

Lombardo Associates, Inc.

Representative Nitrogen Removal
Project Descriptions

Test Centers & Independent Evaluations



- Massachusetts Alternative Septic System Test Center (MASSTC)
- Polson, MT – State of Montana Study
- La Pine, OR – State of Oregon Study

Environmental Engineers/Consultants

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Independent Testing at MASSTC



NITREX™ COMES OUT ON TOP AT MASSTC TESTING FOR NITROGEN REMOVAL



Project Description

The Nitrex™ system is one of a number of alternative septic systems technologies being assessed at the Massachusetts Septic System Test Center.

Project Application Data

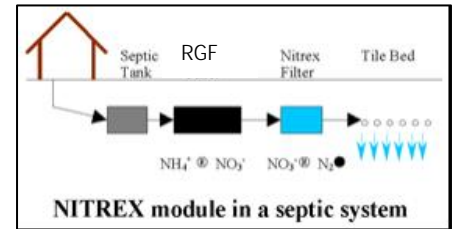
- Location: Otis Air Force Base, Massachusetts
- Site Application: Massachusetts Alternative Septic System Test Center
- Installation Date: October 4, 2001

Design Profile

- Design Wastewater Flow: 330 gpd
- Wastewater Treatment Process: Septic Tank – Recirculating Gravel Filter (RGF) – Nitrex™

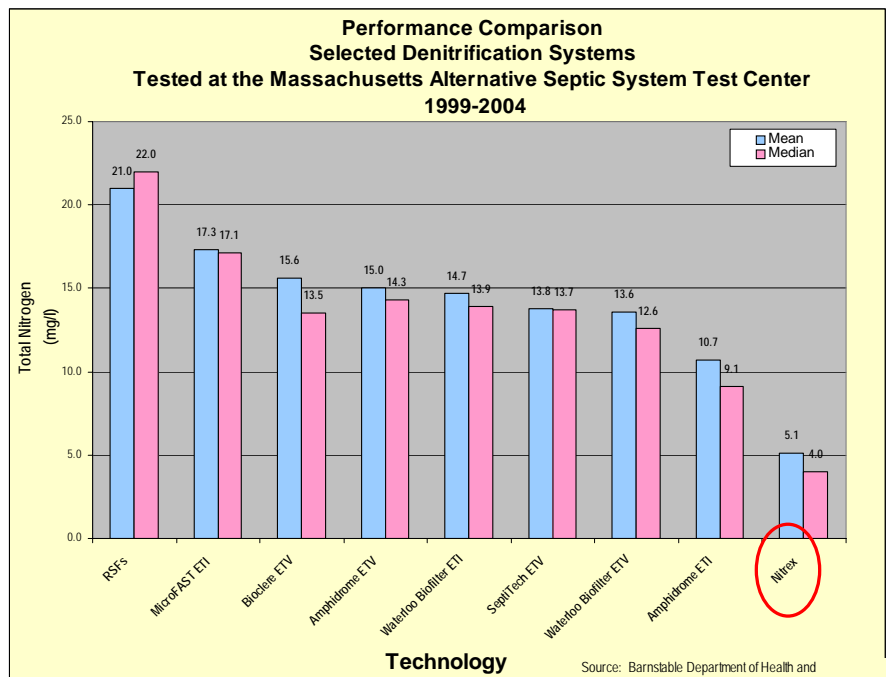
Nitrex™ Treatment Performance

The Nitrex™ filter installed at Otis Air Force base has reduced nitrogen in the effluent by an average of 74.1% over the two years that it has been in operation. The following figures illustrate the nitrate in the effluent and % of nitrate removed from the effluent due to the Nitrex™ filter. The Table provides the actual data measured by an independent laboratory. The lower winter 2003 wastewater temperature from the RGF reduced the performance of the Nitrex™ filter.



