ABSTRACT

WAFER, CARRIE CATHLEEN. Effect of Shrub Buffers, Tillage and Cropping Systems on Shallow Groundwater Nitrate-N in Eastern North Carolina. (Under the directions of Deanna Lynn Osmond.)

Non-point source contributions of nitrogen (N) from agriculture have increased nitrate N (NO_3-N) concentrations in the Neuse River Basin, NC. The goal of this research was to examine the effectiveness of shrub buffers and no-till agricultural production to decrease shallow groundwater NO_3-N concentrations and subsequently decrease the amount of NO_3^--N reaching surface waters. Groundwater monitoring wells were installed 9-, 4.5- and 0-m from drainage ditches with 1-, 4.5- and 9-m wide buffers at the research site near Kinston, NC. Groundwater samples were collected from shallow (0.6 to 0.9 m (2 to 3 ft)), intermediate (0.5 to 2 m (1.5 to 6.5 ft)) and deep (2.2 to 2.8 m (7 to 9 ft)) monitoring wells at the 9-, 4.5- and 0-m locations. The percent decrease of NO_3-N at the intermediate (0.5 to 2 m) depth was calculated from 9 m to 0 m and from 4.5 m to 0 m across the 1-, 4.5- and 9-m buffers. The percent decrease from 9 m to 0 m was significantly lower ($p=0.01$) in the 1-m buffer (67% decrease) than in the 4.5-m (93%) and 9-m (91%) buffers, but no difference due to buffer width was found from 4.5 m to 0 m in the 1-m (66%), 4.5-m (79%) and 9-m (74%) buffers. Redox potential was measured at 1.5 m and 0.75 m with platinum (Pt) tipped redox probes. Redox potentials were examined in relation to the deep (2.2 to 2.8 m) and shallow (0.6 to 0.9 m) groundwater data to determine if denitrification was responsible for any decreased NO_3-N concentrations. Groundwater and redox

data indicated that conditions favored denitrification, which was likely responsible for the decreased NO_3-N concentrations.

Groundwater NO_3-N was examined in a no-till (NT) field on Wickham soils (NT-Wi), and in two fields on predominantly Nixonton soils - a conventional till (CT) field (CT-Ni) and an NT field (NT-Ni) at the research site near Goldsboro, NC. Wheat was grown as a small grain and cover crop on NT-Wi, as a small grain on CT-Ni and rye was grown as a small grain and cover crop on NT-Ni. Each field was treated as a separate cropping system and data could not be analyzed to determine the effect of tillage or cover crop type on groundwater NO_3-N because of the differences in the soil and cropping system in each field. Nitrate N concentrations were compared between fields during each cropping period (corn, small grain, soybean and cover crop/bare soil) because the cropping system periodically changed during the study period (1996 – 2003). During each individual cropping period the average NO_3-N concentrations were similar between NT-Wi and CT-Ni ($p=0.05, 0.1$), but were significantly lower in NT-Ni than in the two other fields. The differences in NO_3-N concentrations appeared to be a result of soil variability and over fertilization on CT-Ni and under fertilization on NT-Ni. Corn and soybean yields were examined between the three fields and no significant yield differences were found. The results from this study indicate that groundwater NO_3-N concentrations were likely influenced by crop fertilization rate and soil variability.

EFFECT OF SHRUB BUFFERS, TILLAGE AND CROPPING SYSTEMS ON SHALLOW GROUNDWATER NITRATE-N IN EASTERN NORTH CAROLINA

by
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DEDICATION

This thesis is dedicated to the resumption of hiking, gardening, enjoying nature and all other fun pursuits that were neglected during the compilation of three years of hard work.

BIOGRAPHY

Carrie Wafer was born in Camden, NY, the land of snowy winters. She graduated from Camden High School in 1994 and began college at Macalester College in St. Paul, MN as a biology major. While in Minne-snow-ta taking a one-credit class during the month of January, Carrie became very involved with cross country skiing and developed a love of being outside when temperatures averaged 30 below zero Fahrenheit. She also discovered that she was more interested in ecology and the interaction of soils and land use on water quality than biology and returned to New York to study Natural Resources at Cornell University. Carrie worked as a technician for Cornell University, after graduating in 1998. During this work she was actually paid to canoe around lakes in the Adirondack Mountains and drive boats on Oneida Lake, NY to collect plant, water and sediment samples. During her work at the Cornell Biological Field Station at Oneida Lake, Carrie also began snowshoeing and taking moonlit outings across snowy fields to observe foxes, coyotes and other wildlife. After three years of working on water, Carrie decided it was time to work on land studying something that related water quality to land use practices, which involved learning more about soils. She was fortunate enough to have e-mailed Dr. Gilliam in the Soil Science Department at NC State University, who forwarded the e-mail to Dr. Osmond. Carrie was offered a position with Dr. Osmond and decided to leave the land of snow to pursue a master's degree. Even though she greatly misses the northern climate, she has decided that the extended growing season is quite nice and the warmer winters make field work a bit more bearable.

ACKNOWLEDGEMENTS

I would like to thank my family in New York and my friends all over the US and in Holland for all of their support during this challenging endeavor. I would also like to thank the Carolina Mudcats and Durham Bulls for broadcasting their games on the radio; I never would have been able to stay up to work on writing if I hadn't had those games to listen to. Dr. Brownie and Dr. Spooner deserve thanks for their help with statistical analyses, which were not easy in this 'not properly designed for statistical analyses' research. I would like to thank my committee members, Dr. Mike Vepraskas and Dr. Wendell Gilliam for their help and constructive criticism, Dr. Robert Evans for joining my committee on short notice and especially Dr. Deanna Osmond for being an excellent advisor, providing outstanding support and giving me limitless opportunities to pursue interests aside from my research. Wesley Childres, Julia Nelson and Will Buetow deserve a great deal of thanks for aiding me in the rough transition to life in Raleigh. Will also deserves a great deal of praise for his help with my field work, doing the dishes and because he was smart enough to ask me to marry him!

Lastly and most importantly I would like to extend my eternal gratitude to Barrett Richards and Wesley Childres for their ingenuity, perseverance and humor when designing, making and installing equipment, their assistance collecting and analyzing data, their willingness to remove field equipment while I was writing and most of all their unending patience with me because I am not the easiest person to work with. I cannot thank them enough and I will miss them terribly when I leave.

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Chapter 1. Effect of Shrub Buffers on Groundwater Nitrate-N[1]

Abstract

Non-point source contributions of nitrogen (N) from agriculture have increased nitrate N (NO_3-N) concentrations in the Neuse River Basin, NC. This work was conducted to evaluate the ability of shrub buffers to remove NO_3-N from groundwater before entering surface waters. Shrub buffers were created by allowing native vegetation to grow between crop fields and drainage ditches. Groundwater monitoring wells were installed 9-, 4.5- and 0-m from drainage ditches with 1-, 4.5- and 9-m wide buffers at the research site near Kinston, NC. Groundwater samples were collected from monitoring wells installed at the shallow (0.6 to 0.9 m (2 to 3 ft)), intermediate (0.5 to 2 m (1.5 to 6.5 ft)) and deep (2.2 to 2.8 m (7 to 9 ft)) depths at the 9-, 4.5- and 0-m locations. Groundwater samples were analyzed for NO_3-N, orthophosphate (PO_4-P), chloride (Cl^-) and dissolved organic carbon (DOC). Probes were also installed to measure soil redox potential and soil temperature at 0.76 m (2.5 ft) and 1.52 m (5 ft) below the ground surface.

The percent decrease of NO_3-N at the intermediate (0.5 to 2 m) depth was calculated from the wells at 9 m to 0 m and from the wells at 4.5 m to 0 m adjacent to the ditches with the 1-, 4.5- and 9-m buffers. The percent decrease from 9 m to 0 m was significantly lower ($p=0.01$) across the area with the 1-m buffer (67% decrease) than across the areas with the 4.5-m (93%) and 9-m (91%) buffers. No difference was found due to buffer width, however from 4.5 m to 0 m across areas with the 1-m (66%), 4.5-m (79%) and 9-m (74%) buffers.

The percent decreases calculated from 9 m to 0 m where higher than those from 4.5 m to 0 m because fertilizer was applied close to or around the wells at the 9-m distance and not close to the ditches.

Soil redox potentials measured at 1.5 m and 0.75 m were examined in relation to the deep (2.2 to 2.8 m) and shallow (0.6 to 0.9 m) groundwater data to determine if denitrification was likely responsible for any decreased NO_3-N concentrations across the 9- and 4.5-m buffers. Redox potentials were consistently below +400 mV at 1.5 m, which indicates that denitrification was likely responsible for decreased NO_3-N concentrations throughout the study period. Denitrification may not have occurred at the 0.75 m depth during the growing season, because the water table dropped and redox potentials were above +400 mV, which indicated that the soils were more aerated. Denitrification did appear to be responsible for NO_3-N decreases during the remainder of the year, however, because redox potentials were below +400 mV. The ratio of NO_3-N to Cl^- also indicated that denitrification was probably responsible for the decreased NO_3-N concentrations through the buffers.

This research showed that buffers wider than 4.5-m provided substantial decreases of groundwater NO_3-N in this particular system with controlled drainage, and denitrification appeared to be responsible for the decreases measured.

[1] The use of trade names in this publication does not imply endorsement by NC State University of the products named, or criticism of similar ones not mentioned.

Introduction

Forested and grassed buffers have been shown to effectively decrease the transport of non-point source (NPS) pollutants to surface water in agricultural watersheds (Ryszkowski et al., 1997). Forested buffers are recommended in the southeastern United States because the buffers were naturally forested, many existing buffers are forested and trees are generally thought to be deeper rooted than grasses (Osmond et al., 2002). Farmers are reluctant to use forested buffers, however, because of concern that the trees will shade crops and decrease crop growth (Gilliam et al., 1997). Additionally, grassed and forested buffers require some maintenance that may be time prohibitive (Lowrance et al., 1995) and they can be cost prohibitive to establish because of costs incurred from planting desired plant species. Despite the concerns, groundwater nitrate N (NO_3-N) concentrations often decrease as water moves through forested and grassed buffers. Studies have measured a 40 to 100% decrease of groundwater NO_3-N concentrations in forested buffers (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Schultz et al., 1994) and a 10 to 94% decrease in grassed buffers (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Schultz et al., 1994; Lowrance et al., 1995; Gilliam et al., 1997; Griffith et al., 1997; Schnabel et al., 1997).

Buffer width is another factor that influences the decrease of groundwater NO_3-N concentrations. Prior studies have found that NO_3-N concentrations tend to decrease more in wide buffers than in narrow ones (Petersen et al., 1992; Fennessy and Cronk, 1997). Nitrate N concentrations decreased from 40 to

100% in buffers wider than 20 m and a majority of the NO_3-N removal occurred in the first 20 m of those buffers (Peterjohn and Correll, 1984; Osborne and Kovacic, 1993; Griffith et al., 1997). The large NO_3-N decreases were attributed to the high amounts of soil organic carbon, contributed by dense vegetative growth at the field edge of the buffer, and elevated concentrations of subsurface NO_3-N that entered the buffer at the field edge provided ample substrate for denitrification (Fennessy and Cronk, 1997). Based on those findings, it seemed that concentrations would decrease in a similar fashion if the buffer was only 20-m wide, even though near 100% removal was not as likely in the narrower buffers. In support of this hypothesis, other studies have shown that NO_3-N concentrations decreased from 60 to 90% in buffers narrower than 20 m (Jacobs and Gilliam, 1985; Osborne and Kovacic, 1993; Vought et al., 1994).

A soil environment in a buffer that favors denitrification is essential for decreasing NO_3-N transport to surface water. Over 95% of all NO_3-N is transported via groundwater flow and denitrification seems to be the primary process responsible for decreases (Cooper et al., 1986; Pinay et al., 1993, Ricks, 2002). Redox potential, measured with platinum tipped redox probes, indicates if soils are reduced enough to favor denitrification or oxidized to the extent that denitrification will not be likely (McBride, 1994). Redox potential measurements can be compared to groundwater NO_3-N to determine the likelihood that any concentration decreases could have resulted from denitrification.

The Neuse River Basin, North Carolina was declared a nutrient-sensitive watershed in 1993. This designation was made in response to decreased water

quality that resulted from increased NO_3-N contributions from the various land uses in the river basin. The Neuse Rules, created in 1998, mandated reduction of N contribution from the sources within the river basin by 30% over a 5-year period in an attempt to decrease the water quality problems. Agriculture is the dominant land use in the river basin, especially in the Coastal Plain (Eastern) Region. Farmers were then required to decrease their N contributions, which were primarily in the form of NO_3-N, to the river. The Neuse Rules required farmers to implement one of the following four possible best management practices (BMP's) in order to comply with the rules: wide buffers; narrower buffers and nutrient management; controlled drainage and nutrient management; or controlled drainage and narrower buffers. Forested and grassed buffers were typically used; narrower buffers were permitted in conjunction with nutrient management and/or controlled drainage because the percent decrease of NO_3-N is often less than 100% in the narrower buffers.

We proposed the use of shrub buffers as an alternative buffer type that would achieve similar or improved NO_3-N concentration decreases. Shrub buffers are created by taking an area out of production adjacent to a water body and allowing the vegetation in the seed bank to grow. Shrub buffers are beneficial because they become established quickly and no cost is incurred due to planting. The vegetation tends to be a heterogeneous mix of grass, shrubby and woody species. Mixed species are beneficial because they provide diverse wildlife habitat and are likely to have varied rooting patterns (Schultz et al., 1995). The buffer vegetation is important because it contributes organic carbon to

groundwater that can possibly aid in the formation of a denitrifying environment within the buffers (Gilliam et al., 1997). The objectives of this study were to determine: if groundwater NO_3-N decreased under a riparian shrub-buffer system; if greater decreases were measured in wider buffers; and if denitrification was the process responsible for any NO_3-N decrease.

Materials and Methods

Site Description

This study was conducted near Kinston (Lenoir County), North Carolina, which is in the Middle Coastal Plain region. A network of ditches provided drainage at the site and a flashboard riser was used to control drainage. Groundwater chemistry and redox potential were monitored in buffers adjacent to five drainage ditches (Figure 1). Three of the ditches had 4.5-m (15-ft) buffers, one had a 9-m (30-ft) buffer and one had a 1-m (3-ft) wide buffer. The buffer vegetation was a heterogeneous mix of weedy species, but briars (*Rubus* spp.) dominated the 4.5 and 1-m buffers and goldenrod (*Solidago* spp.) dominated the 9-m buffer. A rotation of corn and soybeans was grown on the fields studied (Table 1). Nitrogen fertilizer was applied to the corn at a rate of 168 kg ha^{-1} (150 lb ac^{-1}), half of which was applied at planting and the other half at layby. The soybeans did not receive N fertilizer. The crop rows ran parallel with the drainage ditches in fields 7, 8, 9 and 10, and perpendicular to the ditch in field 13.

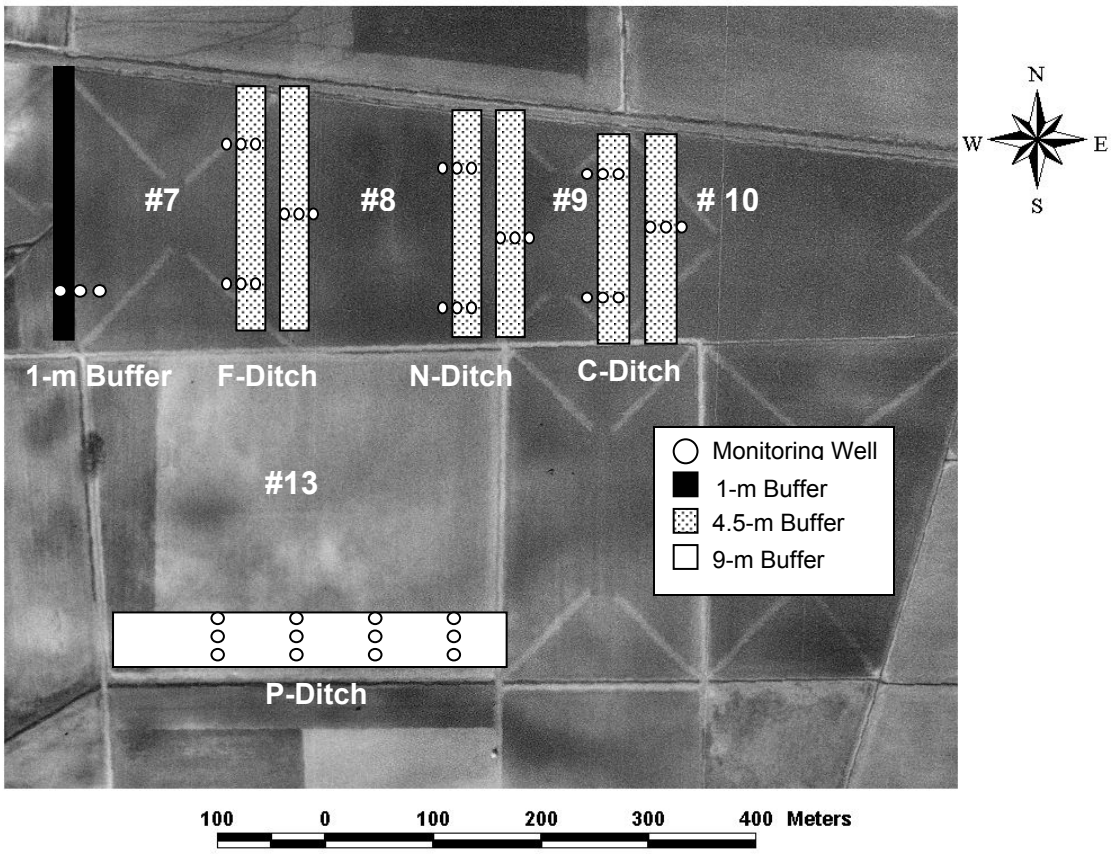


Figure 1. Naming scheme for buffers (ie P-Ditch) and numbering scheme for fields (ie #13) (not to scale).

Table 1. Cropping rotation in each of the fields with a buffer.

Year	Field 7	Field 8	Field 9	Field 10	Field 13
2000	Corn	Corn	Soy	Soy	Corn
2001	Soy	Soy	Corn	Corn	Soy
2002	Corn	Soy	Corn	Corn	Corn
2003	Soy	Corn	Soy	Soy	Corn

The soils at the site were: Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults); Arapahoe (Coarse-loamy, mixed, semiactive, nonacid, thermic Typic Humaquepts); and Roanoke (Fine, mixed, semiactive, thermic Typic Endoaquults), which are all poorly to very poorly drained soils, and topographically flat. The soil surface tended to be sandy loam in texture and was underlain by a horizon of increased clay content, typically sandy clay loam in

texture, which was underlain by coarse to fine sands. Detailed profile descriptions were made at selected locations in each buffer (Appendix A).

Soil samples were collected approximately 2.3 m (7.5 ft) from the ditch in each 4.5-m buffer and at 2.3 m (7.5 ft) and 6.8 m (22.5 ft) in the 9-m buffer (Figure 1); the sampling locations were approximately half way between the nests of groundwater monitoring wells, which are described in the groundwater monitoring section. The soil samples were separated into horizons for the following analyses: oxalate-extractable iron (Fe) and aluminum (Al) by ICP (Johnson, 2004); particle size (hydrometer method) (Gee and Bauder, 1986); and percent total organic carbon (loss on ignition method). In addition, pH, cation exchange capacity, nutrients and metals were analyzed at the N.C. Department of Agriculture & Consumer Services Agronomic Division soil analysis laboratory using their standard procedures (NCDA&CS, 2004). The raw data is presented in Appendix B. The horizon characteristics varied between locations; to facilitate data summarization and presentation the physical and chemical data from each buffer were grouped into generalized soil horizons (Tables 2, 3). The data from each 4.5-m buffer were compiled to make one representative horizon for each buffer. The data from the 9-m buffer were compiled into two representative horizons (one from Transects 1 and 2, the other from Transect 3 and 4) because the soils were not consistent across the buffer (see Figure 2 for the transect naming scheme).

Table 2. Soil physical data from soils within the buffers.

Ditch	Transects	Horizon	Horizon Depth † (cm)	Percentage ††			Texture ††
				Sand	Silt	Clay	
C	All	A	0 - 64	67	21	13	SL
		Btg	64 - 152	71	12	16	LS, SL, SCL
		Cg	152 +	89	4	6	S, SL
F	All	A	0 - 94	59	21	20	SL, SCL
		Btg	94 - 188	67	13	20	LS, SL, SCL
		Cg	188 +	92	3	5	S
N	All	A	0 - 71	67	20	13	SL
		Btg	71 - 152	75	9	16	LS, SCL
		Cg	152 +	93	3	5	S
P	1 and 2	A	0 - 91	78	13	8	LS, SL
		Btg	91 - 165	73	12	15	LS, SL, SCL
		Cg	165 +	91	3	5	S, LS
P	3 and 4	A	0 - 51	60	21	20	SL, SCL
		Btg	51 - 157	62	16	22	SL, SCL
		Cg	157 +	88	5	7	S, LS, SL

† Determined in the field at the time of sample collection.
††Determined in the Soil Particle Size Analysis Laboratory at the Soil Science Department at NC State University.

Table 3. Soil chemical data from soils within the buffers.

Ditch	Transects	Horizon	Horizon Depth † (cm)	pH #	CEC # (meq $100\ mL^{-1}$)	Nutrient and Metal Concentrations (kg/ha)#						TOC % ‡
						P	K	Ca	Mg	Al	Fe	
C	All	A	0 - 64	4.6	7.2	215	177	724	74	10928	718	3.5
		Btg	64 - 152	4.52	6.2	148	88	683	88	2779	719	1.1
		Cg	152 +	4.23	3.4	50	59	464	60	16207	1679	0.3
F	All	A	0 - 94	4.46	7.6	68	188	556	98	13428	636	3.5
		Btg	94 - 188	4.48	5.7	28	98	439	85	3868	4279	0.9
		Cg	188 +	3.2	5.6	25	29	405	44	25698	1562	0.3
N	All	A	0 - 71	4.3	8.0	72	169	503	56	8733	28	4.7
		Btg	71 - 152	4.53	4.7	86	76	279	49	3189	172	1.0
		Cg	152 +	4.68	2.3	46	43	232	34	15852	771	0.2
P	1 and 2	A	0 - 91	3.98	4.3	95	210	530	91	7030	528	0.9
		Btg	91 - 165	5.23	7.1	64	207	1693	199	6856	1969	0.5
		Cg	165 +	4.28	3.1	139	39	206	48	4298	3083	0.2
P	3 and 4	A	0 - 51	4.83	8.0	198	266	1125	268	5081	1748	1.2
		Btg	51 - 157	5.25	10.2	121	135	2676	219	2132	2775	0.6
		Cg	157 +	3.4	7.7	31	59	1380	82	5321	3174	0.3

† Determined in the field at the time of sample collection.
# Determined at the North Carolina Department of Agriculture Soils Analysis Laboratory.
‡ Determined in the Analytical Services Laboratory in the Soil Science Department at NC State University.

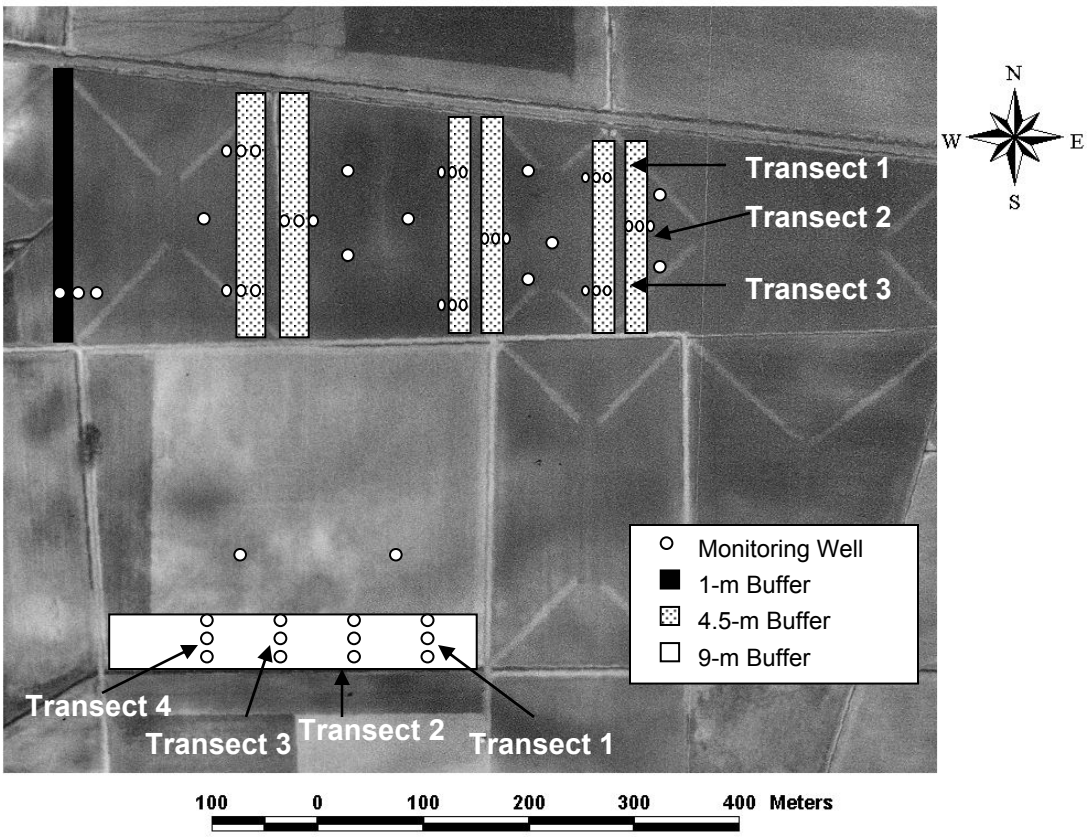


Figure 2. Monitoring well locations in the 1-, 4.5- and 9-m wide buffers and in the fields, and the transect numbering scheme. The transect numbering was the same for all three 4.5-m buffers.

Groundwater Monitoring

A total of 30 well nests made of 5 cm (2 in) diameter wells were installed perpendicular to the drainage ditches within the 4.5-m (15-ft) and 9-m (30-ft) buffers. Each well nest consisted of a deep well [0.6 m (2 ft) screened interval installed to a depth of 2.8 m (9 ft)], an intermediate well [1.5 m (5 ft) screened interval installed to a depth of 2 m (6.5 ft)] and a shallow well [0.3 m (1 ft) screened interval installed to a depth of 1 m (3 ft)]. Four transects of well nests were installed in the 9-m buffer, with well nests installed 0, 4.5 and 9 m from the ditch (Figure 2). Three transects of wells were installed in each of the 4.5-m

buffers; the well nests were installed 0 and 4.5 m from the ditch and a single intermediate depth well (0.5 to 2.0 m (1.5 to 6.5 ft)) was installed 9 m from the ditch in each transect. One transect of intermediate depth wells was installed adjacent to the ditch with the 1-m buffer; the wells were installed 0, 4.5 and 9 m from the ditch. Intermediate depth wells were also installed in the fields, away from the buffers, to obtain samples that were representative of conditions in the fields. Air temperature and precipitation were monitored by a Strison Wireless System (www.strison.com). Measurements were made four times daily from January 2001 to June 2003 and all data was accessible via a Strison website. The precipitation raw data is presented in Appendix C.

The deep (2.2 to 2.8 m (7 to 9 ft)) and intermediate (0.5 to 2.0 m (1.5 to 6.5 ft)) wells within the buffers were sampled monthly beginning in February 2000 and the shallow (0.6 to 0.9 m (2 to 3 ft)) wells were first sampled in March 2002. The intermediate depth wells installed outside of the 4.5-m (15-ft) and 9-m (30-ft) buffers and adjacent to the 1-m buffer were first sampled in June 2002. The depth to the water table was measured with an electronic resistance tape in the intermediate wells. The water level raw data is presented in Appendix D. The depth to the water table also was measured in four deep wells in the P-Ditch and four deep wells in the N-Ditch automatically with a pressure transducer four times daily by the Strison Wireless System. The elevation of the water table was calculated from the elevation of the top of each well, which was determined by surveying and tying into an elevation benchmark.

Forty-milliliter groundwater samples were collected for nutrient analysis in acid washed glass bottles using a peristaltic pump and dedicated tubing. A pH sample of the groundwater was also collected and measured immediately after collection. The groundwater samples were collected after three well volumes were purged from the well or after the well went dry and was allowed to recharge. The samples were stored on ice until they were returned to the lab.

The samples were filtered using syringes and 45-um Millipore Syringe Filters and acidified to a pH of 2 with 5% sulfuric acid solution (5 mL concentrated reagent grade sulfuric acid diluted to 100 mL with deionized water). The samples were capped tightly and refrigerated until analysis. The Analytical Services Laboratory in the Soil Science Department at NC State University analyzed the samples using Lachat methods for NO_3-N (Lachat method # 10-107-04-1-A, Lachat Instruments, Hach Company, Loveland, CO, USA), orthophosphate (PO_4-P) (Lachat method # 10-115-01-1-A, Lachat Instruments, Hach Company, Loveland, CO, USA) and ammonium (NH_4-N) (Lachat method # 10-107-06-2-A, Lachat Instruments, Hach Company, Loveland, CO, USA). These analyses were performed until July 2001. From August 2001 through June 2003, the samples were also analyzed for chlorides (Cl^-) (Standard Methods 4110, Clesceri and Eaton, 1992) with a Dionex Micromembrane suppressor. Dissolved organic carbon (DOC) was measured as total organic carbon (TOC) (TOC-Combustion-Infrared Method, Standard Methods 5310B, Clesceri and Eaton, 1992) with a Shimadzu TOC-5050. Ammonium analyses were stopped in April 2002 because the concentrations were consistently at or below the detection

limit. Groundwater samples collected in December 2002 and January 2003 were also analyzed for dissolved iron (Fe^{2+}), total iron (TFe) and total phosphorus (TP) with the ICP-OES (Standard Methods 3120, Clesceri and Eaton, 1992) to examine the relationship between redox potential, iron and phosphorus. The water sample raw data are presented in Appendix E.

The influence of buffer width on groundwater NO_3-N concentrations was examined using the samples collected from the intermediate wells adjacent to the buffered ditches. The percent decrease of NO_3-N was calculated from the well 9-m from the ditch to the well adjacent to the ditch using the following equation:

$$[(9\text{-m } NO_3\text{-N}) - (0\text{-m } NO_3\text{-N})] / (9\text{-m } NO_3\text{-N})$$

The same equation was used for the 4.5-m well data, by substituting the 4.5-m data for the 9-m data. The average percent decrease reported in the results was calculated from the percent decrease that was calculated for each individual date.

Redox Potential Monitoring

Redox potential monitoring equipment was installed adjacent to the well nests within the 4.5-m (15-ft) and 9-m (30-ft) buffers. Redox probes were manufactured and tested using Light Solution in the Soil Science Department at NC State University, as described by Wafer et al. (2003). Temperature probes (Appendix F) (Hayes, 1998) and potassium chloride salt bridges (KCl salt bridges) (Appendix G) (Veneman and Pickering, 1983; Hayes, 1998) were also constructed. Three deep (1.5 m (5 ft)) probes and five shallow (0.75 m (2.5 ft))

redox probes, a temperature probe that measured soil temperature 1.5 and 0.75 m deep in the soil, a KCl salt bridge and a platform were installed at each well nest within the 4.5- and 9-m buffers in the pattern shown in Figure 3. The redox and temperature probes were installed above and below the average growing season water table elevation to enable measurements from soils that were periodically saturated and ones that were continually saturated (Figure 4). The redox probe installation method is described in Appendix H. The probes were installed in a square pattern that maximized the distance between probes to aid in installation, while keeping the redox probes within 0.3 m (1 ft) of the KCl salt bridge so the salt bridge would still be effective. Equipment was placed on the platform when redox potential and temperature were measured. Redox potential and soil temperature were first measured in December 2001.

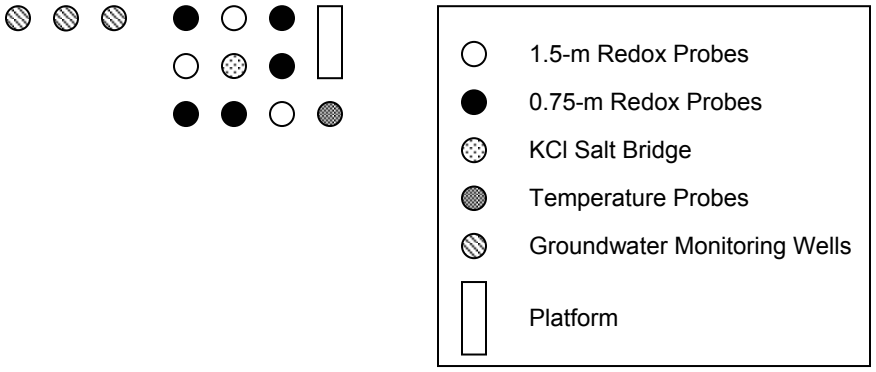


Figure 3. Redox potential and groundwater monitoring equipment setup.

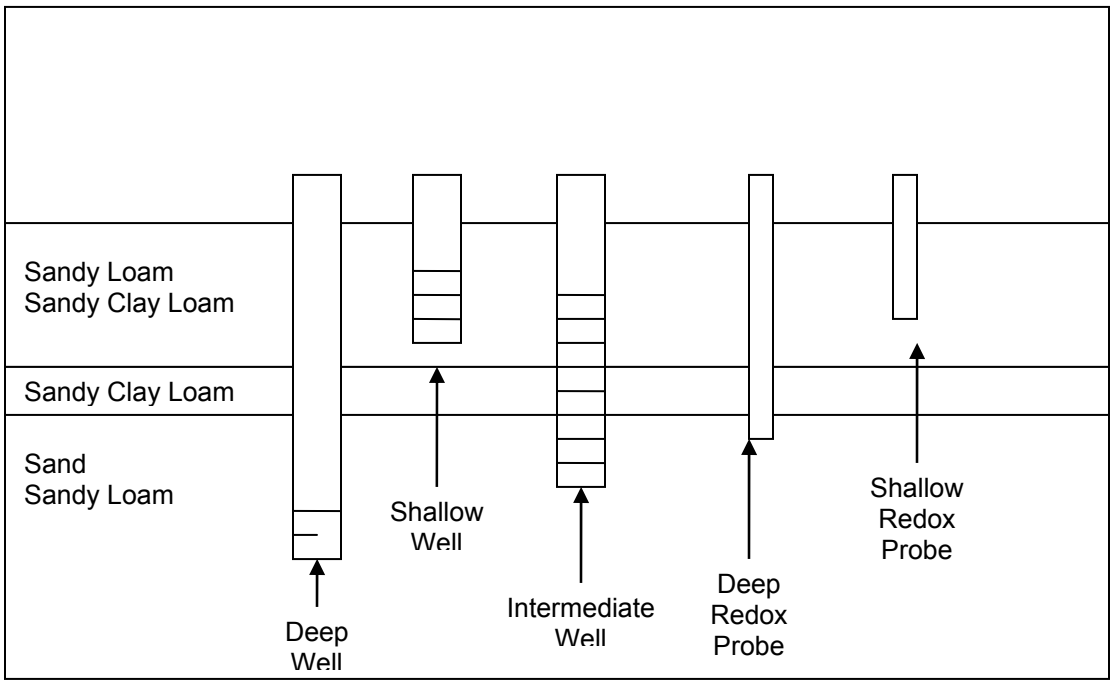


Figure 4. Cross sectional profile of the redox potential and groundwater monitoring equipment setup at the site.

Redox potential was measured by connecting the copper wire from the redox probe to the positive end of a BNC connector that was attached to an Accumet Portable (AP 62) pH/mV meter. A KCl saturated Ag/AgCl reference probe, manufactured by Jensen Instruments, was connected to the grounded prong on the BNC connector (purchased from an electrical supply store). The KCl saturated Ag/AgCl reference probe was inserted into the agar gel in the KCl salt bridge. The salt bridge was used because electrons are more readily exchanged with the soil solution when the KCl saturated Ag/AgCl reference probe is inserted into the salt bridge than when the reference probe is inserted into moist soil. The use of the KCl salt bridge resulted in rapid stabilization of the redox readings. Redox readings with the KCl saturated Ag/AgCl reference probe

were corrected for the potential of the reference probe by the addition of +199 mV to all redox potentials measured to obtain the correct redox potential.

The soils at the study site were pH of approximately 5, so denitrification would be expected to occur at redox potentials below +400 mV; above redox potentials +600 mV the soils were expected to be oxidized and denitrification would be expected to occur only in isolated areas, if at all (Bohn, 1971; McBride, 1994; J.W. Gilliam, personal communication, 2004). It is difficult to say if denitrification would have occurred between +400 and +600 mV. The ratio of NO_3-N to Cl^- was also examined to determine if denitrification or dilution was more likely responsible for any NO_3-N concentration decrease across the buffers. Decreasing NO_3-N /Cl^- ratios across a buffer indicate that the NO_3-N concentrations decreased with distance due to denitrification, plant uptake or that the Cl^- concentrations increased with distance. Ratios that do not change with distance indicate that the NO_3-N and Cl^- concentrations either decreased proportionally because the constituents were diluted or the concentrations did not change.

Statistical Analyses

This study was not properly designed for statistical analyses, as a result each transect in the 4.5-m (15-ft) and 9-m (30-ft) buffers was treated as a replicate for analyses performed on the respective buffers. There were nine replicates for the 4.5-m buffers (three buffers each with three transects), four replicates for the 9-m buffers (one buffer with four transects) and one replicate for

the 1-m buffer (one buffer with one transect). The influence of buffer width on the percent NO_3^--N decrease in the intermediate depth (0.5 to 2.0 m) wells was statistically examined, using the data collected from December 2001 through June 2003. The percent decrease calculated from 9 m to 0 m was statistically analyzed for data collected adjacent to the ditches with the 9-, 4.5- and 1-m buffers using Proc GLM and LS Means in SAS (SAS Institute, 2001, Cary, NC, USA). Differences were considered significant at p=0.01. The same analyses were performed for the percent decrease data from 4.5 m to 0 m.

Statistical analyses were not performed on the deep (2.2 to 2.8 m) groundwater NO_3-N and DOC data and 1.5-m (5-ft) redox potential data because more that half of the NO_3-N data was below the detection limit and the data were not normally distributed. A three-dimensional graph was created, however, to visually examine the relationship between those variables over the entire study period. The influence of seasonal effects on NO_3-N concentrations, DOC concentrations and redox potential was also examined by making a separate 3-D graph for each season (planting season - April to May; growing season - June to September; and the dormant season - October to March).

The percent decrease of shallow (0.6 to 0.9 m (2 to 3 ft)) groundwater NO_3-N across the 9- and 4.5-m buffers was statistically examined. Data collected from December 2001 to June 2003 was examined with Proc GLM and LS Means in SAS (SAS Institute, 2001, Cary, NC, USA). Dissolved organic carbon (the DOC data was normalized by taking the $\log_{10}$) from the shallow (0.6 to 0.9 m) groundwater and the 0.75 m (2.5 ft) redox potential, and the interaction of

seasonality on DOC and redox potential, were examined in relation to the percent decreases. There were nine replicates for the 4.5-m (15-ft) buffers (three buffers each with three transects) and four replicates for the 9-m (30-ft) buffers (one buffer with four transects). Buffer width was found to significantly ($p=0.05$) influence the decrease in concentration. Therefore, separate analyses were performed for the 9- and 4.5-m buffers to decrease the effect of buffer width on the examination of the influence of redox potential, DOC and seasonality on the concentration decreases. Factors were considered to significantly influence the percent decrease at $p=0.05$.

Data from December 2002 and January 2003 was used to examine the relationship between groundwater PO_4-P and the explanatory variables of soluble Fe, DOC and redox potential. Deep (2.2 to 2.8 m (7 to 9 ft)) and shallow (0.6 to 0.9 m (2 to 3 ft)) groundwater and deep (1.5 m (5 ft)) and shallow (0.75 m (2.5 ft)) soil redox potential data were compared using Proc Reg in SAS (SAS Institute, 2001, Cary, NC, USA) (Appendix I). A separate regression was run between PO_4-P and each of the explanatory variables for each buffer and each depth (ie. PO_4-P concentrations were compared to DOC concentrations in the shallow wells in the C-Ditch). The explanatory variables were significantly correlated with PO_4-P at either $p=0.05$ or less.

Results and Discussion

Influence of Buffer Width on NO_3^--N Removal

The average NO_3-N concentrations shown in Table 4 are from data collected from the intermediate (0.5 to 2.0 m (1.5 to 6.5 ft)) depth wells. The most probable source of groundwater NO_3-N was from N fertilizer that was not harvested with the crops and subsequently leached. Based on the data in Table 4, it appears that NO_3-N concentrations in the wells were influenced by the proximity of N fertilizer application to the wells. Fertilizer was applied around the wells that were in the fields (9 m (30 ft) in the 4.5-m (15-ft) buffer and at 9 m and 4.5 m in the 1-m buffer), which is probably why the concentrations are highest in those wells. Nitrate N concentrations were higher in the groundwater in the fields than the concentrations at the field edge of the buffer (9 m in the 9-m buffer; 4.5 m in the 4.5-m buffer). The most probably reason for the difference is that fertilizer was applied adjacent to, but not around, the wells at the field edge of the buffers. Nitrate N concentrations were low in the wells adjacent to the drainage ditches (0-m distance) probably because no N fertilizer was applied around those wells. The NO_3-N concentrations were also low within the buffers and adjacent to the drainage ditch because soil and groundwater conditions favored denitrification of the groundwater NO_3.

Table 4. Average NO_3^--N concentrations at 9, 4.5 and 0 m and the percent NO_3^--N decrease across the 9- and 4.5-m distances in the 1-, 4.5- and 9-m buffers.

Buffer Width	Average NO_3^--N Concentrations (mg L^{-1})				Percent Decreases	
(m)	9 m	4.5 m	0 m	Drainage Ditch	9 m Distance	4.5 m Distance
1	10.5	10.2	3.4	nd	67	66
4.5	9.2	3.0	0.6	1.0	93	79
9	5.8	2.1	0.5	0.3	91	74

* Significance at p=0.01.
nd – no data

The percent decreases of NO_3-N were higher across the 9-m distance than the 4.5-m (15-ft) distance (Table 4). The higher percent decreases across 9 m (30 ft) seemed to partially be a result of the higher NO_3-N concentrations at the 9-m distance due to fertilizer application. Measuring NO_3-N concentrations at 9 m from ditches with the 4.5-m buffers resulted in similar percent decrease across the areas with 4.5- and 9-m buffers, despite the fact that there was no buffer from 9 to 4.5 m in the 4.5 m buffer. This indicated that a process was occurring that decreased NO_3-N in the fields outside of the buffers. The groundwater level was higher in the fields than in the buffers, which created conditions that favored denitrification; dilution or possibly crop uptake could have also decreased the NO_3-N concentrations. If the percent decreases had only been calculated across the actual buffer width, the 4.5-m buffer would not have seemed to be as effective as the 9-m buffer.

The percent decreases across the 9-m (30-ft) distance were significantly lower where the 1-m (3-ft) buffer was located as opposed to the wider buffers (Table 4). There was no difference between buffer width when the percent decrease was calculated from 4.5-m (15-ft) to the ditch. The percent decreases were probably much lower in the 1-m buffer because fertilizer was applied closer

to the 0-m well than to those in the wider buffers. Due to the lack of replication, the pattern seen in the 1-m buffer data may not have been representative of conditions elsewhere along that buffer. Considering that N fertilizer was applied within 2 m of the 0-m well, an average concentration of 3.4 mg N L^{-1} at 0-m is very impressive, compared to the concentration that probably would have existed if no buffer was present.

The intermediate (0.5 to 2.0 m (1.5 to 6.5 ft)) wells used for this study collected groundwater from all three soil horizons. The NO_3-N data from the denitrification portion of this study show that the shallow (0.6 to 0.9 m (2 to 3 ft)) groundwater NO_3-N concentrations were higher (4.3 mg N L-1) than deep (2.2 to 2.8 m (7 to 9 ft)) NO_3-N concentrations (0.8 mg N L-1). The NO_3-N that was measured in the intermediate wells likely came from the N fertilizer that entered the shallow groundwater in the surface horizon (sandy loam). The shallow groundwater probably flowed over the restrictive subsurface horizon into the well when the well was purged. A greater volume of water probably entered the intermediate wells from the coarse sands at the deep depth than the shallow groundwater. The deep groundwater likely diluted some of the NO_3-N from the shallow groundwater, but the amount of dilution was not determined. The dilution likely contributed to lower NO_3-N concentrations at the intermediate depth than the shallow concentrations. Even though some dilution by deeper groundwater probably occurred, the lack of fertilizer application due to the presence of the buffers seemed to also result in decreased NO_3-N concentrations closer to the drainage ditches.

Nitrate-N Removal by Denitrification

The average groundwater table elevation data indicated that the water table was high enough to continually saturate the soils below a depth of approximately 155 cm (1447 cm elevation) (Figures 4, 5). It was likely that those soils were oxygen depleted because the water table briefly dropped below 155 cm, which allowed minimal time for oxygen to diffuse into the soil. The shallower soils above 155 cm were periodically saturated due to seasonal water table fluctuations. The shallow soils may have been depleted of oxygen when the water table was the highest in the winter and spring when the soils were saturated.

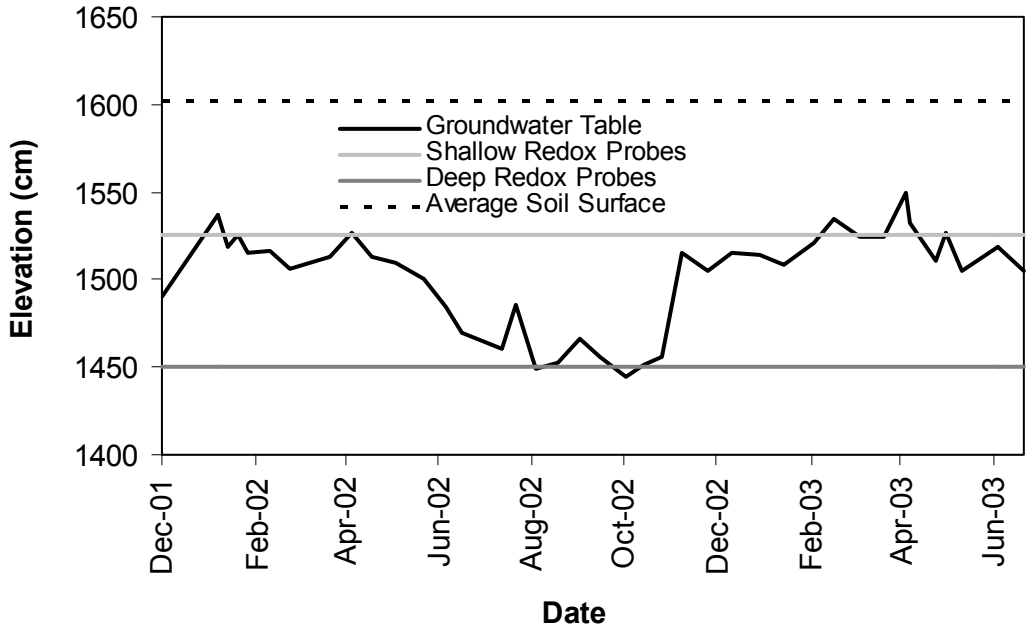


Figure 5. Average groundwater table elevation below the average soil surface elevation and elevation of the shallow and deep redox probes.

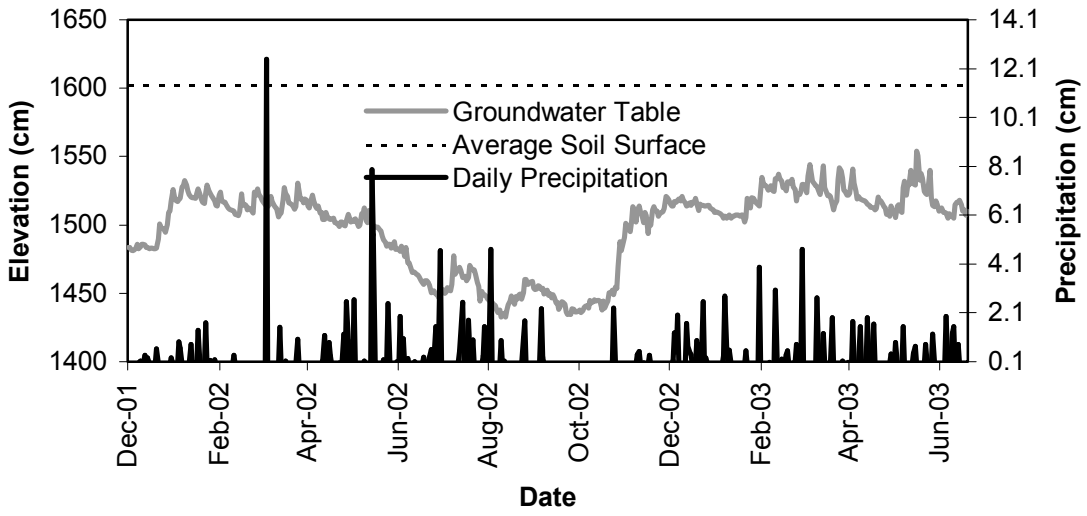


Figure 6. Average daily groundwater table elevation below the average soil surface elevation and daily precipitation measured by the Strison automated system.

Controlled drainage contributed to the high water levels during the winter and spring. Without the controlled drainage structure in place, much of the water that was held in the fields and contributed to the high water levels would have instead been lost as drainage water (Evans et al., 1989; Treece and Jaynes, 1994). The groundwater table dropped as evapotranspiration increased during the growing season and the depth to the water table was extremely low during and after the growing season of 2002 due to a drought (Figures 5, 6). The average groundwater table elevation measured over the entire study period during sampling events and the average daily groundwater table elevation in each buffer are shown in Appendix J. The average groundwater table elevation and the daily precipitation measured by the Strison system over the entire study period are shown in Appendix K.

The soil temperature data show that soil temperatures were above biological zero (5 °C), which indicates that denitrification was not likely hindered by cold temperatures. Seasonal air and soil temperature changes were also observed (Figure 7). The shallow soils were warmer from March to October and the deep soils were warmer during the rest of the year.

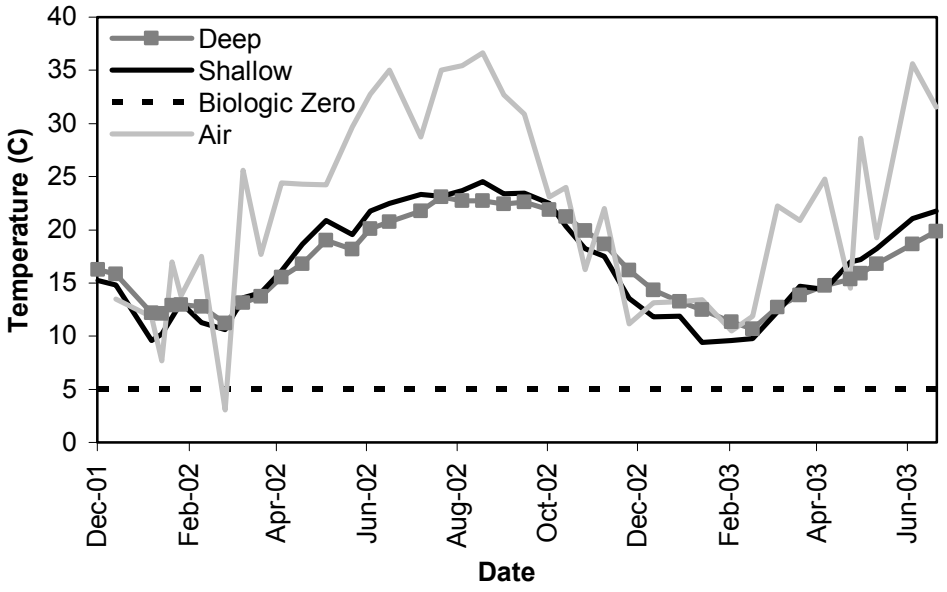


Figure 7. Average deep soil, shallow soil and air temperature in relation to biological zero.

Dissolved organic carbon concentrations above 7 to 10 mg C L^{-1} were expected to promote high rates of NO_3-N removal by denitrification (Obenhouber and Lowrance, 1991; J.W. Gilliam, personal communication, 2003). Low denitrification rates were expected in the deep, sandy soils when DOC was below 4 to 5 mg C L^{-1} (Starr and Gillham, 1993; J.W. Gilliam, personal communication, 2003). Based on the average DOC concentrations, there was

sufficient DOC to promote high denitrification rates in the shallow (0.6 to 0.9 m (2 to 3 ft)) groundwater and low denitrification rates would be expected in the deep groundwater (2.2 to 2.8 m (7 to 9 ft)) (Table 5). The DOC in the groundwater and TOC in the shallow soils (Table 3) were higher in the 4.5-m buffers than in the 9-m buffers. The organic carbon was probably higher in the 4.5-m buffers and adjacent fields due to the high groundwater table that slowed organic matter mineralization and caused organic carbon to accumulate before artificial drainage was installed. The buffer vegetation did not appear to influence the carbon concentrations in the 4.5-m buffers because the concentrations were also high in the fields away from the buffers.

Table 5. Dissolved organic carbon concentration (mg C L^{-1}) in the 4.5- and 9-m buffers.

Well Depth	9-m Buffer	4.5-m Buffers
Deep	3.6	4.0
Intermediate	6.4	11.0
Shallow	10.2	16.2

The deep (2.2 to 2.8 m (7 to 9 ft)) groundwater NO_3-N concentrations did not decrease across the 4.5-m (15-ft) buffers (Figure 8a). The NO_3-N concentrations entering and leaving the buffers at the deep depth were similar and very low, which resulted in a low percent decrease (Figure 8b). The deep NO_3-N concentrations were low because the 1.5-m (5-ft) redox potentials remained below +400 mV, which indicated that the deep soil and groundwater were depleted of oxygen and denitrification was probably responsible for the low concentrations (Figure 8c). The redox potentials of the deep soils remained low because the soils were consistently saturated and oxygen could not diffuse to the deeper soils to cause the redox potential to increase.

The deep (2.2- to 2.8-m (7- to 9-ft)) groundwater NO_3-N data from the 9-m buffer show that the NO_3-N concentrations were higher at the 9-m distance and decreased toward the drainage ditch (Figure 9a). The percent decrease of NO_3-N in the buffer was at or near 100% throughout the study period, except during a portion of the 2002 growing season (Figure 9b). It appears that the lower percent decreases were in response to the lower concentrations of NO_3-N entering the buffer. The 1.5-m (5-ft) redox potentials were also consistently below +400 mV, which indicates that denitrification was probably responsible for the lower NO_3-N concentrations within the buffer (Figure 9c).

The three-dimensional graphs of the deep NO_3-N, redox potential and DOC data from the 9-m (30-ft) and 4.5-m (15-ft) buffers show that most of the NO_3-N concentrations were low (less than 1 mg N L^{-1}) and were typically associated with low redox potentials (less than 0 mV) and DOC (less than 5 to 6 mg C L^{-1}) during all three seasons (Appendix L). The higher NO_3-N concentrations seen in the three-dimensional plots were associated with the high concentrations at the field edge of 9-m buffer during the dormant season, when leaching most likely occurred.

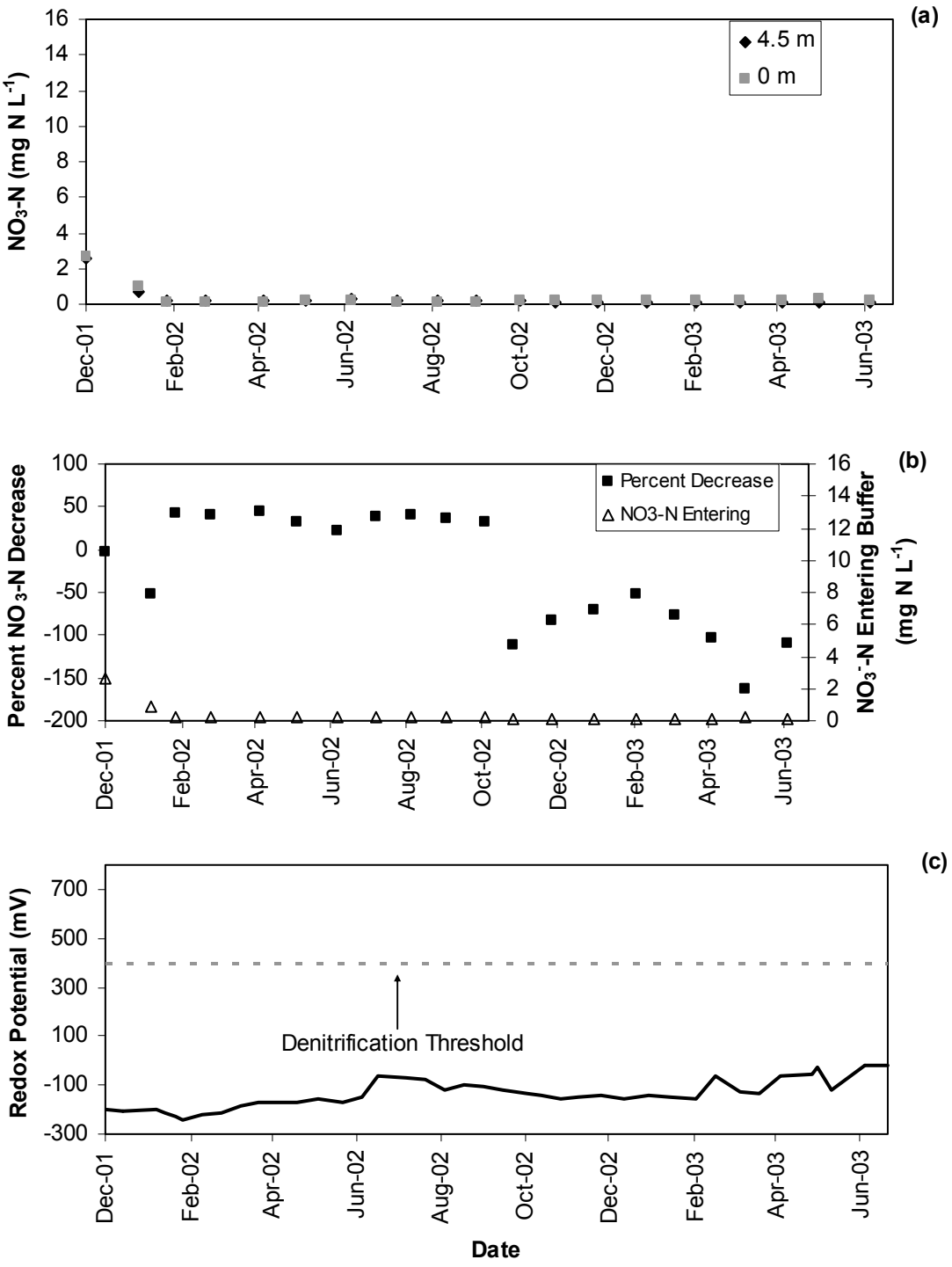


Figure 8. Data from the 4.5-m buffer: (a) NO_3-N in the deep wells at 0 m and 4.5 m; (b) percent NO_3-N decrease in relation to NO_3-N entering the buffer; and (c) deep redox potential.

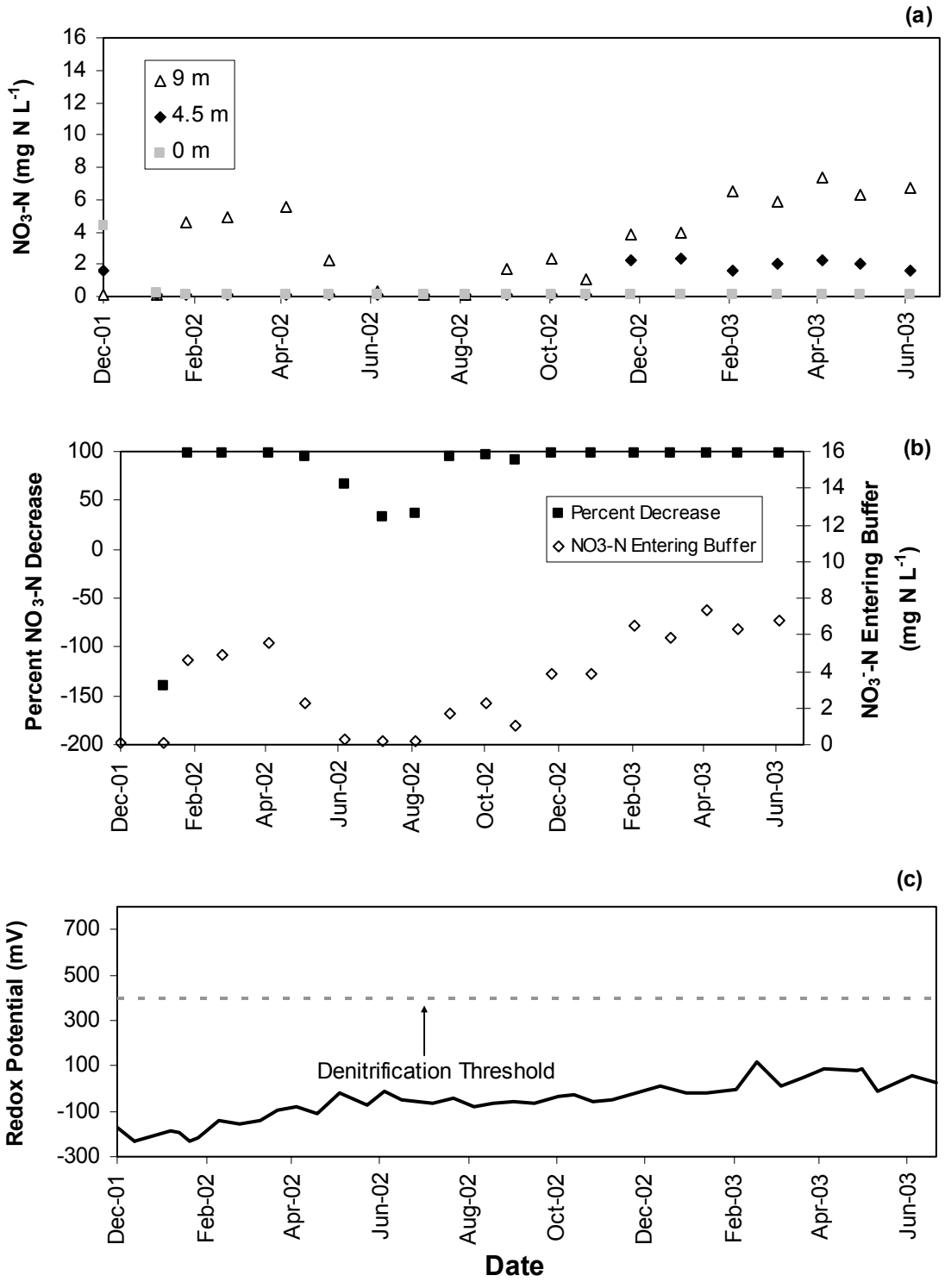


Figure 9. Data from the 9 m buffer: (a) NO_3-N in the deep wells at 0 m, 4.5 m and 9 m; (b) percent NO_3-N decrease in relation to NO_3-N entering the buffer; and (c) deep redox potential.

The shallow (0.6 to 0.9 m (2 to 3 ft)) groundwater NO_3-N concentrations fluctuated more than the deep (2.2 to 2.8 m (7 to 9 ft)) concentrations in the 4.5-m (15-ft) buffers (Figure 10a). Despite the fluctuations, shallow NO_3-N concentrations still decreased by 50% or more throughout most of the study period (Figure 10b). The majority of the decrease was probably due to denitrification because the 0.75-m (2.5-ft) soil redox potential was often below +400 mV (Figure 10c). The shallow soils became oxidized when the water level dropped below the level of the redox probes (Figure 10c), but the NO_3-N concentrations could not be examined because the monitoring wells were also dry.

The shallow NO_3-N concentrations did not decrease across the entire width of the 9-m (30-ft) buffer throughout the study period (Figure 11a). During the winter and spring of 2003, the concentrations at the 9- and 0-m distances were similar; they were also lower than the concentrations at the 4.5-m (15-ft) distance. The percent decrease of NO_3-N across the entire 9-m of the buffer dropped after extended periods of low concentrations of NO_3^--N entering the buffer (Figure 11b). Despite drops in the percent decrease, denitrification appeared to be responsible for the decrease in the spring of 2002 and winter and spring of 2003 when the 0.75-m (2.5-ft) redox potentials were below +400 mV (Figure 11c). The soils were oxidized in the summer and fall of 2003, because the water level dropped below the depth of the redox probes and oxygen could diffuse into the soil. Nitrate N concentrations were not examined because the monitoring wells were dry and groundwater samples were not collected.

Nitrate N decreases appeared to be influenced by the amount of NO_3-N entering the buffer. A literature review by Fennessy and Cronk (1997) found that as the amount of NO_3-N entering a buffer increased, the amount removed by denitrification increased. It is expected that the opposite also holds true, when low concentrations enter the buffer the loss due to denitrification would decrease. This was seen in early 2003 in the 9-m (30-ft) buffer when NO_3-N concentrations entering the buffer were consistent, but low, and the percent decrease dropped (Figure 11b). Denitrification is probably responsible for the decreases because the varied degrees of oxidation and reduction in the shallow soils probably created optimum conditions for denitrification (Reddy and Patrick, 1974). The potential for denitrification was also high at the shallow depths because the DOC concentrations were high in both the 4.5-m (16.2 mg C L^{-1}) and 9-m (10.2 mg C L^{-1}) buffers (Table 5).

Dissolved organic carbon concentrations, seasonal changes (ie. changing environmental conditions, fertilizer application, crop uptake of nutrients) and seasonal DOC changes all significantly ($p=0.05$) explained the concentration decreases across the 4.5-m (15-ft) buffer, while redox potential and seasonal changes in redox potential did not. The decrease of NO_3-N concentrations across the 9-m (30-ft) buffer was not significantly explained by any of the factors. One likely reason for the lack of significance in the 9-m buffer was because one or more shallow wells was dry in each transect, which resulted in a small sample size for the percent decrease data.

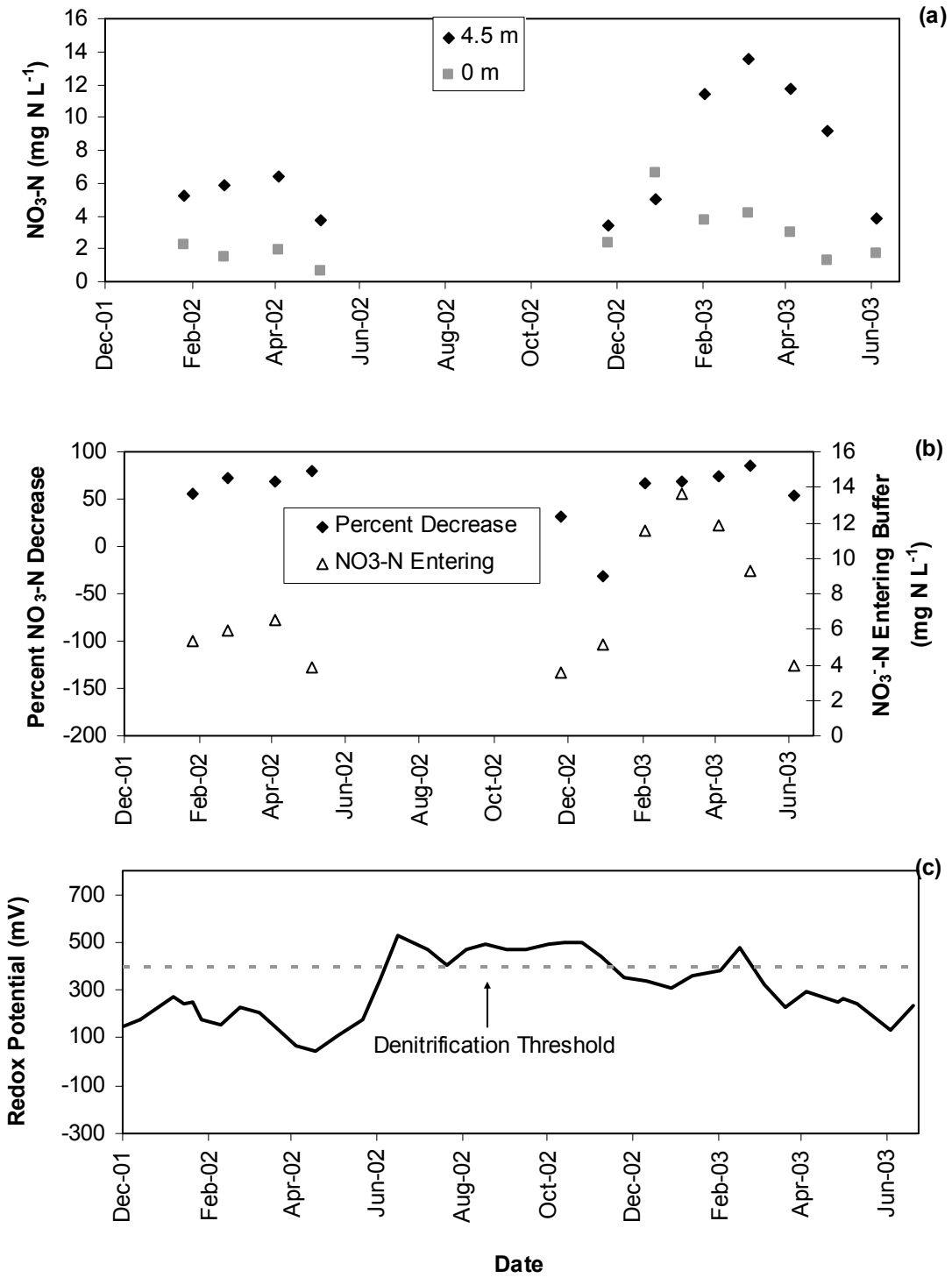


Figure 10. Data from the 4.5 m buffer: (a) NO_3-N in the shallow wells at 0 m and 4.5 m; (b) shallow redox potential; and (c) percent NO_3-N decrease in relation to NO_3-N entering the buffer.

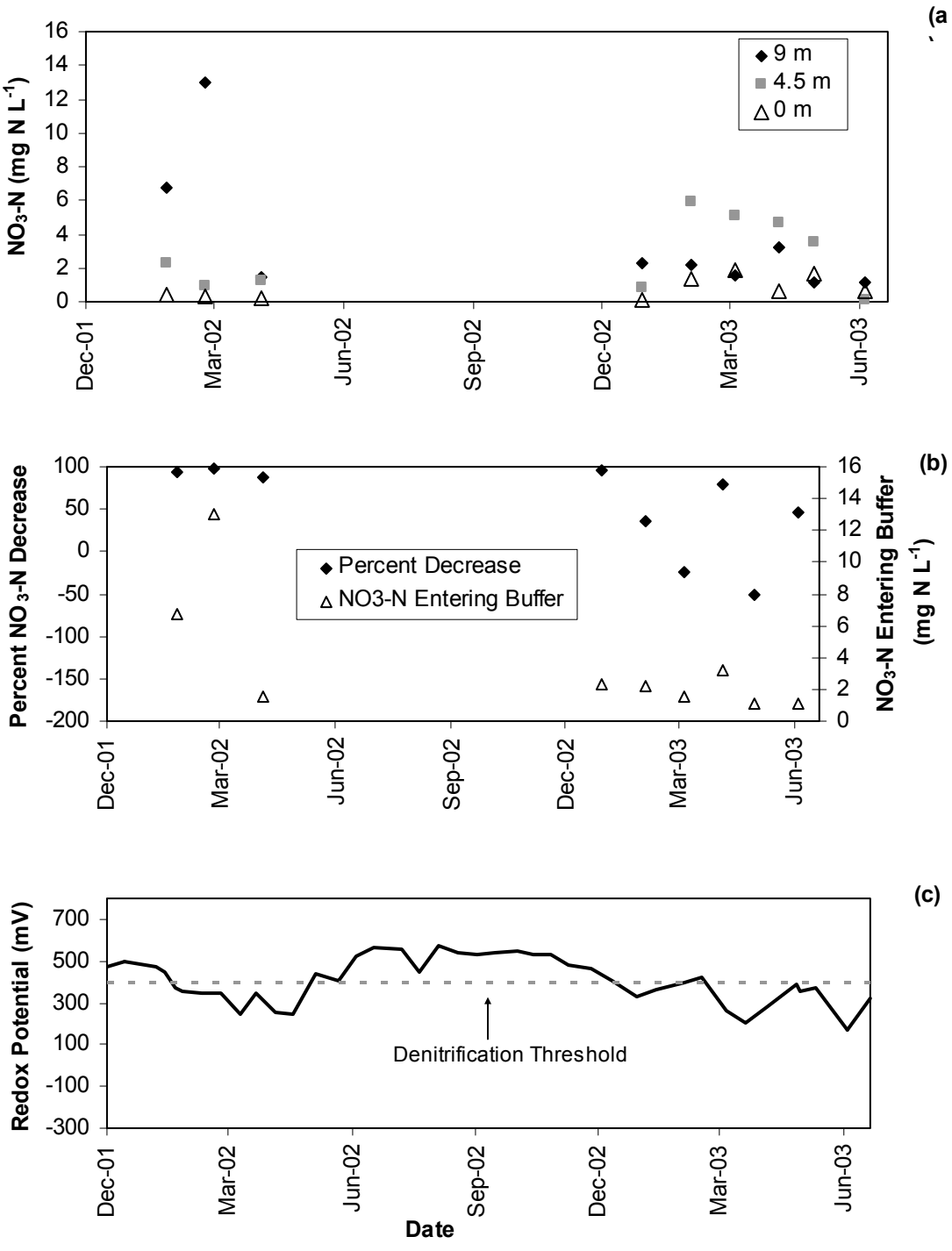


Figure 11. Data from the 9 m buffer: (a) NO_3-N in the shallow wells at 0 m, 4.5 m and 9 m; (b) shallow redox potential; and (c) percent NO_3-N decrease in relation to NO_3-N entering the buffer.

Dilution did not appear to influence the decrease of NO_3-N across the buffers. The deep NO_3-N /Cl^- ratios changed minimally because NO_3-N concentrations were low throughout the buffers most likely due to denitrification and not dilution (Table 6). The NO_3-N /Cl^- ratios decreased from the fields through the buffers at the intermediate depth and through the buffers at the shallow depth. The groundwater water data show that NO_3-N concentrations decreased toward the ditches and in some instances the Cl^- concentrations slightly increased toward the ditches. Some Cl^- may have leached from the KCl salt bridges, which could have caused the slight increases of Cl^- and caused the ratio to decrease. This data indicates that dilution was not responsible for the decreased NO_3-N concentrations through the buffers because NO_3-N and Cl^- concentrations did not change proportionally. The amount of Cl^- contributed from the salt bridges was not examined, however, because the work required greatly exceeded the scope of this project.

Table 6. Ratios of NO_3-N to Cl^- at the deep, intermediate and shallow depths in the buffers and fields (nd=no data).

Well Depth	Distance (m)	Buffer Width (m)	
		4.5	9
Deep	9	nd	0.11
	4.5	0.02	0.03
	0	0.02	0.01
Intermediate	Field	0.33	1.67
	9	0.85	0.50
	4.5	0.19	0.09
	0	0.04	0.03
Shallow	9	nd	0.92
	4.5	0.64	0.15
	0	0.16	0.02

Orthophosphate Leaching in Relation to Iron Dissolution

Orthophosphate concentrations fluctuated at the shallow, intermediate and deep depths through the period when redox potentials were monitored (Figure 11) and throughout the entire study period (Appendix M).

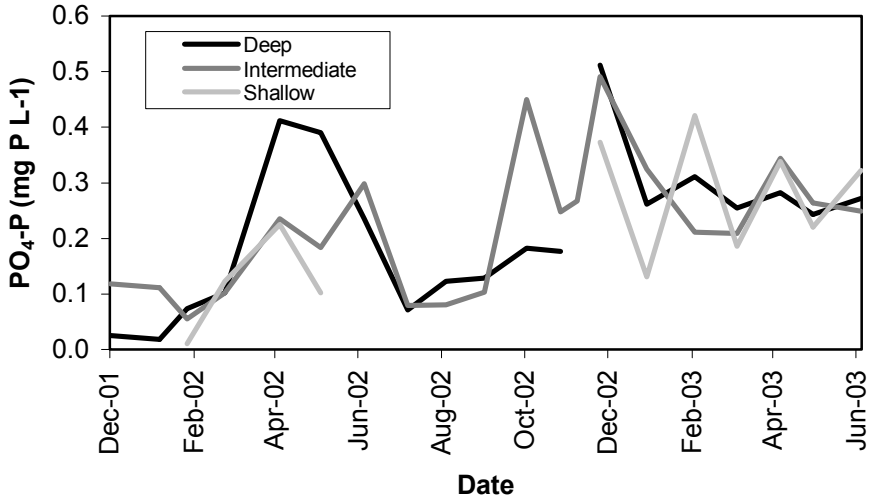


Figure 12. Orthophosphate in the deep, intermediate and shallow groundwater.

Precipitated iron was noticed in groundwater samples collected in December 2002 and January 2003. The concentration of PO_4-P in groundwater was significantly correlated to Fe^{2+} and DOC in the deep and shallow groundwater samples, but the influence was most consistent in the deep and shallow groundwater in the C-Ditch and in the deep groundwater in the P-Ditch (Table 7). The PO_4-P concentrations are correlated with the Fe^{2+} concentrations because PO_4-P that is sorbed onto minerals containing Fe^{3+} is released when Fe^{3+} is reduced to Fe^{2+}. Some iron in the soils was probably reduced at the time of sample collection because the redox potentials were predominantly below +300 mV, which is the redox potential at which Fe^{3+} becomes reduced in pH 5

soils (Ann et al., 2000). Additionally, the deep, sandy soils in the C-Ditch buffer were a blue-green color, which indicates that reducing conditions exist and most iron would likely be reduced and in the soil solution (S. Buol, personal communication, 2003). Orthophosphate was also correlated with DOC in multiple buffers at both depths, but the relationship between PO_4-P and DOC was not examined. Total phosphorus and total iron in the groundwater were also analyzed because iron had precipitated in the sample bottle, but the concentrations were the same as their dissolved constituents, so no further statistical analysis was performed.

Table 7. Average PO_4-P , Fe^{2+} and DOC concentrations and average redox potential in the deep and shallow groundwater and surface water in each buffer (December 2002 and January 2003).

	n	PO_4-P	Fe^{2+}	DOC	redox
		mg P L^{-1}	mg Fe L^{-1}	mg C L^{-1}	mV
Deep Groundwater					
P-Ditch	24	0.21	10.30 ***	5.14 ***	-17
C-Ditch	12	0.82	15.95 ***	6.33 **	-161
F-Ditch	12	0.34	3.48	2.18 *	-157
N-Ditch	12	0.35	0.18	2.10	-109
Average		0.39	8.04	3.94	-92
Shallow Groundwater					
P-Ditch	6	0.12	0.28	7.33 *	377
C-Ditch	10	0.34	0.51 ***	13.32 ***	242
F-Ditch	6	0.03	0.92	8.03	211
N-Ditch	9	0.27	0.37	17.96 ***	452
Average		0.22	0.50	11.66	323
Surface Water	4	0.62	3.53	8.30	

* Significantly correlated at p=0.05.
** Significantly correlated at p=0.01.
*** Significantly correlated at p=0.001.

Conclusions

Wider shrub buffers did not result in greater decreases of NO_3-N when the percent decrease of NO_3-N was calculated from 4.5 m (15 ft) to 0 m; the percent

decreases were similar in the different width buffers (1-m (3-ft) buffer 66% decrease, 4.5-m buffer 79% decrease, 9-m (30-ft) buffer 74% decrease). The percent decreases were similar when the percent decrease was calculated from 9 m to 0 m where 4.5- and 9-m buffers were present (4.5-m buffer 93% decrease, 9-m buffer 91% decrease). The percent decrease across 9 m was significantly ($p=0.01$) lower where the 1-m buffer (1-m buffer 67% decrease) was located because fertilizer was applied closer to the drainage ditch and the concentrations remained higher.

Redox potential data indicate that denitrification was likely responsible for NO_3-N decreases at the deeper soil depths. In the shallower soils, denitrification seemed to occur on a more seasonal basis due to drops in the water table elevation during the growing season. Denitrification did appear to be responsible for NO_3-N decreases during the remainder of the year, however, because redox potentials were below +400 mV. The ratio of NO_3-N to Cl^- also indicated that denitrification and not dilution was responsible for the decreased NO_3-N concentrations through the buffers. The use of a controlled drainage structure probably contributed to decreased NO_3-N concentrations by decreasing the loss of drainage water to maintain a high water table and increasing the amount of water that remained in the field, although the effect of controlled drainage was not specifically examined.

This research shows that at this location shrub buffers wider than 4.5 m (15 ft) substantially decrease groundwater NO_3-N concentrations; buffers wider than 4.5 m did not appear to be more effective than the 4.5-m buffers. The

majority of buffer studies have measured higher NO_3-N decreases across wider buffers; but this study site was unique because the soil characteristics and elevated water table due to controlled drainage increased the likelihood for denitrification outside of the buffers. The buffers were beneficial because they contributed to decreased NO_3-N concentrations entering the drainage ditches because N fertilizer was not applied near the ditches and they provide wildlife habitat, which is a benefit of the buffers that should not be overlooked (Vought et al., 1991).

Bibliography

Ann, Y., K.R. Reddy, and J.J. Delfino. 2000. Influence of redox potential on phosphorus solubility in chemically amended wetland organic soils. Ecological Engineering. 14: 169-180.

Bohn, H.L. 1971. Redox Potentials. Soil Science. 112: 39-45.

Cooper, J.R., J.W. Gilliam, and T.C. Jacobs. 1986. Riparian areas as a control of nonpoint pollutants. P. 166-190. *In* D.C. Correll (ed). Watershed Research Perspectives. Smithsonian Institute Press, Washington, D.C.

Evans, R.O., J.W. Gilliam, and R.W. Skaggs. 1989. Effects of Agricultural Water Table Management on Drainage Water Quality. Water Resources Research Institute of the University of North Carolina Report No. 237.

Fennessy, M.S., and J.K. Cronk. 1997. The effectiveness and restoration potential of riparian ecotones for the management of nonpoint source pollution, particularly nitrate. Critical Reviews in Environmental Science and Technology. 27(4): 285-317.

Gee, G.W. and J.W. Bauder. 1986. Particle size analysis. *In* A. Klute (ed.) Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. 2nd ec. Agronomy 9:383-411.

Gilliam, J.W., J.E. Parsons, and R.L. Mikkelsen. 1997. Nitrogen dynamics and buffer zones. P. 54-59. *In* N.E. Haycock et al. (eds.). Buffer Zones: Their Processes and Potential in Water Protection. Quest Environmental Publication.

Griffith, S.M., J.S. Owen, W.R. Horwath, P.J. Wigington, Jr., J.E. Baham, and L.F. Elliot. 1997. Nitrogen movement and water quality at a poorly-drained agricultural and riparian site in the Pacific Northwest. P. 521-526. *In* T. Ando et al. (eds.) Plant Nutrition for Sustainable Food Production and Environment. Kluwer Academic Publishers.

Haycock, N.E., and G. Pinay. 1993. Nitrate retention in grass and poplar vegetated riparian buffer strips during winter. J. Environ. Qual. 22:273.

Hayes, W.A. 1998. Effect of ditching on soil morphology, saturation and reduction in a cantena of coastal plain soils. M.S. thesis. NC State University, Raleigh.

Jacobs, T.C., and J.W. Gilliam. 1985. Riparian losses of nitrate from agricultural drainage waters. J. Environ. Qual. 14:472-478.

Johnson, A. 2004. Phosphorus loss assessment in North Carolina. Ph.D. diss. NC State University, Raleigh.

Lowrance, R.R., G. Vellidis, and R.K. Hubbard. 1995. Denitrification in a restored riparian forest wetland. J. Environ. Qual. 24: 808.

McBride, M. 1994. Environmental Chemistry of Soils. M. McBride (ed.). Oxford University Press, New York, NY.

NCDA&CS. 2004. Soil Test Methodologies. http://www.agr.state.nc.us/agronomi/stmethod.htm

Obenhuber, D.C. and R. Lowrance. 1991. Reduction of nitrate in aquifer microcosms by carbon additions. J. Environ. Qual. 20:255-258.

Osborne, L.L., and D.A. Kovacic. 1993. Riparian vegetated buffer strips in water-quality restoration and stream management. Freshwater Biology. 29:243-258.

Osmond, D.L., J.W. Gilliam, and R.O. Evans. 2002. Riparian buffers and controlled drainage to reduce agricultural nonpoint source pollution. North Carolina Agricultural Research Service Technical Bulletin 318. North Carolina State University, Raleigh, NC.

Peterjohn, W.T. and D.L. Correll. 1984. Nutrient dynamics in an agricultural watershed: observations on the role of a riparian forest. Ecology. 65(5):1466-1475.

Petersen, R.C., L.B.M. Petersen, and J. Lacoursiere. 1992. A building-block model for stream restoration. p. 293-309. *In* P.J. Boon et al. (eds.) River Conservation and Management. John Wiley & Sons, New York.

Pinay, G., L. Roqes, and A. Fabre. 1993. Spatial and temporal patterns of denitrification in a riparian forest. Journal of Applied Ecology. 30(4): 581-891.

Reddy, K.R. and W.H. Patrick, Jr. 1975. Effect of alternate aerobic and anaerobic conditions on redox potential, organic matter decomposition and nitrogen loss in a flooded soil. Soil Biol. Biochem. 7: 87-94.

Ricks, S.N. 2002. Effect of riparian buffers on soil redox potentials. M.S. thesis. NC State University, Raleigh.

Ryszkowski, L., A. Bartoszewicz, and A. Kedziora. 1997. The potential role of mid-field forests as buffer zones. P. 171 – 191. *In* N.E. Haycock et al. (eds.) Buffer Zones: Their Processes and Potential in Water Protection. Quest Environmental.

Schnabel, R.R., J.A. Schaffer, W.L. Stout, and L.F. Cornish. 1997. Denitrification distributions in four valley and ridge riparian ecosystems. Environ. Management. 21(2):283-290.

Schultz, R.C., T.M. Isenhart, and J.P. Colletti. 1994. Riparian buffer systems in range and cropland. Agroforestry and Sustainable Systems: Symposium Proceedings. Publication RM-GTR-261. USDA.

Schultz, R.C., J.P. Colletti, T.M. Isenhart, W.W. Simpkins, C.W. Mize, and M.L. Thompson. 1995. Design and placement of a multi-species riparian buffer strip system. Agroforestry Systems. 29:201-226.

Starr, R.C., and R.W. Gillham. 1993. Denitrification and organic carbon availability in two aquifers. Ground Water. 31 (6): 934-947.

Treece, M.W. Jr., and M.L. Jaynes. 1994. Effects of Water-Control Structures on Hydrologic and Water-Quality Charactersitics in Selected Agricultural Drainage Canals in Eastern North Carolina. Water-Resources Investigations Report 94-4226. U.S. Geological Survey.

Veneman, P.L.M. and E.W. Pickering. 1983. Salt bridge for field redox potential measurements. Commun. In Soil Sci. Plant Analysis. 14 (8): 669-677.

Vought, L.B.-M., J.O. Lacoursiere, and N. Voelz. 1991. Streams in the Agricultural Landscapes. Vatten. 47:321.

Vought, L.B.-M., J. Dahl, C.L. Pedersen, and J.O. Lacoursiere. 1994. Nutrient retention in riparian ecotones. Ambio. 23:342.

Wafer, C.C., J.B. Richards, and D.L. Osmond. 2004. Construction of platinum-tipped redox probes for the determination of soil redox potential. JEQ (in press)

APPENDICES

Appendix A. Soil Profile Descriptions
C-Ditch

Transect 1 — 4.5 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 67 cm; black (N2.5/0) mucky sandy loam; very friable, slightly sticky and nonplastic.

67 to 99 cm; dark gray (2.5Y 4/1) sandy clay loam; friable, slightly sticky and slightly plastic.

99 to 150 cm; greenish gray (10Y 5/1) clay loam; firm, moderately stick and moderately plastic.

150 to170 cm; dark gray (2.5Y 4/1) sandy loam; very friable, slightly sticky and slightly plastic; diffuse boundary.

170 to 180 cm; grayish brown (2.5Y 5/2) coarse sand; single grained, structureless; loose, nonsticky and nonplastic.

Transect 3 — 0 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 80 cm; black (10YR 2/1) mucky sandy loam; strong moderate granular structure; very friable, slightly sticky and nonplastic; diffuse boundary.

80 to 130 cm; very dark gray (10YR 3/1) sandy loam; moderate fine granular structure; very friable, slightly sticky and nonplastic; gradual boundary.

130 to 150 cm; grayish brown (10YR 5/2) sandy clay loam; few fine very dark gray (10YR 3/1) mottles; moderate fine subangular blocky structure; friable, moderately sticky and moderately plastic; gradual boundary.

150 to 162 cm; greenish gray (10Y 6/1) clay loam; few fine strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm, very sticky and very plastic; clear boundary.

162 + cm; grayish brown (2.5Y 5/2) coarse sand; single grained, structureless; loose, nonsticky and nonplastic.

Transect 3 — 4.5 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 71 cm; black (10YR 2/1) mucky sandy loam; strong moderate granular structure; very friable, slightly sticky and nonplastic; diffuse boundary.

71 to 110 cm; very dark gray (10YR 3/1) sandy loam; moderate fine granular structure; very friable, slightly sticky and nonplastic; gradual boundary.

110 to 155 cm; grayish brown (10YR 5/2) sandy clay loam; few fine very dark gray (10YR 3/1) mottles; moderate fine subangular blocky structure; friable, moderately sticky and moderately plastic; gradual boundary.

155 to 164 cm; greenish gray (10Y 6/1) clay loam; few fine strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm, very sticky and very plastic; clear boundary.

164 + cm; grayish brown (2.5Y 5/2) coarse sand; single grained, structureless; loose, nonsticky and nonplastic.

N-Ditch

Transect 1 – 0 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 78 cm; black (10YR 2/1) sandy loam; strong medium granular structure; very friable, slightly sticky and slightly plastic; diffuse boundary.

78 to 155 cm; grayish brown (10YR 5/2) sandy clay loam; common coarse very dark gray (10YR 3/1) and few fine yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable, sticky and plastic; gradual boundary.

155 to 180 cm; greenish gray (5GY 6/1) clay loam; weak fine subangular blocky structure; firm, very sticky and plastic; abrupt boundary.

180 + cm; grayish brown (2.5Y 5/2); coarse sand; single grained, structureless; loose.

Transect 1 — 4.5 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 70 cm; black (10YR 2/1) medium sandy loam; strong medium granular structure; very friable, slightly sticky and slightly plastic; diffuse boundary.

70 to 170 cm; grayish brown (10YR 5/2) sandy clay loam; weak medium subangular blocky; friable, moderately sticky and moderately plastic; gradual boundary.

170 to 180 cm; light brownish gray (10YR 6/2) sand; single grained, structureless; loose, nonsticky and nonplastic.

Transect 3 — 0 m distance
Arapahoe (Coarse-loamy, mixed, semiactive, nonacid, thermic Typic Humaquepts)
0 to 56 cm; black (N 2.5/) mucky fine sandy loam; strong fine granular structure.

56 to 84 cm; black (10YR 2/1) fine sandy loam; moderate medium granular structure; very friable, slightly sticky and nonplastic; common fine and few medium roots; gradual boundary.

84 to 125 cm; dark grayish brown (10YR 4/2) fine sandy loam; few fine light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; very friable, slightly sticky and nonplastic; few fine roots; diffuse boundary.

125 to 136 cm; light brownish gray (10YR 6/2) loamy fine sand; single grained, structureless; very friable, nonsticky and nonplastic; diffuse boundary.

136 to 156 cm; light brownish gray (10YR 6/2) fine sand; single grained, structureless; loose, nonsticky and nonplastic; diffuse boundary.

156 to 180 cm; light brownish gray (10YR 6/2) sand; single grained, structureless; loose, nonsticky and nonplastic.

Transect 3 — 4.5 m distance
Arapahoe (Coarse-loamy, mixed, semiactive, nonacid, thermic Typic Humaquepts)
0 to 36 cm; black (N 2.5/) mucky sandy loam; strong medium granular structure; very friable, slightly sticky and nonplastic; gradual boundary.

36 to 76 cm; black (10YR 2/1) sandy loam; moderate fine subangular blocky structure; very friable, slightly sticky and nonplastic; diffuse boundary.

76 to 105 cm; light brownish gray (10YR 6/2) loamy fine sand; single grain, structureless; very friable, nonsticky and nonplastic; diffuse boundary.

105 to 150 cm; light brownish gray (10YR 6/2) fine sand; single grain, structureless; loose, nonsticky and nonplastic; diffuse boundary.

150 to 180 cm; light brownish gray (10YR 6/2) sand; single grain, structureless; loose, nonsticky and nonplastic.

P-Ditch

Between Transects 1 and 2 — 0 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 20 cm; very dark gray (10YR 3/1) loamy sand; moderate fine granular structure; very friable, nonsticky and nonplastic; roots; clear boundary (likely ditch spoil).

20 to 61 cm; black (10YR 2/1) sandy loam; strong medium granular; very friable, nonsticky and nonplastic; roots; clear boundary.

61 to 98 cm; black (10YR 2/1) sandy clay loam; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; diffuse boundary.

98 to 142 cm; dark gray (2.5Y 4/1) sandy loam; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; clear boundary.

142 to 150 cm; light brownish gray (2.5Y 6/2) coarse sand; single grain, structureless; loose.

Between Transects 1 and 2 — 9 m distance
Tomotley (Fine-loamy, mixed, semiactive, thermic Typic Endoaquults)
0 to 35 cm; very dark gray (10YR 3/1) loamy sand; moderate fine granular structure; very friable, nonsticky and nonplastic; roots; clear boundary (likely ditch spoil).

35 to 76 cm; black (10YR 2/1) sandy loam; strong medium granular; very friable, nonsticky and nonplastic; roots; clear boundary.

76 to 122 cm; dark gray (10YR 4/1) sandy clay loam; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; diffuse boundary.

122 to 155 cm; dark gray (2.5Y 4/1) loamy sand, with lumps of heavier material; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; clear boundary.

155 + cm; light brownish gray (2.5Y 6/2) coarse sand; single grain, structureless; loose.

Between Transects 3 and 4 — 0 m distance
Roanoke (Fine, mixed, semiactive, thermic Typic Endoaquults)
0 to 33 cm; very dark gray (2.5Y 3/1) sandy loam; moderate medium granular structure; very friable, slightly sticky and slightly plastic; roots; clear boundary.

