**ABSTRACT**

KING, SCOTT EDWIN. Riparian Buffer Effectiveness in Removing Groundwater Nitrate as Influenced by Vegetative Type. (Under the direction of Dr. Deanna L. Osmond.)

Nonpoint source contributions of nitrogen, particularly from agriculture, have become a serious concern for many watersheds in North Carolina. Recent regulatory action has increased the implementation of various best management practices (BMPs), particularly riparian buffer zones, for the purpose of reducing groundwater $NO_3$-N pollution. However, the best design for such buffers has been the subject of great debate. The objectives of this project were to evaluate the relative effects of buffer vegetation and width on groundwater $NO_3$-N removal and to determine if denitrification was the process most responsible. The main project consisted of four identically-designed buffer replications located on a farm in the Coastal Plain of North Carolina.

The influence of vegetative type on buffer $NO_3$-N concentration decreases were as follows; trees had an average decrease of 57% (from 8.79 to 3.78 mg $NO_3$-N $L^{-1}$), fescue had a decrease of 40% (from 6.33 to 3.77 mg $NO_3$-N $L^{-1}$), switchgrass had a decrease of 44% (from 5.52 to 3.09 mg $NO_3$-N $L^{-1}$), native vegetation had a decrease of 37% (from 6.47 to 4.07 mg $NO_3$-N $L^{-1}$), and the no-buffer control had a decrease of 27% (from 4.93 to 3.62 mg $NO_3$-N $L^{-1}$). These calculations are averages for each vegetation type from all of the wells from both widths and depths from all four buffer replications.

For the 8 m buffer width, a total average $NO_3$-N concentration decrease of 12% (from 9.97 to 8.75 mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 54% (from 5.26 to 2.41 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth. For the 15 m buffer width, a total average $NO_3$-N concentration decrease of 59% (from 6.42 to 2.61

mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 75% (from 4.31 to 1.06 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth.

Despite these apparent observed differences in the $NO_3$-N concentration decreases, there were no overall statistically significant differences ($p>0.05$) between any of the vegetation types or between the two buffer widths or depths. The lack of significance is due to the variability of the results observed between the four buffer replications.

An evaluation for buffer dilution using $NO_3$-N/Cl ratio comparisons revealed that dilution appears to be a slight, if not inconsequential, factor in observed $NO_3$-N concentration decreases. Redox monitoring probe results revealed low redox potential (Eh) values, indicating that substantial denitrification potential was present in all three of the buffer replications evaluated for redox. Dissolved organic carbon (DOC) concentrations indicate that the site has relatively low carbon present (overall average 3.1 mg $L^{-1}$) and is considered to be an important limiting factor in the overall nitrate removal ability of the buffers.

Additionally, a second riparian buffer study was conducted on a farm in the North Carolina Mountains to compare vegetative effect with the Coastal Plain. This buffer, with four vegetative treatment types of shrubs, fescue, native vegetation, and a no-buffer control was installed in April 2004 after one year of pre-buffer groundwater monitoring. Preliminary results are mixed and may be the result of significant preferential groundwater flow paths caused by the very rocky nature of the soil on site. However, the vegetation is not yet fully established in the buffer and the monitoring will continue in an effort to determine if any $NO_3$-N removal trends develop between the vegetation types.

# RIPARIAN BUFFER EFFECTIVENESS IN REMOVING GROUNDWATER NITRATE AS INFLUENCED BY VEGETATIVE TYPE

by
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## DEDICATION

This thesis is dedicated to my father who taught me from an early age to appreciate the outdoors and encouraged my curiosity as to how it all worked. He, more than anyone else, would have been most sincerely eager to read this paper, and would have had more questions for me than anyone but my own committee.

I also owe him an apology for the teasing I repeatedly gave him over the years for never quite turning in his own dissertation. As it turns out, these things are more difficult to complete than one might think and I, unlike him, wasn't even married with two children, working full time, and in the National Guard. Sorry dad!

## BIOGRAPHY

Scott King was born to parents living in graduate student housing just off campus in Tuscaloosa, Alabama where he lived until the age of 10. After his father rejoined the U.S. Army after teaching high school for several years, Scott moved to Hampton, Virginia and then to Woodbridge, Virginia, where he went to High School. After graduating from The College of William and Mary with a degree in biology, he set off to backpack Europe, settling in Prague, Czech Republic for a year. Returning home, he tried living and working in Missoula, Montana, then a year in San Francisco, California, then back to Hampton, always finding steady work in the environmental consulting field.

In 2002, however, the international traveling bug struck Scott again and he backpacked throughout Australia, New Zealand, and Southeast Asia for 9 months. Upon returning home, Scott decided that graduate school was the next step to take in order to fill some holes in his academic background with regards to the environmental sciences. He applied to NC State after interviewing with Dr. Deanna Osmond, and hasn't regretted it since!

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First off, I would like to express my deepest gratitude to Wesley Childres, the technician who cheerfully assisted me in my entire sampling effort in both the heat and humidity of summer and the in cold rains of winter, despite always having an early morning start time.  Thanks Wes, you made many a potentially tough day in the field downright fun.

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### LITERATURE REVIEW

### History

In the 1980's and 90's, a series of high profile environmental incidents occurred in the Neuse River in eastern North Carolina resulting in greater public and legislative interest in the quality of rivers and estuaries in the State. The incidents often involved algal blooms with their associated decreases in oxygen and occasional fish kills. The blooms were largely blamed on excessive nutrient concentrations, particularly nitrogen, from multiple sources, including agriculture. Declining water quality lead the State to designate the watershed as nutrient sensitive in 1993. Eventually, due to continued concern for the river's health, the Neuse Rules for nitrogen reduction were established in 1998 by the NC Environmental Management Commission. The Rules are comprised of multiple strategies designed for the purpose of achieving a 30% reduction in nitrogen in the Neuse River over a five-year period. The primary strategies include the use of nutrient management plans, the installation of best management practices (BMPs) such as riparian buffers and controlled drainage structures, or a combination of these, with localities given the authority to decide which among them was preferred to achieve a local nitrogen reduction.

Riparian buffers, a common BMP, are simply vegetated strips of land adjacent to a waterway. The Neuse Rules set the overall width of these buffers at 50 feet (ft), with the 30 ft streamside portion (Zone 1) consisting of forested land and the 20 ft landward portion (Zone 2) consisting of grass species. The Rules also restrict the landowner's activities in the buffers, to protect both the health and functionality of the buffer.

However, there is much debate among the public, legislators, scientists, and the agricultural producers themselves, as to the relative effectiveness of the buffers as described in the Rules. Further research is needed to better determine the ideal design of such a commonly used practice to ensure that the nitrogen reduction function of these buffers are being met without needlessly burdening agricultural producers.

**Nutrient Removal**

Vegetated riparian buffers are recognized to reduce pollutant loading into adjacent waterways from both surface and groundwater sources. For surface flow, the vegetation in the buffer acts as a physical restraint on flow velocity, in particular helping remove both sediment and with it, associated phosphorus (Daniels and Gilliam, 1996; Abu-Zreig et al., 2003). Buffers have also been demonstrated to aid in streambank stabilization (Wynn et al., 2004), thus helping to reduce erosion and sedimentation, as well as providing other benefits like pathogen degradation (Tate et al., 2004) and wildlife habitat (Wenger, 1999; Osmond et al., 2002; Smith, 2005).

However, the focus of this investigation is on groundwater flow, for which the primary nutrient of concern is nitrate pollution. As nitrogen (N) is added to fields either as agricultural fertilizer or from animal waste, it is largely transformed into nitrate N ($NO_3$-N), if not already in that form. Nitrate is readily water soluble and can quickly leach down into the soil and enter the groundwater, then flow out into adjacent waterways. Riparian buffers have repeatedly been demonstrated to improve water quality by helping to promote the removal of $NO_3$-N in groundwater (Lowrance et al., 1984; Peterjohn and Correll, 1984 Gilliam, 1994; Simmons et al., 1992; Hill, 1996; Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Hubbard et al., 1998; Wafer, 2004; Smith, 2005). However, the success with which they have demonstrated this reduction has varied among the literature and has been attributed to different factors.

Studies have shown that buffer groundwater $NO_3$-N concentration decreases can be very high but nevertheless range between 10 and 100% (Haycock and Pinay, 1993; Gilliam et al., 1997; Osborne and Kovacic, 1993), although most demonstrated decreases are on the higher end of the range. Many studies acknowledged that several factors help determine $NO_3$-N removal but nevertheless attempted to identify the most important factor responsible for the removal.

Many studies particularly looked at the hydrogeologic setting of buffers for explanations of their $NO_3$-N removal ability. Some suggest that a shallow horizontal groundwater flow path above an impermeable layer is needed to ensure denitrification by increasing groundwater residence time in the upper horizons of a buffer's soil (Hill, 1996; Lowrance et al., 2000). By comparison, buffers adjacent to deeply incised streams have demonstrated lower $NO_3$-N removal due to groundwater flowing too far below the buffer (Kunickis, 2000). Another study made a similar observation, noting that nitrate-rich groundwater bypassed the upper layers of a low conductivity peat (with its high denitrification potential), preferring instead to flow through the deeper but coarser textured and high conductivity sand layers into the adjacent river, thus bypassing the organic-rich peat layers and showing little $NO_3$-N removal (Devito et al., 2000). One study also found that soil texture affects nitrate removal, observing much lower denitrification rates in well drained sandy soils as compared with poorly drained clay loam soils (Groffman and Tiedje, 1989). However, they concluded this was the result of the differences in soil oxygen concentrations as a result of the varying drainage rates between the textures, as the clay loam soil held water longer and was thus anaerobic longer. Fennessy and Cronk (1997) noted that increased reliance on artificial drainage, such as tile drains, in agricultural fields helps to speed up groundwater flow and thus provides less opportunity for nitrate removal.

Other factors have also been cited in influencing buffer $NO_3$-N removal effectiveness. Low pH levels ($pH < 5$) had once been thought to inhibit denitrification, but studies have shown that significant denitrification can occur in soils with a pH as low as 3.8 provided they contain enough organic carbon (Waring and Gilliam, 1983). Another study concluded that in a buffer with very high denitrifying conditions, $NO_3$-N was actually the limiting factor for denitrification (Hunt et al., 2004), a view confirmed by Fennessy and Cronk (1997) when they noted that several studies have reported that increased nitrate removal rates result from greater nitrate loading rates in subsurface flow. However, the most commonly identified critical factor in determining the success of buffer zones in removing groundwater $NO_3$-N was the presence of an adequate carbon source, which will be discussed separately.

Adding to the general debate, a range of denitrification rates can often be found within an otherwise similar area or section of soil. This is often explained as being due to localized pockets of denitrification found in microsites located in the soil column (Gilliam et al., 1997). That is, small portions of the soil that have, for example, more organic carbon or are more saturated or reduced than the surrounding soil will experience increased rates of denitrification from adjacent soil.

The manner of $NO_3$-N removal is commonly attributed to two methods, microbial denitrification and direct plant uptake. Denitrification, considered the preferred treatment type, is the microbial-induced chemical reduction of nitrogen from $NO_3$-N to a gaseous form such as $N_2$, $N_2O$, NO, and $NH_3$ (Walker et al., 2002; Vose et al., 2005). Ideally, it is reduced to harmless $N_2$ gas, whereupon it is released into the atmosphere. Yet, direct plant uptake has also been demonstrated as being quite effective in removing groundwater $NO_3$-N (Lowrance, 1992). However, this removal is not permanent as the plant will eventually release the N back into the buffer when it sheds biomass from leaves and stems for example, or when it dies (Groffman et al., 1991). Plants are also unable to remove much $NO_3$-N in the winter months when they are dormant, as opposed to microbial denitrification, which in warmer climates such as those found in the U.S. Southeast, is still able to remove significant groundwater $NO_3$-N (Gilliam, 1994). Plant uptake may also be inhibited if either the water table is too shallow to reach the root zone, or if the plant roots cannot grow deep enough to reach the groundwater. Denitrification is most often cited as the most dominant of the two $NO_3$-N removal processes (Pinay et al., 1993; Fennessy and Cronk, 1997; Jacobs and Gilliam, 1985; Ricks, 2002; Smith, 2005; Wafer, 2004). However, one study has questioned that belief, citing plant uptake as the more dominant (Lowrance, 1992). Gilliam (1994) suggests that a variety of localized factors determine which process dominates for any given site.

Finally, in studying $NO_3$-N removal, it is important to consider whether or not simple dilution is responsible for any observed $NO_3$-N reduction across a given buffer. That is, if an upwelling or input of water is present in the buffer groundwater, then the decrease in $NO_3$-N concentration may simply be the result of the addition of water to the system, not a removal of $NO_3$-N (Altman and Parizek, 1995). To evaluate this possibility, a ratio of $NO_3$-N concentration to chloride (Cl) concentration ([$NO_3$-N] / [Cl]) is compared from the wells before and after the buffer. Chloride is considered a naturally conservative element, not readily removed from the groundwater. Thus, if the ratio remains relatively unchanged, then dilution may be present, while if the ratio decreases, it implies that actual $NO_3$-N removal is occurring in the buffer. However, if dilution was caused by a groundwater source containing a substantial amount of Cl and/or $NO_3$-N, then the results would vary, and could even imply $NO_3$-N removal where none actually occurred. The analysis conducted for this study assumes that any dilution occurring on the site is from uncontaminated groundwater.

**Dissolved Organic Carbon**

Organic carbon is crucial to the process of denitrification as it is the food source consumed by those microbes that, under appropriate conditions, can reduce $NO_3$-N to $N_2$ and other N gases. Numerous studies have implied that a lack of a carbon source can be the most important limiting factor in denitrification (Starr and Gillham, 1993; Obenhuber and Lowrance, 1991; Lowrance and Smittle, 1988; Bradley et al., 1992; Smith, 2005; Hill et al., 2000; Schnabel et al., 1996). Dissolved organic carbon (DOC) concentrations of ±7 to 10 mg C/L were demonstrated to promote high rates of $NO_3$-N reduction through denitrification, while DOC concentrations of ±4 mg/L demonstrated relatively low rates of $NO_3$-N removal (Obenhuber and Lowrance, 1991; Starr and Gillham, 1993; Gilliam - personal communication, 2005). An attempt has been made recently to classify various types of soil organic matter (SOM) by their ability to influence microbiological activity in an effort to better evaluate the denitrification potential of specific locations or soils (Blazejewski et al., 2005).

In general, organic carbon availability decreases with depth for well-drained locations, such as at the site presented in this research. However, in soils with a high water table, carbon breakdown is deterred and can result in comparatively higher DOC concentrations (Starr and Gillham, 1993). One study revealed that in areas where the only appreciable organic matter content was in the upper soil horizon, a seasonally high water table was observed to expose the groundwater $NO_3$-N to this carbon-rich source with a high denitrification rate resulting (Simmons et al., 1992). This demonstrates that even a soil with a relatively low organic matter content and water table can still achieve significant $NO_3$-N removal, even if only seasonally. However, a high seasonal water table is not always required to have a high denitrification potential. One recent study demonstrated that saturated but buried organic-rich layers, common in alluvial areas, can provide adequate organic carbon for a considerable groundwater denitrification rate, despite having an overall water table fluctuation that did not reach the superior organic-rich surface horizons (Hill et al., 2004).

**Vegetation Type**

The vegetation species selected for establishment in buffers has been of particular cause for debate. Historically, the two most common vegetation types have been grass and forested buffers. Previous studies have demonstrated that both high and low levels of denitrification occur in grass and forested buffers. Some researchers observed a generally greater $NO_3$-N removal in forested buffers (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Hefting and Klein, 1998), while some observed greater removal in grass buffers (Schnabel et al., 1996; Lowrance et al., 1995).

Still other studies have suggested that vegetation does not seem to have any significant effect in determining the rate of denitrification for a buffer (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Dukes, 2000; Ricks, 2002; Hubbard et al., 1998; Lowrance et al., 2000; Addy et al., 1999). However, it is nevertheless widely believed that vegetation can directly determine the amount of organic carbon present in a buffer through direct organic matter deposition over time from both above and belowground sources (Fennessy and Cronk, 1997). Forested buffers have historically been considered superior in this regard. For example, Haycock and Pinay (1993) concluded that higher denitrification rates observed in forested buffers over grass buffers were the result of their higher carbon contribution to the buffer's soil. In contrast, deep rooting plants, like certain prairie grasses, have been studied for buffer use on the supposition that their roots might actually contribute more organic carbon to deeper portions of the soil, and because they might be able to directly take up more $NO_3$-N by virtue of simply being able to reach deeper groundwater than other types of plants (Iowa State ext. pub., 1996). One recent study observed very high denitrification rates for a shrub buffer consisting of a mix of native species (Wafer, 2004).

Beyond denitrification potentials, vegetation type may influence other water quality factors such as stream bank erosion where forested systems appear to provide superior protection (Wynn et al., 2004), or for sediment removal where grass or shrub systems appear superior (Osmond and Gilliam, 2002). Different vegetation may also increase a buffer's usefulness with regard to providing wildlife habitat for various birds or mammals, perhaps even benefiting fish and amphibians by providing shade to the adjacent stream (Wenger, 1999; Smith, 2004).

Some agricultural producers feel that forested buffers, a common historically preferred choice, compete too much for water and fertilizer, shade crops from sunlight, and require too much maintenance to establish (Gilliam et al., 1997). Thus, further study of the effectiveness of various species is important as more expensive, difficult, and objectionable buffer types might continue to be established where less objectionable types might actually be of equal or superior effectiveness.

**Buffer Width**

There is debate regarding the ideal buffer width required for maximum effectiveness. Given that there are a variety of factors influencing buffer effectiveness for a given location, including soil texture (which affects water flow rates and thus, buffer retention times), the presence of organic carbon, and depth to water table, it is not too surprising to see that studies have shown mixed results in attempting to identify an ideal buffer width (Wenger, 1999).

Wider buffers have historically been considered superior to narrower buffers in reducing groundwater $NO_3$-N concentrations (Petersen et al., 1992; Fennessy and Cronk, 1997). Yet, other studies have shown that under more ideal conditions, with plenty of organic carbon and a shallow groundwater table, very high reduction rates can be obtained in relatively narrow buffers (Osborne and Kovacic, 1993; Wafer, 2004; Jordan et al., 1993; Smith, 2005; Jacobs and Gilliam, 1985). In observing wider buffers, some studies revealed that most of the denitrification in the buffer occurred in the initial ±20 m portions (Peterjohn and Correll, 1984; Griffith et al., 1997), or even in the initial 5-10 m portion (Lowrance et al., 2000; Haycock and Pinay, 1993). Additionally, and with regards to just surface runoff, one report stated that most of a buffer's filtering potential was observed within the first 25 meters (NCASI, 2000). Wider buffers could also provide other benefits. For example, if part of a buffer's value is the creation of habitat and other protections for wildlife, a wider buffer would therefore be of superior value (Castelle et al., 1994).

Despite the difficulty in establishing effective ideal buffer widths, it remains a very important goal as every acre of buffer established removes an acre from agricultural production. Also, depending on the type of vegetation established in the buffer, increased width means a subsequent increase both in time and cost for any planting or maintenance requirements for the buffer.

**References**

Abu-Zreig M., R.P. Rudra, H.R. Whiteley, M.N. Lalonde, and N.K. Kaushik. 2003. Phosphorus Removal in Vegetated Filter Strips. Journal of Environmental Quality. 32:613-619.

Addy K.L, A.J. Gold, P.M. Groffman, and P.A. Jacinthe. 1999. Ground water nitrate removal in subsoil of forested and mowed riparian buffer zones. Journal of Environmental Quality. 28:962-970.

Altman, S.J. and R.R. Parizek. 1995. Dilution of Nonpoint-Source Nitrate in Groundwater. Journal of Environmental Quality. 24:707-718.

Blazejewski, G.A., M.H. Stolt, A.J. Gold, and P.M. Groffman. 2005. Macro- and Micromorphology of Subsurface Carbon in Riparian Zone Soils. Soil Science Society of America. 69:1320-1329.

Bradley, P.M., M. Fernandez, and F.H. Chapelle. 1992. Carbon Limitation of Denitrification Rates in an Anaerobic Groundwater. Environmental Science and Technology. 26:2377-2381.

Castelle, A.J., A.W. Johnson, and C. Conolly. 1994. Wetland and Stream Buffer Size Requirements – A Review. Journal of Environmental Quality. 23:878-882.

Daniels, R.B., and J.W. Gilliam. 1996. Sediment and chemical load reduction by grass and riparian filters. Soil Science Society of America Journal 60:246-251.

Devito, K.J., D. Fitzgerald, A.R. Hill, and R. Aravena. 2000. Nitrate dynamics in relation to lithology and hydrologic flow path in a river riparian zone. Journal of Environmental Quality. 29:1075-1084.

Dukes, M.D. 2000. Effect of Riparian Buffers and Controlled Drainage on Shallow Groundwater Quality in the North Carolina Middle Coastal Plain. Ph.D. Dissertation. NC State University, Raleigh.

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.

Gilliam, J.W. 1994. Riparian wetlands and water quality. Journal of Environmental Quality. 23:896-900.

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.

Groffman, P.M. and J.M. Tiedje. 1989. Denitrification in North Temperate Forest Soils: Relationships Between Denitrification and Environmental Factors at the Landscape Scale. Soil Biology and Biochemistry. 21:621-626.

Groffman, P.M., E.A. Axelrod, J.L. Lemunyon, and W.M. Sullivan. 1991. Denitrification in grass and forest vegetated filter strips. Journal of Environmental Quality. 20:671-674.

Haycock, N.E., and G. Pinay. 1993. Groundwater nitrate dynamics in grass and poplar vegetated riparian buffer strips during the winter. Journal of Environmental Quality 22:273-278.

Hefting, M.M., J.J. de Klein. 1998. Nitrogen removal in buffer strips along a lowland stream in the Netherlands: a pilot study. Environmental Pollution. 102:521-526.

Hill, A.R. 1996. Nitrate Removal in Stream Riparian Zones. Journal of Environmental Quality. 25:743-755.

Hill, A.R., K.J. Devito, S. Campagnolo, and K. Sanmugadas. 2000. Subsurface denitrification in a forest riparian zone: Interactions between hydrology and supplies of nitrate and organic carbon. Biogeochemistry. 51:193-223.

Hill, A.R., P.G.F. Vidon, and J. Langat. 2004. Denitrification Potential in Relation to Lithology in Five Headwater Riparian Zones. Journal of Environmental Quality. 33:911-919.

Hubbard, R.K., G.L. Newton, J.G. Davis, R. Lowrance, G. Vellidis and C.R. Dove. 1998. Nitrogen assimilation by riparian buffer systems receiving swine lagoon wastewater. American Society of Agricultural Engineers. 41:1295-1304.

Hunt, P.G., T.A. Matheny, and K.C. Stone. 2004. Denitrification in a Coastal Plain Reparian Zone Contiguous to a Heavily Loaded Swine Wastewater Spray Field. Journal of Environmental Quality. 33:2367-2374.

Iowa State University – Extension Publication. Pm-1626a. January 1996.

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

Jordan, T.E., D.L. Correll, and D.E. Weller. 1993. Nutrient interception by a riparian forest receiving inputs from adjacent cropland. Journal of Environmental Quality 22:467-473.

Kunickis, S.H. 2000. The Effect of Riparian Buffers with Controlled Drainage on Soil Redox Potential. Ph.D. Dissertation. NC State University, Raleigh.

Lowrance, R.R. Todd, J. Fail, Jr., O. Hendrickson, Jr., R. Leonard, and L. Asmussen. 1984a. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34: 374-377.

Lowrance, R. and D. Smittle. 1988. Nitrogen Cycling in a Multiple-Crop Vegetable Production System. Journal of Environmental Quality. 17:158-162.

Lowrance, R. 1992. Groundwater nitrate and denitrification in a Coastal Plain riparian forest. Journal of Environmental Quality. 21:401-405.

Lowrance, R., G. Vellidis, and R.K. Hubbard. 1995. Denitrification in a Restored Riparian Forest Wetland. Journal of Environmental Quality. 24:808-815.

Lowrance, R., R.K. Hubbard, and R.G. Williams. 2000. Effects of a Managed Three Zone Riparian Buffer System on Shallow Groundwater Quality in the Southeastern Coastal Plain. Journal of Soil and Water Conservation. Second Quarter: 212-220.

National Council for Air and Stream Improvement (ncasi). Technical Bulletin No. 799. Feb. 2000. Riparian Vegetation Effectiveness.

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

Osmond, D.L., and J.W. Gilliam. 2002. Agricultural Riparian Buffers. NC State Cooperative Extension. SoilFacts AG-439-38.

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.

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.

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

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

Schnabel, R.R., L.F. Cornish, W.L. Stout, and J.A. Shaffer. 1996. Denitrification in a grassed and wooded, Valley and Ridge, riparian ecotone. Journal of Environmental Quality 25:1230-1235.

Simmons, R.C., A.J. Gold, and P.M. Groffman. 1992. Nitrate Dynamic in Riparian Forests: Groundwater Studies. Journal of Environmental Quality. 21(4):659-665.

Smith, T.A. 2005. Shallow groundwater nitrate and breeding bird habitat in a riparian buffer restored by volunteer vegetation. M.S. Thesis. NC State University, Raleigh.

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

Tate, K.W., M.C. Pereira, and E.R. Atwill. 2004. Efficacy of Vegetated Buffer Strips for Retaining *Cryptosporidium parvum*. Journal of Environmental Quality. 33:2243-2251.

Vose J.M., C. Geron, J.T. Walker, K. Raulund-Rasmussen. 2005. Restoration effects on N cycling pools and processes. In: Restoration of boreal and temperate forests; Stanturf, John A., Madsen, Palle., eds. Boca Raton, FL: CRC Press: 77-94. Chapter 5.

Wafer, C.C. 2004. Effect of Shrub Buffers, Tillage and Cropping Systems on Shallow Groundwater Nitrate-N in Eastern North Carolina. M.S. Thesis. NC State University, Raleigh.

Walker, F.T, C.D. Geron, J.M. Vose, and W.T. Swank. 2002. Nitrogen trace gas emissions from a riparian ecosystem in southern Appalachia. Chemosphere. 49:1389-1398.

Waring, S.A. and J.W. Gilliam. 1983. The Effect of Acidity on Nitrate Reduction and Denitrification in Lower Coastal Plain Soils. Soil Science Society of America Journal. 47(2):246-251.

Wenger, S. 1999. A review of the scientific literature on riparian buffer width, extent, and vegetation. Institute of Ecology, University of Georgia, Athens, GA.

Wynn, T.M., S. Mostaghimi, J.A. Burger, A.A. Harpold, M.B. Henderson, and L. Henry. 2004. Variation in Root Density along Stream Banks. Journal of Environmental Quality. 33:2030-2039.

## Chapter 2: Vegetative Effect on $NO_3$-N Removal in Riparian Buffers in the North Carolina Coastal Plain


### ABSTRACT

KING, SCOTT EDWIN. Riparian Buffer Effectiveness in Removing Groundwater Nitrate as Influenced by Vegetative Type. (Under the direction of Dr. Deanna L. Osmond.)

Nonpoint source contributions of nitrogen, particularly from agriculture, have become a serious concern for the Neuse River basin in North Carolina. Recent regulatory action has increased the implementation of various best management practices (BMPs), particularly riparian buffer zones, for the purpose of reducing groundwater $NO_3$-N pollution derived from agricultural fields. However, the best design for such buffers has been the subject of great debate. The objectives of this project were to evaluate the relative effects of buffer vegetation and width on groundwater $NO_3$-N removal and to determine if denitrification was the process most responsible. The project consisted of four identically-designed buffer replications located on a farm in the Coastal Plain of North Carolina.

The influence of vegetative type on buffer $NO_3$-N concentration decreases were as follows; trees had an average decrease of 57% (from 8.79 to 3.78 mg $NO_3$-N $L^{-1}$), fescue had a decrease of 40% (from 6.33 to 3.77 mg $NO_3$-N $L^{-1}$), switchgrass had a decrease of 44% (from 5.52 to 3.09 mg $NO_3$-N $L^{-1}$), native vegetation had a decrease of 37% (from 6.47 to 4.07 mg $NO_3$-N $L^{-1}$), and the no-buffer control had a decrease of 27% (from 4.93 to 3.62 mg $NO_3$-N $L^{-1}$). These calculations are averages for each vegetation type from all of the wells from both widths and depths from all four buffer replications.

For the 8 m buffer width, a total average $NO_3$-N concentration decrease of 12% (from 9.97 to 8.75 mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 54% (from 5.26 to 2.41 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth. For the 15 m buffer width, a total average $NO_3$-N concentration decrease of 59% (from 6.42 to 2.61 mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 75% (from 4.31 to 1.06 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth.

Despite these apparent observed differences in the $NO_3$-N concentration decreases, there were no overall statistically significant differences ($p>0.05$) between any of the vegetation types or between the two buffer widths or depths. The lack of significance is due to the variability of the results observed between the four buffer replications.

An evaluation for buffer dilution using $NO_3$-N/Cl ratio comparisons revealed that dilution appears to be a slight, if not inconsequential, factor in observed $NO_3$-N concentration decreases. Redox monitoring probe results revealed low redox potential (Eh) values, indicating that substantial denitrification potential was present in all three of the buffer replications evaluated for redox. Dissolved organic carbon (DOC) concentrations indicate that the site has relatively low carbon present (overall average 3.1 mg $L^{-1}$) and is considered to be an important limiting factor in the overall nitrate removal ability of the buffers.

# INTRODUCTION

A series of high profile environmental incidents in the 1980's and 90's in the Neuse River in eastern North Carolina, including algal blooms with their occasional associated fish kills, were largely blamed on excessive nutrient concentrations, particularly nitrate ($NO_3$-N) from agriculture sources. As a result, the Neuse Rules were established in 1998 for the purpose of achieving a 30% reduction in nitrogen in the Neuse River over a five-year period. The installation of best management practices (BMPs) such as riparian buffers were a key element in the plan to achieve this reduction. Riparian buffers are simply vegetated strips of land adjacent to a waterway, designed to intercept and improve surface runoff and subsurface groundwater flow before it enters into the adjacent waterway. However, there is much debate among the public, legislators, scientists, and the agricultural producers themselves, as to the relative effectiveness of the riparian buffers. Further research is needed to better determine the ideal design of such a commonly used, yet contentious, practice.

Riparian buffers have repeatedly been demonstrated to improve water quality by helping to promote the removal of $NO_3$-N in groundwater (Lowrance et al., 1984a; Peterjohn and Correll, 1984; Gilliam, 1994; Simmons et al., 1992; Hill, 1996; Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Hubbard et al., 1998; Wafer, 2004; Smith, 2005). The success with which they have demonstrated this reduction has, however, varied among the literature and has been attributed to different factors.

Studies have shown that buffer groundwater $NO_3$-N concentration decreases can be very high but nevertheless range between 10 and 100% (Haycock and Pinay, 1993; Gilliam et al., 1997; Osborne and Kovacic, 1993), although most demonstrated decreases are on the higher end of the range. Many studies acknowledged that several factors help determine $NO_3$-N removal but nevertheless attempted to identify the most important factor responsible for the removal.

Many studies particularly looked at the hydrogeologic setting of buffers for explanations of their $NO_3$-N removal ability. Some suggest that a shallow horizontal groundwater flow path above an impermeable layer is needed to ensure denitrification by increasing groundwater residence time in the upper horizons of a buffer's soil (Hill, 1996; Lowrance et al., 2000). By comparison, buffers adjacent to deeply incised streams have demonstrated lower $NO_3$-N removal due to groundwater flowing too far below the buffer (Kunickis, 2000). One study also found that soil texture affects nitrate removal, observing much lower denitrification rates in well drained sandy soils as compared with poorly drained clay loam soils (Groffman and Tiedje, 1989). They concluded this was the result of the differences in soil oxygen concentrations as a result of the varying drainage rates between the textures. Fennessy and Cronk (1997) noted that increased reliance on artificial drainage, such as tile drains, in agricultural fields helps to speed up groundwater flow and thus provides less opportunity for nitrate removal.

However, the most commonly identified critical factor in determining the success of buffer zones in removing groundwater $NO_3$-N was the presence of an adequate carbon source. Organic carbon is crucial to the process of denitrification as it is the food source consumed by those microbes that reduce $NO_3$-N to $N_2$ and other N gases. Numerous studies have implied that a lack of a carbon source can be the most important limiting factor in denitrification (Starr and Gillham, 1993; Obenhuber and Lowrance, 1991; Lowrance and Smittle, 1988; Bradley et al., 1992; Smith, 2005; Hill et al., 2000;

Schnabel et al., 1996). Dissolved organic carbon (DOC) concentrations of ±7 to 10 mg C/L were demonstrated to promote high rates of $NO_3$-N reduction through denitrification, while DOC concentrations of ±4 mg/L demonstrated relatively low rates of $NO_3$-N removal (Obenhuber and Lowrance, 1991; Starr and Gillham, 1993; Gilliam - personal communication, 2005).

The vegetation species selected for establishment in buffers has been of particular cause for debate. Historically, the two most common vegetation types have been grass and forested buffers. Previous studies have demonstrated that both high and low levels of denitrification occur in grass and forested buffers. Some researchers observed a generally greater $NO_3$-N removal in forested buffers (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Hefting and Klein, 1998), while some observed greater removal in grass buffers (Schnabel et al., 1996; Lowrance et al., 1995). One recent study observed very high denitrification rates for a shrub buffer consisting of a mix of native species (Wafer, 2004). Still other studies have suggested that vegetation does not seem to have any significant effect in determining the rate of denitrification for a buffer (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Dukes, 2000; Ricks, 2002; Hubbard et al., 1998; Lowrance et al., 2000; Addy et al., 1999).

There is also debate regarding the ideal buffer width required for maximum effectiveness. Studies have shown mixed results in attempting to identify an ideal buffer width (Wenger, 1999). Nevertheless, wider buffers have historically been considered superior to narrower buffers in reducing groundwater $NO_3$-N concentrations (Petersen et al., 1992; Fennessy and Cronk, 1997). Yet, other studies have shown that under more ideal conditions, with plenty of organic carbon and a shallow groundwater table, very high reduction rates can be obtained in relatively narrow buffers (Osborne and Kovacic, 1993; Wafer, 2004; Jordan et al., 1993; Smith, 2005; Jacobs and Gilliam, 1985). In observing wider buffers, some studies revealed that most of the denitrification in the buffer occurred in the initial ±20 m portions (Peterjohn and Correll, 1984; Griffith et al., 1997), or even in the initial 5-10 m portion (Lowrance et al., 2000; Haycock and Pinay, 1993).

Thus, further research is needed to better determine the ideal design of such a commonly used practice. The objectives of this study were: i) to determine if vegetation type is a significant influencing factor in determining $NO_3$-N removal in riparian buffers, ii) to determine if buffer width is a significant influencing factor in determining $NO_3$-N removal in riparian buffers, and iii) to determine if denitrification is the process most responsible for the observed $NO_3$-N decreases.

## MATERIALS AND METHODS

### Site Description

This study was conducted at the Center for Environmental Farming Systems' (CEFS) Cherry Research Farm site located in the Middle Coastal Plain outside Goldsboro (Wayne County), North Carolina. This is an experimental farm operated by the NC Department of Agriculture and Consumer Service's Research Stations Division. Within the farm, four independent but identically designed buffers were selected for study (Figure 1). Each buffer is located adjacent to the farm's extensive and deeply incised drainage ditch network, which empties into the Neuse River located immediately South of the farm. The four buffer areas (identified as R1, R2N, R4W, and R5N) are each divided into two sections by width, one being the narrow, 8-m wide section, and the other the wide, 15-m section (Figures 2 and 3). Each of the two width sections are further subdivided into five separate buffer strips, each randomly selected for use for the following five experimental types: trees (mostly *Pinus taeda,* some mixed hardwoods including *Platanus occidentalis* and *Fraxinus pennsylvanica*), switchgrass (*Panicum vergatum* – variety Alamo), fescue grass (*Festuca elatior* – variety Kentucky 31), native vegetation, and a no-buffer control. The native vegetation strips were left alone and allowed to revegetate naturally in whatever species arose, mostly grass, vines (*Campsis radicans*, *Rubus sp*., *Lonicera japonica*) and weeds (*Solidago spp*.). The no-buffer control strips consisted of dairy pasture (predominantly ryegrass or clover) for buffers R4W and R5N and of adjacent crop species (predominantly either soybeans or corn) for buffers R1 and R2N. The crop and pasture fields were actively managed during the sampling period. Appendix A shows both the specific adjacent field use for each buffer by width, as well as their cropping records and fertilization rates.

The subsurface groundwater flow paths for each buffer were determined using the relative water table elevations calculated from monthly depth to water measurements along with the previously gathered survey data for all of the wells on the site. Standard 3-point survey contours were created and the results indicate that subsurface flow was generally perpendicular towards the stream in each of the buffers. However, the hydraulic gradients were often very low. There were no seasonal variations noted for any of the flow paths in any of the buffers.

The soil series' as mapped by the *Soil Survey of Wayne County, North Carolina* (Barnhill et al., 1974) at each of the buffers are as follows:

R1 – Lumbee sandy loam (fine-loamy over sandy or sandy-skeletal, siliceous, thermic Typic Endoaquults) found in the buffer, with Wickham sandy loam (fine loamy, mixed, thermic Typic Hapludults) in the adjacent field.

R2N – Nahunta very fine sandy loam (fine silty, siliceous, thermic Aeric Paleaquults) in buffer, with Wickham loamy sand in the adjacent field.

R4W – Lumbee sandy loam in the buffer, with Wagram loamy sand (Loamy, kaolinitic, thermic Arenic Kandiudults) in the adjacent field.

R5N – Weston loamy sand (coarse-loamy, siliceous, thermic Typic Endoaquults) in the eastern portion of the buffer and field, and Kalmia sandy loam (fine-loamy over sandy or sandy-skeletal, siliceous, thermic Typic Hapludults) in the western portion with some Rains sandy loam (fine-loamy, siliceous, thermic Typic Paleaquults) at the most western end.

Field sampling to confirm the soil descriptions was previously conducted for buffers R1 and R2N, and more recently for buffers R4W and R5N. Results generally confirm the soil survey's findings. See Appendix B for field profile descriptions. Of particular importance for this study, these soils are generally low in organic matter composition. Appendix B also contains the soil series organic matter composition estimates as well as previously conducted field measurements.

## Groundwater Monitoring

Each of the combined 40 buffer strips (10 per separate buffer) had two well nests installed, one located along the field edge of the buffer strip, and one located along the ditch edge of the buffer strip. Each well nest consisted of three wells, one shallow (0.6-

1.0 m), one intermediate (1.5-2.1 m), and one deep (2.1-3.5 m) as measured from ground surface to the top of the well screen (Figure 4). Previous studies have shown that the shallow wells are too frequently dry to be of practical use so they were not monitored for this project. The intermediate wells were placed at a depth so as to sample from the upper portion of the local shallow groundwater aquifer, while the deep wells were placed at a depth so as to sample from the lower portion of the same aquifer. All wells were made of polyvinyl chloride (PVC) and had a 0.6 m screened section below the bottom of the well. Additionally, four well nests per buffer (two nests per width) were installed in the adjacent fields, 15 m away from the edge of the buffers, to obtain samples from the fields for comparative purposes. The results for these wells can be found in Appendix A alongside the adjacent field use data.

Each of the intermediate and deep wells were sampled monthly starting in December 2003 and ending in August 2005. Samples were collected in 40 ml acid-washed glass bottles using an Isco150 Well Pump brand peristaltic pump after having purged the well of three well volumes. Adjacent stream samples were also taken at each buffer, with the results found in Appendix D. All samples were kept on ice until they reached the laboratory. Once there, the samples were filtered using 0.45 μm Durapore brand filters then acidified to pH 2 with a 5% $H_2SO_4$, solution and stored at 4° C in a cold room until analyzed.

The samples were originally analyzed for nitrate ($NO_3$-N), ammonium ($NH_4$-N), phosphate ($PO_4$-P), chloride (Cl), and dissolved organic carbon (DOC) by the Analytical Services Laboratory in the Soil Science Department at NC State University. However, analysis of ammonium ($NH_4$-N) was terminated after two months due to consistently low values at or below the detection limit. The lab used a Lachat Instruments QuikChem brand 8000 Automated Ion Analyzer to measure $NO_3$-N, $NH_4$-N, and $PO_4$-P. A Haack-Buchler Digital Chloridometer was used to measure chloride. A Shimadzu Total Organic Carbon Analyzer 5050 was used to measure DOC. Prior to sampling, the depth to water table was also measured for each well using a Solinst brand water level meter.

## Redox Potential Monitoring

Redox potential monitoring was conducted using previously installed platinum tipped redox probes for buffers R1, R2N, and R4W. Three deep (300 cm) and three intermediate (152 cm) depth probes were located near a salt bridge by each monitoring well station in each buffer. Each salt bridge consisted of an open-bottomed tube filled with a KCl saturated agar solution and functions as an aid in establishing an electrical connection between the soil and redox probes. The probes and salt bridges were installed in stages by Kunickis (2000) and Ricks (2002) for their respective studies located on site.

The voltage potential measurements were taken by connecting one end of an Accumet Portable (AP 62) pH/mV meter to the redox probes and the other end to the salt bridge using a Jensen Instruments Ag/AgCl reference electrode (Figure 5). The reference electrode was placed directly into the gelatinous KCl solution in the salt bridge. The resulting connection results in the formation of a potential electrical circuit between the salt bridge and redox probe going through the earth. The portable mV meter recorded the resulting potential voltage present in the circuit. In general, the more positive numbers indicated more oxidized soil conditions, while more negative numbers indicate more reduced soil conditions. The redox potential voltages were averaged for each depth and the standard correction factor of +200 mV was added to each to compensate for the potential of the reference electrode itself.

Using the soil pH values previously measured, and subsequently confirmed, in the field, an established reduction sequence diagram was then used to determine at what approximate soil redox potential denitrification is expected to occur. Using the buffers'soil pH of around 5.20, denitrification is expected at potentials below approximately 350 mV while oxidation is expected above 350 mV (McBride, 1994; Essington, 2004; Vepraskas - personal communication, 2005). However, this mV value is not a hard cut-off point for denitrification. It really represents more of a focal point around which a gradient of denitrification rates is expected to occur. Thus, as Eh values decrease below 350 mV, an increase in denitrification is expected, and as Eh values increase above 350 mV, a decrease in denitrification is expected, eventually ceasing altogether at around 600 mV (Gilliam - personal communication, 2005).

### Dilution

A comparison of $NO_3$-N to chloride (Cl) concentration ratios were made between the field-edge and ditch-edge wells to determine if a dilution effect was causing any observed decreases in $NO_3$-N concentration. Chloride is considered a conservative element with respect to groundwater, so if the $NO_3$-N/Cl ratio remains constant across the buffer, it implies that water has been added to the groundwater, not having had $NO_3$-N removed from it. Thus, if we were to observe a 50% $NO_3$-N concentration decrease across a given buffer plot, then we would expect the $NO_3$-N/Cl ratio to also decrease by about 50% if there was true $NO_3$-N removal. However, if the ratio remained the same we might suspect that dilution was responsible for the observed $NO_3$-N concentration decrease, while if the ratio only decreased by about 20%, we might consider the possibility that some true removal was taking place along with some dilution.

Dilution may also be caused by a groundwater source containing a substantial amount of Cl and/or $NO_3$-N, in which case the results would vary and could even imply $NO_3$-N removal where none actually occurred. The analysis conducted for this study assumes that any dilution occurring on the site is from uncontaminated groundwater, which is more likely a better assumption with regards to deep groundwater than shallow groundwater.

## Statistical Analysis

Statistical analysis for the data was performed using the SAS software program. PROC MIXED was used for the $NO_3$-N analysis. The data were approximately normal and so no transformations were required. Analyses were conducted for the response variable of relative $NO_3$-N percent reduction differences (field-edge wells minus ditch-edge wells divided by the field-edge wells).

PROC MIXED was also used for the dissolved organic carbon (DOC) analysis. The data were not normally distributed (skewed to the right) and were logarithmically transformed prior to evaluation. Mean DOC was determined by averaging the DOC concentrations of all of the ditch-edge wells for either a given width or vegetation type.

# RESULTS AND DISCUSSION

## Groundwater Monitoring Results

### *Influence of Vegetative Type*

The influence of vegetative type on buffer $NO_3$-N concentration decreases were as follows; trees had an average decrease of 57% (from 8.79 to 3.78 mg $NO_3$-N $L^{-1}$), fescue had a decrease of 40% (from 6.33 to 3.77 mg $NO_3$-N $L^{-1}$), switchgrass had a decrease of 44% (from 5.52 to 3.09 mg $NO_3$-N $L^{-1}$), native vegetation had a decrease of 37% (from 6.47 to 4.07 mg $NO_3$-N $L^{-1}$), and the no-buffer control had a decrease of 27% (from 4.93 to 3.62 mg $NO_3$-N $L^{-1}$). These calculations are averages for each vegetation type from all of the wells from both widths and depths from all four buffer replications (Figure 6).

Yet despite these apparent observed differences in the $NO_3$-N concentration decreases, there were no statistically significant differences ($p>0.05$) between any of the vegetation types. This is due to the fact that there was no consistent vegetation effect observed for every replication. Adding to the difficulty of analysis was the fact that while general $NO_3$-N concentration results were fairly consistent within each individual buffer replication, there was great variability in concentration levels between the replications. Taken individually, however, each buffer replication had some significant vegetation effect ($p<0.05$), yet no single vegetation effect was consistently observed between any of the replications.

The results generally corroborate previous research conducted at this site, although the recently observed average reductions tend to be slightly greater than those previously reported. Table 1 shows a comparison of results from the current study to those of Dukes (2000) and Ricks (2002). Note that Ricks' study was only conducted for buffers R1, R2N, and R4W.

| Table 1. Previous study comparisons of $NO_3$-N reduction by vegetative type. | | | | | |
|---|---|---|---|---|---|
| Study | Trees | Fescue | Switchgrass | Native Vegetation | Control |
| Dukes (2000) Includes R5N | 49% | 37% | 33% | 32% | 35% |
| Current Includes R5N | 57% | 40% | 44% | 37% | 27% |
| Ricks (2002) Excludes R5N | 48% | 48% | 41% | 33% | 32% |
| Current Excludes R5N | 56% | 43% | 48% | 33% | 27% |

A possible explanation for the general increase in reduction percentages for the site, particularly for the tree vegetation type, could be the continued maturation of the vegetation in the buffers. While not statistically significant yet, these differences could be part of a trend that over time will reveal significant vegetation differences. Lowrance (1992) implied it may take up to 20 years for a riparian forest to become an effective N sink, while stating in another study (Lowrance et al., 1995) that the $NO_3$-N removal ability of newly restored forested buffers would not be realized in the near term (defined in that study as 2 years after restoration).

Another possible explanation for why the trees have a higher removal average (though not statistically significant) might be due to the disproportionately higher average $NO_3$-N input for the tree plots, primarily due to buffer R4W. In that buffer, higher $NO_3$-N input concentrations, as measured in the field-edge wells, were generally found for the 8 m width, with the highest found in the intermediate depth. By chance of this particular buffer design, the tree plots here were arranged such that they had the greatest overall $NO_3$-N input. Higher input rates have often been associated with higher removal rates

(Fennessy and Cronk, 1997; Haycock and Pinay, 1993). However, while this trend is generally observed for the overall vegetative type comparisons, it is not consistently observed in each of the buffer replications, nor is this trend observed for the overall buffer width and depth comparisons. Still, other factors such as soil saturation or organic carbon levels might explain why buffer width and depth removal rates do not follow this trend.

The results observed for this site are not surprising or unusual for such buffer studies. However, most other studies do generally report greater reduction rates, although they tend to use much wider buffers. For example, Jordan et al. (1993) found ±95% reduction rates across a 60-m forested buffer (though that reduction occurred in the first 30-m of the buffer), and Hanson et al. (1994) found ±77-94% removal rates across a 31-m wide forested buffer. Still, those studies that had more similar width buffers also often reported higher removal rates; Haycock and Pinay (1993) found ±84% reductions across a 17-m grass buffer, and Osborne and Kovacic (1993) reported reduction rates greater than 90% across 16-m forested buffers.

Numerous other studies have found similar overall $NO_3$-N removal rates as compared to the subject site; Lowrance et al. (1984b) found ±54% reductions across ±25-m forested buffers, Peterjohn and Correll (1984) found ±60% removal rates for the first 19-m of a forested buffer, and Osborne and Kovacic (1993) cited results in which ±10-60% reduction rates were observed for a 27-m grass buffer and ±40-90% reduction rates were observed for a 19-m forested buffer. With respect to vegetative type, several studies have also found that forested buffers are superior in $NO_3$-N removal as compared with grass buffers (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Hefting and Klein, 1998).

However, when considering all of the above studies and their results regarding width and vegetative type, it is important to consider the particular landscape or hydrogeologic position upon which they were conducted before drawing any absolute conclusions. Many of these studies were conducted on more gently sloping buffers that gradually connect into a riparian area as compared to the current subject site with its deeply incised ditches. Thus, these landscape positional differences may be the best explanation for the differences in the width and vegetative type results between the various studies.

For the full set of data for vegetation type please see Appendix E.

***Influence of Buffer Width***

For the 8 m buffer width, a total average $NO_3$-N concentration decrease of 12% (from 9.97 to 8.75 mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 54% decrease (from 5.26 to 2.41 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth. For the 15 m buffer width, a total average $NO_3$-N concentration decrease of 59% (from 6.42 to 2.61 mg $NO_3$-N $L^{-1}$) was observed for the intermediate well depth, while a 75% decrease (from 4.31 to 1.06 mg $NO_3$-N $L^{-1}$) was observed for the deep well depth (see Figure 7).

Despite the apparent overall observed differences between $NO_3$-N concentration decreases, there were no statistically significant differences ($p>0.05$) between the 8 m and 15 m buffers or between the intermediate and deep well depths. Again we find that data variability and inconsistencies in trends among the buffer replications are the causes for the lack of significance. However, within each individual replication there was frequently a significant width and/or depth effect observed. For example, in buffer replications R1, R2N, and R4W, the 15 m wide buffers all show significantly greater $NO_3$-N reductions ($p<0.05$) as compared to their respective 8 m widths, and within those 15 m buffers, the deep wells all showed significantly greater $NO_3$-N reduction ($p<0.05$) as compared to the intermediate wells.

The observed average differences between the buffer widths (while not significant) is not surprising and can be explained by the fact that the additional width provides a longer $NO_3$-N residence time within the buffer for potential removal to occur, as well as potentially providing greater organic carbon to the system from the greater vegetation mass that would aid the process of denitrification. As previously noted, several other studies have also observed removal rates similar to this project site with similar width buffers, and many studies have also observed greater removal rates associated with wider buffers. Those studies that reported substantially greater $NO_3$-N removal rates across similar or narrower width buffers as compared to the subject site typically had greater average organic carbon levels and/or a higher water table (Haycock and Pinay, 1993; Osborne and Kovacic, 1993; Wafer, 2004).

The differences observed between well depths might be partially explained by water table depths for the buffers. The soil around the deep wells for all of the buffers was continuously saturated with water, increasing the likelihood of maintaining the constant anaerobic soil conditions well suited for denitrification. However, for the intermediate wells, not all of the buffers revealed similar continuously saturated soil conditions. Buffers R1 and R2N have intermediate well water table depths that fluctuate at or around the average installed well depths. Generally speaking, it is thought that more shallow soil zones are superior to deeper soil zones in reducing $NO_3$-N (provided they are both equally saturated) because they typically have greater organic carbon levels (Hill, 1996; Simmons et al., 1992; Groffman et al., 1992). At this site we find that the deeper zones are often equally, if not more, effective but we observe that neither zone has a greater level of dissolved organic carbon (DOC) than the other (see DOC Section below). Perhaps since there is no benefit provided by any increased DOC in the intermediate wells at this site, the continuously saturated and anaerobic nature of soil around the deep wells provides them with increased denitrification ability.

Previously reported results from the site revealed similar findings; Dukes (2000) demonstrated reductions in the 8 m buffers of 12% in the intermediate and 50% in the deep wells, and in the 15 m buffers of 38% in the intermediate and 67% in the deep wells, while Ricks (2002) demonstrated reductions in the 8 m buffers of 8% in the intermediate and 38% in the deep wells, and in the 15 m buffers of 45% in the intermediate and 78% in the deep wells. Ricks' study was only conducted for buffers R1, R2N, and R4W. No trends appear evident from the data comparisons.

For the full set of data for width and depth please see Appendix F.

### ***Dilution***

A comparison of $NO_3$-N to chloride (Cl) concentration ratios were made for the field-edge and ditch-edge wells to determine if a dilution effect was causing any observed decreases in $NO_3$-N concentration. Chloride is considered a conservative element with respect to groundwater, so if the $NO_3$-N/Cl ratio was to remain constant across the buffer, it implies that water has been added to the groundwater, not having had $NO_3$-N removed from it. Thus, if we were to observe a 50% $NO_3$-N concentration decrease across a given buffer plot, then we would expect the $NO_3$-N/Cl ratio to also decrease by about 50% if there was true $NO_3$-N removal. However, if the ratio remained the same we might suspect that dilution was responsible for the observed $NO_3$-N concentration decrease, while if the ratio only decreased by about 20%, we might consider the possibility that some true removal was taking place along with some dilution. Dilution may also be caused by a groundwater source containing a substantial amount of Cl and/or $NO_3$-N, in which case the results would vary and could even imply $NO_3$-N removal where none actually occurred. The analysis conducted for this study assumes that any dilution occurring on the site is from uncontaminated groundwater, which is more likely a better assumption with regards to deep groundwater than shallow groundwater.

One potential source for error in these calculations is the presence of the KCl agar solution in the redox salt bridge. As it slowly leaches into the soil from precipitation, it could contribute a Cl source to the groundwater. Relatively little dissolution of the KCl agar was observed during the course of the study, however, and as the potential Cl additions are very low anyway, it was not considered to be a likely source of any significant potential error. The primary source of Cl in groundwater for this study site, as in many agricultural areas, is potassium fertilizer, added as potassium chloride (KCl). The average Cl concentrations for the buffers are provided in Tables 2 and 3.

The results indicate that dilution does not appear to be a substantial influencing factor for the buffers taken as a whole, as the $NO_3$-N/Cl ratios suggest that the observed decreases in $NO_3$-N concentrations across the buffers were largely the result of actual $NO_3$-N removal and not from any major dilution effect (Table 4).

The $NO_3$-N/Cl ratios for the 8m buffer width decreased 34% (from 0.90 to 0.59) in the intermediate wells and 50% (from 0.30 to 0.15) in the deep wells. The decrease for the deep wells corresponds favorably with their observed $NO_3$-N concentration decrease of 54%, but less so for the intermediate wells with their $NO_3$-N decrease of just 12%. A more substantial $NO_3$-N decrease would have been anticipated with a ratio decrease of 34%. This apparent incongruity is due exclusively to buffer R2N, where the wells for this width and depth experienced a consistent increase in chloride (Cl) concentrations across the buffer (from field-edge to ditch-edge). The field immediately adjacent to these wells contains successional vegetation and has not been actively farmed for several years. Not surprisingly, these wells have the overall lowest Cl concentrations as a result of not having had any potassium chloride (KCl) fertilizer added to the adjacent field.

A review of the field notes taken for this buffer reveals that many of the salt bridges associated with these wells had indeed required refilling in June of 2005, yet calculations revealed that the potential amount of Cl added to the groundwater from the salt bridges was not nearly enough to have caused the observed increase. Another explanation might be that an upwelling of Cl rich groundwater occurs here, adding Cl to the system, but the associated $NO_3$-N concentrations do not also decrease for these wells as would be expected. Thus, the exact cause for the observed Cl increase here is unknown.

The $NO_3$-N/Cl ratios for the 15m buffer width decreased 41% (from 0.44 to 0.26) in the intermediate wells and 67% (from 0.30 to 0.10) in the deep wells. These decreases generally correspond with $NO_3$-N concentration decreases of 59% in the intermediate wells and 75% for the deep wells. The slight dilution effect observed for the intermediate wells here is due exclusively to two plots in buffer R2N in which a sizeable dilution effect was observed.

By vegetation type, overall $NO_3$-N/Cl ratios decreased 58% (from 0.61 to 0.25) for trees, 43% (from 0.49 to 0.25) for fescue, 29% (from 0.43 to 0.29) for switchgrass, 41% (from 0.50 to 0.29) for native vegetation, and 12% (from 0.35 to 0.31) for the no-buffer control (Table 5). These decreases generally correspond with similar $NO_3$-N concentration decreases of 57% for trees, 40% for fescue, and 37% for native vegetation, but are slightly lower when compared to the $NO_3$-N reductions of 44% for switchgrass and 27% for the no-buffer control. The switchgrass and control plots appear to experience a some slight dilution effect as both their $NO_3$-N concentration decreases imply slightly greater removal rates than the $NO_3$-N/Cl ratio decreases imply. These slight dilution effects can be traced to the results from one individual buffer for each: R2N for the switchgrass and R5N for the control.

## Redox Data

In each of the buffer replications, the water table rose closer to the ground surface across the buffer. That is, the water table was nearer the surface at the ditch-edge wells than at the field-edge wells for both the intermediate and deep wells. Buffers R1 and R2N had water levels between ±150-200 cm below surface, buffer R4W had levels between ±80-120 cm below surface, and buffer R5N had levels ±120-160 cm below surface (Figures 8-15). There were no seasonal trends noted for any of the groundwater table fluctuations, perhaps as a result of the deeply incised nature of the drainage ditches adjacent to the buffers. The incision helps maintains a constant year-round water table depth. There are also controlled drainage structures in place for the ditching network on the site that may have helped artificially alter any natural seasonal variation.

In each of the three replications that had redox probes installed (R1, R2N, and R4W), the observed redox measurements (in Eh) and their associated expectations of oxidation or denitrification generally matched observed $NO_3$-N removal results. That is, wherever lower Eh values were observed, implying more denitrification, we also observed greater $NO_3$-N removal rates (Figures 8-13). For R1, we observed high Eh values of ±600-750 mV for the intermediate wells (which implied oxidation) and low Eh values of ±200-300 mV for the deep wells (which implied denitrification), both of which correlate with the much higher $NO_3$-N removal rates observed for the deep wells (68%) than the intermediate wells (23%). For R2N, we observed higher Eh values of ±400-600 mV in the field-edge position wells (which implied some oxidation) and lower Eh values of ±100-400 mV in the ditch-edge wells (which implied denitrification) for both the intermediate and deep wells. These similar redox results for both well depths correlate with the relatively similar $NO_3$-N removal rates observed between the depths, as the intermediate wells removed 62% while the deep wells removed 50% of the $NO_3$-N. For buffer R4W, we observed high Eh values of ±400-550 mV in the intermediate wells (which implied mostly oxidation) and much lower Eh values of ±100-400 mV for the deep wells (which implied mostly denitrification). These results correlate with those showing that the intermediate wells removed much less $NO_3$-N (14%) as compared to the deep wells (74%). These results indicate that substantial denitrification is occurring in some portion of each of the three buffer replications in which redox measurements were taken.

## Dissolved Organic Carbon

For the 8 m buffer widths, the average dissolved organic carbon (DOC) values observed in the ditch-edge wells were 3.2 mg C $L^{-1}$ for the intermediate depth and 2.7 mg C $L^{-1}$ for the deep depth. For the 15 m buffer widths, the average values observed were 3.9 mg C $L^{-1}$ for the intermediate depth and 3.0 mg C $L^{-1}$ for the deep depth (Table 6).

Overall, the total DOC values in the ditch-edge wells were not statistically significantly greater ($p>0.05$) for the 15 m buffer width (3.4 mg C $L^{-1}$) as compared to the 8 m buffer width (3.0 mg C $L^{-1}$), nor were the total DOC values significantly greater for the intermediate wells (3.6 mg C $L^{-1}$) as compared to the deep wells (2.8 mg C $L^{-1}$). While not significant, the observed differences are not surprising as we might expect to find more organic carbon accumulating over a wider vegetated buffer, as well as find less carbon present in the deep wells as it gets consumed while settling through the soil profile, and as it gets farther from the root zone (which acts as a carbon source). The results do corroborate previous studies conducted on the site (Dukes, 2000 and Ricks, 2002).

There were also no statistically significant DOC differences ($p>0.05$) observed in the ditch-edge wells between the vegetation types (Table 7). Tree plots averaged 3.0 mg C/L, fescue plots 3.4 mg C $L^{-1}$, switchgrass plots 3.2 mg C $L^{-1}$, native vegetation plots 3.1, and the no-buffer control plots 3.3 mg C $L^{-1}$. This implies that at least over the initial 7 year period from installation (and less for the plots that required revegetation after the damaging hurricane of Sept.1999), none of these vegetation types is superior in providing an addition of organic carbon to the buffers.

These values represent relatively low levels of organic carbon and present an inhibiting, but not an outright prohibiting, influence on denitrification (Gilliam - personal communication, 2005) as evidenced by the fact that the observed $NO_3$-N concentration decreases were appreciable but not nearly as complete as on other similar sites. Other studies in the coastal plain of North Carolina in similar conditions have demonstrated much higher percent reductions with greater DOC levels. Smith (2005), showed lower DOC levels in some of his wells (2.8 mg C $L^{-1}$) were similar to those found here and subsequently revealed a similar $NO_3$-N reduction (19.5%) as compared to other wells at his site, which demonstrated very high reductions (95.0%) when associated with higher DOC levels (16.1 mg C $L^{-1}$). At another location, Wafer (2004) found lower removal rates associated with DOC levels of 3.6 to 4.0 mg C $L^{-1}$, and very high removal rates frequently associated with DOC levels of 10.2 to 16.2 mg C $L^{-1}$.

Soil type may also affect the optimum concentrations of DOC necessary for high levels of denitrification. Sandier soils, such as those found on this study site, have shorter groundwater residence times than finer textured soils, and therefore generally require more DOC to achieve similar $NO_3$-N reduction rates.

A previous study on this site observed lower DOC values for these same buffers. In sampling from June 2000 to Oct. 2001, Ricks (2002) observed average DOC concentrations in the ditch-edge wells for buffers R1, R2N, and R4W of 2.0 mg C $L^{-1}$ for the intermediate depth, and 1.8 mg C $L^{-1}$ for the deep depth. These values appear less than the more recently observed values (Dec. 2003 to Aug. 2005) in the ditch-edge wells for the same three buffers of 2.8 mg C $L^{-1}$ for intermediate depth and 2.3 mg C $L^{-1}$ for the deep depth. Thus, the average increase observed between the sampling periods was 0.8 mg C $L^{-1}$ for the intermediate depth and 0.5 mg C $L^{-1}$ for the deep depth. However, these differences may not necessarily represent actual carbon increases, but may simply be due to differing error rates associated with particular laboratory equipment, procedures, and/or individual technicians.

Furthermore, any expectation that these increased DOC concentrations (if they are real) should have resulted in increased denitrification rates as compared to previous site studies should be tempered by the fact that while there may be noted increases in carbon for the buffers, the concentrations are still relatively low and still represent an inhibiting factor towards denitrification.

## CONCLUSIONS

For the vegetation types studied, the observed $NO_3$-N concentration decreases across all combined plots were; trees 57% (from 8.79 to 3.78 mg $NO_3$-N $L^{-1}$), fescue plots 40% (from 6.33 to 3.77 mg $NO_3$-N $L^{-1}$), switchgrass 44% (from 5.52 to 3.09 mg $NO_3$-N $L^{-1}$), native vegetation 37% (from 6.47 to 4.07 mg $NO_3$-N $L^{-1}$), and no-buffer control 27% (from 4.93 to 3.62 mg $NO_3$-N $L^{-1}$).

For the buffer width comparisons, the observed $NO_3$-N concentration decreases across all combined plots were; 8 m width – intermediate depth 12% (from 9.97 to 8.75 mg $NO_3$-N $L^{-1}$) and deep depth 54% (from 5.26 to 2.41 mg $NO_3$-N $L^{-1}$), 15 m width – intermediate depth 59% (from 6.42 to 2.61 mg $NO_3$-N $L^{-1}$) and deep depth 75% (from 4.31 to 1.06 mg $NO_3$-N $L^{-1}$).

However, despite the apparent observed differences, neither vegetation type nor buffer width appeared to be a statistically significant influencing factor ($p>0.05$) in determining $NO_3$-N removal ability, primarily due to the variability of the results found between the buffer replications.

Dilution was determined to be a very slight, if not inconsequential, factor in the observed $NO_3$-N concentration decreases, with the exception of a few plots found in one buffer replication. From redox potential measurements, denitrification was determined to be the process most likely responsible for the often substantial $NO_3$-N concentration decreases observed in the buffers. The redox measurements revealed that significant reduction is occurring in each of the three buffers equipped with probes, particularly in the deeper wells and particularly along the ditch-edge wells (which generally have higher water table levels).

