GLOSSARY

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advanced wastewater treatment: any combination of physical, chemical, or biological treatment process used to accomplish a degree of treatment greater than that achieved by secondary treatment; usually implies removal or a greater level of suspended solids and BOD removal.

aerobic: environment with the presence of air. Organisms that require air for life.

AMSA: Association of Metropolitan Sewerage Agencies.

anaerobic: environment without air. Organisms capable of living without oxygen or requiring the absence of air for life.

aquifer: a confined layer or formation of permeable rock that is both overlain and underlain by impermeable strata through which ground water can flow.

base elevation: reference elevation for all earthwork elevation control and water surface elevation definitions. The base elevation is set equal to the invert elevation of the inlet and outlet marshes.

basin: a naturally-occurring depression in the landscape; or, as an alluvial basin, a filled geologic formation, often bounded by other physical or hydrologic formations.

benthic: of, relating to, or occurring at the bottom of a body of water.

benthos: organisms that live on or in the bottom of bodies of water.

biochemical oxygen demand (BOD): (1) the quantity of oxygen consumed in the biochemical oxidation of organic matter; and (2) a standard test used in assessing wastewater strength.

biota: fauna and flora together.

brackish: waters with total dissolved solids content between sea water and those that are suitable for man's purposes.

CEQA: California Environmental Quality Act.

chlorophyll-a: pigment measurement commonly used to estimate algal production.

chlorotic: a condition in green plants marked by yellowing or blanching.

cienega: a swamp or marsh, especially one supported by springs or seepage.

connecting marsh: area between inlet marshes and the open pond. Contains nesting islands and special emergent test areas.

culm: the specialized stem of grasses, sedges, and rushes.

denitrification: the reduction of nitrate and nitrite to nitrogen by certain anaerobic microorganisms.

donor marsh: a natural wetland which supplies plant material for a constructed or mitigated wetland.

effluent: partially or completely treated wastewater flowing out of a treatment facility, reservoir, or basin.

electrical conductivity (EC): the ability of water to conduct an electrical charge, used to give a rough measure of salinity.

EMWD: Eastern Municipal Water District.

EPA: United States Environmental Protection Agency.

evapotranspiration: the combined loss of water from a given area and during a specified period of time by direct evaporation and by transpiration from plants.

gal/min: gallons per minute.

imported water: water supplied by the State Water Project or Colorado River water.

influent: generally considered as wastewater flowing into a treatment plant or treatment process.

inlet marsh: wetlands region between inlet structures and connecting marsh. Each of the five inlet marshes will have a length to width ratio of 2:1 or greater. The initial size and shape is based on preliminary water treatment design capacity and research requirements.

invertebrate: an animal lacking a backbone and internal skeleton.

in situ: in the natural or original position.

"junk tubers": bare rhizomes with no shoot attached.

kPa: kilopascals.

lb/in^2: pounds per square inch.

lodging: plants falling or lying down.

macroinvertebrates: aquatic invertebrate organisms, such as beetles, worms, insects, arachnids, etc., that can easily be seen with the naked eye.

Mgal/d: million gallons per day.

mg/L: milligrams per liter.

moist-soil test areas: areas adjacent and parallel to inlet marsh 1, 2, and 3. These areas can be flooded or drained at selected times, depending on wildlife management requirements.

NBS: National Biological Survey.

O&M: operation and maintenance.

open pond: central pond in wetlands system, connecting inlet marshes with outlet marshes through either connecting marsh or direct connection. Bottom contours, shape, and cross-sections are designed to produce specific shallow-bench areas at pond margins.

outlet marsh: connects open pond to four-system outlet structures. Marsh is divided into two parts for redundancy, to satisfy water treatment design requirements, and allow for whole wetlands system to fit onto site.

outlet structure: hydraulic control structure designed to collect and measure flow out of system and to regulate depth of water through entire wetlands system.

oxidation-reduction potential (ORP): a measurement of instantaneous tendency of redox conditions.

pH: hydrogen-ion concentration; a measurement of acid or basic conditions, defined as the negative logarithm of hydrogen ion concentration in a solution.

PTF: Planning Task Force.

polychlorinated biphenyls (PCB's): any of several compounds that are produced by replacing hydrogen atoms in biphenyl with chlorine, have various industrial applications, and are poisonous environmental pollutants which tend to accumulate in animal tissues.

recharge: the process, by man or nature, of putting water into soil or into a ground-water aquifer zone.

reclaimed water: wastewater that, as a result of treatment, is suitable for a second beneficial use.

reverse osmosis (RO) process: a system for separating salts and other mineral constituents from water by using differential osmotic pressures across a semi-permeable membrane.

riparian: an ecological zone defined as water-influenced, such as along the bank of a river or lake.

RWRF: Regional Water Reclamation Facility.

shallow emergent test area: southwest portion of open pond area designed to be less than 2 feet deep at design water depth.

SJWR: San Jacinto Wildlife Refuge, a 5000-acre wildlife refuge in the San Jacinto River Valley, which is owned and operated by the California Department of Fish and Game.

TAC: Technical Advisory Committee.

TFC: thin-film composite.

TRC: Technical Review Committee.

tertiary treatment: see advanced wastewater treatment.

total dissolved solids (TDS): the sum of all dissolved solids in water or wastewater and an expression of water salinity in mg/L.

total organic carbon (TOC): the total quantity of carbon of organic material that is either in solution or suspended.

total suspended solids (TSS): the sum of all suspended materials in water or wastewater. Generally considered materials which are retained by a .45 micron filter.

transects: a line established as a basis for measuring wetland attributes.

transpiration: release of water vapor from leaves and other plant parts.

USBR: United States Bureau of Reclamation.

USGS: United States Geological Survey.

wetlands, constructed: man-made wetlands constructed and operated expressly for the purpose of wastewater treatment or multipurpose objectives incorporating environmental enhancement or other features.

wetlands, natural: those naturally-occurring and sustained areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that normally do support, a prevalence of vegetation species that are adapted to saturated soil conditions.

wetlands system: set of constructed water system components linked together to form a natural wastewater treatment system. The system can also provide environmental enhancements, a wildlife refuge, and a cost-effective means of reusing and recycling clean water back into the environment.

APPENDICES

APPENDIX A

APPENDIX A

WATER QUALITY AND SEDIMENT DATA

Water Quality and Sediment Data

NURSERY CELLS WATER QUALITY

These data are on file with the National Biological Survey in Denver, Colorado.

RESEARCH CELLS

1. Sediment Data: Monthly in situ measurements of pH, redox potential, EC, nitrate-N, and phosphorus (total and ortho) and yearly measurements of trace elements, particle-size analysis, organic carbon, calcium carbonate, organic carbon, calcium carbonate, cation exchange capacity are on file at EMWD offices in San Jacinto, California, and are discussed in Chapter 4 of this report.

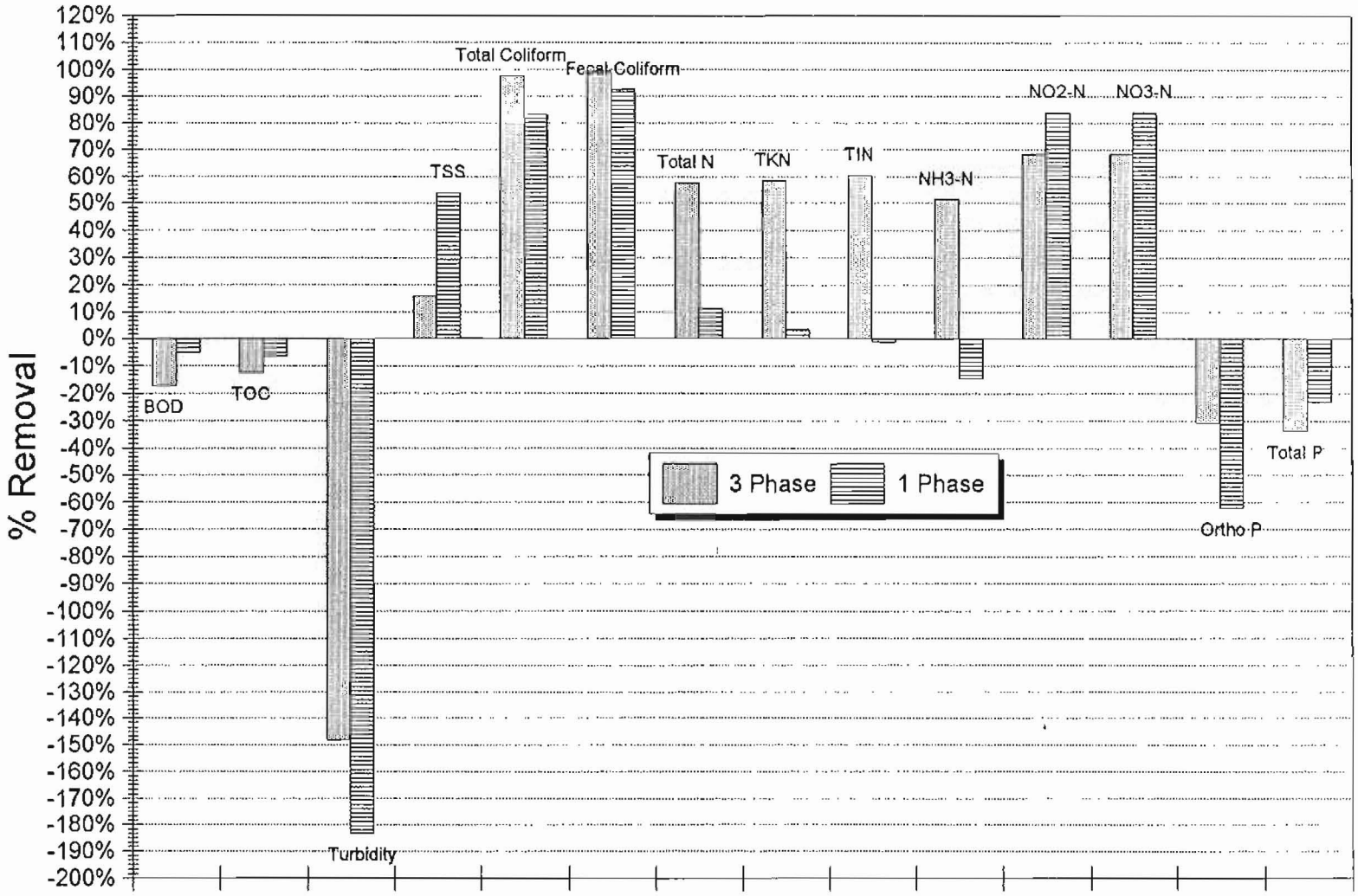
2. Hydrolab DataSonde Measurements: Hourly in situ measurements of water temperature, conductivity, pH, and dissolved oxygen concentrations and saturation percentages from both the inlet box and the outlet boxes of the three-phase and one-phase cells are on file on floppy disks at EMWD offices in San Jacinto, California.

3. Inflow Rate Measurements: Daily inflow rate measurements obtained during Series 1A are on file on floppy disks at EMWD offices in San Jacinto, California.

4. Laboratory Chemical Analyses Results: Appended hereafter are 17 Series 1A data and statistical tables for the water quality constituents discussed in this report. The entire Series 1/1A laboratory analyses results data set is on file on floppy disks at EMWD offices in San Jacinto, California.

%Removal Summary: Inlet vs. Outlets

EMWD Wetlands Research Cells:Phase 1A



Biochemical Oxygen Demand

General Statistics

	Inlet	3 Phase	1 Phase
Mean	4.875	5.714286	5.125
Standard Error	0.895176	1.614138	0.833185
Median	4.5	4	4.5
Mode	4	4	4
Standard Deviation	2.531939	4.270608	2.356602
Variance	6.410714	18.2381	5.553571
Kurtosis	2.764435	5.334343	2.505268
Skewness	0.890022	2.198768	1.19934
Range	9	13	8
Minimum	1	2	2
Maximum	10	15	10
Sum	39	40	41
Count	8	7	8
Confidence Level(0.950000)	1.754512	3.163653	1.633012

Data Table

Week	Inlet	3 Phase	1 Phase
29	10	15	10
32	1	6	4
38	6	4	6
41	4	5	5
44	5	4	4
47	4	4	6
50	5	2	2

Average Removal/Gain

	3 Phase		1 Phase	
Change	0.84	Gained	0.25	Gained
% Change	17.22%	Gain	5.13%	Gain

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	5.714286	5.285714	5	5.7142857	5	5.285714
Variance	18.2381	6.238095	7.333333	18.238095	7.3333333	6.238095
Observations	7	7	7	7	7	7
Pearson Correlation	0.86833		0.662928		0.7146116	
Pooled Variance	12.2381		12.78571		6.7857143	
Hypothesized Mean Differenc	0		0		0	
df	6		6		6	
t	0.464758		-0.59062		-0.382546	
P(T<=t) one-tail	0.329246		0.288163		0.3576204	
t Critical one-tail	1.94318		1.94318		1.9431803	
P(T<=t) two-tail	0.658492		0.576327		0.7152408	
t Critical two-tail	2.446912		2.446912		2.4469119	

Total Organic Carbon

General Statistics

	Inlet	3 Phase	1 Phase
Mean	10.3875	11.675	11.05
Standard Error	0.239372	0.638847	1.301922
Median	10.5	11.5	10.5
Mode	11	11	NA
Standard Deviation	0.677047	1.806931	3.682391
Variance	0.458393	3.265	13.56
Kurtosis	-2.26799	0.756242	0.135877
Skewness	-0.23608	0.809615	0.215431
Range	1.5	5.6	11.8
Minimum	9.5	9.5	5.2
Maximum	11	15.1	17
Sum	83.1	93.4	88.4
Count	8	8	8
Confidence Level(0.950000)	0.469161	1.252116	2.55172

Data Table

Week	Inlet	3 Phase	1 Phase
29	11	12	12
32	10	15.1	17
35	9.5	11	15
38	10	11	8.9
41	9.6	12	10
44	11	9.5	5.2
47	11	9.8	9.3
50	11	13	11

Average Removal/Gain

	3 Phase		1 Phase	
Change	1.29	Gained	0.66	Gained
% Change	12.39%	Gain	6.38%	Gain

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	11.675	11.05	10.3875	11.675	10.3875	11.05
Variance	3.265	13.56	0.458393	3.265	0.458393	13.56
Observations	8	8	8	8	8	8
Pearson Correlation	0.75295		-0.25602		-0.47301	
Pooled Variance	8.4125		1.861696		7.009196	
Hypothesized Mean Differen	0		0		0	
df	7		7		7	
t	0.677659		-1.74605		-0.46304	
P(T<=t) one-tail	0.259875		0.062154		0.328695	
t Critical one-tail	1.894579		1.894579		1.894579	
P(T<=t) two-tail	0.51975		0.124307		0.65739	
t Critical two-tail	2.364624		2.364624		2.364624	

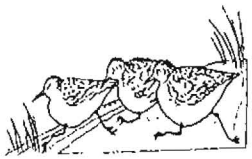
Total Suspended Solids

General Statistics

	Inlet	3 Phase	1 Phase
Mean	10	8.4	4.6
Standard Error	3.820995	2.063977	1.122497
Median	6	9	4
Mode	5	4	3
Standard Deviation	8.544004	4.615192	2.50998
Variance	73	21.3	6.3
Kurtosis	4.228373	-0.68836	4.225246
Skewness	2.044212	0.514732	2.017344
Range	20	11	6
Minimum	5	4	3
Maximum	25	15	9
Sum	50	42	23
Count	5	5	5
Confidence Level(0.950000)	7.489012	4.04532	2.200054

Data Table

Week	Inlet	3 Phase	1 Phase
35	5	15	9
38	9	4	3
41	25	10	4
44	6	9	3
50	5	4	4



Average Removal/Gain

	3 Phase		1 Phase	
Change	1.60	Removed	5.40	Removed
% Change	16.00%	Removal	54.00%	Removal

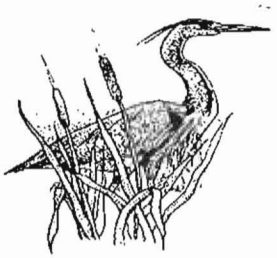
t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	8.4	4.6	10	8.4	10	4.6
Variance	21.3	6.3	73	21.3	73	6.3
Observations	5	5	5	5	5	5
Pearson Correlation	0.794196		0.0951		-0.233152	
Pooled Variance	13.8		47.15		39.65	
Hypothesized Mean Differen	0		0		0	
df	4		4		4	
t	2.801397		0.384012		1.277771	
P(T<=t) one-tail	0.024371		0.360255		0.1352239	
t Critical one-tail	2.131847		2.131847		2.1318468	
P(T<=t) two-tail	0.048742		0.720509		0.2704478	
t Critical two-tail	2.776445		2.776445		2.7764451	

Turbidity

General Statistics

	Inlet	3 Phase	1 Phase
Mean	4.091667	10.15417	11.59167
Standard Error	0.866902	2.267061	3.892141
Median	2.55	5.7	4.3
Mode	1.7	2.7	1.7
Standard Deviation	4.246934	11.10628	19.06752
Variance	18.03645	123.3495	363.5704
Kurtosis	2.387984	2.199001	7.6118
Skewness	1.893403	1.677189	2.87947
Range	15.4	40.9	70.3
Minimum	0.6	1.3	1.7
Maximum	16	42.2	72
Sum	98.2	243.7	278.2
Count	24	24	24
Confidence Level(0.950000)	1.699096	4.443357	7.628457



Average Removal/Gain

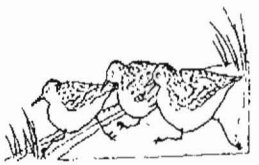
	3 Phase	1 Phase
Change	6.06 Gained	7.50 Gained
% Change	148.17% Gain	183.30% Gain

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	10.15417	11.59167	4.091667	10.15417	4.091667	11.59167
Variance	123.3495	363.5704	18.03645	123.3495	18.03645	363.5704
Observations	24	24	24	24	24	24
Pearson Correlation	0.189047		0.279614		0.219005	
Pooled Variance	243.46		70.693		190.8034	
Hypothesized Mean Differen	0		0		0	
df	23		23		23	
t	-0.34914		-2.76944		-1.97489	
P(T<=t) one-tail	0.365081		0.005454		0.030202	
t Critical one-tail	1.713872		1.713872		1.713872	
P(T<=t) two-tail	0.730163		0.010908		0.060404	
t Critical two-tail	2.068658		2.068658		2.068658	

Data Table

Week	Inlet	3 Phase	1 Phase
29	11	30	72
30	2.8	11.7	13.6
31	2.2	11	6
32	2.9	32	9
33	12.2	42.2	5.1
34	0.6	24	3.7
35	2.3	9.8	8.8
36	13	1.3	18
37	1.2	13	14
38	3.4	2.5	1.8
39	1.8	10	16
40	1.5	14.8	4.1
41	16	6.5	3
42	0.9	5.6	4.5
43	3.6	5.8	8.1
44	1.8	5.3	2.2
45	1.7	2.7	3.2
46	3.5	3.8	1.9
48	2.4	1.5	71
49	1.7	2.2	1.7
50	2.5	2.7	3.8
51	2.6	1.6	1.7
54	2.6	1.9	3
55	4	1.8	2



Total Coliform

With Chlorinated Samples

General Statistics

	Inlet	3 Phase	1 Phase
Mean	272952.5	6187.5	45430
Standard Error	111897.8	1540.227	20742.86
Median	190000	5500	11150
Mode	NA	NA	170
Standard Deviation	316494.6	4356.42	58669.67
Variance	1E+11	18978393	3.44E+09
Kurtosis	-0.55715	-0.36952	-1.42835
Skewness	0.971601	0.766474	0.830027
Range	799980	12000	129830
Minimum	20	2000	170
Maximum	800000	14000	130000
Sum	2183620	49500	363440
Count	8	8	8
Confidence Level(0.950000)	219315.6	3018.789	40655.26

Data Table

Week	Inlet	3 Phase	1 Phase
29	140000	4000	130000
32	1600	10000	20000
35	300000	2000	170
38	700000	8000	170
41	800000	2300	2300
44	2000	14000	80000
47	20	7000	130000
50	240000	2200	800

Average Removal/Gain

	3 Phase		1 Phase	
Change	1.644572	Logs Removed	0.778744	Logs Removed
% Change	97.73%	Removal	83.36%	Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	6187.5	45430	272952.5	6187.5	272952.5	45430
Variance	18978393	3.44E+09	1E+11	18978393	1E+11	3.44E+09
Observations	8	8	8	8	8	8
Pearson Correlation	0.285036		-0.44957		-0.60475	
Pooled Variance	1.73E+09		5.01E+10		5.18E+10	
Hypothesized Mean Difference	0		0		0	
df	7		7		7	
t	-1.92767		2.369168		1.812442	
P(T<=t) one-tail	0.047624		0.024833		0.056405	
t Critical one-tail	1.894579		1.894579		1.894579	
P(T<=t) two-tail	0.095248		0.049667		0.112811	
t Critical two-tail	2.364624		2.364624		2.364624	

Total Coliform

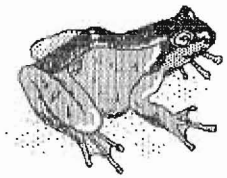
Without Chlorinated Samples

General Statistics

	Inlet	3 Phase	1 Phase
Mean	363600	6416.667	25573.33
Standard Error	129611.3	2869.892	21120.3
Median	270000	3150	1550
Mode	NA	NA	170
Standard Deviation	317481.6	7029.77	51733.96
Variance	1.01E+11	49417667	2.68E+09
Kurtosis	-1.49602	3.801549	5.517888
Skewness	0.566394	1.956144	2.335667
Range	798400	18000	129830
Minimum	1600	2000	170
Maximum	800000	20000	130000
Sum	2181600	38500	153440
Count	6	6	6
Confidence Level(0.950000)	254033.5	5624.884	41395.03

Data Table

Week	Inlet	3 Phase	1 Phase
29	140000	4000	130000
32	1600	20000	20000
35	300000	2000	170
38	700000	8000	170
41	800000	2300	2300
50	240000	2200	800



Average Removal/Gain

	3 Phase		1 Phase	
Change	1.753314	Logs Removed	1.152837	Logs Removed
% Change	98.24%	Removal	92.97%	Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	6416.667	25573.33	363600	6416.667	363600	25573.33
Variance	49417667	2.68E+09	1.01E+11	49417667	1.01E+11	2.68E+09
Observations	6	6	6	6	6	6
Pearson Correlation	-0.0307		-0.4336		-0.43053	
Pooled Variance	1.36E+09		5.04E+10		5.17E+10	
Hypothesized Mean Difference	0		0		0	
df	5		5		5	
t	-0.89511		2.729064		2.414336	
P(T<=t) one-tail	0.205872		0.020663		0.03027	
t Critical one-tail	2.015048		2.015048		2.015048	
P(T<=t) two-tail	0.411744		0.041326		0.060539	
t Critical two-tail	2.570582		2.570582		2.570582	

Fecal Coliform

With Chlorinated Samples

General Statistics

	Inlet	3 Phase	1 Phase
Mean	305200.3	4212.5	49047.5
Standard Error	106270	1359.417	24296.03
Median	270000	2500	5500
Mode	1	NA	NA
Standard Deviation	300576.8	3845.011	68719.55
Variance	9.03E+10	14784107	4.72E+09
Kurtosis	-1.71208	-1.6117	-0.56043
Skewness	0.318069	0.681519	1.06533
Range	699999	9200	169920
Minimum	1	800	80
Maximum	700000	10000	170000
Sum	2441602	33700	392380
Count	8	8	8
Confidence Level(0.950000)	208285.3	2664.408	47619.35

Data Table

Week	Inlet	3 Phase	1 Phase
29	700000	1000	1000
32	1600	10000	10000
35	500000	2000	170000
38	700000	3000	80
41	300000	800	500
44	1	9000	80000
47	1	7000	130000
50	240000	900	800

Average Removal/Gain

	3 Phase		1 Phase	
Change	1.860045	Logs Removed	0.793968	Logs Removed
% Change	98.62%	Removal	83.93%	Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	4212.5	49047.5	305200.3	4212.5	305200.3	49047.5
Variance	14784107	4.72E+09	9.03E+10	14784107	9.03E+10	4.72E+09
Observations	8	8	8	8	8	8
Pearson Correlation	0.226785		-0.74329		-0.23266	
Pooled Variance	2.37E+09		4.52E+10		4.75E+10	
Hypothesized Mean Difference	0		0		0	
df	7		7		7	
t	-1.86624		2.805517		2.239296	
P(T<=t) one-tail	0.052126		0.013157		0.03007	
t Critical one-tail	1.894579		1.894579		1.894579	
P(T<=t) two-tail	0.104252		0.026315		0.06014	
t Critical two-tail	2.364624		2.364624		2.364624	

Fecal Coliform

Without Chlorinated Samples

General Statistics

	Inlet	3 Phase	1 Phase
Mean	406933.3	2950	30396.67
Standard Error	113142.1	1451.838	27963.16
Median	400000	1500	900
Mode	NA	NA	NA
Standard Deviation	277140.4	3556.262	68495.48
Variance	7.68E+10	12647000	4.69E+09
Kurtosis	-1.17988	4.798989	5.934998
Skewness	-0.30049	2.158329	2.433139
Range	698400	9200	169920
Minimum	1600	800	80
Maximum	700000	10000	170000
Sum	2441600	17700	182380
Count	6	6	6
Confidence Level(0.950000)	221754.5	2845.55	54806.79

Data Table

Week	Inlet	3 Phase	1 Phase
29	700000	1000	1000
32	1600	10000	10000
35	500000	2000	170000
38	700000	3000	80
41	300000	800	500
50	240000	900	800

Average Removal/Gain

	3 Phase		1 Phase	
Change	2.139701	Logs Removed	1.126697	Logs Removed
% Change	99.28%	Removal	92.53%	Removal

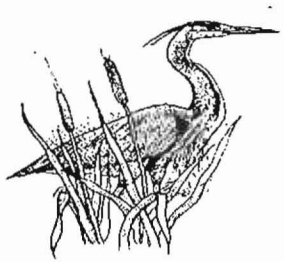
t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	2950	30396.67	406933.3	2950	406933.3	30396.67
Variance	12647000	4.69E+09	7.68E+10	12647000	7.68E+10	4.69E+09
Observations	6	6	6	6	6	6
Pearson Correlation	-0.07854		-0.59472		0.12535	
Pooled Variance	2.35E+09		3.84E+10		4.07E+10	
Hypothesized Mean Difference	0		0		0	
df	5		5		5	
t	-0.97625		3.543355		3.329458	
P(T<=t) one-tail	0.186889		0.008252		0.010396	
t Critical one-tail	2.015048		2.015048		2.015048	
P(T<=t) two-tail	0.373778		0.016504		0.020791	
t Critical two-tail	2.570582		2.570582		2.570582	

Ammonium Nitrogen

General Statistics

	Inlet	3 Phase	1 Phase
Mean	11.712	5.672	13.416
Standard Error	0.660059	0.64134	0.839855
Median	12	5.5	13
Mode	12	3.6	13
Standard Deviation	3.300293	3.206701	4.199274
Variance	10.89193	10.28293	17.6339
Kurtosis	1.381588	-0.015411	2.08235
Skewness	-0.610008	0.410044	0.92197
Range	15.3	12.7	19.9
Minimum	2.7	0.3	6.1
Maximum	18	13	26
Sum	292.8	141.8	335.4
Count	25	25	25
Confidence Level(0.950000)	1.293691	1.257004	1.646085



Data Table

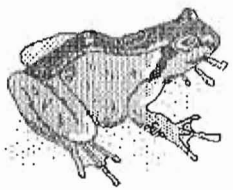
Week	Inlet	3 Phase	1 Phase
29	12	7	9
30	13	13	17
31	12	6.7	11
32	15	7.4	11
33	13	6	13
34	6.1	8.5	14
35	13	8.1	18
36	2.7	11	18
37	10	3.6	12
38	12	4.7	13
39	13	3.2	7.6
40	9.5	1.6	6.1
41	18	4.8	9.6
42	12	2.1	12
43	9.7	3.9	9.1
44	12	0.3	13
45	10	4.1	13
46	10	4	10
47	15	5.5	16
48	10	11	26
49	7.8	6.9	14
50	17	0.5	14
51	11	6.5	17
54	14	7.8	14
55	15	3.6	18

Average Removal/Gain

	3 Phase	1 Phase
Change	6.04 Removed	1.70 Gained
% Change	51.57% Removal	14.55% Gain

t-Test: Paired Two-Sample for Means

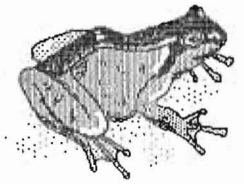
	3 Phase	1 Phase	Inlet	1 Phase	Inlet	3 Phase
Mean	5.672	13.416	11.712	13.416	11.712	5.672
Variance	10.28293	17.6339	10.89193	17.6339	10.89193	10.28293
Observations	25	25	25	25	25	25
Pearson Correlation	0.563034		-0.123822		-0.310093	
Pooled Variance	13.95842		14.26292		10.58743	
Hypothesized Mean Differenc	0		0		0	
df	24		24		24	
t	-10.84232		-1.507129		5.73412	
P(T<=t) one-tail	4.95E-11		0.072414		3.29E-06	
t Critical one-tail	1.710882		1.710882		1.710882	
P(T<=t) two-tail	9.9E-11		0.144829		6.57E-06	
t Critical two-tail	2.063899		2.063899		2.063899	



Nitrite Nitrogen

General Statistics

	Inlet	3 Phase	1 Phase
Mean	1.929	0.6106	0.306
Standard Error	0.266609	0.2397	0.118255
Median	2.2	0.3	0.14
Mode	2.7	0.1	0.05
Standard Deviation	1.333045	1.198499	0.591275
Variance	1.777008	1.436401	0.349606
Kurtosis	-1.60912	20.1774	18.05453
Skewness	-0.22147	4.333803	4.043819
Range	3.745	6.095	2.945
Minimum	0.005	0.005	0.005
Maximum	3.75	6.1	2.95
Sum	48.225	15.265	7.65
Count	25	25	25
Confidence Level(0.950000)	0.522544	0.469803	0.231776



