parsons
3450 Buschwood Park Drive, Suite 345
Tampa, FL 33618

Re: AquaDAF™ Budget Proposal

Dear Tory:

In accordance with your recent request, we are pleased to submit our preliminary AquaDAF™ proposal for the following:

- Eight (8) 15.0-MGD AquaDAF™ units with auxiliaries
- Two (2) 5.0-MGD AquaDAF™ units with auxiliaries

The wide range of treatment flows requires more flexibility than usual, consequently small and large capacity basins were proposed. The proposed layout represents only one of multiple orientations of influent and effluent nozzles and channels, as well as overall basin orientation.

We have endeavored to provide complete information here, but if you have any questions or do need additional information please don't hesitate to contact me at 800.446.1150 at your convenience. We look forward to further discussions with you concerning this project.

Sincerely,

Ryan J. Hess
Applications Engineer
IDI - Separations Group

TABLE OF CONTENTS

1. ABOUT INFILCO DEGREMONT, INC.

Infilco Degremont offers a full array of integrated water solutions in the U. S. and throughout the world. We are part of the Degremont Group, which employs more than 3,000 people in over 70 countries, serving over 1 billion people with water and wastewater solutions.

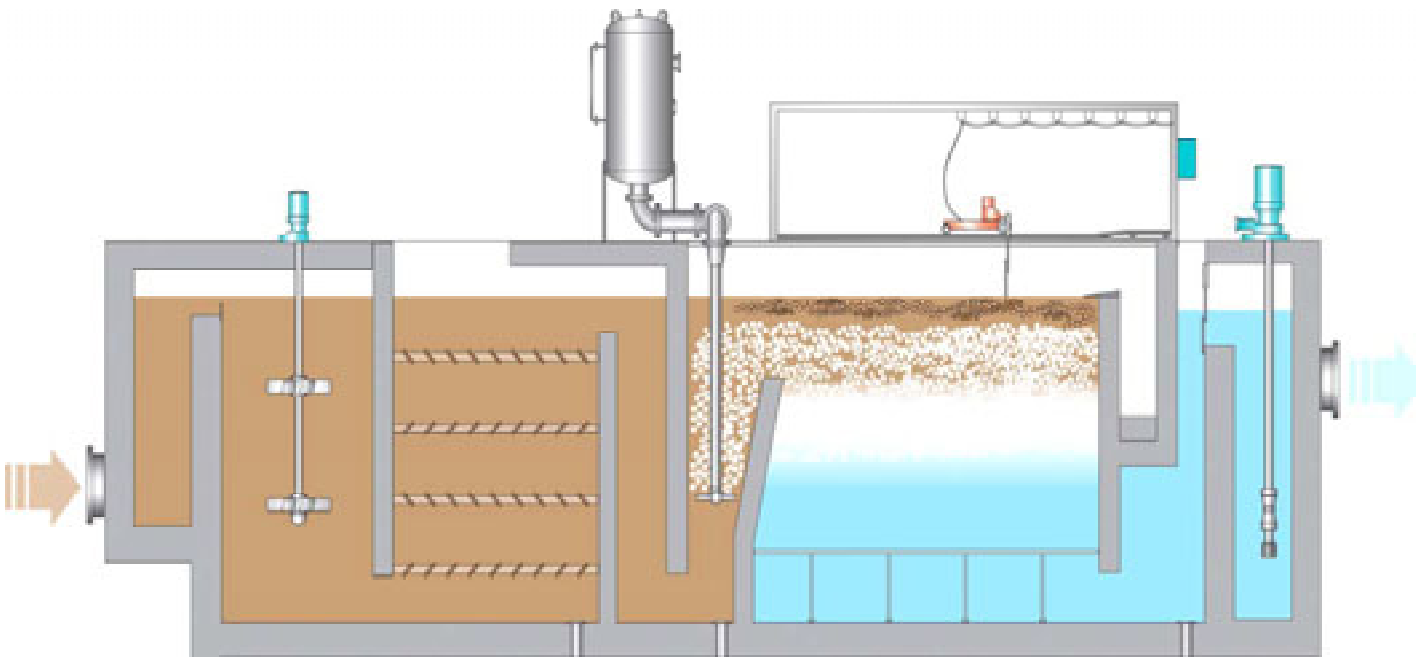
IDI creates solutions to solve challenges in the areas of headworks, biosolids, disinfection, membrane filtration, separations and biofiltration. Our technologies are longstanding market references, like the Climber Screen® Mechanical Bar Screen, ABW® Traveling Bridge Filter, and Cannon® Digester Mixing System.

Infilco Degremont continues to be the technology leader in the industry with technological advances such as the Biofor™ Biological Aerated Filter, IDI 2PAD™ Two-phase Anaerobic Digestion System for Class A Biosolids and the Aquaray® Ultraviolet Disinfection System.

Degremont is a subsidiary of SUEZ Environment. SUEZ, the premier global energy, water and waste services group has sales of over $35 billion and is listed on the New York Stock Exchange (ticker symbol SZE).

2. AquaDAF PROCESS DESCRIPTION

After in-line rapid mixing and two stages of flocculation the water enters the AquaDAF™ dissolved air flotation section of the unit. In this zone, the previously formed floc particles attach to microbubbles and are entrained by the bubbles to the surface. The microbubbles are produced by the depressurization of a partially air saturated pressurized recycle stream. This recycle stream is a portion of the clarified water stream that is pressurized by a recycle pump and saturated in a specially designed saturator tank. Depressurization of the stream takes place through proprietary dispersion nozzles fixed on a header that is located at the entrance of the DAF section. The clarified water passes through a patented perforated floor and leaves the unit over a weir plate into an effluent channel.



As floated floc particles accumulate on the surface of the DAF unit, a thick sludge layer is formed. Periodic removal of the sludge layer is required and may be carried out by one of two methods. Either by hydraulic means, where by raising the water level in the unit causes the overflow of the sludge blanket into the sludge collection trough. This is accomplished by raising an automatic effluent weir plate on a prescribed frequency and duration. If highly concentrated sludge is desired, a mechanical scraper system may be implemented to scrape the accumulated sludge onto a sludge beach and into the sludge trough.

3. AquaDAF DESIGN BRIEF

SIZING CRITERIA

Total No. of DAF Basins (large units) .... 8 N
Total No. of DAF Basins (small) .... 2 N
Total Design Flow 130-MGD
Unit Design Flow (large units) 15.0-MGD
Unit Design Flow (small units) 5.0-MGD
Loading Rate at Peak Flow .... 18.0 gpm/ft^2

Unit Width (large units)....................................... 32 ft
Unit Width (small units) .... 16 ft
Unit Length (large units) .... 59.75 ft
Unit Length (small units)..................................... 46.75 ft
Unit Water Depth.. 14.75 ft
Unit Height (includes freeboard) .... 17 ft

Method of Flocculation .... Mechanical/Hydraulic
Total Flocculation Time at Peak Flow .... 8.0 minutes

OPERATION & INSTALLATION

Estimated Power Consumption (large units)*.......... 16,375 kW*hr/day (full load - all units online)
Estimated Power Consumption (small units)* .... 1,700 kW*hr/day (full load - all units online)

Estimated Concrete (large units)*.......................... 2,700 cubic yards
Estimated Concrete (small units)*.......................... 415 cubic yards
(Includes: Inlet/outlet channels, Floc/DAF, sludge channels, DAF walkways & basin slabs)
(Assumes 15” outer walls & basin slabs; 12” interior walls)

Sludge Removal Method... Mechanical Scraping
Est. Solids Concentration....................................... 2.0-4.0%

*Estimates are based on previously executed projects or preliminary data and are provided as a courtesy and are for estimating purposes only. Actual quantities may vary.

4. STANDARD SCOPE OF SUPPLY

IDI proposes to furnish the following equipment for **EACH** AquaDAF™ unit (unless noted):

1. Three (3) primary vertical mount mechanical flocculator mixers and one set of IDI designed hydraulic aluminum flocculation baffles. Each mechanical mixer shall be designed per IDI recommendation. Motors: Each mixer shall have a 460-volt, 3 phase, 60 hertz, TEFC, 1.0 HP (min) motor with a variable frequency drive. All motors shall have Class F insulation with a 1.15 service factor. All wetted material of construction shall be 316SS. The CONTRACTOR shall provide the flocculator support bridges.

2. Air saturator vessel (one per basin) consisting of one (1) 304 stainless steel tank designed and ASME stamped to a working pressure of 150 psi. Miscellaneous components include pressure relief, needle and solenoid valves, air check valves, pressure gauges, level controller, site glass, diffuser, flanges and gaskets.

3. One (1) Lot of Sch. 10 304 stainless piping from saturator vessel outlet to the air dispersion header including header supports. Removable threaded PVC dispersion nozzles will be supplied with each header.

4. Recycle pumps consisting of one (1) vertical turbine per unit (plus one (1) spare pump per two units), variable frequency pump including cast iron casing, casing cover and frame. Impellers and shafts will be 316 stainless steel.

5. Air compressor system (6 duty, 2 spare – total) - Rotary screw type, with 460V/3/60Hz motor for the entire DAF system. Other components are air inlet filter, inlet throttling valve, motor, belt drive with guard, air/oil separator reservoir, air cooled oil cooler, air cooled after-cooler, separator, one (1) control panel for operation of all supplied compressors, noise enclosure and valves. All interconnecting piping and skids/concrete pads shall be by others. Each compressor shall be sized per IDI's recommendation.

6. Pre-drilled false floor with patented floor pattern to be fabricated from 4' x 8' x 1/8" thick aluminum sheets with aluminum support columns. Floor includes removable sections for access. All components shipped loosed for installation by Contractor.

7. Flanged-type General Service isolation butterfly and check valves for valves for recycle pump and recycle line isolation shall be provided.

8. One (1) 304 SS scraper mechanism system for sludge removal

9. One (1) spray header sludge dilution system will be provided around the periphery of the sludge trough. Includes 304SS piping, spray nozzles, automatic and manual isolation valves. All connection piping outside of the DAF basin shall be by Others.

10. One (1) influent distribution weir and effluent weir, each fabricated of 1/4" thick 304 SS. For the mechanical scraper option, a 304 SS sludge beach will be provided, in lieu of the sludge weir plate.

11. One (1) magnetic type flowmeter with transmitter for insertion in recycle line and one (1) level transmitter per recycle pump sump.

12. A total of one (1) main DAF control panel in NEMA 4X (FRP) enclosure for the entire DAF system. The control panel will include an Allen-Bradley PLC and Panelview MMI and required control devices to provide automatic and manual control of recycle pumps, saturators, and associated instruments. The DAF control panel will contain necessary input/output devices for control capabilities through the plant main SCADA system (by others).

13. Twenty (20) days of service - Shall be supplied for construction inspections, start-up and performance testing in no more than six (6) trips to the jobsite.

SCOPE TO BE SUPPLIED BY OTHERS

1. Installation of any kind, supervision of installation & unloading of equipment from delivering carrier
2. All concrete, grout and fill
3. Building or cover structure for DAF basins (required)
4. Sludge sumps and sludge waste pumps
5. All influent, effluent, recycle, sludge waste, drain and compressed air piping & piping supports.
6. All valves not specified herein
7. All required walkways, access stairs & ladders
8. All chemical feed systems, chemicals and chemical feed lines
9. In-line static mixers (required)
10. All basin drains and drain valves
11. Supply and installation of all power and control wiring and conduit to the equipment served plus interconnections between IDI equipment as required - wire, cable, junction boxes, fittings, conduit, safety disconnect switches, circuit breakers, etc.
12. Install and provide all motor control centers, motor starters, field wiring, wireways, supports and transformers
13. All embedded pipe sleeves, nozzles and anchor bolts
14. All other necessary equipment and services not otherwise listed as supplied by IDI.

5. PHOTO GALLERY

(Left) DAF basins at the Tampere WTP, Finland installation operating at loading rates of 8-12gpm/sq.ft.

(Below) DAF basins at the Lake Deforest WTP, NY installation operating at 12.5 gpm/sq.ft

(Left) DAF basins at the Manaus, Brazil 80-MGD system

(Left & Below) A typical saturator vessel. Influent injector piece yields a high saturator efficiency, resulting in a small, compact saturator tank. All saturator MOC is 304 SS

(Above) Saturator valves & instrumentation.

(Right) Rictor-type Air dispersion headers and nozzles

(Above) Automated pneumatic effluent weir actuator controls prescribed sludge removal cycle.

(Left) Sludge blanket flows into sludge trough during removal

(Above) Surface of DAF basin immediately following sludge removal. (Left) Sludge clean line washes down the basin walls during sludge removal.

6. PRELIMINARY DRAWINGS

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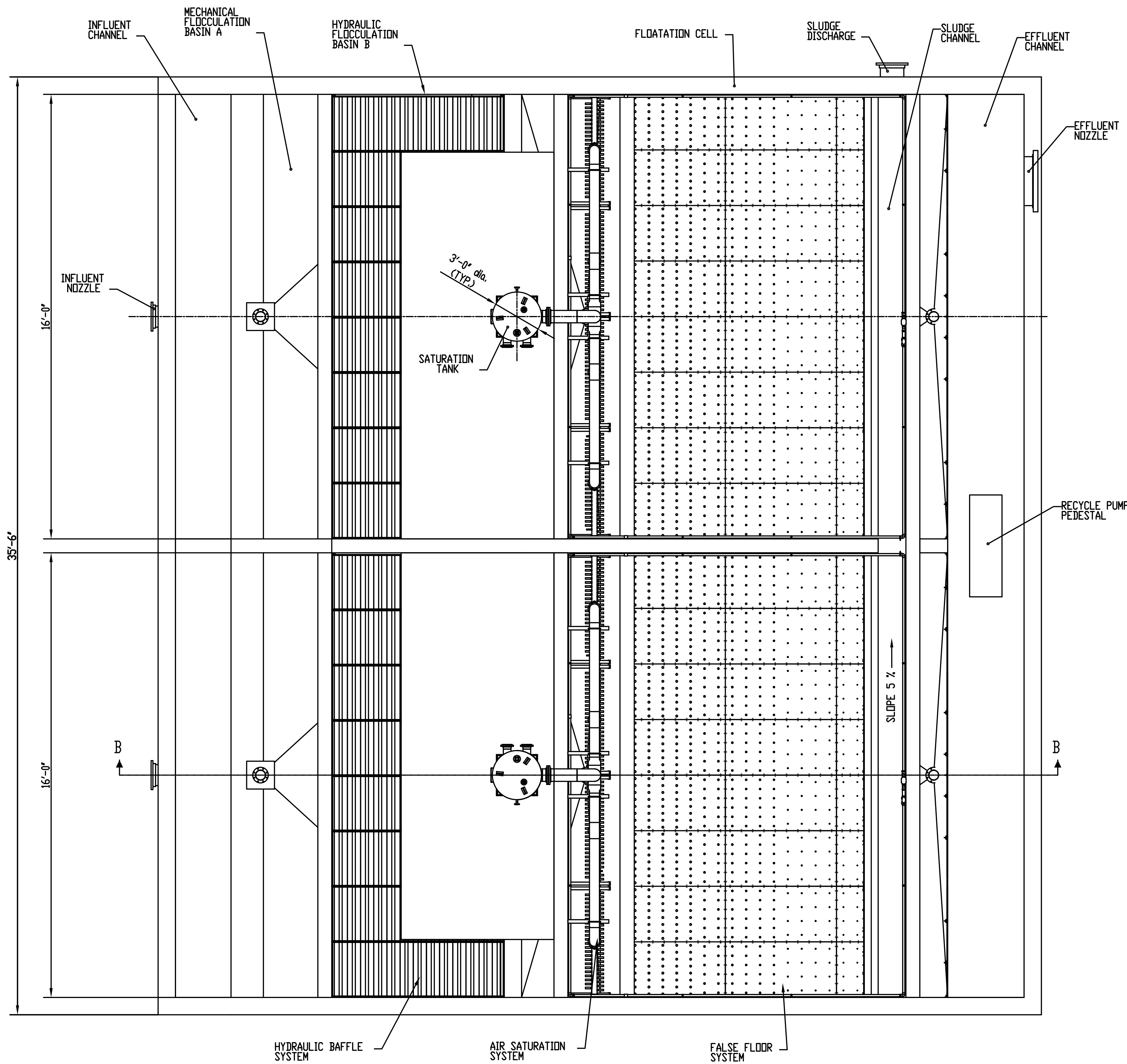

NOTE:

1) ALL BASINS TO BE SLOPED 1% TOWARD RESPECTIVE DRAIN.
2) DESIGN OF CONCRETE STRUCTURES IS NOT BY IDI
3) SLUDGE SCRAPER MECHANISM IS NOT SHOWN FOR CLARITY

PRELIMINARY NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE	CDD	RH	RH	01/07

PROJECT INFORMATION

Infilco Degremont
Infilco Degremont, Inc.
Post Office Box 71390
Richmond, Virginia 23255-1390
(800) 446-1150

	BY	DATE
DRAWN	CDD	01/05
CHECKED	RH	01/05
APP	RH	01/05
REF.		
DO NOT SCALE		
SCALE	NONE	

LAYOUT & ELEVATION VIEWS
AQUADAF SIZE 04
TWO (2) 5.0-MGD UNITS

SIZE D | DWG. NO. -001 | REV. -

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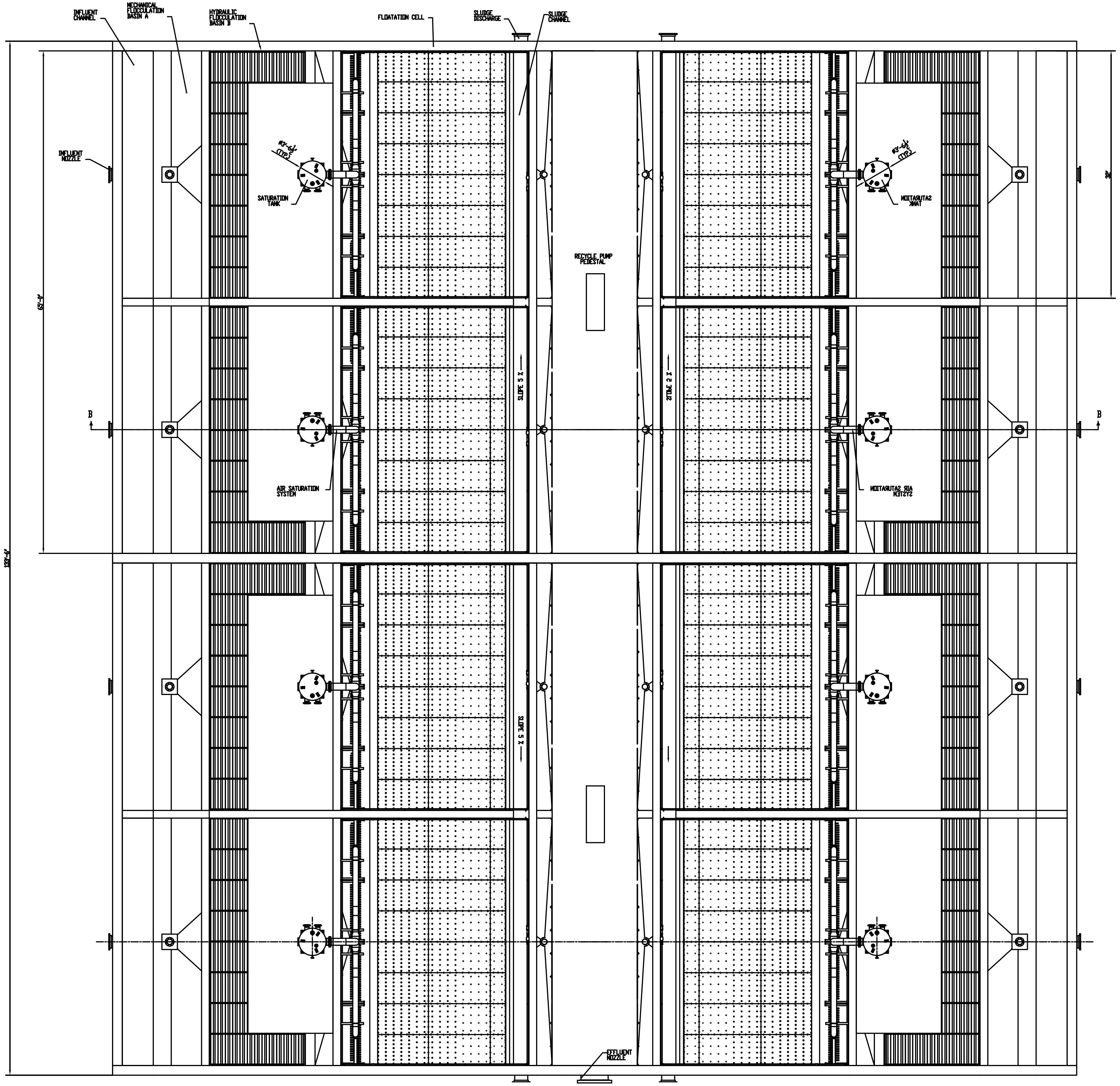

NOTE:

1) ALL BASINS TO BE SLOPED 1% TOWARD RESPECTIVE DRAIN.
2) DESIGN OF CONCRETE STRUCTURES IS NOT BY IDI
3) SLUDGE SCRAPER MECHANISM IS NOT SHOWN FOR CLARITY

PRELIMINARY NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE	CDD	RH	RH	01/07

PROJECT INFORMATION

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Richmond, Virginia 23255-1390
(800) 446-1150

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DRAWN	CDD	01/05
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APP	RH	01/05
REF.		