33 to 51 cm; very dark gray (2.5Y 3/1) sandy clay loam; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; roots; gradual boundary.

51 to 91 cm; dark grayish brown (2.5Y 4/2) clay; few fine yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; roots; gradual boundary.

91 to 119 cm; gray (2.5Y 6/1) clay; many fine brownish yellow (10YR 6/8) mottles; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; gradual boundary.

119 to 183 cm; gray (2.5Y 6/1) sandy clay loam; few fine yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; gradual boundary.

183 to 191 cm; dark grayish brown (2.5Y 4/2) sandy loam; massive structure; very friable, slightly sticky and slightly plastic.

Between Transects 3 and 4 — 9 m distance
Roanoke (Fine, mixed, semiactive, thermic Typic Endoaquults)
0 to 41 cm; (10YR 3/1) sandy loam; moderate medium granular structure; friable, slightly sticky and slightly plastic; clear boundary.

41 to 91 cm; (10YR 4/2) sandy clay; common fine (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm, slightly stick and slightly plastic; gradual boundary.

91 to 127 cm; gray (10YR 6/1) clay; few fine light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; firm, slightly sticky and slightly plastic; gradual boundary.

127 to 140 cm; gray (10YR 6/1) sandy loam; weak medium subangular blocky structure; gradual boundary.

140 to 150 cm; gray (2.5Y 5/1) sand; single grain, structureless.

Appendix B. Soil Analysis Raw Data

Ditch	Transect	Depth	Distance	H2O	CEC Buffer	P	K	Ca	Mg	Na	Mn	Zn
		cm	m	pH	meq/100cm^3	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
C	TR1	0 - 71	2.25	4.5	8.5	70.0	234.6	764.0	65.7	0.0	2.0	3.0
C	TR1	71-135	2.25	4.5	6.7	122.4	109.5	644.0	99.7	0.0	0.6	1.0
C	TR1	135-150	2.25	4.4	7.3	86.8	86.0	948.0	80.3	0.0	1.2	0.6
C	TR1	150-191	2.25	4	6.1	75.8	101.7	956.0	99.7	0.0	2.2	1.4
C	TR1	191-244	2.25	4.5	1.2	15.6	31.3	112.0	29.2	0.0	0.4	0.6
C	TR2	0-61	2.25	4.6	6.5	288.8	156.4	664.0	87.6	0.0	2.8	3.0
C	TR2	61-91	2.25	4.6	4.6	203.8	70.4	356.0	60.8	0.0	1.2	0.8
C	TR2	91+	2.25	4.4	2.1	54.0	39.1	224.0	26.8	0.0	0.8	0.8
C	TR3	0-61	2.25	4.7	6.5	286.2	140.8	744.0	68.1	0.0	1.8	2.4
C	TR3	61-91	2.25	4.6	6.4	250.2	93.8	672.0	92.4	0.0	0.6	0.8
C	TR3	91-152	2.25	4.5	5.9	75.8	78.2	796.0	107.0	0.0	1.0	0.8
C	TR3	152+	2.25	4	4	55.0	62.6	564.0	82.7	0.0	1.0	1.8
F	TR1	0-97	2.25	4.7	7	75.0	132.9	688.0	148.4	0.0	14.0	1.2
F	TR1	97-132	2.25	4.7	5	33.6	70.4	400.0	85.1	0.0	1.4	0.4
F	TR1	132-203	2.25	4.3	4.2	41.4	54.7	296.0	43.8	0.0	1.0	0.6
F	TR1	203-244	2.25	3.1	5.9	24.8	31.3	788.0	65.7	0.0	2.8	3.4
F	TR2	0-91	2.25	4.4	8	34.8	242.4	744.0	114.3	0.0	3.0	1.4
F	TR2	91-183	2.25	4.5	7.3	14.0	164.2	600.0	133.8	0.0	1.4	1.2
F	TR2	183-244	2.25	3.2	6.2	23.0	23.5	288.0	41.3	0.0	1.0	3.2
F	TR3	0-91	2.25	4.5	6.6	24.0	125.1	504.0	90.0	0.0	1.4	1.2
F	TR3	91-183	2.25	4.4	6.2	24.4	101.7	460.0	75.4	0.0	1.2	0.8
F	TR3	183+	2.25	3.3	4.6	26.6	31.3	140.0	24.3	46.0	0.8	1.2
N	TR1	0-61	2.25	4.2	9.2	124.8	312.8	504.0	65.7	0.0	2.2	4.0
N	TR1	61-155	2.25	4.5	7	80.6	125.1	340.0	73.0	0.0	1.0	0.8
N	TR1	155-206	2.25	4.6	2.8	57.4	54.7	216.0	34.0	0.0	1.0	1.0
N	TR1	206-244	2.25	4.6	1.7	22.0	31.3	148.0	31.6	0.0	0.6	0.8
N	TR2	0-61	2.25	4.3	7.9	54.6	117.3	556.0	38.9	0.0	1.8	4.2
N	TR2	61-152	2.25	4.5	3.6	79.6	46.9	224.0	43.8	46.0	0.8	1.0
N	TR2	152-213	2.25	4.6	2.3	37.6	39.1	188.0	38.9	0.0	0.6	0.8
N	TR3	0-91	2.25	4.4	6.8	36.8	78.2	448.0	63.2	0.0	1.4	1.2
N	TR3	91-152	2.25	4.6	3.4	96.6	54.7	272.0	31.6	0.0	1.0	0.8
N	TR3	152-213	2.25	4.9	2.3	65.6	46.9	376.0	31.6	0.0	1.2	1.2
P	TR1	0-91	2.25	4.4	4.8	157.8	172.0	340.0	55.9	0.0	1.2	2.4
P	TR1	91-165	2.25	5.2	4	19.2	54.7	676.0	158.1	0.0	0.6	0.8
P	TR1	0-61	6.25	4.9	4.9	105.0	242.4	468.0	90.0	0.0	1.4	1.4
P	TR1	61-127	6.25	4.8	8.2	58.8	602.1	1288.0	277.2	0.0	170.0	8.6
P	TR1	127-165	6.25	5.7	13.8	147.2	132.9	4436.0	284.5	0.0	16.8	1.4
P	TR2	0-69	2.25	5.1	4.5	110.0	132.9	720.0	73.0	0.0	2.4	0.6
P	TR2	69-185	2.25	5.2	2.5	32.0	39.1	372.0	77.8	0.0	0.8	0.6
P	TR2	185-234	2.25	3.8	2.7	31.0	39.1	152.0	38.9	0.0	0.6	0.8
P	TR2	0-127	6.25	4.7	3.5	140.0	109.5	364.0	51.1	0.0	2.8	2.0
P	TR2	127-165	6.25	4.7	2.4	61.6	62.6	200.0	55.9	0.0	1.4	1.2
P	TR2	165-244	6.25	3.4	4.8	430.4	15.6	100.0	19.5	46.0	0.8	2.0
P	TR3	0-91	2.25	4.7	4.7	206.4	86.0	504.0	114.3	0.0	1.0	0.8
P	TR3	91-107	2.25	5.8	10.4	178.4	62.6	3608.0	75.4	46.0	0.8	1.2
P	TR3	107-122	2.25	5.9	13.4	232.8	117.3	4740.0	133.8	46.0	3.6	0.4
P	TR3	122-130	2.25	6.2	12.8	160.4	140.8	4504.0	158.1	46.0	5.4	1.0
P	TR3	130-216	2.25	4.8	8.3	53.8	125.1	2400.0	138.6	0.0	6.8	2.2
P	TR3	0-61	6.25	5.4	8.3	445.2	437.9	1788.0	347.8	0.0	8.8	3.8
P	TR3	61-107	6.25	5.1	7.7	210.6	156.4	1316.0	389.1	0.0	1.2	0.8
P	TR3	107-137	6.25	6.1	14.1	170.4	156.4	4808.0	243.2	46.0	3.6	1.0
P	TR3	137-183	6.25	3.3	7.4	29.6	70.4	1468.0	70.5	0.0	1.8	1.2
P	TR3	183-234	6.25	3.1	4.5	23.8	23.5	560.0	51.1	0.0	1.0	1.4

Appendix B. Soil Analysis Raw Data (continued)

Ditch	Transect	Depth	Distance	Cu	Al	Fe	Sand	Silt	Clay	Texture
		cm	m	kg/ha	kg/ha	kg/ha	%	%	%	
C	TR1	0 - 71	2.25	0.6	11157.3	609.1	59.21	26.5	14.29	SL
C	TR1	71-135	2.25	0.6	6795.0	1027.4	61.77	17.75	20.48	SCL
C	TR1	135-150	2.25	0.4	794.2	397.9	65.3	14.7	20	SCL
C	TR1	150-191	2.25	1.0	661.4	986.6	78.8	10.35	10.85	SL
C	TR1	191-244	2.25	1.0	21630.4	2134.6	96.46	1.37	2.18	S
C	TR2	0-61	2.25	1.6	8520.7	428.6	72.88	16.26	10.85	SL
C	TR2	61-91	2.25	0.6	1005.0	241.9	82.99	1.01	10	LS
C	TR2	91+	2.25	0.8	30118.1	3084.0	94.17	0.83	5	S
C	TR3	0-61	2.25	0.8	13106.6	1115.7	67.83	19.61	12.56	SL
C	TR3	61-91	2.25	0.6	2276.1	515.6	70.36	14.64	15	SL
C	TR3	91-152	2.25	0.4	3023.3	1413.1	72.88	11.2	15.91	SL
C	TR3	152+	2.25	0.4	12419.3	509.0	88.4	4.95	6.65	S
F	TR1	0-97	2.25	0.6	9945.4	363.2	61.51	19.09	19.4	SL
F	TR1	97-132	2.25	0.4	2478.4	255.3	75.41	9.13	15.45	SL
F	TR1	132-203	2.25	0.4	2768.0	4547.4	80.47	9.53	10	LS
F	TR1	203-244	2.25	1.6	20933.5	1781.9	92.46	2.58	4.96	S
F	TR2	0-91	2.25	0.8	24156.6	893.2	54.09	26.5	19.4	SL
F	TR2	91-183	2.25	0.4	5623.9	8889.4	52.1	20.07	27.83	SCL
F	TR2	183-244	2.25	2.6	23386.7	1389.7	90.83	3.62	5.55	S
F	TR3	0-91	2.25	0.4	15010.8	1259.2	64.82	18.34	16.84	SL
F	TR3	91-183	2.25	0.4	4603.3	3423.5	61	13.48	25.51	SCL
F	TR3	183+	2.25	0.6	32775.0	1514.2	92.5	2.5	5	S
N	TR1	0-61	2.25	1.0	14345.1	28.4	57.71	28	14.29	SL
N	TR1	61-155	2.25	0.4	3684.0	bd	59.21	12.45	28.34	SCL
N	TR1	155-206	2.25	0.8	1562.5	BD	89.75	4.97	5.27	S
N	TR1	206-244	2.25	1.8	19714.5	882.5	94.33	1.81	3.86	S
N	TR2	0-61	2.25	1.4	5322.5	BD	72.45	16.7	10.85	SL
N	TR2	61-152	2.25	0.4	3675.2	bd	82.12	7.46	10.42	LS
N	TR2	152-213	2.25	1.6	30554.1	444.2	93.1	1.9	5	S
N	TR3	0-91	2.25	0.4	6530.3	bd	70.36	16.26	13.38	SL
N	TR3	91-152	2.25	0.4	2207.3	172.5	83.88	6.12	10	LS
N	TR3	152-213	2.25	0.8	11577.8	985.7	93.33	2.5	4.17	S
P	TR1	0-91	2.25	2.6	7907.7	210.3	77.08	14.64	8.28	SL
P	TR1	91-165	2.25	0.4	12742.6	464.8	80.91	8.68	10.4	LS
P	TR1	0-61	6.25	0.6	15618.4	441.1	75.4	14.2	10.4	SL
P	TR1	61-127	6.25	3.2	5376.2	1886.7	71.15	13.42	15.43	SL
P	TR1	127-165	6.25	0.6	4796.9	511.3	54.22	19.79	25.99	SCL
P	TR2	0-69	2.25	0.8	6169.5	99.9	80.91	12.46	6.63	LS
P	TR2	69-185	2.25	0.4	4508.2	5012.0	84.36	7.76	7.89	LS
P	TR2	185-234	2.25	2.2	3806.7	361.1	95	0.58	4.42	S
P	TR2	0-127	6.25	1.8	7107.9	BD	86.02	8.23	5.75	LS
P	TR2	127-165	6.25	1.0	4580.5	3875.8	88.93	4.43	6.63	S
P	TR2	165-244	6.25	0.4	.	.	96.67	1.18	2.15	S
P	TR3	0-91	2.25	1.2	4654.7	4792.9	67.66	20.27	12.07	SL
P	TR3	91-107	2.25	0.6	745.2	749.8	64.59	14.49	20.92	SCL
P	TR3	107-122	2.25	0.4	742.3	60.0	57.36	15.39	27.25	SCL
P	TR3	122-130	2.25	0.4	212.5	216.4	62	14.55	23.46	SCL
P	TR3	130-216	2.25	2.6	9380.8	3816.6	80.05	9.55	10.4	SL
P	TR3	0-61	6.25	2.2	8115.0	995.4	69.76	20.7	9.54	SL
P	TR3	61-107	6.25	0.4	2349.7	611.0	65.58	18.11	16.31	SL
P	TR3	107-137	6.25	0.6	977.9	2916.2	57.9	13.58	28.52	SCL
P	TR3	137-183	6.25	0.6	2014.6	8904.1	90.08	4.4	5.52	S
P	TR3	183-234	6.25	1.2	11500.1	1490.5	94.55	1.87	3.58	S

Appendix B. Soil Analysis Raw Data (continued)

Ditch	Transect	Depth	Distance	H2O	CEC Buffer	P	K	Ca	Mg	Na	Mn	Zn
		cm	m	pH	meq/100cm^3	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha
P	TR4	0-28	2.25	4.6	8.1	119.0	234.6	804.0	194.6	0.0	2.8	1.4
P	TR4	28-71	2.25	4.7	9.1	31.8	242.4	1024.0	204.3	0.0	2.4	0.8
P	TR4	71-130	2.25	4.8	11.9	6.0	109.5	2400.0	330.8	0.0	1.8	1.0
P	TR4	130-152	2.25	4.9	9.3	56.2	93.8	2804.0	155.6	0.0	3.0	0.8
P	TR4	152-183	2.25	2.6	8.1	10.8	7.8	536.0	55.9	0.0	1.2	3.6
P	TR4	0-25	6.25	4.9	7.2	354.2	398.8	1220.0	299.1	46.0	8.2	3.8
P	TR4	25*79	6.25	4.7	10.7	28.4	195.5	1408.0	445.1	0.0	3.2	1.4
P	TR4	79-165	6.25	4.8	8.2	48.0	125.1	2324.0	155.6	0.0	6.8	2.2
P	TR4	165+	6.25	3.2	10	37.0	70.4	1936.0	94.8	0.0	3.2	1.0

Ditch	Transect	Depth	Distance	Cu	Al	Fe	Sand	Silt	Clay	Texture
		cm	m	kg/ha	kg/ha	kg/ha	%	%	%	
P	TR4	0-28	2.25	0.4	6677.7	796.3	56.82	22.26	20.92	SCL
P	TR4	28-71	2.25	0.4	5364.5	1568.2	47.66	20.22	32.12	SCL
P	TR4	71-130	2.25	0.8	1810.8	1701.8	53.9	15.05	31.05	SCL
P	TR4	130-152	2.25	2.2	1082.9	4966.0	72.35	12.65	15	SL
P	TR4	152-183	2.25	3.8	3669.8	1546.4	94.55	2.12	3.33	S
P	TR4	0-25	6.25	2.4	4271.0	969.0	65.58	22.35	12.07	SL
P	TR4	25*79	6.25	0.6	1404.8	1367.1	50.22	19.47	30.31	SCL
P	TR4	79-165	6.25	2.6	4104.4	11577.8	80.51	9.09	10.4	LS
P	TR4	165+	6.25	1.0	40.0	112.7	82.68	7.32	10	LS

Appendix C. Precipitation Raw Data

Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)
1/1/2001	0.00	2/26/2001	0.00	4/23/2001	0.00	6/18/2001	0.00
1/2/2001	0.00	2/27/2001	0.00	4/24/2001	0.00	6/19/2001	0.00
1/3/2001	0.00	2/28/2001	0.18	4/25/2001	1.02	6/20/2001	0.00
1/4/2001	0.00	3/1/2001	0.00	4/26/2001	0.00	6/21/2001	0.00
1/5/2001	0.00	3/2/2001	0.00	4/27/2001	0.00	6/22/2001	0.18
1/6/2001	0.00	3/3/2001	nd	4/28/2001	0.00	6/23/2001	0.03
1/7/2001	0.00	3/4/2001	nd	4/29/2001	0.00	6/24/2001	0.15
1/8/2001	0.05	3/5/2001	nd	4/30/2001	0.00	6/25/2001	2.49
1/9/2001	0.13	3/6/2001	0.00	5/1/2001	0.00	6/26/2001	0.08
1/10/2001	0.00	3/7/2001	0.00	5/2/2001	0.00	6/27/2001	0.03
1/11/2001	0.00	3/8/2001	0.00	5/3/2001	0.00	6/28/2001	0.00
1/12/2001	0.36	3/9/2001	0.00	5/4/2001	0.00	6/29/2001	0.00
1/13/2001	0.00	3/10/2001	0.00	5/5/2001	0.00	6/30/2001	0.00
1/14/2001	0.25	3/11/2001	0.00	5/6/2001	0.00	7/1/2001	0.10
1/15/2001	0.03	3/12/2001	0.00	5/7/2001	0.00	7/2/2001	0.00
1/16/2001	0.00	3/13/2001	0.36	5/8/2001	0.00	7/3/2001	1.96
1/17/2001	0.00	3/14/2001	0.00	5/9/2001	0.00	7/4/2001	0.05
1/18/2001	0.00	3/15/2001	nd	5/10/2001	0.00	7/5/2001	1.04
1/19/2001	0.00	3/16/2001	0.00	5/11/2001	0.00	7/6/2001	0.00
1/20/2001	0.61	3/17/2001	0.00	5/12/2001	0.15	7/7/2001	0.00
1/21/2001	0.03	3/18/2001	0.00	5/13/2001	1.17	7/8/2001	0.23
1/22/2001	0.00	3/19/2001	0.00	5/14/2001	0.00	7/9/2001	0.00
1/23/2001	0.00	3/20/2001	nd	5/15/2001	0.00	7/10/2001	0.00
1/24/2001	0.00	3/21/2001	0.03	5/16/2001	0.89	7/11/2001	0.00
1/25/2001	0.00	3/22/2001	0.00	5/17/2001	0.33	7/12/2001	0.00
1/26/2001	0.00	3/23/2001	0.00	5/18/2001	0.00	7/13/2001	0.10
1/27/2001	0.00	3/24/2001	0.00	5/19/2001	0.00	7/14/2001	0.00
1/28/2001	0.00	3/25/2001	nd	5/20/2001	0.00	7/15/2001	0.00
1/29/2001	0.00	3/26/2001	0.00	5/21/2001	0.03	7/16/2001	0.00
1/30/2001	0.25	3/27/2001	0.00	5/22/2001	0.00	7/17/2001	0.00
1/31/2001	0.00	3/28/2001	nd	5/23/2001	0.05	7/18/2001	0.03
2/1/2001	0.00	3/29/2001	nd	5/24/2001	0.00	7/19/2001	0.28
2/2/2001	0.00	3/30/2001	nd	5/25/2001	0.00	7/20/2001	0.00
2/3/2001	0.00	3/31/2001	nd	5/26/2001	1.22	7/21/2001	0.00
2/4/2001	0.91	4/1/2001	nd	5/27/2001	0.00	7/22/2001	0.10
2/5/2001	0.66	4/2/2001	nd	5/28/2001	2.57	7/23/2001	0.28
2/6/2001	0.00	4/3/2001	nd	5/29/2001	0.97	7/24/2001	0.58
2/7/2001	0.00	4/4/2001	12.47	5/30/2001	0.00	7/25/2001	0.00
2/8/2001	0.00	4/5/2001	0.00	5/31/2001	0.00	7/26/2001	0.20
2/9/2001	0.00	4/6/2001	0.00	6/1/2001	0.20	7/27/2001	1.52
2/10/2001	0.00	4/7/2001	0.00	6/2/2001	2.64	7/28/2001	0.00
2/11/2001	0.00	4/8/2001	0.00	6/3/2001	0.00	7/29/2001	0.51
2/12/2001	0.81	4/9/2001	0.00	6/4/2001	0.00	7/30/2001	4.65
2/13/2001	0.00	4/10/2001	0.00	6/5/2001	0.00	7/31/2001	0.00
2/14/2001	0.08	4/11/2001	0.00	6/6/2001	0.00	8/1/2001	0.00
2/15/2001	0.00	4/12/2001	0.00	6/7/2001	0.03	8/2/2001	0.00
2/16/2001	0.00	4/13/2001	1.50	6/8/2001	0.00	8/3/2001	0.00
2/17/2001	1.37	4/14/2001	0.00	6/9/2001	0.13	8/4/2001	0.00
2/18/2001	0.00	4/15/2001	0.00	6/10/2001	0.00	8/5/2001	0.00
2/19/2001	0.00	4/16/2001	0.00	6/11/2001	0.00	8/6/2001	0.00
2/20/2001	0.00	4/17/2001	0.13	6/12/2001	0.00	8/7/2001	0.00
2/21/2001	0.00	4/18/2001	0.00	6/13/2001	0.00	8/8/2001	0.00
2/22/2001	1.70	4/19/2001	0.00	6/14/2001	7.95	8/9/2001	0.00
2/23/2001	0.00	4/20/2001	0.00	6/15/2001	5.31	8/10/2001	0.00
2/24/2001	0.03	4/21/2001	0.00	6/16/2001	0.10	8/11/2001	0.08
2/25/2001	0.15	4/22/2001	0.00	6/17/2001	0.00	8/12/2001	0.51

Appendix C. Precipitation Raw Data (continued)

Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)
8/13/2001	1.30	10/8/2001	0.00	12/3/2001	0.00	1/28/2002	0.00
8/14/2001	2.54	10/9/2001	0.00	12/4/2001	0.00	1/29/2002	0.00
8/15/2001	0.00	10/10/2001	0.00	12/5/2001	0.00	1/30/2002	0.00
8/16/2001	0.00	10/11/2001	0.00	12/6/2001	0.00	1/31/2002	0.00
8/17/2001	0.00	10/12/2001	0.00	12/7/2001	0.00	2/1/2002	0.00
8/18/2001	1.80	10/13/2001	0.00	12/8/2001	0.00	2/2/2002	0.00
8/19/2001	0.56	10/14/2001	0.00	12/9/2001	0.00	2/3/2002	0.00
8/20/2001	0.00	10/15/2001	0.00	12/10/2001	0.38	2/4/2002	0.00
8/21/2001	0.99	10/16/2001	0.00	12/11/2001	0.51	2/5/2002	0.00
8/22/2001	0.00	10/17/2001	0.00	12/12/2001	0.03	2/6/2002	0.33
8/23/2001	0.00	10/18/2001	0.00	12/13/2001	0.00	2/7/2002	2.79
8/24/2001	0.00	10/19/2001	0.00	12/14/2001	0.05	2/8/2002	0.66
8/25/2001	0.00	10/20/2001	0.00	12/15/2001	0.00	2/9/2002	0.00
8/26/2001	0.00	10/21/2001	0.00	12/16/2001	0.00	2/10/2002	0.56
8/27/2001	0.00	10/22/2001	0.00	12/17/2001	0.00	2/11/2002	0.00
8/28/2001	0.33	10/23/2001	0.00	12/18/2001	0.36	2/12/2002	0.00
8/29/2001	1.52	10/24/2001	0.00	12/19/2001	0.00	2/13/2002	0.00
8/30/2001	0.00	10/25/2001	0.00	12/20/2001	0.00	2/14/2002	0.00
8/31/2001	0.00	10/26/2001	0.00	12/21/2001	0.00	2/15/2002	0.00
9/1/2001	0.36	10/27/2001	0.00	12/22/2001	0.00	2/16/2002	0.03
9/2/2001	4.70	10/28/2001	0.00	12/23/2001	0.00	2/17/2002	0.00
9/3/2001	0.00	10/29/2001	0.00	12/24/2001	0.00	2/18/2002	0.00
9/4/2001	0.00	10/30/2001	0.00	12/25/2001	0.00	2/19/2002	0.00
9/5/2001	0.00	10/31/2001	0.00	12/26/2001	0.00	2/20/2002	0.00
9/6/2001	0.00	11/1/2001	0.00	12/27/2001	0.00	2/21/2002	0.53
9/7/2001	0.00	11/2/2001	0.00	12/28/2001	0.00	2/22/2002	0.00
9/8/2001	0.00	11/3/2001	0.00	12/29/2001	0.00	2/23/2002	0.00
9/9/2001	0.97	11/4/2001	0.00	12/30/2001	0.00	2/24/2002	0.00
9/10/2001	0.03	11/5/2001	0.00	12/31/2001	0.00	2/25/2002	0.00
9/11/2001	0.13	11/6/2001	0.00	1/1/2002	0.00	2/26/2002	0.00
9/12/2001	0.00	11/7/2001	0.00	1/2/2002	0.00	2/27/2002	0.00
9/13/2001	0.00	11/8/2001	0.00	1/3/2002	0.15	2/28/2002	0.00
9/14/2001	0.00	11/9/2001	0.00	1/4/2002	1.27	3/1/2002	0.00
9/15/2001	0.00	11/10/2001	0.00	1/5/2002	0.48	3/2/2002	3.96
9/16/2001	0.00	11/11/2001	0.00	1/6/2002	2.01	3/3/2002	0.05
9/17/2001	0.00	11/12/2001	0.00	1/7/2002	0.00	3/4/2002	0.03
9/18/2001	0.00	11/13/2001	0.00	1/8/2002	0.00	3/5/2002	0.00
9/19/2001	0.00	11/14/2001	0.00	1/9/2002	0.00	3/6/2002	0.00
9/20/2001	0.00	11/15/2001	0.00	1/10/2002	0.00	3/7/2002	0.00
9/21/2001	0.00	11/16/2001	0.00	1/11/2002	0.00	3/8/2002	0.00
9/22/2001	0.00	11/17/2001	0.00	1/12/2002	1.68	3/9/2002	0.08
9/23/2001	0.00	11/18/2001	0.00	1/13/2002	0.74	3/10/2002	0.00
9/24/2001	1.07	11/19/2001	0.00	1/14/2002	0.48	3/11/2002	0.00
9/25/2001	1.78	11/20/2001	0.00	1/15/2002	0.38	3/12/2002	0.08
9/26/2001	0.00	11/21/2001	0.00	1/16/2002	0.00	3/13/2002	3.02
9/27/2001	0.00	11/22/2001	0.00	1/17/2002	0.00	3/14/2002	0.00
9/28/2001	0.00	11/23/2001	0.00	1/18/2002	0.00	3/15/2002	0.00
9/29/2001	0.00	11/24/2001	2.29	1/19/2002	0.97	3/16/2002	0.00
9/30/2001	0.00	11/25/2001	0.00	1/20/2002	0.23	3/17/2002	0.20
10/1/2001	0.00	11/26/2001	0.00	1/21/2002	0.81	3/18/2002	0.00
10/2/2001	0.00	11/27/2001	0.03	1/22/2002	0.00	3/19/2002	0.00
10/3/2001	0.00	11/28/2001	0.00	1/23/2002	2.57	3/20/2002	0.38
10/4/2001	0.00	11/29/2001	0.03	1/24/2002	0.00	3/21/2002	0.53
10/5/2001	0.00	11/30/2001	0.00	1/25/2002	0.25	3/22/2002	0.00
10/6/2001	2.26	12/1/2001	0.00	1/26/2002	0.00	3/23/2002	0.00
10/7/2001	0.28	12/2/2001	0.00	1/27/2002	0.00	3/24/2002	0.00

Appendix C. Precipitation Raw Data (continued)

Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)
3/25/2002	0.00	5/20/2002	0.00	7/15/2002	0.03	9/9/2002	0.00
3/26/2002	0.13	5/21/2002	0.00	7/16/2002	0.00	9/10/2002	0.53
3/27/2002	0.81	5/22/2002	0.00	7/17/2002	0.00	9/11/2002	0.00
3/28/2002	0.00	5/23/2002	0.00	7/18/2002	0.00	9/12/2002	0.00
3/29/2002	0.00	5/24/2002	0.00	7/19/2002	0.00	9/13/2002	0.00
3/30/2002	0.33	5/25/2002	0.00	7/20/2002	0.00	9/14/2002	0.33
3/31/2002	4.70	5/26/2002	0.00	7/21/2002	0.00	9/15/2002	0.03
4/1/2002	0.03	5/27/2002	0.00	7/22/2002	1.85	9/16/2002	0.69
4/2/2002	0.00	5/28/2002	0.00	7/23/2002	0.03	9/17/2002	0.00
4/3/2002	0.00	5/29/2002	0.05	7/24/2002	0.25	9/18/2002	0.00
4/4/2002	0.00	5/30/2002	0.41	7/25/2002	1.02	9/19/2002	0.00
4/5/2002	0.00	5/31/2002	0.00	7/26/2002	1.22	9/20/2002	0.00
4/6/2002	0.00	6/1/2002	0.00	7/27/2002	0.00	9/21/2002	0.00
4/7/2002	0.00	6/2/2002	0.89	7/28/2002	0.56	9/22/2002	0.10
4/8/2002	0.00	6/3/2002	0.00	7/29/2002	0.00	9/23/2002	0.00
4/9/2002	0.00	6/4/2002	0.00	7/30/2002	0.00	9/24/2002	0.00
4/10/2002	2.72	6/5/2002	0.00	7/31/2002	0.00	9/25/2002	0.00
4/11/2002	0.00	6/6/2002	0.00	8/1/2002	0.00	9/26/2002	0.38
4/12/2002	0.00	6/7/2002	1.55	8/2/2002	0.00	9/27/2002	0.03
4/13/2002	0.00	6/8/2002	0.00	8/3/2002	0.00	9/28/2002	0.00
4/14/2002	1.24	6/9/2002	0.00	8/4/2002	0.00	9/29/2002	0.00
4/15/2002	0.10	6/10/2002	0.00	8/5/2002	0.00	9/30/2002	0.00
4/16/2002	0.00	6/11/2002	0.00	8/6/2002	0.00	10/1/2002	0.00
4/17/2002	0.00	6/12/2002	0.00	8/7/2002	0.00	10/2/2002	0.00
4/18/2002	0.00	6/13/2002	0.00	8/8/2002	0.00	10/3/2002	0.00
4/19/2002	0.00	6/14/2002	0.43	8/9/2002	0.00	10/4/2002	0.00
4/20/2002	1.91	6/15/2002	0.74	8/10/2002	0.00	10/5/2002	0.00
4/21/2002	0.00	6/16/2002	0.00	8/11/2002	0.00	10/6/2002	0.00
4/22/2002	0.00	6/17/2002	0.00	8/12/2002	0.00	10/7/2002	0.00
4/23/2002	0.00	6/18/2002	0.00	8/13/2002	0.00	10/8/2002	0.00
4/24/2002	0.00	6/19/2002	0.00	8/14/2002	0.00	10/9/2002	0.00
4/25/2002	0.03	6/20/2002	0.00	8/15/2002	0.64	10/10/2002	0.00
4/26/2002	0.00	6/21/2002	0.00	8/16/2002	0.00	10/11/2002	1.78
4/27/2002	0.13	6/22/2002	0.81	8/17/2002	0.43	10/12/2002	0.03
4/28/2002	0.03	6/23/2002	0.18	8/18/2002	0.03	10/13/2002	0.76
4/29/2002	0.00	6/24/2002	0.00	8/19/2002	2.36	10/14/2002	0.03
4/30/2002	0.00	6/25/2002	0.00	8/20/2002	0.03	10/15/2002	0.23
5/1/2002	0.08	6/26/2002	0.00	8/21/2002	0.00	10/16/2002	0.03
5/2/2002	0.00	6/27/2002	1.22	8/22/2002	0.00	10/17/2002	0.03
5/3/2002	0.00	6/28/2002	0.05	8/23/2002	0.00	10/18/2002	0.00
5/4/2002	1.75	6/29/2002	0.03	8/24/2002	0.00	10/19/2002	0.00
5/5/2002	0.10	6/30/2002	0.00	8/25/2002	0.08	10/20/2002	0.00
5/6/2002	0.00	7/1/2002	0.00	8/26/2002	1.09	10/21/2002	0.05
5/7/2002	0.00	7/2/2002	0.00	8/27/2002	0.15	10/22/2002	0.25
5/8/2002	0.00	7/3/2002	0.00	8/28/2002	0.76	10/23/2002	0.00
5/9/2002	1.55	7/4/2002	0.00	8/29/2002	0.38	10/24/2002	0.23
5/10/2002	0.00	7/5/2002	0.08	8/30/2002	0.53	10/25/2002	0.00
5/11/2002	0.00	7/6/2002	1.96	8/31/2002	2.54	10/26/2002	0.03
5/12/2002	0.00	7/7/2002	0.00	9/1/2002	0.38	10/27/2002	0.00
5/13/2002	0.00	7/8/2002	0.00	9/2/2002	0.00	10/28/2002	0.91
5/14/2002	1.91	7/9/2002	0.00	9/3/2002	0.00	10/29/2002	0.43
5/15/2002	0.00	7/10/2002	1.27	9/4/2002	0.00	10/30/2002	0.13
5/16/2002	0.00	7/11/2002	1.55	9/5/2002	0.00	10/31/2002	0.00
5/17/2002	0.00	7/12/2002	0.00	9/6/2002	0.00	11/1/2002	0.00
5/18/2002	1.65	7/13/2002	0.05	9/7/2002	0.00	11/2/2002	0.00
5/19/2002	0.05	7/14/2002	0.81	9/8/2002	0.00	11/3/2002	0.00

Appendix C. Precipitation Raw Data (continued)

Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)	Date	Precip. (cm)
11/4/2002	0.15	12/30/2002	0.00	2/24/2003	0.00	4/21/2003	0.00
11/5/2002	0.69	12/31/2002	0.00	2/25/2003	0.00	4/22/2003	0.41
11/6/2002	2.03	1/1/2003	0.74	2/26/2003	0.25	4/23/2003	0.00
11/7/2002	0.00	1/2/2003	0.03	2/27/2003	1.91	4/24/2003	0.00
11/8/2002	0.00	1/3/2003	0.03	2/28/2003	0.00	4/25/2003	0.61
11/9/2002	0.00	1/4/2003	0.00	3/1/2003	0.08	4/26/2003	0.91
11/10/2002	0.23	1/5/2003	0.00	3/2/2003	0.05	4/27/2003	0.00
11/11/2002	1.17	1/6/2003	0.00	3/3/2003	0.00	4/28/2003	0.03
11/12/2002	3.23	1/7/2003	0.00	3/4/2003	0.03	4/29/2003	0.00
11/13/2002	1.73	1/8/2003	0.00	3/5/2003	0.23	4/30/2003	0.61
11/14/2002	0.00	1/9/2003	0.00	3/6/2003	1.75	5/1/2003	0.00
11/15/2002	0.00	1/10/2003	0.00	3/7/2003	0.23	5/2/2003	0.00
11/16/2002	1.65	1/11/2003	0.00	3/8/2003	0.00	5/3/2003	0.00
11/17/2002	0.33	1/12/2003	0.00	3/9/2003	0.00	5/4/2003	0.00
11/18/2002	0.00	1/13/2003	0.00	3/10/2003	0.00	5/5/2003	0.03
11/19/2002	0.00	1/14/2003	0.00	3/11/2003	0.61	5/6/2003	3.30
11/20/2002	0.00	1/15/2003	0.00	3/12/2003	0.03	5/7/2003	0.00
11/21/2002	0.23	1/16/2003	0.51	3/13/2003	0.10	5/8/2003	0.00
11/22/2002	0.03	1/17/2003	0.08	3/14/2003	0.08	5/9/2003	0.00
11/23/2002	0.00	1/18/2003	0.00	3/15/2003	0.15	5/10/2003	0.00
11/24/2002	0.00	1/19/2003	0.00	3/16/2003	1.22	5/11/2003	0.00
11/25/2002	0.00	1/20/2003	0.00	3/17/2003	0.08	5/12/2003	0.00
11/26/2002	0.00	1/21/2003	0.18	3/18/2003	0.13	5/13/2003	0.00
11/27/2002	0.00	1/22/2003	0.00	3/19/2003	0.03	5/14/2003	0.00
11/28/2002	0.00	1/23/2003	0.00	3/20/2003	5.72	5/15/2003	0.00
11/29/2002	0.00	1/24/2003	0.00	3/21/2003	0.64	5/16/2003	0.41
11/30/2002	0.00	1/25/2003	0.00	3/22/2003	0.00	5/17/2003	0.00
12/1/2002	0.00	1/26/2003	0.00	3/23/2003	0.00	5/18/2003	0.00
12/2/2002	0.00	1/27/2003	0.00	3/24/2003	0.00	5/19/2003	3.73
12/3/2002	0.00	1/28/2003	0.00	3/25/2003	0.00	5/20/2003	0.00
12/4/2002	0.00	1/29/2003	0.03	3/26/2003	0.00	5/21/2003	0.00
12/5/2002	1.11	1/30/2003	0.64	3/27/2003	0.00	5/22/2003	1.32
12/6/2002	0.00	1/31/2003	0.05	3/28/2003	0.00	5/23/2003	5.94
12/7/2002	0.00	2/1/2003	0.03	3/29/2003	0.28	5/24/2003	0.15
12/8/2002	0.00	2/2/2003	0.00	3/30/2003	0.61	5/25/2003	0.00
12/9/2002	0.00	2/3/2003	0.00	3/31/2003	0.03	5/26/2003	2.31
12/10/2002	0.38	2/4/2003	0.05	4/1/2003	0.00	5/27/2003	0.99
12/11/2002	0.41	2/5/2003	0.00	4/2/2003	0.00	5/28/2003	0.00
12/12/2002	0.00	2/6/2003	0.71	4/3/2003	0.00	5/29/2003	0.36
12/13/2002	1.47	2/7/2003	2.11	4/4/2003	0.00	5/30/2003	0.61
12/14/2002	0.00	2/8/2003	0.00	4/5/2003	0.00	5/31/2003	2.87
12/15/2002	0.00	2/9/2003	0.00	4/6/2003	0.00	6/1/2003	0.86
12/16/2002	0.00	2/10/2003	1.02	4/7/2003	1.98	6/2/2003	0.00
12/17/2002	0.00	2/11/2003	0.00	4/8/2003	0.08	6/3/2003	0.00
12/18/2002	0.00	2/12/2003	0.00	4/9/2003	3.35	6/4/2003	0.56
12/19/2002	0.18	2/13/2003	0.00	4/10/2003	2.67	6/5/2003	0.00
12/20/2002	0.66	2/14/2003	0.00	4/11/2003	0.10	6/6/2003	0.00
12/21/2002	0.00	2/15/2003	0.15	4/12/2003	0.00	6/7/2003	0.25
12/22/2002	0.00	2/16/2003	3.30	4/13/2003	0.00	6/8/2003	0.84
12/23/2002	0.00	2/17/2003	0.05	4/14/2003	0.00	6/9/2003	0.00
12/24/2002	1.09	2/18/2003	0.00	4/15/2003	0.00	6/10/2003	0.00
12/25/2002	0.10	2/19/2003	0.00	4/16/2003	0.00	6/11/2003	0.00
12/26/2002	0.00	2/20/2003	0.00	4/17/2003	0.00	6/12/2003	0.00
12/27/2002	0.00	2/21/2003	0.00	4/18/2003	0.00	6/13/2003	0.00
12/28/2002	0.00	2/22/2003	1.09	4/19/2003	0.18	6/14/2003	1.65
12/29/2002	0.00	2/23/2003	0.00	4/20/2003	0.00	6/15/2003	0.00

Appendix C. Precipitation Raw Data (continued)

Date	Precip. (cm)
6/16/2003	0.58
6/17/2003	0.08
6/18/2003	0.58
6/19/2003	0.55
6/20/2003	0.00
6/21/2003	0.00
6/22/2003	0.00
6/23/2003	0.00
6/24/2003	0.00
6/25/2003	0.00
6/26/2003	0.00

Appendix D. Water Level Raw Data (cm above Mean Sea Level)

Well	Transect	Depth	Distance (m)	11/18/1999	2/7/2000	3/8/2000	4/5/2000	5/10/2000
C7	3	Shallow	4.5	1561.4	1545.6	1527.0	1533.1	1519.7
C8	3	Shallow	0.0	1567.8	1537.3	1526.9	1533.0	1521.4
C9	1	Shallow	4.5	1566.2	1537.8	1523.8	1530.5	1516.8
C10	1	Shallow	0.0	1566.1	1550.3	1525.6	1531.1	1517.6
C11	2	Shallow	4.5	1558.4	1538.9	1521.2	1527.3	1515.4
C12	2	Shallow	0.0	1567.4	1535.4	1525.9	1531.4	1521.7
F7	3	Shallow	4.5	1560.2	1526.3	1516.3	1526.3	1513.5
F8	3	Shallow	0.0	1563.2	1532.4	1518.7	1527.2	1513.8
F9	1	Shallow	4.5	1562.2	1537.2	1518.6	1527.2	1512.8
F10	1	Shallow	0.0	1563.7	1539.9	1519.2	1527.4	1513.4
F11	2	Shallow	4.5	1563.7	1525.9	1519.2	1528.3	1514.3
F12	2	Shallow	0.0	1564.4	1540.0	1520.8	1528.7	1515.0
N7	3	Shallow	4.5	1559.6	1542.2	1523.6	1530.3	1517.2
N8	3	Shallow	0.0	1563.9	1533.7	1522.8	1529.2	1516.7
N9	1	Shallow	4.5	1565.0	1531.4	1521.4	1529.3	1515.3
N10	1	Shallow	0.0	1534.3	1529.7	1520.3	1528.2	1514.8
N11	2	Shallow	4.5	1564.0	1538.4	1522.5	1529.8	1517.9
N12	2	Shallow	0.0	1566.1	1531.1	1521.3	1529.5	1515.2
P13	1	Shallow	9.0	1496.0	1508.1	1489.9	1495.3	1486.5
P14	1	Shallow	4.5	1493.3	1505.5	1486.6	1493.6	1484.5
P15	1	Shallow	0.0	1497.4	1507.2	1493.5	1497.8	1489.2
P16	2	Shallow	9.0	1502.3	1524.2	1498.6	1504.7	1487.9
P17	2	Shallow	4.5	1464.7	1508.9	1486.1	1491.5	1479.7
P18	2	Shallow	0.0	1470.0	1482.1	1469.6	1473.0	1465.4
P19	3	Shallow	9.0	1500.9	1509.8	1489.0	1495.4	1485.4
P20	3	Shallow	4.5	1500.8	1510.0	1489.9	1494.7	1486.2
P21	3	Shallow	0.0	1498.3	1506.5	1487.9	1493.7	1484.5
P22	4	Shallow	9.0	1485.7	1492.5	1476.9	1481.8	1473.9
P23	4	Shallow	4.5	1477.4	1480.1	1468.2	1470.4	1465.5
P24	4	Shallow	0.0	1475.9	1480.2	1466.5	1469.8	1464.0

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	6/14/2000	7/19/2000	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001
C7	1491.0	1480.0	1578.2	1518.4	1534.6	1545.3	1536.7
C8	1490.3	1478.2	1560.5	1518.4	1535.5	1536.7	1531.2
C9	1496.1	1489.3	1571.3	1520.4	1534.8	1537.2	1532.6
C10	1491.4	1486.9	1559.1	1519.2	1532.9	1534.1	1529.8
C11	1497.1	1470.9	1573.6	1513.9	1531.3	1538.6	1532.5
C12	1489.7	1478.4	1559.8	1518.6	1534.8	1536.9	1531.7
F7	1489.8	1480.6	1562.0	1511.1	1527.3	1529.4	1519.3
F8	1491.2	1480.6	1547.6	1514.7	1529.3	1524.8	1518.7
F9	1495.2	1494.8	1581.7	1512.5	1531.4	1531.4	1521.1
F10	1491.1	1495.4	1548.7	1521.3	1531.0	1525.9	1516.7
F11	1490.5	1488.4	1555.4	1516.7	1532.6	1530.4	1521.9
F12	1492.8	1489.1	1550.4	1517.8	1532.1	1527.2	1520.8
N7	1489.5	1481.2	1581.2	1515.7	1532.4	1540.7	1530.9
N8	1490.2	1480.7	1555.4	1514.8	1531.9	1531.9	1526.7
N9	.	1498.2	1563.4	1518.6	1525.3	1532.0	1524.4
N10	.	1502.9	1553.8	1513.3	1527.0	1528.2	1521.2
N11	1492.0	1489.0	1589.9	1518.2	1533.8	1537.8	1529.2
N12	1493.0	1491.7	1560.9	1518.9	1533.2	1531.1	1522.5
P13	1473.1	1465.8	1571.5	1479.2	1485.0	1503.6	1493.5
P14	1472.0	1464.4	1566.8	1476.6	1483.6	1501.0	1489.7
P15	1478.9	1474.3	1555.4	1483.7	1488.0	1503.2	1495.6
P16	1473.6	1469.3	1591.3	1481.2	1486.1	1516.0	1497.4
P17	1469.3	1469.3	1582.7	1475.4	1479.0	1501.6	1486.1
P18	1460.8	1465.7	1539.4	1466.3	1465.4	1474.5	1467.8
P19	1470.1	1468.6	1576.8	1482.3	1486.0	1504.9	1490.3
P20	1471.6	1470.0	1580.1	1483.1	1486.5	1505.4	1491.1
P21	1470.5	1467.2	1547.3	1479.1	1482.4	1500.4	1488.2
P22	1474.5	1478.4	1569.3	1473.9	1474.5	1502.8	1476.3
P23	1463.3	1468.2	1553.9	1467.6	1467.0	1480.4	1467.9
P24	1463.7	1467.1	1540.5	1468.0	1465.6	1474.1	1467.1

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	5/15/2001	6/28/2001	7/26/2001	9/4/2001	10/9/2001	11/12/2001	12/8/2001
C7	1513.3	1557.8	1490.4	1552.9	1536.7	1506.2	1509.6
C8	1510.8	1530.0	1488.5	1545.8	1536.1	1504.7	1510.5
C9	1508.2	1529.6	1487.8	1548.2	1537.8	1509.5	1516.5
C10	1505.1	1528.3	1489.3	1544.8	1535.9	1508.2	1515.2
C11	1507.5	1528.5	1483.7	1545.6	1534.0	1505.1	1509.6
C12	1509.8	1530.5	1490.6	1545.1	1536.3	1505.8	1512.5
F7	1499.8	1526.6	1489.8	1541.0	1526.9	1497.7	1494.0
F8	1498.9	1523.2	1489.4	1540.9	1530.6	1496.7	1495.2
F9	1498.8	1524.7	1504.3	1542.1	1531.1	1504.0	1507.7
F10	1499.3	1518.2	1492.6	1540.2	1532.3	1504.2	1507.6
F11	1503.6	1523.4	1489.9	1541.1	1532.6	1503.0	1506.1
F12	1504.1	1526.3	1490.9	1540.6	1533.3	1504.1	1504.1
N7	1511.1	1530.9	1490.1	1544.6	1531.5	1504.1	1505.6
N8	1508.4	1534.7	1488.6	1541.4	1532.5	1503.0	1505.7
N9	1510.1	1525.3	1492.4	1550.3	1533.6	1508.0	1510.7
N10	1509.0	.	1492.2	1541.0	1530.3	1476.7	1509.3
N11	1510.6	1526.8	1492.3	1546.0	1535.3	1506.7	1510.9
N12	1508.8	1523.1	1491.4	1542.6	1534.1	1506.1	1509.1
P13	1478.0	1502.1	1470.7	1503.0	1482.8	1469.1	1471.6
P14	1476.6	1499.4	1469.0	1501.3	1481.8	1468.6	1469.0
P15	1481.9	1500.5	1477.3	1503.8	1488.0	1477.0	1477.3
P16	1475.1	1512.6	1470.3	1510.2	1481.2	1465.7	1468.4
P17	1468.4	1497.6	1463.8	1502.2	1476.3	1463.8	1465.3
P18	1460.2	1474.5	1459.0	1479.4	1469.6	1460.2	1459.9
P19	1476.9	1501.5	1470.1	1502.2	1480.5	1469.2	1468.6
P20	1477.1	1501.4	1471.0	1501.1	1480.1	1467.0	1468.5
P21	1475.4	1498.3	1468.4	1495.8	1476.3	1466.3	1465.0
P22		1487.0	1458.0	1497.6	1478.1	1458.3	1458.0
P23	1459.4	1471.0	1455.1	1475.2	1471.0	1454.2	1455.1
P24	1457.9	1468.0	1455.8	1474.1	1458.9	1455.2	1452.8

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	1/13/2002	1/20/2002	1/27/2002	2/2/2002	2/16/2002	3/2/2002	3/28/2002
C7	1568.1	.	1555.6	1540.4	1540.1	1527.6	1537.0
C8	1551.3	1545.5	1540.9	1535.8	1534.2	1526.3	1532.7
C9	1556.7	.	1542.4	1535.1	1535.4	1525.0	1532.6
C10	1547.8	1538.4	1536.2	1532.9	1532.6	1525.0	1530.8
C11	1569.1	.	1548.0	1533.7	1535.5	1523.3	1533.1
C12	1549.1	1542.1	1540.9	1533.9	1533.9	1525.9	1531.7
F7	1539.1	.	1535.2	1526.3	1527.3	1516.9	1523.9
F8	1535.4	1523.2	1524.8	1521.4	1522.9	1517.1	1521.4
F9	1547.6	.	1517.1	1525.9	1526.2	1517.1	1522.6
F10	1537.1	1522.8	1523.1	1519.8	1520.7	1515.8	1522.8
F11	1543.2	.	1532.0	1524.7	1525.3	1517.6	1523.7
F12	1537.6	1527.8	1532.1	1526.9	1525.7	1519.3	1522.6
N7	1557.1	.	1546.2	1534.3	1535.2	1522.4	1532.1
N8	1545.6	1537.7	1532.5	1528.9	1527.9	1521.2	1527.0
N9	1546.4	.	1529.9	1522.6	1523.8	1517.1	1521.7
N10	1544.3	1515.4	1523.0	1518.4	1520.3	1516.6	1519.0
N11	1555.1	.	1543.5	1530.7	1531.7	1522.2	1529.2
N12	1546.3	1526.5	1527.7	1491.4	1522.8	1517.6	1522.2
P13	1510.9	1507.5	1519.1	1507.5	1509.7	1493.2	1499.3
P14	1505.8	1504.0	1515.0	1504.3	1506.4	1491.2	1497.3
P15	1506.9	1506.3	1515.4	1506.9	1509.0	1496.5	1501.4
P16	1530.6	1525.7	1535.8	1513.2	1518.7	1498.3	1504.7
P17	1519.6	1509.5	1526.0	1504.3	1506.2	1489.4	1494.6
P18	1486.1	1483.1	1488.5	1481.8	1483.1	1474.8	1477.6
P19	1522.3	1516.2	1522.0	1506.4	1507.6	1491.5	1498.2
P20	1518.2	1506.3	1524.0	1504.5	1507.5	1491.4	1497.5
P21	1541.8	1508.9	1497.3	1499.5	1501.9	1487.3	1494.6
P22	1554.3	1539.7	1508.0	1485.4	1487.0	1475.4	1480.3
P23	1528.0	1514.2	1489.6	1477.4	1478.9	1471.3	1474.9
P24	1500.0	1495.4	1480.8	1472.9	1472.6	1466.5	1469.8

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	4/11/2002	4/25/2002	5/11/2002	5/29/2002	6/12/2002	6/23/2002	7/19/2002	7/28/2002
C7	1554.4	1534.9	1531.5	1515.7	1498.3	1478.2	1460.2	1501.1
C8	1540.6	1529.7	1527.5	1513.8	1490.3	1474.5	1459.0	1507.4
C9	1543.3	1530.8	1531.1	1514.9	1492.4	1473.8	1458.0	1509.2
C10	1539.3	1529.2	1528.0	1513.1	1489.9	1471.9	1458.5	1513.7
C11	1550.2	1529.4	1527.9	1511.1	1493.8	1471.5	1450.5	1495.6
C12	1540.3	1529.3	1526.9	1513.1	1483.9	1477.2	1461.9	1507.3
F7	1536.7	1525.4	1521.8	1507.1	1487.3	1471.8	1452.0	1485.8
F8	1528.7	1522.0	1520.5	1506.5	1483.9	1473.9	1454.4	1483.6
F9	1533.9	1521.4	1520.5	1505.2	.	1473.2	1469.6	1498.8
F10	1526.5	1519.2	1518.2	1503.9	1485.3	1476.2	1464.6	1498.4
F11	1534.4	1523.1	1522.8	1509.1	1486.9	1474.7	1457.6	1493.6
F12	1530.6	1522.6	1522.3	1509.2	1491.3	1476.9	1459.2	1493.4
N7	1548.9	1531.5	1528.5	1513.5	1495.9	1476.7	1461.4	1491.9
N8	1530.4	1526.7	1525.5	1512.4	1494.1	1474.9	1459.7	1491.1
N9	1536.6	1522.3	1520.8	1511.0	1497.9	1479.0	1508.9	1505.5
N10	1529.7	1521.2	1519.7	1510.2	1493.4	1476.4	1495.6	1505.3
N11	1544.8	1528.0	1525.3	1513.1	1499.3	1480.4	1516.1	1505.1
N12	1533.2	1522.2	1520.1	1509.7	1492.3	1470.1	1461.9	1497.8
P13	1514.9	1503.0	1495.3	1488.9	1478.9	1468.5	1450.5	1462.4
P14	1512.5	1501.0	1493.0	1488.8	1476.6	1466.5	1450.4	1461.9
P15	1515.1	1504.5	1498.7	1494.4	.	1474.6	1460.0	1470.6
P16	1530.3	1509.3	1497.4	1487.6	1474.8	1463.3	1449.5	1461.1
P17	1515.6	1497.6	1484.8	1482.1	1471.7	1461.4	1448.3	1462.0
P18	1487.3	1479.4	1473.9	.	1467.5	1459.6	1450.1	1457.8
P19	1518.0	1502.8	1495.4	1490.3	1476.5	1464.7	1449.4	1461.0
P20	1518.2	1502.7	1495.0	1489.5	1475.8	1463.6	1449.0	1460.6
P21	1514.1	1499.5	1490.3	1484.2	1472.0	1461.7	1446.1	1460.5
P22	1511.4	1482.7	1485.4	1473.6	1460.8	1455.6	1452.2	1476.6
P23	1497.8	1475.2	1474.3	1467.6	.	1451.8	1444.1	1469.4
P24	1486.6	1471.4	1469.8	1468.0	1461.3	1456.1	1451.2	1465.0

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	8/11/2002	8/25/2002	9/8/2002	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002
C7	1452.0	1458.1	1477.3	1465.1	1452.3	1463.6	1469.2	1538.2
C8	1448.6	1454.4	1475.4	1463.2	1449.2	1462.3	1469.6	1532.7
C9	1452.8	1465.6	1479.0	1467.7	1453.7	1470.1	1488.9	1534.2
C10	1450.3	1460.6	1477.7	1465.8	1452.1	1468.6	1474.2	1529.5
C11	1443.2	1453.8	1473.0	1458.4	1445.6	1460.6	1467.5	1535.2
C12	1450.0	1456.1	1476.3	1463.8	1450.0	1463.8	1471.4	1530.8
F7	1448.6	1448.0	1466.9	1456.8	1444.0	1453.2	1459.0	1526.6
F8	1447.3	1447.0	1466.9	1456.5	1444.0	1454.4	1459.8	1521.4
F9	1454.6	1453.7	1473.5	1475.0	1446.7	1462.2	1469.9	1529.9
F10	1453.0	1456.1	1473.1	1461.9	1449.1	1464.9	1472.5	1520.1
F11	1450.6	1452.1	1471.3	1445.7	1446.9	1456.4	1466.1	1523.4
F12	1452.2	1453.5	1470.5	1460.8	1448.0	1460.5	1466.3	1519.9
N7	1450.8	1453.2	1473.9	1463.0	1449.5	1461.4	1467.5	1531.5
N8	1449.6	1452.7	1474.0	1463.0	1446.6	1455.7	1466.7	1524.6
N9	1454.6	1464.4	1478.4	1464.1	1450.1	1466.5	1472.0	1520.5
N10	1453.5	1459.0	1477.3	1465.4	1451.4	1466.6	1464.2	1514.8
N11	1453.9	1457.3	1476.2	1465.2	1450.3	1465.5	1471.3	1532.9
N12	1452.1	1456.4	1476.2	1465.5	1452.4	1465.2	1471.3	1522.5
P13	1446.6	1440.2	1449.6	1446.6	1435.9	1460.9	1435.0	1508.1
P14	1446.1	.	1453.7	1445.8	1435.7	1434.2	1433.9	1487.8
P15	1455.4	1449.9	1463.0	1454.8	1444.7	1418.2	1443.5	1475.5
P16	1446.5	1443.1	1460.2	1448.9	.	1402.0	.	1440.1
P17	1445.8	1440.3	1454.7	1445.2	1435.5	1434.2	1433.6	1501.0
P18	1445.6	1441.0	1450.7	1444.7	1434.3	1467.8	1433.4	1558.3
P19	1447.0	1442.4	1455.2	1448.8	1439.7	1422.0	1438.4	1479.3
P20	1445.0	1441.7	1456.0	1448.4	1439.0	1439.0	1438.6	1506.6
P21	1442.8	1440.0	1452.2	1447.0	1437.0	1453.1	1439.1	1516.5
P22	1444.9	1491.8	1451.0	1443.7	1434.8	1447.0	1432.7	1498.2
P23	1438.0	1441.4	1448.7	1440.8	1433.5	1432.9	1430.7	1488.9
P24	1440.9	1440.3	1448.2	1442.1	1433.9	1418.9	1432.0	1493.0

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	12/2/2002	12/18/2002	1/5/2003	1/20/03	2/9/03	2/23/03	3/12/03	3/27/03
C7	1530.6	1542.2	1536.1	1526.7	1543.1	1557.8	1546.2	1543.1
C8	1528.4	1538.2	1528.4	1524.5	1532.1	1538.2	1534.2	1532.1
C9	1528.1	1535.1	1529.3	1524.7	1533.2	1541.8	1534.2	1533.5
C10	1526.8	1532.0	1526.2	1523.4	1528.0	1528.0	1525.9	1528.9
C11	1526.4	1537.4	1531.6	1523.6	1541.3	1558.4	1541.6	1537.4
C12	1528.1	1536.0	1527.5	1524.1	1531.1	1538.4	1533.3	1531.4
F7	1520.5	1527.9	1524.2	1517.2	1528.8	1539.4	1533.0	1534.0
F8	.	1521.1	1519.9	1517.1	1522.0	1526.3	1524.5	1525.1
F9	.	1528.1	1525.9	1518.6	1530.2	1535.4	1531.4	1531.1
F10	1516.1	1518.9	1518.2	1515.2	1520.4	1524.0	1523.1	1522.8
F11	1519.5	1525.0	1523.1	1517.9	1526.2	1532.6	1527.7	1528.0
F12	1518.7	1520.8	1520.2	1517.5	1521.4	1525.4	1524.2	1524.5
N7	1526.7	1536.7	1532.4	1523.3	1537.9	1552.0	1542.5	1539.5
N8	1523.4	1526.1	1524.3	1521.5	1525.8	1528.9	1527.3	1527.9
N9	.	1522.3	1518.0	1514.1	1522.0	1527.5	1523.2	1521.7
N10	1513.9	1518.4	1515.4	1512.6	1516.6	1519.7	1517.2	1517.8
N11	1527.4	1535.0	1531.4	1523.4	1537.4	1548.4	1539.6	1537.1
N12	1518.9	1522.5	1520.1	1518.6	1526.5	1532.6	1528.0	1524.7
P13	1486.8	1517.0	1500.2	1492.3	1505.4	1529.2	1517.9	1526.4
P14	1485.1	1497.6	1494.9	1490.9	1503.7	1522.9	1515.3	1522.6
P15	1490.1	1482.5	1501.4	1495.3	1506.9	1521.5	1516.0	1521.5
P16	1500.4	1447.1	1509.9	1448.3	1528.2	1553.8	1531.5	1536.7
P17	1483.0	1498.2	1498.9	1490.0	1513.5	1537.9	1517.4	1523.2
P18	1469.6	1545.5	1483.7	1530.3	1488.2	1498.0	1490.7	1494.6
P19	1488.7	1482.6	1506.7	1496.7	1517.7	1549.7	1529.3	1528.1
P20	1489.2	1504.2	1506.9	1496.9	1513.3	1539.8	1524.9	1525.8
P21	1484.5	1519.3	1501.3	1492.8	1508.3	1519.9	1515.6	1517.2
P22	1475.7	1492.8	1498.9	1487.9	1515.3	1565.3	1514.1	1507.1
P23	1471.6	1479.8	1485.6	1481.3	1499.3	1529.8	1494.7	1488.3
P24	1469.5	1478.1	1483.2	1479.3	1492.4	1512.8	1492.4	1483.9

Appendix D. Water Level Raw Data (cm above MSL) (continued)

Well	4/11/03	4/13/03	4/30/03	5/7/03	5/18/03	6/11/03	6/27/03
C7	1574.8	1558.5	1533.2	1551.8	1528.4	1541.8	1526.2
C8	1545.8	1538.7	1528.9	1537.8	1526.8	1530.1	1523.4
C9	1559.8	1542.8	1523.3	1537.3	1520.6	1529.7	1517.5
C10	1541.1	1533.3	1521.7	1527.2	1519.6	1526.6	1516.3
C11	1581.3	1559.9	1524.9	1547.7	1520.3	1534.3	1518.5
C12	1548.8	1539.7	1526.2	1538.4	1524.4	1531.1	1520.5
F7	1556.5	1547.6	1526.2	1535.4	1521.4	1535.7	1518.3
F8	1537.0	1524.0	1513.7	1521.3	1510.6	1518.9	1506.8
F9	1553.7	1531.8	1511.4	1527.3	1507.4	1521.8	1505.3
F10	1530.4	1529.0	1522.0	1527.8	1519.9	1525.4	1515.3
F11	1544.2	1533.8	1519.2	1530.1	1516.1	1523.7	1509.7
F12	1533.0	1525.4	1518.7	1524.8	1516.2	1522.6	1511.4
N7	1569.6	1557.6	1532.7	1549.7	1528.1	1541.8	1523.2
N8	1537.4	1515.1	1510.2	1514.5	1505.9	1512.3	1501.1
N9	1542.7	1523.6	1505.6	1521.5	1505.9	1513.9	1503.2
N10	1535.5	1538.9	1527.6	1538.6	1526.7	1532.5	1524.3
N11	1561.5	1547.2	1524.0	1541.4	1518.5	1531.4	1514.9
N12	1538.4	1526.8	1517.3	1529.5	1513.4	1521.3	1511.5
P13	1559.7	1537.7	1503.6	1518.2	1497.5	1516.7	1497.5
P14	1551.6	1534.2	1501.6	1515.9	1496.1	1514.4	1496.1
P15	1540.1	1530.7	1506.9	1518.2	1501.4	1515.4	1502.6
P16	1594.9	1532.4	1509.9	1540.4	1502.9	1526.3	1480.6
P17	1572.3	1548.8	1498.2	1519.3	1491.8	1513.5	1490.3
P18	1509.0	1501.3	1484.3	1493.4	1480.6	1490.7	1510.5
P19	1571.6	1547.9	1501.8	1524.7	1495.4	1519.8	1478.1
P20	1568.8	1544.4	1502.0	1519.1	1495.0	1516.7	1497.2
P21	1525.7	1520.2	1495.8	1511.1	1458.9	1503.7	1494.3
P22	1566.8	1517.8	1486.1	1516.8	1476.6	1495.5	1493.1
P23	1535.6	1503.3	1476.1	.	1470.7	1477.7	1474.9
P24	1509.2	1492.7	1473.8	1489.3	1469.8	1478.1	1481.1

Appendix E. Water Chemistry Raw Data – Orthophosphate (PO_4-P) (mg P/L)

Sample	Transect	Depth	Distance (m)	2/7/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
C-1	3	Deep	4.5	0.010	0.010	0.010	0.021	0.010	0.010
C-2	3	Deep	0.0	0.010	0.010	0.010	0.025	0.010	0.010
C-3	1	Deep	4.5	0.010	0.010	0.010	0.012	0.011	0.010
C-4	1	Deep	0.0	0.010	0.010	0.010	0.026	0.010	0.010
C-5	2	Deep	4.5	0.010	0.010	0.010	0.010	0.010	0.010
C-6	2	Deep	0.0	0.010	0.010	0.010	0.010	0.014	0.010
C-7	3	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
C-8	3	Intermed	0.0	0.010	0.010	0.010	.	0.010	0.010
C-9	1	Intermed	4.5	0.010	0.010	0.010	.	0.010	.
C-10	1	Intermed	0.0	0.010	0.010	0.010	.	0.010	0.010
C-11	2	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.016
C-12	2	Intermed	0.0	0.010	0.010	0.010	0.010	0.010	0.010
C-13	3	Shallow	4.5	.	.	.	.	.	.
C-14	3	Shallow	0.0	.	.	.	.	.	.
C-15	1	Shallow	4.5	.	.	.	.	.	.
C-16	1	Shallow	0.0	.	.	.	.	.	.
C-17	2	Shallow	4.5	.	.	.	.	.	.
C-18	2	Shallow	0.0	.	.	.	.	.	.
C-19	3	Intermed	9.0	.	.	.	.	.	.
C-20	1	Intermed	9.0	.	.	.	.	.	.
C-21	2	Intermed	9.0	.	.	.	.	.	.
C-22	W of tr2	Intermed	Field	.	.	.	.	.	.
C-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
C-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
C-DITCH		Surface	DITCH	0.010	0.010	0.012	0.010	.	.
F-1	3	Deep	4.5	0.010	0.010	0.010	0.010	0.010	0.010
F-2	3	Deep	0.0	0.010	0.010	0.010	0.010	0.137	0.010
F-3	1	Deep	4.5	0.017	0.020	.	0.042	0.044	0.034
F-4	1	Deep	0.0	0.024	0.041	0.035	0.010	0.024	0.025
F-5	2	Deep	4.5	0.010	0.061	0.065	0.125	0.069	0.015
F-6	2	Deep	0.0	0.013	0.062	0.062	0.010	0.064	0.083
F-7	3	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
F-8	3	Intermed	0.0	0.010	0.010	0.010	0.436	0.010	0.010
F-9	1	Intermed	4.5	0.010	0.010	.	0.010	0.010	0.010
F-10	1	Intermed	0.0	0.010	0.010	0.010	0.010	0.010	.
F-11	2	Intermed	4.5	0.010	0.010	0.010	0.067	0.010	0.014
F-12	2	Intermed	0.0	0.010	0.054	.	0.010	0.092	0.022
F-13	3	Shallow	4.5	.	.	.	.	.	.
F-14	3	Shallow	0.0	.	.	.	.	.	.
F-15	1	Shallow	4.5	.	.	.	.	.	.
F-16	1	Shallow	0.0	.	.	.	.	.	.
F-17	2	Shallow	4.5	.	.	.	.	.	.
F-18	2	Shallow	0.0	.	.	.	.	.	.
F-19	3	Intermed	9.0	.	.	.	.	.	.
F-20	1	Intermed	9.0	.	.	.	.	.	.
F-21	2	Intermed	9.0	.	.	.	.	.	.
F-22	W of tr2	Intermed	Field	.	.	.	.	.	.
F-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
F-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
F-DITCH		Surface	DITCH	0.010	0.010	0.010	0.010	.	.
N-1	3	Deep	4.5	1.043	0.747	.	0.794	0.922	0.750
N-2	3	Deep	0.0	0.992	0.834	0.955	0.015	1.018	1.051
N-3	1	Deep	4.5	0.021	0.013	0.010	0.010	0.015	0.011
N-4	1	Deep	0.0	0.164	0.154	nd	0.896	0.183	0.048

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
C-1	0.020	0.010	0.010	0.010	0.010	0.010	0.011	0.010	0.010
C-2	0.054	0.010	0.010	0.010	0.010	0.010	0.011	0.010	0.070
C-3	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.019	0.270
C-4	0.141	0.010	0.010	.	0.010	0.010	0.012	0.010	0.890
C-5	0.082	0.010	0.010	0.011	0.010	0.010	0.012	0.013	0.060
C-6	0.231	0.010	0.010	0.010	0.010	0.010	0.011	0.019	0.220
C-7	0.019	0.010	0.011	0.010	0.010	0.010	0.011	0.010	0.150
C-8	0.020	0.011	0.010	0.010	0.010	0.010	0.011	0.010	0.120
C-9	0.201	0.010	0.010	0.011	0.010	0.010	0.010	0.010	0.020
C-10	0.010	0.010	0.010	.	0.010	0.010	0.010	0.010	0.110
C-11	0.010	0.011	0.011	0.010	0.010	0.010	0.013	0.010	0.030
C-12	0.010	0.010	0.010	0.010	0.010	0.017	0.010	.	0.030
C-13	.	.	.	.	.	.	.	.	.
C-14	.	.	.	.	.	.	.	.	.
C-15	.	.	.	.	.	.	.	.	.
C-16	.	.	.	.	.	.	.	.	.
C-17	.	.	.	.	.	.	.	.	.
C-18	.	.	.	.	.	.	.	.	.
C-19	.	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	.	.
C-23	.	.	.	.	.	.	.	.	.
C-24	.	.	.	.	.	.	.	.	.
C-DITCH	0.119	.	0.249	0.024	0.075	0.038	0.018	nd	0.870
F-1	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.018	1.300
F-2	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.020
F-3	0.012	.	0.024	nd	0.010	0.023	0.031	0.042	0.150
F-4	0.047	0.023	0.028	0.031	0.016	0.022	0.033	0.057	0.010
F-5	0.338	0.025	0.010	0.038	0.010	0.021	0.056	0.082	0.030
F-6	0.297	0.035	0.038	0.044	0.010	0.034	0.050	0.093	0.350
F-7	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.810
F-8	0.010	.	0.010	0.010	0.010	0.010	0.010	0.010	0.020
F-9	0.107	0.099	0.038	nd	0.011	0.020	0.064	0.023	0.150
F-10	0.011	0.011	0.017	0.029	0.022	0.012	0.033	0.010	0.020
F-11	0.030	0.010	0.035	0.011	0.010	0.010	0.012	0.010	0.010
F-12	0.013	0.013	0.019	0.025	0.054	0.018	0.059	0.068	0.030
F-13	.	.	.	.	.	.	.	.	.
F-14	.	.	.	.	.	.	.	.	.
F-15	.	.	.	.	.	.	.	.	.
F-16	.	.	.	.	.	.	.	.	.
F-17	.	.	.	.	.	.	.	.	.
F-18	.	.	.	.	.	.	.	.	.
F-19	.	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	.	.
F-23	.	.	.	.	.	.	.	.	.
F-24	.	.	.	.	.	.	.	.	.
F-DITCH	0.010	.	0.049	0.016	0.010	0.010	0.017	0.011	0.010
N-1	0.870	0.821	0.751	0.791	0.736	0.843	0.891	0.980	0.010
N-2	0.964	0.925	0.810	0.821	0.881	0.943	0.878	1.005	0.420
N-3	0.017	0.016	0.015	nd	0.010	0.014	0.021	0.016	0.150
N-4	0.177	0.151	0.125	0.137	0.114	0.150	0.134	0.026	0.220

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002
C-1	0.010	0.080	0.040	0.010	0.01	0.11	0.12	0.1	0.03
C-2	0.010	0.190	0.010	0.010	0.01	0.11	0.16	0.14	0.08
C-3	0.010	0.180	0.010	0.010	0.01	0.11	0.59	0.35	0.24
C-4	0.020	0.060	0.080	0.070	0.01	0.11	0.58	0.4	0.19
C-5	0.010	0.250	0.010	0.010	0.02	0.1	0.05	0.05	0.06
C-6	0.010	0.170	0.170	0.160	0.04	0.1	0.34	0.26	0.26
C-7	0.010	0.030	0.180	0.150	0.01	0.1	0.11	0.08	0.04
C-8	0.010	0.030	0.010	0.010	0.01	0.13	0.03	0.02	0.08
C-9	0.010	0.060	0.010	0.010	0.01	0.1	0.02	0.02	0.08
C-10	0.010	0.020	0.020	0.020	0.01	0.1	0.92	0.1	.
C-11	0.030	0.020	0.010	0.010	0.01	0.1	0.16	0.03	0.42
C-12	0.010	0.730	0.010	0.010	0.01	0.1	0.05	0.03	0.05
C-13	.	.	.	.	0.01	0.1	1.3	0.06	.
C-14	.	.	.	.	0.01	0.1	0.13	0.01	.
C-15	.	.	.	.	0.01	0.12	0.14	0.02	.
C-16	.	.	.	.	0.01	0.1	0.28	1.4	.
C-17	.	.	.	.	0.01	0.1	0.05	0.02	.
C-18	.	.	.	.	0.01	.	.	0.01	.
C-19	.	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	.	.
C-23	.	.	.	.	.	.	.	.	.
C-24	.	.	.	.	.	.	.	.	.
C-DITCH	0.010	nd	0.010	0.010	0.01	0.1	0.02	0.07	.
F-1	0.020	0.980	0.040	0.010	0.01	0.1	0.01	0.01	0.01
F-2	0.160	1.600	0.010	0.010	0.01	0.1	0.15	0.01	0.01
F-3	0.010	0.020	0.010	0.010	0.01	0.1	0.47	0.21	0.16
F-4	0.030	0.170	0.010	0.010	0.01	0.1	0.24	0.28	0.31
F-5	0.340	0.010	0.010	0.010	0.18	0.1	0.48	0.34	0.31
F-6	0.040	0.030	0.010	0.010	0.12	0.1	0.52	0.3	0.27
F-7	0.010	0.600	0.010	0.040	0.01	0.1	0.03	0.02	0.02
F-8	0.020	0.170	0.030	0.010	0.01	0.1	0.01	0.01	0.01
F-9	0.010	0.050	0.030	0.010	0.01	0.1	0.11	0.03	.
F-10	0.010	0.140	0.050	0.010	0.01	0.1	0.38	0.2	0.48
F-11	0.020	0.010	0.070	0.010	0.01	0.1	0.14	0.03	0.04
F-12	0.010	0.010	0.020	0.010	0.01	0.1	1.1	0.68	0.02
F-13	.	.	.	.	0.01	.	0.06	0.01	.
F-14	.	.	.	.	0.01	0.12	0.02	0.01	.
F-15	.	.	.	.	0.01	0.1	0.03	0.04	.
F-16	.	.	.	.	0.01	.	0.07	0.04	.
F-17	.	.	.	.	0.01	.	0.21	0.02	.
F-18	.	.	.	.	0.01	.	0.13	0.02	.
F-19	.	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	.	.
F-23	.	.	.	.	.	.	.	.	.
F-24	.	.	.	.	.	.	.	.	.
F-DITCH	0.010	0.230	0.010	0.010	0.01	0.1	0.01	0.02	0.05
N-1	0.010	0.010	0.010	0.010	0.89	0.1	0.93	0.86	0.91
N-2	0.010	0.010	0.010	0.010	0.49	0.1	0.92	0.72	0.81
N-3	0.010	0.120	0.010	0.010	0.02	0.1	0.13	0.16	0.06
N-4	0.010	0.160	0.010	0.010	0.15	0.1	0.15	0.15	0.16

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003
C-1	0.01	0.01	0.01	0.08	0.05	.	0.03	0.03	0.02
C-2	0.01	0.01	0.01	0.07	0.08	.	0.12	0.18	0.25
C-3	.	0.11	0.11	0.21	0.27	.	1.1	0.82	1
C-4	0.01	0.09	0.1	0.24	0.28	.	2.7	0.67	0.44
C-5	0.01	0.01	0.03	0.07	0.07	.	0.06	0.05	0.04
C-6	0.01	0.16	0.2	0.28	0.26	.	3.8	0.33	0.49
C-7	0.01	0.01	0.01	0.18	0.07	0.14	0.42	0.18	0.23
C-8	0.01	0.01	0.01	0.13	0.05	0.1	0.05	0.05	0.18
C-9	.	0.01	0.01	1.6	0.03	0.03	0.02	0.03	0.07
C-10	0.01	0.01	0.01	0.05	0.02	0.13	0.04	0.04	0.05
C-11	0.01	0.01	0.14	0.01	0.03	0.08	0.01	0.06	0.03
C-12	0.01	0.01	0.01	0.04	0.01	0.02	0.01	0.05	0.03
C-13	.	.	.	.	.	.	0.29	0.41	0.15
C-14	.	.	.	.	.	.	0.01	0.07	0.12
C-15	.	.	.	.	.	.	0.04	0.05	0.08
C-16	.	.	.	.	.	.	.	0.31	0.36
C-17	.	.	.	.	.	.	0.27	0.41	0.51
C-18	.	.	.	.	.	.	1.5	.	0.35
C-19	.	.	.	.	.	0.05	0.06	0.11	0.15
C-20	.	.	.	.	.	0.06	0.01	0.02	0.09
C-21	.	.	.	.	.	0.01	0.03	0.02	0.03
C-22	.	.	.	0.05	0.08	.	0.07	0.01	0.24
C-23	.	.	.	0.32	0.18	.	0.07	0.13	0.05
C-24	.	.	.	1.2	0.39	.	0.28	0.2	0.17
C-DITCH	.	.	.	.	.	.	0.08	0.01	0.02
F-1	0.01	0.01	0.01	0.01	0.01	.	0.03	0.01	0.01
F-2	0.01	0.01	0.01	0.01	0.01	.	0.01	0.01	0.02
F-3	0.01	0.09	0.1	0.33	0.14	.	0.22	0.5	0.94
F-4	0.01	0.01	0.01	0.65	0.25	.	0.32	0.33	0.29
F-5	0.01	0.27	0.28	0.38	0.28	.	0.34	0.26	0.25
F-6	0.01	0.29	0.33	0.32	0.24	.	1.5	0.57	1
F-7	0.01	0.01	0.01	0.05	0.1	0.01	0.01	0.01	0.01
F-8	0.01	0.01	0.01	0.02	0.01	0.01	.	0.01	0.01
F-9	0.01	0.01	0.01	.	0.09	1.5	.	0.01	0.01
F-10	0.03	0.03	0.08	0.28	0.09	0.01	0.45	0.12	0.41
F-11	0.01	0.01	0.01	0.04	0.07	0.12	0.02	0.05	0.04
F-12	0.01	0.04	0.34	0.23	1.1	0.26	0.54	5.6	1.2
F-13	.	.	.	.	.	.	.	0.04	.
F-14	.	.	.	.	.	.	0.01	0.05	.
F-15	.	.	.	.	.	.	0.04	0.01	0.31
F-16	.	.	.	.	.	.	.	.	.
F-17	.	.	.	.	.	.	.	0.02	0.26
F-18	.	.	.	.	.	.	.	.	.
F-19	.	.	.	.	.	0.03	0.01	0.01	0.01
F-20	.	.	.	.	.	0.06	0.02	0.01	0.01
F-21	.	.	.	.	.	0.01	0.05	0.07	0.07
F-22	.	.	.	2	0.22	.	0.26	0.03	0.02
F-23	.	.	.	0.3	0.07	.	0.14	0.02	0.01
F-24	.	.	.	2.9	0.39	.	0.63	0.04	0.02
F-DITCH	0.02	.	.	.	0.01	.	0.01	0.01	0.01
N-1	0.93	0.96	0.98	1	0.94	.	0.83	0.8	0.76
N-2	0.7	0.84	0.86	0.85	0.7	.	0.73	0.9	0.85
N-3	0.02	0.02	0.02	0.03	0.03	.	0.09	0.03	0.03
N-4	0.13	0.14	0.14	0.15	0.15	.	0.15	0.14	0.14

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	3/12/2003	4/13/2003	5/7/2003	6/11/03
C-1	0.1	0.02	0.02	0.02
C-2	0.33	0.11	0.11	0.09
C-3	0.36	0.26	0.19	0.18
C-4	0.36	0.18	0.18	0.21
C-5	0.06	0.07	0.07	0.1
C-6	0.37	0.25	0.24	0.23
C-7	0.21	0.38	0.19	0.17
C-8	0.01	0.08	0.02	0.04
C-9	0.04	0.02	0.05	0.02
C-10	0.05	0.05	0.2	0.29
C-11	0.03	0.12	0.11	0.16
C-12	0.13	0.04	0.03	0.11
C-13	0.03	0.93	0.21	0.13
C-14	0.25	0.08	0.03	0.02
C-15	1	0.14	0.03	0.06
C-16	0.14	0.5	0.06	0.17
C-17	0.01	0.54	0.17	0.2
C-18	0.79	0.17	0.02	0.2
C-19	0.06	0.12	0.04	0.18
C-20	0.32	0.12	0.05	0.03
C-21	0.04	0.07	0.04	0.02
C-22	0.13	0.14	0.12	0.1
C-23	0.13	0.02	0.12	0.01
C-24	0.46	0.08	0.46	0.12
C-DITCH	0.01	0.08	0.02	0.1
F-1	0.01	0.005	0.005	0.005
F-2	0.01	0.01	0.005	0.005
F-3	0.14	0.16	0.13	0.11
F-4	0.44	0.73	0.33	0.24
F-5	0.28	0.36	0.36	0.34
F-6	0.57	0.39	0.37	0.37
F-7	0.01	0.01	0.005	0.005
F-8	0.02	0.005	0.005	0.03
F-9	0.02	0.03	0.09	0.45
F-10	0.25	0.87	0.22	0.09
F-11	0.04	0.16	0.06	0.08
F-12	1.4	2.2	0.76	1.1
F-13	0.01	0.04	0.09	0.04
F-14	0.03	0.1	0.01	0.04
F-15	0.06	0.33	0.05	0.07
F-16	0.03	0.12	0.03	0.02
F-17	0.04	0.09	.	0.01
F-18	0.1	0.19	0.23	0.06
F-19	0.06	0.02	0.005	0.005
F-20	0.01	0.06	0.01	0.1
F-21	0.04	0.04	0.01	0.005
F-22	0.06	0.005	0.08	0.005
F-23	0.05	0.005	0.08	0.03
F-24	0.08	0.01	0.08	0.06
F-DITCH	0.06	0.005	0.01	0.04
N-1	0.83	0.9	0.91	0.91
N-2	1.1	0.89	0.91	0.87
N-3	0.03	0.02	0.02	0.02
N-4	0.15	0.15	0.15	0.16

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	Transect	Depth	Distance (m)	2/7/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
N-5	2	Deep	4.5	0.010	0.010	nd	0.010	0.011	0.011
N-6	2	Deep	0.0	0.035	0.023	0.024	0.023	0.025	0.026
N-7	3	Intermed	4.5	0.657	0.655	0.742	0.749	0.837	0.861
N-8	3	Intermed	0.0	0.389	0.369	0.517	0.577	0.222	nd
N-9	1	Intermed	4.5	0.010	0.010	0.014	0.010	0.010	0.010
N-10	1	Intermed	0.0	0.013	0.012	0.014	0.010	0.010	0.010
N-11	2	Intermed	4.5	0.010	0.010	0.010	0.014	0.010	0.010
N-12	2	Intermed	0.0	0.010	0.010	0.010	0.021	0.010	0.010
N-13	3	Shallow	4.5	.	.	.	.	.	.
N-14	3	Shallow	0.0	.	.	.	.	.	.
N-15	1	Shallow	4.5	.	.	.	.	.	.
N-16	1	Shallow	0.0	.	.	.	.	.	.
N-17	2	Shallow	4.5	.	.	.	.	.	.
N-18	2	Shallow	0.0	.	.	.	.	.	.
N-19	3	Intermed	9.0	.	.	.	.	.	.
N-20	1	Intermed	9.0	.	.	.	.	.	.
N-21	2	Intermed	9.0	.	.	.	.	.	.
N-22	W of tr2	Intermed	Field	.	.	.	.	.	.
N-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
N-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
N-DITCH		Surface	DITCH	0.027	0.016	0.010	0.010	.	0.061
P-1	1	Deep	9.0	0.010	0.010	0.010	0.010	0.010	0.010
P-2	1	Deep	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-3	1	Deep	0.0	0.010	0.010	0.010	0.010	0.010	0.010
P-4	2	Deep	9.0	0.010	0.010	0.010	0.016	0.010	0.010
P-5	2	Deep	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-6	2	Deep	0.0	0.010	0.010	0.010	0.010	0.010	0.010
P-7	3	Deep	9.0	0.010	0.010	0.010	0.010	0.010	0.010
P-8	3	Deep	4.5	0.010	0.010	0.010	0.025	0.010	0.010
P-9	3	Deep	0.0	0.010	0.010	0.010	0.039	0.011	0.010
P-10	4	Deep	9.0	0.010	0.010	0.010	0.010	0.010	.
P-11	4	Deep	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-12	4	Deep	0.0	0.010	0.010	0.010	0.034	0.010	0.010
P-13	1	Intermed	9.0	0.010	0.010	0.010	0.010	0.010	.
P-14	1	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-15	1	Intermed	0.0	0.010	0.010	0.010	0.010	0.010	0.010
P-16	2	Intermed	9.0	0.010	0.010	0.010	0.010	0.010	0.010
P-17	2	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-18	2	Intermed	0.0	0.010	0.010	0.010	0.010	0.010	0.010
P-19	3	Intermed	9.0	0.010	0.010	0.010	0.010	0.010	0.010
P-20	3	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-21	3	Intermed	0.0	0.010	0.010	0.010	0.010	0.012	0.081
P-22	4	Intermed	9.0	0.010	0.010	0.011	0.010	0.026	0.040
P-23	4	Intermed	4.5	0.010	0.010	0.010	0.010	0.010	0.010
P-24	4	Intermed	0.0	0.010	0.010	0.010	0.010	.	0.010
P-25	1	Shallow	9.0	.	.	.	.	.	.
P-26	1	Shallow	4.5	.	.	.	.	.	.
P-27	1	Shallow	0.0	.	.	.	.	.	.
P-28	2	Shallow	9.0	.	.	.	.	.	.
P-29	2	Shallow	4.5	.	.	.	.	.	.
P-30	2	Shallow	0.0	.	.	.	.	.	.
P-31	3	Shallow	9.0	.	.	.	.	.	.
P-32	3	Shallow	4.5	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
N-5	0.010	0.013	0.011	0.013	0.010	0.010	0.013	0.010	0.230
N-6	0.045	0.019	0.027	0.030	0.020	0.025	0.030	0.025	0.010
N-7	0.588	0.749	0.648	nd	0.735	0.799	0.749	0.431	0.010
N-8	0.038	0.265	0.043	0.074	0.214	0.613	0.286	0.143	0.610
N-9	0.021	0.012	0.010	0.012	0.010	0.016	0.013	0.010	0.410
N-10	0.045	0.012	0.024	0.020	0.014	0.046	0.037	0.010	0.020
N-11	0.011	0.010	0.010	nd	0.010	0.017	0.029	0.010	0.560
N-12	0.010	0.010	0.010	0.010	0.010	0.010	0.011	0.010	0.100
N-13	.	.	.	.	.	.	.	.	.
N-14	.	.	.	.	.	.	.	.	.
N-15	.	.	.	.	.	.	.	.	.
N-16	.	.	.	.	.	.	.	.	.
N-17	.	.	.	.	.	.	.	.	.
N-18	.	.	.	.	.	.	.	.	.
N-19	.	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	.	.
N-23	.	.	.	.	.	.	.	.	.
N-24	.	.	.	.	.	.	.	.	.
N-DITCH	0.176	0.516	0.016	0.032	0.010	0.010	0.017	0.015	0.010
P-1	0.010	0.010	0.010	.	0.010	0.010	0.010	0.010	0.010
P-2	0.010	0.010	0.010	.	0.010	0.010	0.010	0.010	0.030
P-3	0.018	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.180
P-4	0.036	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.170
P-5	0.010	.	0.010	0.010	0.010	0.010	0.012	0.010	0.110
P-6	0.010	.	0.010	0.011	0.010	0.010	0.010	0.010	0.520
P-7	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.040
P-8	0.025	0.011	0.010	0.012	0.010	0.010	0.010	0.013	0.110
P-9	0.166	0.010	0.010	0.011	0.010	0.010	0.010	0.021	0.140
P-10	0.082	0.010	0.010	0.010	0.010	0.010	0.010	0.015	0.280
P-11	0.102	.	0.010	0.010	0.010	0.010	0.010	0.010	0.140
P-12	0.046	0.011	0.010	0.011	0.010	0.010	0.010	0.010	0.150
P-13	0.013	0.010	0.010	.	0.010	0.010	0.010	0.010	0.010
P-14	0.010	0.010	0.010	.	0.010	0.010	0.010	0.010	0.020
P-15	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
P-16	0.010	0.010	0.011	0.011	0.010	0.010	0.010	0.010	0.080
P-17	0.010	0.011	0.012	0.012	0.010	0.010	0.015	0.011	0.030
P-18	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.030
P-19	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.130
P-20	0.010	0.011	0.012	0.016	0.010	0.010	0.010	0.010	0.330
P-21	0.010	0.012	0.012	0.013	0.010	0.010	0.010	0.010	0.560
P-22	0.010	0.014	0.015	0.084	0.036	.	0.010	0.010	0.290
P-23	0.010	0.011	0.010	0.010	0.010	0.010	0.010	0.010	0.210
P-24	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.470
P-25	.	.	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	.	.	.	.	.	.	.	.
P-29	.	.	.	.	.	.	.	.	.
P-30	.	.	.	.	.	.	.	.	.
P-31	.	.	.	.	.	.	.	.	.
P-32	.	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002
N-5	0.010	0.300	0.010	0.010	0.01	0.1	2	0.44	0.06
N-6	0.010	0.280	0.010	0.010	0.03	0.1	2.3	1.4	0.4
N-7	0.010	0.010	0.060	0.010	0.77	0.1	1.1	0.87	0.77
N-8	0.010	0.010	0.020	0.040	0.48	0.1	1.2	0.96	1.1
N-9	0.010	0.220	0.080	0.050	0.01	0.1	0.04	0.15	0.34
N-10	0.010	0.110	0.160	0.060	0.02	0.1	0.72	0.3	0.25
N-11	0.180	0.050	0.010	0.070	0.01	0.1	0.25	0.02	0.08
N-12	0.980	0.290	0.010	0.020	0.01	0.1	0.09	0.03	0.04
N-13	.	.	.	.	0.01	0.1	0.63	0.06	.
N-14	.	.	.	.	0.02	0.1	0.24	0.02	.
N-15	.	.	.	.	0.01	0.29	0.39	0.02	.
N-16	.	.	.	.	0.01	0.1	0.22	0.06	.
N-17	.	.	.	.	0.01	0.1	0.12	0.01	.
N-18	.	.	.	.	0.01	0.16	0.1	0.01	.
N-19	.	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	.	.
N-23	.	.	.	.	.	.	.	.	.
N-24	.	.	.	.	.	.	.	.	.
N-DITCH	0.950	0.400	0.010	0.040	0.01	0.1	0.01	0.04	0.09
P-1	0.010	0.030	0.010	.	0.01	0.1	0.06	0.08	0.07
P-2	0.010	0.170	0.010	0.010	0.01	0.1	0.02	0.1	0.09
P-3	0.010	0.120	0.030	0.020	0.01	0.1	0.06	0.73	0.05
P-4	0.010	0.110	0.060	0.010	0.01	0.1	0.05	0.31	0.19
P-5	0.010	0.440	0.030	0.040	0.01	0.1	0.06	0.37	0.2
P-6	0.010	0.060	0.080	0.010	0.01	0.1	0.03	1.1	0.59
P-7	0.010	0.130	0.010	0.010	0.01	0.1	0.14	0.09	0.06
P-8	0.010	0.150	0.010	0.010	0.01	0.1	0.52	0.33	0.25
P-9	0.010	0.100	0.010	0.010	0.01	0.1	0.84	0.36	0.27
P-10	0.010	0.180	0.010	0.010	0.07	0.1	0.3	0.26	0.18
P-11	0.010	0.200	0.010	0.010	0.01	0.1	0.09	0.96	0.27
P-12	0.010	0.040	0.010	0.010	0.01	0.11	0.05	0.84	0.49
P-13	0.010	0.030	0.050	0.010	0.01	0.1	0.1	0.09	0.04
P-14	0.010	0.010	0.780	0.850	0.01	0.1	0.06	0.02	0.01
P-15	0.010	0.300	1.200	1.300	0.01	0.1	0.01	0.01	.
P-16	0.010	0.020	0.010	0.020	0.01	0.1	0.01	0.28	0.18
P-17	0.010	0.020	0.140	0.140	0.01	0.1	0.07	0.04	0.07
P-18	0.020	0.200	0.010	0.010	0.01	0.14	0.01	0.02	0.02
P-19	0.020	0.510	0.020	0.020	0.05	0.1	0.08	0.14	0.14
P-20	0.020	2.100	0.480	0.290	0.03	0.1	0.05	0.58	0.49
P-21	0.010	0.210	0.020	0.110	0.01	0.1	0.12	0.2	0.46
P-22	0.010	0.770	0.010	0.010	0.06	0.1	0.01	0.22	0.43
P-23	0.010	0.060	0.010	0.010	0.01	0.1	0.02	0.12	2.1
P-24	0.010	0.250	0.010	0.020	0.01	0.1	0.06	0.19	.
P-25	.	.	.	.	0.01	0.1	.	.	.
P-26	.	.	.	.	0.01	0.2	0.16	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	.	.	.	0.01	.	0.13	.	.
P-29	.	.	.	.	0.01	.	0.04	.	.
P-30	.	.	.	.	.	.	.	.	.
P-31	.	.	.	.	0.01	.	0.64	.	.
P-32	.	.	.	.	0.01	0.1	0.15	.	.