Average Removal/Gain

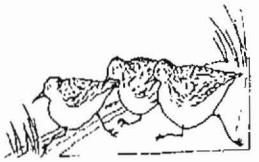
	3 Phase	1 Phase
Change	1.32 Removed	1.62 Removed
% Change	68.35% Removal	84.14% Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	1 Phase	Inlet	3 Phase
Mean	0.6106	0.306	1.929	0.306	1.929	0.6106
Variance	1.436401	0.349606	1.777008	0.349606	1.777008	1.436401
Observations	25	25	25	25	25	25
Pearson Correlation	-0.02407		0.133077		-0.25802	
Pooled Variance	0.893003		1.063307		1.606704	
Hypothesized Mean Differen	0		0		0	
df	24		24		24	
t	1.128883		5.861332		3.280516	
P(T<=t) one-tail	0.135053		2.4E-06		0.001579	
t Critical one-tail	1.710882		1.710882		1.710882	
P(T<=t) two-tail	0.270105		4.8E-06		0.003158	
t Critical two-tail	2.063899		2.063899		2.063899	

Data Table

Week	Inlet	3 Phase	1 Phase
29	0.4	0.4	0.1
30	0.25	0.45	0.4
31	1.35	0.68	0.82
32	3.6	0.3	0.3
33	0.1	0.2	0.7
34	2.7	0.1	0.39
35	0.2	0.005	0.05
36	1.8	0.6	0.2
37	3.75	1.32	0.15
38	0.8	0.2	0 1
39	3.05	0.25	0.15
40	3 4	0 02	0.02
41	2.7	0.18	0.17
42	2	0.7	0.2
43	3.25	0.46	0.14
44	0.005	1 4	0.005
45	3.6	0.39	0.5
46	2.97	0.64	2.95
47	2.2	0.3	0.01
48	3.1	0.16	0.005
49	0.23	6.1	0.08
50	2.7	0.1	0.05
51	2.85	0.11	0.05
54	0.95	0.12	0.07
55	0.27	0.08	0.04



Nitrate Nitrogen

General Statistics

	Inlet	1 Phase	3 Phase
Mean	0.772	0.764	0.612
Standard Error	0.08377	0.066803	0.085307
Median	0.7	0.8	0.5
Mode	0.4	0.7	0.5
Standard Deviation	0.418848	0.334016	0.426536
Variance	0.175433	0.111567	0.181933
Kurtosis	1.852442	-0.095591	5.199766
Skewness	1.131153	0.021083	1.863956
Range	1.9	1.4	2
Minimum	0.1	0.1	0.1
Maximum	2	1.5	2.1
Sum	19.3	19.1	15.3
Count	25	25	25
Confidence Level(0.950000)	0.164185	0.130932	0.167199

Average Removal/Gain

	3 Phase	1 Phase
Change	0.01 Removed	0.16 Removed
% Change	1.04% Removal	20.73% Removal

t-Test: Paired Two-Sample for Means

	1 Phase	3 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	0.764	0.612	0.772	0.764	0.772	0.612
Variance	0.111567	0.181933	0.175433	0.111567	0.175433	0 181933
Observations	25	25	25	25	25	25
Pearson Correlation	-0.344868		-0.03431		0.708633	
Pooled Variance	0.14675		0.1435		0.178683	
Hypothesized Mean Difference	0		0		0	
df	24		24		24	
t	1.214227		0.073447		2.478709	
P(T<=t) one-tail	0.118237		0.47103		0.010303	
t Critical one-tail	1.710882		1.710882		1.710882	
P(T<=t) two-tail	0.236474		0.942059		0.020606	
t Critical two-tail	2.063899		2.063899		2.063899	

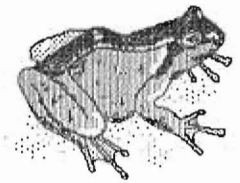
Data Table

Week	Inlet	3 Phase	1 Phase
29	1.5	1.5	1.2
30	0.4	0.6	0.5
31	0.9	0.7	0.8
32	1	0.3	0.7
33	0.4	0.7	1
34	2	0.1	2.1
35	0.7	1	0.2
36	0.8	0.5	0.8
37	1.1	1.1	0.5
38	0.7	0.9	0.5
39	0.1	0.4	0.4
40	0.9	0.6	1.1
41	0.5	1	0.4
42	0.7	0.7	0.3
43	0.8	0.3	0.8
44	0.7	0.7	0.6
45	0.9	0.8	0.5
46	0.5	0.8	0.5
47	0.3	1	0.1
48	0.4	0.3	0.1
49	1.3	1	0.3
50	0.4	0.9	0.4
51	0.6	1.3	0.2
54	1.2	0.8	0.8
55	0.5	1.1	0.5

Total Inorganic Nitrogen

General Statistics

	Inlet	3 Phase	1 Phase
Mean	14.261	5.622	14.429
Standard Error	0.6804425	0.638971	0.8465701
Median	14.05	5.5	14.47
Mode	13.5	3.6	19.4
Standard Deviation	3.4022125	3.1948552	4.2328504
Variance	11.57505	10.2071	17.917023
Kurtosis	2.0950966	0.066016	1.6735474
Skewness	-0.45371	0.4624078	0.6734865
Range	16.4	12.7	19.985
Minimum	4.9	0.3	6.52
Maximum	21.3	13	26.505
Sum	356.525	140.55	360.725
Count	25	25	25
Confidence Level(0.950000)	1.3336428	1.2523602	1.6592469



Average Removal/Gain

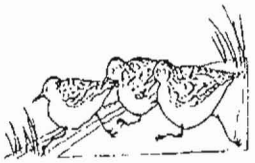
	3 Phase	1 Phase
Change	8.64 Removed	0.17 Gained
% Change	60.58% Removal	1.18% Gain

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	5.622	14.429	14.261	5.622	14.261	14.429
Variance	10.2071	17.917023	11.57505	10.2071	11.57505	17.917023
Observations	25	25	25	25	25	25
Pearson Correlation	0.6076931		-0.374068		-0.249895	
Pooled Variance	14.062061		10.891075		14.746036	
Hypothesized Mean Differen	0		0		0	
df	24		24		24	
t	-12.88034		7.8976107		-0.138678	
P(T<=t) one-tail	1.424E-12		1.981E-08		0.4454308	
t Critical one-tail	1.7108821		1.7108821		1.7108821	
P(T<=t) two-tail	2.847E-12		3.961E-08		0.8908616	
t Critical two-tail	2.0638986		2.0638986		2.0638986	

Data Table

Week	Inlet	3 Phase	1 Phase
29	13.9	5.75	9
30	14.25	13	19.4
31	14.05	6.7	12.92
32	19.3	7.4	12.2
33	13.6	6	14.5
34	9.5	8.5	14.89
35	13.5	8.1	19.35
36	4.9	11	19.4
37	14.25	3.6	12.75
38	13.5	4.7	13.8
39	16.15	3.2	8.25
40	14	1.6	6.52
41	21.3	4.8	10.47
42	14.3	2 1	13
43	13.75	3.9	9.54
44	13.005	0 3	14.305
45	14.4	4.1	14.825
46	13.47	4	13.65
47	18.2	5.5	16.21
48	13.9	11	26.505
49	8.43	6.9	14.48
50	20	0 5	14.65
51	14.35	6.5	17.1
54	15.05	7.8	14.47
55	15.47	3.6	18.54



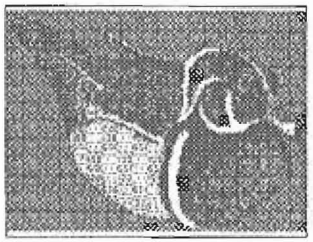
Total Kjeldahl Nitrogen

General Statistics

	Inlet	3 Phase	1 Phase
Mean	16.143	6.7	15.571
Standard Error	0.7377	1.2987	1.2884
Median	16	6.7	15
Mode	18	NA	15
Standard Deviation	1.9518	3.4361	3.4087
Variance	3.8095	11.807	11.619
Kurtosis	-1.0054	-0.5844	1.0748
Skewness	-0.465	0.2031	-0.0166
Range	5	9.8	11
Minimum	13	2.2	10
Maximum	18	12	21
Sum	113	46.9	109
Count	7	7	7
Confidence Level(0.950000)	1.4459	2.5454	2.5251

Data Table

Week	Inlet	3 Phase	1 Phase
32	16	9.6	15
35	15	12	21
38	15	6.7	15
41	18	5.9	10
44	13	2.2	14
47	18	7.4	18
50	18	3.1	16



Average Removal/Gain

	3 Phase		1 Phase	
Change	9.44	Removed	0.57	Removed
% Change	58.50%	Removal	3.54%	Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	6.7	15.571	16.143	6.7	16.14286	15.571
Variance	11.807	11.619	3.8095	11.807	3.809524	11.619
Observations	7	7	7	7	7	7
Pearson Correlation	0.5521		0.0199		-0.13957	
Pooled Variance	11.713		7.8081		7.714286	
Hypothesized Mean Differenc	0		0		0	
df	6		6		6	
t	-7.2461		6.3768		0.363636	
P(T<=t) one-tail	0.0002		0.0003		0.364299	
t Critical one-tail	1.9432		1.9432		1.94318	
P(T<=t) two-tail	0.0004		0.0007		0.728599	
t Critical two-tail	2.4469		2.4469		2.446912	

Total Nitrogen

General Statistics

	Inlet	3 Phase	1 Phase
Mean	18.543571	7.8478571	16.483571
Standard Error	1.1732305	1.1549159	1.2990119
Median	20.3	7.2	16.2
Mode	NA	NA	NA
Standard Deviation	3.1040762	3.0556203	3.4368623
Variance	9.6352893	9.3368155	11.812023
Kurtosis	-1.976841	-1.060173	1.9197187
Skewness	-0.548346	0.1320851	0.1619009
Range	7.295	8.405	11.48
Minimum	14.005	4	10.87
Maximum	21.3	12.405	22.35
Sum	129.805	54.935	115.385
Count	7	7	7

Data Table

Week	Inlet	3 Phase	1 Phase
32	20.3	9.95	16.2
35	15.5	12.405	22.35
38	16.5	7.2	15.8
41	21.3	7.08	10.87
44	14.005	4.5	15.305
47	21.2	9.8	18.21
50	21	4	16.65

Average Removal/Gain

	3 Phase		1 Phase	
Change	10.70	Removed	2.06	Removed
% Change	57.68%	Removal	11.11%	Removal

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	7.8478571	16.483571	18.543571	7.8478571	18.543571	16.483571
Variance	9.3368155	11.812023	9.6352893	9.3368155	9.6352893	11.812023
Observations	7	7	7	7	7	7
Pearson Correlation	0.5962001		-0.00074		-0.345033	
Pooled Variance	10.574419		9.4860524		10.723656	
Hypothesized Mean Differen	0		0		0	
df	6		6		6	
t	-7.779087		6.4944221		1.0154327	
P(T<=t) one-tail	0.0001188		0.0003171		0.1745417	
t Critical one-tail	1.9431803		1.9431803		1.9431803	
P(T<=t) two-tail	0.0002376		0.0006341		0.3490834	
t Critical two-tail	2.4469119		2.4469119		2.4469119	

Total Phosphorus

General Statistics

	Inlet	3 Phase	1 Phase
Mean	4	5.35	4.925
Standard Error	0.133631	0.381257	0.296859
Median	4.1	5.05	5
Mode	4.3	NA	4.8
Standard Deviation	0.377964	1.078359	0.839643
Variance	0.142857	1.162857	0.705
Kurtosis	-0.94192	2.546164	-0.406441
Skewness	-0.761976	1.334269	-0.620469
Range	1	3.6	2.5
Minimum	3.4	4	3.5
Maximum	4.4	7.6	6
Sum	32	42.8	39.4
Count	8	8	8
Confidence Level(0.950000)	0.261911	0.747251	0.581832

Data Table

Week	Inlet	3 Phase	1 Phase
29	4.4	4	4
32	3.4	6	4.8
35	3.9	7.6	3.5
38	4.3	4.7	4.8
41	4.3	5.1	5.5
44	3.5	5	5.2
47	4	4.9	5.6
50	4.2	5.5	6

Average Removal/Gain

	3 Phase		1 Phase	
Change	1.35	Gained	0.92	Gained
% Change	33.75%	Gain	23.12%	Gain

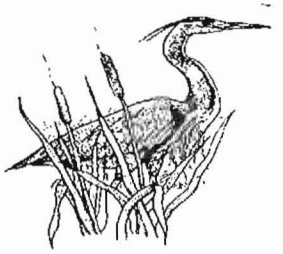
t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	3 Phase	Inlet	1 Phase
Mean	5.35	4.925	4	5.35	4	4.925
Variance	1.162857	0.705	0.142857	1.162857	0.142857	0.705
Observations	8	8	8	8	8	8
Pearson Correlation	-0.369199		-0.42761		0.027009	
Pooled Variance	0.933929		0.652857		0.423929	
Hypothesized Mean Differenc	0		0		0	
df	7		7		7	
t	0.754784		-2.968749		-2.870522	
P(T<=t) one-tail	0.237501		0.010422		0.011987	
t Critical one-tail	1.894579		1.894579		1.894579	
P(T<=t) two-tail	0.475001		0.020845		0.023974	
t Critical two-tail	2.364624		2.364624		2.364624	

Orthophosphate

General Statistics

	Inlet	3 Phase	1 Phase
Mean	3.288	4.304	5.336
Standard Error	0.185051	0.187126	0.50629
Median	3.4	4.2	4.6
Mode	2.5	4	3.9
Standard Deviation	0.925257	0.935628	2.531449
Variance	0.8561	0.8754	6.408233
Kurtosis	-0.24551	1.509879	13.67578
Skewness	0.353274	-0.93323	3.3674
Range	3.5	4	12.9
Minimum	1.7	1.6	3.1
Maximum	5.2	5.6	16
Sum	82.2	107.6	133.4
Count	25	25	25
Confidence Level(0.950000)	0.362694	0.366759	0.99231



Average Removal/Gain

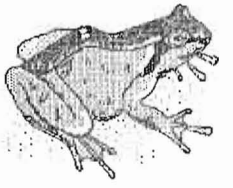
	3 Phase	1 Phase
Change	1.02 Gained	2.05 Gained
% Change	30.90% Gain	62.29% Gain

t-Test: Paired Two-Sample for Means

	3 Phase	1 Phase	Inlet	1 Phase	Inlet	3 Phase
Mean	4.304	5.336	3.288	5.336	3.288	4.304
Variance	0.8754	6.408233	0.8561	6.408233	0.8561	0.8754
Observations	25	25	25	25	25	25
Pearson Correlation	0.274724		-0.12327		0.273440801	
Pooled Variance	3.641817		3.632167		0 86575	
Hypothesized Mean Differen	0		0		0	
df	24		24		24	
t	-2.10968		-3.65673		-4.52909974	
P(T<=t) one-tail	0.022751		0.000624		6.87696E-05	
t Critical one-tail	1.710882		1.710882		1.710882077	
P(T<=t) two-tail	0.045502		0.001248		0.000137539	
t Critical two-tail	2.063899		2.063899		2 063898559	

Data Table

WEEK#	Inlet	3 Phase	1 Phase
29	2.8	2.9	3.9
30	3.9	5.5	6.5
31	3.4	5.4	6.1
32	2.9	5.6	4.4
33	5	4.4	3.8
34	2.6	4.8	16
35	3.8	4 7	3.1
36	3.1	3.1	6 6
37	2 5	3.3	5.8
38	3.9	4.5	4.5
39	2.5	4.2	3.8
40	1.9	4.2	3.9
41	3.4	4.1	4.2
42	4.9	5.2	5
43	5.2	5.2	5.7
44	2.4	3.6	5.2
45	2.1	4.4	4.6
46	3.5	4.1	3.9
47	3.7	4.2	5.4
48	3.2	5.2	8.5
49	3.8	1.6	3.2
50	3.8	5.4	5.6
51	2.5	4	4.5
54	3.7	4	4.2
55	1.7	4	5



APPENDIX B

APPENDIX B

NURSERY CELLS
AND
RESEARCH CELLS INVERTEBRATE DATA

APPENDIX B

NURSERY CELLS AND RESEARCH CELLS INVERTEBRATE DATA

Nursery Cells Invertebrate Data

These data are on file with the National Biological Survey in Denver, Colorado.

Research Cells Invertebrate Data

Appended hereafter are the benthic invertebrate data for the research cells.

BENTHIC INVERTEBRATE DATA

Research Cells

Invertebrate data from Research Cells at the EMWD Hemet facility. Coding is as follows: Cell Number; Position (I=Inlet, M=Middle, O=Outlet); Sampling Method (AS=Artifical substrate, SN=Sweep net); Date of collection (Year-month-day); Sample number; Replicate number; Taxonomic identification (Three columns possible); Abundance in sample; Taxon ID Code; Celltype (1P=1-Phase, 3P=3-Phase). Duplicate records indicate a split sample; counts presented in results are the sums of such records for a given sample.

5I	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		215	11P
5I	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		1	41P
5I	AS	19930427	1	1COLEOPTERA	HYDROPHILIDAE		1	51P
5I	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		3	311P
5I	AS	19930427	1	1GASTROPODA			1	501P
5I	AS	19930427	1	1HEMIPTERA	CORIXIDAE		2	601P
5I	AS	19930427	1	1OSTRACODA			158	901P
5I	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		128	11P
5I	AS	19930727	1	1COLEOPTERA	DYTISCIDAE		2	41P
5I	AS	19930727	1	1COLEOPTERA	HYDROPHILIDAE		1	51P
5I	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		25	311P
5I	AS	19930727	1	1GASTROPODA			15	501P
5I	AS	19930727	1	1OSTRACODA			96	901P
5M	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		382	11P
5M	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		9	41P
5M	AS	19930427	1	1COLEOPTERA	HYDROPHILIDAE		1	51P
5M	AS	19930427	1	1COLLEMBOLA			1	151P
5M	AS	19930427	1	1DIPTERA	CERATAPOGONIDAE		1	301P
5M	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		1	311P
5M	AS	19930427	1	1GASTROPODA			50	501P
5M	AS	19930427	1	1HEMIPTERA	CORIXIDAE		1	601P
5M	AS	19930427	1	1OSTRACODA			440	901P
5O	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		89	11P
5O	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		9	41P
5O	AS	19930427	1	1COLEOPTERA	HYDROPHILIDAE		1	51P
5O	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		7	311P
5O	AS	19930427	1	1GASTROPODA			9	501P
5O	AS	19930427	1	1HEMIPTERA	CORIXIDAE		1	601P
5O	AS	19930427	1	1OSTRACODA			78	901P
5O	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		27	11P
5O	AS	19930727	1	1COLEOPTERA	DYTISCIDAE		2	41P
5O	AS	19930727	1	1CRUSTACEA	GAMMARUS		8	221P
5O	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		43	311P
5O	AS	19930727	1	1GASTROPODA			106	501P
5O	AS	19930727	1	1OSTRACODA			50	901P
5O	AS	19931103	1	1ANNELIDA	OLIGOCHAETA		11	11P
5O	AS	19931103	2	1ANNELIDA	OLIGOCHAETA		9	11P
5O	AS	19931103	1	1DIPTERA	CHIRONOMIDAE		2	311P
5O	AS	19931103	2	1DIPTERA	CHIRONOMIDAE		7	311P
5O	AS	19931103	1	1GASTROPODA			3	501P
5O	AS	19931103	1	1OSTRACODA			90	901P
5O	AS	19931103	2	1OSTRACODA			33	901P
6I	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		11	11P
6I	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		7	311P
6I	AS	19930427	1	1GASTROPODA			10	501P
6I	AS	19930427	1	1OSTRACODA			20	901P
6I	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		685	11P
6I	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		266	311P
6I	AS	19930727	1	1DIPTERA	CULICIDAE	CULEX	1	341P

6I	AS	19930727	1	1OSTRACODA			314 901P
6M	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		25 11P
6M	AS	19930427	1	1COLLEMBOLA			1 151P
6M	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		29 311P
6M	AS	19930427	1	1EPHEMENOPTERA	BAETIDAE		1 401P
6M	AS	19930427	1	1GASTROPODA			5 501P
6M	AS	19930427	1	1OSTRACODA			240 901P
6O	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		24 11P
6O	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		10 311P
6O	AS	19930427	1	1GASTROPODA			20 501P
6O	AS	19930427	1	1OSTRACODA			217 901P
6O	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		415 11P
6O	AS	19930727	1	1CRUSTACEA	COPEPODA		2 211P
6O	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		27 311P
6O	AS	19930727	1	1DIPTERA	CULICIDAE	CULEX	2 341P
6O	AS	19930727	1	1GASTROPODA			19 501P
6O	AS	19930727	1	1OSTRACODA			200 901P
6O	AS	19931103	1	1ANNELIDA	OLIGOCHAETA		31 11P
6O	AS	19931103	2	1ANNELIDA	OLIGOCHAETA		10 11P
6O	AS	19931103	1	1DIPTERA	CHIRONOMIDAE		9 311P
6O	AS	19931103	2	1DIPTERA	CHIRONOMIDAE		3 311P
6O	AS	19931103	1	1OSTRACODA			12 901P
6O	AS	19931103	2	1OSTRACODA			8 901P
1I	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		58 13P
1I	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		2 43P
1I	AS	19930427	1	1COLEOPTERA	STAPHYLINIDAE		1 63P
1I	AS	19930427	1	1CRUSTACEA	CLADOCERA		1 203P
1I	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		15 313P
1I	AS	19930427	1	1GASTROPODA			15 503P
1I	AS	19930427	1	1OSTRACODA			340 903P
1I	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		168 13P
1I	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		186 313P
1M	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		3 43P
1M	AS	19930427	1	1CRUSTACEA	CLADOCERA		3 203P
1M	AS	19930427	1	1OSTRACODA			1839 903P
1M	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		5 13P
1M	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		1 313P
1M	AS	19930727	1	1GASTROPODA			16 503P
1M	AS	19930727	1	1OSTRACODA			200 903P
1M	AS	19931103	1	1ANNELIDA	OLIGOCHAETA		6 13P
1M	AS	19931103	2	1ANNELIDA	OLIGOCHAETA		15 13P
1M	AS	19931103	2	1ANNELIDA	HIRUDINEA		1 23P
1M	AS	19931103	1	1ANNELIDA	HIRUDINEA		1 23P
1M	AS	19931103	2	1DIPTERA	CHIRONOMIDAE		39 313P
1M	AS	19931103	1	1DIPTERA	CHIRONOMIDAE		47 313P
1M	AS	19931103	2	1OSTRACODA			55 903P
1M	AS	19931103	1	1OSTRACODA			39 903P
1O	AS	19930427	1	1DIPTERA	CULICIDAE		6 3P
1O	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		7 43P
1O	AS	19930427	1	1CRUSTACEA	CLADOCERA		25 203P
1O	AS	19930427	1	1CRUSTACEA	COPEPODA		1 213P
1O	AS	19930427	1	1DIPTERA	CERATAPOGONIDAE		3 303P
1O	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		56 313P
1O	AS	19930427	1	1GASTROPODA			9 503P
1O	AS	19930427	1	1OSTRACODA			168 903P
1O	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		447 13P
1O	AS	19930727	1	1CRUSTACEA	CLADOCERA		14 203P
1O	AS	19930727	1	1CRUSTACEA	COPEPODA		28 213P
1O	AS	19930727	1	1CRUSTACEA	GAMMARUS		1 223P
1O	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		145 313P
1O	AS	19930727	1	1GASTROPODA			322 503P

10	AS	19930727	1	1OSTRACODA			472 903P
2I	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		106 13P
2I	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		1 43P
2I	AS	19930427	1	1CRUSTACEA	CLADOCERA		1 203P
2I	AS	19930427	1	1DIPTERA	CERATAPOGONIDAE		1 303P
2I	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		5 313P
2I	AS	19930427	1	1GASTROPODA			43 503P
2I	AS	19930427	1	1OSTRACODA			47 903P
2I	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		131 13P
2I	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		45 313P
2I	AS	19930727	1	1GASTROPODA			2 503P
2I	AS	19930727	1	1ODONATA	ZYGOPTERA		1 813P
2I	AS	19930727	1	1OSTRACODA			19 903P
2M	AS	19930427	1	1CRUSTACEA	CLADOCERA		1 203P
2M	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		13 313P
2M	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		32 313P
2M	AS	19930427	1	1GASTROPODA			1 503P
2M	AS	19930427	1	1OSTRACODA			40 903P
2M	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		12 13P
2M	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		3 313P
2M	AS	19930727	1	1OSTRACODA			128 903P
2M	AS	19931103	2	1ANNELIDA	OLIGOCHAETA		2 13P
2M	AS	19931103	2	1ANNELIDA	HIRUDINEA		1 23P
2M	AS	19931103	1	1ANNELIDA	HIRUDINEA		3 23P
2M	AS	19931103	2	1DIPTERA	CHIRONOMIDAE		7 313P
2M	AS	19931103	1	1DIPTERA	CHIRONOMIDAE		5 313P
2M	AS	19931103	2	1OSTRACODA			52 903P
2M	AS	19931103	1	1OSTRACODA			74 903P
20	AS	19930427	1	1ANNELIDA	OLIGOCHAETA		52 13P
20	AS	19930427	1	1COLEOPTERA	DYTISCIDAE		14 43P
20	AS	19930427	1	1COLLEMBOLA			2 153P
20	AS	19930427	1	1CRUSTACEA	CLADOCERA		2 203P
20	AS	19930427	1	1CRUSTACEA	COPEPODA		2 213P
20	AS	19930427	1	1DIPTERA	CHIRONOMIDAE		91 313P
20	AS	19930427	1	1GASTROPODA			51 503P
20	AS	19930427	1	1OSTRACODA			134 903P
20	AS	19930727	1	1ANNELIDA	OLIGOCHAETA		497 13P
20	AS	19930727	1	1CRUSTACEA	COPEPODA		43 213P
20	AS	19930727	1	1CRUSTACEA	GAMMARUS		4 223P
20	AS	19930727	1	1DIPTERA	CHIRONOMIDAE		147 313P
20	AS	19930727	1	1DIPTERA	CULICIDAE	CULEX	2 343P
20	AS	19930727	1	1EPHEMEROPTERA	BAETIDAE		1 403P
20	AS	19930727	1	1GASTROPODA			1432 503P
20	AS	19930727	1	1ODONATAA	ZYGOPTERA		14 813P
20	AS	19930727	1	1OSTRACODA			1397 903P
5I	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		78 11P
5I	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		6 311P
5I	SN	19931103	1	1GASTROPODA			1 501P
5I	SN	19931103	1	1HEMIPTERA	CORIXIDAE		1 601P
5I	SN	19931103	1	1OSTRACODA			11 901P
5M	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		43 11P
5M	SN	19931103	1	1CRUSTACEA	CLADOCERA		7 201P
5M	SN	19931103	1	1CRUSTACEA	GAMMARUS		2 221P
5M	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		5 311P
5M	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	1 341P
5M	SN	19931103	1	1GASTROPODA			3 501P
5M	SN	19931103	1	1HEMIPTERA	CORIXIDAE		1 601P
5M	SN	19931103	1	1OSTRACODA			10 901P
50	SN	19930727	1	1	BIVALVE CLAM		129 1P
50	SN	19930727	1	1ANNELIDA	OLIGOCHAETA		6834 11P
50	SN	19930727	1	1CRUSTACEA	CLADOCERA		57 201P
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5O	SN	19930727	1	1CRUSTACEA	GAMMARUS		5 221P
5O	SN	19930727	1	1DIPTERA	CHIRONOMIDAE		148 311P
5O	SN	19930727	1	1DIPTERA	CULICIDAE	CULEX	9 341P
5O	SN	19930727	1	1EPHEMEROPTERA	BAETIDAE		62 401P
5O	SN	19930727	1	1GASTROPODA			75 501P
5O	SN	19930727	1	1HEMIPTERA	CORIXIDAE		90 601P
5O	SN	19930727	1	1HEMIPTERA	NAUCORIDAE		37 611P
5O	SN	19930727	1	1HEMIPTERA	NOTONECTIDAE		9 621P
5O	SN	19930727	1	1OSTRACODA			479 901P
6I	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		27 11P
6I	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		9 311P
6I	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	7 341P
6I	SN	19931103	1	1HEMIPTERA	CORIXIDAE		9 601P
6I	SN	19931103	1	1OSTRACODA			3 901P
6I	SN	19931103	1	1OSTRACODA			3 901P
6M	SN	19931103	1	1CRUSTACEA	CLODOCERA		638 1P
6M	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		29 11P
6M	SN	19931103	1	1CRUSTACEA	GAMMARUS		2 221P
6M	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		3 311P
6M	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	6 341P
6M	SN	19931103	1	1DIPTERA	CULICIDAE	ANOPHELES	1 351P
6M	SN	19931103	1	1EPEHEMEROPTERA	BAETIDAE		1 401P
6M	SN	19931103	1	1HEMIPTERA	NAUCORIDAE		1 611P
6M	SN	19931103	1	1LEPIDOPTERA			1 701P
6M	SN	19931103	1	1ODONATA	ANISOPTERA		5 801P
6M	SN	19931103	1	1OSTRACODA			7 901P
6M	SN	19931103	1	1OSTRACODA			7 901P
6O	SN	19930727	1	1ANNELIDA	OLIGOCHAETA		1209 11P
6O	SN	19930727	1	1COLEOPTERA	DYTISCIDAE		1 41P
6O	SN	19930727	1	1CRUSTACEA	COPEPODA		57 211P
6O	SN	19930727	1	1DIPTERA	CHIRONOMIDAE		43 311P
6O	SN	19930727	1	1EPHEMEROPTERA	BAETIDAE		51 401P
6O	SN	19930727	1	1GASTROPODA			84 501P
6O	SN	19930727	1	1HEMIPTERA	CORIXIDAE		33 601P
6O	SN	19930727	1	1HEMIPTERA	NOTONECTIDAE		4 621P
6O	SN	19930727	1	1ODONATAA	ZYGOPTERA		1 811P
6O	SN	19930727	1	1OSTRACODA			29 901P
1I	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		85 13P
1I	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		20 313P
1I	SN	19931103	1	1HEMIPTERA	CORIXIDAE		24 603P
1I	SN	19931103	1	1OSTRACODA			1 903P
1M	SN	19930727	1	1ANNELIDA	OLIGOCHAETA		497 13P
1M	SN	19930727	1	1ARACHNOIDEA	HYDRACARINA		9 33P
1M	SN	19930727	1	1CRUSTACEA	CLADOCERA		57 203P
1M	SN	19930727	1	1CRUSTACEA	COPEPODA		1201 213P
1M	SN	19930727	1	1CRUSTACEA	GAMMARUS		11 223P
1M	SN	19930727	1	1DIPTERA	CHIRONOMIDAE		29 313P
1M	SN	19930727	1	1EPHEMEROPTERA	BAETIDAE		4 403P
1M	SN	19930727	1	1GASTROPODA			30 503P
1M	SN	19930727	1	1HEMIPTERA	CORIXIDAE		114 603P
1M	SN	19930727	1	1HEMIPTERA	NAUCDRIDAEAE		44 613P
1M	SN	19930727	1	1HEMIPTERA	NOTONECTIDAE		40 623P
1M	SN	19930727	1	1OSTRACODA			172 903P
1O	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		324 13P
1O	SN	19931103	1	1CRUSTACEA	CLADOCERA		9 203P
1O	SN	19931103	1	1CRUSTACEA	COPEPODA		30 213P
1O	SN	19931103	1	1CRUSTACEA	GAMMARUS		1 223P
1O	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		12 313P
1O	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	1 343P
1O	SN	19931103	1	1HEMIPTERA	CORIXIDAE		13 603P
1O	SN	19931103	1	1ODONATA	ANISOPTERA		4 803P
1D	SN	19931103	1	1OSTRACODA			20 903P
2I	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		39 13P
2I	SN	19931103	1	1DIPTERA	CHIRONOMIDAE		5 313P
2I	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	3 343P