DO NOT SCALE
SCALE NONE

FULL PLAN VIEW (LARGE UNITS)
AQUADAF SIZE 09
EIGHT (8) 15-MGD UNITS SHOWN

SIZE D | DWG. NO. -001A | REV. -

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NOTE:

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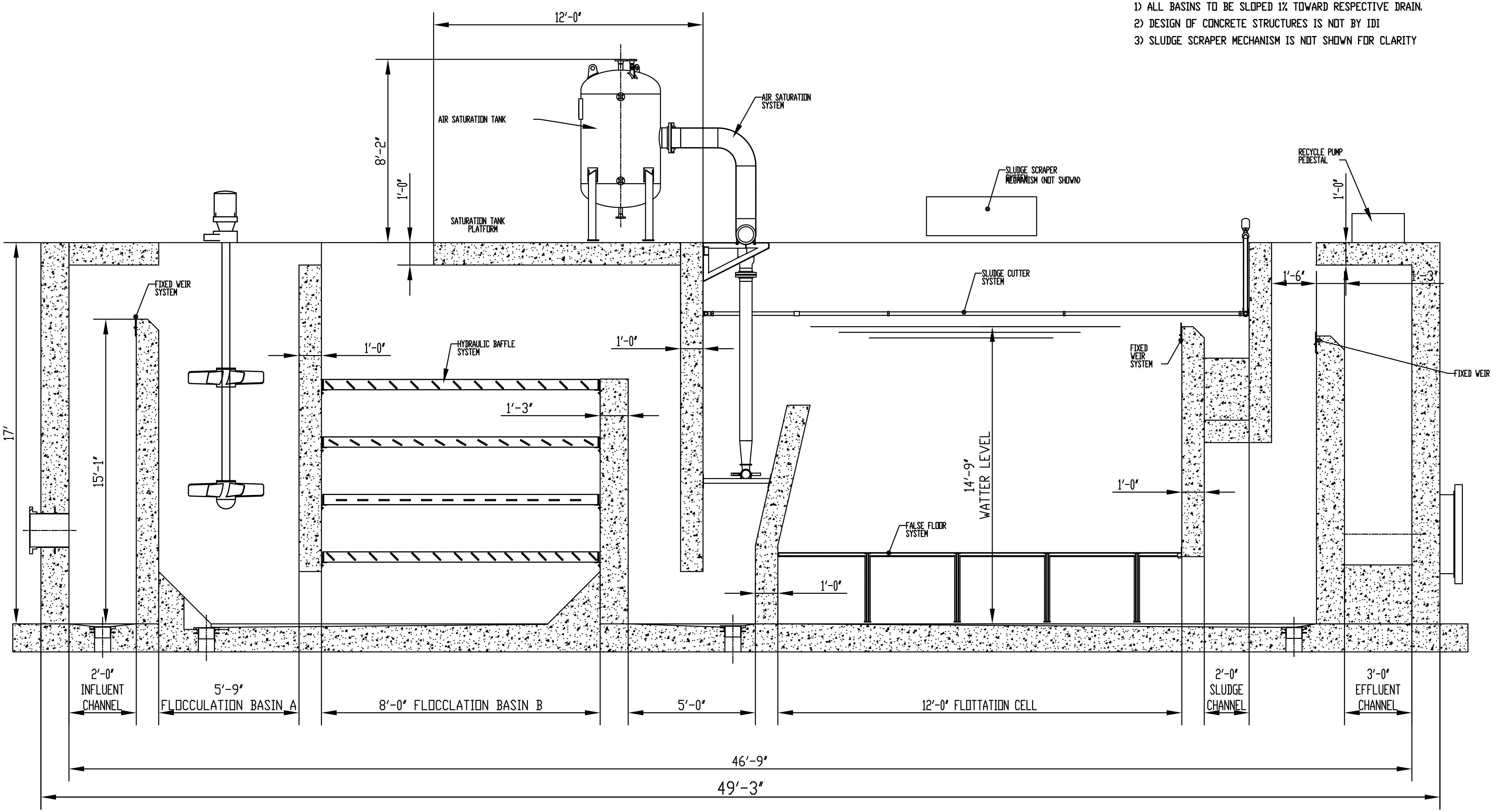
3) SLUDGE SCRAPER MECHANISM IS NOT SHOWN FOR CLARITY



SECTION B-B

PRELIMINARY NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE	CDD	RH	RH	01/05

PROJECT INFORMATION

Infilco Degremont
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Post Office Box 71390
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(800) 446-1150

	BY	DATE
DRAWN	CDD	01/05
CHECKED	RH	01/05
APP	RH	01/05

REF.
DO NOT SCALE
SCALE NONE

LAYOUT & ELEVATION VIEWS
AQUADAF SIZE 04
5.0-MGD UNIT SECTION

SIZE D DWG. NO. -002 REV. -

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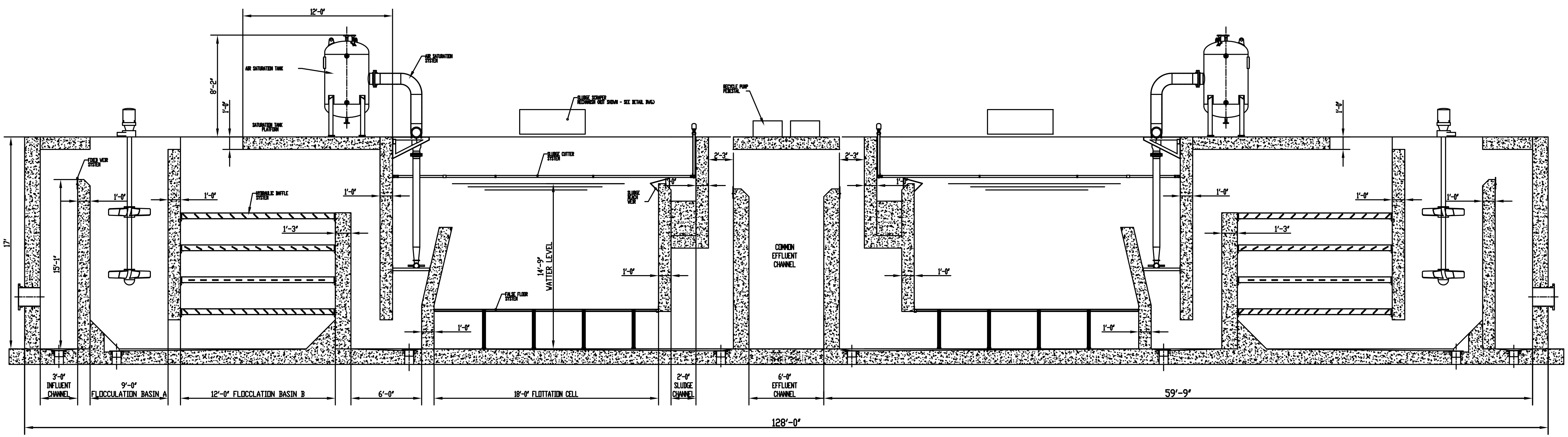
NOTE:

1) ALL BASINS TO BE SLOPED 1% TOWARD RESPECTIVE DRAIN.
2) DESIGN OF CONCRETE STRUCTURES IS NOT BY IDI
3) SLUDGE SCRAPER MECHANISM IS NOT SHOWN FOR CLARITY



SECTION B-B

PRELIMINARY NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE	CDD	RH	RH	01/05

PROJECT INFORMATION

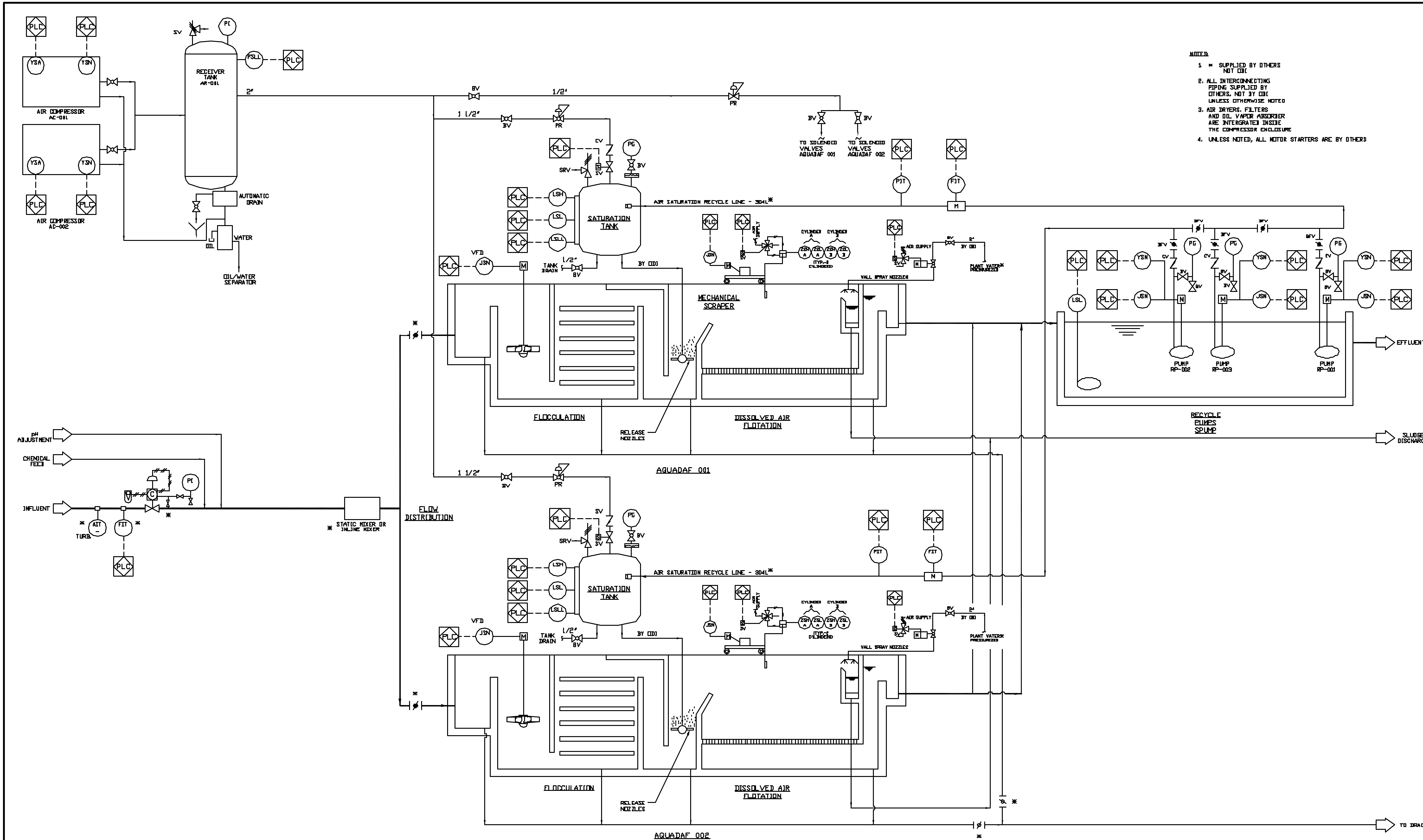
Infilco Degremont, Inc.
Post Office Box 71390
Richmond, Virginia 23255-1390
(800) 446-1150

	BY	DATE
DRAWN	CDD	01/05
CHECKED	RH	01/05
APP	RH	01/05

REF.
DO NOT SCALE
SCALE NONE

LAYOUT & ELEVATION VIEWS
AQUADAF SIZE 09
TWO (2) 15.0-MGD UNITS SECTION

SIZE D DWG. NO. -002A REV. -



NOTES:

1. * SUPPLIED BY OTHERS NOT ODI
2. ALL INTERCONNECTING PIPING SUPPLIED BY OTHERS, NOT BY ODI UNLESS OTHERWISE NOTED
3. AIR DRYERS, FILTERS AND OIL VAPOR ABSORBER ARE INTERGRATED INSIDE THE COMPRESSOR ENCLOSURE
4. UNLESS NOTED, ALL MOTOR STARTERS ARE BY OTHERS

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
-	ORIGINAL ISSUE				

PROJECT INFORMATION

ONDEO Degremont, Inc.
Post Office Box 71390
Richmond, Virginia 23255-1390
PH: (800) 446-1150

ONDEO Degrémont

	BY	DATE
DRAWN		
CHECKED		
APP		

REF.