Nitrex™ System Performance Summary

	Total Nitrogen Median (mg/l)	
	Nitrex™ Influent	Effluent
Otis, MA	19.7	4.5



Date	Discharge Temp. (°C)	Influent			Effluent					
		TN (mg/l)	TKN	TN (mg/l)	Nitrite	Nitrate	NH4 (mg/l)	TKN	CBOD	TSS
10/24/01		19		3.1	0.4	0.1	1.3	2.6		
11/07/01		19		3.8	0.1	1.9	1.1	1.8		
11/20/01		19		2.2	0.1	0.1	0.9	2		
12/04/01		19		2.2	0.2	0.1	0.2	1.9		
12/19/01		19		2.5	0.1	0.1	0.4	2.3		
01/03/02		19		1.6	0.1	0.1	0.2	1.4		
01/16/02		19		1.7	0.1	0.1	0.2	1.5		
02/13/02		19		2.1	0.1	0.1	0.9	1.9		
03/13/02		19		2.8	0.1	0.6	1.2	2.1		
04/10/02		19		2.4	0.1	0.8	0.2	1.5		
05/08/02		19		3	0.1	0.1	0.6	2.8		
05/22/02		14.8	2.5	2	0.1	0.1	0.3	1.8		
06/12/02		16.7	3	2.5	0.1	0.1	0.2	2.3		
07/10/02		13.6	3.6	3.4	0.1	0.1	2.2	3.2		
08/14/02	77.4	15.8	1.3	2.7	0.1	0.1	1.1	2.5		
09/11/02	73.8	20.5	1.3	2.1	0.1	0.1	0.8	1.9		
10/09/02	68	15.5	0.3	2	0.1	0.3	1.4	1.6		
11/13/02	56.5	18.9	1.3	6.7	0.2	1.8	0.2	4.7		
12/11/02	44.8	18.7	0.5	6.1	0.3	4.3	0.4	1.5		
01/08/03	41.5	11.2	4.2	8	0.3	4.4	2.7	3.3		
02/12/03	37.6	18.2	7.8	13.1	0.3	5.4	6.2	7.4		
03/12/03	36.9	16.9	9.8	12.6	0.1	2.8	7.9	9.7		
04/09/03	41.5	17.9	4.7	8.9	0.1	4	4.2	4.8		
05/14/03		11.7	3.2	6	0.1	2.1	0.9	3.8		
06/11/03	60.3	10.23		7.2	0.05	0.1				
06/25/03	61.7									
07/09/03	72									
10/15/03	18.1	21.76	0.5	5.71	0.06	0.05	3.2	5.6	11	32
11/12/03	12.2	25.1	1.6	4.8	0.1	3.3	0.5	1.4	1	2
12/10/03	6.2	14.76	0.5	5.11	0.21	3.6	0.6	1.3	1	0.5
01/07/04	6	13.1	4.1	3.93	0.07	0.86	1.8	3	2.9	1
03/11/04	2.3	24.82	11	18.15	0.05	0.1	13	18	10	5.5
12/01/04	10.2	21.83	0.8	10.33	0.03	7.7	0.8	2.6	4	2.5
12/08/04	9.4	23.13	3.1	8.73	0.03	6.6	0.3	2.1	8	2.5
12/15/04	8.5	22.43	3.4	11.53	0.03	8.3	0.5	3.2	4	2.5
12/22/04	6.7	20.28	0.25	11.23	0.03	9.7	0.5	1.5	1	2.5
01/05/05	7.3	19.73	3.7	10.19	0.19	8.2	0.3	1.8	11	2.5
01/12/05	5.8	17.83	3.8	6.03	0.03	4.1	0.1	1.9	6	2.5
01/19/05	5.3	19.93	1.9	10.23	0.03	8.5	0.5	1.7	11	2.5
02/02/05	3.3	20.73	0.7	11.28	0.03	11	0.3	0.25	14	2.5
02/09/05		40.63	1.6	16.43	0.03	15	0.4	1.4	4	2.5
02/16/05	4.1	25.33	1.3	12.33	0.03	10	0.3	2.3	1	2.5
02/23/05	3.3	20.23	1.2	11.23	0.03	9.8	0.3	1.4	4	2.5
03/04/05	2.5	28.28	0.25	17.03	0.03	16	0.3	1	5	2.5
03/11/05	2.7	20.83	2.8	10.03	0.03	7.6	0.2	2.4	5	2.5
03/18/05	3.6	22.93	2.9	8.23	0.03	6.4	0.4	1.8	5	2.5
03/25/05	3.9	18.73	2.7	6.63	0.03	4.3	0.5	2.3	3	2.5
04/08/05	7.9	23.49	1.9	8.33	0.03	6.1	0.4	2.2	3	2.5
04/15/05	7.7	23.35	0.25	8.13	0.03	6.4	3	1.7	4	2.5
04/22/05		25.68	1.9	9.23	0.03	7.2	0.5	2	4	2.5
05/13/05	11.4	16.63	1.2	3.23	0.03	1.3	0.4	1.9	3	5.4
05/20/05	11.5	16.23	2.2	1.08	0.03	0.05	0.1	1	8	5
05/27/05	11.1	11.93	4.1	3.23	0.03	1.3	0.3	1.9	5	2.5
06/03/05		20.55	0.9	3.73	0.03	2	0.1	1.7	5	2.5
06/10/05		24	1.3	5.33	0.03	3.5	0.3	1.8	3	2.5
06/17/05	17.8	14.79	2.9	3.97	0.17	1.8	0.1	2	7	2.5
06/24/05		16.33	3.3	2.82	0.03	0.99	0.6	1.8	4	2.5
07/01/05	19.3	16.43	2.4	3.73	0.03	1.1	1.4	2.6	6	2.5
07/08/05		20.48	2.7	3.73	0.03	1.7	0.7	2	6	2.5
07/15/05	20.7	21.75	1.4	3.83	0.03	1.8	0.5	2	5	2.5
07/22/05	22.7	22.3	0.25	3.35	1.5	0.15	0.6	1.7	5	2.5
07/29/05	22.5	28.33	1.3	4.93	0.03	2.2	0.5	2.7	5	2.5
08/03/05	22.6	28.65	0.25	4.73	0.03	2.6	0.7	2.1	4	2.5
08/10/05	23.4	23.31	0.9	4.03	0.03	2	0.6	2	4	2.5
08/17/05		26.61	0.25	5.53	0.03	3.3	0.3	2.2	4	2.5
08/24/05	23.2	31.83	3.8	3.73	0.03	1.8	0.2	1.9	30	2.5
08/31/05	23.5	28.13	1.9	4.43	0.03	2.4	0.4	2	6	2.5
09/14/05	22.7	26.28	0.25	4.53	0.03	2.6	0.4	1.9	11	2.5
09/21/05	22.4	24.15	0.7	2.76	0.06	1.2	0.8	1.5	7	2.5
09/28/05	21.5	23.86	2.5	3.63	0.13	2	0.3	1.5	2.2	2.5
10/05/05	19.9	19.74	0.25	3.59	0.09	2.1	0.1	1.4	1	2.5
Average	23.0	20.4	2.3	6.0	0.1	3.3	1.1	2.5	5.8	3.3
Median	18.1	19.7	1.9	4.5	0.1	2.0	0.5	2.0	5.0	2.5
St Dev	21.4	5.1	2.2	4.0	0.2	3.7	2.0	2.4	4.8	4.5

