

OCEANSIDE INSTALLATION



Setting in Place

OCEANSIDE INSTALLATION



Installing Media & Planting



OCEANSIDE INSTALLATION



Finished Project

PLANT GROWTH



**April,
2008**


MODULAR
WETLANDS

PLANT GROWTH



**June,
2008**

PLANT GROWTH



**October,
2008**

MODULAR
WETLANDS

PLANT GROWTH



May, 2009

Three weeks after the plants cut all the way to the ground. Fast growth!


MODULAR
WETLANDS

PLANT GROWTH



May, 2009



**Removal of
plants for
observation**

MODULAR
WETLANDS

PERFORMANCE



PERFORMANCE



Test Run	pH		TSS (mg/L)		TKN (mg/L)		Dissolved Phosphorus (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	7.07	7.21	73	17				
2	7.13	9.49	52	15			3.81	0.46
3	7.13	9.53	52	13			3.81	0.39
4	8.65	8.65	100	3	10.4	8.29	1.37	0.68
5	8.65	8.7	100	5	10.4	8.64	1.37	0.75
6	8.65	8.69	100	1	10.4	10.9	1.37	0.72
7	8.65	8.69	100	6	10.4	10.1	1.37	0.69
8	8.65	8.69	100	2	10.4	7.4	1.37	0.7
Averages	8.0725	8.70625	84.63	12.40	10.40	9.07	2.07	0.63
Age Removal Efficiency (%)			85.35%		12.83%		69.66%	

Using Sil-Co-Sil 105

BioMedia **GREEN** 

Mean particle size = 19 microns

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Ortho Phosphorus (mg/L)		Dissolved Cadmium (mg/L)		Dissolved Copper (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
1			0.584	0.48	0.951	0.34
2			0.503	0.01	0.906	0.009
3			0.503	0.006	0.906	0.005
4	3.98	3.13	0.302	0.192	0.354	0.115
5	3.98	2.15	0.302	0.193	0.354	0.119
6	3.98	2.2	0.302	0.206	0.354	0.13
7	3.98	2.11	0.302	0.203	0.354	0.11
8	3.98	2.04	0.302	0.193	0.354	0.117
Averages	3.98	2.33	0.39	0.19	0.57	0.12
average Removal Efficiency (%)		41.56%		52.16%		79.15%

BioMedia**GREEN** 

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Dissolved Lead (mg/L)		Dissolved Zinc (mg/L)		Dissolved Mercury (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	0.201	0.015	1.33	0.93	0.009	0.002
2	0.192	0.005	1.32	0.05	0.006	0.002
3	0.192	0.005	1.32	0.05	0.006	0.002
4	0.492	0.008	0.4	0.06	n/d	n/d
5	0.492	0.007	0.4	0.06	n/d	n/d
6	0.492	0.005	0.4	0.05	n/d	n/d
7	0.492	0.005	0.4	0.05	n/d	n/d
8	0.492	0.005	0.4	0.05	n/d	n/d
Averages	0.38	0.01	0.75	0.16	0.01	0.00
Age Removal Efficiency (%)	98.19%		78.22%		71.43%	

BioMedia**GREEN** 

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Oil & Grease (mg/L)		TPH (mg/L)		Turbidity (NTU)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	360	11				
2	67	1				
3	67	1				
4	13	7	1.4	0	36	0.2
5	13	3	1.4	0	36	0.5
6	13	7	1.4	0	36	0.2
7	13	10	1.4	0	36	0.5
8	13	12	1.4	0	36	0.2
Averages	69.88	6.50	1.40	0.00	36.00	0.32
Age Removal Efficiency (%)	90.70%		100.00%		99.11%	

BioMedia**GREEN** 

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Total Coliform (MPN/100 mL)		Fecal Coliform (MPN/100 mL)	
	Influent	Effluent	Influent	Effluent
1	1600000	1600000	1250000	500000
2	1600000	500000	1250000	300000
3	1600000	500000	1250000	300000
4	1600000	900000	1250000	500000
Averages	1600000	875000	1250000	400000
Average Removal Efficiency (%)	45.31%		68.00%	

BioMedia**GREEN** 

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.