DO NOT SCALE

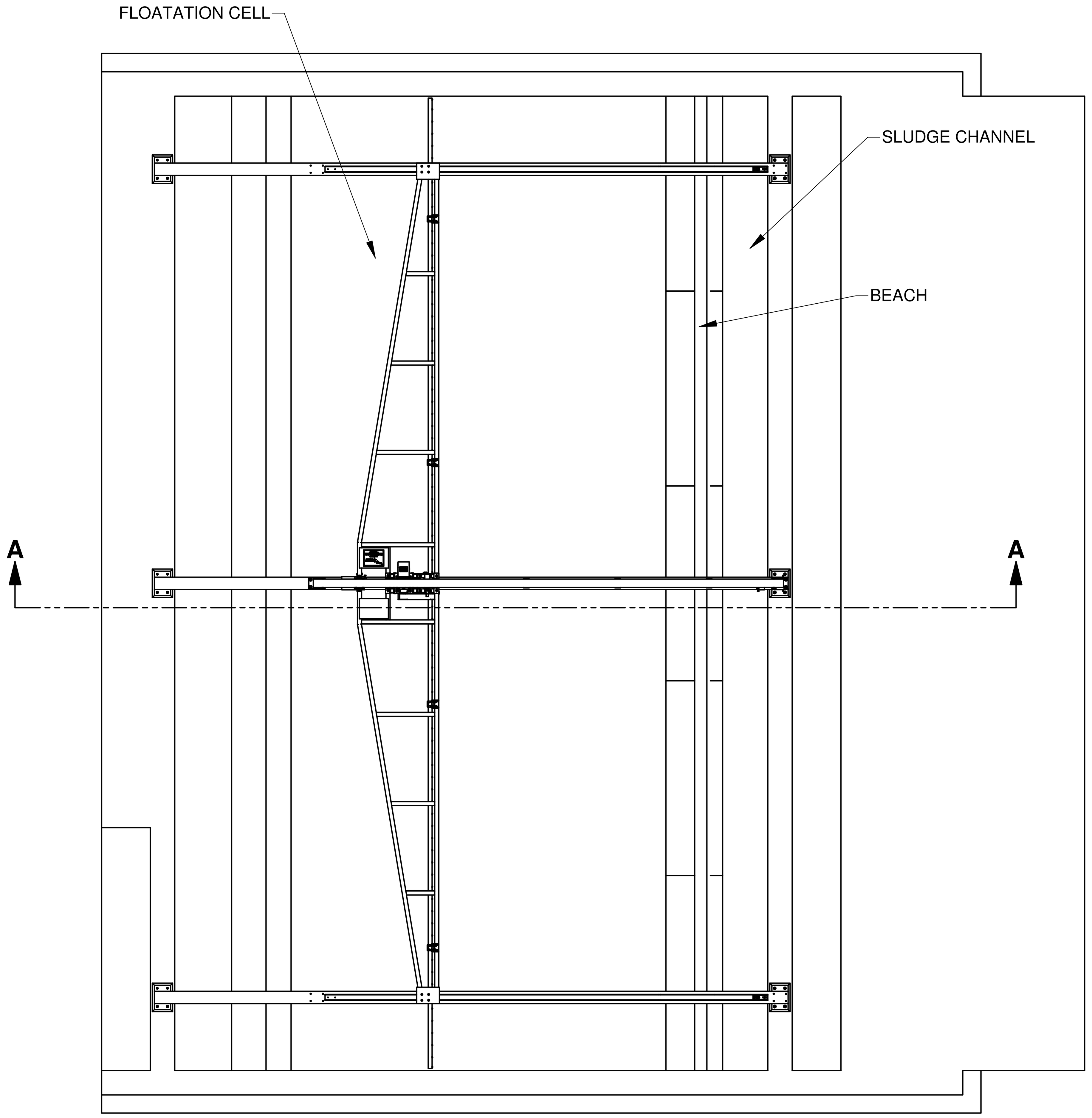
SCALE NONE

P & I D

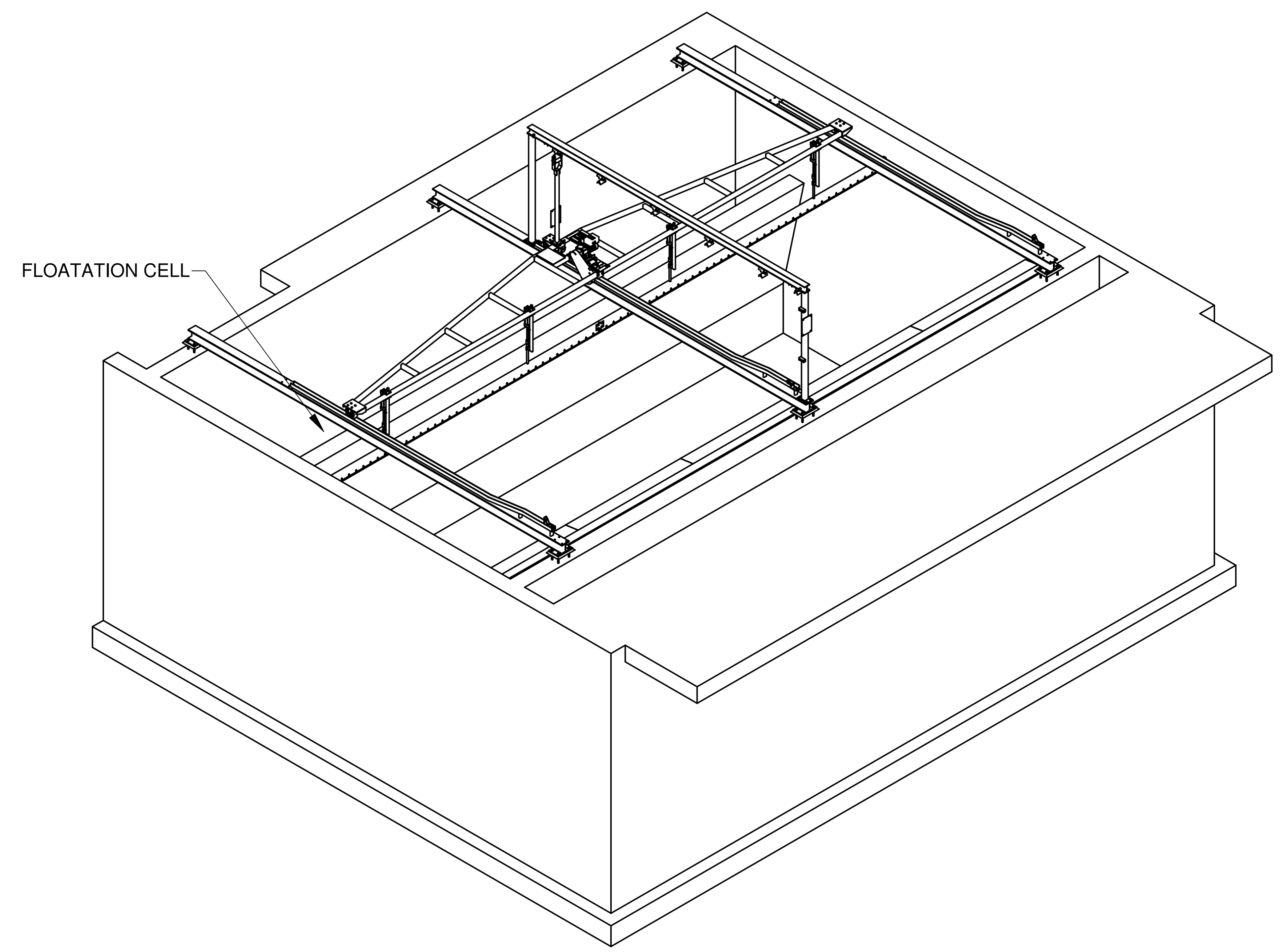
MECHANICAL DESLUDGING OPTION

AQUADAF SYSTEM HD

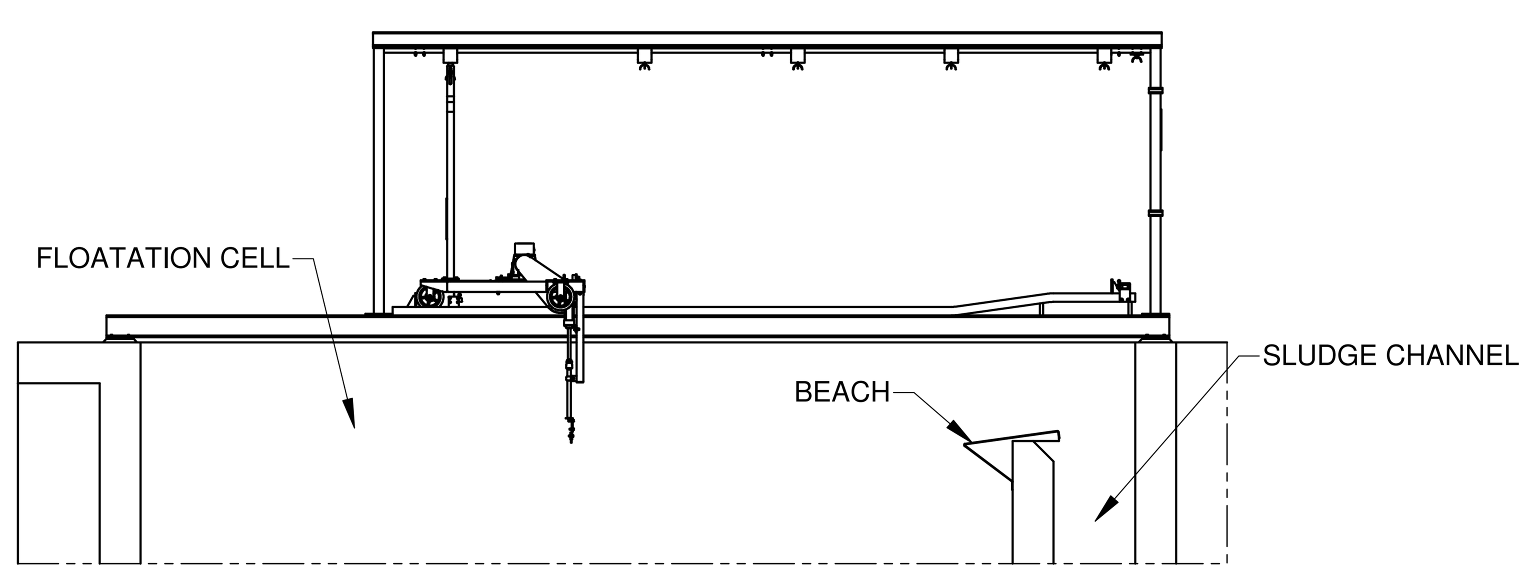
SIZE D | DWG. NO. -003 | REV. B



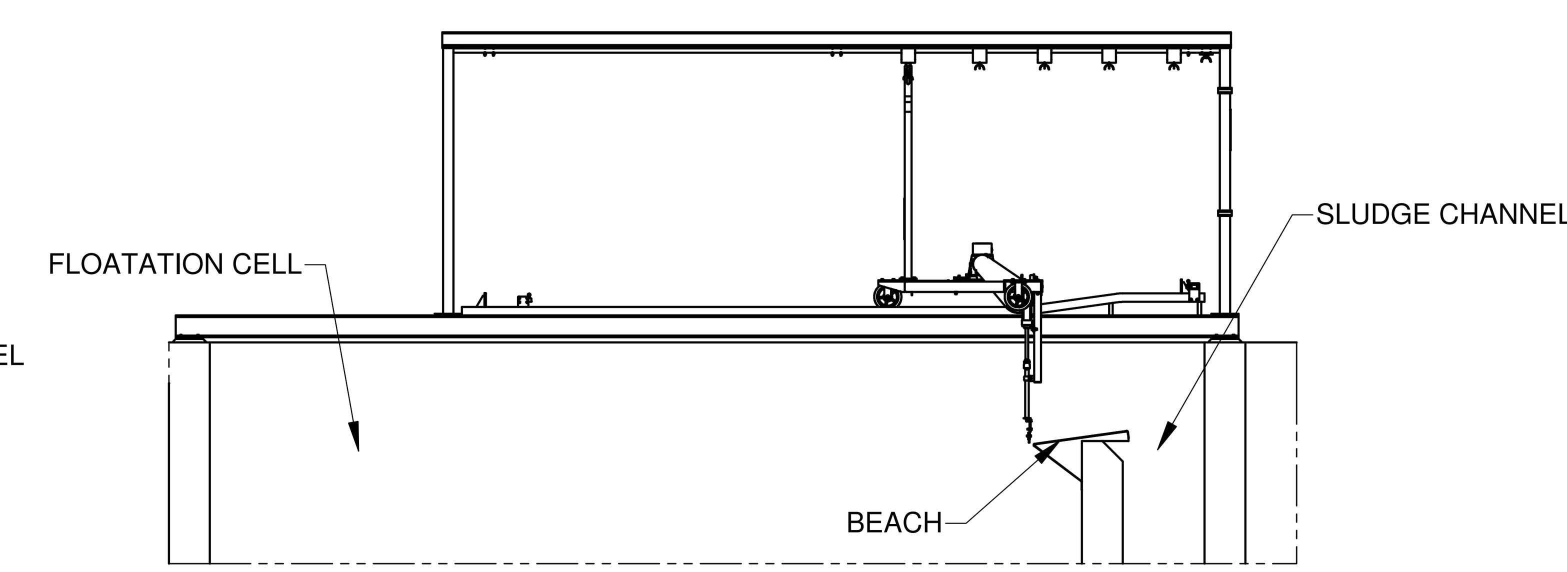
PLAN VIEW



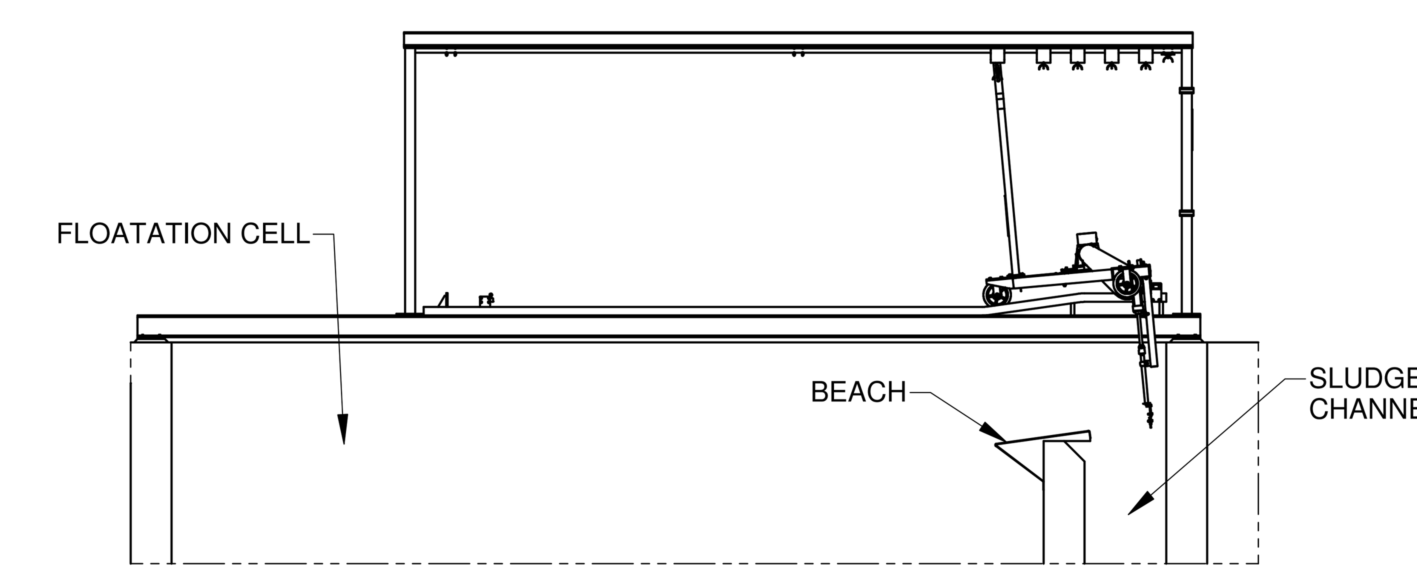
ISOMETRIC VIEW



START POSITION



SCRAPING POSITION



PARK POSITION

SECTION A-A
SCRAPER POSITIONS

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE

REV	REVISION DESCRIPTION	DRAWN	CHECKED	APP	DATE
0	ORIGINAL ISSUE	JWP	HY	EGB	4/04

PROJECT INFORMATION

Infilco Degremont
Infilco Degremont, Inc.
Post Office Box 71390
Richmond, Virginia 23255-1390
Phone: (800) 446-1150

	BY	DATE
DRAWN	JWP	09/03
CHECKED	HY	09/03
APP	EGB	09/03
REF.	515-000-9100	
REF.	-	
SCALE	N.T.S.	

MECHANICAL SLUDGE SCRAPER
INSTALLATION
AQUADAF®

SIZE D DWG. NO. **515-000-9100** REV. 0

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7. BUDGET PRICING

IDI's current budget price for the complete AquaDAF system described above, including freight to jobsite, is $REP WILL ADVISE. This price will be valid for 90 days. Payment terms will be as follows and commercial terms and conditions are given on the following page. This price is in accordance with the Scope of Supply and terms of this proposal and any changes may require the price to be adjusted.

SHIPPING TERMS
FOB Shipping Point, Full Freight Allowed

PAYMENT TERMS	
10%	Net Cash, Payable in thirty (30) days from date of submittal of initial drawings for approval
85%	Net Cash, Payable in progress payments thirty (30) days from dates of respective shipments of the Products
5%	Net Cash, Payable in thirty (30) days from Product installation and acceptance or Ninety (90) days after date of final Product delivery, whichever occurs first

8. COMMERCIAL TERMS & CONDITIONS

1. TERMS AND CONDITIONS OF SALE. The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services (hereinafter referred to as Products or Services) to Purchaser, and supersedes all prior quotations, purchase orders, correspondence or communications whether written or oral between the Purchaser and IDI. Notwithstanding any contrary language in Purchaser's purchase order, correspondence or other form of acknowledgement, Purchaser shall be bound by these Terms and Conditions when it sends a purchase order or otherwise indicates acceptance of this Contract, or when it accepts delivery from IDI of the Products or Services. The contract for sale of the Products and Services is expressly limited to the terms and conditions of sale stated herein. Any additional or different terms proposed by Purchaser are rejected, unless expressly agreed to in writing by IDI. No contract shall exist except as herein provided.

2. COMPLETE AGREEMENT. No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on IDI unless made in writing by an authorized representative of IDI. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this Contract even though the accepting or acquiescing party had knowledge of the nature of the performance and the opportunity for objection.

3. ADEQUATE ASSURANCES. If, in the judgment of IDI, the financial condition of the Purchaser, at any time during the period of the contract, does not justify the terms of payment specified, IDI may require full or partial payment in advance, or an acceptable form of payment guarantee such as a bank letter of credit, or other modifications to the terms of payment.

4. DELAYED PAYMENT. If payment are not made in accordance with the terms contained herein, a service charge may, without prejudice to the right of IDI to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance.

5. TAXES. The Purchase Price does not include any taxes. Purchaser shall be responsible for the payment of all taxes applicable to, or arising from the transaction, the Products, its sale, value or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

6. RISK OF LOSS. Risk of loss or damage to the Products, or any part thereof, shall pass to Purchaser upon delivery of the Products or part to Purchaser at the f.o.b. point stated herein.

7. EXCUSABLE DELAY. IDI shall not be liable for any delay in performance or failure to perform due to fire, flood or any other act of God, strike or other labor difficulty, act of any civil or military authority or of Purchaser, Engineer, or Owner, insurrection, riot, embargo, unavailability or delays in transportation or car shortages, or any other cause beyond IDI's reasonable control. In the event IDI's performance is delayed by any of the foregoing causes, IDI's schedule for performance shall be extended accordingly without penalty. If Purchaser's, Engineer's or Owner's actions delay IDI's performance, Purchaser shall pay IDI any additional costs incurred by IDI resulting from such delay. If Purchaser or Owner orders IDI to delay shipment of Products, or any part thereof, or by other actions refuses to permit IDI to deliver Products, or any part thereof, to Owner's Premises, in addition to paying IDI for costs of storage and insurance, Purchaser shall also pay IDI's invoice for such stored Products, or any part thereof, as if they had been delivered to Owner's Premises on the date such Products, or any part thereof, were produced and ready for shipment.

8. PROPRIETARY INFORMATION. All information, plans, drawings, tracings, specifications, programs, reports, models, mock-ups, designs, calculations, schedules, technical information, data, manuals, proposals, CADD documents and other materials, including those in electronic form (collectively the "Documents") prepared and furnished by IDI are Instruments of Service for use solely with respect to this Project. IDI shall be deemed the author and owner of these Instruments of Service and shall retain all common law, statutory and other reserved rights, including copyrights. The Purchaser, Engineer, or Owner shall not use these Instruments of Service for future additions or alterations to this Project or for other projects, without the prior written agreement by the IDI. The Documents furnished by IDI are proprietary to IDI, submitted in strict confidence and shall not be reproduced, transmitted, disclosed or used in any other manner without IDI's written authorization.

9. INSPECTION BY PURCHASER. Purchaser may inspect the Products at the point of manufacture, provided that such inspection is arranged and conducted so as not to unreasonably interfere with IDI's or the manufacturer's operations. Purchaser's inspection of the Products and release for shipment shall constitute Purchaser's acceptance of the Products as conforming to the requirements of this Contract.

10. WARRANTY OF TITLE. IDI warrants and guarantees that title to all Products covered by any invoice submitted to Purchaser, whether incorporated into the Project or not, will pass to Purchaser no later than the time of payment free and clear of all Liens. This paragraph does not apply to any Documents covered by paragraphs above entitled "Proprietary Information."

11. WARRANTY. IDI warrants the Products shall conform to the description contained herein and be free from defects in material and workmanship for a period of one (1) year from date the Products are initially placed in operation or eighteen (18) months from date the Products are shipped, whichever occurs first. Upon IDI's receipt of written notice within thirty (30) days of discovery of any defect, and a determination by IDI that such defect is covered under the foregoing warranty, IDI's responsibility is limited to correction of the defect by, at IDI's option, repair or replacement of the defective part or parts, f.o.b. factory. This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with IDI's written instructions and requirements or due to accident, misuse, abuse, neglect or corrosion. This warranty does not cover reimbursement for labor, gaining access, removal, installation, temporary power or any other expenses that may be incurred with repair or replacement. This warranty does not apply to equipment not manufactured by IDI. IDI limits itself to extending the same warranty it receives from the supplier. IDI shall have no responsibility for the condition of primed or finish painted surfaces after the Products leave their point of manufacture. Field touch-up of shop primed or painted surfaces are normal and shall be at Purchaser or Owner's expense. Any touch-up or repainting required to shop primed or painted surfaces, for reasons other than improper or incorrect application in the shop, shall be Purchaser or Owner's responsibility. UNLESS STATED ELSEWHERE HEREIN, IDI PROVIDES NO WARRANTY OF PRODUCT PERFORMANCE OR PROCESS RESULTS. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROIVDED ABOVE SHALL CONSTITUTE IDI'S SOLE LIABILITY AND PURCHASER'S EXCLUSIVE REMEDY FOR FAILURE OF IDI TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF PURCHASER ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE.

12. BACKCHARGES. IDI shall not be liable for any charges incurred by Purchaser for work, repairs, replacements or alterations to the Products, without IDI's prior written authorization, and any adverse consequences resulting from such unauthorized work shall be Purchaser's full responsibility.

13. LIQUIDATED DAMAGES. Contracts which include liquidated damages clause for failure to meet shipping or job completion promises are not acceptable or binding upon IDI, unless such clauses are specifically accepted in writing by an authorized representative of IDI at its headquarters office.