Reference Contact:
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Polson, Montana Residential System



Project Description

This Nitrex™ system was installed as a demonstration sponsored by the Montana Environmental Health Dept. for the purpose of evaluating alternative wastewater systems for enhanced NO₃ removal.

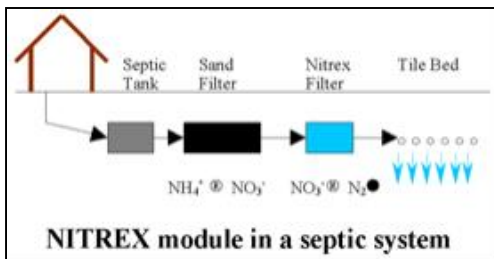
	Total Nitrogen (mg/l)	
	Influent	Effluent
Polson, MT	32.8	3.4

Project Application Data

- Location: Polson, Montana
- Site Application: Single Family Residence
- Installation Date: June 1, 1999

Design Profile

- Design Wastewater Flow: 264 gpd
- Wastewater Treatment Process: Septic Tank – ISF – Nitrex™



Nitrex™ Treatment Performance

The Nitrex™ filter installed at Polson has reduced the nitrogen by an average of 88.7% from the sand filter effluent over the two and a half years that it has been in operation. The following figures illustrate the nitrate in the effluent and % of nitrate removed from the effluent due to the Nitrex™ filter. The Table provides the actual data measured by an independent laboratory.