MODULAR
WETLANDS

PERFORMANCE



Test Run	pH		TSS (mg/L)		Dissolved Phosphorus (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	7.26	7.68	270	6	0.68	0.12
2	7.26	7.43	270	3	0.68	0.65
3	7.26	7.35	270	2	0.68	0.77
4	7.26	7.36	270	1	0.68	0.58
5						
6						
7						
8						
Averages	7.26	7.455	270	3	0.68	0.53
Average Removal Efficiency (%)			98.89%		22.06%	

Using Sil-Co-Sil 106

MWS-LINEAR 

Mean particle size = 19 microns

Testing of Quarter Scale Model - at Flow Rate of 1.9 GPM. This flow rate is equal to 121.6 GPM for full size system.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Dissolved Cadmium (mg/L)		Dissolved Copper (mg/L)		Dissolved Lead (mg/L)		Dissolved Mercury (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	0.61	0.02	0.757	0.028	0.543	0.1	0.018	0.002
2	0.61	0.07	0.757	0.055	0.543	0.1	0.018	0.002
3	0.61	0.2	0.757	0.066	0.543	0.1	0.018	0.002
4	0.61	0.33	0.757	0.072	0.543	0.1	0.018	0.002
5								
6								
7								
8								
Averages	0.61	0.155	0.757	0.05525	0.543	0.1	0.018	0.002
Average Removal Efficiency (%)	74.59%		92.70%		81.58%		88.89%	

MWS-LINEAR 

Testing of Quarter Scale Model - at Flow Rate of 1.9 GPM. This flow rate is equal to 121.6 GPM for full size system.


MODULAR
WETLANDS

PERFORMANCE



Test Run	Dissolved Nickel (mg/L)		Dissolved Zinc (mg/L)		Oil & Grease (mg/L)		TPH (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	0.37	0.01	0.95	0.05	10	1	19	0
2	0.37	0.25	0.95	0.05	10	1	19	0
3	0.37	0.3	0.95	0.21	10	2.5	19	0
4	0.37	0.34	0.95	0.43	10	2	19	0
5								
6								
7								
8								
Averages	0.37	0.225	0.95	0.185	10	1.625	19	0
Average Removal Efficiency (%)	39.19%		80.53%		83.75%		100.00%	

MWS-LINEAR 

Testing of Quarter Scale Model - at Flow Rate of 1.9 GPM. This flow rate is equal to 121.6 GPM for full size system.


 M O D U L A R
 W E T L A N D S

PERFORMANCE



Test Run	Turbidity (NTU)		Fecal Coliform (MPN/100 mL)		E.Coli (MPN/100 mL)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	21	0.5				
2	21	1.5				
3	21	1.5				
4	21	2.8				
5						
6			1600	170	1600	110
7						
8			1600	900	1600	900
Averages	21	1.575	1600	535	1600	636.6667
Average Removal Efficiency (%)		92.50%		66.56%		60.21%

MWS-LINEAR 

Red text indicates concentrations are greater than testing limits of 1600 MPN/100mL.

Testing of Quarter Scale Model - at Flow Rate of 1.9 GPM. This flow rate is equal to 121.6 GPM for full size system.