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003
N-5	0.01	0.01	0.01	0.04	0.05	.	0.04	0.04	0.04
N-6	0.03	0.03	0.02	0.17	0.1	.	0.13	0.27	0.15
N-7	0.72	0.42	0.82	1.1	0.97	0.43	0.85	1.4	0.92
N-8	0.87	0.4	0.41	0.74	0.63	0.28	0.58	1.3	0.61
N-9	0.16	0.1	0.08	0.2	0.39	0.06	.	0.1	0.09
N-10	0.08	0.14	0.07	1.5	0.39	0.09	0.1	0.07	0.09
N-11	0.17	0.15	0.18	0.42	0.54	0.2	0.54	0.19	0.21
N-12	0.01	0.01	0.01	0.08	0.01	0.03	0.01	0.01	0.01
N-13	.	.	.	.	.	.	0.21	0.04	0.67
N-14	.	.	.	.	.	.	0.22	0.17	0.27
N-15	.	.	.	.	.	.	.	.	0.92
N-16	.	.	.	.	.	.	0.31	0.15	0.12
N-17	.	.	.	.	.	.	1.2	0.13	0.13
N-18	.	.	.	.	.	.	.	0.02	0.18
N-19	.	.	.	.	.	0.15	0.12	0.13	0.09
N-20	.	.	.	.	.	3.9	0.62	0.2	0.09
N-21	.	.	.	.	.	0.03	0.06	0.03	0.02
N-22	.	.	.	0.1	0.02	.	0.02	0.01	0.09
N-23	.	.	.	0.25	0.27	.	1.1	0.3	0.56
N-24	.	.	.	0.1	0.11	.	0.4	0.07	0.02
N-DITCH	0.01	.	.	.	.	.	2.2	0.01	0.05
P-1	0.01	0.01	0.01	0.01	0.05	.	0.1	0.04	0.04
P-2	0.01	0.01	0.01	0.01	0.03	.	0.03	0.02	0.05
P-3	0.01	0.01	0.01	0.01	0.06	.	0.12	0.23	0.11
P-4	0.02	0.05	0.04	0.01	0.14	.	0.34	0.1	0.13
P-5	0.01	0.01	0.01	0.04	0.07	.	0.04	0.06	0.08
P-6	0.01	0.01	0.04	0.01	0.29	.	1.8	0.21	1
P-7	0.01	0.02	0.03	0.02	0.05	.	0.04	0.04	0.05
P-8	0.01	0.02	0.03	0.05	0.14	.	0.09	0.12	0.09
P-9	0.01	0.14	0.15	0.14	0.16	.	0.17	0.27	0.09
P-10	0.01	0.09	0.08	0.09	0.14	.	0.08	0.13	0.14
P-11	0.01	0.1	0.1	0.1	0.15	.	0.16	0.13	0.14
P-12	0.01	0.15	0.12	0.1	0.12	.	0.17	0.57	0.68
P-13	0.01	0.01	0.01	0.01	0.02	.	0.05	0.05	0.06
P-14	0.01	0.01	0.01	0.01	0.01	.	0.01	0.01	0.02
P-15	0.01	0.01	0.01	0.01	0.02	.	0.03	0.02	0.01
P-16	0.01	0.01	0.01	.	.	.	0.81	0.08	0.06
P-17	0.01	0.01	0.01	0.01	0.01	.	0.17	0.05	0.06
P-18	0.01	0.01	0.01	0.01	0.01	.	0.03	0.01	0.01
P-19	0.01	0.02	0.07	0.02	0.26	.	0.66	0.13	0.23
P-20	0.02	0.57	0.26	0.06	0.51	.	0.51	0.28	0.22
P-21	0.01	0.01	0.12	0.11	0.17	.	0.46	0.12	0.18
P-22	0.04	0.34	0.24	.	0.15	.	0.37	0.17	0.08
P-23	0.01	0.02	0.04	2.9	0.48	.	0.32	0.14	0.19
P-24	0.01	0.01	0.08	0.01	.	.	0.95	0.06	0.07
P-25	.	.	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	.	.	.	.	.	.	.	0.52
P-29	.	.	.	.	.	.	.	.	0.45
P-30	.	.	.	.	.	.	.	.	.
P-31	.	.	.	.	.	.	.	0.44	0.78
P-32	.	.	.	.	.	.	.	0.04	1.3

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	3/12/2003	4/13/2003	5/7/2003	6/11/03
N-5	0.03	0.07	0.02	0.01
N-6	0.05	1.3	0.04	0.11
N-7	0.95	0.95	0.82	0.98
N-8	1.2	0.27	0.62	0.59
N-9	0.07	0.04	0.03	0.02
N-10	0.11	0.08	0.05	0.06
N-11	0.07	0.18	0.03	0.05
N-12	0.01	0.03	0.04	0.05
N-13	0.17	0.09	0.09	0.41
N-14	0.3	0.31	0.12	0.12
N-15	0.04	0.45	0.02	0.06
N-16	0.14	0.16	0.03	0.25
N-17	0.03	0.05	0.01	.
N-18	0.09	0.21	.	.
N-19	0.2	0.08	0.06	0.18
N-20	0.09	0.06	0.08	0.04
N-21	0.05	0.04	0.03	0.06
N-22	0.03	0.01	0.04	0.04
N-23	0.19	0.22	0.06	0.07
N-24	0.09	0.02	0.13	0.05
N-DITCH	0.19	0.07	0.08	0.08
P-1	0.04	0.04	0.03	0.03
P-2	0.02	0.02	0.04	0.03
P-3	0.09	0.07	0.07	0.08
P-4	0.1	0.13	0.1	0.11
P-5	0.06	0.08	0.09	0.08
P-6	0.36	1.5	2.1	3.1
P-7	0.05	0.04	0.05	0.06
P-8	0.09	0.11	0.1	0.11
P-9	0.11	0.12	0.16	0.16
P-10	0.31	0.1	0.09	0.09
P-11	0.18	0.14	0.14	0.13
P-12	1	0.23	0.25	0.18
P-13	0.04	0.25	0.03	0.09
P-14	0.01	0.02	0.01	0.05
P-15	0.01	0.01	0.005	0.005
P-16	0.12	0.29	0.29	0.19
P-17	0.11	0.19	0.17	0.15
P-18	0.01	0.02	0.02	0.01
P-19	0.25	0.61	0.41	0.7
P-20	0.22	0.4	0.56	0.42
P-21	0.16	0.26	0.28	0.68
P-22	0.12	0.29	0.45	0.1
P-23	0.16	0.11	.	0.09
P-24	0.19	0.06	0.25	0.23
P-25	.	0.1	.	.
P-26	0.14	0.08	0.17	.
P-27	.	.	.	.
P-28	0.29	0.23	0.26	0.83
P-29	.	0.12	.	0.29
P-30	.	.	.	.
P-31	0.66	0.99	1	0.65
P-32	0.12	0.85	1.6	.

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	Transect	Depth	Distance (m)	2/7/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
P-33	3	Shallow	0.0	.	.	.	.	.	.
P-34	4	Shallow	9.0	.	.	.	.	.	.
P-35	4	Shallow	4.5	.	.	.	.	.	.
P-36	4	Shallow	0.0	.	.	.	.	.	.
P-37	betw 1-2	Intermed	Field	.	.	.	.	.	.
P-38	betw 3-4	Intermed	Field	.	.	.	.	.	.
P-DITCH		Surface	DITCH	0.010	0.010	0.010	0.013	0.010	0.010
B-1		Intermed	0.0	.	.	.	.	.	.
B-2		Intermed	4.5	.	.	.	.	.	.
B-3		Intermed	9.0	.	.	.	.	.	.

Sample	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
P-33	.	.	.	.	.	.	.	.	.
P-34	.	.	.	.	.	.	.	.	.
P-35	.	.	.	.	.	.	.	.	.
P-36	.	.	.	.	.	.	.	.	.
P-37	.	.	.	.	.	.	.	.	.
P-38	.	.	.	.	.	.	.	.	.
P-DITCH	0.010	.	0.010	.	0.010	0.010	0.010	0.010	0.040
B-1	.	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.	.

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002
P-33	.	.	.	.	0.01	0.1	0.17	.	.
P-34	.	.	.	.	0.01	.	0.18	.	.
P-35	.	.	.	.	0.01	.	0.14	.	.
P-36	.	.	.	.	.	.	0.11	.	.
P-37	.	.	.	.	.	.	.	.	.
P-38	.	.	.	.	.	.	.	.	.
P-DITCH	0.010	0.010	0.010	0.010	0.01	0.1	0.07	0.02	0.01
B-1	.	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.	.

Sample	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003
P-33	.	.	.	.	.	.	.	0.06	0.83
P-34	.	.	.	.	.	.	.	0.05	0.19
P-35	.	.	.	.	.	.	.	0.08	0.2
P-36	.	.	.	.	.	.	.	0.06	0.56
P-37	.	.	.	0.02	1.5	.	10.6	5	3.7
P-38	.	.	.	0.04	0.2	.	1.1	0.17	0.21
P-DITCH	0.01	.	.	.	.	.	0.17	0.01	0.01
B-1	.	.	.	.	.	0.02	0.01	0.01	0.01
B-2	.	.	.	.	.	0.08	0.01	0.01	0.01
B-3	.	.	.	.	.	0.01	.	0.04	0.03

Appendix E. Water Chemistry Raw Data – PO_4-P (mg P/L) (continued)

Sample	3/12/2003	4/13/2003	5/7/2003	6/11/03
P-33	0.03	0.22	0.64	0.37
P-34	0.12	0.56	0.06	1.5
P-35	0.05	0.63	0.09	1.6
P-36	0.15	1.2	0.26	.
P-37	2.2	8.3	5.6	4.8
P-38	0.28	0.14	0.31	0.22
P-DITCH	0.01	0.05	0.02	0.02
B-1	0.02	0.01	.	0.005
B-2	0.45	0.02	0.005	0.01
B-3	0.02	0.34	0.02	0.005

Appendix E. Water Chemistry Raw Data – Ammonium (NH_4-N) (mg N/L)

Sample	Transect	Depth	Distance (m)	2/7/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
C-1	3	Deep	4.5	0.10	0.10	0.10	0.10	0.11	0.10
C-2	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
C-3	1	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
C-4	1	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
C-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
C-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
C-7	3	Intermed	4.5	0.10	0.10	0.12	0.10	0.10	0.10
C-8	3	Intermed	0.0	0.10	0.10	0.10	.	0.17	0.10
C-9	1	Intermed	4.5	0.10	0.10	0.10	.	0.10	.
C-10	1	Intermed	0.0	0.10	0.10	0.10	.	0.10	0.23
C-11	2	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
C-12	2	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	0.10
C-13	3	Shallow	4.5	.	.	.	.	.	.
C-14	3	Shallow	0.0	.	.	.	.	.	.
C-15	1	Shallow	4.5	.	.	.	.	.	.
C-16	1	Shallow	0.0	.	.	.	.	.	.
C-17	2	Shallow	4.5	.	.	.	.	.	.
C-18	2	Shallow	0.0	.	.	.	.	.	.
C-DITCH		Surface	DITCH	0.10	0.10	0.10	0.23	.	.
F-1	3	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
F-2	3	Deep	0.0	0.10	0.10	0.10	0.12	0.10	0.10
F-3	1	Deep	4.5	0.10	0.10	.	0.10	0.10	0.10
F-4	1	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
F-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
F-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
F-7	3	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
F-8	3	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	0.10
F-9	1	Intermed	4.5	0.10	0.10	.	0.10	0.13	0.10
F-10	1	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	.
F-11	2	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
F-12	2	Intermed	0.0	0.10	0.10	.	2.21	0.10	0.10
F-13	3	Shallow	4.5	.	.	.	.	.	.
F-14	3	Shallow	0.0	.	.	.	.	.	.
F-15	1	Shallow	4.5	.	.	.	.	.	.
F-16	1	Shallow	0.0	.	.	.	.	.	.
F-17	2	Shallow	4.5	.	.	.	.	.	.
F-18	2	Shallow	0.0	.	.	.	.	.	.
F-DITCH		Surface	DITCH	0.10	0.10	0.10	0.10	.	.
N-1	3	Deep	4.5	0.10	0.10	.	0.10	0.10	0.10
N-2	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
N-3	1	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
N-4	1	Deep	0.0	0.10	0.10	.	0.97	0.10	0.15
N-5	2	Deep	4.5	0.10	0.10	.	0.10	0.10	0.10
N-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
N-7	3	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
N-8	3	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	.
N-9	1	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.27
N-10	1	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	0.10
N-11	2	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
N-12	2	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	0.10
N-13	3	Shallow	4.5	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – NH_4-N (mg N/L) (continued)

Sample	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
C-1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.13
C-2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.13
C-3	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C-4	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.11
C-5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C-6	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C-7	0.10	0.10	0.10	0.10	0.10	0.21	0.22	0.25	0.10
C-8	0.10	0.11	0.10	0.10	0.10	0.11	0.16	0.14	0.11
C-9	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11
C-10	0.10	0.10	0.10	.	0.10	0.10	0.10	0.14	0.10
C-11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
C-12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	.	0.10
C-13	.	.	.	.	.	.	.	.	.
C-14	.	.	.	.	.	.	.	.	.
C-15	.	.	.	.	.	.	.	.	.
C-16	.	.	.	.	.	.	.	.	.
C-17	.	.	.	.	.	.	.	.	.
C-18	.	.	.	.	.	.	.	.	.
C-DITCH	0.10	.	0.11	0.10	0.70	0.29	0.10	.	0.10
F-1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-3	0.10	.	0.10	.	0.10	0.10	0.10	0.10	0.10
F-4	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-6	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-7	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-8	0.10	.	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-9	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
F-10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-11	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
F-13	.	.	.	.	.	.	.	.	.
F-14	.	.	.	.	.	.	.	.	.
F-15	.	.	.	.	.	.	.	.	.
F-16	.	.	.	.	.	.	.	.	.
F-17	.	.	.	.	.	.	.	.	.
F-18	.	.	.	.	.	.	.	.	.
F-DITCH	0.10	.	0.10	0.10	0.22	0.10	0.10	0.32	0.10
N-1	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-2	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-3	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
N-4	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-5	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-6	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-7	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
N-8	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-9	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-11	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
N-12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
N-13	.	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – NH_4-N (mg N/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002
C-1	0.12	0.13	0.1	0.1	0.2	0.11
C-2	0.10	0.11	0.13	0.11	0.18	0.11
C-3	0.10	0.13	0.13	0.11	0.18	0.11
C-4	0.10	0.10	0.1	0.1	0.23	0.11
C-5	0.10	0.10	0.1	0.1	0.11	0.1
C-6	0.10	0.10	0.1	0.1	0.14	0.1
C-7	0.10	0.11	0.1	0.1	0.15	0.1
C-8	0.10	0.10	0.1	0.1	0.19	0.13
C-9	0.10	0.10	0.1	0.1	0.1	0.1
C-10	0.10	0.10	0.1	0.1	0.1	0.1
C-11	0.10	0.10	0.1	0.1	0.1	0.1
C-12	0.17	0.46	0.1	0.1	0.12	0.1
C-13	.	.	.	.	0.1	0.1
C-14	.	.	.	.	0.12	0.1
C-15	.	.	.	.	0.1	0.12
C-16	.	.	.	.	0.1	0.1
C-17	.	.	.	.	0.1	0.1
C-18	.	.	.	.	0.1	.
C-DITCH	0.13	.	0.1	0.1	0.1	0.1
F-1	0.10	0.10	0.1	0.1	0.17	0.1
F-2	0.10	0.10	0.1	0.1	0.17	0.1
F-3	0.10	0.10	0.12	0.1	0.1	0.1
F-4	0.10	0.10	0.11	0.1	0.1	0.1
F-5	0.10	0.10	0.14	0.1	0.1	0.1
F-6	0.10	0.10	0.11	0.14	0.1	0.1
F-7	0.10	0.10	0.12	0.1	0.1	0.1
F-8	0.10	0.11	0.1	0.1	0.13	0.1
F-9	0.10	0.10	0.1	0.1	0.1	0.1
F-10	0.10	0.10	0.1	0.1	0.1	0.1
F-11	0.11	0.10	0.1	0.1	0.1	0.1
F-12	0.28	0.10	0.1	0.1	0.1	0.1
F-13	.	.	.	.	0.1	.
F-14	.	.	.	.	0.14	0.12
F-15	.	.	.	.	0.11	0.1
F-16	.	.	.	.	0.1	.
F-17	.	.	.	.	0.1	.
F-18	.	.	.	.	0.1	.
F-DITCH	0.11	0.10	0.11	0.1	0.16	0.1
N-1	0.12	0.10	0.1	0.18	0.1	0.1
N-2	0.12	0.10	0.1	0.11	0.11	0.1
N-3	0.10	0.10	0.11	0.13	0.1	0.1
N-4	0.10	0.10	0.1	0.11	0.1	0.1
N-5	0.10	0.10	0.1	0.1	0.1	0.1
N-6	0.11	0.10	0.1	0.12	0.1	0.1
N-7	0.10	0.10	0.1	0.12	0.1	0.1
N-8	0.10	0.10	0.1	0.11	0.1	0.1
N-9	0.10	0.10	0.1	0.1	0.1	0.1
N-10	0.10	0.10	0.1	0.1	0.1	0.1
N-11	2.30	0.10	0.1	0.1	0.1	0.1
N-12	0.10	0.10	0.1	0.1	0.1	0.1
N-13	.	.	.	.	0.1	0.1

Appendix E. Water Chemistry Raw Data – NH_4-N (mg N/L) (continued)

Sample	Transect	Depth	Distance (m)	2/7/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
N-14	3	Shallow	0.0	.	.	.	.	.	.
N-15	1	Shallow	4.5	.	.	.	.	.	.
N-16	1	Shallow	0.0	.	.	.	.	.	.
N-17	2	Shallow	4.5	.	.	.	.	.	.
N-18	2	Shallow	0.0	.	.	.	.	.	.
N-DITCH		Surface	DITCH	0.10	0.10	0.10	0.38	.	0.11
P-1	1	Deep	9.0	0.10	0.10	0.10	0.10	0.10	0.10
P-2	1	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-3	1	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
P-4	2	Deep	9.0	0.10	0.10	0.10	0.10	0.10	0.10
P-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
P-7	3	Deep	9.0	0.10	0.10	0.10	0.10	0.10	0.10
P-8	3	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-9	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
P-10	4	Deep	9.0	0.10	0.10	0.10	0.10	0.10	.
P-11	4	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-12	4	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.10
P-13	1	Intermed	9.0	0.10	0.10	0.10	0.10	0.10	.
P-14	1	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-15	1	Intermed	0.0	0.10	0.10	0.10	0.10	0.10	0.10
P-16	2	Intermed	9.0	0.10	0.10	0.10	0.10	0.10	0.10
P-17	2	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-18	2	Intermed	0.0	0.10	0.10	0.10	0.10	0.12	0.10
P-19	3	Intermed	9.0	0.10	0.10	0.10	0.10	0.12	0.10
P-20	3	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-21	3	Intermed	0.0	0.10	0.10	0.10	0.10	0.15	0.10
P-22	4	Intermed	9.0	0.10	0.10	0.10	0.56	0.51	0.10
P-23	4	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.10
P-24	4	Intermed	0.0	0.10	0.10	0.10	0.10	.	0.10
P-25	1	Shallow	9.0	.	.	.	.	.	.
P-26	1	Shallow	4.5	.	.	.	.	.	.
P-27	1	Shallow	0.0	.	.	.	.	.	.
P-28	2	Shallow	9.0	.	.	.	.	.	.
P-29	2	Shallow	4.5	.	.	.	.	.	.
P-9	2	Shallow	0.0	.	.	.	.	.	.
P-31	3	Shallow	9.0	.	.	.	.	.	.
P-32	3	Shallow	4.5	.	.	.	.	.	.
P-33	3	Shallow	0.0	.	.	.	.	.	.
P-34	4	Shallow	9.0	.	.	.	.	.	.
P-35	4	Shallow	4.5	.	.	.	.	.	.
P-36	4	Shallow	0.0	.	.	.	.	.	.
P-DITCH		Surface	DITCH	0.10	0.10	0.10	0.10	0.10	0.10

Appendix E. Water Chemistry Raw Data – NH_4-N (mg N/L) (continued)

Sample	9/26/2000	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
N-14	.	.	.	.	.	.	.	.	.
N-15	.	.	.	.	.	.	.	.	.
N-16	.	.	.	.	.	.	.	.	.
N-17	.	.	.	.	.	.	.	.	.
N-18	.	.	.	.	.	.	.	.	.
N-DITCH	0.10	0.10	0.10	0.10	0.39	0.10	0.10	0.10	0.12
P-1	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.11
P-2	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.13
P-3	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-4	0.10	0.12	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-5	0.10	.	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-6	0.10	.	0.10	0.10	0.10	0.10	0.10	0.10	0.13
P-7	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-8	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-9	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11
P-11	0.10	.	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-12	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-13	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
P-14	0.10	0.10	0.10	.	0.10	0.10	0.10	0.10	0.10
P-15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11
P-16	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-17	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-18	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11	0.15
P-19	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
P-20	0.10	0.10	0.10	0.10	0.10	0.10	0.23	0.20	0.10
P-21	9.60	0.10	0.10	0.10	0.10	0.10	0.25	0.22	0.10
P-22	0.10	0.10	0.10	0.10	0.10	.	0.10	0.10	0.10
P-23	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.44	0.10
P-24	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.22	0.10
P-25	.	.	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	.	.	.	.	.	.	.	.
P-29	.	.	.	.	.	.	.	.	.
P-9	.	.	.	.	.	.	.	.	.
P-31	.	.	.	.	.	.	.	.	.
P-32	.	.	.	.	.	.	.	.	.
P-33	.	.	.	.	.	.	.	.	.
P-34	.	.	.	.	.	.	.	.	.
P-35	.	.	.	.	.	.	.	.	.
P-36	.	.	.	.	.	.	.	.	.
P-DITCH	0.10	.	0.10	.	0.10	0.10	0.10	0.10	0.10

Appendix E. Water Chemistry Raw Data – NH_4-N (mg N/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002
N-14	.	.	.	.	0.12	0.1
N-15	.	.	.	.	0.12	0.29
N-16	.	.	.	.	0.1	0.1
N-17	.	.	.	.	0.1	0.1
N-18	.	.	.	.	0.2	0.16
N-DITCH	0.10	0.88	0.1	0.1	0.1	0.1
P-1	0.10	0.12	0.14	.	0.1	0.1
P-2	0.10	0.10	0.14	0.1	0.18	0.1
P-3	0.10	0.10	0.13	0.1	0.11	0.1
P-4	0.10	0.10	0.15	0.1	0.12	0.1
P-5	0.10	0.10	0.1	0.1	0.16	0.1
P-6	0.12	0.10	0.1	0.1	0.14	0.1
P-7	0.10	0.10	0.1	0.1	0.14	0.1
P-8	0.10	0.10	0.1	0.1	0.1	0.1
P-9	0.10	0.10	0.1	0.1	0.1	0.1
P-10	0.10	0.10	0.1	0.1	0.13	0.1
P-11	0.10	0.10	0.1	0.1	0.14	0.1
P-12	0.10	0.10	0.1	0.1	0.16	0.11
P-13	0.10	0.10	0.1	0.25	0.1	0.1
P-14	0.12	0.12	0.1	0.1	0.1	0.1
P-15	0.10	0.10	0.1	0.1	0.17	0.1
P-16	0.10	0.10	0.1	0.1	0.1	0.1
P-17	0.15	0.15	0.1	0.1	0.1	0.1
P-18	0.10	0.13	0.1	0.1	0.21	0.14
P-19	0.10	0.10	0.1	0.1	0.1	0.1
P-20	0.10	0.10	0.1	0.1	0.1	0.1
P-21	0.11	0.10	0.1	0.1	0.1	0.1
P-22	0.17	0.10	0.1	0.1	0.1	0.1
P-23	0.10	0.10	0.1	0.1	0.1	0.1
P-24	0.53	0.14	0.1	0.1	0.1	0.1
P-25	.	.	.	.	0.13	0.1
P-26	.	.	.	.	0.1	0.2
P-27	.	.	.	.	.	.
P-28	.	.	.	.	0.1	.
P-29	.	.	.	.	0.1	.
P-9	.	.	.	.	.	.
P-31	.	.	.	.	0.1	.
P-32	.	.	.	.	0.11	0.1
P-33	.	.	.	.	0.1	0.1
P-34	.	.	.	.	0.1	.
P-35	.	.	.	.	0.1	.
P-36	.	.	.	.	.	.
P-DITCH	0.12	0.15	0.1	0.1	0.1	0.1

Appendix E. Water Chemistry Raw Data – Nitrate (NO_3-N) (mg N/L)

Sample	Transect	Depth	Distance	2/9/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
C-1	3	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.15
C-2	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
C-3	1	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.16
C-4	1	Deep	0.0	0.10	0.10	0.10	0.10	0.28	0.15
C-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.16
C-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
C-7	3	Intermed	4.5	0.73	0.10	0.10	0.10	0.30	0.74
C-8	3	Intermed	0.0	0.10	0.10	0.10	.	0.17	0.18
C-9	1	Intermed	4.5	2.24	0.10	2.54	.	0.29	.
C-10	1	Intermed	0.0	0.59	0.10	0.13	.	0.21	0.49
C-11	2	Intermed	4.5	1.01	0.17	0.82	1.07	0.37	0.23
C-12	2	Intermed	0.0	0.54	0.10	0.10	0.10	0.10	0.15
C-13	3	Shallow	4.5	.	.	.	.	.	.
C-14	3	Shallow	0.0	.	.	.	.	.	.
C-15	1	Shallow	4.5	.	.	.	.	.	.
C-16	1	Shallow	0.0	.	.	.	.	.	.
C-17	2	Shallow	4.5	.	.	.	.	.	.
C-18	2	Shallow	0.0	.	.	.	.	.	.
C-19	3	Intermed	9.0	.	.	.	.	.	.
C-20	1	Intermed	9.0	.	.	.	.	.	.
C-21	2	Intermed	9.0	.	.	.	.	.	.
C-22	W of tr2	Intermed	Field	.	.	.	.	.	.
C-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
C-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
C-DITCH		Surface	DITCH	0.36	0.10	0.24	0.10	.	.
F-1	3	Deep	4.5	3.50	0.10	0.10	0.10	0.10	0.34
F-2	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.34
F-3	1	Deep	4.5	0.10	0.10	.	0.10	0.10	0.15
F-4	1	Deep	0.0	0.10	0.10	0.10	0.10	0.18	0.17
F-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.16
F-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
F-7	3	Intermed	4.5	0.10	0.86	0.91	0.10	0.20	0.36
F-8	3	Intermed	0.0	0.10	0.10	0.10	0.10	0.20	0.15
F-9	1	Intermed	4.5	0.22	0.10	.	0.10	0.23	0.38
F-10	1	Intermed	0.0	5.17	0.10	0.32	0.53	0.19	.
F-11	2	Intermed	4.5	2.71	2.67	0.81	0.10	0.18	0.15
F-12	2	Intermed	0.0	0.49	0.10	.	0.10	0.10	0.15
F-13	3	Shallow	4.5	.	.	.	.	.	.
F-14	3	Shallow	0.0	.	.	.	.	.	.
F-15	1	Shallow	4.5	.	.	.	.	.	.
F-16	1	Shallow	0.0	.	.	.	.	.	.
F-17	2	Shallow	4.5	.	.	.	.	.	.
F-18	2	Shallow	0.0	.	.	.	.	.	.
F-19	3	Intermed	9.0	.	.	.	.	.	.
F-20	1	Intermed	9.0	.	.	.	.	.	.
F-21	2	Intermed	9.0	.	.	.	.	.	.
F-22	W of tr2	Intermed	Field	.	.	.	.	.	.
F-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
F-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
F-DITCH		Surface	DITCH	3.55	0.10	0.10	0.10	.	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	9/26/2001	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
C-1	0.15	0.36	0.29	0.75	0.35	0.28	0.30	0.18	0.10
C-2	0.15	0.32	0.27	0.32	0.32	0.29	0.31	0.18	0.10
C-3	0.33	0.38	0.29	1.80	0.31	0.27	0.39	0.18	0.10
C-4	0.29	0.29	0.26	.	0.32	0.29	0.32	0.43	0.10
C-5	0.15	0.29	0.25	10.27	0.32	0.16	0.29	0.40	0.10
C-6	0.25	0.27	0.26	0.35	0.61	0.26	0.31	0.37	0.10
C-7	0.36	0.28	0.35	0.34	0.42	0.65	0.33	0.19	0.11
C-8	0.15	0.26	0.26	0.44	0.45	0.29	0.31	0.19	0.10
C-9	0.15	0.26	0.34	0.39	3.22	0.26	0.71	0.16	0.10
C-10	0.33	0.29	0.44	.	0.49	0.28	0.29	0.16	0.10
C-11	0.48	0.31	4.05	0.35	9.14	6.37	16.61	0.31	0.13
C-12	0.35	0.43	0.35	0.53	0.32	0.29	0.30	.	0.10
C-13	.	.	.	.	.	.	.	.	.
C-14	.	.	.	.	.	.	.	.	.
C-15	.	.	.	.	.	.	.	.	.
C-16	.	.	.	.	.	.	.	.	.
C-17	.	.	.	.	.	.	.	.	.
C-18	.	.	.	.	.	.	.	.	.
C-19	.	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	.	.
C-23	.	.	.	.	.	.	.	.	.
C-24	.	.	.	.	.	.	.	.	.
C-DITCH	0.43	.	0.69	1.54	0.66	0.29	0.35	.	0.10
F-1	0.15	0.45	0.29	0.33	0.39	0.29	0.29	0.17	0.10
F-2	0.15	0.42	0.26	0.34	0.31	0.29	0.28	0.18	0.31
F-3	0.41	nd	0.20	nd	0.34	0.22	0.23	0.26	0.10
F-4	0.27	0.29	0.20	0.29	0.27	0.22	0.23	0.17	1.30
F-5	0.15	0.33	0.51	0.32	0.27	0.24	0.24	0.25	0.36
F-6	0.15	0.30	0.21	0.29	0.29	0.23	0.24	0.25	0.10
F-7	5.30	0.46	0.26	1.51	0.37	0.28	1.73	0.47	0.10
F-8	0.48	.	0.29	0.37	0.33	0.28	0.28	0.32	0.10
F-9	0.15	0.34	0.21	nd	0.30	0.24	0.24	0.28	0.10
F-10	2.17	0.38	0.38	0.49	0.35	0.20	0.24	0.17	0.43
F-11	4.31	0.37	0.21	2.17	1.25	1.79	0.31	0.30	0.10
F-12	0.89	0.45	0.92	0.55	0.40	0.24	0.24	0.16	0.10
F-13	.	.	.	.	.	.	.	.	.
F-14	.	.	.	.	.	.	.	.	.
F-15	.	.	.	.	.	.	.	.	.
F-16	.	.	.	.	.	.	.	.	.
F-17	.	.	.	.	.	.	.	.	.
F-18	.	.	.	.	.	.	.	.	.
F-19	.	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	.	.
F-23	.	.	.	.	.	.	.	.	.
F-24	.	.	.	.	.	.	.	.	.
F-DITCH	3.08	.	0.53	0.94	0.37	0.27	0.28	0.28	0.10

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002
C-1	0.10	0.10	0.56	0.1	0.1	0.1	0.1	0.1
C-2	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
C-3	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
C-4	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
C-5	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
C-6	0.20	0.10	0.1	0.1	0.1	0.1	0.1	0.1
C-7	0.10	0.10	0.1	0.1	0.84	2.3	0.43	3.2
C-8	0.14	0.10	0.21	0.1	0.1	0.1	0.1	0.1
C-9	0.10	0.10	0.1	0.1	5.7	4.8	4.5	3.4
C-10	0.10	0.19	0.11	0.1	5.2	4.8	2.9	0.92
C-11	0.10	0.10	0.66	0.1	9.9	6.1	7.7	3.9
C-12	0.10	0.10	0.41	0.1	0.1	0.1	0.49	0.1
C-13	.	.	.	.	8.5	8.8	11	7.2
C-14	.	.	.	.	1.4	1.9	0.99	0.1
C-15	.	.	.	.	6.5	5.2	5.6	3.5
C-16	.	.	.	.	6.3	5.8	4	0.7
C-17	.	.	.	.	5.4	4.3	3.4	3.3
C-18	.	.	.	.	4.3	.	.	1.1
C-19	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	.
C-23	.	.	.	.	.	.	.	.
C-24	.	.	.	.	.	.	.	.
C-DITCH	0.10	.	0.1	0.1	0.46	0.19	1.2	0.54
F-1	0.28	0.10	0.44	3.3	0.1	0.1	0.1	0.1
F-2	0.10	0.10	13	6.5	0.1	0.1	0.1	0.1
F-3	1.30	0.28	1.9	0.1	0.1	0.1	0.1	0.1
F-4	0.28	0.10	0.1	2.1	0.1	0.1	0.1	0.1
F-5	1.30	1.10	0.53	2.1	0.1	0.1	0.1	0.1
F-6	0.10	0.30	0.1	0.1	0.1	0.1	0.1	0.1
F-7	1.30	0.10	0.1	0.1	0.63	0.1	0.45	0.45
F-8	0.54	0.12	0.1	0.1	0.1	0.1	0.1	0.1
F-9	1.20	0.11	0.1	0.1	0.1	0.1	0.93	1.2
F-10	0.10	0.10	0.1	0.16	0.12	0.1	0.45	0.1
F-11	0.10	1.60	0.1	0.1	0.64	0.1	0.44	0.23
F-12	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
F-13	.	.	.	.	0.87	.	1.7	1.5
F-14	.	.	.	.	0.32	0.1	0.1	0.1
F-15	.	.	.	.	7.4	6.7	13	0.14
F-16	.	.	.	.	1.7	.	1.6	0.68
F-17	.	.	.	.	4.3	.	2.5	0.49
F-18	.	.	.	.	3.4	.	2.7	2.1
F-19	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	.
F-23	.	.	.	.	.	.	.	.
F-24	.	.	.	.	.	.	.	.
F-DITCH	0.10	0.10	0.1	0.1	0.57	0.38	4.5	0.2

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002
C-1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
C-2	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
C-3	0.1	.	0.1	0.1	0.1	0.1	.	0.1
C-4	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
C-5	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
C-6	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
C-7	0.24	0.1	0.2	0.87	2	0.85	11	7.6
C-8	0.1	0.1	0.1	0.1	0.3	0.15	0.66	3.5
C-9	0.1	.	0.1	0.1	0.1	0.1	1.3	4.1
C-10	.	0.1	0.1	0.1	0.1	0.1	1	1.4
C-11	2.3	0.22	0.1	0.11	0.15	0.1	2.9	4.5
C-12	0.1	0.1	0.1	0.1	0.1	0.1	1.1	0.1
C-13	.	.	.	.	.	.	.	3.4
C-14	.	.	.	.	.	.	.	4.6
C-15	.	.	.	.	.	.	.	4.1
C-16	.	.	.	.	.	.	.	.
C-17	.	.	.	.	.	.	.	4.1
C-18	.	.	.	.	.	.	.	3.7
C-19	.	.	.	.	.	.	4.3	7
C-20	.	.	.	.	.	.	3.4	4.4
C-21	.	.	.	.	.	.	7.4	8.3
C-22	.	.	.	.	0.33	0.13	.	1.3
C-23	.	.	.	.	0.1	0.1	.	4.9
C-24	.	.	.	.	0.1	0.1	.	1.6
C-DITCH	.	.	.	.	.	.	.	0.33
F-1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-2	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-3	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-4	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-5	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-6	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
F-7	0.11	0.1	0.12	0.1	0.1	0.1	0.13	0.1
F-8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	.
F-9		0.1	0.1	0.1		0.1	0.26	.
F-10	0.1	0.1	0.1	0.17	0.1	0.1	0.43	0.1
F-11	0.3	0.1	0.1	0.1	0.1	0.1	0.79	2.5
F-12	0.1	0.1	0.15	0.19	0.1	0.1	0.6	1.4
F-13	.	.	.	.	.	.	.	.
F-14	.	.	.	.	.	.	.	0.1
F-15	.	.	.	.	.	.	.	1.2
F-16	.	.	.	.	.	.	.	.
F-17	.	.	.	.	.	.	.	.
F-18	.	.	.	.	.	.	.	.
F-19	.	.	.	.	.	.	4.6	9
F-20	.	.	.	.	.	.	8.1	11
F-21	.	.	.	.	.	.	6.2	5.6
F-22	.	.	.	.	0.1	0.1	.	7.5
F-23	.	.	.	.	0.1	0.1	.	0.63
F-24	.	.	.	.	0.1	0.1	.	4.3
F-DITCH	0.1	0.1	.	.	.	0.1	.	0.96

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
C-1	0.1	0.1	0.1	0.1	0.1	0.1
C-2	0.1	0.1	0.1	0.1	0.1	0.1
C-3	0.1	0.1	0.1	0.1	0.1	0.1
C-4	0.1	0.1	0.1	0.1	0.1	0.1
C-5	0.1	0.1	0.1	0.1	0.1	0.1
C-6	0.1	0.1	0.1	0.1	0.1	0.1
C-7	4.9	6.2	6	2.5	1.8	0.36
C-8	0.49	0.8	3	0.61	0.45	0.1
C-9	5.2	5.6	7	5.8	3.5	2.4
C-10	4.1	4.5	6	0.99	1.6	1
C-11	6.8	9.9	7.7	8.8	7.4	4.6
C-12	0.1	0.1	0.1	0.1	0.1	0.1
C-13	5.1	8.5	7.5	7.1	4.4	3.6
C-14	5.9	7.6	4.2	2.3	0.31	0.05
C-15	5.5	7	7.7	6	4.3	2.4
C-16	3.7	4.4	5.5	4.7	2.4	1.1
C-17	6.1	8.3	7	7.6	6.5	3.7
C-18	.	5.5	5.5	1.9	0.8	0.1
C-19	8.6	10	11	11	9.7	7.3
C-20	5.6	7.3	7	5.9	4.6	2.9
C-21	10	14	14	15	14	15
C-22	4.4	6.2	5.8	3.4	2.5	3.3
C-23	7.4	8.2	7.1	11	9.6	9.9
C-24	3.9	5.5	5.1	8.4	7.1	5.9
C-DITCH	0.35	2.2	2.3	2.7	1.8	0.54
F-1	0.1	0.1	0.1	0.1	0.1	0.1
F-2	0.1	0.1	0.1	0.1	0.1	0.1
F-3	0.1	0.1	0.1	0.1	0.1	0.1
F-4	0.1	0.1	0.1	0.1	0.1	0.1
F-5	0.1	0.1	0.1	0.1	0.1	0.1
F-6	0.1	0.1	0.1	0.1	0.1	0.1
F-7	0.1	0.16	2.2	4.4	1.3	0.12
F-8	0.1	0.1	0.1	0.1	0.1	0.1
F-9	1.7	0.97	5.4	0.61	0.47	0.1
F-10	0.19	2	3.1	0.76	0.27	0.1
F-11	1.5	2.4	3.3	5.6	2.1	1
F-12	0.1	0.6	1.8	0.8	0.5	0.22
F-13	3.1	.	6.5	9.6	3.4	1.5
F-14	0.1	.	0.1	1.6	0.12	0.1
F-15	6.7	11	14	9.2	4.4	0.1
F-16	.	.	4.4	0.89	0.69	0.11
F-17	4.7	5	7.3	7.8	.	8.9
F-18	.	.	5	5.3	1.7	3.9
F-19	10	13	15	10	8.4	5.6
F-20	14	14	15	10	6.4	0.86
F-21	6.1	7.3	8.9	9.5	8.7	8.2
F-22	12	13	13	11	8.7	13
F-23	1.5	1.8	5.9	9.5	0.79	1.1
F-24	11	12	14	13	12	3.9
F-DITCH	0.43	2.2	2.8	5.8	2.6	1.2

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	Transect	Depth	Distance	2/9/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
N-1	3	Deep	4.5	0.10	0.10	.	0.10	0.10	0.20
N-2	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
N-3	1	Deep	4.5	0.10	0.10	0.29	0.10	0.29	0.36
N-4	1	Deep	0.0	0.10	0.10	.	0.13	0.10	0.15
N-5	2	Deep	4.5	1.89	1.43	.	1.59	1.52	1.21
N-6	2	Deep	0.0	0.63	0.41	0.70	0.77	0.52	0.18
N-7	3	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.15
N-8	3	Intermed	0.0	0.10	0.10	0.12	0.10	0.20	.
N-9	1	Intermed	4.5	3.95	3.09	4.14	2.81	0.23	0.35
N-10	1	Intermed	0.0	1.27	0.10	0.22	0.17	0.19	0.33
N-11	2	Intermed	4.5	1.11	1.38	1.34	1.56	0.33	0.38
N-12	2	Intermed	0.0	0.18	0.10	0.33	0.26	0.23	0.56
N-13	3	Shallow	4.5	.	.	.	.	.	.
N-14	3	Shallow	0.0	.	.	.	.	.	.
N-15	1	Shallow	4.5	.	.	.	.	.	.
N-16	1	Shallow	0.0	.	.	.	.	.	.
N-17	2	Shallow	4.5	.	.	.	.	.	.
N-18	2	Shallow	0.0	.	.	.	.	.	.
N-19	3	Intermed	9.0	.	.	.	.	.	.
N-20	1	Intermed	9.0	.	.	.	.	.	.
N-21	2	Intermed	9.0	.	.	.	.	.	.
N-22	W of tr2	Intermed	Field	.	.	.	.	.	.
N-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
N-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
N-DITCH		Surface	DITCH	0.21	0.10	0.10	0.10	.	0.34
P-1	1	Deep	9.0	14.25	14.72	15.93	15.43	0.32	0.15
P-2	1	Deep	4.5	4.43	9.80	6.68	9.49	0.33	0.46
P-3	1	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
P-4	2	Deep	9.0	3.72	1.77	1.61	1.56	0.35	0.24
P-5	2	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.15
P-6	2	Deep	0.0	0.10	0.10	0.10	0.10	0.24	0.15
P-7	3	Deep	9.0	0.10	0.10	0.10	0.10	0.29	0.17
P-8	3	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.16
P-9	3	Deep	0.0	0.10	0.10	0.10	0.10	0.10	0.15
P-10	4	Deep	9.0	0.10	0.10	0.10	0.10	0.10	.
P-11	4	Deep	4.5	0.10	0.10	0.10	0.10	0.10	0.15
P-12	4	Deep	0.0	21.94	0.10	0.10	0.10	0.10	0.15
P-13	1	Intermed	9.0	0.10	18.32	20.39	20.36	9.95	.
P-14	1	Intermed	4.5	1.75	2.62	2.63	4.14	3.16	2.21
P-15	1	Intermed	0.0	0.10	0.10	0.10	0.10	0.20	0.34
P-16	2	Intermed	9.0	11.47	11.37	16.37	22.61	16.06	12.28
P-17	2	Intermed	4.5	5.49	3.97	3.70	3.44	2.02	1.16
P-18	2	Intermed	0.0	0.10	0.10	0.10	0.10	0.19	0.34
P-19	3	Intermed	9.0	0.10	0.10	0.10	0.10	0.24	0.17
P-20	3	Intermed	4.5	0.10	0.10	0.10	0.10	0.10	0.15
P-21	3	Intermed	0.0	0.10	0.10	0.10	0.10	0.27	0.37
P-22	4	Intermed	9.0	8.40	6.40	10.44	14.08	9.80	2.15
P-23	4	Intermed	4.5	0.10	0.10	0.10	0.10	1.11	0.47
P-24	4	Intermed	0.0	0.10	0.10	0.10	0.10	.	0.15
P-25	1	Shallow	9.0	.	.	.	.	.	.
P-26	1	Shallow	4.5	.	.	.	.	.	.
P-27	1	Shallow	0.0	.	.	.	.	.	.
P-28	2	Shallow	9.0	.	.	.	.	.	.
P-29	2	Shallow	4.5	.	.	.	.	.	.
P-30	2	Shallow	0.0	.	.	.	.	.	.
P-31	3	Shallow	9.0	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	9/26/2001	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
N-1	0.15	0.27	0.22	0.33	0.36	0.26	0.23	0.16	0.10
N-2	0.15	0.25	0.27	0.36	0.37	0.26	0.26	0.17	0.10
N-3	5.88	0.31	0.30	.	0.38	0.33	0.34	0.39	0.10
N-4	0.33	0.25	0.23	0.33	0.32	0.26	0.26	0.28	0.10
N-5	0.33	1.27	1.19	1.32	1.40	0.95	1.26	1.90	0.10
N-6	0.34	0.32	0.50	0.66	0.92	0.73	0.81	0.71	0.10
N-7	0.32	0.25	0.22	.	0.32	0.23	0.38	0.28	0.10
N-8	0.30	0.29	0.33	0.87	0.40	0.28	0.31	0.34	0.10
N-9	0.41	0.47	3.26	4.21	6.09	0.65	3.75	0.53	0.10
N-10	3.36	0.32	0.37	1.33	1.04	0.24	0.62	0.17	0.10
N-11	1.25	0.58	0.51	.	1.27	3.68	4.49	0.71	0.10
N-12	0.33	0.35	0.31	0.63	0.53	0.37	0.51	0.18	0.10
N-13	.	.	.	.	.	.	.	.	.
N-14	.	.	.	.	.	.	.	.	.
N-15	.	.	.	.	.	.	.	.	.
N-16	.	.	.	.	.	.	.	.	.
N-17	.	.	.	.	.	.	.	.	.
N-18	.	.	.	.	.	.	.	.	.
N-19	.	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	.	.
N-23	.	.	.	.	.	.	.	.	.
N-24	.	.	.	.	.	.	.	.	.
N-DITCH	0.33	0.40	0.46	1.23	0.38	0.28	0.41	0.15	0.54
P-1	11.20	0.73	2.58	.	7.27	0.91	7.64	3.29	0.10
P-2	1.82	0.54	0.98	.	6.15	0.29	6.99	1.66	0.10
P-3	0.15	0.27	0.37	0.33	0.30	0.37	0.29	0.36	0.10
P-4	2.38	0.40	1.57	4.42	9.85	0.26	2.32	0.84	0.10
P-5	0.24	.	0.30	0.35	0.36	0.29	0.26	0.17	0.10
P-6	0.28	.	0.30	0.35	0.31	0.27	0.28	0.14	0.10
P-7	0.15	0.27	0.31	0.38	0.39	0.27	0.30	0.39	0.10
P-8	0.15	0.29	0.26	0.37	0.33	0.29	0.28	0.16	0.10
P-9	0.15	0.31	0.27	0.37	0.32	0.28	0.27	0.34	0.10
P-10	0.15	0.29	0.26	0.28	0.31	0.27	0.28	0.49	0.10
P-11	0.15	.	0.26	0.36	0.32	0.27	0.29	0.14	0.10
P-12	0.15	0.30	0.28	0.35	0.33	13.62	0.30	0.35	0.10
P-13	7.48	11.11	14.08	.	16.37	2.93	19.74	26.56	2.70
P-14	2.77	4.13	5.43	.	3.52	4.89	3.20	8.02	6.70
P-15	0.28	0.29	0.48	0.67	0.39	0.36	0.68	0.46	0.10
P-16	1.65	3.64	13.22	20.85	2.45	20.05	2.81	8.33	1.20
P-17	0.41	1.10	1.22	5.78	9.57	1.15	5.82	3.94	1.70
P-18	0.40	0.28	0.38	0.42	0.40	0.29	0.49	0.19	0.10
P-19	0.30	0.29	0.37	0.46	0.50	0.27	0.38	0.39	0.10
P-20	0.31	0.30	0.39	0.37	0.35	0.19	0.29	0.16	0.10
P-21	0.68	0.32	0.34	0.86	0.41	0.29	0.30	0.35	0.10
P-22	0.47	0.52	1.56	12.56	5.70	.	2.61	3.39	0.16
P-23	0.27	0.41	0.34	2.41	0.85	0.27	0.68	0.40	0.11
P-24	0.32	0.30	0.34	1.10	0.41	0.25	0.65	0.56	0.15
P-25	.	.	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	.	.	.	.	.	.	.	.
P-29	.	.	.	.	.	.	.	.	.
P-30	.	.	.	.	.	.	.	.	.
P-31	.	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002
N-1	0.10	0.10	18	0.1	0.1	0.1	0.1	0.1
N-2	0.10	0.10	3.4	0.1	0.1	0.1	0.1	0.1
N-3	0.10	0.10	0.14	0.1	0.29	0.28	0.23	0.22
N-4	0.10	0.10	6.9	0.1	0.22	0.13	0.1	0.1
N-5	0.10	0.10	1.7	0.1	1.2	1.1	1.1	1.3
N-6	0.10	0.10	0.38	0.1	0.34	0.4	0.34	0.72
N-7	0.11	0.10	4.7	0.1	0.1	0.1	0.1	0.1
N-8	0.10	0.10	0.37	0.1	0.1	0.1	0.1	0.1
N-9	0.13	0.10	0.36	0.1	3.4	2.1	6.3	2.5
N-10	0.10	0.10	2.8	0.1	1.3	0.12	0.88	0.1
N-11	0.12	0.10	3.7	0.1	1	0.7	8.2	1.2
N-12	0.10	0.10	0.83	0.1	0.4	0.4	0.25	0.28
N-13	.	.	.	.	3.6	3.9	0.26	0.13
N-14	.	.	.	.	0.46	0.1	0.1	0.1
N-15	.	.	.	.	2.5	1.5	4	2.7
N-16	.	.	.	.	2.3	0.96	5.1	1.7
N-17	.	.	.	.	9.2	11	17	16
N-18	.	.	.	.	0.86	0.95	1.7	0.43
N-19	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	.
N-23	.	.	.	.	.	.	.	.
N-24	.	.	.	.	.	.	.	.
N-DITCH	0.10	0.10	0.41	0.1	0.51	0.39	1.6	0.41
P-1	1.80	0.69	0.1	.	16	12	14	5.6
P-2	0.10	0.10	0.1	0.1	2.1	7.1	8.2	3.1
P-3	0.39	0.10	0.1	0.1	0.1	0.1	0.1	0.1
P-4	0.10	0.10	0.1	0.1	0.1	0.55	0.1	0.1
P-5	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
P-6	0.10	0.10	0.1	0.1	0.1	0.1	0.1	0.1
P-7	0.10	0.10	4.2	0.1	0.1	0.1	0.1	0.1
P-8	0.10	0.10	0.43	0.1	0.1	0.1	0.1	0.1
P-9	0.10	0.10	4.1	0.1	0.1	0.1	0.1	0.1
P-10	0.10	0.10	2.2	0.18	0.1	0.1	0.1	0.1
P-11	0.10	0.10	12	0.32	0.1	0.1	0.1	0.1
P-12	10.00	5.10	1.1	0.44	0.1	0.1	0.1	0.1
P-13	5.50	7.10	0.79	0.1	18	20	20	23
P-14	0.33	0.10	0.1	0.1	2.3	3.8	6.6	8.8
P-15	2.70	0.77	0.1	0.1	0.27	0.57	1.1	0.7
P-16	1.10	1.60	0.23	0.25	9.6	6.3	2.5	2.4
P-17	0.25	0.10	0.17	0.1	2.7	3.1	2.8	3.8
P-18	0.15	0.10	1	1	0.17	0.13	0.31	0.1
P-19	0.10	0.10	0.58	0.43	4.6	1.1	0.29	0.1
P-20	0.10	0.26	0.2	0.2	0.12	0.1	0.1	0.1
P-21	2.50	0.11	0.85	0.1	0.12	0.11	0.1	0.1
P-22	0.10	0.10	2	0.1	3.7	2.9	2.1	4.6
P-23	0.32	0.10	0.74	0.1	1.4	1.1	0.55	0.98
P-24	0.11	0.10	4.9	0.33	0.3	0.1	0.35	0.1
P-25	.	.	.	.	13	13	.	.
P-26	.	.	.	.	5.7	1.1	2.9	.
P-27	.	.	.	.	.	.	.	.
P-28	.	.	.	.	9.6	.	1.6	.
P-29	.	.	.	.	1.9	.	0.43	.
P-30	.	.	.	.	.	.	.	.
P-31	.	.	.	.	0.65	.	0.19	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002
N-1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
N-2	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
N-3	0.26	0.19	0.26	0.28	0.31	0.2	.	0.18
N-4	0.1	0.1	0.1	0.1	0.1	0.1	.	0.12
N-5	1.3	0.96	0.96	1	1.1	0.73	.	0.72
N-6	0.96	0.4	0.33	0.45	0.63	0.38	.	0.12
N-7	0.1	0.1	0.1	0.13	0.1	0.1	0.7	0.1
N-8	0.1	0.1	0.1	0.1	0.1	0.1	0.52	0.1
N-9	0.1	0.16	0.1	1.8	0.65	0.1	9.9	.
N-10	0.1	0.1	0.21	0.27	0.1	0.1	3	1.2
N-11	2.5	0.19	0.22	0.11	0.1	0.1	3.8	7.1
N-12	0.15	0.1	0.1	0.1	0.15	0.1	0.18	0.15
N-13	.	.	.	.	.	.	.	2.2
N-14	.	.	.	.	.	.	.	1
N-15	.	.	.	.	.	.	.	.
N-16	.	.	.	.	.	.	.	4
N-17	.	.	.	.	.	.	.	4.7
N-18	.	.	.	.	.	.	.	.
N-19	.	.	.	.	.	.	2	3.1
N-20	.	.	.	.	.	.	7	5.6
N-21	.	.	.	.	.	.	3.1	4.2
N-22	.	.	.	.	0.1	0.1	.	6.9
N-23	.	.	.	.	5.8	4.3	.	5.1
N-24	.	.	.	.	0.1	0.1	.	0.57
N-DITCH	0.1	0.35	.	.	.	.	.	0.47
P-1	0.56	0.3	0.33	6.6	8.9	3.9	.	15
P-2	0.44	0.1	0.1	0.1	0.1	0.1	.	8.8
P-3	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-4	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-5	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-6	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-7	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-8	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-9	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-10	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-11	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-12	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-13	12	15	17	21	25	22	.	8.4
P-14	9.3	5.2	2	5.4	8.1	7.8	.	6.1
P-15	.	0.1	0.13	0.16	0.1	3.3	.	0.63
P-16	3	0.26	0.1	1.9	.	.	.	2.9
P-17	3	0.83	2.4	0.81	0.32	0.11	.	1.1
P-18	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1
P-19	0.1	0.1	0.15	0.14	0.1	0.1	.	0.47
P-20	0.1	0.11	0.1	0.2	1.1	0.1	.	1.4
P-21	0.1	0.1	0.23	0.23	0.1	0.19	.	0.13
P-22	0.1	3.5	0.1	0.13	.	0.3	.	1.6
P-23	0.1	0.12	0.12	0.2	0.1	0.1	.	0.18
P-24	.	0.65	0.26	0.12	0.24	.	.	0.27
P-25	.	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.
P-28	.	.	.	.	.	.	.	.
P-29	.	.	.	.	.	.	.	.
P-30	.	.	.	.	.	.	.	.
P-31	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
N-1	0.1	0.1	0.1	0.1	0.1	0.1
N-2	0.1	0.1	0.1	0.1	0.1	0.1
N-3	0.17	0.12	0.14	0.21	0.23	0.11
N-4	0.1	0.1	0.1	0.1	0.1	0.1
N-5	0.65	0.55	0.52	0.93	0.61	0.55
N-6	0.11	0.1	0.33	0.1	0.92	0.63
N-7	0.1	0.19	0.15	0.2	0.36	0.1
N-8	0.1	0.51	0.71	0.1	0.16	0.1
N-9	4.7	5.1	6.9	9.3	6.4	11
N-10	1.9	1.4	4.9	4.4	3.4	6.9
N-11	22	41	42	22	35	12
N-12	0.21	0.75	1.3	0.25	0.46	0.23
N-13	6.2	6.7	11	6.9	2.1	0.1
N-14	0.59	0.57	2.1	1.2	0.13	0.1
N-15	.	4.7	6.8	9.2	5.8	11
N-16	3.8	3.8	5.6	7.7	5	9.1
N-17	29	41	55	43	43	.
N-18	0.72	1.1	6.3	2.6	.	.
N-19	5.3	4.9	4	6.3	4.7	2.8
N-20	5.8	5.3	7.9	9.8	8.3	15
N-21	13	17	32	28	25	20
N-22	10	11	12	14	0.54	11
N-23	3.6	2.3	2.8	6.3	5.5	6.6
N-24	1.1	0.66	2.2	5.4	4.5	1.9
N-DITCH	0.23	0.74	2.3	3	1.5	1.2
P-1	15	25	22	28	24	26
P-2	8.9	6.3	7.8	8.6	7.7	6.1
P-3	0.1	0.1	0.1	0.1	0.1	0.14
P-4	0.41	0.91	1.3	1.2	0.91	0.78
P-5	0.1	0.1	0.1	0.1	0.1	0.1
P-6	0.1	0.1	0.1	0.1	0.1	0.15
P-7	0.1	0.1	0.1	0.1	0.1	0.1
P-8	0.1	0.1	0.1	0.1	0.1	0.1
P-9	0.1	0.1	0.1	0.1	0.1	0.1
P-10	0.1	0.1	0.1	0.1	0.1	0.1
P-11	0.1	0.1	0.1	0.1	0.1	0.1
P-12	0.1	0.1	0.1	0.1	0.1	0.1
P-13	9.7	14	26	11	19	8.5
P-14	8.3	5.4	7.6	3.7	7.1	7
P-15	3.1	4	2.1	2.2	2.3	1.5
P-16	4.9	6.4	3.3	0.53	1.6	0.46
P-17	1.8	3.1	2.1	1.1	2.3	1.1
P-18	0.19	0.19	0.21	0.21	0.31	0.16
P-19	1.3	4.2	0.87	0.31	0.12	0.16
P-20	1.2	2	1.1	1.5	0.25	0.1
P-21	0.14	0.1	0.1	0.05	0.05	0.1
P-22	4.7	14	9.6	6.7	11	2.2
P-23	0.38	0.23	0.45	0.26	.	0.1
P-24	0.1	0.1	0.12	0.1	0.17	0.16
P-25	.	.	.	11	.	.
P-26	.	.	3.7	1.5	3.3	.
P-27	.	.	.	.	.	.
P-28	.	3.2	2.5	1.2	2	2.1
P-29	.	2.7	.	0.89	.	1.1
P-30	.	.	.	.	.	.
P-31	0.76	0.94	0.36	0.57	0.36	0.13

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	Transect	Depth	Distance	2/9/2000	3/8/2000	4/5/2000	5/10/2000	6/14/2000	7/19/2000
P-32	3	Shallow	4.5	.	.	.	.	.	.
P-33	3	Shallow	0.0	.	.	.	.	.	.
P-34	4	Shallow	9.0	.	.	.	.	.	.
P-35	4	Shallow	4.5	.	.	.	.	.	.
P-36	4	Shallow	0.0	.	.	.	.	.	.
P-37	betw 1-2	Intermed	Field	.	.	.	.	.	.
P-38	betw 3-4	Intermed	Field	.	.	.	.	.	.
P-DITCH		Surface	DITCH	0.32	0.10	0.10	0.10	0.20	0.36
B-1		Intermed	0.0	.	.	.	.	.	.
B-2		Intermed	4.5	.	.	.	.	.	.
B-3		Intermed	9.0	.	.	.	.	.	.

Sample	9/26/2001	11/9/2000	1/18/2001	3/7/2001	4/16/2001	5/15/2001	6/28/2001	7/26/2001	9/14/2001
P-32	.	.	.	.	.	.	.	.	.
P-33	.	.	.	.	.	.	.	.	.
P-34	.	.	.	.	.	.	.	.	.
P-35	.	.	.	.	.	.	.	.	.
P-36	.	.	.	.	.	.	.	.	.
P-37	.	.	.	.	.	.	.	.	.
P-38	.	.	.	.	.	.	.	.	.
P-DITCH	0.40	.	0.34	.	0.43	0.26	0.35	0.17	0.10
B-1	.	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.	.

Sample	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002	3/2/2002	4/11/2002	5/11/2002
P-32	.	.	.	.	1	0.68	0.24	.
P-33	.	.	.	.	0.39	0.36	0.1	.
P-34	.	.	.	.	3.7	.	2.6	.
P-35	.	.	.	.	0.4	.	1.4	.
P-36	.	.	.	.	.	.	0.28	.
P-37	.	.	.	.	.	.	.	.
P-38	.	.	.	.	.	.	.	.
P-DITCH	0.10	0.10	0.22	0.1	0.22	0.11	0.28	0.1
B-1	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.

Sample	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002	11/15/2002	12/2/2002
P-32	.	.	.	.	.	.	.	.
P-33	.	.	.	.	.	.	.	.
P-34	.	.	.	.	.	.	.	.
P-35	.	.	.	.	.	.	.	.
P-36	.	.	.	.	.	.	.	.
P-37	.	.	.	.	13	17	.	16
P-38	.	.	.	.	8	8.6	.	17
P-DITCH	0.1	0.1	.	.	.	.	.	0.12
B-1	.	.	.	.	.	.	0.96	4.4
B-2	.	.	.	.	.	.	10	11
B-3	.	.	.	.	.	.	13	.

Appendix E. Water Chemistry Raw Data – NO_3-N (mg N/L) (continued)

Sample	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
P-32	1	0.98	0.7	0.18	0.18	.
P-33	0.1	0.1	0.1	0.1	0.1	0.1
P-34	3.8	11	9.9	8.7	6.8	0.15
P-35	0.57	1.3	0.43	0.32	0.38	0.1
P-36	0.1	0.1	0.1	0.1	0.15	.
P-37	16	17	19	8.1	6.7	7.2
P-38	24	30	31	43	22	33
P-DITCH	0.1	0.45	0.52	1.3	0.44	0.42
B-1	1.3	0.27	1.5	3.6	.	12
B-2	11	11	9.5	11	7.8	10
B-3	7.5	9.9	13	11	12	7.3

Appendix E. Water Chemistry Raw Data – Chlorides (Cl^-) (mg Cl/L)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002
C-1	3	Deep	4.5	28.1	26.9	31.6	15.9	11
C-2	3	Deep	0.0	32.5	6.76	36.4	26.4	22.4
C-3	1	Deep	4.5	35	7.72	36.4	31	22.9
C-4	1	Deep	0.0	35.5	8.72	29.1	5.08	4.06
C-5	2	Deep	4.5	28.6	7.44	22.1	4.74	4.25
C-6	2	Deep	0.0	22.5	14.8	18.7	9.34	8.41
C-7	3	Intermed	4.5	20.3	14.3	18.5	6.2	6.65
C-8	3	Intermed	0.0	21.4	7.89	17.6	19.6	17.6
C-9	1	Intermed	4.5	31.1	11	28.9	16.6	12.7
C-10	1	Intermed	0.0	34.7	14.1	16.5	4.47	4.79
C-11	2	Intermed	4.5	24.5	11.2	18.3	6.19	4.89
C-12	2	Intermed	0.0	18.3	29.3	20.3	12.3	10.7
C-13	3	Shallow	4.5	.	.	.	.	.
C-14	3	Shallow	0.0	.	.	.	.	.
C-15	1	Shallow	4.5	.	.	.	.	.
C-16	1	Shallow	0.0	.	.	.	.	.
C-17	2	Shallow	4.5	.	.	.	.	.
C-18	2	Shallow	0.0	.	.	.	.	.
C-19	3	Intermed	9.0	.	.	.	.	.
C-20	1	Intermed	9.0	.	.	.	.	.
C-21	2	Intermed	9.0	.	.	.	.	.
C-22	W of tr2	Intermed	Field	.	.	.	.	.
C-23	E of tr2 S	Intermed	Field	.	.	.	.	.
C-24	E of tr2 N	Intermed	Field	.	.	.	.	.
C-DITCH		Surface	DITCH	11.3	32.8	.	6.45	10.4
F-1	3	Deep	4.5	12.6	11.6	10.5	15.4	25.7
F-2	3	Deep	0.0	12.2	10.6	12.7	32.5	24.1
F-3	1	Deep	4.5	9.51	26.1	10.8	27.8	27.1
F-4	1	Deep	0.0	23.8	20.3	8.37	21.7	16.3
F-5	2	Deep	4.5	19.4	11.1	24.7	21.4	23.6
F-6	2	Deep	0.0	10.8	12.8	20.1	20.2	26.6
F-7	3	Intermed	4.5	15.9	13.1	9.76	20	28.3
F-8	3	Intermed	0.0	11.5	11.9	13.8	37.2	28.4
F-9	1	Intermed	4.5	10.5	5.3	12.2	30.9	27.2
F-10	1	Intermed	0.0	19.6	18.6	12.2	27.2	13.2
F-11	2	Intermed	4.5	17.5	13.9	16.8	28.7	26.1
F-12	2	Intermed	0.0	14.7	13	17.3	28.7	17.1
F-13	3	Shallow	4.5	.	.	.	.	.
F-14	3	Shallow	0.0	.	.	.	.	.
F-15	1	Shallow	4.5	.	.	.	.	.
F-16	1	Shallow	0.0	.	.	.	.	.
F-17	2	Shallow	4.5	.	.	.	.	.
F-18	2	Shallow	0.0	.	.	.	.	.
F-19	3	Intermed	9.0	.	.	.	.	.
F-20	1	Intermed	9.0	.	.	.	.	.
F-21	2	Intermed	9.0	.	.	.	.	.
F-22	W of tr2	Intermed	Field	.	.	.	.	.
F-23	E of tr2 S	Intermed	Field	.	.	.	.	.
F-24	E of tr2 N	Intermed	Field	.	.	.	.	.
F-DITCH		Surface	DITCH	27.9	27.1	14.7	30.5	18.5
N-1	3	Deep	4.5	24.5	35.7	22.4	23.8	15.2
N-2	3	Deep	0.0	5.72	36.2	21.5	15.4	26.7

Appendix E. Water Chemistry Raw Data - Cl^- (mg Cl/L) (continued)

Sample	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002
C-1	27.1	29.7	34.2	36.2	32.4	30.4	28.9	32.3
C-2	29.5	29.8	32.6	39.3	31.1	30.9	5.08	28.9
C-3	32.4	33.8	37.1	39.7	35.4	.	33.6	35.8
C-4	32.3	33.8	36.8	40.5	29.9	32.8	31	36.4
C-5	26.7	28.1	29.4	35.7	30.5	30.6	29.5	37
C-6	21.8	23.6	26.7	27	22.9	20.6	19.8	23.7
C-7	26.6	25.4	27.8	21.9	37.2	10.2	17.7	22.8
C-8	31.1	30.2	35	35.3	30.3	20.2	24	33.1
C-9	18.1	18.1	19.4	20.2	25	.	16.1	17.9
C-10	19	18.9	20.1	23.7	.	30.1	23.4	32.1
C-11	24.8	25.9	18	27.6	24.5	20.2	26.2	22.6
C-12	22.4	22	24.6	30.2	24.9	23.2	17.7	21.4
C-13	21	22.5	26.5	25.1	.	.	.	.
C-14	21.3	22.4	27.2	29.8	.	.	.	.
C-15	18.9	18.3	20	20.7	.	.	.	.
C-16	18.9	18.9	20.4	20.1	.	.	.	.
C-17	23.9	25.1	25.6	20.9	.	.	.	.
C-18	18.6	.	.	30.3	.	.	.	.
C-19	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	.
C-23	.	.	.	.	.	.	.	.
C-24	.	.	.	.	.	.	.	.
C-DITCH	20.8	21.8	18.3	21.6	.	.	.	.
F-1	34.1	35.1	32	27.9	26.4	23.8	24.5	30.6
F-2	43.4	34.5	33.8	32.1	30.1	26.3	29	35.9
F-3	3.95	4.3	5.53	5.42	5.8	4.97	4.74	5.95
F-4	4.33	3.83	6.46	6.9	6.63	5.04	20.5	6.2
F-5	5.33	4.93	6.62	7.13	6.09	5.57	9.89	14
F-6	4.39	4.62	5.61	8.04	5.58	5.09	4.8	6.06
F-7	16.5	15.7	16.5	17.8	21.1	21.1	20.1	23.7
F-8	28.1	29.7	36.6	37.2	33.9	27.6	23.5	27.6
F-9	4.57	5.18	8.35	8.02	.	5.6	3.62	5.81
F-10	4.96	4.76	7.45	6.32	6.11	5.19	5.19	6.09
F-11	12	9.01	12	10.1	9.26	6.95	8.17	12.3
F-12	4.51	4.86	6.14	6.45	5.41	5.36	6.13	7.96
F-13	15.6	.	15.8	17.7	.	.	.	.
F-14	17.5	34.8	30.5	26.1	.	.	.	.
F-15	10.8	10.7	9.03	3.25	.	.	.	.
F-16	8.03	.	8.61	8.46	.	.	.	.
F-17	21.2	.	19.9	16.5	.	.	.	.
F-18	18.7	.	13.1	15.6	.	.	.	.
F-19	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	.
F-23	.	.	.	.	.	.	.	.
F-24	.	.	.	.	.	.	.	.
F-DITCH	18.7	17.7	15.3	18.5	14.4	10.1	.	.
N-1	13.2	13.8	13.4	12.5	11.3	10.9	10.2	11.6
N-2	26.3	15.1	9.65	10.8	9.47	11.5	8.52	9.66

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003
C-1	32.2	24.4	.	25.1	26.7	30.5	34.2
C-2	31.9	24.2	.	22	27.4	33	34.5
C-3	37.1	25.6	.	29.5	30.7	34.6	36.9
C-4	36.6	27.2	.	30.6	29.9	34.9	37.9
C-5	33.9	24.8	.	27.7	28.6	32.3	36.6
C-6	24.5	18.1	.	20.6	20.8	25.1	27.9
C-7	34.2	21.6	20.1	18.3	15.2	17.7	19
C-8	35.2	24	24.9	44.9	29.5	34.4	31.8
C-9	21.4	15.2	11.2	13.7	15	15.8	16.7
C-10	33	21.5	22.1	22	17.5	17.6	19.5
C-11	31.7	22.3	11.9	18.6	20.1	19.6	15
C-12	24.8	17.6	19.1	23.4	24.1	30.7	32.3
C-13	.	.	.	16.7	18.7	21.9	19.2
C-14	.	.	.	39	28.5	31	27.5
C-15	.	.	.	14	15	16.1	15.4
C-16	.	.	.	.	15.5	18	16.3
C-17	.	.	.	20.5	22.5	23.9	18.6
C-18	.	.	.	26.3	.	72.4	48.4
C-19	.	.	12.7	16.9	17.9	20.1	17.5
C-20	.	.	12	13.2	13.8	15	15.5
C-21	.	.	21.5	22.1	23.3	28.2	25.7
C-22	51.6	40.3	.	47.9	41.7	43.8	36.1
C-23	40.2	32.2	.	17.5	18.7	20.9	22.1
C-24	39.3	31.4	.	23.3	22.7	25.1	20
C-DITCH	.	.	.	16.9	26	25	23
F-1	30.7	24.6	.	29.1	28.3	32.9	24.6
F-2	37.3	31.9	.	31.8	26.8	38.4	21.4
F-3	55.4	5.23	.	5.95	4.25	4.89	4.46
F-4	5.6	4.97	.	5.2	5.27	5.2	4.68
F-5	68.5	17	.	6.14	5.97	6.18	4.85
F-6	6.54	4.9	.	6	4.43	4.91	5.94
F-7	26.1	22	22.4	15.5	15.3	19.8	17.2
F-8	33.5	25.9	24.1	.	29.1	38.5	31.7
F-9	.	4.59	4.19	.	5.11	6.79	7.51
F-10	7.28	5.95	7.27	6.25	7.05	10.2	7.8
F-11	9.21	15.9	13	17.5	13.6	16.9	12.2
F-12	6.29	13	11.5	11.8	5.59	9.51	8.66
F-13	.	.	.	.	16.5	.	17
F-14	.	.	.	32.3	31.9	.	27.8
F-15	.	.	.	8.32	10.9	11.3	10.2
F-16	.	.	.	.	.	.	9.03
F-17	.	.	.	.	19.7	20.6	13.2
F-18	.	.	.	.	.	.	13.9
F-19	.	.	10.5	12	12.7	12.8	10.8
F-20	.	.	5.68	11.8	12.4	13.3	10.3
F-21	.	.	16.7	27.7	20.8	22	18.1
F-22	18.5	14	.	9.03	9.1	10.5	8.51
F-23	33.5	27.2	.	26.9	25.7	28.2	24.6
F-24	14.1	13.3	.	26	19.6	21.8	17.5
F-DITCH	.	12.9	.	13	15.6	17.1	16.3
N-1	12.4	12.2	.	15.5	9.27	12.3	8.98
N-2	8.11	6.49	.	13.9	9.35	7.4	7.25

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	4/13/2003	5/7/03	6/11/2003
C-1	28.6	32	31
C-2	29.4	36.3	41
C-3	30.4	32.5	33.1
C-4	33.7	35.2	34.9
C-5	32.4	37.1	38.8
C-6	22.3	26.4	27.4
C-7	.	18.3	23.6
C-8	28.2	28.2	34.2
C-9	8.58	9.96	8.3
C-10	21.9	13.2	10.4
C-11	8.65	8.45	8.78
C-12	27.3	27.6	29.5
C-13	14.5	13.7	13.6
C-14	18.5	22	22.4
C-15	9.53	10.3	8.38
C-16	11.8	11.3	8.67
C-17	15.3	12.6	12.1
C-18	24.5	27.8	18.4
C-19	12	12	9.48
C-20	10.7	11	8.92
C-21	22.9	24.5	23.2
C-22	20.7	18.2	15.9
C-23	18.1	19.4	17.1
C-24	19.8	21	18.7
C-DITCH	18.1	16	19.9
F-1	40.7	37.8	43.5
F-2	35.7	40.4	40.3
F-3	4.46	4.82	4.81
F-4	4.78	5.82	5.06
F-5	4.51	5.25	5.53
F-6	4.61	4.74	5.55
F-7	10.7	13.8	14
F-8	28	32.9	42.5
F-9	5.48	5.19	6.44
F-10	7.67	5.45	5.76
F-11	15.2	9.76	7.03
F-12	6.81	5.88	5.38
F-13	20.3	11.4	12.8
F-14	27.7	26.4	26.5
F-15	8.88	5.7	5.99
F-16	6.19	4.45	4.98
F-17	15.6	.	14
F-18	13.1	8.58	10.1
F-19	11	9.55	8.09
F-20	7.56	6.51	6.23
F-21	15.5	14.9	6.59
F-22	7.05	7.67	15.3
F-23	20	30.2	21.1
F-24	12.5	12.1	13.2
F-DITCH	9.3	11	14.4
N-1	6.54	6.05	6.4
N-2	5.18	4.96	5.57

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002
N-3	1	Deep	4.5	6.32	28.2	5.57	28	29.7
N-4	1	Deep	0.0	10.3	21.1	5.99	4.04	20.8
N-5	2	Deep	4.5	7.57	16.9	9.45	12.2	16.7
N-6	2	Deep	0.0	21.3	20	7.38	24.3	21.8
N-7	3	Intermed	4.5	15.8	14.8	17.4	32.6	21.1
N-8	3	Intermed	0.0	6.48	26.7	14.2	25	37.5
N-9	1	Intermed	4.5	7.75	13.5	6.91	17.5	29.1
N-10	1	Intermed	0.0	13.3	17.1	7.79	4.17	25
N-11	2	Intermed	4.5	12.6	14.8	13.4	13.4	28.4
N-12	2	Intermed	0.0	13.4	9.31	14.7	13.1	28.2
N-13	3	Shallow	4.5	.	.	.	.	.
N-14	3	Shallow	0.0	.	.	.	.	.
N-15	1	Shallow	4.5	.	.	.	.	.
N-16	1	Shallow	0.0	.	.	.	.	.
N-17	2	Shallow	4.5	.	.	.	.	.
N-18	2	Shallow	0.0	.	.	.	.	.
N-19	3	Intermed	9.0	.	.	.	.	.
N-20	1	Intermed	9.0	.	.	.	.	.
N-21	2	Intermed	9.0	.	.	.	.	.
N-22	W of tr2	Intermed	Field	.	.	.	.	.
N-23	E of tr2 S	Intermed	Field	.	.	.	.	.
N-24	E of tr2 N	Intermed	Field	.	.	.	.	.
N-DITCH		Surface	DITCH	28.7	13.7	20	18	31.2
P-1	1	Deep	9.0	31.1	33.4	33	25	.
P-2	1	Deep	4.5	33.9	27.4	21.4	30.7	26.3
P-3	1	Deep	0.0	23.5	25	23.7	32.4	32.3
P-4	2	Deep	9.0	20.6	25.9	24.5	32.7	33.1
P-5	2	Deep	4.5	24.5	22.8	23	28.3	26.2
P-6	2	Deep	0.0	25	43.9	39.4	20.7	17.1
P-7	3	Deep	9.0	42.4	35.6	30.3	17.3	15.1
P-8	3	Deep	4.5	31.3	29.5	28.1	22.3	14.3
P-9	3	Deep	0.0	29.2	35.4	33.7	18	20.8
P-10	4	Deep	9.0	33.9	31.9	33.6	20.6	25.5
P-11	4	Deep	4.5	33.2	34.4	36.5	19.7	19.7
P-12	4	Deep	0.0	35.7	25.7	31.7	16	13.3
P-13	1	Intermed	9.0	30	27.3	31.3	18	21.5
P-14	1	Intermed	4.5	29.5	30.4	34.9	8.8	8.26
P-15	1	Intermed	0.0	32.9	5.02	11.7	13.6	10.9
P-16	2	Intermed	9.0	14.2	24.6	29.2	8.65	8.37
P-17	2	Intermed	4.5	27.2	29.9	32.8	7.54	7.53
P-18	2	Intermed	0.0	32.2	12.4	30.6	21.6	20.4
P-19	3	Intermed	9.0	31.8	22.2	32.2	17.3	17.3
P-20	3	Intermed	4.5	34.3	20.4	27	18.1	8.95
P-21	3	Intermed	0.0	34.3	8.28	8.17	17	10.6
P-22	4	Intermed	9.0	11.8	10.5	16.1	12.4	10.9
P-23	4	Intermed	4.5	28.4	14.2	22.2	12.7	8.64
P-24	4	Intermed	0.0	34.4	19.8	21.3	14.4	18.1
P-25	1	Shallow	9.0	.	.	.	.	.
P-26	1	Shallow	4.5	.	.	.	.	.
P-27	1	Shallow	0.0	.	.	.	.	.
P-28	2	Shallow	9.0	.	.	.	.	.
P-29	2	Shallow	4.5	.	.	.	.	.
P-30	2	Shallow	0.0	.	.	.	.	.
P-31	3	Shallow	9.0	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002
N-3	7.35	7.34	7.97	8.44	8.88	8.19	7.37	8.3
N-4	6.27	6.16	7.31	7.31	7.68	7.68	7.23	7.61
N-5	22.2	22.3	25	25	24.5	28.5	23	25.1
N-6	16	16.5	18.5	21.6	21.7	20.3	17.7	19.5
N-7	12.6	11.5	14.1	16.2	13.7	12.7	11.8	10.9
N-8	23.4	19.9	11.8	11	9.72	16.6	9.14	10.4
N-9	14.7	11.8	14.2	11.2	8.7	6.56	8.49	10.1
N-10	9.79	6.62	8.93	8.56	8.14	8.34	7.1	7.27
N-11	21.4	21.4	18.5	28.3	21.5	7.57	12.2	16.6
N-12	19.1	19.4	19.1	26.7	21.6	23.7	18.8	19.4
N-13	10.5	9.6	11.6	14.6	.	.	.	.
N-14	11.9	14.8	11.8	13.5	.	.	.	.
N-15	10.4	9.85	15.1	18.7	.	.	.	.
N-16	12.2	9.7	12.3	12.6	.	.	.	.
N-17	13.7	14.8	14.5	15.9	.	.	.	.
N-18	18.8	18.5	17.3	20.6	.	.	.	.
N-19	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	.
N-23	.	.	.	.	.	.	.	.
N-24	.	.	.	.	.	.	.	.
N-DITCH	16.3	15.2	16.7	22.2	18.7	6.27	.	.
P-1	33.5	33.8	31.4	35.5	28.9	35.6	31.2	36.3
P-2	29	32.8	31.7	37.3	27.3	36.2	33.1	38
P-3	19.3	19.9	22.5	24	23.8	25.6	25.1	28.4
P-4	19	21.7	24.5	22.5	21.2	23	20.6	22.2
P-5	18.6	19.5	23.8	24.9	22.4	23.2	23.4	31.3
P-6	17.4	20.1	16.5	19.1	19.6	20.4	22.1	24.1
P-7	36.3	38.2	33.9	42.3	34.8	22.5	23.8	24.3
P-8	29.5	32.3	34	38.4	28.2	31.6	35	42.8
P-9	26.6	27.1	29.3	28.8	24.6	26.7	23.1	28.6
P-10	26.2	28.8	29.4	32.4	27.6	27.5	26.4	29
P-11	26.3	28.8	24.8	32.4	27.8	27.3	25.1	28.9
P-12	24.9	28.3	31.4	34.4	24.9	30.3	30.5	30.4
P-13	15.7	18.1	25.5	36.2	33.4	34.8	33.1	38.4
P-14	11.1	14.7	40.1	62	43.1	40.2	35.9	44.8
P-15	40.2	26.8	31.7	30.7	.	22.9	21.4	28.2
P-16	5.18	4.61	3.23	2.6	6.82	8.42	8.64	14.3
P-17	14	10.4	10.6	12.6	18.4	21.7	16.9	19.8
P-18	25.9	25	25	30.3	33.2	28.7	29	32.1
P-19	37.2	39.2	25.5	34.7	33.6	30.9	20.7	10.7
P-20	25.1	24.9	23.9	22.8	34.8	17.7	20.8	11
P-21	28.3	30.9	24.2	23.1	34.6	28.4	19.6	17.2
P-22	6.58	5.86	4.45	4.69	13.5	3.84	3.58	3.17
P-23	13.3	15.5	18.2	11	23.6	20.5	43.6	48.8
P-24	18.1	27.7	13.9	21.1	.	17	15.1	15.4
P-25	5.33	7.13	.	.	.	.	.	.
P-26	16.1	7.24	5.56	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.
P-28	9.58	.	6.92	.	.	.	.	.
P-29	8.81	.	11.9	.	.	.	.	.
P-30	.	.	.	.	.	.	.	.
P-31	18.5	.	24.8	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003
N-3	11.4	6.97	.	7.32	6.52	7.78	6.29
N-4	7.11	6.09	.	6.78	6.42	6.32	4.7
N-5	23	20.4	.	20.6	21.3	24.4	24.1
N-6	19.3	18.2	.	13	14.6	17.6	8.5
N-7	11.9	11	9.24	39.2	13.6	17.9	12.9
N-8	9.12	8.83	27.8	16.6	7.47	11	6.59
N-9	9.45	26.3	8.96	.	12.2	12.7	7.97
N-10	8.58	9.27	12.7	11.7	13.5	11.1	9.78
N-11	22.6	32.5	11.2	20	16.7	14.4	10.3
N-12	23.8	18.2	17.6	19.8	17.5	22.6	14.2
N-13	.	.	.	8.51	5.02	8.05	4.2
N-14	.	.	.	13.1	10.7	9.57	8.54
N-15	.	.	.	.	.	12.1	12.2
N-16	.	.	.	14.4	11.8	12.2	10.5
N-17	.	.	.	13.6	13.4	14.2	12.3
N-18	.	.	.	23.2	21	21	15.9
N-19	.	.	6.33	11.5	10.6	10.2	9.57
N-20	.	.	10.1	14	13.1	14.6	12
N-21	.	.	5.41	8.22	8.88	8.79	8.98
N-22	38	32.5	.	25.9	18	20.3	19.3
N-23	16.4	13.1	.	11.7	13.6	19.5	18.5
N-24	33.6	25.1	.	21.6	18.2	21.4	19.7
N-DITCH	.	.	.	16.9	14	15.4	17.7
P-1	41.1	31.2	.	30.4	28.5	32.5	25.2
P-2	38.1	31	.	32.4	33.8	40.4	90.6
P-3	31.3	30.7	.	21.9	21.1	24.3	21.7
P-4	23.8	21.4	.	19.9	20.3	21.4	19.4
P-5	30.2	24.7	.	15.1	19.1	23	22.5
P-6	26.4	25	.	21.8	18.3	20.3	19
P-7	25.7	20.5	.	22	24.3	33.2	32.6
P-8	39.8	31.5	.	29.6	30.1	35.7	33.3
P-9	28.2	27.7	.	31.9	27.9	34.4	30.6
P-10	31.2	25.3	.	23.2	22	24.7	24.1
P-11	25.9	24.8	.	23.8	19.7	28.1	26.3
P-12	25.4	25.1	.	26	24.1	30.2	25.7
P-13	34	30.9	.	32.6	50.4	68.5	19.5
P-14	47	41.1	.	44	43.8	46.1	48.2
P-15	29.3	26.6	.	33.5	31	42.5	26.6
P-16	.	.	.	4.18	3.4	4.06	1.73
P-17	21.8	19.3	.	21.7	18.4	17.2	5.11
P-18	29.5	24.7	.	23	21.5	22.6	20.5
P-19	31.5	26.7	.	59	46.6	25.2	16.7
P-20	31.8	23.1	.	19.2	19.3	22.7	21.4
P-21	30.8	27.9	.	16.6	17.9	19.4	31
P-22	.	14.7	.	4.01	4.47	4.76	3.51
P-23	30	20.1	.	11.7	13.1	15	10.8
P-24	27	.	.	18.9	20.1	25.7	28.1
P-25	.	.	.	.	.	.	.
P-26	.	.	.	.	.	.	16.4
P-27	.	.	.	.	.	.	.
P-28	.	.	.	.	.	3.87	1.77
P-29	.	.	.	.	.	8.6	.
P-30	.	.	.	.	.	.	.
P-31	.	.	.	.	12.3	9.63	5.31

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	4/13/2003	5/7/03	6/11/2003
N-3	7.97	8	7.63
N-4	24.4	6.58	7.67
N-5	25.3	26.9	27.5
N-6	7.28	26.5	31.5
N-7	5.94	7.03	7.16
N-8	6.01	7.33	6.29
N-9	8.98	9.58	13.2
N-10	8.75	9.86	10.7
N-11	14.8	11.8	16.1
N-12	23.9	26	29.7
N-13	4.47	3.41	7.24
N-14	6.02	6.26	7.17
N-15	8.79	9.5	11.9
N-16	8.66	9.61	11
N-17	7.98	9.52	.
N-18	18.7	.	.
N-19	10.3	10.4	11.4
N-20	8.91	10.5	14.2
N-21	7.38	6.98	7.72
N-22	17.7	21.1	23.5
N-23	12.9	16.2	9.61
N-24	16.9	22.8	18.1
N-DITCH	12.1	12.8	16.2
P-1	17.4	20.7	17
P-2	92.2	64.9	76
P-3	22.4	21.4	23.2
P-4	20.2	17.4	15.9
P-5	19.4	19.6	19.5
P-6	11.6	11.5	5.86
P-7	31.9	33.6	32.7
P-8	32.9	35.5	33.7
P-9	29.7	30.2	28.4
P-10	22.3	23.7	20.4
P-11	24.2	24.4	22.2
P-12	27.7	26.5	25.8
P-13	8.66	10	8.07
P-14	13.5	28.2	17.4
P-15	30.2	23.8	24
P-16	1.14	3.17	6.6
P-17	2.09	6.55	4.33
P-18	20.8	26.1	21.6
P-19	7.1	15	18.3
P-20	16.1	10.6	9.49
P-21	32.3	28	33.1
P-22	3.2	4.74	3.77
P-23	6.23	.	13.1
P-24	22.2	19.1	27.3
P-25	6.22	.	.
P-26	5.94	17.5	.
P-27	.	.	.
P-28	1.89	1.47	6.47
P-29	2.55	.	3.36
P-30	.	.	.
P-31	4.74	7.19	11.1

Appendix E. Water Chemistry Raw Data – Cl^- (mg Cl/L) (continued)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002
P-32	3	Shallow	4.5	.	.	.	.	.
P-33	3	Shallow	0.0	.	.	.	.	.
P-34	4	Shallow	9.0	.	.	.	.	.
P-35	4	Shallow	4.5	.	.	.	.	.
P-36	4	Shallow	0.0	.	.	.	.	.
P-37	betw 1-2	Intermed	Field	.	.	.	.	.
P-38	betw 3-4	Intermed	Field	.	.	.	.	.
P-DITCH		Surface	DITCH	21.7	26.5	29	16.6	15.6
B-1		Intermed	0.0	.	.	.	.	.
B-2		Intermed	4.5	.	.	.	.	.
B-3		Intermed	9.0	.	.	.	.	.

Sample	2/2/2002	3/2/2002	4/11/2002	5/11/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002
P-32	11.5	14.4	11.3	.	.	.	.	.
P-33	11.1	10.8	5.84	.	.	.	.	.
P-34	5.92	.	4.06	.	.	.	.	.
P-35	4.57	.	11.3	.	.	.	.	.
P-36	.	.	8.68	.	.	.	.	.
P-37	.	.	.	.	.	.	.	.
P-38	.	.	.	.	.	.	.	.
P-DITCH	16.9	18	19	20.6	21.5	12.9	.	.
B-1	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.