Reference Contact:

Rebecca Dupuis
 Osprey Environmental Consulting
 606 4th Avenue East
 Polson, MT 59860
 (406) 883-5603

Date	Temp (oC)	Septic Tank Influent				Nitrex™ Effluent				% TN Removal (mg/L)
		TN	NO ₃ -N (mg/L)	NH ₄ -N (mg/L)	TKN (mg/L)	TN	NO ₃ -N (mg/L)	NH ₄ -N (mg/L)	TKN (mg/L)	
Oct1/99	19	19	12	1.3	7.3	1.8	0.1	0.1	1.7	90.5%
Oct2/99	10	19	17	0.3	1.6	1.3	0.1	0.1	1.2	93.0%
Oct3/99	15	8	7	0.3	1.6	1.3	0.1	0.1	1.2	84.0%
Oct4/99	14	20	17	0.2	2.5	3.1	0.1	0.1	3.0	84.3%
Oct5/99	12	18	16	0.2	1.4	1.5	0.1	0.1	1.4	91.5%
Nov7/99	9	16	14	0.9	1.8	1.6	0.1	0.2	1.5	89.9%
Nov8/99	10	18	16	0.8	2.5	1.8	0.1	0.2	1.7	90.1%
Nov9/99	9	17	14	1.1	3.4	2.0	0.1	0.3	1.9	88.4%
Nov10/99	10	20	18	1.2	2.1	1.3	0.1	0.4	1.2	93.5%
Dec2/99	9	37	31	0.5	6.0	1.9	0.1	0.5	1.8	94.9%
Dec3/99	7	38	35	0.2	2.6	1.8	0.1	0.2	1.7	95.2%
Dec4/99	9	52	37	0.3	14.5	2.0	0.1	0.2	1.9	96.1%
Dec5/99	8	41	36	0.3	4.7	1.7	0.1	0.1	1.6	95.8%
Dec6/99		40	38	0.2	2.1	1.9	0.1	0.2	1.8	95.3%
Jan7/00	10	48	48	1.1	0.1	2.0	0.1	0.3	1.9	95.8%
Jan8/00	11	50	49	0.1	1.2	1.7	0.1	0.4	1.6	96.6%
Jan9/00	9	51	50	0.1	1.1	2.1	0.1	0.5	2.0	95.9%
Jan10/00	10	50	48	0.1	1.5	2.8	0.2	0.1	2.6	94.3%
Feb3/00	8	23	22	0.2	1.2	9.0	7.9	0.3	1.1	61.2%
Feb4/00	6	30	29	0.7	0.9	8.5	5.6	1.0	2.9	71.6%
Feb5/00	8	34	33	0.2	1.3	5.1	2.7	0.3	2.4	85.1%
Feb6/00	9	35	33	0.2	1.5	3.0	1.2	0.1	1.8	91.3%
Feb7/00	10	32	31	0.7	0.8	2.3	0.6	0.2	1.7	92.8%
Mar10/00	11	34	32	0.3	2.2	2.3	0.2	0.5	2.1	93.3%
Mar11/00	7	36	32	0.3	4.3	2.1	0.1	0.5	2.0	94.2%
Mar12/00	9	33	32	0.2	0.9	2.1	0.1	0.5	2.0	93.6%
Mar13/00	9	34	33	0.3	0.8	2.2	0.1	0.5	2.1	93.5%
Mar14/00	9	35	32	0.5	2.6	2.3	0.1	0.3	2.2	93.4%
Apr6/00	11	40	39	0.2	1.1	3.8	0.5	0.8	3.3	90.5%
Apr7/00		47	44	0.1	3.0	9.1	0.1	0.8	9.0	80.6%
Apr8/00	11	47	46	0.1	1.2	2.4	0.1	0.9	2.3	94.9%
Apr9/00	12	49	46	0.3	2.7	2.4	0.1	1.0	2.3	95.1%
Apr10/00	15	45	44	0.1	1.4	2.8	0.2	1.0	2.6	93.8%
May13/00	14	40	39	0.2	0.7	2.5	0.1	1.1	2.4	93.7%
May14/00	12	42	41	0.2	1.4	2.7	0.1	1.6	2.6	93.6%
May15/00	19	41	40	0.1	1.2	3.0	0.1	1.2	2.9	92.7%
May16/00	16	41	40	0.2	1.2	2.9	0.1	1.3	2.8	93.0%
May17/00	12	41	40	0.2	0.7	2.8	0.1	1.4	2.7	93.1%
Jun7/00	22	32	31	0.1	0.9	2.9	0.3	0.8	2.6	90.9%
Jun8/00	16	33	31	2.1	2.4	3.8	0.3	0.9	3.5	88.6%
Jun9/00	16	32	31	0.1	0.6	2.8	0.3	1.0	2.5	91.1%
Jun10/00	17	32	31	0.1	0.5	2.8	0.3	0.7	2.5	91.1%
Jun11/00	13	36	35	0.1	0.9	2.7	0.4	1.2	2.3	92.5%
Jul08/00	15	22	21	0.4	1.2	2.3	0.1	0.7	2.2	89.6%
Jul09/00	20	26	25	0.1	1.2	2.2	0.1	0.6	2.1	91.6%
Jul10/00	20	26	25	0.8	1.1	2.4	0.1	0.6	2.3	90.8%
Jul11/00	23	26	25	0.2	0.9	2.3	0.1	0.7	2.2	91.1%
Jul12/00	21	25	24	0.2	0.9	3.0	0.1	0.5	2.9	88.0%
Aug03/00	21	31	28	0.2	3.1	2.4	0.1	0.2	2.3	92.3%
Aug04/00	24	32	29	0.3	2.7	2.5	0.1	0.3	2.4	92.1%
Aug05/00	20	27	25	0.3	2.0	2.5	0.1	0.3	2.4	90.7%
Sept10/00	14	12	11	0.2	1.3	4.2	0.1	2.3	4.1	65.9%
Oct08/00	21	25	23	0.2	1.9	2.6	0.1	0.8	2.5	89.6%
Nov04/00	8	9	8.9	0.1	0.4	2.1	0.1	0.1	2.0	77.4%
Dec09/00	6	30	29	0.3	0.5	2.4	1.8	0.6	0.6	91.9%
Jan07/01	5	42	40	0.3	2.3	18.8	18.0	0.4	0.8	55.6%
Feb11/01	7	47	47	0.1	0.2	16.2	16.0	0.1	0.2	65.7%
Apr08/01	6	21	19	0.6	1.5	12.7	10.2	1.1	2.5	38.0%
May13/01	13	47	46	0.3	0.8	3.0	1.4	0.5	1.6	93.6%
Jun10/01	13	32	31	0.2	0.8	1.3	0.1	0.1	1.2	95.9%
Jun28/01	21	29	27	0.4	2.3	2.5	0.1	0.1	2.4	91.5%
Aug18/01	22	42	41	0.3	1.3	1.8	0.1	0.4	1.7	95.7%
Avg	12.9	32.8	30.9	0.4	1.9	3.4	1.2	0.6	2.2	88.7%
St Dev	5.1	11.1	11.0	0.4	2.1	3.3	3.4	0.4	1.1	10.8%