MODULAR
WETLANDS

LATEST FIELD TESTING



MWS-LINEAR

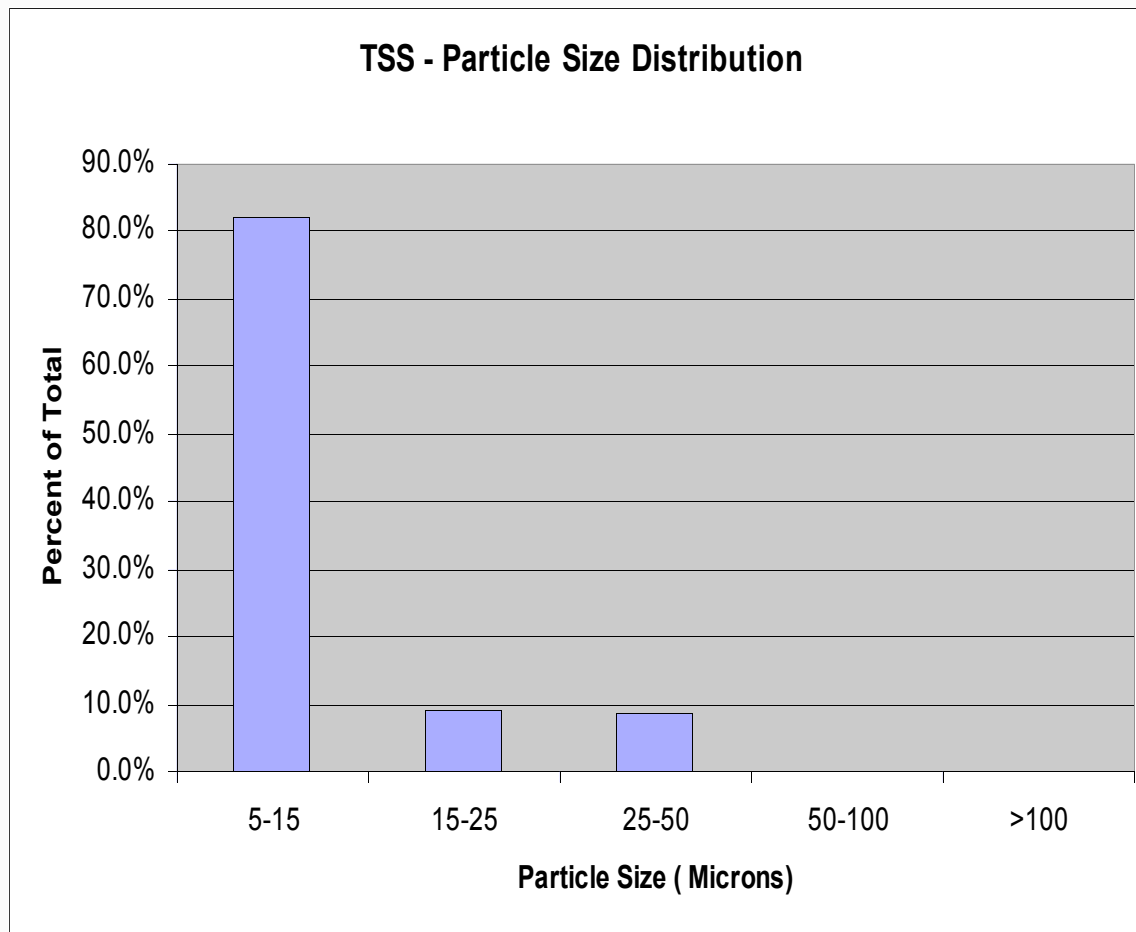


OCEANSIDE BOAT WASH - MONITORING

“4000 to 6000 gallons every day”



LATEST FIELD TESTING



**Exceeds
Washington's
TAPE Protocol
Requirement
for Basic
Treatment**

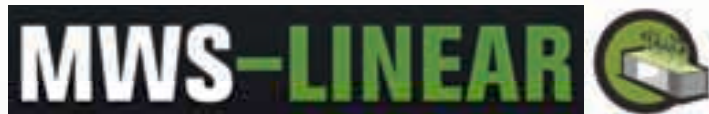
82% of TSS Influent < 15 microns



LATEST FIELD TESTING



Test Run	Nitrate-N (mg/L)		TSS (mg/L)		Copper (mg/L)		Lead (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
5/30/2008			43	3	0.03	0.02	0.1	0.1
6/12/2008			40	0.13	0.06	0.03	0.1	0.1
6/14/2008			22	4	0.04	0.02	0.1	0.1
6/20/2008			68	4	0.04	0.02	0.1	0.1
7/7/2008	0.97	0.16	92	17	0.02	0.02	0.1	0.1
7/18/2008	0.93	0.28	52	17			0.1	0.1
8/1/2008	0.05	0.07	35	5	0.04	0.02	0.1	0.1
8/15/2008	0.85	0.17	32	6	0.02	0.02	0.1	0.1
8/28/2008	0.92	0.21	27	18	0.04	0.02	0.1	0.1
Averages	0.74	0.18	45.67	8.24	0.04	0.02	0.10	0.10
Average Removal Efficiency (%)	76.08%		81.96%		52.78%		0.00%	
			82% 5-15 microns		0.02 in red was less than decetable limit		0.1 in red was less than decetable limit	



Mean particle size < 8 microns

Independent Third Party Field Testing - at Oceanside Harbor Boat Wash Drainage Area - 2008



LATEST FIELD TESTING



Test Run	Zinc (mg/L)		TPH - Gasoline (mg/L)		TPH - Diesel (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent
5/30/2008	0.36	0.05	0.14	0	0	0
6/12/2008	0.18	0.05	0	0	0	0
6/14/2008	0.11	0.05	0	0	0	0
6/20/2008	0.28	0.05	0	0	0	0
7/7/2008	0.25	0.05	0	0	0	0
7/18/2008	0.23	0.05	0	0	0	0
8/1/2008	0.38	0.06	0	0	2.65	0
8/15/2008	0.23	0.05	1.29	0.65	0	0
8/28/2008	0.18	0.05	0.55	0.49	0	0
Averages	0.24	0.05	0.22	0.13	0.29	0.00
Average Removal Efficiency (%)	79.09%		42.42%		100.00%	

0.05 in red was less than detectable limit



Independent Third Party Field Testing - at Oceanside Harbor Boat Wash Drainage Area - 2008



LATEST FIELD TESTING



Test Run	TPH - Motor Oil (mg/L)		Fecal Coliform (MPN/100 mL)		E.Coli (MPN/100 mL)		Enterococci (MPN/100 mL)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
5/30/2008	0.43	0						
6/12/2008	0.5	0						
6/14/2008	0	0						
6/20/2008	0	0						
7/7/2008	0	0	50000	8000	250	52	2851	860
7/18/2008	0	0						
8/1/2008	6.13	0						
8/15/2008	0.06	0						
8/28/2008	0.39	0						
Averages	0.83	0.00	50000.00	8000.00	250.00	52.00	2851.00	860.00
Average Removal Efficiency (%)	100.00%		84.00%		79.20%		69.84%	



Independent Third Party Field Testing - at Oceanside Harbor Boat Wash Drainage Area - 2008



