

Project Annual Report : 2006-2007

**USE OF ORGANIC AMENDMENTS TO REDUCE LOADS OF NITROGEN AND
PHOSPHORUS IN SURFACE RUNOFF FROM CITRUS GROVES AND VEGETABLE
FIELDS (Contract # 0011200)**

By

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ABSTRACT

This project was initiated on May 31, 2004 to evaluate the use of organic amendment to reduce nitrogen (N) and phosphorus (P) concentrations and loads in storm runoff water from agricultural production fields in the Indian River area. This report covers field demonstration and monitoring data from July 1, 2006 to March 31, 2007, as the 3rd year's research was only partially funded (50% of original budget) due to funding shortage. A total of 345 runoff water samples were collected during this period and they were analyzed for pH, electrical conductivity (EC), turbidity, solids, phosphorus (total, dissolved total, reactive, and ortho-P), nitrogen (total, TKN, NO₃-N, NH₄-N), metals, and other elements related to water quality. Organic amendment (OA) reduced total P, dissolved total P, and ortho-P by 40-60% and total N, TKN by 10-15% at location #4, but there was no difference in available N (NO₃-N + NH₄-N) between the OA and the control site for this location. For location #3, Total N, TKN, and available N (NO₃-N + NH₄-N) were significantly decreased, but there was no differences in the concentrations of total P, dissolved total P, and ortho-P. The concentrations of Ca, K, and SO₄²⁻-S were reduced but Cu and Fe concentrations were slightly increased by organic amendment. These results indicate that organic amendment can generally reduce the losses of nutrients (N, P, Ca, K, and S) but also tends to increase transport of Cu and Fe from soil to water.

Organic amendment increased N and P concentrations in citrus leaf for location #4 and Mg concentration for locations #3 and #4. However, there was no significant difference in leaf N, P concentrations for location #3 and in leaf K concentration for both locations (#3 and #4) between

the OA and the conventional site. The concentrations of leaf Cu and Fe were decreased by organic amendment for both locations but the decrease in leaf Zn and Mn concentration occurred only at location #4. Since the concentrations are within a normal range for each of the micro-nutrients, organic amendment is unlikely to cause any deficiency or toxicity of these trace elements.

Organic amendment tended to increase fruit size, juice and soluble solids content of grapefruit at location #4 and increased Brix/acid ratio by decreasing acid in navel orange at location #3. However, there was no difference in the juice content, Brix and solids concentration of navel orange (#3) between the amended and the conventional sites (Table 12). Organic amendment increased fruit yield by 30% (Fig. 1), which may result from improved soil quality and reduced nutrient losses.

In conclusion, organic amendment can partially replace water soluble fertilizers for sand soils in the Indian River area. The benefits include improvement of crop yield and quality and reduction of environmental impacts.

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SCOPE OF WORK

In the Indian River area, transport of nutrients, especially N and P, from agricultural production systems through leaching and surface runoff may contribute to the water quality degradation of the St. Lucie Estuary and the Indian River Lagoon. Implementation of best management practices (BMPs) has proven to be effective to reduce N and P loads in runoff water. Most soils in the Indian River area are very sandy with minimal holding capacity for nutrients because of low clay and organic contents. Utilization of soil amendment to increase soil's holding capacity is one of the most effective BMPs to reduce nutrient losses in agriculture and to restore the environment. In the past, application of inorganic soil amendment such as water plant residues and liming materials has been well evaluated and documented. However, minimal data are available regarding the use of organic amendment to improve N and P utilization efficiency by crops and reduce their losses into waters.

This three-year project was initiated on April 2, 2004 with funding from the Florida Department of Agricultural and Consumer Services (DACS). The objectives of this project were to evaluate the effectiveness of organic amendment in reducing N and P loads in surface runoff and to develop soil amendment best management practices (BMPs) for citrus and vegetable production systems.

In the first year, laboratory analysis, incubation and greenhouse experiments were conducted to characterize and identify adequate organic amendment and to preliminarily evaluate the identified materials with respect to their potential in reducing nutrient losses and sustaining crop production on sandy soils in South Florida. The 2nd year's research focused on the collection of

field data regarding the effects of organic amendments on water quality, soil fertility, plant nutrition, and crop yield and quality. The field data collected in the 2nd year confirmed our findings obtained from laboratory. Organic amendment reduced the concentrations of total P, dissolved total P, and ortho-P for all the locations. The reduction rates were 13 to 60% for ortho-P, 13 to 63% for the dissolved total P, and 12 to 51% for total P. The effects of organic amendment on the concentrations of total N, TKN, NO_3^- -N, and NH_4^+ -N varied from locations and N forms. A reduction of 40 to 60% in total N and TKN in runoff waters was achieved for locations #2 and #3, but negative results in runoff water N concentrations were observed for location #4. Likely, the effects of organic amendment are related to soil properties. Soil in location #4 was acidic, and microbial activity may be limited. Due to the damage of Hurricane Wilma, no yield or fruit quality data were obtained in the 2nd year.

The major research tasks completed in the 3rd year include:

1. Re-established field trials on commercial citrus and vegetable farms in the Indian River area, including application of organic amendment, re-installation of autosamplers and rain gauges, which were damaged by the hurricane.
2. Collection of surface runoff water samples and analyzed for physical and chemical quality, including pH, electrical conductivity (EC), turbidity, suspended solids, total P, total dissolved P, reactive P, and Ortho-phosphate, total N, TKN, NO_3^- -N, NH_4 -N, and dissolved metals (Ca, Mg, K, Na, Cu, Zn, Mn, Fe, Cd, Pb, Ni, Co and Cu);
3. Collection of surface runoff discharge data for quantifying nutrient and heavy metal loads in surface runoff;

4. Collection of soil samples at 0-15 cm and 15-30 cm for determination of pH, EC, available soil N and P, and metals;
5. Collection of plant tissue samples (citrus leaf, bell pepper leaf, and pepper) for plant nutrition analysis;
6. Collection of fruit samples for quality analysis.
7. Collection of crop yield data.

This report covered the 3rd year's research tasks and deliverables.

MATERIALS AND METHODS

Field Trial Establishment:

Four field locations, two citrus groves (Locations #3 and #4) and two vegetable fields (Locations #2 and #3) of representative commercial agricultural farms in the Indian River area were re-established for this demonstration study.

The codes of locations and sites are listed in Table 1.

Table 1. Codes and basic information of the evaluation locations (2004- present)

Locations	Sites*	Codes	Site area (m ²)	Fertilization plan	Sampling Status
#2(Vegetable)	OA	23	3686	1100 kg /ha organic amendment 50% of basal broadcast of CON	Running
	CON	21	3686	N 291 P 90 kg/ha	Running
#3(Citrus)	OA	33	5427	1100 kg /ha organic amendment 67% of annual fertilizer rate	Running
	CON	31	5427	N 168 P 37 kg/ha	Running

#4(Citrus)	OA	83	2511	1100 kg /ha organic amendment 67% of annual fertilizer rate	Running
	CON	81	2511	N 168 P 37 kg/ha	Running
#9(Vegetable)	OA	93	3240	1100 kg /ha organic amendment 50% of basal broadcast of CON	Running
	CON	91	3240	N 291 P 90 kg/ha	Running

* OA: Organic amendment treatment; CON: Grower's practices.

The organic amendment used in the demonstration trials is the same as used in the previous year, that pellet product called GreenEdge provided by Green Technologies Inc and featured as slow release fertilizer, as reported in our progress reports 3-5 (He et al, 2005). The nutritional values, and agronomic properties and potential impact of this organic amendment were reported in our progress report two-organic amendment characterization (He et al, 2004).

The demonstration field trial consists of organic amendment treatment and conventional plots. The application rate of organic amendment was 1100 kg/ha for both citrus and vegetable field and simultaneously the basal application rate of fertilizers was reduced by 50% for vegetable production system whereas total annual fertilizer rate was reduced by 33% for citrus production system (Table 1).

Table 2. Field management practices of the demonstration citrus groves and vegetable farms, 2005-

Locations	Fertilization			Irrigation		Variety /planting
	Rate kg/ha	Frequenc y#	Method	Rate hr/wk	Method	
#2(Vegetable)	N291 P90	2D+17FS	Broadcast +Band+Foliar spraying	N/A	Seepage	Peppers /Spring crop
#3(Citrus)	N168 P37	4 times/yr	Dry application	8	Microjet	Flame gft/1990
#4(Citrus)	N142 P16	2D+2FS	Dry+Foliar spraying	12	Microjet	Red ruby/1988

#9(Vegetable)	N292 P 93	2D+5F	Broadcast +Band+ Fertigation	N/A	Seepage	Peppers /Fall crop
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Current growers' practices of management (conventional) were presented in Table 2. In general, more P is applied in vegetable crop production system, with 50% of N and 100% of P being applied as basal broadcast before bedding. Therefore, 50% of reduction in basal fertilizer rate means 50% reduction in inorganic fertilizer P and 25% reduction in inorganic N fertilizer. The application rate of organic amendment (1100 kg/ha) for the field trials was based on our previous studies with laboratory incubation, column leaching, and greenhouse experiments. At this rate, the application of organic amendment reduced N and P leaching and increased the utilization efficiency of P by crop (He et al, 2004; 2005). The mechanisms are related to microbial incorporation of soil available N and P into microbial biomass and organic fractions and the nutrients in microbial biomass and organic matter are not subjected to leaching or surface runoff loss, but potentially available to crops.

Application of Organic Amendment

The application of organic amendment (GreenEdge) for citrus groves (locations #3 and #4) were conducted on January 27, 2006. The pellet organic material was applied using a mechanic spreader (photos 1-4). The organic amendment for location #9 (vegetable) was applied on July 24, 2006 (Photo 5-6) and the crop was bell pepper. No crop was planted on location #2 (vegetable) in 2006 as the farm owner decided to fallow the land for one year, but our monitoring operation is continued to examine residual effects.

Surface Runoff Sampling and Analyses

The autosamplers (SIGMA 900MAX portable sampler) were programmed so that all the surface runoff samples can be divided into the first flush samples and the remaining composite samples. The first flush samples, defined as the samples collected in the first two hours, were collected into three bottles, each for 40 minutes in sequence. During the first 40 minutes the sampler collected three samples (one sample every 13 minutes and 20 seconds) and placed them into bottle No. 1, bottle No. 2 and 3 samples were collected in a similar manner during the 2nd and 3rd 40-minutes periods, respectively. The composite samples were collected into another three bottles, each for 8 hours in sequence. During the first 8 hours, the sampler collected three samples (one sample every two hours and 40 minutes) and placed them into bottle No. 4. Bottle No. 5 and 6 samples were collected in a similar way during the 2nd and 3rd 8-hours periods, respectively. These three samples represented for the 8th, 16th and 24th hours events (six samples in 24 hours). The autosamplers were checked daily to ensure proper performance and to collect surface runoff samples, if available. Water samples collected from the autosamplers were immediately transported to the IRREC Soil and Water Laboratory in an ice-chest.

Prior to filtration, pH and EC of the water samples were determined using a pH/ion/conductivity meter (pH/ Conductivity Meter, Model 220, Denver Instrument, Denver, CO) following EPA 150.1 and EPA 120.1, respectively. Turbidity of water samples was measured using a Turbidity meter (DRT-100B, HF Scientific Inc., Fort Myers, FL). Solid concentrations of the water samples were measured using a gravimetry method with oven drying. Total P in the unfiltered surface runoff sample was determined by the molybdenum-blue method after digestion

with acidified ammonium persulfate (EPA 365.2). Sub-samples were filtered through Whatman 42 filter paper. Portions of the sub-samples were filtered further through a 0.45 µm membrane for measurement of total dissolved P and PO₄-P. The concentrations of anions including F, Cl, Br, NO₃-N, PO₄-P and SO₄-S were measured within 24 h after sample collection using an Ion Chromatograph (DX 500; Dionex Corporation Sunnyvale, CA) following EPA method 300.0 NH₄-N and Total Kjeldahl N (TKN) in the runoff sample were measured using an autoanalyzer (EasyChem Plus, Syntex Scientific, Oak Brook, IL) following EPA method 351.3. Total N in the runoff sample was calculated as the sum of TKN and NO₃-N. Concentrations of total dissolved macro-elements in water were determined using the Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES, Ultima, JY Horiba Inc. Edison, N.J.) following EPA method 200.7. The loads of total P, dissolved total P, PO₄-P, TKN, NO₃-N, total N, and suspended solid in runoff for each runoff event were determined as a product of nutrient or solid concentration in each runoff sample and each runoff discharge per rainfall event:

$$\text{Load (g /ha)} = \text{Concentration (mg/L)} \times \text{Discharge (m}^3\text{)} \times 10^4 / \text{Site area (m}^2\text{)}$$

Soil Sampling and Analysis

Soil samples were collected from 0-15 and 15-30 cm depths of each citrus or vegetable field locations on July 20, 2006 and January 19, 2007. The soils were air-dried, ground, and passed through a 2-mm sieve prior to physical and chemical analyses. Soil pH was measured in slurry with deionized water and 1 M KCl solution at a solid: solution ratio of 1:1 using a pH/ion/conductivity meter (pH. Conductivity Meter, Model 220, Denver Instrument, Denver,

CO). Electrical conductivity (EC) was measured in slurry with deionized water at a soil:water ratio of 1:2 using a pH/ion/conductivity meter (pH. Conductivity Meter, Model 220, Denver Instrument, Denver, CO). Available N (NH_4^+ -N and NO_3^- -N) was determined by shaking a 2.5 gram air-dried sample in 25 ml 2 M KCl for 1 h. Concentrations of NH_4^+ -N and NO_3^- -N in the filtrate were analyzed with a N/P Discrete Autoanalyzer (EasyChem, Syntex Scientific LLC, Oak Brook, IL). Available P (Olsen-P) was extracted using 0.5 M NaHCO_3 and P concentration in the extract was determined by the molybdenum-blue method (Kuo, 1996). Available metals were determined by extracting the samples with Mehlich III solution (Mehlich, 1984), and measuring the metal concentrations using an Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES, Ultima, JY Horiba, Edison, NJ), following EPA method 200.7 (EPA, 1998). Briefly, 2.5 g air-dried samples were weighed, placed into 50-ml polystyrene centrifuge tubes, and 25 ml of Mehlich III extractant were added. The suspension was shaken for 5 min and filtered through Whatman 42 filter paper. Concentrations of extractable metals in the filtrate were analyzed using the ICPAES.

Plant sample collection and analysis

Six-month old spring flush leaves were randomly sampled on July 20, 2006 from the organic amendment and the conventional sites of each field location for determining mineral concentrations. The leaf samples were washed in detergent, rinsed several times in tap water, soaked in 5% HCl for 20 seconds, and rinsed in distilled water. The leaves were dried at 70 °C for 48 hours, ground using a stainless micro ball-Mill and passed through a 1-mm sieve. Ground

leaf tissue (0.5g) was digested in concentrated HNO_3 using a semi-auto block digestion system (AIM 500, A. I. Scientific, Queensland, Australia) and the concentrations of P and metals in the digester were determined using the ICPAES. Total N in the leaf samples was determined using a CN-Analyzer.

Fruit Sample Collection and Analysis

Representative citrus fruit samples were collected on Nov. 29, 2006 for quality and nutrient analysis. Internal quality properties of the fruit including juice, Brix, acid, and soluble solids were analyzed following standard procedure at the postharvest laboratory, Indian River Research and Education Center, Fort Pierce. Subsamples of the fruit were cleaned using deionized water, cut into small pieces, and oven dried at 70 °C and the dried fruit material was ground to <1 mm prior to analysis. Fruit C and N contents were determined using a CN Analyzer (vario Max CN, Elemental Analysensystem GmbH, Hanau, Germany). Subsamples (each 0.400 g) were digested with 5 mL of concentrated HNO_3 using a block digestion system (AIM 500-C, A.I. Scientific Inc., Australia). The concentrations of P, Ca, Mg, K, Na, Cu, Zn, Pb, Cd, Cr, Fe, Mn, and Ni in the digester were determined using the ICPAES.

Crop Harvest and Yield Record

Fruit harvest was conducted on Feb. 22, 2007 manually by randomly picking up two trees per bed or four trees per plot and recording the yield by filling the fruit in standard bins.

RESULTS AND DISCUSSION

General Water Quality

Physical properties of runoff water samples collected during the 2005-06 period are presented in Table 3. In general, there is no difference in pH, electrical conductivity (EC), turbidity, and solids of water samples between the organic amendment plot and the control (Table 3). These parameters varied greatly spatially and temporarily as affected by soil properties, hydrology condition, and storm intensity. The concentrations of anions (F^- , Cl^- , Br^- , NO_3^-N , $PO_4^{3-}P$, $SO_4^{2-}S$) and NH_4^+N in runoff waters are presented in Table 4. Application of organic amendment did not affect the concentrations of F^- , Cl^- , Br^- , and $SO_4^{2-}S$ in runoff waters, but reduced $PO_4^{3-}P$ concentration in runoff water for location #4. The concentrations of NO_3^-N in runoff water were reduced by organic amendment for all the locations (Table 4). The concentrations of total dissolved macro-elements including Ca, Mg, K, Na, and P are presented in Table 5. There were no significant differences in total dissolved macro-element concentrations in runoff waters between the organic amended plot and the control. The applied organic amendment contained considerable amounts of Ca, but this input was not reflected in runoff water. Organic amendment decreased total dissolved P in runoff waters for location #4 (Table 5), which will be discussed in more detail in the following sections. Among the heavy metals, Cd, Co, Cr, Ni, and Pb were mostly below detection limits (Table 6). The concentrations of Fe, Mn, Cu, and Zn in runoff waters were considerable. Iron and Mn are mostly inherited from their oxides in the soils, Cu and Zn may result from the repeated use of fungicides that contained these elements. There was a trend of increased concentrations of Fe in runoff waters by organic amendment (Table 6).

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 006-March, 2007.

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#9-CON	611001	2006-8-19	12:15	6.48	132.4	216	0.095
#9-CON	611002	2006-9-1	12:08-12:21	6.65	89.31	5.03	0.715
#9-CON	611003	2006-9-7	17:35	6.62	102.1	486	0.925
#9-CON	611004	2006-12-16	10:45-11:11	6.24	178.9	35.6	0.405
#9-CON	611005	2006-12-16	11:25-11:51	6.30	209.1	10.8	0.250
#9-CON	611006	2006-12-16	12:05-12:18	6.27	220.8	16.3	0.145
#9-CON	611007	2006-12-17	4:11	6.55	217.4	167	10.27
#3-CON	631009	2006-7-1	06:03-06:30	7.03	971.5	148	0.645
#3-CON	631010	2006-7-1	06:43-07:10	6.85	528.6	36.2	0.190
#3-CON	631011	2006-7-1	07:23-07:50	6.83	848.3	8.43	0.330
#3-CON	631012	2006-7-1	08:30-13:50	7.32	1132	37.6	0.545
#3-CON	631013	2006-7-1	16:36-21:50	7.36	1415	18.5	0.650
#3-CON	631014	2006-7-2	00:30-05:50	7.49	1341	25.9	0.605
#3-CON	631015	2006-7-2	08:32-13:50	7.30	1238	36.5	0.560
#3-CON	631016	2006-7-2	16:30-21:50	7.29	1350	18.6	0.620
#3-CON	631017	2006-7-3	00:30-03:10	7.45	1337	82.3	0.790
#3-CON	631018	2006-8-23	19:31-22:11	7.27	998.7	6.23	0.560
#3-CON	631019	2006-8-24	00:51-06:11	7.48	1279	7.04	0.535
#3-CON	631020	2006-8-24	08:51-14:11	7.47	1396	7.81	0.635
#3-CON	631021	2006-8-24	16:51-22:11	7.32	1413	9.04	0.630
#3-CON	631022	2006-8-25	00:51-06:11	7.39	1440	8.06	0.590
#3-CON	631023	2006-8-25	8:51	7.47	1451	11.6	0.630
#3-CON	631024	2006-8-25	12:54-13:21	7.42	983.1	13.4	0.915
#3-CON	631025	2006-8-25	13:34-13:47	7.37	955.6	11.6	1.025
#3-CON	631026	2006-8-26	02:01-04:41	7.56	1125	3.62	1.155
#3-CON	631027	2006-8-26	07:21-12:41	7.15	1275	5.07	1.355
#3-CON	631028	2006-8-26	15:21	7.62	1284	7.47	1.330
#3-CON	631029	2006-8-29	22:21-01:01	7.11	997.6	6.44	0.210
#3-CON	631030	2006-8-30	03:41-09:01	6.89	461.2	5.37	0.185
#3-CON	631031	2006-8-30	17:01	7.43	756.4	3.94	0.430
#3-CON	631032	2006-8-31	1:01	7.47	753.8	4.07	0.345
#3-CON	631033	2006-9-1	19:12-21:52	7.42	831.2	5.97	0.615
#3-CON	631034	2006-9-2	00:32-05:52	7.29	861.3	3.4	0.615
#3-CON	631035	2006-9-2	08:32-13:52	7.30	754.6	5.91	0.510

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#3-CON	631036	2006-9-2	16:32-21:52	7.24	638.1	4.46	0.350
#3-CON	631037	2006-9-3	00:32-05:52	7.21	764.2	7.54	0.500
#3-CON	631038	2006-9-3	08:32-11:12	7.51	798.5	7.86	0.540
#3-OA	633021	2006-7-10	15:40	7.10	658.1	161	1.170
#3-OA	633022	2006-7-10	18:20-23:40	7.08	628.7	12.1	0.805
#3-OA	633023	2006-7-10	02:20-07:40	7.24	694.4	8.26	0.880
#3-OA	633024	2006-8-23	15:22-15:49	7.01	659.1	11.8	0.130
#3-OA	633025	2006-8-30	3:09	7.30	401.1	14.6	0.060
#3-OA	633026	2006-8-30	05:49-11:09	7.34	321.6	8.93	0.165
#3-OA	633027	2006-8-30	9:09	7.54	483.7	4.79	0.075
#3-OA	633028	2006-8-30	21:49	7.56	503.5	4.07	0.090
#3-OA	633029	2006-8-31	16:29	7.32	550.2	5.06	0.120
#3-OA	633030	2006-9-1	15:40	7.48	591.3	4.23	0.125
#3-OA	633031	2006-9-2	13:00-15:40	7.42	380.6	5.9	0.210
#3-OA	633032	2006-12-11	11:27-11:54	7.84	1523	27.8	1.110
#3-OA	633033	2006-12-11	12:07-12:34	7.88	1575	10.9	1.160
#3-OA	633034	2006-12-11	12:47-13:14	8.01	1563	7.66	1.225
#3-OA	633035	2006-12-11	13:45-19:14	7.98	1561	4.39	1.185
#3-OA	633036	2006-12-11	21:54-03:14	7.99	1562	5.34	1.215
#3-OA	633037	2006-12-12	05:54-11:14	7.97	1560	4.73	1.190
#3-OA	633038	2006-12-12	13:54-16:34	7.99	1561	4.08	1.195
#3-OA	633039	2006-12-25	17:36-22:56	7.10	697.1	6.32	0.500
#3-OA	633040	2006-12-26	1:36-6:56	7.33	1033	7.57	0.760
#3-OA	733001	2007-1-23	15:40-18:20	7.16	2036	12.8	1.240
#3-OA	733002	2007-2-6	0.114583333	7.59	2521	164	1.765
#3-OA	733003	2007-2-6	5:22-8:02	8.13	1883	131	1.340
#3-OA	733004	2007-3-16	18:46-19:13	7.01	1434	138	0.905
#3-OA	733005	2007-3-16	19:26-19:53	7.07	1467	36.9	0.875
#3-OA	733006	2007-3-16	20:06-20:33	7.11	1465	23.4	0.890
#3-OA	733007	2007-3-17	21:13-2:33	7.18	1475	15.7	1.050
#3-OA	733008	2007-3-17	5:13-10:33	7.37	1602	14.2	0.930
#3-OA	733009	2007-3-17	13:13-18:33	7.36	1658	11.9	0.975
#3-OA	733010	2007-3-18	21:13-2:33	7.35	1683	10.5	1.095
#3-OA	733011	2007-3-18	5:13-10:33	7.32	1714	15.5	1.210
#3-OA	733012	2007-3-18	0.550694444	7.53	1721	48.9	1.245
#3-OA	733013	2007-3-18	15:07-15:34	7.82	1698	15.4	1.060
#3-OA	733014	2007-3-18	15:47-16:14	7.81	1718	11.5	1.160

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006 - March, 2007 (Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#3-OA	733015	2007-3-18	16:27-16:54	7.82	1726	10.4	1.145
#3-OA	733016	2007-3-18	17:34-22:54	7.89	1723	7.58	1.080
#3-OA	733017	2007-3-19	1:34-6:54	7.78	1767	55.6	1.040
#3-OA	733018	2007-3-19	9:34-15:54	7.93	1757	47.9	1.060
#3-OA	733019	2007-3-19	17:34-22:54	7.94	1769	17.6	1.280
#3-OA	733020	2007-3-20	1:34-6:54	8.01	1767	16.5	1.415
#3-OA	733021	2007-3-20	9:34-12:14	8.08	1761	11.4	1.405
#4-CON	681026	2006-7-11	16:56-17:23	6.43	297.1	15.4	0.280
#4-CON	681027	2006-7-11	17:36-18:03	6.46	280.6	7.3	0.375
#4-CON	681028	2006-7-11	18:16-18:43	6.68	368.4	3.5	0.420
#4-CON	681029	2006-7-11	19:23-00:47	6.90	1113	13.1	1.045
#4-CON	681030	2006-7-12	03:23-08:43	6.87	1704	8.5	1.575
#4-CON	681031	2006-7-12	11:23-16:43	6.38	1280	5.5	1.260
#4-CON	681032	2006-7-12	19:23-00:43	6.32	1339	5.9	1.305
#4-CON	681033	2006-7-13	03:23-08:43	6.30	1419	9.4	1.395
#4-CON	681034	2006-8-19	13:46-14:13	6.73	628.2	42.8	0.030
#4-CON	681035	2006-8-19	14:26-14:52	7.18	854.6	28.7	0.070
#4-CON	681036	2006-8-19	15:06-15:33	7.46	1025	19.2	0.195
#4-CON	681037	2006-8-19	16:13-21:33	7.61	1267	22.7	0.455
#4-CON	681038	2006-8-20	00:13-05:33	7.60	1355	26.5	0.185
#4-CON	681039	2006-8-20	08:13-13:33	7.46	1248	25.9	0.135
#4-CON	681040	2006-8-20	16:13-21:33	7.30	1190	36.3	0.035
#4-CON	681041	2006-8-21	00:13-05:33	7.23	1332	29.4	0.715
#4-CON	681042	2006-8-21	8:13	7.27	1496	38.7	0.533
#4-CON	681043	2006-8-26	16:53-17:20	7.21	630.3	15.1	0.195
#4-CON	681044	2006-8-26	17:33-18:00	7.17	594.1	12.3	0.070
#4-CON	681045	2006-8-26	18:13-18:40	7.14	616.2	19.2	0.275
#4-CON	681046	2006-8-26	19:20-00:40	7.23	684.1	16.6	0.130
#4-CON	681047	2006-8-27	03:20-08:40	7.24	768.2	12.3	0.120
#4-CON	681048	2006-8-27	11:20-16:40	7.06	848.9	12.7	0.110
#4-CON	681049	2006-8-27	17:20-00:40	7.16	875.7	12.5	0.750
#4-CON	681050	2006-12-24	15:04-15:31	6.38	959	29.3	0.465
#4-CON	681051	2006-12-24	15:44-16:11	6.52	963.4	12.6	0.480
#4-CON	681052	2006-12-24	16:24-16:51	6.58	1053	8.32	0.145
#4-CON	681053	2006-12-24	17:31-22:51	6.91	1024	6.81	0.635
#4-CON	681054	2006-12-25	1:31-6:51	7.01	1320	8.56	0.910
#4-CON	681055	2006-12-25	9:31-14:51	6.96	1434	11.3	0.855

