

Data and Results for “Reclaiming the Ecosystem”
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Lake Machado Analysis

Phosphate (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Storm Drain 1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Storm Drain 2	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Storm Drain 3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Agricultural Runoff	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5
D. Oxygen (mg/L)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	7.6	7.6	7.5	7.5	7.3	7.3	7.3	7.2	7.2	7.2
Storm Drain 1	7.1	7.1	7.1	7.0	7.0	6.9	6.9	6.8	6.8	6.8
Storm Drain 2	7.2	7.1	7.1	7.1	7.0	6.9	6.9	6.9	6.9	6.9
Storm Drain 3	6.4	6.4	6.3	6.3	6.3	6.2	6.2	6.1	6.1	6.1
Agricultural Runoff	4.2	4.1	4.0	4.0	3.9	3.8	3.8	3.7	3.7	3.7
pH	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Storm Drain 1	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Storm Drain 2	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Storm Drain 3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Agricultural Runoff	6.8	6.8	6.8	6.8	6.8	6.7	6.7	6.7	6.7	6.7
Salinity (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
Storm Drain 1	2.0	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.3	2.3
Storm Drain 2	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
Storm Drain 3	2.3	2.3	2.4	2.4	2.4	2.5	2.6	2.6	2.7	2.7
Agricultural Runoff	1.8	1.8	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.1
Calcium (ppb)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	40	40	45	45	45	45	50	50	50	50
Storm Drain 1	90	90	90	95	95	95	95	95	95	95
Storm Drain 2	190	190	190	190	195	195	195	195	200	200
Storm Drain 3	140	140	140	140	145	145	145	145	145	145
Agricultural Runoff	70	70	75	75	75	75	75	80	80	80
Ammonium (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
Storm Drain 1	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9
Storm Drain 2	1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5
Storm Drain 3	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Agricultural Runoff	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7

Initial Phosphate Reduction Analysis

Phosphate (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4
CaCO ₃	1.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5
CaCO ₃ /Plant	1.5	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4
CaCO ₃ /NH ₄ Cl	1.5	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1
CaCO ₃ /NH ₄ Cl/Plant	1.5	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
D. Oxygen (mg/L)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	5.6	5.6	5.7	5.6	5.6	5.6	5.5	5.5	5.5	5.5
CaCO ₃	5.6	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
CaCO ₃ /Plant	5.6	5.6	5.8	6.0	6.3	6.6	6.8	6.9	6.9	7.1
CaCO ₃ /NH ₄ Cl	5.6	3.0	2.9	2.7	2.6	2.5	2.4	2.2	2.1	2.0
CaCO ₃ /NH ₄ Cl/Plant	5.7	5.6	5.8	5.6	4.4	3.7	2.9	2.7	2.4	2.2
pH	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	6.8	6.8	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
CaCO ₃	6.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
CaCO ₃ /Plant	6.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
CaCO ₃ /NH ₄ Cl	6.8	7.0	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2
CaCO ₃ /NH ₄ Cl/Plant	6.8	7.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Salinity (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
CaCO ₃	2.0	2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.3	2.3
CaCO ₃ /Plant	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1
CaCO ₃ /NH ₄ Cl	2.3	2.3	2.4	2.4	2.4	2.5	2.6	2.6	2.7	2.7
CaCO ₃ /NH ₄ Cl/Plant	1.8	1.8	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.1
Calcium (ppb)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	70	70	75	75	75	75	75	80	80	80
CaCO ₃	90	90	90	90	90	90	90	95	95	95
CaCO ₃ /Plant	90	90	90	90	90	90	90	90	95	95
CaCO ₃ /NH ₄ Cl	120	120	120	120	120	125	125	125	125	130
CaCO ₃ /NH ₄ Cl/Plant	110	110	110	110	110	110	110	115	115	115
Ammonium (parts per million)	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12	Day 14	Day 16	Day 18	Day 20
Control	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6
CaCO ₃	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
CaCO ₃ /Plant	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7
CaCO ₃ /NH ₄ Cl	0.5	3.0	3.1	3.1	3.2	3.2	3.2	3.2	3.3	3.3
CaCO ₃ /NH ₄ Cl/Plant	0.5	3.0	3.1	3.2	3.2	3.3	3.4	3.5	3.5	3.6

