US EPA Environmental Technology Initiative

Onsite Wastewater Technology Testing Report

Massachusetts
Alternative
Septic
System
Test
Center

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WASTEFLOW®

Technology Vendor

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The Massachusetts Alternative Septic System Test Center (MASSTC) is operated by the Barnstable County Department of Health and the Environment (BCDHE) with support from the United States Environmental Protection Agency (USEPA), The Massachusetts Department of Environmental Protection (MDEP) and Barnstable County. The mention of any products or proprietary methods within this document does not constitute an endorsement of same by these agencies. Opinions expressed herein do not necessarily reflect those of the supporting agencies. The Test Center can be contacted through George Heufelder, Barnstable County Department of Health and the Environment, Box 427, Barnstable, Massachusetts 02630 – Phone 508-375-6616, or visit the website at http://www.buzzardsbay.org/etimain.htm.

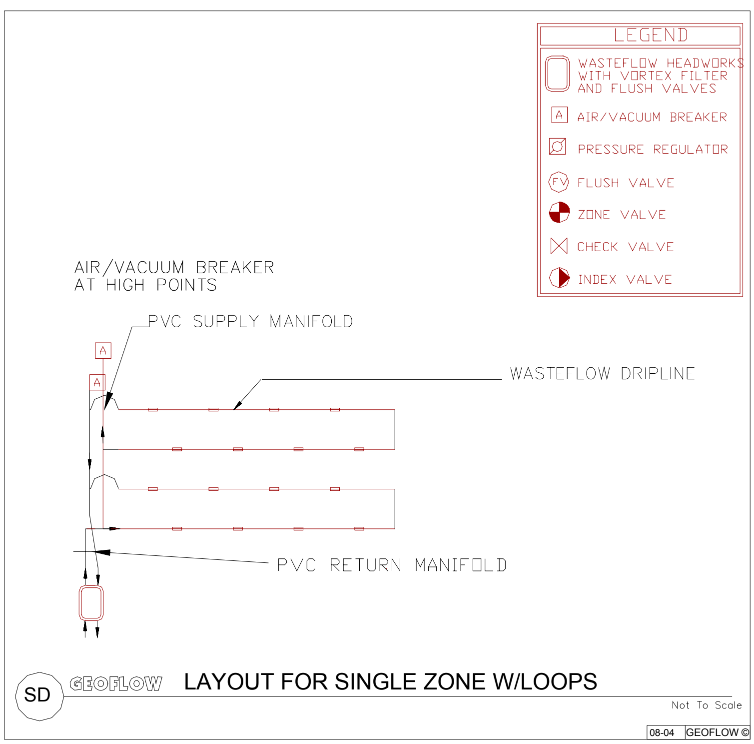
1. Technology description

General

The Wasteflow® dripline is part of a broad category of technologies that use drip emitters for disposal or dispersal of wastewater. Geoflow, Inc. has uniquely packaged and combined a number of patented technologies into this wastewater disposal system, including ROOTGUARD® to prevent root intrusion, Ultra-Fresh to prevent slime build-up within the dripline and emitters and Wasteflow "Classic" and "PC" emitters. This technology is most commonly used in conjunction with secondary effluent treatment systems.

Components

Each of three replicate Geoflow systems configured for the Massachusetts Alternative Septic System Test Center installations, consisted of: a 1,500 gallon pre-cast septic tank fitted with a Zabel™ A1800 effluent filter, a 1,000 gallon pre-cast pump chamber and a Zoeller ™ 2" effluent pump to supply the drip system. The Wasteflow™ dispersal system contained a headworks which contained a vortex filter and flush valve and parallel lengths of the ½" diameter tubing in which Wasteflow PC® drip emitters were installed at specified intervals (6" at the Test Center installations) and line spacing of 12". Each parallel length of tube was connected to a supply manifold at the proximal end and a return manifold at the distal end. The systems were controlled by microprocessor, with all three replicate microprocessors housed in the same panel box. Air vacuum breakers are situated in the Wasteflow line system at positions recommended by the manufacturer. Each of the triplicates resembled the typical installation shown in below (provided by Geoflow, Inc.).



Siting Considerations and Installation Notes

Wasteflow is adaptable to most site conditions because it is a pressure distribution system. It is critical in freezing climates that the drip line network be installed so that all PVC manifolds are self-draining by gravity back to the pump chamber after each dose. All valve boxes and pressure relief boxes should be insulated against cold and be installed for ease of accessibility. Field training of the installer by the manufacturer or distributor during installation is recommended.

Observations suggest that installation in areas where vehicle loads are even occasionally possible should be avoided. The luxuriant growth of the lawn over the drip dispersal system requires additional lawn mowing or alternative vegetation can be considered. Because of its shallow vertical profile, this technology is suited for areas where there are shallow soil horizons prior to encountering limiting conditions.

Hydraulic Flow description

Flow from the wastewater source passes through the septic tank and effluent filter into the pump chamber. At the Test Center, the volume of flow after the septic tank was divided in order to provide a hydraulic loading rate as close as possible to 0.75 gal/day/sq ft which is the value allowed under Commonwealth of Massachusetts regulations for the receiving soil. At a specified time interval, the discharge pump forces wastewater through a vortex filter and pressurizes the drip line network causing the drip emitters to discharge when a preset system pressure is reached. Excess circulating flow is returned to the pump chamber through the return manifold. During the dosing cycle a vacuum breaker valve allows for air purging as the drip line filled and for air entrance to the drip line to permit gravity drainage of liquid in the manifolds back to the pump chamber at the end of the dose. As installed at the Test Center with primary effluent, the three Geoflow® units incorporated automatic flushing of the filter and dripfield. The filter flush valve opens at the end of every pump cycle to accommodate flushing of the Vortex filter. The field flush valve opens approximately once daily to flush debris from the dripfield (this automation is not typically required on systems receiving secondary treated effluent). To accommodate surge flows, the pump system is equipped with a first-timer override float switch that activates the pump more frequently when this override float switch is closed.

Passing out of the drip emitters, the effluent is released to the surrounding soil. Effluent water that is not released as evapotranspiration by plants is dispersed downward and laterally in a manner and extent dictated by the soil type. The installation at the Test Center was in medium sands meeting MA DEP Title 5 requirements for soil absorption systems. The drip line was then covered with 4-6 of topsoil and a layer of sod.

Theory of operation

As in a conventional system, the 1,500 gallon septic tank provides for reduction of suspended solids by gravity settling, ammonification of organic nitrogen and some slow anoxic digestion of accumulated solids. The 1,000 gallon pump chamber provides additional retention and surge volume or emergency capacity.

The remainder of treatment in the system purportedly occurs in the receiving soils. Two factors that are in certain ways unique to this type of system account for its treatment. First, by optimizing the distribution across the infiltrative surface at instantaneously low loading rates, breakdown of the wastewater can occur in an unsaturated aerobic setting which is conducive to the stabilization of wastes and inactivation of certain pathogens. Secondly, since the effluent distribution occurs in the root zone of the overlying grasses, water from the wastewater can be eliminated through evapotranspiration, further reducing the hydraulic loading on the receiving soils. The roots of the plants are also positioned to take up certain soluble constituents of the wastewater and incorporate them into plant biomass and allow a substrate for microbes that further stabilize wastewater. If properly managed, this may prevent these contaminants (i.e. nutrients) from reaching the groundwater.

2. Costs

<u>Installation</u>

The manufacturer claims that the suggested retail costs for the components of are $1,000, while installation plus components are $2,000 more than an equivalent conventional system. Readers should use the above estimates as approximations of average costs, because the costs of installation for any treatment technology are very dependent upon the particular site conditions.

Design and permitting costs vary with the site conditions and local permitting requirements.

<u>Electric usage</u>

Average electric usage by the three units for the period (2/28/00 – 2/22/02) was 1.34 kW per day per unit or about $0.15 per day at $.11 per kW; monthly this comes to $4.48 per month, and $53.77 per year. By comparison with other technologies at MASSTC, this electric cost is near the lower end of the range of costs ($4.48 - $29/mo) of technologies tested at MASSTC.

<u>Maintenance</u>

Massachusetts requires that all alternative technologies have a service contract in force for the life of the installation. Costs for this service vary but are approximately $400 per year. The service occurs quarterly and should include: checking the septic tank sludge levels; checking the effluent filter and cleaning as needed; checking the operation of floats, alarms, filter, air vents and control panel, and initiating a manual field flush. Septic tanks are pumped to remove accumulated solids at a frequency based on usage, but an approximate cost for this unit is $60 - $90 per annum. This technology did not require pumping during the test period. Based upon the experience of performance at MASSTC, this type of treatment unit appears to require pumping at the same frequency as a conventional system of similar size and hydraulic loading.

Replacement parts
The pump has a one-year warranty and a cost of $300. Geoflow® claims the ROOTGUARD will last 30 years. The polyethylene dripline should last indefinitely (as long as polyethylene lasts).