Oregon DEQ Nitrogen Removal Testing



Nitrex™ Effluent TN < 2.4 mg/l



Project Description

The US EPA has funded the La Pine National Decentralized Wastewater Demonstration Project, a collaborative effort between the Oregon Dept. of Environmental Quality (DEQ), Deschutes County Environmental Health and the US Geological Survey (USGS), to accomplish innovative on-site (decentralized) wastewater systems with enhanced nitrogen-reducing capabilities. The Nitrex™ filter was a chosen technology to be evaluated on its capability to protect groundwater from the impacts of on-site septic systems.

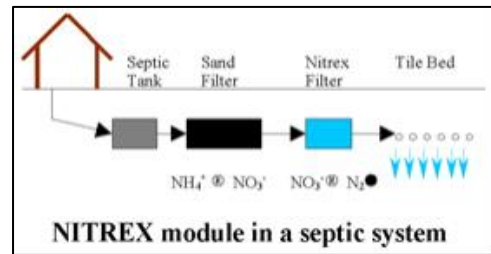
Project Application Data

- Location: La Pine, Oregon
- Site Application: Two Single Family Residences
- Installation Date: November, 2000

Wastewater Engineer: Lombardo Associates, Inc.
Boston, MA & Malibu, CA
www.LombardoAssociates.com