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#4-CON	681056	2006-12-25	17:31-22:51	6.79	813.6	15.9	0.150
#4-CON	681057	2006-12-26	1:31-6:51	7.48	1208	13.1	0.940
#4-CON	681058	2006-12-26	9:31-12:11	7.27	1106	10.2	0.765
#4-CON	781001	2007-2-27	5:14-5:41	6.97	1490	81.4	0.780
#4-CON	781002	2007-2-27	5:54-6:21	7.14	1478	52.6	0.955
#4-CON	781003	2007-2-27	6:34-7:01	7.2	1524	43.4	1.060
#4-CON	781004	2007-2-27	7:41-13:01	7.71	1581	24.6	1.125
#4-CON	781005	2007-2-27	15:41-21:01	8.02	1650	9.24	1.115
#4-CON	781006	2007-2-28	23:41-5:01	8.01	1664	10.8	0.565
#4-CON	781007	2007-2-28	7:41-13:01	8.02	1685	5.89	0.585
#4-CON	781008	2007-2-28	15:41-21:01	8.01	1691	5.72	0.980
#4-CON	781009	2007-3-1	23:11-2:21	8.04	1703	4.43	1.080
#4-CON	781010	2007-3-16	14:44-15:11	6.97	1484	49.5	1.170
#4-CON	781011	2007-3-16	15:24-15:51	6.98	1470	22.1	1.085
#4-CON	781012	2007-3-16	16:04-16:31	7.02	1465	17.4	0.945
#4-CON	781013	2007-3-16	17:11-22:31	7.06	1418	15.3	0.950
#4-CON	781014	2007-3-17	1:11-6:31	7.19	1470	9.47	1.045
#4-CON	781015	2007-3-17	9:11-14:31	7.33	1503	5.72	1.025
#4-CON	781016	2007-3-17	17:11-22:31	7.47	1608	3.06	1.055
#4-CON	781017	2007-3-18	1:11-6:31	7.71	1852	17.4	1.410
#4-CON	781018	2007-3-18	9:11-11:51	7.05	17.6	2.94	1.175
#4-CON	781019	2007-3-22	17:24-17:51	7.71	1784	1.92	1.145
#4-CON	781020	2007-3-22	18:04-18:31	7.74	1811	11.2	0.265
#4-CON	781021	2007-3-22	18:44-19:11	7.76	1813	10.4	1.350
#4-CON	781022	2007-3-23	19:51-1:11	7.68	1795	6.97	1.325
#4-CON	781023	2007-3-23	3:51-9:11	7.58	1806	10.3	1.315
#4-CON	781024	2007-3-23	11:51-17:11	7.59	1860	14.7	1.360
#4-CON	781025	2007-3-24	19:51-1:11	7.62	1842	15.4	1.330
#4-CON	781026	2007-3-24	3:51-9:11	7.65	1776	13.2	1.260
#4-CON	781027	2007-3-24	11:51-14:31	7.87	1592	7.47	1.105
#4-OA	683016	2006-7-12	16:27-17:07	6.62	404	23.8	0.975
#4-OA	683017	2006-7-12	17:07-17:47	5.94	304.3	2.19	0.820
#4-OA	683018	2006-7-12	17:47-18:54	6.05	251.7	5.63	0.650
#4-OA	683019	2006-7-12	21:34	6.38	280.7	6.47	0.530
#4-OA	683020	2006-8-19	13:37-14:04	5.94	409.8	7.73	0.355
#4-OA	683021	2006-8-19	14:16-14:44	6.01	481.3	6.96	0.305
#4-OA	683022	2006-8-19	14:57-15:24	6.23	528.3	5.63	0.320

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#4-OA	683023	2006-8-19	16:04	6.93	714.1	5.97	0.355
#4-OA	683024	2006-8-20	13:24	6.80	480.3	11.3	0.222
#4-OA	683025	2006-8-20	16:04-21:24	6.33	596.8	8.27	0.360
#4-OA	683026	2006-8-21	00:04-05:24	6.36	712.1	7.46	0.460
#4-OA	683027	2006-8-21	8:04	7.10	754.4	4.86	0.380
#4-OA	683028	2006-8-23	14:35-15:02	6.06	260.9	16.9	0.100
#4-OA	683029	2006-8-23	15:15-15:42	6.43	238.6	6.4	0.045
#4-OA	683030	2006-8-23	15:55-16:22	5.98	240.3	5.09	0.085
#4-OA	683031	2006-8-23	17:02-22:22	5.97	253.2	4.79	0.070
#4-OA	683032	2006-8-24	01:02-06:22	6.05	331.1	6.71	0.045
#4-OA	683033	2006-8-24	09:02-14:22	6.21	392.6	7.18	0.090
#4-OA	683034	2006-8-24	17:02-22:22	6.34	401.8	9.43	0.035
#4-OA	683035	2006-8-25	01:02-06:22	6.61	417.6	14.8	0.065
#4-OA	683036	2006-8-25	18:18-18:45	6.56	431.6	11.6	0.805
#4-OA	683037	2006-8-25	18:58-19:25	6.76	438.2	13.8	0.865
#4-OA	683038	2006-8-25	19:38-20:05	6.53	437.4	15.1	0.860
#4-OA	683039	2006-8-25	20:45-02:05	6.49	430.4	12.6	0.850
#4-OA	683040	2006-8-26	04:45-10:05	6.71	542.3	21.2	0.925
#4-OA	683041	2006-8-26	12:45-18:05	6.32	571.2	22.3	0.880
#4-OA	683042	2006-8-26	20:45-02:05	6.35	534.1	19.9	0.695
#4-OA	683043	2006-8-27	04:45-10:05	6.08	630.6	28.4	0.710
#4-OA	683044	2006-8-27	12:45-15:25	6.50	610.7	16.2	0.690
#4-OA	683045	2006-8-30	2:22-2:49	6.45	393.2	24.2	0.350
#4-OA	683046	2006-8-30	3:02-3:29	6.57	352.1	13.9	0.385
#4-OA	683047	2006-8-30	3:42-4:09	6.61	238.8	21.5	0.085
#4-OA	683048	2006-8-30	4:49-10:09	6.50	225.6	11.7	0.120
#4-OA	683049	2006-8-30	12:49-18:09	6.68	394.1	17.1	0.070
#4-OA	683050	2006-8-30	20:49-02:09	6.67	470.9	14.2	0.305
#4-OA	683051	2006-8-31	4:49-10:09	6.70	503.9	16.3	0.310
#4-OA	683052	2006-8-31	12:49-18:09	6.48	516.7	17.5	0.270
#4-OA	683053	2006-8-31	20:49-23:29	6.87	491.4	18.2	0.170
#4-OA	683054	2006-12-8	15:12-15:39	6.98	1635	23.9	0.975
#4-OA	683055	2006-12-11	10:37-11:04	8.06	1490	3.39	1.005
#4-OA	683056	2006-12-11	11:17-11:44	8.14	1525	3.68	3.750
#4-OA	683057	2006-12-11	11:57-12:24	8.07	1518	2.96	1.225
#4-OA	683058	2006-12-11	13:04-18:24	8.08	1489	2.77	1.240
#4-OA	683059	2006-12-11	21:04-02:24	8.05	1530	2.73	1.140

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006 - March, 2007(Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#4-OA	683060	2006-12-12	05:04-10:24	8.04	1529	2.06	1.140
#4-OA	683061	2006-12-12	13:04-18:24	8.00	1526	4.62	1.145
#4-OA	683062	2006-12-12	21:04	8.08	1524	2.95	1.185
#4-OA	783001	2007-2-3	12:26-12:53	7.52	1657	71.4	1.055
#4-OA	783002	2007-2-3	13:06-13:33	7.72	1643	14.3	1.030
#4-OA	783003	2007-2-3	13:46-14:13	7.73	1640	12.1	1.015
#4-OA	783004	2007-2-3	14:53-20:13	7.66	1636	6.36	0.980
#4-OA	783005	2007-2-4	22:53-4:13	7.69	1624	5.37	1.050
#4-OA	783006	2007-2-4	6:53-12:13	7.63	1631	4.73	0.975
#4-OA	783007	2007-2-4	14:53-20:13	7.53	1647	4.09	1.015
#4-OA	783008	2007-2-5	22:53-4:13	7.35	1680	2.48	1.010
#4-OA	783009	2007-2-5	6:53-9:33	7.45	1696	24.7	1.050
#4-OA	783010	2007-2-6	1:25-4:05	8.09	1578	4.16	1.025
#4-OA	783011	2007-2-6	6:45-12:05	8.23	1604	2.62	1.025
#4-OA	783012	2007-2-23	20:52-21:19	7.46	1673	27.2	1.350
#4-OA	783013	2007-2-23	21:32-21:19	7.85	1630	7.03	1.420
#4-OA	783014	2007-2-23	22:12-22:39	7.84	1625	1.59	1.010
#4-OA	783015	2007-2-23	23:19-4:39	7.88	1610	1.82	0.980
#4-OA	783016	2007-2-24	7:19-12:39	4.01	1607	1.9	1.095
#4-OA	783017	2007-2-24	15:19-20:39	7.84	1609	2.04	1.070
#4-OA	783018	2007-2-24	23:19-4:39	7.8	1613	2.45	0.965
#4-OA	783019	2007-2-25	7:19-12:39	7.74	1614	2.41	1.050
#4-OA	783020	2007-2-25	15:19-17:59	7.77	1615	2.62	1.115
#4-OA	783021	2007-2-26	13:27-13:54	8.06	1601	1.78	1.000
#4-OA	783022	2007-2-26	14:07-14:34	8.04	1608	1.34	1.070
#4-OA	783023	2007-2-26	14:47-15:14	8.11	1613	0.86	0.945
#4-OA	783024	2007-2-26	15:54-21:14	8.07	1617	1.31	1.000
#4-OA	783025	2007-2-27	23:54-5:14	7.63	1526	26.4	0.895
#4-OA	783026	2007-2-27	7:54-13:14	7.62	1518	21.3	0.955
#4-OA	783027	2007-2-27	15:54-21:14	8.02	1607	2.62	0.965
#4-OA	783028	2007-2-28	23:54-5:14	8.06	1620	3.3	0.985
#4-OA	783029	2007-2-28	7:54-10:34	8.12	1637	3.71	0.685
#4-OA	783034	2007-3-20	15:45-16:12	7.91	1588	21.2	1.245
#4-OA	783035	2007-3-20	16:25-16:52	8.01	1676	4.15	1.200
#4-OA	783036	2007-3-20	17:05-17:32	8.02	1698	3.58	1.120
#4-OA	783037	2007-3-20	18:45-23:32	8.01	1688	3.13	1.100
#4-OA	783038	2007-3-21	2:12-7:32	8.04	1698	2.45	1.175

Table 3. Electrical conductivity (EC), pH, turbidity, suspended solid concentrations of surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date	Time	pH	EC (μ S/cm)	Turbidity (NTU)	Solids (g L ⁻¹)
#4-OA	783039	2007-3-21	10:12-15:32	7.63	1700	138	1.320
#4-OA	783040	2007-3-21	18:12-23:32	7.96	1699	16.5	1.090
#4-OA	783041	2007-3-22	2:12-7:32	8.01	1685	6.49	1.065
#4-OA	783042	2007-3-22	10:12-12:52	8.02	1678	4.81	1.155
#4-OA	783043	2007-3-30	20:11-20:38	7.71	1687	94.1	1.330
#4-OA	783044	2007-3-30	20:51-21:18	7.81	1711	25.2	1.180
#4-OA	783045	2007-3-30	21:31-21:58	7.88	1713	6.43	1.140
#4-OA	783046	2007-3-31	22:38-3:58	7.87	1703	15.9	1.155
#4-OA	783047	2007-3-31	6:38-11:58	8.01	1717	20.8	1.840
#4-OA	783048	2007-3-31	14:38-19:58	7.77	1712	5.6	1.645

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006 - March, 2007.

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#9-CON	611001	2006-8-19	12:15	0.18	4.44	0.69	0.81	1.33	7.85	0.486
#9-CON	611002	2006-9-1	12:08-12:21	0.20	1.95	0.21	0.07	2.16	2.01	0.149
#9-CON	611003	2006-9-7	17:35	1.62	23.44	0.00	0.56	0.00	0.00	0.055
#9-CON	611004	2006-12-16	10:45-11:11	0.16	5.63	1.08	0.12	0.80	13.06	0.210
#9-CON	611005	2006-12-16	11:25-11:51	0.13	6.18	0.96	0.27	0.65	17.05	0.206
#9-CON	611006	2006-12-16	12:05-12:18	0.13	6.65	1.03	0.42	0.72	17.95	0.198
#9-CON	611007	2006-12-17	4:11	0.12	8.67	1.04	0.13	0.92	12.46	BDL
#3-CON	631009	2006-7-1	06:03-06:30	0.46	265.87	3.78	0.44	0.88	28.58	0.603
#3-CON	631010	2006-7-1	06:43-07:10	0.31	144.58	BDL	2.02	0.80	19.55	0.620
#3-CON	631011	2006-7-1	07:23-07:50	0.29	216.76	BDL	2.06	0.80	32.91	1.124
#3-CON	631012	2006-7-1	08:30-13:50	0.70	310.84	0.59	0.92	0.52	31.20	0.337
#3-CON	631013	2006-7-1	16:36-21:50	0.53	413.83	1.80	0.23	1.04	25.41	0.395
#3-CON	631014	2006-7-2	00:30-05:50	0.34	392.85	0.95	0.46	1.25	25.38	0.221
#3-CON	631015	2006-7-2	08:32-13:50	0.46	347.88	1.58	0.33	1.01	23.68	0.34
#3-CON	631016	2006-7-2	16:30-21:50	0.51	387.98	1.68	0.38	0.96	31.49	0.348
#3-CON	631017	2006-7-3	00:30-03:10	0.49	400.66	0.98	0.25	0.67	34.10	0.235
#3-CON	631018	2006-8-23	19:31-22:11	0.25	242.20	0.63	5.22	1.14	28.16	0.149
#3-CON	631019	2006-8-24	00:51-06:11	0.31	320.82	0.80	8.14	0.85	37.86	0.011
#3-CON	631020	2006-8-24	08:51-14:11	0.36	351.49	1.65	8.67	0.76	42.13	BDL
#3-CON	631021	2006-8-24	16:51-22:11	0.40	362.95	1.04	7.42	0.90	43.40	0.270
#3-CON	631022	2006-8-25	00:51-06:11	0.34	373.26	0.90	6.83	0.70	44.58	BDL
#3-CON	631023	2006-8-25	8:51	0.35	377.93	1.47	6.55	0.72	45.38	BDL
#3-CON	631024	2006-8-25	12:54-13:21	0.35	226.18	0.66	4.03	1.07	25.85	0.393
#3-CON	631025	2006-8-25	13:34-13:47	0.31	213.12	0.58	3.64	1.16	23.70	0.493
#3-CON	631026	2006-8-26	02:01-04:41	0.38	247.33	0.78	11.36	1.26	33.92	0.216
#3-CON	631027	2006-8-26	07:21-12:41	0.38	298.23	0.93	13.50	0.75	40.86	0.364
#3-CON	631028	2006-8-26	15:21	0.38	305.92	1.01	13.20	0.44	42.41	0.321
#3-CON	631029	2006-8-29	22:21-01:01	0.34	264.64	0.90	2.34	1.12	31.22	0.089
#3-CON	631030	2006-8-30	03:41-09:01	0.17	87.19	0.31	2.57	1.42	11.94	0.081
#3-CON	631031	2006-8-30	17:01	0.28	166.61	0.65	5.85	1.56	24.93	0.041
#3-CON	631032	2006-8-31	1:01	0.37	160.20	0.50	6.24	1.69	24.27	0.001
#3-CON	631033	2006-9-1	19:12-21:52	0.43	180.46	0.59	5.06	1.48	27.15	0.175
#3-CON	631034	2006-9-2	00:32-05:52	0.41	186.29	0.56	4.89	1.13	28.22	0.104
#3-CON	631035	2006-9-2	08:32-13:52	0.58	158.46	0.78	3.57	1.39	23.20	0.042
#3-CON	631036	2006-9-2	16:32-21:52	0.29	113.20	0.38	3.55	1.90	16.99	0.139

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#3-CON	631037	2006-9-3	00:32-05:52	0.44	152.66	0.51	4.50	2.08	23.74	0.045
#3-CON	631038	2006-9-3	08:32-11:12	0.71	165.10	0.44	4.41	2.08	25.69	0.063
#3-OA	633021	2006-7-10	15:40	0.27	154.55	ND	0.30	2.09	8.53	0.155
#3-OA	633022	2006-7-10	18:20-23:40	0.21	117.09	1.40	0.17	2.18	8.85	0.236
#3-OA	633023	2006-7-10	02:20-07:40	0.25	127.58	0.38	0.07	1.12	7.05	0.19
#3-OA	633024	2006-8-23	15:22-15:49	0.20	150.51	0.60	1.03	1.75	22.90	0.097
#3-OA	633025	2006-8-30	3:09	0.29	80.80	0.37	0.99	1.36	8.65	BDL
#3-OA	633026	2006-8-30	05:49-11:09	0.18	47.88	0.18	1.10	2.51	7.13	BDL
#3-OA	633027	2006-8-30	9:09	0.21	87.99	0.36	0.49	2.41	12.20	BDL
#3-OA	633028	2006-8-30	21:49	0.23	93.86	0.38	0.85	3.11	13.04	0.063
#3-OA	633029	2006-8-31	16:29	0.23	108.86	0.64	0.20	3.25	13.16	BDL
#3-OA	633030	2006-9-1	15:40	0.32	113.07	0.47	0.10	3.51	10.62	0.097
#3-OA	633031	2006-9-2	13:00-15:40	0.22	57.16	0.00	0.32	4.10	5.30	0.065
#3-OA	633032	2006-12-11	11:27-11:54	0.38	580.45	2.49	0.17	0.45	41.28	0.921
#3-OA	633033	2006-12-11	12:07-12:34	0.37	599.19	2.98	0.17	0.52	42.63	2.189
#3-OA	633034	2006-12-11	12:47-13:14	0.37	615.71	1.73	0.15	0.46	43.75	0.134
#3-OA	633035	2006-12-11	13:45-19:14	0.37	604.53	2.60	0.09	0.30	43.33	0.155
#3-OA	633036	2006-12-11	21:54-03:14	0.40	605.68	1.74	0.05	0.56	43.96	0.184
#3-OA	633037	2006-12-12	05:54-11:14	0.35	600.95	1.98	0.07	0.20	44.43	0.277
#3-OA	633038	2006-12-12	13:54-16:34	0.36	611.13	2.07	0.02	0.51	47.09	0.261
#3-OA	633039	2006-12-25	17:36-22:56	0.18	161.58	0.25	0.30	1.71	15.24	0.471
#3-OA	633040	2006-12-26	1:36-6:56	0.22	269.79	0.48	0.22	1.53	29.30	0.466
#3-OA	733001	2007-1-23	15:40-18:20	0.44	640.12	8.03	0.64	0.00	45.43	0.479
#3-OA	733002	2007-2-6	2:45	4.77	938.55	4.78	1.60	12.33	80.96	15.350
#3-OA	733003	2007-2-6	5:22-8:02	0.87	654.64	3.62	1.07	1.64	47.88	0.171
#3-OA	733004	2007-3-16	18:46-19:13	0.40	360.82	1.00	4.42	1.57	50.52	0.955
#3-OA	733005	2007-3-16	19:26-19:53	0.29	356.68	1.06	5.14	1.86	53.97	1.209
#3-OA	733006	2007-3-16	20:06-20:33	0.21	274.79	0.59	3.92	1.43	40.42	1.161
#3-OA	733007	2007-3-17	21:13-2:33	0.35	390.25	0.99	4.10	1.76	55.49	1.288
#3-OA	733008	2007-3-17	5:13-10:33	0.35	301.98	0.91	2.14	1.12	38.56	1.069
#3-OA	733009	2007-3-17	13:13-18:33	0.46	483.29	1.30	1.72	1.60	61.49	1.110
#3-OA	733010	2007-3-18	21:13-2:33	0.47	469.58	2.08	1.20	1.42	58.98	1.202
#3-OA	733011	2007-3-18	5:13-10:33	0.33	394.86	1.45	0.50	1.18	48.19	1.269
#3-OA	733012	2007-3-18	13:13	0.36	479.69	1.59	0.59	1.34	59.73	1.206
#3-OA	733013	2007-3-18	15:07-15:34	0.38	458.71	1.20	0.37	1.25	55.77	0.150

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#3-OA	733014	2007-3-18	15:47-16:14	0.38	495.77	2.10	0.39	1.27	62.11	0.163
#3-OA	733015	2007-3-18	16:27-16:54	0.41	495.17	1.02	0.32	1.20	62.09	0.209
#3-OA	733016	2007-3-18	17:34-22:54	0.42	499.59	1.87	0.25	1.26	63.91	0.524
#3-OA	733017	2007-3-19	1:34-6:54	0.30	492.02	2.14	0.16	1.26	62.53	0.143
#3-OA	733018	2007-3-19	9:34-15:54	0.43	504.79	1.67	1.10	1.27	56.94	0.083
#3-OA	733019	2007-3-19	17:34-22:54	0.46	517.94	1.61	0.32	1.23	56.06	0.133
#3-OA	733020	2007-3-20	1:34-6:54	0.45	511.45	1.45	0.14	1.30	52.93	0.433
#3-OA	733021	2007-3-20	9:34-12:14	0.51	516.01	2.33	0.20	1.13	52.31	0.408
#4-CON	681026	2006-7-11	16:56-17:23	0.09	54.84	BDL	0.42	1.50	8.58	0.239
#4-CON	681027	2006-7-11	17:36-18:03	0.08	48.20	BDL	0.19	1.75	7.56	0.321
#4-CON	681028	2006-7-11	18:16-18:43	0.09	75.36	BDL	0.13	1.95	10.77	0.450
#4-CON	681029	2006-7-11	19:23-00:47	0.33	338.38	BDL	0.16	1.89	40.56	0.290
#4-CON	681030	2006-7-12	03:23-08:43	0.32	572.21	1.70	0.15	1.85	75.99	0.319
#4-CON	681031	2006-7-12	11:23-16:43	0.29	386.40	1.34	0.10	3.36	58.56	0.455
#4-CON	681032	2006-7-12	19:23-00:43	0.44	411.94	0.97	BDL	3.59	60.66	0.537
#4-CON	681033	2006-7-13	03:23-08:43	0.45	452.15	2.19	0.00	3.58	66.98	0.492
#4-CON	681034	2006-8-19	13:46-14:13	0.12	142.16	0.00	1.48	1.62	22.26	0.103
#4-CON	681035	2006-8-19	14:26-14:52	0.25	218.28	0.77	1.03	1.43	24.06	0.183
#4-CON	681036	2006-8-19	15:06-15:33	0.24	293.65	0.83	0.54	1.11	23.88	0.222
#4-CON	681037	2006-8-19	16:13-21:33	0.37	371.87	0.86	0.20	0.77	24.53	0.215
#4-CON	681038	2006-8-20	00:13-05:33	0.32	404.38	1.41	0.12	0.57	25.15	0.227
#4-CON	681039	2006-8-20	08:13-13:33	0.28	363.94	1.62	0.23	0.87	28.28	0.19
#4-CON	681040	2006-8-20	16:13-21:33	0.30	362.81	1.36	0.14	0.78	37.81	0.036
#4-CON	681041	2006-8-21	00:13-05:33	0.29	411.31	0.96	0.07	0.69	43.91	0.046
#4-CON	681042	2006-8-21	8:13	0.28	481.02	1.41	0.00	1.21	47.34	0.525
#4-CON	681043	2006-8-26	16:53-17:20	0.31	148.52	0.51	0.53	3.93	16.57	-0.080
#4-CON	681044	2006-8-26	17:33-18:00	0.30	126.04	0.30	0.20	4.17	13.81	0.011
#4-CON	681045	2006-8-26	18:13-18:40	0.29	129.83	0.84	0.27	4.24	14.16	0.024
#4-CON	681046	2006-8-26	19:20-00:40	0.26	150.58	0.54	0.20	4.30	17.05	0.011
#4-CON	681047	2006-8-27	03:20-08:40	0.38	175.61	0.65	0.23	4.25	20.01	0.089
#4-CON	681048	2006-8-27	11:20-16:40	0.45	203.68	0.68	0.09	4.03	22.30	0.164
#4-CON	681049	2006-8-27	17:20-00:40	0.46	203.72	0.52	0.27	3.85	22.28	0.244
#4-CON	681050	2006-12-24	15:04-15:31	0.10	61.93	0.00	0.34	0.89	10.75	0.065
#4-CON	681051	2006-12-24	15:44-16:11	0.21	95.14	0.24	0.63	1.82	25.55	0.277
#4-CON	681052	2006-12-24	16:24-16:51	0.21	112.06	0.00	0.44	1.93	27.94	0.224