Other costs
Quarterly effluent quality monitoring is required for some permits at a cost of $300 or more annually. Monitoring of the secondary treatment system effluent that feeds the dripline is required, while the dripline area itself should be inspected for any breakout. Following an initial period specified in the approval letter, monitoring may be reduced by requesting a reduction from MA DEP and/or the local approving authority.

3. ETI Testing Protocol Synopsis

Technology operation
The testing duration was for two years. The technology was installed in triplicate, with identical components. Due to space limitations for this installation the Geoflow® drip irrigation units received only 220 gallons per day, however the Geoflow® septic tanks received wastewater at the rate of 330 gallons per day (gpd), to replicate the septic tank loading rate used for other technologies being tested under the ETI protocols. The reduction of flow from 330 to 220 gpd was accomplished in the distribution box by splitting flow from the Geoflow® septic tanks, so that 220 gpd was directed to the Geoflow® pump chamber. The 330 gpd volume is the Massachusetts Department of Environmental Protection (MA DEP) minimum design flow for a new residential house of three bedrooms or less.

The wastewater was apportioned into fifteen equal doses of 22 gallons each, on a schedule which was designed to mimic the pattern of wastewater use in a typical residence: 45% of daily flow prior to 09:00 AM; 25% of flow during midday; 35% of flow in the evening; (see NSFI/AINSI Standard 40). Periodic calibration of dose volumes delivered to each technology ensured equal dosing to each replicate and to different technologies.

Pan lysimeters were installed at depths of 6 inches and 18 inches below the level of the drip line network and were variably successful in collecting soil water samples. The lysimeters were sampled bi-weekly when liquid was available: the replicate #2 lysimeter at 18” yielded a sample once in two years and has been omitted from the data tables discussed below. The other lysimeters had variable success in capturing soil water samples. Additional samples were obtained from soil absorption system sump that was sampled at bi-weekly intervals. A polyethylene liner at about 10 feet below grade collected all leachate from the three technology replicates. In the Geoflow® installation, leachate from the dripline traveled a vertical distance of approximately 9 feet through medium sand before reaching liner and the sump. In the conventional systems that utilized leach trenches for soil disposal of septic tank leachate, this vertical distance was about 6.5 feet before reaching the liner.

Technology Monitoring

The technologies were sampled of at two-week intervals. During each sampling event, technology influent wastewater was sampled at the common dosing channel. Technology effluent was sampled at the lysimeters and the sump. Influent wastewater was sampled using automated samplers, programmed to obtain fifteen flow-weighted samples composited over a twenty-four hour period. Lysimeters were sampled using suction methods or by bailer.

Composite samples were kept refrigerated at 4 degrees centigrade either by ice packed in the sampler or by use of a refrigerated sampler. Upon completion of the sampling schedule samples were processed at the MASSTC. Analysis for pH and specific conductance were conducted at MAASTC during sample processing. Subsamples for BOD_5 and fecal coliform were sent to the Barnstable County Department of Health and the Environment laboratory. Subsamples for nitrogen and phosphorus analysis: ammonium (NH_4), nitrate plus nitrite (NO_x), dissolved organic nitrogen, (DON), particulate organic nitrogen (PON), alkalinity, orthophosphate (PO_4) and total phosphorus (TP); were sent to the Coastal Systems Laboratory at the School for Marine Science University of Massachusetts, Dartmouth (SMAST).

Electrical usage was measured by a single electric meter for all three units and recorded monthly. Kilowatt usage was then divided by three to calculate individual unit use.

Mechanical and other non-quantitative performance monitoring

Alarms, mechanical failures, condition of sod and soils, unusual sounds, and smells were recorded as they occurred in a logbook. Restorative measures taken by the technology vendor to address non-normal conditions were also recorded and appear in Section 6 “Operation and Maintenance” section of this report.

4. Testing Objectives

The Wasteflow® system by Geoflow® was tested to demonstrate reliability of the various components when supplied with primary-treated effluent from a septic tank and employed in the northeast region of the country. In addition, measurement of the pathogen removal, as indicated by a surrogate measure fecal coliform, was sought. Since MA DEP requires all alternative/innovative treatment technologies to provide treatment comparable or better than a conventional system, implied in the testing intentions was that the Geoflow® treatment should be at least comparable to that of a conventional system with conventional soil absorption system. At the MASSSTC three conventional systems were operated concurrently with Geoflow® for comparative purposes.

5. Contaminant Removal Performance Summary for the Geoflow®

Treatment and removal performance for the three Geoflow® installations was monitored by the 6-inch and 18-inch lysimeters installed below the dripline and at the SAS sump.

Technology operating history

The three Geoflow® units were started up on 11/30/99 and operated until 12/28/99 when breakout of effluent occurred and all three systems were shut down. After the manufacturer made changes to the dosing program, the units were restarted on 2/28/00 following a thawing of the ground. The three units were operated continuously for the two-year test period with a last sampling date of 4/09/02. All three units continued to be operated from this date without sampling until 5/6/02 when they were shut down due to breakout on two of the three systems. Following a site visit by the manufacturer, the units were restarted but were again shut down on 7/01/02 due to breakout on two of three systems.

Fecal Coliform removal - Geoflow®

Fecal coliform removal by 6-18" of the soil immediately below the Wasteflow emitter line was generally in the range of 2.5 to 3.8 log units or about 99.9% (Table 1). This removal is based on septic tank geometric mean fecal coliform value of 833,601 col/100ml derived from two years of concurrent data from the three MASSTC conventional septic tank effluent measurements (n= 170).

Median values of fecal coliform at the sump for Geoflow were comparable to the conventional system's sump, 5 col/100ml, while maximum values were higher in the conventional system sump, 1,420 versus 240 col/100ml. The lower maximum value may be due to the greater vertical distance traveled by dripline effluent, 9 feet versus 6.5 feet for the conventional soil absorption system.

Table 1

Fecal Coliform	Influent (col/100ml)	Rep 1 6" lys	Rep 1 18" lys	Rep 2 6" lys	Rep 3 6" lys	Rep 3 18" lys	Geoflow Sump	Conventional Sump
Geomean	3,548,000	1,942	572	702	648	139	6	6
Median	3,600,000	1,400	170	505	650	100	5	5
Max	26,000,000	129,000	342,000	32,900	40,000	2,300	240	1,420
Min	300,000	50	5	20	5	5	1	1
Count	51	25	11	26	46	7	49	53

*** No samples were recovered from the 18' pan of replicate #2**

Nitrogen removal –
(Note: Nitrogen removal was not a testing objective for Geoflow.)

Although nitrogen removal was not a testing objective of the Geoflow system, crude measures of nitrogen removal performance of the drip emitter-soil system were made using data collected at the 6" and 18" lysimeter and the sump which collects the filtrate beneath all three replicates. The calculations assume that total dissolved nitrogen (TDN) in lysimeters and sumps was equivalent to total nitrogen (TN) measured elsewhere in the process stream. Since our ability to retrieve sufficient sample volumes for filtration and analysis of particulate N from lysimeters was limited, we assumed that the relative amount of particulates would be very small.

One data exception is noted. In reviewing the data collected by the lysimeters, one date (7/31/01) stood out as an anomaly with values for TDN between 150 and 200% greater than the influent TN. We have elected to exclude that date from the statistics because we believe the high nitrogen values were an indirect product of an infestation of army worms (*Pseudaletia unipuncta*) which ate large portions of the above-ground sod biomass. A 1-inch rainfall occurring 5 days prior to the sampling may have flushed large concentrations of nitrate and ammonium from the upper soil zone. Inclusion of this one date would have affected the statistics, particularly the 18inch lysimeter data which have fewer sample numbers.

We found that nitrogen reduction at the 6 inch depth below the drip line ranged from 29% to 47% measured as TDN versus influent TN (Table 2). Reductions at 18 inches below the drip line ranged from 25% to 46% which suggests that there was little increase in nitrogen removal over the additional foot of medium sand. Unfortunately, many fewer samples were recovered from the 18 inch lysimeters (n=16) than from those at 6 inches (n=87), so the comparison between depths should not be over-emphasized.

In addition to the possible mechanisms of adsorption of ammonium and nitrification-denitrification, we again employed crude measures to estimate the impact of plant uptake.