Design Profile

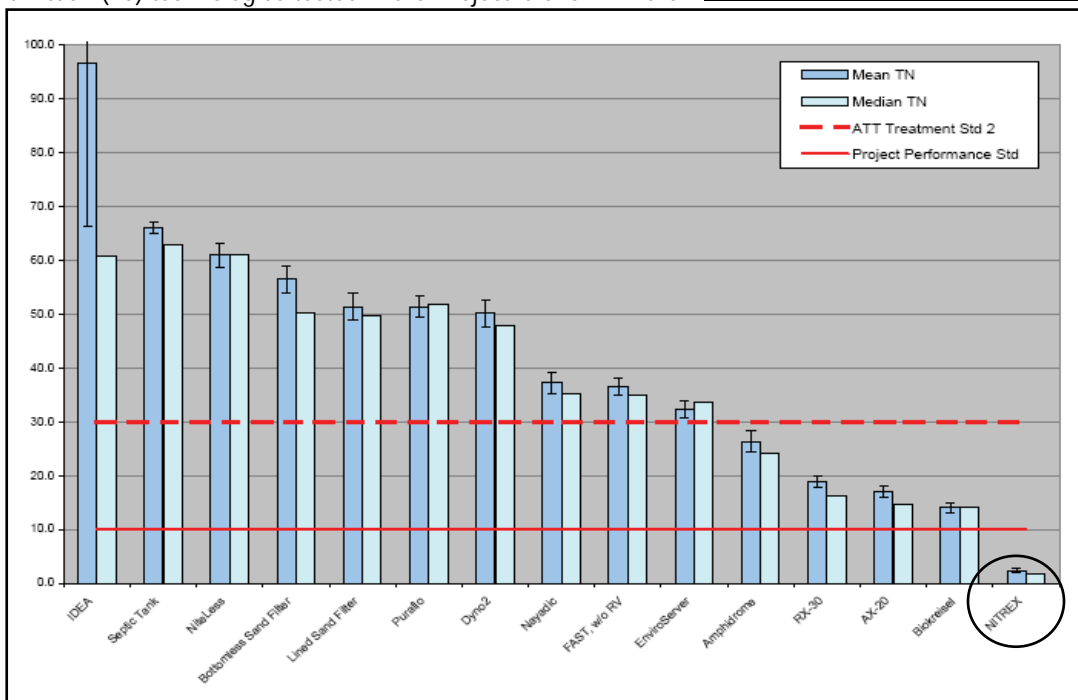
- Design Wastewater Flow: Site #1: 132 gpd
Site #2: 210 gpd
- Wastewater Treatment Process: Septic Tank – ISF – Nitrex™



Nitrex™ Treatment Performance

The Nitrex™ filter installed at La Pine, Oregon has provided almost complete (average of 94.3% at) removal of nitrate from the sand filter effluent. The performance of the fifteen (15) technologies tested in the Project is shown in the graph below.

	% N Removal	Total Nitrogen (mg/l)	
		Influent	Effluent
Site #1	95%	53.2	2.7
Site #2	92%	58.5	4.4