14. LIMITATION OF LIABILITY. THE REMEDIES OF THE PURCHASER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR FAILURE OF IDI TO COMPLY WITH ITS OBLIGATIONS HEREUNDER. Notwithstanding any provision in this Contract to the contrary, in no event shall IDI be liable for any special, incidental, indirect, statutory, exemplary, punitive or consequential damages, of any kind whatsoever, or for any lost profits, business or revenue, loss of use or goodwill, or other lost economic advantage, arising out of or related to or arising from IDI's obligations under this Contract or the breach hereof, whether such claims are based on breach of contract, breach of warranty, strict liability, tort, any federal or state statutory claim, or any other legal theory and even if IDI knew, should have known, or has been advised of the possibility of such damages. THE TOTAL CUMULATIVE LIABILITY OF IDI ARISING FROM OR RELATED TO THIS CONTRACT SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED. In no circumstance will any liability under any portion of this Contract or associated contracts exceed the total Purchase Price. In the event that more than one claim is substantiated, the aggregate amount of all claims combined will not exceed the total Purchase Price. The limitation specified in this section shall survive and apply even if any limited remedy specified herein is determined to have failed of its essential purpose.

15. CANCELLATION BY PURCHASER. If Purchaser cancels this Contract or refuses to accept delivery of the Products, Purchaser shall be liable to IDI for reasonable cancellation charges, including loss of anticipated profits, administrative costs, commissions to sales representatives, costs incurred by IDI for all work performed or in process up to the time of cancellation or refusal to accept delivery, cancellation charges from IDI's suppliers or subcontractors, and any other expenses incurred by IDI in connection with Purchaser's cancellation or refusal to accept delivery.

16. DEFAULT BY PURCHASER. Without incurring any liability or waiving any claim for damages IDI may have against Purchaser, IDI may refuse to make or delay making delivery and/or withhold any service if: (a) IDI becomes aware of facts which, in its judgment, render Purchaser's financial condition unsatisfactory or cast doubt on Purchaser's willingness or ability to pay for the Products and/or services; (b) the Purchaser becomes insolvent, (c) the Purchaser has a petition under any chapter of the bankruptcy laws filed by or against it, (d) the Purchaser makes a general assignment for the benefit of its creditors, (e) the Purchaser has a receiver requested for or appointed for it, (f) the Purchaser fails to comply with any of its material obligations under its Contract with IDI, its contract with Owner or any other contract with IDI, or (g) the Purchaser should fail to make prompt payment to IDI in accordance with the terms of this Contract, then IDI may, after first giving Purchaser ten (10) days written notice to cure such default, if Purchaser fails to cure or initiate satisfactory cure during such ten-day period, either (i) stop all work until such default has been cured and recover from Purchaser all reasonable costs and expenses incurred by IDI resulting from Purchaser's default or (ii) terminate this Contract and recover from Purchaser as cancellation charges all costs and expenses incurred by IDI up to time of and in connection with such termination including reasonable allowance for IDI's overhead, administration expenses and profits, such reasonable allowance to be based on prevailing industry practice. If Purchaser is late in paying the Purchase Price or any partial payment due under this Contract, or otherwise breaches this Contract, IDI shall be entitled to the maximum interest rate allowed by law on the overdue amount, and on its damages, calculated from the date of default in payment or other breach, plus court costs, reasonable attorneys' fees and other expenses incurred in any effort to collect.

17. DEFAULT BY IDI. In the event of any default by IDI and prior to Purchaser terminating the work for default, Purchaser shall give fourteen (14) days written notice of default to IDI. IDI shall remedy the default to the reasonable satisfaction of the Purchaser within fourteen (14) days of receipt of such written notice or, if such default cannot reasonable be remedied within such fourteen (14) day period, IDI shall promptly begin to remedy the default within the fourteen (14) day period and thereafter diligently prosecute to conclusion all acts necessary to remedy the default, in which event such default shall be deemed to be remedied.

18. PATENT AND COPYRIGHT INFRINGEMENT.

(a) IDI shall defend any action or proceeding brought against Purchaser based on any claim that the Products, or any part thereof, or the operation or use of the Products or any part thereof, constitutes infringement of any United States patent or copyright, now or hereafter issued. Purchaser shall give prompt written notice to IDI of any such action or proceeding and will reasonably provide authority, information and assistance (at Purchaser's expense) in the defense of same. IDI shall indemnify and hold harmless Purchaser from and against all damages and costs, including but not limited to attorneys' fees and expenses awarded against Purchaser or IDI in any such action or proceeding. IDI agrees to keep Purchaser informed of all developments in the defense of such actions.

(b) If Purchaser is enjoined from the operation or use of the Products, or any part thereof, as the result of any patent or copyright suit, claim, or proceeding, IDI shall at its sole expense take reasonable steps to procure the right to operate or use the Products. If IDI cannot so procure such right within a reasonable time, IDI shall promptly, at IDI's option and at IDI's expense, (i) modify the Products so as to avoid infringement of any such patent or copyright, (ii) replace said Products with Products that do not infringe or violate any such patent or copyright, or (iii) as a last resort, remove the Products and refund the purchase price. In no case does IDI agree to pay any recovery based upon its Purchaser's savings or profit through use of IDI's Products whether the use be special or ordinary. The foregoing states the entire liability of IDI for patent or copyright infringement.

(c) Paragraphs (a) and (b) above shall not be applicable to any suit, claim or proceeding based on infringement or violation of a patent or copyright (i) arising out of the use of IDI's Products in combination with non-IDI recommended Products; (ii) relating solely to a particular process or product of a particular manufacturer specified by Purchaser, Engineer or Owner and not offered or recommended by IDI to Purchaser, Engineer, or Owner or (iii) arising from modifications to the Products by Purchaser or Owner or its agents after acceptance of the Products. If the suit, claim or proceeding is based upon events set forth in the preceding sentence, Purchaser, Engineer or Owner shall defend, indemnify and hold harmless IDI to the same extent IDI is obligated to defend, indemnify and hold harmless Purchaser in Paragraph (a) above.

19. DISPUTE AVOIDANCE AND RESOLUTION. The parties are fully committed to working with each other and agree to communicate regularly with each other at all times so as to avoid or minimize disputes or disagreements. If disputes or disagreements do arise, IDI and Purchaser commit to resolving such disputes or disagreements in an amicable, professional and expeditious manner so as to avoid unnecessary losses, delays and disruptions to the work. IDI and Purchaser will first attempt to resolve disputes or disagreements at the field level through discussions between IDI's Representative and Purchaser's Representative. If a dispute or disagreement cannot be resolved through IDI's Representative and Purchaser's Representative, upon the request of either party, IDI's Senior Representative and Purchaser's Senior Representative shall meet as soon as conveniently possible, but in no case later than thirty (30) days after such a request is made, to attempt to resolve such dispute or disagreement. Prior to any meetings between the Senior Representatives, the parties will exchange relevant information that will assist the parties in resolving their dispute or disagreement. If after meeting the Senior Representatives determine that the dispute or disagreement cannot be resolved on terms satisfactory to both parties, the parties shall submit the dispute or disagreement to non-binding mediation. The mediation shall be conducted by a mutually agreeable impartial mediator, or if the parties cannot so agree, a mediator designated by the American Arbitration Association ("AAA") pursuant to its Construction Industry Mediation Rules. The mediation will be governed by and

conducted pursuant to a mediation agreement negotiated by the parties or, if the parties cannot so agree, by procedures established by the mediator. For purposes of any Process Performance Guarantee, the above procedures shall also apply for any dispute with the Owner.

20. ARBITRATION. Any claims, disputes or controversies between the parties arising out of or relating to this Contract, or the breach thereof, which have not been resolved in accordance with the Dispute Avoidance and Resolution procedures contained herein shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the AAA then in effect, unless the parties mutually agree otherwise. The award of the arbitrator(s) shall be final and binding upon the parties without the right of appeal to the courts. Judgement may be entered upon it in accordance with applicable law by any court having jurisdiction thereof. IDI and Purchaser expressly agree that any arbitration pursuant to this provision may be joined or consolidated with any arbitration involving any other person or entity (i) necessary to resolve the claim, dispute or controversy, or (ii) substantially involved in or affected by such claim, dispute or controversy. Both IDI and Purchaser will include appropriate provisions in all contracts they execute with other parties in connection with the Project to require such joinder or consolidation. The prevailing party in any arbitration, or any other final, binding dispute proceeding upon which the parties may agree, shall be entitled to recover from the other party reasonable attorneys' fees and expenses incurred by the prevailing party. For purposes of any Process Performance Guarantee, the above procedures shall also apply to the Owner.

21. NOTICES. Unless otherwise provided, any notices to be given hereunder shall be given in writing and shall be deemed effectively given (i) upon personal delivery to the party to be notified, (ii) on confirmation of receipt by fax by the party to be notified, (iii) one business day after deposit with a reputable overnight courier, prepaid for overnight delivery and addressed as set forth below, or (iv) three days after deposit with the U.S Post Office, postage prepaid, registered or certified, with return receipt requested.

22. SUCCESSORSHIP. IDI and Purchaser intend that the provisions of this Contract are binding upon the parties, their employees, agents, heirs, successors and assigns.

23. ASSIGNMENT. Neither IDI nor Purchaser may assign this Contract without the prior written consent of the other party, which consent shall not be unreasonably withheld or delayed. Any prohibited assignment shall be null and void.

24. SEVERABILITY. If any term, condition or provision of this Contract or the application thereof to any party or circumstance shall at any time or to any extent be invalid or unenforceable, then the remainder of this Contract, or the application of such term, condition or provision to parties or circumstances other than those which it is held invalid or unenforceable, shall not be affected thereby, and each term, condition and provision of this Contract shall be valid and enforceable to the fullest extent permitted by law.

25. GOVERNING LAW; JURISDICTION. This Contract shall be governed by, interpreted and enforced in accordance with the laws of the Commonwealth of Virginia, without regard to conflicts of law principles. Each party irrevocably consents to the exclusive jurisdiction of the courts of the Commonwealth of Virginia and the federal courts situated in the Commonwealth of Virginia, in connection with any action to enforce the provisions of this Agreement, to recover damages or other relief for breach or default under this Contract, or otherwise arising under or by reason of this Contract.

26. NO WAIVER. The failure of either party to insist upon or enforce strict performance by the other party of any provision of this Contract or to exercise any right under this Contract shall not be construed as a waiver or relinquishment to any extent of such party's right to assert or rely upon any such provision or right in that or any other instance; rather, the same shall be and remain in full force and effect.

9. AquaDAF BROCHURE

Put the **AquaDAF™** Clarifier to work:

- Efficient removal of low-density particles
- Polymer-free membrane pretreatment
- Clarification of water with low turbidity (< 30 NTU), high color, TOC
- Cold water treatment
- Filter backwash applications

ONDEO Degrémont

Contact us for information on cost-effective water treatment solutions.

P.O. Box 71390
Richmond, VA 23255-1390 USA
Phone: (800) 446-1150
(804) 756-7600
Fax: (804) 756-7643
www.ondeo-degremont-usa.com

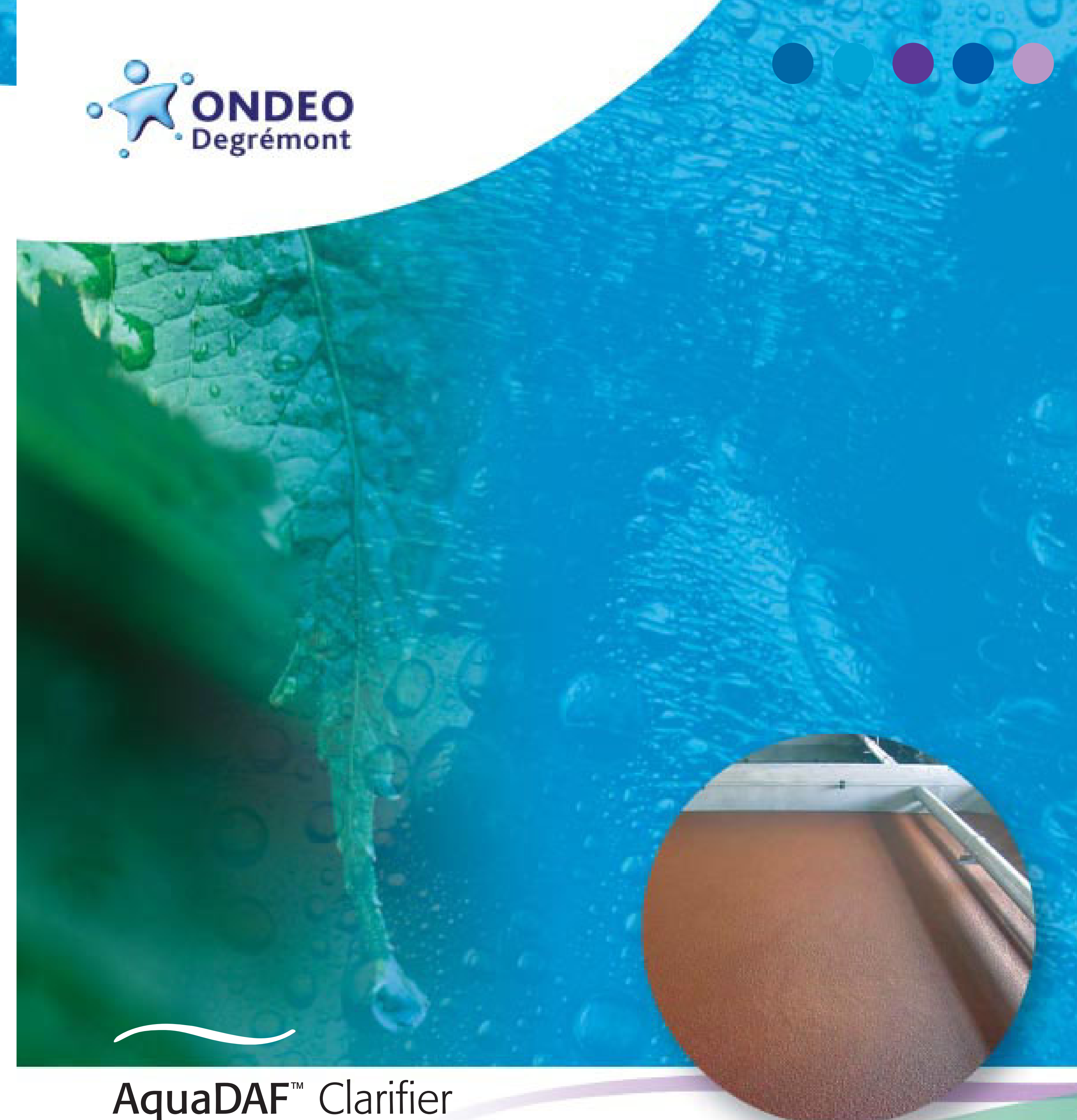
1375 Transcanadienne
Bureau 400
Dorval, Quebec
Canada H9P 2W8
Phone: (514) 683-1200
Fax: (514) 683-1203
www.ondeo-degremont.ca

44 Head Street
Dundas, Ontario
Canada L9H 3H3
Phone: (905) 627-9233
Fax: (905) 628-6623
www.awsl.com

SUEZ

 DB515

ONDEO Degrémont



AquaDAF™ Clarifier High-Rate Dissolved Air Flotation System

High-rate clarification Algae removal TOC/color removal Membrane pretreatment

SUEZ

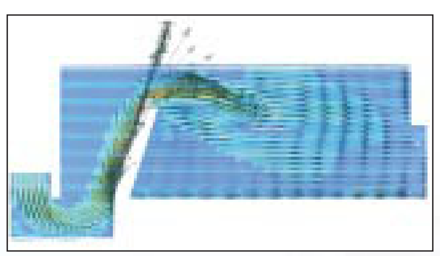
AquaDAF™ Clarifier High-Rate Dissolved Air Flotation System

Highest rate DAF for clarifying low turbidity surface and ground waters

The AquaDAF Clarifier's patented effluent collection system provides operating rates unequaled by conventional flotation technologies. The result: Increased capacity for existing or new treatment facilities with no additional space required.

Dissolved air flotation (DAF) is an excellent solution for clarifying water with high levels of algae and other low-density particles that cannot be removed efficiently with sedimentation. The cost-effective, polymer-free DAF process flocculates water that has been pretreated with coagulant. In the air injection zone, flocculated particles attach to microbubbles created by a supersaturated recycle stream, and the solids float to the water's surface. With the solids removed periodically, either mechanically or hydraulically, the clarified product is free of solids, algae, and some organic matter.

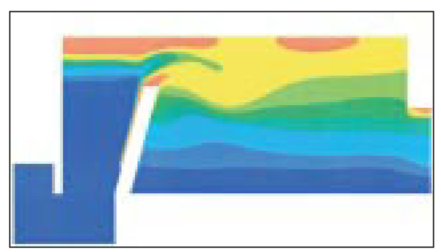
What sets AquaDAF apart from other DAF systems is its patented effluent collection system. AquaDAF creates a vortical flow pattern within the DAF basin that results in a dense air bed and increased bubble surface area for significantly higher flotation rates.



Sample Flow Pattern

AquaDAF has been proven to operate at high loading rates of up to 20 gpm/ft², as much as 10 times greater than conventional DAF systems or settling clarifiers. This unsurpassed capacity means a smaller footprint, reduced installed cost, and lower operating costs.

AquaDAF is flexible when it comes to sludge removal. It will accommodate hydraulic or mechanical means of float removal, depending on the facility's sludge-handling needs. And with few valves or other mechanical components, AquaDAF is easy to operate and maintain.