Sample	10/9/2002	11/3/2002	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003
P-32	.	.	.	.	8.98	9.74	6.83
P-33	.	.	.	.	13	7.75	12.4
P-34	.	.	.	.	4.63	4.47	5.01
P-35	.	.	.	.	9.01	7.94	11.4
P-36	.	.	.	.	11.5	11	13.1
P-37	17.1	10.3	.	7.16	3.95	3.64	5.69
P-38	45.4	33.8	.	34.6	31.2	32.5	32.5
P-DITCH	.	.	.	19.2	20.5	20.1	19.2
B-1	.	.	10.1	12.9	13.3	16.1	17.2
B-2	.	.	11	12.5	13	14.1	10.8
B-3	.	.	13.5	.	7.87	10.8	11.7

Sample	4/13/2003	5/7/03	6/11/2003
P-32	5.43	7.1	.
P-33	16	12.6	27
P-34	3.58	2.94	3.93
P-35	3.16	2.9	5.09
P-36	9.31	7.21	.
P-37	3.55	3.12	4.09
P-38	26.3	33.1	27.2
P-DITCH	17.9	16.4	15.7
B-1	15.1	.	8.63
B-2	9.3	11.1	7.99
B-3	10.1	12	10.3

Appendix E. Water Chemistry Raw Data – DOC (mg C/L)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002
C-1	3	Deep	4.5	4.6	3.5	4.3	10.4	8.8	3.3
C-2	3	Deep	0.0	4.6	1	5	4.8	4.6	4
C-3	1	Deep	4.5	5.7	1	5.6	5.8	5.6	4.3
C-4	1	Deep	0.0	8.1	1.5	4	1.9	1.4	4.6
C-5	2	Deep	4.5	3.6	1.5	3.1	1.7	1.1	3.1
C-6	2	Deep	0.0	2.6	8.3	14.6	1.2	1.8	2.8
C-7	3	Intermed	4.5	10.5	6.4	9.1	2.3	1.6	4.6
C-8	3	Intermed	0.0	11.4	4.8	8.1	8.4	7.3	3.7
C-9	1	Intermed	4.5	5.9	6.4	6.9	6.6	6.5	6.7
C-10	1	Intermed	0.0	7.1	4.3	14.5	4.6	1.6	6.1
C-11	2	Intermed	4.5	12.6	6.3	5.1	6.9	3.7	10.6
C-12	2	Intermed	0.0	6.4	3.8	22.8	5.2	5.6	2.3
C-13	3	Shallow	4.5	.	.	.	.	.	9.6
C-14	3	Shallow	0.0	.	.	.	.	.	7.4
C-15	1	Shallow	4.5	.	.	.	.	.	6.7
C-16	1	Shallow	0.0	.	.	.	.	.	6.1
C-17	2	Shallow	4.5	.	.	.	.	.	11.9
C-18	2	Shallow	0.0	.	.	.	.	.	6.2
C-19	3	Intermed	9.0	.	.	.	.	.	.
C-20	1	Intermed	9.0	.	.	.	.	.	.
C-21	2	Intermed	9.0	.	.	.	.	.	.
C-22	W of tr2	Intermed	Field	.	.	.	.	.	.
C-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
C-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
C-DITCH		Surface	DITCH	4.5	5.1	.	1.6	5	6.7
F-1	3	Deep	4.5	5.7	1.6	3.5	14.1	4.6	3.5
F-2	3	Deep	0.0	5.8	1	5.5	4.3	7.4	3.5
F-3	1	Deep	4.5	1	3.5	1.6	5	5.9	1.1
F-4	1	Deep	0.0	3.2	3.8	1.1	3.9	9.8	1
F-5	2	Deep	4.5	2.3	5.7	3.4	3.2	6.3	1
F-6	2	Deep	0.0	4.6	8.2	3.1	4.2	3.4	1
F-7	3	Intermed	4.5	8.9	8	6.1	3.8	4.3	6.7
F-8	3	Intermed	0.0	2.8	6.4	8.7	3.2	2.7	3.6
F-9	1	Intermed	4.5	4.3	11.2	6.4	3	3	2.2
F-10	1	Intermed	0.0	8.2	5.3	7.1	3.6	5	1.3
F-11	2	Intermed	4.5	5.6	12.6	7.4	4.4	2.8	2.4
F-12	2	Intermed	0.0	7.2	10.1	5.6	2.8	5.6	1
F-13	3	Shallow	4.5	.	.	.	.	.	5.7
F-14	3	Shallow	0.0	.	.	.	.	.	6.3
F-15	1	Shallow	4.5	.	.	.	.	.	8.2
F-16	1	Shallow	0.0	.	.	.	.	.	5.5
F-17	2	Shallow	4.5	.	.	.	.	.	5.6
F-18	2	Shallow	0.0	.	.	.	.	.	5.1
F-19	3	Intermed	9.0	.	.	.	.	.	.
F-20	1	Intermed	9.0	.	.	.	.	.	.
F-21	2	Intermed	9.0	.	.	.	.	.	.
F-22	W of tr2	Intermed	Field	.	.	.	.	.	.
F-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
F-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
F-DITCH		Surface	DITCH	5.8	4.5	13.3	2.8	2.7	5
N-1	3	Deep	4.5	5.5	4	6.2	8	6.9	3.9
N-2	3	Deep	0.0	1.3	3.9	6.2	8.8	3.7	2.7

Appendix E. Water Chemistry Raw Data – DOC (mg C/L) (continued)

Sample	3/2/2002	4/11/2002	5/12/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002
C-1	3.9	6.5	5.7	5.1	4.5	4.9	4.4	4.8	5.4
C-2	3.8	7.2	6.5	5.3	5.2	5.5	4.7	4.8	4.8
C-3	4.4	5.8	5.3	5	.	5	4.7	5	5.5
C-4	4.5	6	5.3	4.8	5	5.3	5	5.3	5.9
C-5	3.1	3.8	4.5	4	4.6	3.7	3.6	3.7	4
C-6	2.9	4.3	3.7	3	2.6	3.2	2.9	2.8	3.2
C-7	4.2	8.4	8.6	7.6	18.2	22	12.1	11.1	8.1
C-8	3.6	10.2	8.5	9.4	7.4	7.4	12.3	10.5	6.9
C-9	6.1	7.7	8.1	6.9	.	7.3	9.2	42.8	18.5
C-10	6	19.3	9.4	.	3.9	6	4.9	5.3	5.2
C-11	10.9	13.5	12.2	14.4	10.1	8.2	9.5	6.9	7.1
C-12	2.6	6.9	5	4.5	2.8	4.1	3.6	4.3	4.4
C-13	8.9	14.1	9.9	.	.	.	.	.	.
C-14	6.8	11.4	7.9	.	.	.	.	.	.
C-15	6.4	8.6	8.3	.	.	.	.	.	.
C-16	5.9	9.7	18.8	.	.	.	.	.	.
C-17	10.1	9.8	12.3	.	.	.	.	.	.
C-18	.	.	9.4	.	.	.	.	.	.
C-19	.	.	.	.	.	.	.	.	.
C-20	.	.	.	.	.	.	.	.	.
C-21	.	.	.	.	.	.	.	.	.
C-22	.	.	.	.	.	.	.	8.5	8.3
C-23	.	.	.	.	.	.	.	8.4	7.2
C-24	.	.	.	.	.	.	.	9	7.3
C-DITCH	6.3	9.7	10	.	.	.	.	.	.
F-1	3.4	4.6	4.2	4.1	3.9	4.2	4.1	3.8	4.2
F-2	3.2	7.3	3.8	4.1	4.1	4.1	4.3	4	4.6
F-3	1	1.4	1.2	1.3	1.2	1.3	1.3	1.1	1.7
F-4	1	2.3	1.6	1.6	1	1.7	1.1	1	1.4
F-5	1	2	1.6	1.4	1	1.2	1.1	1.1	1.1
F-6	1	1.4	1.5	1.3	1.1	1.2	1.2	1	1
F-7	5.7	8.8	7.4	7.1	6	7.4	6.2	7.2	8.8
F-8	3.9	6.5	6.4	6.3	4.9	5.1	6.1	8.7	5.2
F-9	1.6	5.2	3.4	3.1	1.6	1.4	1.7	.	1.8
F-10	1.1	3.3	2.2	3.3	2.2	5.6	7.7	4.8	3.8
F-11	1.6	10	3.5	1.2	2.4	3.7	5.7	2.8	6.8
F-12	1.1	1.8	1.9	.	3	5.5	9.1	2.5	12.8
F-13	.	12	7	.	.	.	.	.	.
F-14	3.8	7.4	5.8	.	.	.	.	.	.
F-15	7.6	10.1	9.9	.	.	.	.	.	.
F-16	.	8.1	5.3	.	.	.	.	.	.
F-17	.	11	6.5	.	.	.	.	.	.
F-18	.	4.8	5.4	.	.	.	.	.	.
F-19	.	.	.	.	.	.	.	.	.
F-20	.	.	.	.	.	.	.	.	.
F-21	.	.	.	.	.	.	.	.	.
F-22	.	.	.	.	.	.	.	10.9	5.4
F-23	.	.	.	.	.	.	.	6	3.8
F-24	.	.	.	.	.	.	.	9.5	2.2
F-DITCH	4.6	6.1	6.4	8.9	14.5	.	.	.	7.2
N-1	3.1	2.3	2.6	2	3.7	3.7	3.5	3.3	3.3
N-2	1.9	1.6	2	2	1.4	1.5	1.7	2.3	3

Appendix E. Water Chemistry Raw Data – DOC (mg C/L) (continued)

Sample	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
C-1	.	4.3	4.3	4.1	5.1	5.6	5.3	5
C-2	.	4.7	5	5.4	7.6	5.6	6.2	5.9
C-3	.	8	8.4	8.1	5.3	5.3	5.2	5.3
C-4	.	15.9	6.8	5.9	5.9	5.3	5.7	5.3
C-5	.	4	3.7	4.3	4	4.2	4.8	4.9
C-6	.	7.9	3	3.5	4.3	3.4	3.8	3.2
C-7	8.6	10	8.3	8.9	8.9	11.7	9.1	8.3
C-8	6.1	6.8	6	22.1	6.5	7.9	6.7	7.9
C-9	8.5	7.8	7.2	9.1	7.9	8.3	8.9	9.1
C-10	6.8	5.5	6.8	6.9	8.9	5.8	12.1	10.6
C-11	13.7	11.7	11.3	12	12.6	14.7	14.3	15.6
C-12	5.1	3.9	7.4	12.4	6.4	5.5	4.3	5.3
C-13	.	11.3	10.5	10	9.8	13.6	11.9	10.4
C-14	.	8.3	8.1	9.5	7.6	11	8.8	8.9
C-15	.	8.1	7.4	8.1	9.6	10.9	8.8	10.8
C-16	.	.	9.6	9.5	12.2	21.9	8.4	10
C-17	.	13.2	14.6	16.1	13	17.9	14.6	14.7
C-18	.	42.1	.	11.2	15.4	11	8.7	13.6
C-19	10.5	11.1	10.5	11.2	10.7	10.8	11.1	13.8
C-20	7.7	7.5	7.2	7.5	8.6	9.3	8.6	10.7
C-21	14	14.2	12.5	13.1	12.4	13.3	12.2	13.2
C-22	.	13	13.7	17.4	15.5	22.6	23.9	22.6
C-23	.	11.7	12.3	11.2	10	11.1	11.3	11.9
C-24	.	8.2	8.7	8.3	8.9	8.5	10.3	9.4
C-DITCH	.	7.7	7.5	7.5	6.2	8	9.4	10.6
F-1	.	4.2	4.3	4.3	3.5	4.3	4.4	5.5
F-2	.	4	4.4	3.9	3.1	4.3	4.6	5.8
F-3	.	1.1	1.1	1.2	1.1	1.4	1.2	1.8
F-4	.	1.3	1.5	1.2	1.3	1.7	1.2	1.7
F-5	.	1.1	1	1.3	1.2	1.2	1	1.7
F-6	.	1.1	1	1	1.2	1.8	1	1.9
F-7	7.3	7.2	7.1	7.2	7.5	8.5	7.4	9.1
F-8	5.8	.	8	9.3	6.8	8.9	5.7	6.6
F-9	4.3	.	4.3	4.3	4.5	3.5	3.6	6.8
F-10	3.4	2.6	2	5.7	5.4	4.4	5.3	2.7
F-11	5.5	4.4	3.4	4.8	4.6	7.2	4.9	3.6
F-12	4.8	3.8	3.5	3	3.7	2.8	2.5	2.1
F-13	.		10.1	.	6.7	13.1	14.2	8.3
F-14	.	5.2	8.9	.	7	20.8	7.8	12
F-15	.	9.1	8.9	12.5	8.2	13.8	10.9	12.1
F-16	.	.	.	.	7.6	9.2	6.9	7.3
F-17	.	.	6	11	5.9	8	.	5.6
F-18	.	.	.	.	6.6	12.2	14.9	5
F-19	6.6	6.7	6.6	6.4	7	7.7	7.3	8.5
F-20	9.3	9.4	9.3	9.2	9.9	11.7	12.3	16.7
F-21	5.3	6.1	5.9	6.1	6.2	6.5	5.8	10.5
F-22	.	8.8	7.7	7.5	8.1	10.3	9.1	5.8
F-23	.	5.3	4.5	4.9	5.4	5.4	5.4	5
F-24	.	7.7	6.3	7.4	8.1	8	8	8.8
F-DITCH	.	6.5	7	6.2	5.4	5.7	6.7	7
N-1	.	2.9	2	1.7	1.7	2.2	1.6	2.4
N-2	.	1.7	1.6	1.2	1.2	1.6	1.1	2.1

Appendix E. Water Chemistry Raw Data – DOC (mg C/L) (continued)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002
N-3	1	Deep	4.5	1.4	3.8	1	3.7	3.5	1
N-4	1	Deep	0.0	1.5	2.5	1.4	19.7	3.5	1
N-5	2	Deep	4.5	1	7.8	1.8	13.1	3.4	2.8
N-6	2	Deep	0.0	10.1	5.8	15	4.6	3.4	1.6
N-7	3	Intermed	4.5	8.2	8	7.2	12.5	3.6	4.5
N-8	3	Intermed	0.0	5.2	7.2	4.9	10	3.2	3.8
N-9	1	Intermed	4.5	5.8	16.1	4	9.7	2.9	4.6
N-10	1	Intermed	0.0	6	4.7	3.5	11.1	3	2.4
N-11	2	Intermed	4.5	6.4	9.9	4.4	7.4	2.6	3.1
N-12	2	Intermed	0.0	7.2	2.1	6	6.2	2.6	2.7
N-13	3	Shallow	4.5	.	.	.	.	.	8.8
N-14	3	Shallow	0.0	.	.	.	.	.	7
N-15	1	Shallow	4.5	.	.	.	.	.	5.8
N-16	1	Shallow	0.0	.	.	.	.	.	8.9
N-17	2	Shallow	4.5	.	.	.	.	.	6.4
N-18	2	Shallow	0.0	.	.	.	.	.	5.3
N-19	3	Intermed	9.0	.	.	.	.	.	.
N-20	1	Intermed	9.0	.	.	.	.	.	.
N-21	2	Intermed	9.0	.	.	.	.	.	.
N-22	W of tr2	Intermed	Field	.	.	.	.	.	.
N-23	E of tr2 S	Intermed	Field	.	.	.	.	.	.
N-24	E of tr2 N	Intermed	Field	.	.	.	.	.	.
N-DITCH		Surface	DITCH	4.4	4.1	6.6	8.9	2.6	4.3
P-1	1	Deep	9.0	4.5	5.1	4.4	4.7	.	3.1
P-2	1	Deep	4.5	4.3	3.3	4.9	4.7	4.4	3
P-3	1	Deep	0.0	4.2	2.7	4.5	6.1	4.7	2.6
P-4	2	Deep	9.0	3.6	3.9	3.3	6.2	4.9	2.3
P-5	2	Deep	4.5	3.3	3.7	5.1	4.2	3.6	2.1
P-6	2	Deep	0.0	6.5	2.9	2.9	3.4	2.6	2.4
P-7	3	Deep	9.0	3.1	3.8	2.4	11.5	9.6	2.1
P-8	3	Deep	4.5	3	2.6	2.7	6.8	7.2	1.9
P-9	3	Deep	0.0	2.4	2.3	2.6	7.2	6	2
P-10	4	Deep	9.0	2.2	2.6	2.2	7.4	4.5	2.2
P-11	4	Deep	4.5	2.4	2.9	3.3	11.8	13.7	1.3
P-12	4	Deep	0.0	2.8	9	6.8	5.2	6.2	2.8
P-13	1	Intermed	9.0	4.7	8.6	7.9	14	10.2	7.4
P-14	1	Intermed	4.5	6.6	3.6	7.4	4	4.9	8
P-15	1	Intermed	0.0	4.7	17	22.7	4.9	6.1	2.5
P-16	2	Intermed	9.0	14.9	9.2	8.1	1.9	1.5	13.2
P-17	2	Intermed	4.5	7.1	3.6	5.2	1.1	1.5	11.9
P-18	2	Intermed	0.0	4.9	7.8	5.8	3.2	3.5	2.6
P-19	3	Intermed	9.0	3.9	6.8	4.2	2.5	2.6	10.8
P-20	3	Intermed	4.5	3.5	4.4	9.3	5.4	7.4	6.7
P-21	3	Intermed	0.0	4.3	4	7.3	7.1	6.5	2.8
P-22	4	Intermed	9.0	6	5.8	11.1	5.9	5.5	4.2
P-23	4	Intermed	4.5	6.6	5.5	4	4.1	3.9	6.5
P-24	4	Intermed	0.0	6.7	3.3	9.7	7.7	6.7	2.9
P-25	1	Shallow	9.0	.	.	.	.	.	9
P-26	1	Shallow	4.5	.	.	.	.	.	11.5
P-27	1	Shallow	0.0	.	.	.	.	.	.
P-28	2	Shallow	9.0	.	.	.	.	.	13.8
P-29	2	Shallow	4.5	.	.	.	.	.	12.5
P-30	2	Shallow	0.0	.	.	.	.	.	.
P-31	3	Shallow	9.0	.	.	.	.	.	14
P-32	3	Shallow	4.5	.	.	.	.	.	11.4

Appendix E. Water Chemistry Raw Data – DOC (mg C/L) (continued)

Sample	3/2/2002	4/11/2002	5/12/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002
N-3	1	1.3	1.8	1.2	1.3	1.2	1.4	1.7	1.2
N-4	1.1	1.2	1.3	1.2	1.7	2.5	1.5	1.8	1.4
N-5	3	12.5	5.4	3.6	3.6	3.3	3.6	3.5	3.1
N-6	2	13.9	10.3	4.2	2.6	4.8	2.7	3.1	3.1
N-7	3.6	2.8	2.7	2.5	3.4	5	4	3.6	3.8
N-8	3.6	5.2	2.4	2.5	2.2	2.3	3.7	3.3	4.2
N-9	3	5.8	4.4	5.8	16.8	8.1	7.2	5.2	18.9
N-10	1.5	5.8	2.9	3.5	11.8	9.6	9	7.6	15.8
N-11	3.1	11.5	4.4	8.2	24.9	17.2	11.8	7.3	20.6
N-12	3	5.7	4.4	4.5	3.9	4	4.8	4.9	4.3
N-13	8.1	14.7	7.1	.	.	.	.	.	.
N-14	5.4	9.4	6.9	.	.	.	.	.	.
N-15	7.1	9.5	6.4	.	.	.	.	.	.
N-16	2.4	6.9	4.4	.	.	.	.	.	.
N-17	6.8	13.9	6.6	.	.	.	.	.	.
N-18	4.9	11.9	5.3	.	.	.	.	.	.
N-19	.	.	.	.	.	.	.	.	.
N-20	.	.	.	.	.	.	.	.	.
N-21	.	.	.	.	.	.	.	.	.
N-22	.	.	.	.	.	.	.	4.5	3.6
N-23	.	.	.	.	.	.	.	13.7	13.9
N-24	.	.	.	.	.	.	.	4.4	5.4
N-DITCH	3.7	10.1	6.4	28.7	8.9	.	.	.	.
P-1	3.4	6	4.5	4.4	4	3.6	3.6	4	4
P-2	3.2	6.6	5.8	4.4	3.6	3.9	4.4	4.1	6.6
P-3	2.7	3.9	5.2	3.5	2.7	3.5	3	3.4	3.5
P-4	2.6	3.9	3.6	3.4	3.5	3.4	3.3	3.1	3.5
P-5	2.2	4.1	4.1	3.3	3	3	3.4	3.3	3.5
P-6	2.8	5	7.1	5.7	3.6	3.9	3	3.2	4.8
P-7	2.1	3.5	3.2	3.2	2.5	2.7	2.4	2.3	2.5
P-8	2.2	3.5	3.5	3.2	2.4	2.4	2.8	2.8	3.1
P-9	2.1	3.6	2.9	3	2.8	2.8	3.3	2.7	2.7
P-10	1.9	3.6	3.3	2.8	2.3	2.6	2.8	2.4	2.8
P-11	2.1	3.2	4.2	2.7	2.2	2.8	2.7	2.6	2.7
P-12	2.3	3.5	4.2	3.2	4.4	2.7	2.5	2.9	3.3
P-13	6	9.6	7.3	5.9	5.5	5.5	5.6	5.2	5.5
P-14	7.7	9.2	6	5.7	7	5.5	5.6	5.9	6.2
P-15	2.5	3.9	4.1	.	5.5	7	9	5.2	9.8
P-16	17.1	22.2	26.8	16.3	15.4	13.8	9.9	.	.
P-17	10.8	14.4	9.7	10.5	5.4	9.1	8.5	8.6	7.6
P-18	2.5	4.5	4.8	5.5	3.4	3.6	3.7	3.5	4.6
P-19	6.3	9.2	9.6	5.4	4.2	12.9	11.6	6.3	5.1
P-20	5.1	5.3	10.4	6.3	10.2	12.9	11.8	4.9	6.8
P-21	3.1	5	4.3	5.2	3.4	7.2	9	5	4.3
P-22	3.3	4.4	6.4	7.3	6.5	9.9	7.5	.	5.7
P-23	3.9	6.3	5.6	10.9	3.8	8.7	7.5	12.8	7.7
P-24	2.3	5.6	9.9	.	14.6	8.8	6.3	7	.
P-25	8.1	.	.	.	.	.	.	.	.
P-26	12.9	45	.	.	.	.	.	.	.
P-27	.	.	.	.	.	.	.	.	.
P-28	.	25.9	.	.	.	.	.	.	.
P-29	.	13.6	.	.	.	.	.	.	.
P-30	.	.	.	.	.	.	.	.	.
P-31	.	9.7	.	.	.	.	.	.	.
P-32	6.7	7.7	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data –DOC (mg C/L) (continued)

Sample	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
N-3	.	1.4	1.1	1	1.1	1.4	1.1	1.5
N-4	.	1.3	1.1	1	1	4.3	1.1	1.9
N-5	.	3.7	3.2	3.1	3.7	3.3	3.7	4.6
N-6	.	2.5	2.7	2.7	2.5	2.2	3.1	4.4
N-7	6.2	2.9	2.5	2.8	2.1	2.5	2.1	2.7
N-8	4.2	2.5	1.9	3	3.5	2.4	3.7	3.1
N-9	5.8	.	5.6	5.7	5.9	6.2	5.9	5.5
N-10	3.8	3.7	3.8	3.6	4.4	4.2	4.7	4.6
N-11	8.2	11	7.8	8.2	6.5	7.8	6.6	7.4
N-12	3.9	3.5	3.6	4.1	4.5	4.6	4.6	5.8
N-13	.	10.5	10.2	17.8	10.8	9.4	12.2	8.8
N-14	.	15.7	9.8	3.7	5.5	9.9	6.9	7.2
N-15	.	.	.	10.2	5.7	8.3	5.8	6.5
N-16	.	6.9	5.5	5.2	6	6.5	5.6	6.4
N-17	.	76.7	12.4	11.1	7	8.9	7	.
N-18	.	.	13.9	19.9	8.1	38.8	.	.
N-19	6.6	9.1	10.8	9.1	6.7	9.7	7.8	7.5
N-20	6.8	6.5	6.3	7.5	6.2	7.1	6.6	6.7
N-21	10.1	10.3	8.5	8.4	8.4	9.1	9.1	10.9
N-22	.	7.1	9.2	9.1	8.6	8.8	8.9	9.4
N-23	.	25.2	15.6	18.1	14	15.6	12.1	13.7
N-24	.	7.8	7.1	6.6	6.9	7.4	8.6	7.4
N-DITCH	.	13.2	4.4	5.4	6.3	5.3	5.4	6.1
P-1	.	4.3	4.1	4.4	4.7	7.3	4.9	4.1
P-2	.	4.7	4.1	6	4.5	6.7	5.4	5.1
P-3	.	4.1	6.1	4	4	5	3.9	4
P-4	.	4.7	3.2	3.5	3.6	4.5	3.4	3.5
P-5	.	3.5	3.7	4.5	3.7	4.3	3.5	3.5
P-6	.	37.2	6.9	19	5.8	6	5.7	6.2
P-7	.	3.3	2.5	3	3.1	4.4	3.3	3.4
P-8	.	2.8	2.8	2.6	2.6	3.6	3	2.6
P-9	.	3	2.9	2.5	2.8	3.6	2.6	2.8
P-10	.	3.1	2.8	2.8	2.7	3.8	2.5	2.6
P-11	.	3.4	2.7	2.8	3	3.4	2.6	2.7
P-12	.	3.3	4.2	4.1	6.6	3.7	2.9	2.7
P-13	.	7.6	8.2	7.7	7.9	22.8	9.1	15
P-14	.	7.5	6.5	7.2	7.3	11.5	10	16.2
P-15	.	10.7	4.3	5.1	5.3	7.8	5.8	8.4
P-16	.	26.6	15.8	16	20	14.9	20.3	13
P-17	.	13.9	10.3	13.6	20.2	31.7	19.5	21.3
P-18	.	7.3	5.1	6.7	5.1	14.6	6	8.2
P-19	.	10.3	8.2	11.1	16.4	19.6	13.2	19
P-20	.	10	9.2	10.3	9.3	14.7	8.4	17.5
P-21	.	8.3	6.3	6.6	3.7	4.5	3.7	5.4
P-22	.	6.9	4.4	4.4	4.7	6.2	4.6	5.4
P-23	.	6.8	5.4	5	6.1	7.4	.	5.1
P-24	.	16.5	3.8	3.6	4.2	4.8	5.3	.
P-25	.	.	.	.	.	22.8	.	.
P-26	.	.	.	.	39.7	32.5	48.9	.
P-27	.	.	.	.	.	.	.	.
P-28	.	.	.	30.7	17.6	21.1	20.6	25.5
P-29	.	.	.	42.2	.	32.7	.	31.6
P-30	.	.	.	.	.	.	.	.
P-31	.	.	16.1	17.9	22	24.3	14.2	14.5
P-32	.	.	8.8	14.9	12.3	17.6	17.5	.

Appendix E. Water Chemistry Raw Data – DOC (mg C/L) (continued)

Sample	Transect	Depth	Distance (m)	9/14/2001	10/9/2001	11/2/2001	12/8/2001	1/13/2002	2/2/2002
P-33	3	Shallow	0.0	.	.	.	.	.	5.8
P-34	4	Shallow	9.0	.	.	.	.	.	5.6
P-35	4	Shallow	4.5	.	.	.	.	.	7.8
P-36	4	Shallow	0.0	.	.	.	.	.	.
P-37	betw 1-2	Intermed	Field	.	.	.	.	.	.
P-38	betw 3-4	Intermed	Field	.	.	.	.	.	.
P-DITCH		Surface	DITCH	7.2	3.7	4.5	4.8	4.9	3
B-1		Intermed	0.0	.	.	.	.	.	.
B-2		Intermed	4.5	.	.	.	.	.	.
B-3		Intermed	9.0	.	.	.	.	.	.

Sample	3/2/2002	4/11/2002	5/12/2002	6/12/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002	11/3/2002
P-33	6	7.1	.	.	.	.	.	.	.
P-34	.	6.2	.	.	.	.	.	.	.
P-35	.	5.5	.	.	.	.	.	.	.
P-36	.	3.9	.	.	.	.	.	.	.
P-37	.	.	.	.	.	.	.	7.4	10.5
P-38	.	.	.	.	.	.	.	4.3	4.3
P-DITCH	2.7	5.9	3.6	8.7	4.9	.	.	.	.
B-1	.	.	.	.	.	.	.	.	.
B-2	.	.	.	.	.	.	.	.	.
B-3	.	.	.	.	.	.	.	.	.

Sample	11/15/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/03	6/11/2003
P-33	.	.	4.9	9.5	4.6	6.7	7.5	5.9
P-34	.	.	4.1	4	4	6.5	4.4	11
P-35	.	.	5.2	5.2	4.2	8	5.2	14.9
P-36	.	.	4.9	8.1	5.4	10	6.6	.
P-37	.	56.5	32.2	21.1	14.6	47	34.5	31.2
P-38	.	12.7	5.4	5.9	7.5	6.9	6	5.8
P-DITCH	.	5.8	2.8	3.6	3.3	5.1	4.9	3.8
B-1	7.4	5	4.4	4.1	4.1	5.4	.	6.4
B-2	4.9	5.4	4.9	4.6	6.1	6.2	5.4	6.5
B-3	5.8	.	5.3	4.9	5.5	6.1	5.7	5.6

Appendix E. Water Chemistry Raw Data – Fe^{2+}, TFe, TP

Sample	Date	Fe	Total Fe	TP
		mg /L	mg /L	mg P/L
P-1	12/02/2002	2.6	2.2	0.1
P-2	12/02/2002	1.9	1.8	0.1
P-3	12/02/2002	7.6	6.2	0.1
P-4	12/02/2002	12	10	0.3
P-5	12/02/2002	6.4	5.2	0.1
P-6	12/02/2002	120	123	3.2
P-7	12/02/2002	3.9	3	0.1
P-8	12/02/2002	3.1	2.6	0.1
P-9	12/02/2002	2	1.7	0.2
P-10	12/02/2002	3.4	2.9	0.1
P-11	12/02/2002	5.5	4.8	0.2
P-12	12/02/2002	3.9	3.4	0.2
P-13	12/02/2002	0.2	0.2	0.1
P-14	12/02/2002	0.1	0.1	0.1
P-15	12/02/2002	31	27	0.2
P-16	12/02/2002	1.2	4.7	0.7
P-17	12/02/2002	0.4	1.1	0.3
P-18	12/02/2002	22	27	0.2
P-19	12/02/2002	12	12	0.8
P-20	12/02/2002	2.2	2.4	0.5
P-21	12/02/2002	3.7	4	0.5
P-22	12/02/2002	1.3	1.2	0.4
P-23	12/02/2002	2.6	3.5	0.4
P-24	12/02/2002	15	29	2.5
P-37	12/02/2002	0.5	0.7	11
P-38	12/02/2002	5.3	66	7.8
P-DITCH	12/02/2002	13	12	0.2
C-1	12/02/2002	6.7	5.6	0.1
C-2	12/02/2002	9.4	7.8	0.2
C-3	12/02/2002	17	15	1
C-4	12/02/2002	47	41	2.6
C-5	12/02/2002	5.2	4.1	0.1
C-6	12/02/2002	50	48	4.2
C-7	12/02/2002	5.2	5.8	0.5
C-8	12/02/2002	3.3	2.9	0.1
C-9	12/02/2002	1.2	1	0.1
C-10	12/02/2002	0.8	0.8	0.1
C-11	12/02/2002	0.1	0.1	0.1
C-12	12/02/2002	4.6	3.9	0.1
C-13	12/02/2002	0.2	0.8	0.5
C-14	12/02/2002	0.2	0.5	0.2
C-15	12/02/2002	0.1	0.2	0.1
C-17	12/02/2002	0.5	1	0.4
C-18	12/02/2002	2.9	5.8	3.4
C-19	12/02/2002	0.1	0.2	0.1
C-20	12/02/2002	0.1	0.2	0.1
C-21	12/02/2002	0.1	0.1	0.1
C-22	12/02/2002	0.3	0.3	0.1
C-23	12/02/2002	0.8	0.9	0.1
C-24	12/02/2002	1.6	1.8	0.3
C-DITCH	12/02/2002	0.4	0.3	0.1
F-1	12/02/2002	4.6	3.7	0.1
F-2	12/02/2002	4.1	3.5	0.1

Appendix E. Water Chemistry Raw Data – Fe^{2+}, TFe, TP (continued)

Sample	Date	Fe	Total Fe	TP
		mg /L	mg /L	mg P/L
F-3	12/02/2002	1.8	1.5	0.2
F-4	12/02/2002	2.8	3	0.3
F-5	12/02/2002	1.6	1.3	0.3
F-6	12/02/2002	7.9	6.5	1.3
F-7	12/02/2002	0.2	0.2	0.1
F-10	12/02/2002	2.4	2.2	0.4
F-11	12/02/2002	0.9	0.8	0.1
F-12	12/02/2002	2.1	1.9	0.5
F-14	12/02/2002	2.9	2.3	0.1
F-15	12/02/2002	0.3	0.4	0.1
F-19	12/02/2002	0.2	0.2	0.1
F-20	12/02/2002	0.2	0.3	0.1
F-21	12/02/2002	0.3	0.5	0.1
F-22	12/02/2002	2.6	2.8	0.3
F-23	12/02/2002	1.4	1.9	0.2
F-24	12/02/2002	10	12	0.9
F-DITCH	12/02/2002	0.1	0.1	0.1
N-1	12/02/2002	0.2	0.2	0.7
N-2	12/02/2002	0.5	0.4	0.7
N-3	12/02/2002	0.5	0.7	0.1
N-4	12/02/2002	0.01	0.1	0.2
N-5	12/02/2002	0.01	0.1	0.1
N-6	12/02/2002	0.01	0.1	0.1
N-7	12/02/2002	0.2	0.2	0.7
N-8	12/02/2002	0.1	0.2	0.5
N-10	12/02/2002	0.1	0.2	0.1
N-11	12/02/2002	8.2	7.9	0.6
N-12	12/02/2002	0.1	0.2	0.1
N-13	12/02/2002	0.3	1.1	0.3
N-14	12/02/2002	1.8	2.9	0.3
N-16	12/02/2002	0.1	0.3	0.4
N-17	12/02/2002	0.1	1.5	3.8
N-18	12/02/2002	.	9	1.5
N-19	12/02/2002	0.2	0.4	0.2
N-20	12/02/2002	0.3	0.3	0.6
N-21	12/02/2002	0.2	0.3	0.1
N-22	12/02/2002	1	0.9	0.1
N-23	12/02/2002	0.1	0.2	1.1
N-24	12/02/2002	1.6	1.7	0.4
N-DITCH	12/02/2002	0.6	0.5	1.9
B-1	12/02/2002	0.2	0.2	0.1
B-2	12/02/2002	0.2	0.2	0.1
P-1	01/05/2003	1.9	2.3	0.1
P-2	01/05/2003	1.5	2.5	0.1
P-3	01/05/2003	14	15	0.5
P-4	01/05/2003	4.6	4	0.1
P-5	01/05/2003	8.3	8.3	0.1
P-6	01/05/2003	14	19	0.9
P-7	01/05/2003	3.7	3.2	0.1
P-8	01/05/2003	3.2	3.1	0.2
P-9	01/05/2003	3.5	3.3	0.3
P-10	01/05/2003	3.9	3.5	0.2

Appendix E. Water Chemistry Raw Data – Fe^{2+}, TFe, TP (continued)

Sample	Date	Fe	Total Fe	TP
		mg /L	mg /L	mg P/L
P-11	01/05/2003	4.4	4	0.2
P-12	01/05/2003	12	12	0.8
P-13	01/05/2003	0.2	0.2	0.1
P-14	01/05/2003	0.1	0.1	0.1
P-15	01/05/2003	1.1	2.4	0.1
P-16	01/05/2003	0.2	0.9	0.3
P-17	01/05/2003	0.1	0.6	0.1
P-18	01/05/2003	8.1	22	0.1
P-19	01/05/2003	1.1	1.9	0.3
P-20	01/05/2003	0.9	1.9	0.5
P-21	01/05/2003	0.4	1	0.2
P-22	01/05/2003	0.3	0.6	0.3
P-23	01/05/2003	0.8	2	0.3
P-24	01/05/2003	0.5	0.9	0.1
P-31	01/05/2003	0.5	1.9	0.8
P-32	01/05/2003	0.1	0.2	0.1
P-33	01/05/2003	0.3	1.3	0.1
P-34	01/05/2003	0.1	0.1	0.1
P-35	01/05/2003	0.2	0.5	0.2
P-36	01/05/2003	0.5	1.1	0.1
P-37	01/05/2003	0.1	0.4	7.1
P-38	01/05/2003	0.8	1.6	0.3
C-1	01/05/2003	6.1	5.5	0.1
C-2	01/05/2003	11	9.4	0.2
C-3	01/05/2003	18	17	1
C-4	01/05/2003	11	10	0.8
C-5	01/05/2003	3.9	3.4	0.1
C-6	01/05/2003	6.1	5.1	0.3
C-7	01/05/2003	2.1	3.2	0.3
C-8	01/05/2003	5.6	5.6	0.1
C-9	01/05/2003	1	1.9	0.1
C-10	01/05/2003	1.1	1.4	0.1
C-11	01/05/2003	0.1	0.2	0.1
C-12	01/05/2003	26	29	0.1
C-13	01/05/2003	0.2	0.6	0.6
C-14	01/05/2003	0.1	0.3	0.2
C-15	01/05/2003	0.1	0.1	0.1
C-16	01/05/2003	0.7	1.2	0.5
C-17	01/05/2003	0.1	0.3	0.6
C-19	01/05/2003	0.1	0.3	0.2
C-20	01/05/2003	0.1	0.2	0.1
C-21	01/05/2003	0.1	0.1	0.1
C-22	01/05/2003	0.1	0.1	0.1
C-23	01/05/2003	0.2	0.8	0.3
C-24	01/05/2003	1.1	3.1	0.8
F-1	01/05/2003	4.5	3.8	0.1
F-2	01/05/2003	4	3.5	0.1
F-3	01/05/2003	4.1	4.1	0.5
F-4	01/05/2003	2	2.5	0.4
F-5	01/05/2003	1.5	1.3	0.3
F-6	01/05/2003	2.8	2.5	0.5
F-7	01/05/2003	0.1	0.1	0.1
F-8	01/05/2003	13	12	0.1

Appendix E. Water Chemistry Raw Data – Fe^{2+}, TFe, TP (continued)

Sample	Date	Fe	Total Fe	TP
		mg /L	mg /L	mg P/L
F-9	01/05/2003	0.4	0.3	0.1
F-10	01/05/2003	0.7	0.7	0.1
F-11	01/05/2003	0.9	1.2	0.1
F-12	01/05/2003	31	34	7.5
F-13	01/05/2003	0.2	0.4	0.2
F-14	01/05/2003	1.9	3.8	0.2
F-15	01/05/2003	0.1	0.1	0.1
F-17	01/05/2003	0.1	0.1	0.1
F-19	01/05/2003	0.1	0.3	0.1
F-20	01/05/2003	0.1	0.1	0.1
F-21	01/05/2003	0.1	0.3	0.1
F-22	01/05/2003	0.4	0.4	0.1
F-23	01/05/2003	0.1	0.1	0.1
F-24	01/05/2003	0.8	0.8	0.1
N-1	01/05/2003	0.1	0.1	0.7
N-2	01/05/2003	0.4	0.4	0.8
N-3	01/05/2003	0.1	0.6	0.1
N-4	01/05/2003	0.1	0.1	0.1
N-5	01/05/2003	0.1	0.1	0.1
N-6	01/05/2003	0.1	0.3	0.3
N-7	01/05/2003	1.9	2.5	1.5
N-8	01/05/2003	0.7	0.8	1.2
N-9	01/05/2003	0.2	0.7	0.2
N-10	01/05/2003	0.1	0.2	0.1
N-11	01/05/2003	2.7	3.6	0.4
N-12	01/05/2003	0.4	0.4	0.1
N-13	01/05/2003	0.1	0.2	0.1
N-14	01/05/2003	0.4	4.8	3.1
N-16	01/05/2003	0.1	0.1	0.2
N-17	01/05/2003	0.1	0.2	0.4
N-18	01/05/2003	0.3	3.8	6.4
N-19	01/05/2003	0.1	0.2	0.1
N-20	01/05/2003	0.1	0.1	0.2
N-21	01/05/2003	0.1	0.1	0.1
N-22	01/05/2003	0.1	0.2	0.1
N-23	01/05/2003	0.1	0.4	0.4
N-24	01/05/2003	0.6	0.9	0.1
B-1	01/05/2003	0.1	0.2	0.1
B-2	01/05/2003	0.1	0.2	0.1
B-3	01/05/2003	0.3	1	0.1

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C)

Ditch	Transect	Distance (m)	Depth	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002	2/2/2002
C	1	0	Deep	15.9	15.4	12.2	11.9	12.6	12.9
C	1	4.5	Deep	16.3	15.7	12.6	12.1	12.4	13.1
C	2	0	Deep	16.2	15.7	12.1	12.2	12.6	12.8
C	2	4.5	Deep	16.3	15.6	12.5	12.3	12.5	13.1
C	3	0	Deep	15.9	6.2	11.9	12	12.8	12.3
C	3	4.5	Deep	16.2	16.3	12.5	12.1	12.4	12.7
C	1	0	Shallow	14.9	14.3	10.1	10.1	11.8	13.2
C	1	4.5	Shallow	15.1	14.6	10.4	10.4	11.2	13.3
C	2	0	Shallow	15.3	14.9	9.7	10.5	11.4	12.9
C	2	4.5	Shallow	15.1	14.4	9.7	10.3	11.1	12.9
C	3	0	Shallow	14.5	5	9.6	10.5	11.9	12.3
C	3	4.5	Shallow	15.2	15.3	9.6	10	11.6	12.5
C			Air	.	10.3	13.68	8.5	20.5	13.8
F	1	0	Deep	15.2	16.4	11.6	11.6	12.1	12.1
F	1	4.5	Deep	15.8	16.8	12.4	12	12.9	13.2
F	2	0	Deep	15.7	16.1	11.7	12.2	11.8	12
F	2	4.5	Deep	16.7	15.8	12.4	12.5	11.9	12.4
F	3	0	Deep	16.3	15.6	11.4	10.8	11.6	12.6
F	3	4.5	Deep	15.6	16.8	12.5	12.2	11.7	12.5
F	1	0	Shallow	14.4	15.2	9	9.8	11	12
F	1	4.5	Shallow	14.9	16.2	10	10.2	11.9	13.2
F	2	0	Shallow	14.9	15.4	9.8	10.5	10.9	12.3
F	2	4.5	Shallow	15.8	14.9	9.6	10.5	11	12
F	3	0	Shallow	15.2	16.5	9.3	9.9	10.5	12.9
F	3	4.5	Shallow	14.8	16.2	9.1	10.1	10.6	12.4
F			Air	.	15	8.3	6.1	9.2	16
N	1	0	Deep	15.5	16.4	13.3	13.1	14.9	14.7
N	1	4.5	Deep	16.4	17	13	12.8	12.7	13.9
N	2	0	Deep	15.2	15.6	11.4	11.9	12.7	13.5
N	2	4.5	Deep	16.5	15.7	12.4	12.2	13	13.7
N	3	0	Deep	15.9	16	12	12.4	13.6	13.6
N	3	4.5	Deep	16.4	16.4	12.6	12.7	13.3	13.2
N	1	0	Shallow	14.9	15.4	10.5	11.1	13.2	14.1
N	1	4.5	Shallow	15.4	15.8	10	10.6	13.7	13.6
N	2	0	Shallow	14.5	14.3	9.5	10	11.6	13.9
N	2	4.5	Shallow	15.8	14.5	9.9	10.4	11.5	13.8
N	3	0	Shallow	14.8	14.8	9.7	10.5	12.21	13.4
N	3	4.5	Shallow	15.6	15.7	9.9	10.7	12.3	13.4
N			Air	.	12.7	11.1	8	15.7	14.2
P	1	0	Deep	16.4	15.9	12	12	13.4	13.3
P	1	4.5	Deep	16.8	16.2	12.5	12.3	13.3	13
P	1	9	Deep	16.7	16.7	12.1	11.9	13	12.4
P	2	0	Deep	16	15.8	11.2	11.2	12.7	12.4
P	2	4.5	Deep	16.6	16.4	12	11.8	13.1	12.7
P	2	9	Deep	16.8	15.3	11.9	11.9	12.9	12.6
P	3	0	Deep	16.1	15.9	11.6	11.6	13.1	12.5
P	3	4.5	Deep	16.4	17	12.1	12.2	13.2	12.8
P	3	9	Deep	16.4	16.9	12	12.3	13.2	12.7
P	4	0	Deep	17	16.4	12.8	12.8	14.4	14.2
P	4	4.5	Deep	17	16.6	12.6	12.7	13.6	13.5

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	tance	Depth	2/16/2002	3/4/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
C	1	0	Deep	12.7	12.3	12.6	13.3	15.3	16.4	17.4
C	1	4.5	Deep	12.7	12.3	12.7	13	15.2	16.1	17.2
C	2	0	Deep	12.8	13	12.8	13.7	15.9	16	16.9
C	2	4.5	Deep	12.8	12.5	12.7	13.6	15.6	15.9	16.8
C	3	0	Deep	12.7	12.4	12.4	13.7	15.7	15.8	16.7
C	3	4.5	Deep	13.1	12.4	12.4	13.2	16.1	15.7	18.3
C	1	0	Shallow	11.4	11.4	12.9	13.6	16.3	18	19.3
C	1	4.5	Shallow	11.3	11.1	13	13.4	16.1	18	19
C	2	0	Shallow	11.5	12.3	13.3	13.1	16.2	17.9	18.7
C	2	4.5	Shallow	11.2	11.8	13.1	13.9	16.7	17.7	19
C	3	0	Shallow	11.8	11.8	13.1	14.5	16.5	17.9	18.7
C	3	4.5	Shallow	11.4	11.3	12.5	13.3	16.2	17.3	16.5
C			Air	20.2	5.6	25.8	.	27.5	21.2	26
F	1	0	Deep	11.9	11.4	12.4	12.6	14	15.8	17.2
F	1	4.5	Deep	12.2	11.5	12.4	13	13.7	15.1	16.8
F	2	0	Deep	12.7	12.4	13	13.2	14.4	15.9	17.7
F	2	4.5	Deep	12.3	12.7	13.1	13.7	14.8	16	17.5
F	3	0	Deep	12.3	11.9	12.6	13.1	14.6	16.1	16.5
F	3	4.5	Deep	12.6	12	12.6	12.8	14.6	16	17.5
F	1	0	Shallow	10.5	10.7	13.3	13.3	14.7	17.9	19.4
F	1	4.5	Shallow	10.9	10.7	12.8	12.8	14.1	16.5	18.8
F	2	0	Shallow	11.2	11.8	13.3	14	15.4	17.7	19.4
F	2	4.5	Shallow	11	11.6	13.6	14.1	15.6	18.1	19.6
F	3	0	Shallow	10.9	11.2	13.3	13.7	15.2	18	19.44
F	3	4.5	Shallow	11	11.2	12.8	12.9	15.1	17.6	19
F			Air	12.5	2.4	23.2	20	27.8	22.4	24.4
N	1	0	Deep	13.8	13.2	14.1	14.8	15.9	16	17
N	1	4.5	Deep	13.4	12.7	13.9	14.5	15.5	16.3	17.3
N	2	0	Deep	12.2	11.8	13.2	14	16.3	17.1	17.8
N	2	4.5	Deep	12.5	12	13	13.7	15.9	16.8	17.8
N	3	0	Deep	13.3	12.8	13.4	13.9	15.6	16.6	17.9
N	3	4.5	Deep	13.1	12.6	13.2	14	15.6	17.9	18
N	1	0	Shallow	12.8	11.9	13.8	15.1	16	18	18.9
N	1	4.5	Shallow	11.9	11.5	14	14.8	15.9	18.2	19.4
N	2	0	Shallow	11.2	11.4	14	14.4	16.7	19.3	19.9
N	2	4.5	Shallow	11.2	11.4	13.4	14.3	17.1	18.1	19.5
N	3	0	Shallow	11.5	11.9	13.9	14.2	16	18.8	19.8
N	3	4.5	Shallow	11.6	11.7	13.7	14.4	16.6	19.4	20.1
N			Air	15.4	4.1	23.6	20.4	22.7	22.9	22.9
P	1	0	Deep	12.7	8.2	13.7	14.7	15.3	18.4	18.1
P	1	4.5	Deep	12.7	7.8	13.4	14	15.8	17.8	18.1
P	1	9	Deep	12.1	7.4	12.9	13.8	15.8	18.1	18.6
P	2	0	Deep	12.6	10.7	14.1	14.2	15.5	18.4	18.4
P	2	4.5	Deep	12.7	10.6	13.9	14.1	15.9	18.4	22.5
P	2	9	Deep	12.4	10.3	13.2	13.2	15.9	17.8	22.2
P	3	0	Deep	12.8	10	13.6	14.1	16.3	17.2	22.7
P	3	4.5	Deep	13	10	13.2	14.1	16.4	17	22.7
P	3	9	Deep	12.9	10.3	12.8	13.5	16	17.1	22.7
P	4	0	Deep	13.3	10.1	13.7	14.4	16	17.3	23.6
P	4	4.5	Deep	13.1	9.7	13.4	13.8	15.8	16.9	23.8

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditc	ranse	tance	Depth	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
C	1	0	Deep	18.4	19.4	20.7	23.4	21.3	22.6	22.3	22.6
C	1	4.5	Deep	18.1	19.6	21	21.5	21.0	22.0	22.0	22.0
C	2	0	Deep	18.3	19.6	20.6	22	21.8	22.3	22.2	22.2
C	2	4.5	Deep	18.4	20.2	20.8	21.8	23.0	22.2	22.0	21.7
C	3	0	Deep	17.6	19.2	20.2	21.7	22.8	22.1	22.0	21.7
C	3	4.5	Deep	17.6	19.2	20.6	21.3	23.5	21.9	22.0	21.7
C	1	0	Shallow	19.5	21.5	22.9	21.8	21.5	23.7	24.0	23.3
C	1	4.5	Shallow	19.6	21.5	22.8	23	21.5	23.3	23.8	23.2
C	2	0	Shallow	19.3	21.3	22.3	23.8	21.8	23.3	23.9	23.2
C	2	4.5	Shallow	19.7	21.5	22	22.9	23.0	22.8	23.8	23.0
C	3	0	Shallow	19.2	21.3	21.9	23.2	23.5	22.8	24.0	22.6
C	3	4.5	Shallow	19	21	22.3	22.7	23.5	22.5	23.6	22.6
C			Air	35	33.9	37	35.7	.	38.6	38.2	34.9
F	1	0	Deep	17.3	19.1	20	19.9	21.6	21.9	21.9	22.0
F	1	4.5	Deep	17.2	18.3	19.7	19.3	22.5	21.6	21.3	21.4
F	2	0	Deep	17	18	18.4	20.2	21.5	22.2	21.4	21.5
F	2	4.5	Deep	17.1	18.2	18.7	20.1	23.3	22.4	21.4	21.9
F	3	0	Deep	17.2	18.6	19.1	20.6	24.2	22.4	22.3	22.0
F	3	4.5	Deep	17.1	18.1	19.2	20.4	23.7	22.2	22.2	22.0
F	1	0	Shallow	18.5	20.6	21.6	21.7	21.6	22.8	23.7	23.0
F	1	4.5	Shallow	18	19.6	20.8	20.7	22.4	22.3	22.7	22.3
F	2	0	Shallow	18.6	20.1	20.5	22	22.5	23.6	23.7	22.9
F	2	4.5	Shallow	18.6	20.2	20.8	21.7	23.9	23.4	23.4	22.9
F	3	0	Shallow	18.5	20.4	20.9	22.2	23.9	23.4	24.3	23.3
F	3	4.5	Shallow	18.2	19.6	20.9	21.8	24.4	23.1	24.0	23.0
F			Air	27.8	29.9	34.2	26.5	.	37.5	35.3	33.0
N	1	0	Deep	17.5	19.6	20.7	22.5	22.8	23.6	23.2	23.1
N	1	4.5	Deep	18.2	20.1	20.8	22.2	23.0	23.4	23.0	22.9
N	2	0	Deep	18.2	19.9	20.4	21.9	22.6	23.2	22.5	22.3
N	2	4.5	Deep	18.2	20	19.9	21.3	24.6	22.9	21.6	22.2
N	3	0	Deep	18.2	19.8	20.2	22.9	25.0	23.7	22.7	22.2
N	3	4.5	Deep	19	20	20.6	23	24.7	24.0	23.2	22.7
N	1	0	Shallow	18.9	21.3	22.7	24.5	22.1	25.0	24.9	24.2
N	1	4.5	Shallow	19.6	22.2	22.9	24	22.9	24.5	24.5	23.8
N	2	0	Shallow	19.7	21.6	22.3	23.9	22.6	24.7	24.3	23.2
N	2	4.5	Shallow	19.5	21.5	21.4	23.3	23.3	23.3	23.1	23.1
N	3	0	Shallow	20.2	21.4	21.8	24.3	24.6	24.7	24.3	22.9
N	3	4.5	Shallow	20.4	.	22.6	25	24.3	25.1	24.8	23.4
N			Air	28.7	33.2	33.5	22.9	35.0	37.6	38.0	32.8
P	1	0	Deep	18.8	21.3	22.1	21.4	21.8	21.9	23.3	22.6
P	1	4.5	Deep	18.9	21.2	22.4	22	22.6	22.2	23.4	23.0
P	1	9	Deep	19.3	21.9	23.3	22.7	23.0	23.6	23.9	22.8
P	2	0	Deep	19.2	22.2	22.4	23	21.5	23.7	24.2	23.2
P	2	4.5	Deep	19.6	22.4	23.1	23.4	22.8	23.9	24.5	23.5
P	2	9	Deep	20.6	23.7	22.9	23.2	22.2	23.3	24.1	23.7
P	3	0	Deep	17.5	20.2	20.3	21.1	24.2	22.0	22.4	22.0
P	3	4.5	Deep	17.9	20.9	20.5	21.8	24.4	22.4	22.9	22.4
P	3	9	Deep	18.2	21.3	21.4	22.4	24.9	22.8	23.7	23.2
P	4	0	Deep	18	20.2	20.6	21.3	23.3	22.9	22.8	22.5
P	4	4.5	Deep	18.1	19.9	21	21.6	24.7	22.5	23.1	22.5

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	Distance	Depth	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002
C	1	0	Deep	22.4	21.4	21.2	19.4	18.4	15.6	13.8
C	1	4.5	Deep	22.6	21.5	21.1	19.1	18.4	15.8	14.1
C	2	0	Deep	21.8	21.5	20.6	19.5	18.2	15.8	14.1
C	2	4.5	Deep	22.2	.	20.8	19.9	18.9	16	14.6
C	3	0	Deep	22.4	21.4	20.7	19.4	18.4	14.8	13.3
C	3	4.5	Deep	22.4	21.6	21	19.9	18.8	15.9	14.1
C	1	0	Shallow	23.2	22.3	20.5	18.4	17.8	12.9	11.6
C	1	4.5	Shallow	23.3	22.3	20.6	18.3	17.6	13.1	11.7
C	2	0	Shallow	22.5	22.4	19.9	18.4	17.5	13.4	11.8
C	2	4.5	Shallow	22.9	.	20	18.4	17.9	13.3	12.1
C	3	0	Shallow	23.2	22.4	20	17.8	17.7	12.7	11.5
C	3	4.5	Shallow	23.4	22.4	20.1	18.3	17.6	13	11.6
C			Air	37.6	.	27.6	21.9	24.9	11.9	15.2
F	1	0	Deep	22.5	21.5	20.8	19.7	18.6	15.9	13.5
F	1	4.5	Deep	21.9	21.2	21	20.1	18.6	16.4	14.3
F	2	0	Deep	21.8	20.9	20.5	19.6	17.7	16.1	14.9
F	2	4.5	Deep	21.7	21.5	21.1	21	18.9	16.9	15.3
F	3	0	Deep	22.7	21.2	21	19.1	17.9	15.6	13.6
F	3	4.5	Deep	22.6	21.4	21.4	19.7	18.4	16.2	13.9
F	1	0	Shallow	22.8	22.3	20.1	18.1	17.7	13.7	11.2
F	1	4.5	Shallow	22.5	21.6	20.3	19	17.9	14.1	11.8
F	2	0	Shallow	22.8	21.9	20	18.7	17.1	13.7	12.8
F	2	4.5	Shallow	22.5	22.4	20.8	19.9	18.2	14.9	13.2
F	3	0	Shallow	23.9	22	20.1	17.4	16.9	13.1	11.2
F	3	4.5	Shallow	23.4	21.7	20.4	18	17.3	13.8	11.4
F			Air	22.7	22.9	23	14.7	21.4	11.8	13.6
N	1	0	Deep	22.7	22.3	21.4	20.6	19.8	17.6	15.9
N	1	4.5	Deep	22.9	22.3	21.8	20.6	19.8	17.3	15.3
N	2	0	Deep	22.7	22	20.7	19.6	17.6	15.7	14.2
N	2	4.5	Deep	22.7	21.6	20.8	20.1	18.5	16.2	14.3
N	3	0	Deep	22.7	22	21.3	20.1	18.2	16	14.5
N	3	4.5	Deep	23.0	22.1	21.8	20.4	18.7	16.3	14.9
N	1	0	Shallow	23.7	23.4	21	19.4	19.1	15.3	13.5
N	1	4.5	Shallow	23.6	23.2	21	19.1	18.6	14.7	13
N	2	0	Shallow	23.6	22.8	20	18.2	16.8	13	11.6
N	2	4.5	Shallow	23.6	22.6	20.3	18.9	17.7	13.9	12.4
N	3	0	Shallow	23.5	22.6	20.6	18.5	17	13.1	11.9
N	3	4.5	Shallow	23.8	22.8	20.9	18.9	17.8	13.8	12.5
N			Air	34.0	27.8	26.4	19.6	26	14.1	13.8
P	1	0	Deep	22.6	22.4	21.1	19.9	18	16.8	14.7
P	1	4.5	Deep	22.7	22.6	21.5	20.1	18.2	16.4	14.6
P	1	9	Deep	23.1	22.7	21.6	20.1	18.4	16.4	14.1
P	2	0	Deep	22.7	22.5	21.3	19.4	18.2	15.9	13.7
P	2	4.5	Deep	23.2	22.9	21.7	20	18.8	16	13.9
P	2	9	Deep	23.8	22.6	21.7	20.1	19.1	16.1	13.9
P	3	0	Deep	21.9	21.5	20.9	19.3	18.6	15.8	13.9
P	3	4.5	Deep	22.6	22	21.3	19.9	19.5	16.3	14.2
P	3	9	Deep	23.0	22.6	21.3	20	18.9	16.3	14.2
P	4	0	Deep	22.5	21.9	21.6	20.1	18.8	16.9	14.7
P	4	4.5	Deep	23.0	22	21.8	20.4	19.1	16.8	14.6

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	Distance	Depth	1/5/2003	1/20/2003	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/13/2003
C	1	0	Deep	13.1	12.2	11	10.5	11.8	13.5	15.4
C	1	4.5	Deep	13.1	12.2	11.2	10.5	11.9	13.3	15
C	2	0	Deep	12.9	12.1	10.8	10.8	12.2	14	13.9
C	2	4.5	Deep	13.2	12.1	10.9	10.4	11.7	14	14.9
C	3	0	Deep	12.2	11.9	10.7	10.3	11.8	13.9	14.5
C	3	4.5	Deep	12.9	11.8	11.1	10.3	12	13.6	14.2
C	1	0	Shallow	11.7	9.3	9.5	9.5	11.5	14.4	14.9
C	1	4.5	Shallow	11.5	9.6	9.6	9.5	11.2	14	14.5
C	2	0	Shallow	11.7	9.6	9.4	9.9	11.7	15.1	14.4
C	2	4.5	Shallow	11.7	9.3	9.2	9.5	11.3	14.4	14.1
C	3	0	Shallow	11	9.3	9	9.4	11.4	14.7	14.3
C	3	4.5	Shallow	11.3	9.1	9.2	9.2	11.3	14.4	13.5
C			Air	14.6	15.8	12.2	11.8	24.3	23	26.9
F	1	0	Deep	12.7	12	11.7	10.1	12.7	13.1	15.2
F	1	4.5	Deep	13.1	13.3	12	10.4	12.3	12.8	14.8
F	2	0	Deep	13.8	12.1	11.2	11.2	12.3	14.2	15.2
F	2	4.5	Deep	13.7	13.4	11.2	11.2	12.7	13.9	14.8
F	3	0	Deep	12.4	11.9	11.2	10.3	12.5	13.7	14.5
F	3	4.5	Deep	12.7	12.2	11.3	10.3	12.2	13.3	14.7
F	1	0	Shallow	11.5	9.5	10.2	9.4	12.8	14.1	15.2
F	1	4.5	Shallow	12	10.3	10.6	9.3	11.9	13.2	14.8
F	2	0	Shallow	12.4	9	9.7	10	12.2	14.8	14.7
F	2	4.5	Shallow	12.3	10.7	10.2	10	12.3	14.7	15.3
F	3	0	Shallow	11.1	8.9	9.5	9.5	12.2	14.5	14
F	3	4.5	Shallow	11.4	9.6	9.8	9.3	12.1	14.3	13.8
F			Air	14.6	12.2	10.9	11.1	22.1	21.9	25.3
N	1	0	Deep	15.5	14.8	13.5	12.4	14.2	15.1	16.2
N	1	4.5	Deep	14.4	14	13.1	11.4	13.1	14.6	15.9
N	2	0	Deep	13.5	12.2	11	11	12.3	14.6	15.3
N	2	4.5	Deep	13.1	12.9	10.7	10.6	12.1	14.4	14.5
N	3	0	Deep	13.5	13.5	11.8	11.4	13.1	14.1	15.4
N	3	4.5	Deep	13.6	13.3	11.9	11.2	12.6	14.1	15.5
N	1	0	Shallow	13.8	12.2	11.5	10.8	13.4	15.4	16.2
N	1	4.5	Shallow	12.8	11.1	10.9	10.1	12.6	15.2	15.2
N	2	0	Shallow	12.1	9.8	9.3	10.2	11.7	16	14.8
N	2	4.5	Shallow	12.2	10.7	9.2	9.6	11.8	15.1	14.5
N	3	0	Shallow	11.8	10.6	10.2	10.6	12.5	15.5	15.4
N	3	4.5	Shallow	12.2	10.9	10	10	12	15	15.4
N			Air	14.4	15.6	10.9	11.2	23.7	22.6	28
P	1	0	Deep	12.9	11.9	10.6	11.2	12.4	14	13.8
P	1	4.5	Deep	12.5	11.7	10.5	10.6	11.8	13.8	14.6
P	1	9	Deep	12.2	11.4	10.1	10	11	13.2	14.2
P	2	0	Deep	12.8	11.7	10.8	10.5	13.7	14.2	14.3
P	2	4.5	Deep	13	11.2	10.7	10.3	13.2	13.7	14.2
P	2	9	Deep	13	11.6	11	9.8	12.8	13.4	14.1
P	3	0	Deep	13.9	13	11.6	10.3	13.9	14.1	14.7
P	3	4.5	Deep	13.6	12.8	11.3	10.1	13.6	13.9	14.7
P	3	9	Deep	13.4	12.4	11.1	9.6	13.5	13.6	13.9
P	4	0	Deep	14.1	13.2	12.1	11.3	14.3	13.8	14.7
P	4	4.5	Deep	13.7	12.6	11.9	10.9	13.8	13.7	14.1

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	Distance (m)	Depth	4/30/2003	5/7/2003	5/18/2003	6/11/2003	6/27/2003
C	1	0	Deep	15.2	14.8	16.4	16.8	20
C	1	4.5	Deep	15	15.1	16.1	17.1	20.1
C	2	0	Deep	14.7	16	17	18.7	19.7
C	2	4.5	Deep	15.2	15.6	17.2	18.6	20.2
C	3	0	Deep	15.6	15.4	17	18.5	20.3
C	3	4.5	Deep	15.3	15.5	16.9	18.9	20.5
C	1	0	Shallow	16.8	16.2	17.8	19	21.7
C	1	4.5	Shallow	16.6	16.4	17.5	18.8	21.9
C	2	0	Shallow	16.7	17.2	18.5	21.6	21.6
C	2	4.5	Shallow	17.1	16.7	18.7	21	22
C	3	0	Shallow	15.2	16.3	18.2	20.3	22.6
C	3	4.5	Shallow	17	17	18.4	21.6	22.7
C			Air	15.6	30.9	21	37.3	35.5
F	1	0	Deep	14.7	15.6	15.9	18.1	19
F	1	4.5	Deep	14.1	15	15.2	17.2	18.6
F	2	0	Deep	14.8	15.3	16	17.9	19
F	2	4.5	Deep	14.6	14.9	15.6	18.2	19.3
F	3	0	Deep	14	15.7	16.4	18.1	19.2
F	3	4.5	Deep	14.7	15.1	15.9	18.4	19.4
F	1	0	Shallow	16.3	17.2	17.2	20.3	21.1
F	1	4.5	Shallow	15.1	15.8	16.1	19	19.9
F	2	0	Shallow	16.3	16.2	17.3	20.1	20.5
F	2	4.5	Shallow	15.8	16.3	16.9	20.1	20.7
F	3	0	Shallow	15	17.2	17.8	20.6	21.3
F	3	4.5	Shallow	15.9	16.2	16.9	20.8	21.1
F			Air	14	28.4	18.1	39.3	27.9
N	1	0	Deep	15.7	16.4	16.5	19.1	18.7
N	1	4.5	Deep	15.9	16.3	16.5	19	20.6
N	2	0	Deep	15.8	16.1	17.2	18.4	19.6
N	2	4.5	Deep	15.5	15.3	17	18.8	20.9
N	3	0	Deep	14.5	15.7	17	18.6	19.4
N	3	4.5	Deep	15.7	16	17.1	19.2	19.6
N	1	0	Shallow	17	17.6	18	21.6	20.5
N	1	4.5	Shallow	17.3	17.9	18.1	20.8	22.8
N	2	0	Shallow	17.5	17.3	18.8	20.7	20.8
N	2	4.5	Shallow	16.9	16.6	18.2	21	22.3
N	3	0	Shallow	15.7	17	18.4	21	21.3
N	3	4.5	Shallow	17.1	17.1	18.5	21.4	20.8
N			Air	14.5	32.2	20	33.6	34.2
P	1	0	Deep	16.5	15.8	16.9	18.3	19.3
P	1	4.5	Deep	16.3	15.7	17.1	19	19.9
P	1	9	Deep	16	15.7	17.3	19.8	20.6
P	2	0	Deep	16.8	17.5	18.1	20.3	21
P	2	4.5	Deep	16.7	17.3	18.3	20.7	21.2
P	2	9	Deep	16.1	16.6	17.7	20.2	21.5
P	3	0	Deep	15.6	16	16.9	18.7	19.1
P	3	4.5	Deep	15.4	15.8	16.8	18.7	19.5
P	3	9	Deep	15.4	15.4	17.2	18.7	19.5
P	4	0	Deep	15.2	16.8	16.6	18.7	19.6
P	4	4.5	Deep	15	16.6	16.6	18.3	20

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	Distance (m)	Depth	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002	2/2/2002
P	4	9	Deep	16.9	17.1	12.1	12.2	13.7	13.1
P	1	0	Shallow	15.1	14.2	9	9.8	11.4	13.5
P	1	4.5	Shallow	15.6	14.8	9.8	10.2	11.7	13.4
P	1	9	Shallow	15.5	15.3	9.4	9.7	11.4	12.8
P	2	0	Shallow	15	14.3	8.9	9.4	11.7	13.2
P	2	4.5	Shallow	15.9	15.1	9.7	10.1	12.3	13.5
P	2	9	Shallow	15.7	16.8	9.4	9.8	11.6	13.3
P	3	0	Shallow	14.9	14.8	9	9.6	12	12.7
P	3	4.5	Shallow	15.2	15.2	9.4	10	12	13.3
P	3	9	Shallow	15.3	15.6	9.4	10.3	12.2	13.1
P	4	0	Shallow	15.7	14.9	9.7	10.4	12.6	13.9
P	4	4.5	Shallow	15.9	15.1	9.5	10.3	12.2	13.8
P	4	9	Shallow	15.3	15.1	8.9	9.7	11.9	13.6
P			Air	.	16	14.2	8.2	22.6	11.1

Ditch	Transect	Distance	Depth	2/16/2002	3/4/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
P	4	9	Deep	13.1	9.5	13.1	13.7	16	17.2	23.9
P	1	0	Shallow	10.8	9.9	14.4	15.1	16.2	20.1	20.7
P	1	4.5	Shallow	11.1	7.4	14.2	14.8	17	20.1	20.5
P	1	9	Shallow	10.4	7	13.6	14.2	16.5	20.1	21
P	2	0	Shallow	11.7	10.3	14.7	14.9	16.3	20.3	23.9
P	2	4.5	Shallow	11.9	10.3	14.9	14.8	16.5	20.4	24
P	2	9	Shallow	10.9	9.6	14	13.7	16.1	19.8	23.7
P	3	0	Shallow	11.3	9.6	14	14.5	16.5	18.7	24.1
P	3	4.5	Shallow	11.3	9.6	13.9	14.5	16.7	18.9	24.2
P	3	9	Shallow	11.5	9.6	13.7	14.4	16.9	19.5	24.2
P	4	0	Shallow	11.5	9.6	14	14	16.2	19.4	25.2
P	4	4.5	Shallow	11.3	9.3	13.9	14.6	16.6	19.1	25.4
P	4	9	Shallow	11.1	9	14	14.1	16.5	19.3	25.6
P			Air	22	0.1	29.8	12.7	19.6	30.6	23.7

Ditch	Transect	Distance	Depth	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
P	4	9	Deep	18.1	21	21.7	23.6	24.4	23.5	23.9	23.4
P	1	0	Shallow	20.9	23.2	23.4	23.4	21.9	23.6	25.7	23.5
P	1	4.5	Shallow	20.9	23.5	23.4	24	22.9	23.5	25.8	24.1
P	1	9	Shallow	21.3	24	24.6	24.2	22.8	24.5	25.8	23.7
P	2	0	Shallow	20.9	23.1	24.4	24	21.7	24.7	26.2	24.1
P	2	4.5	Shallow	21.2	24.2	25	24.7	21.8	25.0	26.3	24.5
P	2	9	Shallow	19.3	22.6	24.1	25.3	23.0	24.2	25.9	24.8
P	3	0	Shallow	18.7	21.9	21.7	23.1	24.3	22.7	24.1	22.8
P	3	4.5	Shallow	19.2	22.1	22.1	23.1	24.8	22.8	24.8	23.2
P	3	9	Shallow	20.2	23.5	23.2	23.9	24.5	24.0	25.8	24.1
P	4	0	Shallow	19.5	21.6	22.5	23.4	23.8	23.9	24.7	23.5
P	4	4.5	Shallow	19.7	22.3	22.8	23.5	23.9	23.5	25.1	23.5
P	4	9	Shallow	19.5	23	23.4	24.1	24.9	24.2	25.7	24.0
P			Air	27.3	34	35.5	29.8	.	28.0	35.0	30.1

Appendix E. Water Chemistry Raw Data – Soil Temperature (°C) (continued)

Ditch	Transect	Distance	Depth	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002
P	4	9	Deep	24.3	22.7	22.3	20.6	19.4	16.6	14.4
P	1	0	Shallow	23.6	17.2	19.7	17.4	16	13.2	11.6
P	1	4.5	Shallow	23.8	23.5	20	17.8	16.8	13.6	11.9
P	1	9	Shallow	23.9	23.4	20	17.6	16.7	13.4	11.5
P	2	0	Shallow	23.9	23.3	19.9	17.2	16.9	12.9	11.2
P	2	4.5	Shallow	24.0	23.8	20.2	17.6	17.1	13	11.4
P	2	9	Shallow	24.3	23.3	20.3	17.7	17.5	13.5	11.3
P	3	0	Shallow	22.6	22.2	19.9	17.6	17.2	13.3	11.4
P	3	4.5	Shallow	22.9	22.6	20.3	18	17.8	13.4	11.6
P	3	9	Shallow	23.8	23.3	20.5	17.8	17.7	13.3	11.5
P	4	0	Shallow	23.3	22.8	20.4	18.3	17.6	13.7	11.8
P	4	4.5	Shallow	23.8	22.8	20.6	18.4	17.6	13.6	11.8
P	4	9	Shallow	24.6	23.2	20.9	18.3	17.6	13.3	11.2
P			Air	29.2	18.6	18.9	8.9	15.62	6.8	10

Ditch	Transect	Distance	Depth	1/5/2003	1/20/2003	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/13/2003
P	4	9	Deep	13.3	12.1	11.8	10.7	13.6	13.7	14.8
P	1	0	Shallow	11	7.9	8.5	10.5	11.5	14.8	13.2
P	1	4.5	Shallow	11	8.1	8.5	10.1	11.2	14.9	14.3
P	1	9	Shallow	10.6	7.7	8.4	9.5	10.5	14.3	13.8
P	2	0	Shallow	11.7	8	9.4	10.2	13.2	15	13.8
P	2	4.5	Shallow	11.9	8.2	8.6	9.9	12.9	14.8	13.9
P	2	9	Shallow	11.8	8.3	9.1	9.3	12.6	14.5	13.5
P	3	0	Shallow	12.6	9.8	9.5	9.6	13.6	14.8	14.1
P	3	4.5	Shallow	12.5	9.7	9.6	9.1	13.6	14.7	13.9
P	3	9	Shallow	12.2	9.3	9.4	9.1	13.5	14.5	13.9
P	4	0	Shallow	12.5	9.4	10.4	10.2	13.8	14.8	14
P	4	4.5	Shallow	12.2	9	10	10	13.5	14	14.3
P	4	9	Shallow	11.7	8.3	9.5	9.5	13.8	14.6	14.1
P			Air	9.3	10.2	8	13.3	18.9	15.9	18.8

Ditch	Transect	Distance (m)	Depth	4/30/2003	5/7/2003	5/18/2003	6/11/2003	6/27/2003
P	4	9	Deep	15	16.9	16.6	18.2	21
P	1	0	Shallow	18.4	17.5	19	21.4	21.8
P	1	4.5	Shallow	18.5	17.4	19	22	22.4
P	1	9	Shallow	18.2	16.9	19.2	23	23
P	2	0	Shallow	18.7	18.8	19.6	22.8	22.8
P	2	4.5	Shallow	18.8	18.7	20.1	23.5	23.7
P	2	9	Shallow	18.1	17.7	19.4	22.5	23
P	3	0	Shallow	16.8	16.9	18	21.1	21
P	3	4.5	Shallow	17.1	16.9	18.3	21	21.2
P	3	9	Shallow	17.5	17.1	18.9	21.8	21.9
P	4	0	Shallow	17.2	18.9	18.3	21.6	21.7
P	4	4.5	Shallow	17	18.1	18.2	20.4	21.7
P	4	9	Shallow	16.8	18.4	18.2	20.7	22.4
P			Air	14	23	18	32.3	28.5

Appendix E. Water Chemistry Raw Data – Groundwater pH

Ditch	Transect	Distance (m)	Depth	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002	2/2/2002
C	1	0	Deep	.	.	.	.	.	.
C	1	0	Intermed	.	4.36	3.96	4.75	4.29	4.48
C	1	0	Shallow	.	.	.	.	.	.
C	1	4.5	Deep	.	.	.	.	.	.
C	1	4.5	Intermed	.	4.59	3.98	4.73	4.51	4.44
C	1	4.5	Shallow	.	.	.	.	.	.
C	2	0	Deep	.	.	.	.	.	.
C	2	0	Intermed	.	.	4.18	4.65	4.26	4.63
C	2	0	Shallow	.	.	.	.	.	.
C	2	4.5	Deep	.	.	.	.	.	.
C	2	4.5	Intermed	.	.	3.91	4.65	4.53	4.51
C	2	4.5	Shallow	.	.	.	.	.	.
C	3	0	Deep	.	.	.	.	.	.
C	3	0	Intermed	.	4.43	4.9	4.39	4.33	4.35
C	3	0	Shallow	.	.	.	.	.	.
C	3	4.5	Deep	.	.	.	.	.	.
C	3	4.5	Intermed	.	4.97	4.13	4.31	4.09	4.07
C	3	4.5	Shallow	.	.	.	.	.	.
F	1	0	Deep	.	.	.	.	.	.
F	1	0	Intermed	.	5.27	5.19	4.78	4.87	4.66
F	1	0	Shallow	.	.	.	.	.	.
F	1	4.5	Deep	.	.	.	.	.	.
F	1	4.5	Intermed	.	4.87	5.04	4.73	4.7	4.52
F	1	4.5	Shallow	.	.	.	.	.	.
F	2	0	Deep	.	.	.	.	.	.
F	2	0	Intermed	.	.	5.9	5.48	5.63	5.73
F	2	0	Shallow	.	.	.	.	.	.
F	2	4.5	Deep	.	.	.	.	.	.
F	2	4.5	Intermed	.	.	4.49	4.27	4.41	4.41
F	2	4.5	Shallow	.	.	.	.	.	.
F	3	0	Deep	.	.	.	.	.	.
F	3	0	Intermed	.	4.7	4.84	4.35	4.15	4.13
F	3	0	Shallow	.	.	.	.	.	.
F	3	4.5	Deep	.	.	.	.	.	.
F	3	4.5	Intermed	.	.	4.98	4.83	4.82	4.73
F	3	4.5	Shallow	.	.	.	.	.	.
N	1	0	Deep	.	.	.	.	.	.
N	1	0	Intermed	.	4.93	4.76	4.64	4.45	4.62
N	1	0	Shallow	.	.	.	.	.	.
N	1	4.5	Deep	.	.	.	.	.	.
N	1	4.5	Intermed	.	4.74	4.46	4.28	4.1	4.15
N	1	4.5	Shallow	.	.	.	.	.	.
N	2	0	Deep	.	.	.	.	.	.
N	2	0	Intermed	.	.	4.64	4.51	4.32	4.45
N	2	0	Shallow	.	.	.	.	.	.
N	2	4.5	Deep	.	.	.	.	.	.
N	2	4.5	Intermed	.	.	4.36	4.33	4.05	4.24
N	2	4.5	Shallow	.	.	.	.	.	.
N	3	0	Deep	.	.	.	.	.	.
N	3	0	Intermed	.	6.23	5.54	5.5	5.42	5.59
N	3	0	Shallow	.	.	.	.	.	.
N	3	4.5	Deep	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance (	Depth	2/16/2002	3/4/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
C	1	0	Deep	.	.	no pH;	.	5.36	5.48	5.02
C	1	0	Intermed	4.47	4.59	forgot	4.44	4.94	4.66	4.15
C	1	0	Shallow	.	.	bottles	.	.	4.8	5
C	1	4.5	Deep	.	.	.	.	5.32	5.52	4.93
C	1	4.5	Intermed	4.41	4.64	.	4.45	4.51	4.46	4.09
C	1	4.5	Shallow	.	.	.	.	.	4.54	4.23
C	2	0	Deep	.	.	.	.	4.89	5.44	4.81
C	2	0	Intermed	3.98	5.23	.	4.67	4.8	4.65	4.44
C	2	0	Shallow	.	.	.	.	.	4.85	4.33
C	2	4.5	Deep	.	.	.	.	5.12	5.01	4.4
C	2	4.5	Intermed	4.41	4.75	.	4.51	4.89	4.48	4
C	2	4.5	Shallow	.	.	.	.	.	4.55	4.15
C	3	0	Deep	.	.	.	.	4.86	4.92	4.71
C	3	0	Intermed	3.86	4.7	.	4.3	4.83	4.89	4.44
C	3	0	Shallow	.	.	.	.	.	4.81	4.5
C	3	4.5	Deep	.	.	.	.	4.7	4.5	4.11
C	3	4.5	Intermed	3.8	4.22	.	4.11	4.75	4.5	4
C	3	4.5	Shallow	.	.	.	.	.	4.59	4.18
F	1	0	Deep	.	.	.	.	4.98	5.52	5.65
F	1	0	Intermed	4.57	4.92	.	4.69	5.21	4.93	4.91
F	1	0	Shallow	.	.	.	.	.	5.12	5.37
F	1	4.5	Deep	.	.	.	.	5.38	5.58	5.49
F	1	4.5	Intermed	4.49	4.94	.	4.57	4.72	4.77	4.9
F	1	4.5	Shallow	.	.	.	.	.	4.96	5.26
F	2	0	Deep	.	.	.	.	5.52	5.66	5.83
F	2	0	Intermed	5.43	6.05	.	4.43	4.72	5.66	5.69
F	2	0	Shallow	.	.	.	.	.	4.53	4.87
F	2	4.5	Deep	.	.	.	.	5.65	5.79	5.76
F	2	4.5	Intermed	4.29	4.71	.	5.43	4.59	4.71	4.62
F	2	4.5	Shallow	.	.	.	.	.	4.52	4.77
F	3	0	Deep	.	.	.	.	4.24	4.45	4.36
F	3	0	Intermed	3.68	4.15	.	3.71	4.24	4.31	4.65
F	3	0	Shallow	.	.	.	.	.	4.44	4.34
F	3	4.5	Deep	.	.	.	.	4.16	4.47	4.73
F	3	4.5	Intermed	4.56	4.76	.	4.41	4.36	4.76	4.5
F	3	4.5	Shallow	.	.	.	.	.	4.65	4.62
N	1	0	Deep	.	.	.	.	5.79	5.45	5.12
N	1	0	Intermed	5.35	4.9	.	4.78	4.66	4.97	4.7
N	1	0	Shallow	.	.	.	.	.	4.48	4.24
N	1	4.5	Deep	.	.	.	.	4.8	4.7	4.33
N	1	4.5	Intermed	4.35	4.41	.	4.37	4.85	4.32	4.15
N	1	4.5	Shallow	.	.	.	.	.	4.44	4.17
N	2	0	Deep	.	.	.	.	4.56	4.83	4.63
N	2	0	Intermed	4.69	5.21	.	4.58	4.97	4.48	4.14
N	2	0	Shallow	.	.	.	.	.	4.36	4.08
N	2	4.5	Deep	.	.	.	.	4.67	4.58	4.13
N	2	4.5	Intermed	4.44	4.58	.	4.55	4.54	4.42	3.98
N	2	4.5	Shallow	.	.	.	.	.	4.33	3.92
N	3	0	Deep	.	.	.	.	5.33	5.78	5.86
N	3	0	Intermed	5.71	5.3	.	5.85	6.06	5.58	5.2
N	3	0	Shallow	.	.	.	.	.	4.86	4.21
N	3	4.5	Deep	.	.	.	.	5.92	5.92	5.47

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance	Depth	5/29/2002	6/10/2002	6/23/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002
C	1	0	Deep	5.46	5.44	5.52	obe only worke	6.1	probe	5.71
C	1	0	Intermed	5.59	4.89	4.97	during Fditch	5.75	not work	4.77
C	1	0	Shallow	.	.	.	.	.	.	.
C	1	4.5	Deep	5.37	5.41	5.56	.	6.16	.	5.63
C	1	4.5	Intermed	4.68	4.61	4.96	.	5.82	.	5.87
C	1	4.5	Shallow	.	.	.	.	.	.	.
C	2	0	Deep	5.5	5.5	5.56	.	6.18	.	5.65
C	2	0	Intermed	4.94	5.17	5.13	.	5.71	.	5.19
C	2	0	Shallow	.	.	.	.	.	.	.
C	2	4.5	Deep	5.07	5.25	5.35	.	6.02	.	5.81
C	2	4.5	Intermed	4.58	4.96	4.89	.	5.63	.	5.15
C	2	4.5	Shallow	.	.	.	.	.	.	.
C	3	0	Deep	5.13	5.07	5.3	.	5.46	.	5.33
C	3	0	Intermed	5.5	5.04	5.03	.	6.28	.	5.75
C	3	0	Shallow	.	.	.	.	.	.	.
C	3	4.5	Deep	4.7	5.09	5.02	.	5.84	.	4.89
C	3	4.5	Intermed	4.68	5	4.81	.	5.93	.	6
C	3	4.5	Shallow	.	.	.	.	.	.	.
F	1	0	Deep	5.69	5.48	5.94	4.83	6.73	.	6.41
F	1	0	Intermed	5.13	4.79	5.24	5.03	6.22	.	5.7
F	1	0	Shallow	.	.	.	.	.	.	.
F	1	4.5	Deep	5.55	5.31	5.87	6.93	6.57	.	6.24
F	1	4.5	Intermed	5.4	4.62	5.28	6.94	5.84	.	5.22
F	1	4.5	Shallow	.	.	.	.	.	.	.
F	2	0	Deep	5.68	5.73	6.03	6.16	6.96	.	6.12
F	2	0	Intermed	5.55	5.45	5.86	5.76	6.73	.	5.9
F	2	0	Shallow	.	.	.	.	.	.	.
F	2	4.5	Deep	5.77	5.65	6	5.98	6.22	.	6.07
F	2	4.5	Intermed	5.1	4.5	5.03	4.93	6.65	.	4.7
F	2	4.5	Shallow	.	.	.	.	.	.	.
F	3	0	Deep	4.48	4.35	4.85	4.94	5.69	.	4.77
F	3	0	Intermed	4.33	3.98	4.47	4.47	5.55	.	.
F	3	0	Shallow	.	.	.	.	.	.	.
F	3	4.5	Deep	4.38	4.28	4.88	4.81	5.57	.	4.8
F	3	4.5	Intermed	4.64	nd	4.72	4.66	5.4	.	4.68
F	3	4.5	Shallow	.	.	.	.	.	.	.
N	1	0	Deep	5.52	5.45	5.43	.	5.9	.	5.64
N	1	0	Intermed	5.18	5.24	5.15	.	5.87	.	.
N	1	0	Shallow	.	.	.	.	.	.	.
N	1	4.5	Deep	4.84	4.92	4.86	.	5.47	.	5.05
N	1	4.5	Intermed	4.78	4.81	4.74	.	5.51	.	5.05
N	1	4.5	Shallow	.	.	.	.	.	.	.
N	2	0	Deep	4.99	5.15	5.22	.	5.92	.	5.46
N	2	0	Intermed	4.67	5.32	4.91	.	5.85	.	5.19
N	2	0	Shallow	.	.	.	.	.	.	.
N	2	4.5	Deep	4.65	4.97	5	.	5.77	.	5.16
N	2	4.5	Intermed	4.6	5.32	5	.	6.08	.	5.7
N	2	4.5	Shallow	.	.	.	.	.	.	.
N	3	0	Deep	5.85	5.99	5.93	.	6.85	.	6.21
N	3	0	Intermed	5.65	5.8	5.79	.	6.59	.	5.92
N	3	0	Shallow	.	.	.	.	.	.	.
N	3	4.5	Deep	5.99	6.03	6.02	.	6.77	.	6.25

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance	Depth	11/2/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/2003	6/11/2003
C	1	0	Deep	5.09	4.83	5.22	5.18	5.1	5.37	5.69	no pH
C	1	0	Intermed	4.22	4.44	4.3	4.57	4.92	4.38	5.2	probe
C	1	0	Shallow	.	4.54	4.95	5.07	4.06	4.87	5.23	broken
C	1	4.5	Deep	5.27	4.81	5.2	5.15	5.1	5.39	5.68	
C	1	4.5	Intermed	5.98	4.02	4.62	4.63	4.42	4.78	5.3	
C	1	4.5	Shallow	.	4.78	4.57	4.71	4.33	4.79	5.4	
C	2	0	Deep	4.01	4.37	5.2	5.12	4.97	5.68	5.6	
C	2	0	Intermed	4.55	4.1	4.77	4.5	4.7	5.32	5.65	
C	2	0	Shallow	.	5.1	.	4.67	4.66	5.52	5.79	
C	2	4.5	Deep	4.68	3.59	4.12	3.81	4.62	5.25	5.64	
C	2	4.5	Intermed	4.66	4.34	4.59	4.5	4.51	5.53	5.32	
C	2	4.5	Shallow	.	4.35	4.61	4.62	4.47	5.07	5.21	
C	3	0	Deep	4.21	3.74	4.62	4.92	4.51	5.1	5.28	
C	3	0	Intermed	4.31	4.42	4	4.55	4.16	4.8	4.97	
C	3	0	Shallow	.	4.77	4.9	4.84	4.68	5.08	5.08	
C	3	4.5	Deep	3.95	3.61	3.85	3.93	3.87	4.66	4.83	
C	3	4.5	Intermed	4.57	4.59	4.72	4.7	4.63	4.83	4.63	
C	3	4.5	Shallow	.	4.6	4.62	4.72	4.57	4.86	4.85	
F	1	0	Deep	5.6	5.66	5.1	5.28	4.8	5.75	6.3	
F	1	0	Intermed	5.22	4.52	4.59	5.11	4.94	5.48	5.94	
F	1	0	Shallow	.	5.02	.	.	5.34	5.62	6.08	
F	1	4.5	Deep	5.49	5.18	5.02	5.36	5.04	5.68	6.43	
F	1	4.5	Intermed	4.5	4.12	3.95	4.51	4.52	5.28	5.98	
F	1	4.5	Shallow	.	4.66	4.53	4.72	4.61	5.18	6.22	
F	2	0	Deep	5.83	5.47	5.33	5.39	5.32	6.25	6.45	
F	2	0	Intermed	5.93	5.4	5.34	5.43	5.21	6.14	6.13	
F	2	0	Shallow	.	.	.	.	4.6	5.38	5.95	
F	2	4.5	Deep	5.51	5.47	5.39	5.4	5.06	5.57	6.71	
F	2	4.5	Intermed	4.01	3.93	3.97	4.52	4.22	5.98	5.89	
F	2	4.5	Shallow	.	.	4.19	4.63	4.09	5.18	5.91	
F	3	0	Deep	4.17	3.94	3.77	4.05	4.01	4.73	5.25	
F	3	0	Intermed	3.94	4.77	3.58	4.17	3.95	4.48	5.16	
F	3	0	Shallow	.	5.41	4.64	.	4.6	5.21	5.46	
F	3	4.5	Deep	4.08	4.04	3.58	4	4.01	4.6	5.65	
F	3	4.5	Intermed	4.34	3.77	4.5	4.7	4.93	5.25	5.19	
F	3	4.5	Shallow	.	.	4.36	.	4.46	4.94	5.44	
N	1	0	Deep	5.55	5.21	5.41	5.39	5.08	5.74	5.69	
N	1	0	Intermed	5.52	4.56	4.81	5.13	4.53	5.15	5.54	
N	1	0	Shallow	.	4.7	4.59	4.93	4.44	4.88	5.09	
N	1	4.5	Deep	4.79	4.53	4.78	4.86	4.61	5.08	5.36	
N	1	4.5	Intermed	5.1	4.19	4.39	4.44	4.29	4.72	5.01	
N	1	4.5	Shallow	.	5.01	.	4.84	4.45	4.69	5.12	
N	2	0	Deep	4.94	4.76	4.76	5.22	4.72	5.55	5.78	
N	2	0	Intermed	5.37	4.44	4.48	4.83	4.5	5.28	5.46	
N	2	0	Shallow	.	4.58	4.57	4.67	4.4	5.03	5.24	
N	2	4.5	Deep	4.69	4.41	4.45	4.65	4.53	5.27	5.22	
N	2	4.5	Intermed	5.04	4.39	4.21	4.43	4.48	5.18	5.23	
N	2	4.5	Shallow	.	4.63	4.37	4.4	4.2	4.82	5.05	
N	3	0	Deep	6.01	5.83	5.74	5.67	5.68	6.04	6.49	
N	3	0	Intermed	6.22	5.66	5.67	5.49	5.91	5.96	6.39	
N	3	0	Shallow	.	5.17	5.21	5.23	5.23	5.32	6.16	
N	3	4.5	Deep	6.18	5.88	5.81	5.82	5.93	6.11	6.12	

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance (m)	Depth	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002	2/2/2002
N	3	4.5	Intermed	.	6.04	5.8	5.61	5.62	5.54
N	3	4.5	Shallow	.	.	.	.	.	.
P	1	0	Deep	.	.	.	.	.	.
P	1	0	Intermed	.	4.15	3.51	3.73	3.75	3.62
P	1	0	Shallow	.	.	.	.	.	.
P	1	4.5	Deep	.	.	.	.	.	.
P	1	4.5	Intermed	.	.	4.1	4.8	4.72	4.72
P	1	4.5	Shallow	.	.	.	.	.	.
P	1	9	Deep	.	.	.	.	.	.
P	1	9	Intermed	.	4.53	3.92	4.71	4.71	4.57
P	1	9	Shallow	.	.	.	.	.	.
P	2	0	Deep	.	.	.	.	.	.
P	2	0	Intermed	.	.	3.34	3.77	4.6	3.89
P	2	0	Shallow	.	.	.	.	.	.
P	2	4.5	Deep	.	.	.	.	.	.
P	2	4.5	Intermed	.	.	4.35	4.97	5.2	4.85
P	2	4.5	Shallow	.	.	.	.	.	.
P	2	9	Deep	.	.	.	.	.	.
P	2	9	Intermed	.	.	4.82	5.37	5.3	5.07
P	2	9	Shallow	.	.	.	.	.	.
P	3	0	Deep	.	.	.	.	.	.
P	3	0	Intermed	.	.	5.6	6.02	5.84	5.75
P	3	0	Shallow	.	.	.	.	.	.
P	3	4.5	Deep	.	.	.	.	.	.
P	3	4.5	Intermed	.	.	5	5.86	5.7	5.58
P	3	4.5	Shallow	.	.	.	.	.	.
P	3	9	Deep	.	.	.	.	.	.
P	3	9	Intermed	.	.	4.93	5.81	5.74	5.52
P	3	9	Shallow	.	.	.	.	.	.
P	4	0	Deep	.	.	.	.	.	.
P	4	0	Intermed	.	6.08	4.57	5.4	5.34	5.37
P	4	0	Shallow	.	.	.	.	.	.
P	4	4.5	Deep	.	.	.	.	.	.
P	4	4.5	Intermed	.	.	4.4	4.94	5.15	4.88
P	4	4.5	Shallow	.	.	.	.	.	.
P	4	9	Deep	.	.	.	.	.	.
P	4	9	Intermed	.	5.66	5.17	5.46	5.46	5.15
P	4	9	Shallow	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance (	Depth	2/16/2002	3/4/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
N	3	4.5	Intermed	5.94	5.98	.	5.93	5.51	5.94	5.44
N	3	4.5	Shallow	.	.	.	.	.	5.23	4.66
P	1	0	Deep	.	.	.	.	5.77	5.52	4.96
P	1	0	Intermed	3.69	3.78	.	3.84	.	4.16	3.68
P	1	0	Shallow	.	.	.	.	.	.	.
P	1	4.5	Deep	.	.	.	.	3.92	3.93	3.66
P	1	4.5	Intermed	4.6	4.64	.	4.49	4.99	4.3	3.99
P	1	4.5	Shallow	.	.	.	.	.	.	.
P	1	9	Deep	.	.	.	.	4.02	4.03	3.67
P	1	9	Intermed	4.48	4.97	.	4.39	4.8	4.25	3.96
P	1	9	Shallow	.	.	.	.	.	.	.
P	2	0	Deep	.	.	.	.	5.24	5.25	5.01
P	2	0	Intermed	3.45	3.39	.	3.85	6.45	4.16	3.35
P	2	0	Shallow	.	.	.	.	.	.	.
P	2	4.5	Deep	.	.	.	.	5.18	5.09	4.91
P	2	4.5	Intermed	4.78	4.91	.	4.71	4.89	4.84	4.28
P	2	4.5	Shallow	.	.	.	.	.	.	.
P	2	9	Deep	.	.	.	.	5.32	5.27	5.1
P	2	9	Intermed	5.13	4.58	.	5.3	5.2	4.99	4.8
P	2	9	Shallow	.	.	.	.	.	5.03	.
P	3	0	Deep	.	.	.	.	5.6	5.63	5.47
P	3	0	Intermed	5.81	5.84	.	5.96	5.7	5.64	5.39
P	3	0	Shallow	.	.	.	.	.	5.66	.
P	3	4.5	Deep	.	.	.	.	5.49	5.58	5.27
P	3	4.5	Intermed	5.67	5.62	.	5.55	5.4	5.67	5.44
P	3	4.5	Shallow	.	.	.	.	.	5.66	.
P	3	9	Deep	.	.	.	.	5.35	5.62	5.41
P	3	9	Intermed	5.33	5.14	.	5.7	5.09	5.51	5.28
P	3	9	Shallow	.	.	.	.	.	5.59	.
P	4	0	Deep	.	.	.	.	5.25	5.51	5.34
P	4	0	Intermed	5.25	5.25	.	.	5.01	5.19	5.48
P	4	0	Shallow	.	.	.	.	.	5.31	.
P	4	4.5	Deep	.	.	.	.	5.26	5.39	5.29
P	4	4.5	Intermed	4.74	4.96	.	4.92	5.02	5.15	4.69
P	4	4.5	Shallow	.	.	.	.	.	5.07	.
P	4	9	Deep	.	.	.	.	5.41	5.37	5.15
P	4	9	Intermed	5.02	5.48	.	5.22	5.55	5.37	4.87
P	4	9	Shallow	.	.	.	.	.	5.2	.