Site #1 Raw Data

Sample Date	Temp (C)	Influent				Effluent				% TN Removed
		TN (mg/L)	TKN (mg/L)	NH4-N (mg/L)	Nitrate-N (mg/L)	TN (mg/L)	TKN (mg/L)	NH4-N (mg/L)	Nitrate-N (mg/L)	
12/26/2000	6	8	1.5	0.4	7	2	1.7	0.1	0.01	79%
1/29/2001	6	36	1.2	0.3	35	2	1.7	0.3	0.05	95%
2/27/2001	7	49	1.3	0.0	48	3	2.2	0.6	1.12	93%
3/26/2001	8	58	0.9	0.0	57	10	2.7	1.0	7.44	83%
4/23/2001	9	57	1.1	0.1	55		2.1	0.5		
5/21/2001	14	68	1.1	0.1	67	5	2.3	0.5	2.72	93%
6/25/2001	15	78	1.0	0.1	77	3	2.5	0.4	0.01	97%
7/30/2001	16	63	1.2	0.1	62	2	2.0	0.2	0.01	97%
8/27/2001	18	49	0.8	0.0	48	2	1.8	0.2		96%
9/24/2001	17	47	1.0	0.0	46	2	1.5	0.0		97%
10/22/2001	13	41	0.9	0.0	40	1	1.3	0.0		97%
11/19/2001	10	40	1.0	0.0	39	1	1.3	0.3		97%
1/29/2002	6	38	1.0	0.0	37	1	0.9			98%
3/25/2002	7	64	0.1	0.0	64	1	1.1			98%
5/20/2002	11	76	0.1	0.0	76	2	1.7	0.1	0.01	98%
7/29/2002	17		0.7	0.0	59		2.0	0.7	0.01	
9/23/2002	17		1.3	0.0	71		2.2	0.2	0.01	
9/25/2002	16									
11/11/2002	11	58	1.3	0.0	57	1	1.1	0.0	0.00	98%
1/27/2003	8	56	2.0	0.0	54	4	1.4	0.1	2.75	93%
3/24/2003	8	72	2.1	0.0	70	4	1.7	0.3	2.11	95%
Avg	11.5	53.2	1.1	0.1	53.4	2.7	1.8	0.3	1.3	94.3%
St Dev	4.2	17.0	0.5	0.1	16.8	2.3	0.5	0.3	2.2	5.3%

Site #2 Raw Data

Sample Date	Temp (C)	Septic Tank Effluent				Nitrex Effluent				% TN Removed
		TN (mg/L)	TKN (mg/L)	NH4-N (mg/L)	Nitrate-N (mg/L)	TN (mg/L)	TKN (mg/L)	NH4-N (mg/L)	Nitrate-N (mg/L)	
12/26/2000	7	49.0	49.0	33.0	0.0	3.9	3.9	2.1	0.0	92.0%
1/29/2001	7	56.0	56.0	42.0	0.0	10.0	3.0	1.4	7.0	82.1%
2/27/2001	5	47.0	47.0	42.0	0.0	11.3	2.4	0.8	8.9	76.1%
3/26/2001	8	57.0	57.0	49.0	0.0	8.3	2.1	0.7	6.2	85.5%
4/23/2001	10	52.0	52.0	43.0	0.0	17.4	1.8	0.2	15.6	66.6%
5/21/2001	15	64.0	64.0	49.0	0.0	2.5	2.2	0.5	0.3	96.1%
6/25/2001	17	48.0	48.0	38.0	0.0	1.5	1.5	0.2	0.0	96.9%
7/30/2001	18	52.1	52.0	46.0	0.1	1.6	1.6	0.3	0.0	96.9%
8/27/2001	21	63.0	63.0	49.0	0.0	1.5	1.5	0.2	0.0	97.6%
9/24/2001	18	55.0	55.0	39.0	0.0	0.8	0.8	0.0	0.0	98.5%
10/22/2001	13	59.0	59.0	54.0	0.0	0.9	0.9	0.1	0.0	98.5%
11/19/2001	6	62.0	62.0	54.0	0.0	0.8	0.7	0.1	0.1	98.7%
1/28/2002	6	70.0	70.0	55.0	0.0	1.2	0.8	0.1	0.4	98.3%
1/30/2002	5									
3/25/2002	7	61.0	61.0	50.0	0.0	1.1	0.9	0.1	0.2	98.2%
5/20/2002	12	54.0	54.0	52.0	0.0	1.2	1.2	0.4	0.0	97.8%
7/29/2002	20			47.0	0.0		1.4		0.0	
9/23/2002	18		62.0	52.0	0.0		2.0	1.2	0.0	
11/11/2002	10	60.0	60.0	49.0	0.0	1.8	1.8	1.0	0.0	97.0%
11/11/2002	10					1.9	1.9	0.9	0.0	
1/21/2003	7	58.0	58.0	22.0	0.0	5.4	5.2	2.4	0.2	90.7%
3/24/2003	8	55.0	55.0	46.0	0.0	8.7	4.6	3.6	4.1	84.1%
5/5/2003	9	51.0	51.0	45.0	0.0	6.0	5.5	5.1	0.5	88.2%
Avg	11.2	56.5	56.8	45.5	0.0	4.4	2.2	1.0	2.0	91.6%
St Dev	5.2	6.0	6.0	7.8	0.0	4.6	1.4	1.3	4.0	9.1%

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