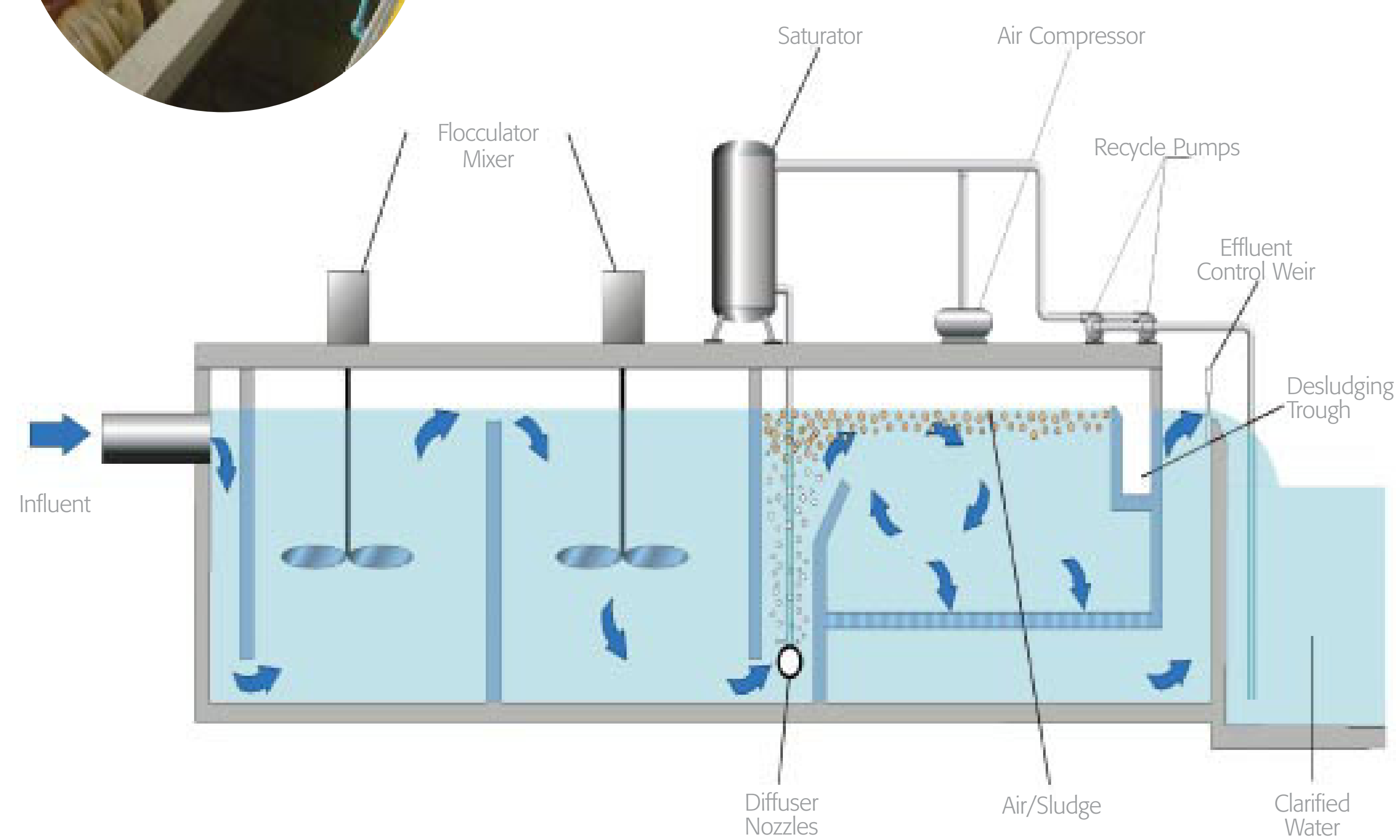
Sample Bubble Density

AquaDAF stands for high loading rates of up to 20 gpm/ft².

AquaDAF truly raises DAF technology to the next level:

- Unequaled loading rates thanks to revolutionary, patented technology
- Easily retrofit or expand a plant's capacity without additional basins
- Efficient, economic operation with less space, less manpower

Call Ondeo Degremont to find out more.



The AquaDAF process

1. **Pretreated raw water** (with coagulant) enters the flocculation basin for two-stage flocculation.
2. **Flocculated particles** enter the DAF upflow channel; diffuser nozzles create millions of microbubbles that attach to floc particles.
3. **Solid particles** float to the surface; clarified water flows down through the false floor and out the upflow channel.

APPENDIX H

KRUGER DISCFILTER PROPOSAL
FOR LAKE HANCOCK

Krüger

I. Kruger Inc.
401 Harrison Oaks Boulevard - Suite 100
Cary, NC 27513

TELEPHONE 919-677-8310
FACSIMILE 919-677-0082

September 9, 2004

Mr. Tory Champlin, Ph.D, P.E.
Parsons Engineering
3450 Buschwood Park Drive Suite 345
Tampa, FL
Tel: (813) 261-8310
Fax: (813) 930-7332

Re: Discfilter Proposal for Lake Hancock, FL
Kruger Project Number: 42090435

Dear Dr. Champlin,

Enclosed please find our *preliminary* Discfilter proposal and detailed scope of supply for the above-referenced project. The sizing for the Kruger/Hydrotech Discfilter is provided based on surface water with an influent TSS of 100 mg/L for the following four options:

Option 1: 15 MGD (10,425 gpm)
Option 2: 30 MGD (20,850 gpm)
Option 3: 45 MGD (31,275 gpm)
Option 4: 60 MGD (41,700 gpm)

The following table summarizes the type and number of Discfilters needed for each option:

Option	Peak Flow	Model Number	Number of Units Required
1	15 MGD	HSF-2216/15-2F	3
2	30 MGD	HSF-2218-2F	5
3	45 MGD	HSF-2220-2F	7
4	60 MGD	HSF-2220-2F	9

The system is designed to provide solids removal to a final effluent average concentration of ≤5 mg/L TSS. The Discfilter units will be constructed of stainless steel and will be placed in concrete basins (provided by others). The initial sizing stated above is based on an *estimation* of filter performance and could be modified at a later date.

Kruger's Scope of Supply for this project includes the filter elements, drive system, local control system, backwash pump, engineering support, freight, start-up services, spare parts and one-year warranty for each unit supplied.

Our budgetary for the four options are as follows:

Option 1: 15 MGD (10,425 gpm)	**$687,788**
Option 2: 30 MGD (20,850 gpm)	**$1,282,389**
Option 3: 45 MGD (31,275 gpm)	**$1,950,886**
Option 4: 60 MGD (41,700 gpm)	**$2,500,189**

VEOLIA Water Systems

Pricing is valid for 90 days from the date of this proposal. Please refer to our attached terms of sale.

MTS and Kruger appreciate the opportunity to provide this proposal to you. If you have any questions or need any additional information, please do not hesitate to call our local representative, Mr. Bob Bierhorst with MTS Environmental at 813-929-4454.

Best regards,

April Kandray
Application Engineer
(919) 653-4531 Direct
(919) 677-8310 Main
(919) 677-0082 Fax
april.kandray@veoliawater.com

ENC

cc: Project File

Discfilter Proposal
For
Lake Hancock, FL

Submitted
September 9, 2004

By

I. Kruger Inc.
401 Harrison Oaks Boulevard, Suite 100
Cary, NC 27513

Phone: 919-677-8310 Fax: 919-677-0082

I. Summary

Kruger is pleased to present our proposal for Kruger/Hydrotech Discfilter technology. The Kruger/Hydrotech Discfilter presents several advantages compared to other filtration technologies. These advantages include:

- Compact footprint.
- Minimal mechanical equipment.
- Simple automated control system.
- Easy maintenance without the need to drain the system.
- Minimal backwash requirements (approx. 1-3% of influent flow).
- Typical head-loss through filter: Normal 8-10" Maximum 12"

The following Kruger/Hydrotech Discfilter design is based on the information listed below. Table 1 summarizes the influent and effluent design criteria for this project.

Table 1: Influent & Effluent Design Criteria

Wastewater Composition	
Peak Flow, mgd (gpm)	Option 1: 15 (10,425) Option 2: 30 (20,850) Option 3: 45 (31,275) Option 4: 60 (41,700)
Peak Influent TSS, mg/L	≤100*

** Assumed*

II. Scope of Supply

Kruger is pleased to present the following detailed scope. The work will be performed to Kruger's high standards under the direction of a project engineer. All matters related to the design, installation, or performance of the system shall be communicated through our representative, giving the engineer and owner ready access to Kruger's extensive capabilities.

1. **Field Services** – Kruger will furnish a Service Engineer as specified at the time of start-up to inspect the installation of the completed system, place the system in initial operation and to instruct operating personnel on the proper use of the equipment. Specifically, Kruger will provide:

   - On-site equipment checkup, start-up assistance and operator training for a period not exceeding four (4) man days and two (2) site visits.

2. **Equipment** – Kruger will supply the following equipment associated with the system:

   Each Discfilter unit includes:

   - 304 stainless steel construction.
   - Filter discs with filter elements.
   - One drive motor.
   - One (1) backwash pump with interconnecting piping.
   - Local control system for automatic backwash with control box, starters/motor protector, VFD for soft start (if applicable) and manual speed control of filter, motor level relay and time relay, and installed level sensor.

Tables 2 through 5 summarize the Discfilter equipment to be provided.

Table 2: Filter Equipment Option 1 (15 MGD)

Number of Discfilter units:	3
Discfilter Model:	HSF2216/15-2F
Drum:	
Material	SS304
Disc:	
Material	ABS Plastic/SS304
Filter element:	
Frame material	SS304
Filter media	Woven Polyester
Filter pore size, µm	10
Number of discs installed per unit	15
Total filter area, ft^2	904
Submerged filter area, ft^2	587
Hydraulic Loading (gpm/ft^2)	6
Drive system:	
Gearbox and motor manufacturer	SEW Eurodrive
Filter motor	1.5 Hp, 480V, 3-phase, 60Hz
Back-wash pump:	
Rinse water pump type	Grundfos
Pump motor	15 Hp, 480V, 3-phase, 60Hz
Capacity at 110 psi	70 gpm
Covers:	
Material	Aluminum
Tank:	
Material	SS304/concrete (by others)

Table 3: Filter Equipment Option 2 (30 MGD)

Number of Discfilter units:	5
Discfilter Model:	HSF2218-2F
Drum:	
Material	SS304
Disc:	
Material	ABS Plastic/SS304
Filter element:	
Frame material	SS304
Filter media	Woven Polyester
Filter pore size, µm	10
Number of discs installed per unit	18
Total filter area, ft^2	1145
Submerged filter area, ft^2	705
Hydraulic Loading (gpm/ft^2)	6
Drive system:	
Gearbox and motor manufacturer	SEW Eurodrive
Filter motor	1.5 Hp, 480V, 3-phase, 60Hz
Back-wash pump:	
Rinse water pump type	Grundfos
Pump motor	15 Hp, 480V, 3-phase, 60Hz
Capacity at 110 psi	70 gpm
Covers:	
Material	Aluminum
Tank:	
Material	SS304/concrete (by others)

Table 4: Filter Equipment Option 3 (45 MGD)

Number of Discfilter units:	7
Discfilter Model:	HSF2220-2F
Drum:	
Material	SS304
Disc:	
Material	ABS Plastic/SS304
Filter element:	
Frame material	SS304
Filter media	Woven Polyester
Filter pore size, µm	10
Number of discs installed per unit	20
Total filter area, ft^2	1205
Submerged filter area, ft^2	783
Hydraulic Loading (gpm/ft^2)	6
Drive system:	
Gearbox and motor manufacturer	SEW Eurodrive
Filter motor	1.5 Hp, 480V, 3-phase, 60Hz
Back-wash pump:	
Rinse water pump type	Grundfos
Pump motor	15 Hp, 480V, 3-phase, 60Hz
Capacity at 110 psi	70 gpm
Covers:	
Material	Aluminum
Tank:	
Material	SS304/concrete (by others)

Table 5: Filter Equipment Option 4 (60 MGD)

Number of Discfilter units:	9
Discfilter Model:	HSF2220-2F
Drum:	
Material	SS304
Disc:	
Material	ABS Plastic/SS304
Filter element:	
Frame material	SS304
Filter media	Woven Polyester
Filter pore size, µm	10
Number of discs installed per unit	20
Total filter area, ft^2	1205
Submerged filter area, ft^2	783
Hydraulic Loading (gpm/ft^2)	6
Drive system:	
Gearbox and motor manufacturer	SEW Eurodrive
Filter motor	1.5 Hp, 480V, 3-phase, 60Hz
Back-wash pump:	
Rinse water pump type	Grundfos
Pump motor	15 Hp, 480V, 3-phase, 60Hz
Capacity at 110 psi	70 gpm
Covers:	
Material	Aluminum
Tank:	
Material	SS304/concrete (by others)

3. **Delivery Terms** – Deliverables will be supplied as detailed below:

    - Shop drawings will be submitted within 6 weeks of receipt of an executed contract.
    - All equipment will be delivered within 16 weeks of receipt of approved shop drawings.
    - Operation and Maintenance Manuals will be furnished 30 days prior to delivery of equipment.

4. **Warranty** – The equipment will be supplied with our standard warranty detailed below:

    - One-year warranty (12 months from beneficial use or 18 months from delivery which ever occurs first) on Discfilter parts and materials as detailed in the attached terms of sale.

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Appendix 1

Product Brochure

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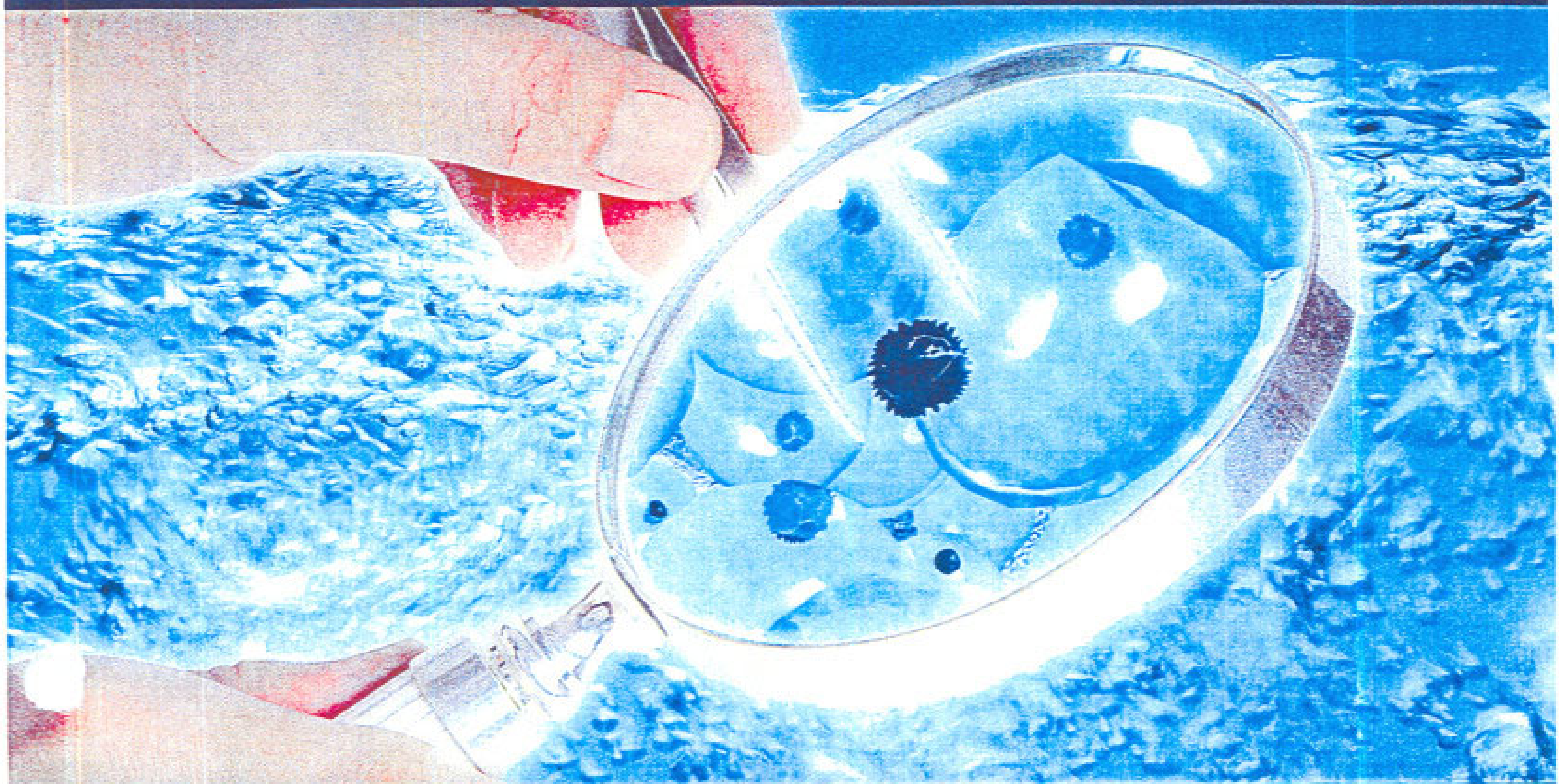


USFilter

HYDROTECH DISCFILTER:

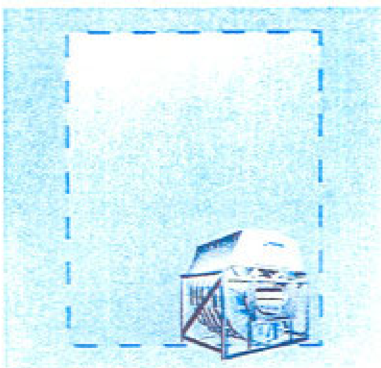
FILTRATION

MADE SIMPLE

HIGHLY COST EFFECTIVE

When evaluating filtration systems, criteria such as reliability, ease of use, size, maintenance, safety, and cost are all-important. The Hydrotech Discfilter meets or exceeds these expectations with its superior design.

SIMPLE DESIGN



Hydrotech Discfilter technology requires far less space than other filtration methods.

The Hydrotech Discfilter is the ideal filtration system for fine solids removal and product recovery. The Hydrotech Discfilter employs woven cloth filter elements installed on multiple discs, which allows for a large filter area within a small footprint.

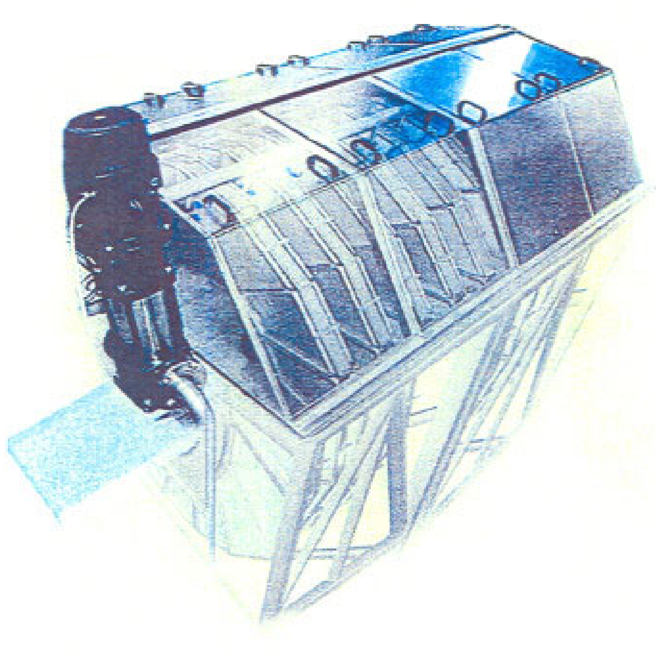
Its compact design makes this system a good choice for:

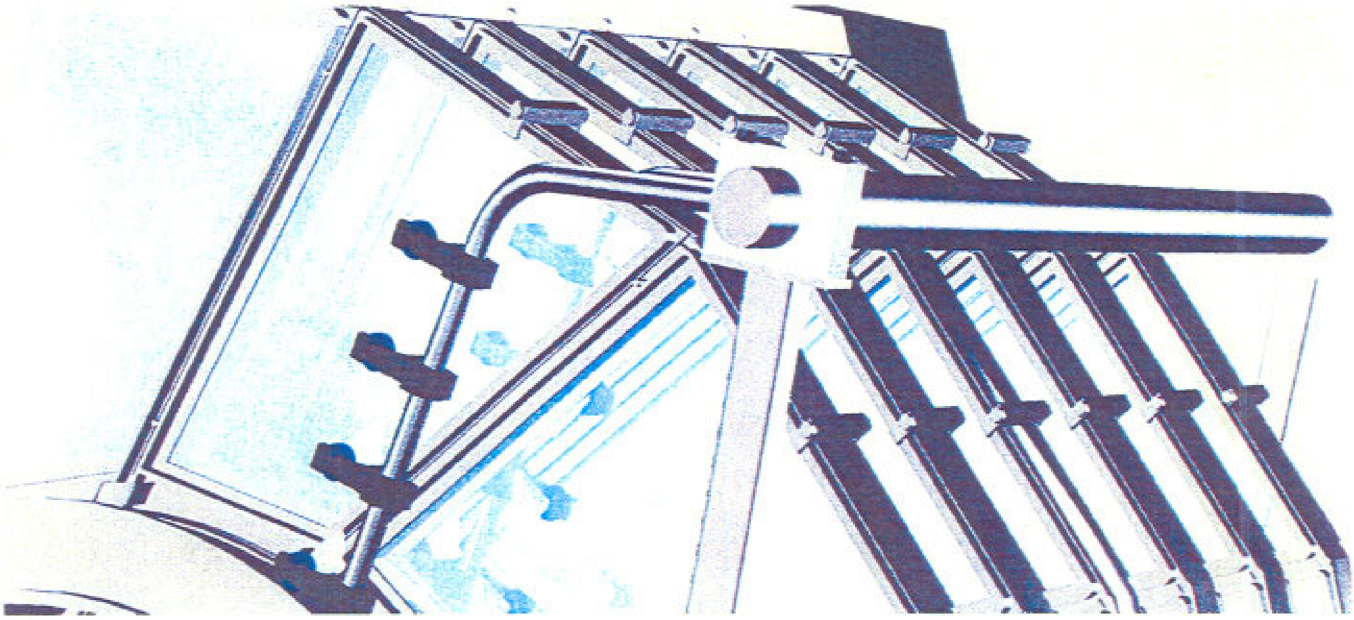
- Effluent polishing of wastewater,
- Water reclamation and reuse,
- Algae removal,
- Product recovery,
- Process water filtration, and other filtration applications where a space-saving filter with fine filter openings and a large filter area are required.