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance	Depth	5/29/2002	6/10/2002	6/23/2002	7/14/2002	8/11/2002	9/8/2002	10/9/2002
N	3	4.5	Intermed	6	5.99	5.9	.	6.49	.	6.09
N	3	4.5	Shallow	.	.	.	.	.	.	.
P	1	0	Deep	5.46	5.91	5.66	.	5.56	.	5.75
P	1	0	Intermed	4.4	.	4.78	.	4.67	.	4.63
P	1	0	Shallow	.	.	.	.	.	.	.
P	1	4.5	Deep	4	5	4.71	.	4.35	.	3.93
P	1	4.5	Intermed	4.28	4.95	4.98	.	4.62	.	4.24
P	1	4.5	Shallow	.	.	.	.	.	.	.
P	1	9	Deep	4.26	5	4.87	.	4.53	.	3.81
P	1	9	Intermed	3.99	5.1	5.01	.	4.65	.	4.23
P	1	9	Shallow	.	.	.	.	.	.	.
P	2	0	Deep	5.1	5.69	5.37	.	5	.	5.24
P	2	0	Intermed	3.83	4.83	4.47	.	4.04	.	3.66
P	2	0	Shallow	.	.	.	.	.	.	.
P	2	4.5	Deep	4.91	5.95	5.46	.	5.23	.	5.2
P	2	4.5	Intermed	4.22	5.34	4.67	.	4.48	.	4.26
P	2	4.5	Shallow	.	.	.	.	.	.	.
P	2	9	Deep	5.31	5.8	5.61	.	5.47	.	5.42
P	2	9	Intermed	4.97	5.47	4.95	.	4.66	.	4.03
P	2	9	Shallow	.	.	.	.	.	.	.
P	3	0	Deep	5.56	6	5.56	.	5.61	.	5.74
P	3	0	Intermed	5.43	5.77	5.55	.	5.75	.	5.99
P	3	0	Shallow	.	.	.	.	.	.	.
P	3	4.5	Deep	5.5	6	5.39	.	5.55	.	5.55
P	3	4.5	Intermed	5.69	6.14	5.6	.	5.81	.	5.91
P	3	4.5	Shallow	.	.	.	.	.	.	.
P	3	9	Deep	5.56	6	5.54	.	5.78	.	5.63
P	3	9	Intermed	5.62	6.14	5.74	.	5.93	.	6.1
P	3	9	Shallow	.	.	.	.	.	.	.
P	4	0	Deep	5.5	6.05	5.51	.	6.19	.	5.76
P	4	0	Intermed	5.5	6.08	5.38	.	6.24	.	6.13
P	4	0	Shallow	.	.	.	.	.	.	.
P	4	4.5	Deep	5.45	5.7	5.46	.	6.21	.	5.84
P	4	4.5	Intermed	5.13	5.75	5.09	.	6.15	.	6.29
P	4	4.5	Shallow	.	.	.	.	.	.	.
P	4	9	Deep	5.41	5.8	5.42	.	6.14	.	5.7
P	4	9	Intermed	5.54	5.88	5.64	.	6.27	.	6.09
P	4	9	Shallow	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Groundwater pH (continued)

Ditch	Transect	Distance	Depth	11/2/2002	12/2/2002	1/5/2003	2/9/2003	3/12/2003	4/13/2003	5/7/2003	6/11/2003
N	3	4.5	Intermed	6.09	5.72	5.77	5.85	5.55	6.05	6.11	
N	3	4.5	Shallow	.	4.69	4.62	4.94	4.59	5.33	5.82	
P	1	0	Deep	4.16	4.17	4.5	4.97	4.8	5.42	4.11	
P	1	0	Intermed	5.06	4.16	4.1	4.15	3.95	4.02	5.26	
P	1	0	Shallow	.	.	.	.	.	.	.	
P	1	4.5	Deep	3.65	3.9	4.05	4	3.79	3.93	3.99	
P	1	4.5	Intermed	4.6	4.37	4.59	4.64	4.44	5.02	4.45	
P	1	4.5	Shallow	.	.	.	.	4.9	5.17	4.81	
P	1	9	Deep	3.96	4.02	4.24	4.2	4.1	4.31	4.16	
P	1	9	Intermed	4.57	4.54	4.64	4.53	4.5	5.06	4.58	
P	1	9	Shallow	.	.	.	.	.	5.08	4.72	
P	2	0	Deep	4.28	4.75	5.23	5.06	4.99	5.39	4.09	
P	2	0	Intermed	3.79	3.33	3.53	3.8	3.56	3.7	5.18	
P	2	0	Shallow	.	.	.	.	5.69	.	.	
P	2	4.5	Deep	4.53	4.72	4.7	4.33	4.9	5.25	5.05	
P	2	4.5	Intermed	4.51	4.29	4.77	4.79	4.94	5.38	4.96	
P	2	4.5	Shallow	.	.	.	5.02	4.94	5.41	4.98	
P	2	9	Deep	5.65	5.02	5.38	5.19	5.1	5.38	5.25	
P	2	9	Intermed	4.28	5.38	5.35	5.25	5.28	5.75	5.33	
P	2	9	Shallow	.	.	.	5.28	5.19	5.55	5.35	
P	3	0	Deep	5.8	5.54	5.22	5.41	5.41	5.71	5.87	
P	3	0	Intermed	6.32	5.69	5.57	5.66	5.45	5.64	5.91	
P	3	0	Shallow	.	.	5.44	5.71	5.62	5.66	5.89	
P	3	4.5	Deep	5.47	5.01	4.93	5.23	5.17	5.49	5.75	
P	3	4.5	Intermed	5.87	5.28	5.27	5.32	5.63	5.63	5.86	
P	3	4.5	Shallow	.	.	5.1	5.46	5.54	5.81	5.9	
P	3	9	Deep	5.56	5.37	5.15	5.38	4.21	5.6	5.66	
P	3	9	Intermed	5.98	5.25	5.45	5.41	5.14	5.89	5.78	
P	3	9	Shallow	.	.	5.22	5.66	5	5.93	6.01	
P	4	0	Deep	5.3	5.16	4.99	5.42	5.17	5.51	6.93	
P	4	0	Intermed	5.9	5.18	5.11	5.34	5.02	5.52	6.49	
P	4	0	Shallow	.	.	4.9	5.75	5.32	5.77	6.74	
P	4	4.5	Deep	5.18	5.23	4.91	5.39	4.92	5.45	6.03	
P	4	4.5	Intermed	4.95	5.01	4.75	5.09	4.88	5.32	6.05	
P	4	4.5	Shallow	.	.	4.62	5.34	4.83	5.45	6.25	
P	4	9	Deep	5.4	5.34	5.24	5.46	5.06	5.53	5.95	
P	4	9	Intermed	5.6	5.15	4.81	5.31	5.06	5.63	5.97	
P	4	9	Shallow	.	.	4.78	5.11	4.85	5.15	5.93	

Appendix E. Water Chemistry Raw Data – Redox Potential (mV)

Ditch	Transe	Distance (m)	Position	Depth	soil pH	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002
C	1	0	1	shallow	4.46	-263	-248	-283	-265	-264
C	1	0	2	deep	4.25	-237	-223	-236	-239	-238
C	1	0	3	shallow	4.39	-229	-218	-200	-193	-9
C	1	0	4	shallow	4.36	-67	-104	711	700	652
C	1	0	5	deep	4.14	-189	-195	-140	-198	-208
C	1	0	6	shallow	4.32	-119	-66	29	52	46
C	1	0	7	shallow	4.38	-206	-204	-155	-190	-15
C	1	0	8	deep	4.23	-264	-223	-253	-261	-268
C	1	4.5	1	shallow	4.43	9	39	233	282	387
C	1	4.5	2	deep	4.34	-204	-190	-224	-249	-260
C	1	4.5	3	shallow	4.45	-140	-166	523	408	412
C	1	4.5	4	shallow	4.51	-276	-249	-133	-145	-142
C	1	4.5	5	deep	4.40	-200	-190	-203	-194	-207
C	1	4.5	6	shallow	4.44	-249	-151	-138	-182	-129
C	1	4.5	7	shallow	4.57	-241	-234	-227	-121	205
C	1	4.5	8	deep	4.35	-272	-250	-268	-268	-275
C	2	0	1	shallow	4.52	-155	-134	-117	-150	-192
C	2	0	2	deep	4.46	-253	-239	-237	-261	-242
C	2	0	3	shallow	4.58	-170	116	52	-71	-100
C	2	0	4	shallow	4.43	724	715	698	706	673
C	2	0	5	deep	4.68	-280	-253	-274	-294	-307
C	2	0	6	shallow	4.42	-153	-20	554	575	567
C	2	0	7	shallow	4.35	124	279	297	281	233
C	2	0	8	deep	4.53	-286	-273	-295	-299	-306
C	2	4.5	1	shallow	4.42	519	689	668	647	615
C	2	4.5	2	deep	4.43	-267	-248	-259	-267	-273
C	2	4.5	3	shallow	4.57	-41	-97	106	105	558
C	2	4.5	4	shallow	4.54	-298	-263	326	241	119
C	2	4.5	5	deep	4.45	-227	-221	-241	-249	-256
C	2	4.5	6	shallow	4.46	21	241	243	174	173
C	2	4.5	7	shallow	4.33	171	368	327	316	295
C	2	4.5	8	deep	4.55	-226	-220	-233	-240	-248
C	3	0	1	shallow	4.32	-258	-241	-269	-299	-264
C	3	0	2	deep	4.31	-263	-247	-260	-261	-265
C	3	0	3	shallow	4.59	-216	-203	398	390	244
C	3	0	4	shallow	4.29	-135	444	519	488	451
C	3	0	5	deep	4.32	-113	-143	-120	-139	-154
C	3	0	6	shallow	4.46	-212	-200	-58	-142	-175
C	3	0	7	shallow	4.38	390	520	536	491	480
C	3	0	8	deep	4.23	-262	-242	-252	-257	-261
C	3	4.5	1	shallow	4.44	27	-89	-124	-81	49
C	3	4.5	2	deep	4.38	-74	-202	-233	-253	-260
C	3	4.5	3	shallow	4.34	-130	-138	-24	-84	-124
C	3	4.5	4	shallow	4.52	-119	-108	338	223	265
C	3	4.5	5	deep	4.33	-216	-235	-251	-257	-264
C	3	4.5	6	shallow	4.60	-148	-178	-84	-63	51
C	3	4.5	7	shallow	4.52	-247	-279	-230	-252	-259
C	3	4.5	8	deep	4.34	-250	-242	-261	-271	-281
C	3	4.5	1epoxy	shallow	.	.	.	.	.	.
C	3	4.5	2 epoxy	deep	.	.	.	.	.	.
C	3	4.5	3 epoxy	shallow	.	.	.	.	.	.
C	3	4.5	4 epoxy	shallow	.	.	.	.	.	.
C	3	4.5	5 epoxy	deep	.	.	.	.	.	.
C	3	4.5	6 epoxy	shallow	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	2/2/2002	2/16/2002	3/2/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
C	1	0	1	-304	-295	-271	-167	.	-240	-222	-126
C	1	0	2	-256	-251	-232	-137	-220	-209	-204	-108
C	1	0	3	-65	-196	-166	-61	-103	-143	-95	22
C	1	0	4	550	548	707	698	463	468	465	560
C	1	0	5	-222	-195	-201	-77	-147	-193	-198	-116
C	1	0	6	39	85	69	200	153	135	160	262
C	1	0	7	360	393	411	515	489	448	447	545
C	1	0	8	-278	-284	-255	-157	-196	-234	-232	-140
C	1	4.5	1	583	431	457	442	561	502	481	573
C	1	4.5	2	-285	-262	-244	-233	-139	-187	-191	-101
C	1	4.5	3	475	378	144	276	24	-130	-136	-32
C	1	4.5	4	-180	-225	-138	-125	-41	-97	-80	30
C	1	4.5	5	-269	-211	-202	-207	-121	-185	-187	-98
C	1	4.5	6	90	-112	-96	-120	-50	-107	-152	-5
C	1	4.5	7	253	353	412	416	512	462	462	103
C	1	4.5	8	-257	-276	-257	-257	-171	-223	-228	-133
C	2	0	1	-256	-240	-163	-163	-120	-205	-200	-106
C	2	0	2	-276	-257	-252	-227	-158	-254	-243	-172
C	2	0	3	-125	-147	92	-106	-47	-106	126	400
C	2	0	4	655	46	628	744	600	176	35	418
C	2	0	5	-319	-300	-292	-262	-109	-275	-269	-190
C	2	0	6	514	468	126	259	89	-64	-137	-73
C	2	0	7	229	63	218	248	79	-134	-158	3
C	2	0	8	-318	-309	-296	-249	-207	-281	-279	-192
C	2	4.5	1	583	511	569	349	44	-51	-20	64
C	2	4.5	2	-285	-272	-260	-241	-130	-214	-185	-109
C	2	4.5	3	475	-31	-92	-91	1	-147	-150	-66
C	2	4.5	4	-180	-154	-180	-166	-61	-148	-121	-37
C	2	4.5	5	-269	-260	-246	-229	-141	-225	-215	-125
C	2	4.5	6	90	-44	-21	-68	-89	-184	-191	-102
C	2	4.5	7	253	223	71	-36	194	-110	-119	-16
C	2	4.5	8	-257	-255	-239	-201	-159	-238	-235	-143
C	3	0	1	-312	-279	-206	4	-19	-28	-64	-83
C	3	0	2	-278	-269	-261	-129	-247	-226	-236	-223
C	3	0	3	347	333	331	353	320	351	391	326
C	3	0	4	-29	26	552	422	-28	-21	-54	-83
C	3	0	5	-152	-178	-175	-93	-203	-176	-174	-210
C	3	0	6	-224	-233	-222	-132	-211	-187	-199	-203
C	3	0	7	377	386	404	498	420	450	445	-142
C	3	0	8	-258	-242	-237	-143	-225	-193	-190	-213
C	3	4.5	1	-2	-42	-4	4	158	442	399	433
C	3	4.5	2	-266	-270	-257	-261	-196	-223	-239	-232
C	3	4.5	3	-183	-229	-212	-214	-181	-173	-191	-194
C	3	4.5	4	291	144	311	153	185	79	169	-21
C	3	4.5	5	-277	-268	-258	-261	-241	-238	-235	-233
C	3	4.5	6	-38	-152	-76	-95	-107	-101	-148	-228
C	3	4.5	7	-256	-191	-146	-55	382	409	419	286
C	3	4.5	8	-292	-283	-269	-270	-249	-246	-244	-227
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
C	1	0	1	-216	-130	-154	-135	-167	1	-51	-84
C	1	0	2	-200	-107	-131	-30	-41	-135	-125	-123
C	1	0	3	-93	149	713	636	-166	272	559	545
C	1	0	4	453	838	795	780	658	805	808	787
C	1	0	5	-210	-126	-117	-135	-173	-195	-167	-190
C	1	0	6	101	522	764	795	684	811	814	747
C	1	0	7	69	613	647	677	.	704	694	668
C	1	0	8	-231	-148	-164	-181	-226	-211	-192	-185
C	1	4.5	1	475	533	739	799	727	812	745	783
C	1	4.5	2	-191	-134	-122	-101	-131	-162	-162	-188
C	1	4.5	3	-153	252	537	494	414	505	492	460
C	1	4.5	4	-59	98	597	721	443	592	627	487
C	1	4.5	5	-196	-119	-104	-110	-162	-177	-167	-193
C	1	4.5	6	-175	-112	528	625	421	681	658	555
C	1	4.5	7	-82	-20	579	720	557	775	750	710
C	1	4.5	8	-223	-136	-70	10	23	38	48	6
C	2	0	1	345	468	652	637	667	713	689	697
C	2	0	2	-264	-246	-133	-208	-207	-210	-205	-200
C	2	0	3	322	373	457	379	360	383	392	407
C	2	0	4	326	621	784	704	691	662	649	664
C	2	0	5	-277	-270	-155	-91	-129	-182	-181	-181
C	2	0	6	-155	527	573	525	389	388	346	397
C	2	0	7	284	424	464	345	297	338	299	282
C	2	0	8	-285	-277	-182	-224	-132	-171	-181	-177
C	2	4.5	1	-2	697	789	738	691	747	721	745
C	2	4.5	2	-207	-191	-134	-148	-103	-143	-91	562
C	2	4.5	3	-169	530	671	590	567	614	607	631
C	2	4.5	4	345	393	419	572	501	629	633	605
C	2	4.5	5	-213	-173	-4	38	28	-2	8	-126
C	2	4.5	6	-84	322	383	359	310	352	282	259
C	2	4.5	7	183	306	465	403	392	408	388	377
C	2	4.5	8	-236	.	.	-185	-178	-181	-188	-182
C	3	0	1	-107	-117	-126	-210	-167	-122	130	303
C	3	0	2	-240	-219	-125	-184	-158	-197	-225	-212
C	3	0	3	-156	515	587	333	-63	434	406	385
C	3	0	4	-152	650	705	561	460	511	492	436
C	3	0	5	-217	-183	-90	-63	-2	-146	-157	-144
C	3	0	6	-225	221	785	585	453	492	457	295
C	3	0	7	-174	569	640	554	502	561	531	526
C	3	0	8	-218	-178	-89	-101	-27	-92	-137	-154
C	3	4.5	1	423	573	615	514	518	592	491	495
C	3	4.5	2	-182	-129	-45	-189	-31	-32	-17	-110
C	3	4.5	3	-190	40	589	735	715	759	737	720
C	3	4.5	4	355	415	562	325	312	446	394	330
C	3	4.5	5	-231	-144	-64	-191	21	-55	-38	-88
C	3	4.5	6	-223	5	525	114	134	192	87	50
C	3	4.5	7	-70	478	519	-55	-32	173	443	-154
C	3	4.5	8	-211	-135	-102	-148	-167	-150	-176	-178
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002	1/5/2003
C	1	0	1	3	134	503	627	-33	-100	517	437
C	1	0	2	-2	-72	-40	-43	-36	-22	-17	2
C	1	0	3	503	541	532	550	480	94	73	131
C	1	0	4	744	772	770	779	771	758	719	523
C	1	0	5	-192	-204	-198	-203	-211	-194	-200	-189
C	1	0	6	790	830	823	833	824	810	689	556
C	1	0	7	665	629	612	499	482	454	456	470
C	1	0	8	-214	-179	-174	-169	-179	-156	-162	-151
C	1	4.5	1	734	793	784	792	783	752	684	510
C	1	4.5	2	-175	-194	-194	-200	-212	-198	-215	-208
C	1	4.5	3	465	480	471	486	410	289	293	96
C	1	4.5	4	545	612	506	396	273	-88	417	-112
C	1	4.5	5	-194	-200	-199	-198	-201	-190	-196	-187
C	1	4.5	6	609	606	599	558	242	7	-79	-136
C	1	4.5	7	773	788	774	791	780	740	640	494
C	1	4.5	8	-30	683	-128	-192	-224	-216	-226	-214
C	2	0	1	722	728	714	718	629	314	221	492
C	2	0	2	-220	-182	-180	-168	-172	-124	-114	-95
C	2	0	3	390	400	389	395	341	408	32	442
C	2	0	4	642	653	633	619	608	631	649	636
C	2	0	5	-181	-181	-180	-173	-173	-151	-153	-134
C	2	0	6	465	541	506	558	618	640	635	614
C	2	0	7	290	312	337	338	277	255	276	294
C	2	0	8	-151	-152	-147	-167	-167	-151	-165	-152
C	2	4.5	1	748	743	737	734	711	619	541	-63
C	2	4.5	2	-88	-221	-224	-221	-222	-208	-221	-210
C	2	4.5	3	627	644	638	611	593	577	517	477
C	2	4.5	4	608	614	582	547	510	413	184	178
C	2	4.5	5	3	-136	-86	-132	-202	-172	-178	-174
C	2	4.5	6	254	243	225	224	220	84	31	29
C	2	4.5	7	377	391	392	420	563	401	275	61
C	2	4.5	8	-194	-197	-203	-199	-204	-190	-205	-193
C	3	0	1	371	699	738	584	412	29	-51	419
C	3	0	2	-85	-191	-205	-205	-213	-199	-204	-184
C	3	0	3	386	355	388	374	299	-157	-20	23
C	3	0	4	223	194	154	166	208	-135	-147	-126
C	3	0	5	-119	-94	-53	-60	-67	-39	-47	-30
C	3	0	6	162	174	172	208	190	136	-168	-147
C	3	0	7	524	540	547	569	559	436	544	461
C	3	0	8	-188	-204	-199	-202	-206	-183	-187	-160
C	3	4.5	1	516	535	528	528	507	435	421	447
C	3	4.5	2	-104	-179	-167	-172	-190	-171	-175	-160
C	3	4.5	3	710	707	689	688	670	657	267	47
C	3	4.5	4	342	347	342	355	348	200	266	430
C	3	4.5	5	-50	-199	-203	-211	615	-200	-225	-210
C	3	4.5	6	23	24	24	33	14	-155	-186	-222
C	3	4.5	7	-25	735	714	420	-187	-179	-188	-174
C	3	4.5	8	-179	-196	-198	-198	-207	nd	-226	-215
C	3	4.5	epo	.	.	.	.	.	-189	-53	59
C	3	4.5	epo	.	.	.	.	.	-12	9	5
C	3	4.5	epo	.	.	.	.	.	-205	306	441
C	3	4.5	epo	.	.	.	.	.	-174	-8	6
C	3	4.5	epo	.	.	.	.	.	-214	-156	-69
C	3	4.5	epo	.	.	.	.	.	-200	-9	55

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	1/20/03	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/11/2003	4/30/2003	5/7/2003
C	1	0	1	558	435	507	455	462	530	539	161
C	1	0	2	-10	7	89	44	35	83	80	131
C	1	0	3	128	106	295	158	167	215	192	235
C	1	0	4	512	561	824	787	532	593	566	617
C	1	0	5	-198	-204	-133	-158	-183	-121	-129	-71
C	1	0	6	497	465	835	612	508	529	517	554
C	1	0	7	460	461	530	481	483	545	545	598
C	1	0	8	-158	-160	-94	-137	-141	-86	-90	-35
C	1	4.5	1	497	494	231	802	750	692	561	618
C	1	4.5	2	-215	-223	-156	-212	-210	-153	-156	-106
C	1	4.5	3	137	130	169	95	34	267	114	109
C	1	4.5	4	-145	-29	142	193	70	368	21	64
C	1	4.5	5	-195	-200	-133	-173	-184	-129	-135	-84
C	1	4.5	6	-147	-90	196	117	88	331	43	89
C	1	4.5	7	501	472	754	651	522	633	556	609
C	1	4.5	8	-220	-224	-154	-199	-198	-138	-139	-102
C	2	0	1	685	679	693	459	-66	-77	-96	-41
C	2	0	2	-101	-94	-27	-86	-105	-35	-41	11
C	2	0	3	398	299	193	104	38	88	332	250
C	2	0	4	632	681	704	125	-90	-68	238	210
C	2	0	5	-134	-112	9	-106	-146	-84	-96	-45
C	2	0	6	631	622	691	607	530	765	159	180
C	2	0	7	267	299	352	279	206	336	382	380
C	2	0	8	-161	-168	-102	-167	-165	-94	-105	-54
C	2	4.5	1	-95	-124	575	25	-82	2	-62	93
C	2	4.5	2	-214	-221	-132	-201	-193	-121	-149	-95
C	2	4.5	3	569	543	654	562	13	12	-27	84
C	2	4.5	4	166	142	388	232	178	195	117	165
C	2	4.5	5	-210	-225	-151	-207	-207	-151	-153	-101
C	2	4.5	6	16	221	266	108	63	110	103	187
C	2	4.5	7	-39	-35	404	227	55	62	18	75
C	2	4.5	8	-201	-207	-139	-199	-197	-140	-134	-82
C	3	0	1	444	441	504	442	446	520	518	568
C	3	0	2	-198	-240	-153	-189	-183	-123	-131	-100
C	3	0	3	14	-43	377	77	-49	64	63	110
C	3	0	4	-133	154	524	19	-67	-38	-10	38
C	3	0	5	-38	-35	35	-29	-28	35	32	89
C	3	0	6	-158	-177	-112	-176	-175	-115	-124	-75
C	3	0	7	459	536	646	554	463	529	524	575
C	3	0	8	-174	-170	-87	-151	-143	-80	-71	-26
C	3	4.5	1	452	442	582	453	458	524	522	572
C	3	4.5	2	-167	-193	-117	-125	-48	-63	-27	-5
C	3	4.5	3	0	-34	569	10	-12	48	62	109
C	3	4.5	4	431	430	603	448	456	521	519	569
C	3	4.5	5	-218	-245	-174	-188	-192	-136	-137	-133
C	3	4.5	6	-186	-193	-113	-185	-181	-121	-173	-80
C	3	4.5	7	-180	-183	-109	-168	-163	-103	-73	-47
C	3	4.5	8	-221	-230	-164	-224	-223	-162	-105	-107
C	3	4.5	epo	368	-42	435	441	468	119	486	514
C	3	4.5	epo	-5	-21	54	-2	7	67	64	107
C	3	4.5	epo	445	529	700	-221	441	442	463	395
C	3	4.5	epo	-39	347	475	478	518	607	565	647
C	3	4.5	epo	-76	-62	86	6	185	69	149	134
C	3	4.5	epo	82	79	478	450	226	540	546	592

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/18/2003	6/11/2003	6/27/2003
C	1	0	1	-144	36	-77
C	1	0	2	20	152	95
C	1	0	3	114	82	-76
C	1	0	4	486	557	269
C	1	0	5	-193	-44	-122
C	1	0	6	440	380	313
C	1	0	7	451	45	-14
C	1	0	8	-148	-32	-82
C	1	4.5	1	501	508	536
C	1	4.5	2	-218	-104	-137
C	1	4.5	3	135	5	-65
C	1	4.5	4	-69	4	-58
C	1	4.5	5	-186	-77	-123
C	1	4.5	6	-52	30	-54
C	1	4.5	7	496	581	572
C	1	4.5	8	-217	-82	-117
C	2	0	1	547	-58	726
C	2	0	2	-98	-2	-41
C	2	0	3	369	14	349
C	2	0	4	349	-39	-99
C	2	0	5	-142	-49	-83
C	2	0	6	-44	-14	-68
C	2	0	7	273	407	372
C	2	0	8	-168	-111	-126
C	2	4.5	1	-125	-45	-86
C	2	4.5	2	-123	-65	-93
C	2	4.5	3	-89	27	-29
C	2	4.5	4	34	171	103
C	2	4.5	5	-209	-99	-127
C	2	4.5	6	212	128	224
C	2	4.5	7	-47	63	8
C	2	4.5	8	-189	-70	-107
C	3	0	1	-114	-46	161
C	3	0	2	-192	-55	-30
C	3	0	3	-1	132	-22
C	3	0	4	-85	45	-45
C	3	0	5	-38	144	136
C	3	0	6	-187	-82	-124
C	3	0	7	465	570	382
C	3	0	8	-131	32	21
C	3	4.5	1	463	572	535
C	3	4.5	2	-128	-52	-79
C	3	4.5	3	-10	100	65
C	3	4.5	4	459	568	532
C	3	4.5	5	-139	-100	-128
C	3	4.5	6	-192	19	-128
C	3	4.5	7	-141	-18	-90
C	3	4.5	8	-170	-93	-124
C	3	4.5	epo	432	405	104
C	3	4.5	epo	-1	112	74
C	3	4.5	epo	390	533	503
C	3	4.5	epo	541	591	276
C	3	4.5	epo	73	120	118
C	3	4.5	epo	479	562	-8

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditch	Transe	Distance (m)	Position	Depth	soil pH	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002
C	3	4.5	7 epoxy	shallow	.	.	.	.	.	.
C	3	4.5	8 epoxy	deep	.	.	.	.	.	.
F	1	0	1	shallow	4.43	438	91	150	184	166
F	1	0	2	deep	4.36	-250	-293	-278	-283	-289
F	1	0	3	shallow	4.31	-225	-289	-241	-257	-271
F	1	0	4	shallow	4.32	613	-63	178	339	315
F	1	0	5	deep	4.67	-173	-236	-199	-163	-229
F	1	0	6	shallow	4.14	334	416	552	305	418
F	1	0	7	shallow	4.25	273	345	342	373	332
F	1	0	8	deep	4.48	.	.	.	.	.
F	1	4.5	1	shallow	4.50	-70	-99	450	399	277
F	1	4.5	2	deep	4.62	-195	-237	-216	-161	-240
F	1	4.5	3	shallow	4.42	637	545	514	450	439
F	1	4.5	4	shallow	4.43	357	176	176	179	176
F	1	4.5	5	deep	4.32	-18	-86	-246	-266	-269
F	1	4.5	6	shallow	4.40	605	-98	211	130	-223
F	1	4.5	7	shallow	4.45	586	-98	483	-209	-218
F	1	4.5	8	deep	4.29	-170	-212	-194	-242	-246
F	2	0	1	shallow	4.06	449	441	423	394	366
F	2	0	2	deep	4.16	-100	-88	-65	-64	-114
F	2	0	3	shallow	4.04	-73	-53	129	144	102
F	2	0	4	shallow	4.10	-58	133	224	145	224
F	2	0	5	deep	4.10	-156	-197	-180	-196	-208
F	2	0	6	shallow	4.18	347	352	307	287	317
F	2	0	7	shallow	4.02	287	260	235	188	223
F	2	0	8	deep	4.19	-82	-127	-158	-171	-194
F	2	4.5	1	shallow	3.96	696	702	698	687	677
F	2	4.5	2	deep	4.04	-265	-268	-249	-256	-267
F	2	4.5	3	shallow	4.01	539	568	482	328	214
F	2	4.5	4	shallow	4.03	-161	-29	206	167	171
F	2	4.5	5	deep	4.13	-192	-216	-150	-211	-221
F	2	4.5	6	shallow	3.96	-247	211	79	43	72
F	2	4.5	7	shallow	3.97	272	471	565	493	471
F	2	4.5	8	deep	3.91	-191	-144	-207	-207	-232
F	3	0	1	shallow	3.57	661	637	712	727	725
F	3	0	2	deep	3.48	-245	-274	-194	-257	-252
F	3	0	3	shallow	3.84	-277	-267	-275	-244	-255
F	3	0	4	shallow	3.72	554	519	514	504	491
F	3	0	5	deep	3.46	-224	-249	-225	-233	-221
F	3	0	6	shallow	3.73	625	610	624	590	556
F	3	0	7	shallow	3.80	-166	32	38	161	80
F	3	0	8	deep	3.51	-221	-257	-230	-244	-287
F	3	4.5	1	shallow	3.99	-134	-142	490	432	464
F	3	4.5	2	deep	4.05	-231	-270	-111	-236	-240
F	3	4.5	3	shallow	4.06	563	544	540	520	492
F	3	4.5	4	shallow	4.05	676	635	611	598	607
F	3	4.5	5	deep	4.05	-51	-63	9	-35	-22
F	3	4.5	6	shallow	4.17	669	544	599	550	518
F	3	4.5	7	shallow	4.20	696	666	749	743	727
F	3	4.5	8	deep	4.24	-31	-49	-33	-61	-60
N	1	0	1	shallow	4.22	-58	-52	-235	-244	-229
N	1	0	2	deep	4.12	-189	-224	-223	-235	-240
N	1	0	3	shallow	4.10	-158	-134	-171	-190	-147
N	1	0	4	shallow	4.16	-120	-96	280	318	302
N	1	0	5	deep	4.05	-70	-53	38	-38	-49

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	2/2/2002	2/16/2002	3/2/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
F	1	0	1	-111	96	160	145	-104	-171	-194	-203
F	1	0	2	-296	-284	-272	-247	-238	-247	-245	-242
F	1	0	3	-282	-274	-263	-111	-238	-249	-238	-250
F	1	0	4	343	341	447	424	277	191	-171	305
F	1	0	5	-248	-255	-236	-179	-213	-233	-225	-250
F	1	0	6	489	489	502	488	519	471	409	514
F	1	0	7	187	253	313	273	333	191	348	348
F	1	0	8	.	.	-795	-795	-789	1192	.	.
F	1	4.5	1	-165	98	481	160	-166	-184	-193	309
F	1	4.5	2	-249	-236	-226	-200	-190	-197	-173	-194
F	1	4.5	3	-183	-125	490	-55	-157	-132	127	478
F	1	4.5	4	-35	169	388	353	51	441	-165	-151
F	1	4.5	5	-277	-261	-250	-237	-219	-236	-235	-235
F	1	4.5	6	-234	-221	-139	-190	-195	-205	-208	-211
F	1	4.5	7	-224	-197	-187	-183	-111	-193	301	471
F	1	4.5	8	-258	-227	-238	-213	-209	-217	-210	-214
F	2	0	1	300	165	295	232	382	-43	448	358
F	2	0	2	-121	-168	-149	-147	-140	-111	-70	-70
F	2	0	3	-3	36	183	176	-147	-158	-94	164
F	2	0	4	176	240	194	167	89	-77	368	277
F	2	0	5	-222	-212	-203	-184	-167	-184	-175	-184
F	2	0	6	200	96	269	229	261	244	255	262
F	2	0	7	100	118	338	216	-104	116	-143	-110
F	2	0	8	-209	-191	-179	-163	-148	-150	-131	-136
F	2	4.5	1	660	175	211	165	51	198	191	292
F	2	4.5	2	-280	-252	-257	-251	-222	-234	-233	-228
F	2	4.5	3	177	170	225	220	11	207	-180	-185
F	2	4.5	4	138	144	122	135	70	82	74	128
F	2	4.5	5	-233	-191	-201	-200	-170	-154	-150	-143
F	2	4.5	6	-125	-125	-140	-5	-143	-151	-177	108
F	2	4.5	7	406	314	421	297	-100	-124	-134	-140
F	2	4.5	8	-246	-196	-227	-212	-196	-210	-203	-206
F	3	0	1	710	709	500	749	726	711	589	726
F	3	0	2	-262	-256	-234	-236	-202	-192	-207	-198
F	3	0	3	-282	-276	503	-241	-231	-216	-245	-225
F	3	0	4	469	452	613	509	505	474	533	552
F	3	0	5	-246	-230	-40	-190	-187	-189	-195	-188
F	3	0	6	485	389	549	397	490	-114	536	558
F	3	0	7	-304	162	750	236	-88	-154	-187	-8
F	3	0	8	-296	-284	-50	-247	-248	-237	-241	-201
F	3	4.5	1	421	380	745	359	141	-126	-184	377
F	3	4.5	2	-255	-245	-250	-204	-204	-200	-195	-166
F	3	4.5	3	465	453	-265	457	280	-141	-186	355
F	3	4.5	4	582	593	506	609	558	337	436	622
F	3	4.5	5	-64	-43	-224	-29	-47	-29	-63	-25
F	3	4.5	6	442	143	594	10	-90	-46	-69	199
F	3	4.5	7	715	695	264	733	628	286	180	770
F	3	4.5	8	-74	-58	-276	-66	-65	-58	-61	-61
N	1	0	1	-262	-256	-213	-244	-218	-232	-226	-236
N	1	0	2	-247	-240	-226	-223	-190	-201	-196	-180
N	1	0	3	-257	-224	-166	-227	-211	-215	-212	-221
N	1	0	4	323	364	445	379	405	260	28	458
N	1	0	5	-63	-55	-66	-72	-39	-45	-44	-5

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
C	3	4.5	epo	.	.	.	.	.	.	.	.
C	3	4.5	epo	.	.	.	.	.	.	.	.
F	1	0	1	-160	49	252	130	106	157	113	83
F	1	0	2	-236	-192	-143	103	-185	-206	-214	-215
F	1	0	3	-227	-190	-161	643	-174	-234	-64	-14
F	1	0	4	489	494	572	365	317	560	640	556
F	1	0	5	-248	-242	-158	-104	-193	-189	-201	-228
F	1	0	6	567	373	225	114	63	123	120	139
F	1	0	7	236	217	149	374	68	238	665	439
F	1	0	8	.	199	174	-65	75	153	199	165
F	1	4.5	1	456	373	290	82	125	223	138	152
F	1	4.5	2	-176	-140	24	-139	-60	-120	-49	-50
F	1	4.5	3	654	630	705	-140	629	611	616	605
F	1	4.5	4	529	447	487	467	353	428	397	362
F	1	4.5	5	-202	-211	-130	-132	-193	-196	-191	-199
F	1	4.5	6	-76	281	374	169	87	108	37	26
F	1	4.5	7	653	648	698	70	382	571	543	520
F	1	4.5	8	-167	-186	-110	164	-12	-173	-148	-144
F	2	0	1	516	493	556	454	432	450	452	435
F	2	0	2	-35	-16	29	40	-28	-114	-119	-104
F	2	0	3	597	526	407	212	182	295	306	296
F	2	0	4	287	246	328	191	157	74	60	46
F	2	0	5	-112	-174	-91	-50	-135	-164	-151	-175
F	2	0	6	484	478	548	562	393	468	500	527
F	2	0	7	459	395	509	454	402	444	421	393
F	2	0	8	-52	-66	114	116	99	153	289	3
F	2	4.5	1	491	463	550	545	386	557	595	406
F	2	4.5	2	-223	-210	-125	-84	-158	-169	-93	-178
F	2	4.5	3	321	218	325	264	224	252	267	265
F	2	4.5	4	132	140	256	206	84	111	104	79
F	2	4.5	5	-129	-98	-50	-12	-111	-119	-98	-136
F	2	4.5	6	181	255	421	441	333	430	420	390
F	2	4.5	7	372	580	762	667	561	691	692	674
F	2	4.5	8	-193	-166	-99	-66	-122	-174	-134	-179
F	3	0	1	682	730	835	784	716	796	780	779
F	3	0	2	-190	-168	-88	-30	-66	-166	199	196
F	3	0	3	-217	-199	-115	-121	-127	-129	399	334
F	3	0	4	580	610	655	642	587	593	621	615
F	3	0	5	-187	-157	-101	-33	-34	-130	-122	-50
F	3	0	6	559	573	622	614	578	611	643	618
F	3	0	7	98	154	277	302	213	197	130	110
F	3	0	8	-180	-162	-92	-90	-116	-152	-179	-148
F	3	4.5	1	583	533	594	545	507	545	600	565
F	3	4.5	2	-156	-123	-32	-83	5	-81	-217	-185
F	3	4.5	3	453	451	530	444	339	309	147	216
F	3	4.5	4	644	640	722	710	641	623	656	641
F	3	4.5	5	-39	-6	70	110	48	-12	11	38
F	3	4.5	6	413	409	578	495	410	396	380	348
F	3	4.5	7	781	752	856	807	775	778	752	745
F	3	4.5	8	-94	-62	12	57	85	27	112	143
N	1	0	1	50	377	607	452	474	469	446	471
N	1	0	2	-173	-134	-28	-22	-8	-77	-50	-108
N	1	0	3	-184	-11	548	547	524	561	463	312
N	1	0	4	452	474	791	739	656	757	730	732
N	1	0	5	-16	-5	122	91	81	55	130	76

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002	1/5/2003
C	3	4.5	epo	.	.	.	.	.	-148	55	49
C	3	4.5	epo	.	.	.	.	.	-199	-21	-49
F	1	0	1	73	64	63	53	-20	75	22	-14
F	1	0	2	-237	-236	-245	-236	-244	-221	-241	-223
F	1	0	3	366	515	510	514	-180	-192	-203	-187
F	1	0	4	575	673	659	648	582	528	576	583
F	1	0	5	-223	-168	-175	-167	-181	-174	-192	-186
F	1	0	6	147	201	203	212	251	637	621	624
F	1	0	7	574	674	620	614	599	397	431	558
F	1	0	8	203	nd	nd	-247	-284	-271	-282	-227
F	1	4.5	1	93	103	104	126	41	-133	-26	-164
F	1	4.5	2	-37	-123	-135	-89	-148	-78	-66	-96
F	1	4.5	3	594	595	580	578	573	-61	-147	-154
F	1	4.5	4	271	223	274	222	222	-138	249	112
F	1	4.5	5	-200	-199	-202	-198	-202	-180	-192	-182
F	1	4.5	6	24	18	6	22	-8	-192	-212	-212
F	1	4.5	7	539	305	146	463	375	-146	-159	-54
F	1	4.5	8	-185	-175	-154	-171	-180	-176	-207	-188
F	2	0	1	622	636	598	572	452	433	406	398
F	2	0	2	-106	-141	-145	-161	-170	-156	-165	-161
F	2	0	3	298	284	240	241	184	279	330	635
F	2	0	4	56	68	84	72	32	164	66	241
F	2	0	5	-161	-169	-179	-190	-198	-180	-194	-189
F	2	0	6	515	530	489	466	437	464	488	478
F	2	0	7	415	380	368	368	301	118	260	146
F	2	0	8	114	-3	-1	-1	9	-14	-87	-68
F	2	4.5	1	633	653	603	592	542	671	685	653
F	2	4.5	2	-174	-176	-180	-186	-199	-186	-195	-193
F	2	4.5	3	316	589	577	581	521	-87	380	296
F	2	4.5	4	79	78	70	74	53	-133	-24	44
F	2	4.5	5	-115	-151	-147	-194	-182	-166	-180	-167
F	2	4.5	6	455	483	447	466	426	-75	361	58
F	2	4.5	7	689	-305	694	694	662	69	631	438
F	2	4.5	8	-167	-193	-138	-202	-189	-193	-210	-203
F	3	0	1	774	777	769	748	775	796	742	751
F	3	0	2	-110	-159	-166	-219	-240	-217	-213	-233
F	3	0	3	373	344	305	320	144	76	37	41
F	3	0	4	616	621	601	597	587	601	589	607
F	3	0	5	-137	-147	-133	-144	-136	-179	-197	-186
F	3	0	6	587	292	364	396	359	439	477	511
F	3	0	7	98	95	90	89	100	114	128	138
F	3	0	8	-147	-164	-159	-195	-243	-244	-254	-249
F	3	4.5	1	551	612	536	530	498	453	421	206
F	3	4.5	2	-101	-195	-225	-224	-230	-219	-229	-223
F	3	4.5	3	184	226	200	247	285	329	315	318
F	3	4.5	4	654	667	675	677	688	690	651	647
F	3	4.5	5	27	48	44	34	44	46	43	63
F	3	4.5	6	364	382	402	409	382	291	199	132
F	3	4.5	7	727	744	724	709	700	694	686	603
F	3	4.5	8	62	143	107	44	74	32	33	41
N	1	0	1	555	557	558	550	485	579	366	534
N	1	0	2	-196	-174	-163	-157	-160	-131	-152	-134
N	1	0	3	266	263	256	275	218	250	-175	-167
N	1	0	4	693	731	730	736	712	736	717	733
N	1	0	5	88	39	54	34	42	42	23	35

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	1/20/03	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/11/2003	4/30/2003	5/7/2003
C	3	4.5	epo	6	-26	108	-19	-41	48	13	86
C	3	4.5	epo	-66	-126	-42	-97	-60	6	-9	33
F	1	0	1	80	84	106	39	-192	-125	-143	-104
F	1	0	2	-229	-237	-160	-221	-225	-154	-162	-125
F	1	0	3	-111	74	-100	-179	-177	-120	-134	-96
F	1	0	4	570	545	607	523	448	369	506	509
F	1	0	5	-195	-188	-117	-176	-174	-94	-109	-64
F	1	0	6	662	651	721	657	597	632	719	750
F	1	0	7	600	618	716	645	594	588	670	681
F	1	0	8	-219	-231	-156	-213	-201	-113	-163	-101
F	1	4.5	1	444	404	371	-130	-168	-104	159	151
F	1	4.5	2	-100	-117	50	-50	-37	23	83	93
F	1	4.5	3	625	605	446	-141	-137	-68	719	352
F	1	4.5	4	417	433	374	-40	-52	-72	-88	-30
F	1	4.5	5	-177	-188	-57	-175	-173	-105	-95	-68
F	1	4.5	6	-214	-158	-169	-238	-237	-172	-133	-141
F	1	4.5	7	522	552	-65	-135	-139	-95	-69	-79
F	1	4.5	8	-186	-185	-127	-197	-183	-117	-38	-46
F	2	0	1	431	406	463	381	263	422	326	478
F	2	0	2	-159	-167	-57	-90	-130	-55	-72	-30
F	2	0	3	675	684	756	666	596	758	306	617
F	2	0	4	346	254	323	268	52	116	408	212
F	2	0	5	-184	-196	-116	-186	-182	-109	-119	-81
F	2	0	6	388	430	520	412	42	395	504	-65
F	2	0	7	378	334	398	233	-33	194	-3	26
F	2	0	8	-81	-78	-50	-78	-125	90	49	-66
F	2	4.5	1	673	668	753	664	668	749	732	752
F	2	4.5	2	-189	-205	-120	-191	-184	-107	-112	-75
F	2	4.5	3	-92	391	467	232	-36	296	-50	-23
F	2	4.5	4	215	49	179	106	74	98	99	99
F	2	4.5	5	-191	-206	508	-191	-185	-115	-117	-78
F	2	4.5	6	353	308	233	-63	-133	-96	-66	197
F	2	4.5	7	659	691	709	553	450	571	12	55
F	2	4.5	8	-205	-217	-83	-158	-190	-111	-105	173
F	3	0	1	774	781	872	786	765	844	793	870
F	3	0	2	-220	-239	-159	-204	-222	-144	-147	-123
F	3	0	3	168	303	387	353	159	238	175	205
F	3	0	4	619	607	681	605	557	661	645	656
F	3	0	5	-163	-177	-94	-143	-132	-53	-68	-19
F	3	0	6	612	608	659	409	115	469	325	344
F	3	0	7	165	149	225	101	16	185	205	233
F	3	0	8	-242	-254	-176	-245	-238	-167	-177	-137
F	3	4.5	1	605	606	623	126	88	102	32	55
F	3	4.5	2	-223	-228	-149	-216	-226	-154	-160	-125
F	3	4.5	3	595	582	436	26	-43	-58	96	149
F	3	4.5	4	689	667	706	22	-8	10	675	523
F	3	4.5	5	49	43	144	71	78	144	136	188
F	3	4.5	6	402	613	468	207	187	254	279	318
F	3	4.5	7	758	740	779	286	195	220	777	801
F	3	4.5	8	12	27	129	113	82	154	149	201
N	1	0	1	506	444	448	413	-20	41	485	187
N	1	0	2	-144	-192	-117	-169	-168	-94	-102	-58
N	1	0	3	422	361	410	25	213	-26	-59	-26
N	1	0	4	729	705	765	696	663	701	757	756
N	1	0	5	50	28	110	50	38	108	103	70

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/18/2003	6/11/2003	6/27/2003
C	3	4.5	epo	-28	54	51
C	3	4.5	epo	-68	45	37
F	1	0	1	-208	-135	-147
F	1	0	2	-227	-138	-117
F	1	0	3	-200	-127	-135
F	1	0	4	454	61	424
F	1	0	5	-177	-100	-96
F	1	0	6	656	279	742
F	1	0	7	592	477	640
F	1	0	8	-202	-92	-81
F	1	4.5	1	441	-134	-93
F	1	4.5	2	-4	66	121
F	1	4.5	3	676	-82	419
F	1	4.5	4	413	-102	-94
F	1	4.5	5	-162	-109	-90
F	1	4.5	6	-201	-163	-160
F	1	4.5	7	478	-112	-111
F	1	4.5	8	-86	53	121
F	2	0	1	387	168	529
F	2	0	2	-109	-149	-34
F	2	0	3	739	126	784
F	2	0	4	393	-7	470
F	2	0	5	-184	-136	-87
F	2	0	6	512	459	595
F	2	0	7	472	21	613
F	2	0	8	5	113	210
F	2	4.5	1	667	554	704
F	2	4.5	2	-177	-89	-46
F	2	4.5	3	69	-16	421
F	2	4.5	4	-63	33	-9
F	2	4.5	5	-180	-90	-74
F	2	4.5	6	134	-48	-13
F	2	4.5	7	77	49	546
F	2	4.5	8	-124	-86	-36
F	3	0	1	740	759	778
F	3	0	2	-240	-82	-130
F	3	0	3	13	-41	-31
F	3	0	4	617	314	742
F	3	0	5	-134	-13	20
F	3	0	6	358	-45	-108
F	3	0	7	118	-86	-82
F	3	0	8	-221	-132	-107
F	3	4.5	1	229	106	162
F	3	4.5	2	-217	-127	-132
F	3	4.5	3	135	-56	103
F	3	4.5	4	702	-53	-67
F	3	4.5	5	75	171	157
F	3	4.5	6	350	184	158
F	3	4.5	7	779	72	834
F	3	4.5	8	84	114	164
N	1	0	1	493	29	495
N	1	0	2	-162	-34	-25
N	1	0	3	496	11	589
N	1	0	4	677	806	777
N	1	0	5	41	173	123

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditch	Transe	Distance (m)	Position	Depth	soil pH	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002
N	1	0	6	shallow	4.21	-165	535	283	-39	4
N	1	0	7	shallow	4.23	-93	-105	469	411	448
N	1	0	8	deep	4.06	-223	-227	-224	-217	-231
N	1	4.5	1	shallow	4.01	401	446	-120	-168	-202
N	1	4.5	2	deep	3.82	-206	-211	-172	-249	-256
N	1	4.5	3	shallow	4.05	-125	445	-156	-166	-164
N	1	4.5	4	shallow	3.98	749	762	753	757	752
N	1	4.5	5	deep	3.88	-204	-229	-205	-221	-226
N	1	4.5	6	shallow	4.17	436	530	64	109	423
N	1	4.5	7	shallow	4.08	703	706	682	649	661
N	1	4.5	8	deep	3.83	-218	-207	-124	-122	-124
N	2	0	1	shallow	4.35	578	711	752	746	730
N	2	0	2	deep	4.66	-202	-172	-182	-179	-179
N	2	0	3	shallow	4.42	-106	310	438	400	355
N	2	0	4	shallow	4.51	427	541	643	647	645
N	2	0	5	deep	4.49	-257	-242	-228	-238	-244
N	2	0	6	shallow	4.44	-166	-157	109	151	158
N	2	0	7	shallow	4.33	71	404	635	664	653
N	2	0	8	deep	4.47	-156	-172	-226	-213	-214
N	2	4.5	1	shallow	4.44	-174	203	458	442	352
N	2	4.5	2	deep	4.32	-197	-236	-251	-248	-256
N	2	4.5	3	shallow	4.45	347	449	679	678	676
N	2	4.5	4	shallow	4.45	684	462	-23	287	532
N	2	4.5	5	deep	4.34	-188	-231	-241	-249	-255
N	2	4.5	6	shallow	4.40	389	460	454	417	353
N	2	4.5	7	shallow	4.32	554	647	189	163	115
N	2	4.5	8	deep	4.38	-167	-157	-116	-112	-130
N	3	0	1	shallow	4.25	587	663	716	675	650
N	3	0	2	deep	3.98	-264	-271	-229	-203	-330
N	3	0	3	shallow	4.36	-133	-137	389	431	418
N	3	0	4	shallow	4.31	77	19	426	418	435
N	3	0	5	deep	4.06	-228	-239	-244	-153	-201
N	3	0	6	shallow	4.25	712	669	743	690	736
N	3	0	7	shallow	4.27	-297	-310	-225	-207	-135
N	3	0	8	deep	4.29	-226	-215	-195	-234	-241
N	3	4.5	1	shallow	4.34	612	672	649	221	130
N	3	4.5	2	deep	4.27	-168	-207	-183	-213	-223
N	3	4.5	3	shallow	4.22	300	192	389	558	520
N	3	4.5	4	shallow	4.30	397	1	-91	-128	-138
N	3	4.5	5	deep	4.53	-206	-258	-207	-269	-275
N	3	4.5	6	shallow	4.26	-257	-251	-121	-34	207
N	3	4.5	7	shallow	4.46	-86	-92	-15	-52	-10
N	3	4.5	8	deep	4.32	-252	-279	-270	-283	-291
P	1	0	1	shallow	4.72	316	327	356	285	313
P	1	0	2	deep	4.39	-190	-216	-200	-204	-218
P	1	0	3	shallow	4.48	472	475	514	386	435
P	1	0	4	shallow	4.51	713	696	692	701	688
P	1	0	5	deep	4.36	-208	-227	-209	-210	-213
P	1	0	6	shallow	4.45	646	636	662	659	653
P	1	0	7	shallow	4.58	702	699	729	702	665
P	1	0	8	deep	4.43	-41	-64	-8	-22	-41
P	1	4.5	1	shallow	4.61	630	638	645	648	625
P	1	4.5	2	deep	4.55	-240	-253	-211	-217	-221
P	1	4.5	3	shallow	4.54	577	586	591	611	593
P	1	4.5	4	shallow	4.33	-37	378	710	693	678

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	2/2/2002	2/16/2002	3/2/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
N	1	0	6	-111	444	566	359	145	111	113	57
N	1	0	7	413	418	429	447	476	472	471	277
N	1	0	8	-243	-218	-239	-238	-196	-208	-197	-198
N	1	4.5	1	-233	-230	-151	-177	-180	-194	-194	-194
N	1	4.5	2	-263	-237	-221	-199	-188	-201	-198	-192
N	1	4.5	3	-193	-184	-153	-156	-175	-207	-216	-210
N	1	4.5	4	693	739	705	723	745	732	262	266
N	1	4.5	5	-252	-220	-154	-211	-196	-213	-201	-211
N	1	4.5	6	354	194	251	193	295	120	-84	-115
N	1	4.5	7	632	660	678	687	679	640	212	155
N	1	4.5	8	-127	-93	-131	-89	-67	-94	-76	-62
N	2	0	1	702	705	727	708	507	454	467	388
N	2	0	2	-141	262	302	314	345	334	407	345
N	2	0	3	184	49	427	378	-83	-56	32	-50
N	2	0	4	633	685	703	711	611	-48	455	720
N	2	0	5	-259	-243	-230	-214	-186	538	-121	-168
N	2	0	6	-141	-141	321	9	-69	-86	9	-79
N	2	0	7	587	597	652	638	355	264	258	250
N	2	0	8	-229	-205	-215	-165	-136	-133	-24	-174
N	2	4.5	1	330	328	137	395	343	305	43	392
N	2	4.5	2	-268	-256	-242	-238	-210	-209	-197	-200
N	2	4.5	3	671	694	565	690	464	582	417	331
N	2	4.5	4	552	501	521	602	530	358	280	213
N	2	4.5	5	-268	-240	-155	-77	-158	-144	-136	-158
N	2	4.5	6	62	8	65	66	124	104	-55	-86
N	2	4.5	7	61	66	454	399	372	218	-45	-89
N	2	4.5	8	-141	-125	-119	-107	-83	-81	75	-68
N	3	0	1	409	213	140	567	129	87	-158	-91
N	3	0	2	-344	-333	-333	-322	-283	-266	-297	-230
N	3	0	3	66	-40	-76	-80	-31	-105	-120	-129
N	3	0	4	372	293	184	37	-5	-34	-127	-38
N	3	0	5	-278	-270	-254	-235	-203	-217	-88	-219
N	3	0	6	619	432	138	245	280	221	-69	-25
N	3	0	7	-234	-142	-117	-101	-185	-147	-232	-209
N	3	0	8	-264	-215	-233	-213	-174	-195	-167	-189
N	3	4.5	1	69	21	5	-14	1	31	19	5
N	3	4.5	2	-246	-210	-235	-206	-172	-205	-148	-161
N	3	4.5	3	478	468	498	558	181	-144	-163	-121
N	3	4.5	4	-167	-199	-226	-212	-175	-212	-239	-207
N	3	4.5	5	-266	-256	-262	-246	-209	-239	-227	-197
N	3	4.5	6	213	241	318	256	-136	-181	-195	-179
N	3	4.5	7	-165	-223	-209	-151	-123	-163	-204	-203
N	3	4.5	8	-308	-270	-271	-257	-220	-249	-239	-236
P	1	0	1	283	239	264	259	402	374	405	528
P	1	0	2	-226	-224	-195	-195	-82	-171	-162	-80
P	1	0	3	431	371	449	537	530	324	571	674
P	1	0	4	694	696	721	664	686	274	499	612
P	1	0	5	-218	-206	-185	-46	-54	-114	-126	-40
P	1	0	6	653	650	690	657	813	720	717	823
P	1	0	7	622	609	100	-12	255	445	206	645
P	1	0	8	-52	-52	-9	-49	118	33	56	144
P	1	4.5	1	622	628	655	612	774	606	640	798
P	1	4.5	2	-231	-230	-212	-222	-93	-172	-146	-29
P	1	4.5	3	572	559	636	568	753	645	603	757
P	1	4.5	4	665	634	484	428	552	574	614	727

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
N	1	0	6	41	711	837	767	714	796	746	737
N	1	0	7	-5	-22	811	769	699	795	736	773
N	1	0	8	-182	-183	-86	72	-102	-169	-130	-151
N	1	4.5	1	-104	-84	63	-59	-87	313	655	608
N	1	4.5	2	-168	-187	-88	-107	-90	-158	-136	-167
N	1	4.5	3	-119	-110	-15	-64	-139	-99	-80	-98
N	1	4.5	4	817	759	822	806	733	737	716	699
N	1	4.5	5	-168	-186	-102	-88	-97	-170	-170	-182
N	1	4.5	6	501	398	565	675	365	734	573	491
N	1	4.5	7	745	757	846	784	714	779	765	754
N	1	4.5	8	22	-58	80	-54	-102	-65	-119	-159
N	2	0	1	362	729	792	603	764	805	755	756
N	2	0	2	316	318	395	-191	59	-111	-28	-110
N	2	0	3	445	513	568	764	478	478	466	436
N	2	0	4	721	707	784	704	750	835	807	815
N	2	0	5	-180	-168	-107	13	-129	-174	-165	-197
N	2	0	6	-88	-48	416	640	244	187	243	186
N	2	0	7	228	355	570	436	544	730	704	782
N	2	0	8	-207	-209	-126	81	-169	-217	-213	-218
N	2	4.5	1	-17	466	534	741	568	659	696	662
N	2	4.5	2	-215	-203	-127	325	-157	-193	-200	-202
N	2	4.5	3	331	755	856	456	754	783	767	753
N	2	4.5	4	154	756	854	768	733	757	739	748
N	2	4.5	5	-151	-142	-10	-155	151	-70	-106	-86
N	2	4.5	6	412	120	444	352	506	527	450	488
N	2	4.5	7	-113	462	522	583	425	463	417	425
N	2	4.5	8	-61	-19	59	-186	156	104	48	71
N	3	0	1	-107	450	827	739	756	776	788	761
N	3	0	2	-154	-157	-73	-145	-70	-138	-128	-136
N	3	0	3	-157	-154	570	676	766	771	786	781
N	3	0	4	-25	-25	350	460	474	625	711	688
N	3	0	5	-215	-225	-127	-197	-73	-196	-151	-179
N	3	0	6	-68	374	828	745	789	795	762	793
N	3	0	7	-200	-151	525	523	556	566	574	766
N	3	0	8	-184	-185	-112	-155	-129	-168	-139	-101
N	3	4.5	1	-6	234	615	655	603	605	625	624
N	3	4.5	2	-107	-168	-22	-112	-83	-143	-104	-127
N	3	4.5	3	-76	670	722	202	601	614	613	561
N	3	4.5	4	-249	-169	-93	-149	-170	-123	-78	-45
N	3	4.5	5	-241	-207	-88	-212	-205	-212	-168	-192
N	3	4.5	6	-207	-205	415	310	299	283	320	311
N	3	4.5	7	-228	-218	261	259	168	262	265	280
N	3	4.5	8	-247	-227	-140	-185	-146	-172	-141	-166
P	1	0	1	446	426	117	-9	53	43	41	89
P	1	0	2	-173	60	-126	-152	-115	-124	-144	-145
P	1	0	3	603	690	516	411	308	337	329	312
P	1	0	4	516	573	229	174	207	225	220	203
P	1	0	5	-137	234	-89	-85	-58	-73	-113	-117
P	1	0	6	723	809	718	684	654	687	656	643
P	1	0	7	580	691	731	714	730	764	725	710
P	1	0	8	61	90	28	107	79	60	80	114
P	1	4.5	1	693	747	559	540	536	487	491	623
P	1	4.5	2	-113	-6	-58	-53	133	-39	14	30
P	1	4.5	3	652	790	702	675	697	717	694	683
P	1	4.5	4	596	628	565	399	239	323	182	124

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002	1/5/2003
N	1	0	6	736	760	754	741	730	713	502	694
N	1	0	7	780	796	788	787	739	729	737	769
N	1	0	8	-168	-194	-190	-195	-220	-206	-225	-214
N	1	4.5	1	615	620	586	571	537	571	233	717
N	1	4.5	2	-161	-179	-176	-186	-224	-211	-230	-216
N	1	4.5	3	-97	-55	-77	566	-203	-181	-197	-187
N	1	4.5	4	701	722	733	720	757	802	771	786
N	1	4.5	5	-148	-164	-51	-208	-214	-187	-199	-189
N	1	4.5	6	407	372	347	359	332	392	396	395
N	1	4.5	7	-349	757	738	433	167	179	176	163
N	1	4.5	8	-130	-163	-167	-157	-168	-141	-154	-151
N	2	0	1	783	757	787	779	785	770	778	733
N	2	0	2	-128	-156	-152	-163	-176	439	440	355
N	2	0	3	433	430	434	436	405	360	335	288
N	2	0	4	815	819	812	808	813	814	793	787
N	2	0	5	-203	-200	-210	-216	-185	-167	-183	-169
N	2	0	6	278	336	325	311	315	322	290	17
N	2	0	7	738	778	777	776	756	792	788	789
N	2	0	8	-224	-234	-230	-236	-245	-199	-226	-199
N	2	4.5	1	689	708	671	646	574	526	482	420
N	2	4.5	2	-204	-210	-211	-207	-195	-181	-199	-191
N	2	4.5	3	710	743	736	757	742	753	751	761
N	2	4.5	4	710	750	749	752	739	734	745	754
N	2	4.5	5	-98	-112	-128	-194	-199	-198	-213	-206
N	2	4.5	6	474	546	552	520	419	456	463	438
N	2	4.5	7	420	432	408	452	447	425	398	386
N	2	4.5	8	75	46	68	46	42	55	36	51
N	3	0	1	768	755	726	739	726	721	641	140
N	3	0	2	-135	-133	-134	-136	-134	-114	-127	-117
N	3	0	3	775	588	773	776	757	707	669	602
N	3	0	4	748	773	771	783	746	664	503	335
N	3	0	5	-175	-170	-165	-164	-149	-122	-119	-110
N	3	0	6	794	804	789	809	804	807	766	502
N	3	0	7	568	585	564	560	519	412	379	418
N	3	0	8	-124	-102	-137	-138	-149	-148	-152	-125
N	3	4.5	1	663	686	687	668	641	115	60	126
N	3	4.5	2	-16	-77	-76	-121	-122	-110	-119	-109
N	3	4.5	3	547	520	507	502	464	456	386	134
N	3	4.5	4	-52	-39	-39	-29	-25	3	13	-62
N	3	4.5	5	-182	-203	-195	-190	-184	-165	-171	-182
N	3	4.5	6	318	293	290	290	282	257	182	180
N	3	4.5	7	392	406	403	380	359	154	-195	-189
N	3	4.5	8	-140	-150	-148	-145	-131	-132	-146	-161
P	1	0	1	104	109	193	290	381	418	447	462
P	1	0	2	-142	-144	-130	-157	-148	-27	-132	-164
P	1	0	3	291	283	335	323	302	343	379	407
P	1	0	4	172	134	133	135	162	233	449	452
P	1	0	5	-117	61	324	371	199	400	412	422
P	1	0	6	644	662	659	601	593	631	639	629
P	1	0	7	699	685	659	655	621	627	612	609
P	1	0	8	151	120	132	114	62	439	553	604
P	1	4.5	1	603	526	522	544	592	622	634	646
P	1	4.5	2	133	117	51	131	187	-44	-158	-176
P	1	4.5	3	680	698	677	663	645	640	624	610
P	1	4.5	4	265	141	145	137	128	234	226	232

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	1/20/03	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/11/2003	4/30/2003	5/7/2003
N	1	0	6	768	773	798	699	159	182	113	147
N	1	0	7	785	784	855	807	796	255	537	425
N	1	0	8	-217	-219	-144	-202	-216	-135	-113	-101
N	1	4.5	1	644	703	772	700	680	728	691	482
N	1	4.5	2	-215	-224	-149	-209	-204	-129	-73	-93
N	1	4.5	3	-141	-124	-90	-182	-184	-125	-133	-93
N	1	4.5	4	817	800	863	803	798	877	816	840
N	1	4.5	5	-197	-194	-112	-190	-186	-113	-42	-81
N	1	4.5	6	479	311	358	224	106	479	49	81
N	1	4.5	7	625	642	588	325	177	249	199	241
N	1	4.5	8	-150	-154	-81	-145	-129	-58	8	-19
N	2	0	1	730	781	879	791	754	852	497	526
N	2	0	2	239	426	528	467	470	540	528	569
N	2	0	3	332	520	548	331	212	207	88	126
N	2	0	4	781	790	861	782	764	827	729	723
N	2	0	5	-179	-199	-123	-188	-187	-117	-118	-72
N	2	0	6	-87	150	402	248	196	350	90	127
N	2	0	7	795	800	861	767	526	432	430	510
N	2	0	8	-213	-206	-81	-121	-118	-98	-114	-77
N	2	4.5	1	244	367	592	516	200	278	95	125
N	2	4.5	2	-195	-207	-134	-198	-198	-131	-137	-93
N	2	4.5	3	752	758	839	769	763	831	682	780
N	2	4.5	4	744	727	831	719	733	833	348	335
N	2	4.5	5	-204	-224	-120	-193	-203	-135	-126	-89
N	2	4.5	6	419	403	151	411	102	215	3	44
N	2	4.5	7	373	362	459	406	373	397	123	108
N	2	4.5	8	56	48	114	46	35	97	97	128
N	3	0	1	125	95	154	65	61	144	32	61
N	3	0	2	-126	-170	-78	-140	-136	-56	-65	-22
N	3	0	3	317	237	821	601	315	331	217	243
N	3	0	4	375	359	849	678	418	416	420	432
N	3	0	5	-109	-119	-41	-100	-100	-31	-41	2
N	3	0	6	375	565	807	418	341	470	124	91
N	3	0	7	429	409	483	422	434	496	-12	-6
N	3	0	8	-136	-162	-75	-146	-115	-21	53	54
N	3	4.5	1	74	361	293	170	157	236	133	171
N	3	4.5	2	-122	-134	-39	-48	-55	32	25	70
N	3	4.5	3	-161	-177	266	471	409	403	-81	-45
N	3	4.5	4	-147	-48	302	294	143	-41	-61	-17
N	3	4.5	5	-164	-162	-86	-152	-149	-136	-27	-74
N	3	4.5	6	191	183	310	263	244	260	243	290
N	3	4.5	7	-195	-211	-72	-201	-198	-133	-128	-99
N	3	4.5	8	-165	.	-85	-131	-154	-87	-26	-44
P	1	0	1	489	470	556	474	449	498	469	479
P	1	0	2	-155	-163	-46	140	236	275	243	234
P	1	0	3	436	432	534	478	446	492	478	478
P	1	0	4	460	470	600	548	557	626	617	620
P	1	0	5	470	587	721	665	694	777	783	790
P	1	0	6	642	629	749	702	714	800	763	812
P	1	0	7	630	601	685	596	587	540	630	631
P	1	0	8	634	630	726	603	648	711	690	685
P	1	4.5	1	651	655	737	659	656	720	704	734
P	1	4.5	2	8	-17	68	5	26	88	81	89
P	1	4.5	3	615	590	651	569	562	656	662	638
P	1	4.5	4	229	249	333	181	54	158	395	509

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	5/18/2003	6/11/2003	6/27/2003
N	1	0	6	-24	141	579
N	1	0	7	215	591	870
N	1	0	8	-213	-102	-147
N	1	4.5	1	653	-15	436
N	1	4.5	2	-194	-85	-62
N	1	4.5	3	-204	86	104
N	1	4.5	4	831	464	846
N	1	4.5	5	-204	-73	-30
N	1	4.5	6	-49	16	240
N	1	4.5	7	135	262	287
N	1	4.5	8	-37	94	-6
N	2	0	1	356	305	207
N	2	0	2	464	564	530
N	2	0	3	351	171	348
N	2	0	4	737	208	210
N	2	0	5	-179	-53	-91
N	2	0	6	-45	-54	-112
N	2	0	7	714	146	485
N	2	0	8	-177	-72	-98
N	2	4.5	1	11	102	80
N	2	4.5	2	-105	-43	-86
N	2	4.5	3	764	483	805
N	2	4.5	4	281	282	486
N	2	4.5	5	-184	-70	-57
N	2	4.5	6	366	60	547
N	2	4.5	7	-17	72	20
N	2	4.5	8	27	156	130
N	3	0	1	28	83	80
N	3	0	2	-130	-29	-57
N	3	0	3	100	180	129
N	3	0	4	203	194	174
N	3	0	5	-75	12	-6
N	3	0	6	-12	96	70
N	3	0	7	-113	-54	-99
N	3	0	8	-54	82	66
N	3	4.5	1	4	107	79
N	3	4.5	2	1	77	86
N	3	4.5	3	-154	-62	-91
N	3	4.5	4	-123	-32	-65
N	3	4.5	5	-144	-47	-35
N	3	4.5	6	175	266	228
N	3	4.5	7	-208	-103	-130
N	3	4.5	8	-145	-17	22
P	1	0	1	412	295	568
P	1	0	2	-25	-119	-264
P	1	0	3	387	337	451
P	1	0	4	561	658	660
P	1	0	5	719	734	45
P	1	0	6	732	718	788
P	1	0	7	557	508	632
P	1	0	8	559	497	414
P	1	4.5	1	677	654	727
P	1	4.5	2	14	33	38
P	1	4.5	3	629	-43	433
P	1	4.5	4	465	-115	331

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditch	Transe	Distance (m)	Position	Depth	soil pH	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002
P	1	4.5	5	deep	4.55	-187	-205	-182	-185	-188
P	1	4.5	6	shallow	4.52	-138	-91	674	648	655
P	1	4.5	7	shallow	4.62	705	694	705	696	657
P	1	4.5	8	deep	4.43	-176	-185	-170	-172	-209
P	1	9	1	shallow	4.77	618	587	598	577	549
P	1	9	2	deep	4.57	-163	-195	-184	-202	-208
P	1	9	3	shallow	4.78	575	538	512	512	452
P	1	9	4	shallow	4.77	650	672	667	654	649
P	1	9	5	deep	4.55	-180	-218	-204	-204	-197
P	1	9	6	shallow	4.78	650	659	233	109	32
P	1	9	7	shallow	4.89	662	634	310	291	165
P	1	9	8	deep	4.62	-196	-217	-191	-195	-191
P	2	0	1	shallow	4.85	637	626	656	658	615
P	2	0	2	deep	4.38	-264	-277	-246	-220	-255
P	2	0	3	shallow	4.79	589	553	617	606	614
P	2	0	4	shallow	4.71	548	544	565	558	536
P	2	0	5	deep	4.43	-188	-228	-210	-220	-242
P	2	0	6	shallow	4.85	662	679	630	665	613
P	2	0	7	shallow	4.77	-173	584	582	562	532
P	2	0	8	deep	4.37	-228	-246	-216	-215	-217
P	2	4.5	1	shallow	4.65	670	656	610	617	618
P	2	4.5	2	deep	4.34	-232	-253	-224	-245	-249
P	2	4.5	3	shallow	4.75	656	625	633	590	444
P	2	4.5	4	shallow	4.49	527	516	540	576	517
P	2	4.5	5	deep	4.56	-221	-230	-217	-114	-188
P	2	4.5	6	shallow	4.63	647	642	663	440	385
P	2	4.5	7	shallow	4.66	656	654	649	593	507
P	2	4.5	8	deep	4.41	617	-215	-32	79	-632
P	2	9	1	shallow	4.40	685	687	533	477	514
P	2	9	2	deep	3.66	78	-22	146	64	87
P	2	9	3	shallow	4.28	661	653	667	645	608
P	2	9	4	shallow	4.94	652	673	682	511	507
P	2	9	5	deep	4.13	127	91	138	73	102
P	2	9	6	shallow	4.89	619	641	551	578	567
P	2	9	7	shallow	4.95	585	598	642	621	625
P	2	9	8	deep	3.80	-9	-55	185	60	17
P	3	0	1	shallow	4.99	37	-36	-210	-225	-238
P	3	0	2	deep	4.93	-270	-304	-268	-277	-290
P	3	0	3	shallow	4.76	-144	155	680	624	587
P	3	0	4	shallow	4.78	551	612	512	455	-30
P	3	0	5	deep	5.51	-250	-284	-265	-279	-302
P	3	0	6	shallow	4.87	-55	119	-124	-160	-163
P	3	0	7	shallow	4.93	-282	-290	-210	-199	-215
P	3	0	8	deep	5.13	-307	-333	-326	-324	-334
P	3	4.5	1	shallow	5.21	254	223	157	128	85
P	3	4.5	2	deep	5.48	-130	-212	-113	-129	-292
P	3	4.5	3	shallow	5.13	351	386	169	607	458
P	3	4.5	4	shallow	5.28	-115	-112	-103	-130	-172
P	3	4.5	5	deep	5.11	-283	-312	-289	-304	-229
P	3	4.5	6	shallow	5.15	104	440	40	-146	-229
P	3	4.5	7	shallow	5.22	-65	-47	183	69	-99
P	3	4.5	8	deep	5.02	-271	-278	-265	-234	-271
P	3	9	1	shallow	4.65	613	600	605	576	549

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Tra	Dista	Pos	2/2/2002	2/16/2002	3/2/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
P	1	4.5	5	-191	19	249	583	784	732	709	807
P	1	4.5	6	631	616	652	626	727	666	623	791
P	1	4.5	7	685	679	722	699	832	714	636	850
P	1	4.5	8	-220	-194	-130	-85	191	413	406	488
P	1	9	1	521	516	526	529	626	84	71	192
P	1	9	2	-212	-186	-191	-176	6	-38	-53	-60
P	1	9	3	468	455	150	196	402	397	366	527
P	1	9	4	637	636	659	648	765	679	665	738
P	1	9	5	-141	-9	240	290	467	73	3	273
P	1	9	6	4	42	58	49	179	49	25	219
P	1	9	7	490	428	569	403	622	481	659	786
P	1	9	8	-152	-121	-88	-105	-71	-155	-141	-101
P	2	0	1	491	198	523	74	160	-28	-96	770
P	2	0	2	-269	-181	-240	-226	-219	-198	-218	-54
P	2	0	3	623	721	668	637	688	690	665	786
P	2	0	4	424	519	487	449	558	606	571	708
P	2	0	5	-264	-233	-223	-175	-193	-150	-88	-45
P	2	0	6	681	695	635	656	736	751	706	859
P	2	0	7	502	560	573	583	640	645	650	770
P	2	0	8	-254	-198	-199	-180	-181	-160	-177	-75
P	2	4.5	1	631	71	77	86	132	118	426	792
P	2	4.5	2	-264	-236	-231	-219	-199	-180	-190	-93
P	2	4.5	3	367	443	199	-42	234	-173	-57	829
P	2	4.5	4	436	35	121	99	143	135	-91	255
P	2	4.5	5	-140	-133	-149	-149	-114	-111	-142	-115
P	2	4.5	6	247	295	245	311	486	167	165	263
P	2	4.5	7	411	530	630	115	541	527	676	813
P	2	4.5	8	86	51	42	49	24	29	-79	-100
P	2	9	1	211	77	122	203	404	376	392	533
P	2	9	2	67	122	24	85	210	178	68	41
P	2	9	3	579	549	541	-45	440	-167	10	216
P	2	9	4	486	529	433	-11	555	33	-63	824
P	2	9	5	62	130	129	203	232	342	301	508
P	2	9	6	550	575	588	498	227	377	285	345
P	2	9	7	600	102	256	518	503	550	532	685
P	2	9	8	0	58	53	-87	-103	-95	-72	20
P	3	0	1	-261	-171	-237	-246	-225	-143	-205	-128
P	3	0	2	-314	-230	-291	-287	-265	-175	-191	-134
P	3	0	3	597	634	-7	-83	-73	-21	-98	5
P	3	0	4	-213	-121	-201	-238	-204	-125	-179	-106
P	3	0	5	-315	-206	-281	-281	-261	-176	-214	-98
P	3	0	6	-185	-141	-260	-286	-278	-204	-241	-165
P	3	0	7	-273	-188	-242	-258	-217	-136	-200	-121
P	3	0	8	-343	-248	-311	-304	-276	-202	-260	-170
P	3	4.5	1	48	84	-166	-191	-187	-109	-174	-99
P	3	4.5	2	-316	-211	-291	-281	-282	-240	-276	-87
P	3	4.5	3	469	147	16	13	-41	-41	-119	-43
P	3	4.5	4	-202	-157	-231	-231	-230	-193	-231	-145
P	3	4.5	5	-331	-226	-292	-278	-270	-217	-240	-129
P	3	4.5	6	-243	-152	-230	-228	-229	-191	-225	-134
P	3	4.5	7	-151	-131	-208	-191	-181	-152	-190	-92
P	3	4.5	8	-304	-120	-271	-230	-256	-184	-224	-135
P	3	9	1	488	47	617	-39	650	-45	-74	14

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
P	1	4.5	5	695	737	645	297	213	173	165	235
P	1	4.5	6	415	590	460	400	81	444	324	191
P	1	4.5	7	727	817	722	716	721	732	717	711
P	1	4.5	8	363	366	280	178	113	-105	-124	203
P	1	9	1	134	172	294	629	594	527	443	393
P	1	9	2	-161	-78	-89	-116	-76	-113	-133	-141
P	1	9	3	425	546	502	637	623	585	553	596
P	1	9	4	657	691	663	678	677	649	609	608
P	1	9	5	194	134	162	58	-25	-72	122	143
P	1	9	6	257	319	259	473	437	438	426	441
P	1	9	7	253	711	45	604	567	747	654	657
P	1	9	8	-200	-139	-171	-144	-112	-137	-147	-170
P	2	0	1	687	759	699	659	658	662	578	593
P	2	0	2	-204	-101	-165	-112	-131	-108	-172	-169
P	2	0	3	684	759	745	776	724	787	705	676
P	2	0	4	604	668	605	667	607	634	605	565
P	2	0	5	-39	10	-55	-58	42	56	-13	-5
P	2	0	6	745	751	797	829	728	819	756	733
P	2	0	7	674	729	717	749	699	764	695	657
P	2	0	8	-178	-90	-137	-94	-85	-64	-142	-137
P	2	4.5	1	676	788	751	724	729	639	675	651
P	2	4.5	2	-173	-105	-130	-145	-121	-169	-168	-179
P	2	4.5	3	713	795	756	658	654	634	623	628
P	2	4.5	4	11	166	320	294	332	503	510	510
P	2	4.5	5	-205	-119	-142	-145	-163	-192	-183	-202
P	2	4.5	6	662	764	768	723	666	630	625	617
P	2	4.5	7	714	806	772	738	713	697	676	673
P	2	4.5	8	-217	-131	-147	-154	-175	-186	-174	574
P	2	9	1	422	536	628	790	732	720	677	647
P	2	9	2	-55	33	-20	-74	-108	-130	-76	-148
P	2	9	3	60	101	-23	58	41	97	136	206
P	2	9	4	700	772	704	775	687	696	631	621
P	2	9	5	447	557	314	644	307	544	513	468
P	2	9	6	433	652	641	651	578	507	576	467
P	2	9	7	650	702	642	736	623	569	584	546
P	2	9	8	-59	22	-37	36	39	-13	19	8
P	3	0	1	-216	-141	-48	351	284	120	117	169
P	3	0	2	-145	-113	-148	-115	-38	-91	-92	-103
P	3	0	3	648	763	724	735	677	688	644	629
P	3	0	4	-114	611	543	683	642	651	602	614
P	3	0	5	-121	-112	-153	-134	-95	-151	-147	-171
P	3	0	6	-247	-149	-47	-120	400	379	274	158
P	3	0	7	-223	-143	-191	-125	-146	-133	-140	-176
P	3	0	8	-247	-204	-229	-225	-137	-202	-36	-116
P	3	4.5	1	-194	-49	-73	718	671	721	644	600
P	3	4.5	2	-9	-74	-105	-40	-8	-119	-39	-71
P	3	4.5	3	16	-45	731	632	390	463	335	330
P	3	4.5	4	-237	-122	-113	660	612	622	553	502
P	3	4.5	5	-128	-76	-99	-68	-56	-65	-61	-96
P	3	4.5	6	-104	38	451	258	-80	623	558	506
P	3	4.5	7	-170	-115	159	635	497	731	655	602
P	3	4.5	8	-72	-111	-62	-77	10	-214	-21	-88
P	3	9	1	166	778	731	678	437	735	665	629

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002	1/5/2003
P	1	4.5	5	205	637	754	774	787	788	782	781
P	1	4.5	6	340	291	269	300	277	379	546	593
P	1	4.5	7	700	697	693	699	717	694	697	688
P	1	4.5	8	83	150	192	205	209	43	66	81
P	1	9	1	420	441	368	369	465	237	126	85
P	1	9	2	-116	-143	-94	-13	135	373	327	336
P	1	9	3	633	656	625	636	631	613	605	606
P	1	9	4	616	622	612	594	608	523	503	498
P	1	9	5	332	105	136	133	324	345	387	381
P	1	9	6	472	516	495	473	444	219	146	131
P	1	9	7	646	697	631	633	554	663	633	599
P	1	9	8	-165	-160	-118	-53	-159	19	-36	-74
P	2	0	1	562	538	528	527	535	557	557	576
P	2	0	2	-157	-157	-131	-138	-149	-193	-197	-200
P	2	0	3	690	676	636	621	586	590	585	597
P	2	0	4	541	556	524	511	484	494	611	585
P	2	0	5	-24	-56	-12	-28	-2	-83	-67	-79
P	2	0	6	730	734	698	696	691	713	724	754
P	2	0	7	649	642	598	590	556	603	572	636
P	2	0	8	-132	-115	-30	-108	-147	394	330	-160
P	2	4.5	1	632	631	629	614	581	636	568	556
P	2	4.5	2	-188	-184	-168	-193	-198	-192	-196	-193
P	2	4.5	3	639	640	624	635	463	658	581	203
P	2	4.5	4	537	539	438	416	432	433	341	215
P	2	4.5	5	-217	-212	-200	-82	-31	46	83	62
P	2	4.5	6	593	587	547	506	463	356	379	296
P	2	4.5	7	654	627	597	564	383	347	356	358
P	2	4.5	8	-170	184	226	-122	-165	129	82	24
P	2	9	1	627	604	588	581	562	569	547	570
P	2	9	2	-157	-159	-159	-136	-191	-179	453	-39
P	2	9	3	246	280	279	279	262	285	305	295
P	2	9	4	625	654	657	630	658	665	620	621
P	2	9	5	399	524	447	-151	-122	-128	218	285
P	2	9	6	499	497	439	422	466	543	438	402
P	2	9	7	577	562	525	505	384	604	287	470
P	2	9	8	30	0	474	380	295	232	234	234
P	3	0	1	183	203	210	213	-72	-163	-175	-174
P	3	0	2	-106	-103	-110	-129	-118	-109	-110	-105
P	3	0	3	619	616	606	606	578	514	512	394
P	3	0	4	603	587	586	590	588	462	428	-47
P	3	0	5	-159	-175	-145	-154	-141	-154	-146	-140
P	3	0	6	69	355	369	387	243	-32	-31	-131
P	3	0	7	-149	-160	-115	165	195	155	57	-112
P	3	0	8	-117	-140	-157	-159	-152	-137	-143	-139
P	3	4.5	1	641	659	631	634	628	570	501	27
P	3	4.5	2	-27	-120	-48	-293	-291	-259	-238	-215
P	3	4.5	3	254	280	267	256	229	184	188	-102
P	3	4.5	4	577	604	586	588	425	-129	-145	-208
P	3	4.5	5	-93	-96	-106	-111	-172	-148	-153	-146
P	3	4.5	6	607	617	596	608	584	-94	-42	-178
P	3	4.5	7	623	592	545	543	537	447	-131	-157
P	3	4.5	8	-67	-199	-200	-210	-229	-235	-212	-217
P	3	9	1	663	677	674	684	662	626	649	593

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	1/20/03	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/11/2003	4/30/2003	5/7/2003
P	1	4.5	5	769	767	847	766	779	843	839	846
P	1	4.5	6	668	679	746	677	620	693	777	757
P	1	4.5	7	692	694	765	693	654	717	764	748
P	1	4.5	8	86	92	179	73	59	150	204	221
P	1	9	1	111	102	186	118	130	229	238	256
P	1	9	2	100	114	189	163	364	434	427	431
P	1	9	3	603	593	690	648	666	682	707	716
P	1	9	4	517	502	586	513	514	631	687	687
P	1	9	5	419	415	494	139	352	427	426	429
P	1	9	6	144	133	192	145	62	205	306	439
P	1	9	7	687	641	688	617	674	674	772	719
P	1	9	8	-78	-96	53	-13	0	76	96	104
P	2	0	1	589	578	698	640	647	712	719	727
P	2	0	2	-203	-233	-152	-228	-226	-155	-148	-135
P	2	0	3	578	583	715	662	674	751	763	769
P	2	0	4	586	572	692	608	619	676	679	687
P	2	0	5	-116	-88	118	44	-22	-4	-8	11
P	2	0	6	783	790	860	766	743	825	834	865
P	2	0	7	638	634	737	677	668	742	735	766
P	2	0	8	-81	-110	482	-65	-118	-128	-116	-82
P	2	4.5	1	611	580	620	433	435	477	593	595
P	2	4.5	2	-196	-203	-91	-170	-167	-108	-107	-97
P	2	4.5	3	605	539	572	480	439	497	674	610
P	2	4.5	4	228	362	388	282	317	526	366	415
P	2	4.5	5	20	114	287	227	215	171	111	52
P	2	4.5	6	319	277	594	625	683	781	782	790
P	2	4.5	7	573	476	401	362	412	538	640	636
P	2	4.5	8	62	12	237	145	159	253	66	55
P	2	9	1	570	559	616	492	-78	514	728	636
P	2	9	2	-21	-40	29	-50	-47	10	-16	-26
P	2	9	3	290	234	309	238	46	0	413	295
P	2	9	4	629	596	661	538	-140	-103	763	628
P	2	9	5	194	191	294	231	386	497	531	539
P	2	9	6	145	336	249	122	190	493	494	503
P	2	9	7	205	412	481	259	191	579	642	650
P	2	9	8	241	235	338	293	300	354	367	312
P	3	0	1	-170	-182	-108	-174	-161	-102	-102	-93
P	3	0	2	-96	-105	-24	-97	-95	-29	-29	-16
P	3	0	3	183	-88	-88	-165	-164	-97	-86	-74
P	3	0	4	-118	-158	-94	-173	-182	-121	-118	-106
P	3	0	5	-127	-135	-56	-124	-124	-60	-57	-42
P	3	0	6	-154	-181	-141	-255	-272	-204	-212	-203
P	3	0	7	-129	-149	-78	-138	-159	-89	-95	-83
P	3	0	8	-141	-171	-81	-131	-119	-47	-39	-30
P	3	4.5	1	-147	-166	-74	-147	-144	-85	-91	-79
P	3	4.5	2	-196	-199	-105	-185	-178	-142	-149	-140
P	3	4.5	3	-65	397	401	-120	-127	-68	-68	-60
P	3	4.5	4	-204	-216	-133	-199	-184	-126	-116	-114
P	3	4.5	5	-130	-141	-75	-148	-154	-104	-69	-57
P	3	4.5	6	-184	-182	-127	-185	-187	-119	-117	-104
P	3	4.5	7	-160	-179	-103	-177	-169	-104	-84	-84
P	3	4.5	8	-202	-213	-135	-204	-173	-69	-116	-102
P	3	9	1	687	697	716	287	47	-5	-56	-2

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/18/2003	6/11/2003	6/27/2003
P	1	4.5	5	766	748	833
P	1	4.5	6	675	-78	629
P	1	4.5	7	678	454	540
P	1	4.5	8	177	293	233
P	1	9	1	202	87	159
P	1	9	2	359	422	421
P	1	9	3	636	660	662
P	1	9	4	619	69	754
P	1	9	5	331	307	188
P	1	9	6	301	316	403
P	1	9	7	714	751	830
P	1	9	8	18	36	42
P	2	0	1	654	689	724
P	2	0	2	-203	-183	-128
P	2	0	3	700	782	824
P	2	0	4	598	674	706
P	2	0	5	-46	16	69
P	2	0	6	787	585	882
P	2	0	7	712	-104	806
P	2	0	8	-151	-124	-83
P	2	4.5	1	547	-101	616
P	2	4.5	2	-179	-145	-105
P	2	4.5	3	619	-115	658
P	2	4.5	4	222	63	303
P	2	4.5	5	-165	-122	-101
P	2	4.5	6	733	704	780
P	2	4.5	7	553	6	581
P	2	4.5	8	-200	-108	-100
P	2	9	1	717	-52	659
P	2	9	2	-166	-129	-153
P	2	9	3	356	-107	-58
P	2	9	4	758	-97	701
P	2	9	5	470	545	555
P	2	9	6	422	387	493
P	2	9	7	551	501	563
P	2	9	8	46	45	31
P	3	0	1	-100	-82	-104
P	3	0	2	-50	-3	-20
P	3	0	3	-150	-47	-73
P	3	0	4	-183	-95	-114
P	3	0	5	-118	-21	-32
P	3	0	6	-267	-196	-210
P	3	0	7	-161	-51	-69
P	3	0	8	-108	-11	-27
P	3	4.5	1	-147	-60	-73
P	3	4.5	2	-214	-131	-168
P	3	4.5	3	-133	-24	-62
P	3	4.5	4	-184	-91	-86
P	3	4.5	5	-133	-28	-44
P	3	4.5	6	-139	17	6
P	3	4.5	7	-116	-53	-70
P	3	4.5	8	-168	-52	-66
P	3	9	1	262	-60	-56

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditch	Transe	Distance (m)	Position	Depth	soil pH	12/8/2001	12/20/2001	1/13/2002	1/20/2002	1/27/2002
P	3	9	2	deep	5.32	-327	-342	-230	-275	-305
P	3	9	3	shallow	5.24	620	630	568	508	428
P	3	9	4	shallow	5.17	641	629	509	422	265
P	3	9	5	deep	5.28	-170	-201	-216	-256	-284
P	3	9	6	shallow	5.25	600	573	529	543	528
P	3	9	7	shallow	5.21	642	662	415	403	274
P	3	9	8	deep	5.22	-286	-329	-197	-160	-261
P	4	0	1	shallow	4.58	-13	-34	70	-28	-175
P	4	0	2	deep	3.37	-278	-330	-295	-308	-310
P	4	0	3	shallow	4.48	598	589	607	571	513
P	4	0	4	shallow	4.56	668	645	680	654	621
P	4	0	5	deep	3.95	-265	-286	-176	-227	-235
P	4	0	6	shallow	4.52	627	585	440	383	167
P	4	0	7	shallow	4.54	494	-181	-127	-122	247
P	4	0	8	deep	4.02	-206	-295	-285	-281	-299
P	4	4.5	1	shallow	4.59	476	480	320	273	220
P	4	4.5	2	deep	5.23	-222	-300	-254	-220	-273
P	4	4.5	3	shallow	4.57	364	558	468	436	398
P	4	4.5	4	shallow	4.55	679	684	659	618	559
P	4	4.5	5	deep	5.03	-290	-324	-232	-309	-317
P	4	4.5	6	shallow	4.60	667	615	582	561	531
P	4	4.5	7	shallow	4.55	683	654	625	617	601
P	4	4.5	8	deep	4.75	.	.	.	.	.
P	4	9	1	shallow	4.33	594	612	226	273	63
P	4	9	2	deep	4.91	-114	-216	-187	-217	-235
P	4	9	3	shallow	4.27	690	683	648	573	305
P	4	9	4	shallow	4.33	644	668	708	458	233
P	4	9	5	deep	4.92	-61	-138	-266	-274	-263
P	4	9	6	shallow	4.35	466	462	341	283	226
P	4	9	7	shallow	4.32	634	613	722	718	-245
P	4	9	8	deep	5.06	-235	-267	-270	-270	-257

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	2/2/2002	2/16/2002	3/2/2002	3/16/2002	3/28/2002	4/11/2002	4/25/2002	5/11/2002
P	3	9	2	-317	-211	-225	-240	-277	-244	-262	-162
P	3	9	3	177	-22	-90	-129	-132	-114	-146	-23
P	3	9	4	487	509	438	-66	-101	-101	-136	-57
P	3	9	5	-303	-194	-269	-241	-228	-198	-192	-91
P	3	9	6	528	627	592	512	59	10	-3	114
P	3	9	7	23	-88	520	-167	-164	-166	-153	447
P	3	9	8	-245	-123	-218	-259	-263	-254	-274	-191
P	4	0	1	-65	398	722	698	719	805	821	885
P	4	0	2	-318	-189	-235	-189	-174	-86	-169	-31
P	4	0	3	497	574	587	467	533	422	-82	-5
P	4	0	4	612	729	663	675	685	761	654	773
P	4	0	5	-238	-123	-208	-296	-170	-39	-137	-28
P	4	0	6	-145	7	411	229	581	-15	489	581
P	4	0	7	-181	-118	-180	-169	-157	-76	-180	-81
P	4	0	8	-305	-205	-288	-258	-239	-150	-244	-123
P	4	4.5	1	153	294	428	352	503	532	496	581
P	4	4.5	2	-276	-160	-227	-164	-196	-102	-167	-72
P	4	4.5	3	371	470	474	437	460	598	172	570
P	4	4.5	4	549	726	657	664	654	729	633	768
P	4	4.5	5	-318	-208	-281	-291	-295	-195	-285	-165
P	4	4.5	6	530	564	566	522	523	156	324	330
P	4	4.5	7	592	657	612	571	596	242	558	665
P	4	4.5	8	-307	-192	-266	-257	-252	-156	-211	-113
P	4	9	1	267	79	263	-157	344	385	299	386
P	4	9	2	-170	-106	39	-183	124	-132	-146	-129
P	4	9	3	580	535	560	309	667	374	.	746
P	4	9	4	-10	9	267	-74	-90	6	493	609
P	4	9	5	-280	-195	-260	-138	-232	-121	-191	-98
P	4	9	6	435	539	347	182	544	221	437	128
P	4	9	7	631	734	700	663	625	84	-91	778
P	4	9	8	-229	-165	-214	-166	-210	-142	-211	-141

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/29/2002	6/10/2002	6/23/2002	7/14/2002	7/28/2002	8/11/2002	8/25/2002	9/8/2002
P	3	9	2	-196	-163	-126	-164	-131	-178	-102	-203
P	3	9	3	-3	460	709	739	686	758	718	641
P	3	9	4	-86	292	391	340	265	291	295	289
P	3	9	5	-133	-153	-129	-188	-81	-115	-136	-123
P	3	9	6	591	747	695	734	709	758	688	668
P	3	9	7	541	637	775	698	675	704	667	698
P	3	9	8	-178	-188	-178	-151	-114	-138	-214	-218
P	4	0	1	765	814	896	677	692	840	799	765
P	4	0	2	-107	-38	-48	0	-15	-68	-53	-81
P	4	0	3	623	739	697	747	717	823	803	745
P	4	0	4	673	758	744	369	168	203	213	129
P	4	0	5	-86	-41	-30	-72	-38	-69	-62	-70
P	4	0	6	321	581	725	639	-76	674	653	637
P	4	0	7	-185	-106	802	772	756	811	792	755
P	4	0	8	-215	-110	-95	-97	-50	-71	-49	-77
P	4	4.5	1	599	441	704	327	244	335	382	343
P	4	4.5	2	-72	-51	-107	-182	-121	-153	-170	-173
P	4	4.5	3	563	440	565	580	-20	75	480	493
P	4	4.5	4	711	795	794	664	45	642	395	465
P	4	4.5	5	-233	-99	-107	-158	-73	-134	-139	-132
P	4	4.5	6	344	444	759	533	4	637	634	619
P	4	4.5	7	584	668	878	674	248	740	559	402
P	4	4.5	8	-146	-114	-80	-164	-132	-121	-121	-159
P	4	9	1	305	466	771	472	271	662	617	577
P	4	9	2	-109	-132	33	-194	-77	34	-22	-186
P	4	9	3	623	268	838	641	71	849	741	815
P	4	9	4	732	830	820	34	580	746	739	766
P	4	9	5	-153	-134	-55	-157	-95	-186	-137	-196
P	4	9	6	494	645	792	394	-44	717	664	685
P	4	9	7	714	871	877	691	100	853	758	802
P	4	9	8	-221	-131	-26	-171	-174	-85	-191	-224

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	9/22/2002	10/9/2002	10/20/2002	11/2/2002	11/15/2002	12/2/2002	12/18/2002	1/5/2003
P	3	9	2	-178	-158	-199	-221	-223	-255	-267	-255
P	3	9	3	639	650	645	643	576	524	-38	145
P	3	9	4	356	412	427	442	440	334	344	328
P	3	9	5	-91	-116	-117	-161	-128	-153	-160	-155
P	3	9	6	689	681	670	661	645	638	648	638
P	3	9	7	677	667	670	655	619	531	595	534
P	3	9	8	-219	-199	-200	-213	-10	-196	-84	-71
P	4	0	1	791	779	714	717	682	718	698	675
P	4	0	2	-64	-103	-90	-136	-91	-103	-91	-86
P	4	0	3	790	782	761	754	574	555	603	159
P	4	0	4	174	161	158	221	83	128	74	-26
P	4	0	5	-62	-93	-77	-77	-79	-62	-95	-57
P	4	0	6	640	593	540	567	560	562	576	-25
P	4	0	7	783	780	762	744	607	576	535	397
P	4	0	8	-69	-80	-85	-77	-80	-69	-77	-66
P	4	4.5	1	235	357	550	559	534	544	509	nd
P	4	4.5	2	-161	-133	-145	-106	-101	-96	-92	-89
P	4	4.5	3	584	565	378	177	67	168	129	101
P	4	4.5	4	573	584	570	620	613	664	651	630
P	4	4.5	5	-120	-116	-128	-120	-121	-115	-117	-111
P	4	4.5	6	712	746	744	723	650	681	663	648
P	4	4.5	7	533	613	589	575	536	549	511	481
P	4	4.5	8	-153	-153	-169	-155	-158	-165	-183	-229
P	4	9	1	551	512	511	513	393	523	144	47
P	4	9	2	-102	-182	-163	-198	-174	-206	-239	-244
P	4	9	3	473	821	754	nd	583	593	470	nd
P	4	9	4	814	821	785	816	458	791	65	-68
P	4	9	5	-145	-192	-188	-171	-203	-225	-144	-200
P	4	9	6	743	745	572	562	134	269	198	37
P	4	9	7	768	805	760	747	669	661	593	427
P	4	9	8	-219	615	-239	-239	-223	-242	-239	-229

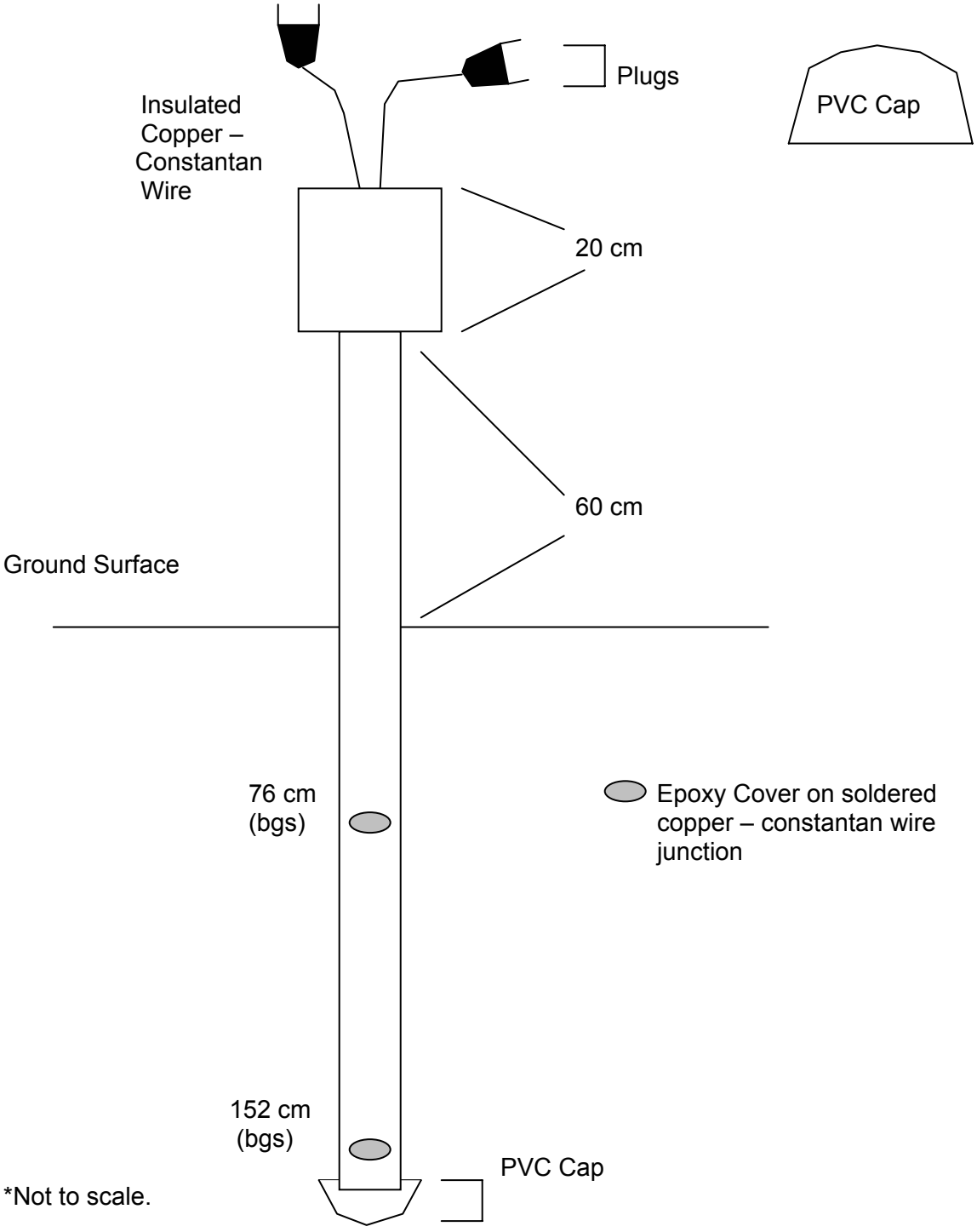
Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	1/20/03	2/9/2003	2/23/2003	3/12/2003	3/27/2003	4/11/2003	4/30/2003	5/7/2003
P	3	9	2	-248	-206	-154	-296	-272	-215	-205	-194
P	3	9	3	491	578	137	-99	-130	-74	-75	-61
P	3	9	4	341	433	537	-111	484	36	-15	-10
P	3	9	5	-134	-162	-88	-163	-117	-102	-54	-41
P	3	9	6	621	676	741	634	365	33	-28	-36
P	3	9	7	595	662	711	213	43	36	-36	-45
P	3	9	8	-140	349	614	2	602	-140	-159	-147
P	4	0	1	679	675	731	-45	-90	705	819	784
P	4	0	2	-78	-137	-52	-112	-99	-18	-24	-15
P	4	0	3	720	656	510	528	659	554	724	635
P	4	0	4	-28	138	6	-100	-104	-58	-63	-47
P	4	0	5	-58	-70	7	-68	-62	4	8	1
P	4	0	6	227	574	95	-135	-133	-74	224	16
P	4	0	7	-136	-153	-81	-154	-150	-90	-87	-67
P	4	0	8	-55	-67	11	-63	-59	8	3	26
P	4	4.5	1	512	517	579	617	116	535	535	566
P	4	4.5	2	-81	-88	-42	-91	-90	-30	-45	-23
P	4	4.5	3	13	349	456	-54	-127	72	467	186
P	4	4.5	4	664	677	742	595	-48	36	774	787
P	4	4.5	5	-115	-124	-44	-116	-111	-50	-51	-27
P	4	4.5	6	670	665	729	618	113	254	773	629
P	4	4.5	7	548	532	548	17	-108	-51	81	78
P	4	4.5	8	-250	-245	-49	-253	-247	-155	-180	-133
P	4	9	1	201	179	168	-106	-103	-26	169	0
P	4	9	2	-219	-247	-79	-242	-243	-178	-160	-145
P	4	9	3	-116	397	123	-136	-151	-87	-98	.
P	4	9	4	461	641	450	166	91	10	758	91
P	4	9	5	-217	-215	-63	-161	-214	-115	-114	-97
P	4	9	6	444	402	254	-50	-23	-15	626	-4
P	4	9	7	502	599	523	-101	-99	-42	-37	-8
P	4	9	8	-237	-244	-145	-220	-240	.	-160	-120

Appendix E. Water Chemistry Raw Data – Redox Potential (mV) (continued)

Ditc	Trai	Dista	Pos	5/18/2003	6/11/2003	6/27/2003
P	3	9	2	-265	-167	-176
P	3	9	3	219	-25	428
P	3	9	4	-81	-14	-41
P	3	9	5	-84	-9	-25
P	3	9	6	-140	-48	-79
P	3	9	7	606	-64	-32
P	3	9	8	-222	-121	-147
P	4	0	1	749	642	688
P	4	0	2	-82	32	1
P	4	0	3	619	331	543
P	4	0	4	-118	-10	-27
P	4	0	5	-66	47	17
P	4	0	6	93	-18	41
P	4	0	7	-23	-43	-76
P	4	0	8	-61	49	17
P	4	4.5	1	504	217	269
P	4	4.5	2	-110	-7	-33
P	4	4.5	3	403	-17	81
P	4	4.5	4	737	20	37
P	4	4.5	5	-112	-5	-28
P	4	4.5	6	741	200	407
P	4	4.5	7	134	0	-29
P	4	4.5	8	-220	-93	-36
P	4	9	1	117	-13	-109
P	4	9	2	-193	-93	-114
P	4	9	3	105	81	-81
P	4	9	4	698	308	2
P	4	9	5	-187	-61	-81
P	4	9	6	405	15	90
P	4	9	7	468	395	123
P	4	9	8	-218	-108	-147

Appendix F. Temperature Probe Construction*



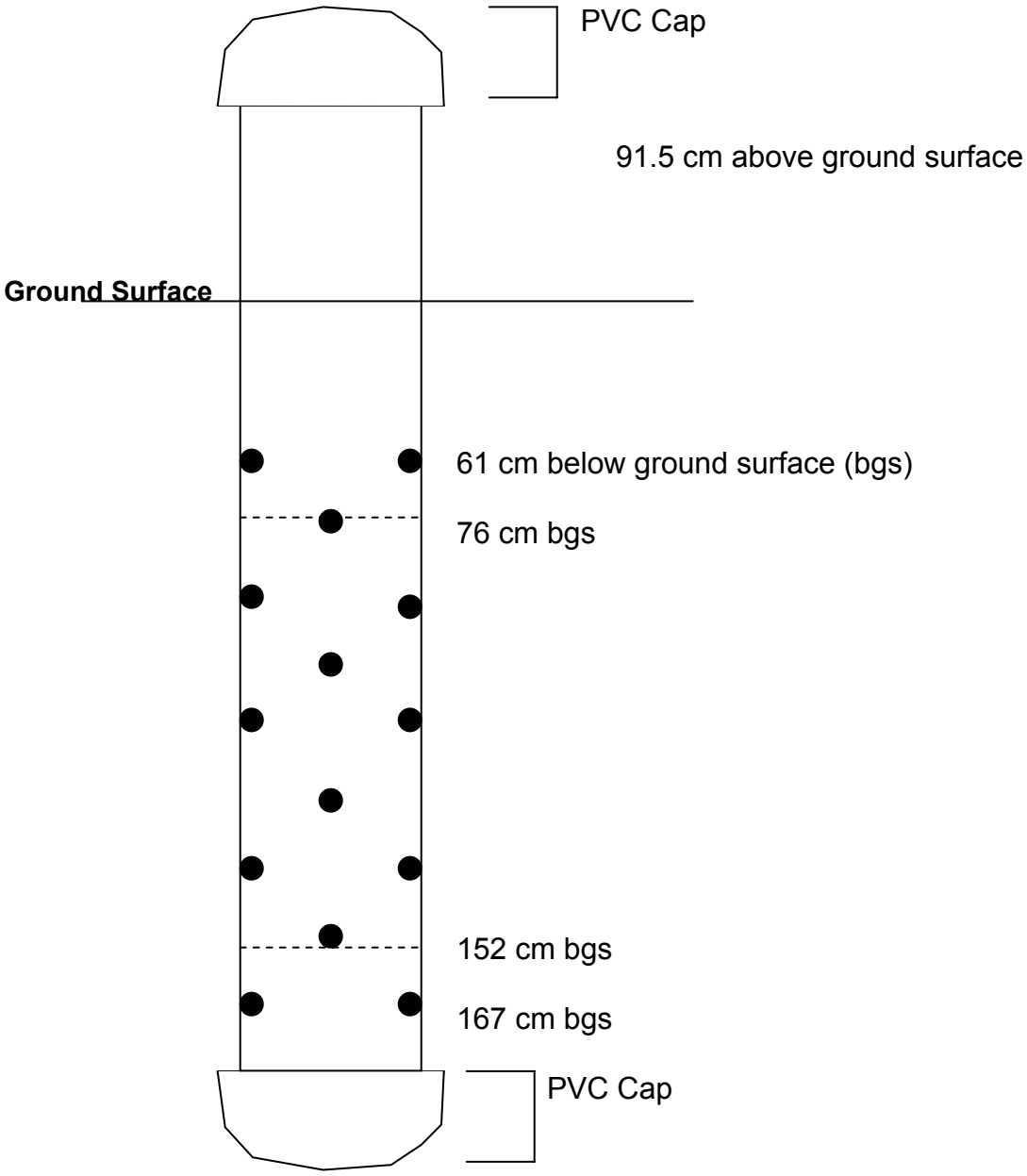
Temperature probes were made with 1.9 cm (¾ in) PVC pipe, cut into approximately 220 cm (87 in) lengths. A 3.8 cm (1 ½ in) PVC pipe was cut into 20 cm (8 in) sections. A coupler was glued to the primed 3.8 cm PVC and the 1.9 cm PVC to join the two. This larger diameter PVC

was used to store the excess lengths of wire that were needed so the ends of the wire could reach the platform where equipment was placed. Two 0.32 cm (1/8 in) diameter holes were drilled 1 cm apart at the location for the 76 cm and 152 cm below the ground surface measurements. A channel was dug into the pipe between the two holes using a Dremel tool.