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#4-CON	681053	2006-12-24	17:31-22:51	0.27	212.89	0.42	0.30	1.95	46.24	0.288
#4-CON	681054	2006-12-25	1:31-6:51	0.31	333.76	0.96	0.31	1.28	65.71	0.020
#4-CON	681055	2006-12-25	9:31-14:51	0.29	380.47	0.62	0.09	1.31	72.11	0.172
#4-CON	681056	2006-12-25	17:31-22:51	0.23	175.55	0.19	0.31	2.28	32.47	0.222
#4-CON	681057	2006-12-26	1:31-6:51	0.31	292.33	0.58	0.12	1.43	55.66	0.318
#4-CON	681058	2006-12-26	9:31-12:11	0.36	283.17	0.46	0.05	1.85	44.16	0.276
#4-CON	781001	2007-2-27	5:14-5:41	0.38	448.01	1.56	16.22	3.66	76.55	1.891
#4-CON	781002	2007-2-27	5:54-6:21	0.24	363.22	0.87	10.60	4.35	64.39	2.055
#4-CON	781003	2007-2-27	6:34-7:01	0.25	386.24	1.04	8.73	3.58	62.69	1.262
#4-CON	781004	2007-2-27	7:41-13:01	0.37	471.91	1.15	3.42	1.48	64.31	0.100
#4-CON	781005	2007-2-27	15:41-21:01	0.37	502.32	1.40	0.50	0.00	59.90	0.078
#4-CON	781006	2007-2-28	23:41-5:01	0.37	531.03	1.53	0.15	0.18	56.89	0.065
#4-CON	781007	2007-2-28	7:41-13:01	0.38	541.57	2.73	0.18	0.16	53.22	0.107
#4-CON	781008	2007-2-28	15:41-21:01	0.39	539.79	2.56	0.19	0.00	53.01	0.100
#4-CON	781009	2007-3-1	23:11-2:21	0.37	551.45	1.98	0.09	0.00	51.67	0.122
#4-CON	781010	2007-3-16	14:44-15:11	0.47	463.69	1.63	0.13	1.24	44.68	0.588
#4-CON	781011	2007-3-16	15:24-15:51	0.33	408.15	1.28	2.98	1.46	45.34	0.603
#4-CON	781012	2007-3-16	16:04-16:31	0.38	402.33	1.16	2.95	1.41	44.04	0.580
#4-CON	781013	2007-3-16	17:11-22:31	0.27	388.54	1.50	2.70	1.42	42.32	0.576
#4-CON	781014	2007-3-17	1:11-6:31	0.37	395.57	0.89	2.32	1.53	43.42	0.581
#4-CON	781015	2007-3-17	9:11-14:31	0.26	371.12	1.30	0.94	0.86	36.28	0.445
#4-CON	781016	2007-3-17	17:11-22:31	0.39	431.38	1.26	1.09	1.05	42.38	0.225
#4-CON	781017	2007-3-18	1:11-6:31	0.40	428.45	1.82	0.45	0.68	38.60	0.704
#4-CON	781018	2007-3-18	9:11-11:51	0.00	21.52	0.00	0.18	0.00	2.07	0.043
#4-CON	781019	2007-3-22	17:24-17:51	0.39	565.32	3.18	0.05	0.66	33.28	0.110
#4-CON	781020	2007-3-22	18:04-18:31	0.00	22.78	0.00	0.00	0.00	1.32	0.126
#4-CON	781021	2007-3-22	18:44-19:11	0.32	455.60	2.29	0.12	0.67	26.52	0.136
#4-CON	781022	2007-3-23	19:51-1:11	0.14	203.10	1.19	0.00	0.35	10.94	0.133
#4-CON	781023	2007-3-23	3:51-9:11	0.39	485.60	2.34	0.00	0.66	31.36	0.080
#4-CON	781024	2007-3-23	11:51-17:11	0.29	502.88	2.67	0.00	0.69	32.56	0.055
#4-CON	781025	2007-3-24	19:51-1:11	0.32	435.56	1.06	0.00	0.53	27.62	0.102
#4-CON	781026	2007-3-24	3:51-9:11	0.00	26.39	0.00	0.00	0.14	1.70	0.069
#4-CON	781027	2007-3-24	11:51-14:31	0.23	440.06	1.34	0.00	0.22	34.06	0.067
#4-OA	683016	2006-7-12	16:27-17:07	0.13	122.20	BDL	1.72	0.87	16.34	0.015
#4-OA	683017	2006-7-12	17:07-17:47	0.11	84.37	BDL	1.58	0.95	11.98	BDL
#4-OA	683018	2006-7-12	17:47-18:54	0.10	63.64	BDL	1.74	0.90	10.21	BDL

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#4-OA	683019	2006-7-12	21:34	0.10	68.09	BDL	0.82	0.72	11.84	0.082
#4-OA	683020	2006-8-19	13:37-14:04	0.10	93.87	0.00	0.98	0.97	14.90	0.01
#4-OA	683021	2006-8-19	14:16-14:44	0.14	119.92	0.00	0.80	0.89	18.68	0.064
#4-OA	683022	2006-8-19	14:57-15:24	0.10	131.65	0.00	0.69	0.78	21.10	0.051
#4-OA	683023	2006-8-19	16:04	0.00	3.74	0.00	0.06	0.00	0.68	0.1
#4-OA	683024	2006-8-20	13:24	0.10	113.31	0.37	0.14	0.99	15.18	0.001
#4-OA	683025	2006-8-20	16:04-21:24	0.23	153.19	0.00	0.11	0.96	17.89	0.035
#4-OA	683026	2006-8-21	00:04-05:24	0.22	190.81	0.00	0.12	0.85	20.82	0.03
#4-OA	683027	2006-8-21	8:04	0.18	208.68	0.00	0.05	0.98	23.20	0.016
#4-OA	683028	2006-8-23	14:35-15:02	0.17	59.61	0.00	0.21	0.78	6.86	0.008
#4-OA	683029	2006-8-23	15:15-15:42	0.15	54.88	0.00	0.20	0.76	6.34	0.050
#4-OA	683030	2006-8-23	15:55-16:22	0.13	56.30	0.00	0.16	0.73	6.50	0.017
#4-OA	683031	2006-8-23	17:02-22:22	0.13	55.41	0.00	0.05	0.82	7.64	0.032
#4-OA	683032	2006-8-24	01:02-06:22	0.15	77.32	0.00	0.02	1.16	10.49	BDL
#4-OA	683033	2006-8-24	09:02-14:22	0.23	95.58	0.48	0.05	1.25	12.23	BDL
#4-OA	683034	2006-8-24	17:02-22:22	0.19	98.44	0.30	0.04	1.42	11.28	BDL
#4-OA	683035	2006-8-25	01:02-06:22	0.21	106.06	0.00	0.00	1.63	8.82	BDL
#4-OA	683036	2006-8-25	18:18-18:45	0.30	82.81	0.24	0.35	1.28	10.78	0.162
#4-OA	683037	2006-8-25	18:58-19:25	0.26	80.05	0.14	0.60	1.52	10.98	0.031
#4-OA	683038	2006-8-25	19:38-20:05	0.21	75.90	0.28	0.63	1.60	11.24	0.085
#4-OA	683039	2006-8-25	20:45-02:05	0.43	80.84	0.26	0.61	1.49	11.88	0.559
#4-OA	683040	2006-8-26	04:45-10:05	0.14	109.19	0.40	0.63	1.59	16.68	0.152
#4-OA	683041	2006-8-26	12:45-18:05	0.14	115.18	0.40	0.57	1.63	17.32	0.415
#4-OA	683042	2006-8-26	20:45-02:05	0.44	105.44	0.59	0.63	1.66	15.85	0.487
#4-OA	683043	2006-8-27	04:45-10:05	0.26	129.81	0.81	0.40	2.03	18.35	0.378
#4-OA	683044	2006-8-27	12:45-15:25	0.31	139.22	0.43	0.16	1.57	16.68	0.108
#4-OA	683045	2006-8-30	2:22-2:49	0.18	111.44	0.63	0.11	0.94	11.60	BDL
#4-OA	683046	2006-8-30	3:02-3:29	0.24	89.19	0.27	0.18	0.68	9.97	BDL
#4-OA	683047	2006-8-30	3:42-4:09	0.13	52.33	0.00	0.31	0.71	5.68	0.131
#4-OA	683048	2006-8-30	4:49-10:09	0.08	43.69	0.00	0.26	0.65	5.17	0.008
#4-OA	683049	2006-8-30	12:49-18:09	0.09	92.00	0.21	0.46	1.23	11.74	BDL
#4-OA	683050	2006-8-30	20:49-02:09	0.19	110.88	0.40	0.59	1.73	15.86	BDL
#4-OA	683051	2006-8-31	4:49-10:09	0.18	121.81	0.28	0.32	2.02	17.52	BDL
#4-OA	683052	2006-8-31	12:49-18:09	0.19	125.58	0.55	0.29	1.86	17.03	0.000
#4-OA	683053	2006-8-31	20:49-23:29	0.18	119.58	0.24	0.16	2.02	15.68	BDL
#4-OA	683054	2006-12-8	15:12-15:39	0.90	484.46	9.29	2.92	BDL	0.00	0.452
#4-OA	683055	2006-12-11	10:37-11:04	0.38	559.91	4.03	0.17	BDL	42.42	0.150

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#4-OA	683056	2006-12-11	11:17-11:44	0.39	567.65	1.70	0.11	BDL	41.61	0.156
#4-OA	683057	2006-12-11	11:57-12:24	0.38	563.91	3.37	0.20	BDL	41.09	0.094
#4-OA	683058	2006-12-11	13:04-18:24	0.34	566.06	3.01	0.13	BDL	41.01	0.098
#4-OA	683059	2006-12-11	21:04-02:24	0.34	572.71	1.76	0.03	BDL	41.57	0.121
#4-OA	683060	2006-12-12	05:04-10:24	0.40	573.50	2.64	0.11	BDL	41.51	0.103
#4-OA	683061	2006-12-12	13:04-18:24	0.30	573.18	1.85	0.10	BDL	41.16	0.078
#4-OA	683062	2006-12-12	21:04	0.36	571.15	2.05	0.01	BDL	41.27	0.105
#4-OA	783001	2007-2-3	12:26-12:53	0.50	440.87	8.48	1.01	0.23	64.43	0.218
#4-OA	783002	2007-2-3	13:06-13:33	0.45	418.00	4.30	0.60	0.28	62.60	0.159
#4-OA	783003	2007-2-3	13:46-14:13	0.42	412.79	3.31	0.42	0.14	61.28	0.141
#4-OA	783004	2007-2-3	14:53-20:13	0.44	411.71	3.24	0.32	0.20	61.42	0.115
#4-OA	783005	2007-2-4	22:53-4:13	0.37	409.99	2.99	0.28	0.12	60.40	0.110
#4-OA	783006	2007-2-4	6:53-12:13	0.44	415.33	1.36	0.19	0.00	59.69	0.102
#4-OA	783007	2007-2-4	14:53-20:13	0.42	420.47	1.29	0.16	0.00	58.76	0.084
#4-OA	783008	2007-2-5	22:53-4:13	0.44	446.82	1.39	0.14	0.00	57.42	0.082
#4-OA	783009	2007-2-5	6:53-9:33	0.44	453.34	2.57	0.12	0.00	56.32	0.069
#4-OA	783010	2007-2-6	1:25-4:05	0.54	472.95	9.08	0.77	0.21	64.49	0.190
#4-OA	783011	2007-2-6	6:45-12:05	0.50	482.18	1.44	0.04	0.00	64.05	0.369
#4-OA	783012	2007-2-23	20:52-21:19	0.00	1058.53	6.40	0.00	0.00	34.77	1.146
#4-OA	783013	2007-2-23	21:32-21:19	0.49	486.07	6.44	0.72	0.00	65.14	0.391
#4-OA	783014	2007-2-23	22:12-22:39	0.47	477.75	1.49	0.31	0.00	63.93	0.249
#4-OA	783015	2007-2-23	23:19-4:39	0.49	478.78	1.71	0.19	0.00	62.92	0.172
#4-OA	783016	2007-2-24	7:19-12:39	0.47	480.15	1.54	0.11	0.00	63.49	0.963
#4-OA	783017	2007-2-24	15:19-20:39	0.45	491.45	2.88	0.21	0.00	64.61	0.316
#4-OA	783018	2007-2-24	23:19-4:39	0.48	481.35	2.87	0.23	0.00	62.76	0.163
#4-OA	783019	2007-2-25	7:19-12:39	0.45	479.85	2.60	0.11	0.00	62.08	0.171
#4-OA	783020	2007-2-25	15:19-17:59	0.53	512.35	1.44	0.09	0.00	67.52	0.165
#4-OA	783021	2007-2-26	13:27-13:54	0.44	504.39	9.92	0.72	0.00	62.78	0.245
#4-OA	783022	2007-2-26	14:07-14:34	0.44	477.54	5.39	0.38	0.00	61.53	0.249
#4-OA	783023	2007-2-26	14:47-15:14	0.42	476.01	1.82	0.01	0.00	61.94	0.230
#4-OA	783024	2007-2-26	15:54-21:14	0.48	484.36	1.48	0.12	0.00	61.59	0.204
#4-OA	783025	2007-2-27	23:54-5:14	0.30	453.21	1.80	4.25	0.86	63.63	0.538
#4-OA	783026	2007-2-27	7:54-13:14	0.34	431.53	0.94	4.97	1.04	63.12	0.760
#4-OA	783027	2007-2-27	15:54-21:14	0.43	488.50	1.59	0.49	0.14	62.65	0.388
#4-OA	783028	2007-2-28	23:54-5:14	0.45	497.95	2.96	0.27	0.00	64.08	0.280
#4-OA	783029	2007-2-28	7:54-10:34	0.40	503.77	1.73	0.10	0.00	62.07	0.320
#4-OA	783034	2007-3-20	15:45-16:12	0.28	359.40	1.46	0.11	0.00	29.30	0.115

Table 4. Concentrations of anions and ammonium (NH₄⁺-N) in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	F ⁻	Cl ⁻	Br ⁻	NO ₃ ⁻ -N	PO ₄ ³⁻ -P	SO ₄ ²⁻ -S	NH ₄ ⁺ -N
				mg L ⁻¹						
#4-OA	783035	2007-3-20	16:25-16:52	0.35	431.40	1.13	0.06	0.00	35.60	0.124
#4-OA	783036	2007-3-20	17:05-17:32	0.38	409.05	2.26	0.11	0.00	0.00	0.108
#4-OA	783037	2007-3-20	18:45-23:32	0.29	384.18	1.31	0.07	0.00	138.91	0.074
#4-OA	783038	2007-3-21	2:12-7:32	0.54	423.73	1.25	0.04	0.00	37.62	0.116
#4-OA	783039	2007-3-21	10:12-15:32	0.35	430.94	1.81	0.17	0.00	35.57	0.297
#4-OA	783040	2007-3-21	18:12-23:32	0.31	436.50	2.09	0.16	0.00	35.74	0.066
#4-OA	783041	2007-3-22	2:12-7:32	0.26	383.28	1.09	0.06	0.00	30.61	0.071
#4-OA	783042	2007-3-22	10:12-12:52	0.32	436.15	1.66	0.00	0.00	35.39	0.109
#4-OA	783043	2007-3-30	20:11-20:38	0.23	440.51	1.31	0.06	0.00	35.14	0.187
#4-OA	783044	2007-3-30	20:51-21:18	0.34	445.02	1.70	0.00	0.00	35.41	0.160
#4-OA	783045	2007-3-30	21:31-21:58	0.34	442.26	1.48	0.00	0.00	34.73	0.155
#4-OA	783046	2007-3-31	22:38-3:58	0.06	432.07	0.35	0.00	0.00	31.15	0.139
#4-OA	783047	2007-3-31	6:38-11:58	0.62	370.30	1.57	0.49	0.30	33.56	0.146
#4-OA	783048	2007-3-31	14:38-19:58	0.29	437.09	1.39	0.00	0.00	33.90	0.099

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006-March, 2007.

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K mg L ⁻¹	Na	P
#9-CON	611001	2006-8-19	12:15	8.37	2.13	12.57	2.80	1.97
#9-CON	611002	2006-9-1	12:08-12:21	10.27	1.65	4.29	0.85	2.54
#9-CON	611003	2006-9-7	17:35	9.80	2.13	6.72	1.20	1.29
#9-CON	611004	2006-12-16	10:45-11:11	15.82	3.33	17.14	1.68	0.75
#9-CON	611005	2006-12-16	11:25-11:51	18.95	3.97	18.86	2.63	0.63
#9-CON	611006	2006-12-16	12:05-12:18	19.29	4.30	21.16	2.93	0.64
#9-CON	611007	2006-12-17	4:11	18.91	4.96	20.01	3.63	1.11
#3-CON	631009	2006-7-1	06:03-06:30	62.87	14.75	54.33	67.08	1.39
#3-CON	631010	2006-7-1	06:43-07:10	35.51	8.87	51.98	29.92	1.90
#3-CON	631011	2006-7-1	07:23-07:50	53.92	13.90	59.82	41.35	2.19
#3-CON	631012	2006-7-1	08:30-13:50	77.82	18.34	40.92	79.19	1.40
#3-CON	631013	2006-7-1	16:36-21:50	100.79	23.46	24.67	118.22	1.12
#3-CON	631014	2006-7-2	00:30-05:50	97.13	22.45	29.73	109.20	1.53
#3-CON	631015	2006-7-2	08:32-13:50	87.56	19.85	21.59	101.58	1.01
#3-CON	631016	2006-7-2	16:30-21:50	99.60	22.56	25.05	110.34	0.93
#3-CON	631017	2006-7-3	00:30-03:10	104.14	23.46	25.29	113.47	0.74
#3-CON	631018	2006-8-23	19:31-22:11	76.35	18.89	32.07	60.92	1.24
#3-CON	631019	2006-8-24	00:51-06:11	95.81	23.90	37.60	79.64	0.96
#3-CON	631020	2006-8-24	08:51-14:11	101.92	25.75	39.40	88.18	0.78
#3-CON	631021	2006-8-24	16:51-22:11	102.24	25.86	40.17	90.31	0.93
#3-CON	631022	2006-8-25	00:51-06:11	102.64	26.22	39.69	91.51	0.69
#3-CON	631023	2006-8-25	8:51	NA	NA	NA	NA	NA
#3-CON	631024	2006-8-25	12:54-13:21	65.07	16.06	28.69	55.77	1.36
#3-CON	631025	2006-8-25	13:34-13:47	58.27	14.52	25.84	52.08	1.43
#3-CON	631026	2006-8-26	02:01-04:41	76.95	19.02	29.08	62.48	1.43
#3-CON	631027	2006-8-26	07:21-12:41	85.82	21.60	32.62	72.19	1.14
#3-CON	631028	2006-8-26	15:21	84.71	21.77	31.98	73.31	1.00
#3-CON	631029	2006-8-29	22:21-01:01	70.78	17.60	32.10	68.40	1.38
#3-CON	631030	2006-8-30	03:41-09:01	36.78	8.42	17.37	26.85	2.01
#3-CON	631031	2006-8-30	17:01	58.83	13.97	26.87	48.52	2.13
#3-CON	631032	2006-8-31	1:01	57.88	13.86	26.73	47.95	2.28
#3-CON	631033	2006-9-1	19:12-21:52	61.91	15.38	26.47	53.17	2.00
#3-CON	631034	2006-9-2	00:32-05:52	62.96	15.66	26.99	53.99	1.89
#3-CON	631035	2006-9-2	08:32-13:52	55.31	13.72	24.02	46.19	1.98
#3-CON	631036	2006-9-2	16:32-21:52	48.65	11.69	21.51	36.18	2.52

NA: data not available.

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006 - March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#3-CON	631037	2006-9-3	00:32-05:52	57.61	14.13	24.97	46.46	2.40
#3-CON	631038	2006-9-3	08:32-11:12	60.20	14.81	25.62	48.94	2.26
#3-OA	633021	2006-7-10	15:40	52.99	9.85	30.74	33.58	1.29
#3-OA	633022	2006-7-10	18:20-23:40	49.63	9.60	36.02	27.61	2.27
#3-OA	633023	2006-7-10	02:20-07:40	56.91	10.86	36.14	30.97	2.60
#3-OA	633024	2006-8-23	15:22-15:49	48.38	11.82	32.17	40.97	2.20
#3-OA	633025	2006-8-30	3:09	29.73	6.97	18.03	25.63	1.93
#3-OA	633026	2006-8-30	05:49-11:09	26.12	5.94	16.95	18.66	2.64
#3-OA	633027	2006-8-30	9:09	26.13	5.96	17.09	18.82	2.67
#3-OA	633028	2006-8-30	21:49	40.13	9.17	23.39	31.07	3.39
#3-OA	633029	2006-8-31	16:29	39.88	9.32	24.29	32.55	3.48
#3-OA	633030	2006-9-1	15:40	44.40	10.34	26.97	36.22	4.14
#3-OA	633031	2006-9-2	13:00-15:40	46.43	10.85	26.94	37.68	4.68
#3-OA	633032	2006-12-11	11:27-11:54	112.84	31.74	7.78	168.76	0.48
#3-OA	633033	2006-12-11	12:07-12:34	116.93	32.49	7.69	175.08	0.55
#3-OA	633034	2006-12-11	12:47-13:14	117.82	32.49	5.95	177.17	0.40
#3-OA	633035	2006-12-11	13:45-19:14	118.61	32.66	6.24	174.21	0.43
#3-OA	633036	2006-12-11	21:54-03:14	118.25	32.56	6.68	174.40	0.48
#3-OA	633037	2006-12-12	05:54-11:14	118.00	32.16	7.16	174.17	0.50
#3-OA	633038	2006-12-12	13:54-16:34	117.29	31.62	7.93	170.64	0.55
#3-OA	633039	2006-12-25	17:36-22:56	38.83	10.25	14.68	40.86	1.61
#3-OA	633040	2006-12-26	1:36-6:56	65.55	16.08	20.48	60.28	1.43
#3-OA	733001	2007-1-23	15:40-18:20	112.81	32.61	12.60	161.27	0.24
#3-OA	733002	2007-2-6	0.114583333	127.18	38.14	79.88	262.52	9.65
#3-OA	733003	2007-2-6	5:22-8:02	122.13	34.15	13.71	200.22	0.37
#3-OA	733004	2007-3-16	18:46-19:13	114.20	21.07	48.02	100.54	2.10
#3-OA	733005	2007-3-16	19:26-19:53	111.97	21.41	44.07	104.42	1.82
#3-OA	733006	2007-3-16	20:06-20:33	111.08	20.74	45.28	98.21	2.12
#3-OA	733007	2007-3-17	21:13-2:33	120.39	22.53	43.54	108.96	2.03
#3-OA	733008	2007-3-17	5:13-10:33	127.18	24.76	37.32	124.23	1.80
#3-OA	733009	2007-3-17	13:13-18:33	131.17	26.18	35.58	134.21	1.75
#3-OA	733010	2007-3-18	21:13-2:33	130.29	26.28	34.29	132.93	1.78
#3-OA	733011	2007-3-18	5:13-10:33	129.73	26.26	33.19	135.24	1.63
#3-OA	733012	2007-3-18	0.550694444	134.63	26.97	38.44	135.29	1.72
#3-OA	733013	2007-3-18	15:07-15:34	141.89	28.39	36.13	146.68	2.00
#3-OA	733014	2007-3-18	15:47-16:14	142.79	28.44	36.11	145.24	1.97
#3-OA	733015	2007-3-18	16:27-16:54	143.12	28.57	36.24	145.10	1.96

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006 - March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#3-OA	733016	2007-3-18	17:34-22:54	143.17	28.67	35.35	146.59	2.00
#3-OA	733017	2007-3-19	1:34-6:54	142.80	29.35	33.84	151.26	2.05
#3-OA	733018	2007-3-19	9:34-15:54	145.59	29.86	30.68	155.59	2.01
#3-OA	733019	2007-3-19	17:34-22:54	144.62	30.00	28.99	156.48	2.14
#3-OA	733020	2007-3-20	1:34-6:54	143.60	30.06	27.36	161.55	2.12
#3-OA	733021	2007-3-20	9:34-12:14	143.99	30.25	26.76	159.99	2.12
#4-CON	681026	2006-7-11	16:56-17:23	19.73	4.61	6.85	17.41	1.53
#4-CON	681027	2006-7-11	17:36-18:03	20.50	4.60	7.06	15.14	1.94
#4-CON	681028	2006-7-11	18:16-18:43	30.02	6.60	8.60	23.13	2.17
#4-CON	681029	2006-7-11	19:23-00:47	92.75	19.08	14.20	74.63	2.08
#4-CON	681030	2006-7-12	03:23-08:43	148.38	30.48	21.10	119.45	2.10
#4-CON	681031	2006-7-12	11:23-16:43	107.76	23.69	21.92	88.24	3.54
#4-CON	681032	2006-7-12	19:23-00:43	114.16	24.53	21.79	95.99	4.07
#4-CON	681033	2006-7-13	03:23-08:43	121.28	26.11	22.88	103.78	3.94
#4-CON	681034	2006-8-19	13:46-14:13	41.23	8.71	18.17	45.70	1.54
#4-CON	681035	2006-8-19	14:26-14:52	58.85	13.23	16.42	69.27	1.39
#4-CON	681036	2006-8-19	15:06-15:33	74.93	17.53	13.76	93.05	1.09
#4-CON	681037	2006-8-19	16:13-21:33	90.68	21.64	10.35	116.89	0.71
#4-CON	681038	2006-8-20	00:13-05:33	100.68	24.06	9.47	126.88	0.63
#4-CON	681039	2006-8-20	08:13-13:33	93.35	22.07	10.87	113.71	0.90
#4-CON	681040	2006-8-20	16:13-21:33	92.90	21.79	11.28	109.86	0.82
#4-CON	681041	2006-8-21	00:13-05:33	102.55	23.85	11.34	119.01	0.78
#4-CON	681042	2006-8-21	8:13	125.76	27.19	12.87	128.56	1.27
#4-CON	681043	2006-8-26	16:53-17:20	55.58	10.94	12.24	40.93	3.72
#4-CON	681044	2006-8-26	17:33-18:00	55.79	10.73	12.37	39.23	4.10
#4-CON	681045	2006-8-26	18:13-18:40	57.13	10.97	12.29	39.92	4.24
#4-CON	681046	2006-8-26	19:20-00:40	62.81	12.22	12.68	45.56	4.32
#4-CON	681047	2006-8-27	03:20-08:40	67.13	13.42	12.88	51.71	4.52
#4-CON	681048	2006-8-27	11:20-16:40	73.55	15.14	12.81	60.29	4.38
#4-CON	681049	2006-8-27	17:20-00:40	75.57	15.52	12.26	61.18	4.82
#4-CON	681050	2006-12-24	15:04-15:31	33.69	6.76	17.61	34.58	1.94
#4-CON	681051	2006-12-24	15:44-16:11	34.08	6.92	16.85	35.45	2.09
#4-CON	681052	2006-12-24	16:24-16:51	37.82	7.85	16.86	39.61	2.03
#4-CON	681053	2006-12-24	17:31-22:51	64.31	13.43	19.70	65.61	1.80
#4-CON	681054	2006-12-25	1:31-6:51	90.69	19.46	22.52	95.28	1.37
#4-CON	681055	2006-12-25	9:31-14:51	100.19	21.32	22.84	105.21	1.24
#4-CON	681056	2006-12-25	17:31-22:51	57.04	10.92	16.76	52.54	2.09