Organic carbon is suspected of being a limiting factor as dissolved organic carbon (DOC) concentrations were fairly low across all buffer replications for width, depth, and vegetation type. The concentrations were low enough in range that a lack of sufficient carbon is considered to be an inhibiting factor for the microbial induced process of denitrification to occur. However, organic carbon may be increasing from previous studies as the vegetation matures and their detritus accumulates on site.

The results of this study might be useful in establishing or modifying riparian buffer requirements with regards to both type of vegetation established as well as buffer width for areas of similar land use and soil types. However, as noted, other sites in the same general project area have recorded higher observed $NO_3$-N removal rates though with significantly higher DOC which is believed to be a highly influential factor.

# REFERENCES

Addy K.L, A.J. Gold, P.M. Groffman, and P.A. Jacinthe. 1999. Ground water nitrate removal in subsoil of forested and mowed riparian buffer zones. Journal of Environmental Quality. 28:962-970.

Barnhill, W.L., R.A. Goodwin, Jr., M.R. Bostian, N.A. McLoda, G.W. Leishman, and R.J. Scanu. 1974. *Soil Survey of Wayne County, North Carolina.* Soil Conservation Service, Washington, DC.

Bradley, P.M., M. Fernandez, and F.H. Chapelle. 1992. Carbon Limitation of Denitrification Rates in an Anaerobic Groundwater. Environmental Science and Technology. 26:2377-2381.

Dukes, M.D. 2000. Effect of Riparian Buffers and Controlled Drainage on Shallow Groundwater Quality in the North Carolina Middle Coastal Plain. Ph.D. Dissertation. NC State University, Raleigh.

Essington, M.E. 2004. Soil and Water Chemistry: An Integrative Approach. pp. 455-458. CRC Press, Boca Raton, FL.

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.

Gilliam, J.W. 1994. Riparian wetlands and water quality. Journal of Environmental Quality. 23:896-900.

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.

Groffman, P.M. and J.M. Tiedje. 1989. Denitrification in North Temperate Forest Soils: Relationships Between Denitrification and Environmental Factors at the Landscape Scale. Soil Biology and Biochemistry. 21:621-626.

Groffman, P.M., A.J. Gold, and R.C. Simmons. 1992. Nitrate Dynamics in Riparian Forests: Microbial Studies. Journal of Environmental Quality. 21:666-671.

Hanson, G.C., P.M. Groffman, and A.J. Gold. 1994. Denitrification in Riparian Wetlands Receiving High and Low Groundwater Nitrate Inputs. Journal of Environmental Quality 23:917-922.

Haycock, N.E., and G. Pinay. 1993. Groundwater nitrate dynamics in grass and poplar vegetated riparian buffer strips during the winter. Journal of Environmental Quality 22:273-278.

Hefting, M.M., J.J. de Klein. 1998. Nitrogen removal in buffer strips along a lowland stream in the Netherlands: a pilot study. Environmental Pollution. 102:521-526.

Hill, A.R. 1996. Nitrate Removal in Stream Riparian Zones. Journal of Environmental Quality. 25:743-755.

Hill, A.R., K.J. Devito, S. Campagnolo, and K. Sanmugadas. 2000. Subsurface denitrification in a forest riparian zone: Interactions between hydrology and supplies of nitrate and organic carbon. Biogeochemistry. 51:193-223.

Hubbard, R.K., G.L. Newton, J.G. Davis, R. Lowrance, G. Vellidis and C.R. Dove. 1998. Nitrogen assimilation by riparian buffer systems receiving swine lagoon wastewater. American Society of Agricultural Engineers. 41:1295-1304.

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

Jordan, T.E., D.L. Correll, and D.E. Weller. 1993. Nutrient interception by a riparian forest receiving inputs from adjacent cropland. Journal of Environmental Quality 22:467-473.

Kunickis, S.H. 2000. The Effect of Riparian Buffers with Controlled Drainage on Soil Redox Potential. Ph.D. Dissertation. NC State University, Raleigh.

Lowrance, R.R. Todd, J. Fail, Jr., O. Hendrickson, Jr., R. Leonard, and L. Asmussen. 1984a. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34: 374-377.

Lowrance, R.R., R.L. Todd, and L.E. Asmussen. 1984b. Nutrient Cycling in an Agricultural Watershed: I. Phreatic Movement. Journal of Environmental Quality. 13:22-27.

Lowrance, R. and D. Smittle. 1988. Nitrogen Cycling in a Multiple-Crop Vegetable Production System. Journal of Environmental Quality. 17:158-162.

Lowrance, R. 1992. Groundwater nitrate and denitrification in a Coastal Plain riparian forest. Journal of Environmental Quality. 21:401-405.

Lowrance, R., G. Vellidis, and R.K. Hubbard. 1995. Denitrification in a Restored Riparian Forest Wetland. Journal of Environmental Quality. 24:808-815.

Lowrance, R., R.K. Hubbard, and R.G. Williams. 2000. Effects of a Managed Three Zone Riparian Buffer System on Shallow Groundwater Quality in the Southeastern Coastal Plain. Journal of Soil and Water Conservation. Second Quarter: 212-220.

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

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

Peterjohn, W.T. and D.L. Correll. 1984. Nutrient dynamics in an agricultural watershed: Observations on the role of a riparian forest. Ecology. 65: 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.

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

Schnabel, R.R., L.F. Cornish, W.L. Stout, and J.A. Shaffer. 1996. Denitrification in a grassed and wooded, Valley and Ridge, riparian ecotone. Journal of Environmental Quality 25:1230-1235.

Simmons, R.C., A.J. Gold, and P.M. Groffman. 1992. Nitrate Dynamic in Riparian Forests: Groundwater Studies. Journal of Environmental Quality. 21(4):659-665.

Smith, T.A. 2005. Shallow groundwater nitrate and breeding bird habitat in a riparian buffer restored by volunteer vegetation. M.S. Thesis. NC State University, Raleigh.

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

Wafer, C.C. 2004. Effect of Shrub Buffers, Tillage and Cropping Systems on Shallow Groundwater Nitrate-N in Eastern North Carolina. M.S. Thesis. NC State University, Raleigh.

Wenger, S. 1999. A review of the scientific literature on riparian buffer width, extent, and vegetation. Institute of Ecology, University of Georgia, Athens, GA.

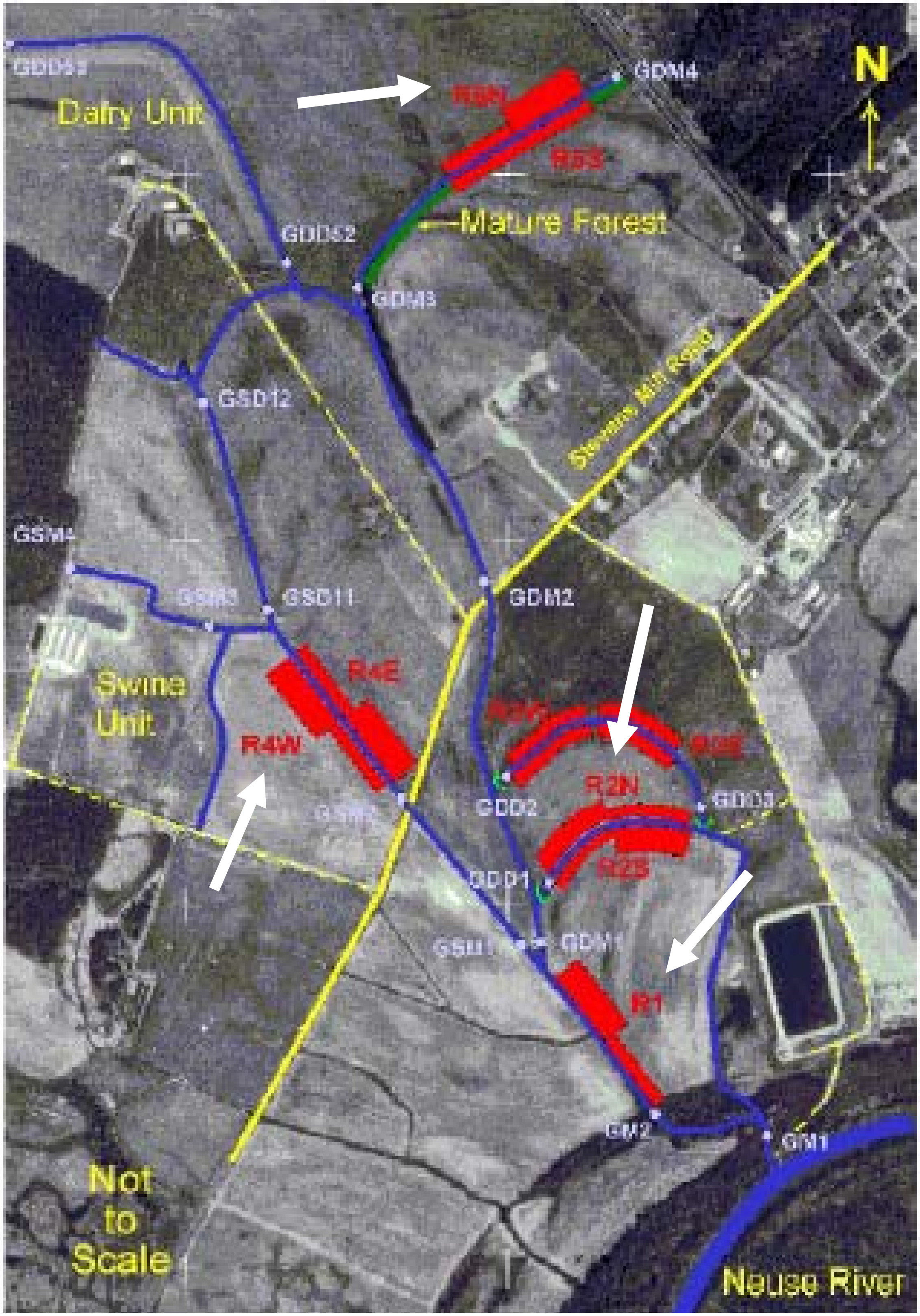


Figure 1. Aerial photograph of subject buffers R1, R2N, R4W, and R5N located at the CEFS Cherry Research Farm in Goldsboro, North Carolina.

Note: Photo taken and adapted from Dukes' dissertation (2000).

*Buffer Layouts*

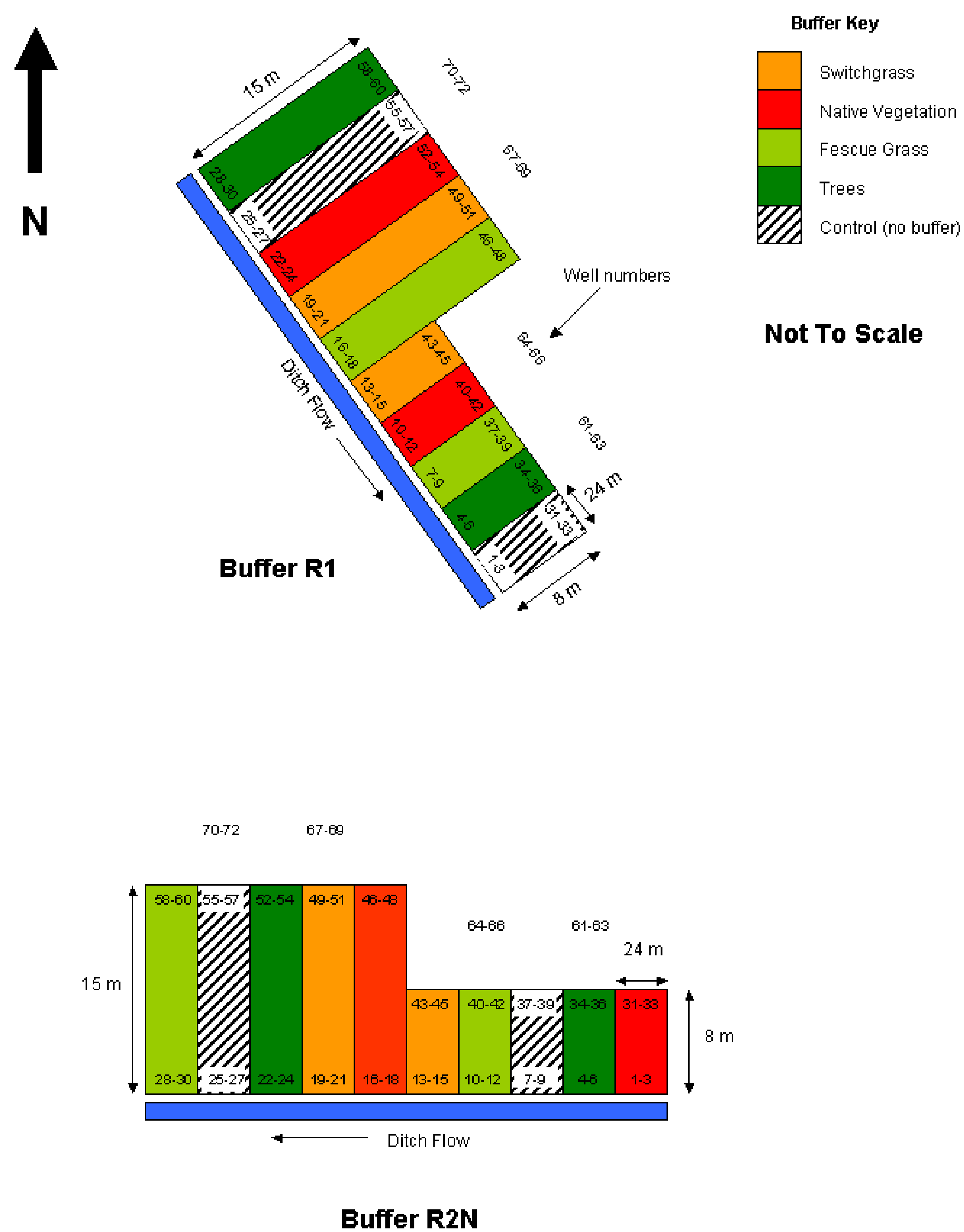


Figure 2. Buffers R1 and R2N vegetative details.

*Buffer Layouts*

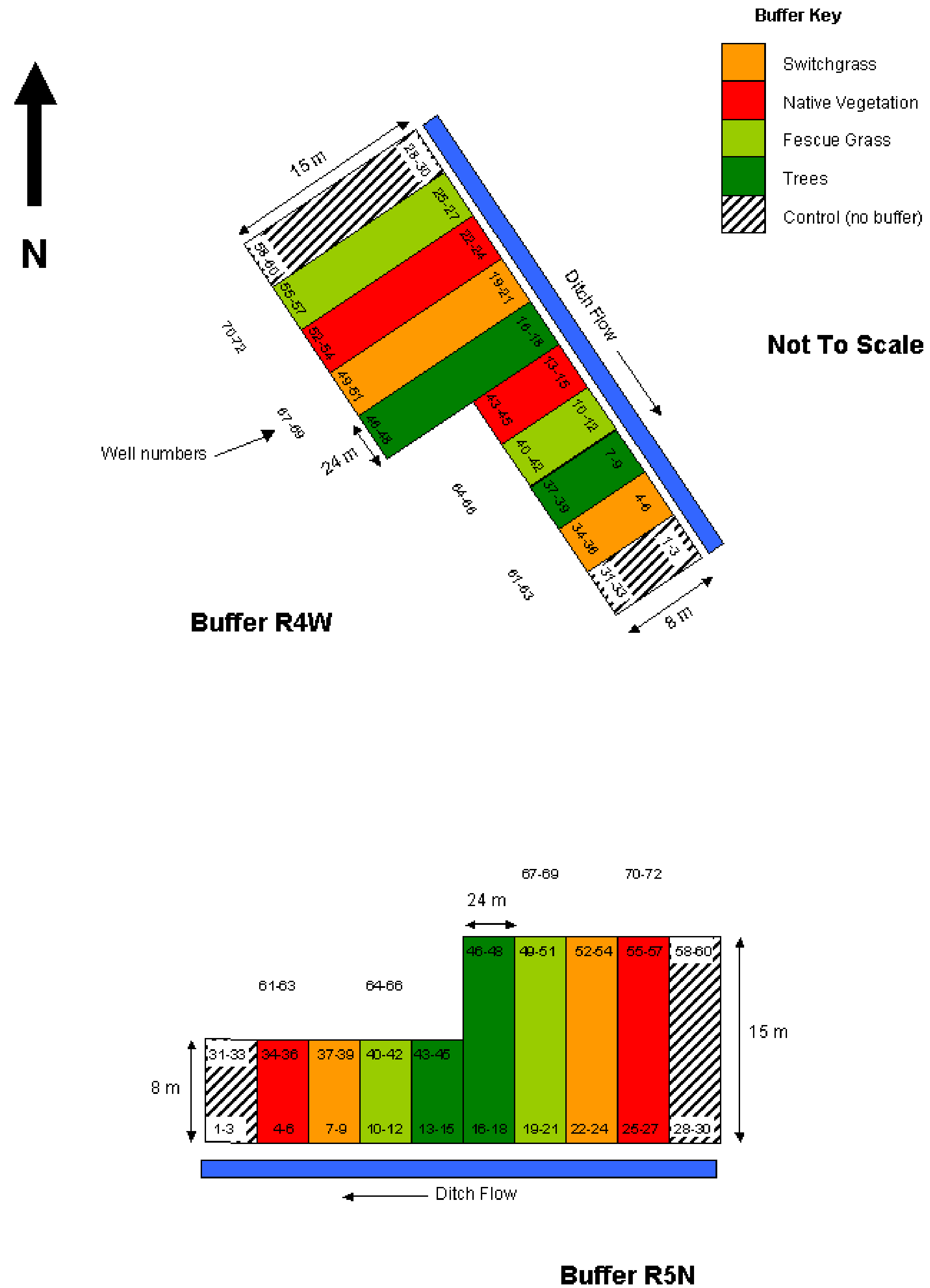


Figure 3. Buffers R4W and R5N vegetative details.

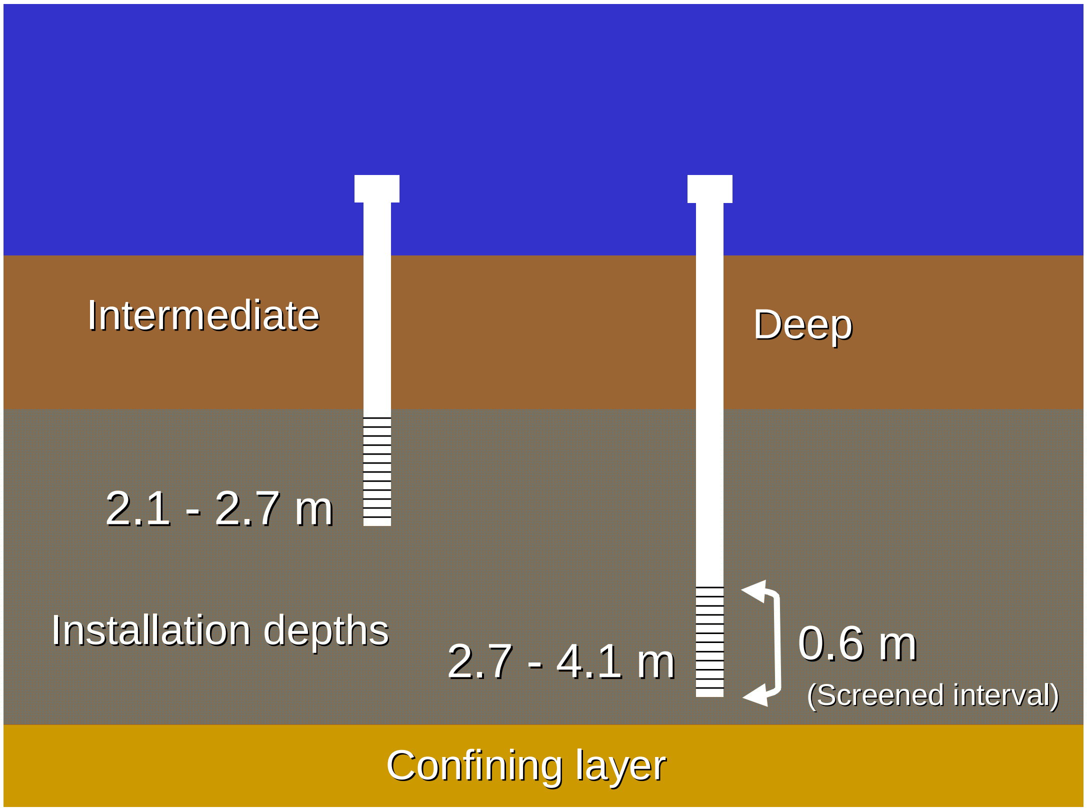

Figure 4. The intermediate and deep monitoring well design.

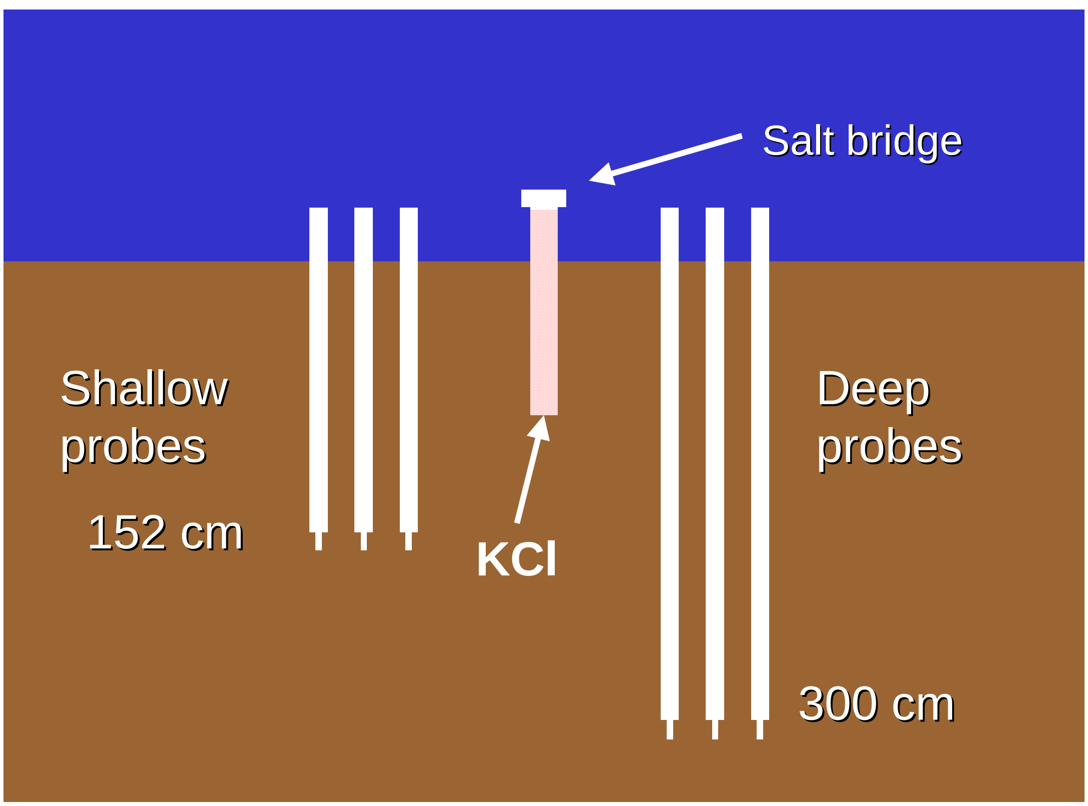

Figure 5. The redox probe and salt bridge arrangement.

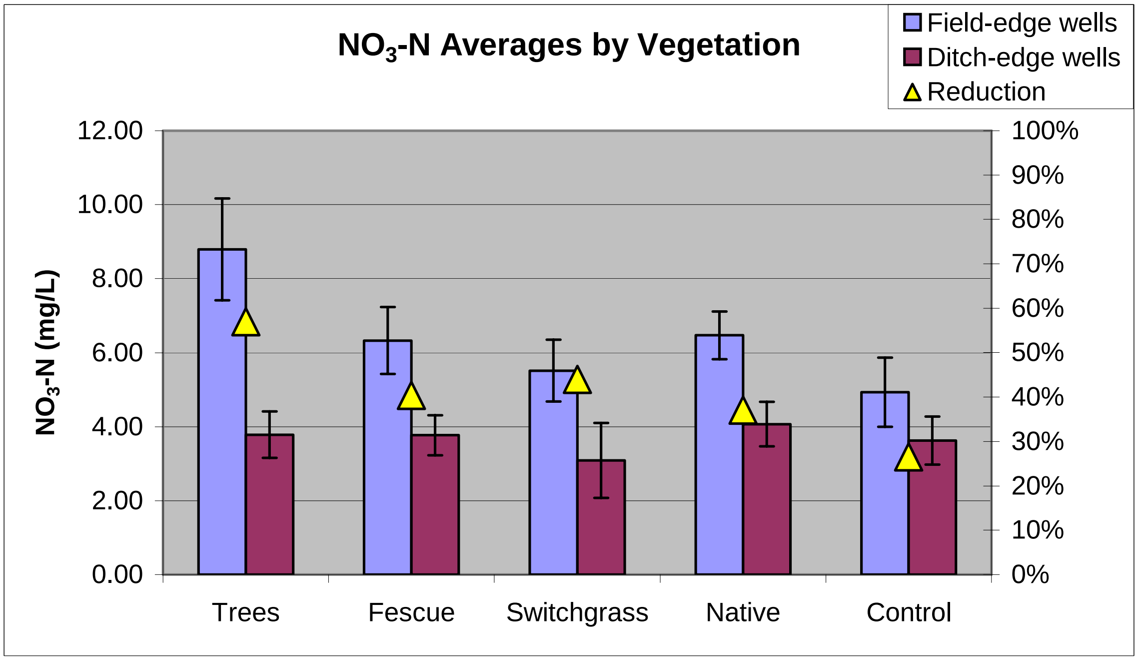


Figure 6. Average $NO_3$-N concentrations by vegetative type.

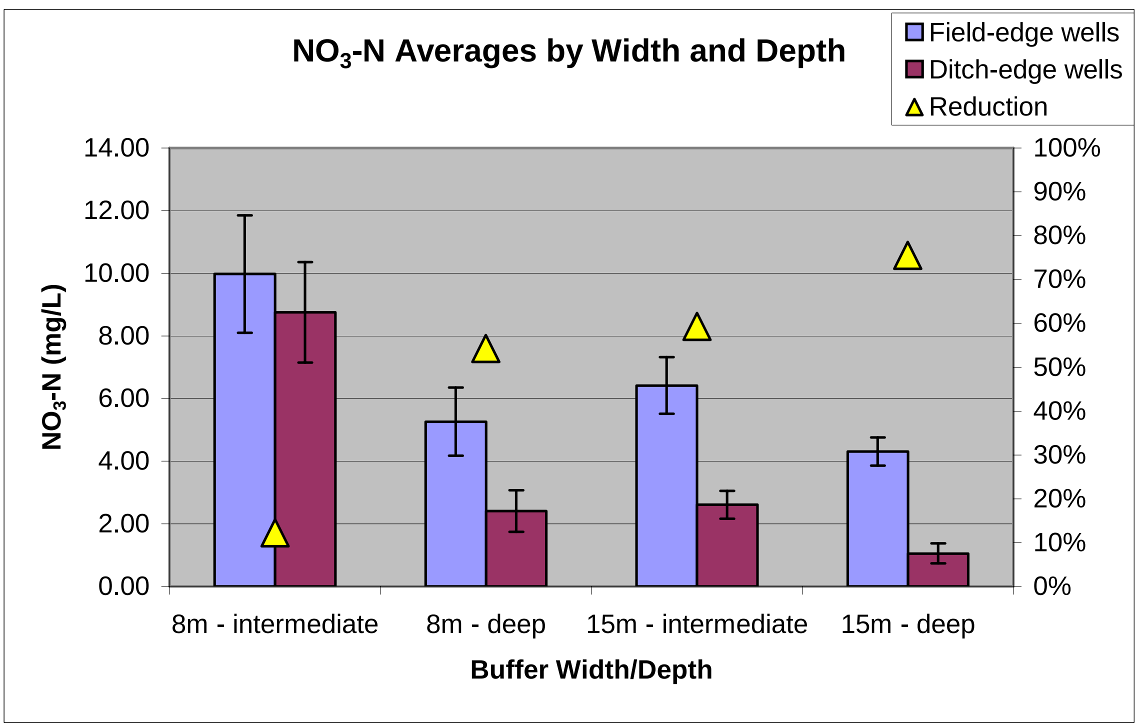


Figure 7. Average $NO_3$-N concentrations by buffer width and well depth.

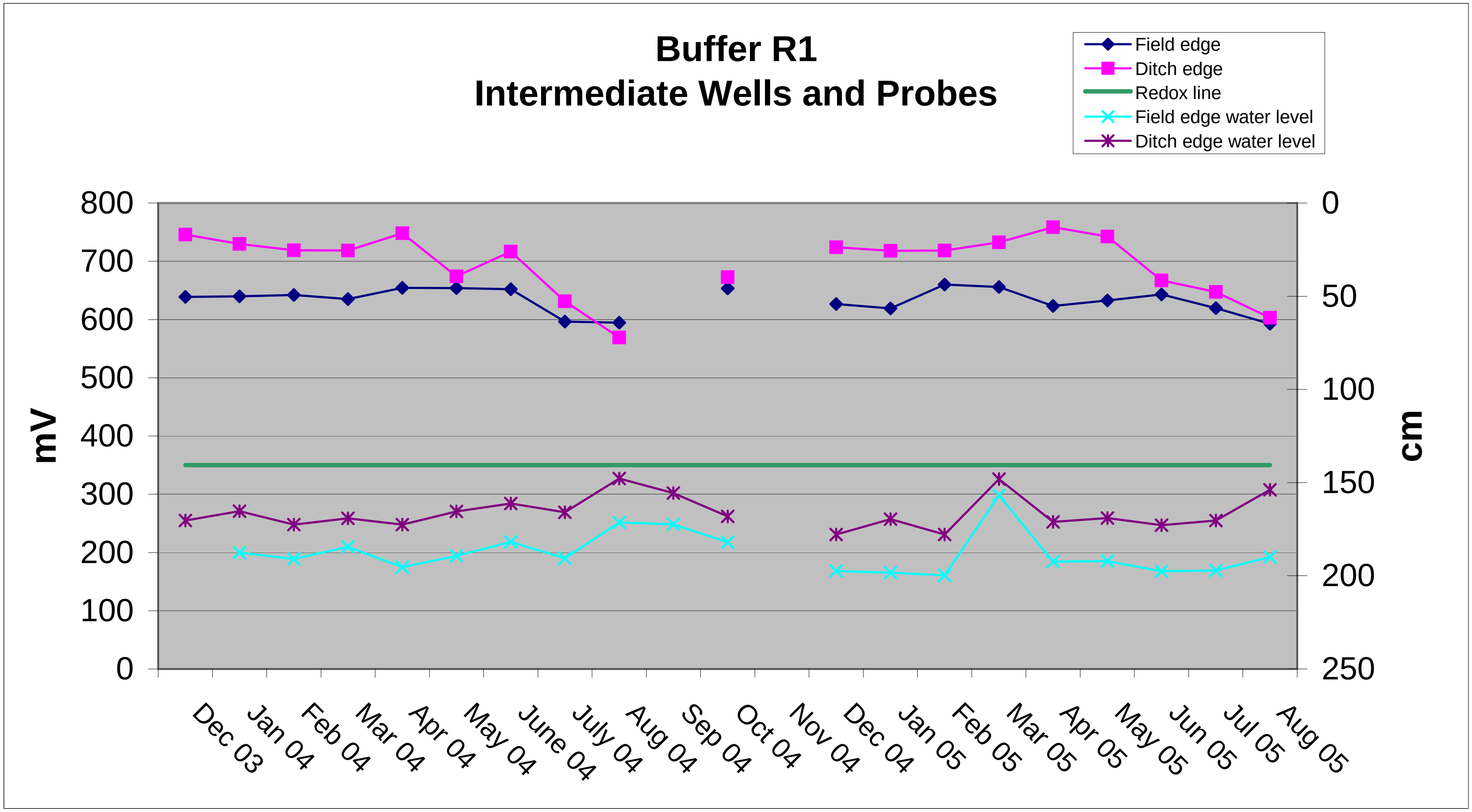


Figure 8. Buffer R1 – Intermediate wells and probes.

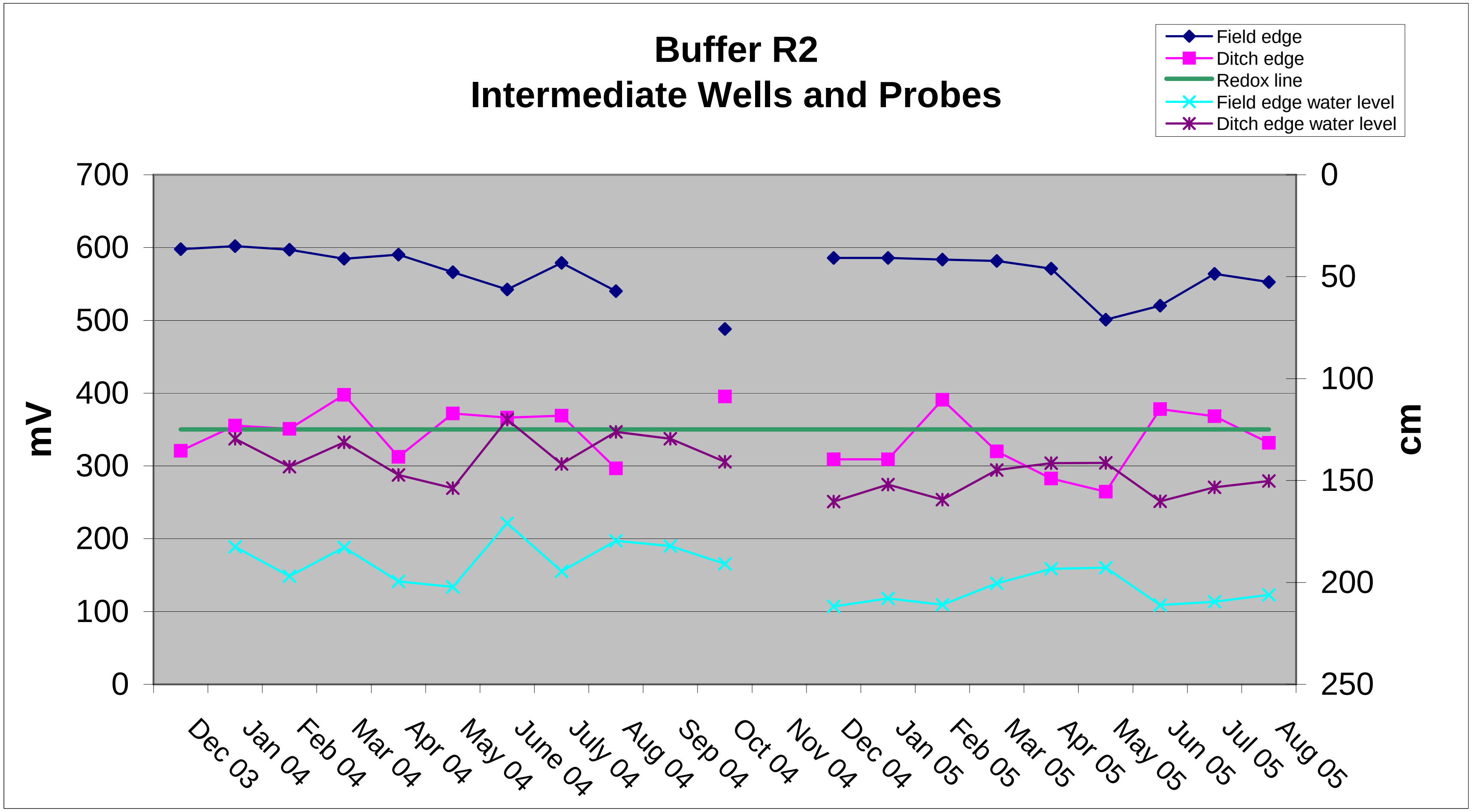


Figure 9. Buffer R2N – Intermediate wells and probes.

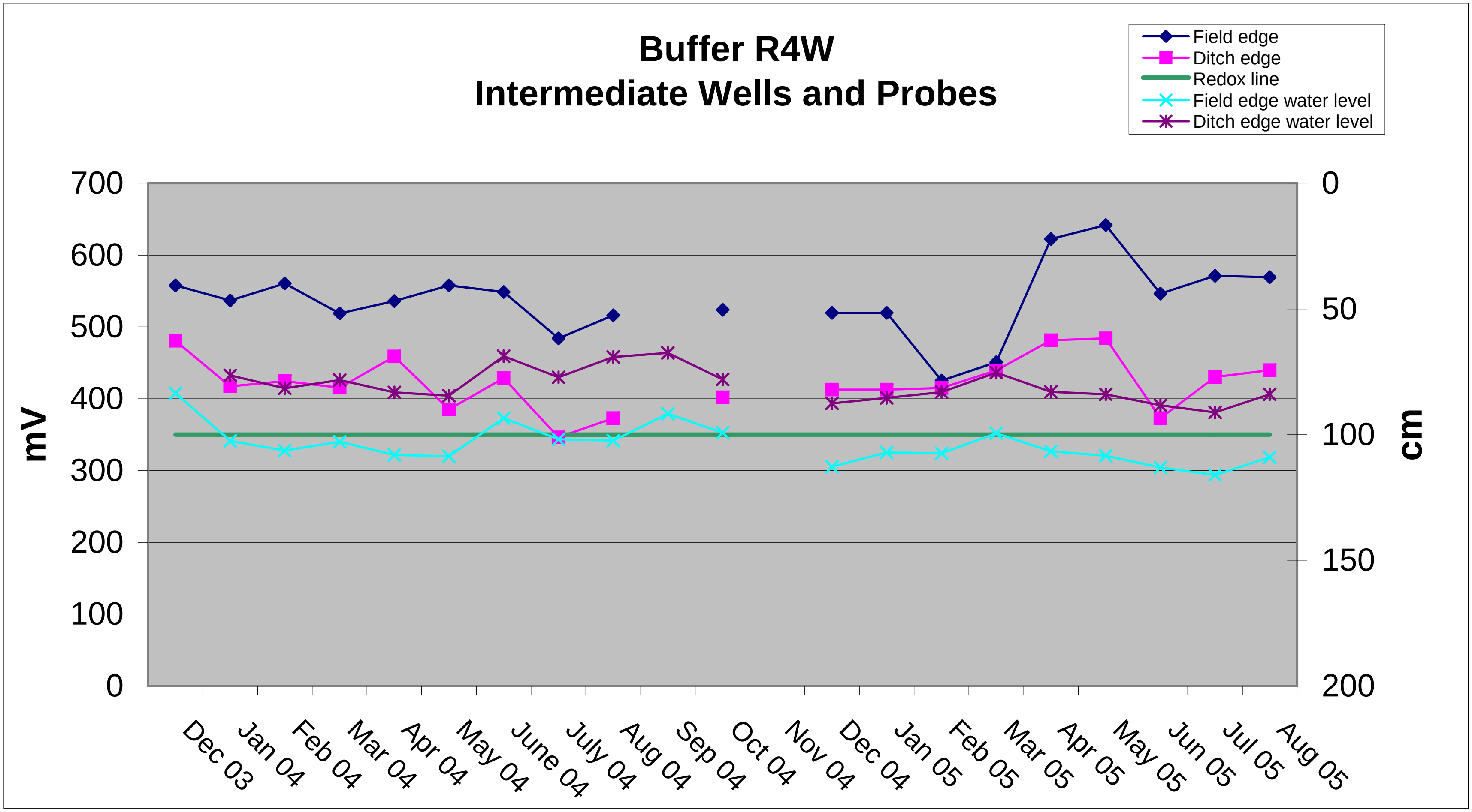


Figure 10. Buffer R4W – Intermediate wells and probes.

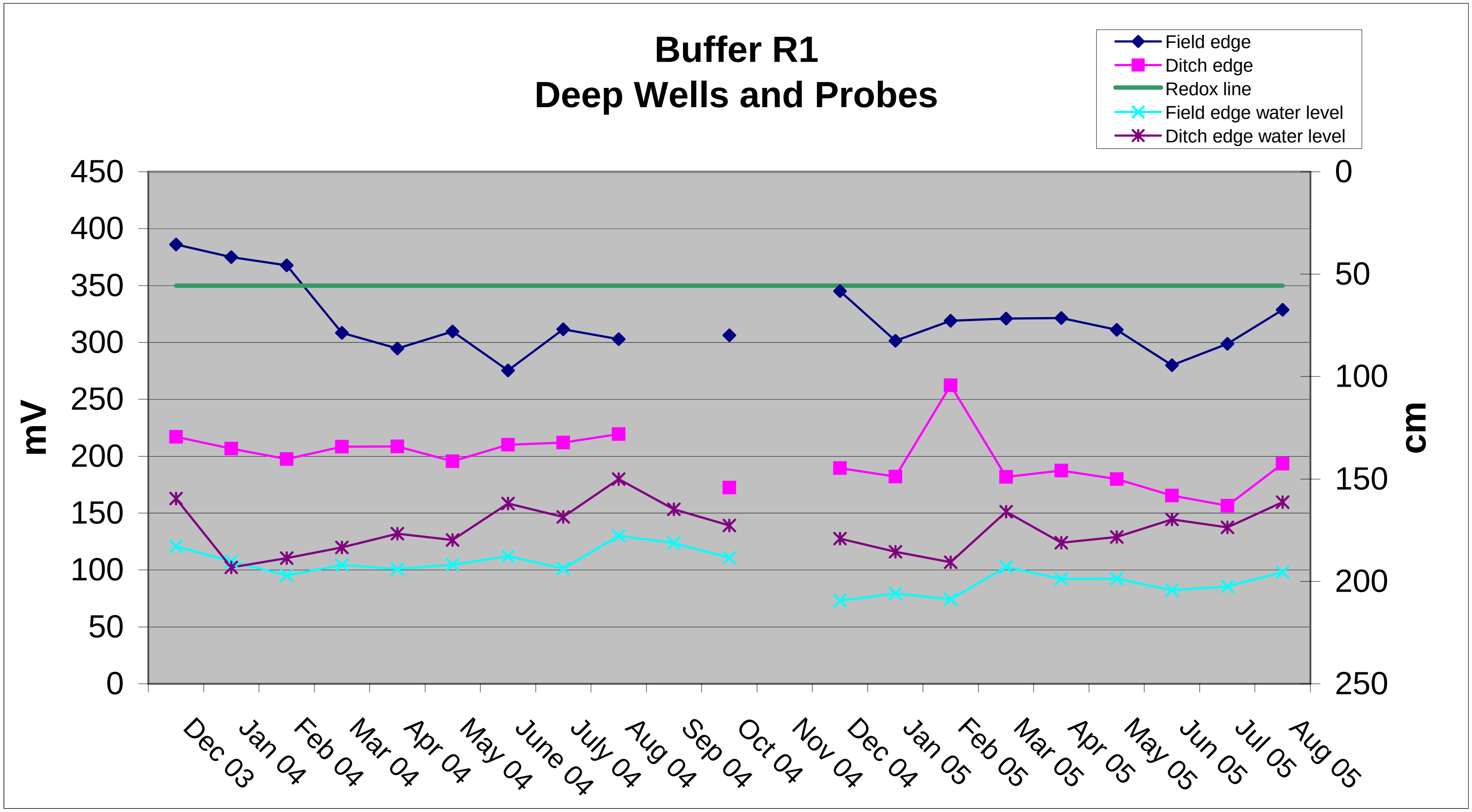


Figure 11. Buffer R1 – Deep wells and probes.

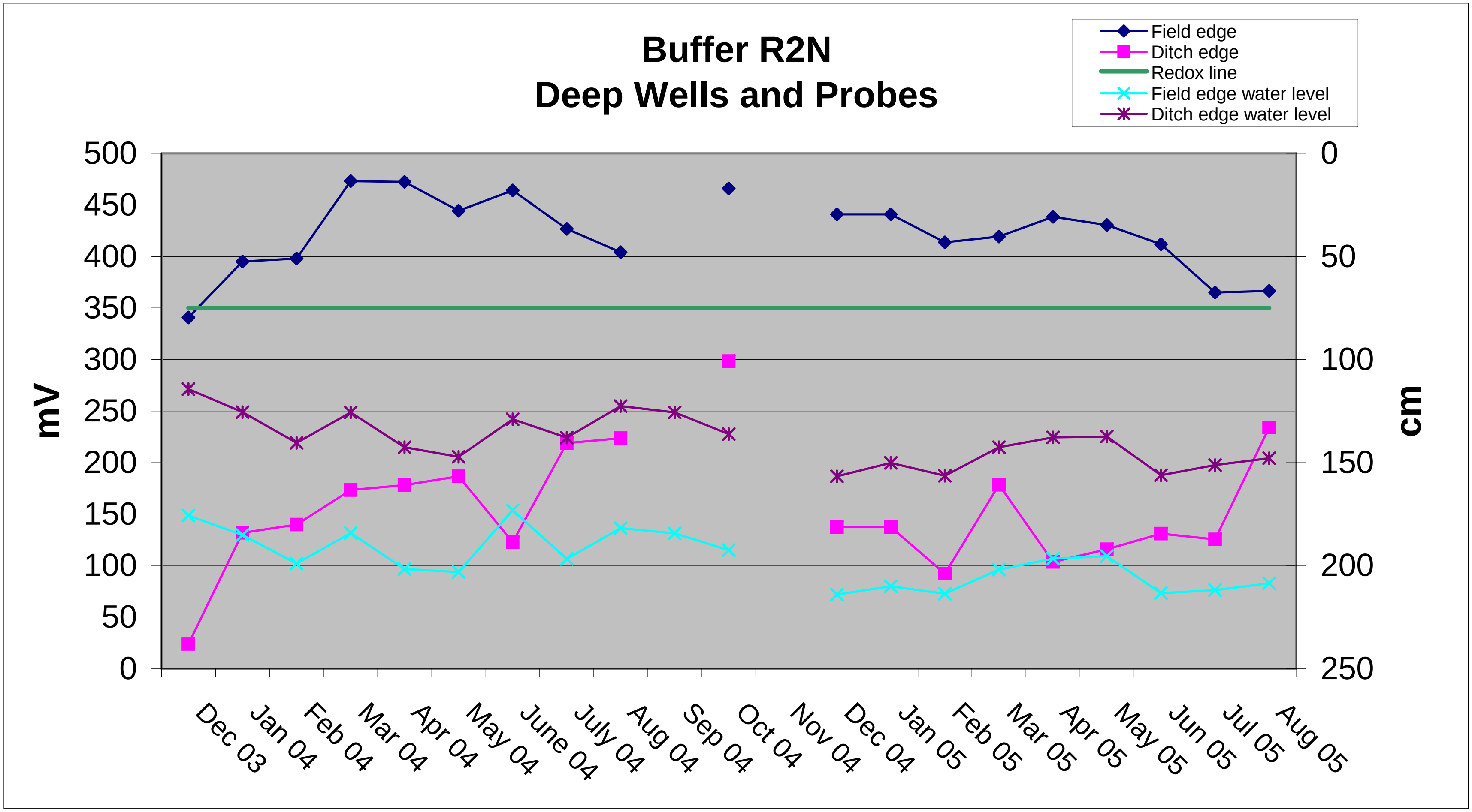


Figure 12. Buffer R2N – Deep wells and probes.

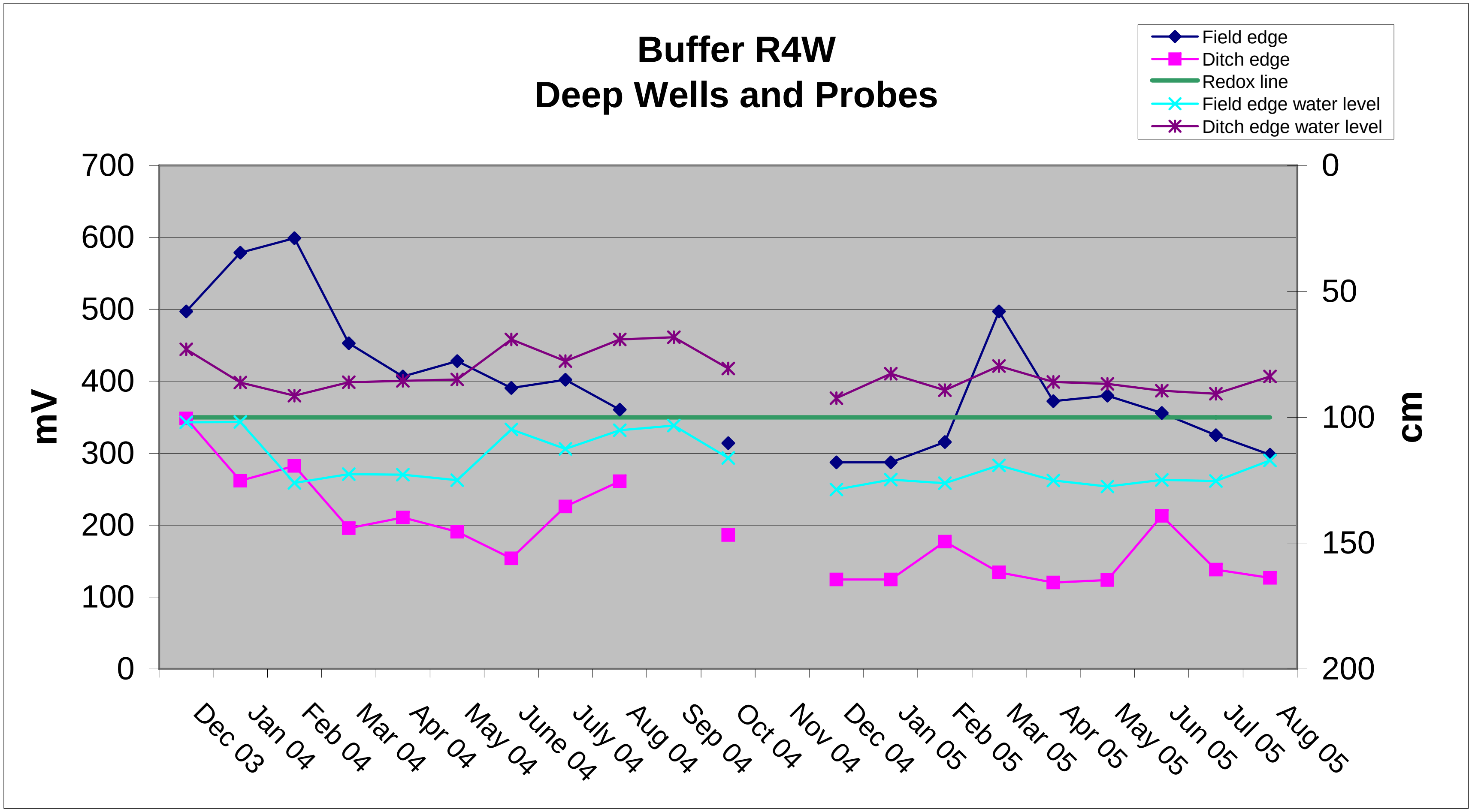


Figure 13. Buffer R4W – Deep wells and probes.

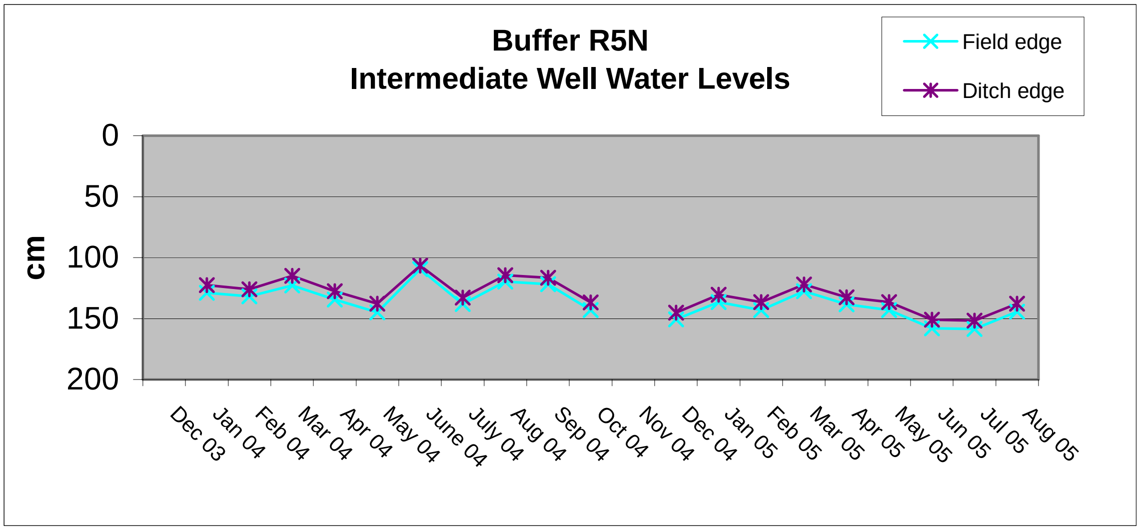


Figure 14. Buffer R5N – Intermediate well water levels.

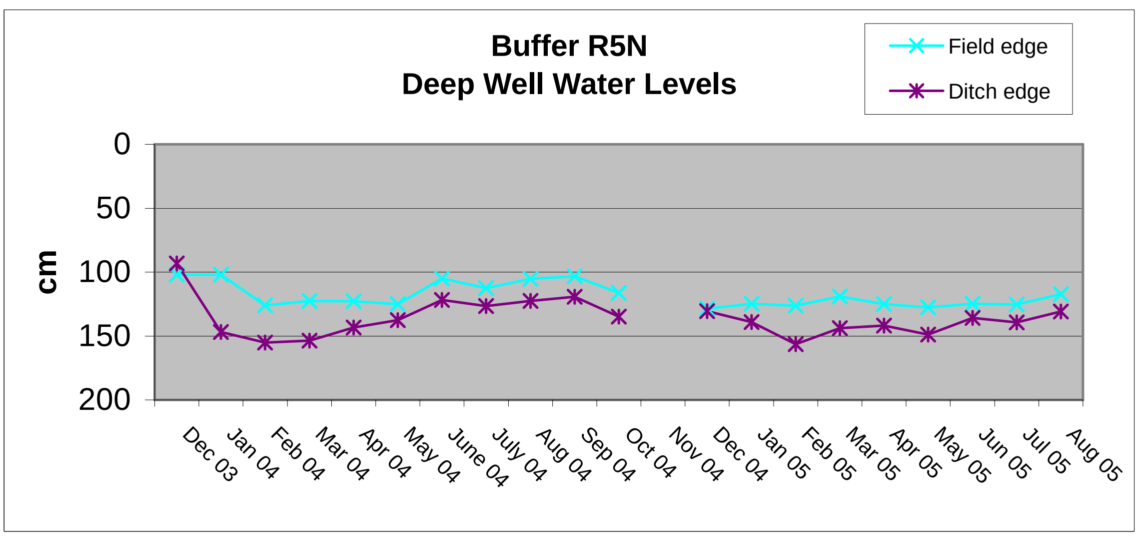


Figure 15. Buffer R5N – Deep well water levels.

| Table 2. Dilution determination: Cl concentrations by width and depth. | | | | |
|---|---|---|---|---|
| Width | Depth | Mean Cl (mg/L) | | Reduction |
| | | Field-edge wells | Ditch-edge wells | |
| 8m | Intermediate | 13.9 | 14.3 | -3% |
| | Deep | 17.6 | 17.9 | -2% |
| 15m | Intermediate | 17.4 | 14.9 | 15% |
| | Deep | 19.0 | 15.0 | 21% |

| Table 3. Dilution determination: Cl concentrations by vegetation type. | | | |
|---|---|---|---|
| Vegetation Type | Mean Cl (mg/L) | | Cl reduction |
| | Field-edge wells | Ditch-edge wells | |
| Trees | 17.1 | 14.5 | 15% |
| Fescue | 18.3 | 17.1 | 7% |
| Switchgrass | 15.6 | 13.5 | 14% |
| Native vegetation | 15.4 | 15.0 | 3% |
| No-buffer control | 18.2 | 16.8 | 8% |

| Table 4. Dilution determination: $NO_3$-N/Cl ratios by width and depth. | | | | | |
|---|---|---|---|---|---|
| Width | Depth | Mean $NO_3$-N/Cl ratios | | Ratio reduction | $NO_3$-N reduction |
| | | Field-edge wells | Ditch-edge wells | | |
| 8m | Intermediate | 0.90 | 0.59 | 34% | 12% |
| | Deep | 0.30 | 0.15 | 50% | 54% |
| 15m | Intermediate | 0.44 | 0.26 | 41% | 59% |
| | Deep | 0.30 | 0.10 | 67% | 75% |

| Table 5. Dilution determination: $NO_3$-N/Cl ratios by vegetation type. | | | | |
|---|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N/Cl ratios | | Ratio reduction | $NO_3$-N reduction |
| | Field-edge wells | Ditch-edge wells | | |
| Trees | 0.62 | 0.26 | 58% | 57% |
| Fescue | 0.48 | 0.27 | 43% | 40% |
| Switchgrass | 0.42 | 0.30 | 29% | 44% |
| Native vegetation | 0.52 | 0.30 | 41% | 37% |
| No-buffer control | 0.37 | 0.33 | 10% | 27% |

| Table 6. Dissolved organic carbon (DOC) by width and depth. | | | |
|---|---|---|---|
| Width | Depth | Mean DOC concentrations (mg C/L) | |
| | | Field-edge wells | Ditch-edge wells |
| 8m | Intermediate | 3.3 | 3.2 |
| | Deep | 2.7 | 2.7 |
| 15m | Intermediate | 3.4 | 3.9 |
| | Deep | 2.7 | 3.0 |

| Table 7. Dissolved organic carbon (DOC) by vegetation type. | | |
|---|---|---|
| Vegetation Type | Mean DOC concentrations (mg C/L) | |
| | Field-edge wells | Ditch-edge wells |
| Trees | 3.1 | 3.0 |
| Fescue | 3.0 | 3.4 |
| Switchgrass | 2.9 | 3.2 |
| Native vegetation | 2.9 | 3.1 |
| No-buffer control | 3.1 | 3.3 |

## APPENDICES – CHAPTER 2

Appendix A: Adjacent Field Data

Table A.1. Adjacent field use and field well $NO_3$-N data for each buffer by width.

| Buffer | Width | Adjacent field use | Adjacent field well $NO_3$-N (mg N/L) | |
|---|---|---|---|---|
| | | | Intermediate Depth | Deep Depth |
| R1 | 8 m | Crops | 8.48 | 4.28 |
| | 15 m | Crops | 10.83 | 7.55 |
| R2N | 8 m | Successional vegetation | 3.24 | 3.73 |
| | 15 m | Crops | 12.69 | 4.95 |
| R4W | 8 m | Dairy pasture | 23.43 | 15.42 |
| | 15 m | Dairy pasture | 5.99 | 4.31 |
| R5N | 8 m | Dairy pasture | 2.92 | 0.35 |
| | 15 m | Dairy pasture | 1.22 | 3.55 |

| Table A.2. Crop planting and fertilization rates in adjacent fields by buffer. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | R1 | | R2N | | R4W | | R5N | |
| | Crop | N fertilization rate (lbs/ac) | Crop | N fertilization rate (lbs/ac) | Crop | N fertilization rate (lbs/ac) | Crop | N fertilization rate (lbs/ac) |
| 2003 | Soybeans | None | Peanuts | None | Millet | 72 | Fescue | 75 |
| | | | Ryegrass | None | Ryegrass | 160 | Ryegrass | 80 |
| 2004 | Fallow (no crops) | None | Corn | 157 | Sudangrass | 40 | Clover | None |
| | | | Ryegrass | None | Ryegrass | 100 | | |
| 2005 (thru Aug.) | Sudangrass | 120 | Corn | 156 | Sudangrass | 40 | Clover | None |
| | | | Ryegrass | None | | | | |

Appendix B: Soil Profile Descriptions

Profile descriptions as listed in the *Soil Survey for Wayne County, North Carolina* (1974):

R1 – Lumbee sandy loam (fine-loamy over sandy or sandy-skeletal, siliceous, thermic Typic Endoaquults) found in the buffer, with Wickham sandy loam (fine loamy, mixed, thermic Typic Hapludults) in the adjacent field.

R2N – Nahunta very fine sandy loam (fine silty, siliceous, thermic Aeric Paleaquults) in buffer, with Wickham loamy sand in the adjacent field.

R4W – Lumbee sandy loam in the buffer, with Wagram loamy sand (Loamy, kaolinitic, thermic Arenic Kandiudults) in the adjacent field.

R5N – Weston loamy sand (coarse-loamy, siliceous, thermic Typic Endoaquults) in the eastern portion of the buffer and field, and Kalmia sandy loam (fine-loamy over sandy or sandy-skeletal, siliceous, thermic Typic Hapludults) in the western portion with some Rains sandy loam (fine-loamy, siliceous, thermic Typic Paleaquults) at the most western end.

Soil organic matter composition estimates as taken from official soil series descriptions (OSD) are described below in Table B.1.

Table B.1. Soil organic matter estimates taken from official series descriptions (OSD).

| | Soil series: | | | | | | |
|---|---|---|---|---|---|---|---|
| | Lumbee sandy loam | Wickham sandy loam | Nahunta very fine sandy loam | Wagram loamy sand | Weston loamy sand | Kalmia sandy loam | Rains sandy loam |
| Depth (cm) | 0-35 | 0-15 | 0-30 | 0-61 | 0-4 | 0-36 | 0-30 |
| % C | 2.0-4.0 | 0.5-1.0 | 2.0-4.0 | 0.5-2.0 | 1.0-3.0 | 0.5-2.0 | 1.0-6.0 |
| Depth | 35-91 | 15-198 | 30-201 | 61-191 | | 36-152 | 30-201 |
| % C | 0.0-1.0 | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | | 0.0-0.5 | 0.5-1.0 |
| Depth | 91-152 | | | | | | |
| % C | 0.0-0.5 | | | | | | |

Previous soil organic matter field measurements as taken from Sheryl Kunickis' dissertation (2000) as given in averages from soil surface to 152 cm deep are shown below in Table B.2.

Table B.2. Soil organic matter measurements taken from the field.

| Average soil organic matter (% C) | | | |
|---|---|---|---|
| Buffer | Ditch-edge | Field-edge | |
| | | 8 m width | 15 m width |
| R1 | 0.85 % | 0.47 % | - |
| R2N | 0.84 % | 0.44 % | 0.25 % |

Note: The higher carbon content along the ditch edge was attributed to vegetation growing along the side of the ditch and into the buffer, providing carbon at depth.

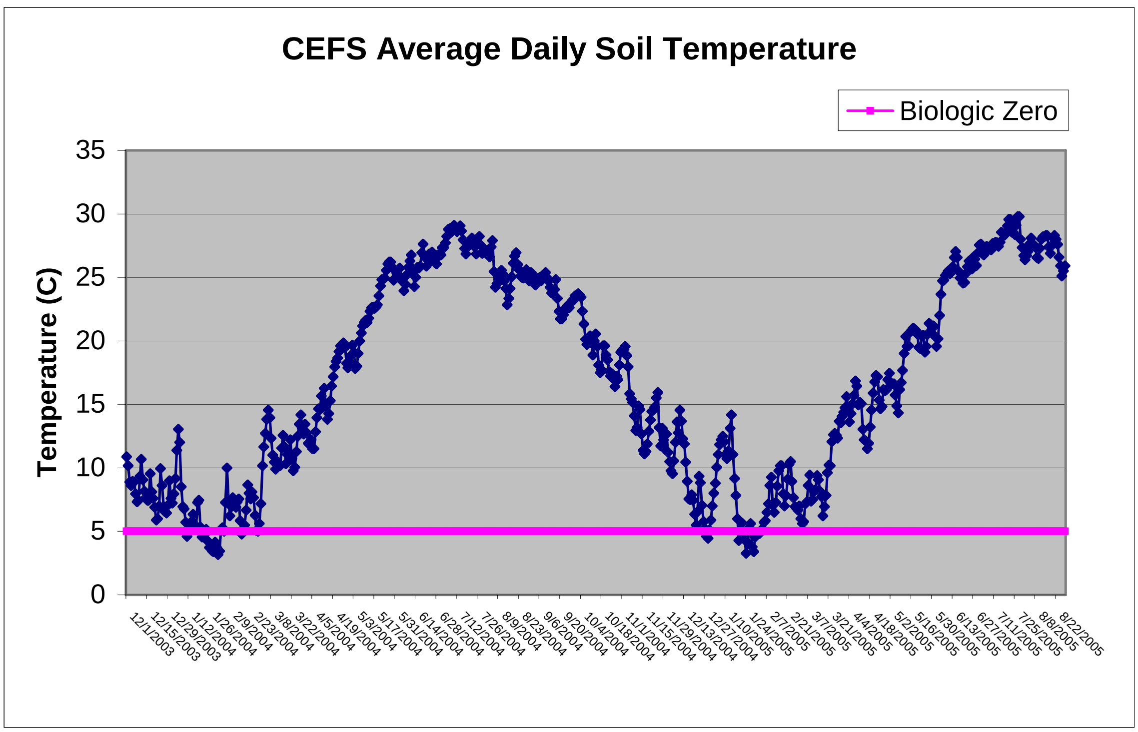


Figure B.1. Average daily soil temperature at 10 cm for the CEFS site.