The simple design of the Hydrotech Discfilter allows for the minimization of mechanical equipment and other ancillary pieces. The components of the Hydrotech Discfilter that do require periodic maintenance are easily accessible from outside the filter. Designed for trouble-free operation, the filter's materials-of-construction ensure durability under the toughest conditions.

The Hydrotech Discfilter is made of either 304 or 316 stainless steel, and can be made of titanium or special alloys for corrosive environments. By requiring a footprint that is 75 percent smaller than a traditional sand filter, the Hydrotech Discfilter is a cost-effective alternative to other technologies.

ROBUST CONSTRUCTION





Filter media segments are changeable, interchangeable, and replaceable for maximum operational flexibility. The Hydrotech Discfilter employs a unique "counter-current" high pressure spray backwash system—nozzles are never underwater.

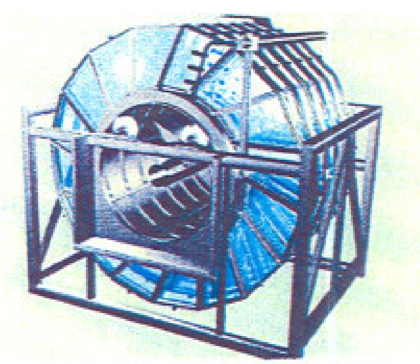
CONTINUOUS FLOW,

EVEN DURING BACKWASH

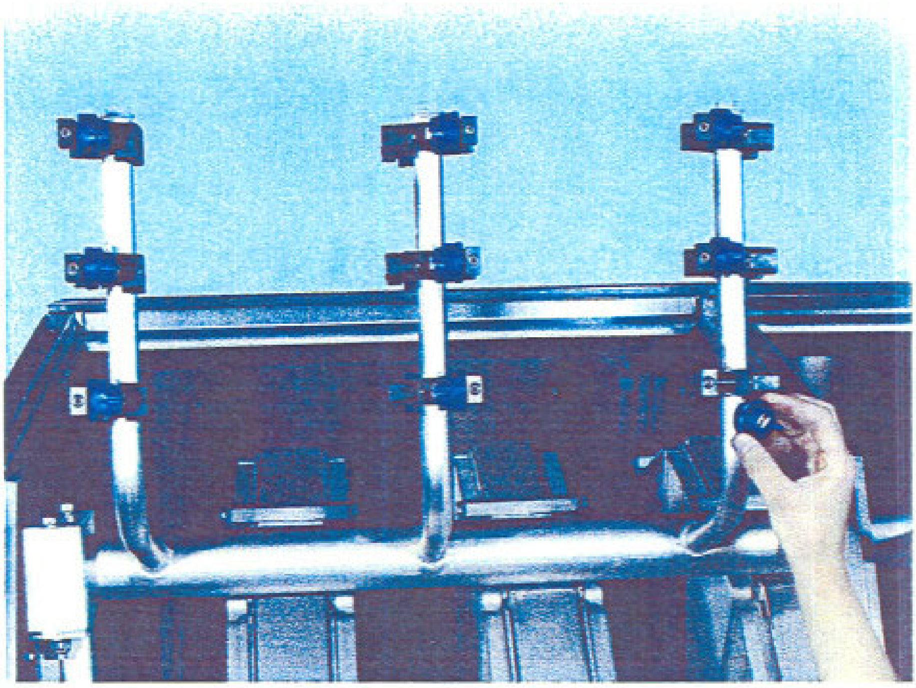
Operating at 60 percent submergence may seem inefficient, but in reality allows many operational benefits. Since the backwash cleaning system is above the submergence level, the effluent collection tank does not need to be drained to clean the filter. Additionally, flow through the filter is continuous, even during a backwash cleaning cycle. The moving backwash spray header of the Hydrotech Discfilter ensures efficient cleaning of the filter media. This feature increases the life expectancy of the filter media and results in a 20 percent savings in rinse water consumption. Additionally, the backwash spray headers fold out to facilitate maintenance of the spray nozzles which can be removed and replaced without the use of any tools.

The modular filter panels consist of either polyester or stainless steel woven filter media, which is held within a stainless steel frame. The Hydrotech Discfilter's media is a woven material with precise pore sizes, which allows for better filtration than filters containing non-woven media that provide an "average" pore size. The woven filter media is available in pore sizes between 10 microns and 1 mm.

Individual filter panels are held within a stainless steel frame.



MORE DISCS CAN BE ADDED AS FLOW RATES INCREASE



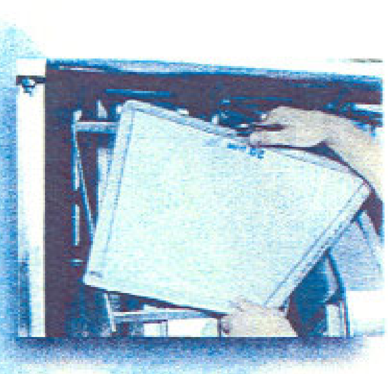
The spray head is retractable for easy access and no tools are necessary for the changing of nozzles.

THE ULTIMATE IN FLEXIBILITY

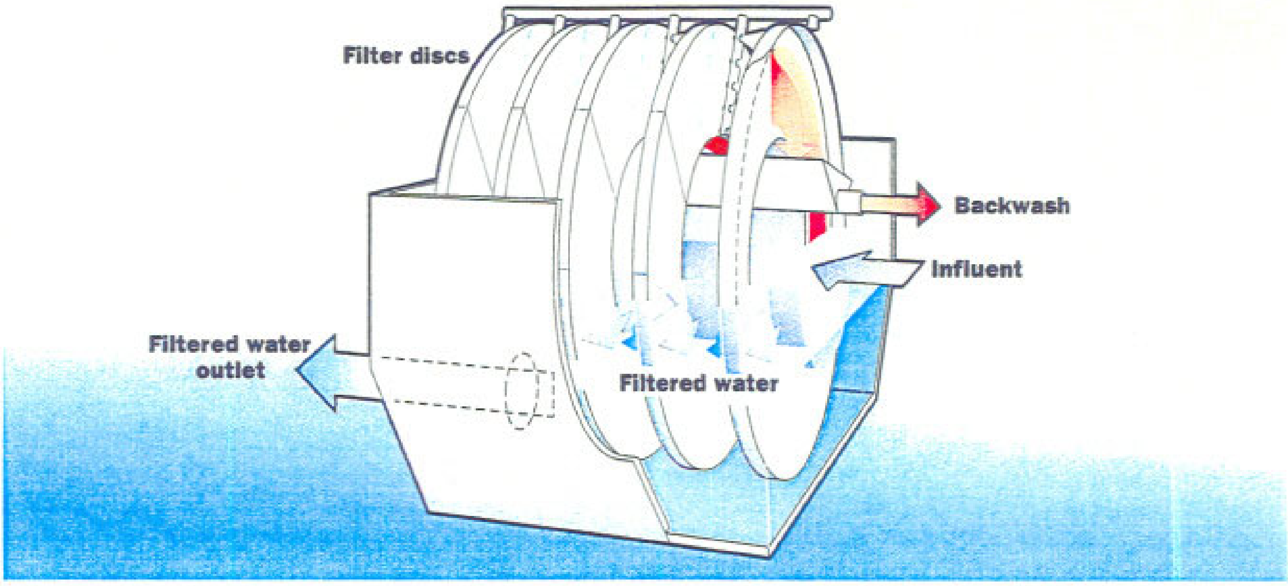
The Hydrotech Discfilter offers the ultimate in flexibility, with filter panels that are secured to the disc by a single clamp, allowing for easy replacement. The panel's patented design facilitates replacement without the need for expensive service or system downtime. If operational or performance needs change, the design allows an easy switch to a filter media with a different opening size. Depending on the application, the filter panels will only require replacement every 3 to 5 years. Because the filter discs operate at approximately 60 percent submergence, inspection and replacement is easy. The largest filter can contain up to 12 discs; however, a filter containing fewer discs can be installed with more discs added as flow rates increase.

Only one fastener has to be removed to release each filter.

This can be easily accomplished from the walkway.



The filter basin does not have to be drained prior to the removal of filter media panels.



The counter-current flow path and moving spray headers ensure thorough cleaning of the filter media with minimal water use.

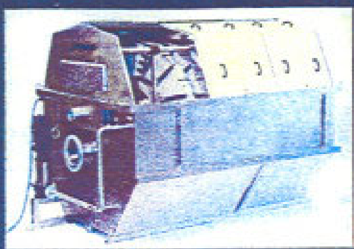
USES SIMPLE GRAVITATIONAL FORCES

The water to be treated flows by gravity into the filter segments from the center drum. Solids are separated from the water by the filter panels mounted on the two sides of the disc segments. The solids are retained within the filter discs while the clean water flows to the outside of the discs into the collection tank. Only clean water passes through the tank with this arrangement. Maintenance is reduced, since solids will not accumulate in the tank.

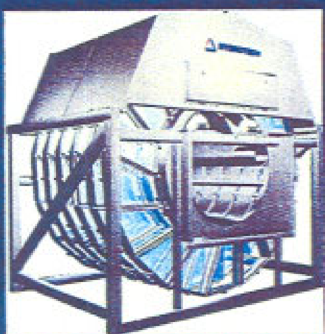
FILTERED EFFLUENT

PROVIDES BACKWASH WATER

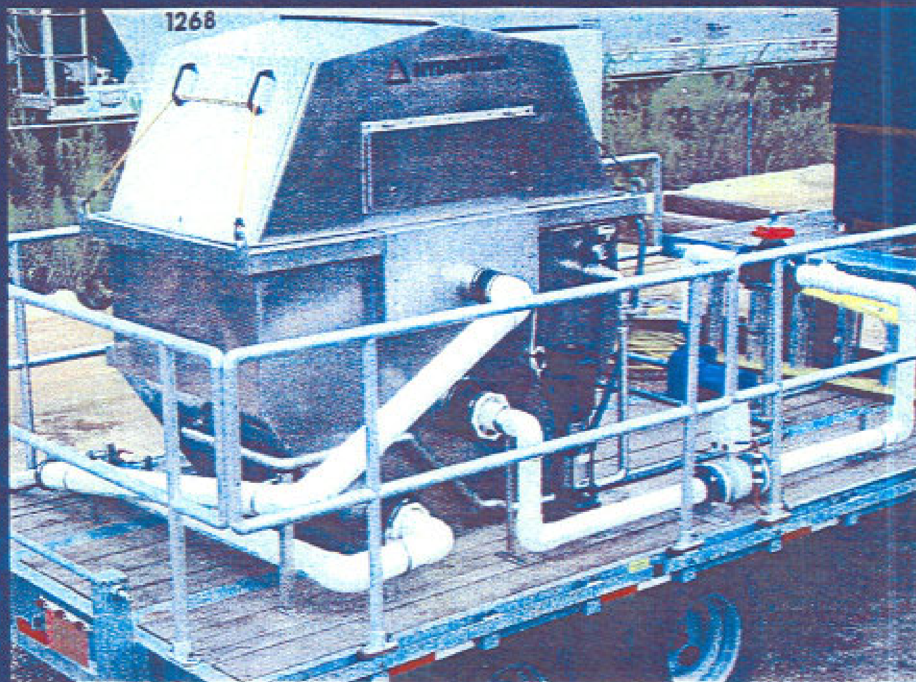
During normal operation, the discs remain static until the water level in the inlet channels rises to a special point. When this occurs, the backwash cycle is automatically initiated. The filtered effluent is a perfect source of backwash water, eliminating the need for a separate source of cleaning water or an additional clean water collection tank. The clean effluent is pumped to a spray header and nozzles in order to backwash solids into the collection trough as the discs rotate. The counter-current flow path and moving spray headers ensure thorough cleaning of the filter media with minimal water use. Typically, the backwash water required is 1- 3 percent of the total flow to the filter. In normal operation, the Hydrotech Discfilter is approximately 60 percent submerged and the head loss across the disc ranges between 2 and 8 inches. Maximum allowable head loss in continuous operation is 12 inches. Backwash, and associated disk rotation, can be controlled by an automatic level control system or can be set for continuous operation.



The Hydrotech Discfilter is available with self-contained tankage.



The Hydrotech Discfilter is available for installation in your basin.



USFilter provides a pilot Hydrotech Discfilter for on-site demonstrations of the effectiveness of this innovative technology. USFilter also offers the Hydrotech test-tube, which provides a simple, quick test of filtration capacity and efficiency by simulating the Hydrotech Discfilter operation. The test-tube is a hand-portable lightweight filter, with easily changeable filter discs. Contact USFilter or your area representative to schedule a demonstration using your water or effluent.

USFilter

401 Harrison Oaks Blvd. Suite 100
Cary, NC 27513
919.677.8310 *phone*
919.677.0082 *fax*
www.usfilter.com *website*

DV-HD-BR-901

a Vivendi water company

Appendix 2

Drawing(s)

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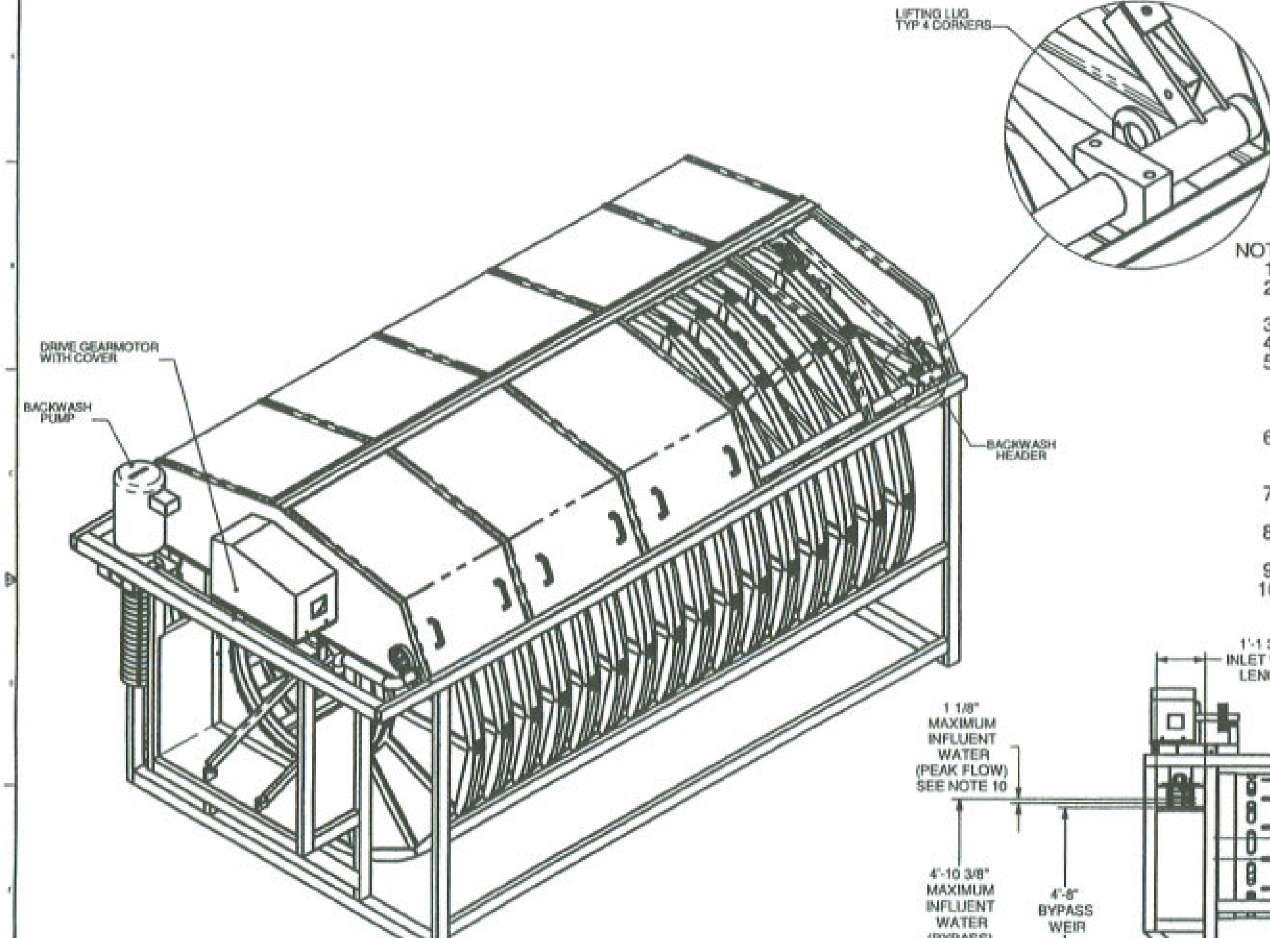
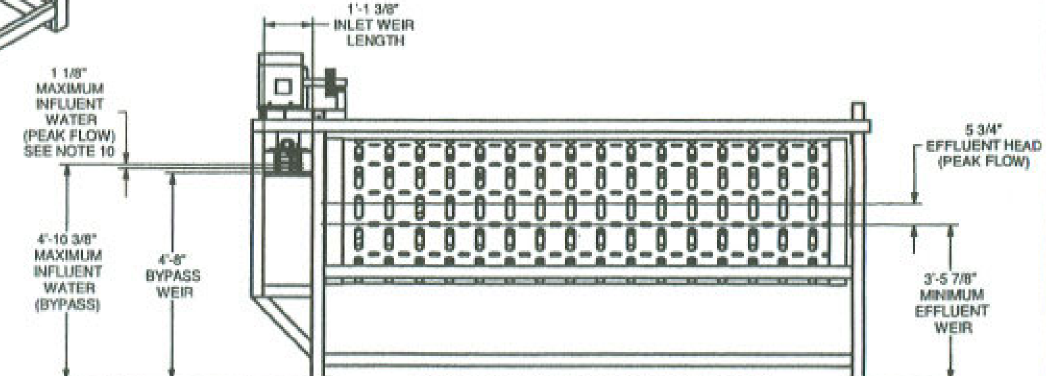


NOTES;
1. UNIT SHOWN WITH SOME PROTECTIVE COVERS REMOVED.
2. QUANTITY OF FILTER DISKS = 16, 448 FILTER PANELS (MODEL 2216)
15, 420 FILTER PANELS (MODEL 2215)
3. APPROXIMATE UNIT WEIGHT = 6173 LBS (2800 KG)
4. APPROXIMATE WEIGHT REMOVABLE COVER = 35 LBS (15.9 KG)
5. BACKWASH PUMP INFORMATION;
GRUNDFOS P/N: MTR32-11/3 (BOTH MODELS 2216 & 2215)
VOLTAGE: 480 V (3 PH)
HP RATING: 15 HP (BOTH MODELS 2216 & 2215)
6. DRIVE MOTOR INFORMATION;
VOLTAGE: 480 V (3 PH)
HP RATING: 1.5 HP
7. LEVEL SENSOR INFORMATION;
VOLTAGE: 24 V
8. BACKWASH TROUGH FLANGE SIZE (NOT SHOWN);
6" 125# LAP JOINT FLANGE
9. WETTED PARTS TO BE STAINLESS STEEL.
10. BACKWASH SENSOR ELEVATION LOCATED 1.18" BELOW INLET BYPASS WEIR.