Table 2

Total Dissolved Nitrogen	Influent (mg/l)	Rep 1 6"	Rep 1 18"	Rep 2 6"	Rep 2 18"	Rep 3 6"	Rep 3 18"	Sump	6" Mean
Average	33.91	23.02	18.36	18.03	25.31	24.12	21.93	22.46	22.45
Median	34.12	22.95	17.71	19.19	25.31	24.41	21.66	20.84	
Max	42.25	32.27	24.50	27.46	27.65	37.50	26.88	45.84	
Min	21.05	11.45	13.75	4.30	22.96	12.70	18.44	6.11	
Count	58	21	8	20	2	46	6	48	
Reduction %	0.00	32.11	45.84	46.82	25.36	28.87	35.32	33.76	

Sod overlying the drip field was mechanically mowed during year 1 at intervals to simulate residential lawn care practice. Grass was maintained to a height of approximately 2-1/2 inches. Grass clippings from these periodic mowing were removed from each plot and disposed of away from the plots. We measured nitrogen incorporated into the mown plant biomass of the sod during the first growing season (5/5/00 to10/5/00) by collecting the clippings of grass from within randomly-placed one-meter square quadrats situated within the surface of each replicate lawn. The total amount of grass removed could then be extrapolated based on the one-meter quadrats. The clippings from the quadrats were weighed, dried and analyzed by CHN combustion (Perkin-Elmer) for nitrogen (per cent dry weight). By calculating the percentage of weight attributable to nitrogen, a crude estimate of total nitrogen removed in grass clippings could be made. Based on mowing frequency an average nitrogen mass (grams/day) removed by mowing is presented in Table 3; column 1. We calculated the mass (g/d) of nitrogen lost between influent TN and the 6 inch lysimeters, by multiplying the average nitrogen concentration difference (11.45 mg/l) at those locations by the daily liquid volume pumped to the

Geoflow units, 833 l/d (Table 3; column 2). Table 3 column 3 shows the difference between uptake and export as grass clippings versus the reduction of nitrogen as measured at the 6 inch lysimeters. The amount, 60.4% is to us a surprisingly large fraction of nitrogen lost, since some retention and loss of nitrogen normally occurs in both the septic tank (~5%) and also in the pump chamber.

Table 3

Export Grass N Mean	N Lost by 6 inch Depth	N Fraction in Export Grass
5.76 g/d	9.54 g/d	60.4%

Fate of Phosphorus

Unlike many nitrogen species, substantial amounts of phosphorus can be retained on iron and aluminum soil mineral sites while some phosphorus is incorporated into grass biomass. Overall reduction in orthophosphate (PO_4) is evident in the data from lysimeter samples however there appeared no consistent trend of lower levels at deeper lysimeters (Table 4) and with time (Appendix 1). At the sump very little orthophosphate is left. This pattern likely reflects the adsorption of orthophosphate by soil particles.

The capacity of the washed medium sand to adsorb phosphorus is finite and as we also have noted elsewhere in the other SAS sumps at MASSTC, with the passage of time orthophosphate concentrations in the sump increase slowly with time (see sump data near end of record – Appendix 1 & 2).

Table 4

Orthophosphate PO_4	Influent (mg/l)	Rep 1 6"	Rep 1 18"	Rep 2 6"	Rep 2 18"	Rep 3 6"	Rep 3 18"	Sump
Average	3.28	2.96	1.69	1.70	1.67	2.41	2.58	0.30
Median	3.31	2.99	1.89	1.81	1.67	2.39	2.68	0.22
Max	4.43	3.85	2.45	3.25	1.96	3.61	3.09	1.13
Min	2.41	1.73	0.32	0.33	1.39	1.05	1.99	0.01
Count	57	21	9	21	2	47	6	48
Reduction %	0.0	9.9	48.4	48.2	49.1	26.5	21.4	91.0

6. Operation and Maintenance Monitoring – Geoflow®

Breakout

Monitoring of the Geoflow® technologies at MASSTC was visual and tactile, looking for evidence of hydraulic failure (breakout of untreated septic tank effluent). Breakout of wastewater for this technology was manifested in several forms: as seepage to the surface at the edges of the sod (12/99); by surface ponding from leakage at piping connections in access boxes (4/00), contractor installation error; as seepage through the sod and saturation of the sod-soil surface manifested as a sponginess of the sod when walked upon (5/02); by blistering or a separation of the sod from soil with liquid in between

(7/02). The systems ran with no breakout from 5/00 to 5/02. Recurring problems with hydraulic failure after 5/02 led to the final shut down of all three systems in 7/02.

Comments: The performance evaluation of the three Geoflow® installations primarily consisted of inspecting for hydraulic failure (breakout). While all three units performed without failure for two years, all three systems ultimately were shut down due to hydraulic failure after 26 months of operation. At that time, the manufacturer observed biomat formation around emitters in certain areas of the field. They note that the dripline and emitters were not flushed as recommended by the manufacturer. The solenoid valves had not been serviced and were not operating properly, therefore the field flush did not occur as scheduled. It is critical that when using solenoid valves with primary effluent that the valves are cleaned on an annual basis to prevent malfunctioning. The failure did not appear weather related: the failure at 5/02 occurred during the late spring when the sod was undergoing luxuriant growth under sunny conditions and average rainfall; and subsequent failures occurred during the onset of a summer-long drought.

The drip system was installed above highly permeable medium sand that should have provided advantageous conditions for movement of effluent downward, however, the manufacturer notes that less pervious loam used above the system may have entered between the dripline and the sand during installation, causing localized areas of saturation. These conditions would account for the observation of biomass buildup beneath some emitters.

Mechanical Components

There were no mechanical failures of pumps or valves during the testing period, however there were several instances of mechanical problems due to faulty installation and layout of the technology components. There were several instances of faulty pipe connections that failed during operation, leading to high water alarms in the pump chamber.

Installation

It is our opinion that a higher degree of oversight during installation might have eliminated many of the problems that occurred with the operation of the technology. While on paper the design and installation of the system appear to be relatively straightforward, in practice errors made during installation affected the performance of the system.

The spin filters and associated valves were initially installed in shallow utility boxes set with covers flush to grade. After freezing of pipes in these boxes in the winter of 1999 – 2000, the filters and valves were moved to the access riser of the pump chamber. At this time, further insulation was installed around the air purge valves to prevent freezing.

Areas of critical concern during installation included ensuring that the slope of the drip line and header network provided drainage of the network back to the pump chamber. The manufacturer had to return after start up of the systems to correct the slope of at least one the systems to establish gravity drainage. This condition should have been discovered during initial tests of the system. The installation elevation of dripline appeared to be irregular and may have contributed breakout problems. In addition, the infiltration of finer soils between the dripline and the sand during installation, may have promoted localized saturated conditions and subsequent ponding.

<u>Noise</u>
There is no noticeable source of noise from the technology.

<u>Ease of maintenance</u>
Components such as the pump and spin filter were accessible through the pump riser; the air purge valve was accessible through an irrigation valve box cover.

<u>Solids removal</u>
Frequency of pumping septic tank solids is dependent upon the rate of wastewater use in the residence. At MASSTC the wastewater flow to the Geoflow septic tanks was 330 gallons per day. At that loading rate, solids accumulation did not interfere with treatment performance during the two-years of operation. We would anticipate that the frequency of solids removal for this technology would be similar to that of a conventional system under similar hydraulic and organic loading.