2I	SN	19931103	1	1ODONATA	ANISOPTERA		2 803P
2I	SN	19931103	1	1ODONATA	ZYGOPTERA		1 813P
2M	SN	19930727	1	1ANNELIDA	OLIGOCHAETA		99 13P
2M	SN	19930727	1	1ARACHNOIDEA	HYDRACARINA		2 33P
2M	SN	19930727	1	1CRUSTACEA	CLADOCERA		14 203P
2M	SN	19930727	1	1CRUSTACEA	COPEPODA		1101 213P
2M	SN	19930727	1	1CRUSTACEA	GAMMARUS		1 223P
2M	SN	19930727	1	1DIPTERA	CHIRONOMIDAE		11 313P
2M	SN	19930727	1	1GASTROPODA			24 503P
2M	SN	19930727	1	1HEMIPTERA	CORIXIDAE		78 603P
2M	SN	19930727	1	1HEMIPTERA	NAUCORIDAEAE		16 613P
2M	SN	19930727	1	1HEMIPTERA	NOTONECTIDAE		10 623P
2M	SN	19930727	1	1OSTRACODA			201 903P
2O	SN	19931103	1	1ANNELIDA	OLIGOCHAETA		66 13P
2O	SN	19931103	1	1CRUSTACEA	CLADOCERA		540 203P
2O	SN	19931103	1	1CRUSTACEA	COPEPODA		8 213P
2O	SN	19931103	1	1CRUSTACEA	GAMMARUS		1 223P
2O	SN	19931103	1	1DIPTERA	CULICIDAE	CULEX	8 343P
2O	SN	19931103	1	1DIPTERA	CULICIDAE	ANOPHELES	2 353P
2O	SN	19931103	1	1HEMIPTERA	CORIXIDAE		1 603P
2O	SN	19931103	1	1ODONATA	ANISOPTERA		4 803P
2O	SN	19931103	1	1OSTRACODA			21 903P

APPENDIX C

APPENDIX C

SALINE MARSH AND EVAPORATION CELLS DATA

Saline Vegetated Marsh Conductivity Readings

South Marsh Cell

Date	Station 1	TDS	Station 2	TDS	Station 3	TDS	Station 4	TDS	Avg EC	Avg TDS
07/13/93	6520	4238	7220	4693	7330	4765	7420	4823	7123	4630
07/14/93	6820	4433	6810	4427	7360	4784	7510	4882	7125	4631
07/21/93	7200	4680	7220	4693	8080	5252	8330	5415	7708	5010
07/23/93	3220	2093	2780	1807	2390	1554	3550	2308	2985	1940
07/29/93	5510	3582	5470	3556	6520	4238	6560	4264	6015	3910
08/02/93	6600	4290	6450	4193	6510	4232	6440	4186	6500	4225
08/04/93	6870	4466	6730	4375	7040	4576	7210	4687	6963	4526
08/09/93	7580	4927	8840	5746	8630	5610	9460	6149	8628	5608
08/12/93	7500	4875	7260	4719	9090	5909	9050	5883	8225	5346
08/18/93	6040	3926	6180	4017	6220	4043	6250	4063	6173	4012
09/01/93	7680	4992	7640	4966	9990	6494	10021	6514	8833	5741
01/18/94	5200	3380	6250	4063	6500	4225	6500	4225	6113	3973
01/21/94	5800	3770	6400	4160	6700	4355	6850	4453	6438	4184
01/26/94	5400	3510	5500	3575	5700	3705	5500	3575	5525	3591
02/24/94	2600	1690	2500	1690	2500	1625	2500	1625	2525	1658
03/03/94	2900	1885	2900	1885	3000	1950	2800	1820	2900	1885
03/11/94	3200	2080	3100	2015	3100	2015	3200	2080	3150	2048
03/18/94	4100	2665	4200	2730	4000	2600	4000	2600	4075	2649
03/28/94	2300	1495	2300	1495	2300	1495	2200	1430	2275	1479
04/04/94	2800	1820	3000	1950	2900	1885	2900	1885	2900	1885
04/19/94	2500	1625	2700	1755	2900	1885	2800	1820	2725	1771
04/27/94	750	488	1600	1040	2800	1820	2800	1820	1988	1292
05/06/94	3400	2210	4000	2600	3800	2470	4000	2600	3800	2470

North Marsh Cell

Date	Station 5	TDS	Station 6	TDS	Station 7	TDS	Station 8	TDS	Avg EC	Avg TDS
07/13/93	6360	4134	6680	4342	6580	4277	6550	4258	6543	4253
07/14/93	6470	4206	6710	4362	6570	4271	6930	4505	6670	4336
07/21/93	6250	4063	6550	4258	7140	4641	7640	4966	6895	4482
07/23/93	2120	1378	2190	1424	3530	2295	4490	2919	3083	2004
07/29/93	5200	3380	5100	3315	5200	3380	5310	3452	5203	3382
08/02/93	5400	3510	5640	3666	5520	3588	5350	3478	5478	3560
08/04/93	5280	3432	5490	3569	5630	3660	5490	3569	5473	3557
08/09/93	6860	4459	7000	4550	7220	4693	7320	4758	7100	4615
08/12/93	6270	4076	8710	5662	7070	4596	7880	5122	7483	4864
08/18/93	4860	3159	4870	3166	4790	3114	4710	3062	4808	3125
09/01/93	5570	3621	7420	4823	7990	5194	6890	4479	6968	4529
01/18/94	3500	2275	3800	2470	3950	2568	4250	2763	3875	2519
01/21/94	4050	2633	4190	2724	4360	2834	4500	2925	4275	2779
02/24/94	1400	910	1350	878	1300	845	1350	878	1350	878
03/03/94	1550	1008	1600	1040	1650	1073	1700	1105	1625	1056
03/11/94	1650	1073	1850	1203	1800	1170	1950	1268	1813	1178
03/18/94	2300	1495	2400	1560	2400	1560	2400	1560	2375	1544
03/28/94	1450	943	1800	1170	1700	1105	1750	1138	1675	1089
04/04/94	1900	1235	2200	1430	2100	1365	2300	1495	2125	1381
04/19/94	950	618	1800	1170	2500	1625	2400	1560	1913	1243
04/27/94	550	358	1050	683	2100	1365	2600	1690	1575	1024
05/06/94	1550	1008	2200	1430	2900	1885	2900	1885	2388	1552

South Evap Cell

Date	Outlet
02/24/94	4900
03/03/94	4900
03/11/94	5000
03/18/94	5200
03/28/94	4400
04/04/94	4700

North Evap Cell

02/24/94	5100
03/03/94	5200
03/11/94	5300
03/18/94	5600
03/28/94	4800
04/04/94	500

TO: LEANNE HAMILTON
FROM: STEPHEN SHOCKEY
DATE: 5/6/94
SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS	Temperature
Station 1	3,400	2,435	16° C
Station 2	4,000	2,923	15° C
Station 3	3,800	2,759	15° C
Station 4	4,000	2,923	16° C
Average	3,800	2,760	15.5

Pond #2	Electric Conductivity	TDS	Temperature
Station 5	1,550	1001	16° C
Station 6	2,200	1,490	14° C
Station 7	2,900	2,037	16° C
Station 8	2,900	2,037	14° C
Average	2,388	1,641	15° C

	EC	TDS	Temperature
Evap. Cell #1			
Evap. Cell #2			
R.O. Reject Stream			

GALLONS OF WATER PER WEEK

Pond #1

Date	# Gallons
5-6-94	2,500

Pond #2

Date	# Gallons
5-6-94	2,500

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 4-27-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	750	453
Station 2	1,600	1,037
Station 3	2,800	1,958
Station 4	2,800	1,958
Average	1,988	5,406

Pond #2	Electric Conductivity	TDS
Station 5	550	326
Station 6	1,050	651
Station 7	2,100	1,413
Station 8	2,600	1,801
Average	1,575	1,048

Evap. Cell #1	NO water
Evap. Cell #2	NO water
R.O. Reject Stream	NO water

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 4-19-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	2,500	1,723
Station 2	2,700	1,879
Station 3	2,900	2,037
Station 4	2,800	1,958
Average	2,725	1,899

Pond #2	Electric Conductivity	TDS
Station 5	950	584
Station 6	1,800	1,185
Station 7	2,500	1,723
Station 8	2,400	1,645
Average	1,913	1,284

Evap. Cell #1	No water
Evap. Cell #2	No water
R.O. Reject Stream	No water

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 4-4-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	2,800	1,958
Station 2	3,000	2,116
Station 3	2,900	2,037
Station 4	2,900	2,037
Average	2,900	2,037

Pond #2	Electric Conductivity	TDS
Station 5	1,900	1,260
Station 6	2,200	1,490
Station 7	2,100	1,413
Station 8	2,300	1,567
Average	2,125	1,433

Evap. Cell #1	4,700/3,500
Evap. Cell #2	5,000/3,754
R.O. Reject Stream	NO water

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 3-28-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	2,300	1,567
Station 2	2,300	1,567
Station 3	2,300	1,567
Station 4	2,200	1,490
Average	2,275	1,548

Evap. Cell #1	4,400/3,253
Evap. Cell #2	4,800/3,586
R.O. Reject Stream	No water

Pond #2	Electric Conductivity	TDS
Station 5	1,450	929
Station 6	1,800	1,185
Station 7	1,700	1,111
Station 8	1,750	1,148
Average	1,675	1,093

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 3-18-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	4,100	3,005
Station 2	4,200	3,067
Station 3	4,000	2,923
Station 4	4,000	2,923
Average	4,075	2,980

Pond #2	Electric Conductivity	TDS
Station 5	2,300	1,567
Station 6	2,400	1,645
Station 7	2,400	1,645
Station 8	2,400	1,645
Average	2,375	1,626

Evap. Cell #1	5,200/3,920
Evap. Cell #2	5600/4,260
R.O. Reject Stream	No water

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TO: LEANNE HAMILTON
FROM: STEPHEN SHOCKEY
DATE: 3-11-94
SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	3,200	2,275
Station 2	3,100	2,195
Station 3	3,100	2,195
Station 4	3,200	2,275
Average	3,150	2,235

Pond #2	Electric Conductivity	TDS
Station 5	1,650	1,074
Station 6	1,850	1,222
Station 7	1,800	1,185
Station 8	1,950	1,298
Average	1,813	1,195

Evap. Cell #1	5,000/3,754
Evap. Cell #2	5,300/4,010
R.O. Reject Stream	No water

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TO: LEANNE HAMILTON

FROM: STEPHEN SHOCKEY

DATE: 3-3-94

SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	2,900	2,037
Station 2	2,900	2,037
Station 3	3,000	2,116
Station 4	2,800	1,958
Average	2,900	2,037

Pond #2	Electric Conductivity	TDS
Station 5	1,550	1,001
Station 6	1,600	1,037
Station 7	1,650	1,074
Station 8	1,700	1,111
Average	1,625	1,056

Evap. Cell #1	4,900/3,670
Evap. Cell #2	5,200/3,920
R.O. Reject Stream	No water

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TO: LEANNE HAMILTON
FROM: STEPHEN SHOCKEY
DATE: 2-24-94
SUBJECT: ELECTRIC CONDUCTIVITY & TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Pond #1	Electric Conductivity	TDS
Station 1	2,600	1,801
Station 2	2,500	1,723
Station 3	2,500	1,723
Station 4	2,500	1,723
Average	2,525	1,743

Evap. Cell #1	4,900/3,670
Evap. Cell #2	5,100/3,838
R.O. Reject Stream	no water

Pond #2	Electric Conductivity	TDS
Station 5	1,400	893
Station 6	1,350	858
Station 7	1,300	823
Station 8	1,350	858
Average	1,350	858

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- CERTIFICATE OF ANALYSIS -

To: WATER RESOURCES, WETLANDS
RESOURCE DEVELOPMENT

Attn: STEVE CROMBIE Phone: (909)203-2804 Sample date: 12/02/1993
Acct: 10041516391309 Sample time: 09:30

Lab# : EMWD9309529
Sample ID : SALINE MARSH SUMP OVERFLOW EVAP. POND
Sample Matrix : RECLAIMED

PARAM_NAME	RESULTS	UNITS
TOTAL DISSOLVED SOLIDS	5860	mg/L
CONDUCTIVITY	7990	umhos/cm

Approved By

- CERTIFICATE OF ANALYSIS -

To: WATER RESOURCES, WETLANDS
RESOURCE DEVELOPMENT

Attn: STEVE CROMBIE Phone: (909)203-2804 Sample date: 12/02/1993
Acct: 10041516391309 Sample time: 09:30

Lab# : EMWD9309527
Sample ID : SALINE MARSH CELL 1, INLET
Sample Matrix : RECLAIMED

PARAM_NAME	RESULTS	UNITS
TOTAL DISSOLVED SOLIDS	3055	mg/L
CONDUCTIVITY	4800	umhos/cm

Approved By

- CERTIFICATE OF ANALYSIS -

To: WATER RESOURCES, WETLANDS
RESOURCE DEVELOPMENT

Attn: STEVE CROMBIE Phone: (909)203-2804 Sample date: 12/02/1993
Acct: 10041516391309 Sample time: 09:30

Lab# : EMWD9309525
Sample ID : SALINE MARSH CELL 1, STATION 2
Sample Matrix : RECLAIMED

PARAM_NAME	RESULTS	UNITS
TOTAL DISSOLVED SOLIDS	3605	mg/L
CONDUCTIVITY	5390	umhos/cm

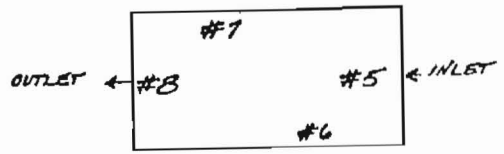
Approved By

TO: RAVI, MIKE GARNER, BEHROOZ MOSTAZAVI &
CHRISTIE CROTHER, LEANNE HAMILTON & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: SEPTEMBER 1, 1993 11:10
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

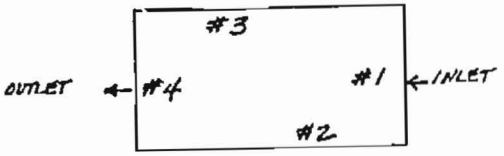
Cell #1	Electric Conductivity	TDS	Temperature	Water Added
Station 1	7,680	4,915	29	
Station 2	7,640	4,885	27	No Water Added
Station 3	9,990	6,363	26	
Station 4	10,021	6,413	24	
Average	8,832.75	5644	26.5	

Cell #2	Electric Conductivity	TDS	Temperature	Water Added
Station 5	5,570	3,564	30	
Station 6	7,420	4,748	31	No Water Added
Station 7	7,990	5,113	25	
Station 8	6,890	4,409	23	
Average	6967.5	4458.5	27.25	

NORTH CELL



SOUTH CELL



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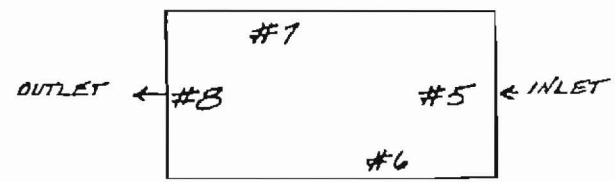
TO: RAVI, MIKE GARNER, BEHROOZ MORTAZAVI
CHRISTIE CROTHER, LEANNE HAMILTON & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: AUGUST 18, 1993 8:00 a.m.
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

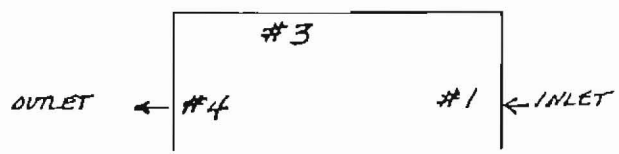
Cell #1	Electric Conductivity	TDS	Temperature	Water Added
Station 1	6,040	3,865	19	
Station 2	6,180	3,955	19	5,000 Gallons
Station 3	6,220	3,980	20	
Station 4	6,250	4,000	20	
Average	6,172.50	3950	19.5	

Cell #2	Electric Conductivity	TDS	Temperature	Water Added
Station 5	4,860	3,110	19	
Station 6	4,870	3,116	19	5,00 Gallons
Station 7	4,790	3,065	19.5	
Station 8	4,710	3,014	19.5	
Average	4807.5	3076.25	19.25	

NORTH CELL



SOUTH CELL



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TO: [illegible]
CHRISTIE CROTHER, LEANNE HAMILTON AN THULLEN
FROM: STEPHEN SHOCKEY
DATE: AUGUST 12, 1993 15:00
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

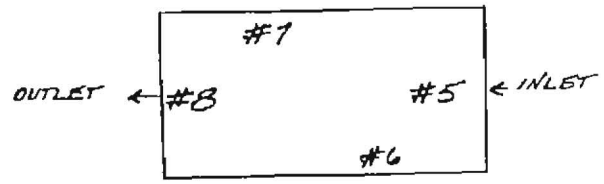
Cell #1	Electric Conductivity	TDS	Temperature
Station 1	7,500	4,800	32
Station 2	7,260	4,646	30
Station 3	9,090	5,817	29
Station 4	9,050	5,817	29
Average	8,225.00	5270	30

NO WATER ADDED

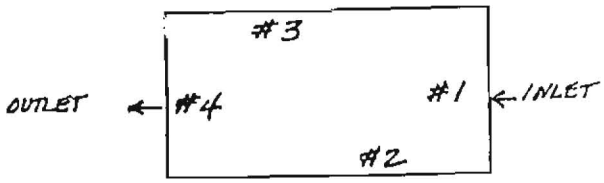
Cell #2	Electric Conductivity	TDS	Temperature
Station 5	6,270	4,012	35
Station 6	8,710	5,574	34
Station 7	7,070	4,574	28
Station 8	7,880	5,043	30
Average	7482.5	4800.75	31.75

NO WATER ADDED

NORTH CELL



SOUTH CELL



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TO: RAVI, MIKE GARNER, BEHROOZ MORTAZAVI &
CHRISTIE CROTHER, LEANNE HAMILTON & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: AUGUST 9, 1993 8:54 a.m.
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

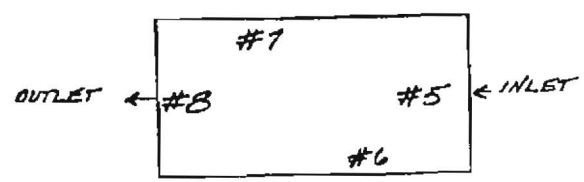
Cell #1	Electric Conductivity	TDS	Temperature
Station 1	7,580	4,851	20.2
Station 2	8,840	5,657	19.9
Station 3	8,630	5,523	20.1
Station 4	9,460	6,054	20.3
Average	8,627.50	5521.25	20.125

NO WATER ADDED

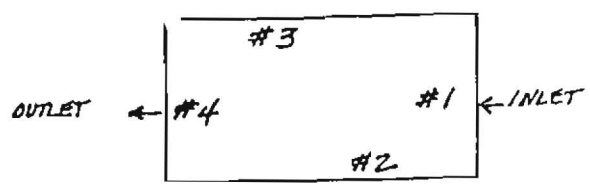
Cell #2	Electric Conductivity	TDS	Temperature
Station 5	6,860	4,390	20
Station 6	7,000	4,480	21
Station 7	7,220	4,620	20.2
Station 8	7,320	4,684	20.2
Average	7100	4543.5	20.35

NO WATER ADDED

NORTH CELL



SOUTH CELL



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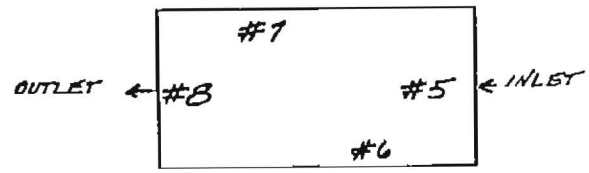
TO: RAVI, MIKE GARNER, BEHROOZ MORTAZAVI &
CHRISTIE CROTHER, LEANNE HAMILTON & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: AUGUST 4, 1993 13:23
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

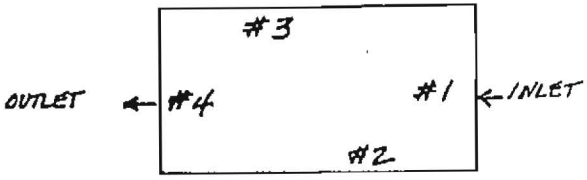
Cell #1	Electric Conductivity	TDS	Temperature	
Station 1	6,870	4,396	33.4	
Station 2	6,730	4,307	31.8	NO WATER ADDED
Station 3	7,040	4,505	30.7	
Station 4	7,210	4,614	30.2	
Average	6,962.50	4455.5	31.52	

Cell #2	Electric Conductivity	TDS	Temperature	
Station 5	5,280	3,379	35.3	
Station 6	5,490	3,513	33.9	NO WATER ADDED
Station 7	5,630	3,603	28.3	
Station 8	5,490	3,513	30.1	
Average	5472.5	3502	31.90	

NORTH CELL



SOUTH CELL



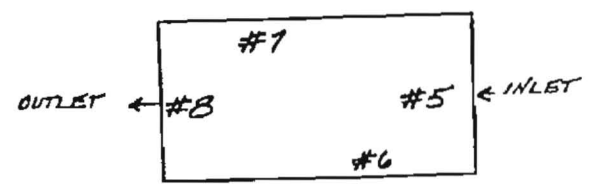
Q-Pro\EC&TDS\SS.sg 7.14.93

TO: RAVI, MIKE GARNER, BEHROOZ MC ZAVI &
CHRISTIE CROTHER, LEANNE HAMILTON & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: AUGUST 2, 1993 9:00 a.m.
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

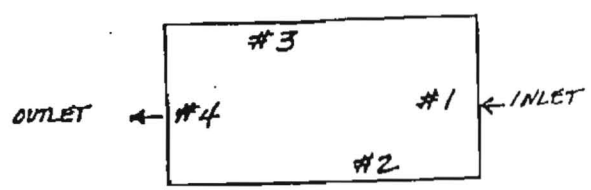
Cell #1	Electric Conductivity	TDS	Temperature	
Station 1	6,600	4,224	24.2	
Station 2	6,450	4,128	22.6	NO WATER ADDED
Station 3	6,510	4,166	22.8	
Station 4	6,440	4,121	22.4	

Cell #2	Electric Conductivity	TDS	Temperature	
Station 5	5,400	3,456	25.5	
Station 6	5,640	3,609	24.9	NO WATER ADDED
Station 7	5,520	3,532	22.7	
Station 8	5,350	3,424	22.4	

NORTH CELL



SOUTH CELL



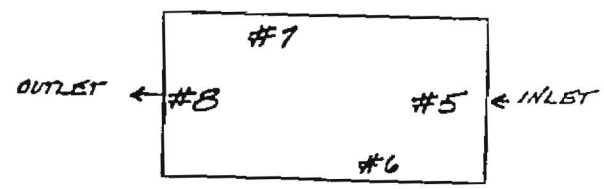
Q-Pro\EC&TDS.ag 7.14.93

CHRISTIE CROTHER, LEANNE HAMIL[illegible]N & JOAN THULLEN
FROM: STEPHEN SHOCKEY
DATE: JULY 29,1993 14:00
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Cell #1	Electric Conductivity	TDS	Temperature	
Station 1	5,510	3,526	30.2	
Station 2	5,470	3,500	31.3	NO WATER ADDED
Station 3	6,520	4,172	28.7	
Station 4	6,560	4,198	22.7	

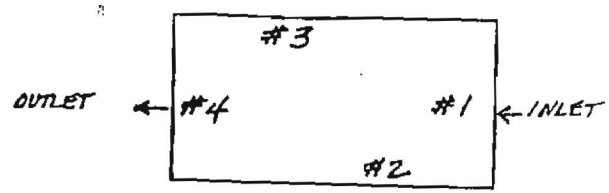
Cell #2	Electric Conductivity	TDS	Temperature	
Station 5	5,200	3,328	32.1	
Station 6	5,100	3,264	30.7	NO WATER ADDED
Station 7	5,200	3,328	25.3	
Station 8	5,310	3,398	25.4	

NORTH CELL



Q-Pro\EC&TDS.ag 7.14.93

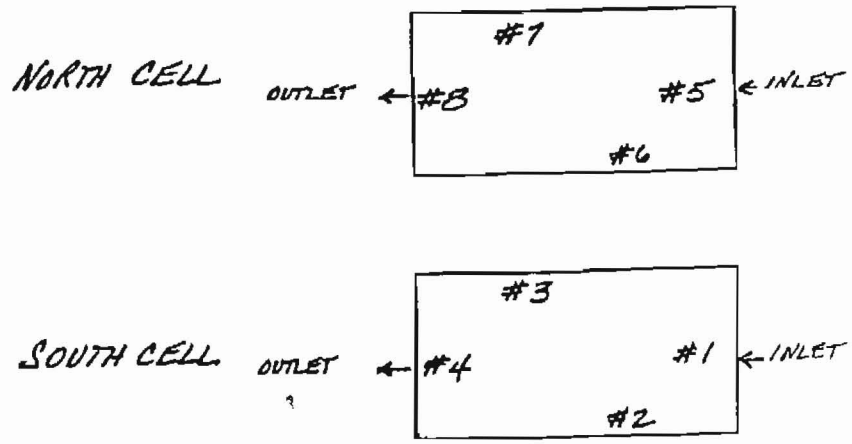
SOUTH CELL



TO; MIKE GARNER
FROM: STEPHEN SHOCKEY
DATE: JULY 14, 1993 14:41
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

Cell #1	Electric Conductivity	TDS	Temperature
Station 1	6820	4364	24.4
Station 2	6810	4358	24
Station 3	7360	4710	23.8
Station 4	7510	4806	23.2

Cell #2	Electric Conductivity	TDS	Temperature
Station 5	6470	4140	28
Station 6	6710	4294	26.1
Station 7	6570	4204	23.4
Station 8	6930	4435	22.3



cc: B Montezavl
C Crollier
Q-Pro\EC&TDS ag 7 13 93

TO; MIKE GARNER
FROM: STEPHEN SHOCKEY
DATE: JULY 13, 1993 10:30 a.m.
SUBJECT: ELECTRIC CONDUCTIVITY AND TOTAL DISSOLVED SOLIDS IN THE SALINE VEGETATED MARSHES

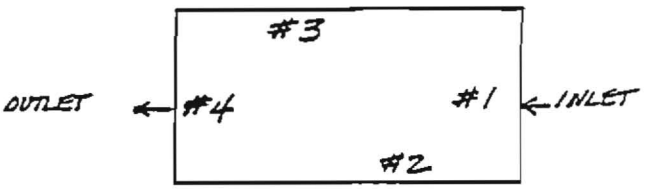
Cell #1	Electric Conductivity	TDS	Temperature
Station 1	6520	4172	21.1 c
Station 2	7220	4620	20.6
Station 3	7330	4691	21.3
Station 4	7420	4748	21

Cell #2	Electric Conductivity	TDS	Temperature
Station 5	6360	4070	20.5
Station 6	6680	4275	20.8
Station 7	6580	4211	21.2
Station 8	6550	4192	21.2

cc: B. Mortazavi
C. Crother
Q-Pro\EC&TDS.ag.7.13.93

NORTH CELL

SOUTH CELL



Client: Eastern Municipal Water Dist.
Lab No: G58472-03

Constiteunt	Method	Results	
Iron	EPA 200.7	0.03	mg/l
Soluble Iron	EPA 200.7	0.03	mg/l
Manganese	EPA 200.7	0.05	mg/l
Silicon (Si)	SM16/425C	40.1	mg/l
Soluble Silicon (Si)	SM16/425C	38.9	mg/l
Aluminum	EPA 200.7	ND<0.04	mg/l
Boron	EPA 200.7	0.66	mg/l
Total Organic Carbon	EPA 415.1	3.9	mg/l

ASSOCIATED LABORATORIES, by:

Robert A. Webber
Vice President

RAW/gk

Rev. 09/20/93 RAW/gk

NOTE: Unless notified in writing, all samples will be discarded by appropriate disposal protocol 30 days from date reported.

EASTERN MUNICIPAL WATER DISTRICT
Contracted Laboratory Analysis Request Form

Edward S. Babcock & Sons
P.O. Box 432
Riverside, Ca 92502
(909)653-3351

DATE SAMPLED: Apr 28, 1993
DATE SENT: Jan 25, 1994
REQUESTED BY: LeAnne Hamilton
APPROVED BY: Ken Marshall

Purchase Order #93-12583

ANALYSIS REQUESTED:

Beryllium Chromium Cobalt Nickel Copper Zinc Arsenic Selenium Silver Cadmium Antimony Barium Mercury Thallium Lead Iron Manganese Molybdenum, Aluminum

Calcium as $CaCO_3$, Boron, Cyanide, %Solids,

Cation Exchange Capacity, Particle Size (down to 2 μm)

EPA Method 608 (specifically Lindane, DDT, and PCBs)

SOURCE	RELEASE/LAB#	ACCOUNT #
1. Saline Marsh Soil, South Inlet	940124043	10041516391309
2. Saline Marsh Soil, South Middle	940124044	"
3. Saline Marsh Soil, South Outlet	940124045	"
4. Saline Marsh Soil, North Inlet	940124046	"
5. Saline Marsh Soil, North Middle	940124047	"
6. Saline Marsh Soil, North Outlet	940124048	"

REMARKS: LOWEST POSSIBLE DETECTION LIMITS NEEDED. DIGEST WITH A MINIMUM OF 10 GRAMS OR ANALYZE BY ICP/MS.

Note: Please refer to the PO, EMWD lab, and account numbers on the billing invoice and analytical report.

Carrier Release
Reling'd By: Gary Richard Time: 1340 Date: 1-25-94 Rec'd By: Brian Wadell

Chain of Custody Attached? YES ☐ NO ☐

P.O. Box 8300, San Jacinto, California 92383-1300,
(714)925-7676, Fax (714)929-0257

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

RECEIVED
FEB 2 3 1994
E.M.W.D.