INTERNAL HYDRAULIC DIMENSIONS

THE PRESENCE OF A PROFESSIONAL ENGINEERS SEAL ON THIS DRAWING INDICATES THAT A SIGNED AND SEALED ORIGINAL IS ON FILE.

rev	date	description	dwn	chk	app
0	07.17.04	PRELIMINARY RELEASE	SDD	DSD	SDD

COMPANY CONFIDENTIAL

DESIGNER SDD	DATE 07.17.04	TITLE	2216/2215-2F STANDARD PRODUCT RIGHT HAND BACKWASH HEADER
CHECKER DSD	DATE 07.17.04	CLIENT	STANDARD DISCFILTER PRODUCT
ENGINEER DSD	DATE 07.17.04		
SCALE	1:24	DRAWING	2216-2F-RH

Krüger
KRUGER, INC.
401 HARRISON OAKS BLVD. CARY, NC 27513

SHEET 1 OF 2 REV 0

GRAPHICAL SCALE 0 0.5 1 2 3 6

INTERNAL REF NO:

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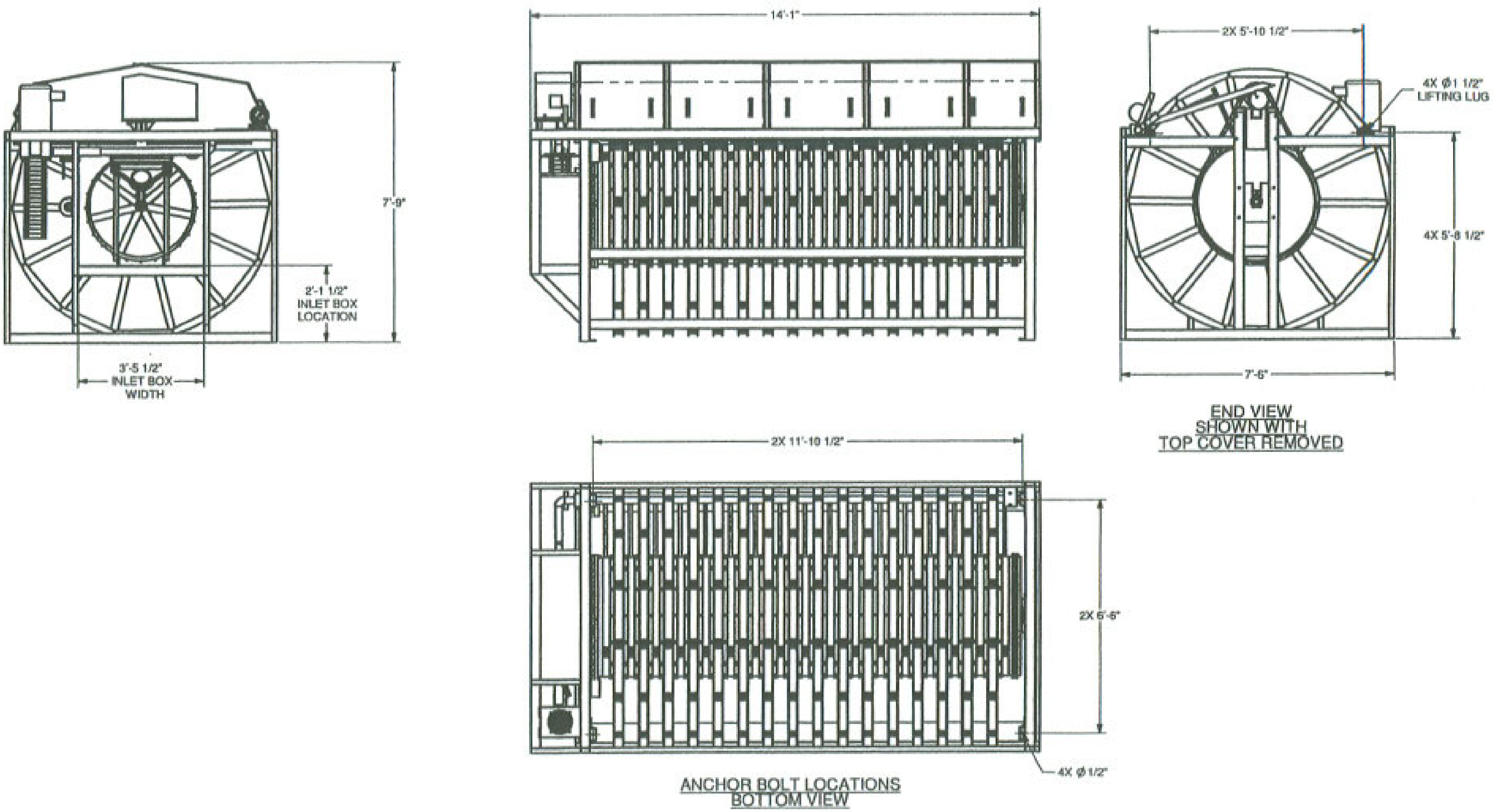

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0	07.17.04	PRELIMINARY RELEASE	SDD	DSD	SDD

GRAPHICAL SCALE 0 0.5 1 2 3 6

COMPANY CONFIDENTIAL

DESIGNER	SDD	07.17.04
CHECKER	DSD	07.17.04
ENGINEER	DSD	07.17.04
SCALE	1:32	

TITLE: 2216/2215-2F STANDARD PRODUCT RIGHT HAND BACKWASH HEADER

CLIENT: STANDARD DISCFILTER PRODUCT

Krüger

KRUGER, INC. 401 HARRISON OAKS BLVD. CARY, NC 27513 (919) 677-8310 FAX (919) 677-0082

DRAWING: 2216-2F-RH SHEET 2 OF 2 REV 0

INTERNAL REF NO:

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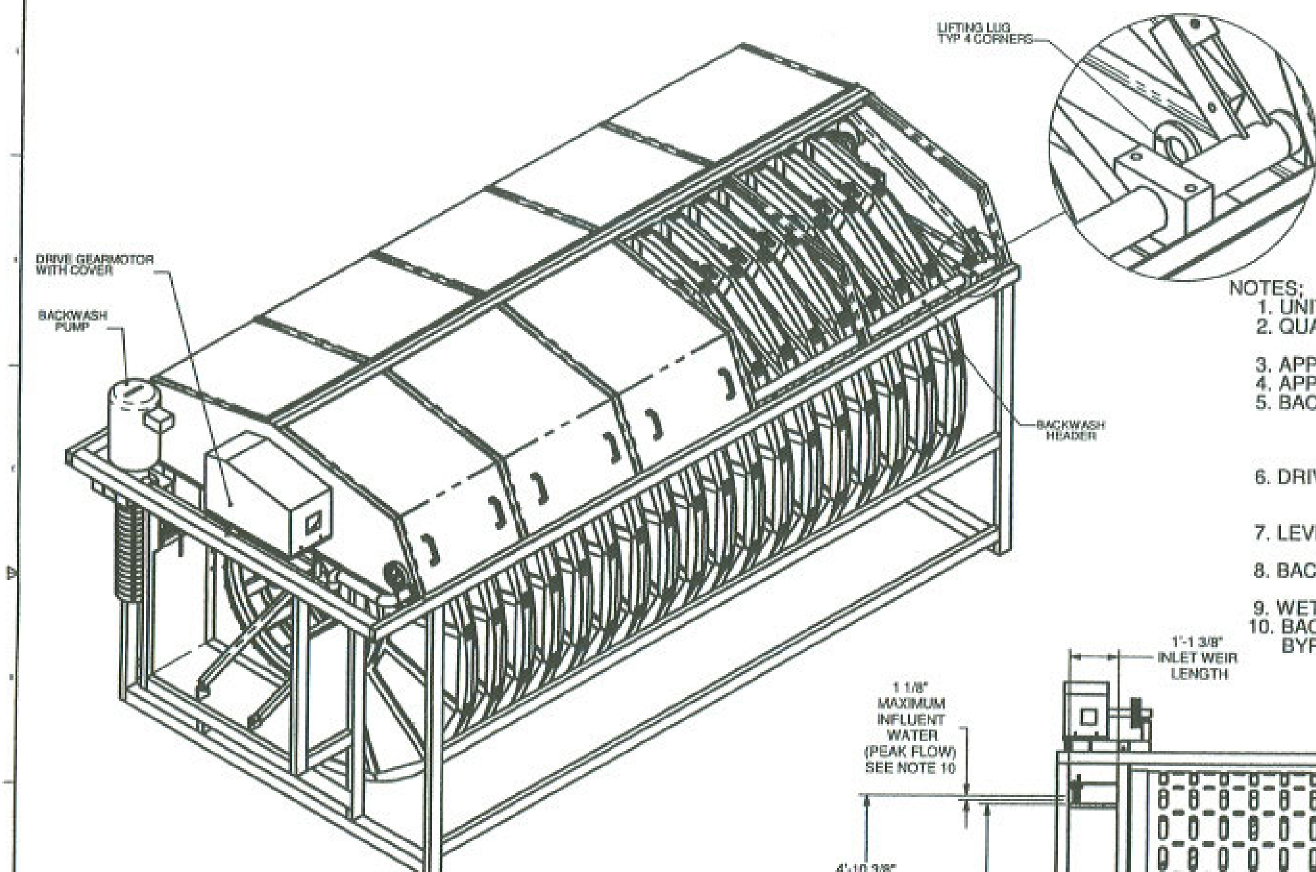
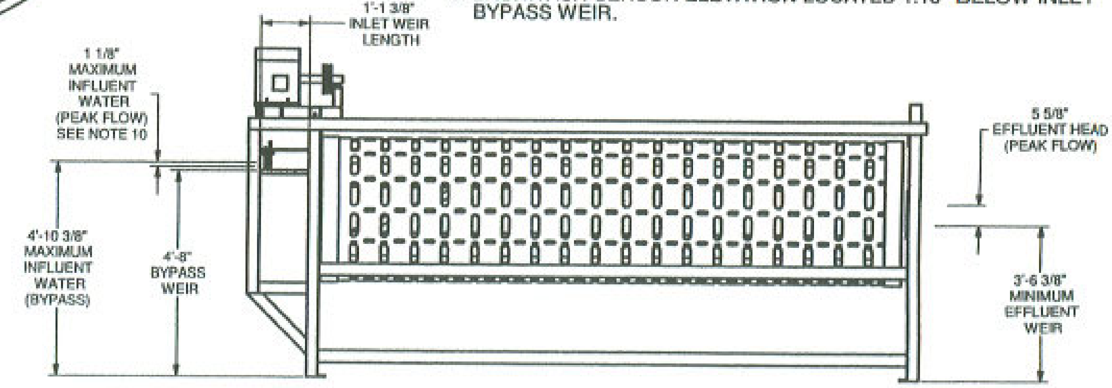


NOTES;
1. UNIT SHOWN WITH SOME PROTECTIVE COVERS REMOVED.
2. QUANTITY OF FILTER DISKS = 18, 504 FILTER PANELS (MODEL 2218)
   17, 476 FILTER PANELS (MODEL 2217)
3. APPROXIMATE UNIT WEIGHT = 6724 LBS (3050 KG)
4. APPROXIMATE WEIGHT REMOVABLE COVER = 35 LBS (15.9 KG)
5. BACKWASH PUMP INFORMATION;
   GRUNDFOS P/N: MTR32-11/3 (BOTH MODELS 2218 & 2217)
   VOLTAGE: 480 V (3 PH)
   HP RATING: 15 HP (BOTH MODELS 2218 & 2217)
6. DRIVE MOTOR INFORMATION;
   VOLTAGE: 480 V (3 PH)
   HP RATING: 1.5 HP
7. LEVEL SENSOR INFORMATION;
   VOLTAGE: 24 V
8. BACKWASH TROUGH FLANGE SIZE (NOT SHOWN);
   6" 125# LAP JOINT FLANGE
9. WETTED PARTS TO BE STAINLESS STEEL.
10. BACKWASH SENSOR ELEVATION LOCATED 1.18" BELOW INLET BYPASS WEIR.



INTERNAL HYDRAULIC DIMENSIONS

THE PRESENCE OF A PROFESSIONAL ENGINEERS SEAL ON THIS DRAWING INDICATES THAT A SIGNED AND SEALED ORIGINAL IS ON FILE.

0	07.17.04	PRELIMINARY RELEASE	SDD	DSD	SDD

COMPANY CONFIDENTIAL

DESIGNER SDD	DATE 07.17.04
CHECKER DSD	DATE 07.17.04
ENGINEER DSD	DATE 07.17.04
SCALE	1:24

2218/2217-2F STANDARD PRODUCT
RIGHT HAND BACKWASH HEADER

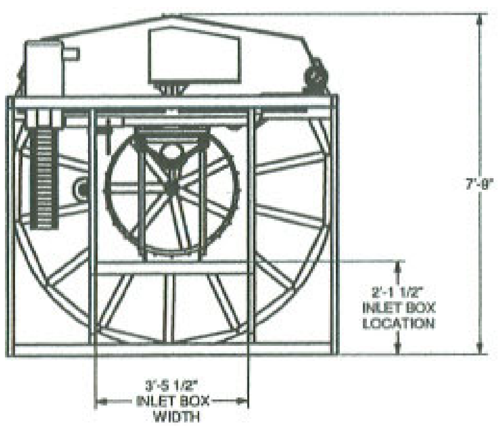
STANDARD DISCFILTER PRODUCT

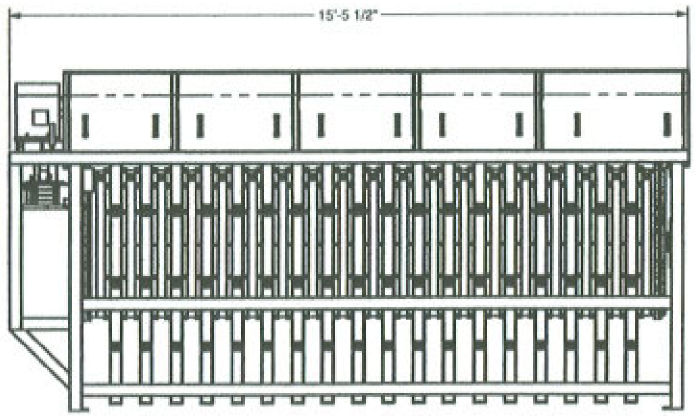
Krüger

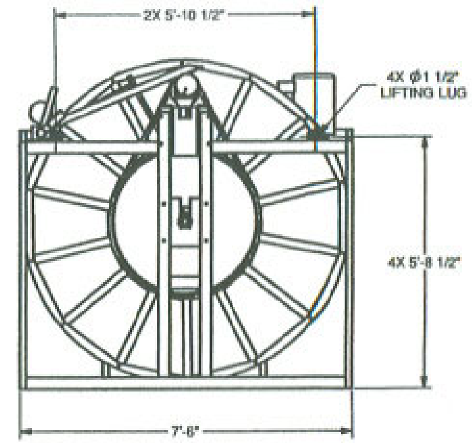
DRAWING 2218-2F-RH — SHEET 1 OF 2 — REV 0

INTERNAL REF NO:

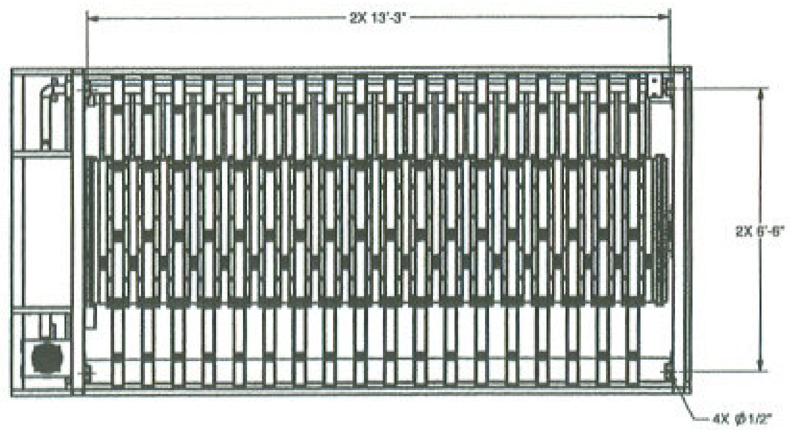
IF BAR IS NOT 1", ADJUST SCALE ACCORDINGLY







END VIEW
SHOWN WITH
TOP COVER REMOVED



ANCHOR BOLT LOCATIONS
BOTTOM VIEW

THE PRESENCE OF A PROFESSIONAL ENGINEERS SEAL ON THIS DRAWING INDICATES THAT A SIGNED AND SEALED ORIGINAL IS ON FILE.

rev	date	description	drn	ck	appr
0	07.17.04	PRELIMINARY RELEASE	SDD	DSD	SDD

GRAPHICAL SCALE 0 .5 1 2 3 6

COMPANY CONFIDENTIAL

DESIGNER SDD	DATE 07.17.04	TITLE 2218/2217-2F STANDARD PRODUCT RIGHT HAND BACKWASH HEADER
CHECKER DSD	DATE 07.17.04	CLIENT STANDARD DISCFILTER PRODUCT
ENGINEER DSD	DATE 07.17.04	Krüger
FILE		DRAWING 2218-2F-RH
SCALE 1:32		SHEET 2 OF 2 REV 0

INTERNAL REF NO:

IF BAR IS NOT 1", ADJUST SCALE ACCORDINGLY

Appendix 3

Standard Terms of Sale

I. KRUGER INC. - STANDARD TERMS OF SALE

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

APPENDIX I

MISCELLANEOUS CORRESPONDENCE

Snow, Hilary

From: Janie.Hagberg@swfwmd.state.fl.us
Sent: Monday, May 07, 2007 3:34 PM
To: Snow, Hilary
Subject: Fw: Lake Hancock

----- Forwarded by Janie Hagberg/MAN/swfwmd on 05/07/2007 03:33 PM -----

Janie Hagberg/MAN/swfwmd
10/25/2005 11:46 AM

To: <terry@bartow-airport.com>
cc: Mark Hammond/MAN/swfwmd@swfwmd, Lizanne Garcia/MAN/swfwmd@swfwmd, Hilary.Snow@Parsons.com
Subject: Re: Lake Hancock(Document link: Janie Hagberg (Archive))

Terry,
Here is my contact information.   I will send out the hard copy of the letter in the mail today. It has been a pleasure coordinating with you and I look forward to continuing to do so.
thanks,
Janie

Janie L. Hagberg, P.E.
SWIM Section
Resource Management Department
Southwest Florida Water Management District
7601 U.S. Highway 301 North
Tampa, Florida 33637

"Terry White" <terry@bartow-airport.com>
10/25/2005 10:50 AM

Please respond to <terry@bartow-airport.com>

To: <Janie.Hagberg@swfwmd.state.fl.us>
cc:
Subject: Lake Hancock

October 21, 2005

Ms. Janie L. Hagberg, P.E.