APPENDIX 1

Graphs of Selected Wastewater Constituents At Discharge

Geoflow®

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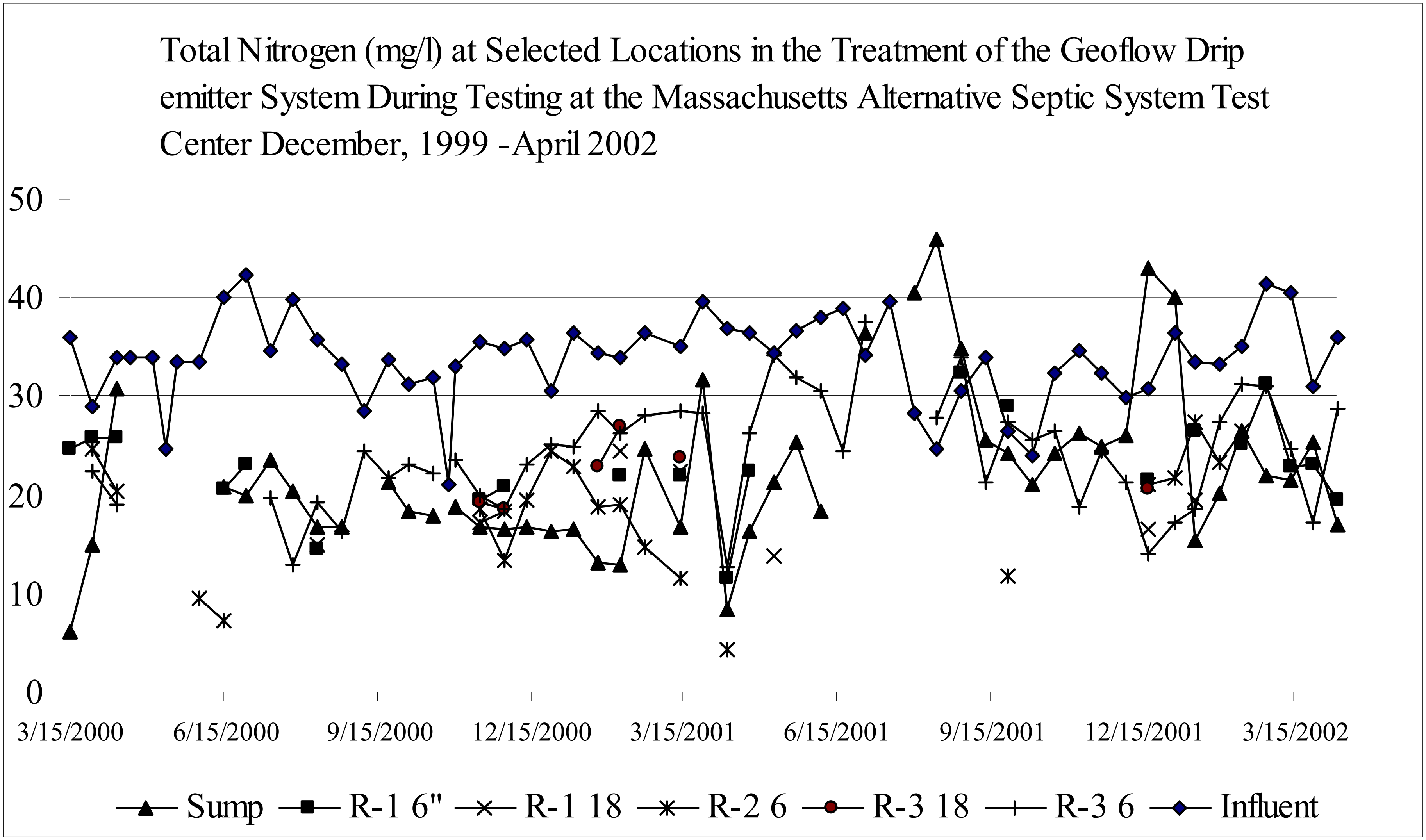
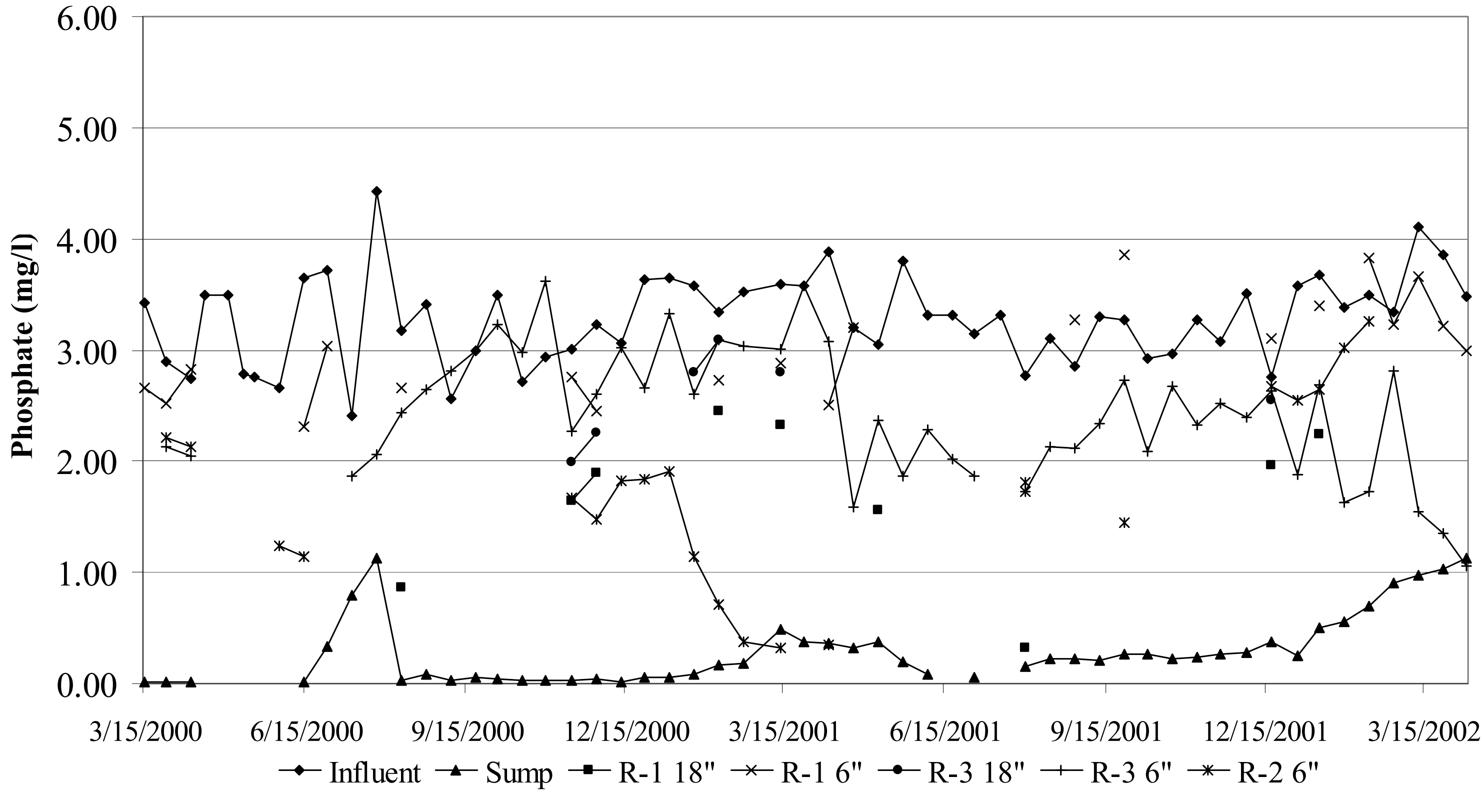
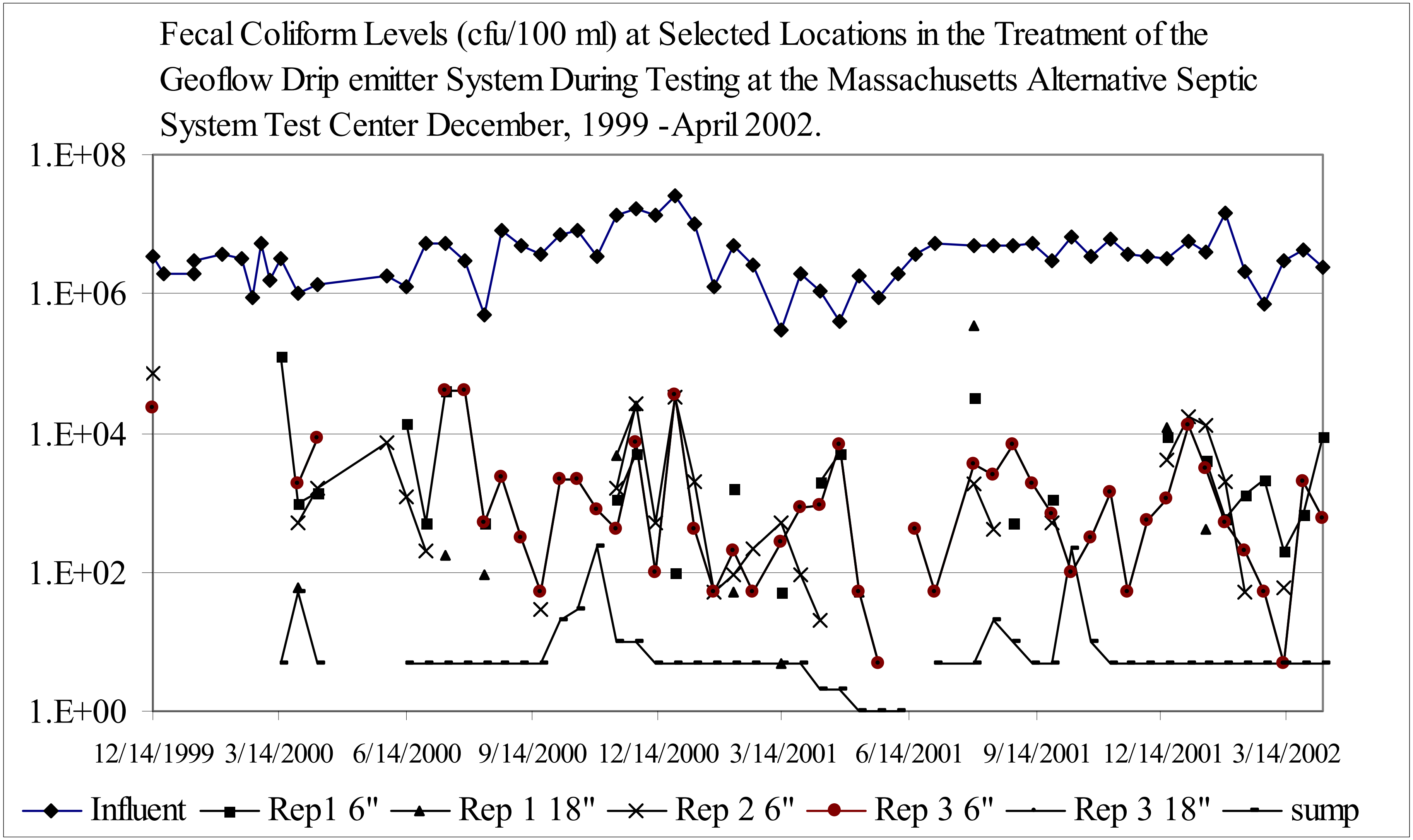
KEY “R-1”, “R-2”, and “R-3” represent replicates 1, 2, and 3 respectively
6” and 18” represent depth of the sampling pan
“Sump” represents the sample taken from the common underlining sump
“Influent” represents the influent to the system as represented by DCEAST



Total Nitrogen (mg/l) at Selected Locations in the Treatment of the Geoflow Drip emitter System During Testing at the Massachusetts Alternative Septic System Test Center December, 1999 -April 2002
50
40
30
20
10
0
3/15/2000
6/15/2000
9/15/2000
12/15/2000
3/15/2001
6/15/2001
9/15/2001
12/15/2001
3/15/2002
Sump
R-1 6"
R-1 18
R-2 6
R-3 18
R-3 6
Influent

Phosphate Concentrations (mg/l) at Selected Locations in the Treatment of the Geoflow Drip emitter System During Testing at the Massachusetts Alternative Septic System Test Center December, 1999 -April 2002.