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)

	South Inlet 940127-1978	Blank Detect. Limit
Aluminum	19200	0.4
Antimony	ND<0.3	0.3
Arsenic	ND<0.7	0.7
Barium	273	0.05
Beryllium	ND<0.4	0.4
Cadmium	0.09	0.03
Chromium	15.2	0.6
Cobalt	7.43	0.04
Copper	18.3	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	1.2	0.1
Nickel	7.4	0.3
Selenium	ND<2	2
Silver	0.85	0.02
Thallium	ND<0.5	0.5
Zinc	92.9	0.2

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)

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	South Middle 940127-1979	Blank Detect. Limit
Aluminum	20300	0.4
Antimony	ND<0.3	0.3
Arsenic	ND<0.4	0.4
Barium	245	0.05
Beryllium	0.7	0.4
Cadmium	0.06	0.03
Chromium	13.4	0.6
Cobalt	7.04	0.04
Copper	12.2	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	1.2	0.1
Nickel	6.8	0.3
Selenium	ND<2	2
Silver	0.16	0.02
Thallium	ND<0.5	0.5
Zinc	79.2	0.2

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

RECEIVED
FEB 23 1994
E.M.W.D.

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)

	South Outlet 940127-1980	Blank Detect. Limit
Aluminum	21400	0.4
Antimony	ND<0.3	0.3
Arsenic	ND<0.6	0.6
Barium	279	0.05
Beryllium	0.7	0.4
Cadmium	0.16	0.03
Chromium	14.6	0.6
Cobalt	7.76	0.04
Copper	13.1	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	1.5	0.1
Nickel	8.9	0.3
Selenium	ND<2	2
Silver	ND<0.02	0.02
Thallium	ND<0.5	0.5
Zinc	76.8	0.2

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

RECEIVED
FEB 23 1994
E.M.W.D.

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)

	North Inlet 940127-1981	Blank Detect. Limit
Aluminum	20300	0.4
Antimony	ND<0.3	0.3
Arsenic	ND<0.4	0.4
Barium	274	0.05
Beryllium	ND<0.4	0.4
Cadmium	0.16	0.03
Chromium	15.4	0.6
Cobalt	7.14	0.04
Copper	23	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	1.1	0.1
Nickel	8.1	0.4
Selenium	ND<2	2
Silver	1.09	0.02
Thallium	ND<0.5	0.5
Zinc	109	0.2

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

RECEIVED
FEB 2 3 1994
E.M.W.D.

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)
Wet Weight

	North Middle 940127-1982	Blank Detect. Limit
Aluminum	17200	0.4
Antimony	ND<0.3	0.3
Arsenic	0.9	0.4
Barium	212	0.05
Beryllium	0.5	0.4
Cadmium	0.23	0.03
Chromium	12.2	0.6
Cobalt	6.1	0.04
Copper	15.4	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	1.5	0.1
Nickel	6.2	0.2
Selenium	ND<2	2
Silver	0.49	0.02
Thallium	ND<0.5	0.5
Zinc	76.4	0.2
Percent Solids	80.6	

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

RECEIVED
FEB 23 1994
E.M.W.D.

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Million (mg/Kg)
Wet Weight

	North Outlet 940127-1983	Blank Detect. Limit
Aluminum	16000	0.4
Antimony	ND<0.3	0.3
Arsenic	ND<0.4	0.4
Barium	198	0.05
Beryllium	1.3	0.4
Cadmium	0.13	0.03
Chromium	11.2	0.6
Cobalt	6.24	0.04
Copper	15.3	0.05
Lead	ND<5	5
Mercury	ND<0.4	0.4
Molybdenum	0.8	0.1
Nickel	6.1	0.3
Selenium	ND<2	2
Silver	0.44	0.02
Thallium	ND<0.5	0.5
Zinc	76	0.2
Percent Solids	78.9	

Date Analyzed: 2/10/94

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

EDWARD S. BABCOCK & SONS, INC.
Ms. Janet Harrison

Job # 25718
February 15, 1994

LABORATORY REPORT

Sample: 940127-1981 North Inlet
Matrix: Soil

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Parts Per Million (mg/Kg)

	Sample	Spike Conc ppm	MS	% Recovery	MSD	% Recovery	% RPD
Aluminum	20300	20	18100		18100		0.0
Antimony	ND<0.3	20	18.5	92.5	17.7	88.5	4.4
Arsenic	ND<0.4	20	22	110	29.2	146*	28.1*
Barium	274	20	266		281		5.5
Beryllium	ND<0.4	20	20.8	104	22.2	111	6.5
Cadmium	0.16	20	19	94.2	18.1	89.7	4.9
Chromium	15.4	20	33.1	88.5	35.7	101.5	7.6
Cobalt	7.14	20	26.6	97.3	27	99.3	1.5
Copper	23	20	38		48.5		24.3
Lead	ND<5	20	24	120	27	135	11.8
Mercury	ND<0.4	2	2	100	1.6	80	22.2
Molybdenum	1.1	20	18.1	85	17.5	82	3.4
Nickel	8.1	20	26.1	90	26.3	91	0.8
Selenium	ND<2	200	194	97	207	103.5	6.5
Silver	1.09	20	19.6	92.6	20.4	96.6	4
Thallium	ND<0.5	20	15.4	77	15.4	77	0
Zinc	109	20	110		135		20.4

Date Analyzed: 02/10/94

* Outside warning limits

WCAS

RECEIVED
FEB 2 3 1994
E.M.W.D.

Abbreviations Summary

General Reporting Abbreviations:

B Blank - Indicates that the compound was found in both the sample and the blank. The sample value is reported without blank subtraction. If the sample value is less than 10X the blank value times the sample dilution factor, the compound may be present as a laboratory contaminant.

D Indicates that the sample was diluted, and consequently the surrogates were too dilute to accurately measure.

DL Detection Limit - Is the minimum value which we believe can be detected in the sample with a high degree of confidence, taking into account dilution factors and interferences. The reported detection limits are equal to or greater than Method Detection Limits (MDL) to allow for day to day and instrument to instrument variations in sensitivity.

J Indicates that the value is an estimate.

ND Not Detected - Indicates that the compound was not found in the sample at or above the detection limit.

ppm
ppb parts per million (billion) in liquids is usually equivalent to mg/l (ug/l), or in solids to mg/kg (ug/kg). In the gas phase it is equivalent to ul/l (ul/m^3).

TR Trace - Indicates that the compound was observed at a value less than our normal reported Detection Limit (DL), but we feel its presence may be important to you. These values are subject to large errors and low degrees of confidence.

kg kilogram	mg milligram	l liter	m meter
g gram	ug microgram	ul microliter	

QC Abbreviations:

Control Control Limits are determined from historical data for a QC parameter. The test value must be within this acceptable range for the test to be considered in control. Usually this range corresponds to the 99% confidence interval for the historical data.

% Error Percent Error - This is a measure of accuracy based on the analysis of a Laboratory Control Standard (LCS). An LCS is a reference sample of known value such as an NIST Standard Reference Material (SRM). The % Error is expressed in percent as the difference between the known value and the experimental value, divided by the known value. The LCS may simply be a solution based standard which confirms calibration (ICV or CCV - initial or continuing calibration verification), or it may be a reference sample taken through preparation and analysis.

BACTERIOLOGY
WATER TESTING
HAZARDOUS WASTE TESTING
CA DHS CERTIFICATION 1156

LABORATORIES
6100 QUAIL VALLEY COURT, RIVERSIDE

E.S. BABCOCK & SONS, INC.
ESTABLISHED 1906

909/653-3351
FAX 909/653-1662

P.O. BOX 432
RIVERSIDE, CA 92502

RECEIVED
FEB 23 1994
E.M.W.D.

]From: Edward S. Babcock & Sons, Inc.
6100 Quail Valley Ct.
Riverside, CA 92507

To: West Coast Analytical
9840 Alburtis Avenue
Santa Fe Springs, CA 90670

Date Shipped: 02-03-94
 # Containers Shipped: 6
Shipped Via: UPS

Please Reference the Following on Laboratory Report

Babcock Lab #	Sample I.D.	CT	Matrix	Sampled Date	Sampled Time	Sampled By	Analysis Requested
Eastern Municipal Water District							
Saline Marsh Soil:							
✓940127-1978	South Inlet	1	soil	4/28/93	---	--	*See Below ON ALL SAMPLES
✓940127-1979	South Middle	1	soil	4/28/93	---	--	
✓940127-1980	South Outlet	1	soil	4/28/93	---	--	
✓940127-1981	North Inlet	1	soil	4/28/93	---	--	
✓940127-1982	North Middle	1	soil	4/28/93	---	--	
✓940127-1983	North Outlet	1	soil	4/28/93	---	--	

*Lowest Possible Detection Limits (ICP/MS)
Be, Cr, Co, Ni, Cu, Zn, As, Se, Ag, Cd, Sb, Ba,
Hg, Tl, Pb, Mo, and Al

CDHS Drinking Water Report Forms Required: No

CT	Container Type	Preservative	Special Comments
6	glass	None	Please report each sample on a separate sheet.

Sample Received By: Mary Mulahey #25718

Date Sample Received: 2-4-94

Time Sample Received: 11:42 A.M.

(Janet) 1-~~[illegible]~~-948-2725
310

BACTERIOLOGY
WATER TESTING
HAZARDOUS WASTE TESTING
CA DHS CERTIFICATION 1156

LABORATORIES
6100 QUAIL VALLEY COURT, RIVERSIDE

E.S. BABCOCK & SONS, INC.
ESTABLISHED 1906

909/653-3351
FAX 909/653-1662

P.O. BOX 432
RIVERSIDE, CA 92502

RECEIVED
MAR 0 3 1994
E.M.W.D.

2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1984
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
South Inlet
EMWD #940124043

Parameter	**Result**
Iron (Fe)	23000 ppm
Manganese (Mn)	400 ppm
Calcium as $CaCO_3$	2.65 %
Boron (B)	6.4 ppm
Cyanide (CN)	<0.8 ppm
% Solids	93.4 %
Cation Exchange Capacity	3.75 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	2.2 %
35	Coarse sand	0.5 mm	4.8 %
60	Medium sand	0.25 mm	16 %
140	Fine sand	0.10 mm	13 %
300	Very fine sand	0.05 mm	21 %
(hydrometer)	Silt	0.002 mm	30 %
(hydrometer)	Clay	<0.002 mm	13 %

Date Analysis Completed: 02/23/94

Edward S. Babcock & Sons, Inc.

Allison Mack

BACTERIOLOGY
WATER TESTING
HAZARDOUS WASTE TESTING
CA DHS CERTIFICATION 1156

LABORATORIES
6100 QUAIL VALLEY COURT, RIVERSIDE

E.S. BABCOCK & SONS, INC.
ESTABLISHED 1906

909/653-3351
FAX 909/653-1662

P.O. BOX 432
RIVERSIDE, CA 92502

RECEIVED
MAR 0 3 1994
E.M.W.D.

2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1985
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
South Middle
EMWD #940124044

Parameter	**Result**
Iron (Fe)	22000 ppm
Manganese (Mn)	390 ppm
Calcium as $CaCO_3$	2.35 %
Boron (B)	5.9 ppm
Cyanide (CN)	<0.8 ppm
% Solids	90.6 %
Cation Exchange Capacity	3.75 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	2.7 %
35	Coarse sand	0.5 mm	5.8 %
60	Medium sand	0.25 mm	15 %
140	Fine sand	0.10 mm	14 %
300	Very fine sand	0.05 mm	14 %
(hydrometer)	Silt	0.002 mm	27 %
(hydrometer)	Clay	<0.002 mm	17 %

Date Analysis Completed: 02/23/94

Edward S. Babcock & Sons, Inc.

BACTERIOLOGY
WATER TESTING
HAZARDOUS WASTE TESTING
CA DHS CERTIFICATION 1156

LABORATORIES
6100 QUAIL VALLEY COURT, RIVERSIDE

E.S. BABCOCK & SONS, INC.
ESTABLISHED 1906

909/653-3351
FAX 909/653-1662

P.O. BOX 432
RIVERSIDE, CA 92502

RECEIVED
MAR 0 3 1994
E.M.W.D.

2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1986
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
South Outlet
EMWD #940124045

Parameter	Result
Iron (Fe)	26000 ppm
Manganese (Mn)	430 ppm
Calcium as $CaCO_3$	2.63 %
Boron (B)	7.3 ppm
Cyanide (CN)	<0.8 ppm
% Solids	95.0 %
Cation Exchange Capacity	1.25 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	2.6 %
35	Coarse sand	0.5 mm	5.6 %
60	Medium sand	0.25 mm	14 %
140	Fine sand	0.10 mm	13 %
300	Very fine sand	0.05 mm	19 %
(hydrometer)	Silt	0.002 mm	28 %
(hydrometer)	Clay	<0.002 mm	18 %

Date Analysis Completed: 02/24/94

Edward S. Babcock & Sons, Inc.

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HAZARDOUS WASTE TESTING
CA DHS CERTIFICATION 1156

LABORATORIES
6100 QUAIL VALLEY COURT, RIVERSIDE

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2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1987
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
North Inlet
EMWD #940124046

Parameter	Result
Iron (Fe)	23000 ppm
Manganese (Mn)	390 ppm
Calcium as $CaCO_3$	2.58 %
Boron (B)	5.7 ppm
Cyanide (CN)	<0.8 ppm
% Solids	93.0 %
Cation Exchange Capacity	3.75 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	2.5 %
35	Coarse sand	0.5 mm	4.5 %
60	Medium sand	0.25 mm	15 %
140	Fine sand	0.10 mm	15 %
300	Very fine sand	0.05 mm	26 %
(hydrometer)	Silt	0.002 mm	30 %
(hydrometer)	Clay	<0.002 mm	14 %

Date Analysis Completed: 02/24/94

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2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1988
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
North Middle
EMWD #940124047

Parameter	Result
Iron (Fe)	23000 ppm
Manganese (Mn)	400 ppm
Calcium as $CaCO_3$	2.65 %
Boron (B)	4.4 ppm
Cyanide (CN)	<0.08 ppm
% Solids	78.8 %
Cation Exchange Capacity	2.50 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	1.2 %
35	Coarse sand	0.5 mm	4.6 %
60	Medium sand	0.25 mm	15 %
140	Fine sand	0.10 mm	13 %
300	Very fine sand	0.05 mm	24 %
(hydrometer)	Silt	0.002 mm	28 %
(hydrometer)	Clay	<0.002 mm	19 %

Date Analysis Completed: 02/25/94

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2 March, 1994

To:
Eastern Municipal Water District
ATTN: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92351-8300

Lab No. 940127-1989
Invoice No. 99907

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	13:33	

Chain of Custody on File: No

Sample Marked: Saline Marsh Soil
North Outlet
EMWD #940124048

Parameter	**Result**
Iron (Fe)	22000 ppm
Manganese (Mn)	390 ppm
Calcium as $CaCO_3$	2.70 %
Boron (B)	4.8 ppm
Cyanide (CN)	<0.08 ppm
% Solids	78.1 %
Cation Exchange Capacity	1.25 me/100g

SIEVE ANALYSIS

Sieve Size	Soil Particle Size	Particle Size Diameter	Fraction Retained
18	Very coarse sand	>1.0 mm	1.8 %
35	Coarse sand	0.5 mm	1.0 %
60	Medium sand	0.25 mm	14 %
140	Fine sand	0.10 mm	15 %
300	Very fine sand	0.05 mm	16 %
(hydrometer)	Silt	0.002 mm	26 %
(hydrometer)	Clay	<0.002 mm	19 %

Date Analysis Completed: 02/25/94

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02/08/94

To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1990
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
Sample Marked: Saline Marsh Soil South Inlet EMWD#940124043 Acct#10041516391309	By BW Date 01/25/94 Time 15:15	04/28/93

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	12**	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg **Second column confirmation utilized.

cc: Sample submitted past holding time.

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Allison MacCoy

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HAZARDOUS WASTE TESTING
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To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1991
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
Sample Marked: Saline Marsh Soil South Middle EMWD#940124044 Acct#10041516391309	By BW Date 01/25/94 Time 15:15	04/28/93

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	ND	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg Sample submitted past holding time.

cc:

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To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1992
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
Sample Marked: Saline Marsh Soil South Outlet EMWD#940124045 Acct#10041516391309	By BW Date 01/25/94 Time 15:15	04/28/93

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	ND	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg Sample submitted past holding time.

cc:

Edward S. Babcock & Sons, Inc.

Allison Mack

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To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1993
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	15:15	

Sample Marked: Saline Marsh Soil North
Inlet EMWD#940124046
Acct#10041516391309

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	19**	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg **Second column confirmation utilized.
cc: Sample submitted past holding time.

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02/08/94

To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1994
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	15:15	

Sample Marked: Saline Marsh Soil North
Middle EMWD#940124047
Acct#10041516391309

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	ND	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg Sample submitted past holding time.

cc:

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02/08/94

To: Eastern Municipal Water Dist.
Attn: Mike Creighton
P.O. Box 8300
San Jacinto, CA 92581-8300

Lab No. 940127-1995
Invoice No. 99908
Customer No. ea0103

	Submitted	Sampled
By	BW	
Date	01/25/94	04/28/93
Time	15:15	

Sample Marked: Saline Marsh Soil North
Outlet EMWD#940124048
Acct#10041516391309

Chain of Custody on file: N

Organochlorine Pesticides and PCB's

EPA Method 608/8080

Parameter	Results(µg/kg)	Parameter	Results(µg/kg)
Aldrin	ND	PCB-1016	ND
α-BHC	ND	PCB-1221	ND
b-BHC	ND	PCB-1232	ND
δ-BHC	ND	PCB-1242	ND
y-BHC	ND	PCB-1248	ND
Chlordane	ND	PCB-1254	ND
4,4'-DDD	ND	PCB-1260	ND
4,4'-DDE	ND	Kepone	ND
4,4'-DDT	ND	Mirex	ND
Dieldrin	ND		
Endosulfan I	ND		
Endosulfan II	ND		
Endosulfan sulfate	ND		
Endrin	ND		
Endrin aldehyde	ND		
Heptachlor	ND		
Heptachlor epoxide	ND		
Toxaphene	ND		

ND=None detected, detection limit: * µg/kg NI=Not identifiable
Date analysis completed: 02/04/94 NA=Not analyzed

Notes: *Practical Quantitation Limit = MDL's x 670; See attached sheet.
PCB's PQL = 500 µg/kg Sample submitted past holding time.

cc:

Edward S. Babcock & Sons, Inc.

Allisa Mack

APPENDIX D

APPENDIX D

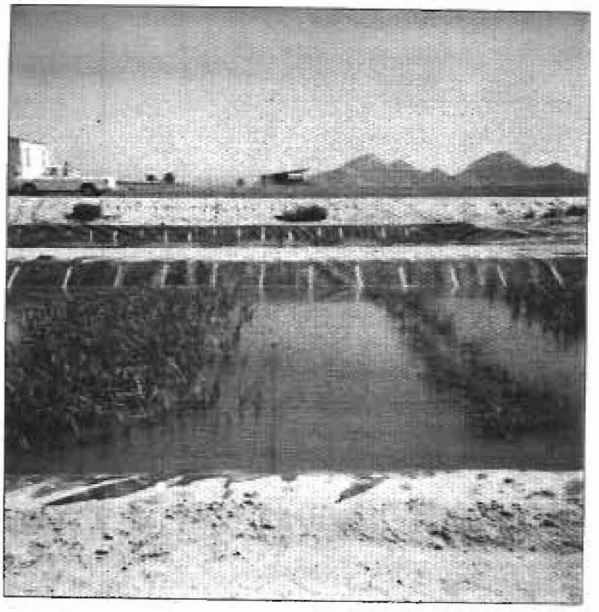
PICTORIAL HISTORY OF VEGETATION GROWTH AND ESTABLISHMENT IN SALINE MARSH

Note: S = South pond
N = North pond

S1 25 MAY 93. South Saline Pond. One month after planting. Different salinity tolerant species were planted between the yellow bands to expose plants to increasing concentrations of salinity.

N1 25 MAY 93. North Saline Pond. Same as S1.

S2 11 JUNE 93. Six weeks after planting. Plants from corms spreading.



N2 11 JUNE 93. Same as S2.

S3 23 JUNE 93. Rapid growth.

N3 23 JUNE 93. Same as S3.

S4 19 JULY 93. *Scirpus robustus* is still in a rapid growth phase and flowering. *Eleocharis palustris* showing die back.

N4 19 JULY 93. *S. robustus* and *E. palustris* showing rapid growth and flowering.

S5 5 AUGUST 93. *S. robustus* encroaching on *E. palustris*.

N5 5 AUGUST 93. *S. robustus* encroaching on *E. palustris*.

S6 2 SEPT 93. Overall browning. Unvegetated band with smartweed.

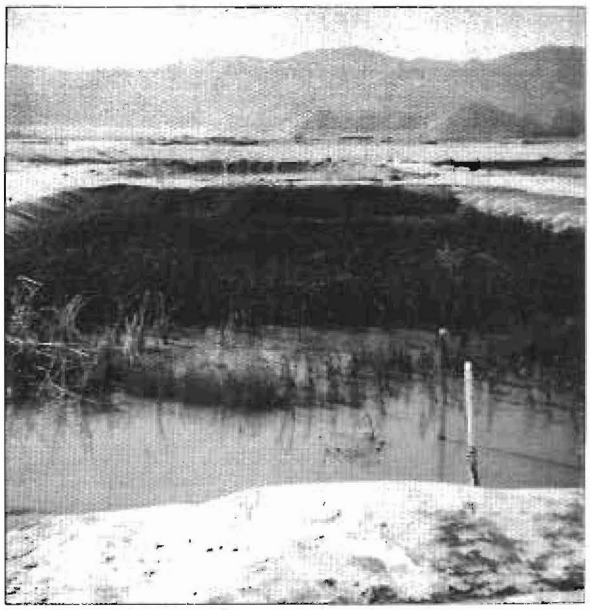
N6 2 SEPT 93. Overall browning.

S7 16 SEPT 93. Continued browning.

N7 16 SEPT 93. Continued browning.

S8 4 OCT 93. Continued browning.

N8 4 OCT 93. Continued browning.



S9 25 FEB 94. *E. palustris* greening.

N9 25 FEB 94. *E. palustris* greening

S10 25 FEB 94. *S. robustus* shows new growth.

N10 25 FEB 94. *S. robustus* shows new growth.

S11 18 MARCH 94. Rapid growth.

N11 18 MARCH 94. Rapid growth. Algal mats (*Spirogyra*) floating on water surface and covering bottom.

S12 24 MARCH 94. Rapid growth.

N12 24 MARCH 94. Rapid growth. Algal mats still visible.

S13 8 APRIL 94. Continued rapid growth.

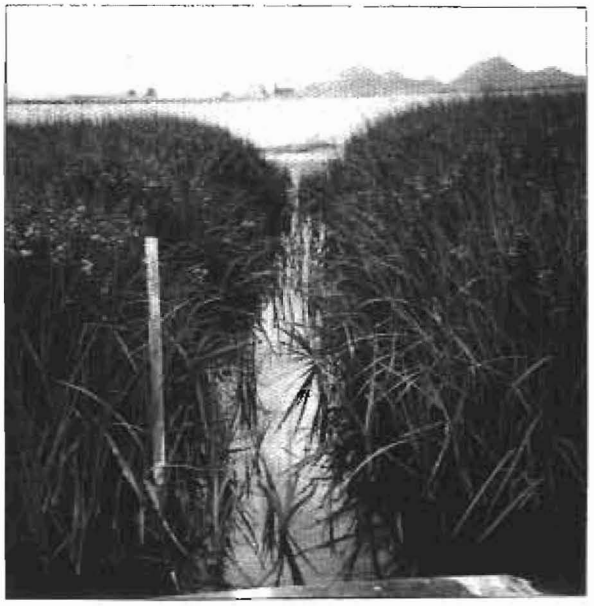
N13 8 APRIL 94. Continued rapid growth. Algal mats still visible.

S14 22 APRIL 94. Rapid expansion of growth area.

N14 22 APRIL 94. Rapid expansion of growth area. *E. palustris* beginning to fall over.

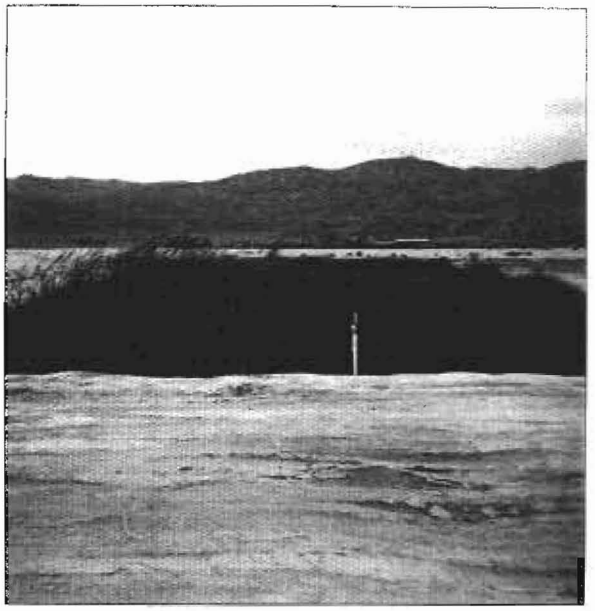
S15 6 MAY 94. Continued rapid growth. Flowering evident.

N15 6 MAY 94. Continue rapid growth. Flowering evident. Algal mat still present.



S16 6 MAY 94. *S. robustus* invading removed bands.

N16 6 MAY 94. *S. robustus* and to a lesser degree *E. palustris* invading removed bands.



S17 6 MAY 94. Overview of South Saline Pond.

N17 6 MAY 94. Overview of North Saline Pond.

LOCAL DONOR MARSH 1

22 APRIL 94. *E. palustris* in natural setting. Flowering evident.

LOCAL DONOR MARSH 2

22 APRIL 94. *S. robustus* in natural setting. Flowering evident.

APPENDIX E

APPENDIX E

SALINE MARSH RESEARCH PROGRAM
AND
PROPOSED MONITORING PROGRAM

Saline Vegetated Marshes and Evaporation Ponds Research Program

(Revised 02\22\94)

Background

EMWD is interested in the use of reverse osmosis (RO) units for treating brackish groundwater for M&I use and/or groundwater recharge. This initial investigation will determine the feasibility of additional uses of the RO reject stream, to sustain saline vegetated marshes, prior to final concentration and disposal. The pilot investigation will evaluate the quality of the reject stream and changes in the reject stream characteristics as it passes through the marshes. It will also examine the issues of toxicity and bioaccumulation in the marshes and evaporation ponds. Another tentative aspect of the research is investigation of the use of a framework/hose netting system to mechanically assist evaporation.

As part of the pilot studies program of the Multipurpose Wetlands Research and Demonstration Study, the saline marshes and the evaporation ponds have been constructed at the Hemet/San Jacinto RWRF site at the USBR/EMWD Wetlands Research Facility.

Project Overview

Two ~~8~~40 x 80 x 2 ft. lined ponds (saline marshes) have been constructed and planted with three types of saline tolerant vegetation. The saline marshes will operate in parallel. The south pond receives reverse osmosis unit reject water and the north pond, which acts as a control, receives a blend of reject water and product water from the RO unit.

The overflow from the south pond flows into two evaporation ponds to achieve further evaporative concentration of the salts. The evaporation ponds operate in series. Rather than flowing to the evaporation cells, the overflow from the north pond goes to a sump, as shown on Figure 1.

NOTE: There is potential for evaporation of the RO reject stream to concentrate toxic constituents to levels that may be hazardous to wildlife. Therefore, the evaporation ponds have been made as unattractive to wildlife as possible. The ponds have been constructed with steep nonvegetated sides so that no food, shelter or nesting areas are available. Other measures to discourage

use by wildlife shall be employed if necessary.

Research Program Objectives

General

This investigation will determine the feasibility of using the reject stream of the desalting process in vegetated saline marshes to provide an additional use of brackish water in arid areas through the irrigation of amenities such as green belts, open space and habitat areas.

Specific areas of research

Saline Marshes

1. To determine whether the reject stream of a desalination process can be used to sustain a variety of flora and fauna.
2. To demonstrate that saline marshes will not accumulate toxic materials or result in hazards to wildlife due to water quality.

Evaporation Ponds

1. To determine the effectiveness of pond design and engineering in discouraging use by wildlife.
2. To determine rates of evaporation in evaporation ponds equipped with the netting framework as opposed to standard evaporation ponds (Optional).
3. To determine whether toxics are present and concentrate to significant levels in the RO reject stream as indicated by their presence in the evaporation pond concentrate.

Specific Studies

STUDY I. Bioproductivity: Sustaining Habitat With An RO Reject Stream.

Background: The combined problems of drought and brine disposal have lead to the suggestion that high TDS, non-potable, water be used to sustain greenbelts instead of potable water. Only specific plants are tolerant to high salt content in water and soil and many of these may not tolerate the other constituents in the RO reject stream. If desalination becomes more prevalent, it will be useful to know if the reject stream can be

used for providing irrigation for greenbelts prior to final concentration and disposal. Additionally, the variety of vegetation and invertebrates present in an environment is a good indicator of habitat quality.

The Hypothesis is that the reject stream of the RO process will sustain a variety of flora and fauna as measured by plant growth and invertebrate studies.

The Experiment:

1. Reclamation's botanist will monitor plant growth quarterly. Plant growth will be monitored biweekly at first and then monthly through a combination of methods designed to assess the "sustainability" of the reject stream by District personnel utilizing general observations and a photographic record. The main consideration will be growth or no growth. The "sustainability" of the particular reject stream should be quite obvious from the photographic record.
2. Benthic invertebrates will be collected, counted, and identified annually by USBR personnel to indicate the bioproductivity and biodiversity of the system and its habitat value.
3. General observations will be made on each visit to the site by Reclamation and District personnel and observed wildlife use will be documented.

How EMWD and USBR may benefit from this study:

If saline marshes can be sustained by an RO reject stream, an otherwise "disposable" source of water can provide an additional benefit wherever brackish aquifers are reclaimed by RO or other technologies where brine disposal is a problem.

STUDY II. General Water Quality And Accumulation Of Toxics In Saline Marshes Sustained With An RO Reject Stream.

Background: Constituent concentrations present in the RO source water, and/or the particular combination of constituents, may pose a danger to the flora and fauna present in the marsh system and/or the surrounding environment. Additionally, metals and other constituents can become harmful to living organisms at low concentrations when exposure is over a prolonged period. In order to propose use of RO reject streams to sustain marsh habitat, it is essential to demonstrate that there are no problems associated with the RO reject stream quality that may harm the environment.

The Hypothesis is that the saline marshes sustained by the RO reject stream will not accumulate toxics.