Note: Soil temperature data given by the State Climate Office of North Carolina.

Field profile descriptions:

*Buffer R1*
Descriptions taken from Sheryl Kunickis' dissertation (2000).

Profile 1: Sample taken in the 8 m tree plot.

0 to 58 cm; olive brown (2.5Y 4/3) loam; few fine dark yellowish brown (10YR 4/6) irregularly shaped masses of iron accumulation; fine subangular blocky structure; friable; many very fine, fine, and medium roots; slightly acid.

58 to 69 cm; olive brown (2.5Y 4/3) and dark gray (2.5Y 4/1) loam; few fine dark yellowish brown (10YR 4.6) irregularly shaped masses of iron accumulation; fine subangular blocky structure; friable; many very fine, fine, and medium roots; neutral.

69 to 99 cm; 80 percent strong brown (7.5YR 5/8) and 20 percent gray (2.5Y 5/1) and light brownish gray (2.5Y 6/2) clay; medium subangular blocky structure; firm; neutral.

99 to 135 cm; light brownish gray (2.5Y 6/2) sandy clay loam; few faint light yellowish brown (2.5Y 6/4) masses of iron accumulation; medium subangular blocky structure; firm; slightly acid.

135 to 140 cm; grayish brown (2.5Y 5/2) clay loam; fine subangular blocky structure; firm; pieces of woody debris; slightly acid.

140 to 152 cm; multicolored sand in shades of gray and yellow; granular structure; very friable; slightly acid.

Notes: Water at 140 cm.

Profile 2: Sample taken in the 8 m native vegetation plot.
0 to 41 cm; olive brown (2.5Y 4/3) sandy loam; granular structure; loose; many very fine and fine roots; less than 20 percent gravel by volume; slightly acid.

41 to 61 cm; 60 percent olive yellow (2.5Y 6/6) and 40 percent multicolored in shades of gray and brown clay (2.5Y 6/2), 10YR 5/8, 10YR 4/1, and 2.5Y 6/4); medium subangular blocky structure; very firm; common very fine and fine roots; neutral.

61 to 107 cm; mixed brownish yellow (10YR 6/8), yellowish brown (10YR 5/8), and gray (2.5Y 6/1) clay; few distinct strong brown (7.5YR 5/6) irregularly shaped masses of iron accumulation; few prominent gray (1G 6/N) and white (1G 8N) iron depletions; medium subangular blocky structure; firm; strongly acid.

107 to 135 cm; gray (5Y 6/1) clay; few prominent olive yellow (2.5Y 6/6) and strong brown (7.5YR 5/6) irregularly shaped masses of iron accumulation; medium subangular blocky structure; firm; strongly acid.

135 to 142 cm; strong brown (7.5YR 5/8) sand; granular structure; loose; strongly acid.

142 to 152 cm; olive yellow (2.5Y 6/6) sand; granular structure; loose; strongly acid.

*Buffer R2N*
Descriptions taken from Sheryl Kunickis' dissertation (2000).

Profile 1: Sample taken in the 8 m tree plot.
0-28 cm; light olive brown (2.5Y 4/3) sandy loam; granular structure; friable; many very fine and fine roots; less than 20 percent gravel by volume; moderately acid.

28-43 cm; black (2.5Y 2.5/1) sandy loam; few fine gray (10YR 6/2) iron depletions along root channels; fine subangular blocky structure; friable; few very fine roots; slightly acid.

43 to 97 cm; light brownish gray (2.5Y 5/2) sandy loam; few fine brownish yellow (10YR 6/8) irregularly shaped masses of iron accumulation; fine subangular blocky structure; firm; less than 20 percent gravel by volume; moderately acid.

97 to 125 cm; grayish brown (2.5Y 6/3) gravely coarse sandy loam; loose structure; friable; moderately acid.

125 to 130 cm; light yellowish brown (2.5Y 6/3) gravelly coarse sand; loose structure; friable; moderately acid.

130 to 142 cm; multicolored sand in shades of pale yellow and olive yellow; loose structure; friable; less than 20 percent gravel by volume; moderately acid.

142 to 152 cm; multicolored sand in shades of brown and yellow; loose structure; friable; moderately acid.

Notes: Wet sand at 142 cm.

Profile 2: Sample taken in the 8 m fescue plot.
0 to 41 cm; olive brown (2.5Y 4/3) sandy loam; granular structure; loose; many very fine and fine roots; less than 15 percent gravel by volume; strongly acid.

41-51 cm; very dark gray (2.5Y 3/1) coarse sandy loam; granular/fine subangular blocky structure; friable; few very fine and fine roots; strongly acid.

51 to 86 cm; 60 perecnet light brownish gray (2.5Y 6/2), 20 percent brownish yellow (10YR 6/6), 20 percent gray (10YR 6/1) sandy clay loam; medium subangular blocky structure; firm; strongly acid.

86 to 117 cm; gray (2.5Y 6/2) fine sandy loam; fine subangular blocky structure; friable; less than 15 percent gravel by volume; very strongly acid.

117 to 137 cm; light brownish gray (2.5Y 6/2) sandy loam; few fine pale yellow (2.5Y 7/4) and brownish yellow (10YR 6.8) irregularly shaped masses of iron accumulation; fine subangular blocky structure; friable; very strongly acid.

137 to 150 cm; brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) sand; few fie light brownish gray (2.5 Y 6/2) iron depletions; fine subangular blocky structure; friable; very strongly acid.

150 to 152 cm; 70 percent light yellowish brown (2.5Y 6/4) and 30 percent light gray (2.5Y 7/1) fine sand; granular structure; loose; very friable; very strongly acid.

Profile 3: Sample taken in the 15 m switchgrass plot.
0 to 48 cm; dark yellowish brown (10YR 3/4) sandy loam; loose structure; very friable; many very fine, fine and few medium roots; strongly acid.

48 to 64 cm; black (2.5Y 2.5/1) silt loam with fine pockets of coarse sand; fine subangular blocky structure; friable; common very fine and fine roots; moderately acid.

64 to 112 cm; gray (10YR 6/1) clay; few yellowish brown (10YR 5/8), very dark grayish brown (2.5Y 3/2), and dark yellowish brown (10YR 3/4) irregularly shaped masses of iron accumulation; moderate subangular blocky structure; firm; many slate fragments; strongly acid.

112 to 137 cm; dark gray (10YR 4/1) sandy loam; moderate subangular blocky structure; firm; woody debris; common very fine mica flakes; slightly acid.

137 to 152 cm; dark grayish brown (2.5Y 4/2) sandy clay loam; fine subangular blocky structure; firm; less than 20 percent gravel by volume; some woody debris; neutral.

Profile 4: Sample taken in the 15 m no-buffer control plot.
0 to 33 cm; brown (10YR 4/3) sandy loam; granular structure; friable; many very fine and fine roots; moderately acid.

33 to 91 cm; brownish yellow (10YR 6/6) sand; loose structure; very friable; slightly acid.

91 to 137 cm; multicolored sand in shades of yellow and brown; loose structure; very friable; slightly acid.

137 to 152 cm; yellowish brown (10YR 5/6) sand; pockets of pale yellow (2.5Y 7/4) sand; loose structure; very friable; neutral.

Notes: Surface slightly disturbed due to instrument installation. Soil wet at 137 cm.

*Buffer R4W*

Profile 1: Sample taken in the 15 m fescue plot.
Ap 0 to 15 cm; dark grayish brown (10YR 4/2) loamy sand.
AB 15 to 25 cm; pale brown (10YR 6/3) loamy sand; with few, fine, faint, yellowish red (5YR 5/6) mottles.
Btg1 25 to 59 cm; pale brown (10YR 6/3) sandy clay loam; with many, fine, distinct, yellowish red (5YR 5/8) mottles.
Btg2 59 to 104 cm; grayish brown (10YR 5/2) sandy loam; with common, fine, distinct, yellowish red (5YR 5/8) mottles.
B 104 to 124 cm; dark yellowish brown (10YR 4/4) silty loam.
BC 124 to 145 cm; dark yellowish brown (10YR 4/4) sandy loam.
Note: Water saturated at 124 cm.

Profile 2: Sample taken in the 15 m tree plot.
Ap 0 to 18 cm; light brownish gray (10YR 6/2) loamy sand.
AB 18-41 cm; light brownish gray (10YR 6/2) fine sandy loam.
Btg1 41 to 69 cm; light gray (10YR 7/1) sandy loam.
Btg2 69 to 89 cm; gray (10YR 6/1) clay loam.
Btg3 89 to 109 cm; grayish brown (10YR 5/2) silty loam with few, fine, distinct, yellowish red (5YR 5/8) mottles.
C 109 to 115 cm; grayish brown (10YR 5/2) coarse sand.
Note: Water saturated at 109 cm

Profile 3: Sample taken in the 8 m switchgrass plot.
Ap 0 to 25 cm; brown (10YR 5/3) loamy sand
Btg 25 to 61 cm; light brownish gray (10YR 6/2) sandy loam with common, distinct, yellowish red (5YR 5/8) mottles.
B 61 to 89 cm; pale brown (10YR 6/3) sand.
Btg2 89 to 104 cm; light brownish gray (10YR 6/2) silty loam.
BC 104 to 114 cm; light gray (10YR 7/2) coarse sand.
Note: Water saturated at 104 cm

Profile 4: Sample taken in the 8 m fescue plot.
Ap 0 to 25 cm; brown (10YR 5/3) loamy sand.

Btg 25 to 61 cm; light brownish gray (10YR 6/2) sandy loam with common, distinct, yellowish red (5YR 5/8) mottles.
B 61 to 89 cm; pale brown (10YR 6/3) sand.
Btg2 89 to 104 cm; light brownish gray (10YR 6/2) silty loam.
BC 104 to 114 cm; light gray (10YR 7/2) coarse sand.
Note: Water saturated at 104 cm

*Buffer R5N*

Profile 1: Sample taken in the 15 m native vegetation plot.
Ap 0 to 38 cm; dark gray (10YR 4/1) loamy sand with diffuse boundary.
Btg 38 to 102 cm; light brownish gray (10YR 6/2) sandy clay loam with common, distinct, yellowish red (5YR 5/8) mottles.
Bg 102 to 122 cm; light gray (10YR 7/1) loamy sand.
C 122 to 152 cm; light brownish gray (10YR 6/2) sand.
Note: Water saturated at 152 cm

Profile 2 Sample taken in the 15 m tree plot.
Ap 0 to 28 cm; dark gray (10YR 4/1) loamy sand.
Bt1 28 to 48 cm; light brownish gray (10YR 6/2) fine sandy loam.
Bt2 48 to 112 cm; light brownish gray (10YR 6/2) sandy clay loam with many, distinct, yellowish red (5YR 5/8) mottles.
Bt3 112 to 130 cm; gray (10YR 5/1) fine sandy loam.
C 130 to 152 cm; gray (10YR 5/1) sand.
Note: Water saturated at 152 cm

Profile 3: Sample taken in the 8 m no-buffer control plot.
Ap 0 to 23 cm; dark gray (10YR 4/1) loamy sand.
Bt1 23 to 61 cm; mottled dark gray (10YR 4/1) and light brownish gray (10YR 6/2) sandy loam.
Bt2 61 to 91 cm; gray (10YR 6/1) sandy loam.
B 91 to 112 cm; gray (10YR 6/1) loamy sand.
C 112 to 140 cm; light gray (10YR 7/1) sand.
Note: Water saturated at 140 cm

Profile 4: Sample taken in the 8 m switchgrass plot.
Ap 0 to 15 cm; brown (10YR 5/3) loamy sand.
AB 15 to 25 cm; dark gray (10YR 4/1) loamy sand.
Btg 25 to 86 cm; gray (10YR 6/1) sandy loam.
BC 86 to 107 cm; dark grayish brown (10YR 4/2) loamy sand.
C 107 to 122 cm; light brownish gray (10YR 6/3) coarse sand.
Note: Water saturated at 122 cm

Appendix C: Adjacent Stream Data:

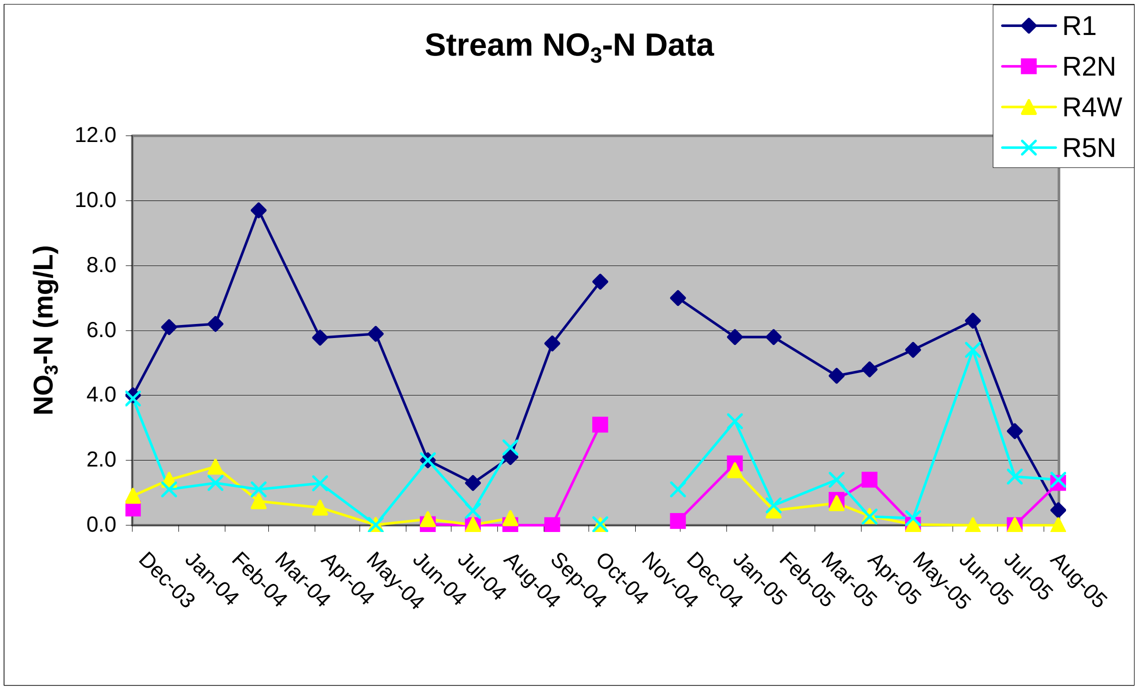


Figure C.1. Adjacent stream $NO_3$-N concentration data.

Note: Missing data implies stream was dry that sampling period.

Appendix D: $NO_3$-N Concentration Data by Vegetative Type:

| Table D.1. Buffer R1: $NO_3$-N Concentration reductions. | | | |
|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N (mg $NO_3$-N/L) | | Reduction |
| | Field wells | Ditch wells | |
| Trees | 9.39 | 4.39 | 53% |
| Fescue | 7.94 | 4.80 | 40% |
| Switchgrass | 6.09 | 1.18 | 81% |
| Native vegetation | 8.53 | 5.11 | 40% |
| No-buffer control | 5.00 | 4.95 | 1% |

| Table D.2. Buffer R2N: $NO_3$-N Concentration reductions. | | | |
|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N (mg $NO_3$-N/L) | | Reduction |
| | Field wells | Ditch wells | |
| Trees | 4.94 | 2.07 | 58% |
| Fescue | 5.34 | 1.94 | 64% |
| Switchgrass | 5.45 | 2.36 | 57% |
| Native vegetation | 3.80 | 2.41 | 37% |
| No-buffer control | 6.52 | 2.27 | 65% |

| Table D.3. Buffer R4W: $NO_3$-N Concentration reductions. | | | |
|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N (mg $NO_3$-N/L) | | Reduction |
| | Field wells | Ditch wells | |
| Trees | 16.29 | 7.02 | 57% |
| Fescue | 11.03 | 7.06 | 36% |
| Switchgrass | 8.40 | 6.79 | 19% |
| Native vegetation | 11.09 | 8.13 | 27% |
| No-buffer control | 6.80 | 6.06 | 11% |

| Table D.4. Buffer R5N: $NO_3$-N Concentration reductions. | | | |
|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N (mg $NO_3$-N/L) | | Reduction |
| | Field wells | Ditch wells | |
| Trees | 4.53 | 1.66 | 63% |
| Fescue | 1.00 | 1.29 | -29% |
| Switchgrass | 2.12 | 2.02 | 5% |
| Native vegetation | 2.44 | 0.63 | 74% |
| No-buffer control | 1.41 | 1.21 | 14% |

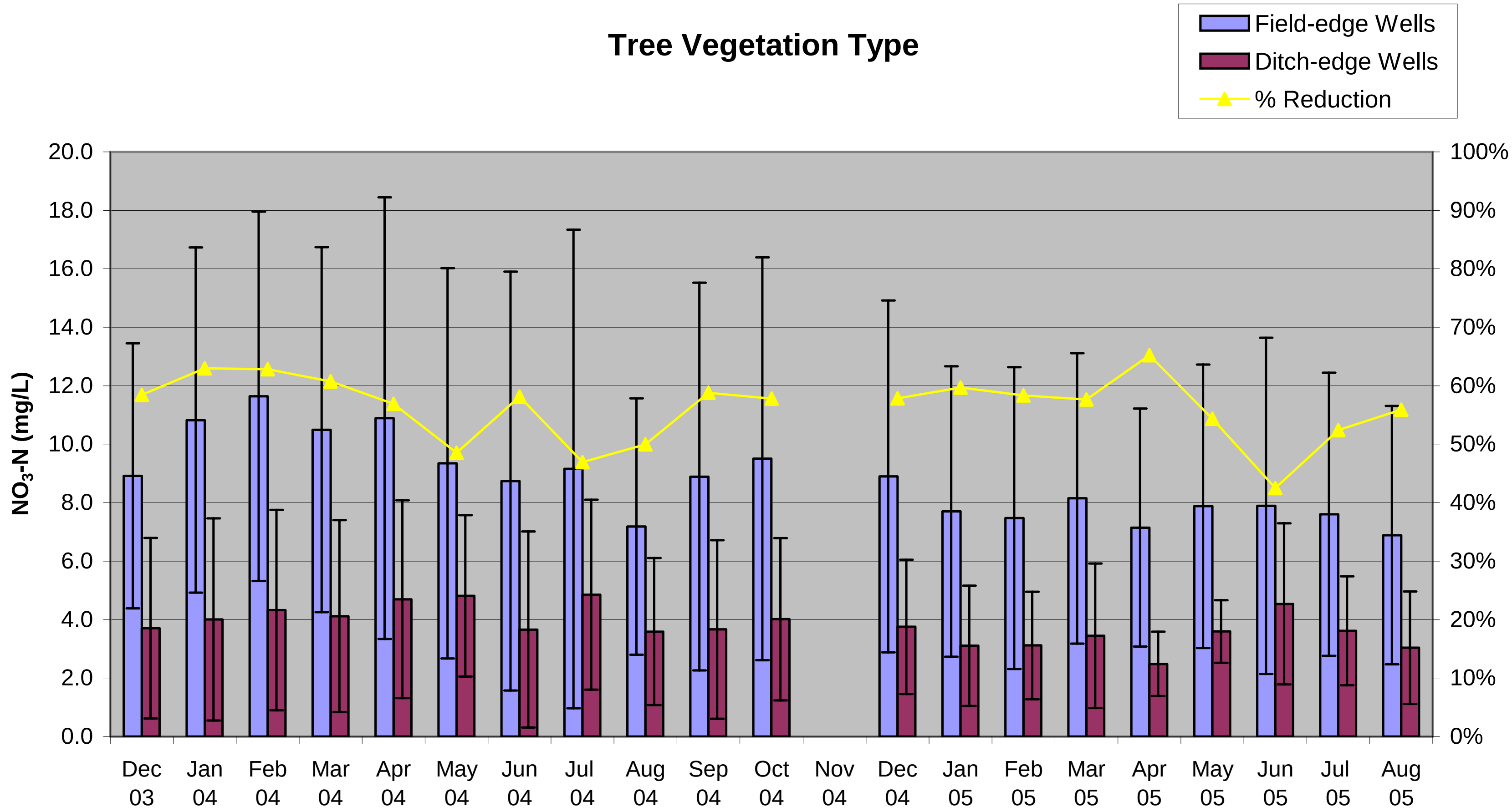


Figure D.1. $NO_3$-N concentration data for the tree vegetation type.

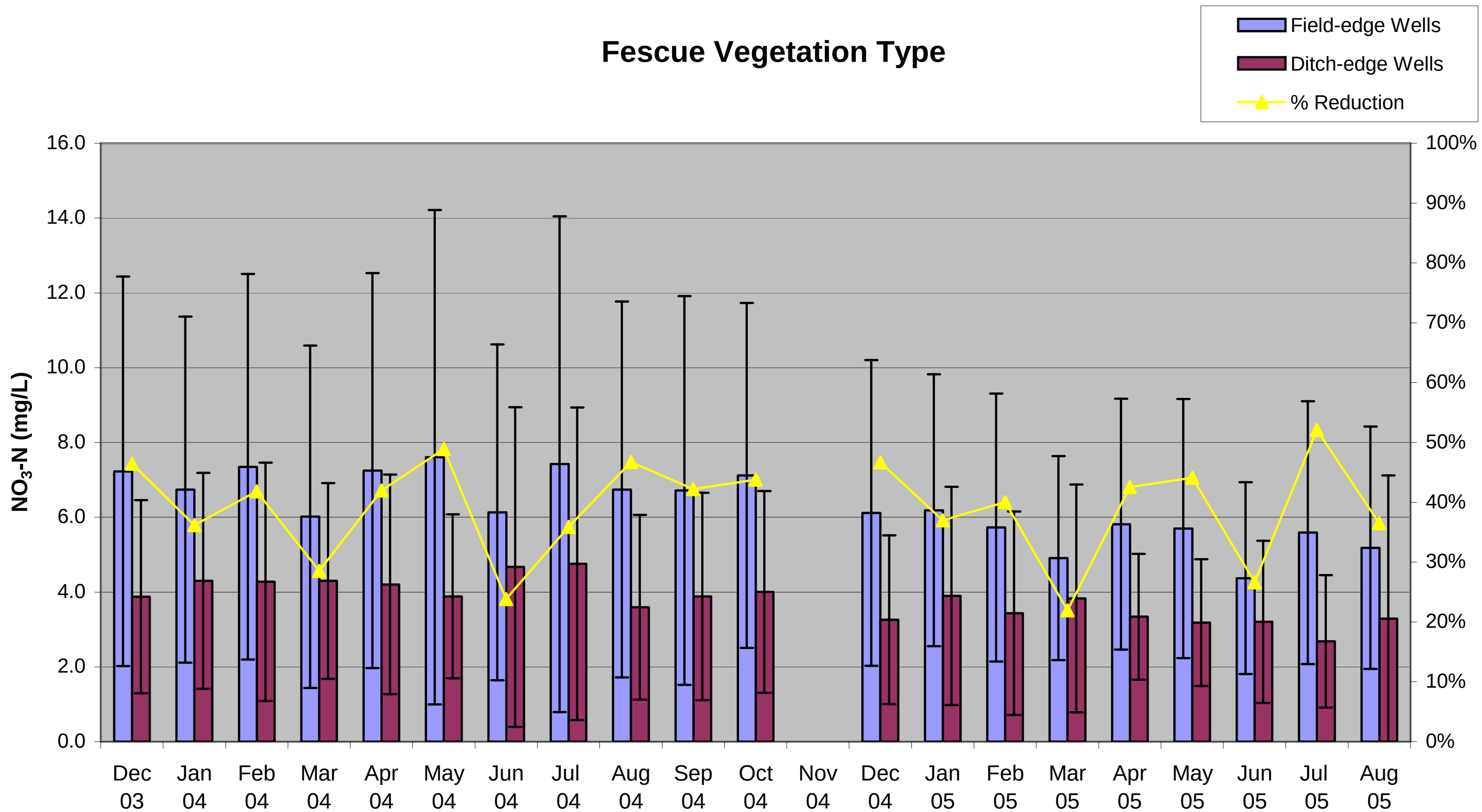


Figure D.2. $NO_3$-N concentration data for the fescue vegetation type.

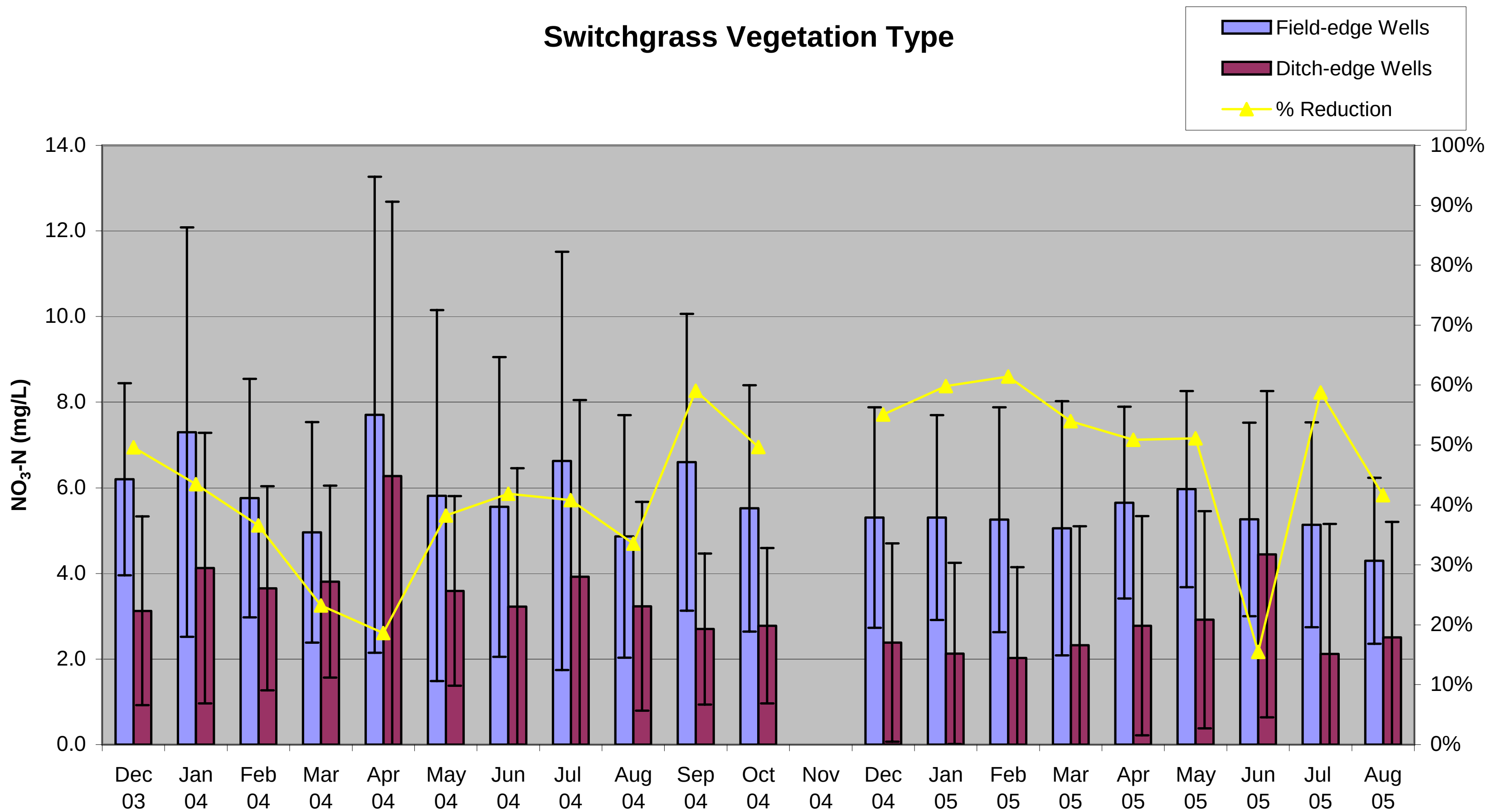


Figure D.3. $NO_3$-N concentration data for the switchgrass vegetation type.

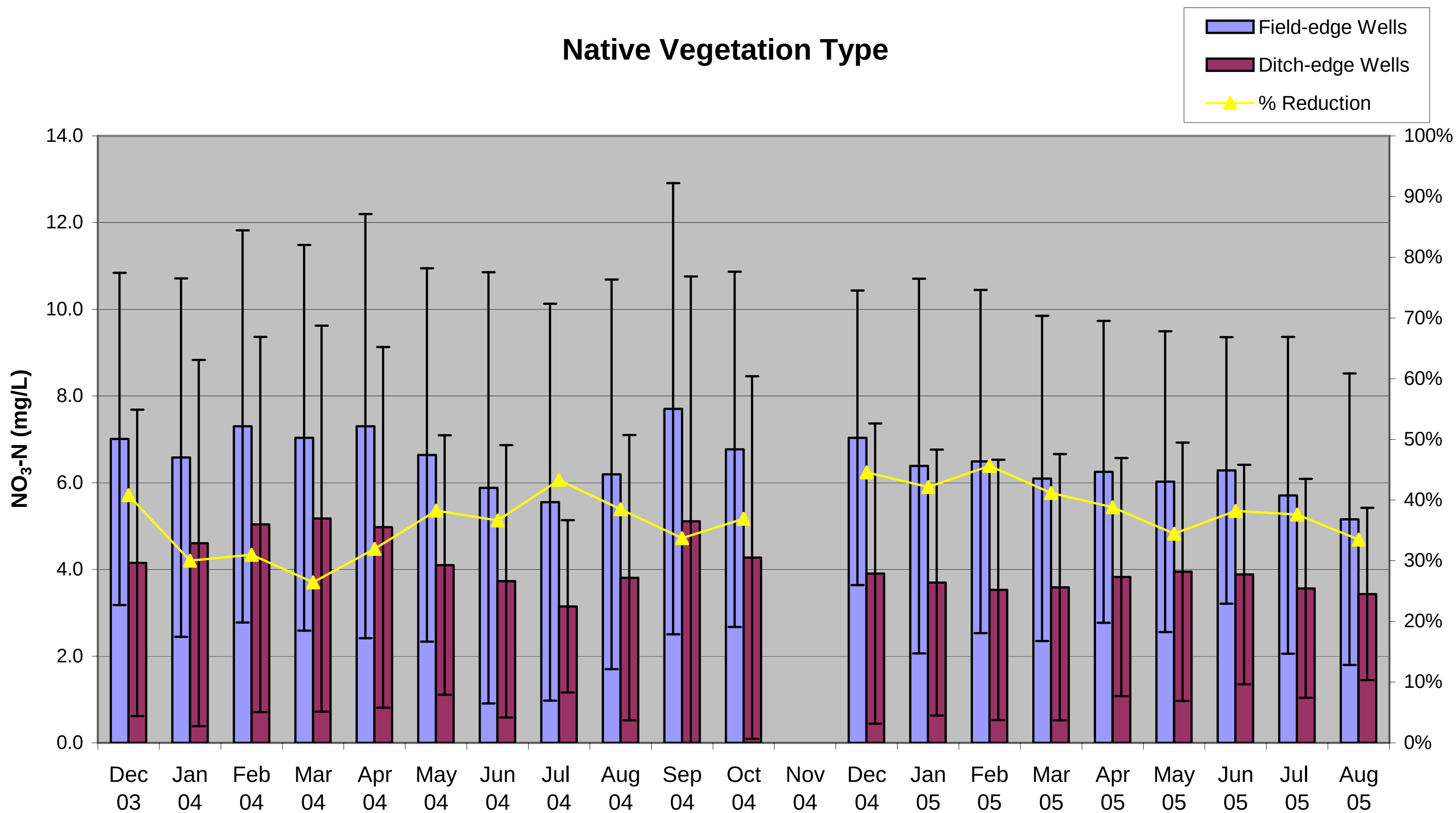


Figure D.4. $NO_3$-N concentration data for the native vegetation type.

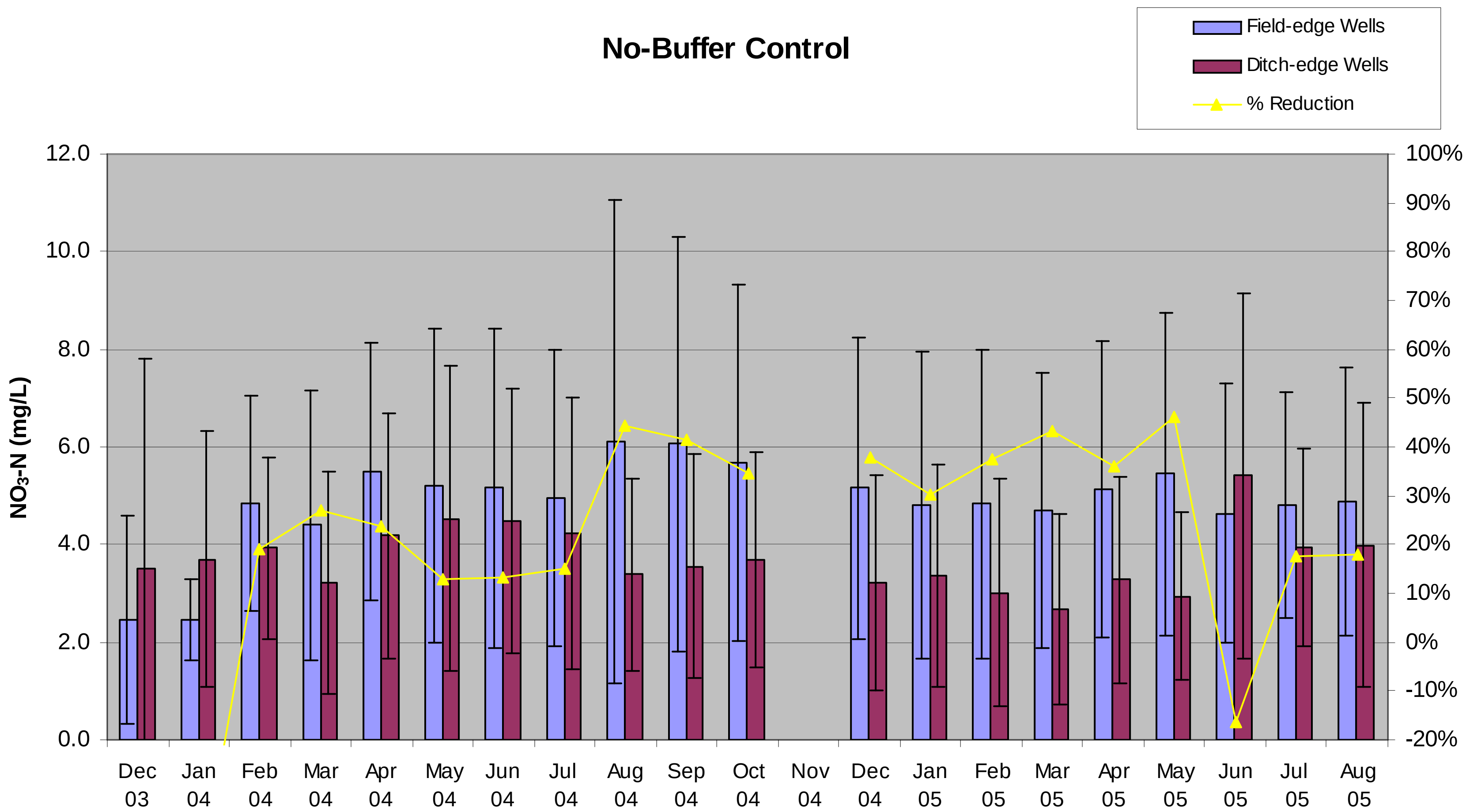


Figure D.5. $NO_3$-N concentration data for the no-buffer control.

Appendix E: $NO_3$-N Concentration Data by Buffer Width and Well Depth:

| Table E.1. Buffer R1: $NO_3$-N concentration reductions. | | | | |
|---|---|---|---|---|
| Width | Depth | Mean $NO_3$-N (mg $NO_3$-N/L) | | |
| | | Field wells | Ditch wells | Reduction |
| 8m | Intermediate | 8.51 | 7.60 | 11% |
| | Deep | 5.07 | 2.05 | 60% |
| 15m | Intermediate | 9.69 | 6.18 | 36% |
| | Deep | 7.80 | 2.22 | 72% |

| Table E.2. Buffer R2N: $NO_3$-N concentration reductions. | | | | |
|---|---|---|---|---|
| Width | Depth | Mean $NO_3$-N (mg $NO_3$-N/L) | | |
| | | Field wells | Ditch wells | Reduction |
| 8m | Intermediate | 3.46 | 3.37 | 3% |
| | Deep | 2.88 | 3.26 | -14% |
| 15m | Intermediate | 9.61 | 1.48 | 85% |
| | Deep | 4.98 | 0.22 | 96% |

| Table E.3. Buffer R4W: $NO_3$-N concentration reductions. | | | | |
|---|---|---|---|---|
| Width | Depth | Mean $NO_3$-N (mg $NO_3$-N/L) | | |
| | | Field wells | Ditch wells | Reduction |
| 8m | Intermediate | 22.14 | 21.16 | 4% |
| | Deep | 12.14 | 3.59 | 70% |
| 15m | Intermediate | 4.96 | 2.22 | 55% |
| | Deep | 3.57 | 0.52 | 85% |

| Table E.4. Buffer R5N: $NO_3$-N concentration reductions. | | | | |
|---|---|---|---|---|
| Width | Depth | Mean $NO_3$-N (mg $NO_3$-N/L) | | |
| | | Field wells | Ditch wells | Reduction |
| 8m | Intermediate | 5.77 | 2.87 | 50% |
| | Deep | 0.96 | 0.71 | 26% |
| 15m | Intermediate | 1.40 | 0.55 | 60% |
| | Deep | 0.88 | 1.26 | -44% |

Appendix F: CEFS Complete Data Set

Table F.1. Complete chemical analysis for wells.