Insulated copper-constantan wire, purchased from Omega, was cut into lengths that reached from the soil measurement location to the platform. Approximately 2.54 cm (1 in) of the insulation that covered the two individually insulated wires was removed. About 2 mm of wire at the end of each wire was bent at a 90 degree angle and the wire was fed through the pipe to the holes drilled in the PVC at the soil measurement locations. When the wire reached the appropriate location, one strand was pulled up through each hole using cruicible tongs. The stripped end of the copper wire was wrapped around the stripped constantan wire. The wires were then soldered together. The soldered connection was forced into the trough made with the Dremel tool. A thin slice of Epoxy putty was cut, kneaded, and used to cover the holes and soldered connection to make a water-tight seal. The soil temperature was measured by the wires under the Epoxy.

A “T” thermocouple specific to the copper – constantan wire, and is plugged into the Omega HH508 Temperature Meter when measuring temperature, was attached to each strand of wire. A small section of the insulation that covered both wires was removed and the last 3-mm of each wire was stripped. The top plate of the plug was removed. Each wire was wrapped around the appropriate contact point. A rubberband was placed around both wires where they leave the plug to makes a tight seal. The rubberband was then placed back in the grove where it had originally set and the top plate was replaced. The bottom 1 cm of the PVC was primed, glue applied and a 1.9 cm (¾ in) PVC cap was glued firmly in place on the bottom of the pipe. A 3.8 cm (1 ½ in) PVC cap was placed over the top of the wire storage PVC, but not glued so it could be removed when measuring temperature. The temperature probe was then ready for installation.

Appendix G. Potassium Chloride Salt Bridge Construction*



1.5 in (3.18 cm) Diameter PVC Pipe
1/8” Diamter Holes
Spaced 6 in (15 cm) Apart

*Not to Scale

Potassium chloride salt bridges were constructed to use with the reference electrode when taking redox measurements in the field. The salt bridge was constructed from a 3.2 cm (1.5 in) diameter PVC pipe. Holes 1/8" diameter were drilled in the 274.3 cm (108 in) long piece of PVC pipe to extend from 15 cm (6 in) above the shallow redox probes to 15 cm (6 in) below the deep redox probes. The holes were 5 cm apart vertically and a set of holes at each depth consisted of two holes, one opposite the other, made by drilling completely through the PVC pipe. A PVC cap was glued to the bottom of the pipe. PVC primer and glue were applied to the pipe and the cap slid firmly into place.

High temperature heat resistant duct tape was placed over each of the holes to prevent the potassium chloride agar solution from leaking out when it was poured hot into the pipe. The potassium chloride agar solution was made with reagent grade potassium chloride and granulated agar – solidifying agent, both from Fisher Scientific. Thirty grams of agar and 350 grams of KCl were measured and poured into an enamel coffee pot, along with 1 L of deionized water (Veneman and Pickering, 1983). The agar and KCl were stirred in the water and the solution was heated to a boil on a camp stove in a well ventilated area. After the solution reached a boil, it was allowed to cool for approximately 5 minutes. The solution was then poured into the PVC pipe. A second cap was placed on the top of the PVC pipe, but was not glued into place as to allow addition of more KCl – agar solution in the future as the level decreases. The KCl salt bridge helped the redox potential measurements to stabilize more quickly during drier months when the upper soil moisture content may not be high enough to conduct electrical current.

Appendix H. Redox Probe Installation

The closest redox probes were installed 50 cm (19.75 in) from the nearest groundwater monitoring well. A plywood template was made with a hole drilled where each probe was to be installed in the grid. The template was laid down 50 cm from the nearest well and pin flags were used to mark the location of each redox probe. Holes were augered with a 1.9 cm (¾ in) Oakfield screw auger to 76 cm (2.5 ft) for the shallow probes and 152 cm (5 ft) for the deep probes. As the soil was removed it was placed into a separate bucket for each horizon. The last 15 cm (6 in) of soil was kept for pH analysis.

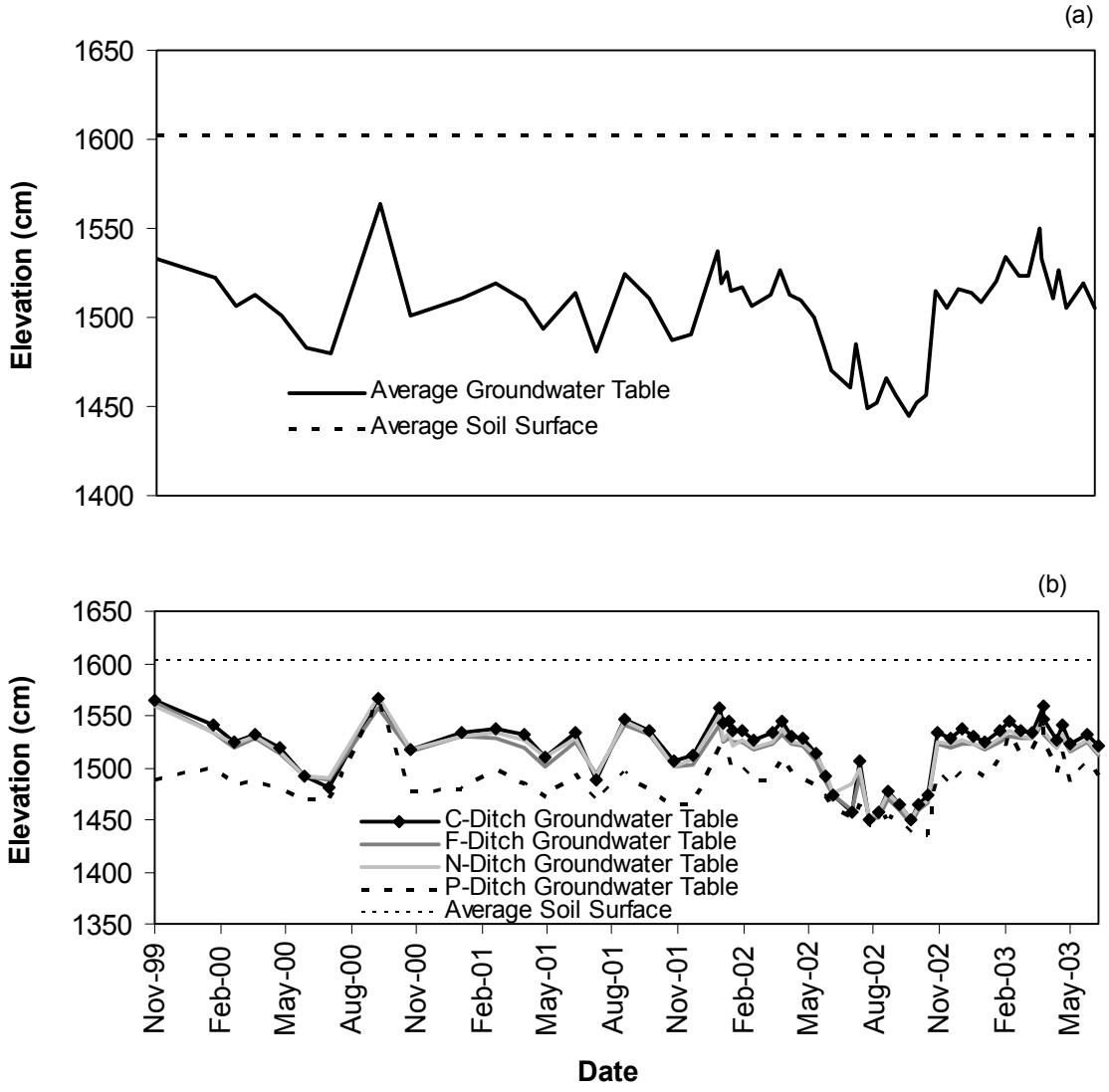
The Pt on each redox probe was sanded and the probe was inserted into the hole until it hit the bottom. The probe was then pushed firmly into the soil to ensure good contact with the Pt. The hole was then backfilled by making a slurry of the removed soil and water. The slurry was poured back into the hole opposite the order it was removed in to avoid mixing of the organic carbon rich A-horizon with the deeper, carobn depleted soils. The cap of each redox probe was siliconed for water proofing.

Each probe was given a number during construction and testing, which was outlined in Wafer et al. (2004). The number of each probe was recorded on a sheet for each nest of redox probes, so the performance of the probes could be tracked over time and related to their testing results. The soil pH was analyzed with a 1:1 soil to water mix in a laboratory in the Soil Science Department at NC State University. This information was used to adjust the redox potential at which denitrification was expected to occur.

Appendix I. Statistical Analysis of Groundwater PO_4-P Data

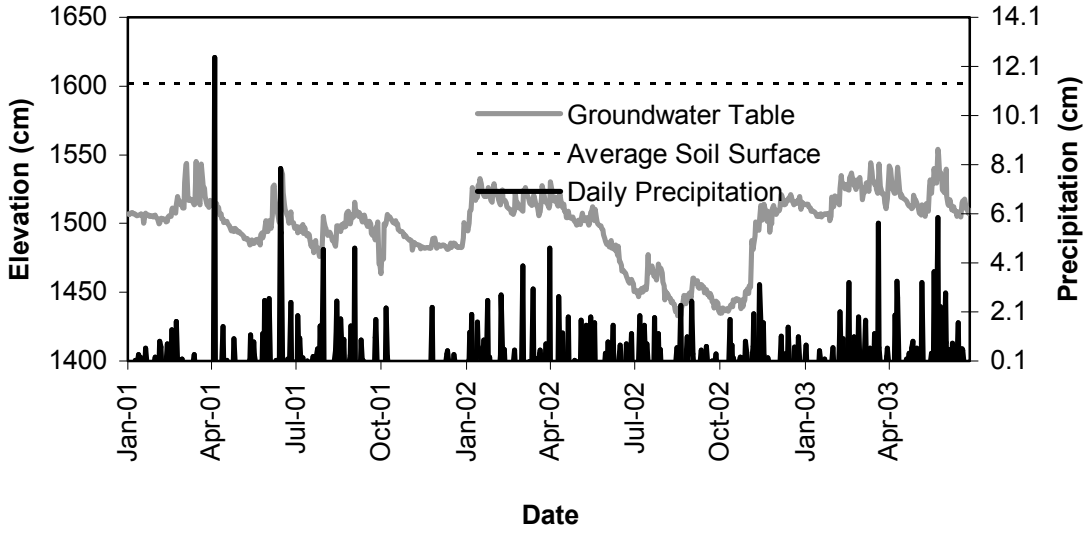
The relationship between groundwater PO_4-P and soluble Fe, DOC and redox potential was examined using Proc Reg in SAS (SAS Institute, 2001, Cary, NC, USA). Groundwater and soil redox potential data were compared at the deep and shallow depths. A separate regression was run between PO_4-P and each of the explanatory variables for each buffer and each depth. For example, PO_4-P concentrations were compared to DOC concentrations in the shallow wells in the C-Ditch. One single regression that used all of the data from the deep or the shallow wells was not run because there was too much variability between ditches and the significance of a single explanatory variable would not have been detected. Comparisons that included all variables from a single depth on one ditch, such as the shallow wells in the C-ditch, were not performed because the explanatory variables are all interrelated. This would have made the determination of significance of individual explanatory variables much more difficult. Even though performing the regressions using a single explanatory variable for each comparison is not the ideal method, it did provide a useful method to gain insight to what factors influenced PO_4-P on a buffer-by-buffer basis.

Appendix J. Groundwater Table Elevation



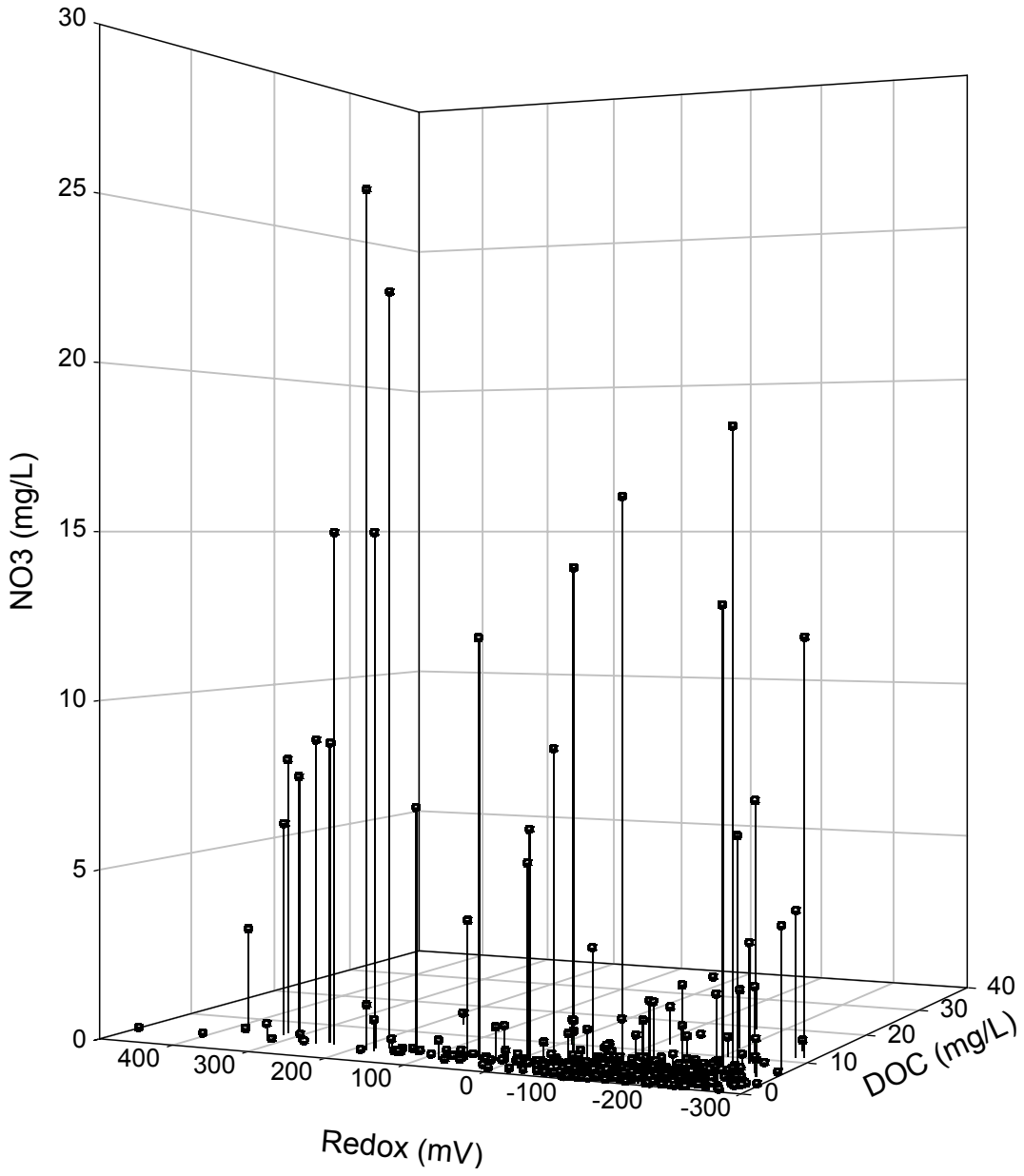
Appendix J.a. Average groundwater table elevation and soil surface elevation over the entire study period (a) and average groundwater table elevation by buffer and average soil surface elevation over the entire study period.

Appendix K. Average Daily Groundwater Table and Daily Precipitation



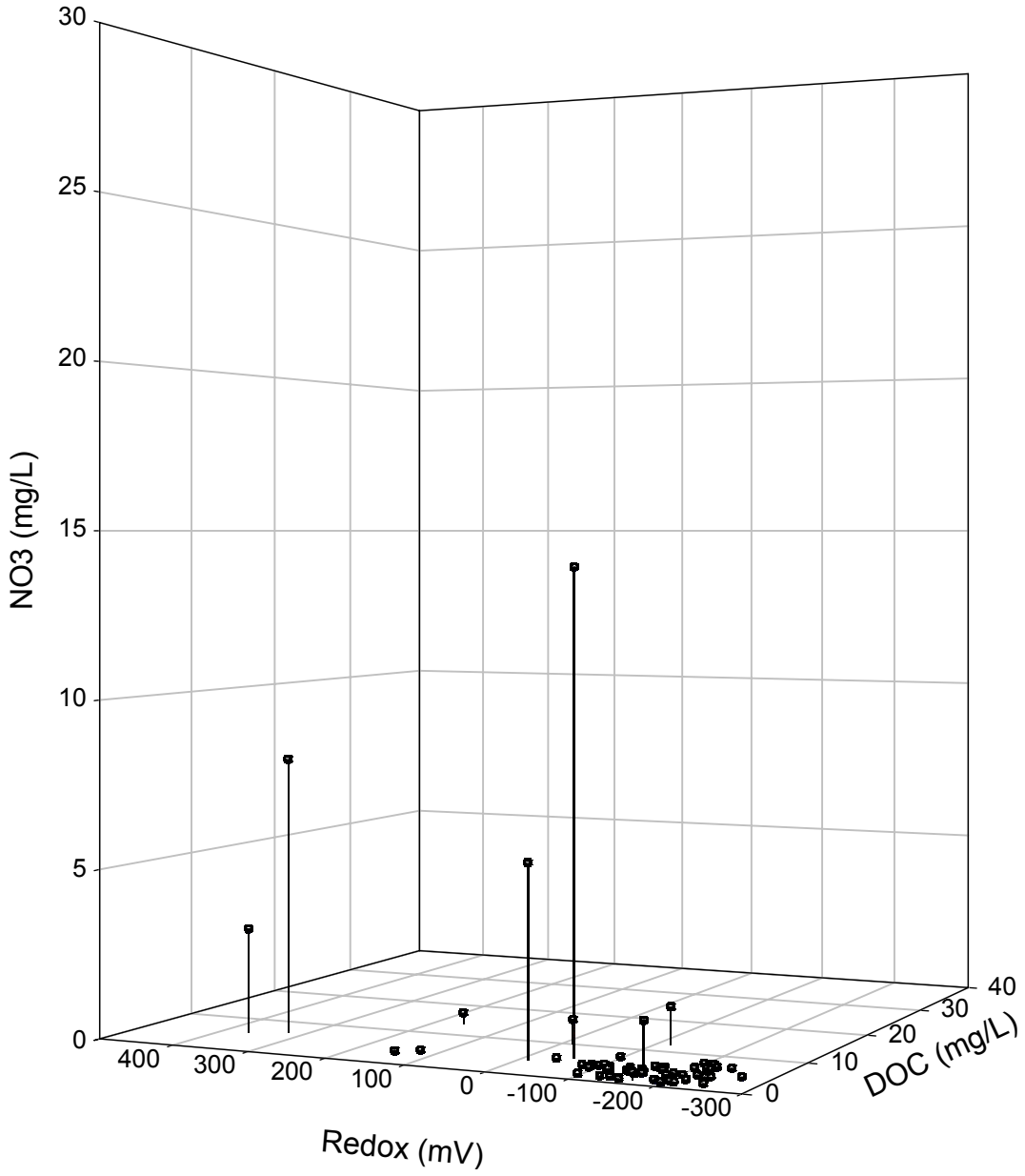
Appendix K. Average daily groundwater table and daily precipitation data collected by the Strison wireless system over the entire study period.

Appendix L. Deep NO_3^--N, DOC and Redox Potential Three-Dimensional Graphs



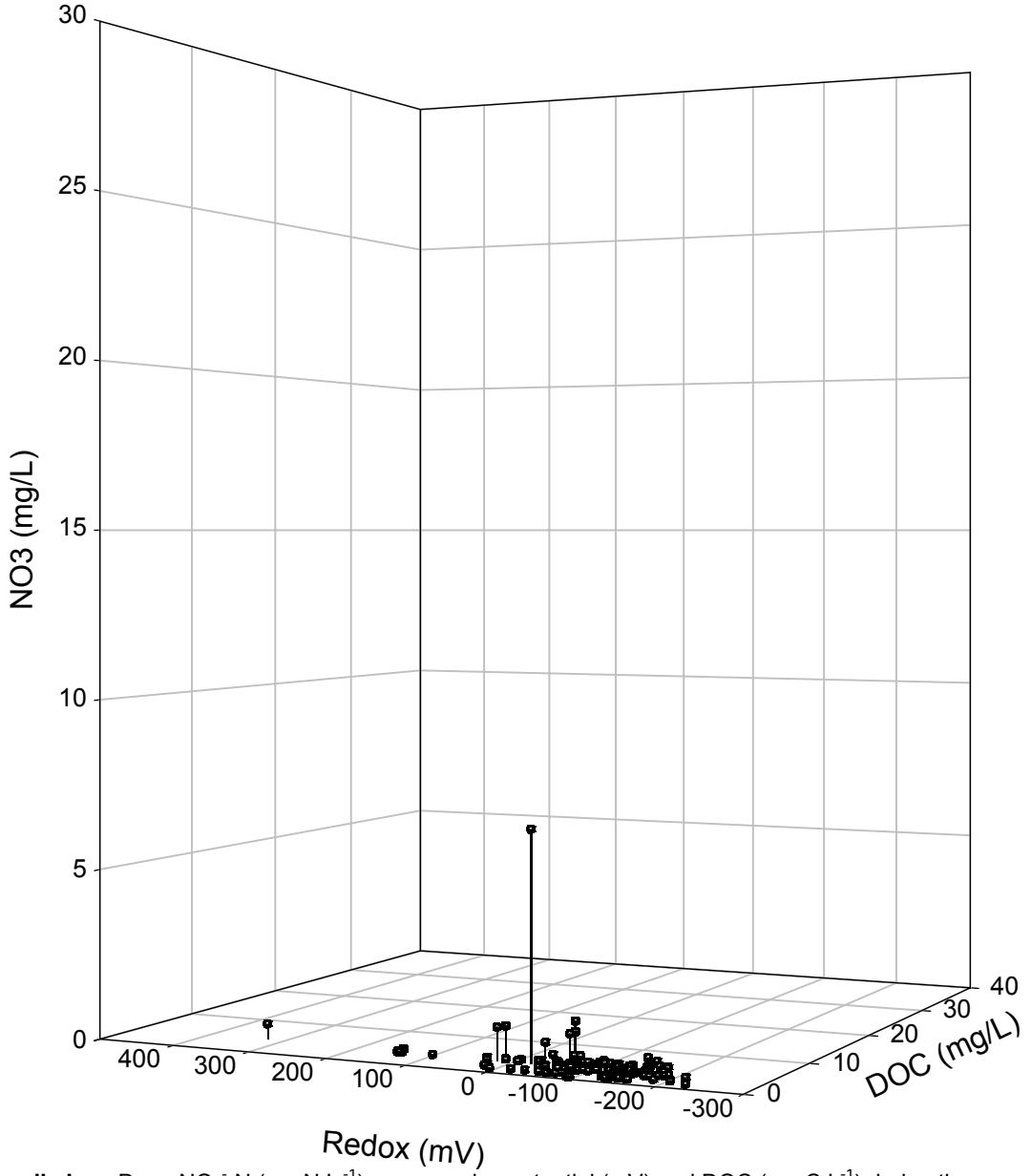
Appendix L.a . Deep NO_3^--N (mg N L^{-1}) versus redox potential (mV) and DOC (mg C L^{-1}) during all three seasons (planting, growing and dormant).

Appendix L. Deep NO_3^--N, DOC and Redox Potential Three-Dimensional Graphs (Continued)



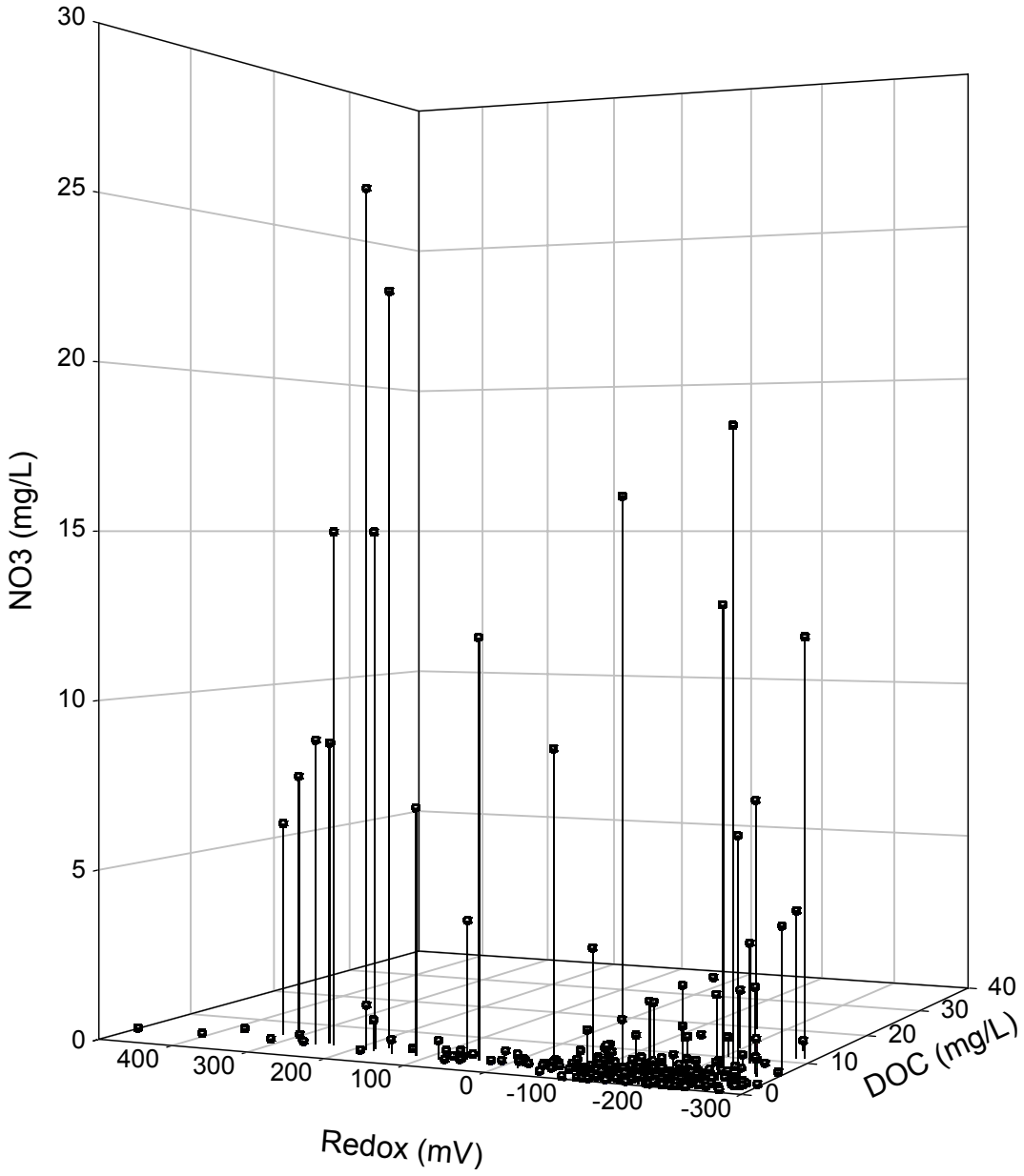
Appendix L.b . Deep NO_3^--N (mg N L^{-1}) versus redox potential (mV) and DOC (mg C L^{-1}) during the planting season (April to May).

Appendix L. Deep NO_3^--N, DOC and Redox Potential Three-Dimensional Graphs (Continued)



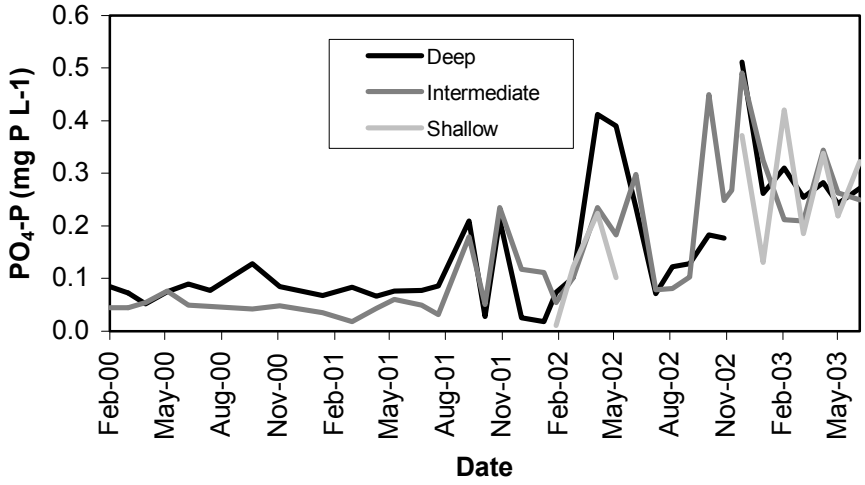
Appendix L.c . Deep NO_3^--N (mg N L^{-1}) versus redox potential (mV) and DOC (mg C L^{-1}) during the growing season (June to September).

Appendix L. Deep NO_3^--N, DOC and Redox Potential Three-Dimensional Graphs (Continued)



Appendix L.d . Deep NO_3^--N (mg N L^{-1}) versus redox potential (mV) and DOC (mg C L^{-1}) during the dormant season (October to March).

Appendix M. Orthophosphate Concentrations



Appendix M. Orthophosphate concentrations over the entire study period.

Chapter 2. Tillage, Cropping Systems, Soil Series and Nitrate Leaching[1]

Abstract

The effects of reduced tillage practices, such as no-till (NT) production, on groundwater NO_3-N are not well understood. The goal of this research was to study groundwater NO_3-N under NT and conventional till (CT) systems on different soils in the Upper Coastal Plain Region of North Carolina, to examine the influence of crop production on NO_3-N dynamics and to examine the influence of tillage on crop yields. Groundwater NO_3-N and crop yields were compared over seven years between two NT fields (NT-Ni on Nixonton soils (Fine-silty, mixed, active, thermic Typic Hapludults), NT-Wi on Wickham soils (Fine-loamy, mixed, semi active, thermic Typic Hapludults)) and one CT field (CT-Ni on Nixonton soils). Rye was grown on NT-Ni as a small grain and cover crop and wheat was grown on NT-Wi as a small grain and cover crop. Wheat was also grown on CT-Ni as a small grain, but the field was tilled and left fallow during the cover cropping period (late fall to early spring). Nitrate N concentrations and yields were compared during each crop production period (corn, small grain, soy, cover crop/bare soil) because the crop rotations changed throughout the study period (1996 – 2003). The groundwater NO_3-N concentrations averaged over the entire study period were similar in NT-Wi (5.5 mg N L^{-1}) and CT-Ni (5.8 mg N L^{-1}), but were lower in NT-Ni (2.4 mg N L^{-1}). This pattern was also evident during individual cropping periods. Fertilization rates, the use of cover crops and soil characteristics appeared to have the largest effect on groundwater NO_3-N concentrations. Data from NT-Ni indicate that NO_3-N concentrations decreased from 3- to 4-m depths in soils with relatively low

available water content, which was probably a result of dilution. There were no substantial crop yield differences between fields, except during a drought year; soybean yields were much higher in NT-Ni (1,709 kg ha^{-1}) (cover crop) than in CT-Ni (971 kg ha^{-1}) (no cover crop) and NT-Wi (601 kg ha^{-1}) (cover crop) during 2002. This data suggests that soybean production benefited from NT production in soils with greater water holding capacity during periods of drought, but no other crop response to tillage was detected. The results from this study indicate that NT production alone will not result in decreased groundwater NO_3-N concentrations. The successfulness of NT to reduce groundwater NO_3-N concentrations was also dependent upon crop fertilization rate and soil properties.

[1] The use of trade names in this publication does not imply endorsement by NC State University of the products named, or criticism of similar ones not mentioned.

Introduction

Agricultural best management practices (BMPs), such as the use of buffers and nutrient management plans, are well known to reduce NO_3-N leaching losses to ground and surface waters in the southeastern United States. The effects of reduced tillage practices, such as no-till (NT) production, on the fate of NO_3-N are less understood. No-till production minimally disturbs the soil and crop residue in order to increase residue cover on the soil surface, decrease soil loss and improve soil moisture content (CTIC, 1989). Some studies show that NO_3^--N leaching losses are lower in NT production than in conventional tillage (CT) production (Touchton and Wells, 1985; Wells and Touchton, 1985), but those findings are refuted by others (Gilliam and Hoyt, 1987; Osmond et al., 2004). Brinsfield and Staver (1991) found that the amount of NO_3-N leached was similar regardless of tillage method; the amount leached from CT fields was 20 to 30 kg N ha^{-1} (18 to 27 lb N ac^{-1}), while 18 to 27 kg N ha^{-1} (16 to 24 lb N ac^{-1}) leached from NT fields. Based on this information and information gathered by Osmond et al. (2000), NT production could not be used on its own as a BMP to reduce NO_3-N leaching loses, especially in the Coastal Plain region of North Carolina.

Winter cover crops, however, have been shown to decrease NO_3-N leaching and produce residue for soil and water conservation (Messinger et al., 1991; Hook and Gascho, 1988; Osmond et al., 2004). Cover crops such as wheat (*Triticum aestivum* L.) and rye (*Secale cereale* L.) effectively decrease NO_3-N leaching; they take up residual NO_3-N that would otherwise be

susceptible to leaching and decrease leaching losses by 30 to 70% (Messinger et al., 1991).

The use of cover crops in conjunction with NT has been shown to further decrease groundwater NO_3-N concentrations. Rye cover crops used in conjunction with NT production decreased NO_3-N leaching losses in continuous corn (*Zea mays* L.) on an Edom silty clay loam by more than 39 kg N ha^{-1} $year^{-1}$ (35 lb N ac^{-1} yr^{-1}) (Hamlett and Brannan, 1991). Staver and Brinsfield (1998) found that groundwater NO_3-N concentrations decreased with the use of a rye cover crop in NT and CT systems, but the decrease was greater in NT. Hoyt and Mikkelsen (1991) found less soil NO_3-N below 127 cm (50 in) in NT cover cropped fields on a Dillard soil (Fine-loamy, mixed, mesic Aquic Hapludults) than in CT non-cover cropped and NT non-cover cropped fields. These studies support the use of NT in conjunction with winter cover crops as a likely N-reducing BMP (Osmond et al., 2004).

Crop yields may also increase in response to NT production. No-till corn and double cropped soybean yields (*Glycine max* L. Merr.) increased as a result of higher soil moisture content in NT fields (Pierce and Rice, 1988; Hamlett and Brannan, 1991; Wagger and Denton, 1992). Yield increases can be hampered in NT fields, however, due to poor seed germination, climactic variability and other factors (Bauer and Reeves, 1999).

Soil characteristics, in conjunction with climate patterns, also influence yield response to different tillage methods in the southeastern United States. Coastal Plain soils tend to be droughthy and have low water holding capacity;

however, precipitation can easily infiltrate into the flat, sandy, non-crusted soil surface. The Piedmont soils are finer textured and the soil surfaces are more sloping and prone to crusting, which decreases the potential for infiltration (Wagger and Denton, 1989). No-till production is not as likely to improve crop yields in the Coastal Plain region because more precipitation falls in that region and the precipitation can more easily enter the soils. No-till tends to increase crop yields in the Piedmont region because the increased residue on the soil surface promotes infiltration and water conservation, which are beneficial on the crusted soil surfaces that receive less precipitation.

Wagger and Denton (1989) measured a 25% yield increase in NT corn compared to CT corn yields in Piedmont soils, but no yield response was evident in the Coastal Plain soils. The improved yield in the NT Piedmont soils was attributed to increased soil moisture content, because crop residues in the NT field improved infiltration. The lack of response in the Coastal Plain fields was because precipitation could more readily infiltrate the soils, regardless of tillage type. No yield difference was measured for soybeans in NT and CT systems in both Piedmont and Coastal Plain soils in North Carolina, because the soybeans in both regions did not suffer from water stress during pod fill (Wagger and Denton, 1992). No-till soybean yields have been higher than CT yields during periods of water stress in both the North Carolina Piedmont and on a Hartsells fine sandy loam in Alabama (Wagger and Denton, 1989; Edwards et al., 1995). The goal of our research was to study patterns in groundwater NO_3-N under

different tillage systems and examine the influence of soil properties and different crop production systems on NO_3-N dynamics and crop yields.

Methods

Site Description

This research was conducted on the Thompson Farm at the Center for Environmental Farming Systems (CEFS) in Goldsboro, NC, which is on a floodplain terrace in the Middle Coastal Plain of North Carolina. Two soil types predominate the fields where research was conducted: Wickham (Fine-loamy, mixed, semi active, thermic Typic Hapludults) and Nixonton (Fine-silty, mixed, active, thermic Typic Hapludults). Two smaller areas of soils are also on the site: McQueen (Fine, mixed, semiactive, thermic Typic Hapludults) and Yeopim (Fine-silty, mixed, semiactive, thermic Aquic Hapludults). McQueen, Nixonton and Wickham are well drained soils and Yeopim is moderately well drained (Barnhill, 1974).

Two NT fields and one CT field were studied. Figure 1 is a site map that shows the relative location of the fields and groundwater sampling wells. One NT field (NT-Wi) was 0.73 ha (1.8 ac) in size and mapped entirely as a Wickham soil (Figure 2). The other NT field (NT-Ni) was 1.47 ha (3.5 ac) in size and predominantly mapped as a Nixonton soil, with a McQueen soil in one corner (Figure 3). The CT field (CT-Ni) was 1.8 ha (4.5 ac) in size and also predominantly mapped as a Nixonton soil, with a small area of Yeopim and an area of McQueen (Figure 4). Research began on the CT-Ni and NT-Wi fields in

1996 to compare groundwater chemistry under CT and NT production, but the soils were later determined to be different. To compensate, research began on the NT-Ni in 1997 in order to compare different tillage on the same soil series. Conventional-tillage was used throughout the study period on the CT-Ni field. No-till began on the NT-Wi field in 1996 and on the NT-Ni field in 1997.

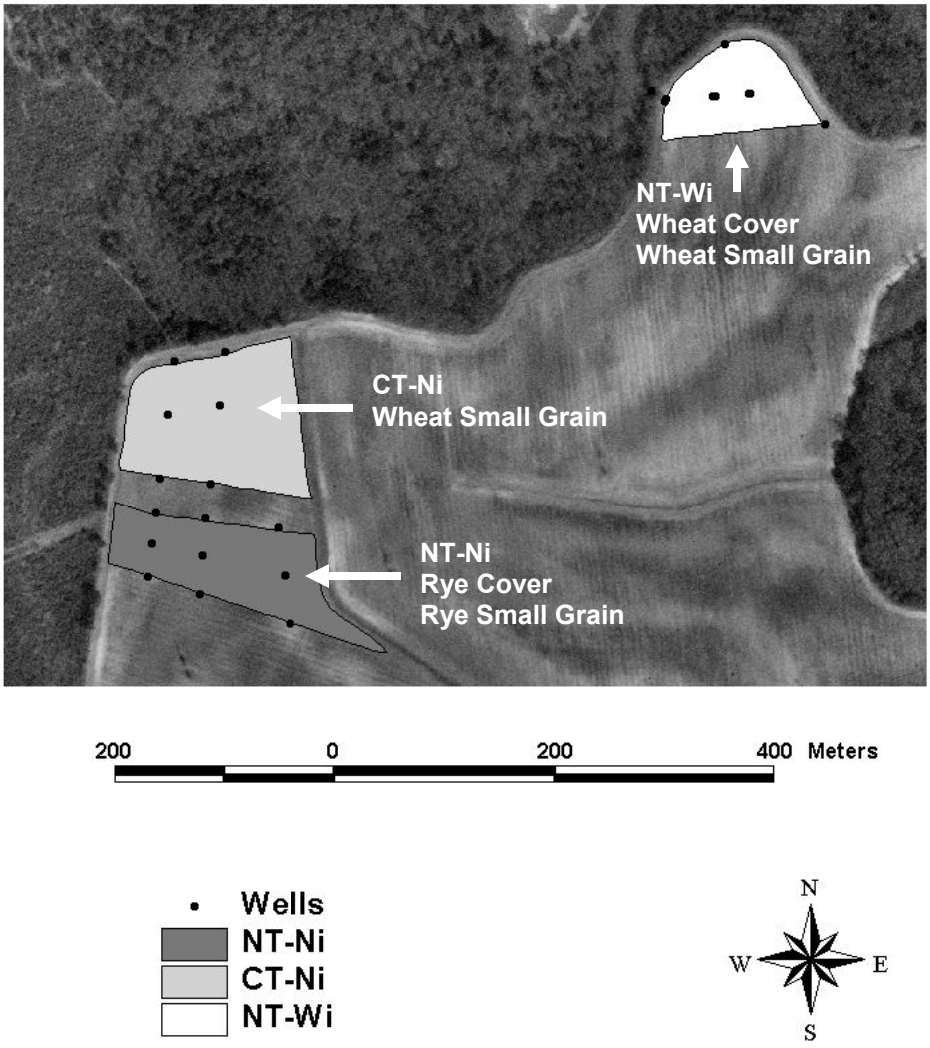


Figure 1. Site map with fields and groundwater sampling wells at CEFS, Goldsboro, NC.

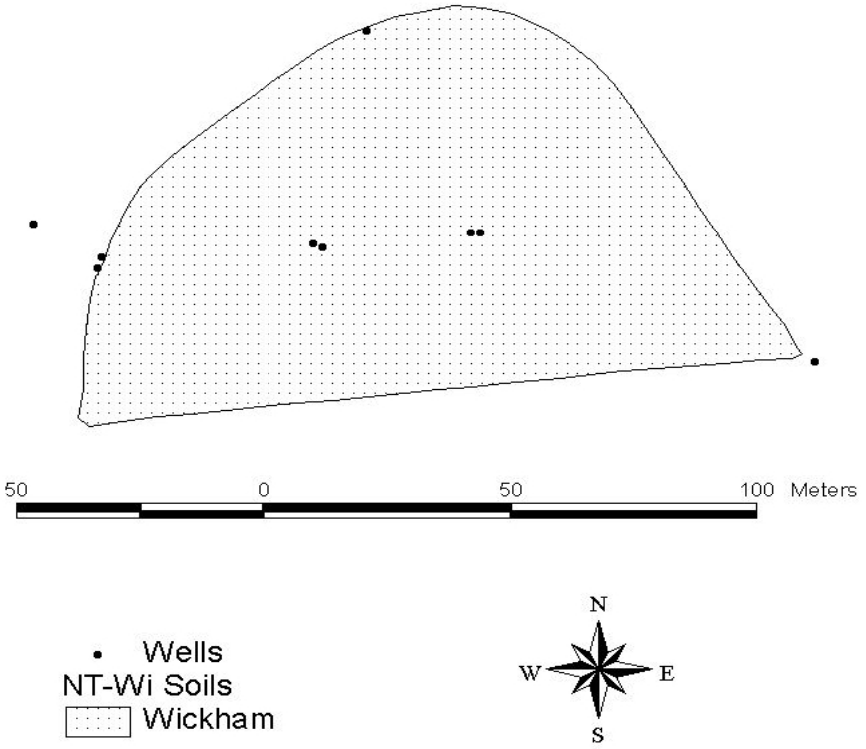


Figure 2. Site map of NT-Wi with soils and groundwater sampling wells at CEFS, Goldsboro, NC.

Figure 3. Site map of NT-Ni with soils and groundwater sampling wells at CEFS, Goldsboro, NC.

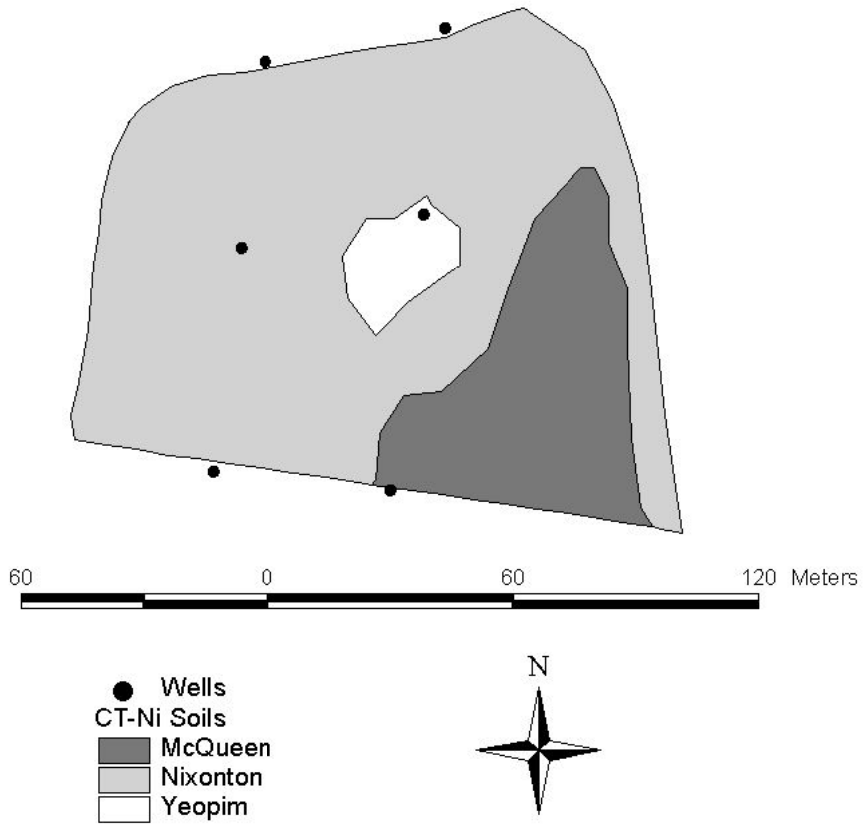


Figure 4. Site map of CT-Ni with soils and groundwater sampling wells at CEFS, Goldsboro, NC.

Cropping Systems

The cropping system was not consistent throughout the study period (Table 1). Before the study began in 1996 all fields were disked with a tandem gang disk and chisel plowed. The corn crops received 180 kg N ha^{-1} yr^{-1} (160 lb N ac^{-1}) until the study was implemented. After the study began, corn N fertilizer rates were reduced to either 134 kg N ha^{-1} yr^{-1} (120 lb N ac^{-1}) or 146 kg N ha^{-1} yr^{-1} (130 lb N ac^{-1}). A rotation of corn – small grain - double-cropped soybeans began in 1999 and was used through 2002. Following the soybeans, winter rye was grown on NT-Ni and winter wheat was grown on NT-Wi. The CT-Ni field was disked, chisel plowed and left bare. Round-up was used to burn down the winter

cover crops in NT-Ni and NT-Wi; the CT-Ni field was disked again within two-weeks of planting the next corn crop in the rotation. The CT-Ni field was chisel plowed and disked before each crop was planted. Following are the average planting rates for each crop: DeKalb Corn 12,000 seed ha^{-1} (4,858 seed ac^{-1}); Coker Wheat 67 kg ha^{-1} (1 bu ac^{-1}); Abruzzi Rye 63 kg ha^{-1} (1 bu ac^{-1}); and Hartz Round-up Ready Soybeans 73 kg ha^{-1} (65 lb ac^{-1}). The approximate crop production duration was as follows: corn – late April to late August/mid-September; small grains – mid-November to early June; double cropped soybeans – mid-June to late November; and winter cover crops – early December to mid-April. Fertilizer rates applied to each crop are also shown in Table 1 and the recommended fertilizer rates are shown in Table 2.

Table 1. Crop type and N fertilizer rates by field and year at CEFS.

	CT- Ni		NT- Ni		NT- Wi	
Year	Cropping System	Fertilizer Rate (kg ha^{-1})	Cropping System	Fertilizer Rate (kg ha^{-1})	Cropping System	Fertilizer Rate (kg ha^{-1})
Crops Grown Prior to Study Period						
1994 †	Corn	180	Corn	180	Corn	180
	Chisel/Disk	N/A ‡	Chisel/Disk	N/A	Chisel/Disk	N/A
1995 †	Soy	0	Soy	0	Soy	0
	Chisel/Disk	N/A	Chisel/Disk	N/A	Chisel/Disk	N/A
Crops Grown During Study Period						
1996	Corn	134	Corn ∞	134 ∞	Corn	134
	Chisel/Disk	N/A	No Data ∞	N/A ∞	No Cover	N/A
1997	Corn	134	Corn	134	Corn	134
	Chisel/Disk	N/A	No Data	N/A	No Data	N/A
1998	Corn	134	Corn	134	Corn	134
	Chisel/Disk	N/A	Rye-Cover	N/A	Wheat-Cover	N/A
1999	Corn	134	Corn	134	Corn	134
	Wheat-Grain	134	Rye-Grain	102	Wheat-Grain	134
2000	Soy	0	Soy	0	Soy	0
	Chisel/Disk	N/A	Rye-Cover	N/A	Wheat-Cover	N/A
2001	Corn	146	Corn	146	Corn	146
	Wheat-Grain	134	Rye-Grain	91	Wheat-Grain	134
2002	Soy	0	Soy	0	Soy	0
	Chisel/Disk	N/A	None	N/A	None	N/A
2003	Corn	No Data	Corn	No Data	Corn	No Data

† Conventionally tilled cropping systems prior to the study (1994, 1995).

‡ N/A indicates that no fertilizer was applied at that time.

∞ This cropping period was prior to inclusion in this study.

Table 2. Recommended N fertilizer rates for each crop and soil at CEFS (NC Interagency Nutrient Management Committee, 2003).

	N Fertilizer Rates (kg ha^{-1} yr^{-1} (lb ac^{-1} yr^{-1}))		
Soil Series	**Corn**	**Wheat**	**Rye**
McQueen	136 (121)	113 (101)	113 (101)
Nixonton ‡	166 (148)	125 (112)	125 (112)
Wickham †	161 (144)	134 (120)	134 (120)
Yeopim	155 (138)	125 (112)	125 (112)

† Predominant soil in NT-Wi.

‡ Predominant soil in NT-Ni and CT-Ni.

Sampling

Groundwater monitoring wells, 5 cm (2 in) in diameter, were installed in each of the three fields (Figure 1). Six shallow wells were installed in the CT-Ni field, nine in the NT-Ni field and five in the NT-Wi field. One shallow well was also

installed outside of the NT-Wi field, in a buffer area near the river. Three additional deep wells were installed in the NT-Wi field because the shallow wells were occasionally dry during sample collection. The shallow wells were 4 m (13 ft) in total depth (from the top of the riser to the bottom of the well), the deep wells were 5.5 m (18 ft) in total depth and all wells had 61 cm (24 in) long screens. The shallow wells were installed approximately 3.7 m (12 ft) below the soil surface and the deep wells in NT-Wi were installed approximately 5.2 m (17 ft) below the soil surface. The groundwater table elevation was measured with an electric resistance tape. The water level raw data are in Appendix A. Precipitation raw data is presented in Appendix B.

Sampling occurred from every one to four weeks until November of 1996, when monthly sample collection began (Appendix C). A peristaltic pump and dedicated tubing were used to collect groundwater samples. Each well was purged until three well volumes worth of water was were removed or until the well went dry. A grab sample was also collected from the Little River. All samples were collected in acid-washed Nalgene bottles.

The samples were immediately put in a cooler on ice after collection. They were filtered using a 0.45 um filter and acidified to pH 2 using a dilute sulfuric acid solution (5% concentrated sulfuric acid) within 24-hours of sample collection. The acidified samples were stored in refridgeration until analysis. The Analytical Services Laboratory in the Soil Science Department at North Carolina State University analyzed the samples using Lachat methods for NO_3-N (Lachat method # 10-107-04-1-A, Lachat Instruments, Hach Company, Loveland, CO,

USA), orthophosphate (PO_4-P) (Lachat method # 10-115-01-1-A, Lachat Instruments, Hach Company, Loveland, CO, USA) and ammonium (NH_4 -N) (Lachat method # 10-107-06-2-A, Lachat Instruments, Hach Company, Loveland, CO, USA). The groundwater chemistry raw data are in Appendix D. Statistical comparisons of groundwater NO_3 -N and were made using Proc Mixed and LS Means in SAS (SAS Institute, 2001, Cary, NC, USA). Statistical analysis of crop yields was performed using Proc ANOVA, means and the pair wise t-test in SAS. A detailed description of the statistical analyses can be found in Appendix E. Differences were considered significant at the p = 0.05 and p=0.10 level.

Results and Discussion

Water Level

The fluctuation of the average groundwater elevation was similar in all fields (Figure 5). The groundwater elevation exhibited cyclical patterns; the elevation was higher from early winter through spring (dormant period) and dropped as the growing season progressed and evapotranspiration increased. A drought from 2000 to 2002 was responsible for lower water levels during the dormant period. Hurricanes and tropical storms that occurred in the fall of 1996, 1998 and 1999 contributed to elevated water levels.

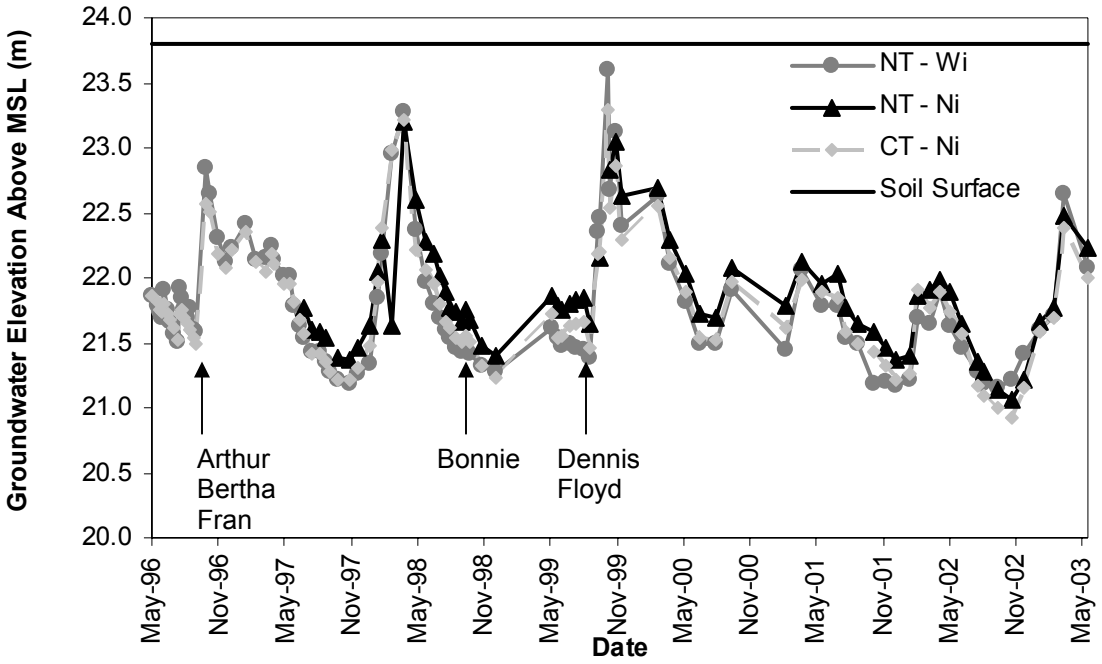


Figure 5. Average water table elevations in the CT-Ni, NT-Ni and NT-Wi fields, the average elevation of the soil surface and the named hurricanes and tropical storms that occurred at CEFS, Goldsboro, NC.

During most of the study period, the groundwater table elevation was slightly higher in the NT-Ni field and slightly lower in the NT-Wi field. This difference could be a result of differences between the Nixonton and Wickham soils; however soil properties were not examined for this project. Based on the Wayne County, NC soil survey, the Nixonton soils that predominate NT-Ni and CT-Ni have a very fine sandy loam surface from 0 to 25 cm (0 to 10 in), while the surface of the Wickham soils in NT-Wi are loamy sands that extend from 0 to 36 cm (0 to 14 in) (Barnhill, 1974). The Nixonton subsoils are moderately permeable silt loams that extend from 25 to 165 cm (10 to 65 in). The Wickham soil surface is underlain by sandy clay loam B horizon (36 to 127 cm (14 to 50 in)). Coarse to gravelly sands extend from 127 to 165 cm (50 to 65 in) below the B horizon in the Wickham soils.

Based on soil textures, infiltration into and water movement through the Wickham soil surface would likely be greater than in the Nixonton soils (Barnhill, 1974). Both subsoils are moderately permeable and transport water at a rate of 1.5 to 5.0 cm hr^{-1} (0.6 to 2.0 in hr^{-1}), but the sands below the B horizon in the Wickham soils have a rapid permeability and transport water at a rate of 15 to 50 cm hr^{-1} (6.0 to 20.0 in hr^{-1}). The coarser texture of the Wickham soils would likely promote a faster rate of water movement through the soils and result in a deeper water table than in the Nixonton soils. This is supported by the seasonal high water table (SHWT) data in the soil survey; the SHWT is greater than 1.5 m (5 ft) in a typical Wickham soil and 0.76 m (2.5 ft) in a typical Nixonton soil. According to the soil survey, the available water capacity in the Wickham soils was less than in the Nixonton soils, which also could have contributed to the groundwater elevation difference. The groundwater elevation in NT-Ni may have been slightly higher than in CT-Ni because the residue on NT-Ni may have decreased evaporative losses and increased soil moisture content, but we don't have pre-NT data to support this.

Proximity of CT-Ni and NT-Wi to the Little River and its floodplain also appeared to influence the groundwater elevation. A hydraulic gradient was created by the lower water table of the river and its floodplain compared to the elevation in the fields. The average elevation over the entire study period in CT-Ni and NT-Wi near the river and floodplain was approximately 0.2 m (0.7 ft) lower than the elevation in the interior portions of the fields. It is possible that the groundwater elevation was slightly higher in NT-Ni because that field was

farthest from the river and floodplain, therefore the hydraulic gradient had less influence on the groundwater elevation.

Groundwater Chemistry

Samples were collected from May 1996 to May 2003, which resulted in almost 90 sampling events. Ammonium N concentrations were consistently below the detection limit. Analysis for NH_4-N was discontinued in March 2002 and the data were not summarized. Orthophosphate concentrations were low, but spikes of increased PO_4-P concentrations occurred in the NT fields throughout the sampling period (Figures 6a, 6b, 6c).

The NO_3-N concentrations in CT-Ni fluctuated between 3.1 and 11.5 mg N L^{-1} during the first year of the study, with an average of 7.9 mg N L^{-1} (Figure 7a). The concentrations stabilized after 1996, with an average concentration of approximately 5.5 mg N L^{-1}. Data collection began in NT-Ni in 1997, after the period of wide fluctuation in NO_3-N concentrations seen in the other fields (Figure 7b). The NO_3-N concentrations ranged between 1.5 and 4.6 mg N L^{-1} from 1997 to 2003, and the average concentration was approximately 2.4 mg N L^{-1}. Data from NT-Wi showed wide fluctuations in both deep and shallow groundwater NO_3^--N concentrations prior to 1997 (Figure 7c). The deep concentrations ranged from 1.2 to 11.4 mg N L^{-1}, averaging 3.8 mg N L^{-1}, and the shallow concentrations ranged from 1.9 to 14.6 mg N L^{-1}, averaging 9.4 mg N L^{-1}. The NO_3-N concentrations in NT-Wi still fluctuated after the 1997 field season began, especially in the shallow groundwater, but the fluctuations were not as

large. The deep NO_3 -N concentrations ranged from 0.2 to 6.7 mg N L^{-1}, averaging 3.2 mg N L^{-1} and the shallow concentrations ranged from 1.3 to 9.6 mg N L^{-1}, averaging 5.3 mg N L^{-1} .

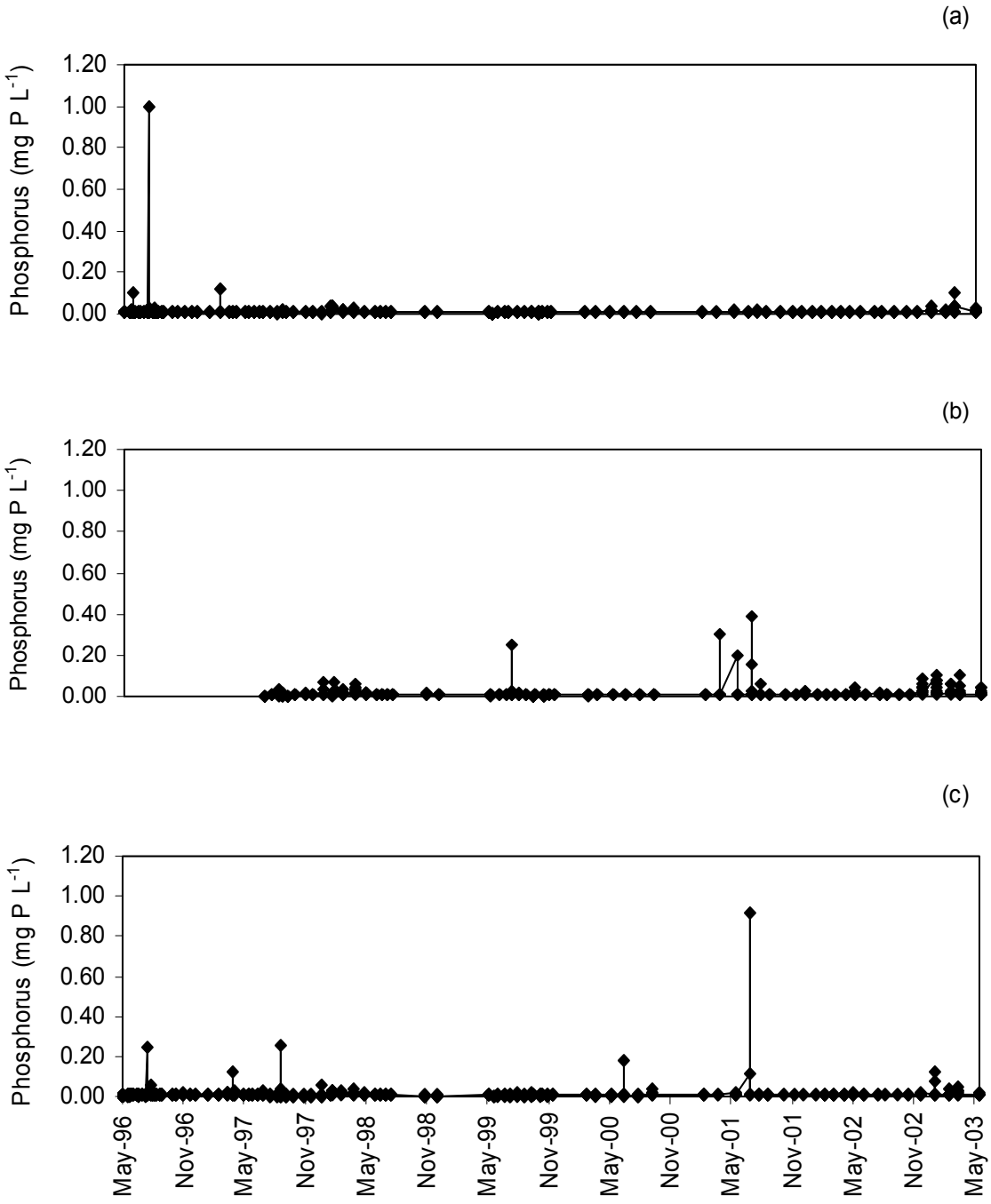


Figure 6. Orthophosphate (mg P L^{-1}) over time in the CT - Ni (a), NT – Ni (b) and NT - Wi (c) at CEFS, Goldsboro, NC.

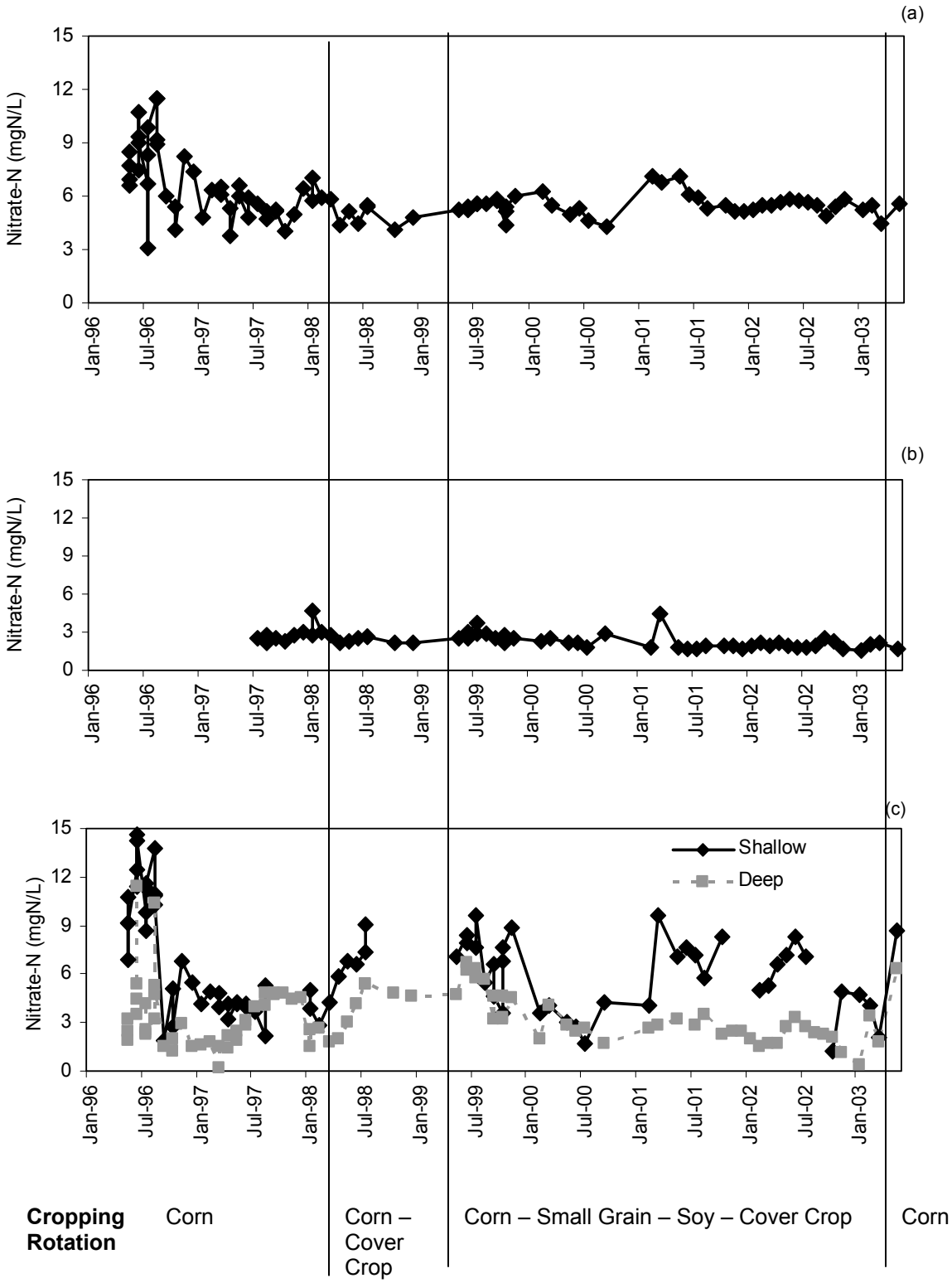


Figure 7. Nitrate N (mg N L^{-1}) and crop rotation over time in CT – Ni (a), NT – Ni (b) and NT - Wi (c) at CEFS, Goldsboro, NC. See Table 1 for N fertilizer rates (kg N ha^{-1}).

Over application of N fertilizer to corn crops prior to this study was assumed to be responsible for the high groundwater NO_3-N concentrations in 1996. The corn grown in 1994 received 180 kg N ha^{-1} (160 lb N ac^{-1}), which was over the 161 kg N ha^{-1} (144 lb N ac^{-1}) recommended for Wickham soils and 166 kg N ha^{-1} (148 lb N ac^{-1}) recommended for Nixonton soils (NC Interagency Nutrient Management Committee, 2003). Application of N fertilizer above the rate required for corn likely led to a high amount of residual NO_3-N in the soil during and after the 1994 growing season. Following 1996, N fertilizer was applied at rates below corn requirements (Table 1, 2). Groundwater NO_3-N concentrations remained relatively stable from that point forward, which was probably due to less residual NO_3-N in the soil. Some smaller increases did occur that were associated with seasonal occurrences such as leaching events or fertilizer application (Figure 7 a, b, c).

Nitrate N concentrations were significantly lower in NT-Ni than in CT-Ni during every cropping period (Table 3). Both fields were predominantly on the same soil, which reduced soil as a confounding factor. Fertilization of the small grain crops could have contributed to the different NO_3-N concentrations. The rye on NT-Ni received 91 to 102 kg N ha^{-1} (80 to 90 lb N ac^{-1}) and the wheat on CT-Ni received 134 kg N ha^{-1} (120 lb N ac^{-1}). The recommended fertilizer rates for both small grain crops on the Nixonton soil is 125 kg N ha^{-1} (112 lb N ac^{-1}) (NC Interagency Nutrient Management Committee, 2003). The rye in NT-Ni was under fertilized to prevent excessive growth and likely decreased the amount of NO_3-N available to leach in NT-Ni. The decreased NO_3-N available to leach may

have contributed to the lower NO_3-N concentrations in NT-Ni (2.1 mg N L^{-1}) than in CT-Ni (5.6 mg N L^{-1}) when small grains were grown and throughout the entire study period. The lack of a cover crop in CT-Ni, which is addressed later in this section, also could have contributed to the higher concentrations in that field.

The difference of groundwater NO_3-N concentrations between NT-Ni and CT-Ni appeared to be a result of conditions that frequently existed throughout one or both fields and caused the NO_3-N concentrations to be significantly higher in CT-Ni over the entire study period. Incorporation of crop residue, by disking and chiseling, after every cropping period in CT-Ni could have encouraged more rapid mineralization of the residue N. This would have increased the chance for NO_3-N leaching and increased the groundwater NO_3-N concentration in CT-Ni, which is a phenomenon that has been seen in some studies (Dick and Daniel, 1987; Messinger et al., 1991), although other reports demonstrate the opposite effects (Sharpley and Smith, 1994; Staver and Brinsfield, 1998). Variability of the soil series in the two fields also could have contributed to the higher concentrations in CT-Ni. Approximately one-quarter of each field is comprised of a soil other than Nixonton. Both fields contain an area of McQueen soil, which has lower N fertilization recommendations for corn (136 kg ha^{-1} yr^{-1}) and wheat (113 kg ha^{-1} yr^{-1}) than does the Nixonton soil (wheat 125 kg ha^{-1} yr^{-1}). The over fertilization (corn prior to 1996 and after 2000; wheat small grain 1999, 2001) on the McQueen soil probably resulted in some leaching losses. Field CT-Ni also contains Yeopim soils, which has a lower recommended N fertilization rate (155 kg ha^{-1} yr^{-1}) than Nixonton (166 kg ha^{-1} yr^{-1}) for corn. The over fertilization of corn

prior to 1996 probably contributed to some of the groundwater NO_3-N in both fields, but the application rate after 1996 was below the recommended amount, thus decreasing the likelihood of NO_3-N contribution (Table 1, 2). Some of the highest NO_3-N concentrations in CT-Ni tended to occur in the well in the Yeopim soil from May 2001 until completion of the study, which contributed to the higher average concentrations in CT-Ni. Denitrification of groundwater NO_3-N in NT-Ni could have been responsible for the lower concentrations in NT-Ni, as soil moisture and organic matter content were probably elevated in that field based on the earlier soil descriptions. No measurements were made, however, to assess the likelihood for denitrification (Gilliam and Hoyt, 1987).

Table 3. Comparison of mean groundwater NO_3-N concentrations (mg N L^{-1}) by field during the four cropping periods.

	Crops			
Field	**Corn**	**Small Grains**	**Soybeans**	**Winter Cover**
NT - Ni	2.3 A*	2.1 A	2.2 A	3.1 A
CT - Ni †	5.4 B	5.6 B	5.1 B	7.0 B
NT - Wi	6.5 B	4.9 B	4.2 AB	6.4 B

* Significance is at the p=0.05 level, except between NT-Ni and NT-Wi with winter cover crops p=0.10.
† No cover crop was planted in this field.

The wheat small grain crop on NT-Wi was over fertilized when the rye small grain crop on NT-Ni was under fertilized, as previously explained (Table 1, 2). The over fertilization, in conjunction with the surface soils and subsoils in NT-Wi being coarser in texture and more permeable than the soils in NT-Ni, likely contributed to the significantly higher (p=0.05) NO_3-N concentrations in NT-Wi (4.9 mg N L^{-1}) than in NT-Ni (2.1 mg N L^{-1}) (Table 3). A factor other than fertilization apparently influenced NO_3-N concentrations, because the concentrations were significantly different between the two fields when there was no difference in fertilization. The corn grown on both fields was under fertilized,

but the NO_3-N concentrations in NT-Wi (6.5 mg N L^{-1}) were significantly (p=0.05) higher than in NT-Ni (2.3 mg N L^{-1}). The NO_3-N concentrations were significantly higher (p=0.10) in NT-Wi (6.4 mg N L^{-1}) than in NT-Ni (3.1 mg N L^{-1}) when cover crops were grown. As previously explained, the higher concentrations in NT-Wi probably occurred because the more porous soils in NT-Wi contributed to leaching of NO_3-N from applied N fertilizer and denitrification could have decreased the NO_3-N concentrations in NT-Ni. There were no significant differences in NO_3-N concentrations between the NT-Wi field and the CT-Ni field during any cropping period.

The groundwater NO_3-N concentrations were lower in the NT fields where cover crops were planted than in the CT field where no cover crop was planted (Table 3). The average groundwater NO_3-N concentration in NT-Ni (rye cover crop) was significantly lower (p=0.05) (3.1 mg N L^{-1}) than CT-Ni (7.0 mg N L^{-1}). The average NO_3-N concentration in NT-Wi (wheat cover crop) was 6.4 mg N L^{-1}. Winter cover crops like wheat and rye have been shown to effectively decrease NO_3-N loss, because the crops consume residual NO_3-N from late fall through early spring when most NO_3-N is leached from the root zone (Messinger et al., 1991). The NO_3-N concentrations in the CT field were probably higher because there was no cover crop to take up NO_3-N during the period of greatest leaching loss. It is also possible that denitrification losses of NO_3-N or more efficient N use occurred in NT-Ni due to increased soil moisture (Gilliam and Hoyt, 1987; Brinsfield and Staver, 1991), but this is purely speculative because redox potentials and soil moisture content were not measured.

The average NO_3-N concentrations when rye was grown as a small grain versus wheat (data averaged from the CT-Ni and NT-Wi fields) is shown in Table 4. Nitrate N concentrations were more than twice as high under the wheat small grain (5.3 mg N L^{-1}) than under rye (2.1 mg N L^{-1}). Nitrate N concentrations were probably higher under the wheat because it was adequately fertilized (135 kg N ha^{-1} (120 lb N ac^{-1})), whereas the rye was under fertilized (91 to 102 kg N ha^{-1} (81 to 91 lb N ac^{-1})) to decrease the likelihood of rank growth in the rye (Naderman, personal communication, 2003).

Table 4. Comparison of mean groundwater NO_3-N concentrations (mg N L^{-1}) by small grain type.

Grain	Small Grains
Rye	2.1 A*
Wheat	5.3 B

*Significance at the p=0.05 level.

Data collected from the shallow and deep wells in the NT-Wi field was used to calculate differences between the NO_3-N concentrations in the shallow wells versus the deep wells. Nitrate N concentrations were significantly (p=0.05) different between the shallow and deep groundwater during six of eight years (Table 5). Both the shallow and deep wells were screened at a depth that collected samples from the fluvial and marine sediments that comprise the soil parent material. It is apparent that NO_3-N leached to the depth of the shallow wells, causing the concentration increases seen in Figure 4c. Throughout most of the study period, the deep NO_3-N increased proportionally to the shallow concentrations. The deep concentrations were probably lower than the shallow concentrations due to one of three possible reasons: the NO_3-N concentrations

were diluted as the downward moving water mixed with the existing groundwater; the NO_3-N at the deeper depths was diluted by river water that recharged the groundwater during very dry periods; or conditions at that depth could have favored denitrification because the soils were continually saturated. No data were collected to prove the mechanism causing reductions in NO_3-N concentrations, but dilution by existing groundwater and/or river water recharge to groundwater is the most likely explanation for the difference.

Table 5. Annual mean difference between deep and shallow groundwater NO_3-N (mg N L^{-1}) concentrations.

Year	Shallow - Deep Differences
1996	8.4 *
1997	3.5 *
1998	3.4 *
1999	3.5 *
2000	1.2
2001	2.3
2002	5.0 *
2003	4.3 *

*Significance at the p=0.05 level.

Nitrate N concentrations were also measured in a shallow well (NT6) outside of NT-Wi, which was in a buffer area west of the field and near the river (Figure 1). During most sampling periods the groundwater NO_3-N concentrations were lower in NT6 than in the field, which shows that NO_3-N was accumulating in the groundwater under the field (Figure 8). Figure 8 also shows that concentration changes in NT6 followed changes within the field. Increases in NO_3-N concentration in NT6 likely were a result of leaching residual NO_3-N from NT-Wi by the fall and winter rains and inflow from the field. By comparison, NO_3-N concentrations in the river were low through the study period, at less than 1 mg

N L^{-1}. Three-point problems determined that groundwater flowed from the field toward NT6 during most periods of the year, which supports the theory that NO_3-N from the field is reaching the buffer area. The groundwater table elevation was at its lowest measured points during the fall of 2001 and 2002. Three point problems determined that during that period the direction of groundwater flow changed and water from the river appeared to be recharging the groundwater in the field.

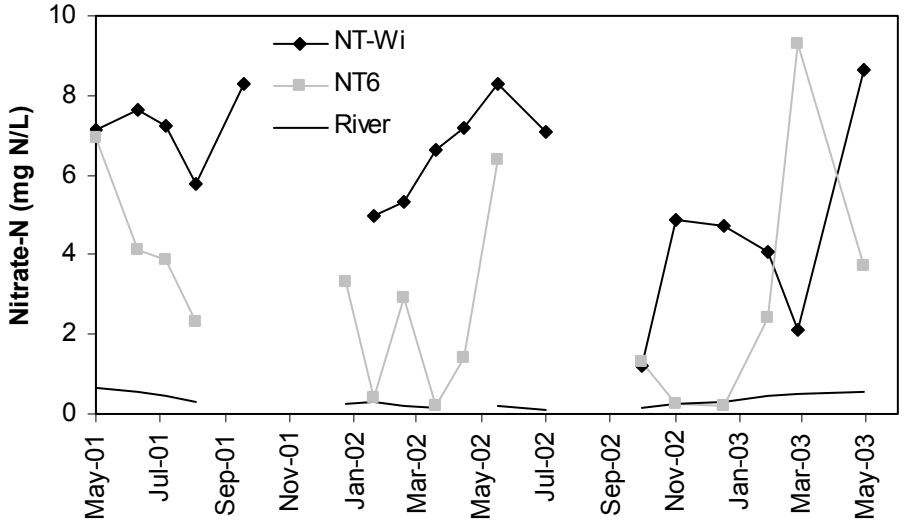


Figure 8. Nitrate-N (mg N L^{-1}) in the shallow wells in NT-Wi, in well NT-6 (in buffered area) and in the river at CEFS, Goldsboro, NC.

Crop Yields

The mean corn yield, calculated using data from all the corn cropping periods, in CT-Ni was 8,179 kg ha^{-1}, NT-Ni 6,455 kg ha^{-1} and NT-Wi 7,143 kg ha^{-1}. No statistically significant difference based on field and tillage was detected, although yields tended to be higher in CT-Ni (Table 6). The lack of a significant yield difference based on tillage type is supported by other studies that found no

significant yield difference with NT corn in the Coastal Plain Region (Wagger and Denton, 1989; Wagger and Denton, 1992; Osmond et al., 2004). Statistical comparisons were not made to examine the difference between annual yield averages from all three fields, but the average annual corn yield was calculated. The mean yields in 2001 (9,745 kg ha^{-1}) and 2003 (7,887 kg ha^{-1}) were higher than the yields in 1997 (6,369 kg ha^{-1}) and 1998 (5,035 kg ha^{-1}). Nitrogen fertilizer application rates to corn were increased from 134 to 146 kg N ha^{-1} in 2001, which could have lead to the higher yields in 2001 and 2003.

Table 6. Annual corn, small grain and soybean yields (kg ha^{-1}) at CEFS, Goldsboro, NC.

Field	Crop	1997	1998	1999	2000	2001	2002	2003
NT-Ni	Corn	5,734	3,706	nd †	-- ‡	8,278	--	8,102
CT-Ni	Corn	7,400	6,245	nd	--	11,037	--	8,033
NT-Wi	Corn	5,973	5,155	nd	--	9,921	--	7,525
NT-Ni	Rye	--	--	nd	--	2,056	--	--
CT-Ni	Wheat	--	--	nd	--	3,460	--	--
NT-Wi	Wheat	--	--	nd	--	3,178	--	--
NT-Ni	Soy	--	--	--	2,385	--	1,709	--
CT-Ni	Soy	--	--	--	2,862	--	971	--
NT-Wi	Soy	--	--	--	2,867	--	601	--

† No data was reported for that growing season.
‡ Crop was not grown that year.

The mean soybean yields were not significantly different between CT-Ni (1,917 kg ha^{-1}), NT-Ni (2,047 kg ha^{-1}) and NT-Wi (1,734 kg ha^{-1}) (Table 6). No-till production over the entire study period did not appear to affect soybean yields, which is supported by other studies in the Coastal Plain region (Wagger and Denton, 1992; Edwards et al., 1995; Osmond et al., 2004). The mean annual soybean yield was also calculated, but statistical analysis was not performed since data was only collected for two years. Yields in 2000 (2,705 kg ha^{-1}) were higher than in 2002 (1,094 kg ha^{-1}). The difference was likely due to differences

in soil water content during pod fill. The water table in 2000 was at a relatively constant elevation throughout the growing period (Figure 5). In 2002, the water table elevation was deeper and the soil water content was probably much lower than in 2000 because of a three-year drought that ended after the 2002 growing season. Other studies have had similar results where soybean yields were significantly lower if they experienced water stress during pod fill (Wagger and Denton, 1989; Wagger and Denton, 1992; Edwards et al., 1995).

An interesting pattern was seen in the 2002 soybean yields (Table 6). The NT-Ni field had the highest yield (1,709 kg ha^{-1}) and NT-Wi had the lowest yield (601 kg ha^{-1}). The NT-Ni yields were probably highest out of the three fields because the soybeans experienced the least amount of water stress during pod fill in that field. It is likely that the soils in NT-Ni contained more moisture because the available water content is higher than in NT-Wi. The residue on NT-Ni probably conserved more soil water and lead to a subsequently higher soil water content than in CT-Ni. These differences in water content of the soils probably contributed to the pattern of soybean yields measured in 2002.