Senior Professional Engineer

SWIM Section

Resource Management

Southwest Florida Water Management District

Subject: Lake Hancock Outfall Treatment Project

Dear Ms. Hagberg:

In reference to our initial conversations and your letter dated October 20, 2005, the Lake Hancock Outfall Treatment Projects are of much interest to the airport. The Bartow Municipal Airport Authority Management Team appreciates you including the Airport during the developmental phases of this project.

Of major concern to the airport, at this time, is that during the initial concept and planning phases your organization addresses any long range impacts that could affect normal air traffic in or out of the Bartow Airport Control Zone including Lake Hancock. For example, if at a later date a sizeable wetland treatment area or the lake is designated as a National Wildlife Refuge. This area could affect takeoffs and landings and normal over flight altitudes per FAA Advisory Circular AC 91-36 and FAR AIM Chapter 7 Section 7-4-6 Flights over Charted U.S. Wildlife Refuges, Parks, and Forest Service Areas.

Also, the Airport would appreciate your organization coordinating, with the Polk County Airport Zoning Commission, any plans that may impact height restrictions.

The Bartow Municipal Airport looks forward to working with you on this project to minimize any future concerns. I personally feel that this treatment project will be an excellent neighbor and will help to eliminate noise issues that are associated with residential development near airports.

Sincerely,

Terry R. White

Assistant Director

Bartow Municipal Airport

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IMPORTANT NOTICE: All E-mail sent to this address are public record and archived. The Southwest Florida Water Management District does not allow use of District equipment and E-mail facilities for non-District business purposes.

Southwest Florida
Water Management District

2379 Broad Street, Brooksville, Florida 34604-6899
(352) 796-7211 or 1-800-423-1476 (FL only)
SUNCOM 628-4150 TDD only 1-800-231-6103 (FL only)
On the Internet at: WaterMatters.org

An Equal Opportunity Employer

Bartow Service Office
170 Century Boulevard
Bartow, Florida 33830-7700
(863) 534-1448 or
1-800-492-7862 (FL only)
SUNCOM 572-6200

Lecanto Service Office
Suite 226
3600 West Sovereign Path
Lecanto, Florida 34461-8070
(352) 527-8131
SUNCOM 667-3271

Sarasota Service Office
6750 Fruitville Road
Sarasota, Florida 34240-9711
(941) 377-3722 or
1-800-320-3503 (FL only)
SUNCOM 531-6900

Tampa Service Office
7601 Highway 301 North
Tampa, Florida 33637-6759
(813) 985-7481 or
1-800-836-0797 (FL only)
SUNCOM 578-2070

October 20, 2005

Mr. Terry R. White
Assistant Director
Bartow Municipal Airport
P.O. Box 650
Bartow, Florida 33831

Subject: Lake Hancock Outfall Treatment Project

Dear Mr. White:

Thank you for speaking with me recently regarding the project referenced above. The Southwest Florida Water Management District (District) is currently evaluating alternative treatment technologies to improve water quality leaving Lake Hancock. The District purchased the former Old Florida Plantation planned development property as a potential site for the water treatment facility. One of the evaluation criteria we are looking at includes potential site constraints associated with the different technologies. The District's property is within 5,000 feet of the western-most airport runway. One of the technologies being considered, a wetland treatment system would occupy most of the District's property. The attached figure provides the limits of the two wetland treatment systems under consideration. The purpose of contacting you is to coordinate early on in the process to determine if issues exist with locating a constructed wetland system near the airport. This step is part of the feasibility study that will conclude in 2007. Construction of the selected alternative is anticipated to be complete in 2010.

During our initial telephone conversation you recommended that I contact Robin McGill, Senior Professional Engineer responsible for permitting airport projects at the District, and Mark Easley with URS Corporation, your environmental consultant for the airport. I also spoke with William Copeland, Senior Environmental Scientist with the District who is also on the District's airport projects permitting team. From separate conversations with Mr. Easley and Mr. Copeland, both are of the opinion that the wildlife that would be attracted to a shallow marsh constructed on the District's property would include wading birds that are low flying. Mr. Easley went on to comment that the concern would be greater for open water features that attract ducks and geese. These waterfowl tend to fly higher and would pose more of a concern at the location of the District's property to aircraft utilizing the airport than the lower flying wading birds. Ms. McGill stated that the existing wetlands adjacent to the airport are more of a concern than offsite wetlands in the area. Currently wetlands and open water features exist on the District's property and the lake itself is heavily used by wildlife.

You mentioned the existing avigation easement that encompasses a 4.5 nautical mile radius from the center of the airport for overflight and associated noise. This area includes the District's property. I spoke with Steve Blaschka, Land Acquisition Manager with the District and he confirmed that the District is aware of the avigation easement. We do not anticipate any conflicts with the proposed treatment wetland and the easement.

Please confirm in writing that based on our conversations, there is no basis for concern with the potential construction of treatment wetlands on the District's property. As we discussed, I will continue to update you on our progress. If you have any questions, do not hesitate to contact me at (813) 985-7481, extension 2216.

Sincerely,

Janie L. Hagberg, P.E.
Senior Professional Engineer
SWIM Section
Resource Management Department

cc: Mark A. Hammond, P.E., Director, Resource Management Dept.
Fritz Musselman, Director, Land Resources Dept.
Paul O'Neil, Director, Technical Services Dept.
Jack Pepper, Deputy General Counsel
Lizanne Garcia, SWIM Program Manager, Resource Management Dept.
Steve Blaschka, Land Acquisition Manager, Land Resources Dept.
Robin McGill, P.E., Senior Professional Engineer, Tampa Regulation Dept.
William Copeland, Senior Environmental Scientist, Tampa Regulation Dept.
Mark Easley, Manager, Environmental Services, URS Corporation
L ~~Hilary~~ Snow, Parsons Water and Infrastructure, Inc.
Project File H014

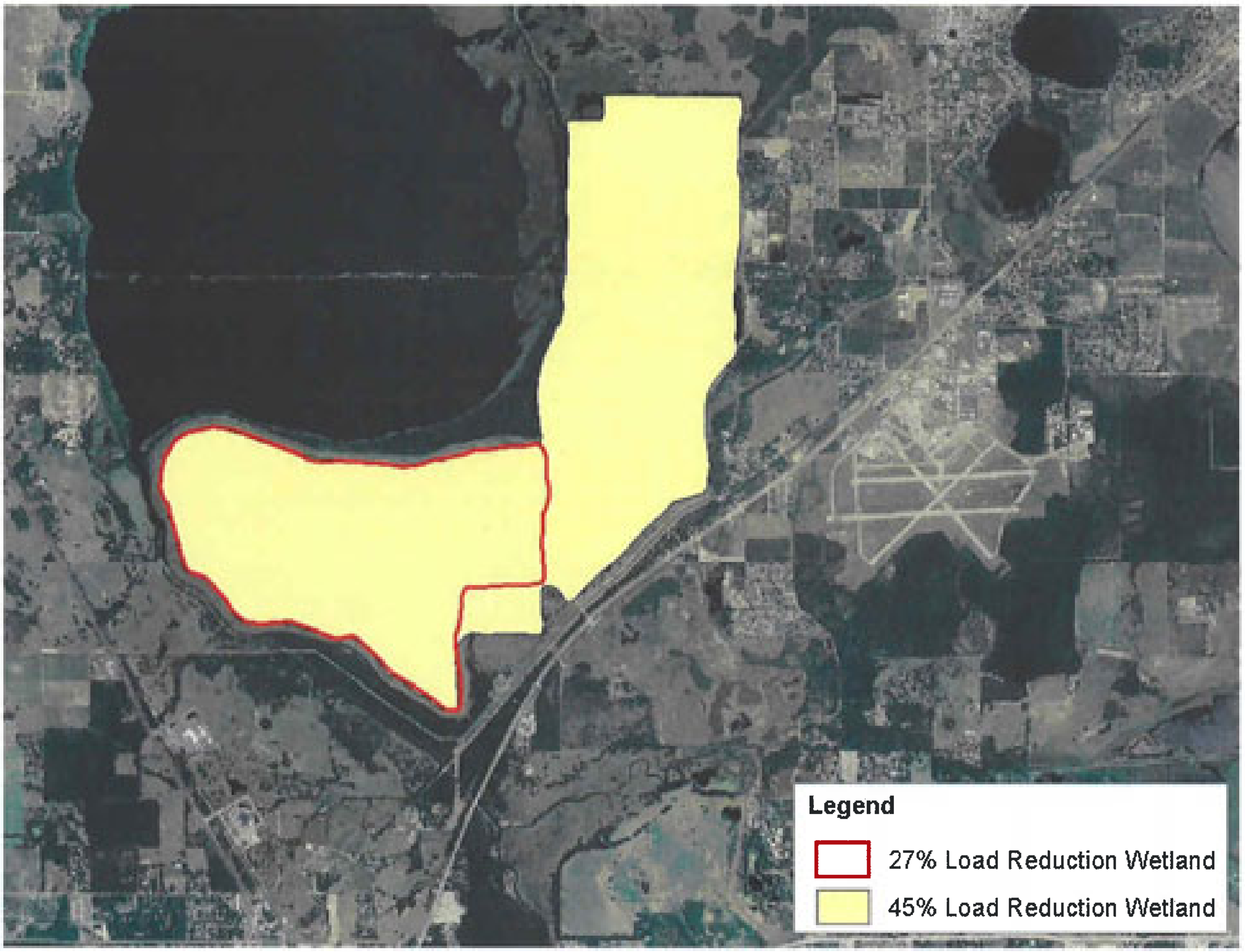

Figure 1: Potential Footprints for Wetland Treatment System Concept Plans for the Lake Hancock Outfall Treatment Project

Bartow Municipal Airport and Industrial Park

October 21, 2005

Ms. Janie L. Hagberg, P.E.
SWIM Section
Resource Management Department
Southwest Florida Water Management District
7601 U.S. Highway 301 North
Tampa, Florida 33637

Subject: Lake Hancock Outfall Treatment Project

Dear Ms. Hagberg:

In reference to our initial conversations and your letter dated October 20, 2005, the Lake Hancock Outfall Treatment Projects are of much interest to the airport. The Bartow Municipal Airport Authority Management Team appreciates you including the Airport during the developmental phases of this project.

Of major concern to the airport, at this time, is that during the initial concept and planning phases your organization addresses any long range impacts that could affect normal air traffic in or out of the Bartow Airport Control Zone including Lake Hancock. For example, if at a later date a sizeable wetland treatment area or the lake is designated as a National Wildlife Refuge. This area could affect takeoffs and landings and normal over flight altitudes per FAA Advisory Circular AC 91-36 and FAR AIM Chapter 7 Section 7-4-6 Flights over Charted U.S. Wildlife Refuges, Parks, and Forest Service Areas.

Also, the Airport would appreciate your organization coordinating, with the Polk County Airport Zoning Commission, any plans that may impact height restrictions.

The Bartow Municipal Airport looks forward to working with you on this project to minimize any future concerns. I personally feel that this treatment project will be an excellent neighbor and will help to eliminate noise issues that are associated with residential development near airports.

Sincerely,

Terry R. White
Assistant Director

Southwest Florida Water Mgmt Dist
OCT 28 2005
Received
Res. Management Dept.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

February 3, 2006

Kris A. Kaufman
Environmental Scientist
Southwest Florida Water Management District
2379 Broad Street
Brooksville, Florida 34604-6899

Service Log No.: 4-1-06-TA-13935
Date Received: October 26, 2005
Project: Lake Hancock Outfall Treatment Project
County: Polk

Dear Mr. Kaufman:

The Service has received your letter and enclosed material date October 24, 2005, for the Lake Hancock Outfall Treatment Project. This letter transmits the Fish and Wildlife Service's (Service) technical assistance on this project.

PROJECT DESCRIPTION

The Southwest Florida Water Management District (District) has requested information regarding potential effect of the project referenced above on federally protected species. Lake Hancock is a 45,000-acre lake in the headwaters of the Peace River Watershed. There has been intensive agricultural and industrial development in the Peace River's watershed for many years with a heavy reliance on groundwater resources. Many of the basins along the Peace River, including Lake Hancock, have been identified by the Florida Department of Environmental Protection as impaired under the Clean Water Act, thus requiring the establishment a Total Daily Loads. The proposed project includes the construction of a regional water quality treatment system to improve the quality of water leaving Lake Hancock flowing into the Peace River. The treatment facility will be located at the discharge point from Lake Hancock into South Saddle Creek at latitude 81 51' 3.70", longitude 27 56' 18.04". The facility will be constructed on District property.

THREATENED AND ENDANGERED SPECIES

The Service has reviewed its Geographic Information System (GIS) database for recorded locations of federally listed threatened and endangered species on or adjacent to your project. The GIS database is a compilation of data received from several sources.

Federally listed species were not identified on your project site. There is no designated critical habitat on the project site. The Service has not conducted a site inspection to verify species occurrence or validate the GIS results. However, we assume listed species occur in suitable ecological communities and recommend site surveys to determine the presence or absence of listed species. Ecological communities suitable for listed species can be found in the species accounts in the *South Florida Multi-Species Recovery Plan*. This document is located at http://www.fws.gov/verobeach/Programs/Recovery/vbms5.html.

We have also provided for your consideration two computer links: (1) http://www.fws.gov/verobeach/Programs/Permits/Section7.html and (2) http://migratorybirds.fws.gov/. The first link is a table of species by county in south Florida that are protected as either threatened or endangered under the Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The table does not include State-listed species. Please contact the Florida Fish and Wildlife Conservation Commission (FWC) at 772-778-5094 to identify potential State-listed species occurring in the vicinity of your project. The second link provides information on species the Service is required to protect and conserve under other authorities, such as the Fish and Wildlife Coordination Act of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*) and the Migratory Bird Treaty Act (40 Stat. 755; 16 U.S.C. 701 *et seq.*). A variety of habitats in Polk County occasionally provide resting, feeding, and nesting sites for a variety of migratory bird species. As a public trust resource, migratory birds must be taken into consideration during project planning and design.

Wood stork

Our records indicate the project occurs within the core foraging area (CFA) (within 18.6 miles) of one wood stork (*Mycteria americana*) nesting colony. The wood stork typically utilizes freshwater marshes, ponds, ditches, tidal creeks and pools, impoundments, pine/cypress depressions, and swamp sloughs for foraging. They forage most effectively in shallow-water areas with highly concentrated prey, such as wetland depressions subject to seasonal drying. The Service believes loss of wetlands within a CFA may reduce foraging opportunities for wood storks. To minimize any adverse effects to wood storks, the Service's *Draft Supplemental Habitat Management Guidelines for the Wood Stork in the South Florida Ecological Services Consultation Area* (Wood Stork Guidelines) (2002a) recommend that wetland habitat lost due to the action be replaced. The compensation should include a temporal lag factor, if necessary, to ensure sites adequately replace wetland functions lost due to the action. Moreover, wetlands offered as compensation should be of the same hydroperiod and located within the CFA of the affected wood stork colony. The Wood Stork Guidelines can be viewed or downloaded at http://verobeach.fws.gov/species/birds/wost/wost_guidelines.pdf.

Bald eagle

The project occurs within the geographic range of the threatened bald eagle (*Haliaeetus leucocephalus*). The FWC records indicate that there is an active bald eagle nest located within 1 mile of the proposed project site. Bald eagles are vulnerable to disturbance early in the nesting season, during courtship, nest building, egg laying, incubation, and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment or chilled or overheated eggs and young. Human activity near the nest later in the nesting cycle may cause premature fledging, thereby reducing the likelihood of fledgling survival.

The Service and the FWC have agreed upon standard protection zones for bald eagle nests. The primary protection zone includes the area within 750 feet of the nest, and the secondary protection zone includes the area extending outward from 750 to 1,500 feet from the primary zone. If bald eagles are found to be nesting within the project area, the Service's *Habitat Management Guidelines for the Bald Eagle in the Southeast Region* (Service 1987) (Bald Eagle Guidelines) provide recommendations to avoid adversely affecting the bald eagle during the nesting season. The Bald Eagle Guidelines can be viewed or downloaded at: http://northflorida.fws.gov/BaldEagles/Documents/eagle-habitat.pdf. In general, development, land clearing, and use of chemicals toxic to wildlife are prohibited within the primary protection zone. Development activities proposed within the secondary protection zone should be restricted to the non-nesting period, May 16 through September 30.

Eastern indigo snake

The eastern indigo snake (*Drymarchon corais couperi*) was federally listed as threatened in 1978 due to dramatic population declines caused by over-collecting for the domestic and international pet trade as well as mortalities caused by rattlesnake collectors who gassed gopher tortoise (*Gopherus polyphemus*) burrows to collect snakes (43 FR 4028). Since then habitat lost to residential and commercial development has become a significant threat. Eastern indigo snakes are frequently associated with high, dry, well-drained soils and have been documented using inactive gopher tortoise burrows. Suitable habitat for the eastern indigo snake may exist on the site. If so, the Service recommends use of our *Draft Standard Protection Measures for the Eastern Indigo Snake* (Service 2002b) during any site preparation and project construction. They can be viewed or downloaded at http://northflorida.fws.gov/IndigoSnakes/east-indigo-snake-measures-071299.htm.

Thank you for the opportunity to comment. If you have any questions, please contact Al Begazo at 772-562-3909, extension 324.

Sincerely yours,

Allen D. Webb for

James J. Slack
Field Supervisor
South Florida Ecological Services Office

LITERATURE CITED

U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. Fish and Wildlife Service, Region 4; Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2002. Draft Supplemental Habitat Management Guidelines for the Wood Stork in the South Florida Ecological Services Consultation Area. Fish and Wildlife Service, South Florida Ecological Services Office; Vero Beach, Florida.

U.S. Fish and Wildlife Service. Draft Standard Protection Measures for the Eastern Indigo Snake. Fish and Wildlife Service, South Florida Ecological Services Office; Vero Beach, Florida.