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#4-CON	681057	2006-12-26	1:31-6:51	95.06	16.85	17.82	81.11	1.50
#4-CON	681058	2006-12-26	9:31-12:11	81.38	15.84	18.27	77.14	2.03
#4-CON	781001	2007-2-27	5:14-5:41	111.58	20.29	43.04	85.02	3.52
#4-CON	781002	2007-2-27	5:54-6:21	99.35	19.38	41.59	85.70	3.74
#4-CON	781003	2007-2-27	6:34-7:01	108.84	21.94	36.45	99.26	3.02
#4-CON	781004	2007-2-27	7:41-13:01	122.84	26.22	21.45	136.66	1.37
#4-CON	781005	2007-2-27	15:41-21:01	127.38	28.16	8.77	149.54	0.21
#4-CON	781006	2007-2-28	23:41-5:01	122.33	27.44	7.65	151.45	0.14
#4-CON	781007	2007-2-28	7:41-13:01	125.34	28.31	7.66	157.83	0.15
#4-CON	781008	2007-2-28	15:41-21:01	124.21	28.32	7.54	160.80	0.09
#4-CON	781009	2007-3-1	23:11-2:21	125.47	28.59	7.69	160.86	0.12
#4-CON	781010	2007-3-16	14:44-15:11	103.31	23.90	19.10	129.61	1.33
#4-CON	781011	2007-3-16	15:24-15:51	98.17	22.67	19.28	122.74	1.60
#4-CON	781012	2007-3-16	16:04-16:31	93.19	21.46	18.30	118.18	1.59
#4-CON	781013	2007-3-16	17:11-22:31	90.36	20.71	17.87	114.96	1.61
#4-CON	781014	2007-3-17	1:11-6:31	98.44	22.64	19.35	123.59	1.59
#4-CON	781015	2007-3-17	9:11-14:31	99.04	23.54	14.08	131.57	1.08
#4-CON	781016	2007-3-17	17:11-22:31	106.22	25.75	10.44	146.49	0.55
#4-CON	781017	2007-3-18	1:11-6:31	128.41	31.47	14.36	176.04	0.43
#4-CON	781018	2007-3-18	9:11-11:51	113.36	27.99	7.48	160.98	0.14
#4-CON	781019	2007-3-22	17:24-17:51	139.30	33.37	17.07	177.81	1.81
#4-CON	781020	2007-3-22	18:04-18:31	130.93	31.96	16.68	171.85	1.10
#4-CON	781021	2007-3-22	18:44-19:11	135.76	32.90	16.95	176.02	1.07
#4-CON	781022	2007-3-23	19:51-1:11	126.39	30.94	14.99	166.79	1.06
#4-CON	781023	2007-3-23	3:51-9:11	137.08	33.39	15.47	181.14	1.09
#4-CON	781024	2007-3-23	11:51-17:11	142.23	34.16	15.99	185.00	1.20
#4-CON	781025	2007-3-24	19:51-1:11	138.66	33.72	14.91	184.24	1.13
#4-CON	781026	2007-3-24	3:51-9:11	128.42	31.49	11.08	177.05	0.76
#4-CON	781027	2007-3-24	11:51-14:31	124.61	30.55	8.95	175.64	0.34
#4-OA	683016	2006-7-12	16:27-17:07	31.61	6.04	7.61	33.75	0.89
#4-OA	683017	2006-7-12	17:07-17:47	21.88	4.39	5.65	22.24	0.86
#4-OA	683018	2006-7-12	17:47-18:54	18.64	3.89	5.78	17.70	0.95
#4-OA	683019	2006-7-12	21:34	23.32	4.64	6.63	18.39	1.08
#4-OA	683020	2006-8-19	13:37-14:04	23.56	4.52	10.73	29.40	0.88
#4-OA	683021	2006-8-19	14:16-14:44	29.23	5.50	8.69	36.29	0.78
#4-OA	683022	2006-8-19	14:57-15:24	33.18	6.54	9.09	40.08	0.78
#4-OA	683023	2006-8-19	16:04	47.03	9.97	10.26	55.46	0.75

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#4-OA	683024	2006-8-20	13:24	30.88	6.04	9.95	34.95	1.11
#4-OA	683025	2006-8-20	16:04-21:24	39.72	7.98	9.25	46.73	1.08
#4-OA	683026	2006-8-21	00:04-05:24	48.78	10.00	9.70	56.47	1.07
#4-OA	683027	2006-8-21	8:04	53.13	11.02	10.21	63.47	1.16
#4-OA	683028	2006-8-23	14:35-15:02	18.63	3.33	4.38	23.94	1.20
#4-OA	683029	2006-8-23	15:15-15:42	17.40	3.16	3.97	23.53	1.07
#4-OA	683030	2006-8-23	15:55-16:22	17.10	3.14	4.19	24.03	1.03
#4-OA	683031	2006-8-23	17:02-22:22	20.03	3.53	4.83	23.69	1.19
#4-OA	683032	2006-8-24	01:02-06:22	28.73	5.01	5.07	30.84	1.37
#4-OA	683033	2006-8-24	09:02-14:22	33.81	5.95	5.19	36.95	1.69
#4-OA	683034	2006-8-24	17:02-22:22	34.81	6.20	5.56	38.66	1.91
#4-OA	683035	2006-8-25	01:02-06:22	36.98	6.80	6.27	42.07	2.34
#4-OA	683036	2006-8-25	18:18-18:45	31.53	5.35	4.45	32.23	1.68
#4-OA	683037	2006-8-25	18:58-19:25	31.58	5.37	4.48	31.40	1.75
#4-OA	683038	2006-8-25	19:38-20:05	31.62	5.38	4.61	31.11	1.79
#4-OA	683039	2006-8-25	20:45-02:05	32.05	5.49	4.82	31.58	1.78
#4-OA	683040	2006-8-26	04:45-10:05	40.65	7.12	5.28	41.11	2.17
#4-OA	683041	2006-8-26	12:45-18:05	41.87	7.41	5.39	42.34	2.21
#4-OA	683042	2006-8-26	20:45-02:05	40.85	7.06	5.42	37.85	2.43
#4-OA	683043	2006-8-27	04:45-10:05	45.64	8.07	5.48	44.99	2.45
#4-OA	683044	2006-8-27	12:45-15:25	45.17	8.08	6.30	47.76	2.58
#4-OA	683045	2006-8-30	2:22-2:49	24.80	4.72	3.14	34.98	0.59
#4-OA	683046	2006-8-30	3:02-3:29	23.07	4.53	3.64	33.25	0.61
#4-OA	683047	2006-8-30	3:42-4:09	15.51	2.89	3.01	20.53	0.64
#4-OA	683048	2006-8-30	4:49-10:09	19.07	3.47	3.63	17.79	0.80
#4-OA	683049	2006-8-30	12:49-18:09	36.77	6.61	4.39	33.28	1.40
#4-OA	683050	2006-8-30	20:49-02:09	44.30	7.73	4.93	38.88	1.98
#4-OA	683051	2006-8-31	4:49-10:09	46.14	8.16	5.17	42.47	2.15
#4-OA	683052	2006-8-31	12:49-18:09	45.78	8.19	5.35	44.54	2.21
#4-OA	683053	2006-8-31	20:49-23:29	42.82	7.63	5.28	42.87	2.28
#4-OA	683054	2006-12-8	15:12-15:39	132.64	27.32	9.83	133.41	0.23
#4-OA	683055	2006-12-11	10:37-11:04	100.36	24.13	6.40	169.30	0.13
#4-OA	683056	2006-12-11	11:17-11:44	92.89	25.31	6.52	171.57	0.11
#4-OA	683057	2006-12-11	11:57-12:24	85.60	26.75	6.50	170.64	0.10
#4-OA	683058	2006-12-11	13:04-18:24	78.45	27.76	6.31	170.02	0.11
#4-OA	683059	2006-12-11	21:04-02:24	86.16	29.85	6.35	172.32	0.12
#4-OA	683060	2006-12-12	05:04-10:24	96.58	30.68	6.08	170.45	0.13

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#4-OA	683061	2006-12-12	13:04-18:24	107.35	30.73	5.84	169.09	0.13
#4-OA	683062	2006-12-12	21:04	113.75	31.02	5.99	170.64	0.12
#4-OA	783001	2007-2-3	12:26-12:53	120.43	25.55	7.66	103.03	0.28
#4-OA	783002	2007-2-3	13:06-13:33	127.53	26.53	7.98	117.98	0.19
#4-OA	783003	2007-2-3	13:46-14:13	128.10	26.58	7.68	116.48	0.17
#4-OA	783004	2007-2-3	14:53-20:13	128.92	26.27	7.64	116.06	0.19
#4-OA	783005	2007-2-4	22:53-4:13	128.58	26.85	7.44	118.35	0.17
#4-OA	783006	2007-2-4	6:53-12:13	126.93	24.98	6.77	112.65	0.20
#4-OA	783007	2007-2-4	14:53-20:13	130.04	25.58	7.38	127.58	0.19
#4-OA	783008	2007-2-5	22:53-4:13	129.16	26.15	7.32	136.31	0.17
#4-OA	783009	2007-2-5	6:53-9:33	130.48	26.17	7.33	121.92	0.17
#4-OA	783010	2007-2-6	1:25-4:05	131.09	28.51	7.54	132.88	0.15
#4-OA	783011	2007-2-6	6:45-12:05	135.25	26.59	7.90	137.10	0.10
#4-OA	783012	2007-2-23	20:52-21:19	136.38	28.29	7.91	145.00	0.28
#4-OA	783013	2007-2-23	21:32-21:19	133.93	28.11	7.56	141.26	0.15
#4-OA	783014	2007-2-23	22:12-22:39	131.84	27.79	7.30	140.16	0.13
#4-OA	783015	2007-2-23	23:19-4:39	131.06	27.68	7.13	139.67	0.11
#4-OA	783016	2007-2-24	7:19-12:39	130.61	27.87	7.08	140.78	0.11
#4-OA	783017	2007-2-24	15:19-20:39	130.00	27.66	7.05	140.54	0.10
#4-OA	783018	2007-2-24	23:19-4:39	130.65	27.51	7.09	141.21	0.10
#4-OA	783019	2007-2-25	7:19-12:39	129.19	27.77	7.04	140.26	0.10
#4-OA	783020	2007-2-25	15:19-17:59	131.52	27.93	7.04	140.84	0.10
#4-OA	783021	2007-2-26	13:27-13:54	132.89	27.93	6.98	140.80	0.12
#4-OA	783022	2007-2-26	14:07-14:34	133.93	28.04	7.06	140.41	0.11
#4-OA	783023	2007-2-26	14:47-15:14	132.84	27.97	7.07	140.29	0.09
#4-OA	783024	2007-2-26	15:54-21:14	132.57	27.88	7.00	138.60	0.09
#4-OA	783025	2007-2-27	23:54-5:14	120.79	24.06	18.34	122.45	0.94
#4-OA	783026	2007-2-27	7:54-13:14	118.17	23.27	21.76	117.93	1.02
#4-OA	783027	2007-2-27	15:54-21:14	131.18	27.46	8.62	137.98	0.17
#4-OA	783028	2007-2-28	23:54-5:14	129.61	27.77	7.66	140.18	0.11
#4-OA	783029	2007-2-28	7:54-10:34	129.49	27.73	7.50	142.59	0.09
#4-OA	783034	2007-3-20	15:45-16:12	123.00	29.72	8.32	171.41	0.22
#4-OA	783035	2007-3-20	16:25-16:52	120.87	29.31	7.91	171.11	0.09
#4-OA	783036	2007-3-20	17:05-17:32	120.27	29.04	7.86	169.29	0.09
#4-OA	783037	2007-3-20	18:45-23:32	121.98	29.54	7.95	172.02	0.08
#4-OA	783038	2007-3-21	2:12-7:32	125.67	30.40	8.17	175.45	0.10
#4-OA	783039	2007-3-21	10:12-15:32	120.13	28.97	8.03	170.77	0.13

Table 5. Concentrations of total dissolved macro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Ca	Mg	K	Na	P
				mg L ⁻¹				
#4-OA	783040	2007-3-21	18:12-23:32	121.72	29.43	8.02	172.88	0.09
#4-OA	783041	2007-3-22	2:12-7:32	120.09	29.08	7.87	170.64	0.09
#4-OA	783042	2007-3-22	10:12-12:52	123.20	30.05	8.05	174.13	0.09
#4-OA	783043	2007-3-30	20:11-20:38	118.87	29.68	8.06	174.14	0.12
#4-OA	783044	2007-3-30	20:51-21:18	113.81	28.67	7.56	167.26	0.09
#4-OA	783045	2007-3-30	21:31-21:58	116.59	29.15	7.71	170.14	0.10
#4-OA	783046	2007-3-31	22:38-3:58	112.51	28.29	7.37	165.47	0.10
#4-OA	783047	2007-3-31	6:38-11:58	114.90	29.02	7.64	169.74	0.09
#4-OA	783048	2007-3-31	14:38-19:58	111.09	28.30	7.27	164.34	0.08

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007.

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe mg L ⁻¹	Ni	Pb	Zn	Mn
#9-CON	611001	2006-8-19	12:15	BDL*	BDL	BDL	0.1399	0.0591	BDL	BDL	0.0338	0.0026
#9-CON	611002	2006-9-1	12:08-12:21	BDL	BDL	BDL	0.0574	0.1596	BDL	BDL	0.0377	0.2102
#9-CON	611003	2006-9-7	17:35	BDL	BDL	BDL	0.0528	0.1447	BDL	BDL	0.0222	0.0745
#9-CON	611004	2006-12-16	10:45-11:11	BDL	BDL	BDL	0.1877	0.0319	BDL	BDL	0.0375	0.0537
#9-CON	611005	2006-12-16	11:25-11:51	BDL	BDL	BDL	0.1892	0.0146	BDL	BDL	0.0341	0.0024
#9-CON	611006	2006-12-16	12:05-12:18	BDL	BDL	BDL	0.1985	0.0192	BDL	BDL	0.0283	0.0021
#9-CON	611007	2006-12-17	4:11	BDL	BDL	BDL	0.1220	0.0250	BDL	BDL	0.0203	0.0822
#3-CON	631009	2006-7-1	06:03-06:30	BDL	BDL	BDL	0.0734	0.4074	BDL	BDL	0.0484	0.0458
#3-CON	631010	2006-7-1	06:43-07:10	BDL	BDL	BDL	0.2593	0.0918	BDL	BDL	0.0926	0.0022
#3-CON	631011	2006-7-1	07:23-07:50	BDL	BDL	BDL	0.2733	0.0706	BDL	BDL	0.1170	0.0011
#3-CON	631012	2006-7-1	08:30-13:50	BDL	BDL	BDL	0.1406	0.4110	BDL	BDL	0.0635	0.0009
#3-CON	631013	2006-7-1	16:36-21:50	BDL	BDL	BDL	0.0450	0.1306	BDL	BDL	0.0217	0.0320
#3-CON	631014	2006-7-2	00:30-05:50	BDL	BDL	BDL	0.0944	0.3238	BDL	BDL	0.0385	0.0502
#3-CON	631015	2006-7-2	08:32-13:50	BDL	BDL	BDL	0.0415	0.2903	BDL	BDL	0.0315	0.0979
#3-CON	631016	2006-7-2	16:30-21:50	BDL	BDL	BDL	0.0422	0.3655	BDL	BDL	0.0238	0.2856
#3-CON	631017	2006-7-3	00:30-03:10	BDL	BDL	BDL	0.0323	0.3450	BDL	BDL	0.0329	0.2295
#3-CON	631018	2006-8-23	19:31-22:11	BDL	BDL	BDL	0.1731	0.1149	BDL	BDL	0.0834	0.0068
#3-CON	631019	2006-8-24	00:51-06:11	BDL	BDL	BDL	0.1360	0.0870	BDL	BDL	0.0923	0.0161

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#3-CON	631020	2006-8-24	08:51-14:11	BDL	BDL	BDL	0.1214	0.0802	BDL	BDL	0.0988	0.0238
#3-CON	631021	2006-8-24	16:51-22:11	BDL	BDL	BDL	0.1558	0.0868	BDL	BDL	0.1058	0.0370
#3-CON	631022	2006-8-25	00:51-06:11	BDL	BDL	BDL	0.1125	0.1158	BDL	BDL	0.0988	0.0440
#3-CON	631024	2006-8-25	12:54-13:21	BDL	BDL	BDL	0.1461	0.1077	BDL	BDL	0.0901	BDL
#3-CON	631025	2006-8-25	13:34-13:47	BDL	BDL	BDL	0.1593	0.1138	BDL	BDL	0.0893	BDL
#3-CON	631026	2006-8-26	02:01-04:41	BDL	BDL	BDL	0.1667	0.1084	BDL	BDL	0.0947	0.0129
#3-CON	631027	2006-8-26	07:21-12:41	BDL	BDL	BDL	0.1324	0.0886	BDL	BDL	0.1163	0.0155
#3-CON	631028	2006-8-26	15:21	BDL	BDL	BDL	0.1292	0.0714	BDL	BDL	0.0959	0.0228
#3-CON	631029	2006-8-29	22:21-01:01	BDL	BDL	BDL	0.1580	0.1262	BDL	BDL	0.1230	0.0072
#3-CON	631030	2006-8-30	03:41-09:01	BDL	BDL	BDL	0.1941	0.1390	BDL	BDL	0.0935	BDL
#3-CON	631031	2006-8-30	17:01	BDL	BDL	BDL	0.2356	0.1482	BDL	BDL	0.1223	0.0111
#3-CON	631032	2006-8-31	1:01	BDL	BDL	BDL	0.2137	0.1585	BDL	BDL	0.1327	0.0148
#3-CON	631033	2006-9-1	19:12-21:52	BDL	BDL	BDL	0.1862	0.1209	BDL	BDL	0.1083	BDL
#3-CON	631034	2006-9-2	00:32-05:52	BDL	BDL	BDL	0.1846	0.1329	BDL	BDL	0.1206	BDL
#3-CON	631035	2006-9-2	08:32-13:52	BDL	BDL	BDL	0.1797	0.1267	BDL	BDL	0.1133	BDL
#3-CON	631036	2006-9-2	16:32-21:52	BDL	BDL	BDL	0.2009	0.1516	BDL	BDL	0.1172	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#3-CON	631037	2006-9-3	00:32-05:52	BDL	BDL	BDL	0.1883	0.1438	BDL	BDL	0.1216	BDL
#3-CON	631038	2006-9-3	08:32-11:12	BDL	BDL	BDL	0.1818	0.1297	BDL	BDL	0.1197	0.0015
#3-OA	633021	2006-7-10	15:40	BDL	BDL	BDL	0.2442	1.0617	BDL	BDL	0.0928	0.2383
#3-OA	633022	2006-7-10	18:20-23:40	BDL	BDL	BDL	0.3591	1.7588	BDL	BDL	0.1958	0.4328
#3-OA	633023	2006-7-10	02:20-07:40	BDL	BDL	BDL	0.4189	2.5503	BDL	BDL	0.1290	0.9499
#3-OA	633024	2006-8-23	15:22-15:49	BDL	BDL	BDL	0.1786	0.3519	BDL	BDL	0.1093	0.1093
#3-OA	633025	2006-8-30	3:09	BDL	BDL	BDL	0.1773	0.1817	BDL	BDL	0.0710	0.0008
#3-OA	633026	2006-8-30	05:49-11:09	BDL	BDL	BDL	0.2331	0.1840	BDL	BDL	0.0908	BDL
#3-OA	633027	2006-8-30	9:09	BDL	BDL	0.0011	0.2358	0.1887	BDL	BDL	0.0996	BDL
#3-OA	633028	2006-8-30	21:49	BDL	BDL	0.0010	0.2254	0.2648	BDL	BDL	0.1325	0.0262
#3-OA	633029	2006-8-31	16:29	BDL	BDL	0.0001	0.2415	0.2618	BDL	BDL	0.1231	0.0241
#3-OA	633030	2006-9-1	15:40	BDL	BDL	BDL	0.2135	0.2976	BDL	BDL	0.1563	0.0399
#3-OA	633031	2006-9-2	13:00-15:40	BDL	BDL	BDL	0.2091	0.3165	BDL	BDL	0.1477	0.0053
#3-OA	633032	2006-12-11	11:27-11:54	BDL	BDL	BDL	0.0367	0.0285	0.0053	BDL	0.0616	BDL
#3-OA	633033	2006-12-11	12:07-12:34	BDL	BDL	BDL	0.0290	0.0156	BDL	BDL	0.0198	BDL
#3-OA	633034	2006-12-11	12:47-13:14	BDL	BDL	BDL	0.0517	0.0156	BDL	BDL	0.0270	BDL
#3-OA	633035	2006-12-11	13:45-19:14	BDL	BDL	BDL	0.0459	0.0169	BDL	BDL	0.0303	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006 - March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#3-OA	633036	2006-12-11	21:54-03:14	BDL	BDL	BDL	0.0477	0.0183	BDL	BDL	0.0331	BDL
#3-OA	633037	2006-12-12	05:54-11:14	BDL	BDL	BDL	0.0409	0.0245	BDL	BDL	0.0312	0.0794
#3-OA	633038	2006-12-12	13:54-16:34	BDL	BDL	BDL	0.0379	0.0459	BDL	BDL	0.0344	0.2175
#3-OA	633039	2006-12-25	17:36-22:56	BDL	BDL	BDL	0.1592	0.0726	BDL	BDL	0.1141	BDL
#3-OA	633040	2006-12-26	1:36-6:56	BDL	BDL	BDL	0.2066	0.0754	BDL	BDL	0.1656	0.0000
#3-OA	733001	2007-1-23	15:40-18:20	BDL	BDL	BDL	0.0244	0.0105	BDL	BDL	0.0246	BDL
#3-OA	733002	2007-2-6	1900-1-0	BDL	BDL	BDL	0.3494	0.0290	BDL	BDL	0.1127	0.0891
#3-OA	733003	2007-2-6	5:22-8:02	BDL	BDL	BDL	0.0562	0.0781	BDL	BDL	0.0221	0.0076
#3-OA	733004	2007-3-16	18:46-19:13	BDL	BDL	BDL	0.2567	0.2154	BDL	BDL	0.2168	0.0111
#3-OA	733005	2007-3-16	19:26-19:53	BDL	BDL	BDL	0.2272	0.2048	BDL	BDL	0.1381	0.0238
#3-OA	733006	2007-3-16	20:06-20:33	BDL	BDL	BDL	0.2639	0.2049	BDL	BDL	0.1499	0.0069
#3-OA	733007	2007-3-17	21:13-2:33	BDL	BDL	BDL	0.2331	0.2032	BDL	BDL	0.1294	0.0081
#3-OA	733008	2007-3-17	5:13-10:33	BDL	BDL	BDL	0.1765	0.2517	BDL	BDL	0.1282	0.0257
#3-OA	733009	2007-3-17	13:13-18:33	BDL	BDL	BDL	0.1492	0.2758	BDL	BDL	0.1017	0.0859
#3-OA	733010	2007-3-18	21:13-2:33	BDL	BDL	BDL	0.1291	0.3435	BDL	BDL	0.1046	0.3278
#3-OA	733011	2007-3-18	5:13-10:33	BDL	BDL	BDL	0.1090	0.3025	BDL	BDL	0.0769	0.2588
#3-OA	733012	2007-3-18	1900-1-0	BDL	BDL	BDL	0.2187	0.2597	BDL	BDL	0.1178	0.2874
#3-OA	733013	2007-3-18	15:07-15:34	BDL	BDL	BDL	0.1171	0.1198	BDL	BDL	0.0292	BDL
#3-OA	733014	2007-3-18	15:47-16:14	BDL	BDL	BDL	0.1176	0.1116	BDL	BDL	0.0366	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#3-OA	733015	2007-3-18	16:27-16:54	BDL	BDL	BDL	0.1175	0.1155	BDL	BDL	0.0332	BDL
#3-OA	733016	2007-3-18	17:34-22:54	BDL	BDL	BDL	0.1088	0.1367	BDL	BDL	0.0433	0.0045
#3-OA	733017	2007-3-19	1:34-6:54	BDL	BDL	BDL	0.1431	0.1047	BDL	BDL	0.0557	0.0043
#3-OA	733018	2007-3-19	9:34-15:54	BDL	BDL	BDL	0.1073	0.1430	BDL	BDL	0.0376	0.0156
#3-OA	733019	2007-3-19	17:34-22:54	BDL	BDL	BDL	0.0747	0.1643	BDL	BDL	0.0303	0.0038
#3-OA	733020	2007-3-20	1:34-6:54	BDL	BDL	BDL	0.0572	0.1970	BDL	BDL	0.0219	0.0034
#3-OA	733021	2007-3-20	9:34-12:14	BDL	BDL	BDL	0.0585	0.1750	BDL	BDL	0.0205	0.0049
#4-CON	681026	2006-7-11	16:56-17:23	BDL	BDL	0.0011	0.1223	0.1022	BDL	BDL	0.0924	0.0014
#4-CON	681027	2006-7-11	17:36-18:03	BDL	BDL	0.0021	0.1312	0.1292	BDL	BDL	0.0923	0.0016
#4-CON	681028	2006-7-11	18:16-18:43	BDL	BDL	0.0012	0.1380	0.1948	BDL	BDL	0.1115	0.0077
#4-CON	681029	2006-7-11	19:23-00:47	BDL	BDL	BDL	0.1680	0.7469	BDL	BDL	0.1951	0.1194
#4-CON	681030	2006-7-12	03:23-08:43	BDL	BDL	0.0009	0.1950	0.8755	BDL	BDL	0.2870	0.6577
#4-CON	681031	2006-7-12	11:23-16:43	BDL	BDL	0.0007	0.2276	1.1899	BDL	BDL	0.3615	0.4317
#4-CON	681032	2006-7-12	19:23-00:43	BDL	BDL	0.0016	0.1832	1.9251	BDL	BDL	0.3614	0.9162
#4-CON	681033	2006-7-13	03:23-08:43	BDL	BDL	BDL	0.1519	2.8069	BDL	BDL	0.3883	1.2457
#4-CON	681034	2006-8-19	13:46-14:13	BDL	BDL	BDL	0.1661	0.1397	BDL	BDL	0.1074	0.0081
#4-CON	681035	2006-8-19	14:26-14:52	BDL	BDL	BDL	0.1288	0.2325	BDL	BDL	0.0691	0.0084
#4-CON	681036	2006-8-19	15:06-15:33	BDL	BDL	BDL	0.0775	0.2596	BDL	BDL	0.0496	0.0024

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-CON	681037	2006-8-19	16:13-21:33	BDL	BDL	BDL	0.0452	0.1980	BDL	BDL	0.0372	0.0035
#4-CON	681038	2006-8-20	00:13-05:33	BDL	BDL	BDL	0.0419	0.1425	BDL	BDL	0.0294	0.0180
#4-CON	681039	2006-8-20	08:13-13:33	BDL	BDL	BDL	0.1037	0.2731	BDL	BDL	0.0525	0.0476
#4-CON	681040	2006-8-20	16:13-21:33	BDL	BDL	BDL	0.1547	0.3871	BDL	BDL	0.0829	0.1231
#4-CON	681041	2006-8-21	00:13-05:33	BDL	BDL	BDL	0.1094	0.6003	BDL	BDL	0.0992	0.2962
#4-CON	681042	2006-8-21	8:13	BDL	BDL	BDL	0.1301	0.6447	BDL	BDL	0.0775	0.7210
#4-CON	681043	2006-8-26	16:53-17:20	BDL	BDL	BDL	0.3707	1.3341	BDL	BDL	0.1081	0.0001
#4-CON	681044	2006-8-26	17:33-18:00	BDL	BDL	BDL	0.3795	1.2966	BDL	BDL	0.1064	0.0032
#4-CON	681045	2006-8-26	18:13-18:40	BDL	BDL	BDL	0.4042	1.3689	BDL	BDL	0.1013	0.0000
#4-CON	681046	2006-8-26	19:20-00:40	BDL	BDL	BDL	0.3733	1.7407	BDL	BDL	0.0991	0.0060
#4-CON	681047	2006-8-27	03:20-08:40	BDL	BDL	BDL	0.3331	2.4849	BDL	BDL	0.1172	0.2283
#4-CON	681048	2006-8-27	11:20-16:40	BDL	BDL	BDL	0.2409	2.8727	BDL	BDL	0.0951	0.3709
#4-CON	681049	2006-8-27	17:20-00:40	BDL	BDL	BDL	0.1495	3.6515	BDL	BDL	0.0588	0.3125
#4-CON	681050	2006-12-24	15:04-15:31	BDL	BDL	BDL	0.2332	0.2381	BDL	BDL	0.1121	0.0040
#4-CON	681051	2006-12-24	15:44-16:11	BDL	BDL	BDL	0.2601	0.2567	BDL	BDL	0.1168	0.0028
#4-CON	681052	2006-12-24	16:24-16:51	BDL	BDL	BDL	0.2169	0.3009	BDL	BDL	0.1172	0.0004