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 2 | 12/15/03 | 0 | 0 | 9.9 | 14.9 | 2.6 |
| R1N | 3 | 12/15/03 | 0 | 0.02 | 0.01 | 5.83 | 2.7 |
| R1N | 5 | 12/15/03 | 0 | 0.01 | 7.6 | 21 | 4.9 |
| R1N | 6 | 12/15/03 | 0 | 0.03 | 0.02 | 14.5 | 2.2 |
| R1N | 8 | 12/15/03 | 0 | 0.01 | 15 | 23.3 | 2 |
| R1N | 9 | 12/15/03 | 0.01 | 0.31 | 0.36 | 16.1 | 1.6 |
| R1N | 11 | 12/15/03 | 0 | 0 | 10.8 | 13.7 | 2.9 |
| R1N | 12 | 12/15/03 | 0 | 0 | 9.5 | 25.4 | 1.6 |
| R1N | 17 | 12/15/03 | 0 | 0.01 | 5.7 | 12.9 | 2.9 |
| R1N | 18 | 12/15/03 | 0 | 0.02 | 3.2 | 17.3 | 1.8 |
| R1N | 20 | 12/15/03 | 0 | 0.12 | 2 | 6.58 | 2.9 |
| R1N | 21 | 12/15/03 | 0 | 0.62 | 0.54 | 11.1 | 2.6 |
| R1N | 23 | 12/15/03 | 0.02 | 0.01 | 6.3 | 6.96 | 3.5 |
| R1N | 24 | 12/15/03 | 0.01 | 0.15 | 0.24 | 9.41 | 2 |
| R1N | 26 | 12/15/03 | 0 | 0.01 | 14.6 | 22.3 | 1.8 |
| R1N | 29 | 12/15/03 | 0 | 0 | 9.4 | 13.1 | 2.8 |
| R1N | 30 | 12/15/03 | 0.02 | 4 | 0.03 | 12.4 | 3.2 |
| R1N | 32 | 12/15/03 | 0 | 1.9 | 0 | 5.34 | 6.6 |
| R1N | 35 | 12/15/03 | 0 | 0.01 | 4.2 | 5.71 | 3.7 |
| R1N | 36 | 12/15/03 | 0 | 0 | 6.9 | 19.1 | 1.7 |
| R1N | 38 | 12/15/03 | 0.01 | 0.01 | 16.8 | 23.5 | 1.7 |
| R1N | 39 | 12/15/03 | 0.01 | 0.21 | 13.1 | 23.8 | 4.9 |
| R1N | 41 | 12/15/03 | 0 | 0.03 | 14.3 | 23.6 | 2.2 |
| R1N | 42 | 12/15/03 | 0 | 0 | 8.1 | 25.3 | 1.6 |
| R1N | 44 | 12/15/03 | -0.01 | 0 | 9 | 21.8 | 1.6 |
| R1N | 45 | 12/15/03 | 0.01 | 0.15 | 0.2 | 7.21 | 1.9 |
| R1N | 47 | 12/15/03 | -0.01 | 0 | 6.3 | 15.8 | 1.6 |
| R1N | 48 | 12/15/03 | -0.01 | 0 | 5.7 | 24.1 | 1.9 |
| R1N | 50 | 12/15/03 | 0 | 0 | 10 | 11.4 | 1.9 |
| R1N | 51 | 12/15/03 | 0 | 0 | 3.4 | 15.9 | 2 |
| R1N | 54 | 12/15/03 | 0 | 0 | 7.1 | 10.5 | 2.2 |
| R1N | 57 | 12/15/03 | -0.01 | 0.01 | 9.9 | 11.3 | 2.3 |
| R1N | 59 | 12/15/03 | 0 | 0.03 | 7.1 | 5.1 | 3.3 |
| R1N | 60 | 12/15/03 | 0 | 0.01 | 12.7 | 20.9 | 3 |
| R1N | 62 | 12/15/03 | 0 | 0.01 | 18.7 | 23.7 | 2.8 |
| R1N | 63 | 12/15/03 | 0 | 0 | 4.7 | 18 | 2.2 |
| R1N | 65 | 12/15/03 | -0.01 | 0.01 | 13.6 | 21.8 | 2.4 |
| R1N | 66 | 12/15/03 | 0 | 0 | 7.5 | 23.9 | 2.2 |
| R1N | 68 | 12/15/03 | -0.01 | 0 | 8.8 | 4.62 | 3.1 |
| R1N | 69 | 12/15/03 | 0 | 0 | 4.6 | 11.6 | 1.9 |
| R1N | 71 | 12/15/03 | -0.01 | 0 | 11.3 | 15.5 | 2.1 |
| R1N | 72 | 12/15/03 | 0 | 0.01 | 11.4 | 15.4 | 2.3 |
| R1N | Stream | 12/15/03 | 0.09 | 0.19 | 4 | 13.7 | 9.2 |
| R2N | 2 | 12/15/03 | 0.02 | 0.01 | 3.5 | 1.97 | 5.2 |
| R2N | 3 | 12/15/03 | 0 | 0 | 2.1 | 4.22 | 3.3 |
| R2N | 5 | 12/15/03 | 0 | 0 | 3.4 | 4.49 | 3.3 |
| R2N | 6 | 12/15/03 | 0 | 0 | 3.1 | 17.1 | 2.1 |
| R2N | 8 | 12/15/03 | 0 | 0 | 4.5 | 10.6 | 2.9 |
| R2N | 9 | 12/15/03 | 0 | 0.01 | 2.6 | 17.7 | 2.2 |
| R2N | 11 | 12/15/03 | -0.01 | 0.1 | 1.6 | 5.35 | 3.2 |
| R2N | 12 | 12/15/03 | -0.01 | 0 | 2.8 | 14.1 | 2.4 |
| R2N | 14 | 12/15/03 | 0 | 0.02 | 1.1 | 8.61 | 4.9 |
| R2N | 15 | 12/15/03 | 0 | 0.01 | 2.8 | 13.4 | 2.9 |
| R2N | 17 | 12/15/03 | 0 | 0.23 | 1.9 | 3.79 | 6.6 |
| R2N | 18 | 12/15/03 | 0 | 0.02 | 0.02 | 11.3 | 2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 20 | 12/15/03 | 0 | 0.11 | 0.34 | 9.02 | 17.5 |
| R2N | 21 | 12/15/03 | 0 | 0.02 | 0.01 | 16.3 | 1.8 |
| R2N | 23 | 12/15/03 | 0.02 | 0.01 | 2.2 | 4.35 | 12.6 |
| R2N | 24 | 12/15/03 | 0.13 | 0.83 | 0 | 21.5 | 3 |
| R2N | 26 | 12/15/03 | 0.03 | 0 | 1.9 | 6.1 | 5 |
| R2N | 27 | 12/15/03 | 0.03 | 0.12 | 0.01 | 23.1 | 1.9 |
| R2N | 29 | 12/15/03 | 0.2 | 0.01 | 0.97 | 1.56 | 7.2 |
| R2N | 30 | 12/15/03 | 0.01 | 0.03 | 0.01 | 15.2 | 2.1 |
| R2N | 32 | 12/15/03 | 0.13 | 0.02 | 6.9 | 1.66 | 4 |
| R2N | 33 | 12/15/03 | 0.01 | 0.02 | 1.5 | 15.2 | 2.1 |
| R2N | 35 | 12/15/03 | 0.09 | 0.02 | 3.5 | 1.33 | 4.8 |
| R2N | 36 | 12/15/03 | 0.01 | 0.02 | 4.4 | 25.9 | 2.5 |
| R2N | 38 | 12/15/03 | 0.01 | 0.02 | 3.6 | 2.32 | 3.6 |
| R2N | 39 | 12/15/03 | 0.01 | 0.02 | 2.7 | 23.7 | 2.4 |
| R2N | 41 | 12/15/03 | 0.01 | 0.01 | 3.8 | 2.17 | 2.8 |
| R2N | 42 | 12/15/03 | 0.01 | 0.02 | 2.1 | 3.81 | 3.7 |
| R2N | 44 | 12/15/03 | 0.01 | 0.02 | 3.2 | 3.56 | 4.1 |
| R2N | 45 | 12/15/03 | 0.01 | 0.02 | 2.7 | 9.75 | 3.8 |
| R2N | 47 | 12/15/03 | 0.01 | 0.02 | 6.2 | 13.2 | 2.8 |
| R2N | 48 | 12/15/03 | 0.01 | 0.03 | 1.9 | 9.37 | 3.1 |
| R2N | 50 | 12/15/03 | 0.01 | 0.03 | 9.5 | 9.64 | 2.9 |
| R2N | 51 | 12/15/03 | 0.01 | 0.11 | 3.9 | 7.15 | 2.4 |
| R2N | 53 | 12/15/03 | 0.01 | 0.01 | 2.7 | 7.42 | 3.3 |
| R2N | 54 | 12/15/03 | 0.01 | 0.02 | 4.3 | 7.23 | 2.3 |
| R2N | 56 | 12/15/03 | 0.13 | 0.02 | 7.4 | 6.79 | 4.1 |
| R2N | 57 | 12/15/03 | 0.01 | 0.02 | 3.8 | 4.2 | 2 |
| R2N | 59 | 12/15/03 | 0.68 | 0.02 | 1.9 | 2 | 4.6 |
| R2N | 60 | 12/15/03 | 0.01 | 0.02 | 3.7 | 7.39 | 2 |
| R2N | 62 | 12/15/03 | 0.13 | 0.01 | 2.5 | 1.67 | 3.2 |
| R2N | 63 | 12/15/03 | 0.01 | 0.03 | 4.6 | 23.6 | 3 |
| R2N | 65 | 12/15/03 | 0.02 | 0.03 | 3.3 | 17.4 | 3.7 |
| R2N | 66 | 12/15/03 | 0.02 | 0.02 | 2.2 | 2.45 | 3.1 |
| R2N | 68 | 12/15/03 | 0 | 0.11 | 8.2 | 8.18 | 4.7 |
| R2N | 69 | 12/15/03 | 0.01 | 0.02 | 2.9 | 8.07 | 2 |
| R2N | 72 | 12/15/03 | 0.01 | 0.01 | 3.8 | 8.71 | 2.8 |
| R2N | Stream | 12/15/03 | 0.92 | 0.11 | 0.51 | 1.82 | 19.2 |
| R4W | 2 | 12/15/03 | 0.02 | 0.02 | 24.3 | 27 | 3.7 |
| R4W | 3 | 12/15/03 | 0.02 | 0.03 | 0.13 | 21.6 | 1.8 |
| R4W | 5 | 12/15/03 | 0.01 | 0.02 | 22.8 | 19.5 | 4.8 |
| R4W | 6 | 12/15/03 | 0.02 | 0.21 | 0.18 | 26.7 | 2.9 |
| R4W | 8 | 12/15/03 | 0.01 | 0.02 | 25 | 24.8 | 5 |
| R4W | 9 | 12/15/03 | 0.02 | 0.03 | 0.03 | 11.2 | 3.1 |
| R4W | 11 | 12/15/03 | 0.01 | 0.02 | 19.8 | 24 | 8.5 |
| R4W | 12 | 12/15/03 | 0.01 | 0.12 | 0.23 | 21.5 | 2 |
| R4W | 14 | 12/15/03 | 0.01 | 0.02 | 14.9 | 22.8 | 3.1 |
| R4W | 15 | 12/15/03 | 0.01 | 0.03 | 12.4 | 23.1 | 2.4 |
| R4W | 17 | 12/15/03 | 0.01 | 0.02 | 5.9 | 25.2 | 3.8 |
| R4W | 18 | 12/15/03 | 0.02 | 0.38 | 0.48 | 16.9 | 2.8 |
| R4W | 20 | 12/15/03 | 0.01 | 0.02 | 1.9 | 27.9 | 7.3 |
| R4W | 21 | 12/15/03 | 0.05 | 1.6 | 0.02 | 10.4 | 4.7 |
| R4W | 23 | 12/15/03 | 0.01 | 0.02 | 1.9 | 28.7 | 4.9 |
| R4W | 24 | 12/15/03 | 0.01 | 0.24 | 0.99 | 28.5 | 3.2 |
| R4W | 26 | 12/15/03 | 0.01 | 0.03 | 2.6 | 27.1 | 8.3 |
| R4W | 27 | 12/15/03 | 0.21 | 0.02 | 1.8 | 30.7 | 5.5 |
| R4W | 29 | 12/15/03 | 0.01 | 0.02 | 1.9 | 27.3 | 7.2 |
| R4W | 30 | 12/15/03 | 0.02 | 0.14 | 0.29 | 30.2 | 5.4 |
| R4W | 33 | 12/15/03 | 0.02 | 0.03 | 0.26 | 19.4 | 2.2 |
| R4W | 35 | 12/15/03 | 0.01 | 0.02 | 25 | 20.2 | 3.7 |
| R4W | 36 | 12/15/03 | 0.02 | 0.24 | 0.03 | 14 | 1.5 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 38 | 12/15/03 | 0.01 | 0.33 | 13.6 | 13.2 | 3.7 |
| R4W | 39 | 12/15/03 | 0.02 | 0.2 | 17.4 | 20.8 | 3.2 |
| R4W | 41 | 12/15/03 | 0.01 | 0.02 | 24.5 | 20.9 | 5 |
| R4W | 42 | 12/15/03 | 0.01 | 0.02 | 24.8 | 19.2 | 4.2 |
| R4W | 44 | 12/15/03 | 0.01 | 0.01 | 17.7 | 19.6 | 7.1 |
| R4W | 45 | 12/15/03 | 0.01 | 0.02 | 19.7 | 20.6 | 5.4 |
| R4W | 47 | 12/15/03 | 0.01 | 0.01 | 11.7 | 19.3 | 3.9 |
| R4W | 48 | 12/15/03 | 0.01 | 0.43 | 12.5 | 19.3 | 4.2 |
| R4W | 50 | 12/15/03 | 0.01 | 0.01 | 5 | 25.4 | 4.1 |
| R4W | 51 | 12/15/03 | 0.01 | 0.01 | 3.3 | 24.1 | 3.7 |
| R4W | 53 | 12/15/03 | 0.01 | 0.01 | 3.9 | 22.9 | 6.4 |
| R4W | 54 | 12/15/03 | 0.01 | 0.01 | 1.4 | 27.4 | 3.6 |
| R4W | 56 | 12/15/03 | 0.01 | 0.01 | 1.1 | 26.2 | 3.8 |
| R4W | 57 | 12/15/03 | 0.02 | 0.01 | 0.46 | 28.7 | 2.8 |
| R4W | 59 | 12/15/03 | 0.02 | 0.01 | 2.7 | 27.8 | 6.6 |
| R4W | 60 | 12/15/03 | 0.01 | 0.12 | 1.8 | 24.6 | 5.5 |
| R4W | 62 | 12/15/03 | 0.01 | 0.01 | 30.7 | 23 | 4.8 |
| R4W | 63 | 12/15/03 | 0.02 | 0.21 | 5.3 | 26.4 | 2.5 |
| R4W | 65 | 12/15/03 | 0.01 | 0.01 | 23.2 | 21.3 | 4.5 |
| R4W | 66 | 12/15/03 | 0.01 | 0.02 | 20 | 19.2 | 3.2 |
| R4W | 68 | 12/15/03 | 0.01 | 0.02 | 8 | 22.1 | 6.1 |
| R4W | 69 | 12/15/03 | 0.02 | 0.02 | 6.3 | 24.8 | 5.2 |
| R4W | 71 | 12/15/03 | 0.01 | 0.01 | 5 | 22.4 | 6.9 |
| R4W | Stream | 12/15/03 | 0.34 | 0.42 | 0.91 | 7.78 | 9.9 |
| R5N | 2 | 12/15/03 | 0.01 | 0.01 | 3.4 | 15.3 | 5 |
| R5N | 3 | 12/15/03 | 0.02 | 0.02 | 2.6 | 14.1 | 3.2 |
| R5N | 5 | 12/15/03 | 0.02 | 0.03 | 2.3 | 11.4 | 3.7 |
| R5N | 6 | 12/15/03 | 0.01 | 0.14 | 1.6 | 16.2 | 8.5 |
| R5N | 8 | 12/15/03 | 0.01 | 0.14 | 7.8 | 12.6 | 6.7 |
| R5N | 9 | 12/15/03 | 0.01 | 0.12 | 2.9 | 14.1 | 5.1 |
| R5N | 11 | 12/15/03 | 0.01 | 0.12 | 3.9 | 11.2 | 4.9 |
| R5N | 12 | 12/15/03 | 0.01 | 0.14 | 0.01 | 25.2 | 3.7 |
| R5N | 14 | 12/15/03 | 0.01 | 0.11 | 2 | 9.51 | 6.6 |
| R5N | 15 | 12/15/03 | 0.01 | 0.15 | 0 | 25.3 | 2.8 |
| R5N | 17 | 12/15/03 | 0.01 | 0.14 | 0.37 | 9.77 | 3.3 |
| R5N | 18 | 12/15/03 | 0.02 | 0.14 | 1.9 | 19.6 | 3 |
| R5N | 20 | 12/15/03 | 0.01 | 0.18 | 0 | 14.5 | 3.7 |
| R5N | 21 | 12/15/03 | 0.02 | 0.13 | 0.94 | 15.1 | 4.6 |
| R5N | 23 | 12/15/03 | 0.01 | 0.15 | 0.01 | 9.55 | 4 |
| R5N | 24 | 12/15/03 | 0.01 | 0.02 | 1.8 | 8.34 | 3.4 |
| R5N | 26 | 12/15/03 | 0.01 | 0.18 | 0 | 14.1 | 4.5 |
| R5N | 27 | 12/15/03 | 0.03 | 0.12 | 0.01 | 7.3 | 2.4 |
| R5N | 29 | 12/15/03 | 0.01 | 0.2 | 0.01 | 15.2 | 6.9 |
| R5N | 30 | 12/15/03 | 0.01 | 0.39 | 0.01 | 21.1 | 5.1 |
| R5N | 32 | 12/15/03 | 0.01 | 0.16 | 5.3 | 10.7 | 4.1 |
| R5N | 33 | 12/15/03 | 0.01 | 0.11 | 3.2 | 12.3 | 5.8 |
| R5N | 35 | 12/15/03 | 0.01 | 0.13 | 15.6 | 8.58 | 3.3 |
| R5N | 36 | 12/15/03 | 0.04 | 0.15 | 2.1 | 7.88 | 6 |
| R5N | 38 | 12/15/03 | 0.01 | 0.17 | 10 | 13 | 9.8 |
| R5N | 39 | 12/15/03 | 0.01 | 0.02 | 0.37 | 23.1 | 3.2 |
| R5N | 41 | 12/15/03 | 0.01 | 0.02 | 3.4 | 9.72 | 5.8 |
| R5N | 42 | 12/15/03 | 0.01 | 0.11 | 0.01 | 25.3 | 4.2 |
| R5N | 44 | 12/15/03 | 0.01 | 0.03 | 36.3 | 16.7 | 10.7 |
| R5N | 45 | 12/15/03 | 0.02 | 0.18 | 0.35 | 26.5 | 3.9 |
| R5N | 47 | 12/15/03 | 0.01 | 0.02 | 6.6 | 8.78 | 9.9 |
| R5N | 48 | 12/15/03 | 0.01 | 0.11 | 0.45 | 21 | 4.7 |
| R5N | 50 | 12/15/03 | 0.01 | 0.03 | 3.3 | 6.45 | 8.7 |
| R5N | 51 | 12/15/03 | 0.01 | 0.02 | 0.19 | 13 | 4.3 |
| R5N | 53 | 12/15/03 | 0.01 | 0.03 | 0.12 | 10.5 | 5.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 54 | 12/15/03 | 0.01 | 0.02 | 4.4 | 11.1 | 3.4 |
| R5N | 56 | 12/15/03 | 0.01 | 0.02 | 0.88 | 7.54 | 6.4 |
| R5N | 57 | 12/15/03 | 0.01 | 0.03 | 0.01 | 15.9 | 3.1 |
| R5N | 59 | 12/15/03 | 0.01 | 0.02 | 4.9 | 8.27 | 4 |
| R5N | 60 | 12/15/03 | 0.01 | 0.02 | 0 | 9.43 | 5.5 |
| R5N | 62 | 12/15/03 | 0.01 | 0.03 | 8.1 | 9.75 | 3.7 |
| R5N | 63 | 12/15/03 | 0.01 | 0.02 | 2.7 | 9.68 | 5.8 |
| R5N | 65 | 12/15/03 | 0.01 | 0.02 | 3.4 | 7.26 | 8.1 |
| R5N | 66 | 12/15/03 | 0.01 | 0.12 | 0.12 | 26.1 | 4.8 |
| R5N | 68 | 12/15/03 | 0.01 | 0.03 | 2.4 | 8.96 | 4.5 |
| R5N | 69 | 12/15/03 | 0.01 | 0.02 | 5.3 | 12.1 | 3 |
| R5N | 71 | 12/15/03 | 0.01 | 0.02 | 4 | 11.5 | 3.9 |
| R5N | 72 | 12/15/03 | 0.02 | 0.1 | 0 | 14.2 | 5 |
| R5N | Stream | 12/15/03 | 0.08 | 0.21 | 3.9 | 18.1 | 12.5 |
| R1N | 2 | 1/8/04 | 0.01 | 0.02 | 8.5 | 19.6 | 2.2 |
| R1N | 3 | 1/8/04 | 0.03 | 0.03 | 0.02 | 6.22 | 2.6 |
| R1N | 5 | 1/8/04 | 0.04 | 0.03 | 7.3 | 18.9 | 4.7 |
| R1N | 6 | 1/8/04 | 0.05 | 0.28 | 0.03 | 15 | 1.2 |
| R1N | 8 | 1/8/04 | 0.01 | 0.03 | 14.7 | 25.3 | 2.9 |
| R1N | 9 | 1/8/04 | 0.05 | 0.22 | 0.17 | 16 | 1.5 |
| R1N | 11 | 1/8/04 | 0.01 | 0.02 | 13.5 | 23 | 1.2 |
| R1N | 12 | 1/8/04 | 0.02 | 0.02 | 9.6 | 24 | 1.9 |
| R1N | 17 | 1/8/04 | 0.02 | 0.02 | 6.1 | 17.7 | 2.2 |
| R1N | 18 | 1/8/04 | 0.02 | 0.02 | 4.2 | 19.6 | 1.2 |
| R1N | 20 | 1/8/04 | 0.02 | 0.02 | 3.4 | 13.4 | 3.1 |
| R1N | 21 | 1/8/04 | 0.02 | 0.27 | 0.22 | 10.6 | 4.7 |
| R1N | 23 | 1/8/04 | 0.02 | 0.11 | 5.3 | 11.2 | 2.1 |
| R1N | 24 | 1/8/04 | 0.03 | 0.14 | 0.01 | 10.1 | 1.3 |
| R1N | 25 | 1/8/04 | 0.29 | 0.03 | 7.9 | 7.55 | 4.9 |
| R1N | 26 | 1/8/04 | 0.01 | 0.1 | 12.3 | 19.9 | 1.2 |
| R1N | 29 | 1/8/04 | 0.02 | 0.03 | 12 | 20.2 | 4.6 |
| R1N | 30 | 1/8/04 | 0.07 | 0.85 | 0.03 | 10.6 | 3.6 |
| R1N | 32 | 1/8/04 | 0.03 | 1.2 | 0.01 | 5.4 | 3.7 |
| R1N | 33 | 1/8/04 | 0.02 | 0.02 | 5.9 | 17.6 | 2.7 |
| R1N | 35 | 1/8/04 | 0.02 | 0.02 | 16 | 24.1 | 1.9 |
| R1N | 36 | 1/8/04 | 0.02 | 0.02 | 5.6 | 18.1 | 2.4 |
| R1N | 38 | 1/8/04 | 0.01 | 0.02 | 16.6 | 24.9 | 1.8 |
| R1N | 39 | 1/8/04 | 0.01 | 0.02 | 13.3 | 24.8 | 2.8 |
| R1N | 41 | 1/8/04 | 0.01 | 0.11 | 14 | 23.2 | 3.7 |
| R1N | 42 | 1/8/04 | 0.02 | 0.02 | 8.4 | 24.4 | 1.7 |
| R1N | 44 | 1/8/04 | 0.01 | 0.03 | 9.8 | 21 | 3.9 |
| R1N | 45 | 1/8/04 | 0.11 | 0.2 | 0.01 | 7.79 | 1.5 |
| R1N | 47 | 1/8/04 | 0.01 | 0.02 | 6.8 | 16 | 2.9 |
| R1N | 48 | 1/8/04 | 0.02 | 0.03 | 6.2 | 24 | 2.9 |
| R1N | 50 | 1/8/04 | 0.02 | 0.11 | 11.1 | 11.5 | 6.7 |
| R1N | 51 | 1/8/04 | 0.02 | 0.03 | 4.4 | 21.9 | 2.8 |
| R1N | 53 | 1/8/04 | 0.01 | 0.03 | 9.4 | 12.1 | 2.1 |
| R1N | 54 | 1/8/04 | 0.02 | 0.12 | 5.8 | 13.7 | 2.4 |
| R1N | 57 | 1/8/04 | 0.01 | 0.02 | 11 | 12.5 | 3.5 |
| R1N | 59 | 1/8/04 | 0.02 | 0.1 | 16.4 | 19 | 3 |
| R1N | 60 | 1/8/04 | 0.02 | 0.03 | 14.2 | 22.7 | 1.8 |
| R1N | 62 | 1/8/04 | 0.02 | 0.03 | 14.4 | 23.8 | 3.5 |
| R1N | 63 | 1/8/04 | 0.02 | 0.02 | 4.7 | 19.1 | 1.6 |
| R1N | 65 | 1/8/04 | 0.01 | 0.03 | 13.7 | 23.6 | 5.1 |
| R1N | 66 | 1/8/04 | 0.02 | 0.02 | 6.7 | 23 | 1.6 |
| R1N | 68 | 1/8/04 | 0.01 | 0.02 | 8.5 | 10.8 | 2.3 |
| R1N | 69 | 1/8/04 | 0.02 | 0.03 | 4.8 | 14.1 | 2.6 |
| R1N | 71 | 1/8/04 | 0.02 | 0.03 | 11 | 16.7 | 3.9 |
| R1N | 72 | 1/8/04 | 0.02 | 0.03 | 9.8 | 15.5 | 2.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | Stream | 1/8/04 | 0.09 | 0.16 | 6.1 | 15.7 | 4.5 |
| R2N | 2 | 1/8/04 | 0.04 | 0.01 | 2.6 | 2.78 | 3.3 |
| R2N | 3 | 1/8/04 | 0.02 | 0.01 | 2.5 | 8.72 | 1.5 |
| R2N | 5 | 1/8/04 | 0.02 | 0.02 | 3.1 | 8.61 | 2.8 |
| R2N | 6 | 1/8/04 | 0.02 | 0.02 | 3.3 | 18 | 2.2 |
| R2N | 8 | 1/8/04 | 0.01 | 0.02 | 3.9 | 11 | 2.8 |
| R2N | 9 | 1/8/04 | 0.02 | 0.02 | 2.9 | 17.4 | 1.8 |
| R2N | 11 | 1/8/04 | 0.01 | 0.01 | 2.1 | 5.37 | 2.4 |
| R2N | 12 | 1/8/04 | 0.02 | 0.02 | 2.8 | 12.6 | 2 |
| R2N | 14 | 1/8/04 | 0.02 | 0.01 | 2.2 | 8.57 | 2.5 |
| R2N | 15 | 1/8/04 | 0.02 | 0.01 | 2.9 | 12.4 | 2 |
| R2N | 17 | 1/8/04 | 0.03 | 0.31 | 0.02 | 5.43 | 8.4 |
| R2N | 18 | 1/8/04 | 0.05 | 0.01 | 0.01 | 10.1 | 2.4 |
| R2N | 20 | 1/8/04 | 0.01 | 0.1 | 1.1 | 5.89 | 5.2 |
| R2N | 21 | 1/8/04 | 0.04 | 0.03 | 0.02 | 16 | 1.7 |
| R2N | 23 | 1/8/04 | 0.02 | 0.02 | 0.99 | 4.6 | 3.7 |
| R2N | 24 | 1/8/04 | 0.03 | 0.13 | 0 | 17.1 | 1.7 |
| R2N | 26 | 1/8/04 | 0.04 | 0.02 | 3.2 | 3.21 | 3.1 |
| R2N | 27 | 1/8/04 | 0.04 | 0.11 | 0.01 | 17.4 | 1.6 |
| R2N | 29 | 1/8/04 | 0.09 | 0 | 2 | 2.56 | 3.1 |
| R2N | 30 | 1/8/04 | 0.01 | 0.01 | 0 | 12.4 | 1.9 |
| R2N | 32 | 1/8/04 | 0.08 | 0 | 3 | 2.29 | 3.5 |
| R2N | 33 | 1/8/04 | 0.01 | 0.01 | 2.7 | 11.3 | 2 |
| R2N | 35 | 1/8/04 | 0.08 | 0.01 | 3.6 | 1.3 | 3.9 |
| R2N | 36 | 1/8/04 | 0 | 0.01 | 4.4 | 21.2 | 2.1 |
| R2N | 38 | 1/8/04 | 0.01 | 0 | 2.6 | 4.44 | 2.9 |
| R2N | 39 | 1/8/04 | 0.01 | 0.01 | 2.5 | 20.2 | 1.8 |
| R2N | 41 | 1/8/04 | 0 | 0.01 | 2.3 | 1.07 | 3.1 |
| R2N | 42 | 1/8/04 | 0.01 | 0.01 | 1.7 | 4.3 | 3.3 |
| R2N | 44 | 1/8/04 | 0 | 0.01 | 2.5 | 3.17 | 2.5 |
| R2N | 45 | 1/8/04 | 0.01 | 0 | 2.3 | 4.23 | 2.2 |
| R2N | 47 | 1/8/04 | 0 | 0.01 | 5.4 | 8.49 | 2.2 |
| R2N | 48 | 1/8/04 | 0.01 | 0.01 | 3 | 7.28 | 1.9 |
| R2N | 51 | 1/8/04 | 0 | 0.01 | 3.8 | 6.03 | 2.4 |
| R2N | 53 | 1/8/04 | 0 | 0 | 6.1 | 9.21 | 2.5 |
| R2N | 54 | 1/8/04 | 0 | 0.02 | 3.3 | 5.86 | 2.3 |
| R2N | 56 | 1/8/04 | 0.09 | 0.02 | 7.4 | 10.5 | 3.3 |
| R2N | 57 | 1/8/04 | 0 | 0.02 | 2.9 | 5.77 | 2.5 |
| R2N | 59 | 1/8/04 | 0.49 | 0.01 | 1.7 | 1.65 | 4 |
| R2N | 60 | 1/8/04 | 0.01 | 0.03 | 2.4 | 10.4 | 1.9 |
| R2N | 62 | 1/8/04 | 0.03 | 0.01 | 4.1 | 1.29 | 3.3 |
| R2N | 63 | 1/8/04 | 0.01 | 0.02 | 4.8 | 26.3 | 1.9 |
| R2N | 65 | 1/8/04 | 0.01 | 0.01 | 3.9 | 1.42 | 2.7 |
| R2N | 66 | 1/8/04 | 0.01 | 0 | 2.9 | 17.8 | 2.2 |
| R2N | 68 | 1/8/04 | 0 | 0.01 | 10.8 | 21.6 | 2.8 |
| R2N | 69 | 1/8/04 | 0 | 0.01 | 2.3 | 9.29 | 3.1 |
| R2N | 72 | 1/8/04 | 0 | 0.01 | 4 | 8.27 | 2 |
| R4W | 2 | 1/8/04 | 0.01 | 0.01 | 26.4 | 20.9 | 2.5 |
| R4W | 3 | 1/8/04 | 0.02 | 0.02 | 0.03 | 27.2 | 1.4 |
| R4W | 5 | 1/8/04 | 0.01 | 0 | 24 | 19.1 | 2.5 |
| R4W | 6 | 1/8/04 | 0.01 | 0.22 | 0.01 | 26.9 | 1.8 |
| R4W | 8 | 1/8/04 | 0.01 | 0.01 | 26.4 | 22.4 | 2 |
| R4W | 9 | 1/8/04 | 0.02 | 0.01 | 0.27 | 13.4 | 1.6 |
| R4W | 11 | 1/8/04 | 0.01 | 0.01 | 26.5 | 19.7 | 1.9 |
| R4W | 12 | 1/8/04 | 0.01 | 0.01 | 0.31 | 21 | 1.8 |
| R4W | 14 | 1/8/04 | 0.01 | 0 | 19.6 | 20.4 | 1.7 |
| R4W | 15 | 1/8/04 | 0.01 | 0 | 14.1 | 22.4 | 2.2 |
| R4W | 17 | 1/8/04 | 0.01 | 0.01 | 6.9 | 24.3 | 2.5 |
| R4W | 18 | 1/8/04 | 0.02 | 0.14 | 0.65 | 18.5 | 1.6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 20 | 1/8/04 | 0.01 | 0.01 | 1.8 | 27.9 | 2.7 |
| R4W | 21 | 1/8/04 | 0.05 | 1.4 | 0.12 | 11.3 | 2.3 |
| R4W | 23 | 1/8/04 | 0.01 | 0.01 | 2 | 29.4 | 2.8 |
| R4W | 24 | 1/8/04 | 0.01 | 0.15 | 1.1 | 28.8 | 2.8 |
| R4W | 26 | 1/8/04 | 0.01 | 0 | 0.49 | 27.7 | 2.8 |
| R4W | 27 | 1/8/04 | 0.01 | 0.01 | 1.7 | 27.8 | 2.7 |
| R4W | 29 | 1/8/04 | 0.01 | 0 | 1.8 | 28 | 3.6 |
| R4W | 30 | 1/8/04 | 0.01 | 0.01 | 0.19 | 0.68 | 2.3 |
| R4W | 32 | 1/8/04 | 0.02 | 0.02 | 1.2 | 20.4 | 1.8 |
| R4W | 33 | 1/8/04 | 0.02 | 0.02 | 1.1 | 20.8 | 1.6 |
| R4W | 35 | 1/8/04 | 0.01 | 0 | 32 | 22.2 | 2.4 |
| R4W | 38 | 1/8/04 | 0.01 | 0.01 | 26.5 | 19.8 | 2.1 |
| R4W | 39 | 1/8/04 | 0.01 | 0.02 | 17.2 | 24.1 | 2 |
| R4W | 41 | 1/8/04 | 0.01 | 0 | 19.7 | 23.8 | 1.8 |
| R4W | 42 | 1/8/04 | 0.01 | 0.01 | 20.7 | 21.2 | 2.2 |
| R4W | 44 | 1/8/04 | 0.01 | 0.01 | 18.9 | 22.9 | 2.2 |
| R4W | 45 | 1/8/04 | 0.01 | 0 | 19 | 20.8 | 1.9 |
| R4W | 47 | 1/8/04 | 0.01 | 0.01 | 13.2 | 19.1 | 2.5 |
| R4W | 48 | 1/8/04 | 0.01 | 0.01 | 12.4 | 20.6 | 2.1 |
| R4W | 50 | 1/8/04 | 0.01 | 0.01 | 4.8 | 26.2 | 2.4 |
| R4W | 51 | 1/8/04 | 0.01 | 0.01 | 3.6 | 26.6 | 2.7 |
| R4W | 53 | 1/8/04 | 0.01 | 0.01 | 3.6 | 23.2 | 2.3 |
| R4W | 54 | 1/8/04 | 0.01 | 0.02 | 1.5 | 27.8 | 2.2 |
| R4W | 56 | 1/8/04 | 0.01 | 0.01 | 1.2 | 25.8 | 2.8 |
| R4W | 57 | 1/8/04 | 0.01 | 0.02 | 0.66 | 28.1 | 2.9 |
| R4W | 59 | 1/8/04 | 0.01 | 0.01 | 1.1 | 27.9 | 2.8 |
| R4W | 60 | 1/8/04 | 0.01 | 0.01 | 1.5 | 24.3 | 2.9 |
| R4W | 62 | 1/8/04 | 0.01 | 0.01 | 30.3 | 24 | 2.2 |
| R4W | 63 | 1/8/04 | 0.01 | 0.15 | 6.4 | 26.7 | 2.2 |
| R4W | 65 | 1/8/04 | 0.01 | 0.01 | 23.9 | 18.7 | 2.9 |
| R4W | 66 | 1/8/04 | 0.01 | 0.01 | 29 | 21.5 | 2.1 |
| R4W | 68 | 1/8/04 | 0.01 | 0.01 | 5.8 | 24.1 | 2.8 |
| R4W | 69 | 1/8/04 | 0.01 | 0.01 | 5.3 | 25.7 | 2.3 |
| R4W | 71 | 1/8/04 | 0.01 | 0 | 3.8 | 17.6 | 3.2 |
| R4W | 72 | 1/8/04 | 0.01 | 0.02 | 0.39 | 30.8 | 3.3 |
| R4W | Stream | 1/8/04 | 0.37 | 0.86 | 1.4 | 14.1 | 8.1 |
| R5N | 2 | 1/8/04 | 0.01 | 0.01 | 2.2 | 17 | 3.5 |
| R5N | 3 | 1/8/04 | 0.01 | 0 | 2.3 | 13.5 | 3.7 |
| R5N | 5 | 1/8/04 | 0 | 0.01 | 1.1 | 17.1 | 4.5 |
| R5N | 6 | 1/8/04 | 0.01 | 0.01 | 0.26 | 22.7 | 3.3 |
| R5N | 8 | 1/8/04 | 0 | 0 | 10 | 12.1 | 7.2 |
| R5N | 9 | 1/8/04 | 0.01 | 0 | 1.9 | 15.1 | 3.9 |
| R5N | 11 | 1/8/04 | 0 | 0.01 | 5.9 | 8.83 | 5 |
| R5N | 12 | 1/8/04 | 0.01 | 0.01 | 0 | 25.6 | 2.8 |
| R5N | 14 | 1/8/04 | 0.01 | 0.01 | 2.7 | 12.7 | 8.3 |
| R5N | 15 | 1/8/04 | 0.01 | 0.01 | 0.02 | 23.5 | 5.5 |
| R5N | 17 | 1/8/04 | 0.01 | 0.01 | 0.55 | 11.8 | 5.6 |
| R5N | 18 | 1/8/04 | 0.02 | 0 | 1.4 | 22.7 | 3.3 |
| R5N | 20 | 1/8/04 | 0.01 | 0.02 | 0.01 | 15.3 | 2.9 |
| R5N | 21 | 1/8/04 | 0.01 | 0.01 | 2.3 | 14.9 | 4.5 |
| R5N | 23 | 1/8/04 | 0.01 | 0.01 | 2 | 11.6 | 9 |
| R5N | 24 | 1/8/04 | 0.01 | 0 | 2 | 8.74 | 2 |
| R5N | 26 | 1/8/04 | 0.01 | 0.02 | 0 | 12.6 | 5.2 |
| R5N | 27 | 1/8/04 | 0.01 | 0.01 | 0 | 8.66 | 3.1 |
| R5N | 29 | 1/8/04 | 0.01 | 0.03 | 0.01 | 14.5 | 9.8 |
| R5N | 30 | 1/8/04 | 0.01 | 0.25 | 0.02 | 19.1 | 6.9 |
| R5N | 32 | 1/8/04 | 0 | 0.01 | 4.1 | 10.4 | 6.1 |
| R5N | 33 | 1/8/04 | 0.01 | 0 | 2.1 | 13.9 | 6.1 |
| R5N | 35 | 1/8/04 | 0 | 0.01 | 13.7 | 8.57 | 5.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **Date** | **mg P/L** | **mg N/L** | **mg N/L** | **mg Cl/L** | **mg C/L** |
| R5N | 36 | 1/8/04 | 0 | 0 | 1.4 | 9.71 | 4.2 |
| R5N | 38 | 1/8/04 | 0 | 0 | 6.7 | 11.7 | 7.5 |
| R5N | 39 | 1/8/04 | 0.01 | 0.27 | 1.4 | 18.7 | 6.6 |
| R5N | 41 | 1/8/04 | 0 | 0.02 | 2.9 | 9.92 | 10.1 |
| R5N | 42 | 1/8/04 | 0.01 | 0.51 | 0.48 | 19.1 | 3.8 |
| R5N | 44 | 1/8/04 | 0.01 | 0 | 33.3 | 18.4 | 4.9 |
| R5N | 45 | 1/8/04 | 0.01 | 1 | 0.66 | 27.8 | 7.5 |
| R5N | 47 | 1/8/04 | 0 | 0.53 | 4.3 | 9.69 | 6.5 |
| R5N | 48 | 1/8/04 | 0.01 | 0.93 | 0.03 | 22.7 | 4.8 |
| R5N | 50 | 1/8/04 | 0 | 1.2 | 2.7 | 7.95 | 6.7 |
| R5N | 51 | 1/8/04 | 0.01 | 1.6 | 0.17 | 12.2 | 5.3 |
| R5N | 53 | 1/8/04 | 0.01 | 0.6 | 0.22 | 11.9 | 2.7 |
| R5N | 54 | 1/8/04 | 0.01 | 0.33 | 4 | 13.5 | 5.4 |
| R5N | 56 | 1/8/04 | 0 | 0.87 | 0.67 | 8.16 | 4.3 |
| R5N | 57 | 1/8/04 | 0.01 | 0.7 | 0 | 14.6 | 5.5 |
| R5N | 59 | 1/8/04 | 0.01 | 0.4 | 4.7 | 8.35 | 12.1 |
| R5N | 60 | 1/8/04 | 0.01 | 0.47 | 0.01 | 17.9 | 9 |
| R5N | 62 | 1/8/04 | 0 | 0 | 8.6 | 11 | 7.1 |
| R5N | 63 | 1/8/04 | 0 | 0.48 | 2.2 | 11.7 | 6 |
| R5N | 65 | 1/8/04 | 0 | 0.58 | 2.1 | 9.68 | 10.8 |
| R5N | 66 | 1/8/04 | 0.01 | 0.03 | 0 | 27.5 | 2.5 |
| R5N | 68 | 1/8/04 | 0 | 0.01 | 3.1 | 9.94 | 14 |
| R5N | 69 | 1/8/04 | 0.01 | 0 | 4.5 | 12.7 | 8.5 |
| R5N | 71 | 1/8/04 | 0.01 | 0 | 1.7 | 11.3 | 5.8 |
| R5N | 72 | 1/8/04 | 0.01 | 0.02 | 0 | 16 | 4.1 |
| R5N | Stream | 1/8/04 | 0.03 | 0.03 | 1.1 | 22.1 | 9.6 |
| R1N | 2 | 2/8/04 | 0.1 | | 9.9 | 21.8 | 2.2 |
| R1N | 3 | 2/8/04 | 0.08 | **$NH_4$** | 0.01 | 6.38 | 2.3 |
| R1N | 5 | 2/8/04 | 0.01 | **Sampling** | 7 | 18.9 | 1.8 |
| R1N | 6 | 2/8/04 | 0.03 | **Ceased** | 0.01 | 16.3 | 1.8 |
| R1N | 8 | 2/8/04 | 0.17 | | 14.8 | 26.5 | 2.8 |
| R1N | 9 | 2/8/04 | 0.06 | | 0.18 | 17.8 | 2.4 |
| R1N | 11 | 2/8/04 | 0.03 | | 13.6 | 25.6 | 2.6 |
| R1N | 12 | 2/8/04 | 0.03 | | 9.4 | 24.2 | 2.6 |
| R1N | 17 | 2/8/04 | 0.01 | | 6.2 | 18.9 | 1.4 |
| R1N | 18 | 2/8/04 | 0.01 | | 4 | 23.2 | 2.4 |
| R1N | 20 | 2/8/04 | 0.01 | | 2.3 | 12.5 | 2.3 |
| R1N | 21 | 2/8/04 | 0.05 | | 0 | 11.4 | 3.1 |
| R1N | 23 | 2/8/04 | 0.13 | | 4.6 | 8.41 | 4.5 |
| R1N | 24 | 2/8/04 | 0.06 | | 0.01 | 10.5 | 2.3 |
| R1N | 26 | 2/8/04 | 0 | | 11.3 | 20.4 | 1.6 |
| R1N | 29 | 2/8/04 | 0.01 | | 13.3 | 22.6 | 2.7 |
| R1N | 30 | 2/8/04 | 0.25 | | 0 | 11.5 | 2.9 |
| R1N | 32 | 2/8/04 | 0.05 | | 6.2 | 18.9 | 2.1 |
| R1N | 33 | 2/8/04 | 0.33 | | 0 | 5.03 | 4.1 |
| R1N | 35 | 2/8/04 | 0.01 | | 15.4 | 26.4 | 2.5 |
| R1N | 36 | 2/8/04 | 0.01 | | 6 | 17.7 | 2.4 |
| R1N | 38 | 2/8/04 | 0.01 | | 17 | 23.2 | 2.4 |
| R1N | 39 | 2/8/04 | 0.11 | | 12.7 | 23 | 2.6 |
| R1N | 41 | 2/8/04 | 0.02 | | 13.8 | 22.2 | 2.3 |
| R1N | 42 | 2/8/04 | 0.02 | | 8 | 22.9 | 2.4 |
| R1N | 44 | 2/8/04 | 0 | | 9.5 | 20.8 | 1.7 |
| R1N | 45 | 2/8/04 | 0.04 | | 0 | 7.66 | 2 |
| R1N | 47 | 2/8/04 | 0 | | 7.2 | 17.5 | 2 |
| R1N | 48 | 2/8/04 | 0.01 | | 6.2 | 24.5 | 2.4 |
| R1N | 50 | 2/8/04 | 0 | | 8.8 | 10.7 | 2.9 |
| R1N | 51 | 2/8/04 | 0 | | 5.1 | 24.5 | 2 |
| R1N | 54 | 2/8/04 | 0.02 | | 7.5 | 18.6 | 1.9 |
| R1N | 57 | 2/8/04 | 0.01 | | 11.9 | 11 | 1.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 59 | 2/8/04 | 0.13 | | 17.2 | 18.3 | 4.1 |
| R1N | 60 | 2/8/04 | 0 | | 11.9 | 20.7 | 2 |
| R1N | 62 | 2/8/04 | 0.01 | | 16.4 | 21.8 | 1.8 |
| R1N | 63 | 2/8/04 | 0 | | 4.2 | 17.2 | 2 |
| R1N | 65 | 2/8/04 | 0.01 | | 14.4 | 22 | 2.1 |
| R1N | 66 | 2/8/04 | 0.01 | | 7.7 | 24.8 | 1.9 |
| R1N | 68 | 2/8/04 | 0 | | 8.2 | 11.7 | 1.6 |
| R1N | 69 | 2/8/04 | 0 | | 5.7 | 17.4 | 1.6 |
| R1N | 72 | 2/8/04 | 0.01 | | 9.3 | 14.5 | 2.2 |
| R1N | Stream | 2/8/04 | 0.14 | | 6.2 | 16.1 | 5.3 |
| R2N | 2 | 2/8/04 | 0.04 | | 3 | 2.95 | 2.9 |
| R2N | 3 | 2/8/04 | 0 | | 3.5 | 8.88 | 2.3 |
| R2N | 5 | 2/8/04 | 0.16 | | 2.6 | 7.6 | 3.9 |
| R2N | 6 | 2/8/04 | 0.04 | | 3.9 | 17 | 1.9 |
| R2N | 8 | 2/8/04 | 0.02 | | 5.4 | 13.9 | 2.6 |
| R2N | 9 | 2/8/04 | 0.01 | | 3.4 | 19.8 | 2.4 |
| R2N | 11 | 2/8/04 | 0.1 | | 2.5 | 5.42 | 3.1 |
| R2N | 12 | 2/8/04 | 0.1 | | 3.1 | 13.9 | 3 |
| R2N | 14 | 2/8/04 | 0.17 | | 2.9 | 12.3 | 2.8 |
| R2N | 15 | 2/8/04 | 0.13 | | 3 | 10.7 | 2.6 |
| R2N | 17 | 2/8/04 | 0.22 | | 0 | 6.91 | 12.7 |
| R2N | 18 | 2/8/04 | 0.04 | | 0.01 | 9.07 | 2.4 |
| R2N | 20 | 2/8/04 | 0.02 | | 0.55 | 5.69 | 5.5 |
| R2N | 21 | 2/8/04 | 0.24 | | 0.01 | 15.8 | 1.8 |
| R2N | 23 | 2/8/04 | 0.12 | | 0.01 | 4.96 | 5.2 |
| R2N | 24 | 2/8/04 | 0.11 | | 0 | 15.9 | 1.2 |
| R2N | 26 | 2/8/04 | 0.06 | | 3.1 | 2.21 | 2.8 |
| R2N | 27 | 2/8/04 | 0.04 | | 0 | 17.7 | 1.5 |
| R2N | 29 | 2/8/04 | 0.16 | | 2.4 | 3.53 | 3.9 |
| R2N | 30 | 2/8/04 | 0.08 | | 0 | 10.7 | 2.2 |
| R2N | 32 | 2/8/04 | 0.15 | | 4.1 | 3.68 | 3.1 |
| R2N | 33 | 2/8/04 | 0.03 | | 2.4 | 10.4 | 1.9 |
| R2N | 35 | 2/8/04 | 0.15 | | 3.9 | 0.82 | 3.3 |
| R2N | 36 | 2/8/04 | 0.08 | | 5.2 | 23.1 | 2.7 |
| R2N | 38 | 2/8/04 | 0.11 | | 3.8 | 5.97 | 3 |
| R2N | 39 | 2/8/04 | 0.13 | | 2.6 | 18.5 | 2.5 |
| R2N | 41 | 2/8/04 | 0.13 | | 3.8 | 1 | 3.4 |
| R2N | 42 | 2/8/04 | 0.01 | | 2.7 | 3.19 | 2.7 |
| R2N | 44 | 2/8/04 | 0.05 | | 3.3 | 2.2 | 2.9 |
| R2N | 45 | 2/8/04 | 0.11 | | 3 | 4.61 | 2.9 |
| R2N | 47 | 2/8/04 | 0.01 | | 3.8 | 7.05 | 1.7 |
| R2N | 48 | 2/8/04 | 0.01 | | 6.1 | 9.44 | 2 |
| R2N | 50 | 2/8/04 | 0.02 | | 13.5 | 26.2 | 2 |
| R2N | 51 | 2/8/04 | 0.01 | | 4.4 | 7.61 | 1.8 |
| R2N | 53 | 2/8/04 | 0.14 | | 5.9 | 13 | 4.8 |
| R2N | 54 | 2/8/04 | 0.04 | | 3.7 | 4.96 | 2.5 |
| R2N | 56 | 2/8/04 | 0.21 | | 4.2 | 5.77 | 3.4 |
| R2N | 57 | 2/8/04 | 0.06 | | 3.2 | 5.02 | 3 |
| R2N | 59 | 2/8/04 | 0.38 | | 2.4 | 0.95 | 3.6 |
| R2N | 60 | 2/8/04 | 0.03 | | 3.3 | 7.93 | 1.6 |
| R2N | 63 | 2/8/04 | 0.03 | | 5.2 | 26.4 | 2.1 |
| R2N | 65 | 2/8/04 | 0.07 | | 1.2 | 1.24 | 3.7 |
| R2N | 66 | 2/8/04 | 0.19 | | 3.5 | 17.1 | 2 |
| R2N | 69 | 2/8/04 | 0.05 | | 3 | 10.6 | 2.6 |
| R2N | 72 | 2/8/04 | 0.04 | | 4.4 | 6.66 | 1.6 |
| R4W | 2 | 2/8/04 | 0.02 | | 22.7 | 19.3 | 2 |
| R4W | 3 | 2/8/04 | 0.04 | | 0.02 | 25.1 | 1.7 |
| R4W | 5 | 2/8/04 | 0.01 | | 24.5 | 18.6 | 2.2 |
| R4W | 6 | 2/8/04 | 0.07 | | 0 | 24.8 | 1.6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 8 | 2/8/04 | 0.03 | | 26.7 | 20 | 2 |
| R4W | 9 | 2/8/04 | 0.03 | | 0.47 | 12.1 | 2.3 |
| R4W | 11 | 2/8/04 | 0.01 | | 26.5 | 17.7 | 2.2 |
| R4W | 12 | 2/8/04 | 0.02 | | 0.24 | 19.2 | 1.6 |
| R4W | 14 | 2/8/04 | 0.01 | | 19.2 | 19.7 | 1.7 |
| R4W | 15 | 2/8/04 | 0.03 | | 16.6 | 19.6 | 1.9 |
| R4W | 17 | 2/8/04 | 0.01 | | 8 | 22.4 | 2.2 |
| R4W | 18 | 2/8/04 | 0.08 | | 0.29 | 15.5 | 1.4 |
| R4W | 20 | 2/8/04 | 0.01 | | 1.8 | 25.6 | 2.5 |
| R4W | 21 | 2/8/04 | 0.18 | | 0.01 | 8.91 | 3.4 |
| R4W | 23 | 2/8/04 | 0.01 | | 2 | 27.5 | 3 |
| R4W | 24 | 2/8/04 | 0.04 | | 0.99 | 25.5 | 2.5 |
| R4W | 26 | 2/8/04 | 0.01 | | 2.4 | 25.1 | 2.7 |
| R4W | 27 | 2/8/04 | 0.01 | | 1.6 | 26.6 | 3.9 |
| R4W | 29 | 2/8/04 | 0.01 | | 1.2 | 31 | 3.7 |
| R4W | 30 | 2/8/04 | 0.05 | | 0.12 | 27.4 | 2.4 |
| R4W | 32 | 2/8/04 | 0.01 | | 23.4 | 23.1 | 2.8 |
| R4W | 33 | 2/8/04 | 0.03 | | 2 | 20.7 | 2.2 |
| R4W | 35 | 2/8/04 | 0.02 | | 24.6 | 19.8 | 2 |
| R4W | 36 | 2/8/04 | 0.08 | | 0.02 | 12.5 | 1.4 |
| R4W | 38 | 2/8/04 | 0.01 | | 27.3 | 19.6 | 1.3 |
| R4W | 39 | 2/8/04 | 0.02 | | 17.8 | 19.7 | 1.8 |
| R4W | 41 | 2/8/04 | 0.01 | | 24 | 21.2 | 1.8 |
| R4W | 42 | 2/8/04 | 0.02 | | 24.2 | 20.6 | 1.5 |
| R4W | 44 | 2/8/04 | 0.01 | | 21.4 | 18.7 | 1.7 |
| R4W | 45 | 2/8/04 | 0.01 | | 20.6 | 19.6 | 1.9 |
| R4W | 47 | 2/8/04 | 0.01 | | 15.4 | 15.9 | 2 |
| R4W | 48 | 2/8/04 | 0.01 | | 16.9 | 18.4 | 1.9 |
| R4W | 50 | 2/8/04 | 0.19 | | 5.9 | 24.2 | 2 |
| R4W | 51 | 2/8/04 | 0.01 | | 4.5 | 23.5 | 1.9 |
| R4W | 53 | 2/8/04 | 0.01 | | 5.2 | 19.8 | 2.3 |
| R4W | 54 | 2/8/04 | 0.03 | | 2.4 | 24.6 | 2.2 |
| R4W | 56 | 2/8/04 | 0.08 | | 1.6 | 23.9 | 3.1 |
| R4W | 57 | 2/8/04 | 0.02 | | 0.03 | 26.2 | 1.7 |
| R4W | 59 | 2/8/04 | 0.02 | | 2 | 25.2 | 2.3 |
| R4W | 60 | 2/8/04 | 0.02 | | 2 | 21.8 | 2.6 |
| R4W | 62 | 2/8/04 | 0.01 | | 28.1 | 22.8 | 1.8 |
| R4W | 63 | 2/8/04 | 0.17 | | 4.2 | 25 | 1.4 |
| R4W | 65 | 2/8/04 | 0.01 | | 22.9 | 17 | 2.4 |
| R4W | 66 | 2/8/04 | 0.03 | | 27.6 | 20.1 | 1.6 |
| R4W | 68 | 2/8/04 | 0.07 | | 8.8 | 23.8 | 2.3 |
| R4W | 69 | 2/8/04 | 0.01 | | 7.9 | 23.6 | 2.6 |
| R4W | 71 | 2/8/04 | 0.02 | | 6 | 20.1 | 2.6 |
| R4W | 72 | 2/8/04 | 0.02 | | 0.33 | 28.9 | 1.9 |
| R4W | Stream | 2/8/04 | 0.73 | | 1.8 | 12.7 | 6.9 |
| R5N | 2 | 2/8/04 | 0.02 | | 4.8 | 11.7 | 3.5 |
| R5N | 3 | 2/8/04 | 0.01 | | 2.6 | 15.4 | 2.9 |
| R5N | 5 | 2/8/04 | 0.01 | | 1.4 | 12.8 | 3.7 |
| R5N | 6 | 2/8/04 | 0.01 | | 1.4 | 14.6 | 3.1 |
| R5N | 8 | 2/8/04 | 0 | | 11.9 | 11.2 | 6.3 |
| R5N | 9 | 2/8/04 | 0.01 | | 1.5 | 14.4 | 3.6 |
| R5N | 11 | 2/8/04 | 0.01 | | 5.3 | 13.1 | 3.9 |
| R5N | 12 | 2/8/04 | 0.01 | | 0 | 24.6 | 2.9 |
| R5N | 14 | 2/8/04 | 0.02 | | 3.7 | 10.5 | 4 |
| R5N | 15 | 2/8/04 | 0.01 | | 0.17 | 23.2 | 3 |
| R5N | 17 | 2/8/04 | 0.01 | | 1 | 9.77 | 3 |
| R5N | 18 | 2/8/04 | 0.02 | | 3 | 16.7 | 2 |
| R5N | 20 | 2/8/04 | 0.01 | | 0.02 | 11.7 | 3.2 |
| R5N | 21 | 2/8/04 | 0.07 | | 0.63 | 12.9 | 2.5 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 23 | 2/8/04 | 0.01 | | 2.3 | 10.1 | 4 |
| R5N | 24 | 2/8/04 | 0.01 | | 2.2 | 7.86 | 2.4 |
| R5N | 26 | 2/8/04 | 0.01 | | 0 | 13.7 | 2.9 |
| R5N | 27 | 2/8/04 | 0.03 | | 0 | 6.51 | 1.2 |
| R5N | 29 | 2/8/04 | 0.01 | | 0 | 12.7 | 3.7 |
| R5N | 30 | 2/8/04 | 0.05 | | 2.2 | 12.1 | 5.9 |
| R5N | 32 | 2/8/04 | 0.01 | | 4.4 | 8.15 | 3.4 |
| R5N | 33 | 2/8/04 | 0.01 | | 2.2 | 12.4 | 2.8 |
| R5N | 35 | 2/8/04 | 0.07 | | 14.1 | 7.04 | 4.2 |
| R5N | 36 | 2/8/04 | 0.01 | | 1.2 | 6.11 | 4.2 |
| R5N | 38 | 2/8/04 | 0.02 | | 8.5 | 9.33 | 6.3 |
| R5N | 39 | 2/8/04 | 0.01 | | 1.1 | 16.6 | 3.7 |
| R5N | 41 | 2/8/04 | 0.02 | | 2.9 | 6.77 | 6.1 |
| R5N | 42 | 2/8/04 | 0.01 | | 0.34 | 20.4 | 3.2 |
| R5N | 44 | 2/8/04 | 0.03 | | 27.7 | 16.1 | 4.6 |
| R5N | 45 | 2/8/04 | 0.02 | | 2.7 | 21.7 | 2.9 |
| R5N | 47 | 2/8/04 | 0.04 | | 11.8 | 10.2 | 5 |
| R5N | 48 | 2/8/04 | 0.02 | | 0.03 | 22.8 | 2.7 |
| R5N | 50 | 2/8/04 | 0.03 | | 2.4 | 6.33 | 5.1 |
| R5N | 51 | 2/8/04 | 0.02 | | 0.03 | 12.9 | 2.5 |
| R5N | 53 | 2/8/04 | 0.01 | | 0.32 | 8.92 | 4.2 |
| R5N | 54 | 2/8/04 | 0.01 | | 3.3 | 11 | 3 |
| R5N | 56 | 2/8/04 | 0.01 | | 0.81 | 6.67 | 4.3 |
| R5N | 57 | 2/8/04 | 0.02 | | 0 | 12.3 | 4.3 |
| R5N | 59 | 2/8/04 | 0.01 | | 5 | 7.54 | 3.6 |
| R5N | 60 | 2/8/04 | 0.04 | | 0.02 | 18.2 | 3.9 |
| R5N | 62 | 2/8/04 | 0.01 | | 9.3 | 11.1 | 3.7 |
| R5N | 63 | 2/8/04 | 0.01 | | 0.79 | 7.36 | 4.6 |
| R5N | 65 | 2/8/04 | 0.08 | | 1.8 | 8.65 | 6.8 |
| R5N | 66 | 2/8/04 | 0.01 | | 0.31 | 32.2 | 2.7 |
| R5N | 68 | 2/8/04 | 0.02 | | 2.6 | 7.54 | 4.7 |
| R5N | 69 | 2/8/04 | 0.01 | | 4.8 | 11.4 | 2.9 |
| R5N | 71 | 2/8/04 | 0.01 | | 3.8 | 12.6 | 3 |
| R5N | 72 | 2/8/04 | 0.02 | | 0 | 10.1 | 2.3 |
| R5N | Stream | 2/8/04 | 0.05 | | 1.3 | 22.4 | 8.7 |
| R1N | 2 | 3/8/04 | 0.03 | | 9.8 | 19.4 | 1.8 |
| R1N | 3 | 3/8/04 | 0.12 | | 0.01 | 4.96 | 1.6 |
| R1N | 5 | 3/8/04 | 0.01 | | 6.5 | 16.8 | 1.8 |
| R1N | 6 | 3/8/04 | 0.07 | | 0 | 15.1 | 2.3 |
| R1N | 8 | 3/8/04 | 0.08 | | 13.3 | 23.8 | 2 |
| R1N | 9 | 3/8/04 | 0.05 | | 0.22 | 15.6 | 1.4 |
| R1N | 11 | 3/8/04 | 0.02 | | 12.8 | 21.5 | 2.4 |
| R1N | 12 | 3/8/04 | 0.02 | | 9.4 | 22.4 | 2.4 |
| R1N | 17 | 3/8/04 | 0.01 | | 5.5 | 20.3 | 1.6 |
| R1N | 18 | 3/8/04 | 0.02 | | 3.6 | 23.4 | 1.3 |
| R1N | 20 | 3/8/04 | 0.02 | | 1.7 | 9 | 2.4 |
| R1N | 21 | 3/8/04 | 0.04 | | 0.03 | 10.7 | 1.9 |
| R1N | 23 | 3/8/04 | 0.1 | | 2.7 | 2.5 | 4.8 |
| R1N | 24 | 3/8/04 | 0.05 | | 0.57 | 10.5 | 1.6 |
| R1N | 26 | 3/8/04 | 0.01 | | 10.1 | 16.9 | 1.4 |
| R1N | 29 | 3/8/04 | 0.03 | | 10.6 | 17.3 | 2.3 |
| R1N | 30 | 3/8/04 | 0.15 | | 0.5 | 8.65 | 2.1 |
| R1N | 32 | 3/8/04 | 0.03 | | 6.4 | 17.7 | 1.4 |
| R1N | 33 | 3/8/04 | 0.33 | | 0.01 | 4.84 | 3.9 |
| R1N | 35 | 3/8/04 | 0.01 | | 14.9 | 24 | 2.4 |
| R1N | 36 | 3/8/04 | 0.01 | | 5.8 | 15.5 | 1.2 |
| R1N | 38 | 3/8/04 | 0.04 | | 15.1 | 23.7 | 1.8 |
| R1N | 39 | 3/8/04 | 0.07 | | 11.9 | 23.5 | 1.9 |
| R1N | 41 | 3/8/04 | 0.03 | | 12.8 | 22.4 | 1.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 42 | 3/8/04 | 0.01 | | 8.8 | 22.9 | 1.1 |
| R1N | 44 | 3/8/04 | 0.01 | | 8.3 | 24.9 | 1.7 |
| R1N | 45 | 3/8/04 | 0.05 | | 0.01 | 8.51 | 1.7 |
| R1N | 47 | 3/8/04 | 0.01 | | 6.5 | 19.7 | 1.9 |
| R1N | 48 | 3/8/04 | 0.01 | | 5 | 25.7 | 2.1 |
| R1N | 50 | 3/8/04 | 0.02 | | 8.3 | 11.6 | 2.4 |
| R1N | 51 | 3/8/04 | 0.01 | | 4.6 | 27.9 | 1.8 |
| R1N | 54 | 3/8/04 | 0.02 | | 7.1 | 21.2 | 1.5 |
| R1N | 57 | 3/8/04 | 0.02 | | 12.5 | 12.8 | 1.2 |
| R1N | 59 | 3/8/04 | 0.13 | | 15.8 | 15.7 | 3.5 |
| R1N | 60 | 3/8/04 | 0.01 | | 11.7 | 22.3 | 1.9 |
| R1N | 62 | 3/8/04 | 0.01 | | 13.5 | 22.6 | 1.3 |
| R1N | 63 | 3/8/04 | 0.01 | | 4.1 | 16.3 | 1.3 |
| R1N | 65 | 3/8/04 | 0.05 | | 13.9 | 21.6 | 1.5 |
| R1N | 69 | 3/8/04 | 0.01 | | 7.1 | 23.7 | 1.6 |
| R1N | 71 | 3/8/04 | 0.02 | | 9.5 | 10.9 | 1.6 |
| R1N | 72 | 3/8/04 | 0.01 | | 5.6 | 16.6 | 1 |
| R1N | Stream | 3/8/04 | 0.03 | | 9.7 | 15.4 | 1.6 |
| R2N | 2 | 3/8/04 | 0.01 | | 8.4 | 15.8 | 1.5 |
| R2N | 3 | 3/8/04 | 0.17 | | 5.4 | 15.5 | 5.5 |
| R2N | 5 | 3/8/04 | 0.05 | | 3.5 | 2.47 | 3 |
| R2N | 6 | 3/8/04 | 0.01 | | 3.5 | 9.69 | 1.7 |
| R2N | 8 | 3/8/04 | 0.23 | | 3.5 | 7.26 | 4.2 |
| R2N | 9 | 3/8/04 | 0.05 | | 3.3 | 16.8 | 1.5 |
| R2N | 11 | 3/8/04 | 0.07 | | 5.6 | 11.7 | 2.3 |
| R2N | 12 | 3/8/04 | 0.02 | | 3.1 | 15.3 | 1.4 |
| R2N | 14 | 3/8/04 | 0.13 | | 2.2 | 2.87 | 2.9 |
| R2N | 15 | 3/8/04 | 0.11 | | 2.8 | 10.3 | 2.1 |
| R2N | 17 | 3/8/04 | 0.19 | | 2.2 | 6.86 | 3.2 |
| R2N | 18 | 3/8/04 | 0.08 | | 3.1 | 9.56 | 1.7 |
| R2N | 20 | 3/8/04 | 0.05 | | 0.01 | 3.77 | 5.7 |
| R2N | 21 | 3/8/04 | 0.02 | | 0.01 | 7.79 | 1.8 |
| R2N | 23 | 3/8/04 | 0.02 | | 0 | 5.02 | 7.8 |
| R2N | 24 | 3/8/04 | 0.12 | | 0 | 11.6 | 1.2 |
| R2N | 26 | 3/8/04 | 0.05 | | 0.01 | 3.39 | 3.7 |
| R2N | 27 | 3/8/04 | 0.07 | | 0 | 15.2 | 0.9 |
| R2N | 29 | 3/8/04 | 0.05 | | 4.4 | 2.78 | 3 |
| R2N | 30 | 3/8/04 | 0.03 | | 0 | 13.6 | 0.9 |
| R2N | 32 | 3/8/04 | 0.12 | | 2.6 | 1.29 | 3.1 |
| R2N | 33 | 3/8/04 | 0.02 | | 0.01 | 8.13 | 1.5 |
| R2N | 35 | 3/8/04 | 0.11 | | 4.8 | 1.57 | 2.3 |
| R2N | 36 | 3/8/04 | 0.04 | | 1.4 | 9.09 | 1.5 |
| R2N | 38 | 3/8/04 | 0.23 | | 4.3 | 0.73 | 3.3 |
| R2N | 39 | 3/8/04 | 0.07 | | 4.6 | 17.5 | 2.2 |
| R2N | 41 | 3/8/04 | 0.07 | | 3.3 | 2.22 | 2.7 |
| R2N | 42 | 3/8/04 | 0.12 | | 2.2 | 16.7 | 3.2 |
| R2N | 44 | 3/8/04 | 0.07 | | 3.1 | 1.11 | 3.2 |
| R2N | 45 | 3/8/04 | 0.01 | | 2.1 | 2.72 | 2.8 |
| R2N | 47 | 3/8/04 | 0.06 | | 3.3 | 1.52 | 2 |
| R2N | 48 | 3/8/04 | 0.13 | | 2.9 | 2.95 | 2.4 |
| R2N | 50 | 3/8/04 | 0.02 | | 5.8 | 9.4 | 2.8 |
| R2N | 51 | 3/8/04 | 0.02 | | 0.63 | 7.45 | 1.8 |
| R2N | 53 | 3/8/04 | 0.03 | | 8.3 | 16 | 2.4 |
| R2N | 54 | 3/8/04 | 0.01 | | 3.3 | 12.1 | 2.8 |
| R2N | 56 | 3/8/04 | 0.08 | | 6.3 | 8.12 | 2.4 |
| R2N | 57 | 3/8/04 | 0.03 | | 3.2 | 5.16 | 1.8 |
| R2N | 59 | 3/8/04 | 0.26 | | 6.7 | 6.88 | 2.9 |
| R2N | 60 | 3/8/04 | 0.03 | | 2.6 | 3.97 | 3.1 |
| R2N | 62 | 3/8/04 | 0.54 | | 1.9 | 0.9 | 3.1 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 63 | 3/8/04 | 0.03 | | 1.8 | 9.86 | 1.4 |
| R2N | 65 | 3/8/04 | 0.11 | | 6.3 | 1.06 | 3.2 |
| R2N | 66 | 3/8/04 | 0.07 | | 5.6 | 26.3 | 2 |
| R2N | 68 | 3/8/04 | 0.02 | | 3.2 | 1.04 | 2.9 |
| R2N | 69 | 3/8/04 | 0.13 | | 3.1 | 18.6 | 3 |
| R2N | 72 | 3/8/04 | 0.02 | | 11.6 | 24.2 | 3 |
| R1N | 66 | 3/8/04 | 0.01 | | 6.8 | 23 | 1.4 |
| R5N | 68 | 3/8/04 | 0.02 | | 9.2 | 10.2 | 1.8 |
| R4W | 2 | 3/8/04 | 0.02 | | 20.2 | 19.3 | 2.3 |
| R4W | 3 | 3/8/04 | 0.06 | | 0.35 | 26.9 | 1.9 |
| R4W | 5 | 3/8/04 | 0.02 | | 22.3 | 16.6 | 2.3 |
| R4W | 6 | 3/8/04 | 0.05 | | 0.01 | 24.2 | 1.3 |
| R4W | 8 | 3/8/04 | 0.01 | | 25.4 | 18.6 | 2.1 |
| R4W | 9 | 3/8/04 | 0.03 | | 0.43 | 12.3 | 1.7 |
| R4W | 11 | 3/8/04 | 0.01 | | 25.2 | 19.8 | 2 |
| R4W | 12 | 3/8/04 | 0.03 | | 0.24 | 20.5 | 1.4 |
| R4W | 14 | 3/8/04 | 0.01 | | 21.2 | 17.3 | 1.6 |
| R4W | 15 | 3/8/04 | 0.01 | | 16.3 | 20.7 | 2.2 |
| R4W | 17 | 3/8/04 | 0.01 | | 8 | 20.3 | 3.2 |
| R4W | 18 | 3/8/04 | 0.04 | | 0.69 | 16.6 | 2.5 |
| R4W | 20 | 3/8/04 | 0.01 | | 2 | 25.6 | 3 |
| R4W | 21 | 3/8/04 | 0.26 | | 0.13 | 10.2 | 3.3 |
| R4W | 23 | 3/8/04 | 0.01 | | 2 | 27.5 | 2.6 |
| R4W | 24 | 3/8/04 | 0.02 | | 1.1 | 25.9 | 4 |
| R4W | 26 | 3/8/04 | 0.01 | | 1.8 | 26.7 | 3.3 |
| R4W | 27 | 3/8/04 | 0.01 | | 1.4 | 27 | 3.1 |
| R4W | 29 | 3/8/04 | 0.01 | | 0.94 | 26.9 | 3.9 |
| R4W | 30 | 3/8/04 | 0.03 | | 0.1 | 29 | 2.6 |
| R4W | 32 | 3/8/04 | 0.01 | | 23 | 22.8 | 1.8 |
| R4W | 33 | 3/8/04 | 0.02 | | 7.1 | 21.7 | 2.1 |
| R4W | 35 | 3/8/04 | 0.01 | | 21.3 | 18.2 | 1.9 |
| R4W | 36 | 3/8/04 | 0.06 | | 0.02 | 11 | 1.7 |
| R4W | 38 | 3/8/04 | 0.01 | | 27.5 | 19.4 | 2.3 |
| R4W | 39 | 3/8/04 | 0.01 | | 16.7 | 19.6 | 2.4 |
| R4W | 41 | 3/8/04 | 0.02 | | 19.7 | 21.6 | 2.3 |
| R4W | 42 | 3/8/04 | 0.03 | | 18.6 | 23.4 | 1.8 |
| R4W | 44 | 3/8/04 | 0.01 | | 19.8 | 20.6 | 3 |
| R4W | 45 | 3/8/04 | 0.01 | | 21.2 | 20.1 | 2.2 |
| R4W | 47 | 3/8/04 | 0.01 | | 15.8 | 17.4 | 2.5 |
| R4W | 48 | 3/8/04 | 0.01 | | 14.1 | 18.3 | 1.8 |
| R4W | 50 | 3/8/04 | 0.01 | | 5.3 | 23.5 | 2.7 |
| R4W | 51 | 3/8/04 | 0.01 | | 4 | 23.3 | 2.4 |
| R4W | 53 | 3/8/04 | 0.01 | | 5.2 | 21.5 | 2.7 |
| R4W | 54 | 3/8/04 | 0.03 | | 1.8 | 24.8 | 2.7 |
| R4W | 56 | 3/8/04 | 0.06 | | 1.9 | 22.6 | 3.2 |
| R4W | 57 | 3/8/04 | 0.02 | | 0.6 | 25.5 | 2.6 |
| R4W | 59 | 3/8/04 | 0.05 | | 1.9 | 26 | 2.8 |
| R4W | 60 | 3/8/04 | 0.04 | | 1.6 | 24.2 | 2.7 |
| R4W | 62 | 3/8/04 | 0.01 | | 25.1 | 23.5 | 2.7 |
| R4W | 63 | 3/8/04 | 0.03 | | 14.1 | 24.7 | 2 |
| R4W | 65 | 3/8/04 | 0.02 | | 20.9 | 17.3 | 4 |
| R4W | 66 | 3/8/04 | 0.05 | | 26.3 | 19.6 | 2 |
| R4W | 68 | 3/8/04 | 0.14 | | 5.6 | 20.3 | 3.4 |
| R4W | 69 | 3/8/04 | 0.02 | | 6.6 | 24.4 | 2.5 |
| R4W | 71 | 3/8/04 | 0.01 | | 5.3 | 18.9 | 2.5 |
| R4W | 72 | 3/8/04 | 0.06 | | 0.21 | 28.7 | 2.9 |
| R4W | Stream | 3/8/04 | 0.68 | | 0.74 | 11.2 | 7.9 |
| R5N | 2 | 3/8/04 | 0.01 | | 1.4 | 15.1 | 3.7 |
| R5N | 3 | 3/8/04 | 0.01 | | 1.9 | 14.6 | 4.2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 5 | 3/8/04 | 0.01 | | 1 | 17 | 4.5 |
| R5N | 6 | 3/8/04 | 0.01 | | 1.4 | 20.9 | 3.4 |
| R5N | 8 | 3/8/04 | 0.01 | | 12.6 | 10.9 | 6.1 |
| R5N | 9 | 3/8/04 | 0.01 | | 1.1 | 14 | 3.4 |
| R5N | 11 | 3/8/04 | 0.01 | | 3.6 | 9.76 | 4.4 |
| R5N | 12 | 3/8/04 | 0.01 | | 0 | 25.1 | 3.1 |
| R5N | 14 | 3/8/04 | 0.03 | | 1.7 | 9.09 | 4 |
| R5N | 15 | 3/8/04 | 0.01 | | 0.02 | 21.5 | 2.9 |
| R5N | 17 | 3/8/04 | 0.02 | | 0.38 | 7.18 | 4.2 |
| R5N | 18 | 3/8/04 | 0.01 | | 3 | 16.5 | 2.4 |
| R5N | 20 | 3/8/04 | 0.03 | | 0 | 12.5 | 2.9 |
| R5N | 21 | 3/8/04 | 0.02 | | 1.6 | 13.3 | 2 |
| R5N | 23 | 3/8/04 | 0.02 | | 2.3 | 10.9 | 3.7 |
| R5N | 24 | 3/8/04 | 0.08 | | 3.2 | 9.41 | 3.5 |
| R5N | 26 | 3/8/04 | 0.01 | | 0.01 | 12.7 | 4.3 |
| R5N | 27 | 3/8/04 | 0.03 | | 0 | 6.37 | 2.1 |
| R5N | 29 | 3/8/04 | 0.02 | | 0 | 17 | 9.6 |
| R5N | 30 | 3/8/04 | 0.03 | | 0 | 17.6 | 6.1 |
| R5N | 32 | 3/8/04 | 0.03 | | 3 | 8.12 | 4.6 |
| R5N | 33 | 3/8/04 | 0.01 | | 1.6 | 10.8 | 3 |
| R5N | 35 | 3/8/04 | 0.02 | | 10.5 | 9.32 | 3.8 |
| R5N | 36 | 3/8/04 | 0.01 | | 0.91 | 9.59 | 4.3 |
| R5N | 38 | 3/8/04 | 0.03 | | 6.7 | 8.56 | 6.6 |
| R5N | 39 | 3/8/04 | 0.01 | | 0.4 | 21.1 | 2.3 |
| R5N | 41 | 3/8/04 | 0.04 | | 2.3 | 9.06 | 6.7 |
| R5N | 42 | 3/8/04 | 0.02 | | 0.01 | 26.9 | 2.9 |
| R5N | 44 | 3/8/04 | 0.04 | | 22.4 | 17.2 | 4.1 |
| R5N | 45 | 3/8/04 | 0.02 | | 1.8 | 22.8 | 2.8 |
| R5N | 47 | 3/8/04 | 0.01 | | 4.2 | 9.82 | 3.6 |
| R5N | 48 | 3/8/04 | 0.02 | | 0.17 | 22.9 | 3.3 |
| R5N | 50 | 3/8/04 | 0.02 | | 1.8 | 5.38 | 5 |
| R5N | 51 | 3/8/04 | 0.01 | | 0.42 | 12.6 | 2.3 |
| R5N | 53 | 3/8/04 | 0.01 | | 0.01 | 9.81 | 3.2 |
| R5N | 54 | 3/8/04 | 0.01 | | 2.9 | 13.7 | 3.2 |
| R5N | 56 | 3/8/04 | 0.02 | | 0.39 | 6.49 | 4.2 |
| R5N | 57 | 3/8/04 | 0.01 | | 0 | 14.1 | 3.2 |
| R5N | 59 | 3/8/04 | 0.01 | | 4 | 8.39 | 2.9 |
| R5N | 60 | 3/8/04 | 0.04 | | 0.03 | 18.8 | 3.7 |
| R5N | 62 | 3/8/04 | 0.03 | | 7.7 | 11.2 | 3.6 |
| R5N | 63 | 3/8/04 | 0.01 | | 1.1 | 12.4 | 3.4 |
| R5N | 65 | 3/8/04 | 0.05 | | 1.5 | 10.4 | 5.8 |
| R5N | 66 | 3/8/04 | 0.01 | | 0.23 | 28.1 | 2.5 |
| R5N | 68 | 3/8/04 | 0.01 | | 2.2 | 7.9 | 3.7 |
| R5N | 69 | 3/8/04 | 0.01 | | 5.3 | 13.2 | 3 |
| R5N | 71 | 3/8/04 | 0.01 | | 1.5 | 10.2 | 3.5 |
| R5N | 72 | 3/8/04 | 0.03 | | 0 | 11 | 2.5 |
| R5N | Stream | 3/8/04 | 0.07 | | 1.1 | 22.8 | 11.4 |
| R1N | 2 | 4/18/04 | 0.05 | | 0.13 | 6.03 | 3.2 |
| R1N | 3 | 4/18/04 | 0.07 | | 9.65 | 22.2 | 2.1 |
| R1N | 5 | 4/18/04 | 0.01 | | 6.29 | 17.6 | 2.1 |
| R1N | 6 | 4/18/04 | 0.04 | | 0.17 | 16.2 | 2 |
| R1N | 8 | 4/18/04 | 0.04 | | 11.06 | 27.5 | 1.6 |
| R1N | 9 | 4/18/04 | 0.03 | | 1.13 | 19.6 | 2.5 |
| R1N | 11 | 4/18/04 | 0.02 | | 11.44 | 24.7 | 1.7 |
| R1N | 12 | 4/18/04 | 0.03 | | 8.87 | 24.7 | 1.4 |
| R1N | 17 | 4/18/04 | 0.01 | | 5.98 | 24.9 | 2.6 |
| R1N | 18 | 4/18/04 | 0.02 | | 3.91 | 27 | 2.8 |
| R1N | 20 | 4/18/04 | 0.02 | | 2.65 | 13.9 | 2.9 |
| R1N | 21 | 4/18/04 | 0.04 | | 0.77 | 12.9 | 1.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 23 | 4/18/04 | 0.07 | | 4.27 | 7.06 | 3.2 |
| R1N | 24 | 4/18/04 | 0.09 | | 0.29 | 10.6 | 1.4 |
| R1N | 26 | 4/18/04 | 0.01 | | 9.74 | 17 | 1.2 |
| R1N | 27 | 4/18/04 | 0.03 | | 7.89 | 18.6 | 1.4 |
| R1N | 29 | 4/18/04 | 0.02 | | 12.66 | 23.4 | 2.5 |
| R1N | 30 | 4/18/04 | 0.07 | | 0.20 | 10.5 | 1.4 |
| R1N | 32 | 4/18/04 | 0.03 | | 6.63 | 18.8 | 1.4 |
| R1N | 33 | 4/18/04 | 0.23 | | 0.18 | 5.81 | 3.5 |
| R1N | 35 | 4/18/04 | 0.02 | | 13.02 | 22.6 | 2.4 |
| R1N | 36 | 4/18/04 | 0.02 | | 4.27 | 16.8 | 2.2 |
| R1N | 38 | 4/18/04 | 0.02 | | 13.00 | 24.6 | 1.7 |
| R1N | 39 | 4/18/04 | 0.03 | | 10.36 | 25.2 | 1.1 |
| R1N | 41 | 4/18/04 | 0.02 | | 11.77 | 23 | 1.6 |
| R1N | 42 | 4/18/04 | 0.01 | | 8.43 | 24.3 | 1 |
| R1N | 44 | 4/18/04 | 0.01 | | 8.20 | 23.4 | 1.8 |
| R1N | 45 | 4/18/04 | 0.05 | | 0.21 | 10.2 | 1.4 |
| R1N | 47 | 4/18/04 | 0.01 | | 7.24 | 19.4 | 1.7 |
| R1N | 48 | 4/18/04 | 0.02 | | 5.98 | 33 | 1.3 |
| R1N | 50 | 4/18/04 | 0.01 | | 9.21 | 13.4 | 1.5 |
| R1N | 51 | 4/18/04 | 0.01 | | 4.91 | 32.2 | 1.1 |
| R1N | 53 | 4/18/04 | 0.02 | | 8.54 | 16.8 | 2 |
| R1N | 54 | 4/18/04 | 0.02 | | 8.08 | 17.3 | 1.3 |
| R1N | 57 | 4/18/04 | 0.01 | | 11.53 | 16.3 | 1 |
| R1N | 59 | 4/18/04 | 0.15 | | 15.58 | 18.5 | 2.8 |
| R1N | 60 | 4/18/04 | 0.01 | | 12.49 | 24.6 | 1.4 |
| R1N | 62 | 4/18/04 | 0.02 | | 11.04 | 21.5 | 1.1 |
| R1N | 63 | 4/18/04 | 0.02 | | 4.37 | 20.6 | 1 |
| R1N | 65 | 4/18/04 | 0.04 | | 11.58 | 23.7 | 2 |
| R1N | 66 | 4/18/04 | 0.02 | | 7.13 | 25.7 | 1.4 |
| R1N | 68 | 4/18/04 | 0.02 | | 8.12 | 17.1 | 1.3 |
| R1N | 69 | 4/18/04 | 0.03 | | 6.60 | 20.7 | 1.9 |
| R1N | 71 | 4/18/04 | 0.02 | | 9.12 | 16.5 | 1.5 |
| R1N | 72 | 4/18/04 | 0.02 | | 8.50 | 14.5 | 1.8 |
| R1N | Stream | 4/18/04 | 0.21 | | 5.78 | 17.7 | 6.3 |
| R2N | 2 | 4/18/04 | 0.01 | | 4.45 | 15.3 | 1.9 |
| R2N | 3 | 4/18/04 | 0.04 | | 5.10 | 6.99 | 3.2 |
| R2N | 5 | 4/18/04 | 0.09 | | 4.34 | 8.95 | 3.8 |
| R2N | 6 | 4/18/04 | 0.03 | | 3.74 | 19.6 | 1.8 |
| R2N | 8 | 4/18/04 | 0.02 | | 5.29 | 15.3 | 2.6 |
| R2N | 9 | 4/18/04 | 0.04 | | 3.51 | 24 | 2.2 |
| R2N | 11 | 4/18/04 | 0.06 | | 2.84 | 7.78 | 2.4 |
| R2N | 12 | 4/18/04 | 0.11 | | 3.28 | 18.6 | 2.2 |
| R2N | 14 | 4/18/04 | 0.03 | | 3.41 | 10.2 | 1.6 |
| R2N | 15 | 4/18/04 | 0.05 | | 3.75 | 13.2 | 1.9 |
| R2N | 17 | 4/18/04 | 0.04 | | 0.14 | 6.84 | 4.6 |
| R2N | 18 | 4/18/04 | 0.03 | | 0.12 | 11.4 | 1.9 |
| R2N | 20 | 4/18/04 | 0.01 | | 0.86 | 5.41 | 4.1 |
| R2N | 21 | 4/18/04 | 0.12 | | 0.12 | 17.6 | 1.1 |
| R2N | 23 | 4/18/04 | 0.04 | | 0.73 | 4.77 | 4 |
| R2N | 24 | 4/18/04 | 0.05 | | 0.14 | 18 | 1 |
| R2N | 26 | 4/18/04 | 0.06 | | 3.93 | 3.94 | 2.2 |
| R2N | 27 | 4/18/04 | 0.04 | | 0.11 | 20.5 | 1 |
| R2N | 29 | 4/18/04 | 0.15 | | 3.01 | 4.81 | 2.4 |
| R2N | 30 | 4/18/04 | 0.03 | | 0.12 | 11.1 | 1.3 |
| R2N | 32 | 4/18/04 | 0.09 | | 5.37 | 4.62 | 2.2 |
| R2N | 33 | 4/18/04 | 0.05 | | 1.32 | 12.8 | 2 |
| R2N | 35 | 4/18/04 | 0.12 | | 4.59 | 2.57 | 3.2 |
| R2N | 36 | 4/18/04 | 0.03 | | 6.24 | 28.9 | 2.5 |
| R2N | 38 | 4/18/04 | 0.03 | | 3.92 | 5.76 | 1.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 39 | 4/18/04 | 0.03 | | 4.00 | 26.7 | 1.4 |
| R2N | 41 | 4/18/04 | 0.05 | | 3.88 | 2.76 | 3 |
| R2N | 42 | 4/18/04 | 0.03 | | 2.61 | 5.56 | 2 |
| R2N | 44 | 4/18/04 | 0.03 | | 4.38 | 3.08 | 2.5 |
| R2N | 45 | 4/18/04 | 0.04 | | 4.31 | 6.4 | 3 |
| R2N | 47 | 4/18/04 | 0.01 | | 6.30 | 13.2 | 2.4 |
| R2N | 48 | 4/18/04 | 0.01 | | 3.62 | 10.1 | 1.6 |
| R2N | 50 | 4/18/04 | 0.02 | | 10.83 | 21.2 | 2.1 |
| R2N | 51 | 4/18/04 | 0.02 | | 1.95 | 9.45 | 1.7 |
| R2N | 53 | 4/18/04 | 0.04 | | 5.46 | 10.6 | 2 |
| R2N | 54 | 4/18/04 | 0.04 | | 2.87 | 6.17 | 1.8 |
| R2N | 56 | 4/18/04 | 0.09 | | 7.86 | 8.01 | 2.6 |
| R2N | 57 | 4/18/04 | 0.02 | | 3.37 | 6.28 | 1.8 |
| R2N | 59 | 4/18/04 | 0.31 | | 4.16 | 4.14 | 2.7 |
| R2N | 60 | 4/18/04 | 0.02 | | 3.12 | 10.3 | 1.4 |
| R2N | 62 | 4/18/04 | 0.05 | | 7.01 | 3.13 | 3.6 |
| R2N | 63 | 4/18/04 | 0.03 | | 7.77 | 34.4 | 3.7 |
| R2N | 65 | 4/18/04 | 0.03 | | 1.83 | 2.13 | 2.7 |
| R2N | 66 | 4/18/04 | 0.36 | | 3.08 | 19.1 | 1.6 |
| R2N | 69 | 4/18/04 | 0.03 | | 2.68 | 14.4 | 1.9 |
| R2N | 72 | 4/18/04 | 0.03 | | 3.64 | 9.35 | 3.6 |
| R4W | 2 | 4/18/04 | 0.10 | | 25.60 | 24.4 | 1.8 |
| R4W | 3 | 4/18/04 | 0.11 | | 0.19 | 29.4 | 1.5 |
| R4W | 5 | 4/18/04 | 0.09 | | 29.50 | 21.3 | 1.5 |
| R4W | 6 | 4/18/04 | 0.04 | | 0.18 | 28.2 | 1.2 |
| R4W | 8 | 4/18/04 | 0.09 | | 28.52 | 22.3 | 1.6 |
| R4W | 9 | 4/18/04 | 0.03 | | 0.29 | 12.5 | 1.2 |
| R4W | 11 | 4/18/04 | 0.09 | | 27.49 | 21.7 | 1.5 |
| R4W | 12 | 4/18/04 | 0.02 | | 0.35 | 22.8 | 1.3 |
| R4W | 14 | 4/18/04 | 0.09 | | 19.68 | 21.1 | 1.6 |
| R4W | 15 | 4/18/04 | 0.10 | | 18.62 | 21.5 | 1.8 |
| R4W | 17 | 4/18/04 | 0.02 | | 8.38 | 23.8 | 1.7 |
| R4W | 18 | 4/18/04 | 0.04 | | 0.40 | 17.5 | 1.1 |
| R4W | 20 | 4/18/04 | 0.02 | | 2.03 | 27.3 | 2.2 |
| R4W | 23 | 4/18/04 | 0.02 | | 1.86 | 31 | 2.3 |
| R4W | 24 | 4/18/04 | 0.03 | | 0.78 | 29.3 | 2.5 |
| R4W | 26 | 4/18/04 | 0.02 | | 1.90 | 29.8 | 2.3 |
| R4W | 27 | 4/18/04 | 0.02 | | 1.11 | 30 | 2.4 |
| R4W | 29 | 4/18/04 | 0.01 | | 0.89 | 30.1 | 3.7 |
| R4W | 30 | 4/18/04 | 0.03 | | 0.28 | 29.5 | 2.4 |
| R4W | 32 | 4/18/04 | 0.09 | | 25.81 | 23.2 | 1.5 |
| R4W | 33 | 4/18/04 | 0.02 | | 5.75 | 22.4 | 1.7 |
| R4W | 35 | 4/18/04 | 0.09 | | 24.44 | 20.1 | 1.6 |
| R4W | 38 | 4/18/04 | 0.09 | | 28.61 | 18.7 | 2.9 |
| R4W | 39 | 4/18/04 | 0.10 | | 23.60 | 21.5 | 1.7 |
| R4W | 41 | 4/18/04 | 0.09 | | 26.02 | 22.4 | 1.6 |
| R4W | 42 | 4/18/04 | 0.09 | | 25.30 | 21.5 | 1.5 |
| R4W | 44 | 4/18/04 | 0.09 | | 20.83 | 19.2 | 2 |
| R4W | 45 | 4/18/04 | 0.10 | | 23.71 | 18.5 | 1.8 |
| R4W | 47 | 4/18/04 | 0.20 | | 16.94 | 18 | 1.9 |
| R4W | 48 | 4/18/04 | 0.09 | | 15.71 | 18.3 | 2 |
| R4W | 50 | 4/18/04 | 0.02 | | 6.70 | 24.1 | 1.9 |
| R4W | 51 | 4/18/04 | 0.02 | | 5.23 | 25.4 | 1.8 |
| R4W | 53 | 4/18/04 | 0.02 | | 5.49 | 22.2 | 1.9 |
| R4W | 54 | 4/18/04 | 0.02 | | 3.23 | 25.7 | 1.7 |
| R4W | 56 | 4/18/04 | 0.06 | | 2.08 | 25 | 2.4 |
| R4W | 57 | 4/18/04 | 0.03 | | 0.55 | 25.6 | 2.1 |
| R4W | 59 | 4/18/04 | 0.03 | | 1.38 | 27.9 | 2.7 |
| R4W | 60 | 4/18/04 | 0.03 | | 1.13 | 24.9 | 2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 62 | 4/18/04 | 0.10 | | 27.46 | 24.2 | 1.5 |
| R4W | 63 | 4/18/04 | 0.04 | | 11.85 | 27 | 1.4 |
| R4W | 65 | 4/18/04 | 0.09 | | 24.81 | 18 | 2.3 |
| R4W | 66 | 4/18/04 | 0.14 | | 30.48 | 20.4 | 3.2 |
| R4W | 68 | 4/18/04 | 0.04 | | 10.95 | 23.7 | 5.4 |
| R4W | 69 | 4/18/04 | 0.02 | | 9.60 | 24.6 | 3.3 |
| R4W | 71 | 4/18/04 | 0.02 | | 5.97 | 23.7 | 1.9 |
| R4W | 72 | 4/18/04 | 0.03 | | 0.91 | 28.9 | 2 |
| R4W | Stream | 4/18/04 | 1.68 | | 0.54 | 12 | 9.7 |
| R5N | 2 | 4/18/04 | 0.01 | | 4.74 | 10.3 | 9.2 |
| R5N | 3 | 4/18/04 | 0.01 | | 1.68 | 17.2 | 2.8 |
| R5N | 5 | 4/18/04 | 0.01 | | 1.28 | 16.1 | 2.7 |
| R5N | 6 | 4/18/04 | 0.02 | | 1.92 | 15.7 | 3.2 |
| R5N | 8 | 4/18/04 | 0.01 | | 9.88 | 10.6 | 4.2 |
| R5N | 9 | 4/18/04 | 0.01 | | 1.13 | 12.7 | 6.5 |
| R5N | 11 | 4/18/04 | 0.01 | | 4.88 | 12.7 | 3.1 |
| R5N | 12 | 4/18/04 | 0.02 | | 0.07 | 27.4 | 4.5 |
| R5N | 14 | 4/18/04 | 0.02 | | 4.03 | 11 | 3 |
| R5N | 15 | 4/18/04 | 0.02 | | 0.28 | 23.8 | 3.4 |
| R5N | 17 | 4/18/04 | 0.01 | | 1.22 | 10.2 | 2.5 |
| R5N | 18 | 4/18/04 | 0.02 | | 5.70 | 16.3 | 2.7 |
| R5N | 20 | 4/18/04 | 0.02 | | 0.56 | 11.3 | 3.7 |
| R5N | 21 | 4/18/04 | 0.02 | | 0.49 | 14.2 | 2.7 |
| R5N | 23 | 4/18/04 | 0.01 | | 3.31 | 12.3 | 2.6 |
| R5N | 24 | 4/18/04 | 0.02 | | 2.55 | 9.86 | 2.9 |
| R5N | 26 | 4/18/04 | 0.02 | | 0.14 | 11.6 | 1.9 |
| R5N | 27 | 4/18/04 | 0.03 | | 0.07 | 8.21 | 2.7 |
| R5N | 29 | 4/18/04 | 0.02 | | 0.07 | 20.8 | 2.2 |
| R5N | 30 | 4/18/04 | 0.03 | | 0.10 | 22 | 6.1 |
| R5N | 32 | 4/18/04 | 0.02 | | 3.52 | 10.3 | 4.8 |
| R5N | 33 | 4/18/04 | 0.01 | | 0.99 | 14.2 | 3.2 |
| R5N | 35 | 4/18/04 | 0.03 | | 8.98 | 7.85 | 2.8 |
| R5N | 36 | 4/18/04 | 0.01 | | 1.40 | 11.9 | 3.2 |
| R5N | 38 | 4/18/04 | 0.02 | | 8.86 | 11.1 | 3.6 |
| R5N | 39 | 4/18/04 | 0.02 | | 0.51 | 17.7 | 5.3 |
| R5N | 41 | 4/18/04 | 0.03 | | 2.05 | 9.74 | 3.5 |
| R5N | 42 | 4/18/04 | 0.02 | | 0.13 | 30.2 | 6 |
| R5N | 44 | 4/18/04 | 0.11 | | 22.16 | 17.5 | 2.3 |
| R5N | 45 | 4/18/04 | 0.03 | | 1.86 | 19.3 | 3.6 |
| R5N | 47 | 4/18/04 | 0.03 | | 0.64 | 24.6 | 2.5 |
| R5N | 48 | 4/18/04 | 0.01 | | 4.59 | 9.44 | 2.1 |
| R5N | 50 | 4/18/04 | 0.01 | | 2.37 | 8.18 | 3.5 |
| R5N | 51 | 4/18/04 | 0.02 | | 0.12 | 10.3 | 3.8 |
| R5N | 53 | 4/18/04 | 0.02 | | 0.25 | 11.5 | 2.2 |
| R5N | 54 | 4/18/04 | 0.02 | | 3.08 | 12.6 | 2.2 |
| R5N | 56 | 4/18/04 | 0.02 | | 0.38 | 7.13 | 2.2 |
| R5N | 57 | 4/18/04 | 0.02 | | 0.07 | 14.3 | 3.2 |
| R5N | 59 | 4/18/04 | 0.02 | | 3.91 | 8.66 | 4.2 |
| R5N | 60 | 4/18/04 | 0.03 | | 0.10 | 21 | 3 |
| R5N | 62 | 4/18/04 | 0.02 | | 6.40 | 13.3 | 3.5 |
| R5N | 63 | 4/18/04 | 0.02 | | 0.62 | 11.2 | 3.2 |
| R5N | 65 | 4/18/04 | 0.06 | | 1.83 | 9.61 | 3.6 |
| R5N | 66 | 4/18/04 | 0.02 | | 0.77 | 28.4 | 4.8 |
| R5N | 68 | 4/18/04 | 0.03 | | 1.62 | 7.84 | 2.2 |
| R5N | 69 | 4/18/04 | 0.02 | | 3.51 | 11.7 | 3.9 |
| R5N | 71 | 4/18/04 | 0.02 | | 2.16 | 12 | 2.5 |
| R5N | 72 | 4/18/04 | 0.02 | | 0.05 | 19 | 2.7 |
| R5N | Stream | 4/18/04 | 0.09 | | 1.29 | 23.7 | 2.3 |
| R1N | 2 | 5/25/04 | 0.02 | | 8.4 | 19.8 | 1.6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 3 | 5/25/04 | 0.2 | | 0 | 5.01 | 2 |
| R1N | 5 | 5/25/04 | 0.02 | | 3.9 | 15.7 | 1.3 |
| R1N | 6 | 5/25/04 | 0.07 | | 0 | 14 | 1.9 |
| R1N | 8 | 5/25/04 | 0.11 | | 9.9 | 23.1 | 2.4 |
| R1N | 9 | 5/25/04 | 0.12 | | 0.01 | 19 | 1.8 |
| R1N | 11 | 5/25/04 | 0.03 | | 10.2 | 21.4 | 1.6 |
| R1N | 12 | 5/25/04 | 0.08 | | 7.6 | 5.26 | 3.4 |
| R1N | 17 | 5/25/04 | 0.02 | | 3.3 | 23.7 | 2.7 |
| R1N | 18 | 5/25/04 | 0.02 | | 5.4 | 22.5 | 1.8 |
| R1N | 20 | 5/25/04 | 0.05 | | 2.1 | 14.8 | 4.5 |
| R1N | 21 | 5/25/04 | 0.04 | | 2 | 14.9 | 4.2 |
| R1N | 23 | 5/25/04 | 0.11 | | 3.8 | 13.7 | 5 |
| R1N | 24 | 5/25/04 | 0.16 | | 0.01 | 10.7 | 3.5 |
| R1N | 26 | 5/25/04 | 0.02 | | 6.3 | 15.2 | 3 |
| R1N | 27 | 5/25/04 | 0.01 | | 11.6 | 13.9 | 3.2 |
| R1N | 29 | 5/25/04 | 0.02 | | 13.1 | 21.4 | 3.9 |
| R1N | 30 | 5/25/04 | 0.27 | | 0 | 10.9 | 5.2 |
| R1N | 32 | 5/25/04 | 0.04 | | 6.1 | 18.9 | 2.4 |
| R1N | 33 | 5/25/04 | 0.31 | | 0 | 5.33 | 5.7 |
| R1N | 35 | 5/25/04 | 0.01 | | 12.5 | 20.8 | 2.1 |
| R1N | 36 | 5/25/04 | 0.04 | | 4 | 14.2 | 2.4 |
| R1N | 38 | 5/25/04 | 0.01 | | 12.4 | 23.2 | 1.4 |
| R1N | 39 | 5/25/04 | 0.04 | | 9.8 | 25 | 1.6 |
| R1N | 41 | 5/25/04 | 0.02 | | 10.5 | 20.4 | 1.4 |
| R1N | 42 | 5/25/04 | 0.01 | | 8 | 21.6 | 1.3 |
| R1N | 44 | 5/25/04 | 0.01 | | 8.3 | 20.2 | 1.3 |
| R1N | 45 | 5/25/04 | 0.13 | | 0.01 | 8.26 | 1.9 |
| R1N | 47 | 5/25/04 | 0.01 | | 7.1 | 21.5 | 1.1 |
| R1N | 48 | 5/25/04 | 0.02 | | 5.3 | 26.6 | 2.2 |
| R1N | 50 | 5/25/04 | 0.03 | | 7.9 | 17.1 | 3.7 |
| R1N | 51 | 5/25/04 | 0.01 | | 4.1 | 28.6 | 2 |
| R1N | 54 | 5/25/04 | 0.01 | | 8.3 | 17.2 | 1.2 |
| R1N | 57 | 5/25/04 | 0.01 | | 10.4 | 14.5 | 1.6 |
| R1N | 59 | 5/25/04 | 0.09 | | 16.6 | 15.8 | 3.7 |
| R1N | 60 | 5/25/04 | 0.02 | | 12.4 | 22.8 | 3.1 |
| R1N | 62 | 5/25/04 | 0.01 | | 9.9 | 17.9 | 1.8 |
| R1N | 63 | 5/25/04 | 0.01 | | 2.8 | 17.1 | 1.3 |
| R1N | 66 | 5/25/04 | 0.02 | | 6.3 | 23.3 | 1.6 |
| R1N | 69 | 5/25/04 | 0.02 | | 5.1 | 19.3 | 2.2 |
| R1N | 72 | 5/25/04 | 0.01 | | 7.8 | 15.7 | 3.1 |
| R1N | Stream | 5/25/04 | 0.06 | | 5.9 | 16.7 | 6.9 |
| R2N | 2 | 5/25/04 | 0.03 | | 4.6 | 7.53 | 2.5 |
| R2N | 3 | 5/25/04 | 0.01 | | 2.9 | 16.1 | 3.2 |
| R2N | 5 | 5/25/04 | 0.14 | | 4.1 | 8.26 | 4 |
| R2N | 6 | 5/25/04 | 0.04 | | 2.2 | 14.9 | 1.8 |
| R2N | 8 | 5/25/04 | 0.02 | | 5.2 | 41.5 | 2.3 |
| R2N | 9 | 5/25/04 | 0.03 | | 3.1 | 24.1 | 1.8 |
| R2N | 11 | 5/25/04 | 0.11 | | 2.7 | 11.6 | 2.7 |
| R2N | 12 | 5/25/04 | 0.27 | | 2.7 | 17.9 | 2.9 |
| R2N | 14 | 5/25/04 | 0.24 | | 3.2 | 10.9 | 2.5 |
| R2N | 15 | 5/25/04 | 0.08 | | 3.8 | 13.8 | 2.2 |
| R2N | 17 | 5/25/04 | 0.06 | | 0 | 5.74 | 9.8 |
| R2N | 18 | 5/25/04 | 0.06 | | 0 | 9.3 | 2.8 |
| R2N | 20 | 5/25/04 | 0.11 | | 0 | 13 | 2.5 |
| R2N | 21 | 5/25/04 | 0.01 | | 2.6 | 2.81 | 4.3 |
| R2N | 23 | 5/25/04 | 0.06 | | 1.7 | 1.81 | 4.3 |
| R2N | 24 | 5/25/04 | 0.07 | | 0 | 14.4 | 4.2 |
| R2N | 26 | 5/25/04 | 0.06 | | 3.8 | 2.98 | 3.8 |
| R2N | 27 | 5/25/04 | 0.05 | | 0 | 16.5 | 2.2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 29 | 5/25/04 | 0.11 | | 2.7 | 2.93 | 3.5 |
| R2N | 30 | 5/25/04 | 0.02 | | 0 | 8.12 | 1.7 |
| R2N | 32 | 5/25/04 | 0.08 | | 4.7 | 1.35 | 2.6 |
| R2N | 33 | 5/25/04 | 0.04 | | 2.2 | 14.2 | 2 |
| R2N | 35 | 5/25/04 | 0.11 | | 4.4 | 0.7 | 3.7 |
| R2N | 36 | 5/25/04 | 0.12 | | 4.5 | 27.3 | 3.5 |
| R2N | 38 | 5/25/04 | 0.02 | | 3.7 | 8.25 | 2.7 |
| R2N | 39 | 5/25/04 | 0.03 | | 2.8 | 21.7 | 1.6 |
| R2N | 41 | 5/25/04 | 0.02 | | 3.2 | 1.03 | 2.7 |
| R2N | 42 | 5/25/04 | 0.01 | | 2.4 | 6.41 | 2.3 |
| R2N | 44 | 5/25/04 | 0.02 | | 4 | 2.87 | 2.5 |
| R2N | 45 | 5/25/04 | 0.05 | | 3.9 | 9.55 | 2.8 |
| R2N | 50 | 5/25/04 | 0.01 | | 11 | 15.2 | 3.3 |
| R2N | 51 | 5/25/04 | 0.02 | | 0.66 | 12.5 | 1.8 |
| R2N | 54 | 5/25/04 | 0.04 | | 2.5 | 6.99 | 1.9 |
| R2N | 56 | 5/25/04 | 0.07 | | 7.6 | 6.24 | 2 |
| R2N | 57 | 5/25/04 | 0.02 | | 7.2 | 12.5 | 2.1 |
| R2N | 59 | 5/25/04 | 0.3 | | 3.4 | 1.88 | 2.7 |
| R2N | 60 | 5/25/04 | 0.02 | | 2.6 | 10 | 2.3 |
| R2N | 62 | 5/25/04 | 0.02 | | 6.9 | 0.58 | 2.1 |
| R2N | 63 | 5/25/04 | 0.04 | | 7.2 | 34.5 | 1.8 |
| R2N | 65 | 5/25/04 | 0.01 | | 2 | 1.24 | 3.2 |
| R2N | 66 | 5/25/04 | 0.03 | | 2.6 | 18.4 | 1.9 |
| R2N | 69 | 5/25/04 | 0.03 | | 3.3 | 16.2 | 2 |
| R2N | 72 | 5/25/04 | 0.01 | | 3.3 | 11.1 | 2.9 |
| R4W | 2 | 5/25/04 | 0.03 | | 27.7 | 22.5 | 2.1 |
| R4W | 3 | 5/25/04 | 0.07 | | 0 | 24.9 | 2.7 |
| R4W | 5 | 5/25/04 | 0.04 | | 26.5 | 18.4 | 2.5 |
| R4W | 6 | 5/25/04 | 0.05 | | 0 | 25.1 | 2.2 |
| R4W | 8 | 5/25/04 | 0.02 | | 28.3 | 20.9 | 2 |
| R4W | 9 | 5/25/04 | 0.04 | | 0.24 | 12.3 | 1.5 |
| R4W | 11 | 5/25/04 | 0.02 | | 25.2 | 18.5 | 2.2 |
| R4W | 12 | 5/25/04 | 0.03 | | 0.03 | 20.6 | 3 |
| R4W | 14 | 5/25/04 | 0.01 | | 16.9 | 17.9 | 2.1 |
| R4W | 15 | 5/25/04 | 0.02 | | 11.1 | 19.5 | 1.7 |
| R4W | 17 | 5/25/04 | 0.01 | | 5 | 23.3 | 2.3 |
| R4W | 18 | 5/25/04 | 0.06 | | 0.38 | 18.1 | 1.5 |
| R4W | 20 | 5/25/04 | 0.01 | | 1 | 25.3 | 2.5 |
| R4W | 21 | 5/25/04 | 0.2 | | 0.02 | 8.09 | 3.6 |
| R4W | 23 | 5/25/04 | 0.01 | | 0.95 | 30.3 | 3 |
| R4W | 24 | 5/25/04 | 0.02 | | 0 | 28.8 | 2.9 |
| R4W | 26 | 5/25/04 | 0.01 | | 0.42 | 27.8 | 3.6 |
| R4W | 27 | 5/25/04 | 0.01 | | 0.13 | 30.4 | 3.2 |
| R4W | 29 | 5/25/04 | 0.01 | | 2.9 | 22.4 | 4.7 |
| R4W | 30 | 5/25/04 | 0.03 | | 0 | 28.5 | 2.7 |
| R4W | 32 | 5/25/04 | 0.01 | | 29.8 | 25.7 | 1.7 |
| R4W | 33 | 5/25/04 | 0.02 | | 4.8 | 21.8 | 1.6 |
| R4W | 35 | 5/25/04 | 0.01 | | 33.2 | 19.7 | 1.7 |
| R4W | 36 | 5/25/04 | 0.08 | | 0.16 | 11 | 1.4 |
| R4W | 38 | 5/25/04 | 0.01 | | 29.8 | 19.5 | 3.1 |
| R4W | 39 | 5/25/04 | 0.02 | | 17 | 16.1 | 3.3 |
| R4W | 41 | 5/25/04 | 0.01 | | 31.8 | 16.7 | 3 |
| R4W | 42 | 5/25/04 | 0.02 | | 32.2 | 17.6 | 2.1 |
| R4W | 44 | 5/25/04 | 0.01 | | 21 | 18.3 | 1.9 |
| R4W | 45 | 5/25/04 | 0.02 | | 20.9 | 16.8 | 1.4 |
| R4W | 47 | 5/25/04 | 0.01 | | 13.7 | 15.6 | 2.1 |
| R4W | 48 | 5/25/04 | 0.02 | | 10.6 | 17.1 | 1.6 |
| R4W | 50 | 5/25/04 | 0.01 | | 6.5 | 18.3 | 2.3 |
| R4W | 51 | 5/25/04 | 0.01 | | 3.7 | 19.4 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 53 | 5/25/04 | 0.07 | | 2.8 | 18.9 | 3.9 |
| R4W | 54 | 5/25/04 | 0.02 | | 1.5 | 20.9 | 2.4 |
| R4W | 56 | 5/25/04 | 0.04 | | 1.1 | 19.7 | 2.7 |
| R4W | 57 | 5/25/04 | 0.02 | | 0.23 | 20.9 | 2.6 |
| R4W | 59 | 5/25/04 | 0.01 | | 1.5 | 22.4 | 3.2 |
| R4W | 60 | 5/25/04 | 0.02 | | 1.1 | 22.3 | 2.7 |
| R4W | 62 | 5/25/04 | 0.02 | | 29.4 | 19.1 | 2.5 |
| R4W | 63 | 5/25/04 | 0.08 | | 10.3 | 20.7 | 3.5 |
| R4W | 65 | 5/25/04 | 0.01 | | 26.5 | 14.2 | 2.6 |
| R4W | 66 | 5/25/04 | 0.02 | | 29.1 | 16.1 | 2.9 |
| R4W | 68 | 5/25/04 | 0.02 | | 10.1 | 17.4 | 2.6 |
| R4W | 69 | 5/25/04 | 0.01 | | 7.7 | 23.3 | 3 |
| R4W | 71 | 5/25/04 | 0.01 | | 4.7 | 23.4 | 2.3 |
| R4W | 72 | 5/25/04 | 0.04 | | 0.52 | 27.8 | 2.7 |
| R4W | Stream | 5/25/04 | 2.3 | | 0.01 | 12.9 | 12.7 |
| R5N | 2 | 5/25/04 | 0.01 | | 3.1 | 10.5 | 3.1 |
| R5N | 3 | 5/25/04 | 0.01 | | 1.3 | 15.3 | 2.7 |
| R5N | 5 | 5/25/04 | 0.01 | | 1.3 | 13.7 | 3.5 |
| R5N | 6 | 5/25/04 | 0.04 | | 1.9 | 15.3 | 4 |
| R5N | 8 | 5/25/04 | 0.01 | | 4.4 | 6.99 | 6.6 |
| R5N | 9 | 5/25/04 | 0.19 | | 2.4 | 12.8 | 3.7 |
| R5N | 11 | 5/25/04 | 0.01 | | 4.3 | 12 | 4.1 |
| R5N | 12 | 5/25/04 | 0.02 | | 0 | 30.2 | 2.5 |
| R5N | 14 | 5/25/04 | 0.01 | | 9.7 | 11.9 | 4.5 |
| R5N | 15 | 5/25/04 | 0.01 | | 0.02 | 18.2 | 2.6 |
| R5N | 17 | 5/25/04 | 0.05 | | 0.93 | 9.43 | 4.6 |
| R5N | 18 | 5/25/04 | 0.01 | | 3.5 | 13.2 | 2.3 |
| R5N | 20 | 5/25/04 | 0.03 | | 0.53 | 9.33 | 3.5 |
| R5N | 21 | 5/25/04 | 0.03 | | 0.33 | 10.9 | 2.3 |
| R5N | 23 | 5/25/04 | 0.01 | | 3.3 | 10.5 | 3.6 |
| R5N | 24 | 5/25/04 | 0.18 | | 0.36 | 10 | 3.4 |
| R5N | 26 | 5/25/04 | 0.04 | | 0.01 | 10.8 | 3.7 |
| R5N | 27 | 5/25/04 | 0.06 | | 0 | 8.34 | 2.5 |
| R5N | 29 | 5/25/04 | 0.02 | | 0 | 15.6 | 5.1 |
| R5N | 30 | 5/25/04 | 0.2 | | 0.01 | 19.7 | 6 |
| R5N | 32 | 5/25/04 | 0.01 | | 2.3 | 10.8 | 4.2 |
| R5N | 33 | 5/25/04 | 0.01 | | 0.27 | 18.7 | 3.4 |
| R5N | 35 | 5/25/04 | 0.03 | | 8.2 | 6.76 | 3.7 |
| R5N | 36 | 5/25/04 | 0.01 | | 2.1 | 11 | 4 |
| R5N | 38 | 5/25/04 | 0.01 | | 0.27 | 17 | 3.4 |
| R5N | 39 | 5/25/04 | 0.01 | | 0.27 | 16.5 | 3.4 |
| R5N | 41 | 5/25/04 | 0.01 | | 2.4 | 7.91 | 6.5 |
| R5N | 42 | 5/25/04 | 0.02 | | 0.16 | 20.1 | 3.3 |
| R5N | 44 | 5/25/04 | 0.22 | | 13.4 | 13.4 | 6.1 |
| R5N | 47 | 5/25/04 | 0.01 | | 2.2 | 7.8 | 4.1 |
| R5N | 48 | 5/25/04 | 0.02 | | 1 | 16.5 | 2.2 |
| R5N | 50 | 5/25/04 | 0.1 | | 1.4 | 5.98 | 6.8 |
| R5N | 51 | 5/25/04 | 0.03 | | 0 | 8.8 | 3.8 |
| R5N | 53 | 5/25/04 | 0.31 | | 0 | 9.74 | 13.5 |
| R5N | 54 | 5/25/04 | 0.01 | | 0.86 | 5.83 | 2.1 |
| R5N | 56 | 5/25/04 | 0 | | 0.15 | 5.74 | 3.7 |
| R5N | 57 | 5/25/04 | 0.04 | | 0 | 12 | 4.4 |
| R5N | 59 | 5/25/04 | 0.01 | | 3.5 | 6.29 | 3.2 |
| R5N | 60 | 5/25/04 | 0.03 | | 0 | 18.6 | 3.9 |
| R5N | 62 | 5/25/04 | 0.01 | | 1.2 | 9.09 | 3.4 |
| R5N | 63 | 5/25/04 | 0.01 | | 0.18 | 9.31 | 4.2 |
| R5N | 65 | 5/25/04 | 0.02 | | 1.6 | 7.07 | 5.8 |
| R5N | 66 | 5/25/04 | 0.02 | | 0.14 | 25.9 | 2.4 |
| R5N | 68 | 5/25/04 | 0.01 | | 0.91 | 5.6 | 4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 69 | 5/25/04 | 0.01 | | 3.2 | 8.83 | 2.7 |
| R5N | 71 | 5/25/04 | 0.01 | | 1.6 | 10.4 | 3.2 |
| R5N | 72 | 5/25/04 | 0.02 | | 0 | 14.7 | 3.7 |
| R5N | Stream | 5/25/04 | 0.28 | | 0.01 | 25.7 | 20 |
| R1N | 2 | 6/29/04 | 0.04 | | 8.4 | 23.9 | 1.4 |
| R1N | 3 | 6/29/04 | 0.37 | | 0.03 | 10.5 | 2.4 |
| R1N | 5 | 6/29/04 | 0.01 | | 4 | 18 | 1.5 |
| R1N | 6 | 6/29/04 | 0.07 | | 0.1 | 17.8 | 1.8 |
| R1N | 8 | 6/29/04 | 0.03 | | 9.9 | 28.3 | 1.3 |
| R1N | 9 | 6/29/04 | 0.22 | | 0.32 | 22 | 1.9 |
| R1N | 11 | 6/29/04 | 0.01 | | 9.2 | 22.8 | 1.7 |
| R1N | 12 | 6/29/04 | 0.01 | | 7.2 | 25.5 | 1.2 |
| R1N | 17 | 6/29/04 | 0 | | 4.8 | 26.3 | 1.7 |
| R1N | 18 | 6/29/04 | 0.04 | | 4.1 | 38.1 | 2.4 |
| R1N | 20 | 6/29/04 | 0.02 | | 1.2 | 9.03 | 2.1 |
| R1N | 21 | 6/29/04 | 0.12 | | 0.31 | 18.1 | 2.6 |
| R1N | 23 | 6/29/04 | 0.12 | | 2.6 | 9.14 | 4.9 |
| R1N | 24 | 6/29/04 | 2.1 | | 0.13 | 12.1 | 29.9 |
| R1N | 26 | 6/29/04 | 0.01 | | 11.8 | 13 | 1.7 |
| R1N | 27 | 6/29/04 | 0.02 | | 7.5 | 14.3 | 1.4 |
| R1N | 29 | 6/29/04 | 0.01 | | 6.2 | 9.1 | 2.9 |
| R1N | 30 | 6/29/04 | 0.08 | | 0.14 | 11.3 | 2.6 |
| R1N | 32 | 6/29/04 | 0.03 | | 6.7 | 21.1 | 1.5 |
| R1N | 33 | 6/29/04 | 0.25 | | 0.02 | 6.64 | 2.6 |
| R1N | 35 | 6/29/04 | 0.02 | | 11.7 | 21.5 | 2 |
| R1N | 36 | 6/29/04 | 0 | | 3.2 | 15.6 | 1 |
| R1N | 38 | 6/29/04 | 0.01 | | 11.6 | 26.4 | 1.1 |
| R1N | 39 | 6/29/04 | 0.02 | | 8.8 | 28 | 1.2 |
| R1N | 41 | 6/29/04 | 0.04 | | 12.2 | 24.1 | 1.6 |
| R1N | 42 | 6/29/04 | 0 | | 7.4 | 23.4 | 1.3 |
| R1N | 47 | 6/29/04 | 0 | | 6.5 | 18.1 | 1.5 |
| R1N | 48 | 6/29/04 | 0 | | 5.3 | 25.7 | 1.4 |
| R1N | 50 | 6/29/04 | 0.01 | | 6.1 | 22.4 | 1.6 |
| R1N | 51 | 6/29/04 | 0 | | 2 | 17.4 | 1.1 |
| R1N | 54 | 6/29/04 | 0.01 | | 8.9 | 20.1 | 1 |
| R1N | 57 | 6/29/04 | 0 | | 7.6 | 15.9 | 1.9 |
| R1N | 59 | 6/29/04 | 0.03 | | 13 | 13.2 | 2.2 |
| R1N | 60 | 6/29/04 | 0 | | 11.7 | 24.1 | 1.7 |
| R1N | 62 | 6/29/04 | 0 | | 10.1 | 21.9 | 1.5 |
| R1N | 63 | 6/29/04 | 0 | | 2.7 | 17.3 | 1.2 |
| R1N | 65 | 6/29/04 | 0.02 | | 9.5 | 20.6 | 1.3 |
| R1N | 66 | 6/29/04 | 0 | | 5.6 | 21.3 | 2.6 |
| R1N | 68 | 6/29/04 | 0 | | 13.8 | 11.4 | 1.7 |
| R1N | 69 | 6/29/04 | 0 | | 5.1 | 19.6 | 1.2 |
| R1N | 72 | 6/29/04 | 0.01 | | 7.5 | 22 | 1.7 |
| R1N | Stream | 6/29/04 | 0.2 | | 2 | 14 | 9.2 |
| R2N | 2 | 6/29/04 | 0 | | 3.5 | 8.75 | 1.4 |
| R2N | 3 | 6/29/04 | 0.05 | | 3.7 | 4.59 | 2.7 |
| R2N | 5 | 6/29/04 | 0.08 | | 4.8 | 6.83 | 2.1 |
| R2N | 6 | 6/29/04 | 0.02 | | 2.9 | 17.9 | 1.2 |
| R2N | 8 | 6/29/04 | 0.02 | | 6.4 | 12.3 | 1.7 |
| R2N | 9 | 6/29/04 | 0.01 | | 3.3 | 25.4 | 1.1 |
| R2N | 11 | 6/29/04 | 0.06 | | 2.4 | 6.3 | 2.1 |
| R2N | 12 | 6/29/04 | 0.04 | | 3.9 | 21.4 | 1.6 |
| R2N | 14 | 6/29/04 | 0.06 | | 2.4 | 7.2 | 2 |
| R2N | 15 | 6/29/04 | 0.02 | | 3.6 | 18.2 | 1.4 |
| R2N | 17 | 6/29/04 | 0.11 | | 0.03 | 3.87 | 9.8 |
| R2N | 18 | 6/29/04 | 0.02 | | 0.03 | 11.3 | 1.5 |
| R2N | 20 | 6/29/04 | 0.01 | | 0.02 | 5.44 | 10.6 |