Conclusions

The results of this study showed that NO_3-N leaching losses are a complex function of the N fertilizer application rate, soils, tillage and cropping systems in a given field. The application of N fertilizer beyond crop needs prior to the study increased the amount of NO_3-N available to leach during subsequent cropping seasons, but concentrations decreased after N fertilizer application

rates were decreased. Additionally, NO_3-N in NT-Wi leached to the depth of the shallow wells, but dilution was likely responsible for lower concentrations in the deeper groundwater.

Yield data suggested that corn yields were more affected by fertilization than tillage or soil differences, although the yields tended to be highest in the CT-Ni field. Soybean yields seemed to benefit from NT production and soils with higher available water during drought years, because yields were substantially higher in NT-Ni than in NT-Wi and CT-Ni fields during the drought. There was little difference in soybean and small grain yields during periods of adequate soil moisture.

Bibliography

Barnhill, W.L. 1974. Soil Survey of Wayne County, NC. USDA-NRCS.

Bauer, P.J., and D.W. Reeves. 1999. A comparison of winter cereal species and planting dates as residue cover for cotton growth with conservation tillage. Crop Sci. 39:1824-1830.

Brinsfield, R.B., and K.W. Staver. 1991. Use of cereal grain cover crops for reducing groundwater nitrate contamination in the Chesapeak Bay Region. p. 79-82. *In* W.L. Hargrove (ed.) Cover crops for clean water. Soil and Water Conservation Society, Anekny, IA.

CTIC. 1989. National survey of conservation tillage practices. Conservation Technology Information Center. West Lafayette, IN.

Dick, W.A., and T.C. Daniel. 1987. Soil chemical and biological properties as affected by conservation tillage: environmental implications. p. 125-147. *In* T.J. Logan et al. (ed.) Effects of conservation tillage on groundwater quality: nitrates and pesticides. Lewis Publ., Inc., Chelsea, MI.

Edwards, J.H., D.L. Thurlow, and J.T. Eason. 1985. Soybean relative yield as affected by cropping sequences and conservation tillage. p. 40-44. *In* W.L. Hargrove et al. (ed.) Proc. 1985 Southern Region No-Till Conference, Griffin, GA. 16-17 July 1985. University of Georgia.

Gilliam, J.W., and G.D. Hoyt. 1987. Effect of conservation tillage on fate and transport of nitrogen. p. 217-240. *In* T.J. Logan et al. (ed.) Effects of conservation tillage on groundwater quality: nitrates and pesticides. Lewis Publ., Inc., Chelsea, MI.

Hamlett, J.M., and K. Brannan. 1991. Water quality impacts of winter rye cover with selected best management practices in Pennsylvania. p. 53-55. *In* W.L. Hargrove (ed.) Cover crops for clean water. Soil and Water Conservation Society, Anekny, IA.

Hook, J.E., and G.J. Gascho. 1988. Multiple cropping for efficient use of water and nitrogen. p. 7-20. *In* W.L. Hargrove (ed). Cropping strategies for efficient use of water and nitrogen. ASA Spec. Publ. 51. ASA, Madison, WI.

Hoyt, G.D., and R.L. Mikkelsen. 1991. Soil nitrogen movement under winter cover crops and residues. p. 91-94. *In* W.L. Hargrove (ed.) Cover crops for clean water. Soil and Water Conservation Society, Anekny, IA.

Messinger, J.J., W.L. Hargrove, R.L. Mikkelsen, J.R. Williams, and V.W. Benson. 1991. Effects of cover crops on groundwater quality. p. 57–68. *In* W.L. Hargrove

(ed.) Cover crops for clean water. Soil and Water Conservation Society, Anekny, IA.

NC Interagency Nutrient Management Comittee. 2003. Realistic Yield Expectations in North Carolina. Available at http://www.spatiallab.ncsu.edu/nutman/yields/ (verified 9 Dec. 2003).

Osmond, D., N. Ranells, G. Naderman, M. Wagger, G. Hoyt, J. Havlin, and S. Hodges. 2004. Role of adopting reduced tillage practices to satisfy government mandates in the Neuse River Basin and other sensitive watersheds in North Carolina. p. ?? - ??. *In* D. Jordan (ed.) Proceedings of the Conservation Tillage Conference for Sustainable Agriculture, Raleigh, NC. 8-9 June, 2004. NC State University.

Pierce, F.J., and C.W. Rice. 1988. Crop rotation and its impact on efficiency of water and nitrogen use. p. 21-42. *In* W.L. Hargrove (ed). Cropping strategies for efficient use of water and nitrogen. ASA Spec. Publ. 51. ASA, Madison, WI.

SAS Institute. 2001. The SAS system for Windows. Release 8.02. SAS Inst., Cary, NC.

Sharpley, A.N., and S.J. Smith. 1994. Wheat tillage and water quality in the Southern Plains. Soil Tillage Res. 30: 33–48.

Staver, K.W., and R.B. Brinsfield. 1998. Using cereal grain winter cover crops to reduce groundwater nitrate contamination in the mid-Atlantic Coastal Plain. J. Soil and Water Conserv. 53: 230–240.

Touchton, J., and K. Wells. 1985. Crop management and cropping systems. p. 27–34. *In* W.L. Hargrove et al. (ed.) Proc. 1985 Southern Region No-Till Conference, Griffin, GA. 16-17 July 1985. University of Georgia.

Wagger, M.G., and H.P. Denton. 1992. Crop and tillage rotations: grain yield, residue cover, and soil water. Soil Sci. Soc. Am. J. 56: 1233-1237.

Wagger, M.G., and H.P. Denton. 1989. Tillage effects on grain yield in a wheat, double-crop soybean, and corn rotation. Agron. J. 81: 493-498.

Wells, K.L., and J.T. Touchton. 1985. Soil management and fertility for no-till production. p. 71–77. *In* W.L. Hargrove et al. (ed.) Proc. 1985 Southern Region No-Till Conference, Griffin, GA. 16-17 July 1985. University of Georgia.

APPENDICIES

Appendix A: Water Level Raw Data

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
5/1/1996	CT1		7.52	2.29
5/1/1996	CT1		7.52	2.29
5/1/1996	CT2		8.23	2.51
5/1/1996	CT2		8.23	2.51
5/1/1996	CT3		8.19	2.50
5/1/1996	CT3		8.19	2.50
5/1/1996	CT4		7.17	2.19
5/1/1996	CT4		7.17	2.19
5/1/1996	CT5		6.89	2.10
5/1/1996	CT5		6.89	2.10
5/1/1996	CT6		7.29	2.22
5/1/1996	CT6		7.29	2.22
5/1/1996	NT1	Shallow	11.29	3.44
5/1/1996	NT1	Shallow	11.29	3.44
5/1/1996	NT1D	Deep	nd	.
5/1/1996	NT1D	Deep	nd	.
5/1/1996	NT2	Shallow	11.21	3.42
5/1/1996	NT2	Shallow	11.21	3.42
5/1/1996	NT2D	Deep	nd	.
5/1/1996	NT2D	Deep	nd	.
5/1/1996	NT3	Shallow	10.75	3.28
5/1/1996	NT3	Shallow	10.75	3.28
5/1/1996	NT3D	Deep	nd	.
5/1/1996	NT3D	Deep	nd	.
5/1/1996	NT4	Shallow	11.58	3.53
5/1/1996	NT4	Shallow	11.58	3.53
5/1/1996	NT5	Shallow	10.71	3.26
5/1/1996	NT5	Shallow	10.71	3.26
5/17/1996	CT1		7.75	2.36
5/17/1996	CT1		7.75	2.36
5/17/1996	CT2		8.42	2.57
5/17/1996	CT2		8.42	2.57
5/17/1996	CT3		7.96	2.43
5/17/1996	CT3		7.96	2.43
5/17/1996	CT4		7.33	2.23
5/17/1996	CT4		7.33	2.23
5/17/1996	CT5		7.17	2.19
5/17/1996	CT5		7.17	2.19
5/17/1996	CT6		7.5	2.29
5/17/1996	CT6		7.5	2.29
5/17/1996	NT1	Shallow	11.56	3.52
5/17/1996	NT1	Shallow	11.56	3.52
5/17/1996	NT1D	Deep	nd	.
5/17/1996	NT1D	Deep	nd	.
5/17/1996	NT2	Shallow	11.58	3.53
5/17/1996	NT2	Shallow	11.58	3.53
5/17/1996	NT2D	Deep	11.54	3.52
5/17/1996	NT2D	Deep	11.54	3.52
5/17/1996	NT3	Shallow	10.92	3.33

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
5/17/1996	NT3	Shallow	10.92	3.33
5/17/1996	NT3D	Deep	10.79	3.29
5/17/1996	NT3D	Deep	10.79	3.29
5/17/1996	NT4	Shallow	11.77	3.59
5/17/1996	NT4	Shallow	11.77	3.59
5/17/1996	NT5	Shallow	10.81	3.29
5/17/1996	NT5	Shallow	10.81	3.29
5/24/1996	CT1		8.02	2.44
5/24/1996	CT2		8.67	2.64
5/24/1996	CT3		8.17	2.49
5/24/1996	CT4		7.54	2.30
5/24/1996	CT5		7.29	2.22
5/24/1996	CT6		7.69	2.34
5/24/1996	NT1	Shallow	11.79	3.59
5/24/1996	NT1D	Deep	nd	.
5/24/1996	NT2	Shallow	11.63	3.54
5/24/1996	NT2D	Deep	11.63	3.54
5/24/1996	NT3	Shallow	11.13	3.39
5/24/1996	NT3D	Deep	11	3.35
5/24/1996	NT4	Shallow	12	3.66
5/24/1996	NT5	Shallow	11.02	3.36
5/29/1996	CT1		7.96	2.43
5/29/1996	CT2		8.69	2.65
5/29/1996	CT3		8.25	2.51
5/29/1996	CT4		7.67	2.34
5/29/1996	CT5		7.46	2.27
5/29/1996	CT6		7.77	2.37
5/29/1996	NT1	Shallow	11.83	3.61
5/29/1996	NT1D	Deep	nd	.
5/29/1996	NT2	Shallow	11.75	3.58
5/29/1996	NT2D	Deep	11.75	3.58
5/29/1996	NT3	Shallow	11.29	3.44
5/29/1996	NT3D	Deep	11.17	3.40
5/29/1996	NT4	Shallow	12.17	3.71
5/29/1996	NT5	Shallow	11.17	3.40
6/4/1996	CT1		7.71	2.35
6/4/1996	CT2		8.38	2.55
6/4/1996	CT3		8	2.44
6/4/1996	CT4		7.46	2.27
6/4/1996	CT5		7.25	2.21
6/4/1996	CT6		7.65	2.33
6/4/1996	NT1	Shallow	10.69	3.26
6/4/1996	NT1D	Deep	10.46	3.19
6/4/1996	NT2	Shallow	11	3.35
6/4/1996	NT2D	Deep	10.96	3.34
6/4/1996	NT3	Shallow	10.67	3.25
6/4/1996	NT3D	Deep	10.58	3.22
6/4/1996	NT4	Shallow	11.46	3.49
6/4/1996	NT5	Shallow	10.98	3.35

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
6/12/1996	CT1		8.02	2.44
6/12/1996	CT2		8.69	2.65
6/12/1996	CT3		8.25	2.51
6/12/1996	CT4		7.67	2.34
6/12/1996	CT5		7.52	2.29
6/12/1996	CT6		7.81	2.38
6/12/1996	NT1	Shallow	11.75	3.58
6/12/1996	NT1D	Deep	11.5	3.51
6/12/1996	NT2	Shallow	11.58	3.53
6/12/1996	NT2D	Deep	11.63	3.54
6/12/1996	NT3	Shallow	11.1	3.38
6/12/1996	NT3D	Deep	10.42	3.18
6/12/1996	NT4	Shallow	11.96	3.65
6/12/1996	NT5	Shallow	11.1	3.38
6/19/1996	CT1		8.23	2.51
6/19/1996	CT2		8.85	2.70
6/19/1996	CT3		8.42	2.57
6/19/1996	CT4		7.77	2.37
6/19/1996	CT5		7.65	2.33
6/19/1996	CT6		7.92	2.41
6/19/1996	NT1	Shallow	11.89	3.62
6/19/1996	NT1D	Deep	11.69	3.56
6/19/1996	NT2	Shallow	11.79	3.59
6/19/1996	NT2D	Deep	11.79	3.59
6/19/1996	NT3	Shallow	11.33	3.45
6/19/1996	NT3D	Deep	11.15	3.40
6/19/1996	NT4	Shallow	12.21	3.72
6/19/1996	NT5	Shallow	11.35	3.46
6/28/1996	CT1		8.38	2.55
6/28/1996	CT2		9.08	2.77
6/28/1996	CT3		8.63	2.63
6/28/1996	CT4		8.02	2.44
6/28/1996	CT5		7.83	2.39
6/28/1996	CT6		8.17	2.49
6/28/1996	NT1	Shallow	12.21	3.72
6/28/1996	NT1D	Deep	12	3.66
6/28/1996	NT2	Shallow	12.1	3.69
6/28/1996	NT2D	Deep	12.08	3.68
6/28/1996	NT3	Shallow	11.46	3.49
6/28/1996	NT3D	Deep	11.63	3.54
6/28/1996	NT4	Shallow	12.5	3.81
6/28/1996	NT5	Shallow	11.5	3.51
7/9/1996	CT1		8.79	2.68
7/9/1996	CT2		9.38	2.86
7/9/1996	CT3		8.92	2.72
7/9/1996	CT4		8.38	2.55
7/9/1996	CT5		8.02	2.44
7/9/1996	CT6		8.42	2.57
7/9/1996	NT1	Shallow	12.42	3.79

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/9/1996	NT1D	Deep	12.23	3.73
7/9/1996	NT2	Shallow	12.33	3.76
7/9/1996	NT2D	Deep	12.33	3.76
7/9/1996	NT3	Shallow	11.85	3.61
7/9/1996	NT3D	Deep	11.67	3.56
7/9/1996	NT4	Shallow	12.67	3.86
7/9/1996	NT5	Shallow	11.75	3.58
7/15/1996	CT1		7.56	2.30
7/15/1996	CT2		8.27	2.52
7/15/1996	CT3		8.27	2.52
7/15/1996	CT4		7.88	2.40
7/15/1996	CT5		7.92	2.41
7/15/1996	CT6		8.21	2.50
7/15/1996	NT1	Shallow	9.17	2.80
7/15/1996	NT1D	Deep	8.96	2.73
7/15/1996	NT2	Shallow	11.33	3.45
7/15/1996	NT2D	Deep	11.33	3.45
7/15/1996	NT3	Shallow	11.33	3.45
7/15/1996	NT3D	Deep	11.21	3.42
7/15/1996	NT4	Shallow	12.25	3.73
7/15/1996	NT5	Shallow	11.46	3.49
7/24/1996	CT1		7.88	2.40
7/24/1996	CT2		8.56	2.61
7/24/1996	CT3		8.17	2.49
7/24/1996	CT4		7.54	2.30
7/24/1996	CT5		7.54	2.30
7/24/1996	CT6		7.83	2.39
7/24/1996	NT1	Shallow	11.33	3.45
7/24/1996	NT1D	Deep	11.17	3.40
7/24/1996	NT2	Shallow	11.17	3.40
7/24/1996	NT2D	Deep	11.17	3.40
7/24/1996	NT3	Shallow	10.71	3.26
7/24/1996	NT3D	Deep	10.5	3.20
7/24/1996	NT4	Shallow	11.42	3.48
7/24/1996	NT5	Shallow	10.92	3.33
7/30/1996	CT1		8.13	2.48
7/30/1996	CT2		8.75	2.67
7/30/1996	CT3		8.42	2.57
7/30/1996	CT4		7.79	2.37
7/30/1996	CT5		7.69	2.34
7/30/1996	CT6		8	2.44
7/30/1996	NT1	Shallow	11.67	3.56
7/30/1996	NT1D	Deep	11.42	3.48
7/30/1996	NT2	Shallow	11.54	3.52
7/30/1996	NT2D	Deep	11.5	3.51
7/30/1996	NT3	Shallow	10.98	3.35
7/30/1996	NT3D	Deep	10.83	3.30
7/30/1996	NT4	Shallow	11.75	3.58
7/30/1996	NT5	Shallow	11.02	3.36

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
8/5/1996	CT1		8.29	2.53
8/5/1996	CT2		8.96	2.73
8/5/1996	CT3		8.48	2.58
8/5/1996	CT4		7.98	2.43
8/5/1996	CT5		7.83	2.39
8/5/1996	CT6		8.13	2.48
8/5/1996	NT1	Shallow	11.75	3.58
8/5/1996	NT1D	Deep	11.63	3.54
8/5/1996	NT2	Shallow	11.73	3.58
8/5/1996	NT2D	Deep	11.71	3.57
8/5/1996	NT3	Shallow	11.19	3.41
8/5/1996	NT3D	Deep	11.08	3.38
8/5/1996	NT4	Shallow	12	3.66
8/5/1996	NT5	Shallow	11.21	3.42
8/12/1996	CT1		8.33	2.54
8/12/1996	CT2		9.06	2.76
8/12/1996	CT3		8.67	2.64
8/12/1996	CT4		8.04	2.45
8/12/1996	CT5		7.96	2.43
8/12/1996	CT6		8.31	2.53
8/12/1996	NT1	Shallow	11.19	3.41
8/12/1996	NT1D	Deep	11	3.35
8/12/1996	NT2	Shallow	11.5	3.51
8/12/1996	NT2D	Deep	11.46	3.49
8/12/1996	NT3	Shallow	11.17	3.40
8/12/1996	NT3D	Deep	11	3.35
8/12/1996	NT4	Shallow	11.96	3.65
8/12/1996	NT5	Shallow	11.29	3.44
8/22/1996	CT1		8.63	2.63
8/22/1996	CT2		9.29	2.83
8/22/1996	CT3		8.92	2.72
8/22/1996	CT4		8.33	2.54
8/22/1996	CT5		8.13	2.48
8/22/1996	CT6		8.52	2.60
8/22/1996	NT1	Shallow	12.04	3.67
8/22/1996	NT1D	Deep	11.92	3.63
8/22/1996	NT2	Shallow	12	3.66
8/22/1996	NT2D	Deep	12	3.66
8/22/1996	NT3	Shallow	11.46	3.49
8/22/1996	NT3D	Deep	11.38	3.47
8/22/1996	NT4	Shallow	12.29	3.75
8/22/1996	NT5	Shallow	11.58	3.53
8/28/1996	CT1		8.77	2.67
8/28/1996	CT2		9.44	2.88
8/28/1996	CT3		9.02	2.75
8/28/1996	CT4		8.42	2.57
8/28/1996	CT5		8.33	2.54
8/28/1996	CT6		8.65	2.64
8/28/1996	NT1	Shallow	12	3.66

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
8/28/1996	NT1D	Deep	11.75	3.58
8/28/1996	NT2	Shallow	12.13	3.70
8/28/1996	NT2D	Deep	12.08	3.68
8/28/1996	NT3	Shallow	11.71	3.57
8/28/1996	NT3D	Deep	11.58	3.53
8/28/1996	NT4	Shallow	12.56	3.83
8/28/1996	NT5	Shallow	11.67	3.56
9/25/1996	CT1		5.29	1.61
9/25/1996	CT2		6.04	1.84
9/25/1996	CT3		5.5	1.68
9/25/1996	CT4		4.88	1.49
9/25/1996	CT5		4.67	1.42
9/25/1996	CT6		5.08	1.55
9/25/1996	NT1	Shallow	8.27	2.52
9/25/1996	NT1D	Deep	8.04	2.45
9/25/1996	NT2	Shallow	7.83	2.39
9/25/1996	NT2D	Deep	7.83	2.39
9/25/1996	NT3	Shallow	7.33	2.23
9/25/1996	NT3D	Deep	7.1	2.16
9/25/1996	NT4	Shallow	8.27	2.52
9/25/1996	NT5	Shallow	7.54	2.30
10/9/1996	CT1		5.04	1.54
10/9/1996	CT2		5.96	1.82
10/9/1996	CT3		5.85	1.78
10/9/1996	CT4		5.08	1.55
10/9/1996	CT5		5.08	1.55
10/9/1996	CT6		5.54	1.69
10/9/1996	NT1	Shallow	8.08	2.46
10/9/1996	NT1D	Deep	7.88	2.40
10/9/1996	NT2	Shallow	8.96	2.73
10/9/1996	NT2D	Deep	8.11	2.47
10/9/1996	NT3	Shallow	8.54	2.60
10/9/1996	NT3D	Deep	8.38	2.55
10/9/1996	NT4	Shallow	9.38	2.86
10/9/1996	NT5	Shallow	8.42	2.57
10/31/1996	CT1		6.67	2.03
10/31/1996	CT2		7.33	2.23
10/31/1996	CT3		6.75	2.06
10/31/1996	CT4		6.08	1.85
10/31/1996	CT5		5.83	1.78
10/31/1996	CT6		6.17	1.88
10/31/1996	NT1	Shallow	10.08	3.07
10/31/1996	NT1D	Deep	9.96	3.04
10/31/1996	NT2	Shallow	9.67	2.95
10/31/1996	NT2D	Deep	9.71	2.96
10/31/1996	NT3	Shallow	9.08	2.77
10/31/1996	NT3D	Deep	8.88	2.71
10/31/1996	NT4	Shallow	10	3.05
10/31/1996	NT5	Shallow	8.85	2.70

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
11/21/1996	CT1		7	2.13
11/21/1996	CT2		7.67	2.34
11/21/1996	CT3		7.08	2.16
11/21/1996	CT4		6.5	1.98
11/21/1996	CT5		6.25	1.91
11/21/1996	CT6		6.67	2.03
11/21/1996	NT1	Shallow	10.54	3.21
11/21/1996	NT1D	Deep	10.29	3.14
11/21/1996	NT2	Shallow	10.33	3.15
11/21/1996	NT2D	Deep	10.35	3.15
11/21/1996	NT3	Shallow	9.79	2.98
11/21/1996	NT3D	Deep	9.63	2.94
11/21/1996	NT4	Shallow	10.63	3.24
11/21/1996	NT5	Shallow	9.69	2.95
12/4/1996	CT1		6.46	1.97
12/4/1996	CT2		7.13	2.17
12/4/1996	CT3		6.63	2.02
12/4/1996	CT4		6.08	1.85
12/4/1996	CT5		5.88	1.79
12/4/1996	CT6		6.21	1.89
12/4/1996	NT1	Shallow	9.54	2.91
12/4/1996	NT1D	Deep	9.29	2.83
12/4/1996	NT2	Shallow	10.04	3.06
12/4/1996	NT2D	Deep	10.02	3.05
12/4/1996	NT3	Shallow	9.67	2.95
12/4/1996	NT3D	Deep	9.5	2.90
12/4/1996	NT4	Shallow	10.54	3.21
12/4/1996	NT5	Shallow	9.77	2.98
1/14/1997	CT1		5.89	1.80
1/14/1997	CT2		6.56	2.00
1/14/1997	CT3		6.21	1.89
1/14/1997	CT4		5.6	1.71
1/14/1997	CT5		5.79	1.76
1/14/1997	CT6		5.46	1.66
1/14/1997	NT1	Shallow	8.81	2.69
1/14/1997	NT1D	Deep	8.67	2.64
1/14/1997	NT2	Shallow	9.42	2.87
1/14/1997	NT2D	Deep	9.37	2.86
1/14/1997	NT3	Shallow	9.15	2.79
1/14/1997	NT3D	Deep	9	2.74
1/14/1997	NT4	Shallow	9.92	3.02
1/14/1997	NT5	Shallow	9.39	2.86
2/12/1997	CT1		6.83	2.08
2/12/1997	CT2		7.42	2.26
2/12/1997	CT3		6.96	2.12
2/12/1997	CT4		6.33	1.93
2/12/1997	CT5		6.06	1.85
2/12/1997	CT6		6.44	1.96
2/12/1997	NT1	Shallow	10.25	3.12

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
2/12/1997	NT1D	Deep	10.21	3.11
2/12/1997	NT2	Shallow	10.31	3.14
2/12/1997	NT2D	Deep	10.23	3.12
2/12/1997	NT3	Shallow	9.75	2.97
2/12/1997	NT3D	Deep	9.67	2.95
2/12/1997	NT4	Shallow	10.58	3.22
2/12/1997	NT5	Shallow	9.75	2.97
3/12/1997	CT1		6.88	2.10
3/12/1997	CT2		8.58	2.62
3/12/1997	CT3		7.06	2.15
3/12/1997	CT4		6.46	1.97
3/12/1997	CT5		6.21	1.89
3/12/1997	CT6		6.56	2.00
3/12/1997	NT1	Shallow	10.42	3.18
3/12/1997	NT1D	Deep	10.25	3.12
3/12/1997	NT2	Shallow	10.17	3.10
3/12/1997	NT2D	Deep	10.17	3.10
3/12/1997	NT3	Shallow	9.58	2.92
3/12/1997	NT3D	Deep	9.5	2.90
3/12/1997	NT4	Shallow	10.48	3.19
3/12/1997	NT5	Shallow	9.54	2.91
3/25/1997	CT1		6.6	2.01
3/25/1997	CT2		7.19	2.19
3/25/1997	CT3		6.71	2.05
3/25/1997	CT4		6.19	1.89
3/25/1997	CT5		6	1.83
3/25/1997	CT6		6.27	1.91
3/25/1997	NT1	Shallow	9.75	2.97
3/25/1997	NT1D	Deep	9.6	2.93
3/25/1997	NT2	Shallow	9.92	3.02
3/25/1997	NT2D	Deep	9.85	3.00
3/25/1997	NT3	Shallow	9.56	2.91
3/25/1997	NT3D	Deep	9.42	2.87
3/25/1997	NT4	Shallow	10.23	3.12
3/25/1997	NT5	Shallow	9.63	2.94
4/2/1997	CT1		6.96	2.12
4/2/1997	CT2		7.54	2.30
4/2/1997	CT3		7.02	2.14
4/2/1997	CT4		6.42	1.96
4/2/1997	CT5		6.17	1.88
4/2/1997	CT6		6.5	1.98
4/2/1997	NT1	Shallow	10.35	3.15
4/2/1997	NT1D	Deep	10.23	3.12
4/2/1997	NT2	Shallow	10.27	3.13
4/2/1997	NT2D	Deep	10.21	3.11
4/2/1997	NT3	Shallow	9.69	2.95
4/2/1997	NT3D	Deep	9.56	2.91
4/2/1997	NT4	Shallow	10.5	3.20
4/2/1997	NT5	Shallow	9.83	3.00

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
4/30/1997	CT1		7.31	2.23
4/30/1997	CT2		8	2.44
4/30/1997	CT3		7.52	2.29
4/30/1997	CT4		6.92	2.11
4/30/1997	CT5		6.73	2.05
4/30/1997	CT6		7.17	2.19
4/30/1997	NT1	Shallow	10.25	3.12
4/30/1997	NT1D	Deep	10	3.05
4/30/1997	NT2	Shallow	10.77	3.28
4/30/1997	NT2D	Deep	10.75	3.28
4/30/1997	NT3	Shallow	10.35	3.15
4/30/1997	NT3D	Deep	10.25	3.12
4/30/1997	NT4	Shallow	11.23	3.42
4/30/1997	NT5	Shallow	10.5	3.20
5/14/1997	CT1		7.35	2.24
5/14/1997	CT2		8	2.44
5/14/1997	CT3		7.56	2.30
5/14/1997	CT4		6.89	2.10
5/14/1997	CT5		6.73	2.05
5/14/1997	CT6		7.04	2.15
5/14/1997	NT1	Shallow	10.98	3.35
5/14/1997	NT1D	Deep	10.69	3.26
5/14/1997	NT2	Shallow	10.67	3.25
5/14/1997	NT2D	Deep	10.63	3.24
5/14/1997	NT3	Shallow	10.06	3.07
5/14/1997	NT3D	Deep	10	3.05
5/14/1997	NT4	Shallow	10.89	3.32
5/14/1997	NT5	Shallow	10.19	3.11
5/27/1997	CT1		7.75	2.36
5/27/1997	CT2		8.44	2.57
5/27/1997	CT3		7.92	2.41
5/27/1997	CT4		7.33	2.23
5/27/1997	CT5		7.23	2.20
5/27/1997	CT6		7.56	2.30
5/27/1997	NT1	Shallow	11.65	3.55
5/27/1997	NT1D	Deep	11.39	3.47
5/27/1997	NT2	Shallow	11.39	3.47
5/27/1997	NT2D	Deep	11.42	3.48
5/27/1997	NT3	Shallow	10.88	3.32
5/27/1997	NT3D	Deep	10.75	3.28
5/27/1997	NT4	Shallow	11.67	3.56
5/27/1997	NT5	Shallow	10.81	3.29
6/11/1997	CT1		8.23	2.51
6/11/1997	CT2		8.88	2.71
6/11/1997	CT3		8.42	2.57
6/11/1997	CT4		7.88	2.40
6/11/1997	CT5		7.67	2.34
6/11/1997	CT6		8	2.44
6/11/1997	NT1	Shallow	12	3.66

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
6/11/1997	NT1D	Deep	11.83	3.61
6/11/1997	NT2	Shallow	11.96	3.65
6/11/1997	NT2D	Deep	11.98	3.65
6/11/1997	NT3	Shallow	11.46	3.49
6/11/1997	NT3D	Deep	11.29	3.44
6/11/1997	NT4	Shallow	12.29	3.75
6/11/1997	NT5	Shallow	11.38	3.47
6/24/1997	AQ1		8.67	2.64
6/24/1997	AQ2		7.89	2.40
6/24/1997	AQ3		8.54	2.60
6/24/1997	AQ4		8.06	2.46
6/24/1997	AQ5		7.92	2.41
6/24/1997	AQ6		7.1	2.16
6/24/1997	AQ7		7.67	2.34
6/24/1997	AQ8		7.88	2.40
6/24/1997	AQ9		7.79	2.37
6/24/1997	CT1		8.56	2.61
6/24/1997	CT2		9.25	2.82
6/24/1997	CT3		8.75	2.67
6/24/1997	CT4		8.17	2.49
6/24/1997	CT5		7.96	2.43
6/24/1997	CT6		8.33	2.54
6/24/1997	NT1	Shallow	12.25	3.73
6/24/1997	NT1D	Deep	12.13	3.70
6/24/1997	NT2	Shallow	12.13	3.70
6/24/1997	NT2D	Deep	12.19	3.72
6/24/1997	NT3	Shallow	11.71	3.57
6/24/1997	NT3D	Deep	11.58	3.53
6/24/1997	NT4	Shallow	dry	.
6/24/1997	NT5	Shallow	11.67	3.56
7/16/1997	AQ1		9.17	2.80
7/16/1997	AQ2		8.83	2.69
7/16/1997	AQ3		9	2.74
7/16/1997	AQ4		8.54	2.60
7/16/1997	AQ5		8.42	2.57
7/16/1997	AQ6		7.54	2.30
7/16/1997	AQ7		8.17	2.49
7/16/1997	AQ8		8.38	2.55
7/16/1997	AQ9		8.27	2.52
7/16/1997	CT1		9.04	2.76
7/16/1997	CT2		9.71	2.96
7/16/1997	CT3		9.27	2.83
7/16/1997	CT4		8.67	2.64
7/16/1997	CT5		8.5	2.59
7/16/1997	CT6		8.77	2.67
7/16/1997	NT1	Shallow	12.71	3.87
7/16/1997	NT1D	Deep	12.46	3.80
7/16/1997	NT2	Shallow	12.63	3.85
7/16/1997	NT2D	Deep	12.6	3.84

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/16/1997	NT3	Shallow	12.13	3.70
7/16/1997	NT3D	Deep	12	3.66
7/16/1997	NT4	Shallow	12.83	3.91
7/16/1997	NT5	Shallow	12.13	3.70
8/6/1997	AQ1		9.19	2.80
8/6/1997	AQ2		8.83	2.69
8/6/1997	AQ3		9.08	2.77
8/6/1997	AQ4		8.58	2.62
8/6/1997	AQ5		8.5	2.59
8/6/1997	AQ6		7.65	2.33
8/6/1997	AQ7		8.25	2.51
8/6/1997	AQ8		8.46	2.58
8/6/1997	AQ9		8.29	2.53
8/6/1997	CT1		9.08	2.77
8/6/1997	CT2		9.75	2.97
8/6/1997	CT3		9.29	2.83
8/6/1997	CT4		8.65	2.64
8/6/1997	CT5		8.54	2.60
8/6/1997	CT6		8.77	2.67
8/6/1997	NT1	Shallow	12.58	3.83
8/6/1997	NT1D	Deep	12.38	3.77
8/6/1997	NT2	Shallow	12.54	3.82
8/6/1997	NT2D	Deep	12.52	3.82
8/6/1997	NT3	Shallow	12.13	3.70
8/6/1997	NT3D	Deep	12.04	3.67
8/6/1997	NT4	Shallow	dry	.
8/6/1997	NT5	Shallow	12.27	3.74
8/19/1997	AQ1		9.33	2.84
8/19/1997	AQ2		8.94	2.72
8/19/1997	AQ3		9.21	2.81
8/19/1997	AQ4		8.67	2.64
8/19/1997	AQ5		nd	.
8/19/1997	AQ6		7.79	2.37
8/19/1997	AQ7		8.42	2.57
8/19/1997	AQ8		8.63	2.63
8/19/1997	AQ9		8.42	2.57
8/19/1997	CT1		9.21	2.81
8/19/1997	CT2		9.92	3.02
8/19/1997	CT3		9.46	2.88
8/19/1997	CT4		8.88	2.71
8/19/1997	CT5		9.08	2.77
8/19/1997	CT6		8.67	2.64
8/19/1997	NT1	Shallow	dry	.
8/19/1997	NT1D	Deep	12.6	3.84
8/19/1997	NT2	Shallow	dry	.
8/19/1997	NT2D	Deep	12.85	3.92
8/19/1997	NT3	Shallow	12.42	3.79
8/19/1997	NT3D	Deep	12.25	3.73
8/19/1997	NT4	Shallow	dry	.

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
8/19/1997	NT5	Shallow	dry	.
9/3/1997	AQ1		nd	.
9/3/1997	AQ2		nd	.
9/3/1997	AQ3		nd	.
9/3/1997	AQ4		nd	.
9/3/1997	AQ5		nd	.
9/3/1997	AQ6		nd	.
9/3/1997	AQ7		nd	.
9/3/1997	AQ8		nd	.
9/3/1997	AQ9		nd	.
9/3/1997	CT1		9.5	2.90
9/3/1997	CT2		10.56	3.22
9/3/1997	CT3		9.71	2.96
9/3/1997	CT4		9.08	2.77
9/3/1997	CT5		8.83	2.69
9/3/1997	CT6		9.19	2.80
9/3/1997	NT1	Shallow	dry	.
9/3/1997	NT1D	Deep	12.83	3.91
9/3/1997	NT2	Shallow	dry	.
9/3/1997	NT2D	Deep	13	3.96
9/3/1997	NT3	Shallow	dry	.
9/3/1997	NT3D	Deep	12.5	3.81
9/3/1997	NT4	Shallow	dry	.
9/3/1997	NT5	Shallow	dry	.
9/24/1997	AQ1		9.88	3.01
9/24/1997	AQ2		9.54	2.91
9/24/1997	AQ3		9.69	2.95
9/24/1997	AQ4		9.19	2.80
9/24/1997	AQ5		9.1	2.77
9/24/1997	AQ6		8.33	2.54
9/24/1997	AQ7		8.96	2.73
9/24/1997	AQ8		9.17	2.80
9/24/1997	AQ9		9	2.74
9/24/1997	CT1		9.79	2.98
9/24/1997	CT2		10.35	3.15
9/24/1997	CT3		10	3.05
9/24/1997	CT4		9.39	2.86
9/24/1997	CT5		9.48	2.89
9/24/1997	CT6		9.15	2.79
9/24/1997	NT1	Shallow	dry	.
9/24/1997	NT1D	Deep	13	3.96
9/24/1997	NT2	Shallow	dry	.
9/24/1997	NT2D	Deep	13.17	4.01
9/24/1997	NT3	Shallow	dry	.
9/24/1997	NT3D	Deep	12.71	3.87
9/24/1997	NT4	Shallow	dry	.
9/24/1997	NT5	Shallow	dry	.
10/28/1997	AQ1		9.88	3.01
10/28/1997	AQ2		9.48	2.89

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
10/28/1997	AQ3		9.75	2.97
10/28/1997	AQ4		9.27	2.83
10/28/1997	AQ5		9.1	2.77
10/28/1997	AQ6		8.33	2.54
10/28/1997	AQ7		8.96	2.73
10/28/1997	AQ8		9.17	2.80
10/28/1997	AQ9		9	2.74
10/28/1997	CT1		9.63	2.94
10/28/1997	CT2		10.38	3.16
10/28/1997	CT3		10	3.05
10/28/1997	CT4		9.35	2.85
10/28/1997	CT5		9.13	2.78
10/28/1997	CT6		9.58	2.92
10/28/1997	NT1	Shallow	dry	.
10/28/1997	NT1D	Deep	13.04	3.97
10/28/1997	NT2	Shallow	dry	.
10/28/1997	NT2D	Deep	13.29	4.05
10/28/1997	NT3	Shallow	dry	.
10/28/1997	NT3D	Deep	12.83	3.91
10/28/1997	NT4	Shallow	dry	.
10/28/1997	NT5	Shallow	dry	.
11/19/1997	AQ1		9.56	2.91
11/19/1997	AQ2		9.15	2.79
11/19/1997	AQ3		9.65	2.94
11/19/1997	AQ4		8.98	2.74
11/19/1997	AQ5		8.81	2.69
11/19/1997	AQ6		8	2.44
11/19/1997	AQ7		8.63	2.63
11/19/1997	AQ8		8.77	2.67
11/19/1997	AQ9		8.69	2.65
11/19/1997	CT1		9.35	2.85
11/19/1997	CT2		10.04	3.06
11/19/1997	CT3		9.58	2.92
11/19/1997	CT4		9.13	2.78
11/19/1997	CT5		8.83	2.69
11/19/1997	CT6		9.23	2.81
11/19/1997	NT1	Shallow	12.83	3.91
11/19/1997	NT1D	Deep	12.85	3.92
11/19/1997	NT2	Shallow	12.85	3.92
11/19/1997	NT2D	Deep	13.17	4.01
11/19/1997	NT3	Shallow	12.89	3.93
11/19/1997	NT3D	Deep	12.73	3.88
11/19/1997	NT4	Shallow	dry	.
11/19/1997	NT5	Shallow	12.88	3.93
12/18/1997	AQ1		9	2.74
12/18/1997	AQ2		8.63	2.63
12/18/1997	AQ3		9.17	2.80
12/18/1997	AQ4		8.33	2.54
12/18/1997	AQ5		8.29	2.53

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
12/18/1997	AQ6		7.46	2.27
12/18/1997	AQ7		8.04	2.45
12/18/1997	AQ8		8.29	2.53
12/18/1997	AQ9		8.13	2.48
12/18/1997	CT1		8.79	2.68
12/18/1997	CT2		9.48	2.89
12/18/1997	CT3		9.06	2.76
12/18/1997	CT4		8.5	2.59
12/18/1997	CT5		8.33	2.54
12/18/1997	CT6		8.67	2.64
12/18/1997	NT1	Shallow	12.77	3.89
12/18/1997	NT1D	Deep	12.71	3.87
12/18/1997	NT2	Shallow	12.83	3.91
12/18/1997	NT2D	Deep	13	3.96
12/18/1997	NT3	Shallow	12.54	3.82
12/18/1997	NT3D	Deep	12.42	3.79
12/18/1997	NT4	Shallow	12.73	3.88
12/18/1997	NT5	Shallow	12.67	3.86
1/14/1998	AQ1		7.67	2.34
1/14/1998	AQ2		7.25	2.21
1/14/1998	AQ3		8.29	2.53
1/14/1998	AQ4		7	2.13
1/14/1998	AQ5		6.81	2.08
1/14/1998	AQ6		6	1.83
1/14/1998	AQ7		6.6	2.01
1/14/1998	AQ8		6.81	2.08
1/14/1998	AQ9		6.65	2.03
1/14/1998	CT1		7.13	2.17
1/14/1998	CT2		7.85	2.39
1/14/1998	CT3		7.42	2.26
1/14/1998	CT4		6.88	2.10
1/14/1998	CT5		6.83	2.08
1/14/1998	CT6		7.15	2.18
1/14/1998	NT1	Shallow	10.52	3.21
1/14/1998	NT1D	Deep	10.42	3.18
1/14/1998	NT2	Shallow	11.19	3.41
1/14/1998	NT2D	Deep	11.13	3.39
1/14/1998	NT3	Shallow	10.96	3.34
1/14/1998	NT3D	Deep	10.92	3.33
1/14/1998	NT4	Shallow	11.71	3.57
1/14/1998	NT5	Shallow	11.58	3.53
1/21/1998	AQ1		6.83	2.08
1/21/1998	AQ2		6.42	1.96
1/21/1998	AQ3		7.88	2.40
1/21/1998	AQ4		6.08	1.85
1/21/1998	AQ5		6	1.83
1/21/1998	AQ6		5.1	1.55
1/21/1998	AQ7		5.75	1.75
1/21/1998	AQ8		5.92	1.80

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
1/21/1998	AQ9		5.75	1.75
1/21/1998	CT1		5.38	1.64
1/21/1998	CT2		6.38	1.94
1/21/1998	CT3		6.42	1.96
1/21/1998	CT4		5.71	1.74
1/21/1998	CT5		5.92	1.80
1/21/1998	CT6		5.27	1.61
1/21/1998	NT1	Shallow	8.71	2.65
1/21/1998	NT1D	Deep	8.54	2.60
1/21/1998	NT2	Shallow	10.23	3.12
1/21/1998	NT2D	Deep	10.21	3.11
1/21/1998	NT3	Shallow	10.25	3.12
1/21/1998	NT3D	Deep	10.21	3.11
1/21/1998	NT4	Shallow	10.88	3.32
1/21/1998	NT5	Shallow	10.83	3.30
2/18/1998	AQ1		9	2.74
2/18/1998	AQ2		8.63	2.63
2/18/1998	AQ3		9.17	2.80
2/18/1998	AQ4		8.33	2.54
2/18/1998	AQ5		8.29	2.53
2/18/1998	AQ6		7.46	2.27
2/18/1998	AQ7		8.04	2.45
2/18/1998	AQ8		8.29	2.53
2/18/1998	AQ9		8.13	2.48
2/18/1998	CT1		3.83	1.17
2/18/1998	CT2		4.54	1.38
2/18/1998	CT3		4.21	1.28
2/18/1998	CT4		3.58	1.09
2/18/1998	CT5		3.42	1.04
2/18/1998	CT6		3.77	1.15
2/18/1998	NT1	Shallow	7.33	2.23
2/18/1998	NT1D	Deep	7.13	2.17
2/18/1998	NT2	Shallow	7.58	2.31
2/18/1998	NT2D	Deep	7.58	2.31
2/18/1998	NT3	Shallow	7.17	2.19
2/18/1998	NT3D	Deep	7.08	2.16
2/18/1998	NT4	Shallow	8.08	2.46
2/18/1998	NT5	Shallow	7.42	2.26
3/25/1998	AQ1		3.79	1.16
3/25/1998	AQ2		3.5	1.07
3/25/1998	AQ3		4.54	1.38
3/25/1998	AQ4		3.17	0.97
3/25/1998	AQ5		3.08	0.94
3/25/1998	AQ6		2.21	0.67
3/25/1998	AQ7		2.79	0.85
3/25/1998	AQ8		3	0.91
3/25/1998	AQ9		2.88	0.88
3/25/1998	CT1		2.71	0.83
3/25/1998	CT2		3.46	1.05

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
3/25/1998	CT3		3.44	1.05
3/25/1998	CT4		2.79	0.85
3/25/1998	CT5		2.88	0.88
3/25/1998	CT6		3.33	1.01
3/25/1998	NT1	Shallow	5.69	1.73
3/25/1998	NT1D	Deep	5.67	1.73
3/25/1998	NT2	Shallow	6.63	2.02
3/25/1998	NT2D	Deep	6.58	2.01
3/25/1998	NT3	Shallow	6.33	1.93
3/25/1998	NT3D	Deep	6.25	1.91
3/25/1998	NT4	Shallow	6.94	2.12
3/25/1998	NT5	Shallow	6.75	2.06
4/24/1998	AQ1		5.83	1.78
4/24/1998	AQ2		5.54	1.69
4/24/1998	AQ3		5.54	1.69
4/24/1998	AQ4		5.17	1.58
4/24/1998	AQ5		5.13	1.56
4/24/1998	AQ6		4.33	1.32
4/24/1998	AQ7		4.92	1.50
4/24/1998	AQ8		5.17	1.58
4/24/1998	AQ9		5	1.52
4/24/1998	CT1		6.42	1.96
4/24/1998	CT2		7.08	2.16
4/24/1998	CT3		6.29	1.92
4/24/1998	CT4		5.63	1.72
4/24/1998	CT5		7.33	2.23
4/24/1998	CT6		5.63	1.72
4/24/1998	NT1	Shallow	9.79	2.98
4/24/1998	NT1D	Deep	9.58	2.92
4/24/1998	NT2	Shallow	9.42	2.87
4/24/1998	NT2D	Deep	9.5	2.90
4/24/1998	NT3	Shallow	8.92	2.72
4/24/1998	NT3D	Deep	8.83	2.69
4/24/1998	NT4	Shallow	9.83	3.00
4/24/1998	NT5	Shallow	8.83	2.69
5/26/1998	AQ1		6.92	2.11
5/26/1998	AQ2		6.58	2.01
5/26/1998	AQ3		6.54	1.99
5/26/1998	AQ4		6.25	1.91
5/26/1998	AQ5		6.21	1.89
5/26/1998	AQ6		5.38	1.64
5/26/1998	AQ7		6	1.83
5/26/1998	AQ8		6.17	1.88
5/26/1998	AQ9		6.08	1.85
5/26/1998	CT1		7.08	2.16
5/26/1998	CT2		7.75	2.36
5/26/1998	CT3		7.13	2.17
5/26/1998	CT4		6.58	2.01
5/26/1998	CT5		6.29	1.92

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
5/26/1998	CT6		6.54	1.99
5/26/1998	NT1	Shallow	11	3.35
5/26/1998	NT1D	Deep	10.83	3.30
5/26/1998	NT2	Shallow	10.75	3.28
5/26/1998	NT2D	Deep	10.75	3.28
5/26/1998	NT3	Shallow	10.25	3.12
5/26/1998	NT3D	Deep	10.17	3.10
5/26/1998	NT4	Shallow	11.21	3.42
5/26/1998	NT5	Shallow	10.17	3.10
6/15/1998	AQ1		7.25	2.21
6/15/1998	AQ2		6.88	2.10
6/15/1998	AQ3		7.08	2.16
6/15/1998	AQ4		6.63	2.02
6/15/1998	AQ5		6.46	1.97
6/15/1998	AQ6		5.63	1.72
6/15/1998	AQ7		6.33	1.93
6/15/1998	AQ8		6.54	1.99
6/15/1998	AQ9		6.25	1.91
6/15/1998	CT1		7.46	2.27
6/15/1998	CT2		8.04	2.45
6/15/1998	CT3		7.52	2.29
6/15/1998	CT4		6.88	2.10
6/15/1998	CT5		6.56	2.00
6/15/1998	CT6		6.92	2.11
6/15/1998	NT1	Shallow	11.42	3.48
6/15/1998	NT1D	Deep	11.33	3.45
6/15/1998	NT2	Shallow	11.38	3.47
6/15/1998	NT2D	Deep	11.33	3.45
6/15/1998	NT3	Shallow	10.85	3.31
6/15/1998	NT3D	Deep	10.67	3.25
6/15/1998	NT4	Shallow	11.79	3.59
6/15/1998	NT5	Shallow	10.67	3.25
7/1/1998	AQ1		7.67	2.34
7/1/1998	AQ2		7.42	2.26
7/1/1998	AQ3		7.46	2.27
7/1/1998	AQ4		7.17	2.19
7/1/1998	AQ5		7.13	2.17
7/1/1998	AQ6		6.21	1.89
7/1/1998	AQ7		6.79	2.07
7/1/1998	AQ8		7.08	2.16
7/1/1998	AQ9		6.92	2.11
7/1/1998	CT1		7.92	2.41
7/1/1998	CT2		8.46	2.58
7/1/1998	CT3		7.92	2.41
7/1/1998	CT4		7.46	2.27
7/1/1998	CT5		7.17	2.19
7/1/1998	CT6		7.46	2.27
7/1/1998	NT1	Shallow	11.75	3.58
7/1/1998	NT1D	Deep	11.63	3.54

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/1/1998	NT2	Shallow	11.71	3.57
7/1/1998	NT2D	Deep	11.67	3.56
7/1/1998	NT3	Shallow	11.17	3.40
7/1/1998	NT3D	Deep	11.08	3.38
7/1/1998	NT4	Shallow	12.17	3.71
7/1/1998	NT5	Shallow	11.17	3.40
7/15/1998	AQ1		8.21	2.50
7/15/1998	AQ2		7.08	2.16
7/15/1998	AQ3		7.92	2.41
7/15/1998	AQ4		7.67	2.34
7/15/1998	AQ5		7.63	2.33
7/15/1998	AQ6		6.75	2.06
7/15/1998	AQ7		7.33	2.23
7/15/1998	AQ8		7.58	2.31
7/15/1998	AQ9		7.46	2.27
7/15/1998	CT1		8.38	2.55
7/15/1998	CT2		8.92	2.72
7/15/1998	CT3		8.5	2.59
7/15/1998	CT4		7.88	2.40
7/15/1998	CT5		7.67	2.34
7/15/1998	CT6		8	2.44
7/15/1998	NT1	Shallow	12.08	3.68
7/15/1998	NT1D	Deep	11.83	3.61
7/15/1998	NT2	Shallow	12.13	3.70
7/15/1998	NT2D	Deep	11.92	3.63
7/15/1998	NT3	Shallow	11.46	3.49
7/15/1998	NT3D	Deep	11.42	3.48
7/15/1998	NT4	Shallow	12.5	3.81
7/15/1998	NT5	Shallow	11.46	3.49
7/28/1998	AQ1		8.63	2.63
7/28/1998	AQ2		8.21	2.50
7/28/1998	AQ3		8.38	2.55
7/28/1998	AQ4		8	2.44
7/28/1998	AQ5		7.96	2.43
7/28/1998	AQ6		7.08	2.16
7/28/1998	AQ7		7.63	2.33
7/28/1998	AQ8		7.88	2.40
7/28/1998	AQ9		7.77	2.37
7/28/1998	CT1		7.65	2.33
7/28/1998	CT2		9.39	2.86
7/28/1998	CT3		8.71	2.65
7/28/1998	CT4		8.21	2.50
7/28/1998	CT5		8	2.44
7/28/1998	CT6		8.33	2.54
7/28/1998	NT1	Shallow	12.27	3.74
7/28/1998	NT1D	Deep	12.1	3.69
7/28/1998	NT2	Shallow	12.21	3.72
7/28/1998	NT2D	Deep	12.19	3.72
7/28/1998	NT3	Shallow	11.88	3.62

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/28/1998	NT3D	Deep	11.58	3.53
7/28/1998	NT4	Shallow	12.65	3.86
7/28/1998	NT5	Shallow	11.69	3.56
8/12/1998	AQ1		8.67	2.64
8/12/1998	AQ2		8.33	2.54
8/12/1998	AQ3		8.58	2.62
8/12/1998	AQ4		8.08	2.46
8/12/1998	AQ5		7.96	2.43
8/12/1998	AQ6		7.13	2.17
8/12/1998	AQ7		7.71	2.35
8/12/1998	AQ8		8.04	2.45
8/12/1998	AQ9		7.88	2.40
8/12/1998	CT1		8.67	2.64
8/12/1998	CT2		9.67	2.95
8/12/1998	CT3		8.75	2.67
8/12/1998	CT4		8.17	2.49
8/12/1998	CT5		8.08	2.46
8/12/1998	CT6		8.44	2.57
8/12/1998	NT1	Shallow	12.46	3.80
8/12/1998	NT1D	Deep	12.33	3.76
8/12/1998	NT2	Shallow	12.33	3.76
8/12/1998	NT2D	Deep	12.44	3.79
8/12/1998	NT3	Shallow	12	3.66
8/12/1998	NT3D	Deep	11.88	3.62
8/12/1998	NT4	Shallow	dry	.
8/12/1998	NT5	Shallow	dry	.
8/28/1998	AQ1		8.79	2.68
8/28/1998	AQ2		8.63	2.63
8/28/1998	AQ3		8.78	2.68
8/28/1998	AQ4		8.33	2.54
8/28/1998	AQ5		8.29	2.53
8/28/1998	AQ6		7.42	2.26
8/28/1998	AQ7		8	2.44
8/28/1998	AQ8		8.25	2.51
8/28/1998	AQ9		8.08	2.46
8/28/1998	CT1		8.3	2.53
8/28/1998	CT2		9.5	2.90
8/28/1998	CT3		9.04	2.76
8/28/1998	CT4		8.46	2.58
8/28/1998	CT5		8.29	2.53
8/28/1998	CT6		8.67	2.64
8/28/1998	NT1	Shallow	12.46	3.80
8/28/1998	NT1D	Deep	12.38	3.77
8/28/1998	NT2	Shallow	12.54	3.82
8/28/1998	NT2D	Deep	12.5	3.81
8/28/1998	NT3	Shallow	12.08	3.68
8/28/1998	NT3D	Deep	12.04	3.67
8/28/1998	NT4	Shallow	dry	.
8/28/1998	NT5	Shallow	dry	.

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
9/10/1998	AQ1		8.58	2.62
9/10/1998	AQ2		8.25	2.51
9/10/1998	AQ3		8.58	2.62
9/10/1998	AQ4		8.08	2.46
9/10/1998	AQ5		8	2.44
9/10/1998	AQ6		7.13	2.17
9/10/1998	AQ7		7.67	2.34
9/10/1998	AQ8		7.96	2.43
9/10/1998	AQ9		7.71	2.35
9/10/1998	CT1		8.46	2.58
9/10/1998	CT2		9.83	3.00
9/10/1998	CT3		8.75	2.67
9/10/1998	CT4		8.13	2.48
9/10/1998	CT5		8	2.44
9/10/1998	CT6		8.29	2.53
9/10/1998	NT1	Shallow	12.25	3.73
9/10/1998	NT1D	Deep	12.08	3.68
9/10/1998	NT2	Shallow	12.33	3.76
9/10/1998	NT2D	Deep	12.38	3.77
9/10/1998	NT3	Shallow	11.88	3.62
9/10/1998	NT3D	Deep	11.83	3.61
9/10/1998	NT4	Shallow	12.75	3.89
9/10/1998	NT5	Shallow	11.92	3.63
9/24/1998	AQ1		8.92	2.72
9/24/1998	AQ2		8.54	2.60
9/24/1998	AQ3		8.79	2.68
9/24/1998	AQ4		8.25	2.51
9/24/1998	AQ5		8.13	2.48
9/24/1998	AQ6		7.33	2.23
9/24/1998	AQ7		7.92	2.41
9/24/1998	AQ8		8.17	2.49
9/24/1998	AQ9		8.08	2.46
9/24/1998	CT1		8.75	2.67
9/24/1998	CT2		9.46	2.88
9/24/1998	CT3		9	2.74
9/24/1998	CT4		8.38	2.55
9/24/1998	CT5		8.25	2.51
9/24/1998	CT6		8.58	2.62
9/24/1998	NT1	Shallow	12.58	3.83
9/24/1998	NT1D	Deep	12.5	3.81
9/24/1998	NT2	Shallow	12.6	3.84
9/24/1998	NT2D	Deep	12.54	3.82
9/24/1998	NT3	Shallow	12.17	3.71
9/24/1998	NT3D	Deep	12.13	3.70
9/24/1998	NT4	Shallow	12.83	3.91
9/24/1998	NT5	Shallow	12.21	3.72
10/23/1998	AQ1		9.46	2.88
10/23/1998	AQ2		9.17	2.80
10/23/1998	AQ3		9.25	2.82

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
10/23/1998	AQ4		8.79	2.68
10/23/1998	AQ5		8.75	2.67
10/23/1998	AQ6		7.96	2.43
10/23/1998	AQ7		8.46	2.58
10/23/1998	AQ8		9.67	2.95
10/23/1998	AQ9		8.67	2.64
10/23/1998	CT1		9.38	2.86
10/23/1998	CT2		10.02	3.05
10/23/1998	CT3		9.58	2.92
10/23/1998	CT4		9	2.74
10/23/1998	CT5		8.79	2.68
10/23/1998	CT6		9.17	2.80
10/23/1998	NT1	Shallow	12.75	3.89
10/23/1998	NT1D	Deep	12.79	3.90
10/23/1998	NT2	Shallow	12.83	3.91
10/23/1998	NT2D	Deep	12.96	3.95
10/23/1998	NT3	Shallow	12.54	3.82
10/23/1998	NT3D	Deep	12.5	3.81
10/23/1998	NT4	Shallow	12.75	3.89
10/23/1998	NT5	Shallow	12.63	3.85
12/2/1998	AQ1		9.73	2.97
12/2/1998	AQ2		9.5	2.90
12/2/1998	AQ3		9.65	2.94
12/2/1998	AQ4		9.23	2.81
12/2/1998	AQ5		9.04	2.76
12/2/1998	AQ6		8.29	2.53
12/2/1998	AQ7		8.79	2.68
12/2/1998	AQ8		9.1	2.77
12/2/1998	AQ9		9	2.74
12/2/1998	CT1		9.67	2.95
12/2/1998	CT2		10.33	3.15
12/2/1998	CT3		9.96	3.04
12/2/1998	CT4		9.33	2.84
12/2/1998	CT5		9.08	2.77
12/2/1998	CT6		9.5	2.90
12/2/1998	NT1	Shallow	12.73	3.88
12/2/1998	NT1D	Deep	12.92	3.94
12/2/1998	NT2	Shallow	12.83	3.91
12/2/1998	NT2D	Deep	13.19	4.02
12/2/1998	NT3	Shallow	12.75	3.89
12/2/1998	NT3D	Deep	12.65	3.86
12/2/1998	NT4	Shallow	dry	.
12/2/1998	NT5	Shallow	12.77	3.89
5/5/1999	AQ1		8.29	2.53
5/5/1999	AQ2		7.92	2.41
5/5/1999	AQ3		8.19	2.50
5/5/1999	AQ4		7.67	2.34
5/5/1999	AQ5		7.56	2.30
5/5/1999	AQ6		6.73	2.05

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
5/5/1999	AQ7		7.29	2.22
5/5/1999	AQ8		7.52	2.29
5/5/1999	AQ9		7.29	2.22
5/5/1999	CT1		8.08	2.46
5/5/1999	CT2		8.75	2.67
5/5/1999	CT3		8.25	2.51
5/5/1999	CT4		7.63	2.33
5/5/1999	CT5		7.56	2.30
5/5/1999	CT6		7.88	2.40
5/5/1999	NT1	Shallow	12	3.66
5/5/1999	NT1D	Deep	11.81	3.60
5/5/1999	NT2	Shallow	12	3.66
5/5/1999	NT2D	Deep	11.88	3.62
5/5/1999	NT3	Shallow	11.48	3.50
5/5/1999	NT3D	Deep	11.35	3.46
5/5/1999	NT4	Shallow	12.33	3.76
5/5/1999	NT5	Shallow	11.54	3.52
5/19/1999	AQ1		8.33	2.54
5/19/1999	AQ2		8.13	2.48
5/19/1999	AQ3		8.46	2.58
5/19/1999	AQ4		7.67	2.34
5/19/1999	AQ5		7.67	2.34
5/19/1999	AQ6		7.85	2.39
5/19/1999	AQ7		7.39	2.25
5/19/1999	AQ8		7.71	2.35
5/19/1999	AQ9		7.5	2.29
5/19/1999	CT1		8.33	2.54
5/19/1999	CT2		8.96	2.73
5/19/1999	CT3		8.52	2.60
5/19/1999	CT4		7.92	2.41
5/19/1999	CT5		9.75	2.97
5/19/1999	CT6		8.08	2.46
5/19/1999	NT1	Shallow	12.25	3.73
5/19/1999	NT1D	Deep	12.06	3.68
5/19/1999	NT2	Shallow	12.13	3.70
5/19/1999	NT2D	Deep	12.21	3.72
5/19/1999	NT3	Shallow	11.67	3.56
5/19/1999	NT3D	Deep	11.63	3.54
5/19/1999	NT4	Shallow	12.67	3.86
5/19/1999	NT5	Shallow	11.67	3.56
6/3/1999	AQ1		8.78	2.68
6/3/1999	AQ2		8.31	2.53
6/3/1999	AQ3		8.82	2.69
6/3/1999	AQ4		8.03	2.45
6/3/1999	AQ5		7.11	2.17
6/3/1999	AQ6		7.03	2.14
6/3/1999	AQ7		7.82	2.38
6/3/1999	AQ8		7.8	2.38
6/3/1999	AQ9		7.96	2.43

Appendix A. Water Level Raw Date (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
6/3/1999	CT1		8.69	2.65
6/3/1999	CT2		9.29	2.83
6/3/1999	CT3		8.9	2.71
6/3/1999	CT4		8.16	2.49
6/3/1999	CT5		8	2.44
6/3/1999	CT6		8.38	2.55
6/3/1999	NT1	Shallow	12.54	3.82
6/3/1999	NT1D	Deep	12.32	3.76
6/3/1999	NT2	Shallow	12.46	3.80
6/3/1999	NT2D	Deep	12.46	3.80
6/3/1999	NT3	Shallow	11.91	3.63
6/3/1999	NT3D	Deep	11.82	3.60
6/3/1999	NT4	Shallow	dry	.
6/3/1999	NT5	Shallow	11.92	3.63
6/22/1999	AQ1		8.48	2.58
6/22/1999	AQ2		8.15	2.48
6/22/1999	AQ3		8.56	2.61
6/22/1999	AQ4		7.87	2.40
6/22/1999	AQ5		7.78	2.37
6/22/1999	AQ6		6.92	2.11
6/22/1999	AQ7		7.53	2.30
6/22/1999	AQ8		7.75	2.36
6/22/1999	AQ9		7.6	2.32
6/22/1999	CT1		8.32	2.54
6/22/1999	CT2		8.99	2.74
6/22/1999	CT3		8.59	2.62
6/22/1999	CT4		7.97	2.43
6/22/1999	CT5		7.8	2.38
6/22/1999	CT6		8.15	2.48
6/22/1999	NT1	Shallow	12.4	3.78
6/22/1999	NT1D	Deep	12.25	3.73
6/22/1999	NT2	Shallow	12.38	3.77
6/22/1999	NT2D	Deep	12.38	3.77
6/22/1999	NT3	Shallow	11.92	3.63
6/22/1999	NT3D	Deep	11.8	3.60
6/22/1999	NT4	Shallow	12.8	3.90
6/22/1999	NT5	Shallow	11.94	3.64
7/7/1999	AQ1		8.35	2.55
7/7/1999	AQ2		8.03	2.45
7/7/1999	AQ3		8.4	2.56
7/7/1999	AQ4		7.72	2.35
7/7/1999	AQ5		7.64	2.33
7/7/1999	AQ6		6.8	2.07
7/7/1999	AQ7		7.41	2.26
7/7/1999	AQ8		7.65	2.33
7/7/1999	AQ9		7.5	2.29
7/7/1999	CT1		8.36	2.55
7/7/1999	CT2		8.99	2.74
7/7/1999	CT3		8.57	2.61

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/7/1999	CT4		7.92	2.41
7/7/1999	CT5		7.7	2.35
7/7/1999	CT6		8.04	2.45
7/7/1999	NT1	Shallow	dry	.
7/7/1999	NT1D	Deep	12.38	3.77
7/7/1999	NT2	Shallow	dry	.
7/7/1999	NT2D	Deep	12.52	3.82
7/7/1999	NT3	Shallow	12.09	3.69
7/7/1999	NT3D	Deep	11.96	3.65
7/7/1999	NT4	Shallow	dry	.
7/7/1999	NT5	Shallow	12.08	3.68
7/29/1999	AQ1		8.29	2.53
7/29/1999	AQ2		7.98	2.43
7/29/1999	AQ3		8.32	2.54
7/29/1999	AQ4		7.69	2.34
7/29/1999	AQ5		7.62	2.32
7/29/1999	AQ6		6.79	2.07
7/29/1999	AQ7		7.39	2.25
7/29/1999	AQ8		7.62	2.32
7/29/1999	AQ9		7.47	2.28
7/29/1999	CT1		8.33	2.54
7/29/1999	CT2		8.96	2.73
7/29/1999	CT3		8.49	2.59
7/29/1999	CT4		7.91	2.41
7/29/1999	CT5		7.66	2.33
7/29/1999	CT6		8.01	2.44
7/29/1999	NT1	Shallow	12.5	3.81
7/29/1999	NT1D	Deep	12.33	3.76
7/29/1999	NT2	Shallow	12.5	3.81
7/29/1999	NT2D	Deep	12.5	3.81
7/29/1999	NT3	Shallow	12.06	3.68
7/29/1999	NT3D	Deep	11.95	3.64
7/29/1999	NT4	Shallow	dry	.
7/29/1999	NT5	Shallow	12.09	3.69
8/19/1999	AQ1		8.84	2.69
8/19/1999	AQ2		8.5	2.59
8/19/1999	AQ3		8.75	2.67
8/19/1999	AQ4		8.22	2.51
8/19/1999	AQ5		8.15	2.48
8/19/1999	AQ6		7.32	2.23
8/19/1999	AQ7		7.9	2.41
8/19/1999	AQ8		8.15	2.48
8/19/1999	AQ9		9.02	2.75
8/19/1999	CT1		8.81	2.69
8/19/1999	CT2		9.31	2.84
8/19/1999	CT3		10.02	3.05
8/19/1999	CT4		8.23	2.51
8/19/1999	CT5		8.21	2.50
8/19/1999	CT6		8.55	2.61

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
8/19/1999	NT1	Shallow	dry	.
8/19/1999	NT1D	Deep	12.58	3.83
8/19/1999	NT2	Shallow	12.75	3.89
8/19/1999	NT2D	Deep	12.79	3.90
8/19/1999	NT3	Shallow	dry	.
8/19/1999	NT3D	Deep	12.25	3.73
8/19/1999	NT4	Shallow	dry	.
8/19/1999	NT5	Shallow	12.4	3.78
9/10/1999	AQ1		nd	.
9/10/1999	AQ2		nd	.
9/10/1999	AQ3		nd	.
9/10/1999	AQ4		nd	.
9/10/1999	AQ5		nd	.
9/10/1999	AQ6		nd	.
9/10/1999	AQ7		nd	.
9/10/1999	AQ8		nd	.
9/10/1999	AQ9		nd	.
9/10/1999	CT1		6.08	1.85
9/10/1999	CT2		5.71	1.74
9/10/1999	CT3		7.08	2.16
9/10/1999	CT4		6.44	1.96
9/10/1999	CT5		6.7	2.04
9/10/1999	CT6		7.06	2.15
9/10/1999	NT1	Shallow	8.72	2.66
9/10/1999	NT1D	Deep	8.9	2.71
9/10/1999	NT2	Shallow	9.34	2.85
9/10/1999	NT2D	Deep	9.55	2.91
9/10/1999	NT3	Shallow	9.3	2.83
9/10/1999	NT3D	Deep	9.25	2.82
9/10/1999	NT4	Shallow	9.7	2.96
9/10/1999	NT5	Shallow	10.22	3.12
9/14/1999	AQ1		7.35	2.24
9/14/1999	AQ2		6.99	2.13
9/14/1999	AQ3		8.12	2.47
9/14/1999	AQ4		6.5	1.98
9/14/1999	AQ5		6.5	1.98
9/14/1999	AQ6		5.61	1.71
9/14/1999	AQ7		6.15	1.87
9/14/1999	AQ8		6.38	1.94
9/14/1999	AQ9		6.2	1.89
9/14/1999	CT1		6.02	1.83
9/14/1999	CT2		6.89	2.10
9/14/1999	CT3		6.72	2.05
9/14/1999	CT4		6.13	1.87
9/14/1999	CT5		6.3	1.92
9/14/1999	CT6		6.61	2.01
9/14/1999	NT1	Shallow	7.85	2.39
9/14/1999	NT1D	Deep	8.43	2.57
9/14/1999	NT2	Shallow	9.26	2.82

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
9/14/1999	NT2D	Deep	9.22	2.81
9/14/1999	NT3	Shallow	9.05	2.76
9/14/1999	NT3D	Deep	8.95	2.73
9/14/1999	NT4	Shallow	9.62	2.93
9/14/1999	NT5	Shallow	9.86	3.01
10/6/1999	CT1		2.82	0.86
10/6/1999	CT1			0.00
10/6/1999	CT2		3.54	1.08
10/6/1999	CT2			0.00
10/6/1999	CT3		3.1	0.94
10/6/1999	CT3			0.00
10/6/1999	CT4		2.47	0.75
10/6/1999	CT4			0.00
10/6/1999	CT5		2.36	0.72
10/6/1999	CT5			0.00
10/6/1999	CT6		2.72	0.83
10/6/1999	CT6			0.00
10/6/1999	NT1	Shallow	5.25	1.60
10/6/1999	NT1	Shallow		0.00
10/6/1999	NT1D	Deep	5.05	1.54
10/6/1999	NT1D	Deep		0.00
10/6/1999	NT2	Shallow	5.26	1.60
10/6/1999	NT2	Shallow		0.00
10/6/1999	NT2D	Deep	5.27	1.61
10/6/1999	NT2D	Deep		0.00
10/6/1999	NT3	Shallow	5.03	1.53
10/6/1999	NT3	Shallow		0.00
10/6/1999	NT3D	Deep	4.93	1.50
10/6/1999	NT3D	Deep		0.00
10/6/1999	NT4	Shallow	5.92	1.80
10/6/1999	NT4	Shallow		0.00
10/6/1999	NT5	Shallow	5.86	1.79
10/6/1999	NT5	Shallow		0.00
10/6/1999	Little Riv	Surface	7.9	2.41
10/12/1999	AQ1		4.99	1.52
10/12/1999	AQ2		5.68	1.73
10/12/1999	AQ3		4.42	1.35
10/12/1999	AQ4		4.42	1.35
10/12/1999	AQ5		4.35	1.33
10/12/1999	AQ6		3.53	1.08
10/12/1999	AQ7		4.12	1.26
10/12/1999	AQ8		4.38	1.34
10/12/1999	AQ9		4.29	1.31
10/12/1999	CT1		5.76	1.76
10/12/1999	CT2		6.37	1.94
10/12/1999	CT3		5.61	1.71
10/12/1999	CT4		4.95	1.51
10/12/1999	CT5		4.51	1.37
10/12/1999	CT6		4.88	1.49

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
10/12/1999	NT1	Shallow	9.16	2.79
10/12/1999	NT1D	Deep	9.03	2.75
10/12/1999	NT2	Shallow	8.36	2.55
10/12/1999	NT2D	Deep	8.37	2.55
10/12/1999	NT3	Shallow	7.72	2.35
10/12/1999	NT3D	Deep	7.56	2.30
10/12/1999	NT4	Shallow	8.7	2.65
10/12/1999	NT5	Shallow	7.51	2.29
10/12/1999	Little Riv	Surface	1.8	0.55
10/28/1999	AQ1		4.35	1.33
10/28/1999	AQ2		4.03	1.23
10/28/1999	AQ3		4.26	1.30
10/28/1999	AQ4		3.73	1.14
10/28/1999	AQ5		3.65	1.11
10/28/1999	AQ6		2.84	0.87
10/28/1999	AQ7		3.39	1.03
10/28/1999	AQ8		3.65	1.11
10/28/1999	AQ9		3.58	1.09
10/28/1999	CT1		4.42	1.35
10/28/1999	CT2		5.11	1.56
10/28/1999	CT3		4.55	1.39
10/28/1999	CT4		3.91	1.19
10/28/1999	CT5		3.68	1.12
10/28/1999	CT6		4.05	1.23
10/28/1999	NT1	Shallow	7.12	2.17
10/28/1999	NT1D	Deep	6.91	2.11
10/28/1999	NT2	Shallow	6.89	2.10
10/28/1999	NT2D	Deep	6.87	2.09
10/28/1999	NT3	Shallow	6.53	1.99
10/28/1999	NT3D	Deep	6.41	1.95
10/28/1999	NT4	Shallow	7.44	2.27
10/28/1999	NT5	Shallow	6.9	2.10
10/28/1999	Little Riv	Surface	5.1	1.55
11/12/1999	AQ1		5.75	1.75
11/12/1999	AQ2		5.43	1.66
11/12/1999	AQ3		5.29	1.61
11/12/1999	AQ4		5.16	1.57
11/12/1999	AQ5		5.09	1.55
11/12/1999	AQ6		4.27	1.30
11/12/1999	AQ7		4.78	1.46
11/12/1999	AQ8		5.11	1.56
11/12/1999	AQ9		5.01	1.53
11/12/1999	CT1		6.28	1.91
11/12/1999	CT2		6.88	2.10
11/12/1999	CT3		6.2	1.89
11/12/1999	CT4		6.59	2.01
11/12/1999	CT5		5.22	1.59
11/12/1999	CT6		5.56	1.69
11/12/1999	NT1	Shallow	9.91	3.02

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
11/12/1999	NT1D	Deep	9.74	2.97
11/12/1999	NT2	Shallow	9.42	2.87
11/12/1999	NT2D	Deep	9.43	2.87
11/12/1999	NT3	Shallow	8.7	2.65
11/12/1999	NT3D	Deep	8.46	2.58
11/12/1999	NT4	Shallow	9.72	2.96
11/12/1999	NT5	Shallow	8.57	2.61
2/21/2000	AQ1		5.54	1.69
2/21/2000	AQ2		5.23	1.59
2/21/2000	AQ3		6.11	1.86
2/21/2000	AQ4		4.88	1.49
2/21/2000	AQ5		4.79	1.46
2/21/2000	AQ6		3.91	1.19
2/21/2000	AQ7		4.5	1.37
2/21/2000	AQ8		4.73	1.44
2/21/2000	AQ9		4.56	1.39
2/21/2000	CT1		5.37	1.64
2/21/2000	CT2		6.03	1.84
2/21/2000	CT3		5.54	1.69
2/21/2000	CT4		4.9	1.49
2/21/2000	CT5		4.73	1.44
2/21/2000	CT6		5.08	1.55
2/21/2000	NT1	Shallow	8.45	2.58
2/21/2000	NT1D	Deep	8.3	2.53
2/21/2000	NT2	Shallow	8.6	2.62
2/21/2000	NT2D	Deep	8.57	2.61
2/21/2000	NT3	Shallow	8.22	2.51
2/21/2000	NT3D	Deep	8.1	2.47
2/21/2000	NT4	Shallow	9.01	2.75
2/21/2000	NT5	Shallow	8.49	2.59
2/21/2000	Little Riv	Surface	4.8	1.46
3/22/2000	AQ1		6.8	2.07
3/22/2000	AQ2		6.53	1.99
3/22/2000	AQ3		7.05	2.15
3/22/2000	AQ4		6.09	1.86
3/22/2000	AQ5		6.17	1.88
3/22/2000	AQ6		5.26	1.60
3/22/2000	AQ7		5.9	1.80
3/22/2000	AQ8		6.28	1.91
3/22/2000	AQ9		5.88	1.79
3/22/2000	CT1		6.7	2.04
3/22/2000	CT2		7.4	2.26
3/22/2000	CT3		6.9	2.10
3/22/2000	CT4		5.98	1.82
3/22/2000	CT5		6.18	1.88
3/22/2000	CT6		6.53	1.99
3/22/2000	NT1	Shallow	10.57	3.22
3/22/2000	NT1D	Deep	10.25	3.12
3/22/2000	NT2	Shallow	10.48	3.19

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
3/22/2000	NT2D	Deep	10.55	3.22
3/22/2000	NT3	Shallow	9.9	3.02
3/22/2000	NT3D	Deep	9.85	3.00
3/22/2000	NT4	Shallow	9.82	2.99
3/22/2000	NT5	Shallow	9.9	3.02
5/5/2000	AQ1		7.68	2.34
5/5/2000	AQ2		7.35	2.24
5/5/2000	AQ3		7.71	2.35
5/5/2000	AQ4		7.03	2.14
5/5/2000	AQ5		6.96	2.12
5/5/2000	AQ6		6.14	1.87
5/5/2000	AQ7		6.71	2.05
5/5/2000	AQ8		6.95	2.12
5/5/2000	AQ9		6.87	2.09
5/5/2000	CT1		7.5	2.29
5/5/2000	CT2		8.19	2.50
5/5/2000	CT3		7.78	2.37
5/5/2000	CT4		7.15	2.18
5/5/2000	CT5		6.72	2.05
5/5/2000	CT6		7.32	2.23
5/5/2000	NT1	Shallow	11.32	3.45
5/5/2000	NT1D	Deep	11.2	3.41
5/5/2000	NT2	Shallow	11.3	3.44
5/5/2000	NT2D	Deep	11.27	3.44
5/5/2000	NT3	Shallow	10.81	3.29
5/5/2000	NT3D	Deep	10.7	3.26
5/5/2000	NT4	Shallow	11.68	3.56
5/5/2000	NT5	Shallow	10.85	3.31
6/15/2000	AQ1		8.73	2.66
6/15/2000	AQ2		8.42	2.57
6/15/2000	AQ3		8.55	2.61
6/15/2000	AQ4		8.11	2.47
6/15/2000	AQ5		8.07	2.46
6/15/2000	AQ6		7.21	2.20
6/15/2000	AQ7		7.79	2.37
6/15/2000	AQ8		8.02	2.44
6/15/2000	AQ9		7.92	2.41
6/15/2000	CT1		8.67	2.64
6/15/2000	CT2		9.32	2.84
6/15/2000	CT3		8.87	2.70
6/15/2000	CT4		8.28	2.52
6/15/2000	CT5		8.1	2.47
6/15/2000	CT6		8.42	2.57
6/15/2000	NT1	Shallow	12.38	3.77
6/15/2000	NT1D	Deep	12.18	3.71
6/15/2000	NT2	Shallow	12.36	3.77
6/15/2000	NT2D	Deep	12.32	3.76
6/15/2000	NT3	Shallow	11.89	3.62
6/15/2000	NT3D	Deep	11.76	3.58

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
6/15/2000	NT4	Shallow	dry	.
6/15/2000	NT5	Shallow	11.9	3.63
7/27/2000	AQ1		8.83	2.69
7/27/2000	AQ2		8.47	2.58
7/27/2000	AQ3		8.8	2.68
7/27/2000	AQ4		8.18	2.49
7/27/2000	AQ5		8.12	2.47
7/27/2000	AQ6		7.25	2.21
7/27/2000	AQ7		7.91	2.41
7/27/2000	AQ8		8.07	2.46
7/27/2000	AQ9		7.95	2.42
7/27/2000	CT1		8.77	2.67
7/27/2000	CT2		9.38	2.86
7/27/2000	CT3		8.95	2.73
7/27/2000	CT4		8.38	2.55
7/27/2000	CT5		8.16	2.49
7/27/2000	CT6		8.48	2.58
7/27/2000	NT1	Shallow	11.68	3.56
7/27/2000	NT1D	Deep	11.52	3.51
7/27/2000	NT2	Shallow	12.53	3.82
7/27/2000	NT2D	Deep	12.5	3.81
7/27/2000	NT3	Shallow	12.25	3.73
7/27/2000	NT3D	Deep	12.13	3.70
7/27/2000	NT4	Shallow	dry	.
7/27/2000	NT5	Shallow	12.38	3.77
9/8/2000	AQ1		7.48	2.28
9/8/2000	AQ2		7.19	2.19
9/8/2000	AQ3		7.89	2.40
9/8/2000	AQ4		7.47	2.28
9/8/2000	AQ5		6.72	2.05
9/8/2000	AQ6		5.88	1.79
9/8/2000	AQ7		6.5	1.98
9/8/2000	AQ8		6.7	2.04
9/8/2000	AQ9		6.53	1.99
9/8/2000	CT1		7.2	2.19
9/8/2000	CT2		7.87	2.40
9/8/2000	CT3		7.46	2.27
9/8/2000	CT4		6.88	2.10
9/8/2000	CT5		6.75	2.06
9/8/2000	CT6		7.1	2.16
9/8/2000	NT1	Shallow	10.12	3.08
9/8/2000	NT1D	Deep	9.97	3.04
9/8/2000	NT2	Shallow	10.95	3.34
9/8/2000	NT2D	Deep	10.77	3.28
9/8/2000	NT3	Shallow	10.75	3.28
9/8/2000	NT3D	Deep	11.4	3.47
9/8/2000	NT4	Shallow	11.57	3.53
9/8/2000	NT5	Shallow	11.1	3.38
2/8/2001	AQ1		8.55	2.61

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
2/8/2001	AQ2		8.27	2.52
2/8/2001	AQ3		8.7	2.65
2/8/2001	AQ4		7.89	2.40
2/8/2001	AQ5		7.88	2.40
2/8/2001	AQ6		6.93	2.11
2/8/2001	AQ7		7.61	2.32
2/8/2001	AQ8		7.62	2.32
2/8/2001	AQ9		7.62	2.32
2/8/2001	CT1		9.08	2.77
2/8/2001	CT2		9.07	2.76
2/8/2001	CT3		8.53	2.60
2/8/2001	CT4		8.02	2.44
2/8/2001	CT5		7.3	2.23
2/8/2001	CT6		8.18	2.49
2/8/2001	Little Riv			0.00
2/8/2001	NT1	Shallow	12.475	3.80
2/8/2001	NT1D	Deep	12.245	3.73
2/8/2001	NT2	Shallow	12.545	3.82
2/8/2001	NT2D	Deep	12.425	3.79
2/8/2001	NT3	Shallow	12.125	3.70
2/8/2001	NT3D	Deep	12.025	3.67
2/8/2001	NT4	Shallow	dry	.
2/8/2001	NT5	Shallow	12.275	3.74
2/8/2001	NT6 river well	Shallow	12.905	3.93
3/23/2001	AQ1		7.38	2.25
3/23/2001	AQ2		6.99	2.13
3/23/2001	AQ3		7.93	2.42
3/23/2001	AQ4		.	.
3/23/2001	AQ5		6.6	2.01
3/23/2001	AQ6		6.67	2.03
3/23/2001	AQ7		6.35	1.94
3/23/2001	AQ8		6.7	2.04
3/23/2001	AQ9		6.22	1.90
3/23/2001	CT1		5.94	1.81
3/23/2001	CT2		7	2.13
3/23/2001	CT3		6.95	2.12
3/23/2001	CT4		6.72	2.05
3/23/2001	CT5		6.55	2.00
3/23/2001	CT6		6.9	2.10
3/23/2001	NT1	Shallow	8.9	2.71
3/23/2001	NT1D	Deep	8.6	2.62
3/23/2001	NT2	Shallow	10.68	3.26
3/23/2001	NT2D	Deep	10.8	3.29
3/23/2001	NT3	Shallow	10.61	3.23
3/23/2001	NT3D	Deep	10.75	3.28
3/23/2001	NT4	Shallow	11.42	3.48
3/23/2001	NT5	Shallow	10.2	3.11
3/23/2001	NT6	Shallow	8.35	2.55
5/18/2001	AQ1		7.95	2.42

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
5/18/2001	AQ2		7.7	2.35
5/18/2001	AQ3		7.83	2.39
5/18/2001	AQ4		7.32	2.23
5/18/2001	AQ5		7.28	2.22
5/18/2001	AQ6		6.4	1.95
5/18/2001	AQ7		6.98	2.13
5/18/2001	AQ8		7.22	2.20
5/18/2001	AQ9		7.11	2.17
5/18/2001	CT1		7.92	2.41
5/18/2001	CT2		8.7	2.65
5/18/2001	CT3		8.08	2.46
5/18/2001	CT4		7.49	2.28
5/18/2001	CT5		5.03	1.53
5/18/2001	CT6		7.61	2.32
5/18/2001	Lil Riv			0.00
5/18/2001	NT1	Shallow	11.52	3.51
5/18/2001	NT1D	Deep	11.47	3.50
5/18/2001	NT2	Shallow	11.38	3.47
5/18/2001	NT2D	Deep	11.36	3.46
5/18/2001	NT3	Shallow	10.87	3.31
5/18/2001	NT3D	Deep	10.75	3.28
5/18/2001	NT4	Shallow	11.73	3.58
5/18/2001	NT5	Shallow	10.82	3.30
5/18/2001	NT6	Shallow	12.2	3.72
6/26/2001	AQ1		7.74	2.36
6/26/2001	AQ2		7.4	2.26
6/26/2001	AQ3		7.68	2.34
6/26/2001	AQ4		7	2.13
6/26/2001	AQ5		7.05	2.15
6/26/2001	AQ6		6.11	1.86
6/26/2001	AQ7		6.82	2.08
6/26/2001	AQ8		7.17	2.19
6/26/2001	AQ9		6.78	2.07
6/26/2001	CT1		7.7	2.35
6/26/2001	CT2		8.36	2.55
6/26/2001	CT3		7.75	2.36
6/26/2001	CT4		7.3	2.23
6/26/2001	CT5		7.08	2.16
6/26/2001	CT6		7.4	2.26
6/26/2001	Little Riv			0.00
6/26/2001	NT1	Shallow	11.57	3.53
6/26/2001	NT1D	Deep	11.2	3.41
6/26/2001	NT2	Shallow	11.33	3.45
6/26/2001	NT2D	Deep	11.17	3.40
6/26/2001	NT3	Shallow	10.99	3.35
6/26/2001	NT3D	Deep	10.87	3.31
6/26/2001	NT4	Shallow	11.83	3.61
6/26/2001	NT5	Shallow	11.07	3.37
6/26/2001	NT6 Rachels	*Shallow*	12.15	3.70

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
7/23/2001	AQ1		8.46	2.58
7/23/2001	AQ2		8.13	2.48
7/23/2001	AQ3		8.35	2.55
7/23/2001	AQ4		7.87	2.40
7/23/2001	AQ5		7.78	2.37
7/23/2001	AQ6		7.05	2.15
7/23/2001	AQ7		7.7	2.35
7/23/2001	AQ8		8.07	2.46
7/23/2001	AQ9		7.71	2.35
7/23/2001	CT1		8.56	2.61
7/23/2001	CT2		8.17	2.49
7/23/2001	CT3		9.25	2.82
7/23/2001	CT4		8.7	2.65
7/23/2001	CT5		7.64	2.33
7/23/2001	CT6		8.3	2.53
7/23/2001	Little Riv			0.00
7/23/2001	NT1	Shallow	12.25	3.73
7/23/2001	NT1D	Deep	12.07	3.68
7/23/2001	NT2	Shallow	12.2	3.72
7/23/2001	NT2D	Deep	12.03	3.67
7/23/2001	NT3	Shallow	11.78	3.59
7/23/2001	NT3D	Deep	11.67	3.56
7/23/2001	NT4	Shallow	12.62	3.85
7/23/2001	NT4	Shallow		0.00
7/23/2001	NT5	Shallow	11.81	3.60
7/23/2001	NT6	Shallow	12.78	3.90
08/21/01	AQ1		9	2.74
08/21/01	AQ2		8.66	2.64
08/21/01	AQ3		DRY	.
08/21/01	AQ4		8.25	2.51
08/21/01	AQ5		8.3	2.53
08/21/01	AQ6		7.4	2.26
08/21/01	AQ7		8.05	2.45
08/21/01	AQ8		8.43	2.57
08/21/01	AQ9		8.04	2.45
08/21/01	CT1		8.76	2.67
08/21/01	CT2		9.47	2.89
08/21/01	CT3		8.98	2.74
08/21/01	CT4		8.47	2.58
08/21/01	CT5		8.31	2.53
08/21/01	CT6		8.69	2.65
08/21/01	Lil River			0.00
08/21/01	NT1	Shallow	12.25	3.73
08/21/01	NT1D	Deep	12.06	3.68
08/21/01	NT2	Shallow	12.32	3.76
08/21/01	NT2D	Deep	12.38	3.77
08/21/01	NT3	Shallow	11.96	3.65
08/21/01	NT3D	Deep	11.87	3.62
08/21/01	NT4	Shallow	12.74	3.88

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
08/21/01	NT5	Shallow	12.16	3.71
08/21/01	NT6	Shallow	12.7	3.87
10/04/01	AQ1		9.2	2.80
10/04/01	AQ2		8.88	2.71
10/04/01	AQ3		9.1	2.77
10/04/01	AQ4		8.4	2.56
10/04/01	AQ5		8.5	2.59
10/04/01	AQ6		7.55	2.30
10/04/01	AQ7		8.26	2.52
10/04/01	AQ8		8.6	2.62
10/04/01	AQ9		8.26	2.52
10/04/01	CT1		8.7	2.65
10/04/01	CT2		9.77	2.98
10/04/01	CT3		9.23	2.81
10/04/01	CT4		8.69	2.65
10/04/01	CT5		8.5	2.59
10/04/01	CT6		8.83	2.69
10/04/01	Lil River			0.00
10/04/01	NT1	Shallow	DRY	.
10/04/01	NT1D	Deep	15.04	4.58
10/04/01	NT2	Shallow	DRY	.
10/04/01	NT2D	Deep	13.03	3.97
10/04/01	NT3	Shallow	12.6	3.84
10/04/01	NT3D	Deep	12.52	3.82
10/04/01	NT4	Shallow	DRY	.
10/04/01	NT5	Shallow	DRY	.
10/04/01	NT6	Shallow	DRY	.
11/08/01	AQ1		9.6	2.93
11/08/01	AQ2		9.29	2.83
11/08/01	AQ3		9.45	2.88
11/08/01	AQ4		8.86	2.70
11/08/01	AQ5		8.92	2.72
11/08/01	AQ6		8	2.44
11/08/01	AQ7		8.68	2.65
11/08/01	AQ8		9.05	2.76
11/08/01	AQ9		8.74	2.66
11/08/01	CT1		9.55	2.91
11/08/01	CT2		10.13	3.09
11/08/01	CT3		9.08	2.77
11/08/01	CT4		9.1	2.77
11/08/01	CT5		8.79	2.68
11/08/01	CT6		9.29	2.83
11/08/01	Lil River			0.00
11/08/01	NT1	Shallow	DRY	.
11/08/01	NT1D	Deep	12.99	3.96
11/08/01	NT2	Shallow	DRY	.
11/08/01	NT2D	Deep	13.32	4.06
11/08/01	NT3	Shallow	DRY	.
11/08/01	NT3D	Deep	12.7	3.87

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
11/08/01	NT4	Shallow	DRY	.
11/08/01	NT5	Shallow	DRY	.
11/08/01	NT6	Shallow	DRY	.
12/05/2001	AQ1		9.86	3.01
12/05/2001	AQ2		9.56	2.91
12/05/2001	AQ3		9.74	2.97
12/05/2001	AQ4		9.13	2.78
12/05/2001	AQ5		9.2	2.80
12/05/2001	AQ6		8.29	2.53
12/05/2001	AQ7		8.95	2.73
12/05/2001	AQ8		9.3	2.83
12/05/2001	AQ9		8.99	2.74
12/05/2001	CT1		9.7	2.96
12/05/2001	CT2		10.43	3.18
12/05/2001	CT3		9.91	3.02
12/05/2001	CT4		9.38	2.86
12/05/2001	CT5		9.17	2.80
12/05/2001	CT6		9.54	2.91
12/05/2001	Lil River			0.00
12/05/2001	NT1	Shallow	DRY	.
12/05/2001	NT1D	Deep	13.08	3.99
12/05/2001	NT2	Shallow	DRY	.
12/05/2001	NT2D	Deep	13.41	4.09
12/05/2001	NT3	Shallow	DRY	.
12/05/2001	NT3D	Deep	12.9	3.93
12/05/2001	NT4	Shallow	DRY	.
12/05/2001	NT5	Shallow	DRY	.
12/05/2001	NT6	Shallow	DRY	.
01/10/2002	AQ1		9.81	2.99
01/10/2002	AQ2		9.5	2.90
01/10/2002	AQ3		9.82	2.99
01/10/2002	AQ4		9.05	2.76
01/10/2002	AQ5		9.11	2.78
01/10/2002	AQ6		8.15	2.48
01/10/2002	AQ7		8.84	2.69
01/10/2002	AQ8		9.2	2.80
01/10/2002	AQ9		8.82	2.69
01/10/2002	CT1		9.54	2.91
01/10/2002	CT2		10.05	3.06
01/10/2002	CT3		9.78	2.98
01/10/2002	CT4		9.27	2.83
01/10/2002	CT5		9.1	2.77
01/10/2002	CT6		9.42	2.87
01/10/2002	Lil River			0.00
01/10/2002	NT1	Shallow	DRY	.
01/10/2002	NT1D	Deep	12.65	3.86
01/10/2002	NT2	Shallow	DRY	.
01/10/2002	NT2D	Deep	13.33	4.06
01/10/2002	NT3	Shallow	DRY	.