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-CON	681053	2006-12-24	17:31-22:51	BDL	BDL	BDL	0.2203	0.5581	BDL	BDL	0.1463	0.1093
#4-CON	681054	2006-12-25	1:31-6:51	BDL	BDL	BDL	0.2339	0.5155	BDL	BDL	0.1622	0.0283
#4-CON	681055	2006-12-25	9:31-14:51	BDL	BDL	BDL	0.2167	0.3147	BDL	BDL	0.1283	0.0041
#4-CON	681056	2006-12-25	17:31-22:51	BDL	BDL	BDL	0.2968	0.8971	BDL	BDL	0.1642	0.0148
#4-CON	681057	2006-12-26	1:31-6:51	BDL	BDL	BDL	0.2352	0.5214	BDL	BDL	0.1894	0.7829
#4-CON	681058	2006-12-26	9:31-12:11	BDL	BDL	BDL	0.2771	1.0927	BDL	BDL	0.2177	0.9120
#4-CON	781001	2007-2-27	5:14-5:41	BDL	BDL	BDL	0.7027	0.3720	BDL	BDL	0.1494	0.0876
#4-CON	781002	2007-2-27	5:54-6:21	BDL	BDL	BDL	0.6705	0.0462	BDL	BDL	0.1635	0.1043
#4-CON	781003	2007-2-27	6:34-7:01	BDL	BDL	BDL	0.5517	0.0389	BDL	BDL	0.1234	0.0557
#4-CON	781004	2007-2-27	7:41-13:01	BDL	BDL	BDL	0.2354	0.0681	BDL	BDL	0.0389	0.0190
#4-CON	781005	2007-2-27	15:41-21:01	BDL	BDL	BDL	0.0342	0.0096	BDL	BDL	0.0084	BDL
#4-CON	781006	2007-2-28	23:41-5:01	BDL	BDL	BDL	0.0280	0.0075	BDL	BDL	0.0086	BDL
#4-CON	781007	2007-2-28	7:41-13:01	BDL	BDL	BDL	0.0280	0.0119	BDL	BDL	0.0170	BDL
#4-CON	781008	2007-2-28	15:41-21:01	BDL	BDL	BDL	0.0184	0.0076	BDL	BDL	0.0099	BDL
#4-CON	781009	2007-3-1	23:11-2:21	BDL	BDL	BDL	0.0744	0.0073	BDL	BDL	0.0075	BDL
#4-CON	781010	2007-3-16	14:44-15:11	BDL	BDL	BDL	0.1923	0.2203	BDL	BDL	0.0978	0.0193
#4-CON	781011	2007-3-16	15:24-15:51	BDL	BDL	BDL	0.2205	0.1436	BDL	BDL	0.0884	0.0005
#4-CON	781012	2007-3-16	16:04-16:31	BDL	BDL	BDL	0.2170	0.1383	BDL	BDL	0.0867	BDL
#4-CON	781013	2007-3-16	17:11-22:31	BDL	BDL	BDL	0.2131	0.1452	BDL	BDL	0.0890	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-CON	781014	2007-3-17	1:11-6:31	BDL	BDL	BDL	0.2012	0.1340	BDL	BDL	0.0682	BDL
#4-CON	781015	2007-3-17	9:11-14:31	BDL	BDL	BDL	0.1291	0.0881	BDL	BDL	0.0638	BDL
#4-CON	781016	2007-3-17	17:11-22:31	BDL	BDL	BDL	0.0651	0.0510	BDL	BDL	0.0378	BDL
#4-CON	781017	2007-3-18	1:11-6:31	BDL	BDL	BDL	0.0874	0.0337	BDL	BDL	0.2602	0.0793
#4-CON	781018	2007-3-18	9:11-11:51	BDL	BDL	BDL	0.0172	0.0233	BDL	BDL	0.0209	BDL
#4-CON	781019	2007-3-22	17:24-17:51	BDL	BDL	BDL	0.1781	1.6983	BDL	BDL	0.1896	0.7068
#4-CON	781020	2007-3-22	18:04-18:31	BDL	BDL	BDL	0.0791	0.1804	BDL	BDL	0.0328	0.2759
#4-CON	781021	2007-3-22	18:44-19:11	BDL	BDL	BDL	0.0789	0.1288	BDL	BDL	0.0284	0.2386
#4-CON	781022	2007-3-23	19:51-1:11	BDL	BDL	BDL	0.0677	0.0735	BDL	BDL	0.0269	0.0187
#4-CON	781023	2007-3-23	3:51-9:11	BDL	BDL	BDL	0.0577	0.0865	BDL	BDL	0.0346	0.0039
#4-CON	781024	2007-3-23	11:51-17:11	BDL	BDL	BDL	0.0488	0.1269	BDL	BDL	0.0309	0.0358
#4-CON	781025	2007-3-24	19:51-1:11	BDL	BDL	BDL	0.0408	0.1361	BDL	BDL	0.0202	0.0232
#4-CON	781026	2007-3-24	3:51-9:11	BDL	BDL	BDL	0.0249	0.1289	BDL	BDL	0.0167	0.0860
#4-CON	781027	2007-3-24	11:51-14:31	BDL	BDL	BDL	0.0082	0.0428	BDL	BDL	0.0318	0.1698
#4-OA	683016	2006-7-12	16:27-17:07	BDL	BDL	BDL	0.1715	0.0934	BDL	BDL	0.1200	BDL
#4-OA	683017	2006-7-12	17:07-17:47	BDL	BDL	BDL	0.1359	0.0709	BDL	BDL	0.1523	BDL
#4-OA	683018	2006-7-12	17:47-18:54	BDL	BDL	BDL	0.1234	0.0648	BDL	BDL	0.1354	BDL
#4-OA	683019	2006-7-12	21:34	BDL	BDL	BDL	0.1397	0.0827	BDL	BDL	0.1375	BDL
#4-OA	683020	2006-8-19	13:37-14:04	BDL	BDL	BDL	0.1567	0.0496	BDL	BDL	0.1536	0.0119

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-OA	683021	2006-8-19	14:16-14:44	BDL	BDL	BDL	0.1613	0.0588	BDL	BDL	0.1949	0.0383
#4-OA	683022	2006-8-19	14:57-15:24	BDL	BDL	BDL	0.1555	0.0608	BDL	BDL	0.1701	0.0168
#4-OA	683023	2006-8-19	16:04	BDL	BDL	BDL	0.1539	0.0612	BDL	BDL	0.1355	0.1355
#4-OA	683024	2006-8-20	13:24	BDL	BDL	BDL	0.2452	0.6366	BDL	BDL	0.1620	0.1620
#4-OA	683025	2006-8-20	16:04-21:24	BDL	BDL	BDL	0.2677	0.7763	BDL	BDL	0.2296	0.2296
#4-OA	683026	2006-8-21	00:04-05:24	BDL	BDL	BDL	0.2908	0.8107	BDL	BDL	0.2203	0.2203
#4-OA	683027	2006-8-21	8:04	BDL	BDL	BDL	0.3395	0.8893	BDL	BDL	0.2054	0.2054
#4-OA	683028	2006-8-23	14:35-15:02	BDL	BDL	BDL	0.3433	1.2257	BDL	BDL	0.1721	0.1721
#4-OA	683029	2006-8-23	15:15-15:42	BDL	BDL	BDL	0.3327	0.8234	BDL	BDL	0.1608	0.1608
#4-OA	683030	2006-8-23	15:55-16:22	BDL	BDL	BDL	0.3404	0.7637	BDL	BDL	0.1796	0.1796
#4-OA	683031	2006-8-23	17:02-22:22	BDL	BDL	BDL	0.4011	0.9237	BDL	BDL	0.2124	0.2124
#4-OA	683032	2006-8-24	01:02-06:22	BDL	BDL	0.0021	0.4697	1.7621	BDL	BDL	0.2896	0.0925
#4-OA	683033	2006-8-24	09:02-14:22	BDL	BDL	0.0004	0.4446	2.1192	BDL	BDL	0.2665	0.1561
#4-OA	683034	2006-8-24	17:02-22:22	BDL	BDL	0.0003	0.4337	2.4595	BDL	BDL	0.2179	0.3037
#4-OA	683035	2006-8-25	01:02-06:22	BDL	BDL	BDL	0.2955	3.2679	BDL	BDL	0.1381	0.3953
#4-OA	683036	2006-8-25	18:18-18:45	BDL	BDL	0.0007	0.6842	2.4819	0.0010	0.0031	0.2250	0.0096
#4-OA	683037	2006-8-25	18:58-19:25	BDL	BDL	0.0015	0.6323	2.5821	0.0001	BDL	0.2536	0.0096
#4-OA	683038	2006-8-25	19:38-20:05	BDL	BDL	0.0009	0.7521	2.5532	0.0006	BDL	0.2587	0.0193
#4-OA	683039	2006-8-25	20:45-02:05	BDL	BDL	0.0003	0.6321	2.5282	0.0003	0.0002	0.2469	0.0131

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-OA	683040	2006-8-26	04:45-10:05	BDL	BDL	0.0013	0.6519	3.2915	0.0009	BDL	0.3072	0.0632
#4-OA	683041	2006-8-26	12:45-18:05	BDL	BDL	0.0001	0.5811	3.2159	0.0013	BDL	0.2974	0.0957
#4-OA	683042	2006-8-26	20:45-02:05	BDL	BDL	0.0029	0.6024	3.4024	0.0021	0.0042	0.3005	0.0791
#4-OA	683043	2006-8-27	04:45-10:05	BDL	BDL	0.0035	0.5205	3.8001	0.0019	0.0014	0.2886	0.2722
#4-OA	683044	2006-8-27	12:45-15:25	BDL	BDL	0.0036	0.3203	4.3853	0.0013	0.0037	0.1607	0.2861
#4-OA	683045	2006-8-30	2:22-2:49	BDL	BDL	BDL	0.2359	0.8171	BDL	BDL	0.1419	0.0041
#4-OA	683046	2006-8-30	3:02-3:29	BDL	BDL	BDL	0.2610	0.5812	BDL	BDL	0.1471	0.0059
#4-OA	683047	2006-8-30	3:42-4:09	BDL	BDL	0.0012	0.2548	0.4874	BDL	BDL	0.1064	0.0013
#4-OA	683048	2006-8-30	4:49-10:09	BDL	BDL	0.0004	0.3140	0.7222	BDL	BDL	0.1490	BDL
#4-OA	683049	2006-8-30	12:49-18:09	BDL	BDL	0.0009	0.4999	1.9033	BDL	BDL	0.2368	0.0016
#4-OA	683050	2006-8-30	20:49-02:09	BDL	BDL	BDL	0.5153	2.3921	BDL	BDL	0.2705	0.0070
#4-OA	683051	2006-8-31	4:49-10:09	BDL	BDL	BDL	0.4695	2.4190	BDL	BDL	0.2539	0.0103
#4-OA	683052	2006-8-31	12:49-18:09	BDL	BDL	BDL	0.4496	2.4801	BDL	BDL	0.2450	0.0193
#4-OA	683053	2006-8-31	20:49-23:29	BDL	BDL	BDL	0.4434	2.6116	BDL	BDL	0.2174	0.0205
#4-OA	683054	2006-12-8	15:12-15:39	BDL	BDL	BDL	0.0394	0.0242	BDL	BDL	0.0558	BDL
#4-OA	683055	2006-12-11	10:37-11:04	BDL	BDL	BDL	0.0198	0.0154	BDL	0.0012	0.0129	BDL
#4-OA	683056	2006-12-11	11:17-11:44	BDL	BDL	BDL	0.0120	0.0114	BDL	BDL	0.0095	BDL
#4-OA	683057	2006-12-11	11:57-12:24	BDL	BDL	BDL	0.0111	0.0150	BDL	0.0005	0.0152	BDL
#4-OA	683058	2006-12-11	13:04-18:24	BDL	BDL	BDL	0.0119	0.0166	BDL	BDL	0.0107	BDL
#4-OA	683059	2006-12-11	21:04-02:24	BDL	BDL	BDL	0.0123	0.0125	BDL	0.0028	0.0144	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-OA	683060	2006-12-12	05:04-10:24	BDL	BDL	BDL	0.0183	0.0135	BDL	0.0007	0.0146	BDL
#4-OA	683061	2006-12-12	13:04-18:24	BDL	BDL	BDL	0.0167	0.0217	BDL	BDL	0.0161	BDL
#4-OA	683062	2006-12-12	21:04	BDL	BDL	BDL	0.0175	0.0123	BDL	BDL	0.0161	BDL
#4-OA	783001	2007-2-3	12:26-12:53	BDL	BDL	BDL	0.0248	0.0108	BDL	BDL	0.0229	BDL
#4-OA	783002	2007-2-3	13:06-13:33	BDL	BDL	BDL	0.0158	0.0067	BDL	BDL	0.0074	BDL
#4-OA	783003	2007-2-3	13:46-14:13	BDL	BDL	BDL	0.0133	0.0052	BDL	BDL	0.0120	BDL
#4-OA	783004	2007-2-3	14:53-20:13	BDL	BDL	BDL	0.0141	0.0060	BDL	BDL	0.0087	BDL
#4-OA	783005	2007-2-4	22:53-4:13	BDL	BDL	BDL	0.0114	0.0052	BDL	BDL	0.0134	BDL
#4-OA	783006	2007-2-4	6:53-12:13	BDL	BDL	BDL	0.0132	0.0453	BDL	BDL	0.0221	0.0049
#4-OA	783007	2007-2-4	14:53-20:13	BDL	BDL	BDL	0.0102	BDL	BDL	BDL	0.0156	BDL
#4-OA	783008	2007-2-5	22:53-4:13	BDL	BDL	BDL	0.0049	0.0028	BDL	BDL	0.0203	0.0017
#4-OA	783009	2007-2-5	6:53-9:33	BDL	BDL	BDL	0.0135	0.0040	BDL	BDL	0.0155	0.0077
#4-OA	783010	2007-2-6	1:25-4:05	BDL	BDL	BDL	0.0179	0.0098	BDL	BDL	0.0149	BDL
#4-OA	783011	2007-2-6	6:45-12:05	BDL	BDL	BDL	0.0156	0.0118	BDL	BDL	0.0624	BDL
#4-OA	783012	2007-2-23	20:52-21:19	BDL	BDL	BDL	0.0374	0.0195	BDL	BDL	0.0314	BDL
#4-OA	783013	2007-2-23	21:32-21:19	BDL	BDL	BDL	0.0286	0.0214	BDL	BDL	0.0203	BDL
#4-OA	783014	2007-2-23	22:12-22:39	BDL	BDL	BDL	0.0190	0.0102	BDL	BDL	0.0144	BDL
#4-OA	783015	2007-2-23	23:19-4:39	BDL	BDL	BDL	0.0183	0.0094	BDL	BDL	0.0272	BDL
#4-OA	783016	2007-2-24	7:19-12:39	BDL	BDL	BDL	0.0165	0.0134	BDL	BDL	0.0166	BDL
#4-OA	783017	2007-2-24	15:19-20:39	BDL	BDL	BDL	0.0138	0.0099	BDL	BDL	0.0136	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-OA	783018	2007-2-24	23:19-4:39	BDL	BDL	BDL	0.0140	0.0619	BDL	BDL	0.0239	BDL
#4-OA	783019	2007-2-25	7:19-12:39	BDL	BDL	BDL	0.0252	0.0252	BDL	BDL	0.0155	BDL
#4-OA	783020	2007-2-25	15:19-17:59	BDL	BDL	BDL	0.0165	0.0106	BDL	BDL	0.0216	BDL
#4-OA	783021	2007-2-26	13:27-13:54	BDL	BDL	BDL	0.0191	0.0281	BDL	BDL	0.0240	BDL
#4-OA	783022	2007-2-26	14:07-14:34	BDL	BDL	BDL	0.0195	0.0069	BDL	BDL	0.0217	BDL
#4-OA	783023	2007-2-26	14:47-15:14	BDL	BDL	BDL	0.0151	0.0075	BDL	BDL	0.0218	BDL
#4-OA	783024	2007-2-26	15:54-21:14	BDL	BDL	BDL	0.0159	0.0052	BDL	BDL	0.0201	BDL
#4-OA	783025	2007-2-27	23:54-5:14	BDL	BDL	BDL	0.2321	0.0217	BDL	BDL	0.0689	BDL
#4-OA	783026	2007-2-27	7:54-13:14	BDL	BDL	BDL	0.2762	0.0441	BDL	BDL	0.0842	0.0028
#4-OA	783027	2007-2-27	15:54-21:14	BDL	BDL	BDL	0.0388	0.0104	BDL	BDL	0.0225	BDL
#4-OA	783028	2007-2-28	23:54-5:14	BDL	BDL	BDL	0.0365	0.0098	BDL	BDL	0.0253	BDL
#4-OA	783029	2007-2-28	7:54-10:34	BDL	BDL	BDL	0.0227	0.0098	BDL	BDL	0.0122	BDL
#4-OA	783034	2007-3-20	15:45-16:12	BDL	BDL	BDL	0.0160	0.0285	BDL	BDL	0.0167	BDL
#4-OA	783035	2007-3-20	16:25-16:52	BDL	BDL	BDL	0.0185	0.0185	BDL	BDL	0.0151	BDL
#4-OA	783036	2007-3-20	17:05-17:32	BDL	BDL	BDL	0.0175	0.0192	BDL	BDL	0.0326	BDL
#4-OA	783037	2007-3-20	18:45-23:32	BDL	BDL	BDL	0.0122	0.0148	BDL	BDL	0.0196	BDL
#4-OA	783038	2007-3-21	2:12-7:32	BDL	BDL	BDL	0.0136	0.0146	BDL	BDL	0.0283	BDL
#4-OA	783039	2007-3-21	10:12-15:32	BDL	BDL	BDL	0.0183	0.0214	BDL	BDL	0.0207	BDL
#4-OA	783040	2007-3-21	18:12-23:32	BDL	BDL	BDL	0.0171	0.0115	BDL	BDL	0.0185	BDL

* BDL = below detection limit

Table 6. Concentrations of total dissolved micro-elements in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
				mg L ⁻¹								
#4-OA	783041	2007-3-22	2:12-7:32	BDL	BDL	BDL	0.0128	0.0112	BDL	BDL	0.0225	BDL
#4-OA	783042	2007-3-22	10:12-12:52	BDL	BDL	BDL	0.0083	0.0111	BDL	BDL	0.0276	BDL
#4-OA	783043	2007-3-30	20:11-20:38	BDL	BDL	BDL	0.0201	0.1375	BDL	BDL	0.0225	BDL
#4-OA	783044	2007-3-30	20:51-21:18	BDL	BDL	BDL	0.0091	0.0173	BDL	BDL	0.0137	BDL
#4-OA	783045	2007-3-30	21:31-21:58	BDL	BDL	BDL	0.0091	0.0174	BDL	BDL	0.0125	BDL
#4-OA	783046	2007-3-31	22:38-3:58	BDL	BDL	BDL	0.0082	0.0167	BDL	BDL	0.0113	BDL
#4-OA	783047	2007-3-31	6:38-11:58	BDL	BDL	BDL	0.0080	0.0148	BDL	BDL	0.0109	BDL
#4-OA	783048	2007-3-31	14:38-19:58	BDL	BDL	BDL	0.0058	0.0155	BDL	BDL	0.0159	BDL

The Concentrations of Nutrients and Metals in Runoff Water

The concentrations of total P, dissolved total P, ortho-P, total N, total Kjeldhal N (TKN), and NO_3^- -N in runoff water samples collected in 2006-07 are presented in Table 7. Organic amendment reduced the concentrations of total P, dissolved total P, and ortho-P for location #4, but there was a trend of increased concentrations for these P forms for location #3. The reduction rates in location #4 were 67% for ortho-P, 62% for the dissolved total P, and 60% for total P (Table 8). The decrease in runoff P concentrations by organic amendment could result from incorporation of water soluble P into microbial biomass P and other organic P, as observed in our incubation and column leaching studies (He et al., 2005). However, such effects are related to soil properties and other practices.

Organic amendment reduced the concentrations of total N, TKN, and NO_3^- -N for all the locations but the effect on NH_4^+ -N concentration varied between the locations (Tables 7 and 8). There was a decreased NH_4^+ -N concentration in runoff water from location #4, but no significant difference was observed for location #3. The reduction rates were 40 to 50% for total N, 2 to 33% for TKN, and 59 to 80% for NO_3^- -N in runoff waters (Table 8). A reduction of 40% in NH_4^+ -N concentrations was achieved in location #4. Apparently, organic amendment is effective in reducing N concentration in runoff waters in the 2006-07 (Table 8).

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007.

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P mg L ⁻¹	TN	TKN	NO ₃ ⁻ -N
#9-CON	611001	2006-8-19	12:15	3.44	1.97	1.33	2.79	1.99	0.81
#9-CON	611002	2006-9-1	12:08-12:21	7.60	2.54	2.16	1.69	1.62	0.07
#9-CON	611003	2006-9-7	17:35	5.39	1.29	0.00	1.16	0.61	0.56
#9-CON	611004	2006-12-16	10:45-11:11	1.09	0.75	0.00	1.03	0.91	0.12
#9-CON	611005	2006-12-16	11:25-11:51	0.97	0.63	0.70	1.14	0.87	0.27
#9-CON	611006	2006-12-16	12:05-12:18	1.02	0.64	0.60	1.31	0.89	0.42
#9-CON	611007	2006-12-17	4:11	1.83	1.11	0.92	1.05	0.92	0.13
#3-CON	631009	2006-7-1	06:03-06:30	1.91	1.39	0.88	4.02	3.58	0.44
#3-CON	631010	2006-7-1	06:43-07:10	3.37	1.90	0.80	5.00	2.98	2.02
#3-CON	631011	2006-7-1	07:23-07:50	3.47	2.19	0.80	5.65	3.59	2.06
#3-CON	631012	2006-7-1	08:30-13:50	2.07	1.40	0.52	3.03	2.10	0.92
#3-CON	631013	2006-7-1	16:36-21:50	2.11	1.12	1.04	0.62	0.40	0.23
#3-CON	631014	2006-7-2	00:30-05:50	2.41	1.53	1.25	2.32	1.87	0.46
#3-CON	631015	2006-7-2	08:32-13:50	1.94	1.01	1.01	2.02	1.70	0.33
#3-CON	631016	2006-7-2	16:30-21:50	1.85	0.93	0.96	0.92	0.54	0.38
#3-CON	631017	2006-7-3	00:30-03:10	2.32	0.74	0.67	1.46	1.20	0.25

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#3-CON	631018	2006-8-23	19:31-22:11	1.31	1.24	1.14	8.53	3.31	5.22
#3-CON	631019	2006-8-24	00:51-06:11	1.05	0.96	0.85	11.49	3.35	8.14
#3-CON	631020	2006-8-24	08:51-14:11	0.88	0.78	0.76	11.65	2.98	8.67
#3-CON	631021	2006-8-24	16:51-22:11	1.03	0.93	0.90	10.87	3.46	7.42
#3-CON	631022	2006-8-25	00:51-06:11	0.79	0.69	0.70	8.58	1.75	6.83
#3-CON	631023	2006-8-25	8:51	0.77		0.72	9.54	2.99	6.55
#3-CON	631024	2006-8-25	12:54-13:21	1.36	1.36	1.07	7.89	3.86	4.03
#3-CON	631025	2006-8-25	13:34-13:47	1.44	1.43	1.16	7.29	3.65	3.64
#3-CON	631026	2006-8-26	02:01-04:41	1.47	1.43	1.26	15.02	3.66	11.36
#3-CON	631027	2006-8-26	07:21-12:41	1.14	1.14	0.75	17.09	3.58	13.50
#3-CON	631028	2006-8-26	15:21	1.00	1.00	0.44	16.68	3.48	13.20
#3-CON	631029	2006-8-29	22:21-01:01	1.50	1.38	1.12	4.84	2.51	2.34
#3-CON	631030	2006-8-30	03:41-09:01	2.20	2.01	1.42	4.66	2.09	2.57
#3-CON	631031	2006-8-30	17:01	2.22	2.13	1.56	9.25	3.40	5.85
#3-CON	631032	2006-8-31	1:01	2.21	2.28	1.69	9.14	2.90	6.24
#3-CON	631033	2006-9-1	19:12-21:52	2.10	2.00	1.48	8.78	3.72	5.06
#3-CON	631034	2006-9-2	00:32-05:52	1.97	1.89	1.13	8.31	3.42	4.89

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#3-CON	631035	2006-9-2	08:32-13:52	2.07	1.98	1.39	6.67	3.09	3.57
#3-CON	631036	2006-9-2	16:32-21:52	2.66	2.52	1.90	6.58	3.03	3.55
#3-CON	631037	2006-9-3	00:32-05:52	2.48	2.40	2.08	7.82	3.31	4.50
#3-CON	631038	2006-9-3	08:32-11:12	2.34	2.26	2.08	7.85	3.44	4.41
#3-OA	633021	2006-7-10	15:40	2.34	1.29	1.07	0.30	0.00	0.30
#3-OA	633022	2006-7-10	18:20-23:40	2.38	2.27	2.09	3.69	3.52	0.17
#3-OA	633023	2006-7-10	02:20-07:40	2.71	2.60	2.18	3.10	3.04	0.07
#3-OA	633024	2006-8-23	15:22-15:49	2.31	2.20	1.75	4.35	3.32	1.03
#3-OA	633025	2006-8-30	3:09	2.27	1.93	1.36	1.18	0.19	0.99
#3-OA	633026	2006-8-30	05:49-11:09	2.71	2.64	2.51	2.68	1.59	1.10
#3-OA	633027	2006-8-30	9:09	3.37	2.67	2.41	2.21	1.71	0.49
#3-OA	633028	2006-8-30	21:49	3.42	3.39	3.11	4.15	3.30	0.85
#3-OA	633029	2006-8-31	16:29	4.01	3.48	3.25	3.50	3.30	0.20
#3-OA	633030	2006-9-1	15:40	4.68	4.14	3.51	4.16	4.06	0.10
#3-OA	633031	2006-9-2	13:00-15:40	4.90	4.68	4.10	3.54	3.22	0.32
#3-OA	633032	2006-12-11	11:27-11:54	0.90	0.48	0.45	1.96	1.80	0.17