Fecal Coliform Levels (cfu/100 ml) at Selected Locations in the Treatment of the Geoflow Drip emitter System During Testing at the Massachusetts Alternative Septic System Test Center December, 1999 -April 2002.
1.E+08
1.E+06
1.E+04
1.E+02
1.E+00
12/14/1999
3/14/2000
6/14/2000
9/14/2000
12/14/2000
3/14/2001
6/14/2001
9/14/2001
12/14/2001
3/14/2002
Influent
Rep1 6"
Rep 1 18"
Rep 2 6"
Rep 3 6"
Rep 3 18"
sump

APPENDIX 2

Tables of Selected Wastewater Constituents At Discharge

Geoflow®

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KEY "E1", "E2", and "E3" represent replicates 1, 2, and 3 respectively
6" and 18" represent depth of the sampling pan
"SU" represents the sample taken from the common underlining sump
"DCEAST" represents the influent to the system – data shown to provide representative influent values to system.

Location	Date	pH	Alkalinity (mgl)	BOD5 (mg/l)	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	PON (mg/l)	Total Nitrogen (mg/l)	POC (mg/l)	PO_4 (mg/l)	TP (mg/l)	Sp Cond (uS)	TSS (mgl)
DC EAST	6/9/99	7.40	185.0	176.0	1.80E+06	0.3	27.5	0.00	6.4	34.2	62.2	3.5	5.4	509	131.0
DC EAST	6/23/99	7.32	187.0	163.0	6.00E+06	2.4	29.0	0.02	7.3	38.7	59.3	3.6	5.1	492	134.0
DC EAST	7/7/99	7.18	169.0	238.0	4.80E+06	0.5	23.5	0.05	7.7	31.8	75.4	3.8	4.9	431	131.0
DC EAST	7/21/99	7.47	193.0	176.0	2.10E+06	0.7	28.5	0.08	5.9	35.1	57.7	3.9	5.5	602	128.0
DC EAST	8/11/99	7.33	201.0	143.0	5.80E+06	1.5	31.5	0.08	6.5	39.6	57.8	4.5	5.7	570	128.0
DC EAST	8/30/99	7.36	172.0	110.0	2.00E+06	1.6	25.0	0.18	5.5	32.2	47.7	3.6	6.0	537	103.0
DC EAST	9/22/99	7.42	158.0	167.0	3.10E+06	1.2	27.4	0.00	8.8	37.4	74.8	3.2	5.1	534	168.0
DC EAST	10/13/99	7.25	184.0	186.0	2.80E+06	0.5	25.0	0.00	3.1	28.6	28.1	3.2	4.9	460	56.0
DC EAST	11/3/99	7.30	179.0	274.0	2.20E+06	2.5	23.8	0.06	8.1	34.5	83.1	3.1	4.2	550	184.0
DC EAST	11/18/99	7.36	185.0	117.0	3.70E+06	1.5	26.2	0.05	6.0	33.8	57.3	3.2	5.1	579	118.0
DC EAST	12/14/99	7.33	168.0	192.0	2.50E+06	0.2	27.1	0.04	7.8	35.2	71.2	3.5	4.9	531	175.0
DC EAST	12/21/99	7.39	242.0	212.0	2.30E+06	2.2	27.2	0.10	3.8	33.2	34.6	3.7	5.7	556	77.0
DC EAST	1/12/00	7.42	183.0	152.0	2.10E+06	0.6	28.0	0.04	3.5	32.1	27.4	3.8	5.3	588	49.0
DC EAST	2/2/00	7.30	152.0	179.0	2.60E+06	5.3	23.4	0.03	3.9	32.6	40.4	3.5		514	86.0
DC EAST	2/16/00	7.52	162.0	135.0	3.40E+06	2.7	23.1	0.05	7.6	33.5	75.8	2.9		532	144.0
DC EAST	2/23/00		165.0	129.0	5.00E+05	3.5	21.7	0.03	5.4	30.6	50.3	2.8			107.0
DC EAST	3/1/00	7.45	147.0	106.0	1.80E+06	3.7	22.9	0.04	7.0	33.7	69.5	3.0	5.3	572	80.0
DC EAST	3/8/00	7.17	168.0	187.0	3.50E+06	2.7	24.9	0.02	8.4	36.1	88.1	3.9	5.6	563	182.0
DC EAST	3/15/00	7.27	209.0	150.0	2.80E+06	2.5	23.8	0.04	9.9	36.3	92.6	3.4		570	184.0
DC EAST QA	3/15/00	7.32	176.0	145.0	1.46E+06	3.6	23.2	0.06	7.2	34.0	59.3	3.5	6.0	600	130.0
DC EAST	3/28/00	7.55	159.0	140.0	8.00E+05	2.3	22.4	0.08	5.0	29.7	36.0	3.1	5.3	531	81.0
DC EAST	4/11/00	7.49	168.0	103.0	7.00E+05	3.5	22.9	0.01	7.9	34.3	70.8	3.1	5.2	584	169.0
DC EAST	4/19/00	7.78	162.0	297.0	6.00E+05	4.4	23.5	0.04	7.4	35.3	76.2	3.6		556	189.0
DC EAST	5/2/00	7.38	162.0	201.0	1.20E+06	4.4	26.5	0.04	7.4	38.3	76.2	3.6	7.4	552	164.0
DC EAST	5/11/00	7.33	150.0	205.0	3.50E+06	2.7	21.4	0.01				2.6	4.0	531	216.0
DC EAST	5/17/00	7.42	161.0	206.0	2.20E+06	3.7	21.6	0.09	12.1	37.5	102.3	2.8	5.2	570	222.0
DC EAST	5/31/00	7.37	170.0	170.0	1.30E+06	4.8	20.7	0.17	7.3	32.9	70.6	2.7	5.0	564	160.0
DC EAST	6/14/00	7.09	130.0	317.0	1.00E+05	0.9	30.1	0.12	8.7	39.7	93.1	3.9	5.7	600	198.0
DC EAST QA	6/14/00	7.09	51.2	365.0	2.00E+05	1.3	28.6	0.19	8.3	38.3	79.2	3.7	5.7	600	169.0
DC EAST	6/28/00	7.28	158.0	219.0	2.40E+06	5.9	25.0	0.13	12.6	43.6	164.4	3.3	4.3	657	330.0
DC EAST	7/12/00	7.02	58.8	180.0	3.60E+06	1.7	23.8	0.09	10.5	36.1	105.1	2.8	3.9	532	224.0
DC EAST	7/26/00	7.39	192.0	263.0	3.20E+06	5.0	28.6	0.03	6.6	40.2	54.9	4.2	5.9	675	168.0
DC EAST	8/9/00	7.25	168.0	326.0	6.00E+05	4.4	21.1	0.08	15.8	41.3	366.0	3.2		608	
DC EAST	8/23/00	7.25	150.0	215.0	1.24E+07	1.6	23.3	0.03	11.7	36.7	143.2	3.2	4.9	638	292.0
DC EAST	9/6/00	7.45	140.0	120.0	5.50E+06	1.4	21.8	0.03	10.8	34.0	81.0	3.0	3.8	599	178.0
DC EAST	9/20/00	7.41	138.0	96.0	4.20E+06	1.8	22.0	0.02	8.9	32.8	72.9	3.2	5.3	547	155.0
DC EAST QA	9/20/00	7.38	136.0	97.0	2.13E+06	1.2	22.4	0.03	11.3	35.0	99.9	3.4	5.1	545	209.0
DC EAST	10/3/00	7.28	141.0	160.0	1.21E+07	1.1	24.0	0.03	7.8	32.9	89.0	3.6	4.9	607	185.0
DC EAST	10/17/00	7.28	178.0	100.0	2.09E+07	1.4	19.3	0.16	9.2	30.0	89.8	2.6	4.7	525	198.0