The Experiment:

1. Water quality parameters will be monitored in the saline marsh influent and effluent

semi-annually. EC and TDS may be monitored more frequently if necessary. Parameters measured will include TDS, EC, Cyanide, Metals (Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Total Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc), Ammonium, Calcium, Magnesium, Potassium, Sodium, Bicarbonate, Chloride, Fluoride, Nitrate, Sulfate, BOD, Hardness, Suspended Solids, Ammonia-N, Nitrate-N, Boron and pH.

2. Soil sediment analysis will be performed at initial flooding of the marshes, one time several months after introduction of RO reject water and annually thereafter. Soil samples will be analyzed for presence of metals.

3. Plants growing in the saline vegetated marshes will be collected annually and analyzed to determine the accumulation of toxics, specifically metals, in their tissues.

4. Benthic invertebrates in the saline vegetated marshes will be collected annually and analyzed for accumulation of toxics, specifically metals.

How EMWD and USBR may benefit from this study:

If there are no significant water quality problems in the RO reject stream that pose a danger to the environment, saline marshes could be used to provide habitat on a region-wide basis without the use of potable or reclaimed water. Saline vegetated marshes may also be more acceptable to the general public than acres of evaporation ponds at desalter locations in populated areas.

STUDY III. Controlling Wildlife Use Of Evaporation Ponds.

Background: Because of the possible toxicity of the brine, it is necessary to keep wildlife from using the evaporation ponds. The evaporation ponds will be designed to discourage use by wildlife and will be maintained with no surrounding vegetation. Effectiveness of these features is an important consideration if wide use of evaporation ponds becomes an issue.

The Hypothesis is that the engineering controls, in conjunction with the maintenance controls, will discourage use of the evaporation ponds by wildlife.

The Experiment:

1. Observations will be made formally on a weekly basis during the course of the study. Signs of wildlife use such as tracks and droppings will be looked for as well

as presence of fauna in and around the ponds. Guidance from the California Department of Fish and Game will be sought if necessary.

2. A photographic record will be kept of any significant findings. A carcass log to record any dead animals found in and around the ponds will also be kept.

How EMWD and USBR may benefit from this study:

If no significant wildlife use is observed in the evaporation ponds it will demonstrate that it is possible to design and maintain saline evaporation ponds with little risk to wildlife.

STUDY IV. The Presence Of Toxics In Evaporation Pond Concentrate.

Background: Toxic constituents may be present in source water concentrations that are not detectable using standard laboratory methods. After concentration in evaporation ponds, these constituents, primarily metals, may be at detectable levels in the water. In order to determine whether evaporation ponds pose a significant danger to wildlife, it is necessary to gather data on constituents present in the evaporation ponds.

The Hypothesis is that toxic metals are not present in the saline vegetated marshes or evaporation ponds at levels that may be harmful to wildlife.

The Experiment:

1. Evaporation pond water quality will be sampled annually for metals.

2. Rainfall data will be monitored simultaneously to assure that monitoring/measuring is not done immediately after a storm event.

How EMWD and USBR may benefit from this study:

Determining the levels of toxic constituents in brine concentrate will help to determine whether additional precautions to discourage evaporation pond use by wildlife are necessary.

STUDY V. (TENTATIVE) The Effect of Using a Framework/Hose/Netting System On Evaporation Rate In A Brine Concentration Pond Network.

Background: The primary purpose of the evaporation ponds is to use solar radiation to reduce the volume of brine through evaporation. As a result of this process, the brine

becomes more concentrated. In this study, the first evaporation pond will be equipped with a framework of overhead cables, 'leaky or sweaty' hose, and monofilament netting to increase surface area for evaporation. The effect of the framework/hose/netting system will be quantified and the results will be used to determine if its use increases evaporation and makes economic sense for future projects.

The Hypothesis is that brine evaporation rates can be significantly increased using the framework/hose/netting system over rates attained by using standard evaporation ponds.

The Experiment:

1. Pan Evaporation Readings will be taken weekly.

2. Rainfall data will be monitored simultaneously to assure monitoring/measuring is not done immediately after a storm event.

3. Flow into the system from RO unit will be recorded.

4. Using total flow into the system, staff gauge reading, and pan evaporation rates, the effectiveness of the framework/hose/netting system to increase evaporation will be determined to compare with evaporation without mechanical assistance.

How EMWD and USBR may benefit from this study:

The data gathered in this study can be used to determine the economic feasibility of using the framework/hose/netting system in future brine concentrating projects.

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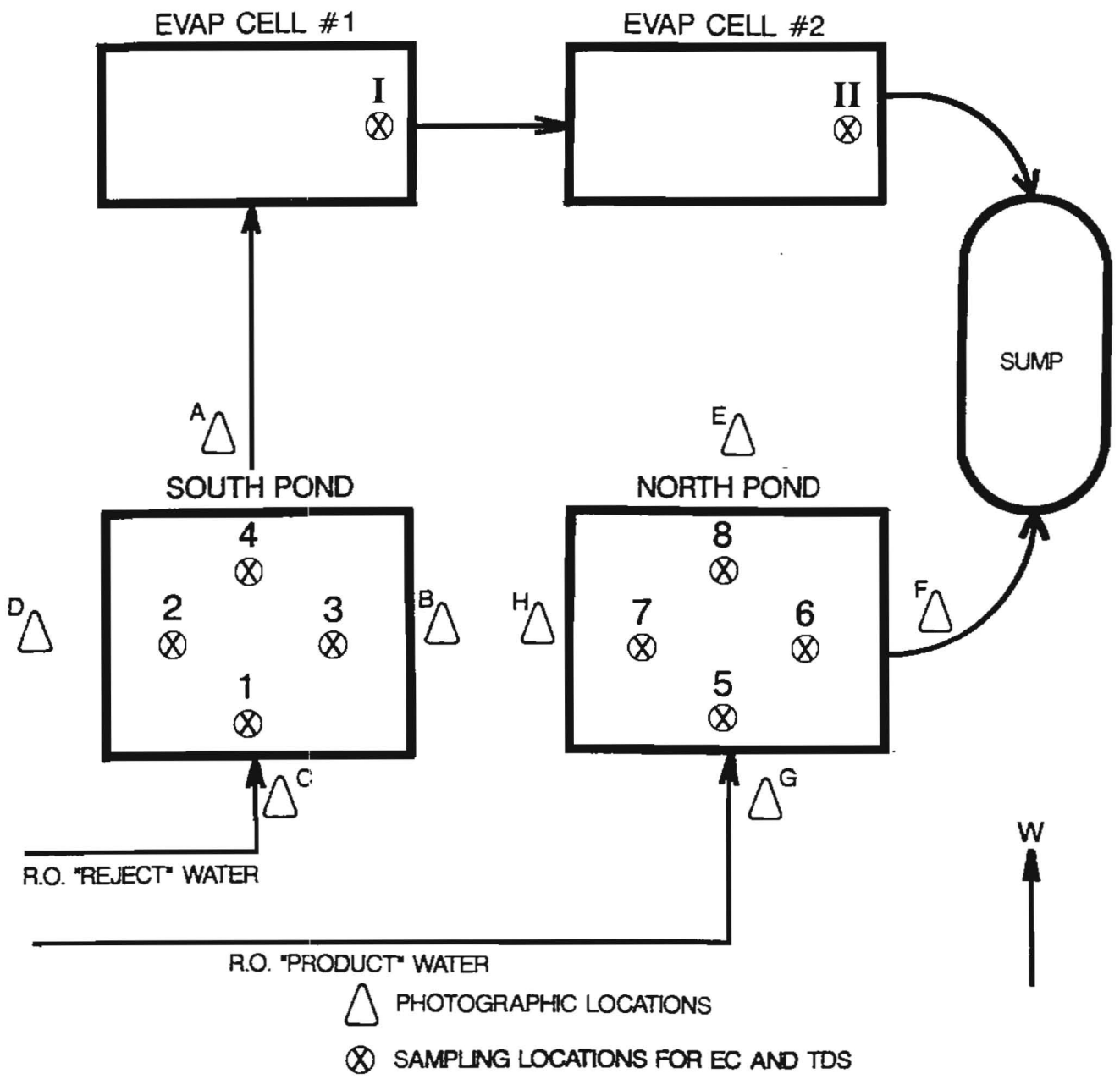
FIGURE I

FLOW SCHEMATIC OF SALINE VEGETATED PONDS AND EVAPORATION CELLS



Proposed
Saline Marsh Monitoring Program

(July 5, 1994)

STUDY I. Bioproductivity: Sustaining Habitat With A Reverse Osmosis Reject Stream

1. NBS' botanist will monitor plant growth quarterly.

2. District personnel will monitor plant growth weekly in both the control and experimental saline marshes. Written observations are to placed in both an Observation Bound Notebook and Observation Form. Copies of the Observation Forms are to be submitted monthly to the Wetland's Project Manager. If possible, the different species plant growth are to be measured weekly. Observation from plant growth by species will be ranked as follows:

<u>Plant Health Rating Scale</u>
from USBR

0 =	No effect
1, 2, 3 =	Leaf injury, epinasty, elongation abnormalities, discoloration, and/or chlorosis, minor to moderate
4, 5, 6 =	Severe symptoms of conditions 1, 2, 3 and possibility of some upper stem injury
7 =	Severe 1, 2, 3 symptoms plus 50 percent (%) stem injury
8 =	Severe 1, 2, 3 symptoms plus rhizome and stem injury; stem usually 75 percent (%) dead
9 =	Upper leaves and stem dead except for remaining 4 to 5 cm above soil; strong possibility of severe rhizome damage
10 =	Plant dead

Also, weekly Polaroid photographic records will be taken at eight (8) locations, and the photographs are permanently placed in a Photo-Logbook. In Figure 1, letters mark the photographic locations. On the photographs will be written the date and photographic location. In addition, monthly photographs on slide film will be taken at the same eight (8) locations as mentioned previously. Significant changes in plant health will also be photographed on slide film.

3. Annually, benthic invertebrates are to be collected, counted and identified, by USBR, District personnel and/or outside benthic invertebrate specialist (if funds are available). In both the control and experimental saline marshes, ten (10) random subsamplings will be collected into a large flat pan to form a composite sample. The random subsamplings will use either a core sampler or Petersen grab sampler. From the composite sample, grids are placed and all benthic organisms within a grid are removed for counting and identification. This is done either by sifting through the sediments or utilizing a series of seives. Grids will be randomly selected until at least one hundred (100) organisms have been obtained from the composite sample. The benthic organisms are to be preserved in formalin, Lugol's solution or some other preservation media for later identification. These organisms are to be classified by family and/or genus. A diversity index will be used to quantify the biological information in both the control and experimental saline marshes.

4. Wildlife and other general observations, such as weather, are to be written daily in the Observation Bound Notebook and summarized weekly on the Observation Form. Again, the Wetland's Project Manager will receive monthly copies of the Observation Forms.

STUDY II. General Water Quality And Accumulation of Toxics In Saline Marshes Sustained With A Reverse Osmosis Reject Stream

1. Semi-annually, water quality parameters will be measured by analyzing five (5) grab samples in the Saline Marshes. The five (5) sample locations are shown in figure 1, location #1, 4, 5 & 8 and the reject stream. Parameters to be measured will include:

   General Minerals - Ammonium (NH_4), Ammonia-N (NH_3-N, Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na), Bicarbonate (HCO_3), Carbonate (CO_3), Hydroxide (OH), Chloride (Cl), Fluoride (F), Nitrate (NO_3), Nitrate-N (NO_3-N), Sulfate (SO_4), Hardness (Hard), Total Dissolved Solids (TDS), Conductivity (EC), Boron (B) and pH

   Miscellaneous - ortho-Phosphate (o-PO_4), Total Phosphate-P (Total PO_4-P), Suspended Solids (TSS), % Sodium, and Sodium Adsorption Ratio (SAR)

Metals - Aluminum (Al), Antimony (Sb), Arsenic (As), Barium (Ba), Beryllium (Be), Cadmium (Cd), Total Chromium (Total Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Mercury (Hg), Nickel (Ni), Selenium (Se), Silver (Ag), Thallium (Tl), Zinc (Zn), and Boron (B)

If funding is available, Mercury (Hg), Selenium (Se), Copper (Cu) and Boron (B) will be monitored more frequently (preferably, monthly) at the five (5) sampling sites mentioned above.

2. Conductivity (EC) and Temperature (and TDS by estimation) are to be monitored weekly at nine (9) sampling sites, locations #1 thru 8 in Figure 1 and the Reverse Osmosis (R.O.) reject line.

3. Monthly, Total Dissolved Solids (TDS @ 180°C) is to be monitored at nine (9) sampling sites , locations #1 thru 8 in Figure 1 and the Reverse Osmosis (R.O.) reject line.

4. Annually, composite soil samples of the inlet and outlet of the Control and Experimental Saline Marshes (location #1, 4, 5, & 8 of Figure 1) are to be analyzed for metals (see above STUDY II Paragraph 1 "Metals"). At each sample location, a minimum of three (3) soil grab samples, 0-3 inches in depth using a core sampler or a Petersen grab sampler, are to be taken across the width of the marsh. These samples are then composited, in a large glass beaker, as one sample for each site. In addition to the "Metals" analyses, the following constituents will be tested for the soil samples.

   Particle-size analysis (PSA), pH, Conductivity (EC), Sodium Adsorption Ratio (SAR), Cation Exchange Capacity (CEC), and Organic Matter Content

5. Annually, the primary species of plants (stems, tubers and leaves) are to be collected, marked and analyzed by an outside contract laboratory for toxic accumulation, specifically Metals (see above STUDY II Paragraph 1 "Metals"). A minimum of two (2) grams (dry weight) of plants are needed for analysis, however, five (5) grams (dry weight) will be optimal. Estimated wet weight needed will be approximately one hundred (100) grams.

6. Annually, the benthic invertebrates in the saline marshes are to be collected randomly (see above STUDY I Paragraph 3) and sent to an outside contract laboratory for analysis of Metal accumulation (see above STUDY II Paragraph 1 "Metals"). In addition to the collection of the benthic organisms, rinsing and purging are required for sample

preservation. Again, a minimum of two (2) grams (dry weight) of benthic invertebrates are needed for analysis, however, five (5) grams (dry weight) will be optimal. Estimated wet weight needed will be approximately one hundred (100) grams. Once this is collected, the live benthic organisms are rinsed with filtered ambient water and held in a beaker with the filtered ambient water for four (4) to six (6) hours. This time period allows for ingested materials to be purged from the benthic organisms. After the purging period, the ambient water is drained. Again, a final rinse is done with filtered ambient water and drained.

7. Flows will be monitored daily for the control and experimental saline marshes. Flow data will be recorded in the Observation Bound Notebook, and weekly summarized on the Observation Form. Monthly, the Wetland's Project Manager will receive copies of the Observation Forms.

STUDY III. Controlling Wildlife Use of Evaporation Ponds.

1. Observations are to be made daily of wildlife use in the marshes or evaporation cellss and recorded in the Observation Bound Notebook. Weekly, the daily observations are to be summarized on the Observation Form. Also, a detailed weekly observation shall include signs of wildlife use such as tracks and droppings and be written down in both the Observation Bound Notebook and Observation Form. Again, the Wetland's Project Manager will receive monthly copies of the Observation Forms. Photographic records are to be kept of any significant findings, and the photographs will then be kept in the Photo-Logbook. On the photographs, the date, time and description of the photographs will be written down.

STUDY IV. The Presence Of Toxics In Evaporation Pond Concentrate.

1. Semi-annually, the water in the evaporation cells is to be sampled for metals (see above STUDY II Paragraph 1 "Metals"). A grab sample shall be taken at location I and II in Figure 1.

2. In addition, weather characteristics such as rainfall and evaporation (from the evaporation pan) are to be observed daily and written down in the Observation Bound Notebook. Weekly, the weather characteristics are to be summarized in the Observation Form, and monthly, copies sent to the Wetlands Project Manager.

Proposed
Saline Marsh Monitoring Program
Summary

Daily

1. Wildlife and other observations such as weather, flow data, and pan evaporation rate are to be observed and written in the Observation Bound Notebook.

Weekly

1. Wildlife and other observations such as daily flow data, weather, pan evaporation rate, are to summarized on the Observation Form.

2. Photographic records are to be taken of the Saline Marshes from eight (8) locations (see figure 1, A thru H), and the photographs are to be permanently placed in a photo-logbook.

3. Detailed wildlife use observations of the Saline Marshes and Evaporation Ponds and are to be written in the Observation Bound Notebook and Observation Form.

4. EC and Temperature (and TDS by summation) are to be monitored at locations #1 thru 8 in Figure 1 and at the R.O. Reject line.

Monthly

1. Copies of the Observation Forms are to be submitted to Wetland's Project Manager.

2. TDS @ 180°C are to be monitored at location #1 thru 8 in Figure 1 and at the R.O. Reject line.

3. Slide photographes are to be taken of the Saline Marshes from eight (8) location (see figure 1, A thru H), and the slides are to be stored in the photo-logbook.

4. Five (5) grab samples (see Figure #1, 4, 5 & 8 and reject stream) will be monitored for Selenium (Se), Mercury (Hg), Copper (Cu) and Boron (B) -- **optional.**

Quarterly

1. NBS' botanist will monitor plant growth. Dates: unknown

Semi-Annually

1. Five (5) grab samples (water) from the Saline Marshes (see Figure 1, #1, 4, 5 & 8 and reject stream for sample locations) will be sampled for General Minerals, Metals and other constituents.

Dates: June 30th and January 30th

2. Two (2) grab samples (water) from the Evaporation Ponds (see Figure 1, I & II for sample locations) are to be sampled and analyzed for Metals. Dates: June 30th and January 30th

Annually

1. From ten (10) random subsamples collected to form a composite sample, benthic invertebrates are to be collected and split. One hundred (100) random specimens are to be preserved in preservation media and identified -- **optional.** For the other split, approximately one hundred (100) grams (wet weight) of specimens will be sent to an outside laboratory for Metals analyses. Dates: June 30th

2. Four (4) composited sediment sample are to be analyzed for Metals (see figure 1, #1, 4, 5 & 8 for sample location. In addition to Metals analyses, Particle-Size Analysis (PSA), pH, Conductivity (EC), Sodium Adsorption Ratio (SAR), Cation Exchange Capacity (CEC) and Organic Matter Content will be analyzed. Dates: June 30th

3. A minimum of two (2) grams (dry weight) for each plant species are to be collected and sent to an outside laboratory for Metals analyses. Dates: June 30th

Notes

1. If samples are to be held overnight, samples are to be preserved according to either the contract laboratory's preservation procedure or 18th Edition of Standard Methods.
2. Dates are approximate days to sample.

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Saline Marsh Monitoring Program
Cost

Daily

1. Wildlife and other observations such as weather, flow data and pan evaporation rate are to be observed and written in the Observation Bound Notebook.

0.5 hr./day; 5 day/wk. = 130 hrs./yr.	$ 3,510
Supplies (Observation Bound Notebook)	$ 25

Weekly

1. Wildlife and other observations such as weather, flow data, and pan evaporation rate are to summarized on the Observation Form.

1 hr./wk. = 52 hrs./yr.	$ 1,404

2. Photographic records are to be taken of the Saline Marshes from eight (8) location (see figure 1, A thru H), and the photographs are permanently placed in a photo-logbook.

0.5 hr./wk. = 26 hrs./yr.	$ 702
Supplies (Polariod Film)	$ 400

3. Detailed wildlife use observation of the Saline Marshes and Evaporation Ponds and are to be written in the Observation Bound Notebook and Observation Form.

0.5 hr./wk. = 26 hrs./yr.	$ 702

4. EC and Temperature (and TDS by summation) are to be monitored at location #1 thru 8 in Figure 1 and at the R.O. Reject line.

Sampling: 1 hr./wk.; 52 hrs./yr. =	$ 1,404
Testing: $19.00/wk. =	$ 988

Monthly

1. Copies of the Observation Forms are to be submitted to Wetland's Project Coordinator.

$ NC

2. TDS @ 180°C are to be monitored at location #1 thru 8 in Figure 1 and at the R.O. Reject line.

Sampling: 1 hr./sampling; 12 hrs./yr. =	$ 324

Testing: $18/sample; $162/mo.; per year = $ 1,944

3. Slide photographs are to be taken of the Saline Marshes from eight (8) location (see figure 1, A thru H), and the slides are to be stored in the photo-logbook.

Sampling: see above "Weekly #2" $ NC
Supply: Film $ 50

*4. Five (5) grab samples (see Figure #1, 4, 5, & 8 and reject stream) will be monitored for Selenium (Se), Mercury (Hg), Copper (Cu) and Boron (B) -- **optional**.*

Sampling: 1 hr./sampling; 12 hrs./yr. = $ 324
Testing: $58/sample; $232/mo.; per year = $ 2,784

Quarterly

1. USBR's botanist will monitor plant growth. Dates: unknown

$ NC

Semi-Annually

1. Five (5) grab samples from the Saline Marshes (see figure 1, #1 4, 5 & 8 and reject stream for sample locations) will be sampled for General Minerals, Metals and other constituents.
Dates: June 30th & January 30th

Sampling: 4 hrs./sampling = 16 hrs./yr. $ 432
Testing: $398/sample; $1,592/semi-annually per year = $ 3,184

2. Two (2) grab samples from the Evaporation Ponds (see figure 1, I & II for sample locations) are to be sampled and analyzed for Metals. Dates: June 30th and January 30th

Sampling: 1 hr./sampling; 2 hrs/yr. = $ 54
Testing: $250/sample; $500/semi-annually per year = $ 1,000

Annually

*1. Benthic invertebrates are to be collected and split. One hundred (100) random specimens are to be preserved in formalin and identified -- **optional** . For the other split, approximately one hundred (100) grams (wet weight) of specimens will be sent to an outside laboratory for Metals analyses.* Dates: June 30th

Sampling & Preserving: 12 hrs./yr. $ 324
Testing: $321/sample; per year = $ 642
Identifying: (optional) $ 200?

2. Four (4) composited sediment sample are to be analyzed for Metals (see figure 1, #1, 4, 5 & 8 for sample location). In addition to Metals anlayses, Particle Size Analysis (PSA), pH, Conductivity (EC), Sodium Adsoprtion Ratio (SAR), Cation Exchange Capacity (CEC) and Organic Matter Content will be analyzed.
Dates: June 30th

Sampling: 2 hrs./yr.	$ 54
Testing: $394/sample; per year =	$ 1,576

3. A minimum of two (2) grams (dry weight) for each plant species are to be collected and sent to an outside laboratory for Metals analyses. Dates: June 30th

Sampling: 8 hrs./yr.	$ 216
Testing: $319/sample; per year =	$ 642

Subtotal

Sampling:	$ 9,450
Testing:	$12,960
Supply:	$ 475

Total = **$22,885**

Notes
1. Laboratory Sampling/Field Cost per hour is $27.
2. Testing Cost is from Babcock & Sons, Laboratory in Riverside, CA; Price reflects E.M.W.D.'s price discount.
3. Metals will be performed on an ICP-MS (West Coast Laboratory, in Santa Fe Springs, CA).
4. Dates are approximate days to sample.

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APPENDIX F

APPENDIX F

PUBLIC INVOLVEMENT

1994 Multipurpose Constructed Wetlands
Public Involvement & Community Relations

Presentations, Tours, Articles, and Awards

Jan.		Moreno Valley Chamber Outlook, article: Dr. Wm. Aldridge, EMWD Board of Directors, accepting NWRA award and mention of international interest in wetlands project.
	27	Planning Task Force, Working Committee Meeting, presentation and wetlands video shown by Christie Crother.
Feb.	3	Dr. Sue Yoder, Sea Grant Program, USC. Request for wetlands information and request for presentation at So. Calif. Academy of Sciences 1994 Annual Meeting, May 6-7.
	3	Bob Bastian, EPA, Technical Advisory Committee member. Request for EMWD wetlands photos for EPA publication. Also sent copy of video.
	9	Society of Iranian Environmental Professionals, presentation with color slides and handout materials. EMWD: Dr. Behrooz Mortazavi.
	10	Multipurpose Constructed Wetlands Dedication. Speakers: Daniel P. Beard, USBR Commissioner; Kay Ceniceros, Supervisor, 3rd District, Riverside County; Patrick A. Williams, Mayor Pro Tem, City of San Jacinto; Wm. G. Aldridge, Vice President, EMWD Board of Directors; and J. Andrew Schlange, General Manager, EMWD. Wetlands video shown at ceremony. Tour for Commissioner Beard and selected guests following press conference. Articles: Riverside Press Enterprise and The Hemet News.
	16	American Business Women's Association, Hemet/San Jacinto Chapter. Wetlands slide presentation and handouts, Christie Crother.
	22	Notification from AMSA of selection of project for 1994 Research and Technology Award. Presentation to be in Washington, D.C., May 23, 1994.
	25	Aida Raymond, Elsinore Valley Municipal Water District. Requested copy of wetlands video, made copy for EVMWD video library.
	28	At request of Dr. Aldridge, wetlands information packet and video sent to Jerry Uecker, Merrill Lynch, Hemet, CA. Mr. Uecker volunteered for any public involvement activities on project.
	28	Copy of wetlands video sent to Jag Salgaonkar, CH2M Hill.

Feb.		Article: Commissioner Beard Dedicates Wetland Project, Employees in Action, USBR Lower Colorado Region Newsletter.
Mar.	1	Three sets of wetlands information packets given to Ted Haring, EMWD Conservaton Coordinator, to be sent to Fred Etheridge, Attorney, East Bay MUD; Connie at ACWA; and one other.
	10	Designing Wetlands to Clean Wastewater, Reclamation/EMWD, Multipurpose Constructed Wetlands Project, Joan S. Thullen, Currents...Developing Technology for Tomorrow's Challenges, USBR Publication.
	11	Director Chet Gilbert, Citizen Ambassador Program, Water Management Delegaton to Australia, The Role of Multipurpose Wetlands in Water Resources Management in Southern California. Slide presentation, video, handouts.
	15	Dave Erlenbach, Mechanical Engineer, and Brenda L. Land, Sanitary Engineer, US Forest Service Technology & Development Center, San Dimas, Calif. Slide presentation and video, handouts, site tour. Copy of video requested and given.
	15	Multipurpose Constructed Wetlands, Progress Report by Eastern Municipal Water District, March 15, 1994, A Cooperative Program with the US Bureau of Reclamation.
	30/31	Career Festival, Fruitvale Elementary School, Hemet Unified School District. EMWD: Joanna Tewksbury, Stella Denison, Cathy Pierce, and Holly Devine. Display included Resource Development poster presentation; four wetlands aquariums containing frogs, tadpoles, gambusia, diving beetles, California and alkali burlush, spikerush, and marsh pennywort; and water conservation materials. Approximately 600 children participated.
Apr.	13	West Valley High School, Hemet Unified School District, Tour: Mr. Jay Morse and Mr. Jim Hofrock, teachers, and thirty students. Tour of Regional Water Reclamation Facility and Wetlands Research Facility, student handouts, teachers packets, and video provided. EMWD: Betty Gibbel, LeAnne Hamilton, Al Javier, and Christie Crother.
	18	John Wodraska, General Manager, Metropolitan Water District (MWD) of Southern California and Greg Taylor, General Counsel to MWD. Slide Presentation and wetlands tour.
	21	Bill Havert, Dangermond & Associates. EMWD: LeAnne Hamilton and John Crossman. Wetlands tour.
May		Wetlands Newsletter #3 (May 1994) distributed.

May 6 Arizona Water & Pollution Control Association, 67th Annual Conference, Prescott, AZ. Technical Program, Wetlands Panel Discussion: Bob Bastian, EPA; Brian Munson, AQEQ, Phoenix; Jim Sartoris, USBR; Mike Gritzuk, City of Phoenix; and Christie Crother, EMWD.

Scheduled:

May 25 Role of Constructed Wetlands in Water Resources Management. Christie Crother, John Crossman, and P. Ravishanker. ASCE Annual Conference, Denver, Colorado, May 25, 1994.

1993 - Multipurpose Wetlands Research & Demonstration Study
Public Involvement
Presentations, Tours, Awards, Articles

Jan.	12	Moreno Valley Rotarians, luncheon meeting, Moreno Valley. Slide presentation and handouts.
Jan.	21	WESTCAS - Western Coalition of Arid States, Tempe, Arizona. Quarterly meeting, January 20-22, 1993. Slide presentation and handout packets.
Jan.	28	Luis A. Garcia, Ph.D., Department of Agricultural and Chemical Engineering, Colorado State University, Fort Collins, CO. Site tour and handouts.
Feb.		Wetlands Newsletter (#1) distributed.
Feb.		EMWD Water News, Vol. 1, No. 1, February 1993, page 3, article: Wetlands Treat Water, Attract Wildlife.
Mar.	3	Tres Rios Wetlands Study, Phoenix, Az. Slide presentation and handouts. (requested by Bill Chase, City of Phoenix and Bill Weisenborn, USBR, Boulder City, NV)
Apr.	6	Hemet Breakfast Lions Club, Hemet. Presentation and handouts.
Apr.	19	Mr. Adron W. Richert, Tres Rios Study participant, 6402 S. 107th Ave., Tolleson, AZ 85353. Presentation, site tour, and handouts.
Apr.	21	Ronald W. Crites, P.E., Nolte and Associates, Sacramento, Calif. Site tour.
Apr.	29	Graduate Seminar, Soils and Environmental Science Department, University of California, Riverside. Slide presentation and handouts.
May	8	Ag. Celebration Day, West Valley High School, Hemet, CA. Manned booth, continuous slide presentation, bulrush display, handouts.
May	11	Daryl McGregor, Manager of Investigation and Design, City of Albury, New South Wales, Australia. Slide presentation, site tour, and handouts.

May	11	Dr. Laszlo J. Szijj, California State Polytechnic University, Pomona. Site tour.
May	27	Mr. Robert Erickson, Director Design/Development, Moreno Highlands (well for RO pilot project at Wetlands Research Facility). Site Tour Wetlands Research Facility.
May	28	Brad Evans, B.E. (Civil), Managing Director, Shepparton Irrigation, Benala Road, Shepparton, Victoria 3630, Australia. Presentation, site tour, handouts.
June		Wetlands Newsletter #2 (June 1993) distributed.
June	4	Colleen Mathews, P.E., Parker Consultants, El Cajon, CA. Presentation and H/SJ site tour.
June	9	District Facilities Tour, EMWD employees. H/SJ RWRF wetlands tour and handouts.
June	10	April Sleigh, Ornithologist (grad. student), California State Polytechnic University, Pomona. H/SJ site tour and information packet.
June	15	City of Hemet, H/SJ site tour following Quarterly Planning Meeting with EMWD Planning Dept. City of Hemet: Sandra Massa-Lavitt, Director of Planning and Mark Goldberg, Director of Community Development and EMWD Planning Department staff. Information packet along with site tour.
June	16	EMWD Engineering Dept. Team for Wetlands Project: Victor Barreto, Sherry Davis, Bob van Dorn, Gene Knott, Cory Wallis, and John Ward. Slide presentation, information packet, site tour.
June	17	EMWD New Employee Orientation. Slide presentation and information packet.
June	21	Mari Nord, Riverside Sewage Treatment Plant, Riverside, CA. Site tour and information packet.
June		California Water Journal, June 1993, Vol. 3, No. 6, page 5, full page profile on EMWD and Wetlands project.
June		Bulletin of the Ecological Society of America, Vol. 74, No. 2, June 1993, page 97, article on USBR/EMWD Wetlands Research Facility.