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#3-OA	633033	2006-12-11	12:07-12:34	0.76	0.55	0.52	3.06	2.89	0.17
#3-OA	633034	2006-12-11	12:47-13:14	0.57	0.40	0.36	1.08	0.93	0.15
#3-OA	633035	2006-12-11	13:45-19:14	0.40	0.43	0.30	0.74	0.65	0.09
#3-OA	633036	2006-12-11	21:54-03:14	0.67	0.48	0.46	0.84	0.79	0.05
#3-OA	633037	2006-12-12	05:54-11:14	0.48	0.50	0.20	1.36	1.30	0.07
#3-OA	633038	2006-12-12	13:54-16:34	0.58	0.55	0.51	0.70	0.68	0.02
#3-OA	633039	2006-12-25	17:36-22:56	1.98	1.61	1.51	2.65	2.35	0.30
#3-OA	633040	2006-12-26	1:36-6:56	1.80	1.43	1.33	4.35	4.13	0.22
#3-OA	733001	1/23/2007	15:40-18:20	0.52	0.24	0.00	2.54	1.90	0.64
#3-OA	733002	2/6/2007	13:06-13:33	10.33	9.65	2.33	7.83	6.23	1.60
#3-OA	733003	2/6/2007	5:22-8:02	2.36	1.73	1.64	2.93	1.86	1.07
#3-OA	733004	3/16/2007	18:46-19:13	2.87	2.10	1.57	8.28	3.86	4.42
#3-OA	733005	3/16/2007	19:26-19:53	2.37	1.82	1.86	10.54	5.40	5.14
#3-OA	733006	3/16/2007	20:06-20:33	2.48	2.12	1.43	11.98	8.06	3.92
#3-OA	733007	3/17/2007	21:13-2:33	2.10	2.03	1.76	7.28	3.18	4.10
#3-OA	733008	3/17/2007	5:13-10:33	2.48	1.80	1.12	5.65	3.51	2.14
#3-OA	733009	3/17/2007	13:13-18:33	2.00	1.75	1.60	6.70	4.98	1.72
#3-OA	733010	3/18/2007	21:13-2:33	2.25	1.78	1.42	5.18	3.99	1.20
#3-OA	733011	3/18/2007	5:13-10:33	1.84	1.63	1.18	4.32	3.82	0.50
#3-OA	733012	3/18/2007	13:13	2.23	1.72	1.34	7.02	6.43	0.59

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#3-OA	733013	3/18/2007	15:07-15:34	2.69	2.00	1.25	2.51	2.14	0.37
#3-OA	733014	3/18/2007	15:47-16:14	2.85	1.97	1.27	3.59	3.20	0.39
#3-OA	733015	3/18/2007	16:27-16:54	2.81	1.96	1.20	3.29	2.97	0.32
#3-OA	733016	3/18/2007	17:34-22:54	2.87	2.00	1.26	3.95	3.71	0.25
#3-OA	733017	3/19/2007	1:34-6:54	2.55	2.05	1.26	3.12	2.95	0.16
#3-OA	733018	3/19/2007	9:34-15:54	2.53	2.01	1.27	1.92	0.82	1.10
#3-OA	733019	3/19/2007	17:34-22:54	2.17	2.14	1.23	0.80	0.48	0.32
#3-OA	733020	3/20/2007	1:34-6:54	2.98	2.12	1.30	1.19	1.06	0.14
#3-OA	733021	3/20/2007	9:34-12:14	2.30	2.12	1.13	0.63	0.42	0.20
#4-CON	681026	2006-7-11	16:56-17:23	1.66	1.53	1.50	1.97	1.56	0.42
#4-CON	681027	2006-7-11	17:36-18:03	2.10	1.94	1.75	2.26	2.07	0.19
#4-CON	681028	2006-7-11	18:16-18:43	2.32	2.17	1.95	1.62	1.49	0.13
#4-CON	681029	2006-7-11	19:23-00:47	2.11	2.08	1.89	1.25	1.09	0.16
#4-CON	681030	2006-7-12	03:23-08:43	2.13	2.10	1.85	1.14	1.00	0.15
#4-CON	681031	2006-7-12	11:23-16:43	3.87	3.54	3.36	3.48	3.38	0.10
#4-CON	681032	2006-7-12	19:23-00:43	4.15	4.07	3.59	4.73	4.73	0.00
#4-CON	681033	2006-7-13	03:23-08:43	4.68	3.94	3.58	0.87	0.87	0.00
#4-CON	681034	2006-8-19	13:46-14:13	1.79	1.54	1.62	2.55	1.07	1.48
#4-CON	681035	2006-8-19	14:26-14:52	1.64	1.39	1.43	2.77	1.74	1.03
#4-CON	681036	2006-8-19	15:06-15:33	1.25	1.09	1.11	2.25	1.70	0.54

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-CON	681037	2006-8-19	16:13-21:33	1.10	0.71	0.77	1.81	1.61	0.20
#4-CON	681038	2006-8-20	00:13-05:33	0.95	0.63	0.57	2.12	2.01	0.12
#4-CON	681039	2006-8-20	08:13-13:33	1.21	0.90	0.87	2.12	1.89	0.23
#4-CON	681040	2006-8-20	16:13-21:33	1.32	0.82	0.78	2.24	2.10	0.14
#4-CON	681041	2006-8-21	00:13-05:33	1.25	0.78	0.69	2.07	2.00	0.07
#4-CON	681042	2006-8-21	8:13	2.71	1.27	1.21	2.52	2.52	0.00
#4-CON	681043	2006-8-26	16:53-17:20	4.33	3.72	3.93	4.15	3.62	0.53
#4-CON	681044	2006-8-26	17:33-18:00	4.95	4.10	4.17	4.43	4.23	0.20
#4-CON	681045	2006-8-26	18:13-18:40	5.00	4.24	4.24	4.72	4.45	0.27
#4-CON	681046	2006-8-26	19:20-00:40	5.19	4.32	4.30	3.00	2.79	0.20
#4-CON	681047	2006-8-27	03:20-08:40	5.13	4.52	4.25	5.57	5.34	0.23
#4-CON	681048	2006-8-27	11:20-16:40	4.80	4.38	4.03	3.52	3.43	0.09
#4-CON	681049	2006-8-27	17:20-00:40	5.10	4.82	3.85	0.47	0.20	0.27
#4-CON	681050	2006-12-24	15:04-15:31	1.90	1.84	0.89	3.44	3.10	0.34
#4-CON	681051	2006-12-24	15:44-16:11	2.56	2.09	1.82	3.98	3.35	0.63
#4-CON	681052	2006-12-24	16:24-16:51	2.48	2.03	1.93	3.18	2.74	0.44
#4-CON	681053	2006-12-24	17:31-22:51	2.37	1.80	1.45	7.48	7.18	0.30
#4-CON	681054	2006-12-25	1:31-6:51	1.41	1.37	1.28	3.37	3.07	0.31

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-CON	681055	2006-12-25	9:31-14:51	1.46	1.24	1.13	4.54	4.45	0.09
#4-CON	681056	2006-12-25	17:31-22:51	2.55	2.09	2.08	4.14	3.83	0.31
#4-CON	681057	2006-12-26	1:31-6:51	1.91	1.50	1.43	2.24	2.12	0.12
#4-CON	681058	2006-12-26	9:31-12:11	2.11	2.03	1.85	2.76	2.70	0.05
#4-CON	781001	2/27/2007	5:14-5:41	3.85	3.52	3.66	20.63	4.41	16.22
#4-CON	781002	2/27/2007	5:54-6:21	4.35	3.74	3.49	15.37	4.76	10.60
#4-CON	781003	2/27/2007	6:34-7:01	3.21	3.02	2.58	12.13	3.40	8.73
#4-CON	781004	2/27/2007	7:41-13:01	1.65	1.37	1.28	4.70	1.28	3.42
#4-CON	781005	2/27/2007	15:41-21:01	0.38	0.21	0.00	1.31	0.81	0.50
#4-CON	781006	2/28/2007	23:41-5:01	0.31	0.14	0.18	0.60	0.45	0.15
#4-CON	781007	2/28/2007	7:41-13:01	0.22	0.15	0.16	0.83	0.65	0.18
#4-CON	781008	2/28/2007	15:41-21:01	0.16	0.09	0.00	0.87	0.68	0.19
#4-CON	781009	3/1/2007	23:11-2:21	0.18	0.12	0.00	0.96	0.87	0.09
#4-CON	781010	3/16/2007	14:44-15:11	2.26	1.33	1.24	4.11	3.98	0.13
#4-CON	781011	3/16/2007	15:24-15:51	1.84	1.60	1.46	4.86	1.88	2.98
#4-CON	781012	3/16/2007	16:04-16:31	1.81	1.59	1.41	6.22	3.27	2.95
#4-CON	781013	3/16/2007	17:11-22:31	1.81	1.61	1.42	4.09	1.39	2.70
#4-CON	781014	3/17/2007	1:11-6:31	1.73	1.59	1.53	5.71	3.39	2.32
#4-CON	781015	3/17/2007	9:11-14:31	1.17	1.08	0.86	3.10	2.16	0.94
#4-CON	781016	3/17/2007	17:11-22:31	0.63	0.55	0.15	1.69	0.60	1.09

DTP = dissolved total P.

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-CON	781017	3/18/2007	1:11-6:31	0.72	0.43	0.68	2.57	2.12	0.45
#4-CON	781018	3/18/2007	9:11-11:51	0.20	0.14	0.00	0.54	0.36	0.18
#4-CON	781019	3/22/2007	17:24-17:51	1.87	1.81	0.66	4.57	4.52	0.05
#4-CON	781020	3/22/2007	18:04-18:31	1.95	1.10	0.00	2.98	2.98	0.00
#4-CON	781021	3/22/2007	18:44-19:11	1.96	1.07	0.67	1.46	1.34	0.12
#4-CON	781022	3/23/2007	19:51-1:11	2.32	1.06	0.35	5.42	5.42	0.00
#4-CON	781023	3/23/2007	3:51-9:11	2.39	1.09	0.66	4.60	4.60	0.00
#4-CON	781024	3/23/2007	11:51-17:11	2.57	1.20	0.69	4.23	4.23	0.00
#4-CON	781025	3/24/2007	19:51-1:11	2.72	1.13	0.53	4.84	4.84	0.00
#4-CON	781026	3/24/2007	3:51-9:11	1.69	0.76	0.14	1.30	1.30	0.00
#4-CON	781027	3/24/2007	11:51-14:31	0.58	0.34	0.22	1.80	1.80	0.00
#4-OA	683016	2006-7-12	16:27-17:07	1.02	0.89	0.87	3.45	1.73	1.72
#4-OA	683017	2006-7-12	17:07-17:47	0.99	0.86	0.95	2.88	1.30	1.58
#4-OA	683018	2006-7-12	17:47-18:54	1.08	0.95	0.90	3.07	1.33	1.74
#4-OA	683019	2006-7-12	21:34	1.20	1.08	0.72	1.08	0.26	0.82
#4-OA	683020	2006-8-19	13:37-14:04	0.99	0.88	0.97	2.00	1.01	0.98
#4-OA	683021	2006-8-19	14:16-14:44	0.82	0.78	0.89	2.03	1.24	0.80
#4-OA	683022	2006-8-19	14:57-15:24	0.79	0.78	0.78	1.94	1.24	0.69
#4-OA	683023	2006-8-19	16:04	0.76	0.75	0.00	1.67	1.61	0.06
#4-OA	683024	2006-8-20	13:24	1.19	1.11	0.99	2.26	2.12	0.14

DTP = dissolved total P.

Table 7 Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-OA	683025	2006-8-20	16:04-21:24	1.09	1.08	0.96	2.46	2.35	0.11
#4-OA	683026	2006-8-21	00:04-05:24	1.25	1.07	0.85	2.67	2.55	0.12
#4-OA	683027	2006-8-21	8:04	1.27	1.16	0.98	3.87	3.82	0.05
#4-OA	683028	2006-8-23	14:35-15:02	1.43	1.20	0.78	2.91	2.70	0.21
#4-OA	683029	2006-8-23	15:15-15:42	1.12	1.07	0.76	3.44	3.24	0.20
#4-OA	683030	2006-8-23	15:55-16:22	1.05	1.03	0.73	2.27	2.11	0.16
#4-OA	683031	2006-8-23	17:02-22:22	1.40	1.19	0.82	3.38	3.33	0.05
#4-OA	683032	2006-8-24	01:02-06:22	1.63	1.37	1.16	4.09	4.07	0.02
#4-OA	683033	2006-8-24	09:02-14:22	2.00	1.69	1.25	4.35	4.30	0.05
#4-OA	683034	2006-8-24	17:02-22:22	2.44	1.91	1.42	4.76	4.72	0.04
#4-OA	683035	2006-8-25	01:02-06:22	2.62	2.34	1.63	5.28	5.28	0.00
#4-OA	683036	2006-8-25	18:18-18:45	2.13	1.68	1.28	4.64	4.29	0.35
#4-OA	683037	2006-8-25	18:58-19:25	2.11	1.75	1.52	4.17	3.57	0.60
#4-OA	683038	2006-8-25	19:38-20:05	2.10	1.79	1.60	3.81	3.18	0.63
#4-OA	683039	2006-8-25	20:45-02:05	2.14	1.78	1.49	6.16	5.55	0.61
#4-OA	683040	2006-8-26	04:45-10:05	2.75	2.17	1.59	0.63	0.00	0.63
#4-OA	683041	2006-8-26	12:45-18:05	2.66	2.21	1.63	6.76	6.19	0.57
#4-OA	683042	2006-8-26	20:45-02:05	2.93	2.43	1.66	5.17	4.54	0.63
#4-OA	683043	2006-8-27	04:45-10:05	3.05	2.45	2.03	6.77	6.37	0.40
#4-OA	683044	2006-8-27	12:45-15:25	2.98	2.58	1.57	5.72	5.56	0.16

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-OA	683045	2006-8-30	2:22-2:49	1.05	0.59	0.94	0.90	0.79	0.11
#4-OA	683046	2006-8-30	3:02-3:29	0.90	0.61	0.68	0.72	0.53	0.18
#4-OA	683047	2006-8-30	3:42-4:09	0.92	0.64	0.71	0.31	0.00	0.31
#4-OA	683048	2006-8-30	4:49-10:09	0.91	0.80	0.65	0.26	0.00	0.26
#4-OA	683049	2006-8-30	12:49-18:09	1.68	1.40	1.23	5.34	4.88	0.46
#4-OA	683050	2006-8-30	20:49-02:09	2.19	1.98	1.73	5.12	4.53	0.59
#4-OA	683051	2006-8-31	4:49-10:09	2.46	2.15	2.02	1.82	1.50	0.32
#4-OA	683052	2006-8-31	12:49-18:09	2.59	2.21	1.86	0.29	0.00	0.29
#4-OA	683053	2006-8-31	20:49-23:29	2.74	2.28	2.02	0.22	0.06	0.16
#4-OA	683054	2006-12-8	15:12-15:39	0.64	0.23	0.00	5.52	2.60	2.92
#4-OA	683055	2006-12-11	10:37-11:04	0.15	0.13	0.00	0.70	0.53	0.17
#4-OA	683056	2006-12-11	11:17-11:44	0.14	0.11	0.00	0.56	0.45	0.11
#4-OA	683057	2006-12-11	11:57-12:24	0.09	0.09	0.00	0.58	0.39	0.20
#4-OA	683058	2006-12-11	13:04-18:24	0.10	0.10	0.00	0.52	0.39	0.13
#4-OA	683059	2006-12-11	21:04-02:24	0.11	0.10	0.00	1.01	0.98	0.03
#4-OA	683060	2006-12-12	05:04-10:24	0.12	0.10	0.00	0.42	0.32	0.11
#4-OA	683061	2006-12-12	13:04-18:24	0.15	0.13	0.00	0.58	0.48	0.10
#4-OA	683062	2006-12-12	21:04	0.13	0.12	0.00	1.38	1.38	0.01
#4-OA	783001	2/3/2007	12:26-12:53	2.01	0.28	0.23	2.33	1.33	1.01
#4-OA	783002	2/3/2007	13:06-13:33	0.50	0.19	0.18	1.75	1.15	0.60
#4-OA	783003	2/3/2007	13:46-14:13	0.43	0.17	0.14	1.60	1.18	0.42

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-OA	783004	2/3/2007	14:53-20:13	0.43	0.19	0.20	1.30	0.98	0.32
#4-OA	783005	2/4/2007	22:53-4:13	0.27	0.17	0.12	1.44	1.16	0.28
#4-OA	783006	2/4/2007	6:53-12:13	0.23	0.20	0.00	1.36	1.17	0.19
#4-OA	783007	2/4/2007	14:53-20:13	0.23	0.19	0.00	1.00	0.84	0.16
#4-OA	783008	2/5/2007	22:53-4:13	0.22	0.17	0.00	1.19	1.05	0.14
#4-OA	783009	2/5/2007	6:53-9:33	0.57	0.17	0.00	1.07	0.94	0.12
#4-OA	783010	2/6/2007	1:25-4:05	0.26	0.15	0.00	1.99	1.22	0.77
#4-OA	783011	2/6/2007	6:45-12:05	0.24	0.10	0.00	1.17	1.13	0.04
#4-OA	783012	2/23/2007	20:52-21:19	0.43	0.28	0.00	2.41	2.41	0.00
#4-OA	783013	2/23/2007	21:32-21:19	0.23	0.15	0.00	1.55	0.83	0.72
#4-OA	783014	2/23/2007	22:12-22:39	0.18	0.13	0.00	1.00	0.69	0.31
#4-OA	783015	2/23/2007	23:19-4:39	0.15	0.11	0.00	0.70	0.51	0.19
#4-OA	783016	2/24/2007	7:19-12:39	0.13	0.11	0.00	0.62	0.51	0.11
#4-OA	783017	2/24/2007	15:19-20:39	0.13	0.10	0.00	0.83	0.62	0.21
#4-OA	783018	2/24/2007	23:19-4:39	0.12	0.10	0.00	0.93	0.69	0.23
#4-OA	783019	2/25/2007	7:19-12:39	0.12	0.10	0.00	0.62	0.51	0.11
#4-OA	783020	2/25/2007	15:19-17:59	0.18	0.10	0.00	0.89	0.80	0.09
#4-OA	783021	2/26/2007	13:27-13:54	0.17	0.12	0.00	1.48	0.76	0.72
#4-OA	783022	2/26/2007	14:07-14:34	0.16	0.11	0.00	2.03	1.65	0.38
#4-OA	783023	2/26/2007	14:47-15:14	0.14	0.09	0.00	1.10	1.09	0.01
#4-OA	783024	2/26/2007	15:54-21:14	0.14	0.09	0.00	0.43	0.31	0.12

Table 7. Concentrations of total P, dissolved total P (DTP), PO₄³⁻-P, total N, total Kjeldahl N (TKN), and NO₃⁻-N in surface runoff samples collected in July, 2006-March, 2007 (Continued).

Location	Field ID	Date of sampling	Time of sampling	Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N
				mg L ⁻¹					
#4-OA	783025	2/27/2007	23:54-5:14	1.08	0.94	0.86	5.92	1.67	4.25
#4-OA	783026	2/27/2007	7:54-13:14	1.15	1.02	1.04	7.31	2.34	4.97
#4-OA	783027	2/27/2007	15:54-21:14	0.22	0.17	0.14	1.14	0.65	0.49
#4-OA	783028	2/28/2007	23:54-5:14	0.16	0.11	0.00	0.81	0.54	0.27
#4-OA	783029	2/28/2007	7:54-10:34	0.13	0.09	0.00	0.23	0.13	0.10
#4-OA	783034	3/20/2007	15:45-16:12	0.30	0.22	0.00	0.94	0.83	0.11
#4-OA	783035	3/20/2007	16:25-16:52	0.15	0.09	0.00	1.13	1.07	0.06
#4-OA	783036	3/20/2007	17:05-17:32	0.12	0.09	0.00	3.45	3.34	0.11
#4-OA	783037	3/20/2007	18:45-23:32	0.13	0.08	0.00	1.13	1.05	0.07
#4-OA	783038	3/21/2007	2:12-7:32	0.12	0.10	0.00	1.68	1.63	0.04
#4-OA	783039	3/21/2007	10:12-15:32	0.83	0.13	0.00	2.70	2.53	0.17
#4-OA	783040	3/21/2007	18:12-23:32	0.21	0.09	0.00	1.40	1.24	0.16
#4-OA	783041	3/22/2007	2:12-7:32	0.15	0.09	0.00	1.08	1.02	0.06
#4-OA	783042	3/22/2007	10:12-12:52	0.12	0.09	0.00	1.36	1.36	0.00
#4-OA	783043	3/30/2007	20:11-20:38	0.98	0.12	0.00	1.17	1.11	0.06
#4-OA	783044	3/30/2007	20:51-21:18	0.33	0.09	0.00	0.13	0.13	0.00
#4-OA	783045	3/30/2007	21:31-21:58	0.18	0.10	0.00	1.46	1.46	0.00
#4-OA	783046	3/31/2007	22:38-3:58	0.29	0.10	0.00	1.65	1.65	0.00
#4-OA	783047	3/31/2007	6:38-11:58	0.29	0.09	0.00	1.21	0.72	0.49
#4-OA	783048	3/31/2007	14:38-19:58	0.14	0.08	0.00	2.28	2.28	0.00

Table 8. Mean values of quality properties of runoff water samples collected during July, 2006-March, 2007

Location	Sample		pH	EC	Turbidity	Solid	SO ₄ ²⁻ -S	Ca	Mg	K	Na
	number			uS/cm	NTU	g L ⁻¹	-----		mg L ⁻¹	-----	
#3-CON	N=30	Mean	7.31	1046	18.60	0.620	29.93	71.33	17.35	30.77	65.78
		SD	0.20	294	29.33	0.292	8.47	24.47	5.92	11.52	28.34
#3-OA	N=40	Mean	7.55	1338	27.71	0.915	39.87	101.2	22.86	27.58	115.0
		SD	0.36	557	42.27	0.445	20.80	41.61	9.78	14.82	62.84
#4-CON	N=59	Mean	7.22	1265	17.14	0.759	36.58	94.64	21.16	15.83	106.5
		SD	0.47	456	14.38	0.458	19.87	33.69	8.38	7.28	49.98
#4-OA	N=87	Mean	7.22	1129	12.80	0.846	35.04	84.50	18.74	7.09	101.5
		SD	0.83	597	18.81	0.520	24.53	45.67	10.94	2.57	58.87
			Total P	DTP	PO ₄ ³⁻ -P	TN	TKN	NO ₃ ⁻ -N	NH ₄ ⁺ -N		
			----- mg L ⁻¹ -----								
#3-CON	N=30	Mean	1.848	1.518	1.118	7.452	2.831	4.621	0.241		
		SD	0.698	0.552	0.430	4.293	0.948	3.702	0.245		
#3-OA	N=40	Mean	2.459	2.060	1.498	3.679	2.774	0.906	0.846		
		SD	1.638	1.552	0.895	2.690	1.815	1.272	2.377		
#4-CON	N=59	Mean	2.234	1.807	1.586	3.671	2.615	1.056	0.303		
		SD	1.403	1.303	1.307	3.364	1.544	2.715	0.388		
#4-OA	N=87	Mean	0.888	0.695	0.522	2.186	1.754	0.431	0.164		
		SD	0.878	0.758	0.647	1.778	1.561	0.774	0.199		
			Cd	Co	Cr	Cu	Fe	Ni	Pb	Zn	Mn
			----- mg L ⁻¹ -----								
#3-CON	N=30	Mean	0.000	0.000	0.000	0.145	0.160	0.000	0.000	0.087	0.032
		SD	0.000	0.000	0.000	0.068	0.107	0.000	0.000	0.037	0.065
#3-OA	N=40	Mean	0.000	0.000	0.000	0.158	0.278	0.000	0.000	0.085	0.080
		SD	0.000	0.000	0.000	0.098	0.472	0.001	0.000	0.054	0.175
#4-CON	N=59	Mean	0.000	0.000	0.000	0.183	0.574	0.000	0.000	0.105	0.155
		SD	0.000	0.000	0.000	0.146	0.807	0.000	0.000	0.088	0.281
#4-OA	N=87	Mean	0.000	0.000	0.000	0.171	0.666	0.000	0.000	0.098	0.040
		SD	0.000	0.000	0.001	0.209	1.117	0.000	0.001	0.098	0.084

Loads of Nutrients and Metals in Runoff Water

The rainfall, discharge, and loads of various N and P forms, solids, and metals are presented in Tables 9-1 to 9-3. Rainfall was comparable between the control and treatment field site and among the locations. However, runoff discharge rate varied greatly with time and among the locations. These variances affected the loads of N, P, solids, and metals from each location. The loads of various P forms per rain event ranged from a few to approximately 5000 g ha⁻¹ and ortho-P accounted for more than 50% of total P loads (Table 9-1). The effects of organic amendment on P loads were largely dominated by discharge variance. For some unknown reason, much less runoff water discharges were recorded at the organic amendment field sites than the conventional sites. As a result, the annual loads of all P forms were greatly reduced (Tables 9-1 and 9-4). More N was lost through surface runoff than P, and the measured load of total N per rain event was as high as 15.6 kg ha⁻¹ (Table 9-2). The annual loads of total N, TKN, and NO₃-N varied greatly among the different field sites (Table 9-4). The highest annual loads of total N, TKN, and NO₃-N were 71, 25 and 46, kg ha⁻¹, respectively. Similar to P, the results of organic amendment effect on N loads were also dominated by the big difference in water discharge rate (Table 9-4).

The loads of Cd, Ni, and Pb in runoff water were negligible, as the concentrations of the metals in most runoff water samples were below detection limit (< 0.3 ppb) (Table 9-3). Copper and Zn were detected in most of the runoff water samples collected during the past year. The highest measured load of Cu per rain event was 481 g ha⁻¹, which is quite considerable for a trace element. There was no clear effect of organic amendment on the loads of Cu and Zn though the annual loads of Cu and Zn were much reduced due to a big difference in discharge rate between the amendment and the conventional site (Table 9-4).

Table 9-1. Mean concentrations and loads of total P, dissolved total P (DTP), PO₄³⁻-P, and solids in surface runoff for each rain event in July, 2006-March, 2007.