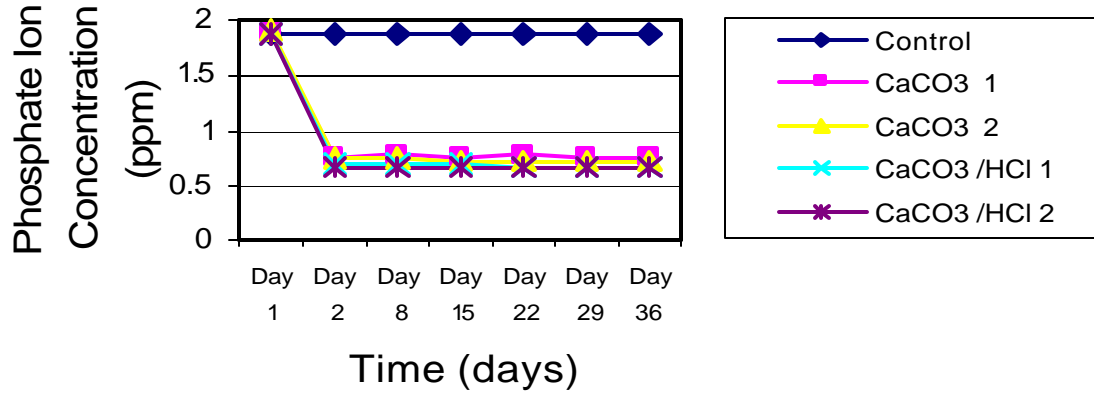
Madrona Marsh Analysis

ppm	PO ₄ ³⁻	NO ₃ ⁻	O ₂	NH ₃	Cl ⁻	Fe	Cu	Cr ⁶⁺	pH
1	1.97	13.97	3.06	0.55	0.1	0.23	0.08	0.01	7.3
2	4.31	14.07	0.31	0.47	0.9	0.57	0.01	0.02	7.7
3	4.57	14.16	0.29	0.39	0.8	0.49	0.02	0.01	7.7
4	2.09	13.39	2.39	0.43	0.3	0.24	0.01	0.05	7.4
5	1.99	12.01	3.54	0.57	0.5	0.17	0.02	0.03	7.3
6	1.73	11.17	5.36	0.61	0.1	0.11	0.03	0.04	7.2
7	1.99	13.17	2.86	0.54	0.3	0.17	0.00	0.03	7.3
8	1.99	13.55	1.96	0.54	0.1	0.19	0.02	0.04	7.4
9	1.97	13.47	3.86	0.57	0.3	0.12	0.12	0.12	7.3
10	1.96	12.72	4.01	0.55	0.2	0.11	0.11	0.11	7.3

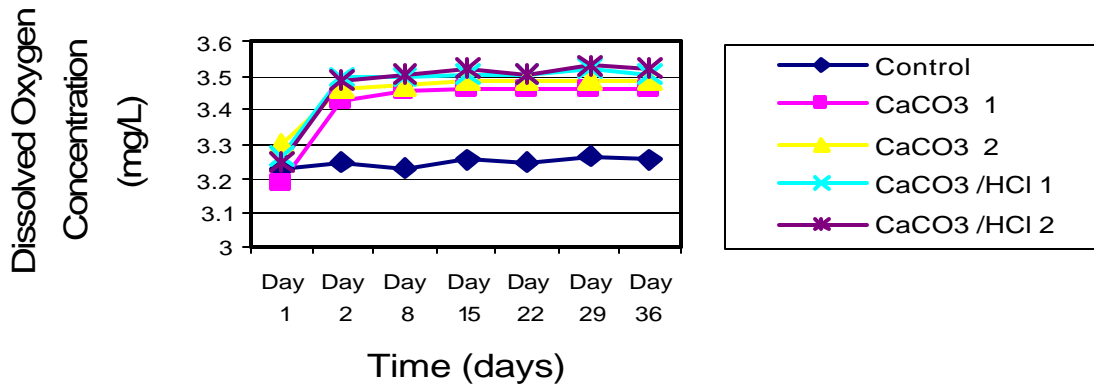
Madrona Marsh Calcium Carbonate Lacing Procedure