July	8	Riverside County Farm Bureau Tour for Douglas Wheeler, Secretary, The Resources Agency, and James Strock, Secretary, CAL-EPA. Tour participants also included Craig O. Schmidt, Special Assistant, Secretary of Resource; Mike Chrisman, Deputy Secretary for Operations, The Resources Agency; Jim Wells, Pesticide Enforcement, Cal-EPA; Jim Wallis, Riverside County Agricultural Commissioner; Cynthia A. Crothers, Mayor, Moreno Valley; Robert Perkins, Executive Manager, Riverside County Farm Bureau; representatives of the California, Riverside County and San Diego County Farm Bureaus; and EMWD: Rodger D. Siems, Board of Directors; Doyle F. Boen, Director, Metropolitan Water District; and Larry Libeu, Deputy Assistant General Manager, Legislative Affairs. Information packets and tour of USBR/EMWD Wetlands Research Facility and H/SJ Demonstration Wetlands site.
July	19	Riverside Land Conservancy, Stewardship Committee for Friendly Hills Ranch (immediately adjacent to Little Valley). Presentation on Little Valley conceptual plans, handouts.
July	28	Workshop on Appropriate Small Community Wastewater Treatment and Reuse Approaches for the Middle East sponsored by Agency for International Development, E.P.A., U.S. Dept. of Interior, Bureau of Reclamation, California Water Resources Control Board and Regional Water Quality Control Board and hosted in California by EMWD, Humbolt State University, Arcata, CA, and National Water Reuse and Reclamation Association. Participants represented the following countries: Algeria, Egypt, Israel, Jordan, Morocco, Oman, West Bank, Gaza Strip, Tunisia, Yemen, and Russia. This forum was part of the Middle East Peace Talks. The days activities included an overview of EMWD, the Total Water Resources Management Program, and reclaimed water reuse; a slide presentation on multipurpose constructed wetlands project; and a presentation on the USBR, the Region, and the Comprehensive Water Reclamation and Reuse Study in Southern California. The afternoon field trip included a visit to the Alessandro Reclaimed Water Recharge Ponds, crops irrigated with reclaimed water, the USBR/EMWD Wetlands Research Facility, and the H/SJ Demonstration Wetlands site. A large information packet was distributed to each participant.
July	29	City of Murrieta Planning Department: Fred Buss, Assistant Planning Director, Advanced Planning; Daniel R. Clark, Assistant City Engineer; and Roger Scherer, Planning Technician. Wetlands Research Facility and H/SJ Demonstration site tours and information packets.
July	30	California Department of Fish and Game: Tom Paulek, Manager San Jacinto Wildlife Area. Wetlands Research Facility and H/SJ Demonstration site tour.

Aug.	19	Dr. Stanley Ponce, Chief, Research & Lab. Services Division, and Dr. Jim LaBounty, USBR. Wetlands Research Facility, H/SJ Demonstration site, and Little Valley site tour and information packet.
Aug.	20	Ronald B. Linsky, Executive Director, National Water Research Institute (NWRI). Wetlands Research Facility and H/SJ Demonstration site tour and information packet.
Aug.	23	Stanley J. Hightower, Head, Analysis and Water Treatment Section, and Bill Boegli, USBR. Wetlands Research Facility and H/SJ Demonstration site tour and information packet.
Aug.		EMWD Reports, Vol. 2, No. 1, August 1993, page 1, article: Wetlands Enhance Local Ecology.
Sep.	1	Ms. Aida Raymond, Civil Engineering Associate, Elsinore Valley Municipal Water District. EMWD: LeAnne Hamilton and Christie Crother. Wetlands packet and tour of H/SJ RWRF Wetlands Research Facility and Demonstration sites.
Sep.	15	EMWD Employees District Facilities Tour (conducted by Charles Kratch.) Handouts and tour of H/SJ RWRF sites.
Sep.	17	Inland Empire West Resource Conservation District, 1993 Conservation Partnership Awards. EMWD wins in Water Quality Category. The first annual Conservation Partnership Awards were presented for Water Quality, Technical Innovation, Community Outreach, Conservation Leadership, Employee Awareness, and Media Coverage. Over 120 projects, organizations and/or individuals were nominated.
Sep.	22	Mr. John Sayre, former Assistant Secretary, U.S. Department of the Interior. EMWD: P. Ravishanker and Christie Crother. Wetlands packet and facilities tour including Little Valley, USBR/EMWD Wetlands Research Facility, H/SJ RWRF Demonstration Wetlands, and PL-84-984 sites.
Sep.	22	Recon (Regional Environmental Consultants) representatives: Cameron C. Patterson, Director Resources Group; Paul S. Fromer, Director Conservation Biology; and Candice Heavin Benn, Business Development Director. Conducted by Roger Turner, Senior Environmental Planner, and Betty Gibbel, Education Specialist/Community Relations. USBR/EMWD Wetlands Research Facility and Demonstration Wetlands site tour and information packets.

Sep.23-25 WESTCAS (Western Coalition of Arid States) Display booth at Tri-State Technical Conference.
Photographs and information on Wetlands and reclaimed water reuse projects provided for display to Mr. James K. Brown, III, City of Phoenix.

Sep. 23 The Human Resource, Vol. II, Number 10, September 1993, (Newsletter included with employee paychecks), page 1, article: EMWD Hosts International Group.

Sep. 30 People's Republic of China: Mr. Li Quihon, Agronomist, Station of Agro-Ecological Environmental Protection, Hubei Province; Mr. Wang Drong, Associate Research Fellow, Institute of Agro-Environmental Protection and Monitoring, Ministry of Agriculture, Beijing; Mr. Yan Cheng, Engineer, Department of Environmental Protection and Energy, Ministry of Agriculture, Beijing; Ms. Bian Hua, Interpreter, Department of International Cooperation, Ministry of Agriculture, Beijing; and, host, Dr.Andrew Chang, Director of Kearney Foundation of Soil Science, University of California, Riverside. Tour sponsored by U.S. Department of Agriculture. EMWD: Roger Turner and Christie Crother.
Slide presentation, H/SJ RWRF site tour, and information packets.
Newspaper articles and pictures appeared in all editions of the Riverside Press Enterprise and The Hemet News.

Oct. 1 Sub-Regional Operating Group (SROG) and U.S. Bureau of Reclamation. Participants: City of Phoenix - Bill Chase, Water Advisor, Mike Gritzuk, Water Services Director, Paul Kinshella, Water Service Department, and Andrew Richardson, Consultant; City of Glendale - Grant Anderson, City Engineer; City of Mesa - William Haney, Assistant Utilities Manager; City of Tempe - Denzil Jones, Water/Wastewater Supervisor; Gila River Indian Community - - Lee Thompson, Director; and Reclamation - Carol Erwin, Planning Chief, Marvin Murray, Civil Engineer, Eric Stiles, Hydraulic Engineer, and Bernice Sullivan, Project Manager. EMWD: C. Crother, L. Hamilton, and B. Gibbel.
Slide presentation, H/SJ RWRF Wetlands Research Facility and Demonstration Wetlands sites and SJWA tour, and information packets.

Oct. EMWD Reports, Vol. 2, No. 2, October 1993. Page 2 article and picture on Middle East visit and tour.

Oct. 8 Mr. Dennis Underwood, former Commissioner, Bureau of Reclamation, and Mrs. Carmen Underwood. EMWD: Mike Garner and Christie Crother.
Tour Wetlands Research Facility and H/SJ Demonstration site; information packet.

Oct. 26 Mr. David Reynolds, Federal Relations Director, Association California Water Agencies (ACWA), Washington, D.C. EMWD: J. Crossman and L. Hamilton.
Site tour, information packet.

Oct.	28	Letter rec'd: David Kincaid, Senior Scientific Advisor, Research and Exchange Division, U.S. Department of Agriculture, Office of International Cooperation and Development re: Sept. 30 visit by Chinese.
Oct.	29	Mr. Robert James, U.S. Fish & Wildlife Service, Fish & Wildlife Biologist, Carlsbad Field Office. EMWD: LeAnne Hamilton/Christie Crother. H/SJ site tour and information packet.
Nov.	9	City of Temecula Planning Department: Saied Naaseh, Planner; Matthew Fagan, Asst. Planner; and Linda Beaudoin, Planning Technician. EMWD: Betty Gibbel H/SJ site tour and information packet.
Nov.	12	Tom Ash, Environmental Education Coordinator, Irvine Ranch Water District, and Horticulturist, U.C. Cooperative Extension. EMWD: LeAnne Hamilton. Tour of H/SJ site and information packet.
Nov.	14	Hemet Junior Womans Club. Judging of grant applications by area teachers by Christie Crother.
Nov.	15	Nancy Rengert, Senior District Aid to Senator Bill Leonard. EMWD: Christie Crother, Dick Heil, Betty Gibbel. Tour of H/SJ site, overview of District and Wetlands Research & Demonstration Study, information packet.
Nov.	16	City of Temecula Planning Department. EMWD: Betty Gibbel H/SJ site tour and information packet.
Nov.	18	Margaret, research asst. to Dr. Bill Frankenburger, UCR. Bulrush for research project.
Nov.	19	Park Hill Elementary School (Teresa Gonter, 5th grade teacher and parents) visit to H/SJ RWRF and Wetlands Research Facility with Gene Hertzog, USBR, to take photos for video. Special presentation by Stella Denison - ecology games and instruction. EMWD: Betty Gibbel, Christie Crother, Steve Crombie, Joanna Tewksbury.
Nov.	20	Dr. Bill Frankenburger (UCR) and Margaret, research asst. Packet, tour of H/SJ site, bulrush for research project for US Navy on Guam (wetlands fouled with oil).
Dec.	1	Press Release: EMWD Praised for National Water Policy Contributions (wetlands project mentioned).
Dec.	9	City of Moreno Valley Planning Department. Moreno Valley: John Feenstra, Dep. City Engineer; Jeff Specter, Nita Bullock, and Chris Ormsby, Moreno

Valley Planning. EMWD: Betty Gibbel
H/SJ site tour and information packet.

Dec. 12/16 Conserve '93, Las Vegas, Nevada. Paper presented by Mike Garner. Poster Presentation by P. Ravishanker and John Crossman, EMWD, and Ron Willhite, USBR.
Requested wetlands materials sent:
Michael A. Nolan, Vernon Irrig. Dist., Vernon, BC, Canada
Phyllis Connor, San Juan Suburban Water District
Robert Kourik, West Coast Editor, Garbage Magazine
John Prendergast, Managing Editor, Civil Engineering
Rosalie Bock, Alameda County Water District

To be Scheduled: 1) USBR, Lower Colorado Region, Boulder City, Nevada, Finance Department.
2) Advisory Committees to EMWD Directors Gilbert and Ashley.

Wetlands Presentations and Tours

1991

Oct. 28	Ted M. Weggeland, District Representative for Congressman Al McCandless, U. S. House of Representatives, and Rodger Siems, President, EMWD Board of Directors. Slide presentation and site tour.
Nov. 1	U.S. Soil Conservation Service: Robert D. Slayback, Plant Materials Specialist, Davis, and Bob Hewitt, San Jacinto. Tour of Wetlands Research Facility.
Nov. 8-9	California Water Policy - Toward a New Consensus - Conference, Los Angeles, CA. Manned booth, continuous slide presentation, handouts.
Nov. 13	J. L. Meyer, P.E., Irrigation and Soils Specialist, Department of Soil and Environmental Sciences, University of California, Riverside. Slide presentation and site tour.
Nov. 15	John Taylor, Public Works Operations Superintendent, City of Sierra Vista, Arizona. Slide presentation and site tour (at request of USBR staff, Denver).
Dec. 11	Steven Moise, Supervising Environmental Health Specialist, and Hugh Murray, Vector Ecologist, Riverside County Department of Health; and Dave Sandell, Vector Control Technician, City of Moreno Valley. Slide presentation and tour.

1992

Jan.10-12	Planning and Conservation League 1992 Environmental Legislative Symposium, Sacramento, CA. Manned booth, continuous slide presentation, handouts.
Feb. 4	Regional Water Quality Control Board, Santa Ana Region, Riverside Office: Bob Nicklen, Linda Garcia, Hope Smythe, and Pat Carrol. Slide presentation and site tour.
Feb. 6	Wetlands Executive Committee. Slide presentation and site tour.

Mar. 5	USBR - Ed Backstrom. Slide presentation and site tour.
Mar. 10	EMWD New Employee Orientation. Slide presentation and handouts.
Mar. 27	Moreno Valley Regional Water Reclamation Facility: treatment plant operators and water operators. Slide presentation and handouts.
Mar. 27	Hemet/San Jacinto Regional Water Reclamation Facility: treatment plant operators and water operators. Slide presentation and handouts.
Apr. 2	Tom Inouye, Water Resources Control Board and TAC; Dr. Mir Mulla, Entomologist, UCR; and Dr. William K. Reisen, Research Entomologist & Director, Arbovirus Field Station, UC Berkeley. Slide presentation and site tour.
Apr. 10	California Water Pollution Control Association Conference, Sacramento, CA. Paper and slide presentation.
Apr. 24	Hidden Valley Wetlands Task Force: Gordon Anderson, RWQCB; Tom Paulek, Calif. Dept. Fish & Game; Gail Briggs McPherson and Patsy Chavez, City of Riverside Dept. of Public Works; Terry Frizzal, Mayor of Riverside; and Carla Wakeman, Riverside County Parks Dept. Slide presentation, handouts and site tour.
Apr. 27	Chuck Williams and Ken Eickelberg, Sacramento Regional Wastewater Treatment Plant, Sacramento. Slide presentation and site tour of plant propagation cells.
May 2	EMWD Administrative Branch staff. Slide presentation and handouts.
May 12	USBR: John Johnson, Bernice Sullivan, Dick Schaefer. Slide presentation and site tour.
May 20	Sun City Regional Water Reclamation Facility: treatment plant operators and water operators. Slide presentation and handouts.
May 26	The Planning Center, Newport Beach: Randy Jackson and Greg Way; and Bill Dyer, EMWD. Slide presentation and handouts.

June 5	Hemet/San Jacinto Groundwater Association (including Francis Boykin, Mayor of San Jacinto; Pam Easter, S.J. City Manager; Clayton Record, NBS Lowry; Larry Minor, Agri-Empire; and Leonard Hale and Bob Elliot, Lake Hemet Municipal Water District.) Site tour, handouts, and article written for GW Association Newsletter.
June 9	EMWD New Employee Orientation. Slide presentation and handouts.
June 23	Nolte & Associates: Ron Crites, Sacramento; Jon Walters and Thomas Chadwick, San Diego; and Tom Stephenson, Mission Viejo. Slide presentation, handouts and site tour.
July 8	EPA: Harry Seraydarian, Director Water Management Division Region IX; Phil Oshida, Wetlands Section Chief; Mary Butterwick, Santa Margarita Watershed Planning; Stephanie Wilson, Wastewater on Wetlands; Rebecca Tuden; and Dave Liden. USBR: Gary Bryant. EMWD: J. A. Schlange, General Manager; Peter Archuleta; Assistant General Manager; and Mike Garner; Resource Development Administrator. Slide presentation, handouts and tour of Wetlands Research Facility.
July 11	Moreno Valley Ecological Protection Committee (including Director Chet Gilbert; Dr. Laszlo J. Szijj, Cal Poly Univ., Pomona; City of Moreno Valley: Nita Bullock, Chris Ormsby, Stuart Sheldon, Bob Bullock, and Glen Krieger; Planning Commission and Candidate for City Council Charles White; EPC: Peter Sturtevant (Chairman), John Ryan (Chairman-elect), Cathy Godfrey, Thea Lee, Coralee Dada, Jerry Budlong, Jan Byers; and Louise Heil. Slide presentation, handouts and site tour.
July 16	EMWD Student Interns (16). Slide Presentation and handouts.
July 28	San Jacinto City Council and Annexation 66 Committee (including Mayor and City Manager of San Jacinto, City Council, Duck Club owners, and property owners adjacent to H/SJ RWRF). Slide presentation, handouts, and tour of H/SJ RWRF site.
Aug. 15	ACWA (Association of California Water Agencies) Congressional Staff Tour. Slide Presentation, Special Packets, Tour of USBR/EMWD Wetlands Research Facility and Demonstration Wetlands Site, and driving tour of San Jacinto Wildlife Area.
Aug. 17	Technical Advisory Committee for Multipurpose Wetlands Research & Demonstration Study including Linda Garcia, RWQCB; Dr. Robert Gearheart, Humbolt State University; Dr. Richard Gersberg, San Diego State University; Dr. Lee Ischinger, US F&WS NERC; John Konecny, US F&WS, Earl Lauppe,

Cal F&G; Dr. Mir Mulla, UCR; Hugh Murray and David Richardson, Riv. Co. Dept. of Health; Tom Paulek, Cal F&G San Jacinto Wildlife Area: Dr. Marilynn Yates, UCR; et al.
Slide presentation and site tour.

Aug. 25 EMWD/Metropolitan Water District (MWD) Staff Meeting. MWD Staff: Greg Taylor, Wiley Horne, Debra Man, Grace Chan, and Adam Tear. EMWD Staff: J. A. Schlange, P. Ravishanker, Tony Pack, Joe Grindstaff, Hooite Rugge, B. Mortazavi, Mike Garner, John Fricker, Jack Devers, Ted Haring, Chuck Rathbone, et al.
Slide presentation and handouts.

Sep. 25 William P. Magdych, PhD, Woodward-Clyde Consultants, San Diego, CA.
Slide presentation, handouts, and tour of H/SJ RWRF site.

Sep. 29 EMWD New Employee Orientation.
Slide presentation and handouts.

Oct. 8 US Geological Survey, San Diego Office: Dr. Terry Rees et al.
Slide presentation, site tour, and handouts.

Oct. 9 Michael Van Erdewyck, Lemna Corporation, St. Paul, MN.
Slide presentation, handouts, and site tour.

Oct. 23 Y.S.Lin, Y.S.Lin Associates, Inc., Monrovia, CA; Feng Weixing, Senior Engineer, Director, Weifang City Science Research Institute of Environmental Protection, Task Group of Prevention of Water Pollution of Wei River Basin, Aiding Item of UNDP; Yang Weirui, Senior Engineer, Associate Director of Environmental Protection Bureau of Weifang City, Member of Environment Science council of Shandong Province, Leader of Task Group of Prevention of Water Pollution of Wei River Basin, Aiding Item of UNDP; Chou-fa Yauo, Weifang City Manager; and Ye-shih Lin, P.E., DEE, President, Weifang City, China.
Slide presentation, handout packet, and site tour.

Oct. 26 EMWD Purchasing, Contracts, and Warehouse Staff Meeting.
Slide Presentation and handouts.

Oct. 26 CH2M Hill: Jag Salgaonkar - Santa Ana, CA, Michelle A. Girts - Portland, Lynn Hosley, and Tom Peterson.
Slide presentation, handouts and site tour.

Nov. 18 USBR, Lower Colorado Regional Office, Boulder City, Nevada: John E. Peterson II, William G. White, Michael T. Walker, Mary Laswell, Kathy Hedges. EMWD: Virgal Woolwolk, Roger Turner, George Borlace.
Slide presentation and tour of all three sites.

Nov. 20 California's Local Government Commission Award for Innovation in Water Conservation, Reclamation and Management for USBR/EMWD Multipurpose Wetlands Research and Demonstration Study. Award accepted by Craig Weaver, Member, EMWD Board of Directors, at annual California Water Policy: Toward a New Consensus II Conference, Los Angeles.

Nov. 24 Al McCandless, Member of Congress, David J. Schroeder, Legislative Assistant. EMWD: Rodger Siems, President, Board of Directors; Ed Hallenbeck, Deputy General Manager; Anthony Pack, Assistant General Manager, Administration; Larry Libeu, Deputy Assistant General Manager - Administration; and Dick Heil and Peter Odencrans, Community Relations Officers.
Slide presentation, site tour, special handout packet.

APPENDIX G

APPENDIX K

MINUTES OF JULY 8, 1994, TECHNICAL ADVISORY COMMITTEE MEETING (INCLUDING COMMENTS ON DRAFT PHASE II/III REPORT FROM TECHNICAL ADVISORY COMMITTEE)

Eastern Municipal Water District

General Manager
J. Andrew Schlange

Legal Counsel
Redwine and Sherrill

Director of The Metropolitan Water District of Southern California
Doyle F. Boen

Treasurer
Rogers M. Cox

Board of Directors
Chester C. Gilbert, President
Wm. G. Aldridge, Vice President
Marion V. Ashley
Rodger D. Siems
Richard R. Hall

Secretary
Mary C. White

August 18, 1994

8/29

TO: EMWD/USBR/NBS Multipurpose Constructed Wetlands Study Technical Advisory Committee

FROM: LeAnne Hamilton
Project Manager

SUBJECT: July 8, 1994 TAC Meeting Minutes

Dear TAC Participant:

Enclosed is a summary of the July 8 TAC Meeting for the Multipurpose Wetlands Research and Demonstration Study. It was a very valuable meeting, providing a wealth of information and suggestions to help us design future research and demonstration studies. Thank you very much for your participation.

If you were unable to attend this meeting, I hope that the minutes will keep you informed and that you will be able to attend the next meeting. Any comments or suggestions that you have are always welcome.

Again, thank you for your interest, time, and support for this project.

LeAnne

Enc.

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Main Office: 2045 S. San Jacinto Avenue, San Jacinto • Customer Service/Engineering Annex: 440 E. Oakland Avenue, Hemet, CA

SUMMARY OF
THE TECHNICAL ADVISORY COMMITTEE MEETING
EMWD/USBR/NBS
MULTIPURPOSE WETLANDS RESEARCH & DEMONSTRATION STUDY
JULY 8, 1994
EMWD BOARD ROOM

ATTENDEES	REPRESENTING
Tim Ulrich	U.S. Bureau of Reclamation
April Sleigh	Cal Poly, Pomona
Andrew Haimov	Cal Poly, Pomona
Dr. Richard Gersberg	San Diego State University
Eric Stiles	U.S. Bureau of Reclamation
Lee Ischinger	NBS-Fort Collins, Colorado
Doug Andersen	NBS-Denver
Robert James	U.S. Fish & Wildlife Service
Joan Thullen	NBS-Denver, Colorado
Jim LaBounty	U.S. Bureau of Reclamation
Dick Whitson	U.S. Bureau of Reclamation
Mir S. Mulla	UC Riverside
Jim Sartoris	NBS/USBR-Denver
Jean Shepherd	USBR-Boulder City, Nevada
Amy Porter	USBR-Boulder City, Nevada
Robert Gearheart	Humboldt State University
Bob Knight	CH2M Hill
Hugh Murray	Riverside County Environmental Health
David Richardson	Riverside County Environmental Health
Linda Garcia	Santa Ana Regional Water Quality Control Board
Alfred Javier	Eastern Municipal Water District
Christie Crother	Eastern Municipal Water District
Mike Garner	Eastern Municipal Water District
LeAnne Hamilton	Eastern Municipal Water District
John Ward	Eastern Municipal Water District
Steve Crombie	Eastern Municipal Water District
Stella Denison	Eastern Municipal Water District

The group was welcomed by Jean Shepherd, USBR Project Manager, and the participants introduced themselves. Ms. Shepherd asked that comments be submitted on the draft Multipurpose Wetlands Research and Demonstration Study Phase II/III report. (Three of the technical advisors submitted written comments after the meeting. The comments are attached).

The agenda was reviewed by LeAnne Hamilton, EMWD Project Manager, and the group then loaded a bus and took a tour of the EMWD/USBR/NBS Multipurpose Wetlands Research and Demonstration Facility at the Hemet/San Jacinto Regional Water Reclamation Facility (RWRF).

The group returned from the tour and Ms. Hamilton briefly explained the program objectives, research objectives, and the issues for discussion by the TAC. The TAC was asked to focus on: 1) the lessons learned so far in the research and demonstration studies; and 2) the recommendations for future wetlands research and demonstration projects. The research objectives were separated into objectives for the pilot cells, saline marshes, and demonstration wetlands. The program objectives included both management objectives (water reuse, public involvement, multipurpose habitat, etc.) and operational objectives (erosion control, vector control, vegetation management, etc.).

Ms. Hamilton asked that the participants break into smaller groups to discuss issues:

Group 1: Water Quality and Sediment/Water Interactions
Group 2: Vector and Pathogen Issues
Group 3: Wildlife, Invertebrate, and Plant Issues.

The discussion groups met for approximately 2½ hours. At the end of the day, the whole group reconvened in one room and a representative of each discussion group gave a brief synopsis of their discussion.

VECTOR AND PATHOGEN ISSUES

Mr. Al Javier summarized the "Vector and Pathogen Group" discussion:

Vectors

Two weeks prior, the mosquito count in the research cells had been 500+ per dip. The latest count was only 100-200 per dip. The possible cause of the reduction could have been the introduction of mosquito fish (*Gambusia*) and/or the increase in temperatures in the vicinity. Twelve (12) species of mosquitoes had been identified. The counts were high enough to cause concern. The recommendation was made to set traps to monitor the mosquitoes. The Riverside County Health Department agreed to do this. The goal would be to reduce the mosquito count to 5-10 per dip.
Dr. Mir Mulla of UC Riverside commented that although treating wastewater in wetlands has many advantages and desirable attributes, establishing these systems in urban and suburban areas could potentially produce tremendous numbers of pest and disease vectoring mosquitoes and possibly other noxious and injurious insects. He emphasized the need for research.

Pest and disease vectoring mosquitoes produced in the wetlands could cause the following problems:

1. They could bite workers, researchers and others visiting the marsh.

2. Insects could fly away into surrounding areas and bite humans and horses. There are many thoroughbred horse ranches within the flight range of mosquitoes produced in the wetlands.

3. Depending on the species and epidemoiologic conditions, mosquitoes could serve as vectors of viral agents causing encephalitis in humans and horses. The epidemiologic cycle of encephalitis involves mosquito vectors, birds (which are abundant in the marsh), and humans and horses.

Dr. Mulla commented that the current status of our knowledge regarding long-range management and remedial measures is inadequate. He proposed that studies look at:

1. Faunistics of Mosquitoes: Determining the abundance and taxa of mosquitoes produced on a seasonal basis. This would include:

   a. Larval Assessment: Sampling on a weekly basis in open areas, margins and inside the ponds. Larvae would be identified to species level. Representative samples would be taken from several ponds to see if there is any variation caused by water quality, plant cover or other factors.

   b. Adult Assessment: Adult mosquitoes would be collected on a weekly or biweekly basis. Several traps would be established in critical areas inside the marsh and outside. All mosquitoes would be identified to species. Observations would be made on the landing and biting activity of adult mosquitoes on horses and other animals in the area.

II. Saline Marshes and Evaporation Cells: These saline habitats could support entirely different species or groups of species of mosquitoes. Larval assessment would be more emphasized in these habitats.

III. Impact of Larvirorus fish: A number of small fish have been shown to decimate mosquito larvae in open bodies of water. However, most predatory fish fail to penetrate the thick plant stands where most larvae are prevailing. Fish worth considering are:

   Gambusia affinis (mosquito fish)
   Cyprinidon maculatus (Desert Pupfish and others)
   Poecilia reticulata (guppy).

IV. Evaluation of Microbials and Insect Hormones: These two (2) groups of mosquito control agents were considered to be environmentally friendly. However, their use on a continuing basis was not recommended. These could be used on an emergency basis.

There was a general question with regard to other types of management, besides biological control of mosquitoes or other insects. Dr. Mulla responded that chemicals can be used but would interfere with other forms of aquatic life. The same is true of using microorganisms. The point was raised that another predatory fish that could possibly be introduced is the Stickleback. Its ability to associate with vegetation was discussed. It is indigenous to California, unlike *Gambusia*. The Pupfish is also a native and it is adapted to high temperatures, but it may be endangered/threatened. A question was raised about possible sources of fish for stocking.

Other potential sites for future wetlands projects are: Mystic Lake, where mosquitoes would be expected to have a low impact, and Little Valley where they could have a high impact due to proximity of a residential area.

Pathogens

The types of viruses present in the influent and effluent of the wetlands research cells are unknown. The types of bacteria have not been identified; some data are available on total and fecal coliform. A study could be performed to identify and enumerate both viruses and bacteria (inlet and outlet). However, the study may not be needed unless the end product would be used for drinking. EMWD is interested in groundwater recharge for indirect potable reuse. The effluent will be chlorinated.

WILDLIFE, INVERTEBRATE, AND PLANT ISSUES

Ms. Stella Denison summarized this group's discussions. The group focused on the need to study the whole ecosystem, since every part is linked to every other part.

Important areas that need investigation are:

1. Succession of algae populations

2. Community structure

   a. Understanding the relationships between birds, mammals, invertebrates, and plants in the system.

   b. Which elements are the important ones?
   Answer: The ones linked to the operation of the system.

   c. What is a "good" system?

   d. How do we understand the structure of the system?
   Answer: Documentation. Document structure of system by:
   - Quantitative - population biology
   - Qualitative - Identification, observations, pictures

3. What do we know currently about our system?

4. What do we need to know? Why do we need to know it?
   Answer: Must be based on stated goals of project.

5. Plant (weed) management

6. Management and understanding of system

7. Management and understanding of natural systems
(Comparison of data needed between constructed and natural system).

8. Mosquito control needed

   a. Native fish are the first choice.
      - 3-Spined Stickleback
      - Pupfish (endangered)
      - Mohave Chub

   b. *Gambusia* - Second choice

9. Sand/gravel/rock areas for waterfowl provide food and grit.

The need was identified for a full-time, on-site coordinator who would coordinate the activities of the different groups and agencies using the wetlands for research at the ground level of operations. There is already coordination at the Executive Committee level.

A monitoring plan for the demonstration wetlands facility should address:

1. Access to islands
   - Markers to locate paths
   - Select particular species to follow

2. Wildlife use of emergent and submerged areas
   - Which birds use these areas?
   - What they eat (by inference) and how much?