Location	Code	Date of rain events	Number of samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						Total P	DTP	PO ₄ ³⁻ -P	Solid	Total P	DTP	PO ₄ ³⁻ -P	Solid
						mg L ⁻¹			g L ⁻¹		g ha ⁻¹		kg ha ⁻¹
#9-CON	11	2006-8-19	1	0.00	0.00	3.44	1.97	1.33	0.10	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-1	1	21.34	0.00	7.60	2.54	2.16	0.72	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-7	1	16.51	5.27	5.39	1.29	0.00	0.92	1173.12	281.34	0.00	201.44
#9-CON	11	2006-12-16	3	22.10	11.32	1.02	0.67	0.64	0.27	479.52	315.09	301.21	124.77
#9-CON	11	2006-12-17	1	14.48	9.98	1.83	1.11	0.92	10.27	752.57	455.77	380.61	4233.92
#3-CON	31	2006-7-1	5	28.70	0.23	2.59	1.60	0.81	0.47	3.24	2.00	1.01	0.59
#3-CON	31	2006-7-2	3	9.91	0.00	2.07	1.16	1.07	0.60	0.00	0.00	0.00	0.00
#3-CON	31	2006-7-3	1	1.27	0.00	2.32	0.74	0.67	0.79	0.00	0.00	0.00	0.00
#3-CON	31	2006-8-23	1	14.22	52.16	1.31	1.24	1.14	0.56	374.06	354.88	326.33	160.33
#3-CON	31	2006-8-24	3	2.03	70.02	0.99	0.89	0.84	0.60	379.14	342.05	321.30	230.57
#3-CON	31	2006-8-25	4	30.23	159.70	1.09	1.16	0.91	0.79	957.79	1016.91	800.13	692.44
#3-CON	31	2006-8-26	3	13.21	150.07	1.20	1.19	0.82	1.28	990.07	980.84	671.30	1054.30
#3-CON	31	2006-8-29	1	10.67	93.37	1.50	1.38	1.12	0.21	768.31	705.65	573.96	107.62
#3-CON	31	2006-8-30	2	51.05	408.39	2.21	2.07	1.49	0.31	4962.75	4640.14	3335.76	689.25
#3-CON	31	2006-8-31	1	6.60	277.48	2.21	2.28	1.69	0.34	3371.94	3469.16	2568.68	525.42
#3-CON	31	2006-9-1	1	5.84	80.97	2.10	2.00	1.48	0.61	934.47	887.33	656.75	273.32
#3-CON	31	2006-9-2	3	14.99	144.92	2.23	2.13	1.47	0.49	1775.82	1691.48	1170.58	391.07
#3-CON	31	2006-9-3	2	7.37	37.94	2.41	2.33	2.08	0.52	502.54	485.61	432.66	108.27

Table 9-1. Mean concentrations and loads of total P, dissolved total P (DTP), PO₄³⁻-P, and solids in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						Total P	DTP	PO ₄ ³⁻ -P	Solid	Total P	DTP	PO ₄ ³⁻ -P	Solid
						mg L ⁻¹			g L ⁻¹		g ha ⁻¹		kg ha ⁻¹
#3-OA	33	2006-7-10	3	47.75	0.00	2.48	2.05	1.78	0.95	0.00	0.00	0.00	0.00
#3-OA	33	2006-8-23	1	14.22	0.45	2.31	2.20	1.75	0.13	5.69	5.42	4.31	0.32
#3-OA	33	2006-8-30	4	51.05	0.70	2.94	2.66	2.35	0.10	11.36	10.27	9.06	0.38
#3-OA	33	2006-9-1	1	5.84	0.50	4.68	4.14	3.51	0.13	12.93	11.44	9.69	0.35
#3-OA	33	2006-9-2	1	14.99	0.44	4.90	4.68	4.10	0.21	11.75	11.22	9.83	0.50
#3-OA	33	2006-12-11	5	0.76	0.00	0.66	0.47	0.42	1.18	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-12	2	0.00	0.00	0.58	0.53	0.35	1.19	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-25	1	13.72	44.30	1.98	1.61	1.51	0.50	480.51	390.79	367.02	121.56
#3-OA	33	2006-12-26	1	9.65	48.74	1.80	1.43	1.33	0.76	482.39	381.36	356.32	203.32
#3-OA	33	2007-1-23	1	6.86	0.29	0.52	0.24	0.00	1.24	0.83	0.38	0.00	1.97
#3-OA	33	2007-2-6	2	0.25	0.21	4.84	5.01	6.99	1.55	5.58	5.77	8.06	1.79
#3-OA	33	2007-3-16	3	10.16	0.00	2.57	2.01	1.62	0.89	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-17	3	0.00	0.00	2.19	1.86	1.49	0.99	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-18	7	0.00	0.00	1.79	1.87	1.27	1.14	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-19	3	0.00	0.00	2.42	2.07	1.25	1.13	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-20	2	7.62	0.00	2.14	2.12	1.22	1.41	0.00	0.00	0.00	0.00
#4-CON	81	2006-7-11	4	58.17	3.63	2.05	1.93	1.77	0.53	33.17	31.27	28.73	8.59
#4-CON	81	2006-7-12	3	4.83	1.03	3.38	3.23	2.93	1.38	15.61	14.93	13.53	6.37
#4-CON	81	2006-8-19	4	7.11	0.00	1.44	1.18	1.23	0.19	0.00	0.00	0.00	0.00

Table 9-1. Mean concentrations and loads of total P, dissolved total P (DTP), PO₄³⁻-P, and solids in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						Total P	DTP	PO ₄ ³⁻ -P	Solid	Total P	DTP	PO ₄ ³⁻ -P	Solid
						mg L ⁻¹			g L ⁻¹	g ha ⁻¹			kg ha ⁻¹
#4-CON	81	2006-8-20	3	19.81	0.00	1.16	0.79	0.74	0.12	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-21	2	0.00	0.00	1.98	1.02	0.95	0.62	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-26	4	16.51	0.12	4.87	4.10	4.16	0.17	2.70	2.27	2.31	0.09
#4-CON	81	2006-8-27	3	0.00	0.00	5.01	4.57	4.04	0.33	0.00	0.00	0.00	0.00
#4-CON	81	2006-12-24	4	33.78	1.13	2.33	1.94	1.52	0.43	11.72	9.76	7.67	2.17
#4-CON	81	2006-12-25	3	40.13	15.04	1.81	1.57	1.50	0.64	121.22	105.15	100.48	42.82
#4-CON	81	2006-12-26	2	0.76	1.31	2.01	1.76	1.64	0.85	11.75	10.31	9.57	4.98
#4-CON	81	2007-2-27	5	9.40	0.00	2.52	2.37	2.61	1.01	0.00	0.00	0.00	0.00
#4-CON	81	2007-2-28	3	0.00	0.00	0.23	0.13	0.11	0.71	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-1	1	0.00	0.00	0.18	0.12	0.00	1.08	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-16	4	15.49	0.00	1.93	1.53	1.38	1.04	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-17	3	0.00	0.00	1.18	1.07	1.15	1.04	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-18	2	0.00	0.00	0.46	0.29	0.34	1.29	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-22	3	8.13	0.00	1.90	1.33	0.44	0.92	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-23	3	5.84	0.00	2.43	1.12	0.57	1.33	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-24	3	0.00	0.00	1.66	0.74	0.29	1.23	0.00	0.00	0.00	0.00
#4-OA	83	2006-7-12	4	4.83	0.00	1.07	0.94	0.86	0.74	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-19	4	7.11	0.00	0.84	0.80	0.66	0.33	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-20	2	19.81	0.00	1.14	1.09	0.98	0.29	0.00	0.00	0.00	0.00

Table 9-1. Mean concentrations and loads of total P, dissolved total P (DTP), PO₄³⁻-P, and solids in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						Total P	DTP	PO ₄ ³⁻ -P	Solid	Total P	DTP	PO ₄ ³⁻ -P	Solid
						mg L ⁻¹			g L ⁻¹		g ha ⁻¹		kg ha ⁻¹
#4-OA	83	2006-8-21	2	0.00	0.00	1.26	1.12	0.92	0.42	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-23	4	25.65	0.00	1.25	1.12	0.77	0.08	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-24	3	2.29	0.00	2.02	1.66	1.27	0.06	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-25	5	33.02	0.00	2.22	1.87	1.50	0.69	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-26	3	16.51	0.00	2.78	2.27	1.62	0.83	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-27	2	0.00	0.00	3.01	2.52	1.80	0.70	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-30	2	51.05	0.00	1.28	1.00	0.99	0.22	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-31	3	6.60	0.00	2.59	2.21	1.96	0.25	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-8	1	0.00	0.00	0.64	0.23	0.00	0.98	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-11	5	1.02	0.00	0.12	0.11	0.00	1.67	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-12	3	0.00	0.00	0.13	0.12	0.00	1.16	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-3	4	0.00	0.00	0.84	0.21	0.21	1.02	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-4	3	0.00	0.06	0.24	0.19	0.04	1.01	0.06	0.05	0.01	0.27
#4-OA	83	2007-2-5	2	0.51	0.00	0.39	0.17	0.00	1.03	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-6	2	0.00	0.00	0.25	0.13	0.11	1.02	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-23	4	0.00	0.00	0.25	0.17	0.00	1.19	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-24	3	0.00	0.27	0.13	0.10	0.00	1.04	0.16	0.12	0.00	1.25
#4-OA	83	2007-2-25	2	0.00	0.02	0.15	0.10	0.00	1.08	0.01	0.01	0.00	0.10
#4-OA	83	2007-2-26	4	0.00	0.00	0.15	0.10	0.00	1.00	0.00	0.00	0.00	0.00

Table 9-1. Mean concentrations and loads of total P, dissolved total P (DTP), $\text{PO}_4^{3-}\text{-P}$, and solids in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						Total P	DTP	$\text{PO}_4^{3-}\text{-P}$	Solid	Total P	DTP	$\text{PO}_4^{3-}\text{-P}$	Solid
						mg L ⁻¹			g L ⁻¹	g ha ⁻¹			kg ha ⁻¹
#4-OA	83	2007-2-27	3	9.40	0.46	0.82	0.71	0.68	0.94	1.68	1.46	1.40	1.93
#4-OA	83	2007-2-28	2	0.00	0.57	0.15	0.10	0.00	0.84	0.38	0.25	0.00	2.14
#4-OA	83	2007-3-20	4	12.19	0.00	0.18	0.12	0.00	1.17	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-21	3	0.51	0.00	0.39	0.11	0.00	1.20	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-22	2	8.13	0.00	0.14	0.09	0.00	1.11	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-30	3	13.46	0.00	0.50	0.10	0.00	1.22	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-31	3	0.25	0.00	0.24	0.09	0.10	1.55	0.00	0.00	0.00	0.00

Table 9-2. Mean concentrations and loads of total N, TKN (TKN), NO₃⁻-N, and NH₄⁺-N in surface runoff for each rain event in July, 2006-March, 2007.

Location	Co de	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN	TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN
						(mg L ⁻¹)				(g ha ⁻¹)			
#9-CON	11	2006-8-19	1	0	0	2.79	0.81	0.49	1.99	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-1	1	21.34	0.00	1.69	0.07	0.15	1.62	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-7	1	16.51	5.27	1.16	0.56	0.06	0.61	253.61	120.99	11.98	132.62
#9-CON	11	2006-12-16	3	22.10	11.32	1.16	0.27	0.20	0.89	541.08	126.23	95.76	414.85
#9-CON	11	2006-12-17	1	14.48	9.98	1.05	0.13	0.00	0.92	431.35	51.66	0.00	379.69
#3-CON	31	2006-7-1	5	28.70	0.23	3.67	1.14	0.62	2.53	4.59	1.42	0.77	3.17
#3-CON	31	2006-7-2	3	9.91	0.00	1.76	0.39	0.30	1.37	0.00	0.00	0.00	0.00
#3-CON	31	2006-7-3	1	1.27	0.00	1.46	0.25	0.24	1.20	0.00	0.00	0.00	0.00
#3-CON	31	2006-8-23	1	14.22	52.16	8.53	5.22	0.15	3.31	2441.94	1494.30	42.66	947.65
#3-CON	31	2006-8-24	3	2.03	70.02	11.34	8.08	0.09	3.26	4356.06	3103.18	35.99	1252.88
#3-CON	31	2006-8-25	4	30.23	159.70	8.33	5.26	0.22	3.06	7298.82	4612.55	194.15	2686.27
#3-CON	31	2006-8-26	3	13.21	150.07	16.26	12.69	0.30	3.57	13394.2	10451.8	247.38	2942.44
#3-CON	31	2006-8-29	1	10.67	93.37	4.84	2.34	0.09	2.51	2481.57	1197.85	45.61	1283.71
#3-CON	31	2006-8-30	2	51.05	408.39	6.95	4.21	0.06	2.74	15588.98	9440.67	136.73	6148.31
#3-CON	31	2006-8-31	1	6.60	277.48	9.14	6.24	0.00	2.90	13917.1	9500.50	1.52	4416.57
#3-CON	31	2006-9-1	1	5.84	80.97	8.78	5.06	0.18	3.72	3902.73	2249.94	77.77	1652.79
#3-CON	31	2006-9-2	3	14.99	144.92	7.18	4.00	0.10	3.18	5714.30	3184.69	75.56	2529.61
#3-CON	31	2006-9-3	2	7.37	37.94	7.83	4.46	0.05	3.38	1630.75	927.75	11.24	703.01

Table 9-2. Mean concentrations and loads of total N, TKN (TKN), NO₃⁻-N, and NH₄⁺-N in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN	TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN
						(mg L ⁻¹)				(g ha ⁻¹)			
#3-OA	33	2006-7-10	3	47.75	0.00	2.37	0.18	0.19	2.19	0.00	0.00	0.00	0.00
#3-OA	33	2006-8-23	1	14.22	0.45	4.35	1.03	0.10	3.32	10.71	2.53	0.24	8.18
#3-OA	33	2006-8-30	4	51.05	0.70	2.55	0.86	0.02	1.70	9.87	3.32	0.06	6.55
#3-OA	33	2006-9-1	1	5.84	0.50	4.16	0.10	0.10	4.06	11.49	0.29	0.27	11.20
#3-OA	33	2006-9-2	1	14.99	0.44	3.54	0.32	0.07	3.22	8.49	0.76	0.16	7.73
#3-OA	33	2006-12-11	5	0.76	0.00	1.54	0.13	0.72	1.41	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-12	2	0.00	0.00	1.03	0.04	0.27	0.99	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-25	1	13.72	44.30	2.65	0.30	0.47	2.35	644.05	73.44	114.51	570.61
#3-OA	33	2006-12-26	1	9.65	48.74	4.35	0.22	0.47	4.13	1163.36	59.56	124.67	1103.8
#3-OA	33	2007-1-23	1	6.86	0.29	2.54	0.64	0.48	1.90	4.04	1.02	0.76	3.02
#3-OA	33	2007-2-6	2	0.25	0.21	5.38	1.34	7.76	4.05	6.20	1.54	8.94	4.67
#3-OA	33	2007-3-16	3	10.16	0.00	10.27	4.49	1.11	5.77	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-17	3	0.00	0.00	6.54	2.66	1.16	3.89	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-18	7	0.00	0.00	4.27	0.52	0.67	3.75	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-19	3	0.00	0.00	1.95	0.53	0.12	1.42	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-20	2	7.62	0.00	0.91	0.17	0.42	0.74	0.00	0.00	0.00	0.00
#4-CON	81	2006-7-11	4	58.17	3.63	1.77	0.22	0.33	1.55	28.76	3.63	5.27	25.13
#4-CON	81	2006-7-12	3	4.83	1.03	3.12	0.08	0.44	3.03	14.39	0.38	2.02	14.00
#4-CON	81	2006-8-19	4	7.11	0.00	2.35	0.82	0.18	1.53	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-20	3	19.81	0.00	2.16	0.16	0.15	2.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-21	2	0.00	0.00	2.30	0.04	0.29	2.26	0.00	0.00	0.00	0.00

Table 9-2. Mean concentrations and loads of total N, TKN (TKN), NO₃⁻-N, and NH₄⁺-N in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN	TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN
						(mg L ⁻¹)				(g ha ⁻¹)			
#4-CON	81	2006-8-26	4	16.51	0.12	4.07	0.30	0.01	3.77	2.26	0.17	0.01	2.10
#4-CON	81	2006-8-27	3	0.00	0.00	3.19	0.20	0.17	2.99	0.00	0.00	0.00	0.00
#4-CON	81	2006-12-24	4	33.78	1.13	4.52	0.43	0.21	4.09	22.77	2.15	1.08	20.62
#4-CON	81	2006-12-25	3	40.13	15.04	4.02	0.23	0.14	3.78	269.41	15.67	9.26	253.74
#4-CON	81	2006-12-26	2	0.76	1.31	2.50	0.09	0.30	2.41	14.58	0.50	1.74	14.08
#4-CON	81	2007-2-27	5	9.40	0.00	10.83	7.89	1.08	2.93	0.00	0.00	0.00	0.00
#4-CON	81	2007-2-28	3	0.00	0.00	0.76	0.17	0.09	0.59	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-1	1	0.00	0.00	0.96	0.09	0.12	0.87	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-16	4	15.49	0.00	4.82	2.19	0.59	2.63	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-17	3	0.00	0.00	3.50	1.45	0.42	2.05	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-18	2	0.00	0.00	1.56	0.32	0.37	1.24	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-22	3	8.13	0.00	3.01	0.06	0.12	2.95	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-23	3	5.84	0.00	4.75	0.00	0.09	4.75	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-24	3	0.00	0.00	2.65	0.00	0.08	2.65	0.00	0.00	0.00	0.00
#4-OA	83	2006-7-12	4	4.83	0.00	2.62	1.47	0.02	1.15	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-19	4	7.11	0.00	1.91	0.63	0.06	1.28	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-20	2	19.81	0.00	2.36	0.12	0.02	2.23	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-21	2	0.00	0.00	3.27	0.08	0.02	3.18	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-23	4	25.65	0.00	3.00	0.15	0.03	2.85	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-24	3	2.29	0.00	4.40	0.04	0.00	4.36	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-25	5	33.02	0.00	4.81	0.44	0.17	4.38	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-26	3	16.51	0.00	4.18	0.61	0.35	3.58	0.00	0.00	0.00	0.00

Table 9-2. Mean concentrations and loads of total N, TKN (TKN), NO₃⁻-N, and NH₄⁺-N in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events				Loads in runoff for each events			
						TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN	TN	NO ₃ ⁻ -N	NH ₄ ⁺ -N	TKN
						(mg L ⁻¹)				(g ha ⁻¹)			
#4-OA	83	2006-8-27	2	0.00	0.00	6.25	0.28	0.24	5.97	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-30	2	51.05	0.00	2.11	0.32	0.02	1.79	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-31	3	6.60	0.00	0.78	0.26	0.00	0.52	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-8	1	0.00	0.00	5.52	2.92	0.45	2.60	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-11	5	1.02	0.00	0.67	0.13	0.12	0.55	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-12	3	0.00	0.00	0.80	0.07	0.10	0.72	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-3	4	0.00	0.00	1.75	0.58	0.16	1.16	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-4	3	0.00	0.06	1.27	0.21	0.10	1.06	0.34	0.06	0.03	0.28
#4-OA	83	2007-2-5	2	0.51	0.00	1.13	0.13	0.08	1.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-6	2	0.00	0.00	1.58	0.40	0.28	1.17	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-23	4	0.00	0.00	1.42	0.31	0.49	1.11	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-24	3	0.00	0.27	0.79	0.18	0.48	0.61	0.95	0.22	0.58	0.73
#4-OA	83	2007-2-25	2	0.00	0.02	0.75	0.10	0.17	0.65	0.07	0.01	0.02	0.06
#4-OA	83	2007-2-26	4	0.00	0.00	1.26	0.31	0.23	0.95	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-27	3	9.40	0.46	4.79	3.24	0.56	1.55	9.83	6.65	1.15	3.18
#4-OA	83	2007-2-28	2	0.00	0.57	0.52	0.19	0.30	0.34	1.32	0.48	0.76	0.86
#4-OA	83	2007-3-20	4	12.19	0.00	1.66	0.09	0.11	1.58	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-21	3	0.51	0.00	1.93	0.12	0.16	1.80	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-22	2	8.13	0.00	1.22	0.03	0.09	1.19	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-30	3	13.46	0.00	0.92	0.02	0.17	0.90	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-31	3	0.25	0.00	1.71	0.16	0.13	1.55	0.00	0.00	0.00	0.00

Table 9-3. Mean concentrations and loads of Cd, Cu, Ni, Pb, and Zn in surface runoff for each rain event in July, 2006-March, 2007.

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events					Loads in runoff for each events				
						Cd	Cu	Ni	Pb	Zn	Cd	Cu	Ni	Pb	Zn
						mg L ⁻¹					g ha ⁻¹				
#9-CON	11	2006-8-19	1	0.00	0.00	0.0000	0.1399	0.0000	0.0000	0.0338	0.00	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-1	1	21.34	0.00	0.0000	0.0574	0.0000	0.0000	0.0377	0.00	0.00	0.00	0.00	0.00
#9-CON	11	2006-9-7	1	16.51	5.27	0.0000	0.0528	0.0000	0.0000	0.0222	0.00	11.49	0.00	0.00	4.84
#9-CON	11	2006-12-16	3	22.10	11.32	0.0000	0.1918	0.0000	0.0000	0.0333	0.00	89.73	0.00	0.00	15.58
#9-CON	11	2006-12-17	1	14.48	9.98	0.0000	0.1220	0.0000	0.0000	0.0203	0.00	50.28	0.00	0.00	8.37
#3-CON	31	2006-7-1	5	28.70	0.23	0.0000	0.1583	0.0000	0.0000	0.0686	0.00	0.20	0.00	0.00	0.09
#3-CON	31	2006-7-2	3	9.91	0.00	0.0000	0.0594	0.0000	0.0000	0.0313	0.00	0.00	0.00	0.00	0.00
#3-CON	31	2006-7-3	1	1.27	0.00	0.0000	0.0323	0.0000	0.0000	0.0329	0.00	0.00	0.00	0.00	0.00
#3-CON	31	2006-8-23	1	14.22	52.16	0.0000	0.1731	0.0000	0.0000	0.0834	0.00	49.57	0.00	0.00	23.88
#3-CON	31	2006-8-24	3	2.03	70.02	0.0000	0.1377	0.0000	0.0000	0.0990	0.00	52.92	0.00	0.00	38.03
#3-CON	31	2006-8-25	4	30.23	159.70	0.0000	0.1393	0.0000	0.0000	0.0927	0.00	122.09	0.00	0.00	81.29
#3-CON	31	2006-8-26	3	13.21	150.07	0.0000	0.1428	0.0000	0.0000	0.1023	0.00	117.59	0.00	0.00	84.27
#3-CON	31	2006-8-29	1	10.67	93.37	0.0000	0.1580	0.0000	0.0000	0.1230	0.00	80.96	0.00	0.00	63.02
#3-CON	31	2006-8-30	2	51.05	408.39	0.0000	0.2148	0.0000	0.0000	0.1079	0.00	481.56	0.00	0.00	241.82
#3-CON	31	2006-8-31	1	6.60	277.48	0.0000	0.2137	0.0000	0.0000	0.1327	0.00	325.49	0.00	0.00	202.13
#3-CON	31	2006-9-1	1	5.84	80.97	0.0000	0.1862	0.0000	0.0000	0.1083	0.00	82.76	0.00	0.00	48.11
#3-CON	31	2006-9-2	3	14.99	144.92	0.0000	0.1884	0.0000	0.0000	0.1170	0.00	149.87	0.00	0.00	93.07
#3-CON	31	2006-9-3	2	7.37	37.94	0.0000	0.1850	0.0000	0.0000	0.1206	0.00	38.53	0.00	0.00	25.12

Table 9-3. Mean concentrations and loads of Cd, Cu, Ni, Pb, and Zn in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events					Loads in runoff for each events				
						Cd	Cu	Ni	Pb	Zn	Cd	Cu	Ni	Pb	Zn
						mg L ⁻¹					g ha ⁻¹				
#3-OA	33	2006-7-10	3	47.75	0.00	0.0000	0.3407	0.0000	0.0000	0.1392	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2006-8-23	1	14.22	0.45	0.0000	0.1786	0.0000	0.0000	0.1093	0.00	0.44	0.00	0.00	0.27
#3-OA	33	2006-8-30	4	51.05	0.70	0.0000	0.2179	0.0000	0.0000	0.0985	0.00	0.84	0.00	0.00	0.38
#3-OA	33	2006-9-1	1	5.84	0.50	0.0000	0.2135	0.0000	0.0000	0.1563	0.00	0.59	0.00	0.00	0.43
#3-OA	33	2006-9-2	1	14.99	0.44	0.0000	0.2091	0.0000	0.0000	0.1477	0.00	0.50	0.00	0.00	0.35
#3-OA	33	2006-12-11	5	0.76	0.00	0.0000	0.0422	0.0000	0.0000	0.0344	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-12	2	0.00	0.00	0.0000	0.0394	0.0000	0.0000	0.0328	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2006-12-25	1	13.72	44.30	0.0000	0.1592	0.0000	0.0000	0.1141	0.00	38.71	0.00	0.00	27.73
#3-OA	33	2006-12-26	1	9.65	48.74	0.0000	0.2066	0.0000	0.0000	0.1656	0.00	55.27	0.00	0.00	44.31
#3-OA	33	2007-1-23	1	6.86	0.29	0.0000	0.0244	0.0000	0.0000	0.0246	0.00	0.04	0.00	0.00	0.04
#3-OA	33	2007-2-6	2	0.25	0.21	0.0000	0.2028	0.0000	0.0000	0.0674	0.00	0.23	0.00	0.00	0.08
#3-OA	33	2007-3-16	3	10.16	0.00	0.0000	0.2493	0.0000	0.0000	0.1682	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-17	3	0.00	0.00	0.0000	0.1863	0.0000	0.0000	0.1198	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-18	7	0.00	0.00	0.0000	0.1311	0.0000	0.0000	0.0631	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-19	3	0.00	0.00	0.0000	0.1084	0.0000	0.0000	0.0412	0.00	0.00	0.00	0.00	0.00
#3-OA	33	2007-3-20	2	7.62	0.00	0.0000	0.0578	0.0000	0.0000	0.0212	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-7-11	4	58.17	3.63	0.0000	0.1399	0.0000	0.0000	0.1228	0.00	2.27	0.00	0.00	1.99
#4-CON	81	2006-7-12	3	4.83	1.03	0.0000	0.2019	0.0000	0.0000	0.3366	0.00	0.93	0.00	0.00	1.55
#4-CON	81	2006-8-19	4	7.11	0.00	0.0000	0.1044	0.0000	0.0000	0.0658	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-20	3	19.81	0.00	0.0000	0.1001	0.0000	0.0000	0.0549	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-21	2	0.00	0.00	0.0000	0.1198	0.0000	0.0000	0.0884	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-8-26	4	16.51	0.12	0.0000	0.3819	0.0000	0.0000	0.1037	0.00	0.21	0.00	0.00	0.06

Table 9-3. Mean concentrations and loads of Cd, Cu, Ni, Pb, and Zn in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events					Loads in runoff for each events				
						Cd	Cu	Ni	Pb	Zn	Cd	Cu	Ni	Pb	Zn
						mg L ⁻¹					g ha ⁻¹				
#4-CON	81	2006-8-27	3	0.00	0.00	0.0000	0.2412	0.0000	0.0000	0.0904	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2006-12-24	4	33.78	1.13	0.0000	0.2326	0.0000	0.0000	0.1231	0.00	1.17	0.00	0.00	0.62
#4-CON	81	2006-12-25	3	40.13	15.04	0.0000	0.2491	0.0000	0.0000	0.1516	0.00	16.71	0.00	0.00	10.17
#4-CON	81	2006-12-26	2	0.76	1.31	0.0000	0.2561	0.0000	0.0000	0.2035	0.00	1.50	0.00	0.00	1.19
#4-CON	81	2007-2-27	5	9.40	0.00	0.0000	0.4389	0.0000	0.0000	0.0967	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-2-28	3	0.00	0.00	0.0000	0.0248	0.0000	0.0000	0.0118	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-1	1	0.00	0.00	0.0000	0.0744	0.0000	0.0000	0.0075	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-16	4	15.49	0.00	0.0000	0.2107	0.0000	0.0000	0.0905	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-17	3	0.00	0.00	0.0000	0.1318	0.0000	0.0000	0.0566	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-18	2	0.00	0.00	0.0000	0.0523	0.0000	0.0000	0.1406	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-22	3	8.13	0.00	0.0000	0.1120	0.0000	0.0000	0.0836	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-23	3	5.84	0.00	0.0000	0.0581	0.0000	0.0000	0.0308	0.00	0.00	0.00	0.00	0.00
#4-CON	81	2007-3-24	3	0.00	0.00	0.0000	0.0246	0.0000	0.0000	0.0229					
#4-OA	83	2006-7-12	4	4.83	0.00	0.0000	0.1426	0.0000	0.0000	0.1363	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-19	4	7.11	0.00	0.0000	0.1568	0.0000	0.0000	0.1635	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-20	2	19.81	0.00	0.0000	0.2564	0.0000	0.0000	0.1958	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-21	2	0.00	0.00	0.0000	0.3152	0.0000	0.0000	0.2128	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-23	4	25.65	0.00	0.0000	0.3544	0.0000	0.0000	0.1812	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-24	3	2.29	0.00	0.0000	0.4494	0.0000	0.0000	0.2580	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-25	5	33.02	0.00	0.0000	0.5992	0.0000	0.0000	0.2244	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-26	3	16.51	0.00	0.0000	0.6118	0.0000	0.0000	0.3017	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-27	2	0.00	0.00	0.0000	0.4204	0.0000	0.0000	0.2247	0.00	0.00	0.00	0.00	0.00

Table 9-3. Mean concentrations and loads of Cd, Cu, Ni, Pb, and Zn in surface runoff for each rain event in July, 2006-March, 2007 (Continued).