Phosphate (parts per million)	Day 1	Day 2	Day 8	Day 15	Day 22	Day 29	Day 36
Control	1.89	1.88	1.87	1.87	1.88	1.87	1.87
CaCO ₃ 1	1.88	0.76	0.77	0.76	0.77	0.76	0.76
CaCO ₃ 2	1.9	0.74	0.74	0.73	0.73	0.73	0.73
CaCO ₃ /HCl 1	1.88	0.69	0.69	0.69	0.68	0.68	0.68
CaCO ₃ /HCl 2	1.89	0.68	0.67	0.67	0.67	0.67	0.67
D. Oxygen (mg/L)	Day 1	Day 2	Day 8	Day 15	Day 22	Day 29	Day 36
Control	3.23	3.25	3.23	3.26	3.25	3.27	3.26
CaCO ₃ 1	3.19	3.43	3.45	3.46	3.46	3.46	3.46
CaCO ₃ 2	3.3	3.46	3.47	3.49	3.49	3.49	3.49
CaCO ₃ /HCl 1	3.27	3.5	3.5	3.51	3.51	3.52	3.51
CaCO ₃ /HCl 2	3.25	3.49	3.51	3.52	3.51	3.53	3.52
Calcium (parts per million)	Day 1	Day 2	Day 8	Day 15	Day 22	Day 29	Day 36
Control	0.06	0.06	0.06	0.07	0.06	0.07	0.06
CaCO ₃ 1	0.09	0.1	0.11	0.1	0.1	0.1	0.1
CaCO ₃ 2	0.14	0.16	0.15	0.16	0.16	0.16	0.16
CaCO ₃ /HCl 1	0.06	0.09	0.1	0.1	0.1	0.1	0.1
CaCO ₃ /HCl 2	0.09	0.13	0.13	0.13	0.14	0.13	0.14

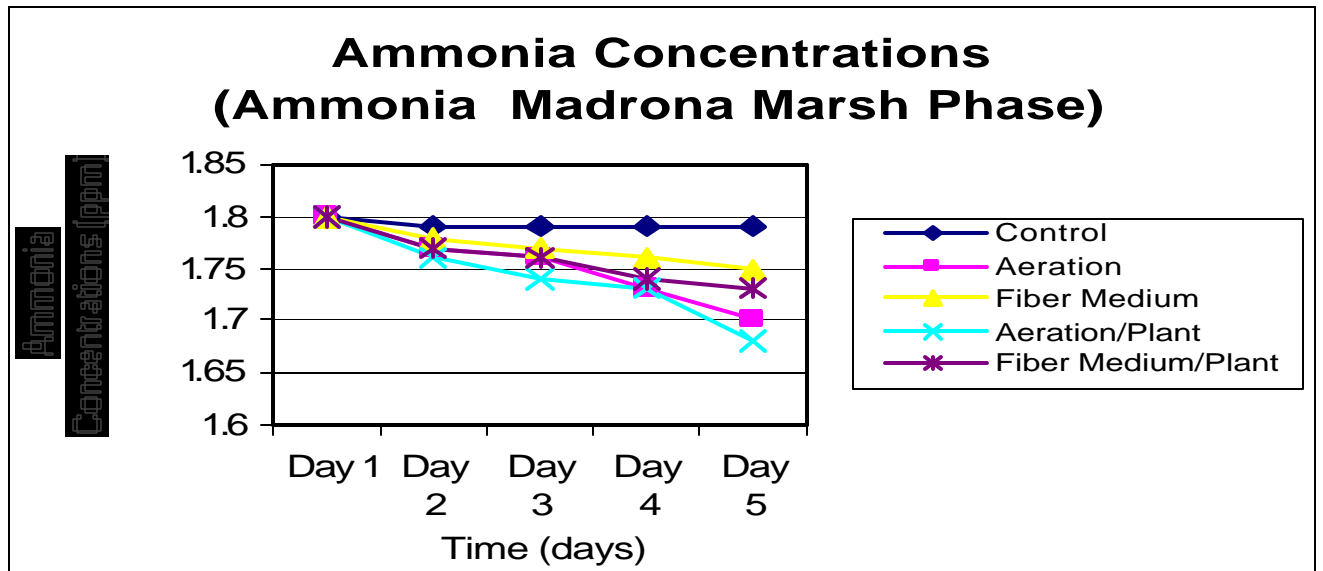
Phosphate Ion Concentrations (Calcium Carbonate Lacing Phase)