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
01/10/2002	NT3D	Deep	12.91	3.93
01/10/2002	NT4	Shallow	DRY	.
01/10/2002	NT5	Shallow	DRY	.
01/10/2002	NT6	Shallow	13.1	3.99
02/05/2002	AQ1		8.21	2.50
02/05/2002	AQ2		7.93	2.42
02/05/2002	AQ3		8.8	2.68
02/05/2002	AQ4		7.46	2.27
02/05/2002	AQ5		7.54	2.30
02/05/2002	AQ6		6.59	2.01
02/05/2002	AQ7		7.25	2.21
02/05/2002	AQ8		7.59	2.31
02/05/2002	AQ9		7.22	2.20
02/05/2002	CT1		7.77	2.37
02/05/2002	CT2		8.5	2.59
02/05/2002	CT3		8.05	2.45
02/05/2002	CT4		7.55	2.30
02/05/2002	CT5		7.45	2.27
02/05/2002	CT6		5.14	1.57
02/05/2002	Lil River			0.00
02/05/2002	NT1	Shallow	11.59	3.53
02/05/2002	NT1D	Deep	11.42	3.48
02/05/2002	NT2	Shallow	11.67	3.56
02/05/2002	NT2D	Deep	11.68	3.56
02/05/2002	NT3	Shallow	11.28	3.44
02/05/2002	NT3D	Deep	11.19	3.41
02/05/2002	NT4	Shallow	12.04	3.67
02/05/2002	NT5	Shallow	11.64	3.55
02/05/2002	NT6	Shallow	12.06	3.68
03/06/2002	AQ1		8.09	2.47
03/06/2002	AQ2		7.75	2.36
03/06/2002	AQ3		8.34	2.54
03/06/2002	AQ4		7.42	2.26
03/06/2002	AQ5		7.39	2.25
03/06/2002	AQ6		6.47	1.97
03/06/2002	AQ7		7.13	2.17
03/06/2002	AQ8		7.46	2.27
03/06/2002	AQ9		7.14	2.18
03/06/2002	CT1		7.85	2.39
03/06/2002	CT2		8.6	2.62
03/06/2002	CT3		8.05	2.45
03/06/2002	CT4		7.55	2.30
03/06/2002	CT5		7.37	2.25
03/06/2002	CT6		7.7	2.35
03/06/2002	Lil River		1.25	0.38
03/06/2002	NT1	Shallow	11.73	3.58
03/06/2002	NT1D	Deep	11.54	3.52
03/06/2002	NT2	Shallow	11.82	3.60
03/06/2002	NT2D	Deep	11.85	3.61

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
03/06/2002	NT3	Shallow	11.47	3.50
03/06/2002	NT3D	Deep	11.33	3.45
03/06/2002	NT4	Shallow	12.23	3.73
03/06/2002	NT5	Shallow	11.62	3.54
03/06/2002	NT6	Shallow	12.16	3.71
04/05/2002	AQ1		7.77	2.37
04/05/2002	AQ2		7.58	2.31
04/05/2002	AQ3		8.23	2.51
04/05/2002	AQ4		7.16	2.18
04/05/2002	AQ5		7.16	2.18
04/05/2002	AQ6		6.16	1.88
04/05/2002	AQ7		6.86	2.09
04/05/2002	AQ8		7.23	2.20
04/05/2002	AQ9		6.84	2.08
04/05/2002	CT1		7.33	2.23
04/05/2002	CT2		8.05	2.45
04/05/2002	CT3		7.67	2.34
04/05/2002	CT4		7.16	2.18
04/05/2002	CT5		7.08	2.16
04/05/2002	CT6		7.41	2.26
04/05/2002	Lil River		4.9	1.49
04/05/2002	NT1	Shallow	10.06	3.07
04/05/2002	NT1D	Deep	9.91	3.02
04/05/2002	NT2	Shallow	11.07	3.37
04/05/2002	NT2D	Deep	11.1	3.38
04/05/2002	NT3	Shallow	10.99	3.35
04/05/2002	NT3D	Deep	10.95	3.34
04/05/2002	NT4	Shallow	11.74	3.58
04/05/2002	NT5	Shallow	11.49	3.50
04/05/2002	NT6	Shallow	10.14	3.09
05/01/2002	AQ1		8.17	2.49
05/01/2002	AQ2		7.9	2.41
05/01/2002	AQ3		8.2	2.50
05/01/2002	AQ4		7.38	2.25
05/01/2002	AQ5		7.47	2.28
05/01/2002	AQ6		6.55	2.00
05/01/2002	AQ7		7.21	2.20
05/01/2002	AQ8		7.57	2.31
05/01/2002	AQ9		7.23	2.20
05/01/2002	CT1		8	2.44
05/01/2002	CT2		8.7	2.65
05/01/2002	CT3		8.17	2.49
05/01/2002	CT4		7.62	2.32
05/01/2002	CT5		7.45	2.27
05/01/2002	CT6		7.78	2.37
05/01/2002	Lil River		.	.
05/01/2002	NT1	Shallow	11.95	3.64
05/01/2002	NT1D	Deep	11.66	3.55
05/01/2002	NT2	Shallow	11.92	3.63

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
05/01/2002	NT2D	Deep	11.89	3.62
05/01/2002	NT3	Shallow	11.36	3.46
05/01/2002	NT3D	Deep	11.43	3.48
05/01/2002	NT4	Shallow	12.19	3.72
05/01/2002	NT5	Shallow	11.46	3.49
05/01/2002	NT6	Shallow	12.43	3.79
06/03/2002	AQ1		8.96	2.73
06/03/2002	AQ2		8.74	2.66
06/03/2002	AQ3		8.76	2.67
06/03/2002	AQ4		8.2	2.50
06/03/2002	AQ5		8.27	2.52
06/03/2002	AQ6		7.36	2.24
06/03/2002	AQ7		8.02	2.44
06/03/2002	AQ8		8.39	2.56
06/03/2002	AQ9		8.06	2.46
06/03/2002	CT1		8.89	2.71
06/03/2002	CT2		9.39	2.86
06/03/2002	CT3		9	2.74
06/03/2002	CT4		8.5	2.59
06/03/2002	CT5		6.7	2.04
06/03/2002	CT6		8.6	2.62
06/03/2002	Lil River		.	.
06/03/2002	NT1	Shallow	DRY	.
06/03/2002	NT1D	Deep	12.31	3.75
06/03/2002	NT2	Shallow	12.47	3.80
06/03/2002	NT2D	Deep	12.47	3.80
06/03/2002	NT3	Shallow	12.05	3.67
06/03/2002	NT3D	Deep	11.95	3.64
06/03/2002	NT4	Shallow	DRY	.
06/03/2002	NT5	Shallow	12.1	3.69
06/03/2002	NT6	Shallow	12.98	3.96
07/17/2002	AQ1		9.95	3.03
07/17/2002	AQ2		9.61	2.93
07/17/2002	AQ3		9.57	2.92
07/17/2002	AQ4		9.2	2.80
07/17/2002	AQ5		9.28	2.83
07/17/2002	AQ6		8.37	2.55
07/17/2002	AQ7		9.03	2.75
07/17/2002	AQ8		9.43	2.87
07/17/2002	AQ9		9.06	2.76
07/17/2002	CT1		9.93	3.03
07/17/2002	CT2		10.61	3.23
07/17/2002	CT3		10.04	3.06
07/17/2002	CT4		9.54	2.91
07/17/2002	CT5		9.3	2.83
07/17/2002	CT6		9.63	2.94
07/17/2002	Lil River		.	.
07/17/2002	NT1	Shallow	DRY	.
07/17/2002	NT1D	Deep	12.88	3.93

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
07/17/2002	NT2	Shallow	DRY	.
07/17/2002	NT2D	Deep	13.1	3.99
07/17/2002	NT3	Shallow	12.68	3.86
07/17/2002	NT3D	Deep	12.6	3.84
07/17/2002	NT4	Shallow	DRY	.
07/17/2002	NT5	Shallow	12.8	3.90
07/17/2002	NT6	Shallow	DRY	.
08/06/2002	AQ1		10.21	3.11
08/06/2002	AQ2		10	3.05
08/06/2002	AQ3		9.92	3.02
08/06/2002	AQ4		9.43	2.87
08/06/2002	AQ5		9.48	2.89
08/06/2002	AQ6		8.59	2.62
08/06/2002	AQ7		9.26	2.82
08/06/2002	AQ8		9.54	2.91
08/06/2002	AQ9		9.33	2.84
08/06/2002	CT1		10.1	3.08
08/06/2002	CT2		10.88	3.32
08/06/2002	CT3		10.25	3.12
08/06/2002	CT4		9.72	2.96
08/06/2002	CT5		9.55	2.91
08/06/2002	CT6		9.85	3.00
08/06/2002	Lil River		.	.
08/06/2002	NT1	Shallow	DRY	.
08/06/2002	NT1D	Deep	13	3.96
08/06/2002	NT2	Shallow	DRY	.
08/06/2002	NT2D	Deep	13.27	4.04
08/06/2002	NT3	Shallow	DRY	.
08/06/2002	NT3D	Deep	12.96	3.95
08/06/2002	NT4	Shallow	DRY	.
08/06/2002	NT5	Shallow	DRY	.
08/06/2002	NT6	Shallow	DRY	.
09/12/2002	AQ1		10.64	3.24
09/12/2002	AQ2		10.36	3.16
09/12/2002	AQ3		10.39	3.17
09/12/2002	AQ4		9.91	3.02
09/12/2002	AQ5		9.98	3.04
09/12/2002	AQ6		9.08	2.77
09/12/2002	AQ7		9.73	2.97
09/12/2002	AQ8		10.1	3.08
09/12/2002	AQ9		9.77	2.98
09/12/2002	CT1		10	3.05
09/12/2002	CT2		11.19	3.41
09/12/2002	CT3		10.69	3.26
09/12/2002	CT4		10.17	3.10
09/12/2002	CT5		9.79	2.98
09/12/2002	CT6		10.32	3.15
09/12/2002	Lil River			0.00
09/12/2002	NT1	Shallow	DRY	.

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
09/12/2002	NT1D	Deep	13.1	3.99
09/12/2002	NT2	Shallow	DRY	.
09/12/2002	NT2D	Deep	13.45	4.10
09/12/2002	NT3	Shallow	DRY	.
09/12/2002	NT3D	Deep	12.95	3.95
09/12/2002	NT4	Shallow	DRY	.
09/12/2002	NT5	Shallow	DRY	.
09/12/2002	NT6	Shallow	DRY	.
10/17/2002	AQ1		10.9	3.32
10/17/2002	AQ2		10.58	3.22
10/17/2002	AQ3		10.67	3.25
10/17/2002	AQ4		10.15	3.09
10/17/2002	AQ5		10.22	3.12
10/17/2002	AQ6		9.3	2.83
10/17/2002	AQ7		9.97	3.04
10/17/2002	AQ8		10.3	3.14
10/17/2002	AQ9		10	3.05
10/17/2002	CT1		10.62	3.24
10/17/2002	CT2		11.35	3.46
10/17/2002	CT3		10.88	3.32
10/17/2002	CT4		10.35	3.15
10/17/2002	CT5		10.05	3.06
10/17/2002	CT6		10.55	3.22
10/17/2002	Lil River		1.7	0.52
10/17/2002	NT1	Shallow	DRY	.
10/17/2002	NT1D	Deep	12.53	3.82
10/17/2002	NT2	Shallow	DRY	.
10/17/2002	NT2D	Deep	13.3	4.05
10/17/2002	NT3	Shallow	DRY	.
10/17/2002	NT3D	Deep	13.03	3.97
10/17/2002	NT4	Shallow	DRY	.
10/17/2002	NT5	Shallow	DRY	.
10/17/2002	NT6	Shallow	13	3.96
11/19/2002	AQ1		10.43	3.18
11/19/2002	AQ2		10.12	3.08
11/19/2002	AQ3		10.55	3.22
11/19/2002	AQ4		9.7	2.96
11/19/2002	AQ5		9.69	2.95
11/19/2002	AQ6		8.68	2.65
11/19/2002	AQ7		9.44	2.88
11/19/2002	AQ8		9.77	2.98
11/19/2002	AQ9		9.3	2.83
11/19/2002	CT1		9.81	2.99
11/19/2002	CT2		10.52	3.21
11/19/2002	CT3		9.9	3.02
11/19/2002	CT4		9.73	2.97
11/19/2002	CT5		9.69	2.95
11/19/2002	CT6		9.5	2.90
11/19/2002	Lil River		4	1.22

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
11/19/2002	NT1	Shallow	11.48	3.50
11/19/2002	NT1D	Deep	11.3	3.44
11/19/2002	NT2	Shallow	12.51	3.81
11/19/2002	NT2D	Deep	14.49	4.42
11/19/2002	NT3	Shallow	12.24	3.73
11/19/2002	NT3D	Deep	12.19	3.72
11/19/2002	NT4		DRY	.
11/19/2002	NT5		DRY	.
11/19/2002	NT6	Shallow	11.52	3.51
01/02/2003	AQ1		8.91	2.72
01/02/2003	AQ2		8.6	2.62
01/02/2003	AQ3		9.4	2.87
01/02/2003	AQ4		8.13	2.48
01/02/2003	AQ5		8.15	2.48
01/02/2003	AQ6		7.23	2.20
01/02/2003	AQ7		7.88	2.40
01/02/2003	AQ8		8.21	2.50
01/02/2003	AQ9		7.95	2.42
01/02/2003	CT1		8.35	2.55
01/02/2003	CT2		9.1	2.77
01/02/2003	CT3		8.66	2.64
01/02/2003	CT4		8.15	2.48
01/02/2003	CT5		8.05	2.45
01/02/2003	CT6		8.38	2.55
01/02/2003	Lil River		2.8	0.85
01/02/2003	NT1	Shallow	11.66	3.55
01/02/2003	NT1D	Deep	11.47	3.50
01/02/2003	NT2	Shallow	12.03	3.67
01/02/2003	NT2D	Deep	12.05	3.67
01/02/2003	NT3	Shallow	11.7	3.57
01/02/2003	NT3D	Deep	11.7	3.57
01/02/2003	NT4	Shallow	12.45	3.79
01/02/2003	NT5	Shallow	12.02	3.66
01/02/2003	NT6	Shallow	11.9	3.63
02/13/2003	AQ1		8.6	2.62
02/13/2003	AQ2		8.26	2.52
02/13/2003	AQ3		9	2.74
02/13/2003	AQ4		7.82	2.38
02/13/2003	AQ5		7.87	2.40
02/13/2003	AQ6		6.9	2.10
02/13/2003	AQ7		7.56	2.30
02/13/2003	AQ8		7.92	2.41
02/13/2003	AQ9		7.6	2.32
02/13/2003	CT1		8.05	2.45
02/13/2003	CT2		8.47	2.58
02/13/2003	CT3		8.39	2.56
02/13/2003	CT4		7.87	2.40
02/13/2003	CT5		7.78	2.37
02/13/2003	CT6		8.13	2.48

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
02/13/2003	Lil River		3.95	1.20
02/13/2003	NT1	Shallow	10.77	3.28
02/13/2003	NT1D	Deep	10.6	3.23
02/13/2003	NT2	Shallow	11.6	3.54
02/13/2003	NT2D	Deep	11.6	3.54
02/13/2003	NT3	Shallow	11.44	3.49
02/13/2003	NT3D	Deep	11.35	3.46
02/13/2003	NT4	Shallow	12.2	3.72
02/13/2003	NT5	Shallow	12.93	3.94
02/13/2003	NT6	Shallow	10.95	3.34
03/14/2003	AQ1		6.18	1.88
03/14/2003	AQ2		5.9	1.80
03/14/2003	AQ3		7.25	2.21
03/14/2003	AQ4		5.37	1.64
03/14/2003	AQ5		5.42	1.65
03/14/2003	AQ6		4.5	1.37
03/14/2003	AQ7		5.11	1.56
03/14/2003	AQ8		5.46	1.66
03/14/2003	AQ9		5.15	1.57
03/14/2003	CT1		5.95	1.81
03/14/2003	CT2		6.61	2.01
03/14/2003	CT3		5.99	1.83
03/14/2003	CT4		5.43	1.66
03/14/2003	CT5		5.29	1.61
03/14/2003	CT6		5.62	1.71
03/14/2003	Lil River		2.5	0.76
03/14/2003	NT1	Shallow	9.22	2.81
03/14/2003	NT1D	Deep	5.52	1.68
03/14/2003	NT2	Shallow	8.79	2.68
03/14/2003	NT2D	Deep	10.05	3.06
03/14/2003	NT3	Shallow	8.3	2.53
03/14/2003	NT3D	Deep	8.23	2.51
03/14/2003	NT4	Shallow	8.98	2.74
03/14/2003	NT5	Shallow	8.92	2.72
03/14/2003	NT6	Shallow	9.98	3.04
05/16/2003	AQ1		7.1	2.16
05/16/2003	AQ2		6.77	2.06
05/16/2003	AQ3		6.67	2.03
05/16/2003	AQ4		6.37	1.94
05/16/2003	AQ5		6.44	1.96
05/16/2003	AQ6		5.52	1.68
05/16/2003	AQ7		6.2	1.89
05/16/2003	AQ8		6.55	2.00
05/16/2003	AQ9		6.23	1.90
05/16/2003	CT1		7.32	2.23
05/16/2003	CT2		7.95	2.42
05/16/2003	CT3		7.3	2.23
05/16/2003	CT4		6.76	2.06
05/16/2003	CT5		6.48	1.98

Appendix A. Water Level Raw Data (continued)

Date	Sample	Depth	Water Level (dec ft)	Water Level (m)
05/16/2003	CT6		6.8	2.07
05/16/2003	Lil River		.	
05/16/2003	NT1	Shallow	10.75	3.28
05/16/2003	NT1D	Deep	10.57	3.22
05/16/2003	NT2	Shallow	10.38	3.16
05/16/2003	NT2D	Deep	10.41	3.17
05/16/2003	NT3	Shallow	9.85	3.00
05/16/2003	NT3D	Deep	9.74	2.97
05/16/2003	NT4	Shallow	10.74	3.27
05/16/2003	NT5	Shallow	9.78	2.98
05/16/2003	NT6	Shallow	11.38	3.47

Appendix B. Precipitation Raw Data

Date	Precipitation (cm)	Date	Precipitation (cm)	Date	Precipitation (cm)
12/22/2000	2.32	2/3/2001	0	3/18/2001	0
12/23/2000	0	2/4/2001	0.07	3/19/2001	0
12/24/2000	0	2/5/2001	0.36	3/20/2001	0
12/25/2000	0	2/6/2001	0	3/21/2001	2.85
12/26/2000	0	2/7/2001	0	3/22/2001	0.21
12/27/2000	0	2/8/2001	0	3/23/2001	0
12/28/2000	0.05	2/9/2001	0	3/24/2001	0
12/29/2000	0	2/10/2001	0	3/25/2001	0
12/30/2000	0	2/11/2001	0	3/26/2001	0.01
12/31/2000	0	2/12/2001	0.23	3/27/2001	0
1/1/2001	0	2/13/2001	0.06	3/28/2001	0
1/2/2001	0	2/14/2001	0.08	3/29/2001	1.04
1/3/2001	0	2/15/2001	0	3/30/2001	0.31
1/4/2001	0	2/16/2001	0	3/31/2001	0
1/5/2001	0	2/17/2001	0.78	4/1/2001	0.23
1/6/2001	0	2/18/2001	0	4/2/2001	0.25
1/7/2001	0	2/19/2001	0	4/3/2001	0.02
1/8/2001	0.1	2/20/2001	0	4/4/2001	0
1/9/2001	0.06	2/21/2001	0	4/5/2001	0
1/10/2001	0	2/22/2001	0.75	4/6/2001	0
1/11/2001	0	2/23/2001	0	4/7/2001	0
1/12/2001	0.02	2/24/2001	0.01	4/8/2001	0
1/13/2001	0.18	2/25/2001	0.07	4/9/2001	0
1/14/2001	0	2/26/2001	0	4/10/2001	0
1/15/2001	0.14	2/27/2001	0	4/11/2001	0
1/16/2001	0	2/28/2001	0.02	4/12/2001	0
1/17/2001	0	3/1/2001	0	4/13/2001	0.18
1/18/2001	0	3/2/2001	0	4/14/2001	0
1/19/2001	0	3/3/2001	0.04	4/15/2001	0
1/20/2001	0.25	3/4/2001	0.84	4/16/2001	0
1/21/2001	0.02	3/5/2001	0.17	4/17/2001	0.1
1/22/2001	0	3/6/2001	0	4/18/2001	0.07
1/23/2001	0	3/7/2001	0	4/19/2001	0
1/24/2001	0	3/8/2001	0	4/20/2001	0
1/25/2001	0	3/9/2001	0	4/21/2001	0
1/26/2001	0	3/10/2001	0	4/22/2001	0
1/27/2001	0	3/11/2001	0	4/23/2001	0
1/28/2001	0	3/12/2001	0	4/24/2001	0
1/29/2001	0	3/13/2001	0.11	4/25/2001	0.34
1/30/2001	0.13	3/14/2001	0	4/26/2001	0.07
1/31/2001	0	3/15/2001	0.54	4/27/2001	0
2/1/2001	0	3/16/2001	0	4/28/2001	0
2/2/2001	0	3/17/2001	0	4/29/2001	0

Appendix B. Precipitation Raw Data (continued)

Date	Precipitation (cm)	Date	Precipitation (cm)	Date	Precipitation (cm)
4/30/2001	0	6/11/2001	0	7/23/2001	0.18
5/1/2001	0	6/12/2001	0.05	7/24/2001	0.48
5/2/2001	0	6/13/2001	0.08	7/25/2001	0.02
5/3/2001	0	6/14/2001	0.49	7/26/2001	0.17
5/4/2001	0	6/15/2001	0.96	7/27/2001	1.02
5/5/2001	0	6/16/2001	0.44	7/28/2001	0.1
5/6/2001	0	6/17/2001	0.32	7/29/2001	0
5/7/2001	0	6/18/2001	0	7/30/2001	0.48
5/8/2001	0	6/19/2001	0	7/31/2001	0
5/9/2001	0	6/20/2001	0	8/1/2001	0
5/10/2001	0	6/21/2001	0	8/2/2001	0
5/11/2001	0	6/22/2001	0	8/3/2001	0
5/12/2001	0	6/23/2001	0.16	8/4/2001	0
5/13/2001	0.23	6/24/2001	0	8/5/2001	0
5/14/2001	0	6/25/2001	0.77	8/6/2001	0
5/15/2001	0	6/26/2001	0	8/7/2001	0
5/16/2001	0.64	6/27/2001	0	8/8/2001	0
5/17/2001	0.11	6/28/2001	0	8/9/2001	.
5/18/2001	0.34	6/29/2001	0	8/10/2001	.
5/19/2001	0	6/30/2001	0	8/11/2001	.
5/20/2001	0	7/1/2001	0	8/12/2001	.
5/21/2001	0.14	7/2/2001	0	8/13/2001	.
5/22/2001	0	7/3/2001	0	8/14/2001	.
5/23/2001	0.04	7/4/2001	0.37	8/15/2001	.
5/24/2001	0	7/5/2001	0.3	8/16/2001	.
5/25/2001	0	7/6/2001	0	8/17/2001	2.54
5/26/2001	1.31	7/7/2001	0	8/18/2001	0.04
5/27/2001	0.42	7/8/2001	0.17	8/19/2001	0.57
5/28/2001	0.64	7/9/2001	0	8/20/2001	0
5/29/2001	0.17	7/10/2001	0.37	8/21/2001	0.4
5/30/2001	0	7/11/2001	0	8/22/2001	0
5/31/2001	0	7/12/2001	0	8/23/2001	0
6/1/2001	0	7/13/2001	0.04	8/24/2001	0
6/2/2001	1.45	7/14/2001	0	8/25/2001	0
6/3/2001	0	7/15/2001	0	8/26/2001	0
6/4/2001	0	7/16/2001	0	8/27/2001	0
6/5/2001	0	7/17/2001	0	8/28/2001	0.31
6/6/2001	0	7/18/2001	0	8/29/2001	0.58
6/7/2001	0	7/19/2001	0.62	8/30/2001	0
6/8/2001	0	7/20/2001	0	8/31/2001	0.03
6/9/2001	0	7/21/2001	0	9/1/2001	0.39
6/10/2001	0	7/22/2001	0	9/2/2001	0.48

Appendix B. Precipitation Raw Data (continued)

Date	Precipitation (cm)	Date	Precipitation (cm)	Date	Precipitation (cm)
9/3/2001	0	10/22/2001	0	12/10/2001	0
9/4/2001	0.01	10/23/2001	0	12/11/2001	0.49
9/5/2001	0	10/24/2001	0	12/12/2001	0.02
9/6/2001	0	10/25/2001	0	12/13/2001	0
9/7/2001	0	10/26/2001	0	12/14/2001	0
9/8/2001	0	10/27/2001	0	12/15/2001	0
9/9/2001	0.74	10/28/2001	0	12/16/2001	0
9/10/2001	0	10/29/2001	0	12/17/2001	0
9/11/2001	0.37	10/30/2001	0	12/18/2001	0.21
9/12/2001	0	10/31/2001	0	12/19/2001	0
9/13/2001	0	11/1/2001	0	12/20/2001	0
9/14/2001	0	11/2/2001	0	12/21/2001	0
9/15/2001	0	11/3/2001	0	12/22/2001	0
9/16/2001	0	11/4/2001	0	12/23/2001	0
9/17/2001	0	11/5/2001	0	12/24/2001	0.04
9/18/2001	0	11/6/2001	0	12/25/2001	0
9/19/2001	0	11/7/2001	0	12/26/2001	0
9/20/2001	0	11/8/2001	0	12/27/2001	0
9/21/2001	0	11/9/2001	0	12/28/2001	0
9/22/2001	0	11/10/2001	0	12/29/2001	0
9/23/2001	0	11/11/2001	0	12/30/2001	0
9/24/2001	0.08	11/12/2001	0	12/31/2001	0
9/25/2001	0.82	11/13/2001	0	1/1/2002	0
9/26/2001	0	11/14/2001	0	1/2/2002	0
9/27/2001	0	11/15/2001	0	1/3/2002	0
9/28/2001	0	11/16/2001	0	1/4/2002	0.04
9/29/2001	0	11/17/2001	0	1/5/2002	0.48
9/30/2001	0	11/18/2001	0	1/6/2002	0.35
10/1/2001	0	11/19/2001	0	1/7/2002	0.77
10/2/2001	0	11/20/2001	0	1/8/2002	0
10/3/2001	0	11/21/2001	0	1/9/2002	0
10/4/2001	0	11/22/2001	0	1/10/2002	0
10/5/2001	0	11/23/2001	0	1/11/2002	0
10/6/2001	0	11/24/2001	0.85	1/12/2002	0
10/7/2001	0.85	11/25/2001	0.21	1/13/2002	0.42
10/8/2001	0	11/26/2001	0.05	1/14/2002	0.13
10/9/2001	0	11/27/2001	0.01	1/15/2002	0.19
10/10/2001	0	11/28/2001	0.01	1/16/2002	0
10/11/2001	0	11/29/2001	0.01	1/17/2002	0
10/12/2001	0	11/30/2001	0	1/18/2002	0
10/13/2001	0	12/1/2001	0	1/19/2002	0
10/14/2001	0	12/2/2001	0	1/20/2002	0.82
10/15/2001	0.03	12/3/2001	0	1/21/2002	0.07
10/16/2001	0	12/4/2001	0	1/22/2002	0.2
10/17/2001	0	12/5/2001	0	1/23/2002	0.37
10/18/2001	0	12/6/2001	0	1/24/2002	0.76
10/19/2001	0	12/7/2001	0	1/25/2002	0.2
10/20/2001	0	12/8/2001	0	1/26/2002	0.03
10/21/2001	0	12/9/2001	0	1/27/2002	0

Appendix B. Precipitation Raw Data (continued)

Date	Precipitation (cm)	Date	Precipitation (cm)
1/28/2002	0.02	3/18/2002	0
1/29/2002	0	3/19/2002	0
1/30/2002	0	3/20/2002	0.01
1/31/2002	0	3/21/2002	0
2/1/2002	0	3/22/2002	0
2/2/2002	0	3/23/2002	0
2/3/2002	0		
2/4/2002	0		
2/5/2002	0		
2/6/2002	0		
2/7/2002	0.48		
2/8/2002	0.31		
2/9/2002	0.18		
2/10/2002	0.09		
2/11/2002	0.07		
2/12/2002	0.06		
2/13/2002	0		
2/14/2002	0		
2/15/2002	0		
2/16/2002	0		
2/17/2002	0		
2/18/2002	0		
2/19/2002	0		
2/20/2002	0		
2/21/2002	0.08		
2/22/2002	0		
2/23/2002	0		
2/24/2002	0		
2/25/2002	0		
2/26/2002	0		
2/27/2002	0		
2/28/2002	0		
3/1/2002	0		
3/2/2002	0		
3/3/2002	0.31		
3/4/2002	0.02		
3/5/2002	0.2		
3/6/2002	0.2		
3/7/2002	0		
3/8/2002	0		
3/9/2002	0		
3/10/2002	0		
3/11/2002	0		
3/12/2002	0.06		
3/13/2002	0.04		
3/14/2002	0.02		
3/15/2002	0		
3/16/2002	0		
3/17/2002	0.01		

Appendix C: Detailed Sampling Information

Sampling occurred from every one to four weeks until November of 1996, when monthly sample collection began. During sampling, the depth to the groundwater table was measured from the top of the well casing using an electronic resistance tape. The elevation of the water table was then determined by subtracting the depth to the water table from the elevation of the top of the well casing. The elevation of the Little River was determined by reading a staff gauge. A peristaltic pump and dedicated tubing were used to collect groundwater samples. Each well was purged until three well volumes worth of water were removed or until the well went dry, which ever came first. A grab sample was also collected from the Little River. All samples were collected in acid washed Nalgene bottles.

Appendix D. Water Chemistry Raw Data

Date	Sample	Orthophosphate (ug/L)	Ammonia (mg/L)	Nitrate (mg/L)
2/8/2001	NT1	<10.0	<0.10	2.07
2/8/2001	AQ9 QC (1/4 ml in 200 mL)	32.24	1.05	3.08
2/8/2001	AQ1	11.69	<0.10	3.29
2/8/2001	AQ2	<10.0	<0.10	0.93
2/8/2001	AQ3	<10.0	<0.10	0.77
2/8/2001	AQ4	11.21	<0.10	0.57
2/8/2001	AQ5	10.93	<0.10	3.26
2/8/2001	AQ6	<10.0	<0.10	0.33
2/8/2001	AQ7	12.63	<0.10	3.00
2/8/2001	AQ8	<10.0	<0.10	2.74
2/8/2001	AQ9	10.63	<0.10	1.30
2/8/2001	NT1D	10.67	<0.10	1.68
2/8/2001	NT1DQC	28.66	1.11	3.55
2/8/2001	NT2	<10.0	<0.10	6.59
2/8/2001	NT2D	<10.0	<0.10	4.32
2/8/2001	NT3	<10.0	<0.10	7.73
2/8/2001	NT3D	<10.0	<0.10	2.02
2/8/2001	NT5	10.39	<0.10	0.86
2/8/2001	NT6	11.53	<0.10	2.93
2/8/2001	CT1	11.86	<0.10	9.61
2/8/2001	CT2	11.28	<0.10	6.86
2/8/2001	CT3	<10.0	<0.10	6.34
2/8/2001	CT4	10.53	<0.10	7.63
2/8/2001	CT5	<10.0	<0.10	4.92
2/8/2001	CT6QC	13.75	1.00	7.32
2/8/2001	Little Riv	11.52	<0.10	0.36
3/23/2001	AQ1	<10.0	<0.10	3.03
3/23/2001	AQ2	<10.0	<0.10	0.71
3/23/2001	AQ3	<10.0	<0.10	0.71
3/23/2001	AQ5	301.12	10.04	22.56
3/23/2001	AQ6	<10.0	<0.10	0.31
3/23/2001	AQ7	<10.0	<0.10	2.87
3/23/2001	AQ9	<10.0	<0.10	1.21
3/23/2001	AQ9QC 200ML	299.55	9.45	18.85
3/23/2001	AQ9QC 200ML	351.07	10.23	20.02
3/23/2001	CT1	<10.0	<0.10	9.20
3/23/2001	CT2	<10.0	<0.10	5.82
3/23/2001	CT3	<10.0	<0.10	6.67
3/23/2001	CT6	<10.0	<0.10	5.30
3/23/2001	NT1DQC	263.87	9.88	18.99
3/23/2001	NT2D	<10.0	<0.10	1.98
3/23/2001	NT3	<10.0	<0.10	7.10
3/23/2001	NT3D	<10.0	<0.10	3.72
3/23/2001	NT4	<10.0	<0.10	12.15
5/18/2001	NT1	21.69	<0.10	3.82
5/18/2001	NT1D	<10.0	<0.10	2.02
5/18/2001	NT2	<10.0	<0.10	7.78
5/18/2001	NT2D	<10.0	<0.10	3.65
5/18/2001	NT3	<10.0	<0.10	15.73
5/18/2001	NT3D	<10.0	<0.10	3.95

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (ug/L)	Ammonia (mg/L)	Nitrate (mg/L)
5/18/2001	NT5	<10.0	<0.10	1.12
5/18/2001	NT6	<10.0	<0.10	6.91
5/18/2001	CT1	<10.0	<0.10	8.67
5/18/2001	CT3	17.20	<0.10	9.67
5/18/2001	CT5	<10.0	<0.10	4.86
5/18/2001	CT6	<10.0	<0.10	5.13
5/18/2001	AQ1	199.75	<0.10	3.03
5/18/2001	AQ2	<10.0	<0.10	1.43
5/18/2001	AQ3	<10.0	<0.10	0.71
5/18/2001	AQ4	<10.0	<0.10	1.15
5/18/2001	AQ4QC	219.72	9.98	19.79
5/18/2001	AQ5	<10.0	<0.10	3.09
5/18/2001	AQ6	<10.0	<0.10	0.40
5/18/2001	AQ7	<10.0	<0.10	2.09
5/18/2001	AQ8	<10.0	<0.10	3.06
5/18/2001	AQ9	<10.0	<0.10	1.32
5/18/2001	Lil Riv	11.34	<0.10	0.63
6/26/2001	Little Riv	25.06	<0.10	0.53
6/26/2001	AQ1	10.99	<0.10	3.91
6/26/2001	AQ2	156.79	<0.10	0.66
6/26/2001	AQ3	<10.0	<0.10	0.64
6/26/2001	AQ4	<10.0	<0.10	0.98
6/26/2001	AQ5	10.49	<0.10	2.72
6/26/2001	AQ6	<10.0	<0.10	0.34
6/26/2001	AQ7	389.47	<0.10	2.15
6/26/2001	AQ8	30.06	<0.10	2.30
6/26/2001	AQ9	<10.0	<0.10	1.29
6/26/2001	CT1	11.16	<0.10	5.40
6/26/2001	CT2	10.77	<0.10	4.20
6/26/2001	CT3	11.04	<0.10	10.78
6/26/2001	CT4	<10.0	<0.10	5.13
6/26/2001	CT6	<10.0	<0.10	5.10
6/26/2001	NT1	116.65	<0.10	3.15
6/26/2001	NT1DQC	196.06	9.65	19.40
6/26/2001	NT2	<10.0	<0.10	7.41
6/26/2001	NT3	914.80	<0.10	14.51
6/26/2001	NT4	<10.0	<0.10	2.99
6/26/2001	NT5	10.56	<0.10	10.01
6/26/2001	NT6	11.73	<0.10	4.13
7/23/2001	AQ1	11.28	<0.10	3.64
7/23/2001	AQ2	<10.0	<0.10	0.57
7/23/2001	AQ3	<10.0	<0.10	0.83
7/23/2001	AQ4	<10.0	<0.10	0.63
7/23/2001	AQ7	61.45	<0.10	1.75
7/23/2001	AQ8	10.18	<0.10	3.16
7/23/2001	AQ9	<10.0	<0.10	1.05
7/23/2001	CT2	15.94	<0.10	5.29
7/23/2001	CT3	<10.0	<0.10	4.08
7/23/2001	CT4	10.57	<0.10	9.24
7/23/2001	CT6	10.60	<0.10	4.97

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (ug/L)	Ammonia (mg/L)	Nitrate (mg/L)
7/23/2001	Little Riv	15.98	<0.10	0.45
7/23/2001	N3D	<10.0	<0.10	3.91
7/23/2001	NT1D	11.52	<0.10	1.70
7/23/2001	NT2	<10.0	<0.10	7.87
7/23/2001	NT3	<10.0	<0.10	10.55
7/23/2001	NT4	10.14	<0.10	10.72
7/23/2001	NT4	<10.0	<0.10	4.50
7/23/2001	NT5	10.46	<0.10	2.42
7/23/2001	NT6	12.52	<0.10	3.89

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
08/21/01	AQ1	< 0.01	< 0.1	4.2
08/21/01	AQ2	< 0.01	< 0.1	1.1
08/21/01	AQ3	< 0.01	< 0.1	0.67
08/21/01	AQ4	< 0.01	< 0.1	0.87
08/21/01	AQ5	< 0.01	< 0.1	3
08/21/01	AQ6	< 0.01	< 0.1	0.17
08/21/01	AQ7	< 0.01	< 0.1	2.3
08/21/01	AQ8	< 0.01	< 0.1	3.7
08/21/01	AQ9	< 0.01	< 0.1	1.1
08/21/01	NT1	< 0.01	0.19	3.3
08/21/01	NT1D	< 0.01	< 0.1	1.6
08/21/01	NT2	< 0.01	< 0.1	6.5
08/21/01	NT2D	< 0.01	< 0.1	5.1
08/21/01	NT3	< 0.01	< 0.1	12
08/21/01	NT3D	< 0.01	< 0.1	3.8
08/21/01	NT5	< 0.01	< 0.1	1.4
08/21/01	NT6	< 0.01	< 0.1	2.3
08/21/01	CT1	< 0.01	< 0.1	6.7
08/21/01	CT2	< 0.01	< 0.1	5
08/21/01	CT3	< 0.01	< 0.1	9.5
08/21/01	CT4	< 0.01	< 0.1	1.5
08/21/01	CT5	< 0.01	< 0.1	4.2
08/21/01	CT6	< 0.01	< 0.1	5.2
08/21/01	Lil River	0.07	< 0.1	0.29
10/04/01	AQ1	< 0.01	< 0.1	4.1
10/04/01	AQ2	< 0.01	< 0.1	0.98
10/04/01	AQ2S	0.03	9.8	20
10/04/01	AQ3	< 0.01	< 0.1	1.2
10/04/01	AQ4	< 0.01	< 0.1	0.99
10/04/01	AQ5	< 0.01	< 0.1	2.9
10/04/01	AQ6	< 0.01	< 0.1	0.15
10/04/01	AQ7	< 0.01	< 0.1	2.5
10/04/01	AQ8	< 0.01	< 0.1	3.3
10/04/01	AQ9	< 0.01	< 0.1	1.2
10/04/01	NT1D	< 0.01	< 0.1	1.5
10/04/01	NT2D	< 0.01	< 0.1	1.6
10/04/01	NT3	< 0.01	< 0.1	8.3
10/04/01	NT3D	< 0.01	< 0.1	3.8
10/04/01	CT1	< 0.01	< 0.1	5.7

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
10/04/01	CT2	< 0.01	< 0.1	5.1
10/04/01	CT3	< 0.01	< 0.1	9.1
10/04/01	CT4	< 0.01	< 0.1	4.5
10/04/01	CT5	< 0.01	< 0.1	3.6
10/04/01	CT6	< 0.01	< 0.1	5
10/04/01	Lil River	0.02	< 0.1	0.23
11/08/01	AQ1	< 0.01	< 0.1	4.1
11/08/01	AQ2	< 0.01	< 0.1	0.77
11/08/01	AQ3	< 0.01	< 0.1	1.1
11/08/01	AQ4	< 0.01	< 0.1	0.57
11/08/01	AQ5	< 0.01	< 0.1	3.1
11/08/01	AQ6	< 0.01	< 0.1	< 0.1
11/08/01	AQ7	< 0.01	< 0.1	2.4
11/08/01	AQ8	< 0.01	< 0.1	3.2
11/08/01	AQ9	< 0.01	< 0.1	1.4
11/08/01	NT1D	< 0.01	< 0.1	1.8
11/08/01	NT2D	< 0.01	< 0.1	1.8
11/08/01	NT3D	< 0.01	< 0.1	3.8
11/08/01	CT1	< 0.01	< 0.1	5.1
11/08/01	CT2	< 0.01	< 0.1	4.8
11/08/01	CT3	< 0.01	< 0.1	8.5
11/08/01	CT4	< 0.01	< 0.1	4.5
11/08/01	CT5	< 0.01	< 0.1	3.3
11/08/01	CT6	< 0.01	< 0.1	4.7
11/08/01	Lil River	0.01	< 0.1	0.11
12/05/2001	AQ1	< 0.01	< 0.1	3.9
12/05/2001	AQ2	< 0.01	< 0.1	0.66
12/05/2001	AQ3	< 0.01	< 0.1	0.84
12/05/2001	AQ4	< 0.01	< 0.1	0.57
12/05/2001	AQ5	< 0.01	< 0.1	3
12/05/2001	AQ6	< 0.01	< 0.1	< 0.1
12/05/2001	AQ7	< 0.01	< 0.1	2.4
12/05/2001	AQ8	0.03	< 0.1	3.2
12/05/2001	AQ9	< 0.01	< 0.1	0.33
12/05/2001	NT1D	< 0.01	< 0.1	1.7
12/05/2001	NT1Ds	0.29	8	18
12/05/2001	NT2D	< 0.01	< 0.1	1.9
12/05/2001	NT3D	< 0.01	< 0.1	3.7
12/05/2001	CT1	< 0.01	< 0.1	5.3
12/05/2001	CT2	< 0.01	< 0.1	5
12/05/2001	CT3	< 0.01	< 0.1	8.6
12/05/2001	CT4	< 0.01	< 0.1	4.5
12/05/2001	CT5	< 0.01	< 0.1	3
12/05/2001	CT6	< 0.01	< 0.1	4.5
12/05/2001	Lil River	0.04	< 0.1	< 0.1
01/10/2002	AQ1	< 0.01	< 0.1	3.8
01/10/2002	AQ2	< 0.01	< 0.1	0.58
01/10/2002	AQ3	< 0.01	< 0.1	1.4
01/10/2002	AQ4	< 0.01	< 0.1	1.4
01/10/2002	AQ5	< 0.01	< 0.1	3

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
01/10/2002	AQ6	< 0.01	< 0.1	< 0.1
01/10/2002	AQ7	< 0.01	< 0.1	2.6
01/10/2002	AQ8	< 0.01	< 0.1	2.6
01/10/2002	AQ9	< 0.01	< 0.1	1.7
01/10/2002	NT1D	< 0.01	< 0.1	1.3
01/10/2002	NT1DSpike	0.12	7.2	16
01/10/2002	NT2D	< 0.01	< 0.1	1.1
01/10/2002	NT3D	< 0.01	< 0.1	3.6
01/10/2002	NT6	< 0.01	< 0.1	3.3
01/10/2002	CT1	< 0.01	< 0.1	5.7
01/10/2002	CT2	< 0.01	< 0.1	5
01/10/2002	CT3	< 0.01	< 0.1	8.8
01/10/2002	CT4	< 0.01	< 0.1	4.4
01/10/2002	CT5	< 0.01	< 0.1	3.1
01/10/2002	CT6	< 0.01	< 0.1	4.5
01/10/2002	Lil River	0.03	< 0.1	0.26
02/05/2002	AQ1	< 0.01	< 0.1	4.2
02/05/2002	AQ2	< 0.01	< 0.1	1.3
02/05/2002	AQ3	< 0.01	< 0.1	2.5
02/05/2002	AQ4	< 0.01	< 0.1	2.5
02/05/2002	AQ5	< 0.01	< 0.1	2.3
02/05/2002	AQ6	< 0.01	< 0.1	0.13
02/05/2002	AQ7	< 0.01	< 0.1	2.5
02/05/2002	AQ8	< 0.01	< 0.1	2.4
02/05/2002	AQ9	< 0.01	< 0.1	1.2
02/05/2002	NT1	< 0.01	< 0.1	2.7
02/05/2002	NT1D	< 0.01	< 0.1	0.59
02/05/2002	NT1DSpike	0.23	7	15
02/05/2002	NT2	< 0.01	< 0.1	6.1
02/05/2002	NT2D	< 0.01	< 0.1	1.5
02/05/2002	NT3	< 0.01	< 0.1	8.8
02/05/2002	NT3D	< 0.01	< 0.1	2.4
02/05/2002	NT4	< 0.01	< 0.1	3.7
02/05/2002	NT5	< 0.01	< 0.1	3.6
02/05/2002	NT6	< 0.01	< 0.1	0.39
02/05/2002	CT1	< 0.01	< 0.1	5.5
02/05/2002	CT2	0.01	< 0.1	5.1
02/05/2002	CT3	< 0.01	< 0.1	9.6
02/05/2002	CT4	< 0.01	< 0.1	5.3
02/05/2002	CT5	< 0.01	< 0.1	3.5
02/05/2002	CT6	< 0.01	< 0.1	3.7
02/05/2002	Lil River	0.03	< 0.1	0.28
03/06/2002	AQ1	< 0.01	< 0.1	4.4
03/06/2002	AQ2	< 0.01	< 0.1	0.89
03/06/2002	AQ3	< 0.01	< 0.1	1.1
03/06/2002	AQ4	< 0.01	< 0.1	2.2
03/06/2002	AQ5	< 0.01	< 0.1	2.7
03/06/2002	AQ6	< 0.01	< 0.1	0.29
03/06/2002	AQ7	< 0.01	< 0.1	2.1
03/06/2002	AQ8	< 0.01	< 0.1	2.4

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
03/06/2002	AQ9	< 0.01	< 0.1	1.4
03/06/2002	NT1	< 0.01	< 0.1	3.1
03/06/2002	NT1D	< 0.01	< 0.1	0.93
03/06/2002	NT1DSpike	0.28	8	17
03/06/2002	NT2	< 0.01	< 0.1	6.7
03/06/2002	NT2D	< 0.01	< 0.1	2.2
03/06/2002	NT3	< 0.01	< 0.1	7.7
03/06/2002	NT3D	< 0.01	< 0.1	2
03/06/2002	NT4	< 0.01	< 0.1	7.1
03/06/2002	NT5	< 0.01	< 0.1	2
03/06/2002	NT6	< 0.01	< 0.1	2.9
03/06/2002	CT1	< 0.01	< 0.1	5.7
03/06/2002	CT2	< 0.01	0.13	4.9
03/06/2002	CT3	< 0.01	< 0.1	9.2
03/06/2002	CT4	< 0.01	< 0.1	5.5
03/06/2002	CT5	< 0.01	< 0.1	3.7
03/06/2002	CT6	< 0.01	< 0.1	3.9
03/06/2002	Lil River	0.02	< 0.1	0.21
04/05/2002	AQ1	< 0.01	.	4.7
04/05/2002	AQ2	< 0.01	.	1.6
04/05/2002	AQ3	< 0.01	.	1.3
04/05/2002	AQ4	< 0.01	.	2.3
04/05/2002	AQ5	0.01	.	3
04/05/2002	AQ6	< 0.01	.	0.35
04/05/2002	AQ7	< 0.01	.	2.5
04/05/2002	AQ8	< 0.01	.	2.8
04/05/2002	AQ9	< 0.01	.	0.79
04/05/2002	NT1	< 0.01	.	7.4
04/05/2002	NT2	< 0.01	.	6.8
04/05/2002	NT3	< 0.01	.	9.8
04/05/2002	NT4	< 0.01	.	7
04/05/2002	NT5	< 0.01	.	2.1
04/05/2002	NT6	0.01	.	0.18
04/05/2002	NT1D	< 0.01	.	1.2
04/05/2002	NT2D	< 0.01	.	0.87
04/05/2002	NT3D	< 0.01	.	3
04/05/2002	CT1	< 0.01	.	5.8
04/05/2002	CT2	< 0.01	.	5
04/05/2002	CT3	< 0.01	.	9.1
04/05/2002	CT4	< 0.01	.	5.9
04/05/2002	CT5	< 0.01	.	4
04/05/2002	CT6	< 0.01	.	4.1
04/05/2002	Lil River	0.03	.	0.16
05/01/2002	AQ1	< 0.01	.	4.6
05/01/2002	AQ2	0.02	.	1.8
05/01/2002	AQ3	0.01	.	0.51
05/01/2002	AQ4	0.04	.	2.1
05/01/2002	AQ5	0.03	.	2.5
05/01/2002	AQ6	0.01	.	< 0.1
05/01/2002	AQ7	0.01	.	2.3

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
05/01/2002	AQ8	0.01	.	2.5
05/01/2002	AQ9	0.01	.	0.95
05/01/2002	NT1	< 0.01	.	7.7
05/01/2002	NT1D	< 0.01	.	2.3
05/01/2002	NT1DSpike	0.22	.	17
05/01/2002	NT2	< 0.01	.	6.4
05/01/2002	NT2D	0.02	.	2.1
05/01/2002	NT3	0.01	.	11
05/01/2002	NT3D	< 0.01	.	3.7
05/01/2002	NT4	0.01	.	6.4
05/01/2002	NT5	0.01	.	4.5
05/01/2002	NT6	< 0.01	.	1.4
05/01/2002	CT1	< 0.01	.	6.1
05/01/2002	CT2	< 0.01	.	5.3
05/01/2002	CT3	< 0.01	.	9.1
05/01/2002	CT4	< 0.01	.	6.6
05/01/2002	CT5	< 0.01	.	3.9
05/01/2002	CT6	< 0.01	.	4.1
06/03/2002	AQ1	< 0.01	.	4.5
06/03/2002	AQ2	< 0.01	.	1.1
06/03/2002	AQ3	< 0.01	.	0.42
06/03/2002	AQ4	< 0.01	.	1.4
06/03/2002	AQ5	< 0.01	.	2.6
06/03/2002	AQ6	< 0.01	.	< 0.1
06/03/2002	AQ7	< 0.01	.	2.2
06/03/2002	AQ8	< 0.01	.	2.7
06/03/2002	AQ9	< 0.01	.	1.5
06/03/2002	NT1D	< 0.01	.	2.3
06/03/2002	NT2	< 0.01	.	7.8
06/03/2002	NT2D	< 0.01	.	3.3
06/03/2002	NT3	< 0.01	.	15
06/03/2002	NT3D	< 0.01	.	4.2
06/03/2002	NT5	< 0.01	.	2
06/03/2002	NT6	< 0.01	.	6.4
06/03/2002	CT1	< 0.01	.	5.7
06/03/2002	CT2	< 0.01	.	5.3
06/03/2002	CT3	< 0.01	.	9.4
06/03/2002	CT4	0.01	.	5.9
06/03/2002	CT5	< 0.01	.	4.1
06/03/2002	CT6	< 0.01	.	4.1
06/03/2002	Lil River	< 0.01	.	0.22
07/17/2002	AQ1	0.02	.	4.3
07/17/2002	AQ2	< 0.01	.	0.75
07/17/2002	AQ3	0.02	.	0.99
07/17/2002	AQ4	0.01	.	0.71
07/17/2002	AQ5	< 0.01	.	3.7
07/17/2002	AQ6	< 0.01	.	0.19
07/17/2002	AQ7	< 0.01	.	2.3
07/17/2002	AQ8	< 0.01	.	2.9
07/17/2002	AQ9	< 0.01	.	0.48

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
07/17/2002	NT3	< 0.01	.	14
07/17/2002	NT5	< 0.01	.	0.13
07/17/2002	NT1D	< 0.01	.	1.6
07/17/2002	NT2D	< 0.01	.	2.9
07/17/2002	NT3D	< 0.01	.	3.6
07/17/2002	CT1	< 0.01	.	6.3
07/17/2002	CT2	< 0.01	.	5.6
07/17/2002	CT3	< 0.01	.	9.1
07/17/2002	CT4	< 0.01	.	5
07/17/2002	CT5	< 0.01	.	4
07/17/2002	CT6	< 0.01	.	3.8
07/17/2002	Lil River	0.02	.	< 0.1
08/06/2002	AQ1	< 0.01	.	4.2
08/06/2002	AQ2	< 0.01	.	0.58
08/06/2002	AQ3	< 0.01	.	1
08/06/2002	AQ4	< 0.01	.	0.53
08/06/2002	AQ5	< 0.01	.	3.2
08/06/2002	AQ6	< 0.01	.	0.43
08/06/2002	AQ7	< 0.01	.	2.5
08/06/2002	AQ8	< 0.01	.	2.8
08/06/2002	AQ9	< 0.01	.	1.6
08/06/2002	NT1D	< 0.01	.	1.7
08/06/2002	NT2D	< 0.01	.	2.3
08/06/2002	NT3D	< 0.01	.	3.1
08/06/2002	CT1	< 0.01	.	6.8
08/06/2002	CT2	< 0.01	.	5.3
08/06/2002	CT3	< 0.01	.	8.7
08/06/2002	CT4	< 0.01	.	4.7
08/06/2002	CT5	< 0.01	.	3.8
08/06/2002	CT6	< 0.01	.	3.6
08/06/2002	Lil River	0.04	.	< 0.1
09/12/2002	AQ1	< 0.01	.	3.9
09/12/2002	AQ2	< 0.01	.	0.23
09/12/2002	AQ3	< 0.01	.	1.9
09/12/2002	AQ4	< 0.01	.	0.79
09/12/2002	AQ5	< 0.01	.	3.2
09/12/2002	AQ6	< 0.01	.	3
09/12/2002	AQ7	< 0.01	.	2.9
09/12/2002	AQ8	0.01	.	3.4
09/12/2002	AQ9	< 0.01	.	3.4
09/12/2002	NT1D	< 0.01	.	2.1
09/12/2002	NT2D	< 0.01	.	1.6
09/12/2002	NT3D	< 0.01	.	3.1
09/12/2002	CT1	< 0.01	.	6.4
09/12/2002	CT2	< 0.01	.	5.4
09/12/2002	CT3	< 0.01	.	7.4
09/12/2002	CT4	< 0.01	.	4.1
09/12/2002	CT5	< 0.01	.	2.9
09/12/2002	CT6	< 0.01	.	3.3
09/12/2002	Lil River	0.05	.	0.27

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
10/17/2002	AQ1	< 0.01	.	3.7
10/17/2002	AQ2	< 0.01	.	0.4
10/17/2002	AQ3	< 0.01	.	2.3
10/17/2002	AQ4	< 0.01	.	0.9
10/17/2002	AQ5	< 0.01	.	3.7
10/17/2002	AQ6	< 0.01	.	1.9
10/17/2002	AQ7	< 0.01	.	3
10/17/2002	AQ8	< 0.01	.	3.2
10/17/2002	AQ9	< 0.01	.	1.2
10/17/2002	NT1	< 0.01	.	1.2
10/17/2002	NT1D	< 0.01	.	2.3
10/17/2002	NT2D	< 0.01	.	0.9
10/17/2002	NT3D	< 0.01	.	3.1
10/17/2002	NT6	< 0.01	.	1.3
10/17/2002	CT1	< 0.01	.	6.7
10/17/2002	CT2	< 0.01	.	8.7
10/17/2002	CT3	< 0.01	.	5.2
10/17/2002	CT4	< 0.01	.	4.5
10/17/2002	CT5	< 0.01	.	3.4
10/17/2002	CT6	< 0.01	.	3.8
10/17/2002	Lil River	0.06	.	0.13
11/19/2002	AQ1	0.03	.	3.1
11/19/2002	AQ2	0.04	.	0.26
11/19/2002	AQ3	0.06	.	1.4
11/19/2002	AQ4	0.09	.	1.4
11/19/2002	AQ5	0.03	.	2.7
11/19/2002	AQ6	0.04	.	0.13
11/19/2002	AQ7	0.02	.	2.2
11/19/2002	AQ8	0.04	.	2.1
11/19/2002	AQ9	< 0.01	.	2.3
11/19/2002	NT1	< 0.01	.	2.2
11/19/2002	NT1D	< 0.01	.	0.49
11/19/2002	NT2	0.01	.	5.7
11/19/2002	NT2D	0.01	.	0.77
11/19/2002	NT3	0.01	.	6.7
11/19/2002	NT3D	< 0.01	.	2.1
11/19/2002	NT6	0.02	.	0.23
11/19/2002	CT1	0.01	.	5.4
11/19/2002	CT2	< 0.01	.	5.9
11/19/2002	CT3	< 0.01	.	10
11/19/2002	CT4	< 0.01	.	5.6
11/19/2002	CT5	< 0.01	.	4
11/19/2002	CT6	< 0.01	.	4
11/19/2002	Lil River	0.05	.	0.23
01/02/2003	AQ1	0.1	.	2.9
01/02/2003	AQ2	0.08	.	1
01/02/2003	AQ3	0.06	.	0.98
01/02/2003	AQ4	0.08	.	2
01/02/2003	AQ5	0.03	.	1.8
01/02/2003	AQ6	0.02	.	< 0.1

Appendix D. Water Chemistry Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
01/02/2003	AQ7	0.04	.	2.1
01/02/2003	AQ8	0.02	.	2
01/02/2003	AQ9	< 0.01	.	0.98
01/02/2003	NT1	0.01	.	1.2
01/02/2003	NT1D	0.01	.	< 0.1
01/02/2003	NT2	0.01	.	7.5
01/02/2003	NT2D	< 0.01	.	0.3
01/02/2003	NT3	0.12	.	7.1
01/02/2003	NT3D	< 0.01	.	0.76
01/02/2003	NT4	0.08	.	4.5
01/02/2003	NT5	< 0.01	.	3.4
01/02/2003	NT6	0.01	.	0.21
01/02/2003	CT1	0.02	.	5.1
01/02/2003	CT2	0.01	.	3.4
01/02/2003	CT3	0.04	.	9.4
01/02/2003	CT4	0.01	.	4.9
01/02/2003	CT5	< 0.01	.	4.6
01/02/2003	CT6	0.02	.	4.2
01/02/2003	Lil River	0.03	.	0.32
02/13/2003	AQ1	0.02	.	3.9
02/13/2003	AQ2	0.06	.	1.8
02/13/2003	AQ3	0.03	.	0.56
02/13/2003	AQ4	0.06	.	2.8
02/13/2003	AQ5	0.02	.	2.3
02/13/2003	AQ6	0.02	.	0.12
02/13/2003	AQ7	0.02	.	2.3
02/13/2003	AQ8	0.02	.	2.5
02/13/2003	AQ9	0.01	.	1.9
02/13/2003	NT1	0.01	.	2.5
02/13/2003	NT1D	< 0.01	.	0.49
02/13/2003	NT2	< 0.01	.	8.3
02/13/2003	NT2D	0.01	.	1.8
02/13/2003	NT3	< 0.01	.	7.2
02/13/2003	NT3D	0.01	.	2.4
02/13/2003	NT4	0.04	.	6
02/13/2003	NT5	< 0.01	.	3.7
02/13/2003	NT6	0.01	.	0.52
02/13/2003	CT1	< 0.01	.	5.5
02/13/2003	CT2	0.01	.	2.9
02/13/2003	CT3	< 0.01	.	8.8
02/13/2003	CT4	< 0.01	.	5.4
02/13/2003	CT5	< 0.01	.	5.1
02/13/2003	CT6	0.02	.	5.1
02/13/2003	Lil River	0.03	.	0.44
03/14/2003	AQ1	0.01	.	3.8
03/14/2003	AQ2	0.03	.	1.7
03/14/2003	AQ3	0.01	.	0.73
03/14/2003	AQ4	0.1	.	4.2
03/14/2003	AQ5	0.02	.	2.2
03/14/2003	AQ6	0.05	.	0.43

Appendix D. Water Quality Raw Data (continued)

Date	Sample	Orthophosphate (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)
03/14/2003	AQ7	0.01	.	2.2
03/14/2003	AQ8	0.01	.	2.5
03/14/2003	AQ9	< 0.01	.	1.7
03/14/2003	NT1	0.05	.	1.2
03/14/2003	NT1D	0.01	.	0.35
03/14/2003	NT2	0.02	.	3.3
03/14/2003	NT2D	0.01	.	2.1
03/14/2003	NT3	0.03	.	3.5
03/14/2003	NT3D	< 0.01	.	9.3
03/14/2003	NT4	0.03	.	3
03/14/2003	NT5	< 0.01	.	1.8
03/14/2003	NT6	0.01	.	0.51
03/14/2003	CT1	< 0.01	.	4.7
03/14/2003	CT2	0.04	.	0.86
03/14/2003	CT3	0.1	.	7.3
03/14/2003	CT4	< 0.01	.	4.7
03/14/2003	CT5	< 0.01	.	4.5
03/14/2003	CT6	0.04	.	4.6
03/14/2003	Lil River	0.04	.	0.51
05/16/2003	AQ1	0.01	.	3.1
05/16/2003	AQ2	0.04	.	1
05/16/2003	AQ3	< 0.01	.	0.5
05/16/2003	AQ4	0.04	.	2.3
05/16/2003	AQ5	0.02	.	2.1
05/16/2003	AQ6	0.03	.	0.62
05/16/2003	AQ7	< 0.01	.	2
05/16/2003	AQ8	0.02	.	2.1
05/16/2003	AQ9	0.01	.	1.7
05/16/2003	NT1	< 0.01	.	12
05/16/2003	NT1D	< 0.01	.	2.7
05/16/2003	NT2	0.01	.	9
05/16/2003	NT2D	0.02	.	3.6
05/16/2003	NT3	0.01	.	16
05/16/2003	NT3D	0.01	.	3.7
05/16/2003	NT4	< 0.01	.	5
05/16/2003	NT5	< 0.01	.	6.7
05/16/2003	NT6	< 0.01	.	7.3
05/16/2003	CT1	< 0.01	.	6.2
05/16/2003	CT2	0.01	.	3.7
05/16/2003	CT3	0.02	.	8.7
05/16/2003	CT4	< 0.01	.	6.6
05/16/2003	CT5	< 0.01	.	3.7
05/16/2003	CT6	0.03	.	4.4
05/16/2003	Lil River	0.07	.	0.57

Appendix E. Statistical Analyses

The NO_3-N data was preliminarily examined using Proc GLM in SAS. A plot of the residual NO_3-N values versus the predicted NO_3-N values showed that some outliers existed and that the residual values fanned out as the predicted values increased. The fanning indicated that the variability of the data increased with larger NO_3-N concentrations, which did not meet the requirement of uniform variability for the statistical analyses used. To help normalize the data, a square root transformation was performed. The square root transformation is recommended when: data is collected from different blocks such as different fields; or the variance of the data is heterogeneous between blocks and the sample size is large (Snedecor and Cochran, 1967). The transformation was successful in normalizing the data, which was seen in a uniform distribution of a plot of residual versus predicted square root of NO_3-N.

The groundwater wells were installed in transects. The samples, however, were treated as if they were random. Due to the uneven number of wells in each field and the lack of replication of treatments, treating the samples as random allowed for more degrees of freedom than if the samples were averaged by transect. It is recognized that annual climactic variability can influence NO_3-N concentrations from year to year. This annual variability was accounted for by adding a term for year in the analyses and by creating a repeated statement that allowed the variance to differ between years.

Both Proc GLM and Proc Mixed were initially used to analyze the groundwater NO_3-N data. Proc GLM could not calculate the mean of the NO_3-N data because of missing data and could not be used because the means of the NO_3-N data were used for the statistical analyses. Proc Mixed was used because it allowed the errors of the data to vary and the analyses could be modified to account for missing data. LS Means, within Proc Mixed, was used to calculate the means of the NO_3-N concentrations for the desired analyses and were used for the statistical comparisons that are described later

in this Appendix. Proc ANOVA was used to analyze the corn and soybean yields because the sample size of the data was balanced (Delwiche and Slaughter, 1998).

There are many confounding factors in this study that made it difficult to determine what factors influenced groundwater NO_3-N concentrations. Different soil types and the use of cover crops made it difficult to determine if changes in the groundwater chemistry were due to tillage methods or cropping system. Additionally, the rye cover crop on the AQ field confounded the determination of whether soils or the cover crop type influences the shallow groundwater chemistry in comparisons made between the NT-Wi and NT-Ni fields. Statistical results from this study served as indicators of what could have influenced groundwater NO_3-N concentrations.

Analysis of tillage and crop influence on NO_3-N trends over the course of the entire study period would have been difficult because of the high variability from the confounding factors, as well as the addition of a variable to address trends over time. To eliminate problems associated with addressing changes over time, groundwater NO_3-N concentrations were examined between the three fields during the same cropping period (corn, small grains, soybeans and winter cover crop). For example, comparisons of groundwater NO_3-N concentrations were made between the three fields for all of the periods when only corn was grown. This isolation decreased problems associated with the confounding factors of different crops and climactic variability over time.

During the periods when soybeans, small grains and winter cover crops were grown, all of the shallow wells in the NT field were dry at least once. This resulted in an uneven number of samples between the NT fields and the other fields, and caused the LSMeans in the NT field during those periods to be non-estimable. Non-estimable means prevented SAS from performing the desired statistical analyses. The missing data were compensated for by only analyzing samples from periods when data was available from all fields.

Soybeans were grown in all three fields, allowing comparisons of groundwater NO_3-N concentrations between all three fields. Two comparisons were made during the period when the small grains were grown. In the first comparison, the data from all of the fields was compared to see if a field difference existed, even though it was highly confounded. In the second comparison, the data between fields with wheat (NT-Wi and CT-Ni) versus the field with rye (NT-Ni) were compared. Comparisons were also made to examine the influence of the presence or absence and type of winter cover crop, by comparing groundwater chemistry under the wheat cover crop (NT-Wi), the rye cover crop (NT-Ni) and the disk/chisel (CT-Ni) field with no cover crop. As previously stated, the average NO_3-N concentrations in each comparison by cropping period (comparing fields, NT vs. CT, wheat vs. rye, etc.) were calculated by LSMeans in Proc Mixed. The statistical difference between each treatment was determined using the pdiff option in LSMeans. Significance was determined when the difference calculated by pdiff between two factors compared (ie the NT and CT fields when corn was grown) had $p = 0.05$ or less.

SAS was also used to compare the NO_3-N concentrations in the shallow versus the deep water in the NT-Wi field. Proc GLM was not used because some of the differences were negative and the procedure could not estimate means with the negative differences. Proc Mixed was used to examine the differences in NO_3-N concentrations from the shallow to the deep wells. The average difference for each year was calculated using LSMeans. Specific years that had concentrations that were significantly different (significance at $p=0.05$) from 0 were identified from the LSMeans output. A difference significant from 0 indicated that during those years the NO_3-N concentrations decreased substantially from the shallow to the deep depth. A difference not significantly different than 0, indicated that no change in NO_3-N concentration occurred.

Statistical comparisons of corn and soybean yields were also performed with SAS. Proc ANOVA was used to calculate means, which were then used with the pair wise t-test. This method was used to determine if the average yield in a field was significantly different than in the other fields at the p=0.05 level. This was also used to determine if the average yield for NT production was significantly different than in CT production at p=0.05. Due to only having one yield value for each field in a given crop year, the statistical model to examine effects on yield were set up with only one classification variable such as 'yield = field'. Yield values from each year were treated as the replicates, therefore yield could not be included as an explanatory variable. If it were included, there would have been zero degrees of freedom and no statistical analyses could have been performed.

Bibliography

Delwiche, L.D., and S.J. Slaughter. 1998. The little SAS book. SAS Publishing, Cary, NC.

Snedecor, G.W., and W.G. Cochran. 1967. Statistical methods. The Iowa State University Press, Ames, IA.

Chapter 3. Construction of Platinum-Tipped Redox Probes for the Determination of Soil Redox Potential[1]

Abstract

Redox probes are typically constructed by soldering Pt wire to a metal wire or rod, such as copper or brass. The junction between the Pt and wire/rod is often sealed with an epoxy resin and hardener or with heat shrink tubing. Micro cracks (small cracks invisible to the unaided eye) can form in the hardened resin and result in incorrect readings. The hardened resin is not easily removed, making repairs difficult. Heat shrink tubing is thin, lacks rigidity and can be damaged in the soil. The method described in this paper used a thick-walled, adhesive-lined terminal insulator to seal the junction. The terminal insulators were easily applied and removed, which made faulty probes easy to repair. Two hundred forty probes were made with this method and eight were made with a marine epoxy resin. The probes were tested with a redox buffer solution (Light Solution) and were usable if they read +476 mV +/- 10 mV. The probes were installed 0.76 m and 1.5 m deep in the soil. The ability of the probes to provide reliable redox readings was examined by testing selected probes after 10 months of use and testing all of the probes after completion of the study (19 months). Ten of the 12 probes tested after 10 months worked satisfactorily, while the other two clearly malfunctioned before testing. After the study was completed, 236 of the 240 of the probes worked satisfactorily. These results indicate that the construction method presented produces reliable, long-lasting probes.

[1] The use of trade names in this publication does not imply endorsement by NC State University of the products named, or criticism of similar ones not mentioned.

Introduction

Redox potential is a measure of electron availability and is a result of electron transfer between oxidized (chemical species that have lost electrons) and reduced (chemical species that have gained electrons) chemical species (Gambrell and Patrick, 1980; Gambrell et al., 1991). The measurements indicate the likelihood of electron donation to or loss from a chemical species and are used to assess characteristics of the soil environment (Gambrell et al., 1991; Pang and Zhang, 1998). Redox potential measurements provide an indication of the soil aeration status and are often used in conjunction with groundwater data to determine the most probable chemical species of groundwater constituents. For example, redox potential measurements below a certain value indicate that denitrification is likely to occur and decreases of groundwater nitrate-N (NO_3^--N) could be attributed to denitrification. On the other hand, redox potential measurements above a certain value indicate that the soil is sufficiently aerated for groundwater NO_3^--N to not be denitrified and remain available to crops.

Platinum tipped redox probes that can be easily made and repaired are an asset to researchers who often require numerous probes for studies of soil redox potential. Platinum is used because it is non-selective, meaning it will accept electrons from all redox reactions, and it is stable, meaning it will accept or release electrons, but will not release chemical species that will influence redox reactions (Bohn, 1971). Various redox probe construction methods have been used during the past 40 years. The Hg junction method fused Pt to the melted end of Pyrex glass tubing that was filled with liquid Hg after the junction had

cooled (Bohn, 1971; Ponnamperuma, 1972; Gambrell et al., 1975; Faulkner et al., 1989). Glass breakage and the health risks associated with liquid Hg were concerns related to the use of this redox probe construction method (Mueller et al., 1985).

Another method fused or soldered Pt to Cu wire (Letey and Stolzy, 1964; Meek et al., 1968; Bohn, 1971; Faulkner et al., 1989; Jordan et al., 1993) or to brass alloy brazing rod (Mann and Stolzy, 1972; Mueller et al., 1985; Jacobs and Gilliam, 1983). Glass tubing was melted at the Pt-Cu/brass junction to waterproof some of the earlier probes (Letey and Stolzy, 1964) but this method was also time consuming and there was a risk of glass breakage (Mueller et al., 1985).

Other methods covered the Cu/brass rod with heat shrink tubing and water proofed the Pt-Cu/brass junction with epoxy resin and hardener (Bohn, 1971; Mann and Stolzy, 1972; Mueller et al., 1985; Faulkner et al., 1989) or with additional heat shrink tubing (Jacobs and Gilliam, 1983). Problems resulted from the use of epoxy resin because some of the resins deteriorated under saturated conditions (Mueller et al., 1985), although marine epoxy has been used because it is resistant to deterioration in saturated conditions. In either case, micro-cracks were found to develop in the epoxy and result in incorrect readings; the epoxy was also difficult to remove, thus hindering repair of the probes (J.W. Gilliam, personal communication, 2003). Care had to be taken to not over apply the epoxy on the Pt-Cu/brass junction and to prevent epoxy from getting on the Pt. The epoxy also had to be sanded when it dried, which made this a time consuming method.

The heat shrink tubing, on the other hand, was easy to apply. There were also fewer concerns about the heat shrink tubing deteriorating in the soil, which provided the durability needed for long-term studies (Jacobs and Gilliam, 1983). The construction method presented in our paper is a modification of the method used by Jacobs and Gilliam (1983). We employed a thick walled heat shrink insulator, which was thicker, more rigid and easier to remove to fix faulty probes than the regular heat shrink tubing used by Jacobs and Gilliam (1983). Our objective for this study was to determine the effectiveness of this modified construction method by testing all of the probes pre-installation, testing selected probes after ten months of readings and testing all probes after 19 months of data collection.

Methods

Redox Probe Manufacturing

The body of the redox probes was 0.32-cm diameter non-flux, low-fuming bronze brazing rod cut to a length of 122 cm. A 1-cm deep hole was made in both ends of the brazing rod using a small #1 combined drill and counter sink on a metal working lathe. One of the holes was deepened to 1.3 cm using a 0.12-cm diameter drill bit. Air was blown into the holes to remove any metal shavings prior to soldering.

A freestanding, flat bottom torch was used for soldering, which allowed the materials to be held by both hands. Rosin core solder (Dutch Boy Brand) was melted into the 1-cm deep hole by heating the end of the rod with the torch and

touching the solder to the hole until it filled with solder (Figure 1). All soldering was done in the fume hood; goggles and heat resistant gloves were worn because the brazing rod became very hot. The soldered end was reheated to melt the solder and a 1.5-cm piece of 18-guage 98.95% pure Pt wire from Fisher Scientific was inserted into the molten solder. The heat was then removed and the solder was allowed to solidify.

Insulated, single strand, 18-guage Cu wire was cut in lengths that extended from the end of the probe to the location where measurements would be made. Approximately three meters (ten feet) was cut for the probes that were inserted 1.5 m deep and one and a half meters (five feet) was cut for the probes that were inserted 0.76 m deep. Approximately 0.5 cm of insulation was stripped off one end and 1 cm off the other end. Solder was melted into the 1.3-cm hole using the previously described method and the 0.5-cm bare Cu wire was soldered into that hole. The lose wire was wound up to facilitate transport of the probes.

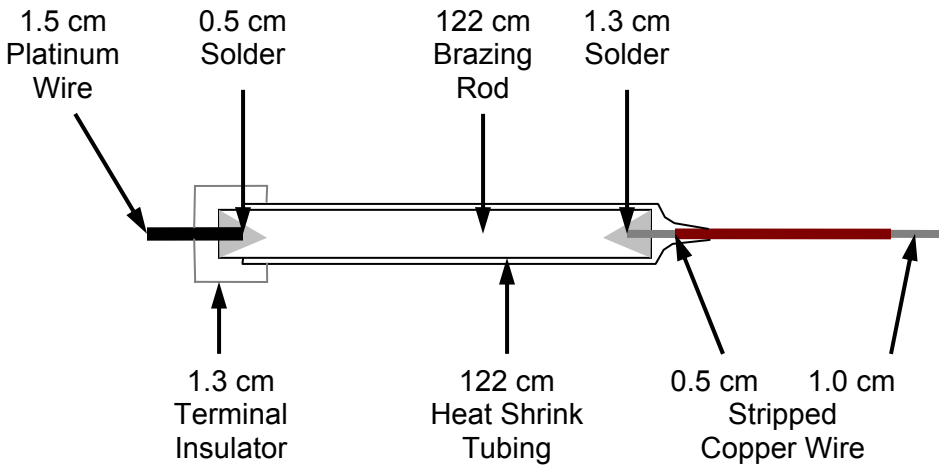


Figure 1. Diagram of a completed redox probe.

Shrink-wrap, adhesive-lined tubing was purchased in 122 cm sections from McMaster-Carr (P.O. Box 740100, Atlanta, GA 30374-0100; ph. (404) 346-7000); Cat. # 74965K22). The tubing was slid over the probe, starting at the end with the Pt tip, and positioned so that one end was approximately 0.5 cm from the Pt-brazing rod connection. From that point the tubing covered the brazing rod, Cu wire-brazing rod connection and a portion of the insulated copper wire. The tubing was shrunk by slowly heating it with a Milwaukee paint stripper heat gun, set on low heat. It was essential to not heat an area too long, because it would cause blistering or air bubble formation.

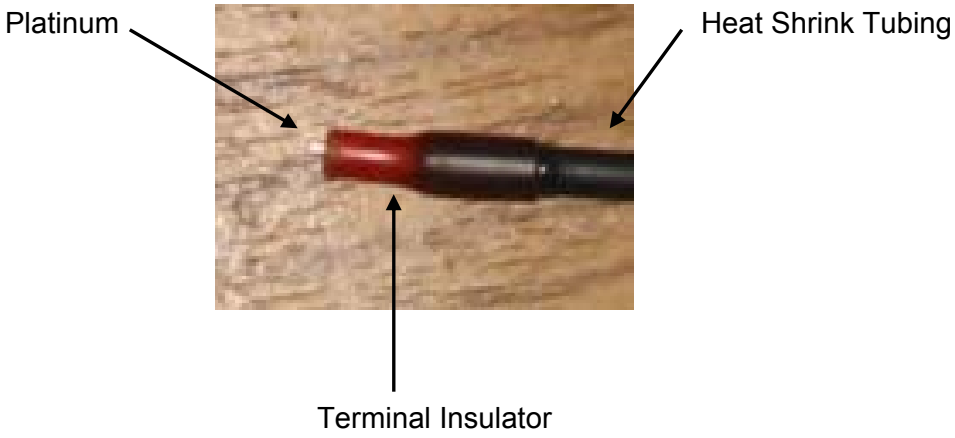


Figure 2. Photograph of terminal insulator.

A rigid terminal insulator (1.3 cm long, adhesive-lined, thick-walled heat shrink tubing (McMaster-Carr Cat # 72675K51 color code red)) was slid over the Pt, leaving approximately 0.32 cm of the Pt exposed. The insulator covered a portion of the Pt, the exposed brazing rod and slightly overlapped the cooled and hardened heat shrink tubing. The adhesive inside the insulators increased the contact with the Pt-brazing rod connection. Insulators without adhesive were tried

as well, but they melted and pulled away from the heat shrink tubing, exposing bare brazing rod. Probes also were constructed by putting heat shrink tubing over the terminal insulator. This proved undesirable, however, because the heat shrink tubing did not seal tightly on the brazing rod near the insulator. There also was concern that the heat shrink tubing covering the insulator would have been pulled off during installation.

The insulators were applied by heating them at high heat with the heat gun, as long as the redox probe was rotated to heat the insulator evenly and reduce the potential for boiling the adhesive. All air bubbles between the insulator and Pt-brazing rod junction were removed by reheating the insulator and lightly squeezing it as the insulator cooled. This prevented water from getting under the insulator and contacting the brazing rod, which could cause false readings. If an insulator had air bubbles that could not be removed, the insulator was removed by either stripping it off with a sharp knife or box cutter or heating it with the heat gun and pulling it off. A new insulator was then installed and heated on low heat to further reduce the chance of boiling. Probe construction took about 20 minutes per probe from the time soldering began until the terminal insulator was applied. Each probe was numbered prior to testing.

Testing Redox Probes

Redox measurements were made with a KCl saturated Ag/AgCl reference probe, which was purchased from Jensen Instruments, and an Accumet Portable pH/mV meter. The redox potential of each completed probe was tested after the probes had cooled at least 4 hours. If 0.32 cm of Pt was not exposed prior to

testing, the terminal insulator was cut with a sharp knife or box cutter to expose the Pt. The Pt on each probe was lightly sanded before testing to remove any oxidized layer that may have formed on the Pt.

Two methods were used to test the redox probes, and all test measurements for each probe were recorded. Initially, probes were tested in a redox buffer solution to assess the accuracy of measurements made with the probes in an environment that would donate or accept electrons from the Pt. The redox buffer solution was a ferrous/ferric Fe solution (Light Solution) that was made according to the procedure described by Light (1972). The expected redox potential in the redox buffer solution was +476 mV because the KCl saturated Ag/AgCl reference probe was used (Light, 1972). To test the probes, five redox probes and the reference probe were placed in the redox buffer solution in an acid washed Nalgene beaker. The redox measurements often stabilized (did not change) within thirty seconds of being connected to the pH/mV meter. The redox probes were left in the solution until three readings were made with each probe, which took five to ten minutes. During that period the probes were in the solution long enough to observe any drift (gradual increase or decrease of the redox potentials equal to or greater than 5 mV) of the redox values. Probes were acceptable if they read +/- 10 mV from the expected redox potential. If the measured redox potentials drifted the probe was reconstructed.

One measurement was then made with the redox probes and reference electrode in tap water to assess whether or not the probes would work in a saturated, but less-buffered environment. The measured redox potentials in tap

water were dependent on the source of the tap water (J.W. Gilliam, personal communication, 2003), but were generally in the range of +300 to +600 mV for the tap water used. Thus, acceptable probes were those that measured redox potentials in this range. Probes that measured redox potentials less than +300 mV, or potentials that fluctuated greatly, often failed a second test in the redox buffer solution. It is possible that the lack of chemicals in the tap water made it less viscous than the redox buffer solution, which could have allowed the water to more readily reach the brazing rod through any holes. The difference between the tap water and redox buffer solution were not examined, making any explanation of the observed testing difference speculative at best. Regardless of the process that caused the difference, the tap water method helped detect unacceptable probes that would have otherwise gone undetected.

If a probe was unacceptable, the terminal insulator around the Pt-brazing rod connection was reheated and pressure was applied as it cooled, which closed air bubbles that may have formed. The probe was tested again in tap water. If the readings remained unsuitable, the insulator was reheated with the heat gun and pulled off or it was stripped off with a box cutter or knife. A new insulator was then applied by previously described methods and the Pt was sanded more vigorously before testing in tap water. If the probe was still unacceptable, it was sanded more heavily and tested in tap water. If one of the repairs produced probes that had results in tap water similar to the previously tested and acceptable probes, they were then tested in redox buffer solution. If those probes failed in redox buffer solution, the repairs were made again. Those

that passed in tap water and redox buffer solution were used in the field. If none of the repairs worked, the insulator and Pt were removed and the Pt was used to make a new probe following the previously described method.

Installation and Subsequent Testing

All acceptable probes made with the terminal insulator were inserted into PVC pipe to provide additional protection and rigidity when the probes were in the soil (Figure 3). The Cu wire and brazing rod were inserted through a hole in a PVC cap that was narrower than the terminal insulator, which allowed the insulator to be flush with the cap. Epoxy putty was put in the cap to hold the probe in place. The Cu wire and brazing rod were then inserted into a PVC pipe long enough to contain the brazing rod and some Cu wire. The PVC cap was permanently affixed to the PVC pipe with PVC primer and glue. A second PVC cap with a hole was slid over the remaining Cu wire and placed on the other end of the PVC pipe. The hole around the wire was sealed with silicone.

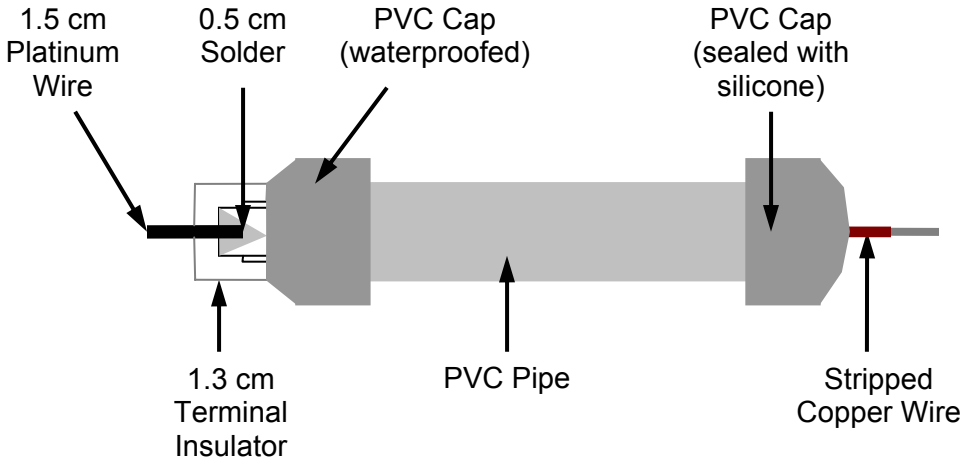


Figure 3. Redox probe encased in PVC for installation.

Redox probes were installed at depths above (0.76 m) and below (1.5 m) the average growing season water table. Installation was completed in December 2001. Holes were dug 0.64 cm short of the desired depth with a 1.9-cm Oakfield auger. Each probe was pushed into the soil to put the Pt in contact with the undisturbed soil. The process of pushing the probe into the soil could have pulled back heat shrink tubing, if it had been applied over the rigid terminal insulator, which was one reason why that method was not used. The rigidity of the terminal insulator also was beneficial because it decreased the likelihood of damage during installation and loss of the water proofing contact between the probe and Pt junction. The Pt tips were sanded again before installation and the location of each probe was recorded during installation. After the probes were installed, the loose end of the Cu wire was attached to a platform. When redox potential measurements were made, the loose Cu wire was connected to a pH/mV meter with an alligator clip (Wafer, 2004).

Select redox probes were examined in October 2002, 10 months after installation. Probes that had suspect readings as well as a few probes with more typical readings were removed from the soil and tested in the redox buffer solution. Probes that measured unacceptable redox potentials were replaced with properly functioning probes. Probes that were tested and found to be acceptable were returned to their original location. All the probes were removed upon completion of the study (19 months after installation) and tested again in the redox buffer solution to determine how well they functioned.

Epoxy versus Terminal Insulators

A set of eight (three deep and five shallow) redox probes also was made with marine epoxy resin and hardener. The epoxy was made according to the package directions and applied so that it was not much wider than the brazing rod. After 24 hours of drying time, the epoxy was sanded enough to allow the flexible heat shrink tubing to be slid over the epoxy. The epoxy probes were tested in the same manner as the terminal insulator probes. Epoxy probes that failed testing were disposed of because the epoxy could not be easily removed to salvage the Pt.

The epoxy probes were installed in December 2002, within a meter of one set of terminal insulator probes. The installation method used for the terminal insulator probes also was used for the epoxy probes. The average deep and shallow redox potentials measured with the epoxy and terminal insulator probes were compared to determine if the different methods produced similar results. All eight epoxy probes were removed upon completion of the study (7 months after installation) and tested again in the redox buffer solution to determine how well they functioned.

Results and Discussion

Probe Construction and Testing

A total of 260 redox probes were made. Fifty-seven percent (151) of the probes were acceptable after initial construction and required no modification (Table 1). The terminal insulator on each of the 109 unacceptable probes was reheated and squeezed, which made 67 more probes (218 total) acceptable

(Table 1). The terminal insulator was replaced on each of the 42 remaining unacceptable probes, which produced 21 additional (239 total probes) acceptable probes (Table 1). Heavy sanding of the Pt made 14 of the remaining 21 unacceptable probes acceptable. This brought the total number of acceptable probes to 253, or 95% of the total 260 probes made (Table 1).

Table 1. Repair type, number of acceptable probes from each repair, cumulative number of acceptable probes and the cumulative success rate.

Repair	Number of Acceptable Probes		Cumulative Success Rate
	For the Repair Method	Cumulative	
None	151	151	57%
Reheat Terminal Insulator	67	218	82%
Replace Terminal Insulator	21	239	90%
Heavy Sanding	14	253	95%

The quick testing methods and the relative ease of repair allowed for testing and repairing of unacceptable probes multiple times a day. The successful repairs involving the terminal insulators were probably a result of eliminating air bubbles under the insulator so the redox buffer solution contacted the Pt and not the brazing rod. We did not examine the terminal insulators to determine if air bubbles formed channels by which the redox buffer solution could contact the brazing rod or to see if the insulators were porous and the bubbles provided a point of contact to the brazing rod. The latter possibility was unlikely, because the same terminal insulators were installed on the probes that properly functioned.

It was possible that the heaving sanding improved some of the unacceptable probes because an oxidized layer may have formed on the Pt during reheating when making repairs. The seven probes that were not successfully repaired were disassembled by reheating and removing the terminal

insulator, which could not be easily done with the epoxy covered junction. The soldered Pt-brazing rod connections were then reheated to remove the Pt and the Pt was reused to make new probes, which saved money.

Probe Installation and Subsequent Testing

The installation of 240 probes (90 - 1.5 m deep; 150 - 0.76 cm deep) was completed in December 2001. In October 2002, probes that malfunctioned, probes suspect of malfunctioning and a select group of well-functioning probes were tested in the redox buffer solution. Two deep probes that clearly malfunctioned based on field measurements also malfunctioned in the redox buffer solution and were replaced with new probes. Two deep probes had readings that fluctuated more than the majority of the readings and two deep probes that had similar readings to the majority of the probes were tested. All four probes were acceptable in the redox buffer solution. Three shallow probes with widely fluctuating redox potentials and three shallow probes that read similar to the majority of the probes were examined. All six probes were also acceptable in the redox buffer solution. Probes that were acceptable were returned to their original location.

After the study was completed, all of the redox probes were removed and tested in the redox buffer solution. Eighty-nine of the 90 deep probes and 147 of the 150 shallow probes were acceptable after being in the field for 19 months. These results demonstrate the long-term usability of the probes with little equipment failure. These results also indicate that the thick walled terminal insulators provided a resistant, water tight seal because the deep probes were

saturated for the entire study period and only three (two at 10 months, one at 19 months) showed signs of failure.

Epoxy versus Terminal Insulators

The epoxy probes also were tested after the study was completed and all three deep and five shallow probes were acceptable after seven months of use. The redox potentials measured with the epoxy probes and adjacent terminal insulator probes were compared over the time period that the epoxy probes were in use (December 2002 – June 2003) (Figure 4). The average deep redox potentials measured with the epoxy probes was 23 mV (+/- 85 mV) (n=3) and -152 mV (+/- 49 mV) (n=3) with the terminal insulator probes. The average shallow redox potentials measured with the epoxy probes was 241 mV (+/- 189 mV) (n=5) and 161 mV (+/- 65 mV) (n=5) with the terminal insulator probes. These results show a slight difference between redox potential measurements made with the deep epoxy probes and the terminal insulator probes; however the redox potentials were similar between the methods at the shallow depth. The small sample sizes prohibited the use of statistics to determine the significance of differences between the construction methods.

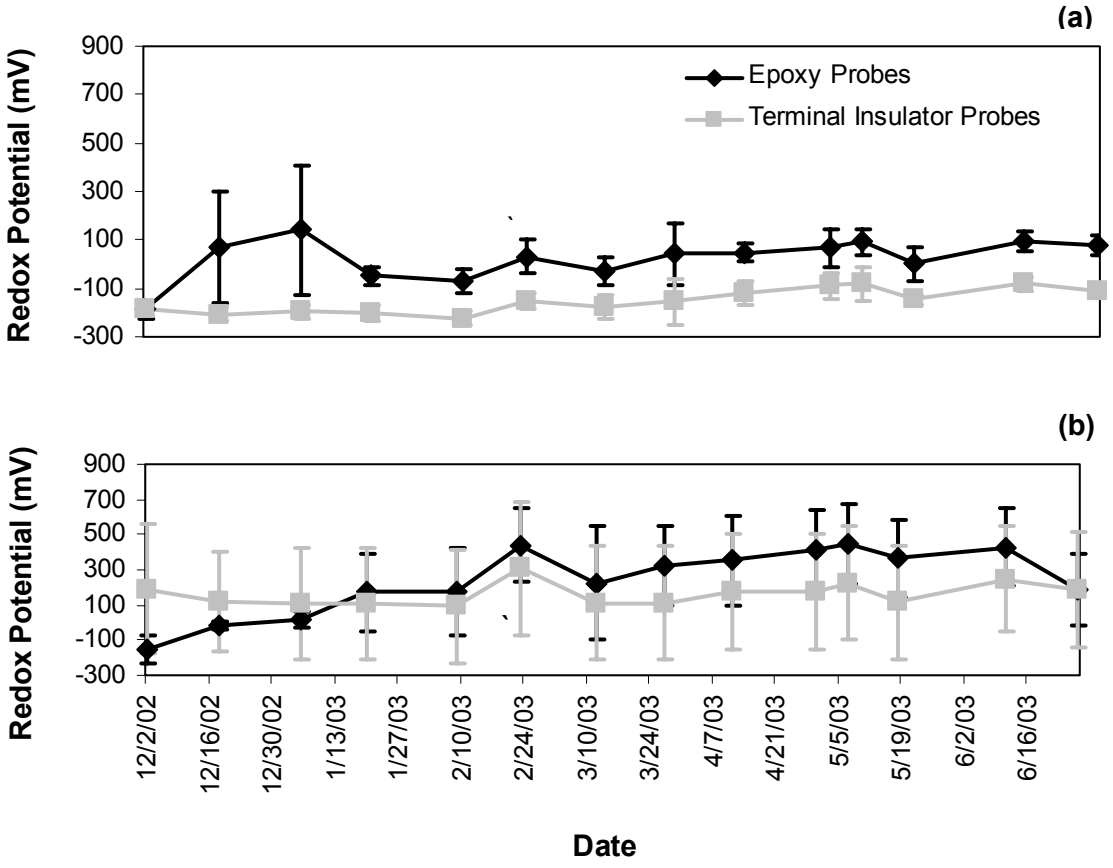


Figure 4. Average redox potential (+/- one standard deviation) from the epoxy and terminal insulator methods for the deep (a) and shallow (b) redox probes.

Conclusions

The revised redox probe construction method presented in this paper is a simple technique that allows for frequent testing and repairs of probes during manufacturing. Redox potential measurements made using the terminal insulator probes were similar to those made with probes constructed using the more common epoxy method. After being in the field for 19 months, 236 of the 240 terminal insulator probes worked satisfactorily. These results indicate that the revised construction method presented in this paper produces reliable, long-

lasting redox probes that are simpler to construct than those made using other current techniques.

Bibliography

Bohn, H.L. 1971. Redox potentials. Soil Science. 112(1):39-45.

Faulkner, S.P., H.W. Patrick, Jr., and R.P. Gambrell. 1989. Field techniques for measuring wetland soil parameters. Soil Sci. Soc. Am. J. 53:883-890.

Gambrell, R.P., J.W. Gilliam, and S.B. Weed. 1975. Denitrification in subsoils of the North Carolina Coastal Plain as affected by soil drainage. JEQ 4(3):311-316.

Gambrell, R.P., and W.H. Patrick, Jr. 1980. Chemical and microbiological properties of anaerobic soils and sediments. p. 375-413. *In* D.D. Hook et al. (ed.) Plant Life in Anaerobic Soils and Sediments. Ann Arbor Science Publishers, Inc. Ann Arbor, MI.

Gambrell, R.P., R.D. Delaune, and W.H. Patrick, Jr. 1991. Plant life under oxygen deprivation. p. 101-117. *In* M.B. Jackson et al. (ed.) Plant Life Under Oxygen Deprivation: Ecology, Physiology and Biochemistry. SPB Academic Publishing, The Hague, The Netherlands.

Jacobs, T.C., and J.W. Gilliam. 1983. Nitrate loss from agricultural drainage waters: Implications for non-point source control. Report No. 209. Water Resources Research Institute of The University of North Carolina. Raleigh, NC.

Jordan, T.E., D.L. Corell, and D.E. Weller. 1993. Nutrient interception by a riparian forest receiving inputs from adjacent cropland. J. Environ. Qual. 22:467-473.

Letey, J., and L.H. Stolzy. 1964. Measurement of oxygen diffusion rates with the platinum microelectrode. I. Theory and equipment. Hilgardia. 35(20):545-554.

Light, T.S.1972. Standard solution for redox potential measurements. Anal. Chem. 44: 1038-1039.

Mann, L.D., and L.H. Stolzy. 1972. An improved construction method for platinum microelectrodes. Soil Sci. Soc. Amer. Proc. 36:853-854.

Meek, B.D., A.J. MacKenzie, and L.B. Grass. 1968. Effects of organic matter, flooding time, and temperature on the dissolution of iron and manganese from soil *in situ*. Soil Sci. Soc. Amer. Proc. 32:634-638.

Mueller, S. C., L. H. Stolzy, and G. W. Fick. 1985. Constructing and screening platinum microelctrodes for measuring soil redox potential. Soil Science. 139(6):558-560.

Pang, H., and T.C. Zhang. 1998. Fabrication of redox potential microelectrodes for studies in vegetated soils or biofilm systems. Eviron. Sci. Technol. 32:3646-3652.

Ponnamperuma, F.N. 1972. The chemistry of submerged soils. p. 29-88. *In* N.C. Brady (ed.) Advances in Agronomy. Academic Press, NY, NY.

Wafer, C.C. 2004. Effect of Shrub Buffers, No-Till Production and Cropping Systems on Shallow Groundwater Nitrate-N Concentrations in Eastern North Carolina. M.S. thesis. NC State University, Raleigh.