Location	Code	Date of rain events	Number of Samples	Rainfall (mm)	Discharge (m ³)	Mean concentrations in runoff for each events					Loads in runoff for each events				
						Cd	Cu	Ni	Pb	Zn	Cd	Cu	Ni	Pb	Zn
						mg L ⁻¹					g ha ⁻¹				
#4-OA	83	2006-8-30	2	51.05	0.00	0.0000	0.3468	0.0000	0.0000	0.1753	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-8-31	3	6.60	0.00	0.0000	0.4542	0.0000	0.0000	0.2388	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-8	1	0.00	0.00	0.0000	0.0394	0.0000	0.0000	0.0558	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-11	5	1.02	0.00	0.0000	0.0134	0.0000	0.0000	0.0126	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2006-12-12	3	0.00	0.00	0.0000	0.0175	0.0000	0.0000	0.0156	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-3	4	0.00	0.00	0.0000	0.0170	0.0000	0.0000	0.0128	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-4	3	0.00	0.06	0.0000	0.0116	0.0000	0.0000	0.0170	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-5	2	0.51	0.00	0.0000	0.0092	0.0000	0.0000	0.0179	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-6	2	0.00	0.00	0.0000	0.0167	0.0000	0.0000	0.0386	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-23	4	0.00	0.00	0.0000	0.0258	0.0000	0.0000	0.0233	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-24	3	0.00	0.27	0.0000	0.0147	0.0000	0.0023	0.0180	0.00	0.02	0.00	0.00	0.02
#4-OA	83	2007-2-25	2	0.00	0.02	0.0000	0.0209	0.0000	0.0000	0.0185	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-26	4	0.00	0.00	0.0000	0.0174	0.0000	0.0039	0.0219	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-2-27	3	9.40	0.46	0.0000	0.1824	0.0000	0.0067	0.0585	0.00	0.37	0.00	0.01	0.12
#4-OA	83	2007-2-28	2	0.00	0.57	0.0000	0.0296	0.0000	0.0040	0.0187	0.00	0.08	0.00	0.01	0.05
#4-OA	83	2007-3-20	4	12.19	0.00	0.0000	0.0161	0.0000	0.0000	0.0210	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-21	3	0.51	0.00	0.0000	0.0163	0.0000	0.0000	0.0225	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-22	2	8.13	0.00	0.0000	0.0105	0.0000	0.0000	0.0251	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-30	3	13.46	0.00	0.0000	0.0128	0.0000	0.0012	0.0163	0.00	0.00	0.00	0.00	0.00
#4-OA	83	2007-3-31	3	0.25	0.00	0.0000	0.0074	0.0000	0.0001	0.0127	0.00	0.00	0.00	0.00	0.00

Table 9-4. Accumulative loads of nutrients and metals in runoff water from citrus field sites

Location	Code	Sample number	Rainfall (mm)	Discharge (m ³)	TP (g ha ⁻¹)	DTP (g ha ⁻¹)	PO ₄ ³⁻ -P (g ha ⁻¹)	Solid (kg ha ⁻¹)	TN (g ha ⁻¹)	TKN (g ha ⁻¹)
#3-CON	31	30	196.09	1475.25	15020.12	14576.06	10858.45	4233.16	70731.04	24566.40
#3-OA	33	40	182.87	95.63	1011.04	816.66	764.29	330.19	1858.21	142.46
#4-CON	81	59	219.96	22.26	196.17	173.70	162.29	65.03	352.17	329.67
#4-OA	83	87	212.34	1.38	2.29	1.89	1.41	5.68	12.51	7.42

Location	Code	Sample number	Rainfall (mm)	Discharge (m ³)	NO ₃ ⁻ -N (g ha ⁻¹)	NH ₄ ⁺ -N (g ha ⁻¹)	Cd (g ha ⁻¹)	Cu (g ha ⁻¹)	Ni (g ha ⁻¹)	Zn (g ha ⁻¹)
#3-CON	31	30	196.09	1475.25	46164.64	869.39	0.00	1501.53	0.00	900.82
#3-OA	33	40	182.87	95.63	142.46	249.61	0.00	96.62	0.00	0.00
#4-CON	81	59	219.96	22.26	22.50	19.36	0.00	22.79	0.00	15.58
#4-OA	83	87	212.34	1.38	7.42	2.54	0.00	0.47	0.00	0.02

Soil Quality

The chemical properties of the soils as affected by organic amendment are presented in Tables 10-1 to 10-6. There were essentially no differences in the measured soil quality parameters (pH, EC, organic matter content, total N, and extractable nutrients and metals between the organic amended and the control plot (Tables 10-1 to 10-2). There were no significant differences in Mehlich III extractable Ca, Mg, K, and P between the amended and the control plot (Tables 10-3 to 10-4). There was no difference in Mehlich III extractable Cd, Co, Cr, Fe, Ni, and Pb in the soil between the organic amended and the control (Tables 10-5 to 10-6). From Tables 8 and 9-4, we know that organic amendment did not increase the concentrations and loads of metals in runoff waters. Therefore, the organic amendment should be safe for use in agriculture.

Table 10-1. Electricity conductivity (EC), pH, Olsen-P and available N of soils samples collected on July, 20, 2006.

Locations	Field ID	Soil Depth (cm)	pH (H ₂ O)	EC (μ S cm ⁻¹)	TON (g kg ⁻¹)	TOC (g kg ⁻¹)	Available N(g kg ⁻¹)		Olsen P (mg kg ⁻¹)
							NH ₄ ⁺ -N	NO ₃ ⁻ -N	
#2-CON	621021	0-15	6.32	35.22	0.27	4.71	1.71	0.98	25.91
#2-CON	621022	15-30	6.25	40.42	0.28	4.42	2.89	1.10	28.98
#2-OA	623021	0-15	6.26	30.72	0.32	4.85	2.15	0.94	22.53
#2-OA	623022	15-30	6.29	37.42	0.32	5.00	1.14	1.39	27.14
#3-CON	631021	0-15	4.90	179.00	1.14	10.88	15.24	10.45	16.18
#3-CON	631022	15-30	4.47	153.85	0.70	6.94	17.29	4.81	12.19
#3-OA	633021	0-15	4.38	122.00	1.22	11.71	12.56	9.89	20.59
#3-OA	633022	15-30	4.10	107.10	0.84	8.45	11.18	5.87	21.41
#4-CON	681021	0-15	5.48	44.31	0.48	4.86	5.82	1.91	9.22
#4-CON	681022	15-30	5.17	49.11	0.31	3.14	2.58	0.94	5.94
#4-OA	683021	0-15	5.48	38.56	0.24	2.35	4.53	1.78	8.60
#4-OA	683022	15-30	5.58	24.08	0.14	1.45	2.31	0.71	4.30
#9-CON	611011	0-15	6.59	82.20	0.38	5.11	2.35	3.04	76.10
#9-CON	611012	15-30	6.87	104.35	0.42	5.51	1.59	3.97	83.98
#9-CON	611013	30-60	6.89	197.30	0.30	4.17	2.05	4.31	39.53
#9-CON	611014	60-90	6.98	245.40	0.16	2.02	3.24	11.33	16.28
#9-OA	613011	0-15	6.67	91.89	0.42	5.96	0.25	6.01	86.54
#9-OA	613012	15-30	6.80	114.35	0.40	5.72	0.44	3.37	36.01
#9-OA	613013	30-60	6.93	179.80	0.33	4.98	0.15	1.76	34.51
#9-OA	613014	60-90	6.84	159.35	0.32	4.86	1.72	1.51	30.21

Table 10-2. Electricity conductivity (EC), pH, Olsen-P and available N of soils samples collected on Jan.19, 2007.

Locations	Field ID	Soil Depth (cm)	pH (H ₂ O)	EC (μ S cm ⁻¹)	TON (g kg ⁻¹)	TOC (g kg ⁻¹)	Available N(g kg ⁻¹)		Olsen P (mg kg ⁻¹)
							NH ₄ ⁺ -N	NO ₃ ⁻ -N	
#9-CON	711001	0-15	6.49	2768	0.77	5.39	6.88	28.11	5.63
#9-CON	711002	15-30	6.78	1570	0.56	5.48	1.93	10.34	1.90
#9-OA	713001	0-15	6.85	2281	0.60	5.74	1.50	14.87	9.31
#9-OA	713002	15-30	7.79	1251	0.46	5.81	0.31	7.78	6.58
#2-CON	721001	0-15	6.66	170.4	0.26	3.27	0.43	0.67	3.25
#2-CON	721002	15-30	6.60	102.7	0.26	3.70	0.42	0.27	0.94
#2-OA	723001	0-15	6.68	378.0	0.27	3.35	0.25	0.39	3.13
#2-OA	723002	15-30	6.63	66.07	0.26	3.35	0.52	0.28	2.05
#3-CON	731001	0-15	5.74	124.8	0.92	8.38	0.57	0.18	1.39
#3-CON	731002	15-30	5.10	88.44	0.58	5.37	0.43	0.19	0.16
#3-OA	733001	0-15	4.72	123.3	1.24	11.25	0.77	0.25	2.14
#3-OA	733002	15-30	4.76	107.7	0.82	7.49	0.44	0.17	1.65
#4-CON	781001	0-15	5.13	39.13	0.40	4.11	0.23	0.17	1.30
#4-CON	781002	15-30	4.33	33.01	0.35	3.23	0.25	0.12	0.35
#4-OA	783001	0-15	5.48	26.26	0.28	2.31	0.23	0.12	0.99
#4-OA	783002	15-30	5.41	17.61	0.17	1.24	0.20	0.11	0.49

Table 10-3. Mehlich III extractable macro-elements in soils samples collected on July, 20, 2006.

Locations	Field ID	Soil Depth (cm)	Ca	Mg	K mg kg ⁻¹	Na	P
#2-CON	621021	0-15	763.82	97.34	243.00	132.18	277.52
#2-CON	621022	15-30	831.92	113.41	178.05	136.77	378.92
#2-OA	623021	0-15	850.40	100.61	150.55	146.10	284.44
#2-OA	623022	15-30	966.73	113.37	149.56	154.54	308.14
#3-CON	631021	0-15	1447.29	110.14	239.06	149.74	104.20
#3-CON	631022	15-30	918.39	79.70	183.84	147.73	54.65
#3-OA	633021	0-15	388.70	54.94	176.70	44.65	110.35
#3-OA	633022	15-30	310.71	53.12	231.26	53.34	94.31
#4-CON	681021	0-15	1013.56	61.64	132.89	142.37	124.34
#4-CON	681022	15-30	693.56	49.45	110.47	148.02	57.61
#4-OA	683021	0-15	398.91	54.68	190.53	121.18	67.29
#4-OA	683022	15-30	234.77	36.57	83.36	98.89	27.42
#9-CON	611011	0-15	1111.24	130.58	190.28	132.38	607.89
#9-CON	611012	15-30	920.17	125.93	229.08	133.78	545.18
#9-CON	611013	30-60	484.43	87.42	234.49	135.16	234.13
#9-CON	611014	60-90	604.69	63.49	186.86	147.90	109.17
#9-OA	613011	0-15	1346.30	159.57	562.15	156.45	478.69
#9-OA	613012	15-30	1200.94	152.25	216.18	152.76	465.81
#9-OA	613013	30-60	966.25	137.25	231.68	166.04	204.80
#9-OA	613014	60-90	834.19	113.49	163.69	163.71	162.50

Table 10-4. Mehlich III extractable macro-elements in soils samples collected on Jan., 19, 2007.

Locations	Field ID	Soil Depth (cm)	Ca	Mg	K mg kg ⁻¹	Na	P
#9-CON	711001	0-15	1040.10	234.78	1464.45	160.18	289.61
#9-CON	711002	15-30	1168.59	193.20	607.73	168.80	269.04
#9-OA	713001	0-15	1496.19	189.97	788.69	186.00	275.07
#9-OA	713002	15-30	1776.96	193.05	495.40	173.42	327.74
#2-CON	721001	0-15	908.13	150.67	27.51	110.66	193.17
#2-CON	721002	15-30	918.47	159.86	11.87	110.53	206.69
#2-OA	723001	0-15	1029.38	144.07	9.51	107.64	198.02
#2-OA	723002	15-30	830.79	138.75	8.98	105.60	199.36
#3-CON	731001	0-15	746.75	74.09	53.31	127.03	54.50
#3-CON	731002	15-30	446.88	49.14	44.24	121.23	31.28
#3-OA	733001	0-15	667.58	75.00	86.67	118.60	64.91
#3-OA	733002	15-30	440.76	52.33	52.83	118.04	37.93
#4-CON	781001	0-15	449.55	39.25	30.56	107.82	66.56
#4-CON	781002	15-30	331.70	33.14	15.24	108.26	52.41
#4-OA	783001	0-15	386.57	44.72	17.34	103.77	46.21
#4-OA	783002	15-30	247.98	27.90	10.15	99.04	24.33

Table 10-5 .Mehlich III extractable micro-elements in soils samples collected on July, 20, 2006.

Locations	Field ID	Soil Depth (cm)	Cd	Co	Cr	Cu	Fe mg kg ⁻¹	Ni	Pb	Zn	Mn
#2-CON	621021	0-15	0.06	0.05	0.94	22.20	125.38	0.20	1.56	32.74	32.66
#2-CON	621022	15-30	0.09	0.07	1.03	24.93	142.37	0.24	1.98	39.61	36.66
#2-OA	623021	0-15	0.00	0.05	1.06	26.35	138.13	0.23	1.57	30.38	32.56
#2-OA	623022	15-30	0.02	0.06	1.15	37.75	150.47	0.27	1.79	32.58	33.79
#3-CON	631021	0-15	0.19	0.02	0.66	113.35	143.30	0.32	5.66	101.40	28.62
#3-CON	631022	15-30	0.10	0.00	0.59	54.81	151.64	0.21	5.65	39.53	16.84
#3-OA	633021	0-15	0.23	0.02	0.67	104.94	239.81	0.42	5.58	65.99	34.74
#3-OA	633022	15-30	0.15	0.00	0.64	77.92	255.19	0.31	6.47	34.44	23.73
#4-CON	681021	0-15	0.08	0.02	0.71	86.21	99.37	0.18	5.16	48.33	23.15
#4-CON	681022	15-30	0.03	BDL	0.66	42.06	80.74	0.12	5.95	17.83	10.16
#4-OA	683021	0-15	0.02	0.00	0.71	60.26	79.50	0.16	2.18	27.66	18.72
#4-OA	683022	15-30	BDL	BDL	0.53	29.17	49.25	0.10	1.88	10.20	7.87
#9-CON	611011	0-15	0.12	0.09	0.99	26.08	252.80	0.24	2.53	55.35	38.38
#9-CON	611012	15-30	0.11	0.08	0.95	22.89	239.76	0.21	2.48	44.96	30.97
#9-CON	611013	30-60	0.06	0.07	0.77	10.38	163.03	0.16	2.14	18.54	11.28
#9-CON	611014	60-90	BDL	0.00	0.59	5.22	63.17	0.10	0.95	6.59	5.29
#9-OA	613011	0-15	0.05	0.09	1.31	34.00	258.64	0.24	2.57	45.87	44.93
#9-OA	613012	15-30	0.06	0.09	1.24	28.25	261.55	0.24	2.63	42.93	37.91
#9-OA	613013	30-60	0.03	0.07	0.98	13.63	177.84	0.21	2.40	18.53	16.33
#9-OA	613014	60-90	0.05	0.02	0.89	13.86	165.00	0.21	2.06	16.16	14.51

Table 10-6 .Mehlich III extractable micro-elements in soils samples collected on Jan., 19, 2007.

Locations	Field ID	Soil Depth (cm)	Cd	Co	Cr	Cu	Fe mg kg ⁻¹	Ni	Pb	Zn	Mn
#9-CON	711001	0-15	0.0317	0.0000	0.3746	19.90	227.1	0.088	1.035	28.11	33.49
#9-CON	711002	15-30	0.0172	0.0000	0.3493	20.09	217.4	0.089	1.036	22.86	30.36
#9-OA	713001	0-15	0.0113	0.0000	0.4154	22.78	157.0	0.119	1.282	17.91	35.12
#9-OA	713002	15-30	0.0200	0.0166	0.4893	27.68	186.6	0.128	1.578	23.05	38.78
#2-CON	721001	0-15	0.0034	0.0000	0.4551	21.43	113.4	0.092	0.767	16.36	33.10
#2-CON	721002	15-30	0.0078	0.0000	0.4712	22.73	112.3	0.111	0.819	15.92	30.36
#2-OA	723001	0-15	0.0000	0.0000	0.3960	22.46	129.5	0.091	0.735	15.80	31.50
#2-OA	723002	15-30	0.0000	0.0000	0.3984	22.52	113.9	0.106	0.784	15.63	30.95
#3-CON	731001	0-15	0.0357	0.0000	0.2232	65.30	125.6	0.102	4.281	22.97	21.21
#3-CON	731002	15-30	0.0083	0.0000	0.0787	29.85	117.9	0.074	3.555	8.07	5.48
#3-OA	733001	0-15	0.0979	0.0083	0.1659	70.52	229.8	0.241	4.532	26.56	19.94
#3-OA	733002	15-30	0.0601	0.0000	0.1341	33.71	172.1	0.276	4.851	11.86	10.19

Plant Nutrition, Fruit Quality and Yield

The concentrations of nutrients and metals in citrus leaf samples are reported in Tables 11-1 and 11-2. Organic amendment increased N and P concentrations in citrus leaf for location #4 and Mg concentration for locations #3 and #4. The increase may be related to a decrease in N and P losses in runoff water (Table 8). However, there was no significant difference in leaf N, P concentrations for location #3 and in leaf K concentration for both locations (#3 and #4) (Table 11-1). The concentrations of leaf Cu and Fe were decreased by organic amendment for both locations but the decrease in leaf Zn and Mn concentration occurred only at location #4 (Table 11-2). Since the concentrations are within a normal range for each of the micro-nutrients, organic amendment is unlikely to cause any deficiency or toxicity of these trace elements.

The quality characteristics of citrus are reported in Table 12. It is interesting to note that organic amendment tended to increase fruit size, juice and soluble solids content of grapefruit at location #4 and increased Brix/acid ratio by decreasing acid in navel orange at location #3. However, there was no difference in the juice content Brix and solids concentration of navel orange (#3) between the amended and the conventional site (Table 12). In conclusion, organic amendment can sustain or improve fruit quality of citrus.

Organic amendment increased crop yield of citrus (navel orange) by approximately 30%. The big increase in yield was unexpected, but welcome. The yield increase could result from several factors:

- 1) Neutralization of soil acidity by the liming materials contained in the amendment;
- 2) Improved soil structure and moisture retention; 3) increased supplies of Ca, and Mg,

though not measurable in soils; 2) Reduced the losses of nutrients (N, P and others) in surface runoff water, therefore, rendering more nutrients available for the crop plants; 3) Background difference in soil quality and tree growth among different beds.

Table 11-1. Concentrations of macro-elements in plant tissue samples collected on June, 17, 2005 and Feb., 07, 2006

Samples	Date	Locations	Al		Ca		K		Mg		P		N	
			Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD
Pepper-fruit	06/17/05	#2/CON	0.04	0.03	1.91	0.37	35.53	5.02	2.40	0.34	3.48	0.25	25.60	0.20
Pepper-fruit	06/17/05	#2/OA	0.00	0.01	1.71	0.30	34.95	6.39	2.31	0.45	3.54	1.03	25.32	0.34
Pepper-leaf	06/17/05	#2/CON	0.06	0.00	17.14	0.80	44.08	0.80	8.19	0.59	2.57	0.07	41.91	0.11
Pepper-leaf	06/17/05	#2/OA	0.05	0.00	14.96	0.08	44.40	2.79	7.13	0.11	2.96	0.33	45.36	0.16
Citrus leaf	07/25/05	#4/CON	0.11	0.02	40.88	9.48	12.71	2.17	3.02	0.06	1.20	0.17	20.45	0.08
Citrus leaf	07/25/05	#4/OA	0.11	0.01	35.49	2.56	12.43	0.71	2.94	0.16	1.25	0.02	21.40	0.08

Table 11-2. Concentrations of micro-elements in plant tissue samples collected on June, 17, 2005 and Feb., 07, 2006

Samples	Sampling date	Location	Cd		Co		Cr		Cu		Fe		Mn		Ni		Pb		Zn	
			Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD	Conc.	SD
Pepper-fruit	06/17/05	#2/CON	BDL	-	BDL	-	BDL	-	13.35	0.00	73.86	0.90	26.03	0.00	0.21	0.00	BDL	-	39.76	0.02
Pepper-fruit	06/17/05	#2/OA	BDL	-	BDL	-	BDL	-	13.32	0.02	68.33	0.04	31.29	0.02	0.71	0.00	BDL	-	40.52	0.04
Pepper-leaf	06/17/05	#2/CON	BDL	-	BDL	-	BDL	-	28.44	0.00	74.14	0.00	215.1	0.00	BDL	-	BDL	-	117.3	0.07
Pepper-leaf	06/17/05	#2/OA	BDL	-	BDL	-	BDL	-	30.47	0.00	80.54	0.01	216.5	0.01	BDL	-	BDL	-	129.8	0.09
Citrus leaf	07/25/05	#4/CON	BDL	-	BDL	-	6.19	0.01	45.26	0.05	83.52	0.02	21.18	0.00	BDL	-	BDL	-	26.08	0.01
Citrus leaf	07/25/05	#4/OA	BDL	-	BDL	-	1.59	0.01	36.24	0.01	66.21	0.02	27.23	0.04	BDL	-	BDL	-	31.15	0.03

BDL= below detection limits

Table 12. Quality analysis of citrus fruit samples collected on 12/01/2006*.

Location	Sample #	Fruit #	Wt. of Fruit (kg.)	Fruit size (g/fruit)	Wt. of Juice (kg.)	Juice content (%)	Brix (%)	Acid (%)	Ratio	Solids (%)
#3-CON	F631001	9	3.62	402	1.54	42.5	11.5	0.65	17.67	4.89
#3-OA	F633001	8	3.48	435	1.48	42.5	11.5	0.52	22.12	4.89
#4-CON	F681001	8	2.57	321	1.33	51.8	11.1	1.30	8.57	5.75
#4-OA	F683001	8	2.59	324	1.38	53.3	11.5	1.36	8.46	6.13

* Analysis of fruit quality was performed immediately after collection.

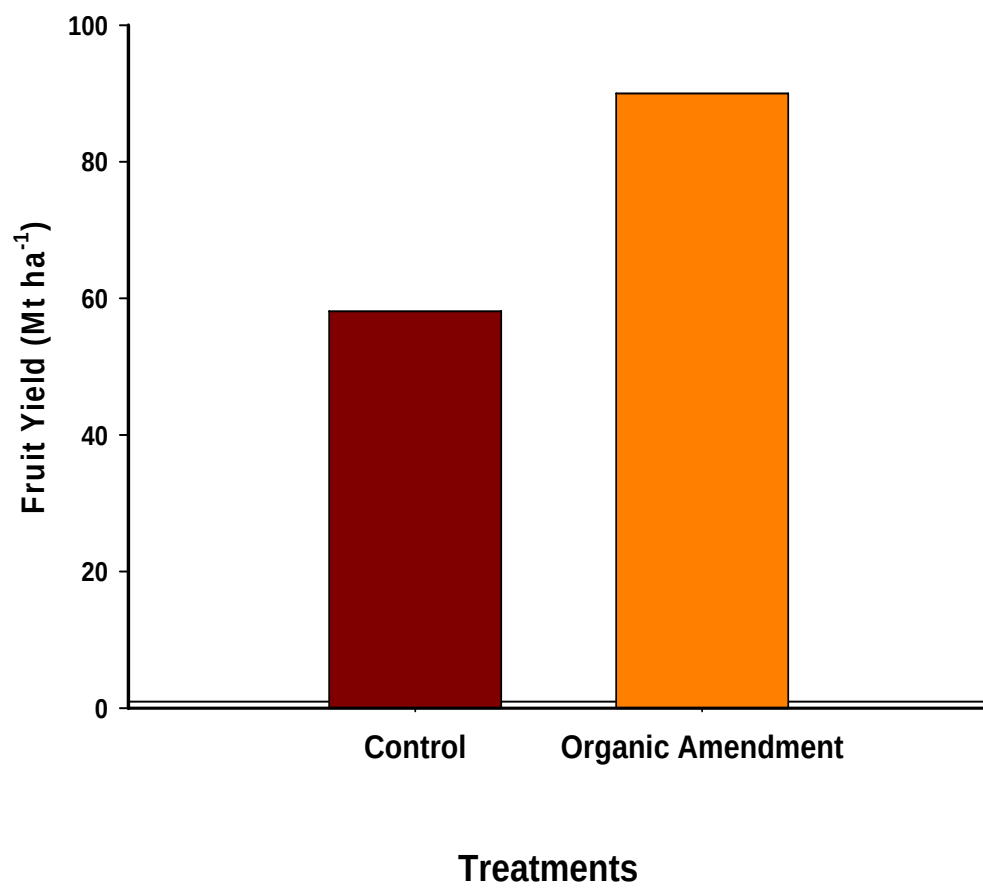


Fig. 1. Effect of organic amendment on fruit yield of Navel orange

CONCLUSIONS

Application of organic amendment (palletized biosolids) to sand soils in the Indian River area can have the following potential benefits:

1. Improves soil quality such as reduced soil acidity and Al toxicity by the contained liming materials and organic substances, improved holding capacity for nutrients and moisture, improved soil structure and nutrient supply as it contained certain amounts of N, P, Ca, and other essential elements for plant growth.
2. Reduces the losses of nutrients (N and P) in surface runoff water, and subsequently the impact on water quality.
3. Improves crop nutrition by increasing N and P concentrations in citrus leaf.
4. Improves fruit quality of citrus such as increased fruit size, juice and soluble solids content of grapefruit at location #4 and increased Brix/acid ratio by decreasing acid in navel orange.
5. Increases crop yield.
6. Reduces the amounts of water soluble fertilizers.

The risks of increased heavy metals such as Cd, Ni, Pb, Cu, Fe, and Mn in soil or runoff water are minimal.

RECOMMENDATION

Based on the data obtained from the 2.5 years' research, organic amendment of environmental quality needs to be applied to sand soils in the Indian River area to partially replace water soluble fertilizers for citrus and vegetable crops. A proportion of 30% organic amendment and 70% regular fertilizers in term of the annual rates of N and P will be beneficial to both crop production and the environment.

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