Location	Date	pH	Alkalinity (mgl)	BOD5 (mg/l)	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	PON (mg/l)	Total Nitrogen (mg/l)	POC (mg/l)	PO_4 (mg/l)	TP (mg/l)	Sp Cond (uS)	TSS (mgl)
DC EAST	10/30/00	7.35	155.5	174.0	1.05E+07	3.8	20.6	0.04	7.3	31.7	69.7	2.8	3.4	461	156.0
DC EAST	11/14/00	7.66	163.0	128.0	1.00E+07	1.9	25.9	0.03	7.5	35.4	59.8	3.1	5.2	482	126.0
DC EAST	11/28/00	7.49	183.5	200.0	1.10E+07	4.2	25.2	0.01	9.7	39.1	145.8	3.2	5.2	550	275.0
DC EAST	12/12/00	7.51	182.0	96.0	6.00E+06	1.3	26.6	0.05	6.4	34.4	62.3	3.0	4.3	569	126.0
DC EAST	12/26/00	7.42	183.0	231.0	2.20E+07	0.6	30.5	0.01	12.0	43.1	104.7	3.6	6.1	547	232.0
DC EAST	1/9/01	7.63	181.0	140.0	3.00E+06	5.5	21.5	0.07	7.6	34.7	73.8	3.8	5.6	561	171.0
DC EAST	1/23/01	7.47	185.0	120.0	1.00E+06		28.4	0.04	6.5	35.0	61.9	3.7	4.8	523	87.5
DC EAST	2/6/01	7.49	181.5	133.0	2.20E+06	3.4	23.5	0.07	6.8	33.8	73.4	3.4	5.0	785	140.5
DC EAST	2/20/01	7.42	185.5	124.0	9.00E+05	3.6	24.3	0.07	9.5	37.5	140.6	3.4	4.9	517	278.2
DC EAST QA	2/20/01	7.43	186.0	151.0	1.00E+06	5.2	23.7	0.05	7.9	36.9	85.9	3.6	5.2	519	197.2
DC EAST	3/13/01	7.39	168.0	93.0	1.30E+06	2.7	23.1	0.14	8.4	34.4	82.4	3.6	5.6	972	178.5
DC EAST	3/27/01	7.50	177.0	122.0	2.30E+06	5.5	29.3	0.01	9.0	43.8	82.0	3.6	5.5	821	165.0
DC EAST QA	3/27/01	7.51	177.0	122.0	9.00E+05	4.2	29.2	0.06	8.9	42.3	82.8	3.5	5.6	830	118.5
DC EAST	4/10/01	7.58	182.5	189.0	5.00E+05	4.1	25.2	0.06	7.1	36.4	74.5	3.9	5.0	499	152.0
DC EAST	4/24/01	7.48	192.0	178.0	1.30E+06	1.9	26.3	0.05	7.5	35.7	73.9	3.3	4.2	546	178.5
DC EAST	5/8/01	7.44	173.5	210.0	2.80E+06	1.5	24.6	0.06	5.2	31.4	52.3	3.3	4.8	516	110.3
DC EAST	5/22/01	7.41	173.0	140.0	2.80E+06	2.9	26.7	0.05	8.0	37.6	73.8	3.9	4.1	499	170.3
DC EAST	6/5/01	7.44	183.5	270.0	1.20E+06	1.2	26.5	0.01	5.5	33.2	41.1	3.3	4.8	536	91.3
DC EAST	6/19/01	7.43	185.0	185.0	9.20E+06	1.5	29.4	0.05	6.7	37.7	60.2	3.3	3.5	525	126.7
DC EAST	7/2/01	7.39	180.5	256.0	1.27E+07	2.5	22.4	0.07	10.2	35.1	117.3	3.2	4.7	550	258.4
DC EAST	7/17/01	7.31	188.0	302.0	4.00E+06	2.2	24.6	0.03	12.8	39.5	152.7	3.5	4.2	536	328.7
DC EAST	7/31/01	7.39	166.5	122.0	4.30E+06	1.1	22.6	0.08	5.8	29.6	44.4	2.8	3.7	474	98.7
DC EAST	8/14/01	7.25	178.5	260.0	5.60E+06	0.7	24.8	0.13				3.4	3.8	540	132.0
DC EAST QA	8/14/01	7.28	180.0	238.0	1.00E+07	0.0	24.8	0.06	9.2	34.1	89.3	3.2	3.4	534	199.8
DC EAST	8/28/01	7.57	180.0	278.0	1.27E+07	3.0	18.1	0.23	7.4	28.7	63.2	2.8	3.3	500	109.4
DC EAST QA	8/28/01		179.5	260.0	5.00E+06	2.0	18.9	0.28	9.2	30.4	112.9	3.0	3.2		227.7
DC EAST	9/11/01	7.35	191.5	251.0	2.90E+06	4.8	21.9	0.13	6.6	33.4	59.9	3.3	4.3	521	134.0
DC EAST	9/25/01	7.10	183.0	255.0	5.10E+06	2.1	20.8	0.09	5.3	28.2	66.0	3.4	4.7	505	150.5
DC EAST	10/9/01	7.25	184.0	243.0	5.80E+06	7.1	16.0	0.10	4.2	27.3	55.0	3.8	4.8	540	178.5

Location	Date	pH	Alkalinity (mgl)	BOD5 (mg/l)	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	PON (mg/l)	Total Nitrogen (mg/l)	POC (mg/l)	PO_4 (mg/l)	TP (mg/l)	Sp Cond (uS)	TSS (mgl)
DC EAST	10/23/01	7.21	182.5	235.0	3.60E+06	8.2	16.1	0.07	7.2	31.6	66.7	2.8	3.1	574	151.5
DC EAST	11/6/01	7.07	184.0	143.0	4.30E+06	2.6	24.5	0.18	7.7	35.0	79.1	3.3	6.0	477	136.0
DC EAST	11/19/01	7.42	179.0	225.0	4.10E+06	4.1	21.0	0.10	6.8	32.0	69.1	3.2	5.6	505	155.0
DC EAST QA	11/19/01	7.44	182.0	238.0	2.00E+06	1.9	22.2	0.09	7.2	31.3	69.2	3.2	5.4	465	132.3
DC EAST	12/4/01	7.41	187.5	149.0	1.40E+06	5.2	21.5	0.04	6.8	33.6	82.8	3.6	7.5	505	176.0
DC EAST	12/18/01	7.30	366.0	210.0	3.50E+06	2.2	19.7	0.05	7.7	29.5	85.1	2.7	5.1	463	179.5
DC EAST	1/2/02	7.42	208.5	269.0	7.20E+06	3.2	25.1	0.05	9.4	37.7	98.4	3.7	6.2	554	212.0
DC EAST	1/15/02	7.59	191.5	251.0	2.80E+06	3.8	24.0	0.06	8.8	36.7	87.2	3.7	7.7	636	187.0
DC EAST	1/29/02	7.48	186.0	252.0	2.70E+06	2.5	24.4	0.09	9.8	36.7	106.6	3.4	6.6	583	206.0
DC EAST QA	1/29/02	7.49	187.5	254.0	1.42E+07	2.2	25.4	0.03	8.0	35.6	92.8	3.4	7.4	584	194.0
DC EAST	2/12/02	7.39	192.5	277.0	2.50E+06	3.4	26.2	0.05	4.9	34.6	56.8	3.4	5.6	558	116.4
DC EAST	2/26/02	7.46	190.0	194.0	1.00E+05	3.9	24.3	0.05	11.9	40.1	82.5	3.3	5.6	529	171.2
DC EAST	3/12/02	7.29	192.5	344.0	3.70E+06	1.8	28.9	0.07	12.2	43.0	162.4	4.3	6.6	587	365.0
DC EAST	3/26/02	7.33	185.5	268.0	3.90E+06	0.2	23.8	0.13	4.2	28.4	55.3	3.9	5.0	506	119.5
DC EAST	4/9/02	7.40	189.5	146.0	1.10E+06	4.5	24.4	0.12	6.5	35.6	71.3	3.5	5.5	577	160.5
DC EAST QA	4/9/02	7.43	193.0	178.0	2.20E+06	5.3	24.6	0.10	6.5	36.5	79.6	3.4	5.8	574	137.0
DC EAST	4/23/02	7.42	51.5	200.0	1.50E+06	2.3	24.1	0.12	10.6	37.1	77.8	3.4	5.8	578	147.0
DC EAST	5/7/02	7.45		248.0	3.30E+06	4.0		0.08	7.4	11.5	78.1	3.7		526	