Table F.1 (continued)

| Sample ID | | Sampling | PO$_4$ | NH$_4$ | NO$_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 21 | 6/29/04 | 0.08 | | 0.03 | 16.6 | 1 |
| R2N | 23 | 6/29/04 | 0.22 | | 0.03 | 2.87 | 7.6 |
| R2N | 24 | 6/29/04 | 0.03 | | 0.1 | 15.1 | 1.1 |
| R2N | 26 | 6/29/04 | 0.11 | | 0.03 | 2.51 | 9.6 |
| R2N | 27 | 6/29/04 | 0.04 | | 0.03 | 19.6 | 1 |
| R2N | 29 | 6/29/04 | 0.46 | | 0.03 | 2.45 | 9 |
| R2N | 30 | 6/29/04 | 0.02 | | 0.03 | 9.85 | 1.3 |
| R2N | 32 | 6/29/04 | 0.13 | | 5.3 | 4.12 | 2.2 |
| R2N | 33 | 6/29/04 | 0.01 | | 1.9 | 16.3 | 1.3 |
| R2N | 35 | 6/29/04 | 0.12 | | 4.3 | 2.43 | 2.9 |
| R2N | 36 | 6/29/04 | 0.01 | | 3.8 | 22.8 | 1.4 |
| R2N | 38 | 6/29/04 | 0.01 | | 4.4 | 6.37 | 1.6 |
| R2N | 39 | 6/29/04 | 0.02 | | 3.1 | 24.8 | 1.3 |
| R2N | 41 | 6/29/04 | 0.01 | | 3.1 | 2.87 | 1.8 |
| R2N | 42 | 6/29/04 | 0.01 | | 2.8 | 8.83 | 1.6 |
| R2N | 44 | 6/29/04 | 0.01 | | 4.7 | 3.7 | 1.7 |
| R2N | 45 | 6/29/04 | 0.01 | | 3.7 | 11.4 | 1.4 |
| R2N | 47 | 6/29/04 | 0 | | 5.6 | 7.46 | 1.8 |
| R2N | 48 | 6/29/04 | 0 | | 4.2 | 8.5 | 1.3 |
| R2N | 50 | 6/29/04 | 0.01 | | 10.5 | 5.94 | 2.1 |
| R2N | 51 | 6/29/04 | 0 | | 3.5 | 7.42 | 1.2 |
| R2N | 53 | 6/29/04 | 0.06 | | 1.6 | 6.65 | 2.6 |
| R2N | 54 | 6/29/04 | 0.02 | | 2.2 | 4.74 | 1.8 |
| R2N | 56 | 6/29/04 | 0.23 | | 5.6 | 4.93 | 2.8 |
| R2N | 57 | 6/29/04 | 0.01 | | 4.2 | 6.17 | 1.5 |
| R2N | 59 | 6/29/04 | 0.86 | | 0.8 | 3.87 | 3.3 |
| R2N | 60 | 6/29/04 | 0 | | 2.3 | 7.37 | 1.6 |
| R2N | 62 | 6/29/04 | 0.13 | | 4.5 | 2.53 | 3.2 |
| R2N | 63 | 6/29/04 | 0.04 | | 6.4 | 38.8 | 1.4 |
| R2N | 65 | 6/29/04 | 0.02 | | 2.8 | 2.46 | 2.1 |
| R2N | 66 | 6/29/04 | 0.09 | | 2.6 | 22 | 1.2 |
| R2N | 68 | 6/29/04 | 0.01 | | 12.1 | 34.8 | 2 |
| R2N | 69 | 6/29/04 | 0.01 | | 2.4 | 13.5 | 1.3 |
| R2N | 72 | 6/29/04 | 0.01 | | 2.7 | 5.58 | 1.6 |
| R2N | Stream | 6/29/04 | 1.4 | | 0.03 | 3.08 | 11.8 |
| R4W | 2 | 6/29/04 | 0.02 | | 29.5 | 23.7 | 1.8 |
| R4W | 3 | 6/29/04 | 0.07 | | 0.12 | 27.1 | 1.9 |
| R4W | 5 | 6/29/04 | 0.01 | | 30.5 | 21.9 | 3.4 |
| R4W | 6 | 6/29/04 | 0.06 | | 0.03 | 27 | 2 |
| R4W | 8 | 6/29/04 | 0.01 | | 29.7 | 23.2 | 1.8 |
| R4W | 9 | 6/29/04 | 0.02 | | 0.33 | 13.5 | 1.3 |
| R4W | 11 | 6/29/04 | 0.01 | | 28.8 | 21.1 | 1.5 |
| R4W | 14 | 6/29/04 | 0.01 | | 16.3 | 20.7 | 1.8 |
| R4W | 15 | 6/29/04 | 0.01 | | 10.9 | 0 | 1.5 |
| R4W | 17 | 6/29/04 | 0 | | 3.9 | 0 | 3.7 |
| R4W | 18 | 6/29/04 | 0.07 | | 0.65 | 18.8 | 1.9 |
| R4W | 20 | 6/29/04 | 0 | | 1.2 | 10.3 | 2 |
| R4W | 21 | 6/29/04 | 0.18 | | 0.15 | 11.3 | 2 |
| R4W | 23 | 6/29/04 | 0 | | 1.3 | 29.7 | 2.5 |
| R4W | 24 | 6/29/04 | 0.02 | | 0.36 | 0 | 2.6 |
| R4W | 26 | 6/29/04 | 0 | | 2.3 | 26.5 | 3 |
| R4W | 27 | 6/29/04 | 0 | | 0.9 | 28.9 | 3.5 |
| R4W | 29 | 6/29/04 | 0 | | 2.1 | 23.6 | 3.5 |
| R4W | 30 | 6/29/04 | 0.01 | | 0.11 | 0 | 2.4 |
| R4W | 32 | 6/29/04 | 0 | | 33.2 | 0 | 1.6 |
| R4W | 33 | 6/29/04 | 0.02 | | 1.1 | 23.1 | 1.6 |
| R4W | 35 | 6/29/04 | 0.01 | | 32.2 | 22.3 | 1.7 |
| R4W | 36 | 6/29/04 | 0.06 | | 0.32 | 13.5 | 3.1 |
| R4W | 38 | 6/29/04 | 0.01 | | 31.7 | 20.7 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 39 | 6/29/04 | 0.01 | | 16.1 | 22.8 | 1.6 |
| R4W | 41 | 6/29/04 | 0.01 | | 32.5 | 20.6 | 2 |
| R4W | 42 | 6/29/04 | 0.01 | | 29.7 | 21.4 | 1.9 |
| R4W | 44 | 6/29/04 | 0.01 | | 19.5 | 22 | 2.1 |
| R4W | 45 | 6/29/04 | 0.01 | | 19.3 | 22.5 | 2.1 |
| R4W | 47 | 6/29/04 | 0 | | 13.4 | 20.9 | 2 |
| R4W | 48 | 6/29/04 | 0 | | 12.3 | 23.5 | 1.7 |
| R4W | 50 | 6/29/04 | 0.01 | | 5.1 | 27.1 | 2.6 |
| R4W | 51 | 6/29/04 | 0 | | 3.5 | 27.1 | 1.9 |
| R4W | 53 | 6/29/04 | 0 | | 3 | 25.5 | 1.9 |
| R4W | 54 | 6/29/04 | 0.04 | | 0.86 | 29.2 | 2.3 |
| R4W | 56 | 6/29/04 | 0.04 | | 0.78 | 28 | 2.8 |
| R4W | 57 | 6/29/04 | 0.02 | | 0.32 | 28.8 | 2.3 |
| R4W | 59 | 6/29/04 | 0.01 | | 1.4 | 30.2 | 2.2 |
| R4W | 60 | 6/29/04 | 0.02 | | 1.3 | 39.4 | 3.1 |
| R4W | 62 | 6/29/04 | 0 | | 29 | 24.6 | 1.5 |
| R4W | 63 | 6/29/04 | 0.02 | | 9.3 | 27.2 | 1.5 |
| R4W | 65 | 6/29/04 | 0 | | 24.1 | 19.2 | 2.7 |
| R4W | 66 | 6/29/04 | 0.01 | | 29.5 | 22.2 | 1.5 |
| R4W | 68 | 6/29/04 | 0.02 | | 6.8 | 21.8 | 2.1 |
| R4W | 69 | 6/29/04 | 0.01 | | 7.5 | 24.4 | 1.9 |
| R4W | 71 | 6/29/04 | 0.01 | | 3.1 | 21.5 | 2 |
| R4W | 72 | 6/29/04 | 0.06 | | 0.54 | 28.9 | 2.7 |
| R4W | Stream | 6/29/04 | 0.76 | | 0.19 | 27.5 | 12.7 |
| R5N | 2 | 6/29/04 | 0.06 | | 3.1 | 9.62 | 3 |
| R5N | 3 | 6/29/04 | 0.01 | | 1.3 | 16.9 | 3.6 |
| R5N | 5 | 6/29/04 | 0 | | 1.7 | 13.4 | 4.6 |
| R5N | 6 | 6/29/04 | 0.01 | | 0.76 | 13.9 | 3 |
| R5N | 8 | 6/29/04 | 0.02 | | 5.5 | 11.4 | 3.6 |
| R5N | 9 | 6/29/04 | 0 | | 0.89 | 18.2 | 2.7 |
| R5N | 11 | 6/29/04 | 0 | | 2.9 | 11 | 3.8 |
| R5N | 12 | 6/29/04 | 0.01 | | 0.48 | 30.2 | 2.6 |
| R5N | 14 | 6/29/04 | 0 | | 1.4 | 13 | 3.3 |
| R5N | 15 | 6/29/04 | 0.01 | | 0.71 | 17.7 | 2.3 |
| R5N | 17 | 6/29/04 | 0.02 | | 0.81 | 8.87 | 3.2 |
| R5N | 18 | 6/29/04 | 0 | | 4.2 | 13.1 | 1.6 |
| R5N | 20 | 6/29/04 | 0.03 | | 0.1 | 10.5 | 2 |
| R5N | 21 | 6/29/04 | 0.01 | | 1.7 | 10.3 | 1.4 |
| R5N | 23 | 6/29/04 | 0 | | 2.6 | 11.2 | 2.3 |
| R5N | 24 | 6/29/04 | 0.01 | | 0.51 | 8.93 | 1.5 |
| R5N | 26 | 6/29/04 | 0 | | 0.17 | 11.1 | 2.2 |
| R5N | 27 | 6/29/04 | 0.02 | | 0.02 | 9.34 | 1.2 |
| R5N | 32 | 6/29/04 | 0 | | 2.1 | 12.3 | 2.6 |
| R5N | 33 | 6/29/04 | 0 | | 0.39 | 19.5 | 2.5 |
| R5N | 35 | 6/29/04 | 0.02 | | 0 | 21 | 3 |
| R5N | 36 | 6/29/04 | 0.01 | | 1.7 | 21.6 | 3.6 |
| R5N | 38 | 6/29/04 | 0.01 | | 5.9 | 8.63 | 3.6 |
| R5N | 39 | 6/29/04 | 0.01 | | 0.67 | 18.7 | 2.2 |
| R5N | 41 | 6/29/04 | 0.01 | | 1.4 | 9.53 | 5.1 |
| R5N | 42 | 6/29/04 | 0.02 | | 0.18 | 3.72 | 3.7 |
| R5N | 44 | 6/29/04 | 0.03 | | 12.1 | 14.1 | 3.9 |
| R5N | 45 | 6/29/04 | 0.02 | | 1.3 | 15.5 | 2.4 |
| R5N | 47 | 6/29/04 | 0.01 | | 1.4 | 9.78 | 2.9 |
| R5N | 48 | 6/29/04 | 0.02 | | 2.3 | 17.1 | 1.4 |
| R5N | 50 | 6/29/04 | 0.04 | | 1.6 | 6.81 | 3.3 |
| R5N | 51 | 6/29/04 | 0.01 | | 0.01 | 9.24 | 2 |
| R5N | 53 | 6/29/04 | 0.02 | | 0 | 11.1 | 2.3 |
| R5N | 54 | 6/29/04 | 0.01 | | 1.4 | 6.85 | 1.7 |
| R5N | 56 | 6/29/04 | 0.03 | | 0.23 | 7.33 | 3.1 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 57 | 6/29/04 | 0.01 | | 0 | 14 | 2.5 |
| R5N | 59 | 6/29/04 | 0.02 | | 2.8 | 7.21 | 2.4 |
| R5N | 60 | 6/29/04 | 0.03 | | 0 | 19.6 | 3.2 |
| R5N | 62 | 6/29/04 | 0.01 | | 3.8 | 10.8 | 2.6 |
| R5N | 63 | 6/29/04 | 0.02 | | 0.5 | 12.1 | 3.4 |
| R5N | 65 | 6/29/04 | 0.02 | | 1.1 | 14.3 | 4.1 |
| R5N | 66 | 6/29/04 | 0.02 | | 0.96 | 21.2 | 2.7 |
| R5N | 68 | 6/29/04 | 0.01 | | 1 | 6.79 | 3.7 |
| R5N | 69 | 6/29/04 | 0.01 | | 2.7 | 8.62 | 2.1 |
| R5N | 71 | 6/29/04 | 0.01 | | 0 | 11.1 | 1.7 |
| R5N | 72 | 6/29/04 | 0.02 | | 2.3 | 12.1 | 2.4 |
| R5N | Stream | 6/29/04 | 0.51 | | 2 | 12.6 | 14 |
| R1N | 2 | 7/29/04 | 0.02 | | 8.1 | 21.3 | 1.4 |
| R1N | 3 | 7/29/04 | 0.02 | | 0 | 0 | 25.9 |
| R1N | 5 | 7/29/04 | 0.02 | | 4.3 | 38.6 | 2 |
| R1N | 6 | 7/29/04 | 0.04 | | 0.27 | 18.2 | 1.2 |
| R1N | 8 | 7/29/04 | 0.03 | | 10.6 | 11.5 | 1.4 |
| R1N | 9 | 7/29/04 | 0.03 | | 1.4 | 20.3 | 1.2 |
| R1N | 11 | 7/29/04 | 0.02 | | 9.1 | 20.6 | 1.6 |
| R1N | 12 | 7/29/04 | 0.01 | | 7.2 | 47.2 | 5.4 |
| R1N | 17 | 7/29/04 | 1.2 | | 5.5 | 123.7 | 7.8 |
| R1N | 18 | 7/29/04 | 0.1 | | 2.5 | 52.4 | 4.9 |
| R1N | 20 | 7/29/04 | 0.02 | | 3.4 | 21.5 | 1.4 |
| R1N | 21 | 7/29/04 | 0.09 | | 0.01 | 13.3 | 6.7 |
| R1N | 23 | 7/29/04 | 0.03 | | 5.1 | 24.5 | 1.9 |
| R1N | 24 | 7/29/04 | 0.05 | | 0 | 10.4 | 1.4 |
| R1N | 26 | 7/29/04 | 0.01 | | 11 | 11.1 | 1.4 |
| R1N | 27 | 7/29/04 | 0.02 | | 7.7 | 12.5 | 1.7 |
| R1N | 29 | 7/29/04 | 0.03 | | 11.7 | 20.1 | 1.7 |
| R1N | 30 | 7/29/04 | 0.03 | | 11.2 | 19.7 | 1.5 |
| R1N | 32 | 7/29/04 | 0.01 | | 6.2 | 94.1 | 13 |
| R1N | 33 | 7/29/04 | 0.11 | | 0.01 | 5.57 | 2.7 |
| R1N | 35 | 7/29/04 | 0.03 | | 10.6 | 20.1 | 1.2 |
| R1N | 36 | 7/29/04 | 0.01 | | 2.5 | 119.6 | 26.3 |
| R1N | 38 | 7/29/04 | 0.01 | | 11.8 | 26.7 | 1.2 |
| R1N | 39 | 7/29/04 | 0.02 | | 8.5 | 25.8 | 1.2 |
| R1N | 41 | 7/29/04 | 0.01 | | 8.5 | 18.3 | 1 |
| R1N | 42 | 7/29/04 | 0.01 | | 6.2 | 24.4 | 3.8 |
| R1N | 47 | 7/29/04 | 0.01 | | 7 | 16.8 | 1 |
| R1N | 48 | 7/29/04 | 0.01 | | 6.1 | 29.3 | 1.5 |
| R1N | 50 | 7/29/04 | 0.02 | | 10.6 | 17.7 | 2 |
| R1N | 51 | 7/29/04 | 0.03 | | 1.7 | 15.6 | 1.1 |
| R1N | 53 | 7/29/04 | 0.02 | | 11.7 | 14.2 | 1.2 |
| R1N | 54 | 7/29/04 | 0.02 | | 9.7 | 17.1 | 1.1 |
| R1N | 57 | 7/29/04 | 0.03 | | 10.2 | 12.6 | 1.3 |
| R1N | 59 | 7/29/04 | 0.01 | | 11.8 | 65.7 | 16.5 |
| R1N | 60 | 7/29/04 | 0.02 | | 10.6 | 21 | 1.7 |
| R1N | 62 | 7/29/04 | 0.01 | | 6.9 | 19.5 | 0.9 |
| R1N | 63 | 7/29/04 | 0.01 | | 2.8 | 16.1 | 0.9 |
| R1N | 65 | 7/29/04 | 0.01 | | 7.2 | 117.7 | 22.1 |
| R1N | 66 | 7/29/04 | 0.01 | | 4.5 | 26.2 | 1.4 |
| R1N | 68 | 7/29/04 | 0.01 | | 12.4 | 12.2 | 1.1 |
| R1N | 69 | 7/29/04 | 0.01 | | 6.8 | 17.5 | 0.9 |
| R1N | 71 | 7/29/04 | 0.01 | | 10.6 | 0 | 30.6 |
| R1N | 72 | 7/29/04 | 0.01 | | 7 | 16.2 | 1.4 |
| R1N | Stream | 7/29/04 | 0.26 | | 1.3 | 12.9 | 8.6 |
| R2N | 2 | 7/29/04 | 0.05 | | 3.8 | 7.72 | 2.1 |
| R2N | 3 | 7/29/04 | 0.01 | | 2.2 | 13.4 | 1.7 |
| R2N | 5 | 7/29/04 | 0.06 | | 3.9 | 7.41 | 1.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 6 | 7/29/04 | 0.02 | | 2.6 | 18.9 | 1.4 |
| R2N | 8 | 7/29/04 | 0.02 | | 4.4 | 13.9 | 1.8 |
| R2N | 9 | 7/29/04 | 0.02 | | 3.4 | 28.2 | 1.5 |
| R2N | 11 | 7/29/04 | 0.03 | | 3.2 | 14.8 | 1.8 |
| R2N | 12 | 7/29/04 | 0.06 | | 3.7 | 22.2 | 1.6 |
| R2N | 14 | 7/29/04 | 0.06 | | 3.3 | 14.7 | 1.5 |
| R2N | 15 | 7/29/04 | 0.05 | | 3.9 | 23.2 | 1.7 |
| R2N | 17 | 7/29/04 | 0.11 | | 0.02 | 5.77 | 6.8 |
| R2N | 18 | 7/29/04 | 0.02 | | 0.01 | 56.1 | 2.5 |
| R2N | 20 | 7/29/04 | 0.01 | | 1.5 | 5.59 | 2.9 |
| R2N | 21 | 7/29/04 | 0.08 | | 0 | 17.9 | 1.9 |
| R2N | 23 | 7/29/04 | 0.06 | | 0.02 | 3.83 | 3.7 |
| R2N | 24 | 7/29/04 | 0.05 | | 0.01 | 18.6 | 1.1 |
| R2N | 26 | 7/29/04 | 0.06 | | 2.9 | 4.26 | 2.7 |
| R2N | 27 | 7/29/04 | 0.05 | | 0 | 18.4 | 1 |
| R2N | 29 | 7/29/04 | 0.12 | | 2.5 | 4.71 | 2.3 |
| R2N | 30 | 7/29/04 | 0.02 | | 0 | 8.77 | 1.3 |
| R2N | 32 | 7/29/04 | 0.03 | | 1.4 | 15.6 | 2.6 |
| R2N | 33 | 7/29/04 | 0.12 | | 4 | 3.45 | 2.3 |
| R2N | 35 | 7/29/04 | 0.02 | | 3.7 | 24.9 | 1.1 |
| R2N | 36 | 7/29/04 | 0.11 | | 3.8 | 2.46 | 2.3 |
| R2N | 38 | 7/29/04 | 0.02 | | 4.1 | 9 | 1.6 |
| R2N | 39 | 7/29/04 | 0.02 | | 3.4 | 28 | 1.3 |
| R2N | 41 | 7/29/04 | 0.01 | | 2.5 | 7.49 | 2 |
| R2N | 42 | 7/29/04 | 0.02 | | 0.62 | 9.55 | 1.5 |
| R2N | 44 | 7/29/04 | 0.02 | | 3.8 | 18.5 | 2.3 |
| R2N | 45 | 7/29/04 | 0.04 | | 4.1 | 39.9 | 2.4 |
| R2N | 47 | 7/29/04 | 0.01 | | 5.8 | 16.3 | 1.8 |
| R2N | 50 | 7/29/04 | 0.02 | | 13.5 | 34.2 | 2.1 |
| R2N | 51 | 7/29/04 | 0.02 | | 0.02 | 19.7 | 2.2 |
| R2N | 53 | 7/29/04 | 0.06 | | 8.1 | 16.8 | 2.5 |
| R2N | 54 | 7/29/04 | 0.01 | | 2.4 | 9.37 | 2 |
| R2N | 56 | 7/29/04 | 0.1 | | 7.7 | 14.3 | 3.4 |
| R2N | 57 | 7/29/04 | 0.01 | | 3 | 2.53 | 2 |
| R2N | 59 | 7/29/04 | 0.47 | | 3.9 | 9.35 | 2.1 |
| R2N | 60 | 7/29/04 | 0.02 | | 2.3 | 11.8 | 1.9 |
| R2N | 62 | 7/29/04 | 0.03 | | 5.4 | 33.9 | 4.1 |
| R2N | 63 | 7/29/04 | 0.01 | | 5.3 | 66.7 | 2.4 |
| R2N | 65 | 7/29/04 | 0.02 | | 1.3 | 3.49 | 1.7 |
| R2N | 66 | 7/29/04 | 0.06 | | 2.5 | 37.1 | 1.8 |
| R2N | 68 | 7/29/04 | 0.01 | | 17.9 | 35.2 | 2.2 |
| R2N | 69 | 7/29/04 | 0.02 | | 3.2 | 24.2 | 2.6 |
| R2N | 71 | 7/29/04 | 0.1 | | 4 | 23.5 | 3 |
| R2N | 72 | 7/29/04 | 0.01 | | 2.6 | 15 | 3.5 |
| R2N | Stream | 7/29/04 | 0.65 | | 0 | 7.91 | 9.5 |
| R4W | 2 | 7/29/04 | 0.03 | | 28.7 | 24.4 | 1.8 |
| R4W | 3 | 7/29/04 | 0.05 | | 0.02 | 27.8 | 1.5 |
| R4W | 5 | 7/29/04 | 0.02 | | 29.3 | 19.3 | 1.8 |
| R4W | 6 | 7/29/04 | 0.05 | | 0.01 | 28.2 | 1.3 |
| R4W | 8 | 7/29/04 | 0.02 | | 28.2 | 21.9 | 1.2 |
| R4W | 9 | 7/29/04 | 0.03 | | 0.25 | 11 | 1.2 |
| R4W | 11 | 7/29/04 | 0.02 | | 27.9 | 20 | 1.3 |
| R4W | 12 | 7/29/04 | 0.02 | | 12.3 | 19.6 | 2.1 |
| R4W | 14 | 7/29/04 | 0.02 | | 17.2 | 21.5 | 3.6 |
| R4W | 15 | 7/29/04 | 0.02 | | 11.3 | 21.9 | 3.3 |
| R4W | 17 | 7/29/04 | 0.01 | | 4.5 | 25.2 | 3.7 |
| R4W | 18 | 7/29/04 | 0.04 | | 0.45 | 16.7 | 1.6 |
| R4W | 20 | 7/29/04 | 0.02 | | 1 | 27.8 | 1.9 |
| R4W | 23 | 7/29/04 | 0.01 | | 0.74 | 30.2 | 4.2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 24 | 7/29/04 | 0.02 | | 0.11 | 31.2 | 3.3 |
| R4W | 26 | 7/29/04 | 0.01 | | 1.2 | 30 | 3.5 |
| R4W | 27 | 7/29/04 | 0.01 | | 0.84 | 30 | 2.9 |
| R4W | 29 | 7/29/04 | 0.01 | | 1.9 | 28.1 | 2.9 |
| R4W | 30 | 7/29/04 | 0.02 | | 0.01 | 30.7 | 3.2 |
| R4W | 32 | 7/29/04 | 0.02 | | 30.8 | 25.5 | 1.6 |
| R4W | 33 | 7/29/04 | 0.02 | | 0.36 | 22.3 | 1.5 |
| R4W | 35 | 7/29/04 | 0.02 | | 30.9 | 21.7 | 3.6 |
| R4W | 36 | 7/29/04 | 0.06 | | 0.23 | 11.8 | 1.6 |
| R4W | 38 | 7/29/04 | 0.02 | | 25.7 | 22.9 | 1.5 |
| R4W | 39 | 7/29/04 | 0.02 | | 30.5 | 20.4 | 1.6 |
| R4W | 41 | 7/29/04 | 0.02 | | 32.2 | 21.6 | 1.4 |
| R4W | 42 | 7/29/04 | 0.02 | | 31.7 | 21.9 | 1.9 |
| R4W | 45 | 7/29/04 | 0.02 | | 23.9 | 22.6 | 1.9 |
| R4W | 47 | 7/29/04 | 0.01 | | 14.2 | 22.1 | 2 |
| R4W | 48 | 7/29/04 | 0.01 | | 12.9 | 23.8 | 1.6 |
| R4W | 50 | 7/29/04 | 0.02 | | 6.7 | 24.8 | 3 |
| R4W | 51 | 7/29/04 | 0.02 | | 4.1 | 33.2 | 2.6 |
| R4W | 53 | 7/29/04 | 0.03 | | 3.5 | 22.7 | 1.8 |
| R4W | 54 | 7/29/04 | 0.04 | | 1.4 | 28.2 | 2.1 |
| R4W | 56 | 7/29/04 | 0.02 | | 0.33 | 26.4 | 1.9 |
| R4W | 57 | 7/29/04 | 0.07 | | 0.53 | 25.9 | 2.4 |
| R4W | 59 | 7/29/04 | 0.02 | | 1.2 | 28.7 | 2.5 |
| R4W | 60 | 7/29/04 | 0.02 | | 0.62 | 27.7 | 2.7 |
| R4W | 62 | 7/29/04 | 0.02 | | 31.4 | 27.7 | 2.1 |
| R4W | 63 | 7/29/04 | 0.03 | | 9.2 | 25.4 | 2 |
| R4W | 65 | 7/29/04 | 0.02 | | 27.8 | 19.5 | 2.3 |
| R4W | 66 | 7/29/04 | 0.02 | | 28.4 | 20.3 | 3.1 |
| R4W | 68 | 7/29/04 | 0.03 | | 11.2 | 21.6 | 2.5 |
| R4W | 69 | 7/29/04 | 0.02 | | 9.3 | 22.9 | 2.1 |
| R4W | 71 | 7/29/04 | 0.02 | | 4.4 | 20.8 | 1.8 |
| R4W | 72 | 7/29/04 | 0.07 | | 0.61 | 29.5 | 1.8 |
| R4W | Stream | 7/29/04 | 1.5 | | 0.01 | 13.7 | 11.5 |
| R5N | 2 | 7/29/04 | 0.03 | | 2.3 | 18.4 | 3.3 |
| R5N | 3 | 7/29/04 | 0.02 | | 1 | 18.6 | 3.6 |
| R5N | 5 | 7/29/04 | 0.01 | | 2.5 | 12.3 | 4.7 |
| R5N | 6 | 7/29/04 | 0.02 | | 0.54 | 13.1 | 3.5 |
| R5N | 8 | 7/29/04 | 0.01 | | 3.2 | 9.84 | 4.9 |
| R5N | 9 | 7/29/04 | 0.01 | | 0.91 | 17.4 | 3.3 |
| R5N | 11 | 7/29/04 | 0.01 | | 3.5 | 11.6 | 4.1 |
| R5N | 12 | 7/29/04 | 0.02 | | 0.22 | 29.4 | 3.1 |
| R5N | 14 | 7/29/04 | 0.02 | | 5.7 | 14.1 | 5 |
| R5N | 15 | 7/29/04 | 0.01 | | 1 | 17.7 | 2.9 |
| R5N | 17 | 7/29/04 | 0.02 | | 1.3 | 9.85 | 4.2 |
| R5N | 18 | 7/29/04 | 0.02 | | 1.9 | 13.6 | 3.6 |
| R5N | 20 | 7/29/04 | 0.03 | | 0.37 | 11.3 | 3.9 |
| R5N | 21 | 7/29/04 | 0.02 | | 1.1 | 10.3 | 2.9 |
| R5N | 23 | 7/29/04 | 0.01 | | 2.5 | 13.3 | 3.8 |
| R5N | 24 | 7/29/04 | 0.02 | | 0.02 | 6.44 | 3 |
| R5N | 26 | 7/29/04 | 0.02 | | 0.02 | 12.4 | 4 |
| R5N | 27 | 7/29/04 | 0.03 | | 0 | 8.82 | 3.8 |
| R5N | 32 | 7/29/04 | 0.01 | | 1.3 | 15.3 | 3.8 |
| R5N | 33 | 7/29/04 | 0.01 | | 0.47 | 21.3 | 4.5 |
| R5N | 35 | 7/29/04 | 0.02 | | 0.01 | 17.4 | 4.7 |
| R5N | 36 | 7/29/04 | 0.04 | | 0.01 | 22.2 | 3.5 |
| R5N | 38 | 7/29/04 | 0.01 | | 3.9 | 12.1 | 4.3 |
| R5N | 39 | 7/29/04 | 0.01 | | 0.38 | 19.2 | 3.6 |
| R5N | 41 | 7/29/04 | 0.01 | | 0.92 | 11.8 | 7.1 |
| R5N | 42 | 7/29/04 | 0.02 | | 0.03 | 25.7 | 3.3 |