3. Vegetation management must deal with organic buildup and sedimentation. Potential methods for removing vegetation include:
   - dredging
   - dynamite
   - mowing
   - burning.

4. General bird usage patterns by observation

5. Plant growth

6. Fish (trap, count, mark, retrap and count percentage)

7. Algae - identified through contract lab or in-house; minimum quarterly basis; limnology survey

8. Community structure
   - After collection of individual components, someone ties information together.
   - Water quality is an important issue.

- Continue to monitor wildlife - general observations.
- Nocturnal wildlife: We definitely have some. How should this be documented?
- Plant/wildlife interactions: Continue observation.

There was discussion about the practicality of maintaining open paths through the bulrush for monitoring or observation purposes by any of the methods proposed (machete, dredging, etc.). It would be a labor and cost problem, and might have been better addressed at the design stage. Access is needed into the interior of the demonstration wetlands to observe wildlife use of the islands and into the interior of the research cells to retrieve artificial substrates for invertebrate analysis. It was also commented that the bulrush grows very tall at the site and the islands are not very large, thus there is the possibility for bulrush to completely cover the islands, replacing the intended habitat. It was suggested that the demonstration wetlands have open water areas around the islands so that access can be obtained by wading.

WATER QUALITY

Mike Garner summarized the results of the Water Quality Group's discussion. The group discussed the following issues:

I) Review of Series 1 Monitoring Program

   A) Objectives

   B) Methodology

II) Problems with Series 1 Monitoring

   A) Budget Limitations
      1) Large number of parameters monitored
      2) Limited sample size (number of data points)

   B) Inadequate Hydraulic Controls
      1) Reasons for problems
      2) Impact upon data
      3) Potential solutions to problems

   C) Limited Flow Data
      1) The need for effluent flow totals
      2) Impacts upon data
      3) Potential solutions to problems

   D) Logistic Difficulties
      1) Rain delays (operating problems)
      2) Evapotranspiration problems (inadequate summer brine flow for saline marsh)
      3) The loss of the Alessandro Well (feedwater for reverse osmosis)

III) Results of Continuous Monitoring (Data Sonde)

A) Types of Data Collected

B) Difficulties in Interpreting and Using Data

C) Potential Roles for Continuous Monitoring

IV) Series 1 Monitoring Results

A) Statistical Quality of Data
1) Impacts of hydraulic problems
2) Small size of data sets
3) Statistical treatment of data

B) The Value of Data Replication

C) Nitrogen Kinetics
1) Open space vs. vegetated cells
2) Carbon availability
3) Relationship of data to previous research
4) Potential explanations of observed nitrogen data

D) Miscellaneous Data
1) Pathogens
2) Phosphorus and BOD
3) Exogenous contaminants (bird droppings)
a) Pathogens
b) Phosphorus
4. Miscellaneous field observations
5. Saline Marsh
a) Plant growth
b) Impacts of logistical problems on data

V) Proposed Series 2 Monitoring

A) Nitrogen Monitoring
1) Sampling methodology
2) Narrower focus (statistical strength)
3) Alternative experimental approaches

B) Vegetation Management

C) Wildlife Inputs

D) Saline Marsh

E) Demonstration Wetlands Monitoring
1) Maturation issues

The discussion concluded with an attempt to develop consensus conclusions and recommendations on what was learned in Series 1 and what should be accomplished in Series 2. A summary of consensus conclusions/recommendations follows:

Research Cells

I) Improve hydraulic control (limit flow variations) prior to implementing Series 2 monitoring. Tracer (e.g., lithium) studies should be performed to assess hydraulic conditions.

II) Develop the ability to monitor research cell effluent flows, with a goal of developing some mass balance data.

III) Narrow the number of parameters monitored (but increase sampling of identified parameters) to develop better statistical strength of data (while observing budget limitations). The major focus of Series 2 should be on one-phase vs. three-phase cell nitrogen removal differences. Nitrogen data should be correlated with carbon (BOD or TOC) and dissolved oxygen data.

IV) Intermittent scans for chloride, iron, sulfur, and total phosphorus should be done. (Chloride in particular may be a conservative indicator useful for correlating with water loss and mass balance data).

V) Data replication is useful and should be pursued where possible. On the other hand, there is considerable value in changing the experimental design, to obtain more information on design and management of demonstration projects, by eliminating the experimental approach (use of duplicate conditions, etc.). Rather than trying to duplicate ecological systems, it may be better to change load, change depth, change the amount of open water, sample within the cells, and strategically measure the aquatic impact.

VI) Vegetation management experiments should not be pursued.

VII) Grab samples will be adequate for assessing effluent water quality. However, variation in influent water quality should be examined. If extreme variability in influent quality is found, it may be necessary too use influent composite samples.

VIII) Series 2 monitoring should develop data on the effects of changing hydraulic loading rates, once baseline data at design loading is deemed adequate. In addition, the effect of changing water depth should be determined.

IX) Mechanical bird exclusion experiments should not be pursued. Birds are unlikely to be the major reason for the nitrogen removal results which were observed. Birds could get caught in the nets. Efforts should be focused on strategic sampling.

Saline Marsh

I) The value of initial data is limited due to logistical problems in Series 1.

II) Narrow the scope of data collected to focus on the specific contaminants detected during sampling to date.

III) Try to develop a non-mobile population of vertebrates (fish) for use in assessing bioaccumulation in addition to plant data.

IV) Two years of operation and data are not enough to determine aquatic life impacts. Ten years is more realistic.

Demonstration Wetlands

I) Water quality data developed during the first two years of system operation will probably not support conclusions about overall system performance in the future. A long-range data collection program should be considered after system maturation.

The Technical Advisory Committee meeting was adjourned at 3:15 pm. A group photograph was taken by EMWD's Community Relations Department.

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FINAL
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CH2M HILL

Engineers
Planners
Economists
Scientists

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Fed Ex

July 14, 1994

SCW38036.WK

Ms. LeAnne Hamilton
Research Coordinator
Eastern Municipal Water District
2045 S. San Jacinto Avenue
P.O. Box 8300
San Jacinto, CA 92581-8300

Dear LeAnne:

Subject: Hemet/San Jacinto Multipurpose Wetlands Review Comments

Thank you for the opportunity to review and comment on the draft Phase II/III Wetlands report and to participate in your Technical Advisory Committee (TAC) meeting on July 8, 1994. The attached memorandum summarizes the issues and recommendations that I raised at the TAC meeting. I have listed all of these issues even though I realize that you may not wish to take action on some because of cost considerations or lack of a consensus among the members of the TAC. If you wish to discuss the scope or rationale for any of these recommendations, please feel free to call me at (904) 331-2442.

The attached memorandum includes comments based on only a brief review of the draft report. If you wish, CH2M HILL could provide a more detailed review and analysis of the data collected during the Series 1 and 1A research efforts. This review and analysis could focus on research cell inflow/outflow water chemistry and flow data, and estimate pollutant removal/transformation rate constants that would be applicable to the design of the Little Valley Wetlands and other wetland projects EMWD may wish to implement in the future. If you wish to discuss a scope and level-of-effort for these services, please let me know.

On behalf of CH2M HILL, I would like to thank you and EMWD for including us in this important project. We look forward to a continuing relationship as you expand your program of wetlands/habitat creation and utilization.

Sincerely,

CH2M HILL

Robert L. Knight

Robert L. Knight, Ph.D.
Senior Environmental Scientist

A.V. copy to L Hamilton

MAIL DIST		ADD COPY	
EX		EX	
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PC		PC	
BD		BD	
		ACT	

GNV/1001629A.WP5
xc: Jag Salgaonkar/SCO
Michelle Girts/PDX

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P.O. Box 147009, Gainesville, FL 32614-7009
904 331-2442
Fax No. 904 331-5320

MEMORANDUM CH2M HILL

TO: LeAnne Hamilton/EMWD

COPIES: Jag Salgaonkar/SCO
Michelle Girts/PDX

FROM: Bob Knight/GNV

DATE: July 14, 1994

SUBJECT: EMWD Multipurpose Wetlands Project Draft Phase II/III Report Technical Review

PROJECT: SCW38036.WK

This memorandum summarizes my comments concerning the above-referenced report as well as the "Water Quality and Sediment/Water Interactions" discussion items at the TAC meeting on July 8, 1994. These comments are based on a brief review of the draft Phase II/III report, on the field trip to the wetlands research/demonstration site, and on discussion with you, your staff, and other participants at the TAC meeting.

Comments on the Draft Report

The draft Phase II/III report is well organized and well-written. The authors have successfully compressed an extensive monitoring effort into an informative summary. I only have a few suggestions for enhancing the usefulness of this draft document:

- Plan and section view illustrations of the research and plant propagation cells should be provided to show cell numbering protocol, cell locations, sample stations, cell dimensions, etc.

- A table should be included that summarizes design criteria for the plant propagation and research cells including information on area, length, width, water depth, flow rates, hydraulic loading rate (HRT), design inflow concentrations and loads, etc.

- Hydraulic residence times (HRT) mentioned in the report are estimated and should be qualified as such.

- Summary tables could be provided for water quality changes, sediment chemistry, plant growth, invertebrate populations, and wildlife studies.

Recommended Changes for Series 2 Research

Some important water quality findings from the Series 1 research include:

- No significant decrease in concentrations of BOD_5 and TSS in any of the treatments;
- Significant reductions in NH_4-N concentrations in the 3 Phase (3P) wetland cells but not in the 1 Phase (1P) cells; and
- No reduction or a slight increase in TP concentrations in all cells.

A better understanding of the basis for these observations can be provided during the Series 2 monitoring effort. Continued research will provide additional information for design of future wetland systems if the following engineering/operational changes are made:

- Consistent inflow rate, accurate measurement of these inflows, and the ability to vary these flow rates with a minimum of operational effort should be provided at the research cells. An inflow splitter box is one alternative that could provide this essential control.
- Mass balance calculations are dependent on an accurate water balance for the research cells. Outflow rates should be consistently monitored to estimate this important component of the water balance. It was suggested that V-notch weir plates could be installed in the existing outlet control boxes and a water level recorder or daily staff gauge readings could be used to monitor outflows with sufficient accuracy.
- Actual HRT and wetland hydraulic characteristics can only be determined by periodic tracer studies in all research cells. A lithium or similar inert tracer is recommended for use in wetlands.
- The existing outlet skimmer design may be contributing to excessive outlet nutrient concentrations because the intake to the outlet weir box is drawn from the floor of the wetland. Several sets of nutrient samples (NH_4-N, TKN, and TP) should be carefully collected over a vertical gradient in the wetland cells just upstream of the outlet boxes to see if Series 1 and 1A samples were biased by the existing skimmer design. New skimmers should be installed that draw water from just below the water surface.

A number of other recommendations concerning the Series 2 research project are less critical but are listed below for your information:

- Chloride measurements provide an inexpensive method of documenting concentration/dilution effects related to evapotranspiration/precipitation. Inflow/outflow chloride measurements should be conducted on a biweekly or monthly basis in all research cells.

- Removal of total residual chlorine (TRC) requires addition of sodium bisulfide on a seasonal basis. This sulfide contributes to the wetlands pollutant loading and may contribute to increased hydrogen sulfide production and subsequent toxicity and odors. You may wish to conduct an experiment to look at the dissipation of TRC in the wetland when it is receiving chlorinated influent. TRC samples should be collected over a longitudinal gradient starting at the influent end and extending down flow until TRC is undetectable.

- You may wish to obtain more insight concerning the effectiveness of transverse open-water zones for enhancing treatment performance by modifying some of the research cells. I would suggest two cells with no deep zones, two with one deep zone, two with two deep zones, and two with three deep zones.

- You may wish to better quantify the effects of HLR (and conversely wetland area) on treatment performance. Two methods were discussed to provide this information. One method is to give up cell-to-cell replication and set inflow rates to give 4 HLR's for each set of 3P and 1P cells for a period of 3 to 6 months. The second method is to test the same HLR across all 8 cells for a period of 3 months, then change all 8 cells to a second HLR for 3 months, etc. I would suggest you test HLR's between about 1 cm/d and 10 cm/d.

- Metals monitoring in the saline test cells has identified As, Ba, Cd, Cu, Mo, Se, and Zn as having detectable concentrations in the RO brine water and sediments. I would suggest that you continue bioaccumulation studies and focus your sampling on two or three of these metals (for example, As, Cu, and Se) in water, sediments, algae, macrophytes, and fish.

- Bulrush harvesting is not recommended as an effective method for either nutrient removal or to improve HRT or system operation. Vegetation management with fire may be considered in the Demonstration wetland cell.

- The quantification of nutrient inputs from birds should be estimated based on routine bird counts and a literature review of nutrient content in bird feces.

Demonstration Wetlands

Construction of the demonstration wetland system is underway. It is fully realized that design changes at this time will be expensive to implement. Nevertheless EMWD and the Bureau of Reclamation may wish to consider the following changes that may improve system performance and facilitate operation:

- Two to three transverse deep zones could be provided in each inlet arm and in the two parallel outlet arms to assist with flow distribution, increase HRT, and enhance fish and waterfowl habitat. These deep zones could be from 30 to 50 feet wide with 2:1 to 3:1 slopes, and be about 4 to 5 feet deep below grade. These deep zones will also provide access to the interior of the wetland cell for monitoring and maintenance.

- Deep zones around the islands will improve their attractiveness for wildlife use.

- Boardwalks located at several key locations would greatly facilitate monitoring access and could be incorporated into the public trail system without excessive wildlife disturbance.

- Skimmers in the outlet weir boxes should be redesigned to draw water from just below the wetland water surface rather than from the wetland floor.

- Start-up monitoring should be considered and could include all parameters of research or operational interest, sampled on a routine (biweekly or monthly) basis.

Summary

The comments and recommendations provided above are based on a limited review of information provided by you about the Research/Demonstration Wetland Projects at Hemet/San Jacinto the potential cost and benefit of each recommendation should be weighed as you consider whether or not to implement these changes.

'06 - 3 1994
E.M.W.D.

SDSU

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July 20, 1994

Ms. LeAnne Hamilton
Project Manager, Multipurpose Wetlands Program
Eastern Municipal Water District
P.O. Box 8300
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Dear LeAnne:

It was a pleasure meeting you, and being able to tour the construction site for the Demonstration Project. I hope that the lively discussions generated at the meeting of the Technical Advisory Committee, specifically concerning the analysis of the series 1/1A monitoring program data for the pilot research facility, was informative and helpful for your future efforts. As you had requested, in the following narrative I will detail my specific comments both regarding your 1/1A research results and my recommendations for the direction of a future research program at this pilot research facility.

One of the most surprising results for the 1/1A research cells was the lack of nitrogen removal in the 1-phase cells. Since the outlet level of N was not significantly above (although it was slightly higher than) the inlet level in these 1-phase cells, I do not necessarily agree with the conclusion that there was nutrient loading (perhaps by birds) that accounted for this higher outlet level of N. Indeed, in the 3-phase cells which showed significant N removal, there is still alot of vegetated area to support bird populations, and even so these 3-phase systems showed a marked decline in N when outflow is compared to inflow. Obviously, something is occurring in the 3-phase cells that is not happening in the 1-phase cells, and this is probably due to a conspicuous lack of nitrification in the 1-phase system. This absence of nitrification is surprising however, since the data for dissolved oxygen in both the 1 and 1A series show oxygen levels ranging from 0-90% saturation with mean values at near 50%.

On the other hand, there are several alternative explanations for the significant N removal in the 3-phase cells. The explanation proposed by both the EMWD and BuRec (NBS) staff is that the N (mostly ammonia) removal that is observed is due to nitrification in the open (pool) area, and subsequent denitrification in anoxic wetland zones. This sequential nitrification-denitrification is certainly possible, but let me now forward another alternative explanation, not just to be contrary, but in order to illustrate

the type of data you need to gather in order to make definitive conclusions on the fate of N in the system. For sequential nitrification-denitrification to occur, the wetlands must supply approx. 4.5 mg/l of oxygen for each mg/l of N for nitrification to be complete. Then, since you do not find any appreciable amount of nitrate in the outlet of the 3-phase cells, all of this nitrate must be denitrified this entailing a carbon (BOD) demand of about 3 mg/l BOD for each mg/l of nitrate-N denitrified.

Possible sources of oxygen in the 3-phase cells to support the nitrification above include wind-induced mixing and algal photosynthesis. Even though algal (chlorophyll) levels were not monitored in the research cells, evidence for the growth and activity of algae in open waters of these wetlands come from some of the statement made by Jim Sartoris and Steve Crombie who noted at the TAC meeting that there was considerable diurnal fluctuation in dissolved oxygen levels observed with continuous monitors placed at outlet structures of the wetland cells (which were unvegetated). These diurnal fluctuations are best explained as reflecting algal photosynthesis, which brings me to the alternative explanation for the N removal observed--that is, algal uptake of ammonia in the unvegetated areas of the wetlands might have been responsible for a significant fraction of the total N removal observed in the 3-phase cells, and these algae are subsequently removed in the vegetated end before discharge. This is made all the more possible by other statements made by Jim Sartoris referring to the relatively long hydraulic residence times (conducive to algal growth) in the cells particularly during the summer when other demands for water were highest, and also the fact that the residence time in the pool areas of the cells accounted for about 50% of total. The main point here is that in your future monitoring of these research cells, you need to measure certain parameters carefully (e.g. DO, chlorophyll, or nitrification--using N-Serve), so that you can determine definitively the mechanisms responsible for N removal.

Since nitrate did not appear in appreciable quantities in the effluent of the 3-phase cells, in order for sequential nitrification-denitrification to have accounted for the N loss, then the nitrate would have to have been entirely removed by denitrification in anoxic environments. With a productivity of about 5 gm of carbon per m^2 per day, and a ratio of approximately 3:1 for the carbon demand of denitrification, then assuming that half of the carbon produced in the wetlands is assimilable, the carbon demand of denitrification could be satisfied. However, considering that much of the carbon produced will be used by aerobic respiration, and that the research cells were young systems with not alot of detrital build-up, my guess is that not all of the nitrate removed was in fact denitrified. Again, this is where algal assimilation might play an important role.

As for phosphorus (P) removal, although there was a significant increase in all cells from inlet to outlet, since only dissolved orthophosphate was analyzed (but not total P), this increase in dissolved P may be attributed to mineralization of TP (particulate P) in the wetlands and not really an overall increase in P. Again, from your data we cannot say for sure.

My recommendations for future research are much the same as we discussed at the TAC meeting. I believe the significant difference observed for N removal in the 3-phase and 1-phase cells certainly deserves further study. The cells must be designed with adequate replication (as you already have), with the hydraulic loading rates under much closer control. The study design should focus on showing that the open water, the 3-phase system stimulates sequential nitrification-denitrification. In this case you need to disprove the hypothesis that algal uptake is responsible for the significant N removal observed.

I agree with the conclusion of the TAC that TP, ortho P, S, and Fe should be monitored on a more infrequent basis with the focus on nitrate, nitrite, ammonia, TKN, BOD, DO, and some measure of algal activity. Since the wastewater is chlorinated and since the ultimate use of the water is for restricted, non-body contact situations, then I question the need for frequent coliform or virus/pathogen monitoring.

I hope these comments have been useful and wish you and your staff the best of luck as you scale-up to the demonstration multi-purpose system.

Sincerely,

Richard M. Gersberg, Ph.D
Professor

To: LeAnne Hamilton

From: Bob Gearheart

Date: August 4, 1994

Subject: Review of Report

Recommendations:

Pilot Mesocosms

1) Change experimental design to obtain more information on design and management of demonstration projects by eliminating the experimental approach (use of duplicate conditions, etc.). It is impossible under the best of conditions to actually have ecological similar conditions. Better to change load, change depth sample within, etc., and strategically measure the aquatic impact.

2) Reconstruct influent flow apparatus to be able to measure the influent flow and to have a reliable constant input (stilling well and weir box).

3) Re-construct the effluent weir boxes to insure the discharge volume is coming from the top of the wetland. Use a "V" notch weir with a depth measurement device (ruler) to be able to measure flow directly without the need for sophisticated electronic measuring equipment.

4) Focus on the water quality issues of concern, nitrogen forms, suspended solids, and public health significant organisms.

5) Determine the bio-mass in the pilot cells (dry weight above ground and below ground).

6) Design an intracellular sampling protocol.

Demonstration Project

1) Deepen the regions in the demo-project which are upstream from the effluent discharge area to allow submergent species to prevail. An attempt should be made to have alternating open water-closed water sections with at least 2-3 days of contact in closed water (emergent vegetation) prior to discharge.

2) Take aerial photographs (vegetation monitoring) every 3 months for the next 15 months to show community succession.

General Comments:

1) Data should be placed into loading format to allow for a kinetic analysis of water quality parameters.

2) Considering the first year was a start up condition, the report was very well done. There is a tremendous amount of data which has not been analyzed in the report. (Again, great work for a student). I'll do my part next year and parcel out some studies to undergraduate or graduate student.

3) Too much work spent doing pseudo statistics (good example is Appendix A) without any real attempt to explain what is happening and what is significant. Statistics should not be a substitute for ecological understanding!

APPENDIX J

SPECIES LISTING

SPECIES LISTING

The following are scientific and common names of species mentioned in the text.

PLANTS

California bulrush	*(Scirpus californicus)*
hardstem bulrush	*(Scirpus acutus) or (S. acutus)*
Alkali bulrush	*(Scirpus robustus)*
rush	*(Juncus spp.)*
duckweed	*(Lemna spp.)*
marsh or water pennywort	*(Hydrocotyle umbellata)*
seepwillow	*(Baccharis glutinosa)*
creeping spikerush	*(Eleocharis palustris)*
marsh smartweed	*(Polygonum muhlenbergii)*
Pennsylvania smartweed	*(Polygonum pensylvanicum)*
smartweed	*(Polygonum spp.)*
cattail	*(Typha spp.)*
swamp timothy	*(Crypsis schoenoides)*
willow	*(Salix spp.)*
watergrass plants	*(Echinochloa crusgalli)*
quillwort	*(Isoetes spp.)*
mallow	*(Malva spp.)*
prickly lettuce	*(Lactuca Serriola)*
plastic flamingo	*(Flamingo plasticus)*

INVERTEBRATES

Scientific and common names of taxa mentioned in the text are presented in Table 4-5 on page 117.

BIRDS

Scientific and common names of birds are presented on subsequent pages.

A Sleigh
1993-94

Species List

CLARK'S GREBE (Aechmophorus clarkii)

October 27, 1993 (1)

EARED GREBE (Podiceps nigricollis)

June 22, 1993 (20)
June 27, 1993 (18)
July 3, 1993 (2)
July 30, 1993 (1)
August 3, 1993 (8)
August 15, 1993 (4)
August 18, 1993 (2)
August 29, 1993 (3)
September 5, 1993 (2)
September 29, 1993 (2)
October 9, 1993 (1)
October 13, 1993 (3)
October 18, 1993 (4)
October 20, 1993 (3)
October 27, 1993 (4)
November 7, 1993 (2)
November 13, 1993 (2)
November 21, 1993 (4)
November 27, 1993 (2)
November 30, 1993 (3)
December 14, 1993 (1)
December 23, 1993 (2)
December 30, 1993 (1)
January 10, 1994 (1)
January 13, 1994 (2)
January 23, 1994 (1)
January 29, 1994 (1)
February 14, 1994 (5)
February 24, 1994 (2)
March 1, 1994 (24)
March 15, 1994 (12)
March 24, 1994 (8)
April 4, 1994 (18)
April 18, 1994 (47)
April 30, 1994 (25)
May 11, 1994 (23)
May 17, 1994 (29)
May 19, 1994 (30)
May 26, 1994 (3)
June 3, 1994 (11)
June 7, 1994 (27)
June 13, 1994 (18)
June 23, 1994 (16)

nesting

DOUBLE-CRESTED CORMORANT (Phalacrocorax auritus)

October 27, 1993 (3)

BLACK-CROWNED NIGHT HERON (Nycticorax nycticorax)

July 3, 1993 (1)
May 11, 1994 (1)
June 23, 1994 (1)

GREEN-BACKED HERON (Butorides virratus)

May 26, 1994 (1)

CATTLE EGRET (Bubulcus ibis)

June 27, 1993 (1)
October 13, 1993 (1)
November 27, 1993 (5)
January 29, 1994 (1)
February 14, 1994 (72)
February 24, 1994 (2)
March 1, 1994 (19)
May 26, 1994 (3) in breeding plumage
June 7, 1994 (7)
June 15, 1994 (4)
June 23, 1994 (1)

SNOWY EGRET (Egretta thula)

August 12, 1993 (1)
September 5, 1993 (1)
November 7, 1993 (1)
February 24, 1994 (1)

GREAT EGRET (Casmerodius albus)

July 3, 1993 (1)
September 5, 1993 (1)
October 18, 1993 (1)
November 27, 1993 (1)
December 23, 1993 (1)
January 29, 1994 (1)
June 3, 1994 (1)

GREAT BLUE HERON (Ardea herodias)

June 23, 1994 (1)

WHITE-FACED IBIS (Plegadis chihi)

June 22, 1993 (25)
July 3, 1993 (1)
September 5, 1993 (1)

CANADA GOOSE (Branta canadensis minima)

August 18, 1993 (1)
August 29, 1993 (1)
September 5, 1993 (1)
September 29, 1993 (1)
October 13, 1993 (1)
October 18, 1993 (1)
December 4, 1993 (1)

CANADA GOOSE (Branta canadensis)

November 13, 1993 (26)
November 21, 1993 (13)
November 27, 1993 (28)
November 30, 1993 (29)
December 4, 1993 (371)
December 23, 1993 (1)
December 30, 1993 (25)
January 23, 1994 (1)
January 29, 1994 (131)
February 14, 1994 (184)
February 24, 1994 (52)

MALLARD (anas platyrhynchos)

August 12, 1993 (5)
August 15, 1993 (2)
August 18, 1993 (11)
August 29, 1993 (6)
September 5, 1993 (5)
September 29, 1993 (38)
October 9, 1993 (166)
October 13, 1993 (116)
October 18, 1993 (114)
October 20, 1993 (37)
October 24, 1993 (24)
October 27, 1993 (37)
November 7, 1993 (31)
November 13, 1993 (28)
November 21, 1993 (38)
November 27, 1993 (9)
November 30, 1993 (30)
December 4, 1993 (3)
December 14, 1993 (3)
January 10, 1994 (2)
January 29, 1994 (2)
February 14, 1994 (48)
February 24, 1994 (6)
March 1, 1994 (2)
March 15, 1994 (8)
March 24, 1994 (9)
April 4, 1994 (18)
April 18, 1994 (19) 10 are juveniles
April 30, 1994 (8)
May 11, 1994 (21)
May 17, 1994 (37) some juveniles
May 19, 1994 (20)
May 26, 1994 (39)
June 3, 1994 (32)
June 7, 1994 (26)
June 13, 1994 (23)
June 23, 1994 (21)

GADWALL (Anas strepera)

August 18, 1993 (10)
August 29, 1993 (7)
March 15, 1994 (1)

March 24, 1994 (3)
May 11, 1994 (15)
May 19, 1994 (2)

GREEN-WINGED TEAL (Anas crecca)

September 5, 1993 (2)
October 27, 1993 (3)
November 7, 1993 (8)
November 13, 1993 (3)
November 21, 1993 (2)
November 30, 1993 (3)
December 4, 1993 (35)
December 14, 1993 (17)
December 23, 1993 (32)
December 30, 1993 (38)
January 10, 1994 (65)
January 13, 1994 (49)
January 16, 1994 (56)
January 23, 1994 (52)
January 29, 1994 (13)
February 14, 1994 (21)
February 24, 1994 (9)
March 1, 1994 (2)
March 15, 1994 (33)
March 24, 1994 (13)
April 4, 1994 (8)
April 30, 1994 (2)
June 13, 1994 (1)

AMERICAN WIGEON (Anas americana)

October 9, 1993 (42)
October 13, 1993 (12)
October 18, 1993 (218)
October 20, 1993 (176)
October 24, 1993 (390)
October 27, 1993 (659)
November 7, 1993 (306)
November 13, 1993 (1102)
November 21, 1993 (2569)
November 27, 1993 (3586)
November 30, 1993 (1534)
December 4, 1993 (2405)
December 14, 1993 (2899)
December 23, 1993 (4108)
December 30, 1993 (6050)
January 10, 1994 (6632)
January 13, 1994 (2833)
January 16, 1994 (8315)
January 23, 1994 (8484)
January 29, 1994 (9107)
February 14, 1994 (1162)
February 24, 1994 (4060)
March 1, 1994 (2179)
March 15, 1994 (1091)
March 24, 1994 (1692)
April 4, 1994 (104)

EURASIAN WIGEON (Anas penelope)

November 27, 1993 (2)
November 30, 1993 (3)
December 4, 1993 (2)
December 14, 1993 (5)
December 23, 1993 (11)
December 30, 1993 (8)
January 10, 1994 (5)
January 13, 1994 (10)
January 16, 1994 (3)
January 23, 1994 (6)
January 29, 1994 (11)
February 14, 1994 (1)
February 24, 1994 (2)
March 1, 1994 (1)
March 15, 1994 (5)
March 24, 1994 (2)

NORTHERN PINTAIL (Anas acuta)

July 30, 1993 (7)
August 3, 1993 (3)
August 12, 1993 (4)
October 13, 1993 (1)
October 18, 1993 (9)
October 20, 1993 (7)
October 24, 1993 (4)
October 27, 1993 (32)
November 7, 1993 (2)
November 27, 1993 (22)
November 30, 1993 (5)
December 4, 1993 (3)
December 14, 1993 (24)
December 23, 1993 (32)
December 30, 1993 (2)
January 10, 1994 (48)
January 13, 1994 (42)
January 16, 1994 (111)
January 23, 1994 (53)
January 29, 1994 (55)
February 14, 1994 (297)
February 24, 1994 (77)
March 15, 1994 (5)
March 24, 1994 (1)

NORTHERN SHOVELER (Anas clypeata)

September 5, 1993 (2)
September 29, 1993 (3)
October 9, 1993 (8)
October 13, 1993 (34)
October 18, 1993 (23)
October 20, 1993 (59)
October 24, 1993 (64)
October 27, 1993 (68)
November 7, 1993 (25)
November 13, 1993 (30)
November 21, 1993 (165)
November 27, 1993 (41)
November 30, 1993 (29)

December 4, 1993 (60)
December 14, 1993 (82)
December 23, 1993 (109)
December 30, 1993 (330)
January 10, 1994 (1259)
January 13, 1994 (3962)
January 16, 1994 (2011)
January 23, 1994 (1028)
January 29, 1994 (1020)
February 14, 1994 (370)
February 24, 1994 (926)
March 1, 1994 (150)
March 15, 1994 (196)
March 24, 1994 (488)
April 4, 1994 (455)
April 18, 1994 (14)
April 30, 1994 (1)
May 17, 1994 (1)
May 26, 1994 (1)