Location	Date	pH	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	Total Nitrogen (mg/l)	PO_4 (mg/l)	TDP (mg/l)	Sp Cond (uS)
E1 6"	3/15/00		129000	0.0	24.5	0.1	24.7	2.7		
E1 6"	3/28/00	6.64	1000	1.3	24.0	0.4	25.8	2.5		635
E1 6"	4/11/00	6.56	1400	0.5	24.0	1.4	25.9	2.8		615
E1 6"	6/14/00	6.70	14000	2.1	14.9	3.7	20.7	2.3		529
E1 6"	6/28/00	6.28	500	1.5	0.2	21.4	23.1	3.0	3.2	494
E1 6"	7/12/00	6.91	40000							476
E1 6"	8/9/00	6.17	500	2.0	1.0	11.5	14.5	2.7	3.3	472
E1 6"	11/14/00	5.86	1100	1.5	0.1	17.8	19.4	2.8	3.3	393
E1 6"	11/28/00	5.87	5100	0.5	1.6	18.6	20.7	2.4	2.9	405
E1 6"	12/26/00	6.36	100							520
E1 6"	2/6/01	6.53	1600	3.2	14.4	4.4	21.9	2.7	2.8	440
E1 6"	3/13/01	6.44	50	0.4	15.6	6.0	22.0	2.9	2.9	454
E1 6"	4/10/01	5.95	1930		0.1	11.4	11.5	2.5	2.8	414
E1 6"	4/24/01	5.84	5000	0.7	4.8	17.0	22.5	3.2		442
E1 6"	7/31/01	6.29	33000	2.4	21.4	43.8	67.7	1.7	2.0	710
E1 6"	8/28/01	5.86	500	2.4	0.0	29.8	32.3	3.3		488
E1 6"	9/25/01	5.83	1100	0.2	0.2	28.4	28.9	3.9	3.9	480
E1 6"	12/18/01	6.18	9200	2.7	1.3	17.5	21.5	3.1	3.1	398
E1 6"	1/15/02	6.21	4200	2.7	3.7	19.9	26.4	3.4	3.5	509
E1 6"	1/29/02	6.19	600							599
E1 6"	2/12/02	6.36	1300	0.4	6.2	18.5	25.1	3.8	4.1	503
E1 6"	2/26/02	6.46	2100	4.6	15.8	10.8	31.1	3.2	3.3	490
E1 6"	3/12/02	6.46	200	0.8	9.3	12.9	22.9	3.7		441
E1 6"	3/26/02	6.10	700	1.1	3.0	19.0	23.0	3.2		358
E1 6"	4/9/02	6.01	9100	1.8	1.3	16.4	19.5	3.0	3.2	358
E1 18"										
E1 18"	7/12/00	7.49	170							321
E1 18"	8/9/00	6.24	90	0.8	0.1	14.0	14.9	0.9	1.1	479
E1 18"	11/14/00	6.05	4600	1.3	0.0	15.9	17.2	1.6	2.2	388
E1 18"	11/28/00	6.17	25000	1.1	1.6	15.6	18.2	1.9	2.1	392
E1 18"	2/6/01	6.40	50	1.9	12.5	10.0	24.5	2.4	2.5	481
E1 18"	3/13/01	6.26	5	2.3	9.5	10.6	22.4	2.3	2.4	488
E1 18"	5/8/01	5.76	50	0.2	0.0	13.5	13.8	1.6	1.8	402
E1 18"	7/31/01	6.05	342000	15.8	3.8	64.4	84.0	0.3	0.5	826
E1 18"	12/18/01	6.16	11800	0.7	0.5	15.4	16.6	2.0	2.0	336
E1 18"	1/15/02	6.59	400	0.4	12.9	6.0	19.4	2.2	2.3	539
E2 6"										
E2 6"	12/14/99	7.02	74000	0.1	14.7	0.4	15.2	0.8		454
E2 6"	3/28/00	6.52	500	1.5	22.8	0.4	24.7	2.2		602
E2 6"	4/11/00	6.57	1600	1.0	18.5	1.0	20.5	2.1		549
E2 6"	5/31/00	6.62	7100	0.9	4.1	4.4	9.4	1.2	1.3	476
E2 6"	6/14/00	6.40	1200	0.7	0.4	6.1	7.3	1.1		422
E2 6"	6/28/00	6.75	200							420
E2 6"	9/20/00	6.54	30							500
E2 6"	11/14/00	6.17	1600	1.5	0.0	16.9	18.5	1.7		394
E2 6"	11/28/00	6.20	27000	0.8	0.9	11.6	13.4	1.5	1.6	374
E2 6"	12/12/00	6.64	500	0.9	0.2	18.3	19.4	1.8	2.1	395
E2 6"	12/26/00	6.26	32900	2.6	6.0	15.9	24.4	1.8	1.9	484
E2 6"	1/9/01	6.42	2000	2.2	10.7	10.0	22.9	1.9	1.9	516
E2 6"	1/23/01	6.28	50		10.0	8.7	18.7	1.1	1.2	345
E2 6"	2/6/01	6.35	90	2.3	12.7	4.0	19.0	0.7	0.8	445
E2 6"	2/20/01	6.38	210	1.3	10.4	2.9	14.7	0.4	0.4	452
E2 6"	3/13/01	6.46	510	0.6	9.6	1.3	11.5	0.3	0.3	413
E2 6"	3/27/01		90				0.0			

Location	Date	pH	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	Total Nitrogen (mg/l)	PO_4 (mg/l)	TDP (mg/l)	Sp Cond (uS)
E2 6"	4/10/01	6.16	20		3.1	1.2	4.3	0.4	0.4	327
E2 6"	7/31/01	5.95	1900	12.6	16.4	65.0	94.1	1.8	2.2	978
E2 6"	8/14/01	5.48	400							555
E2 6"	9/25/01	5.94	500	4.0	0.8	6.9	11.7	1.4	1.6	305
E2 6"	12/18/01	6.17	4100	2.5	0.4	18.2	21.1	2.7	2.7	378
E2 6"	1/2/02	6.33	16800	8.9	1.3	11.6	21.8	2.5	2.6	409
E2 6"	1/15/02	6.47	13000	2.7	3.6	21.1	27.5	2.6	3.1	536
E2 6"	1/29/02	6.64	2000	0.2	11.4	11.8	23.4	3.0	3.5	587
E2 6"	2/12/02	6.39	50	0.5	9.2	16.8	26.4	3.3	3.8	539
E2 6"	3/12/02	6.20	60							422
E2 18"										
E2 18"	1/9/01		200							
E2 18"	3/13/01	6.47	40	2.2	13.7	7.1	23.0	1.4	1.4	464
E2 18"	12/18/01	6.11	540	3.2	0.3	24.2	27.7	2.0	2.3	371
E3 6"										
E3 6"	12/14/99	7.24	22000	0.3	18.2	0.2	18.7	1.2		
E3 6"	3/28/00	6.53	1800	1.0	21.4	0.1	22.5	2.1		602
E3 6"	4/11/00	6.53	8200	0.0	18.6	0.4	19.1	2.0		540
E3 6"	7/12/00	7.23	40000	1.4	13.4	5.0	19.7	1.9	1.9	622
E3 6"	7/26/00	6.69	40000	0.9	0.2	11.8	12.9	2.1		519
E3 6"	8/9/00	6.42	500	4.4	0.4	14.4	19.2	2.4	2.5	503
E3 6"	8/23/00	6.26	2300	2.0	0.0	14.2	16.3	2.6	2.6	514
E3 6"	9/6/00	6.29	300	0.6	0.1	23.7	24.4	2.8	3.0	540
E3 6"	9/20/00	6.40	50	3.3	0.0	18.3	21.6	3.0	3.2	496
E3 6"	10/3/00	6.46	2090	0.3	0.0	22.9	23.1	3.2	3.3	516
E3 6"	10/17/00	6.24	2100	0.8	0.0	21.4	22.2	3.0		481
E3 6"	10/30/00	6.21	800	1.1	0.1	22.4	23.5	3.6	3.7	457
E3 6"	11/14/00	6.21	400	1.3	0.0	18.6	19.9	2.3	3.0	394
E3 6"	11/28/00	6.09	7200	0.9	2.9	14.8	18.5	2.6	3.0	400
E3 6"	12/12/00	6.10	100	0.8	0.8	21.4	23.0	3.0	3.2	388
E3 6"	12/26/00		34500	1.9	5.6	17.8	25.2	2.7	2.7	
E3 6"	1/9/01	6.43	400	2.7	15.0	7.1	24.9	3.3	3.4	539
E3 6"	1/23/01	6.49	50		23.6	4.8	28.4	2.6	2.7	516
E3 6"	2/6/01	6.62	200	3.2	19.4	3.6	26.2	3.1	3.1	501
E3 6"	2/20/01	6.55	50	1.0	24.0	3.1	28.1	3.0	3.1	566
E3 6"	3/13/01	6.53	270	1.8	23.1	3.5	28.4	3.0	3.1	493
E3 6"	3/27/01	6.43	830	5.6	20.0	2.8	28.4	3.6	3.7	458
E3 6"	4/10/01	6.13	900		3.7	9.0	12.7	3.1	3.3	478
E3 6"	4/24/01	5.76	6800	4.2	6.2	15.8	26.2	1.6	1.9	468
E3 6"	5/8/01	5.02	50	1.2	0.0	32.9	34.1	2.4	2.6	524
E3 6"	5/22/01	5.16	5	2.4	0.1	29.4	31.9	1.9	2.0	471
E3 6"	6/5/01	5.95		2.1	0.6	27.9	30.6	2.3	2.6	458
E3 6"	6/19/01	5.78	400	0.7	3.5	20.2	24.4	2.0	2.5	420
E3 6"	7/2/01	5.65	50	3.2	0.2	34.1	37.5	1.9	2.1	517
E3 6"	7/31/01	6.60	3500	12.8	14.2	63.0	90.0	1.7	2.1	1262
E3 6"	8/14/01	5.30	2400	3.1	1.4	23.4	27.9	2.1	2.3	980
E3 6"	8/28/01	5.55	6800	1.3	0.5	32.1	33.9	2.1	2.2	457
E3 6"	9/11/01	6.06	1900	0.5	0.2	20.6	21.2	2.3	2.4	442
E3 6"	9/25/01	5.76	700	1.5	0.1	25.7	27.3	2.7	2.8	438
E3 6"	10/9/01	6.10	100	0.5	0.0	25.0	25.5	2.1	2.1	394
E3 6"	10/23/01	5.88	300	0.3	0.0	26.0	26.4	2.7	2.8	405
E3 6"	11/6/01	6.06	1400	15.3	0.2	3.4	18.9	2.3	2.4	380