Table F.1 (continued)

| Sample ID | | Sampling | PO$_4$ | NH$_4$ | NO$_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 44 | 7/29/04 | 0.02 | | 10.5 | 14.8 | 4.2 |
| R5N | 45 | 7/29/04 | 0.02 | | 0.89 | 16.9 | 5.1 |
| R5N | 47 | 7/29/04 | 0.01 | | 0.34 | 14.6 | 4.5 |
| R5N | 48 | 7/29/04 | 0.02 | | 2.3 | 16.9 | 4.2 |
| R5N | 50 | 7/29/04 | 0.01 | | 1.6 | 11.4 | 5.3 |
| R5N | 51 | 7/29/04 | 0.01 | | 0.28 | 19.8 | 3 |
| R5N | 53 | 7/29/04 | 0.01 | | 0 | 13.6 | 3.6 |
| R5N | 54 | 7/29/04 | 0.01 | | 1.8 | 9.04 | 4.1 |
| R5N | 56 | 7/29/04 | 0.01 | | 0.19 | 8.04 | 3.6 |
| R5N | 57 | 7/29/04 | 0.01 | | 0 | 13.1 | 3.1 |
| R5N | 59 | 7/29/04 | 0.01 | | 2.6 | 31.4 | 8.9 |
| R5N | 60 | 7/29/04 | 0.01 | | 0 | 199.5 | 19.7 |
| R5N | 62 | 7/29/04 | 0.01 | | 4.2 | 15.3 | 3.2 |
| R5N | 63 | 7/29/04 | 0 | | 0.11 | 15.2 | 3 |
| R5N | 65 | 7/29/04 | 0.01 | | 0.81 | 13.6 | 5.4 |
| R5N | 66 | 7/29/04 | 0.01 | | 0.01 | 33.8 | 2.6 |
| R5N | 68 | 7/29/04 | 0.01 | | 0.55 | 10.5 | 11.8 |
| R5N | 69 | 7/29/04 | 0.01 | | 5.8 | 16.5 | 2.6 |
| R5N | 71 | 7/29/04 | 0.01 | | 1 | 0 | 64.4 |
| R5N | 72 | 7/29/04 | 0.01 | | 0 | 31.1 | 6.4 |
| R5N | Stream | 7/29/04 | 0.12 | | 0.44 | 17.1 | 17.9 |
| R1N | 2 | 8/23/04 | 0.03 | | 8.8 | 20.9 | 1.5 |
| R1N | 3 | 8/23/04 | 0.05 | | 0.14 | 6.74 | 2.3 |
| R1N | 5 | 8/23/04 | 0.01 | | 5.1 | 16.4 | 1.3 |
| R1N | 6 | 8/23/04 | 0.03 | | 0 | 15 | 1 |
| R1N | 8 | 8/23/04 | 0.03 | | 10.5 | 31.7 | 2.4 |
| R1N | 9 | 8/23/04 | 0.02 | | 2.3 | 21.4 | 1.1 |
| R1N | 11 | 8/23/04 | 0.02 | | 8.2 | 16.8 | 1.7 |
| R1N | 12 | 8/23/04 | 0.02 | | 6.4 | 20.1 | 1.1 |
| R1N | 17 | 8/23/04 | 0.01 | | 5 | 20.8 | 1.3 |
| R1N | 18 | 8/23/04 | 0.02 | | 3.6 | 22.7 | 1.6 |
| R1N | 23 | 8/23/04 | 0.04 | | 2.9 | 11.6 | 2.7 |
| R1N | 24 | 8/23/04 | 0.08 | | 0 | 10.4 | 1.6 |
| R1N | 26 | 8/23/04 | 0.01 | | 10.4 | 12.7 | 1.1 |
| R1N | 27 | 8/23/04 | 0.01 | | 3.4 | 14 | 1.7 |
| R1N | 29 | 8/23/04 | 0.01 | | 10 | 14.7 | 2.3 |
| R1N | 30 | 8/23/04 | 0.08 | | 0.12 | 12.8 | 1.4 |
| R1N | 32 | 8/23/04 | 0.03 | | 5.7 | 19.9 | 1.7 |
| R1N | 33 | 8/23/04 | 0.26 | | 0.01 | 5.76 | 3.4 |
| R1N | 35 | 8/23/04 | 0.01 | | 9.1 | 18.6 | 2 |
| R1N | 36 | 8/23/04 | 0.01 | | 2.8 | 16.8 | 0.9 |
| R1N | 38 | 8/23/04 | 0.03 | | 11 | 24.1 | 2.3 |
| R1N | 39 | 8/23/04 | 0.02 | | 8.9 | 25.5 | 1.5 |
| R1N | 41 | 8/23/04 | 0.01 | | 7.8 | 20.6 | 1.1 |
| R1N | 42 | 8/23/04 | 0.01 | | 5.7 | 20.2 | 1.3 |
| R1N | 47 | 8/23/04 | 0 | | 7.7 | 17.3 | 1 |
| R1N | 48 | 8/23/04 | 0 | | 5.6 | 35.7 | 2.7 |
| R1N | 50 | 8/23/04 | 0.01 | | 7.7 | 15.4 | 1.3 |
| R1N | 51 | 8/23/04 | 0.01 | | 4.1 | 16.4 | 1.4 |
| R1N | 53 | 8/23/04 | 0.02 | | 12 | 28.5 | 2 |
| R1N | 54 | 8/23/04 | 0.01 | | 10 | 14.8 | 1.2 |
| R1N | 57 | 8/23/04 | 0.01 | | 8.7 | 14.5 | 1.2 |
| R1N | 59 | 8/23/04 | 0.02 | | 15.6 | 16.3 | 2 |
| R1N | 60 | 8/23/04 | 0.01 | | 11.4 | 18.4 | 1.7 |
| R1N | 62 | 8/23/04 | 0.01 | | 6.6 | 18.5 | 1.4 |
| R1N | 63 | 8/23/04 | 0.01 | | 3.1 | 18.8 | 1.1 |
| R1N | 65 | 8/23/04 | 0.02 | | 8.1 | 16.7 | 1.1 |
| R1N | 66 | 8/23/04 | 0.02 | | 3.3 | 21.4 | 1.9 |
| R1N | 68 | 8/23/04 | 0.01 | | 15.4 | 10.9 | 1.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 69 | 8/23/04 | 0.01 | | 7.5 | 15.8 | 2.3 |
| R1N | 71 | 8/23/04 | 0.01 | | 10.6 | 19.8 | 1.6 |
| R1N | 72 | 8/23/04 | 0.01 | | 10.1 | 20.3 | 1.8 |
| R1N | Stream | 8/23/04 | 0.32 | | 2.1 | 16.7 | 11.9 |
| R2N | 2 | 8/23/04 | 0.05 | | 3.7 | 5.25 | 2.7 |
| R2N | 3 | 8/23/04 | 0.01 | | 3.4 | 12.2 | 1.8 |
| R2N | 5 | 8/23/04 | 0.07 | | 4.3 | 7.18 | 3 |
| R2N | 6 | 8/23/04 | 0.03 | | 3.8 | 21.9 | 1.9 |
| R2N | 8 | 8/23/04 | 0.02 | | 5.5 | 11.8 | 2.3 |
| R2N | 9 | 8/23/04 | 0.04 | | 4.7 | 36.6 | 2.2 |
| R2N | 11 | 8/23/04 | 0.02 | | 3.2 | 9.77 | 2.1 |
| R2N | 12 | 8/23/04 | 0.02 | | 4.2 | 22.8 | 1.6 |
| R2N | 14 | 8/23/04 | 0.04 | | 2.7 | 10.4 | 1.7 |
| R2N | 15 | 8/23/04 | 0.01 | | 3.8 | 21.7 | 2.4 |
| R2N | 17 | 8/23/04 | 0.12 | | 0 | 4.17 | 8.7 |
| R2N | 18 | 8/23/04 | 0.02 | | 0 | 11.3 | 1.8 |
| R2N | 20 | 8/23/04 | 0 | | 0.14 | 4.65 | 5.4 |
| R2N | 21 | 8/23/04 | 0.07 | | 0.02 | 17.1 | 1.2 |
| R2N | 23 | 8/23/04 | 0.09 | | 0 | 3.59 | 5.6 |
| R2N | 24 | 8/23/04 | 0.06 | | 0.01 | 16.7 | 1.4 |
| R2N | 26 | 8/23/04 | 0.06 | | 1.6 | 3.35 | 4.8 |
| R2N | 27 | 8/23/04 | 0.04 | | 0 | 18.5 | 1.4 |
| R2N | 29 | 8/23/04 | 0.14 | | 2.7 | 3.97 | 3.1 |
| R2N | 30 | 8/23/04 | 0.01 | | 0 | 8.76 | 1.6 |
| R2N | 32 | 8/23/04 | 0.17 | | 4 | 4.11 | 2.8 |
| R2N | 33 | 8/23/04 | 0.01 | | 0.68 | 15 | 1.5 |
| R2N | 35 | 8/23/04 | 0.12 | | 3.5 | 2.11 | 4 |
| R2N | 36 | 8/23/04 | 0.01 | | 3.4 | 21 | 1.3 |
| R2N | 38 | 8/23/04 | 0.01 | | 4.6 | 5.67 | 2.1 |
| R2N | 39 | 8/23/04 | 0.02 | | 4.5 | 30.4 | 1.4 |
| R2N | 41 | 8/23/04 | 0.01 | | 2.9 | 2.45 | 2.4 |
| R2N | 42 | 8/23/04 | 0 | | 2.8 | 7.66 | 2.3 |
| R2N | 44 | 8/23/04 | 0.01 | | 3.6 | 4.51 | 2 |
| R2N | 45 | 8/23/04 | 0.02 | | 3.8 | 9.23 | 1.7 |
| R2N | 47 | 8/23/04 | 0.04 | | 8.2 | 51.6 | 5.8 |
| R2N | 48 | 8/23/04 | 0 | | 4.4 | 14.6 | 1.7 |
| R2N | 50 | 8/23/04 | 0.01 | | 8.6 | 16.5 | 2.3 |
| R2N | 51 | 8/23/04 | 0.02 | | 3.2 | 16.5 | 1.4 |
| R2N | 53 | 8/23/04 | 0.06 | | 2.5 | 16.9 | 3.1 |
| R2N | 54 | 8/23/04 | 0.02 | | 3.1 | 22.7 | 2.2 |
| R2N | 56 | 8/23/04 | 0.23 | | 2.3 | 5.45 | 3.3 |
| R2N | 57 | 8/23/04 | 0.01 | | 3.8 | 8.7 | 2.3 |
| R2N | 59 | 8/23/04 | 0.98 | | 1.4 | 5.12 | 4 |
| R2N | 60 | 8/23/04 | 0.03 | | 2.8 | 16.8 | 3.1 |
| R2N | 62 | 8/23/04 | 0.06 | | 4.5 | 1.96 | 2.8 |
| R2N | 63 | 8/23/04 | 0.16 | | 5.7 | 32.9 | 2 |
| R2N | 65 | 8/23/04 | 0.04 | | 1.7 | 3.92 | 3.4 |
| R2N | 66 | 8/23/04 | 0.07 | | 2.5 | 21.5 | 1.4 |
| R2N | 68 | 8/23/04 | 0 | | 20.8 | 34.6 | 2.6 |
| R2N | 69 | 8/23/04 | 0 | | 4.2 | 24.2 | 2.4 |
| R2N | 71 | 8/23/04 | 0 | | 4.3 | 23.9 | 1.7 |
| R2N | 72 | 8/23/04 | 0.01 | | 2 | 12.1 | 3.4 |
| R2N | Stream | 8/23/04 | 0.92 | | 0 | 5.42 | 16.2 |
| R4W | 2 | 8/23/04 | 0.02 | | 22.7 | 21.4 | 2.2 |
| R4W | 3 | 8/23/04 | 0.01 | | 0 | 21.1 | 1.8 |
| R4W | 5 | 8/23/04 | 0 | | 22.5 | 16.2 | 2.1 |
| R4W | 6 | 8/23/04 | 0.02 | | 0 | 27.4 | 1.7 |
| R4W | 8 | 8/23/04 | 0.01 | | 22.7 | 17.9 | 1.6 |
| R4W | 9 | 8/23/04 | 0.01 | | 0.46 | 13.1 | 1.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 11 | 8/23/04 | 0 | | 23.1 | 21.3 | 1.9 |
| R4W | 12 | 8/23/04 | 0.01 | | 0.23 | 18.9 | 1.9 |
| R4W | 14 | 8/23/04 | 0.01 | | 18 | 22.2 | 1.7 |
| R4W | 15 | 8/23/04 | 0 | | 13.1 | 21.4 | 1.7 |
| R4W | 17 | 8/23/04 | 0 | | 4.5 | 22.1 | 2 |
| R4W | 18 | 8/23/04 | 0.02 | | 0.64 | 17.5 | 1.3 |
| R4W | 20 | 8/23/04 | 0.03 | | 1.6 | 27.3 | 2.3 |
| R4W | 21 | 8/23/04 | 0.07 | | 0 | 12.6 | 2.5 |
| R4W | 23 | 8/23/04 | 0 | | 0.9 | 29.1 | 3.2 |
| R4W | 24 | 8/23/04 | 0 | | 0.46 | 28.3 | 4.2 |
| R4W | 26 | 8/23/04 | 0 | | 0.61 | 29 | 4.2 |
| R4W | 27 | 8/23/04 | 0 | | 0.16 | 28.5 | 3.9 |
| R4W | 29 | 8/23/04 | 0 | | 0.16 | 27.8 | 4.1 |
| R4W | 30 | 8/23/04 | 0 | | 0.03 | 25.4 | 2.2 |
| R4W | 32 | 8/23/04 | 0 | | 25.2 | 22.7 | 1.7 |
| R4W | 33 | 8/23/04 | 0 | | 24.3 | 18.4 | 2 |
| R4W | 35 | 8/23/04 | 0 | | 23.6 | 25.7 | 2.2 |
| R4W | 36 | 8/23/04 | 0.02 | | 0.18 | 12.9 | 1.8 |
| R4W | 38 | 8/23/04 | 0.01 | | 2.3 | 22.6 | 1.5 |
| R4W | 39 | 8/23/04 | 0.01 | | 17.4 | 20.2 | 1.8 |
| R4W | 41 | 8/23/04 | 0.01 | | 25.7 | 20.4 | 1.9 |
| R4W | 42 | 8/23/04 | 0.01 | | 23.9 | 21.3 | 1.8 |
| R4W | 44 | 8/23/04 | 0.01 | | 18.9 | 16.7 | 2.2 |
| R4W | 45 | 8/23/04 | 0.01 | | 19.9 | 19.2 | 2.2 |
| R4W | 47 | 8/23/04 | 0 | | 14.4 | 18.5 | 2.7 |
| R4W | 48 | 8/23/04 | 0 | | 13.9 | 20.9 | 1.7 |
| R4W | 50 | 8/23/04 | 0.01 | | 6.2 | 24.7 | 2.3 |
| R4W | 51 | 8/23/04 | 0.01 | | 4.3 | 25.1 | 2 |
| R4W | 53 | 8/23/04 | 0.01 | | 3.8 | 23.1 | 2.2 |
| R4W | 54 | 8/23/04 | 0.02 | | 1.8 | 26.5 | 2.3 |
| R4W | 56 | 8/23/04 | 0.02 | | 0.83 | 25.5 | 3.5 |
| R4W | 57 | 8/23/04 | 0.01 | | 0.78 | 25.1 | 2.5 |
| R4W | 59 | 8/23/04 | 0.01 | | 1.5 | 29.1 | 2.9 |
| R4W | 60 | 8/23/04 | 0.02 | | 1.2 | 28.2 | 2.8 |
| R4W | 62 | 8/23/04 | 0.01 | | 25.5 | 23.3 | 1.5 |
| R4W | 63 | 8/23/04 | 0.02 | | 9.5 | 26.6 | 3.1 |
| R4W | 65 | 8/23/04 | 0.01 | | 22.2 | 20.8 | 2.5 |
| R4W | 66 | 8/23/04 | 0.02 | | 24.1 | 20.9 | 2 |
| R4W | 68 | 8/23/04 | 0.01 | | 8.5 | 20.9 | 2.6 |
| R4W | 69 | 8/23/04 | 0.01 | | 9.1 | 24.7 | 1.8 |
| R4W | 71 | 8/23/04 | 0.01 | | 4 | 22.3 | 3.3 |
| R4W | 72 | 8/23/04 | 0.01 | | 1.3 | 24.9 | 3 |
| R4W | Stream | 8/23/04 | 0.87 | | 0.22 | 12.3 | 10 |
| R5N | 2 | 8/23/04 | 0.01 | | 3.1 | 19.7 | 3.5 |
| R5N | 3 | 8/23/04 | 0.01 | | 1.2 | 23 | 3.1 |
| R5N | 5 | 8/23/04 | 0.01 | | 1.1 | 14.3 | 3.8 |
| R5N | 6 | 8/23/04 | 0.01 | | 0.67 | 18.4 | 3.1 |
| R5N | 8 | 8/23/04 | 0.01 | | 2.1 | 9.06 | 5.8 |
| R5N | 9 | 8/23/04 | 0.01 | | 0.87 | 12.8 | 3.3 |
| R5N | 11 | 8/23/04 | 0.01 | | 2.3 | 11.6 | 4.2 |
| R5N | 12 | 8/23/04 | 0.02 | | 0 | 27 | 2.7 |
| R5N | 14 | 8/23/04 | 0.01 | | 2.2 | 12.9 | 4.2 |
| R5N | 15 | 8/23/04 | 0.01 | | 0.15 | 13.6 | 2.8 |
| R5N | 17 | 8/23/04 | 0.01 | | 0.95 | 10.7 | 4.5 |
| R5N | 18 | 8/23/04 | 0.01 | | 3.2 | 17.7 | 2.5 |
| R5N | 20 | 8/23/04 | 0.01 | | 0 | 14.3 | 2.5 |
| R5N | 21 | 8/23/04 | 0.01 | | 1.6 | 11.4 | 1.7 |
| R5N | 23 | 8/23/04 | 0.01 | | 2.4 | 13.6 | 3.1 |
| R5N | 24 | 8/23/04 | 0.01 | | 0.64 | 11.2 | 1.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 26 | 8/23/04 | 0.02 | | 0.02 | 13.8 | 3.3 |
| R5N | 27 | 8/23/04 | 0.02 | | 0 | 8.88 | 1.4 |
| R5N | 29 | 8/23/04 | 0.02 | | 0.03 | 19.8 | 3.5 |
| R5N | 30 | 8/23/04 | 0.03 | | 0.25 | 22.5 | 4.4 |
| R5N | 32 | 8/23/04 | 0.01 | | 1.3 | 16.3 | 3.8 |
| R5N | 33 | 8/23/04 | 0.01 | | 0.78 | 17.2 | 3.1 |
| R5N | 35 | 8/23/04 | 0.01 | | 5.9 | 16 | 2.8 |
| R5N | 36 | 8/23/04 | 0.01 | | 1.4 | 13.2 | 5.3 |
| R5N | 38 | 8/23/04 | 0.01 | | 8.2 | 8.72 | 4.7 |
| R5N | 39 | 8/23/04 | 0.02 | | 0.19 | 26.4 | 2.6 |
| R5N | 41 | 8/23/04 | 0.01 | | 1.5 | 11.5 | 5.6 |
| R5N | 42 | 8/23/04 | 0.01 | | 0.58 | 21 | 3.2 |
| R5N | 44 | 8/23/04 | 0.01 | | 10.9 | 16.8 | 5.1 |
| R5N | 45 | 8/23/04 | 0.01 | | 1.8 | 23.2 | 5.3 |
| R5N | 47 | 8/23/04 | 0.01 | | 0.82 | 9.98 | 3.5 |
| R5N | 48 | 8/23/04 | 0.01 | | 3.2 | 16.6 | 2.2 |
| R5N | 50 | 8/23/04 | 0.01 | | 1.6 | 6.79 | 4.1 |
| R5N | 51 | 8/23/04 | 0.01 | | 0.29 | 10.3 | 2.5 |
| R5N | 53 | 8/23/04 | 0.01 | | 0 | 14.1 | 3.3 |
| R5N | 54 | 8/23/04 | 0.01 | | 2 | 12 | 2.5 |
| R5N | 56 | 8/23/04 | 0.03 | | 0.29 | 16.4 | 4.6 |
| R5N | 57 | 8/23/04 | 0.01 | | 0 | 13.8 | 3 |
| R5N | 59 | 8/23/04 | 0.01 | | 3.3 | 8.25 | 2.8 |
| R5N | 60 | 8/23/04 | 0.02 | | 0.01 | 14.5 | 3.8 |
| R5N | 62 | 8/23/04 | 0.01 | | 5.5 | 10 | 3.5 |
| R5N | 63 | 8/23/04 | 0.01 | | 0.02 | 19.4 | 3.1 |
| R5N | 65 | 8/23/04 | 0.01 | | 1.2 | 10.5 | 4.8 |
| R5N | 66 | 8/23/04 | 0.01 | | 0.01 | 27.7 | 2.3 |
| R5N | 68 | 8/23/04 | 0.01 | | 1.5 | 7.3 | 4.2 |
| R5N | 69 | 8/23/04 | 0.01 | | 7.7 | 12.6 | 2.7 |
| R5N | 71 | 8/23/04 | 0.01 | | 1.5 | 10.6 | 2.9 |
| R5N | 72 | 8/23/04 | 0.01 | | 0 | 10.5 | 1.9 |
| R5N | Stream | 8/23/04 | 0.1 | | 2.4 | 19.5 | 17 |
| R1N | 2 | 9/20/04 | 0.12 | | 7.8 | 19.4 | 2.6 |
| R1N | 3 | 9/20/04 | 0.21 | | 0.02 | 6.37 | 1.9 |
| R1N | 5 | 9/20/04 | 0.06 | | 3.9 | 16.4 | 1.9 |
| R1N | 6 | 9/20/04 | 0.05 | | 0.01 | 13.8 | 1.3 |
| R1N | 8 | 9/20/04 | 0.07 | | 10.7 | 23.2 | 2.1 |
| R1N | 9 | 9/20/04 | 0.06 | | 0 | 17.3 | 1.2 |
| R1N | 11 | 9/20/04 | 0.06 | | 7.9 | 17.5 | 2.4 |
| R1N | 12 | 9/20/04 | 0.12 | | 5.7 | 19.1 | 1.6 |
| R1N | 17 | 9/20/04 | 0.03 | | 5.9 | 19.5 | 2 |
| R1N | 18 | 9/20/04 | 0.02 | | 4.9 | 19.2 | 1.3 |
| R1N | 20 | 9/20/04 | 0.08 | | 4 | 24.2 | 3.6 |
| R1N | 21 | 9/20/04 | 0.12 | | 0.01 | 12.2 | 3.8 |
| R1N | 23 | 9/20/04 | 0.05 | | 4.8 | 16.2 | 1.8 |
| R1N | 24 | 9/20/04 | 0.13 | | 0 | 10.6 | 1.3 |
| R1N | 26 | 9/20/04 | 0.02 | | 10.7 | 11.2 | 1.2 |
| R1N | 27 | 9/20/04 | 0.01 | | 6.7 | 13.8 | 1.1 |
| R1N | 29 | 9/20/04 | 0.03 | | 11.6 | 16 | 1.8 |
| R1N | 30 | 9/20/04 | 0.11 | | 0 | 10.7 | 1.5 |
| R1N | 32 | 9/20/04 | 0.04 | | 5.7 | 20.9 | 2.4 |
| R1N | 33 | 9/20/04 | 0.34 | | 0 | 5.55 | 2.8 |
| R1N | 35 | 9/20/04 | 0.02 | | 7.9 | 19.2 | 1.3 |
| R1N | 36 | 9/20/04 | 0.05 | | 3 | 21.4 | 2.3 |
| R1N | 38 | 9/20/04 | 0.05 | | 10.8 | 56.6 | 6.2 |
| R1N | 39 | 9/20/04 | 0.06 | | 8.6 | 23.5 | 1.7 |
| R1N | 41 | 9/20/04 | 0.04 | | 7.1 | 17.5 | 2.4 |
| R1N | 42 | 9/20/04 | 0.02 | | 6.3 | 19.3 | 1.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 47 | 9/20/04 | 0.01 | | 8.3 | 17 | 1.1 |
| R1N | 48 | 9/20/04 | 0.01 | | 5.7 | 23.6 | 1.3 |
| R1N | 50 | 9/20/04 | 0.02 | | 8.7 | 16.4 | 1.7 |
| R1N | 51 | 9/20/04 | 0.01 | | 6 | 16.2 | 1.4 |
| R1N | 53 | 9/20/04 | 0.02 | | 12.3 | 25.2 | 1.3 |
| R1N | 54 | 9/20/04 | 0.01 | | 11.2 | 13.7 | 1 |
| R1N | 57 | 9/20/04 | 0.02 | | 10 | 15.4 | 1.2 |
| R1N | 59 | 9/20/04 | 0.06 | | 16.3 | 14.9 | 2.2 |
| R1N | 60 | 9/20/04 | 0.01 | | 11.3 | 18.3 | 1.5 |
| R1N | 62 | 9/20/04 | 0.03 | | 6.6 | 18 | 1.5 |
| R1N | 63 | 9/20/04 | 0.02 | | 4.8 | 20.4 | 1.1 |
| R1N | 65 | 9/20/04 | 0.05 | | 7.8 | 17.5 | 2.3 |
| R1N | 66 | 9/20/04 | 0.02 | | 5.2 | 20.1 | 1.5 |
| R1N | 68 | 9/20/04 | 0.04 | | 15.9 | 9.34 | 2.1 |
| R1N | 69 | 9/20/04 | 0.01 | | 7.6 | 14.3 | 2 |
| R1N | 71 | 9/20/04 | 0.04 | | 8.9 | 15.9 | 1.7 |
| R1N | 72 | 9/20/04 | 0.03 | | 6.9 | 16.3 | 1.8 |
| R1N | Stream | 9/20/04 | 0.07 | | 5.6 | 16.3 | 6.3 |
| R2N | 2 | 9/20/04 | 0.05 | | 3.4 | 5.84 | 2.8 |
| R2N | 3 | 9/20/04 | 0.01 | | 3.7 | 13 | 1.7 |
| R2N | 5 | 9/20/04 | 0.13 | | 4.4 | 7.19 | 4.2 |
| R2N | 6 | 9/20/04 | 0.05 | | 4.4 | 18.8 | 2.3 |
| R2N | 8 | 9/20/04 | 0.05 | | 5.2 | 11.7 | 2.6 |
| R2N | 9 | 9/20/04 | 0.02 | | 4.6 | 27.7 | 1.8 |
| R2N | 11 | 9/20/04 | 0.11 | | 2.8 | 7.7 | 3.6 |
| R2N | 12 | 9/20/04 | 0.05 | | 4 | 22.9 | 2.1 |
| R2N | 14 | 9/20/04 | 0.19 | | 2.8 | 11.7 | 3.9 |
| R2N | 15 | 9/20/04 | 0.03 | | 3.7 | 19.1 | 2.4 |
| R2N | 17 | 9/20/04 | 0.14 | | 0.01 | 4.68 | 9.6 |
| R2N | 18 | 9/20/04 | 0.04 | | 0.02 | 11.3 | 2 |
| R2N | 20 | 9/20/04 | 0.02 | | 1.8 | 3.33 | 3.7 |
| R2N | 21 | 9/20/04 | 0.11 | | 0 | 16.9 | 1.4 |
| R2N | 23 | 9/20/04 | 0.09 | | 0.02 | 3.97 | 4.5 |
| R2N | 24 | 9/20/04 | 0.08 | | 0 | 15.9 | 1.8 |
| R2N | 26 | 9/20/04 | 0.09 | | 2.6 | 3.88 | 3.1 |
| R2N | 27 | 9/20/04 | 0.05 | | 0 | 18.7 | 0.9 |
| R2N | 29 | 9/20/04 | 0.16 | | 2.8 | 8.12 | 3.3 |
| R2N | 30 | 9/20/04 | 0.03 | | 0 | 9.45 | 1.7 |
| R2N | 32 | 9/20/04 | 0.2 | | 3.7 | 3.42 | 3 |
| R2N | 33 | 9/20/04 | 0.02 | | 0.28 | 14 | 1.3 |
| R2N | 35 | 9/20/04 | 0.17 | | 3 | 1.71 | 4.1 |
| R2N | 36 | 9/20/04 | 0.02 | | 3.8 | 21.7 | 1.8 |
| R2N | 38 | 9/20/04 | 0.03 | | 4.5 | 6.06 | 2.4 |
| R2N | 39 | 9/20/04 | 0.03 | | 4.9 | 30.7 | 1.8 |
| R2N | 41 | 9/20/04 | 0.03 | | 3 | 2.11 | 2.7 |
| R2N | 42 | 9/20/04 | 0.02 | | 3 | 10.7 | 2.1 |
| R2N | 44 | 9/20/04 | 0.03 | | 3.5 | 4.94 | 1.8 |
| R2N | 45 | 9/20/04 | 0.02 | | 3.4 | 24.6 | 1.9 |
| R2N | 47 | 9/20/04 | 0.01 | | 8.5 | 15.5 | 2.3 |
| R2N | 48 | 9/20/04 | 0.01 | | 3.7 | 14.9 | 1.8 |
| R2N | 50 | 9/20/04 | 0.02 | | 30.4 | 41.5 | 2.6 |
| R2N | 51 | 9/20/04 | 0.01 | | 5.5 | 23.1 | 1.9 |
| R2N | 53 | 9/20/04 | 0.25 | | 7.2 | 24.7 | 3 |
| R2N | 54 | 9/20/04 | 0.02 | | 3.1 | 12.2 | 1.8 |
| R2N | 56 | 9/20/04 | 0.15 | | 29.4 | 27.9 | 2.4 |
| R2N | 57 | 9/20/04 | 0.01 | | 3.4 | 8.82 | 2.1 |
| R2N | 59 | 9/20/04 | 0.43 | | 10.7 | 20.6 | 2.1 |
| R2N | 60 | 9/20/04 | 0.02 | | 2.8 | 14.3 | 2.2 |
| R2N | 62 | 9/20/04 | 0.06 | | 4 | 2.19 | 2.5 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 63 | 9/20/04 | 0.02 | | 5 | 28.6 | 1.4 |
| R2N | 65 | 9/20/04 | 0.05 | | 2 | 3.4 | 2.4 |
| R2N | 66 | 9/20/04 | 0.07 | | 2.6 | 23.8 | 1.3 |
| R2N | 68 | 9/20/04 | 0.02 | | 21.7 | 40.2 | 2.8 |
| R2N | 69 | 9/20/04 | 0.02 | | 3.8 | 24.6 | 1.7 |
| R2N | 71 | 9/20/04 | 0.04 | | 2.8 | 15.5 | 2.2 |
| R2N | Stream | 9/20/04 | 1.4 | | 0 | 7.61 | 14.4 |
| R4W | 2 | 9/20/04 | 0.03 | | 21.7 | 20.3 | 2.1 |
| R4W | 3 | 9/20/04 | 0.07 | | 0 | 21.7 | 1.8 |
| R4W | 5 | 9/20/04 | 0.02 | | 19.8 | 16.8 | 2.2 |
| R4W | 6 | 9/20/04 | 0.07 | | 0 | 25.4 | 1.4 |
| R4W | 8 | 9/20/04 | 0.02 | | 23.7 | 19.6 | 1.4 |
| R4W | 9 | 9/20/04 | 0.05 | | 0.41 | 11.2 | 1.3 |
| R4W | 11 | 9/20/04 | 0.01 | | 21.4 | 18.9 | 1.7 |
| R4W | 12 | 9/20/04 | 0.08 | | 3.4 | 18.8 | 2.1 |
| R4W | 14 | 9/20/04 | 0.01 | | 20.7 | 19.2 | 2.4 |
| R4W | 15 | 9/20/04 | 0.02 | | 17.3 | 19.7 | 1.7 |
| R4W | 17 | 9/20/04 | 0.01 | | 7.2 | 23.1 | 1.9 |
| R4W | 18 | 9/20/04 | 0.06 | | 0.27 | 16.9 | 1 |
| R4W | 20 | 9/20/04 | 0.01 | | 1.1 | 26.2 | 2.1 |
| R4W | 21 | 9/20/04 | 0.12 | | 0 | 9.43 | 2.1 |
| R4W | 23 | 9/20/04 | 0.01 | | 1.6 | 27.4 | 2.7 |
| R4W | 24 | 9/20/04 | 0.02 | | 1.5 | 27.7 | 2.9 |
| R4W | 26 | 9/20/04 | 0.01 | | 1.8 | 27.3 | 2.8 |
| R4W | 27 | 9/20/04 | 0.01 | | 1.3 | 27.6 | 2.8 |
| R4W | 29 | 9/20/04 | 0.02 | | 1.6 | 28.1 | 4.1 |
| R4W | 30 | 9/20/04 | 0.02 | | 0 | 25.8 | 2 |
| R4W | 32 | 9/20/04 | 0.01 | | 24.9 | 22.3 | 1.6 |
| R4W | 33 | 9/20/04 | 0.03 | | 0.39 | 19.9 | 7.3 |
| R4W | 35 | 9/20/04 | 0.01 | | 24 | 18.3 | 1.5 |
| R4W | 36 | 9/20/04 | 0.11 | | 0.2 | 12.2 | 1.2 |
| R4W | 38 | 9/20/04 | 0.01 | | 23.7 | 19.2 | 1.6 |
| R4W | 39 | 9/20/04 | 0.01 | | 17.2 | 22.6 | 1.6 |
| R4W | 41 | 9/20/04 | 0.01 | | 26.4 | 19.9 | 1.4 |
| R4W | 42 | 9/20/04 | 0.02 | | 24.4 | 20.3 | 1.5 |
| R4W | 44 | 9/20/04 | 0.01 | | 20 | 18.8 | 1.8 |
| R4W | 45 | 9/20/04 | 0.01 | | 21.8 | 31.6 | 3.2 |
| R4W | 47 | 9/20/04 | 0.01 | | 15.1 | 16.2 | 2.2 |
| R4W | 48 | 9/20/04 | 0.01 | | 16 | 19.4 | 1.7 |
| R4W | 50 | 9/20/04 | 0.02 | | 5.4 | 25.3 | 3 |
| R4W | 51 | 9/20/04 | 0.01 | | 4.2 | 25.5 | 1.8 |
| R4W | 53 | 9/20/04 | 0.02 | | 3.3 | 22.9 | 1.8 |
| R4W | 54 | 9/20/04 | 0.15 | | 0.89 | 27.3 | 11 |
| R4W | 56 | 9/20/04 | 0.09 | | 0.69 | 24.4 | 3.3 |
| R4W | 57 | 9/20/04 | 0.01 | | 0.44 | 25.6 | 2.3 |
| R4W | 59 | 9/20/04 | 0.01 | | 0.39 | 27.6 | 2.2 |
| R4W | 60 | 9/20/04 | 0.01 | | 0.93 | 28.2 | 2 |
| R4W | 62 | 9/20/04 | 0.01 | | 23.6 | 21.2 | 1.1 |
| R4W | 63 | 9/20/04 | 0.07 | | 4.6 | 25.2 | 1.6 |
| R4W | 65 | 9/20/04 | 0.01 | | 21.8 | 17.4 | 1.9 |
| R4W | 66 | 9/20/04 | 0.02 | | 23.4 | 20.5 | 1.4 |
| R4W | 68 | 9/20/04 | 0.02 | | 9.1 | 23.5 | 2 |
| R4W | 69 | 9/20/04 | 0.01 | | 9.1 | 23.7 | 1.7 |
| R4W | 71 | 9/20/04 | 0.01 | | 2.7 | 23.5 | 3.1 |
| R4W | 72 | 9/20/04 | 0.03 | | 0.12 | 43.9 | 2.9 |
| R5N | 2 | 9/20/04 | 0.01 | | 1.4 | 17 | 3.2 |
| R5N | 3 | 9/20/04 | 0.01 | | 0.96 | 31.5 | 2.9 |
| R5N | 5 | 9/20/04 | 0.01 | | 1 | 13.7 | 3.2 |
| R5N | 6 | 9/20/04 | 0 | | 0.34 | 22 | 2.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 8 | 9/20/04 | 0.01 | | 2.1 | 10 | 4.7 |
| R5N | 9 | 9/20/04 | 0 | | 0.31 | 21 | 2.7 |
| R5N | 11 | 9/20/04 | 0.01 | | 1.9 | 13.3 | 4.2 |
| R5N | 12 | 9/20/04 | 0.01 | | 0.37 | 29.2 | 2.6 |
| R5N | 14 | 9/20/04 | 0.02 | | 1.3 | 11 | 4 |
| R5N | 15 | 9/20/04 | 0.01 | | 0 | 19.1 | 2.4 |
| R5N | 17 | 9/20/04 | 0.03 | | 0.32 | 8.65 | 2.6 |
| R5N | 18 | 9/20/04 | 0.01 | | 3.1 | 15.3 | 1.8 |
| R5N | 20 | 9/20/04 | 0.03 | | 0.02 | 12.2 | 2.2 |
| R5N | 21 | 9/20/04 | 0.01 | | 1.6 | 13.7 | 1.6 |
| R5N | 23 | 9/20/04 | 0 | | 1.3 | 12.9 | 2.8 |
| R5N | 24 | 9/20/04 | 0.01 | | 0.9 | 10 | 1.6 |
| R5N | 26 | 9/20/04 | 0.01 | | 0.01 | 11.3 | 3.1 |
| R5N | 27 | 9/20/04 | 0.03 | | 0 | 9.7 | 1.5 |
| R5N | 29 | 9/20/04 | 0.02 | | 0 | 22.7 | 3.7 |
| R5N | 30 | 9/20/04 | 0.08 | | 0.13 | 22.1 | 3.6 |
| R5N | 32 | 9/20/04 | 0.01 | | 1.4 | 18.5 | 3.8 |
| R5N | 33 | 9/20/04 | 0.04 | | 0.24 | 19.2 | 3.8 |
| R5N | 35 | 9/20/04 | 0.01 | | 7.6 | 14 | 4 |
| R5N | 36 | 9/20/04 | 0.01 | | 1.2 | 14.8 | 3.4 |
| R5N | 38 | 9/20/04 | 0.02 | | 3.8 | 9.64 | 4.7 |
| R5N | 39 | 9/20/04 | 0.01 | | 0.49 | 29 | 3.6 |
| R5N | 41 | 9/20/04 | 0.02 | | 1 | 11.9 | 5.9 |
| R5N | 42 | 9/20/04 | 0.02 | | 0.83 | 24.2 | 2.5 |
| R5N | 44 | 9/20/04 | 0.01 | | 9.7 | 14 | 4.2 |
| R5N | 45 | 9/20/04 | 0.02 | | 3 | 18.1 | 2.4 |
| R5N | 47 | 9/20/04 | 0.01 | | 0.75 | 9.4 | 3.6 |
| R5N | 48 | 9/20/04 | 0.01 | | 2 | 15.8 | 2 |
| R5N | 50 | 9/20/04 | 0.04 | | 1.1 | 6.65 | 4.2 |
| R5N | 51 | 9/20/04 | 0.01 | | 0.21 | 10.7 | 2 |
| R5N | 53 | 9/20/04 | 0.01 | | 0 | 12.5 | 2.9 |
| R5N | 54 | 9/20/04 | 0.01 | | 1.9 | 12.8 | 2.3 |
| R5N | 56 | 9/20/04 | 0.04 | | 0.26 | 8.23 | 3.5 |
| R5N | 57 | 9/20/04 | 0 | | 0 | 13.9 | 2.6 |
| R5N | 59 | 9/20/04 | 0.01 | | 2.5 | 7.93 | 3 |
| R5N | 60 | 9/20/04 | 0.04 | | 0.01 | 14.8 | 3.6 |
| R5N | 62 | 9/20/04 | 0.01 | | 5.3 | 9.26 | 3 |
| R5N | 63 | 9/20/04 | 0.01 | | 0.03 | 19.6 | 3.1 |
| R5N | 65 | 9/20/04 | 0.01 | | 1 | 10.4 | 4.8 |
| R5N | 66 | 9/20/04 | 0.02 | | 0.02 | 34.9 | 2.4 |
| R5N | 68 | 9/20/04 | 0.01 | | 1.3 | 11.1 | 5.1 |
| R5N | 69 | 9/20/04 | 0.01 | | 5.4 | 11.3 | 2.5 |
| R5N | 71 | 9/20/04 | 0.01 | | 1.7 | 15 | 2.8 |
| R5N | 72 | 9/20/04 | 0.02 | | 0 | 11.5 | 1.8 |
| R1N | 2 | 10/22/04 | 0.08 | | 7.5 | 19.4 | 1.6 |
| R1N | 3 | 10/22/04 | 0.09 | | 0 | 6.96 | 1.6 |
| R1N | 5 | 10/22/04 | 0.02 | | 3.7 | 17.4 | 1 |
| R1N | 8 | 10/22/04 | 0.09 | | 9.8 | 20.4 | 1.7 |
| R1N | 9 | 10/22/04 | 0.04 | | 1.1 | 19.8 | 1.2 |
| R1N | 11 | 10/22/04 | 0.07 | | 9.1 | 14.1 | 1.8 |
| R1N | 12 | 10/22/04 | 0.02 | | 6.1 | 18.5 | 1.1 |
| R1N | 17 | 10/22/04 | 0.02 | | 6.8 | 17.5 | 1.2 |
| R1N | 18 | 10/22/04 | 0.02 | | 4.2 | 16.8 | 1.2 |
| R1N | 20 | 10/22/04 | 0.03 | | 4.2 | 18.9 | 1.4 |
| R1N | 21 | 10/22/04 | 0.08 | | 0 | 14.6 | 2 |
| R1N | 23 | 10/22/04 | 0.06 | | 6.4 | 14.3 | 1.9 |
| R1N | 24 | 10/22/04 | 0.16 | | 0.01 | 15 | 1.5 |
| R1N | 26 | 10/22/04 | 0.01 | | 13.4 | 14.6 | 0.8 |
| R1N | 27 | 10/22/04 | 0.01 | | 7.7 | 15.2 | 1.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 29 | 10/22/04 | 0.01 | | 14.5 | 14.4 | 1.6 |
| R1N | 30 | 10/22/04 | 0.08 | | 0 | 14.1 | 1.3 |
| R1N | 32 | 10/22/04 | 0.04 | | 5 | 18.5 | 1.6 |
| R1N | 33 | 10/22/04 | 0.21 | | 0 | 12.5 | 5.8 |
| R1N | 35 | 10/22/04 | 0.02 | | 7.3 | 17.6 | 1.4 |
| R1N | 36 | 10/22/04 | 0.01 | | 3.3 | 19.4 | 1 |
| R1N | 38 | 10/22/04 | 0.06 | | 11.1 | 23.1 | 1.5 |
| R1N | 39 | 10/22/04 | 0.04 | | 8.2 | 26.9 | 1.1 |
| R1N | 41 | 10/22/04 | 0.03 | | 7.1 | 17 | 1.3 |
| R1N | 42 | 10/22/04 | 0.01 | | 6.2 | 18.1 | 0.9 |
| R1N | 47 | 10/22/04 | 0.01 | | 8.6 | 18.5 | 0.8 |
| R1N | 48 | 10/22/04 | 0.01 | | 6 | 23.3 | 1.1 |
| R1N | 50 | 10/22/04 | 0.03 | | 9.2 | 13.1 | 1.7 |
| R1N | 51 | 10/22/04 | 0.01 | | 5.1 | 15.9 | 1.1 |
| R1N | 54 | 10/22/04 | 0.01 | | 10.9 | 12.3 | 1 |
| R1N | 57 | 10/22/04 | 0.01 | | 10.5 | 16.3 | 2 |
| R1N | 59 | 10/22/04 | 0.05 | | 17.4 | 14.3 | 4.9 |
| R1N | 60 | 10/22/04 | 0.01 | | 13.2 | 18.6 | 1.7 |
| R1N | 62 | 10/22/04 | 0.02 | | 6.2 | 18.8 | 1.4 |
| R1N | 63 | 10/22/04 | 0.01 | | 4.1 | 20.1 | 1 |
| R1N | 65 | 10/22/04 | 0.05 | | 6.7 | 18.2 | 1.4 |
| R1N | 66 | 10/22/04 | 0.01 | | 4.5 | 19.2 | 1.3 |
| R1N | 68 | 10/22/04 | 0.01 | | 12.8 | 10.2 | 1.3 |
| R1N | 69 | 10/22/04 | 0.01 | | 6.8 | 15 | 1 |
| R1N | 71 | 10/22/04 | 0.03 | | 7.8 | 13.2 | 1.9 |
| R1N | 72 | 10/22/04 | 0.01 | | 6.4 | 14.3 | 1.7 |
| R1N | Stream | 10/22/04 | 0.06 | | 7.5 | 20.7 | 4 |
| R2N | 2 | 10/22/04 | 0.05 | | 3 | 7.48 | 4.4 |
| R2N | 3 | 10/22/04 | 0.01 | | 3.3 | 14.2 | 1.7 |
| R2N | 6 | 10/22/04 | 0.04 | | 4.2 | 20.5 | 1.7 |
| R2N | 8 | 10/22/04 | 0.07 | | 4 | 13.8 | 2.2 |
| R2N | 9 | 10/22/04 | 0.02 | | 4.1 | 33 | 1.4 |
| R2N | 11 | 10/22/04 | 0.11 | | 3.1 | 14.8 | 3.5 |
| R2N | 12 | 10/22/04 | 0.09 | | 3.7 | 27.2 | 1.9 |
| R2N | 14 | 10/22/04 | 0.09 | | 2.8 | 14.2 | 1.7 |
| R2N | 15 | 10/22/04 | 0.06 | | 3 | 25.3 | 1.4 |
| R2N | 17 | 10/22/04 | 0.11 | | 0 | 7.31 | 8.7 |
| R2N | 18 | 10/22/04 | 0.04 | | 0 | 12.3 | 1.6 |
| R2N | 20 | 10/22/04 | 0.01 | | 2.8 | 6.49 | 3.7 |
| R2N | 21 | 10/22/04 | 0.1 | | 0 | 18.6 | 1.3 |
| R2N | 23 | 10/22/04 | 0.05 | | 0.85 | 5.46 | 3.1 |
| R2N | 24 | 10/22/04 | 0.08 | | 0 | 18.9 | 1 |
| R2N | 26 | 10/22/04 | 0.06 | | 3.1 | 5.45 | 2.5 |
| R2N | 27 | 10/22/04 | 0.05 | | 0 | 21.2 | 1.2 |
| R2N | 29 | 10/22/04 | 0.14 | | 2.8 | 9.53 | 2.6 |
| R2N | 30 | 10/22/04 | 0.03 | | 0 | 9.15 | 1.3 |
| R2N | 32 | 10/22/04 | 0.19 | | 3 | 3.18 | 2.8 |
| R2N | 33 | 10/22/04 | 0.02 | | 0.79 | 34.3 | 3.8 |
| R2N | 35 | 10/22/04 | 0.15 | | 2.8 | 1.83 | 3.2 |
| R2N | 36 | 10/22/04 | 0.03 | | 3.8 | 22.9 | 1.5 |
| R2N | 38 | 10/22/04 | 0.06 | | 3.9 | 7.47 | 2.2 |
| R2N | 39 | 10/22/04 | 0.08 | | 4.6 | 33.8 | 1.7 |
| R2N | 41 | 10/22/04 | 0.05 | | 2.7 | 2.49 | 2.6 |
| R2N | 42 | 10/22/04 | 0.01 | | 2.9 | 11.5 | 2 |
| R2N | 44 | 10/22/04 | 0.04 | | 3.1 | 5.73 | 1.7 |
| R2N | 45 | 10/22/04 | 0.03 | | 3.6 | 21.1 | 1.6 |
| R2N | 47 | 10/22/04 | 0.02 | | 11.3 | 33.6 | 2.3 |
| R2N | 48 | 10/22/04 | 0.01 | | 10.1 | 32.4 | 1.6 |
| R2N | 50 | 10/22/04 | 0.04 | | 22.5 | 58.6 | 2.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 51 | 10/22/04 | 0.1 | | 3.8 | 8.52 | 3.8 |
| R2N | 53 | 10/22/04 | 0.05 | | 9.1 | 41.2 | 2.2 |
| R2N | 54 | 10/22/04 | 0.02 | | 3.1 | 15.8 | 1.8 |
| R2N | 56 | 10/22/04 | 0.33 | | 10.3 | 40.3 | 2.6 |
| R2N | 57 | 10/22/04 | 0.02 | | 6.2 | 28 | 2.1 |
| R2N | 59 | 10/22/04 | 0.31 | | 12.2 | 20.3 | 1.9 |
| R2N | 60 | 10/22/04 | 0.04 | | 1.8 | 13.2 | 1.6 |
| R2N | 62 | 10/22/04 | 0.09 | | 3.6 | 2.46 | 1.9 |
| R2N | 63 | 10/22/04 | 0.02 | | 4.6 | 27.5 | 1.4 |
| R2N | 65 | 10/22/04 | 0.06 | | 2 | 4.86 | 2.1 |
| R2N | 66 | 10/22/04 | 0.63 | | 2.5 | 25.7 | 1.2 |
| R2N | 68 | 10/22/04 | 0.03 | | 18.2 | 38 | 2.4 |
| R2N | 69 | 10/22/04 | 0.02 | | 4.6 | 26.1 | 1.4 |
| R2N | 71 | 10/22/04 | 0.02 | | 7.5 | 25.8 | 1.7 |
| R2N | 72 | 10/22/04 | 0.03 | | 3.1 | 16.9 | 1.7 |
| R2N | Stream | 10/22/04 | 1.1 | | 0 | 11 | 17.2 |
| R4W | 2 | 10/22/04 | 0.03 | | 21.1 | 19.8 | 2.5 |
| R4W | 3 | 10/22/04 | 0.06 | | 0.02 | 23.6 | 1.5 |
| R4W | 5 | 10/22/04 | 0.02 | | 20.5 | 18.9 | 2.7 |
| R4W | 6 | 10/22/04 | 0.05 | | 0.01 | 26 | 1.8 |
| R4W | 8 | 10/22/04 | 0.02 | | 21.2 | 20.8 | 1.5 |
| R4W | 9 | 10/22/04 | 0.04 | | 0.37 | 12.2 | 1.3 |
| R4W | 11 | 10/22/04 | 0.03 | | 21.1 | 20.6 | 1.7 |
| R4W | 12 | 10/22/04 | 0.03 | | 3.7 | 20.7 | 1.8 |
| R4W | 14 | 10/22/04 | 0.03 | | 20.3 | 20.3 | 1.5 |
| R4W | 15 | 10/22/04 | 0.01 | | 16.3 | 22.1 | 3.9 |
| R4W | 17 | 10/22/04 | 0.02 | | 5.1 | 26.4 | 2.2 |
| R4W | 18 | 10/22/04 | 0.05 | | 0.2 | 18.5 | 1.2 |
| R4W | 20 | 10/22/04 | 0.01 | | 1.1 | 25.6 | 2.5 |
| R4W | 21 | 10/22/04 | 0.12 | | 0.02 | 14.9 | 1.7 |
| R4W | 23 | 10/22/04 | 0.02 | | 1.5 | 29 | 2.6 |
| R4W | 24 | 10/22/04 | 0.02 | | 0.91 | 28.8 | 2.4 |
| R4W | 26 | 10/22/04 | 0.01 | | 1.7 | 29 | 2.6 |
| R4W | 27 | 10/22/04 | 0.01 | | 1.7 | 29.6 | 2.7 |
| R4W | 29 | 10/22/04 | 0.01 | | 2.5 | 24.5 | 3.2 |
| R4W | 30 | 10/22/04 | 0.03 | | 0.01 | 28 | 3.5 |
| R4W | 32 | 10/22/04 | 0.01 | | 24.6 | 28.9 | 1.8 |
| R4W | 33 | 10/22/04 | 0.02 | | 1.3 | 25.5 | 2.7 |
| R4W | 35 | 10/22/04 | 0.01 | | 20.2 | 18.5 | 2.5 |
| R4W | 36 | 10/22/04 | 0.05 | | 0.23 | 12.6 | 2.3 |
| R4W | 38 | 10/22/04 | 0.01 | | 23.6 | 23 | 3 |
| R4W | 39 | 10/22/04 | 0.02 | | 14.6 | 20.6 | 1.9 |
| R4W | 41 | 10/22/04 | 0.01 | | 23.8 | 19.6 | 2.2 |
| R4W | 42 | 10/22/04 | 0.03 | | 23.4 | 18.7 | 2.2 |
| R4W | 44 | 10/22/04 | 0.01 | | 20.8 | 20.1 | 2.2 |
| R4W | 45 | 10/22/04 | 0.01 | | 20.8 | 21.2 | 2.3 |
| R4W | 47 | 10/22/04 | 0.01 | | 15.9 | 17.5 | 2.6 |
| R4W | 48 | 10/22/04 | 0.01 | | 16.8 | 21 | 1.7 |
| R4W | 50 | 10/22/04 | 0.03 | | 6.2 | 24.4 | 2.6 |
| R4W | 51 | 10/22/04 | 0.07 | | 4.5 | 24.9 | 3 |
| R4W | 53 | 10/22/04 | 0.01 | | 3.9 | 24 | 2.7 |
| R4W | 54 | 10/22/04 | 0.03 | | 1.4 | 29.6 | 2.1 |
| R4W | 56 | 10/22/04 | 0.06 | | 0.91 | 27 | 2.8 |
| R4W | 57 | 10/22/04 | 0.02 | | 0.02 | 28.2 | 2.2 |
| R4W | 59 | 10/22/04 | 0.04 | | 0.81 | 29.1 | 2.9 |
| R4W | 60 | 10/22/04 | 0.03 | | 0.99 | 26.7 | 2.2 |
| R4W | 62 | 10/22/04 | 0.01 | | 21.8 | 23.5 | 1.5 |
| R4W | 63 | 10/22/04 | 0.04 | | 9.5 | 26.3 | 1.4 |
| R4W | 65 | 10/22/04 | 0.01 | | 20.4 | 20.1 | 2.6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 66 | 10/22/04 | 0.01 | | 21.2 | 22.4 | 2.3 |
| R4W | 68 | 10/22/04 | 0.07 | | 9.7 | 22.5 | 23.3 |
| R4W | 69 | 10/22/04 | 0.01 | | 8.5 | 22.7 | 2.3 |
| R4W | 71 | 10/22/04 | 0.02 | | 3.9 | 22.7 | 2.6 |
| R4W | 72 | 10/22/04 | 0.02 | | 0.59 | 28 | 2.8 |
| R4W | Stream | 10/22/04 | 0.9 | | 0 | 13.8 | 8.8 |
| R5N | 2 | 10/22/04 | 0.02 | | 3.4 | 13.7 | 3 |
| R5N | 3 | 10/22/04 | 0.01 | | 0.89 | 19.8 | 2.6 |
| R5N | 5 | 10/22/04 | 0.01 | | 0.89 | 20.9 | 6 |
| R5N | 6 | 10/22/04 | 0.09 | | 0.23 | 22.9 | 2.9 |
| R5N | 8 | 10/22/04 | 0.01 | | 2.4 | 13.8 | 5.2 |
| R5N | 9 | 10/22/04 | 0.01 | | 0.4 | 21.1 | 3.1 |
| R5N | 11 | 10/22/04 | 0.02 | | 2.5 | 12.6 | 4.5 |
| R5N | 12 | 10/22/04 | 0.04 | | 0.44 | 56.5 | 5.6 |
| R5N | 14 | 10/22/04 | 0.08 | | 3 | 12.8 | 4.7 |
| R5N | 15 | 10/22/04 | 0.02 | | 0.02 | 16 | 2.6 |
| R5N | 17 | 10/22/04 | 0.07 | | 1.5 | 10.1 | 3.2 |
| R5N | 18 | 10/22/04 | 0.02 | | 0.87 | 15.7 | 2.2 |
| R5N | 21 | 10/22/04 | 0.02 | | 1.5 | 13 | 3 |
| R5N | 23 | 10/22/04 | 0.01 | | 1.5 | 12.7 | 3 |
| R5N | 24 | 10/22/04 | 0.02 | | 0.71 | 9.37 | 1.6 |
| R5N | 26 | 10/22/04 | 0.02 | | 0 | 11.4 | 3 |
| R5N | 27 | 10/22/04 | 0.04 | | 0 | 8.16 | 1.3 |
| R5N | 29 | 10/22/04 | 0.01 | | 0.01 | 17.9 | 4 |
| R5N | 30 | 10/22/04 | 0.03 | | 0.01 | 21.8 | 3.3 |
| R5N | 32 | 10/22/04 | 0.04 | | 1.5 | 13.7 | 3.8 |
| R5N | 33 | 10/22/04 | 0.01 | | 0.13 | 18.5 | 3 |
| R5N | 35 | 10/22/04 | 0.03 | | 7.1 | 70.3 | 4.3 |
| R5N | 36 | 10/22/04 | 0.01 | | 1.1 | 13.9 | 3.6 |
| R5N | 38 | 10/22/04 | 0.01 | | 3.9 | 51.3 | 7.1 |
| R5N | 39 | 10/22/04 | 0.01 | | 0.59 | 21.2 | 3.1 |
| R5N | 41 | 10/22/04 | 0.02 | | 1.1 | 45 | 9.2 |
| R5N | 42 | 10/22/04 | 0.01 | | 0.92 | 40 | 3.4 |
| R5N | 44 | 10/22/04 | 0.02 | | 8.6 | 14.3 | 4.1 |
| R5N | 45 | 10/22/04 | 0.02 | | 2.7 | 17.8 | 3.2 |
| R5N | 47 | 10/22/04 | 0.01 | | 0.81 | 8.92 | 3.7 |
| R5N | 48 | 10/22/04 | 0.02 | | 0.75 | 16 | 1.9 |
| R5N | 50 | 10/22/04 | 0.05 | | 1 | 17.9 | 5.3 |
| R5N | 51 | 10/22/04 | 0.01 | | 0.23 | 18.3 | 2.4 |
| R5N | 53 | 10/22/04 | 0.02 | | 0 | 13.4 | 3.1 |
| R5N | 54 | 10/22/04 | 0.01 | | 2 | 17.8 | 3.8 |
| R5N | 56 | 10/22/04 | 0.09 | | 0.27 | 59.9 | 9 |
| R5N | 57 | 10/22/04 | 0.02 | | 0 | 13.3 | 2.8 |
| R5N | 59 | 10/22/04 | 0.02 | | 2.1 | 56.2 | 5.2 |
| R5N | 60 | 10/22/04 | 0.04 | | 0 | 18.8 | 4.1 |
| R5N | 62 | 10/22/04 | 0.02 | | 4.7 | 10.5 | 3.3 |
| R5N | 63 | 10/22/04 | 0.01 | | 0.14 | 18.2 | 3.4 |
| R5N | 65 | 10/22/04 | 0.04 | | 0.95 | 11.5 | 5.5 |
| R5N | 66 | 10/22/04 | 0.01 | | 0.29 | 25.1 | 2.4 |
| R5N | 68 | 10/22/04 | 0.02 | | 1.1 | 57.2 | 7.8 |
| R5N | 69 | 10/22/04 | 0.01 | | 4.8 | 12.1 | 3 |
| R5N | 71 | 10/22/04 | 0.07 | | 0.73 | 10.8 | 3.6 |
| R5N | 72 | 10/22/04 | 0.02 | | 0 | 12.8 | 2.1 |
| R5N | Stream | 10/22/04 | 0.13 | | 0.03 | 25.2 | 12.7 |
| | | **No November Samples Taken** | | | | | |
| R1N | 2 | 12/13/04 | 0.17 | | 5.7 | 19.7 | 3.1 |
| R1N | 3 | 12/13/04 | 0.26 | | 0.03 | 6.77 | 1.9 |
| R1N | 5 | 12/13/04 | 0.04 | | 4.1 | 17.5 | 1.8 |
| R1N | 8 | 12/13/04 | 0.22 | | 7.7 | 19.6 | 3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 9 | 12/13/04 | 0.09 | | 0.21 | 20.1 | 2.4 |
| R1N | 12 | 12/13/04 | 0.03 | | 5.2 | 16.6 | 1.3 |
| R1N | 17 | 12/13/04 | 0.02 | | 6.7 | 15 | 2.3 |
| R1N | 18 | 12/13/04 | 0.02 | | 4.4 | 18.4 | 1.7 |
| R1N | 20 | 12/13/04 | 0.04 | | 1.2 | 17 | 1.8 |
| R1N | 21 | 12/13/04 | 0.14 | | 0.02 | 11.5 | 1.9 |
| R1N | 23 | 12/13/04 | 0.36 | | 2.9 | 8.82 | 5 |
| R1N | 24 | 12/13/04 | 0.34 | | 0.02 | 9.77 | 2 |
| R1N | 26 | 12/13/04 | 0.01 | | 6.2 | 9.59 | 2.8 |
| R1N | 26 | 12/13/04 | 0.01 | | 6.3 | 9.58 | 2.4 |
| R1N | 27 | 12/13/04 | 0.02 | | 4.1 | 10.3 | 1.7 |
| R1N | 27 | 12/13/04 | 0.02 | | 4.2 | 10.4 | 1.4 |
| R1N | 29 | 12/13/04 | 0.03 | | 11.7 | 16.5 | 2 |
| R1N | 30 | 12/13/04 | 0.09 | | 1.2 | 13 | 1.7 |
| R1N | 32 | 12/13/04 | 0.07 | | 3.8 | 20.5 | 2.5 |
| R1N | 33 | 12/13/04 | 0.56 | | 0.02 | 7.19 | 2.8 |
| R1N | 35 | 12/13/04 | 0.02 | | 8.4 | 19.1 | 1.5 |
| R1N | 36 | 12/13/04 | 0.02 | | 4.5 | 15.9 | 1.3 |
| R1N | 38 | 12/13/04 | 0.08 | | 8 | 19.7 | 2.3 |
| R1N | 39 | 12/13/04 | 0.07 | | 7.2 | 19.3 | 1.6 |
| R1N | 41 | 12/13/04 | 0.07 | | 7.1 | 14.5 | 1.8 |
| R1N | 42 | 12/13/04 | 0.01 | | 5 | 18.7 | 1.7 |
| R1N | 47 | 12/13/04 | 0.01 | | 8.8 | 15.8 | 1.1 |
| R1N | 48 | 12/13/04 | 0.01 | | 5.9 | 22.7 | 1.4 |
| R1N | 50 | 12/13/04 | 0.02 | | 9 | 11.1 | 2.3 |
| R1N | 51 | 12/13/04 | 0.01 | | 5 | 11.9 | 1.4 |
| R1N | 54 | 12/13/04 | 0.01 | | 11.7 | 10 | 1.5 |
| R1N | 57 | 12/13/04 | 0.01 | | 12.6 | 12.7 | 1.2 |
| R1N | 59 | 12/13/04 | 0.06 | | 13.2 | 9.15 | 3 |
| R1N | 60 | 12/13/04 | 0.01 | | 11.5 | 17.4 | 1.7 |
| R1N | 62 | 12/13/04 | 0.03 | | 7.4 | 15.6 | 1.5 |
| R1N | 63 | 12/13/04 | 0.01 | | 3.3 | 17.5 | 1.5 |
| R1N | 66 | 12/13/04 | 0.01 | | 7.2 | 19.6 | 1.7 |
| R1N | 68 | 12/13/04 | 0.05 | | 11.6 | 9.55 | 2 |
| R1N | 69 | 12/13/04 | 0.01 | | 8.1 | 11 | 1.4 |
| R1N | 72 | 12/13/04 | 0.01 | | 6.5 | 17.5 | 2.1 |
| R1N | Stream | 12/13/04 | 0.05 | | 7 | 15 | 5.4 |
| R2N | 2 | 12/13/04 | 0.06 | | 2.4 | 4.29 | 2.6 |
| R2N | 3 | 12/13/04 | 0.01 | | 3.2 | 12.7 | 1.9 |
| R2N | 5 | 12/13/04 | 0.06 | | 4.1 | 19.2 | 1.9 |
| R2N | 6 | 12/13/04 | 0.45 | | 2.5 | 2.64 | 5.7 |
| R2N | 8 | 12/13/04 | 0.14 | | 3.7 | 12.3 | 2.9 |
| R2N | 9 | 12/13/04 | 0.02 | | 3.5 | 28.1 | 1.8 |
| R2N | 11 | 12/13/04 | 0.43 | | 2.9 | 12.7 | 4.3 |
| R2N | 12 | 12/13/04 | 0.14 | | 3.8 | 27.1 | 2.2 |
| R2N | 14 | 12/13/04 | 0.21 | | 2.4 | 11.8 | 2.7 |
| R2N | 15 | 12/13/04 | 0.09 | | 2.8 | 25.8 | 2.4 |
| R2N | 17 | 12/13/04 | 0.16 | | 0.19 | 6.6 | 7.6 |
| R2N | 18 | 12/13/04 | 0.05 | | 0.02 | 10.8 | 1.9 |