BLUE-WINGED TEAL (Anas discors)

August 29, 1993 (3)
October 20, 1993 (2)

CINNAMON TEAL (Anas cyanoptera)

August 12, 1993 (6)
August 15, 1993 (5)
August 18, 1993 (20)
August 29, 1993 (8)
September 5, 1993 (42)
September 29, 1993 (1)
October 18, 1993 (8)
October 20, 1993 (19)
October 24, 1993 (20)
October 27, 1993 (72)
November 7, 1993 (65)
November 13, 1993 (32)
November 21, 1993 (21)
November 27, 1993 (8)
November 30, 1993 (3)
December 23, 1993 (28)
December 30, 1993 (4)
January 13, 1994 (19)
January 16, 1994 (1)
January 29, 1994 (10)
February 14, 1994 (41)
February 24, 1994 (29)
March 1, 1994 (60)
March 15, 1994 (89)
March 24, 1994 (52)
April 4, 1994 (61)
April 18, 1994 (27)
April 30, 1994 (8)
May 11, 1994 (4)
May 17, 1994 (10)
May 19, 1994 (20)
May 26, 1994 (13)
June 3, 1994 (15)

June 7, 1994 (22)
June 13, 1994 (18)
June 23, 1994 (33)

RUDDY DUCK (Oxyura jamaicensis)

June 22, 1993 (36)
June 27, 1993 (2)
July 3, 1993 (42)
July 14, 1993 (3)
July 30, 1993 (1)
August 3, 1993 (14)
August 12, 1993 (32)
August 15, 1993 (2)
August 18, 1993 (13)
August 29, 1993 (29)
September 5, 1993 (9)
September 29, 1993 (55)
October 9, 1993 (35)
October 13, 1993 (36)
October 18, 1993 (12)
October 20, 1993 (21)
October 24, 1993 (9)
October 27, 1993 (42)
November 7, 1993 (13)
November 13, 1993 (20)
November 21, 1993 (42)
November 27, 1993 (17)
November 30, 1993 (8)
December 4, 1993 (2)
December 14, 1993 (44)
December 23, 1993 (76)
December 30, 1993 (47)
January 10, 1994 (68)
January 13, 1994 (89)
January 16, 1994 (75)
January 23, 1994 (90)
January 29, 1994 (82)
February 14, 1994 (120)
February 24, 1994 (105)
March 1, 1994 (402)
March 15, 1994 (116)
March 24, 1994 (106)
April 4, 1994 (96)
April 18, 1994 (82)
April 30, 1994 (51)
May 11, 1994 (61)
May 17, 1994 (44) including 6 juveniles
May 19, 1994 (47)
May 26, 1994 (23)
June 3, 1994 (26)
June 7, 1994 (35)
June 13, 1994 (55)
June 23, 1994 (73)

CANVASBACK (Aythya valisineria)

February 14, 1994 (1)

REDHEAD (Aythya americana)

October 24, 1993 (15)
October 27, 1993 (4)
November 7, 1993 (1)
November 21, 1993 (13)
November 27, 1993 (16)
November 30, 1993 (4)
December 4, 1993 (2)
December 14, 1993 (37)
December 23, 1993 (20)
December 30, 1993 (3)
January 10, 1994 (4)
January 16, 1994 (5)
January 29, 1994 (4)
February 14, 1994 (26)
February 24, 1994 (13)
March 1, 1994 (1)
April 4, 1994 (5)
April 18, 1994 (18)
April 30, 1994 (4)
May 11, 1994 (1)
May 17, 1994 (1)
May 19, 1994 (5)
May 26, 1994 (5)
June 3, 1994 (11)
June 7, 1994 (21)
June 13, 1994 (16)
June 23, 1994 (11)

RING-NECKED DUCK (Aythya collaris)

October 20, 1993 (2)
November 13, 1993 (2)
November 27, 1993 (2)
December 30, 1993 (2)
January 13, 1994 (1)
January 29, 1994 (3)
February 14, 1994 (37)
February 24, 1994 (23)
April 4, 1994 (2)
June 7, 1994 (1)
June 13, 1994 (1)
June 23, 1994 (1)

GREATER SCAUP (Aythya marila)

February 14, 1994 (2)
February 24, 1994 (7)
March 15, 1994 (2)

LESSER SCAUP (Aythya affinis)

October 27, 1993 (3)
November 7, 1993 (1)
November 13, 1993 (4)
November 21, 1993 (5)
December 14, 1993 (4)
December 23, 1993 (3)
December 30, 1993 (5)
January 23, 1994 (8)

January 29, 1994 (15)
February 14, 1994 (77)
February 24, 1994 (87)
March 15, 1994 (34)
March 24, 1994 (21)
April 4, 1994 (13)
April 18, 1994 (10)
April 30, 1994 (1)
May 17, 1994 (2)
June 3, 1994 (4)
June 7, 1994 (2)

BUFFLEHEAD (Bucephala albeola)

November 7, 1993 (3)
November 13, 1993 (6)
November 21, 1993 (9)
November 27, 1993 (16)
November 30, 1993 (7)
December 4, 1993 (23)
December 14, 1993 (14)
December 23, 1993 (9)
December 30, 1993 (7)
January 10, 1994 (11)
January 13, 1994 (5)
January 16, 1994 (19)
January 24, 1994 (12)
January 29, 1994 (25)
February 14, 1994 (28)
February 24, 1994 (44)
March 1, 1994 (23)
March 15, 1994 (15)
March 24, 1994 (4)

VIRGINIA RAIL (Rallus limicola)

November 21, 1993 (1)
December 4, 1993 (1)

SORA (Porzana carolina)

October 18, 1993 (2)
October 20, 1993 (1)
October 24, 1993 (1)
October 27, 1993 (1)
November 21, 1993 (1)
November 27, 1993 (2)
November 30, 1993 (2)
December 14, 1993 (1)

COMMON MOORHEN (Gallinula chloropus)

June 22, 1993 (2)
June 27, 1993 (2)
July 3, 1993 (1)
July 14, 1993 (5)
July 30, 1993 (3)
August 3, 1993 (3)
August 12, 1993 (2)
August 15, 1993 (1)

August 18, 1993 (1)
September 5, 1993 (2)
September 29, 1993 (13)
October 9, 1993 (4)
October 13, 1993 (8)
October 18, 1993 (9)
October 20, 1993 (9)
October 24, 1993 (6)
October 27, 1993 (5)
November 7, 1993 (4)
November 13, 1993 (5)
November 21, 1993 (3)
November 27, 1993 (3)
November 30, 1993 (4)
December 4, 1993 (1)
December 23, 1993 (1)
December 30, 1993 (1)
January 10, 1994 (4)
January 13, 1994 (2)
January 16, 1994 (2)
January 23, 1994 (4)
January 29, 1994 (2)
February 14, 1994 (1)
February 24, 1994 (2)
March 1, 1994 (2)
March 15, 1994 (2)
March 24, 1994 (3)
April 18, 1994 (1)
April 30, 1994 (2)
May 11, 1994 (3) also found a nest
May 17, 1994 (3) including 2 juveniles
May 19, 1994 (3) adults
May 26, 1994 (5) 2 adults, 3 juveniles

AMERICAN COOT (Fulica americana)

June 22, 1993 (6)
June 27, 1993 (10)
July 3, 1993 (8)
July 14, 1993 (5)
August 12, 1993 (3)
August 15, 1993 (5)
August 18, 1993 (13)
August 29, 1993 (26)
September 5, 1993 (16)
September 29, 1993 (42)
October 9, 1993 (23)
October 13, 1993 (23)
October 18, 1993 (34)
October 20, 1993 (44)
October 24, 1993 (36)
October 27, 1993 (17)
November 7, 1993 (40)
November 13, 1993 (39)
November 21, 1993 (73)
November 27, 1993 (37)
November 30, 1993 (37)
December 4, 1993 (17)
December 14, 1993 (26)
December 23, 1993 (53)

December 30, 1993 (61)
January 10, 1994 (32)
January 13, 1994 (32)
January 16, 1994 (46)
January 23, 1994 (55)
January 29, 1994 (28)
February 14, 1994 (51)
February 24, 1994 (135)
March 1, 1994 (200)
March 15, 1994 (205)
March 24, 1994 (223)
April 4, 1994 (159)
April 18, 1994 (79)
April 30, 1994 (57)
May 11, 1994 (24)
May 17, 1994 (10)
May 19, 1994 (14)
May 26, 1994 (13)
June 3, 1994 (12)
June 7, 1994 (14)
June 13, 1994 (13)
June 23, 1994 (10)

AMERICAN AVOCET (Recurvirostra americana)

June 22, 1993 (146)
June 27, 1993 (138)
July 3, 1993 (151)
July 14, 1993 (172)
July 30, 1993 (143)
August 3, 1993 (11)
August 12, 1993 (40)
August 15, 1993 (68)
August 18, 1993 (100)
August 29, 1993 (51)
September 5, 1993 (26)
September 29, 1993 (81)
October 9, 1993 (48)
October 13, 1993 (105)
October 18, 1993 (160)
October 20, 1993 (4)
October 24, 1993 (102)
November 7, 1993 (42)
November 13, 1993 (43)
November 21, 1993 (50)
November 27, 1993 (8)
November 30, 1993 (7)
December 4, 1993 (58)
December 14, 1993 (9)
December 23, 1993 (3)
December 30, 1993 (1)
January 10, 1994 (15)
January 13, 1994 (20)
January 16, 1994 (36)
January 23, 1993 (30)
January 29, 1994 (5)
February 14, 1994 (18)
February 24, 1994 (13)
March 1, 1994 (1)
March 15, 1994 (47)

March 24, 1994 (52)
April 4, 1994 (79)
April 18, 1994 (47)
April 30, 1994 (50)
May 11, 1994 (17)
May 17, 1994 (40)
May 19, 1994 (13)
May 26, 1994 (12)
June 3, 1994 (4)
June 7, 1994 (8)
June 13, 1994 (7)

BLACK-NECKED STILT (Himantopus mexicanus)

June 22, 1993 (184)
June 27, 1993 (172)
July 3, 1993 (153)
July 14, 1993 (136)
July 30, 1993 (124)
August 3, 1993 (8)
August 12, 1993 (28)
August 15, 1993 (88)
August 18, 1993 (88)
August 29, 1993 (109)
September 5, 1993 (147)
September 29, 1993 (5)
October 13, 1993 (1)
October 20, 1993 (8)
October 24, 1993 (30)
October 27, 1993 (138)
November 13, 1993 (27)
November 21, 1993 (11)
November 27, 1993 (9)
November 30, 1993 (6)
December 4, 1993 (55)
December 14, 1993 (6)
December 23, 1993 (23)
December 30, 1993 (2)
January 10, 1994 (38)
January 13, 1994 (12)
January 16, 1994 (11)
January 23, 1994 (1)
January 29, 1994 (8)
February 14, 1994 (35)
February 24, 1994 (3)
March 1, 1994 (38)
March 15, 1994 (35)
March 24, 1994 (22)
April 4, 1994 (31)
April 18, 1994 (23)
April 30, 1994 (19)
May 11, 1994 (19)
May 17, 1994 (27)
May 19, 1994 (24) nesting on banks
May 26, 1994 (36)
June 3, 1994 (14)
June 7, 1994 (31) including 3 juveniles
June 13, 1994 (37)
June 23, 1994 (49) including 6 juvenile, also saw 3 eggs in nest

KILLDEER (Charadrius vociferus)

June 22, 1993 (4)
June 27, 1993 (15)
July 3, 1993 (9)
July 14, 1993 (7)
July 30, 1993 (24)
August 3, 1993 (2)
August 12, 1993 (1)
August 15, 1993 (1)
August 18, 1993 (6)
August 29, 1993 (3)
September 5, 1993 (31)
September 29, 1993 (8)
October 9, 1993 (2)
October 13, 1993 (7)
October 20, 1993 (4)
October 24, 1993 (4)
October 27, 1993 (28)
November 7, 1993 (17)
November 13, 1993 (5)
November 27, 1993 (1)
December 14, 1993 (1)
December 23, 1993 (1)
January 10, 1994 (2)
January 13, 1994 (1)
February 24, 1994 (4)
March 1, 1994 (12)
March 15, 1994 (5)
March 24, 1994 (1)
April 4, 1994 (3)
April 18, 1994 (1)
April 30, 1994 (2)
May 11, 1994 (4)
May 17, 1994 (3)
May 26, 1994 (1)
June 3, 1994 (1)
June 7, 1994 (1)
June 13, 1994 (2)

GREATER YELLOWLEGS (Tringa melanoleuca)

September 5, 1993 (1)
September 29, 1993 (1)
November 21, 1993 (1)
December 23, 1993 (4)
February 14, 1994 (2)
March 1, 1994 (9)
March 24, 1994 (9)
April 4, 1994 (3)
April 30, 1994 (1)

LESSER YELLOWLEGS (Tringa flavipes)

September 5, 1993 (2)
March 1, 1994 (1)
March 24, 1994 (2)

SPOTTED SANDPIPER (Actitis macularia)

July 3, 1993 (5)
July 14, 1993 (8)

WILSON'S PHALAROPE (Phalaropus tricolor)

August 3, 1993 (15)
August 12, 1993 (11)
August 15, 1993 (20)
August 18, 1993 (25)
August 29, 1993 (3)
September 5, 1993 (29)
May 11, 1994 (1)

LONG-BILLED DOWITCHER (Limnodromus scolopaceus)

July 3, 1993 (3)
July 30, 1993 (1)
August 3, 1993 (15)
August 12, 1993 (40)
August 15, 1993 (108)
August 18, 1993 (60)
August 29, 1993 (35)
September 5, 1993 (145)
September 29, 1993 (111)
October 9, 1993 (1)
October 13, 1993 (74)
October 18, 1993 (73)
October 20, 1993 (5)
October 24, 1993 (95)
October 27, 1993 (254)
November 7, 1993 (1)
November 13, 1993 (182)
November 27, 1993 (20)
November 30, 1993 (7)
December 4, 1993 (770)
December 14, 1993 (6)
December 23, 1993 (2)
December 30, 1993 (63)
January 10, 1994 (1)
January 13, 1994 (79)
January 16, 1994 (1)
January 29, 1994 (11)
February 14, 1994 (3)
March 1, 1994 (11)
March 15, 1994 (29)
March 24, 1994 (280)
April 18, 1994 (117)
April 30, 1994 (21)

DUNLIN (Calidris alpina)

December 23, 1993 (3)
December 30, 1993 (1)

SEMIPALMATED SANDPIPER (Calidris pusilla)

December 4, 1993 (43)

WESTERN SANDPIPER (Calidris mauri)

September 5, 1993 (4)
September 29, 1993 (22)
October 18, 1993 (142)
October 24, 1993 (76)
October 27, 1993 (32)
November 7, 1993 (9)
November 13, 1993 (7)
November 27, 1993 (31)
November 30, 1993 (5)
December 4, 1993 (203)
December 14, 1993 (51)
December 23, 1993 (7)
December 30, 1993 (8)
January 13, 1994 (100)
January 29, 1994 (9)
March 1, 1994 (38)
March 24, 1994 (4)
April 4, 1994 (43)
April 30, 1994 (15)
May 11, 1994 (2)
May 17, 1994 (1)

LEAST SANDPIPER (Calidris minutilla)

July 30, 1993 (10)
August 3, 1993 (1)
August 12, 1993 (85)
August 15, 1993 (40)
August 18, 1993 (100)
August 29, 1993 (142)
September 5, 1993 (91)
September 29, 1993 (24)
October 9, 1993 (46)
October 13, 1993 (45)
October 18, 1993 (271)
October 24, 1993 (26)
October 27, 1993 (74)
November 7, 1993 (17)
November 13, 1993 (302)
November 30, 1993 (12)
December 4, 1993 (143)
December 14, 1993 (31)
December 23, 1993 (15)
January 10, 1994 (28)
January 13, 1994 (93)
February 24, 1994 (1)
March 15, 1994 (51)
March 24, 1994 (38)
April 4, 1994 (43)
April 18, 1994 (5)
April 30, 1994 (6)

BONAPARTE'S GULLS (Larus philadelphia)

November 21, 1993 (17)
November 27, 1993 (2)
November 30, 1993 (17)
December 4, 1993 (3)
January 16, 1994 (1)

RING-BILLED GULL (Larus delawarensis)

March 1, 1994 (61)
March 15, 1994 (48)
March 24, 1994 (3)

CALIFORNIA GULL (Larus californicus)

March 15, 1994 (3)
March 24, 1994 (51)
April 4, 1994 (2)
April 18, 1994 (514)
April 30, 1994 (321)

TURKEY VULTURE (Cathartes aura)

August 12, 1993 (8)
August 15, 1993 (40)
August 18, 1993 (13)
August 29, 1993 (1)
May 19, 1994 (1)
May 26, 1994 (1)
June 13, 1994 (1)

GOLDEN EAGLE (Aquila chrisaetos)

October 13, 1993 (1)

NORTHERN HARRIER (Circus cyaneus)

November 13, 1993 (1)
November 21, 1993 (1)
November 27, 1993 (2)
November 30, 1993 (2)
December 14, 1993 (1)
December 23, 1993 (2)
January 16, 1994 (2)
January 23, 1994 (1)
January 29, 1994 (3)
February 14, 1994 (3)
February 24, 1994 (2)
March 24, 1994 (2)
April 4, 1994 (1)

RED-TAILED HAWK (Buteo jamaicensis)

August 18, 1993 (1)
September 5, 1993 (1)
October 18, 1993 (1)
October 24, 1993 (1)
November 21, 1993 (1)
November 30, 1993 (2)
December 4, 1993 (1)
December 14, 1993 (2)
December 23, 1993 (1)
December 30, 1993 (3)
February 14, 1994 (2)
February 24, 1994 (1)
June 7, 1994 (1)

June 23, 1994 (1)

FERRUGINOUS HAWK (Buteo regalis)

November 13, 1993 (1)

HARRIS' HAWK (Parabuteo unicinctus)

October 27, 1993 (immature) (1)

AMERICAN KESTREL (Falco sparverius)

August 15, 1993 (1)
August 29, 1993 (1)
September 5, 1993 (2)
September 29, 1993 (3)
October 9, 1993 (2)
October 13, 1993 (4)
October 18, 1993 (3)
October 20, 1993 (2)
October 24, 1993 (1)
October 27, 1993 (2)
November 7, 1993 (3)
November 21, 1993 (1)
November 30, 1993 (3)
December 4, 1993 (3)
December 14, 1993 (4)
December 23, 1993 (1)
December 30, 1993 (2)
January 13, 1994 (2)
January 16, 1994 (2)
January 23, 1994 (2)
January 29, 1994 (1)
February 14, 1994 (1)
February 24, 1994 (1)

PRARIE FALCON (Falco mexicanus)

October 24, 1993 (1)

MOURNING DOVE (Zenaida macroura)

January 23, 1994 (3)
March 15, 1994 (2)
June 7, 1994 (4)
June 13, 1994 (1)

BURROWING OWL (Athene cunicularia)

June 22, 1993 (1)
June 27, 1993 (3)
July 3, 1993 (4)
July 30, 1993 (1)
August 3, 1993 (1)
December 14, 1993 (1)
December 23, 1993 (2)
January 10, 1994 (1)
January 13, 1994 (1)
January 16, 1994 (1)
January 23, 1994 (1)

January 29, 1994 (1)
February 14, 1994 (1)
Februay 24, 1994 (1)
March 1, 1994 (1)
April 18, 1994 (2) One with bands
May 11, 1994 (1) bands

ANNA'S HUMMINGBIRD (Calypta anna)

October 13, 1993 (2)
October 20, 1993 (2)
October 24, 1993 (2)
October 27, 1993 (3)
November 7, 1993 (1)
November 13, 1993 (2)
November 21, 1993 (1)
November 30, 1993 (1)
December 4, 1993 (1)
December 14, 1993 (1)
December 23, 1993 (1)
June 3, 1994 (1)

BELTED KINGFISHER (Ceryle alcyin)

September 5, 1993 (1)
September 29, 1993 (1)

CASSIN'S KINGBIRD (Tyrannus vociferans)

July 3, 1993 (2)
August 18, 1993 (2)
April 18, 1994 (2)
May 17, 1994 (1)
June 13, 1994 (1)

BLACK PHOEBE (Sayornis nigricans)

July 3, 1993 (1)
August 3, 1993 (1)
August 12, 1993 (1)
August 18, 1993 (2)
August 29, 1993 (1)
September 5, 1993 (1)
September 29, 1993 (1)
October 9, 1993 (2)
October 13, 1993 (2)
October 18, 1993 (1)
October 20, 1993 (2)
October 27, 1993 (1)
November 7, 1993 (1)
November 13, 1993 (1)
November 21, 1993 (1)
November 27, 1993 (3)
November 30, 1993 (2)
December 4, 1993 (1)
December 23, 1993 (3)
December 30, 1993 (2)
January 10, 1994 (2)
January 13, 1994 (2)
January 23, 1994 (2)

January 29, 1994 (1)
February 14, 1994 (2)
March 1, 1994 (3)
April 4, 1994 (2)
April 18, 1994 (1)
April 30, 1994 (2)
May 11, 1994 (1)
June 3, 1994 (1)
June 7, 1994 (4)
June 13, 1994 (1)
June 23, 1994 (1)

SAY'S PHOEBE (Sayornis saya)

September 29, 1993 (1)
October 9, 1993 (3)
October 13, 1993 (2)
October 18, 1993 (3)
October 20, 1993 (4)
October 27, 1993 (2)
November 13, 1993 (5)
November 21, 1993 (2)
November 27, 1993 (1)
December 14, 1993 (2)
December 23, 1993 (2)
January 10, 1994 (1)
January 16, 1994 (1)
January 23, 1994 (1)

WESTERN FLYCATCHER (Empidonax flaviventris)

January 16, 1994 (1)

HORNED LARK (Eremophila alpestris)

June 27, 1993 (18)
July 3, 1993 (1)
August 18, 1993 (1)
September 29, 1993 (5)
November 13, 1993 (36)
November 21, 1993 (8)
November 27, 1993 (1)
December 14, 1993 (18)
December 23, 1993 (9)
January 13, 1994 (1)
January 16, 1994 (2)
January 23, 1994 (2)
January 29, 1994 (2)
February 14, 1994 (1)
February 24, 1994 (19)
March 15, 1994 (4)
March 24, 1994 (1)
April 4, 1994 (172)
April 18, 1994 (2)

VIOLET-GREEN SWALLOW (Tachycineta thalassina)

March 24, 1994 (45)
April 30, 1994 (8)
May 17, 1994 (many)

May 19, 1994 (many)
May 26, 1994 (many)

BANK SWALLOW (Riparia riparia)

August 15, 1993 (16)
August 29, 1993 (22)
March 24, 1994 (17)
May 26, 1994 (many)

BARN SWALLOW (Hirundo rustica)

August 15, 1993 (9)
November 13, 1993 (1)
March 24, 1994 (8)
May 11, 1994 (many)
May 17, 1994 (few)
May 19, 1994 (few)
May 26, 1994 (many)

HOUSE WREN (Troglodytes aedon)

January 13, 1994 (1)

MARSH WREN (Cistothorus palustris)

January 29, 1994 (1)

WESTERN BLUEBIRD (Sialia mexicana)
December 23, 1993 (5)
January 10, 1993 (3)
February 24, 1994 (1)

MOUNTAIN BLUEBIRD (Sialia currucoides)

December 14, 1993 (27)
December 23, 1993 (2)
December 30, 1993 (11)
January 10, 1994 (10)
January 13, 1994 (10)
January 16, 1994 (4)
January 23, 1994 (3)
February 14, 1994 (2)
February 24, 1994 (2)

LOGGERHEAD SHRIKE (Lanius ludovicianus)

June 27, 1993 (2)
July 3, 1993 (1)
August 3, 1993 (1)
August 12, 1993 (1)
August 15, 1993 (3)
August 18, 1993 (1)
August 29, 1993 (1)
September 29, 1993 (3)
October 9, 1993 (2)
October 13, 1993 (1)
October 18, 1993 (3)
October 20, 1993 (3)
October 24, 1993 (1)

October 27, 1993 (2)
November 7, 1993 (3)
November 13, 1993 (3)
November 21, 1993 (2)
November 27, 1993 (2)
November 30, 1993 (2)
December 4, 1993 (1)
December 14, 1993 (5)
December 23, 1993 (4)
December 30, 1993 (3)
January 10, 1994 (1)
January 13, 1994 (2)
January 16, 1994 (1)
January 23, 1994 (1)
January 29, 1994 (2)
February 14, 1994 (3)
February 24, 1994 (4)
March 1, 1994 (2)
March 15, 1994 (2)
March 24, 1994 (2)
April 4, 1994 (2)
June 7, 1994 (2)
June 13, 1994 (2)
June 23, 1994 (3)

NORTHERN MOCKINGBIRD (Mimus polyglottos)

December 4, 1993 (1)
January 23, 1994 (1)
February 24, 1994 (1)
April 18, 1994 (1)
June 23, 1994 (1)

AUDUBON'S WARBLER (Dendroica coronata)

October 13, 1993 (4)
October 20, 1993 (25)
October 24, 1993 (13)
October 27, 1993 (8)
November 13, 1993 (26)
November 21, 1993 (2)
November 27, 1993 (13)
November 30, 1993 (4)
December 4, 1993 (3)
December 14, 1993 (60)
December 23, 1993 (2)
December 30, 1993 (2)
January 13, 1994 (3)
January 16, 1994 (1)
January 29, 1994 (1)
February 14, 1994 (12)
February 24, 1994 (1)
March 1, 1994 (1)
April 4, 1994 (1)

COMMON YELLOWTHROAT (Geothlypis trochas)

November 13, 1993 (1)
November 21, 1993 (1)
December 14, 1993 (2)

January 10, 1994 (1)
January 13, 1994 (3)
January 16, 1994 (2)
January 23, 1994 (1)
January 29, 1994 (1)
February 14, 1994 (1)
February 24, 1994 (2)
May 17, 1994 (1)

SONG SPARROW (Melospiza melodia)

November 21, 1993 (3)
December 30, 1993 (1)
January 29, 1994 (2)
April 30, 1994 (1)
May 26, 1994 (2)
June 7, 1994 (1)
June 13, 1994 (1)

SAGE SPARROW (Amphispiza belli)

May 19, 1994 (1)

RUFOUS-CROWNED SPARROW (Aimophila ruficeps)

January 29, 1994 (1)
March 1, 1994 (2)
March 15, 1994 (1)

WHITE-CROWNED SPARROW (Zonotrichia leucophrys)

October 18, 1993 (3)
October 20, 1993 (1)
October 24, 1993 (1)
October 27, 1993 (13)
November 30, 1993 (4)
December 30, 1993 (9)
January 16, 1994 (1)
January 23, 1994 (1)
January 29, 1994 (4)
February 14, 1994 (1)
March 1, 1994 (3)
March 15, 1994 (26)
March 24, 1994 (6)
April 4, 1994 (28)

WESTERN MEADOWLARK (Sturnella neglecta)

September 29, 1993 (1)
October 9, 1993 (2)
October 20, 1993 (2)
October 24, 1993 (2)
October 27, 1993 (1)
November 13, 1993 (1)
December 4, 1993 (1)
December 14, 1993 (1)
December 23, 1993 (15)
December 30, 1993 (2)
January 23, 1994 (1)
January 29, 1994 (1)

February 24, 1994 (2)
March 1, 1994 (2)
March 15, 1994 (2)
March 24, 1994 (5)
May 11, 1994 (1)
May 26, 1994 (4)
June 3, 1994 (1)
June 7, 1994 (1)
June 13, 1994 (6)
June 23, 1994 (1)

YELLOW-HEADED BLACKBIRD (Xanthocephalus xanthocephalus)

August 18, 1993
September 5, 1993
October 24, 1993

RED-WINGED BLACKBIRD (Agelaius phoeniceus)

August 12, 1993
August 15, 1993
August 18, 1993
August 29, 1993
September 5, 1993
September 29, 1993
October 9, 1993
October 13, 1993
October 18, 1993
October 20, 1993
October 24, 1993
October 27, 1993
November 7, 1993
November 13, 1993
November 21, 1993
November 27, 1993
November 30, 1993
December 4, 1993
December 14, 1993
December 23, 1993
December 30, 1993
January 10, 1994
January 13, 1994
January 16, 1994
January 23, 1994
January 29, 1994
February 14, 1994
February 24, 1994
March 1, 1994
March 15, 1994
March 24, 1994 (few)
April 4, 1994 (few, in field, not in bulrush)
April 18, 1994 (1)
May 19, 1994 (few)
May 26, 1994 (few)
June 7, 1994 (2) not in bulrush
June 13, 1994 (few)
June 23, 1994 (look like starting to breed)

TRICOLORED BLACKBIRD (Agelaius tricolor)

June 22, 1993
June 27, 1993
July 3, 1993
August 12, 1993
March 24, 1994 (many)
April 4, 1994
April 18, 1994
April 30, 1994
May 11, 1994
May 17, 1994 (few)

BREWER'S BLACKBIRD (Euphagus cyanocephalus)

June 22, 1993
June 27, 1993
July 14, 1993
July 30, 1993
August 3, 1993
August 12, 1993
August 15, 1993
August 18, 1993
August 29, 1993
September 29, 1993
October 9, 1993
October 13, 1993
October 18, 1993
October 20, 1993
October 24, 1993
October 27, 1993
November 13, 1993
November 21, 1993
November 27, 1993
November 30, 1993
December 4, 1993
December 14, 1993
December 23, 1993
December 30, 1993
January 10, 1994
January 13, 1994
January 16, 1994
January 23, 1994
January 29, 1994
February 14, 1994
February 24, 1994
March 1, 1994
March 15, 1994
March 24, 1994
April 4, 1994
April 18, 1994
April 30, 1994
May 11, 1994
May 17, 1994
May 19, 1994
May 26, 1994
June 3, 1994
June 7, 1994
June 13, 1994
June 23, 1994

BROWN-HEADED COWBIRD (Molothrus ater)

October 18, 1993 (1)

GREAT-TAILED GRACKLE (Quiscalus mexicanus)

April 30, 1994 (2)

HOUSE FINCH (Carpodacus mexicanus)

November 21, 1993 (2)
November 27, 1993
January 10, 1994 (2)
January 13, 1994 (3)
January 16, 1994 (2)
February 24, 1994 (1)
March 1, 1994 (1)
April 4, 1994 (4)

APPENDIX K