Location	Date	pH	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	Total Nitrogen (mg/l)	PO_4 (mg/l)	TDP (mg/l)	Sp Cond (uS)
E3 6"	11/19/01	6.09	50	19.9	0.0	4.4	24.4	2.5	2.6	392
E3 6"	12/4/01	6.11	540	17.3	0.0	3.9	21.3	2.4	2.5	394
E3 6"	12/18/01	6.22	1100	3.7	1.4	8.9	14.0	2.6	2.7	337
E3 6"	1/2/02	5.94	12700	1.3	1.1	14.8	17.1	1.9	1.9	372
E3 6"	1/15/02	6.44	3000	1.5	7.3	9.7	18.5	2.7	3.2	503
E3 6"	1/29/02	6.27	500	0.9	5.2	21.1	27.3	1.6	2.0	551
E3 6"	2/12/02	6.22	200	0.4	5.7	25.1	31.1	1.7	2.3	531
E3 6"	2/26/02	6.38	50	6.3	11.0	13.7	30.9	2.8	2.8	603
E3 6"	3/12/02	5.92	5	0.7	0.3	23.8	24.7	1.5	1.7	452
E3 6"	3/26/02	6.17	1980	1.0	0.0	16.2	17.2	1.4	1.4	333
E3 6"	4/9/02	5.70	600	2.4	0.0	26.2	28.7	1.1	1.1	786
E3 18"										
E3 18"	4/11/00	6.44	5	0.4	0.5	0.3	1.3	0.0		224
E3 18"	11/14/00	6.08	1900	1.1	0.2	17.9	19.2	2.0		399
E3 18"	11/28/00	6.18	2300	0.9	1.0	16.6	18.4	2.3	2.6	393
E3 18"	1/23/01	6.48	50		16.8	5.9	22.8	2.8	3.1	512
E3 18"	2/6/01	6.71	100	3.4	14.0	9.5	26.9	3.1	3.1	527
E3 18"	3/13/01	6.23	20	0.8	8.1	14.9	23.8	2.8	2.9	453
E3 18"	12/18/01	6.39	450	1.9	0.1	18.5	20.6	2.6	2.6	380
E SUMP										
E SU	3/15/00	6.71	5	0.9	1.2	4.0	6.1	0.0		355
E SU	3/28/00	6.29	50	0.3	3.3	11.5	15.0	0.0		417
E SU	4/11/00	6.09	5	0.1	5.9	24.8	30.8	0.0		528
E SU	6/14/00	5.40	5	3.8	0.2	16.7	20.7	0.0		334
E SU	6/28/00	5.62	5	0.4	0.0	19.5	20.0	0.3	0.5	399
E SU	7/12/00	5.81	5	0.6	0.0	22.9	23.5	0.8	0.9	401
E SU	7/26/00	5.85	5	1.8	0.0	18.5	20.4	1.1	2.5	427
E SU	8/9/00	5.93	5	0.6	0.0	16.2	16.8	0.0	0.0	428
E SU	8/23/00	5.91	5	0.1	0.0	16.6	16.7	0.1	0.1	420
E SU	9/6/00	6.22	5		0.0			0.0	0.0	469
E SU	9/20/00	6.16	5	4.7	0.0	16.6	21.3	0.0		463
E SU	10/3/00	6.25	20	0.6	0.0	17.7	18.3	0.0	0.0	466
E SU	10/17/00	6.20	30	1.0	0.0	16.9	17.9	0.0		442
E SU	10/30/00	6.46	240	0.3	0.0	18.5	18.8	0.0	0.0	446
E SU	11/14/00	6.20	10	0.7	0.0	16.0	16.7	0.0	0.0	378
E SU	11/28/00	6.12	10	0.5	0.0	16.0	16.6	0.0	0.0	402
E SU	12/12/00	6.13	5	0.0	0.0	16.8	16.8	0.0	0.0	405
E SU	12/26/00	6.13	5	1.5	0.0	14.8	16.3	0.1	0.1	389
E SU	1/9/01	5.95	5	0.8	0.0	15.7	16.5	0.1	0.1	394
E SU	1/23/01	5.89	5		0.1	13.0	13.0	0.1	0.1	378
E SU	2/6/01	6.11	5	2.5	0.8	9.5	12.9	0.2	0.2	366
E SU	2/20/01	5.98	5	1.4	2.0	21.2	24.5	0.2	0.4	435
E SU	3/13/01	5.72	5	1.1	0.7	15.0	16.8	0.5	0.5	338
E SU	3/27/01	5.61	5	0.8	0.6	30.2	31.6	0.4	0.4	328
E SU	4/10/01	5.52	2		0.0	8.3	8.3	0.4	0.4	304
E SU	4/24/01	5.56	2	1.9	0.0	14.4	16.3	0.3	0.4	377
E SU	5/8/01	5.39	1	1.4	0.0	19.8	21.2	0.4	0.4	427
E SU	5/22/01	5.56	1	10.1	0.0	15.2	25.3	0.2	0.4	426
E SU	6/5/01	5.70	1	3.8	0.0	14.5	18.3	0.1	0.1	370
E SU	7/2/01	5.85	5	6.4	0.0	29.9	36.4	0.1	0.1	411
E SU	7/31/01	5.80	5	0.6	0.0	39.9	40.5	0.2	0.2	519
E SU	8/14/01	5.58	20	1.8	0.4	43.6	45.8	0.2	0.2	657
E SU	8/28/01	5.56	10	4.2	0.0	30.5	34.8	0.2	0.2	475

Location	Date	pH	FC #/100 ml	DON (mg/l)	NH_4 (mg/l)	NO_x (mg/l)	Total Nitrogen (mg/l)	PO_4 (mg/l)	TDP (mg/l)	Sp Cond (uS)
E SU	9/11/01	5.63	5	0.2	0.0	25.3	25.5	0.2	0.3	420
E SU	9/25/01	5.35	5	0.4	0.0	23.8	24.3	0.3	0.3	393
E SU	10/9/01	6.00	210	2.0	0.0	18.9	21.0	0.3	0.3	347
E SU	10/23/01	5.62	10	0.9	0.0	23.4	24.3	0.2	0.2	386
E SU	11/6/01	5.75	5	21.5	0.0	4.8	26.3	0.2	0.3	388
E SU	11/19/01	5.74	5	20.7	0.0	4.3	25.0	0.3	0.3	373
E SU	12/4/01	5.96	5	21.0	0.2	4.8	26.0	0.3	0.3	391
E SU	12/18/01	6.12	5	22.2	0.0	20.8	43.0	0.4	0.4	373
E SU	1/2/02	5.89	5	22.4	0.0	17.7	40.0	0.2	0.4	376
E SU	1/15/02	6.15	5	0.9	0.0	14.6	15.5	0.5	0.6	368
E SU	1/29/02	6.16	5	0.8	0.1	19.2	20.1	0.6	0.6	444
E SU	2/12/02	6.06	5	2.7	0.1	23.5	26.4	0.7	0.7	492
E SU	2/26/02	5.97	5	0.3	0.0	21.5	21.8	0.9	0.9	402
E SU	3/12/02	5.91	5	0.3	0.0	21.2	21.5	1.0	1.0	389
E SU	3/26/02	5.87	5	1.3	0.0	24.0	25.3	1.0	1.1	355
E SU	4/9/02	5.82	5	0.5	0.0	16.5	17.1	1.1	1.2	321