| R2N | 20 | 12/13/04 | 0.02 | | 1 | 5.77 | 4 |
| R2N | 21 | 12/13/04 | 0.11 | | 0.02 | 18.5 | 1.4 |
| R2N | 23 | 12/13/04 | 0.53 | | 0.17 | 6.45 | 6 |
| R2N | 24 | 12/13/04 | 0.11 | | 0.01 | 17.9 | 1.5 |
| R2N | 26 | 12/13/04 | 0.05 | | 2.3 | 7.71 | 2.7 |
| R2N | 27 | 12/13/04 | 0.04 | | 0.01 | 19.4 | 2.6 |
| R2N | 29 | 12/13/04 | 0.08 | | 3.3 | 12.1 | 2.7 |
| R2N | 30 | 12/13/04 | 0.06 | | 0.01 | 8.39 | 2.2 |
| R2N | 32 | 12/13/04 | 0.12 | | 2.1 | 6.07 | 2.8 |
| R2N | 33 | 12/13/04 | 0.05 | | 0.64 | 14.6 | 1.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 35 | 12/13/04 | 0.79 | | 2.1 | 2.81 | 7.7 |
| R2N | 36 | 12/13/04 | 0.08 | | 4.6 | 26.4 | 2.1 |
| R2N | 38 | 12/13/04 | 0.09 | | 3.3 | 8.74 | 2.2 |
| R2N | 39 | 12/13/04 | 0.19 | | 3.4 | 29.3 | 2.2 |
| R2N | 41 | 12/13/04 | 0.11 | | 2.2 | 3.82 | 3.5 |
| R2N | 42 | 12/13/04 | 0.01 | | 3.5 | 15.7 | 1.9 |
| R2N | 44 | 12/13/04 | 0.22 | | 2.5 | 5.87 | 3 |
| R2N | 45 | 12/13/04 | 0.05 | | 3.2 | 21.8 | 1.7 |
| R2N | 47 | 12/13/04 | 0.03 | | 9.3 | 28.6 | 2.5 |
| R2N | 48 | 12/13/04 | 0.02 | | 5.9 | 23.9 | 2 |
| R2N | 50 | 12/13/04 | 0.09 | | 15.5 | 36 | 3 |
| R2N | 51 | 12/13/04 | 0.02 | | 8.5 | 28 | 2 |
| R2N | 53 | 12/13/04 | 0.16 | | 11.2 | 32.4 | 3.6 |
| R2N | 54 | 12/13/04 | 0.04 | | 7 | 24 | 2.2 |
| R2N | 56 | 12/13/04 | 0.28 | | 9.8 | 32.4 | 3.2 |
| R2N | 57 | 12/13/04 | 0.04 | | 6.8 | 29.2 | 2.5 |
| R2N | 59 | 12/13/04 | 0.15 | | 8.8 | 25.7 | 2.6 |
| R2N | 60 | 12/13/04 | 0.04 | | 3 | 16.7 | 1.7 |
| R2N | 63 | 12/13/04 | 0.02 | | 4.8 | 25.6 | 1.4 |
| R2N | 66 | 12/13/04 | 0.06 | | 2.2 | 23.6 | 1.4 |
| R2N | 69 | 12/13/04 | 0.04 | | 6 | 26.6 | 1.9 |
| R2N | 72 | 12/13/04 | 0.03 | | 6 | 24.5 | 1.9 |
| R2N | Stream | 12/13/04 | 0.79 | | 0.13 | 11 | 10.9 |
| R4W | 2 | 12/13/04 | 0.03 | | 21.3 | 21.1 | 2.2 |
| R4W | 3 | 12/13/04 | 0.1 | | 0.13 | 31 | 1.9 |
| R4W | 5 | 12/13/04 | 0.02 | | 21 | 20 | 2.1 |
| R4W | 6 | 12/13/04 | 0.07 | | 0.01 | 27 | 1.4 |
| R4W | 8 | 12/13/04 | 0.02 | | 19.6 | 23 | 1.7 |
| R4W | 9 | 12/13/04 | 0.05 | | 0.22 | 12 | 1.6 |
| R4W | 11 | 12/13/04 | 0.01 | | 19.7 | 19.1 | 2.3 |
| R4W | 12 | 12/13/04 | 0.09 | | 0.22 | 19.1 | 1.6 |
| R4W | 14 | 12/13/04 | 0.01 | | 18.6 | 18.3 | 2 |
| R4W | 15 | 12/13/04 | 0.01 | | 14.3 | 20.6 | 2.1 |
| R4W | 17 | 12/13/04 | 0.01 | | 3.3 | 25.1 | 1.9 |
| R4W | 18 | 12/13/04 | 0.09 | | 0.15 | 17.2 | 1.5 |
| R4W | 20 | 12/13/04 | 0.01 | | 2 | 29.2 | 2.7 |
| R4W | 21 | 12/13/04 | 0.11 | | 0.01 | 7.63 | 2.7 |
| R4W | 23 | 12/13/04 | 0.03 | | 1.1 | 28.5 | 3 |
| R4W | 24 | 12/13/04 | 0.01 | | 2.3 | 27.1 | 3.1 |
| R4W | 26 | 12/13/04 | 0.01 | | 1.8 | 26.7 | 4.3 |
| R4W | 27 | 12/13/04 | 0.01 | | 0.68 | 27.3 | 4.5 |
| R4W | 29 | 12/13/04 | 0.03 | | 3.5 | 21.8 | 4.9 |
| R4W | 30 | 12/13/04 | 0.04 | | 0.18 | 27.2 | 2.4 |
| R4W | 32 | 12/13/04 | 0.02 | | 22.4 | 23.1 | 2.1 |
| R4W | 33 | 12/13/04 | 0.03 | | 0.24 | 19.7 | 1.4 |
| R4W | 35 | 12/13/04 | 0.02 | | 20.1 | 20.7 | 2.5 |
| R4W | 36 | 12/13/04 | 0.09 | | 0.11 | 13.2 | 1.7 |
| R4W | 38 | 12/13/04 | 0.01 | | 21.8 | 19.3 | 2.4 |
| R4W | 39 | 12/13/04 | 0.02 | | 12.8 | 21 | 1.7 |
| R4W | 41 | 12/13/04 | 0.02 | | 19.4 | 19.7 | 1.6 |
| R4W | 42 | 12/13/04 | 0.02 | | 21.2 | 19.8 | 2 |
| R4W | 44 | 12/13/04 | 0.01 | | 20.9 | 19.2 | 1.7 |
| R4W | 45 | 12/13/04 | 0.02 | | 20.7 | 19.5 | 2 |
| R4W | 47 | 12/13/04 | 0.01 | | 17 | 17.8 | 2.4 |
| R4W | 48 | 12/13/04 | 0.01 | | 13.2 | 19.2 | 2 |
| R4W | 50 | 12/13/04 | 0.01 | | 4.9 | 24.8 | 2.5 |
| R4W | 51 | 12/13/04 | 0.01 | | 3.2 | 22.6 | 2.4 |
| R4W | 53 | 12/13/04 | 0.01 | | 2.6 | 23.2 | 2.5 |
| R4W | 54 | 12/13/04 | 0.02 | | 0.76 | 27.1 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 56 | 12/13/04 | 0.04 | | 1.5 | 27.2 | 3 |
| R4W | 57 | 12/13/04 | 0.02 | | 0.44 | 28 | 2.2 |
| R4W | 59 | 12/13/04 | 0.04 | | 2.5 | 29 | 3 |
| R4W | 60 | 12/13/04 | 0.02 | | 1.9 | 33.7 | 3.1 |
| R4W | 62 | 12/13/04 | 0.02 | | 22.4 | 22.4 | 1.7 |
| R4W | 63 | 12/13/04 | 0.09 | | 5 | 24 | 1.8 |
| R4W | 65 | 12/13/04 | 0.01 | | 22.6 | 25.9 | 2.8 |
| R4W | 66 | 12/13/04 | 0.13 | | 18.7 | 24 | 1.8 |
| R4W | 68 | 12/13/04 | 0.03 | | 8.8 | 22.2 | 2.6 |
| R4W | 69 | 12/13/04 | 0.02 | | 7 | 22.6 | 2.2 |
| R4W | 71 | 12/13/04 | 0.03 | | 3.2 | 22.7 | 2.7 |
| R4W | 72 | 12/13/04 | 0.08 | | 0.37 | 27.3 | 2.9 |
| R5N | 2 | 12/13/04 | 0.01 | | 0.74 | 24.3 | 3.1 |
| R5N | 3 | 12/13/04 | 0.01 | | 4.1 | 10.8 | 3.7 |
| R5N | 5 | 12/13/04 | 0.01 | | 3.3 | 7.95 | 3.7 |
| R5N | 6 | 12/13/04 | 0.37 | | 0.3 | 18.6 | 6.6 |
| R5N | 8 | 12/13/04 | 0.01 | | 2 | 7.35 | 6.7 |
| R5N | 8 | 12/13/04 | 0.01 | | 2 | 7.09 | 6.6 |
| R5N | 9 | 12/13/04 | 0.01 | | 0.47 | 18.7 | 4.1 |
| R5N | 11 | 12/13/04 | 0.01 | | 3.1 | 11.8 | 5.7 |
| R5N | 12 | 12/13/04 | 0.01 | | 0.11 | 23 | 3.3 |
| R5N | 14 | 12/13/04 | 0.01 | | 4.2 | 12.2 | 5.4 |
| R5N | 15 | 12/13/04 | 0.01 | | 0.71 | 15.3 | 4.2 |
| R5N | 17 | 12/13/04 | 0.04 | | 1.8 | 7.97 | 4.2 |
| R5N | 18 | 12/13/04 | 0.02 | | 0.53 | 17.2 | 2.9 |
| R5N | 20 | 12/13/04 | 0.02 | | 0.59 | 9.36 | 3.9 |
| R5N | 21 | 12/13/04 | 0.01 | | 0.17 | 10.8 | 3 |
| R5N | 23 | 12/13/04 | 0.01 | | 1.3 | 8.41 | 4.3 |
| R5N | 24 | 12/13/04 | 0.01 | | 1 | 12.1 | 3.1 |
| R5N | 29 | 12/13/04 | 0.02 | | 0.01 | 18.7 | 6.3 |
| R5N | 30 | 12/13/04 | 0.1 | | 0.19 | 23.8 | 4.2 |
| R5N | 32 | 12/13/04 | 0.02 | | 1.4 | 13.4 | 4.3 |
| R5N | 33 | 12/13/04 | 0.01 | | 0.02 | 23 | 3.5 |
| R5N | 35 | 12/13/04 | 0.04 | | 7.6 | 6.84 | 4.1 |
| R5N | 36 | 12/13/04 | 0.01 | | 0.77 | 12.1 | 4.3 |
| R5N | 38 | 12/13/04 | 0.02 | | 4.9 | 7.12 | 6.7 |
| R5N | 39 | 12/13/04 | 0.03 | | 0.71 | 17.9 | 3.8 |
| R5N | 39 | 12/13/04 | 0.02 | | 0.7 | 17.5 | 3.9 |
| R5N | 41 | 12/13/04 | 0.02 | | 1.7 | 11.6 | 6.5 |
| R5N | 42 | 12/13/04 | 0.02 | | 0.73 | 26.5 | 3.4 |
| R5N | 44 | 12/13/04 | 0.01 | | 6.3 | 12.6 | 4.6 |
| R5N | 45 | 12/13/04 | 0.01 | | 2.2 | 13 | 3.8 |
| R5N | 47 | 12/13/04 | 0.01 | | 0.87 | 7.16 | 4.9 |
| R5N | 48 | 12/13/04 | 0.02 | | 0.19 | 14 | 3.1 |
| R5N | 50 | 12/13/04 | 0.03 | | 0.9 | 5.72 | 5.4 |
| R5N | 51 | 12/13/04 | 0.01 | | 0.2 | 13.2 | 3.9 |
| R5N | 53 | 12/13/04 | 0.02 | | 0.01 | 11.5 | 5.4 |
| R5N | 54 | 12/13/04 | 0.01 | | 1.8 | 15.6 | 3.3 |
| R5N | 56 | 12/13/04 | 0.02 | | 0.23 | 9.53 | 4.1 |
| R5N | 57 | 12/13/04 | 0.02 | | 0.02 | 16.8 | 3.4 |
| R5N | 59 | 12/13/04 | 0.02 | | 1.5 | 8.15 | 3.5 |
| R5N | 60 | 12/13/04 | 0.04 | | 0.02 | 11.2 | 4.4 |
| R5N | 62 | 12/13/04 | 0.01 | | 4.4 | 8.82 | 4.2 |
| R5N | 63 | 12/13/04 | 0.01 | | 0.22 | 18.9 | 3.7 |
| R5N | 65 | 12/13/04 | 0.02 | | 0.77 | 9.1 | 6.8 |
| R5N | 66 | 12/13/04 | 0.01 | | 0.21 | 30.5 | 2.8 |
| R5N | 68 | 12/13/04 | 0.01 | | 1.4 | 7.53 | 5.6 |
| R5N | 69 | 12/13/04 | 0.01 | | 7.4 | 12.3 | 3 |
| R5N | 71 | 12/13/04 | 0.01 | | 0.41 | 8.4 | 3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 72 | 12/13/04 | 0.02 | | 0.01 | 13.7 | 3.3 |
| R5N | Stream | 12/13/04 | 0.04 | | 1.1 | 21.1 | 11.5 |
| R1N | Stream | 1/20/05 | 0.09 | | 5.8 | 17.8 | 6.8 |
| R1N | 2 | 1/20/05 | 0.09 | | 6.4 | 21.1 | 2.4 |
| R1N | 3 | 1/20/05 | 0.12 | | 0.03 | 6.44 | 1.5 |
| R1N | 5 | 1/20/05 | 0.02 | | 4.4 | 26.2 | 1.6 |
| R1N | 6 | 1/20/05 | 0.05 | | 0.01 | 14.8 | 3 |
| R1N | 8 | 1/20/05 | 0.07 | | 8 | 18.2 | 1.8 |
| R1N | 9 | 1/20/05 | 0.04 | | 0.29 | 20.9 | 2 |
| R1N | 11 | 1/20/05 | 0.04 | | 8.1 | 15.3 | 1.8 |
| R1N | 12 | 1/20/05 | 0.04 | | 5.3 | 22.3 | 1.7 |
| R1N | 17 | 1/20/05 | 0.01 | | 6.4 | 15.9 | 2.4 |
| R1N | 18 | 1/20/05 | 0.02 | | 3.8 | 19 | 2 |
| R1N | 20 | 1/20/05 | 0.02 | | 1.1 | 16.1 | 2.5 |
| R1N | 21 | 1/20/05 | 0.08 | | 0.01 | 14.8 | 1.8 |
| R1N | 23 | 1/20/05 | 0.12 | | 3.7 | 9.88 | 3.4 |
| R1N | 24 | 1/20/05 | 0.35 | | 0.02 | 10.9 | 2.5 |
| R1N | 24 | 1/20/05 | 0.39 | | 0.02 | 11.4 | 1.8 |
| R1N | 26 | 1/20/05 | 0.03 | | 11.7 | 17.5 | 1.6 |
| R1N | 27 | 1/20/05 | 0.01 | | 7.6 | 13.1 | 1.6 |
| R1N | 29 | 1/20/05 | 0.02 | | 11.7 | 17.9 | 2.3 |
| R1N | 30 | 1/20/05 | 0.06 | | 0.19 | 15.2 | 2 |
| R1N | 32 | 1/20/05 | 0.07 | | 4.5 | 16.5 | 2.2 |
| R1N | 33 | 1/20/05 | 0.33 | | 0.01 | 6.73 | 2.7 |
| R1N | 35 | 1/20/05 | 0.02 | | 8.7 | 68.2 | 4.1 |
| R1N | 36 | 1/20/05 | 0.02 | | 3.8 | 15.1 | 1.5 |
| R1N | 38 | 1/20/05 | 0.07 | | 8.2 | 19.2 | 1.7 |
| R1N | 39 | 1/20/05 | 0.05 | | 6.9 | 19.5 | 1.6 |
| R1N | 41 | 1/20/05 | 0.04 | | 8.3 | 16 | 1.5 |
| R1N | 42 | 1/20/05 | 0.02 | | 5.5 | 19.3 | 1.6 |
| R1N | 47 | 1/20/05 | 0.01 | | 9.1 | 18.2 | 1.2 |
| R1N | 48 | 1/20/05 | 0.03 | | 5.1 | 24 | 1.9 |
| R1N | 48 | 1/20/05 | 0.03 | | 5.2 | 23.8 | 1.8 |
| R1N | 50 | 1/20/05 | 0.05 | | 8.5 | 11.2 | 2.8 |
| R1N | 51 | 1/20/05 | 0.01 | | 5.5 | 16.4 | 1.4 |
| R1N | 54 | 1/20/05 | 0.02 | | 10.6 | 9.93 | 1.6 |
| R1N | 57 | 1/20/05 | 0.02 | | 10.8 | 11.3 | 1.9 |
| R1N | 59 | 1/20/05 | 0.15 | | 8.4 | 6.31 | 4.1 |
| R1N | 60 | 1/20/05 | 0.01 | | 10.7 | 19.7 | 2.3 |
| R1N | 62 | 1/20/05 | 0.02 | | 6.9 | 15.7 | 2 |
| R1N | 63 | 1/20/05 | 0.01 | | 3.4 | 16 | 1.3 |
| R1N | 66 | 1/20/05 | 0.02 | | 5.2 | 18.7 | 1.4 |
| R1N | 68 | 1/20/05 | 0.02 | | 11.2 | 8.71 | 1.5 |
| R1N | 69 | 1/20/05 | 0.01 | | 8.3 | 16.5 | 1.4 |
| R1N | 71 | 1/20/05 | 0.05 | | 6.4 | 19.7 | 2.6 |
| R1N | 72 | 1/20/05 | 0.02 | | 6.2 | 19.4 | 2.2 |
| R2N | Stream | 1/20/05 | 0.68 | | 1.9 | 5.14 | 13.4 |
| R2N | 2 | 1/20/05 | 0.05 | | 2.7 | 5.28 | 3.4 |
| R2N | 3 | 1/20/05 | 0.01 | | 2.7 | 7.07 | 2.2 |
| R2N | 5 | 1/20/05 | 0.4 | | 2.4 | 74.4 | 6.9 |
| R2N | 6 | 1/20/05 | 0.03 | | 3.3 | 17.4 | 2.5 |
| R2N | 8 | 1/20/05 | 0.03 | | 3.7 | 11.1 | 2.5 |
| R2N | 9 | 1/20/05 | 0.02 | | 3 | 25.5 | 1.9 |
| R2N | 11 | 1/20/05 | 0.21 | | 2 | 7.14 | 3.8 |
| R2N | 12 | 1/20/05 | 0.18 | | 3.7 | 24 | 2.8 |
| R2N | 14 | 1/20/05 | 0.45 | | 1.4 | 8.91 | 5.1 |
| R2N | 15 | 1/20/05 | 0.08 | | 2.4 | 27.4 | 3.1 |
| R2N | 17 | 1/20/05 | 0.05 | | 0.02 | 9.02 | 2.3 |
| R2N | 18 | 1/20/05 | 0.09 | | 0.91 | 5.82 | 6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 20 | 1/20/05 | 0.04 | | 0.02 | 10.9 | 2 |
| R2N | 21 | 1/20/05 | 0.01 | | 1.3 | 6.49 | 5.3 |
| R2N | 23 | 1/20/05 | 0.08 | | 0.01 | 15.6 | 1.7 |
| R2N | 24 | 1/20/05 | 0.1 | | 0.21 | 5.29 | 7.6 |
| R2N | 26 | 1/20/05 | 0.12 | | 0.01 | 17.9 | 2 |
| R2N | 27 | 1/20/05 | 0.05 | | 0.99 | 5.97 | 4 |
| R2N | 29 | 1/20/05 | 0.04 | | 0.01 | 20.8 | 1.7 |
| R2N | 30 | 1/20/05 | 0.06 | | 6.4 | 18.5 | 2.9 |
| R2N | 32 | 1/20/05 | 0.07 | | 2.4 | 6.76 | 3.1 |
| R2N | 33 | 1/20/05 | 0.03 | | 0.32 | 16.3 | 2.2 |
| R2N | 35 | 1/20/05 | 0.22 | | 2.3 | 3.23 | 5.5 |
| R2N | 36 | 1/20/05 | 0.05 | | 3.2 | 21.1 | 2.4 |
| R2N | 38 | 1/20/05 | 0.03 | | 3.1 | 44 | 4.3 |
| R2N | 39 | 1/20/05 | 0.01 | | 3.3 | 93.1 | 3.9 |
| R2N | 41 | 1/20/05 | 0.05 | | 2.5 | 4.49 | 2.8 |
| R2N | 42 | 1/20/05 | 0.01 | | 3.6 | 15.6 | 2.5 |
| R2N | 44 | 1/20/05 | 0.09 | | 2.8 | 6.02 | 3.3 |
| R2N | 45 | 1/20/05 | 0.06 | | 3 | 22 | 2.3 |
| R2N | 47 | 1/20/05 | 0.02 | | 13.3 | 32.2 | 2.9 |
| R2N | 48 | 1/20/05 | 0.01 | | 8.8 | 28.9 | 2.1 |
| R2N | 50 | 1/20/05 | 0.07 | | 15.7 | 27.5 | 3.1 |
| R2N | 51 | 1/20/05 | 0.02 | | 8 | 33.1 | 2.4 |
| R2N | 53 | 1/20/05 | 0.1 | | 9.6 | 32.7 | 3.9 |
| R2N | 54 | 1/20/05 | 0.02 | | 6.7 | 28 | 2.3 |
| R2N | 56 | 1/20/05 | 0.24 | | 9.7 | 12.9 | 3.8 |
| R2N | 57 | 1/20/05 | 0.04 | | 10.5 | 32.7 | 3.1 |
| R2N | 59 | 1/20/05 | 0.49 | | 4.7 | 11.3 | 3.6 |
| R2N | 60 | 1/20/05 | 0.03 | | 3.4 | 19.6 | 2.3 |
| R2N | 63 | 1/20/05 | 0.01 | | 4.2 | 23.8 | 1.7 |
| R2N | 66 | 1/20/05 | 0.02 | | 2.7 | 27.2 | 1.5 |
| R2N | 69 | 1/20/05 | 0.03 | | 6 | 25.9 | 2.1 |
| R2N | 72 | 1/20/05 | 0.01 | | 8.8 | 31.5 | 2 |
| R4W | 2 | 1/20/05 | 0.02 | | 19.6 | 20.5 | 1.8 |
| R4W | 3 | 1/20/05 | 0.03 | | 0 | 27.8 | 1.8 |
| R4W | 5 | 1/20/05 | 0.01 | | 19.3 | 19.3 | 2.1 |
| R4W | 6 | 1/20/05 | 0.03 | | -0.01 | 26.8 | 1.5 |
| R4W | 8 | 1/20/05 | 0.01 | | 20 | 22 | 1.7 |
| R4W | 9 | 1/20/05 | 0.02 | | 0.03 | 11.6 | 1.5 |
| R4W | 11 | 1/20/05 | 0.01 | | 19.5 | 18.5 | 1.8 |
| R4W | 12 | 1/20/05 | 0.12 | | 5.5 | 20.9 | 3.1 |
| R4W | 14 | 1/20/05 | 0.01 | | 16.4 | 19.4 | 1.7 |
| R4W | 15 | 1/20/05 | 0.01 | | 10.2 | 21.7 | 2.2 |
| R4W | 17 | 1/20/05 | 0.01 | | 1.9 | 24.9 | 2.3 |
| R4W | 18 | 1/20/05 | 0.04 | | 0.22 | 17.6 | 1.8 |
| R4W | 20 | 1/20/05 | 0.01 | | 1.7 | 28.1 | 3 |
| R4W | 21 | 1/20/05 | 0.07 | | -0.01 | 9.61 | 2 |
| R4W | 23 | 1/20/05 | 0.01 | | 1.9 | 24.5 | 3.4 |
| R4W | 24 | 1/20/05 | 0.01 | | 1.5 | 24.8 | 2.7 |
| R4W | 26 | 1/20/05 | 0 | | 3.6 | 21.4 | 4.1 |
| R4W | 27 | 1/20/05 | 0 | | 2.3 | 22.2 | 4.5 |
| R4W | 29 | 1/20/05 | 0.01 | | 3.6 | 20.4 | 4.8 |
| R4W | 30 | 1/20/05 | 0.02 | | 0.02 | 28.3 | 2.2 |
| R4W | 32 | 1/20/05 | 0.01 | | 20.7 | 20.7 | 1.8 |
| R4W | 33 | 1/20/05 | 0.02 | | 0.85 | 20.8 | 1.4 |
| R4W | 35 | 1/20/05 | 0.01 | | 21.4 | 18.8 | 2.3 |
| R4W | 36 | 1/20/05 | 0.07 | | 0.13 | 12.2 | 1.6 |
| R4W | 38 | 1/20/05 | 0.01 | | 20.7 | 20.5 | 1.9 |
| R4W | 39 | 1/20/05 | 0.01 | | 14.6 | 26.4 | 1.9 |
| R4W | 41 | 1/20/05 | 0.01 | | 18.7 | 19.6 | 2.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 42 | 1/20/05 | 0.01 | | 17 | 20.2 | 2.2 |
| R4W | 44 | 1/20/05 | 0.01 | | 22.4 | 19.1 | 2.2 |
| R4W | 45 | 1/20/05 | 0.01 | | 22.3 | 19.4 | 1.4 |
| R4W | 47 | 1/20/05 | 0.01 | | 13 | 19.6 | 1.8 |
| R4W | 48 | 1/20/05 | 0.01 | | 9.6 | 22.6 | 2.4 |
| R4W | 50 | 1/20/05 | 0.05 | | 3.6 | 23.8 | 2.6 |
| R4W | 51 | 1/20/05 | 0.01 | | 2.4 | 23.8 | 2 |
| R4W | 53 | 1/20/05 | 0.01 | | 1.6 | 23.3 | 3.5 |
| R4W | 54 | 1/20/05 | 0.01 | | 0.3 | 27.7 | 2.7 |
| R4W | 56 | 1/20/05 | 0.07 | | 1.8 | 28.7 | 3 |
| R4W | 57 | 1/20/05 | 0.02 | | 0.55 | 28.4 | 1.9 |
| R4W | 59 | 1/20/05 | 0.02 | | 1.9 | 28 | 3.5 |
| R4W | 60 | 1/20/05 | 0.02 | | 1.6 | 27.9 | 3 |
| R4W | 62 | 1/20/05 | 0.01 | | 21.6 | 20.8 | 1.8 |
| R4W | 63 | 1/20/05 | 0.03 | | 7.6 | 31.5 | 1.7 |
| R4W | 65 | 1/20/05 | 0.01 | | 22.3 | 18.6 | 2.7 |
| R4W | 66 | 1/20/05 | 0.02 | | 19 | 22.5 | 2.7 |
| R4W | 68 | 1/20/05 | 0.05 | | 8.1 | 22.2 | 2.5 |
| R4W | 69 | 1/20/05 | 0.01 | | 7 | 22.9 | 2 |
| R4W | 71 | 1/20/05 | 0.02 | | 2.6 | 21.7 | 3.7 |
| R4W | 72 | 1/20/05 | 0.02 | | 0.16 | 27.8 | 6.8 |
| R4W | Stream | 1/20/05 | 0.28 | | 1.7 | 16 | 7.3 |
| R5N | 2 | 1/20/05 | 0.01 | | 3.2 | 12.7 | 3.6 |
| R5N | 3 | 1/20/05 | 0 | | 0.53 | 19.2 | 2.9 |
| R5N | 5 | 1/20/05 | 0.01 | | 0.74 | 13.4 | 3.9 |
| R5N | 6 | 1/20/05 | 0.11 | | 0.29 | 16.2 | 4 |
| R5N | 8 | 1/20/05 | 0 | | 3 | 7.13 | 5.6 |
| R5N | 9 | 1/20/05 | 0 | | 0.36 | 18.6 | 3.8 |
| R5N | 11 | 1/20/05 | 0.01 | | 2.1 | 12 | 4.5 |
| R5N | 12 | 1/20/05 | 0.01 | | 0.49 | 28.6 | 4.9 |
| R5N | 14 | 1/20/05 | 0.01 | | 1.8 | 9.35 | 4.4 |
| R5N | 15 | 1/20/05 | 0.01 | | 0.51 | 15.3 | 3.1 |
| R5N | 17 | 1/20/05 | 0.01 | | 1.2 | 9.55 | 3.2 |
| R5N | 18 | 1/20/05 | 0.01 | | 1.8 | 17.3 | 2.4 |
| R5N | 20 | 1/20/05 | 0.01 | | 0.36 | 10.1 | 3.1 |
| R5N | 21 | 1/20/05 | 0.01 | | 3.4 | 12.6 | 2.7 |
| R5N | 23 | 1/20/05 | 0.01 | | 0.82 | 7.98 | 3.8 |
| R5N | 24 | 1/20/05 | 0 | | 0.31 | 10.5 | 2.5 |
| R5N | 26 | 1/20/05 | 0 | | -0.01 | 8.65 | 3.4 |
| R5N | 27 | 1/20/05 | 0.02 | | 0 | 17.9 | 2.4 |
| R5N | 29 | 1/20/05 | 0.01 | | -0.01 | 21.9 | 5 |
| R5N | 30 | 1/20/05 | 0.02 | | -0.01 | 23.7 | 3.4 |
| R5N | 32 | 1/20/05 | 0.02 | | 1.1 | 20.5 | 4.8 |
| R5N | 33 | 1/20/05 | 0 | | -0.01 | 19.8 | 3.1 |
| R5N | 35 | 1/20/05 | 0.01 | | 7.1 | 6.87 | 2.6 |
| R5N | 36 | 1/20/05 | 0 | | 0.64 | 11 | 4.1 |
| R5N | 38 | 1/20/05 | 0.01 | | 5 | 6.75 | 5.1 |
| R5N | 39 | 1/20/05 | 0.01 | | 0.83 | 18.1 | 3.3 |
| R5N | 41 | 1/20/05 | 0.02 | | 1.1 | 12.1 | 6.3 |
| R5N | 42 | 1/20/05 | 0.02 | | 2 | 33.3 | 2.9 |
| R5N | 44 | 1/20/05 | 0.01 | | 8.7 | 13.1 | 4.5 |
| R5N | 45 | 1/20/05 | 0.01 | | 1.4 | 15.4 | 2.9 |
| R5N | 47 | 1/20/05 | 0 | | 1.2 | 7.88 | 4 |
| R5N | 48 | 1/20/05 | 0.01 | | -0.01 | 10.5 | 3.4 |
| R5N | 50 | 1/20/05 | 0.01 | | 0.81 | 5.42 | 4.3 |
| R5N | 51 | 1/20/05 | 0.01 | | 0.12 | 8.42 | 2.3 |
| R5N | 53 | 1/20/05 | 0.01 | | -0.01 | 19.5 | 3.4 |
| R5N | 54 | 1/20/05 | 0.01 | | 1.4 | 9.48 | 2.3 |
| R5N | 56 | 1/20/05 | 0.01 | | 0.21 | 9.76 | 3.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 57 | 1/20/05 | 0.01 | | 1.2 | 6.88 | 3.4 |
| R5N | 59 | 1/20/05 | 0.01 | | 0.2 | 9.82 | 3.8 |
| R5N | 60 | 1/20/05 | 0.03 | | -0.01 | 8.51 | 4.1 |
| R5N | 62 | 1/20/05 | 0 | | 4.2 | 8.59 | 3.3 |
| R5N | 63 | 1/20/05 | 0 | | 0.02 | 19.2 | 3.4 |
| R5N | 65 | 1/20/05 | 0.04 | | 0.86 | 12 | 5.7 |
| R5N | 66 | 1/20/05 | 0.01 | | 0 | 31.7 | 2.9 |
| R5N | 68 | 1/20/05 | 0.01 | | 1.3 | 7.56 | 5.2 |
| R5N | 69 | 1/20/05 | 0.01 | | 7.3 | 12.4 | 2.9 |
| R5N | 71 | 1/20/05 | 0.01 | | 0.64 | 9.38 | 3.2 |
| R5N | 72 | 1/20/05 | 0.01 | | -0.01 | 12.5 | 2.4 |
| R5N | Stream | 1/20/05 | 0.01 | | 3.2 | 100.5 | 13.8 |
| R1N | 2 | 2/15/05 | 0.09 | | 6.1 | 16 | 2.5 |
| R1N | 3 | 2/15/05 | 0.33 | | -0.01 | 5.31 | 2 |
| R1N | 5 | 2/15/05 | 0.02 | | 3.2 | 13.7 | 1.6 |
| R1N | 6 | 2/15/05 | 0.15 | | -0.01 | 19.8 | 3 |
| R1N | 8 | 2/15/05 | 0.17 | | 7.9 | 16 | 2.6 |
| R1N | 9 | 2/15/05 | 0.05 | | 0 | 19.5 | 1.7 |
| R1N | 11 | 2/15/05 | 0.19 | | 7.2 | 14 | 3 |
| R1N | 12 | 2/15/05 | 0.06 | | 5.3 | 16 | 1.9 |
| R1N | 17 | 2/15/05 | 0.01 | | 6.1 | 16.5 | 1.4 |
| R1N | 18 | 2/15/05 | 0.04 | | 1.6 | 15.9 | 1.5 |
| R1N | 20 | 2/15/05 | 0.02 | | 0.12 | 14 | 1.8 |
| R1N | 21 | 2/15/05 | 0.1 | | 0.01 | 14.7 | 2.1 |
| R1N | 23 | 2/15/05 | 0.26 | | 2.7 | 8.93 | 5.6 |
| R1N | 24 | 2/15/05 | 0.27 | | -0.01 | 9.6 | 1.4 |
| R1N | 26 | 2/15/05 | 0 | | 10.8 | 9.54 | 1.6 |
| R1N | 27 | 2/15/05 | 0.01 | | 5 | 16.8 | 1.5 |
| R1N | 29 | 2/15/05 | 0.01 | | 12 | 17.7 | 1.6 |
| R1N | 30 | 2/15/05 | 0.11 | | 0 | 9.55 | 2.1 |
| R1N | 32 | 2/15/05 | 0.12 | | 3.7 | 14.4 | 1.9 |
| R1N | 33 | 2/15/05 | 0.31 | | -0.01 | 5.08 | 2 |
| R1N | 35 | 2/15/05 | 0.01 | | 7.6 | 15.6 | 1.8 |
| R1N | 36 | 2/15/05 | 0.01 | | 3.1 | 14.6 | 2.4 |
| R1N | 38 | 2/15/05 | 0.07 | | 8.3 | 16.5 | 2 |
| R1N | 39 | 2/15/05 | 0.03 | | 7.3 | 17.9 | 1.7 |
| R1N | 41 | 2/15/05 | 0.05 | | 8.1 | 12.8 | 1.8 |
| R1N | 42 | 2/15/05 | 0.02 | | 5.9 | 17.6 | 2.2 |
| R1N | 47 | 2/15/05 | 0 | | 7.7 | 15.6 | 1.7 |
| R1N | 48 | 2/15/05 | 0.01 | | 4.5 | 20.5 | 1.6 |
| R1N | 50 | 2/15/05 | 0.12 | | 7 | 12 | 3 |
| R1N | 51 | 2/15/05 | 0.01 | | 5.2 | 15.9 | 1.2 |
| R1N | 54 | 2/15/05 | 0.01 | | 10.3 | 7.46 | 1.5 |
| R1N | 57 | 2/15/05 | 0.01 | | 9.7 | 8.21 | 1.5 |
| R1N | 59 | 2/15/05 | 0.19 | | 7.4 | 5.86 | 5.2 |
| R1N | 60 | 2/15/05 | 0 | | 10.7 | 18.1 | 2 |
| R1N | 62 | 2/15/05 | 0.01 | | 6.5 | 12.9 | 1.3 |
| R1N | 63 | 2/15/05 | 0.01 | | 2.6 | 12.2 | 1.7 |
| R1N | 66 | 2/15/05 | 0.01 | | 5.4 | 16.2 | 1.4 |
| R1N | 68 | 2/15/05 | 0.03 | | 10.5 | 7.57 | 1.6 |
| R1N | 69 | 2/15/05 | 0 | | 6.7 | 9.28 | 1.4 |
| R1N | 72 | 2/15/05 | 0.01 | | 6.8 | 17.4 | 1.8 |
| R1N | Stream | 2/15/05 | 0.07 | | 5.8 | 14.7 | 4.7 |
| R2N | 2 | 2/15/05 | 0.03 | | 2.7 | 5.06 | 2.7 |
| R2N | 3 | 2/15/05 | 0.01 | | 2.8 | 10.8 | 1.8 |
| R2N | 5 | 2/15/05 | 0.29 | | 2.7 | 4.92 | 3.9 |
| R2N | 6 | 2/15/05 | 0.02 | | 2.6 | 13.8 | 1.7 |
| R2N | 8 | 2/15/05 | 0.03 | | 3.7 | 9.18 | 2.2 |
| R2N | 9 | 2/15/05 | 0.01 | | 3 | 23.5 | 1.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 11 | 2/15/05 | 0.16 | | 3.3 | 10 | 2.7 |
| R2N | 12 | 2/15/05 | 0.09 | | 4.4 | 23.4 | 1.9 |
| R2N | 12 | 2/15/05 | 0.09 | | 4.5 | 23 | 2.3 |
| R2N | 14 | 2/15/05 | 0.29 | | 2.4 | 13.8 | 2.8 |
| R2N | 15 | 2/15/05 | 0.05 | | 2.6 | 23.3 | 1.8 |
| R2N | 17 | 2/15/05 | 0.03 | | -0.01 | 5.73 | 4.8 |
| R2N | 18 | 2/15/05 | 0.03 | | -0.01 | 9.73 | 2 |
| R2N | 20 | 2/15/05 | 0.01 | | 0.02 | 6.53 | 6.5 |
| R2N | 21 | 2/15/05 | 0.05 | | -0.01 | 15.7 | 1.9 |
| R2N | 23 | 2/15/05 | 0.09 | | -0.01 | 4.96 | 5 |
| R2N | 24 | 2/15/05 | 0.06 | | -0.01 | 16.5 | 1.1 |
| R2N | 26 | 2/15/05 | 0.05 | | 2.1 | 7.28 | 3.2 |
| R2N | 27 | 2/15/05 | 0.03 | | -0.01 | 18.8 | 1.8 |
| R2N | 29 | 2/15/05 | 0.05 | | 4.9 | 15.3 | 2.8 |
| R2N | 30 | 2/15/05 | 0.03 | | -0.01 | 8.08 | 1.8 |
| R2N | 32 | 2/15/05 | 0.03 | | 2.5 | 5.72 | 2.2 |
| R2N | 33 | 2/15/05 | 0.02 | | 0.23 | 14.2 | 2 |
| R2N | 35 | 2/15/05 | 0.35 | | 2.5 | 2.66 | 5.4 |
| R2N | 36 | 2/15/05 | 0.02 | | 3.5 | 20.9 | 1.6 |
| R2N | 38 | 2/15/05 | 0.04 | | 2.9 | 6.06 | 2.2 |
| R2N | 39 | 2/15/05 | 0.05 | | 3.4 | 25.2 | 1.6 |
| R2N | 41 | 2/15/05 | 0.05 | | 2.7 | 3.26 | 2.6 |
| R2N | 41 | 2/15/05 | 0.04 | | 2.7 | 1.98 | 2.9 |
| R2N | 42 | 2/15/05 | 0.01 | | 4 | 17.6 | 2.1 |
| R2N | 44 | 2/15/05 | 0.36 | | 2.3 | 6.93 | 5.1 |
| R2N | 45 | 2/15/05 | 0.03 | | 2.9 | 17.9 | 2 |
| R2N | 47 | 2/15/05 | 0.01 | | 11.3 | 29.2 | 2.1 |
| R2N | 48 | 2/15/05 | 0.08 | | 6.9 | 26.3 | 2.3 |
| R2N | 50 | 2/15/05 | 0.05 | | 16.7 | 34.3 | 2.7 |
| R2N | 51 | 2/15/05 | 0.02 | | 8.2 | 27.4 | 2.3 |
| R2N | 53 | 2/15/05 | 0.06 | | 10.5 | 33 | 3.1 |
| R2N | 54 | 2/15/05 | 0.02 | | 7.7 | 29.8 | 2.3 |
| R2N | 56 | 2/15/05 | 0.13 | | 16.4 | 37.7 | 4 |
| R2N | 57 | 2/15/05 | 0.01 | | 10.1 | 33.1 | 2.6 |
| R2N | 59 | 2/15/05 | 0.1 | | 10.7 | 29.1 | 2.5 |
| R2N | 60 | 2/15/05 | 0.01 | | 3.8 | 19 | 2.5 |
| R2N | 66 | 2/15/05 | 0.05 | | 3 | 28.5 | 2.6 |
| R2N | 69 | 2/15/05 | 0.02 | | 5.2 | 19.6 | 2.1 |
| R2N | 72 | 2/15/05 | 0.02 | | 7.1 | 27.5 | 2 |
| R4W | 2 | 2/15/05 | 0.02 | | 18.4 | 19.9 | 2.2 |
| R4W | 3 | 2/15/05 | 0.09 | | 0.14 | 28.9 | 2.2 |
| R4W | 5 | 2/15/05 | 0.07 | | 18.1 | 19.3 | 2.4 |
| R4W | 6 | 2/15/05 | 0.05 | | -0.01 | 26.3 | 1 |
| R4W | 8 | 2/15/05 | 0.01 | | 19.6 | 21.8 | 2.4 |
| R4W | 9 | 2/15/05 | 0.02 | | 0.02 | 11.5 | 1.5 |
| R4W | 11 | 2/15/05 | 0.01 | | 19.4 | 18.8 | 2.3 |
| R4W | 12 | 2/15/05 | 0.04 | | 3.2 | 19.6 | 2.3 |
| R4W | 14 | 2/15/05 | 0.01 | | 15.3 | 18.8 | 1.9 |
| R4W | 15 | 2/15/05 | 0.01 | | 9.6 | 21.8 | 2.1 |
| R4W | 17 | 2/15/05 | 0.01 | | 1.9 | 24 | 1.9 |
| R4W | 18 | 2/15/05 | 0.03 | | 0.03 | 17.1 | 1.1 |
| R4W | 20 | 2/15/05 | 0 | | 1.9 | 25.3 | 2.9 |
| R4W | 21 | 2/15/05 | 0.07 | | -0.01 | 9.21 | 2 |
| R4W | 23 | 2/15/05 | 0 | | 2.4 | 22.4 | 4.4 |
| R4W | 24 | 2/15/05 | 0.01 | | 1.9 | 22.1 | 3.2 |
| R4W | 26 | 2/15/05 | 0 | | 4 | 19.4 | 4.3 |
| R4W | 27 | 2/15/05 | 0 | | 1.8 | 20.7 | 3.9 |
| R4W | 29 | 2/15/05 | 0 | | 5.4 | 18.6 | 4.6 |
| R4W | 30 | 2/15/05 | 0.01 | | 0.03 | 26 | 2 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 32 | 2/15/05 | 0.01 | | 19.8 | 20.1 | 1.8 |
| R4W | 33 | 2/15/05 | 0.02 | | 2.6 | 21.1 | 2.2 |
| R4W | 35 | 2/15/05 | 0.01 | | 20.2 | 18.7 | 2.9 |
| R4W | 36 | 2/15/05 | 0.05 | | 0.03 | 11.9 | 2.3 |
| R4W | 38 | 2/15/05 | 0.01 | | 19.6 | 43.6 | 2.7 |
| R4W | 39 | 2/15/05 | 0.01 | | 14.9 | 20.6 | 1.7 |
| R4W | 41 | 2/15/05 | 0.01 | | 18.2 | 19.1 | 1.8 |
| R4W | 42 | 2/15/05 | 0.01 | | 16.4 | 19.5 | 2 |
| R4W | 44 | 2/15/05 | 0.01 | | 21.1 | 18.5 | 1.9 |
| R4W | 45 | 2/15/05 | 0.01 | | 21.6 | 18.7 | 1.7 |
| R4W | 47 | 2/15/05 | 0.01 | | 12.6 | 19.5 | 2 |
| R4W | 48 | 2/15/05 | 0 | | 10.7 | 68.4 | 3.5 |
| R4W | 50 | 2/15/05 | 0.01 | | 3.5 | 22.6 | 2.7 |
| R4W | 51 | 2/15/05 | 0.01 | | 2.4 | 23.9 | 2.7 |
| R4W | 53 | 2/15/05 | 0 | | 1.2 | 24.1 | 2.3 |
| R4W | 54 | 2/15/05 | 0.01 | | 0.28 | 27.4 | 2.3 |
| R4W | 56 | 2/15/05 | 0.11 | | 1.9 | 29.1 | 3.1 |
| R4W | 57 | 2/15/05 | 0.02 | | 0.21 | 28.2 | 2.2 |
| R4W | 59 | 2/15/05 | 0.01 | | 2 | 28 | 3.2 |
| R4W | 60 | 2/15/05 | 0.03 | | 1.7 | 29.7 | 2.7 |
| R4W | 62 | 2/15/05 | 0.01 | | 21.1 | 20.1 | 1.3 |
| R4W | 63 | 2/15/05 | 0.03 | | 7.9 | 23.5 | 1.9 |
| R4W | 65 | 2/15/05 | 0.01 | | 21.7 | 43.5 | 3.3 |
| R4W | 66 | 2/15/05 | 0.02 | | 17.8 | 21.7 | 1.8 |
| R4W | 68 | 2/15/05 | 0.07 | | 7.6 | 21 | 2.1 |
| R4W | 69 | 2/15/05 | 0.01 | | 7.3 | 22.8 | 2 |
| R4W | 71 | 2/15/05 | 0.01 | | 2.3 | 21.8 | 2.1 |
| R4W | 72 | 2/15/05 | 0.03 | | 0.21 | 81 | 5.2 |
| R4W | Stream | 2/15/05 | 0.77 | | 0.45 | 12.8 | 8.2 |
| R5N | 2 | 2/15/05 | 0.01 | | 2.3 | 13.4 | 3.4 |
| R5N | 3 | 2/15/05 | 0.01 | | 0.53 | 18.6 | 2.8 |
| R5N | 5 | 2/15/05 | 0.01 | | 0.42 | 13.4 | 3.5 |
| R5N | 6 | 2/15/05 | 0.01 | | 0.3 | 16.3 | 3 |
| R5N | 8 | 2/15/05 | 0.01 | | 3 | 7.62 | 6.2 |
| R5N | 9 | 2/15/05 | 0.01 | | 0.28 | 19.5 | 3.6 |
| R5N | 11 | 2/15/05 | 0 | | 2.3 | 11.7 | 4.4 |
| R5N | 12 | 2/15/05 | 0.01 | | 0.75 | 29.8 | 2.5 |
| R5N | 14 | 2/15/05 | 0.01 | | 2.4 | 10.3 | 4.9 |
| R5N | 15 | 2/15/05 | 0.01 | | 0.01 | 14.4 | 3.1 |
| R5N | 17 | 2/15/05 | 0.01 | | 1.1 | 9.93 | 3.3 |
| R5N | 18 | 2/15/05 | 0.01 | | 1.9 | 15.7 | 2.5 |
| R5N | 20 | 2/15/05 | 0.01 | | 0.4 | 9.62 | 3.1 |
| R5N | 21 | 2/15/05 | 0.02 | | 2.2 | 11.8 | 2.7 |
| R5N | 23 | 2/15/05 | 0 | | 0.75 | 8.51 | 3.8 |
| R5N | 24 | 2/15/05 | 0.01 | | 0.59 | 9.71 | 2.5 |
| R5N | 26 | 2/15/05 | 0.01 | | -0.01 | 8.89 | 2.9 |
| R5N | 27 | 2/15/05 | 0.02 | | -0.01 | 8.3 | 1.6 |
| R5N | 29 | 2/15/05 | 0.01 | | -0.01 | 13.5 | 4.5 |
| R5N | 30 | 2/15/05 | 0.02 | | -0.01 | 23.1 | 3.5 |
| R5N | 32 | 2/15/05 | 0.01 | | 1.1 | 11.4 | 4.2 |
| R5N | 33 | 2/15/05 | 0 | | 0.01 | 17 | 3.5 |
| R5N | 35 | 2/15/05 | 0.02 | | 6.9 | 7.13 | 3 |
| R5N | 36 | 2/15/05 | 0 | | 0.44 | 10.1 | 4 |
| R5N | 38 | 2/15/05 | 0.01 | | 4.5 | 7.08 | 4.8 |
| R5N | 39 | 2/15/05 | 0.01 | | 0.77 | 18.8 | 3.6 |
| R5N | 41 | 2/15/05 | 0.01 | | 0.83 | 11.9 | 7.3 |
| R5N | 42 | 2/15/05 | 0.01 | | 1.1 | 28.6 | 3.7 |
| R5N | 44 | 2/15/05 | 0.01 | | 5.2 | 12.2 | 4.7 |
| R5N | 45 | 2/15/05 | 0.01 | | 1.6 | 14.8 | 4.1 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 47 | 2/15/05 | 0.01 | | 1.3 | 8.11 | 5 |
| R5N | 48 | 2/15/05 | 0.01 | | 0 | 12.7 | 2.7 |
| R5N | 50 | 2/15/05 | 0 | | 0.7 | 6.05 | 5.4 |
| R5N | 51 | 2/15/05 | 0.01 | | 0.27 | 7.98 | 3.6 |
| R5N | 53 | 2/15/05 | 0.01 | | -0.01 | 12 | 4.1 |
| R5N | 54 | 2/15/05 | 0.01 | | 0.47 | 7.8 | 2.2 |
| R5N | 56 | 2/15/05 | 0.02 | | 0.21 | 8.21 | 3.7 |
| R5N | 57 | 2/15/05 | 0.01 | | -0.01 | 11.8 | 2.9 |
| R5N | 59 | 2/15/05 | 0.01 | | 1.1 | 6.89 | 3.2 |
| R5N | 60 | 2/15/05 | 0.02 | | -0.01 | 7.62 | 4 |
| R5N | 62 | 2/15/05 | 0 | | 4.1 | 8.49 | 3.5 |
| R5N | 63 | 2/15/05 | 0 | | 0.19 | 16.9 | 3.7 |
| R5N | 65 | 2/15/05 | 0.02 | | 1.1 | 13.8 | 5.6 |
| R5N | 66 | 2/15/05 | 0 | | -0.01 | 31.9 | 2.2 |
| R5N | 68 | 2/15/05 | 0 | | 1.1 | 6.84 | 4.6 |
| R5N | 69 | 2/15/05 | 0 | | 8.8 | 12.9 | 3.1 |
| R5N | 71 | 2/15/05 | 0 | | 0.34 | 8.22 | 3.5 |
| R5N | 72 | 2/15/05 | 0.01 | | 0 | 11.1 | 2.3 |
| R5N | Stream | 2/15/05 | 0.03 | | 0.61 | 22.7 | 8.8 |
| R1N | 2 | 3/29/05 | 0.22 | | 6.2 | 15.2 | 2.9 |
| R1N | 3 | 3/29/05 | 0.14 | | 0.01 | 5.19 | 2.7 |
| R1N | 5 | 3/29/05 | 0.01 | | 4.2 | 13.9 | 1.6 |
| R1N | 6 | 3/29/05 | 0.05 | | 0 | 13.2 | 2.2 |
| R1N | 8 | 3/29/05 | 0.08 | | 7.1 | 14.1 | 3.9 |
| R1N | 9 | 3/29/05 | 0.03 | | 0.32 | 20.8 | 2.1 |
| R1N | 11 | 3/29/05 | 0.05 | | 7.4 | 13 | 3.1 |
| R1N | 12 | 3/29/05 | 0.03 | | 5.2 | 16.9 | 2 |
| R1N | 17 | 3/29/05 | 0 | | 5.2 | 15.3 | 1.9 |
| R1N | 18 | 3/29/05 | 0.01 | | 3.5 | 20.2 | 1.4 |
| R1N | 20 | 3/29/05 | 0.04 | | 0.48 | 11.8 | 2.4 |
| R1N | 21 | 3/29/05 | 0.08 | | 0.01 | 14.1 | 2 |
| R1N | 23 | 3/29/05 | 0.13 | | 4 | 6.73 | 3.6 |
| R1N | 24 | 3/29/05 | 0.45 | | 0 | 8.86 | 1.8 |
| R1N | 26 | 3/29/05 | 0.01 | | 11.2 | 9.34 | 1.2 |
| R1N | 27 | 3/29/05 | 0.01 | | 4.2 | 12.7 | 1 |
| R1N | 29 | 3/29/05 | 0.01 | | 11.6 | 17.4 | 1.8 |
| R1N | 30 | 3/29/05 | 0.05 | | 0.01 | 10.1 | 1.9 |
| R1N | 32 | 3/29/05 | 0.05 | | 4 | 20.6 | 2.3 |
| R1N | 33 | 3/29/05 | 0.12 | | 0 | 6.41 | 2.1 |
| R1N | 35 | 3/29/05 | 0.03 | | 6.9 | 13.6 | 2.1 |
| R1N | 36 | 3/29/05 | 0.01 | | 3.3 | 12.5 | 1.2 |
| R1N | 38 | 3/29/05 | 0.07 | | 8.5 | 16.4 | 1.9 |
| R1N | 39 | 3/29/05 | 0.08 | | 6.4 | 16.6 | 2 |
| R1N | 41 | 3/29/05 | 0.05 | | 7.4 | 14.4 | 2.2 |
| R1N | 42 | 3/29/05 | 0.01 | | 5.4 | 16.3 | 2.2 |
| R1N | 47 | 3/29/05 | 0.01 | | 7.1 | 15.7 | 1.4 |
| R1N | 48 | 3/29/05 | 0.01 | | 4.2 | 19.5 | 1.6 |
| R1N | 51 | 3/29/05 | 0.01 | | 4.1 | 16.5 | 1.8 |
| R1N | 54 | 3/29/05 | 0.01 | | 8.9 | 8.69 | 2 |
| R1N | 57 | 3/29/05 | 0.01 | | 9.6 | 8.67 | 1.3 |
| R1N | 59 | 3/29/05 | 0.16 | | 10.6 | 4.7 | 5.6 |
| R1N | 60 | 3/29/05 | 0 | | 10.6 | 18.4 | 2.1 |
| R1N | 62 | 3/29/05 | 0.01 | | 5.6 | 12.8 | 1.7 |
| R1N | 63 | 3/29/05 | 0.01 | | 2.3 | 12.4 | 1.3 |
| R1N | 66 | 3/29/05 | 0.01 | | 4.9 | 15.6 | 1.9 |
| R1N | 68 | 3/29/05 | 0.02 | | 10.1 | 6.89 | 1.9 |
| R1N | 69 | 3/29/05 | 0.01 | | 6.4 | 11.7 | 1.3 |
| R1N | 72 | 3/29/05 | 0.01 | | 8.2 | 20.1 | 2.8 |
| R1N | Stream | 3/29/05 | 0.11 | | 4.6 | 14.7 | 5.5 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 2 | 3/29/05 | 0.04 | | 2.9 | 3.79 | 2.8 |
| R2N | 3 | 3/29/05 | 0.01 | | 3.3 | 9.71 | 2.9 |
| R2N | 5 | 3/29/05 | 0.22 | | 3.1 | 3.36 | 4 |
| R2N | 6 | 3/29/05 | 0.05 | | 2.5 | 13.5 | 2.1 |
| R2N | 8 | 3/29/05 | 0.04 | | 4.2 | 7.47 | 2.1 |
| R2N | 9 | 3/29/05 | 0.03 | | 2.8 | 28 | 1.7 |
| R2N | 11 | 3/29/05 | 0.16 | | 2.9 | 8.59 | 3.2 |
| R2N | 11 | 3/29/05 | 0.16 | | 2.9 | 8.91 | 2.6 |
| R2N | 12 | 3/29/05 | 0.08 | | 5 | 23.3 | 1.9 |
| R2N | 14 | 3/29/05 | 0.34 | | 1.7 | 7.75 | 3.5 |
| R2N | 15 | 3/29/05 | 0.05 | | 2.7 | 21.7 | 1.9 |
| R2N | 17 | 3/29/05 | 0.11 | | 0.56 | 4.96 | 5.2 |
| R2N | 18 | 3/29/05 | 0.02 | | 0.01 | 9.25 | 1.9 |
| R2N | 20 | 3/29/05 | 0.01 | | 0.92 | 6.25 | 5.8 |
| R2N | 21 | 3/29/05 | 0.06 | | 0.01 | 16.7 | 1.1 |
| R2N | 23 | 3/29/05 | 0.12 | | 0.17 | 3.48 | 8.1 |
| R2N | 24 | 3/29/05 | 0.08 | | 0.01 | 16.9 | 1.6 |
| R2N | 26 | 3/29/05 | 0.08 | | 1 | 3.16 | 5.1 |
| R2N | 27 | 3/29/05 | 0.04 | | 0 | 18 | 1.5 |
| R2N | 29 | 3/29/05 | 0.06 | | 5.6 | 12.8 | 2.5 |
| R2N | 30 | 3/29/05 | 0.05 | | 0 | 8.34 | 1.8 |
| R2N | 32 | 3/29/05 | 0.07 | | 4.9 | 4.89 | 2.2 |
| R2N | 33 | 3/29/05 | 0.02 | | 0.51 | 13.7 | 1.7 |
| R2N | 35 | 3/29/05 | 0.14 | | 3.5 | 2.95 | 3.7 |
| R2N | 36 | 3/29/05 | 0.01 | | 3.5 | 19.7 | 1.8 |
| R2N | 38 | 3/29/05 | 0.05 | | 3.2 | 4.73 | 2.4 |
| R2N | 39 | 3/29/05 | 0.04 | | 3.2 | 24.5 | 1.9 |
| R2N | 41 | 3/29/05 | 0.04 | | 3.6 | 4.28 | 3.1 |
| R2N | 42 | 3/29/05 | 0.02 | | 4.3 | 17 | 1.9 |
| R2N | 44 | 3/29/05 | 0.25 | | 2.9 | 4.21 | 3.7 |
| R2N | 45 | 3/29/05 | 0.03 | | 2.9 | 15.6 | 1.9 |
| R2N | 47 | 3/29/05 | 0.01 | | 10.1 | 27.2 | 2.1 |
| R2N | 48 | 3/29/05 | 0.04 | | 7.4 | 29.8 | 2.2 |
| R2N | 50 | 3/29/05 | 0.06 | | 15.1 | 35.8 | 2.4 |
| R2N | 51 | 3/29/05 | 0.01 | | 8.5 | 31.5 | 1.8 |
| R2N | 53 | 3/29/05 | 0.06 | | 11.5 | 33.2 | 3 |
| R2N | 54 | 3/29/05 | 0.06 | | 9.2 | 31.7 | 2.8 |
| R2N | 56 | 3/29/05 | 0.1 | | 12.5 | 24 | 2.4 |
| R2N | 56 | 3/29/05 | 0.1 | | 12.6 | 24.1 | 3.5 |
| R2N | 57 | 3/29/05 | 0.02 | | 10.3 | 30.1 | 2.5 |
| R2N | 59 | 3/29/05 | 0.22 | | 8.5 | 18.6 | 2.2 |
| R2N | 60 | 3/29/05 | 0.01 | | 3.2 | 17.8 | 1.7 |
| R2N | 63 | 3/29/05 | 0.03 | | 3.7 | 16.3 | 1.8 |
| R2N | 66 | 3/29/05 | 0.08 | | 3.7 | 25.9 | 1.8 |
| R2N | 69 | 3/29/05 | 0.01 | | 5.1 | 23.1 | 2 |
| R2N | 72 | 3/29/05 | 0.01 | | 4.5 | 20.9 | 3 |
| R2N | Stream | 3/29/05 | 0.4 | | 0.78 | 2.82 | 14.4 |
| R4W | 2 | 3/29/05 | 0.02 | | 17.1 | 19.2 | 2.6 |
| R4W | 3 | 3/29/05 | 0.04 | | 0.02 | 29.1 | 2.1 |
| R4W | 5 | 3/29/05 | 0.01 | | 16.8 | 18.8 | 2.4 |
| R4W | 6 | 3/29/05 | 0.04 | | 0.01 | 28.5 | 1.9 |
| R4W | 8 | 3/29/05 | 0.01 | | 17.4 | 22.2 | 1.9 |
| R4W | 9 | 3/29/05 | 0.02 | | 0.22 | 18.1 | 1.8 |
| R4W | 11 | 3/29/05 | 0.01 | | 18.5 | 19.5 | 3 |
| R4W | 14 | 3/29/05 | 0.01 | | 15.4 | 17.3 | 2.8 |
| R4W | 15 | 3/29/05 | 0.01 | | 10.7 | 20.1 | 3 |
| R4W | 17 | 3/29/05 | 0.01 | | 2.5 | 24.3 | 2.2 |
| R4W | 20 | 3/29/05 | 0 | | 2.2 | 23 | 3.3 |
| R4W | 23 | 3/29/05 | 0.01 | | 2.1 | 19.6 | 4.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 24 | 3/29/05 | 0.01 | | 1.7 | 24.8 | 3.6 |
| R4W | 26 | 3/29/05 | 0.01 | | 3.2 | 19.1 | 4.4 |
| R4W | 27 | 3/29/05 | 0.01 | | 2.5 | 19.2 | 4.1 |
| R4W | 29 | 3/29/05 | 0.01 | | 2.3 | 19.7 | 3.4 |
| R4W | 30 | 3/29/05 | 0.01 | | 0.1 | 25.4 | 2.3 |
| R4W | 32 | 3/29/05 | 0.01 | | 19.3 | 19.3 | 1.8 |
| R4W | 33 | 3/29/05 | 0.02 | | 1.2 | 18.1 | 1.7 |
| R4W | 35 | 3/29/05 | 0.01 | | 19.1 | 17.8 | 1.8 |
| R4W | 36 | 3/29/05 | 0.03 | | 0.2 | 10.9 | 1.6 |
| R4W | 38 | 3/29/05 | 0.01 | | 19.5 | 19.1 | 1.9 |
| R4W | 39 | 3/29/05 | 0.01 | | 12.3 | 20 | 1.5 |
| R4W | 41 | 3/29/05 | 0.01 | | 17.3 | 18 | 1.9 |
| R4W | 42 | 3/29/05 | 0.02 | | 15.5 | 28.5 | 2.3 |
| R4W | 44 | 3/29/05 | 0.02 | | 20.5 | 68.9 | 13.5 |
| R4W | 45 | 3/29/05 | 0.01 | | 20.8 | 31 | 2.5 |
| R4W | 47 | 3/29/05 | 0.01 | | 12.6 | 21.5 | 2.1 |
| R4W | 48 | 3/29/05 | 0.15 | | 10 | 152.2 | 37.3 |
| R4W | 50 | 3/29/05 | 0.01 | | 3.9 | 23 | 2.6 |
| R4W | 51 | 3/29/05 | 0.01 | | 2.8 | 21.7 | 2 |
| R4W | 53 | 3/29/05 | 0.01 | | 1.4 | 22.6 | 2.4 |
| R4W | 54 | 3/29/05 | 0.01 | | 0.26 | 25.5 | 2 |
| R4W | 56 | 3/29/05 | 0.09 | | 0.9 | 31.3 | 2.7 |
| R4W | 57 | 3/29/05 | 0.01 | | 0.19 | 28.7 | 2 |
| R4W | 59 | 3/29/05 | 0.03 | | 2 | 31 | 2.5 |
| R4W | 60 | 3/29/05 | 0.03 | | 0.97 | 31.5 | 2.6 |
| R4W | 62 | 3/29/05 | 0.01 | | 19.9 | 19.7 | 1.7 |
| R4W | 63 | 3/29/05 | 0.04 | | 5.8 | 20.3 | 1.6 |
| R4W | 65 | 3/29/05 | 0.01 | | 20.4 | 20.3 | 2 |
| R4W | 66 | 3/29/05 | 0.02 | | 16.6 | 19.9 | 1.7 |
| R4W | 68 | 3/29/05 | 0.09 | | 7.3 | 30 | 3 |
| R4W | 69 | 3/29/05 | 0.01 | | 6.9 | 26 | 2.3 |
| R4W | 71 | 3/29/05 | 0.01 | | 1.9 | 20.8 | 2.2 |
| R4W | 72 | 3/29/05 | 0.02 | | 0.14 | 29.6 | 1.9 |
| R4W | Stream | 3/29/05 | 0.3 | | 0.68 | 16.9 | 6.6 |
| R5N | 2 | 3/29/05 | 0.01 | | 1 | 20.5 | 3.3 |
| R5N | 3 | 3/29/05 | 0.01 | | 0.36 | 19 | 2.8 |
| R5N | 5 | 3/29/05 | 0.01 | | 0.23 | 14.6 | 3.5 |
| R5N | 6 | 3/29/05 | 0.01 | | 0.35 | 15.4 | 3.5 |
| R5N | 8 | 3/29/05 | 0.01 | | 3.1 | 9.79 | 4.9 |
| R5N | 9 | 3/29/05 | 0.01 | | 0.64 | 18.3 | 3.4 |