Dissolved Oxygen Concentrations (Calcium Carbonate Lacing Phase)



Ammonia Approach Marsh Analysis Phase



Bacterial Culture Analysis

MacConkey Agar

Escherichia coli (non-pathogenic)
Kelbsiella (pathogenic)
Serratia (pathogenic)
Proteus (pathogenic)
Citrobacter (pathogenic)
Escherichia coli (pathogenic [O157-H7])
Pseudomonas (pathogenic)
Aeromonas (pathogenic)

Hektoen Agar

Salmonella (pathogenic)

Initial studies have also shown that phosphate reduction can significantly reduce the populations of pathogenic bacteria in fresh water. Phosphate reduction of 67% from 1.2ppm to 0.4ppm showed a 33% decline in overall bacterial populations with a 50% decline in present pathogenic species. Calcium carbonate also seemed to have a secondary reducing effect on enteropathogenic populations. These preliminary studies were conducted using MacConkey and Hektoen agars with water collected from Madrona Marsh during a recent illegal sewage infiltration into the preserve.

Filter Model Analysis

Filter Model	Filter Material	Filter Medium	Phosphate (parts per million)	Turbidity (JTU)	time (s)
1 (Spring)	Fiber Media	CaCO ₃ powder	0.58	4	10
1 (Spring)	Fiber Media	Marble Chips	0.41	5	10
1 (Spring)	Fiber Media	Solidified CaCO ₃	0.22	7	12
1 (Spring)	Filter Paper	CaCO ₃ powder	0.49	2	13
1 (Spring)	Filter Paper	Marble Chips	0.39	2	14
1 (Spring)	Filter Paper	Solidified CaCO ₃	0.17	3	18
Filter Model	Filter Material	Filter Medium	Phosphate (parts per million)	Turbidity (JTU)	time (s)
2 (PVC)	Fiber Media	CaCO ₃ powder	0.59	4	7
2 (PVC)	Fiber Media	Marble Chips	0.43	6	8
2 (PVC)	Fiber Media	Solidified CaCO ₃	0.24	8	10
2 (PVC)	Filter Paper	CaCO ₃ powder	0.51	2	9
2 (PVC)	Filter Paper	Marble Chips	0.42	3	11
2 (PVC)	Filter Paper	Solidified CaCO ₃	0.19	5	14
Filter Model	Filter Material	Filter Medium	Phosphate (parts per million)	Turbidity (JTU)	time (s)
3 (metal)	Fiber Media	CaCO ₃ powder	0.58	4	9
3 (metal)	Fiber Media	Marble Chips	0.42	5	11
3 (metal)	Fiber Media	Solidified CaCO ₃	0.21	8	12
3 (metal)	Filter Paper	CaCO ₃ powder	0.51	2	11
3 (metal)	Filter Paper	Marble Chips	0.39	3	13
3 (metal)	Filter Paper	Solidified CaCO ₃	0.18	4	15