| R5N | 11 | 3/29/05 | 0.02 | | 1.1 | 19 | 4.5 |
| R5N | 12 | 3/29/05 | 0.01 | | 0.01 | 29.1 | 2.6 |
| R5N | 14 | 3/29/05 | 0.01 | | 0.89 | 10.2 | 4.1 |
| R5N | 15 | 3/29/05 | 0.01 | | 0.01 | 13.6 | 3 |
| R5N | 17 | 3/29/05 | 0.01 | | 0.3 | 9.89 | 3 |
| R5N | 18 | 3/29/05 | 0.01 | | 3.3 | 23.5 | 2.8 |
| R5N | 20 | 3/29/05 | 0.01 | | 0.03 | 14.6 | 3 |
| R5N | 21 | 3/29/05 | 0.01 | | 5.6 | 13.7 | 2.2 |
| R5N | 23 | 3/29/05 | 0.01 | | 0.66 | 7.94 | 3.2 |
| R5N | 24 | 3/29/05 | 0.01 | | 0.23 | 8.74 | 2 |
| R5N | 26 | 3/29/05 | 0.01 | | 0.13 | 9.4 | 3.2 |
| R5N | 27 | 3/29/05 | 0.03 | | 0 | 6.24 | 1.4 |
| R5N | 29 | 3/29/05 | 0.01 | | 0 | 15.2 | 9.6 |
| R5N | 30 | 3/29/05 | 0.02 | | 0.01 | 22.2 | 4 |
| R5N | 32 | 3/29/05 | 0.03 | | 1.1 | 13 | 4.7 |
| R5N | 33 | 3/29/05 | 0.01 | | 0.23 | 21 | 4.6 |
| R5N | 35 | 3/29/05 | 0.01 | | 7.6 | 7.09 | 4.1 |
| R5N | 36 | 3/29/05 | 0.01 | | 0.34 | 10.6 | 5.6 |
| R5N | 38 | 3/29/05 | 0.02 | | 3.1 | 5.92 | 7.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 39 | 3/29/05 | 0.01 | | 0.63 | 28.1 | 4.2 |
| R5N | 41 | 3/29/05 | 0.01 | | 0.65 | 15.8 | 6.3 |
| R5N | 42 | 3/29/05 | 0.01 | | 1.9 | 35 | 3.2 |
| R5N | 44 | 3/29/05 | 0.01 | | 6.9 | 10.9 | 5 |
| R5N | 45 | 3/29/05 | 0.01 | | 3.1 | 17.1 | 4.8 |
| R5N | 47 | 3/29/05 | 0.01 | | 0.91 | 6.94 | 6.8 |
| R5N | 48 | 3/29/05 | 0.01 | | 0.24 | 16 | 3.1 |
| R5N | 50 | 3/29/05 | 0.01 | | 0.56 | 4.47 | 4.3 |
| R5N | 51 | 3/29/05 | 0.01 | | 0.21 | 8.1 | 3.2 |
| R5N | 53 | 3/29/05 | 0.02 | | 0.01 | 11.9 | 4 |
| R5N | 54 | 3/29/05 | 1.3 | | 1.2 | 15.4 | 3.6 |
| R5N | 56 | 3/29/05 | 1.5 | | 0.23 | 13.7 | 5.6 |
| R5N | 57 | 3/29/05 | 0.67 | | 0 | 12.1 | 3.7 |
| R5N | 59 | 3/29/05 | 0 | | 2 | 7.12 | 3.6 |
| R5N | 60 | 3/29/05 | 0 | | 0.11 | 10.9 | 4.3 |
| R5N | 62 | 3/29/05 | 0 | | 3.9 | 6.83 | 3.5 |
| R5N | 63 | 3/29/05 | 0 | | 0.02 | 14.2 | 4 |
| R5N | 65 | 3/29/05 | 0 | | 0.85 | 15.1 | 5.2 |
| R5N | 66 | 3/29/05 | 0 | | 0.02 | 29.3 | 2.7 |
| R5N | 68 | 3/29/05 | 0 | | 1.1 | 6.25 | 4.9 |
| R5N | 69 | 3/29/05 | 0 | | 10.2 | 13.7 | 2.6 |
| R5N | 71 | 3/29/05 | 0 | | 0.4 | 7.81 | 3.2 |
| R5N | 72 | 3/29/05 | 0 | | 0 | 8.77 | 2.7 |
| R5N | Stream | 3/29/05 | 0 | | 1.4 | 26 | 11.2 |
| R1N | 2 | 4/20/05 | 0.21 | | 6.4 | 37.3 | 5.6 |
| R1N | 3 | 4/20/05 | 0.22 | | 0.02 | 6.8 | 4 |
| R1N | 5 | 4/20/05 | 0.01 | | 3.7 | 11.7 | 2.3 |
| R1N | 6 | 4/20/05 | 0.13 | | 0 | 10.3 | 3.7 |
| R1N | 8 | 4/20/05 | 0.15 | | 8.5 | 13.5 | 3.8 |
| R1N | 9 | 4/20/05 | 0.02 | | 0.4 | 16.8 | 3.1 |
| R1N | 11 | 4/20/05 | 0.15 | | 7.7 | 18.1 | 5 |
| R1N | 12 | 4/20/05 | 0.01 | | 5.7 | 14.2 | 1.9 |
| R1N | 17 | 4/20/05 | 0.02 | | 5.1 | 21.3 | 3.1 |
| R1N | 18 | 4/20/05 | 0.01 | | 3.2 | 28 | 3.1 |
| R1N | 20 | 4/20/05 | 0.02 | | 0.26 | 7.63 | 2.9 |
| R1N | 21 | 4/20/05 | 0.01 | | 0.02 | 8.07 | 2.8 |
| R1N | 23 | 4/20/05 | 0.34 | | 4 | 4.95 | 14.4 |
| R1N | 24 | 4/20/05 | 0.3 | | 0 | 7.42 | 3.8 |
| R1N | 26 | 4/20/05 | 0.01 | | 11.4 | 9.26 | 2.8 |
| R1N | 27 | 4/20/05 | 0.01 | | 9.7 | 38.1 | 4.2 |
| R1N | 29 | 4/20/05 | 0.04 | | 11.4 | 14 | 3.6 |
| R1N | 30 | 4/20/05 | 0.03 | | 0.03 | 8.48 | 3.5 |
| R1N | 32 | 4/20/05 | 0.14 | | 4.3 | 13 | 4.1 |
| R1N | 33 | 4/20/05 | 0.3 | | 0.01 | 3.4 | 3.9 |
| R1N | 35 | 4/20/05 | 0.02 | | 6.6 | 11.8 | 2.9 |
| R1N | 36 | 4/20/05 | 0.02 | | 3.2 | 11.5 | 2.5 |
| R1N | 38 | 4/20/05 | 0.26 | | 8 | 12.4 | 4.4 |
| R1N | 39 | 4/20/05 | 0.09 | | 7.3 | 13.4 | 3.8 |
| R1N | 41 | 4/20/05 | 0.13 | | 7.8 | 22.3 | 5.3 |
| R1N | 42 | 4/20/05 | 0.02 | | 5.7 | 13.5 | 3.1 |
| R1N | 47 | 4/20/05 | 0.01 | | 6.9 | 15.9 | 2.6 |
| R1N | 48 | 4/20/05 | 0.01 | | 4.1 | 16.4 | 2.3 |
| R1N | 50 | 4/20/05 | 0.02 | | 8.6 | 7.79 | 2.9 |
| R1N | 51 | 4/20/05 | 0.01 | | 4.2 | 14.7 | 2.3 |
| R1N | 54 | 4/20/05 | 0.04 | | 9.1 | 7.86 | 2.8 |
| R1N | 57 | 4/20/05 | 0.02 | | 10.6 | 5.81 | 2.7 |
| R1N | 59 | 4/20/05 | 0.12 | | 7.2 | 1.19 | 6.1 |
| R1N | 60 | 4/20/05 | 0.01 | | 9.7 | 16.8 | 3 |
| R1N | 62 | 4/20/05 | 0.02 | | 5.4 | 10.2 | 2.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 63 | 4/20/05 | 0.02 | | 2.3 | 11.4 | 2.5 |
| R1N | 65 | 4/20/05 | 0.11 | | 7.7 | 11.3 | 3.5 |
| R1N | 66 | 4/20/05 | 0.05 | | 4.7 | 17.5 | 3.9 |
| R1N | 68 | 4/20/05 | 0.04 | | 12.2 | 3.71 | 2.9 |
| R1N | 69 | 4/20/05 | 0.01 | | 6.2 | 10.8 | 2.3 |
| R1N | 71 | 4/20/05 | 0.06 | | 12.1 | 18.2 | 4.3 |
| R1N | 72 | 4/20/05 | 0.01 | | 9.8 | 17.1 | 3.5 |
| R1N | Stream | 4/20/05 | 0.16 | | 4.8 | 13.2 | 8.1 |
| R2N | 2 | 4/20/05 | 0.03 | | 3.9 | 3.92 | 3.8 |
| R2N | 3 | 4/20/05 | 0.02 | | 3 | 10.5 | 3 |
| R2N | 5 | 4/20/05 | 0.29 | | 3.3 | 0.01 | 6.2 |
| R2N | 6 | 4/20/05 | 0.03 | | 2.5 | 9.71 | 2.9 |
| R2N | 8 | 4/20/05 | 0.05 | | 3.9 | 4.09 | 3.5 |
| R2N | 9 | 4/20/05 | 0.01 | | 2.8 | 18.8 | 2.4 |
| R2N | 11 | 4/20/05 | 0.39 | | 3.6 | 9.65 | 9.2 |
| R2N | 12 | 4/20/05 | 0.08 | | 5.4 | 21.1 | 4.4 |
| R2N | 14 | 4/20/05 | 0.33 | | 2 | 8.03 | 6.2 |
| R2N | 15 | 4/20/05 | 0.11 | | 2.8 | 17.9 | 4.5 |
| R2N | 17 | 4/20/05 | 0.06 | | 0.02 | 3.23 | 12.2 |
| R2N | 18 | 4/20/05 | 0.03 | | 0 | 7.08 | 2.9 |
| R2N | 20 | 4/20/05 | 0.01 | | 0.02 | 4.82 | 12.7 |
| R2N | 21 | 4/20/05 | 0.17 | | 0 | 14.5 | 2.6 |
| R2N | 23 | 4/20/05 | 0.11 | | 0.01 | 2.2 | 9.4 |
| R2N | 24 | 4/20/05 | 0.09 | | 0 | 14.9 | 2.5 |
| R2N | 26 | 4/20/05 | 0.05 | | 3.9 | 2.21 | 5.5 |
| R2N | 27 | 4/20/05 | 0.03 | | 0 | 16.5 | 2.2 |
| R2N | 29 | 4/20/05 | 0.05 | | 6 | 13.5 | 4.7 |
| R2N | 30 | 4/20/05 | 0.04 | | 0 | 8.4 | 3.5 |
| R2N | 32 | 4/20/05 | 0.07 | | 4.4 | 2 | 3.8 |
| R2N | 33 | 4/20/05 | 0.01 | | 1 | 12.2 | 2.5 |
| R2N | 35 | 4/20/05 | 0.11 | | 4.5 | 2.17 | 4.6 |
| R2N | 38 | 4/20/05 | 0.05 | | 3.5 | 3.53 | 3.8 |
| R2N | 39 | 4/20/05 | 0.02 | | 3.2 | 21.5 | 2.4 |
| R2N | 41 | 4/20/05 | 0.05 | | 4 | 4.95 | 4.3 |
| R2N | 42 | 4/20/05 | 0.01 | | 3.7 | 10.8 | 3.5 |
| R2N | 44 | 4/20/05 | 0.15 | | 3.3 | 5.88 | 4.7 |
| R2N | 45 | 4/20/05 | 0.02 | | 2.9 | 10.6 | 3.1 |
| R2N | 47 | 4/20/05 | 0.01 | | 10.4 | 28.3 | 3.1 |
| R2N | 48 | 4/20/05 | 0.01 | | 6.7 | 27.8 | 2.6 |
| R2N | 50 | 4/20/05 | 0.03 | | 16.8 | 18.1 | 3.8 |
| R2N | 51 | 4/20/05 | 0.01 | | 7.4 | 28.8 | 3.3 |
| R2N | 53 | 4/20/05 | 0.08 | | 12.2 | 24.3 | 4.3 |
| R2N | 54 | 4/20/05 | 0.05 | | 8.7 | 29.7 | 3.6 |
| R2N | 56 | 4/20/05 | 0.22 | | 15.3 | 15.1 | 5 |
| R2N | 57 | 4/20/05 | 0.03 | | 9.2 | 25.2 | 4.8 |
| R2N | 59 | 4/20/05 | 0.26 | | 8.1 | 8.65 | 4.1 |
| R2N | 60 | 4/20/05 | 0.02 | | 3.4 | 15.9 | 3 |
| R2N | 62 | 4/20/05 | 0.17 | | 4.8 | 6.2 | 4.3 |
| R2N | 63 | 4/20/05 | 0.01 | | 3.4 | 16 | 2.8 |
| R2N | 65 | 4/20/05 | 0.21 | | 1.3 | 1.6 | 4.1 |
| R2N | 66 | 4/20/05 | 0.05 | | 3.8 | 23.5 | 3.1 |
| R2N | 69 | 4/20/05 | 0.02 | | 4.9 | 17 | 3.4 |
| R2N | 72 | 4/20/05 | 0.03 | | 5.7 | 21.3 | 3.7 |
| R2N | Stream | 4/20/05 | 0.25 | | 1.4 | 37.7 | 22.7 |
| R4W | 2 | 4/20/05 | 0.03 | | 17.6 | 16.6 | 3.3 |
| R4W | 3 | 4/20/05 | 0.08 | | 0.13 | 23.9 | 3.4 |
| R4W | 5 | 4/20/05 | 0.02 | | 16.8 | 14.2 | 3.8 |
| R4W | 6 | 4/20/05 | 0.09 | | 0 | 22.2 | 3.4 |
| R4W | 9 | 4/20/05 | 0.02 | | 0.23 | 7.68 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **Date** | **mg P/L** | **mg N/L** | **mg N/L** | **mg Cl/L** | **mg C/L** |
| R4W | 11 | 4/20/05 | 0.01 | | 18.6 | 14.9 | 3.5 |
| R4W | 12 | 4/20/05 | 0.07 | | 0.18 | 16.1 | 6.1 |
| R4W | 14 | 4/20/05 | 0.01 | | 15.7 | 14.1 | 3.8 |
| R4W | 15 | 4/20/05 | 0.02 | | 10.2 | 16.5 | 4 |
| R4W | 17 | 4/20/05 | 0.01 | | 2.7 | 18.3 | 4.1 |
| R4W | 20 | 4/20/05 | 0.01 | | 1.1 | 21.8 | 5.1 |
| R4W | 21 | 4/20/05 | 0.07 | | 0.01 | 5.41 | 3.1 |
| R4W | 23 | 4/20/05 | 0.02 | | 1.1 | 17.5 | 7.2 |
| R4W | 24 | 4/20/05 | 0.02 | | 0.75 | 20.3 | 6.1 |
| R4W | 26 | 4/20/05 | 0.01 | | 1.4 | 18.9 | 4.9 |
| R4W | 27 | 4/20/05 | 0.01 | | 0.61 | 20.4 | 4.3 |
| R4W | 29 | 4/20/05 | 0.02 | | 1 | 19.1 | 4.5 |
| R4W | 30 | 4/20/05 | 0.08 | | 0.01 | 18.5 | 4.6 |
| R4W | 32 | 4/20/05 | 0.01 | | 20.4 | 15.5 | 2 |
| R4W | 33 | 4/20/05 | 0.01 | | 5 | 14.6 | 2.2 |
| R4W | 35 | 4/20/05 | 0.01 | | 18.9 | 14.4 | 2.2 |
| R4W | 36 | 4/20/05 | 0.06 | | 0.11 | 8.42 | 2 |
| R4W | 38 | 4/20/05 | 0.01 | | 18.1 | 15.8 | 3.2 |
| R4W | 50 | 4/20/05 | 0.01 | | 3.9 | 17.8 | 3.7 |
| R4W | 51 | 4/20/05 | 0.01 | | 2.7 | 18.2 | 3.1 |
| R4W | 39 | 4/20/05 | 0.02 | | 11.3 | 16.7 | 2.6 |
| R4W | 41 | 4/20/05 | 0.01 | | 17.3 | 15.3 | 2.3 |
| R4W | 42 | 4/20/05 | 0.02 | | 15.7 | 15.6 | 3 |
| R4W | 44 | 4/20/05 | 0.03 | | 20.3 | 14.3 | 2.7 |
| R4W | 45 | 4/20/05 | 0.01 | | 19.8 | 14.4 | 2.1 |
| R4W | 47 | 4/20/05 | 0.02 | | 13.4 | 13.7 | 3.9 |
| R4W | 48 | 4/20/05 | 0.02 | | 11.5 | 16.6 | 2.6 |
| R4W | 53 | 4/20/05 | 0.01 | | 1.4 | 18.5 | 2.9 |
| R4W | 54 | 4/20/05 | 0.02 | | 0.41 | 22 | 2.9 |
| R4W | 56 | 4/20/05 | 0.14 | | 0.95 | 25.5 | 3.8 |
| R4W | 57 | 4/20/05 | 0.02 | | 0.22 | 23.2 | 2.8 |
| R4W | 59 | 4/20/05 | 0.03 | | 1.3 | 25.7 | 3.4 |
| R4W | 60 | 4/20/05 | 0.03 | | 0.82 | 25.3 | 3.5 |
| R4W | 62 | 4/20/05 | 0.02 | | 19.5 | 15 | 2.3 |
| R4W | 65 | 4/20/05 | 0.11 | | 20.6 | 14.6 | 2.6 |
| R4W | 66 | 4/20/05 | 0.03 | | 17.2 | 16.8 | 2.2 |
| R4W | 68 | 4/20/05 | 0.03 | | 8.3 | 17.3 | 3.1 |
| R4W | 69 | 4/20/05 | 0.01 | | 8 | 18.6 | 3.2 |
| R4W | 71 | 4/20/05 | 0.01 | | 2.7 | 16.9 | 2.6 |
| R4W | 72 | 4/20/05 | 0.02 | | 0.52 | 21.5 | 2.5 |
| R4W | Stream | 4/20/05 | 0.74 | | 0.29 | 8.96 | 9 |
| R5N | 2 | 4/20/05 | 0.01 | | 1.3 | 11 | 3.8 |
| R5N | 3 | 4/20/05 | 0.02 | | 0.3 | 20.5 | 3.5 |
| R5N | 5 | 4/20/05 | 0.01 | | 0.29 | 10.7 | 4.5 |
| R5N | 6 | 4/20/05 | 0.03 | | 0.47 | 9.92 | 4 |
| R5N | 8 | 4/20/05 | 0.02 | | 3.1 | 7.19 | 5.7 |
| R5N | 9 | 4/20/05 | 0.02 | | 0.22 | 22.2 | 4.5 |
| R5N | 11 | 4/20/05 | 0.01 | | 1.5 | 7.53 | 5.2 |
| R5N | 12 | 4/20/05 | 0.01 | | 0 | 25.2 | 3.1 |
| R5N | 14 | 4/20/05 | 0.02 | | 1.1 | 6.36 | 5.4 |
| R5N | 15 | 4/20/05 | 0.01 | | 0.03 | 11 | 4.5 |
| R5N | 17 | 4/20/05 | 0.01 | | 0.34 | 6.08 | 4.6 |
| R5N | 18 | 4/20/05 | 0.01 | | 5.3 | 14.1 | 3.1 |
| R5N | 20 | 4/20/05 | 0.02 | | 0.11 | 6.39 | 3.7 |
| R5N | 21 | 4/20/05 | 0.02 | | 5 | 10.1 | 2.9 |
| R5N | 23 | 4/20/05 | 0.01 | | 0.48 | 6.01 | 4.1 |
| R5N | 24 | 4/20/05 | 0.01 | | 1.8 | 7.16 | 3.1 |
| R5N | 26 | 4/20/05 | 0.01 | | 0.12 | 12 | 4.3 |
| R5N | 27 | 4/20/05 | 0.02 | | 0 | 6.55 | 2.7 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 29 | 4/20/05 | 0.01 | | 0 | 14.7 | 5.1 |
| R5N | 30 | 4/20/05 | 0.02 | | 0 | 20.7 | 4.6 |
| R5N | 32 | 4/20/05 | 0.02 | | 0.91 | 9.92 | 5.5 |
| R5N | 33 | 4/20/05 | 0.01 | | 0 | 12.6 | 4 |
| R5N | 35 | 4/20/05 | 0.01 | | 7.4 | 4.23 | 3.7 |
| R5N | 36 | 4/20/05 | 0.01 | | 0.17 | 8.96 | 5.2 |
| R5N | 38 | 4/20/05 | 0.02 | | 4 | 3.11 | 6.1 |
| R5N | 39 | 4/20/05 | 0.01 | | 0.55 | 16.1 | 3.5 |
| R5N | 41 | 4/20/05 | 0.01 | | 0.66 | 8.8 | 8.3 |
| R5N | 42 | 4/20/05 | 0.01 | | 1.9 | 23.8 | 4.7 |
| R5N | 44 | 4/20/05 | 0.01 | | 6.5 | 6.82 | 5.3 |
| R5N | 45 | 4/20/05 | 0.01 | | 1.5 | 8.97 | 3.7 |
| R5N | 47 | 4/20/05 | 0.01 | | 1.1 | 3.6 | 5 |
| R5N | 48 | 4/20/05 | 0.01 | | 0.56 | 10.8 | 3.1 |
| R5N | 50 | 4/20/05 | 0.01 | | 0.79 | 2.81 | 4.9 |
| R5N | 51 | 4/20/05 | 0.01 | | 0.4 | 5.74 | 3.2 |
| R5N | 53 | 4/20/05 | 0.01 | | 0 | 7.43 | 4.9 |
| R5N | 54 | 4/20/05 | 0.01 | | 2.6 | 9.28 | 4 |
| R5N | 56 | 4/20/05 | 0.01 | | 0.13 | 4.11 | 4.3 |
| R5N | 57 | 4/20/05 | 0.01 | | 0 | 9.2 | 4 |
| R5N | 59 | 4/20/05 | 0.01 | | 2.8 | 3.64 | 3.5 |
| R5N | 60 | 4/20/05 | 0.03 | | 0.03 | 5.02 | 7 |
| R5N | 62 | 4/20/05 | 0.01 | | 3.5 | 7.58 | 4.2 |
| R5N | 63 | 4/20/05 | 0.01 | | 0 | 15.7 | 4 |
| R5N | 65 | 4/20/05 | 0.01 | | 0.79 | 16.5 | 6.4 |
| R5N | 66 | 4/20/05 | 0.01 | | 0.12 | 25.4 | 3.3 |
| R5N | 68 | 4/20/05 | 0.01 | | 0.62 | 3.69 | 5.1 |
| R5N | 69 | 4/20/05 | 0.01 | | 6.6 | 28.3 | 3.7 |
| R5N | 71 | 4/20/05 | 0.01 | | 0.16 | 4.87 | 3.5 |
| R5N | 72 | 4/20/05 | 0.02 | | 0 | 10 | 2.9 |
| R5N | Stream | 4/20/05 | 0.07 | | 0.27 | 19 | 10.6 |
| R1N | 2 | 5/19/05 | 0.03 | | 6.2 | 15.4 | 2.3 |
| R1N | 3 | 5/19/05 | 0.05 | | 0.01 | 3.67 | 2.1 |
| R1N | 5 | 5/19/05 | 0.01 | | 3.7 | 11.4 | 1.7 |
| R1N | 6 | 5/19/05 | 0.01 | | 0.01 | 15 | 2.5 |
| R1N | 8 | 5/19/05 | 0.03 | | 8 | 15.2 | 2.5 |
| R1N | 9 | 5/19/05 | 0.02 | | 0.29 | 17.7 | 2.6 |
| R1N | 11 | 5/19/05 | 0.02 | | 7.8 | 14.7 | 1.9 |
| R1N | 12 | 5/19/05 | 0.02 | | 4.7 | 14 | 2.1 |
| R1N | 17 | 5/19/05 | 0.01 | | 4.5 | 13.3 | 2.3 |
| R1N | 18 | 5/19/05 | 0.01 | | 3.3 | 17.4 | 2.2 |
| R1N | 20 | 5/19/05 | 0.02 | | 1.1 | 12.5 | 2.3 |
| R1N | 21 | 5/19/05 | 0.04 | | 0 | 9.46 | 2.4 |
| R1N | 23 | 5/19/05 | 0.07 | | 1.3 | 2.05 | 5.9 |
| R1N | 24 | 5/19/05 | 0.09 | | 0.14 | 8.01 | 3 |
| R1N | 26 | 5/19/05 | 0.01 | | 9.2 | 8.09 | 2.5 |
| R1N | 27 | 5/19/05 | 0.01 | | 6.4 | 12.2 | 7.1 |
| R1N | 29 | 5/19/05 | 0.01 | | 11.1 | 15.4 | 3 |
| R1N | 30 | 5/19/05 | 0.03 | | 0.79 | 9.51 | 1.6 |
| R1N | 32 | 5/19/05 | 0.03 | | 5.4 | 14.8 | 2.1 |
| R1N | 33 | 5/19/05 | 0.13 | | 0 | 3.79 | 2.8 |
| R1N | 35 | 5/19/05 | 0.02 | | 5.8 | 13 | 2.4 |
| R1N | 36 | 5/19/05 | 0.02 | | 2.6 | 12.3 | 2 |
| R1N | 38 | 5/19/05 | 0.03 | | 8.3 | 14.4 | 2.5 |
| R1N | 39 | 5/19/05 | 0.02 | | 6.7 | 16.1 | 1.9 |
| R1N | 41 | 5/19/05 | 0.02 | | 7.4 | 12.7 | 3.6 |
| R1N | 42 | 5/19/05 | 0.01 | | 5.4 | 14.5 | 3.4 |
| R1N | 47 | 5/19/05 | 0.01 | | 6 | 17 | 2.6 |
| R1N | 48 | 5/19/05 | 0.01 | | 4.2 | 22.6 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 50 | 5/19/05 | 0.01 | | 7.8 | 28.9 | 8.1 |
| R1N | 51 | 5/19/05 | 0.01 | | 1.2 | 7.92 | 2.2 |
| R1N | 54 | 5/19/05 | 0.01 | | 8.3 | 11.9 | 2.4 |
| R1N | 57 | 5/19/05 | 0.01 | | 8.3 | 10.4 | 2.4 |
| R1N | 59 | 5/19/05 | 0.05 | | 13.3 | 8.5 | 3.1 |
| R1N | 60 | 5/19/05 | 0.01 | | 8.8 | 17 | 2.2 |
| R1N | 62 | 5/19/05 | 0.01 | | 4.1 | 10.7 | 2 |
| R1N | 63 | 5/19/05 | 0.01 | | 2.2 | 11 | 1.9 |
| R1N | 65 | 5/19/05 | 0.01 | | 6.8 | 12 | 2.4 |
| R1N | 66 | 5/19/05 | 0.02 | | 4.2 | 15.4 | 1.8 |
| R1N | 68 | 5/19/05 | 0.01 | | 11.5 | 8.44 | 2.4 |
| R1N | 69 | 5/19/05 | 0.01 | | 4.6 | 25.1 | 2.2 |
| R1N | 71 | 5/19/05 | 0.02 | | 12 | 18.5 | 3.1 |
| R1N | 72 | 5/19/05 | 0.01 | | 12 | 17.3 | 2.3 |
| R1N | Stream | 5/19/05 | 0.12 | | 5.4 | 15.1 | 5.8 |
| R2N | 2 | 5/19/05 | 0.04 | | 3.7 | 2.5 | 3 |
| R2N | 3 | 5/19/05 | 0.01 | | 2.7 | 10.7 | 2.5 |
| R2N | 5 | 5/19/05 | 0.35 | | 3.2 | 2.46 | 5.5 |
| R2N | 6 | 5/19/05 | 0.03 | | 2.1 | 9.7 | 2.6 |
| R2N | 8 | 5/19/05 | 0.06 | | 3.4 | 4.22 | 3.1 |
| R2N | 9 | 5/19/05 | 0.01 | | 2.6 | 17.4 | 2.2 |
| R2N | 11 | 5/19/05 | 0.32 | | 3.2 | 6.67 | 4.6 |
| R2N | 12 | 5/19/05 | 0.06 | | 5.2 | 20.2 | 2.4 |
| R2N | 14 | 5/19/05 | 0.41 | | 1.9 | 7.92 | 4.1 |
| R2N | 15 | 5/19/05 | 0.08 | | 2.7 | 17 | 2.3 |
| R2N | 17 | 5/19/05 | 0.06 | | 0.02 | 4.19 | 10.1 |
| R2N | 18 | 5/19/05 | 0.03 | | 0 | 6.67 | 2.6 |
| R2N | 20 | 5/19/05 | 0.01 | | 0.03 | 4.31 | 7.1 |
| R2N | 21 | 5/19/05 | 0.09 | | 0 | 14.3 | 1.8 |
| R2N | 23 | 5/19/05 | 0.07 | | 0.1 | 3.8 | 5.6 |
| R2N | 24 | 5/19/05 | 0.07 | | 0 | 14.3 | 1.8 |
| R2N | 26 | 5/19/05 | 0.05 | | 2.4 | 3.52 | 4.7 |
| R2N | 27 | 5/19/05 | 0.03 | | 0 | 16.1 | 2.1 |
| R2N | 29 | 5/19/05 | 0.06 | | 6.1 | 11.3 | 3.2 |
| R2N | 30 | 5/19/05 | 0.03 | | 0 | 8.83 | 2.1 |
| R2N | 32 | 5/19/05 | 0.07 | | 4.8 | 2.59 | 2.7 |
| R2N | 33 | 5/19/05 | 0.01 | | 1.6 | 10.5 | 2.1 |
| R2N | 35 | 5/19/05 | 0.09 | | 4.9 | 0 | 2.7 |
| R2N | 36 | 5/19/05 | 0.01 | | 2.7 | 12 | 1.9 |
| R2N | 38 | 5/19/05 | 0.02 | | 3.5 | 3.63 | 2.4 |
| R2N | 39 | 5/19/05 | 0.02 | | 2.8 | 19.1 | 2.1 |
| R2N | 41 | 5/19/05 | 0.03 | | 3.4 | 0 | 2.5 |
| R2N | 42 | 5/19/05 | 0.01 | | 3.7 | 11.8 | 2.3 |
| R2N | 44 | 5/19/05 | 0.09 | | 2.9 | 2.54 | 3.3 |
| R2N | 45 | 5/19/05 | 0.02 | | 2.9 | 9.97 | 2 |
| R2N | 47 | 5/19/05 | 0.01 | | 13.1 | 30.6 | 2.6 |
| R2N | 48 | 5/19/05 | 0.02 | | 6.9 | 24.3 | 2 |
| R2N | 50 | 5/19/05 | 0.03 | | 19.7 | 36 | 3.6 |
| R2N | 51 | 5/19/05 | 0.03 | | 9 | 30.5 | 2.9 |
| R2N | 53 | 5/19/05 | 0.04 | | 14 | 33.6 | 3.2 |
| R2N | 54 | 5/19/05 | 0.08 | | 8.1 | 27.5 | 2.4 |
| R2N | 56 | 5/19/05 | 0.11 | | 17.2 | 20.7 | 3 |
| R2N | 57 | 5/19/05 | 0.03 | | 9.8 | 22.4 | 3.1 |
| R2N | 59 | 5/19/05 | 0.22 | | 7.5 | 13.8 | 3.3 |
| R2N | 60 | 5/19/05 | 0.03 | | 3.1 | 13.6 | 2.8 |
| R2N | 62 | 5/19/05 | 0.04 | | 5 | 0.89 | 3 |
| R2N | 63 | 5/19/05 | 0.01 | | 2.3 | 13 | 2.3 |
| R2N | 65 | 5/19/05 | 0.07 | | 1.2 | 1.37 | 2.7 |
| R2N | 66 | 5/19/05 | 0.03 | | 3.8 | 21.8 | 1.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 68 | 5/19/05 | 0.04 | | 17.7 | 28.3 | 3.7 |
| R2N | 69 | 5/19/05 | 0.01 | | 4.9 | 18.2 | 1.8 |
| R2N | 72 | 5/19/05 | 0.02 | | 7.2 | 22.4 | 2.5 |
| R2N | Stream | 5/19/05 | 0.79 | | 0.01 | 9.34 | 25.2 |
| R4W | 2 | 5/19/05 | 0.02 | | 17.7 | 16.3 | 2.9 |
| R4W | 3 | 5/19/05 | 0.06 | | 0.03 | 23.7 | 4.1 |
| R4W | 5 | 5/19/05 | 0.01 | | 17.9 | 15.2 | 3.1 |
| R4W | 6 | 5/19/05 | 0.05 | | 0 | 22.6 | 2.1 |
| R4W | 8 | 5/19/05 | 0.01 | | 16.5 | 18.3 | 2.5 |
| R4W | 9 | 5/19/05 | 0.04 | | 0.26 | 9.03 | 2.1 |
| R4W | 11 | 5/19/05 | 0.01 | | 18.2 | 15.2 | 2.5 |
| R4W | 12 | 5/19/05 | 0.24 | | 1.8 | 12.7 | 5.2 |
| R4W | 14 | 5/19/05 | 0.01 | | 16.8 | 14.9 | 2.4 |
| R4W | 15 | 5/19/05 | 0.01 | | 12.5 | 16.6 | 2.4 |
| R4W | 17 | 5/19/05 | 0.01 | | 3 | 19.8 | 2.6 |
| R4W | 18 | 5/19/05 | 0.03 | | 0.16 | 14.1 | 2 |
| R4W | 20 | 5/19/05 | 0.02 | | 1.6 | 25.1 | 3.6 |
| R4W | 21 | 5/19/05 | 0.11 | | 0.01 | 6.04 | 3 |
| R4W | 23 | 5/19/05 | 0.01 | | 0.82 | 20.6 | 4.8 |
| R4W | 24 | 5/19/05 | 0.01 | | 0.44 | 22.3 | 4 |
| R4W | 26 | 5/19/05 | 0.01 | | 0.51 | 20.9 | 4.7 |
| R4W | 27 | 5/19/05 | 0.01 | | 0.13 | 25.1 | 4.6 |
| R4W | 29 | 5/19/05 | 0.02 | | 0.43 | 19.3 | 4.9 |
| R4W | 30 | 5/19/05 | 0.02 | | 0.01 | 20.3 | 3.3 |
| R4W | 32 | 5/19/05 | 0.02 | | 19.6 | 15.8 | 2.3 |
| R4W | 33 | 5/19/05 | 0.03 | | 0.17 | 13.3 | 2 |
| R4W | 35 | 5/19/05 | 0.01 | | 19.1 | 14.7 | 2.5 |
| R4W | 36 | 5/19/05 | 0.06 | | 0.03 | 7.87 | 2 |
| R4W | 38 | 5/19/05 | 0.01 | | 18.6 | 16 | 2.7 |
| R4W | 39 | 5/19/05 | 0.01 | | 12.1 | 16.5 | 2 |
| R4W | 41 | 5/19/05 | 0.01 | | 17.8 | 15.1 | 2.4 |
| R4W | 42 | 5/19/05 | 0.02 | | 16.4 | 14.9 | 2.3 |
| R4W | 44 | 5/19/05 | 0.01 | | 19.7 | 14.4 | 2.8 |
| R4W | 45 | 5/19/05 | 0.02 | | 19.2 | 15.2 | 2 |
| R4W | 47 | 5/19/05 | 0.01 | | 14.5 | 14.2 | 2.6 |
| R4W | 48 | 5/19/05 | 0.01 | | 11.6 | 16.8 | 2.2 |
| R4W | 50 | 5/19/05 | 0.01 | | 4.7 | 18.3 | 3.1 |
| R4W | 51 | 5/19/05 | 0.01 | | 2.8 | 18.9 | 2.8 |
| R4W | 53 | 5/19/05 | 0.01 | | 2.1 | 18.5 | 2.8 |
| R4W | 54 | 5/19/05 | 0.01 | | 0.68 | 22.5 | 2.8 |
| R4W | 56 | 5/19/05 | 0.03 | | 0.95 | 24.8 | 3.1 |
| R4W | 57 | 5/19/05 | 0.01 | | 0.16 | 23.6 | 2.7 |
| R4W | 59 | 5/19/05 | 0 | | 0.4 | 28.6 | 3.3 |
| R4W | 60 | 5/19/05 | 0 | | 0.55 | 27.9 | 3.3 |
| R4W | 62 | 5/19/05 | 0 | | 20.8 | 16.4 | 2 |
| R4W | 63 | 5/19/05 | 0.05 | | 5.3 | 17.8 | 3.2 |
| R4W | 65 | 5/19/05 | 0 | | 21.6 | 15.4 | 5.5 |
| R4W | 66 | 5/19/05 | 0 | | 18.3 | 17.6 | 3.1 |
| R4W | 68 | 5/19/05 | 0.01 | | 8.8 | 18.1 | 3.6 |
| R4W | 69 | 5/19/05 | -0.01 | | 8.7 | 18.9 | 3.5 |
| R4W | 71 | 5/19/05 | -0.01 | | 2.1 | 18.6 | 3.6 |
| R4W | 72 | 5/19/05 | 0.01 | | 0.51 | 21.7 | 3.1 |
| R4W | Stream | 5/19/05 | 1.5 | | 0.02 | 7.89 | 12 |
| R5N | 2 | 5/19/05 | -0.01 | | 1.8 | 10 | 4.5 |
| R5N | 3 | 5/19/05 | -0.01 | | 0.2 | 17 | 3.8 |
| R5N | 5 | 5/19/05 | 0 | | 0.42 | 11.3 | 5.1 |
| R5N | 6 | 5/19/05 | 0 | | 0.57 | 11.6 | 4.7 |
| R5N | 8 | 5/19/05 | -0.01 | | 2.2 | 3.48 | 7.5 |
| R5N | 9 | 5/19/05 | -0.01 | | 0.3 | 43.2 | 15.1 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **Date** | **mg P/L** | **mg N/L** | **mg N/L** | **mg Cl/L** | **mg C/L** |
| R5N | 11 | 5/19/05 | -0.01 | | 2 | 9.63 | 5.8 |
| R5N | 12 | 5/19/05 | -0.01 | | 0 | 26.5 | 3.8 |
| R5N | 14 | 5/19/05 | -0.01 | | 3.1 | 8 | 5.7 |
| R5N | 15 | 5/19/05 | -0.01 | | 2.8 | 15.7 | 4 |
| R5N | 17 | 5/19/05 | 0.02 | | 0.47 | 6.91 | 4.5 |
| R5N | 18 | 5/19/05 | -0.01 | | 4.3 | 17.9 | 3.9 |
| R5N | 20 | 5/19/05 | -0.01 | | 0.23 | 7.58 | 4.3 |
| R5N | 21 | 5/19/05 | -0.01 | | 3.1 | 12.4 | 3.9 |
| R5N | 23 | 5/19/05 | -0.01 | | 0.33 | 25.6 | 4.7 |
| R5N | 24 | 5/19/05 | -0.01 | | 1.7 | 10.7 | 3.6 |
| R5N | 26 | 5/19/05 | -0.01 | | 0.13 | 6.83 | 4.1 |
| R5N | 27 | 5/19/05 | 0 | | 0 | 7.11 | 2.7 |
| R5N | 29 | 5/19/05 | -0.01 | | 0 | 11.8 | 5.8 |
| R5N | 30 | 5/19/05 | 0 | | 0 | 31.5 | 6.9 |
| R5N | 32 | 5/19/05 | 0 | | 0.9 | 20 | 5.1 |
| R5N | 33 | 5/19/05 | -0.01 | | 0.01 | 31 | 5.1 |
| R5N | 35 | 5/19/05 | -0.01 | | 7.5 | 6.04 | 4.2 |
| R5N | 36 | 5/19/05 | -0.01 | | 0.13 | 11.3 | 4.9 |
| R5N | 38 | 5/19/05 | 0 | | 4.8 | 5.2 | 6.5 |
| R5N | 39 | 5/19/05 | -0.01 | | 0.52 | 16.9 | 3.9 |
| R5N | 41 | 5/19/05 | 0 | | 0.52 | 9.58 | 7 |
| R5N | 42 | 5/19/05 | -0.01 | | 1.5 | 27.9 | 4.5 |
| R5N | 44 | 5/19/05 | 0.04 | | 5.5 | 8.66 | 6.2 |
| R5N | 45 | 5/19/05 | 0.01 | | 1.8 | 18.9 | 4.7 |
| R5N | 47 | 5/19/05 | 0.01 | | 0.84 | 26.8 | 6.4 |
| R5N | 48 | 5/19/05 | 0.01 | | 1.4 | 14.8 | 3.4 |
| R5N | 50 | 5/19/05 | 0.01 | | 0.75 | 3.42 | 5.7 |
| R5N | 51 | 5/19/05 | 0.01 | | 0.28 | 6.46 | 3.7 |
| R5N | 53 | 5/19/05 | 0.01 | | 0 | 7.82 | 4.3 |
| R5N | 54 | 5/19/05 | 0.01 | | 3.3 | 10.8 | 3.5 |
| R5N | 56 | 5/19/05 | 0.01 | | 0.01 | 16.2 | 5 |
| R5N | 57 | 5/19/05 | 0.01 | | 0 | 12.5 | 4.3 |
| R5N | 59 | 5/19/05 | 0.02 | | 3.1 | 4.87 | 3.7 |
| R5N | 60 | 5/19/05 | 0.02 | | 0.02 | 8.58 | 4.8 |
| R5N | 62 | 5/19/05 | 0.01 | | 2.1 | 4.88 | 4.4 |
| R5N | 63 | 5/19/05 | 0.01 | | 0 | 12 | 4.3 |
| R5N | 65 | 5/19/05 | 0.01 | | 0.8 | 10.7 | 6.1 |
| R5N | 66 | 5/19/05 | 0.01 | | 0.46 | 26.2 | 3.1 |
| R5N | 68 | 5/19/05 | 0.01 | | 0.34 | 13.9 | 5.2 |
| R5N | 69 | 5/19/05 | 0.01 | | 5.4 | 10.6 | 3.7 |
| R5N | 71 | 5/19/05 | 0.01 | | 0.01 | 5.87 | 3.7 |
| R5N | 72 | 5/19/05 | 0.01 | | 0 | 20.9 | 3.7 |
| R5N | Stream | 5/19/05 | 0.17 | | 0.22 | 18.3 | 12.7 |
| R1N | 2 | 6/28/05 | 0.03 | | 5.8 | 13.7 | 2.3 |
| R1N | 3 | 6/28/05 | 0.11 | | 0 | 3.46 | 2.7 |
| R1N | 5 | 6/28/05 | 0.01 | | 2.9 | 10.4 | 1.9 |
| R1N | 6 | 6/28/05 | 0.03 | | 0 | 8.77 | 3 |
| R1N | 8 | 6/28/05 | 0.03 | | 7.2 | 13.8 | 2.3 |
| R1N | 9 | 6/28/05 | 0.02 | | 0.58 | 16.7 | 1.9 |
| R1N | 11 | 6/28/05 | 0.03 | | 6.6 | 13.3 | 2.5 |
| R1N | 12 | 6/28/05 | 0.05 | | 4.2 | 13.4 | 3.5 |
| R1N | 17 | 6/28/05 | 0.02 | | 4.1 | 13.9 | 2.1 |
| R1N | 18 | 6/28/05 | 0.01 | | 2.9 | 15.6 | 1.7 |
| R1N | 20 | 6/28/05 | 0.01 | | 2.4 | 19.6 | 2.5 |
| R1N | 21 | 6/28/05 | 0.04 | | 0 | 8.96 | 2.8 |
| R1N | 23 | 6/28/05 | 0.05 | | 3.8 | 8.17 | 3.6 |
| R1N | 24 | 6/28/05 | 0.04 | | 0.01 | 7.36 | 2 |
| R1N | 26 | 6/28/05 | 0.01 | | 10.7 | 7.7 | 1.8 |
| R1N | 27 | 6/28/05 | 0.01 | | 7.7 | 8.62 | 1.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 29 | 6/28/05 | 0.01 | | 10.2 | 14.4 | 2.3 |
| R1N | 30 | 6/28/05 | 0.04 | | 0 | 8.65 | 2 |
| R1N | 32 | 6/28/05 | 0.03 | | 5.3 | 11.8 | 2.3 |
| R1N | 33 | 6/28/05 | 0.15 | | 0 | 3.32 | 2.7 |
| R1N | 35 | 6/28/05 | 0.01 | | 4.8 | 11 | 2.1 |
| R1N | 36 | 6/28/05 | 0.01 | | 2.4 | 10.8 | 2 |
| R1N | 38 | 6/28/05 | 0.02 | | 7.4 | 13.7 | 1.7 |
| R1N | 39 | 6/28/05 | 0.02 | | 5.9 | 14.4 | 1.8 |
| R1N | 41 | 6/28/05 | 0.02 | | 6.6 | 13.9 | 1.8 |
| R1N | 42 | 6/28/05 | 0.01 | | 5.1 | 14.8 | 1.8 |
| R1N | 47 | 6/28/05 | 0.01 | | 5.9 | 18.4 | 1.5 |
| R1N | 48 | 6/28/05 | 0.01 | | 4.4 | 23 | 2.2 |
| R1N | 50 | 6/28/05 | 0.01 | | 6.3 | 12.8 | 2.1 |
| R1N | 51 | 6/28/05 | 0.01 | | 2 | 10.1 | 2.3 |
| R1N | 54 | 6/28/05 | 0.01 | | 10.4 | 11.8 | 1.8 |
| R1N | 57 | 6/28/05 | 0.01 | | 8.3 | 12.5 | 2.7 |
| R1N | 59 | 6/28/05 | 0.03 | | 14.1 | 9.69 | 2.7 |
| R1N | 60 | 6/28/05 | 0.01 | | 8.8 | 14.9 | 2.7 |
| R1N | 62 | 6/28/05 | 0.02 | | 3.4 | 9.17 | 1.7 |
| R1N | 63 | 6/28/05 | 0.01 | | 2.2 | 8.9 | 1.7 |
| R1N | 66 | 6/28/05 | 0.01 | | 4.6 | 18.3 | 2 |
| R1N | 69 | 6/28/05 | 0.01 | | 4.1 | 10.8 | 2.1 |
| R1N | 71 | 6/28/05 | 0.01 | | 11.3 | 15.5 | 2.6 |
| R1N | 72 | 6/28/05 | 0.01 | | 11.5 | 16.2 | 2.7 |
| R1N | Stream | 6/28/05 | 0.1 | | 6.3 | 16.6 | 5 |
| R2N | 2 | 6/28/05 | 0.03 | | 3.5 | 6.34 | 2.8 |
| R2N | 3 | 6/28/05 | 0.01 | | 3 | 13.5 | 1.9 |
| R2N | 5 | 6/28/05 | 0.15 | | 3.7 | 2.75 | 4.1 |
| R2N | 6 | 6/28/05 | 0.05 | | 1.6 | 8.81 | 2.7 |
| R2N | 8 | 6/28/05 | 0.02 | | 3.2 | 4.63 | 2.6 |
| R2N | 9 | 6/28/05 | 0.01 | | 2.3 | 17.5 | 2.2 |
| R2N | 11 | 6/28/05 | 0.09 | | 4.2 | 9.26 | 3.2 |
| R2N | 12 | 6/28/05 | 0.04 | | 5.5 | 20.8 | 2.3 |
| R2N | 14 | 6/28/05 | 0.36 | | 2 | 8.23 | 5.1 |
| R2N | 15 | 6/28/05 | 0.02 | | 3 | 18.2 | 2.5 |
| R2N | 17 | 6/28/05 | 0.08 | | 0 | 4.79 | 9.8 |
| R2N | 18 | 6/28/05 | 0.02 | | 0 | 7.72 | 2.5 |
| R2N | 20 | 6/28/05 | 0.01 | | 6.9 | 11.4 | 3.1 |
| R2N | 21 | 6/28/05 | 0.06 | | 0 | 14.7 | 1.7 |
| R2N | 23 | 6/28/05 | 0.05 | | 1.6 | 8.13 | 3.9 |
| R2N | 24 | 6/28/05 | 0.04 | | 0 | 14.7 | 1.8 |
| R2N | 26 | 6/28/05 | 0.07 | | 6.8 | 15.6 | 2.8 |
| R2N | 27 | 6/28/05 | 0.03 | | 0 | 16.4 | 2.2 |
| R2N | 29 | 6/28/05 | 0.08 | | 4.8 | 12 | 4 |
| R2N | 30 | 6/28/05 | 0.02 | | 0 | 11.2 | 1.9 |
| R2N | 32 | 6/28/05 | 0.05 | | 3.1 | 3.32 | 3.5 |
| R2N | 33 | 6/28/05 | 0.01 | | 1 | 12 | 2.1 |
| R2N | 35 | 6/28/05 | 0.06 | | 3.9 | 1.02 | 3.5 |
| R2N | 36 | 6/28/05 | 0.01 | | 2.1 | 11.6 | 2 |
| R2N | 38 | 6/28/05 | 0.02 | | 3 | 3.62 | 3 |
| R2N | 39 | 6/28/05 | 0.05 | | 2.7 | 19 | 2.4 |
| R2N | 41 | 6/28/05 | 0.02 | | 3.1 | 1.96 | 3 |
| R2N | 42 | 6/28/05 | 0.01 | | 3.8 | 9.05 | 2.7 |
| R2N | 44 | 6/28/05 | 0.04 | | 2.6 | 3.04 | 2.8 |
| R2N | 45 | 6/28/05 | 0.03 | | 3.2 | 12.6 | 2.7 |
| R2N | 47 | 6/28/05 | 0.01 | | 10.7 | 25.5 | 4.6 |
| R2N | 48 | 6/28/05 | 0.01 | | 1.2 | 23.4 | 2.6 |
| R2N | 50 | 6/28/05 | 0.02 | | 13.6 | 31.5 | 3.3 |
| R2N | 51 | 6/28/05 | 0.02 | | 1.3 | 21.6 | 3.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 53 | 6/28/05 | 0.02 | | 13.3 | 38.4 | 4 |
| R2N | 54 | 6/28/05 | 0.03 | | 8.1 | 26.5 | 3.4 |
| R2N | 56 | 6/28/05 | 0.11 | | 14.4 | 38 | 3.6 |
| R2N | 57 | 6/28/05 | 0.02 | | 7.9 | 33 | 3.6 |
| R2N | 59 | 6/28/05 | 0.11 | | 14.1 | 14.4 | 2.9 |
| R2N | 60 | 6/28/05 | 0.02 | | 2.8 | 15.1 | 3.7 |
| R2N | 63 | 6/28/05 | 0.02 | | 1.9 | 13 | 2.7 |
| R2N | 66 | 6/28/05 | 0.02 | | 4.1 | 20.7 | 2.5 |
| R2N | 69 | 6/28/05 | 0.01 | | 5.8 | 18.2 | 2.7 |
| R2N | 72 | 6/28/05 | 0.03 | | 3.5 | 16.3 | 2.9 |
| R4W | 2 | 6/28/05 | 0.03 | | 18.1 | 15.4 | 2.5 |
| R4W | 3 | 6/28/05 | 0.07 | | 0 | 21.5 | 2.6 |
| R4W | 5 | 6/28/05 | 0.01 | | 18.5 | 15.4 | 2.6 |
| R4W | 6 | 6/28/05 | 0.06 | | 0 | 22.4 | 2 |
| R4W | 8 | 6/28/05 | 0.01 | | 17.2 | 17.5 | 2.6 |
| R4W | 9 | 6/28/05 | 0.03 | | 0.19 | 9.12 | 2.7 |
| R4W | 11 | 6/28/05 | 0.01 | | 17.5 | 15.5 | 2.7 |
| R4W | 12 | 6/28/05 | 0.12 | | 1.8 | 17.1 | 4.1 |
| R4W | 14 | 6/28/05 | 0.01 | | 16.3 | 14.6 | 2.9 |
| R4W | 15 | 6/28/05 | 0.01 | | 12.4 | 16.3 | 2.6 |
| R4W | 17 | 6/28/05 | 0.01 | | 3.2 | 21 | 3.1 |
| R4W | 18 | 6/28/05 | 0.04 | | 0.18 | 14 | 2 |
| R4W | 20 | 6/28/05 | 0.01 | | 1.1 | 26.7 | 3.2 |
| R4W | 21 | 6/28/05 | 0.09 | | 0 | 13.1 | 2.4 |
| R4W | 23 | 6/28/05 | 0.01 | | 0.45 | 22.2 | 4.9 |
| R4W | 24 | 6/28/05 | 0.02 | | 0.29 | 23.8 | 4.2 |
| R4W | 26 | 6/28/05 | 0.01 | | 0.02 | 20.7 | 5.6 |
| R4W | 27 | 6/28/05 | 0.01 | | 0.01 | 21.1 | 5 |
| R4W | 29 | 6/28/05 | 0.03 | | 1.4 | 18.6 | 5.5 |
| R4W | 30 | 6/28/05 | 0.08 | | 0 | 20.8 | 5.3 |
| R4W | 32 | 6/28/05 | 0.01 | | 20.5 | 15.5 | 2.3 |
| R4W | 33 | 6/28/05 | 0.02 | | 0 | 15.1 | 1.8 |
| R4W | 35 | 6/28/05 | 0.01 | | 21 | 15.5 | 2.5 |
| R4W | 36 | 6/28/05 | 0.05 | | 0.32 | 10.1 | 2 |
| R4W | 38 | 6/28/05 | 0.01 | | 20 | 14.2 | 2.5 |
| R4W | 41 | 6/28/05 | 0.02 | | 17.8 | 16.4 | 2.7 |
| R4W | 44 | 6/28/05 | 0.01 | | 18.7 | 14.6 | 2.4 |
| R4W | 45 | 6/28/05 | 0.01 | | 19 | 15.1 | 2.4 |
| R4W | 47 | 6/28/05 | 0.01 | | 15.1 | 15.5 | 2.9 |
| R4W | 48 | 6/28/05 | 0.01 | | 11.3 | 17.2 | 2.8 |
| R4W | 50 | 6/28/05 | 0.01 | | 4.3 | 22 | 3.3 |
| R4W | 51 | 6/28/05 | 0.01 | | 2.6 | 23.5 | 2.8 |
| R4W | 53 | 6/28/05 | 0.01 | | 1 | 19.9 | 3 |
| R4W | 54 | 6/28/05 | 0.03 | | 0.1 | 24 | 3.7 |
| R4W | 56 | 6/28/05 | 0.04 | | 1.2 | 26.8 | 3.8 |
| R4W | 57 | 6/28/05 | 0.02 | | 0.15 | 25.4 | 3.4 |
| R4W | 59 | 6/28/05 | 0.02 | | 1.6 | 24.5 | 3.3 |
| R4W | 60 | 6/28/05 | 0.02 | | 1.1 | 26 | 3.6 |
| R4W | 62 | 6/28/05 | 0.01 | | 20.5 | 17.9 | 2.7 |
| R4W | 63 | 6/28/05 | 0.04 | | 8.1 | 18.6 | 2.4 |
| R4W | 65 | 6/28/05 | 0.02 | | 20.8 | 15.1 | 3 |
| R4W | 66 | 6/28/05 | 0.02 | | 19 | 23.8 | 3.2 |
| R4W | 68 | 6/28/05 | 0.03 | | 9.8 | 18.2 | 3.4 |
| R4W | 69 | 6/28/05 | 0.02 | | 9.2 | 18.6 | 2.8 |
| R4W | 71 | 6/28/05 | 0.01 | | 1.9 | 19.3 | 3 |
| R4W | 72 | 6/28/05 | 0.04 | | 0.1 | 18.5 | 2.9 |
| R4W | Stream | 6/28/05 | 2.8 | | 0 | 9.56 | 17.7 |
| R5N | 2 | 6/28/05 | 0.01 | | 1.8 | 10.9 | 4.6 |
| R5N | 3 | 6/28/05 | 0.01 | | 0.17 | 16.6 | 3.9 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 5 | 6/28/05 | 0.01 | | 3.4 | 6.93 | 4.4 |
| R5N | 6 | 6/28/05 | 0.01 | | 0.49 | 9.13 | 6.8 |
| R5N | 8 | 6/28/05 | 0.01 | | 2.2 | 4.27 | 6.4 |
| R5N | 9 | 6/28/05 | 0.02 | | 0.92 | 12.1 | 5 |
| R5N | 11 | 6/28/05 | 0.01 | | 1.8 | 7.55 | 5 |
| R5N | 12 | 6/28/05 | 0.01 | | 0.01 | 20.4 | 3.7 |
| R5N | 14 | 6/28/05 | 0.08 | | 1.4 | 7.91 | 7.9 |
| R5N | 15 | 6/28/05 | 0.01 | | 0.36 | 12 | 3.4 |
| R5N | 17 | 6/28/05 | 0.11 | | 0.55 | 6.09 | 4.6 |
| R5N | 18 | 6/28/05 | 0.01 | | 1.6 | 12.3 | 4.2 |
| R5N | 20 | 6/28/05 | 0.15 | | 0.54 | 6.2 | 12.1 |
| R5N | 21 | 6/28/05 | 0.01 | | 0.19 | 11.1 | 3.9 |
| R5N | 23 | 6/28/05 | 0.01 | | 0.42 | 3.42 | 4.3 |
| R5N | 24 | 6/28/05 | 0.01 | | 1.1 | 9.99 | 3.4 |
| R5N | 26 | 6/28/05 | 0.01 | | 0.01 | 5.88 | 3.7 |
| R5N | 27 | 6/28/05 | 0.02 | | 0 | 6.83 | 2.5 |
| R5N | 29 | 6/28/05 | 0.03 | | 0 | 9.61 | 6.2 |
| R5N | 30 | 6/28/05 | 0.06 | | 0 | 21.1 | 6.1 |
| R5N | 32 | 6/28/05 | 0.01 | | 0.57 | 11.1 | 4.5 |
| R5N | 33 | 6/28/05 | 0.01 | | 0.02 | 13 | 4.3 |
| R5N | 35 | 6/28/05 | 0.01 | | 6.9 | 5.34 | 3.7 |
| R5N | 36 | 6/28/05 | 0.01 | | 0.18 | 9.05 | 4.8 |
| R5N | 38 | 6/28/05 | 0.01 | | 2.7 | 7.48 | 5.4 |
| R5N | 39 | 6/28/05 | 0.01 | | 0.45 | 22.2 | 4.2 |
| R5N | 41 | 6/28/05 | 0.02 | | 0.37 | 11.3 | 6.9 |
| R5N | 42 | 6/28/05 | 0.01 | | 1.3 | 26.1 | 3.7 |
| R5N | 44 | 6/28/05 | 0.07 | | 2.4 | 11.4 | 6.4 |
| R5N | 45 | 6/28/05 | 0.09 | | 1.1 | 18 | 5.9 |
| R5N | 47 | 6/28/05 | 0.01 | | 0.19 | 5.35 | 4.8 |
| R5N | 48 | 6/28/05 | 0.01 | | 2.3 | 13.5 | 3.2 |
| R5N | 50 | 6/28/05 | 0.01 | | 0.55 | 5.38 | 5.1 |
| R5N | 51 | 6/28/05 | 0.01 | | 0.66 | 6.69 | 2.9 |
| R5N | 53 | 6/28/05 | 0.01 | | 0 | 8.45 | 4.3 |
| R5N | 54 | 6/28/05 | 0.01 | | 3 | 9.09 | 4.1 |
| R5N | 56 | 6/28/05 | 0.82 | | 0.11 | 6.56 | 20.2 |
| R5N | 57 | 6/28/05 | 0.01 | | 0 | 9.49 | 4.8 |
| R5N | 59 | 6/28/05 | 0.02 | | 2.6 | 5.02 | 3.9 |
| R5N | 60 | 6/28/05 | 0.02 | | 0.01 | 14.4 | 4.6 |
| R5N | 62 | 6/28/05 | 0.01 | | 1.3 | 5.67 | 4.6 |
| R5N | 63 | 6/28/05 | 0.01 | | 0 | 16.4 | 4.2 |
| R5N | 65 | 6/28/05 | 0.01 | | 0.64 | 13.6 | 6.6 |
| R5N | 66 | 6/28/05 | 0.02 | | 0.31 | 24 | 3.2 |
| R5N | 68 | 6/28/05 | 0.01 | | 0.5 | 4.57 | 4.5 |
| R5N | 69 | 6/28/05 | 0.01 | | 7.8 | 8.95 | 3.6 |
| R5N | 71 | 6/28/05 | 0.01 | | 0.15 | 11.9 | 4.2 |
| R5N | 72 | 6/28/05 | 0.01 | | 0 | 13.4 | 3.8 |
| R5N | Stream | 6/28/05 | 0.16 | | 5.4 | 28 | 14.3 |
| R1N | 2 | 7/26/05 | 0.04 | | 5.7 | 13.2 | 2.7 |
| R1N | 3 | 7/26/05 | 0.1 | | 0.12 | 3.45 | 2.9 |
| R1N | 5 | 7/26/05 | 0.01 | | 2.5 | 10.1 | 2.3 |
| R1N | 6 | 7/26/05 | 0.04 | | 0 | 9.29 | 2.9 |
| R1N | 8 | 7/26/05 | 0.05 | | 5.7 | 12.6 | 2.1 |
| R1N | 9 | 7/26/05 | 0.04 | | 0.22 | 14.4 | 2.5 |
| R1N | 11 | 7/26/05 | 0.06 | | 5.4 | 14.4 | 2.5 |
| R1N | 12 | 7/26/05 | 0.02 | | 4.3 | 15 | 1.7 |
| R1N | 17 | 7/26/05 | 0.01 | | 4.2 | 13.7 | 3.1 |
| R1N | 18 | 7/26/05 | 0.02 | | 2.6 | 14.5 | 2.2 |
| R1N | 20 | 7/26/05 | 0.02 | | 2.2 | 10.9 | 2.8 |
| R1N | 21 | 7/26/05 | 0.07 | | 0 | 8.72 | 2.4 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R1N | 23 | 7/26/05 | 0.03 | | 1.4 | 8.46 | 3.7 |
| R1N | 24 | 7/26/05 | 0.1 | | 0.01 | 7.32 | 2 |
| R1N | 26 | 7/26/05 | 0.01 | | 10.4 | 6.96 | 2.5 |
| R1N | 27 | 7/26/05 | 0.01 | | 6.5 | 10.8 | 2.8 |
| R1N | 29 | 7/26/05 | 0.01 | | 9.9 | 14 | 3.1 |
| R1N | 30 | 7/26/05 | 0.06 | | 0.2 | 8.47 | 2.6 |
| R1N | 32 | 7/26/05 | 0.04 | | 5.8 | 12.7 | 2.6 |
| R1N | 33 | 7/26/05 | 0.17 | | 0.03 | 3.59 | 2.7 |
| R1N | 35 | 7/26/05 | 0.01 | | 4.3 | 10.7 | 2.6 |
| R1N | 36 | 7/26/05 | 0.01 | | 2.4 | 10 | 1.8 |
| R1N | 38 | 7/26/05 | 0.04 | | 6.7 | 12.5 | 3.3 |
| R1N | 39 | 7/26/05 | 0.02 | | 5.7 | 13.8 | 2.5 |
| R1N | 41 | 7/26/05 | 0.02 | | 6.4 | 14.3 | 1.9 |
| R1N | 42 | 7/26/05 | 0.01 | | 5 | 16.9 | 2.3 |
| R1N | 44 | 7/26/05 | 0.02 | | 5.7 | 15 | 2 |
| R1N | 45 | 7/26/05 | 0.05 | | 0.02 | 6.36 | 2.5 |
| R1N | 47 | 7/26/05 | 0.01 | | 6.2 | 19.5 | 2.2 |
| R1N | 48 | 7/26/05 | 0.01 | | 4.2 | 21.1 | 3.5 |
| R1N | 50 | 7/26/05 | 0.01 | | 5.3 | 11.5 | 2.6 |
| R1N | 51 | 7/26/05 | 0.01 | | 2.5 | 11 | 2.2 |
| R1N | 54 | 7/26/05 | 0.01 | | 10.1 | 10.8 | 2 |
| R1N | 57 | 7/26/05 | 0.01 | | 9.1 | 11.4 | 2.5 |
| R1N | 59 | 7/26/05 | 0.04 | | 12.8 | 12.1 | 3.7 |
| R1N | 60 | 7/26/05 | 0.01 | | 10.1 | 17.6 | 2.2 |
| R1N | 62 | 7/26/05 | 0.02 | | 3.1 | 9.2 | 3.2 |
| R1N | 63 | 7/26/05 | 0.01 | | 2 | 9.78 | 2.2 |
| R1N | 65 | 7/26/05 | 0.02 | | 6.4 | 14.8 | 2.8 |
| R1N | 66 | 7/26/05 | 0.01 | | 4.5 | 18.2 | 2.2 |
| R1N | 68 | 7/26/05 | 0.01 | | 8.9 | 10.8 | 1.9 |
| R1N | 69 | 7/26/05 | 0.01 | | 5 | 8.28 | 2.1 |
| R1N | 71 | 7/26/05 | 0.02 | | 10.1 | 17 | 3.2 |
| R1N | 72 | 7/26/05 | 0.04 | | 10.2 | 17.2 | 2.4 |
| R1N | Stream | 7/26/05 | 2.3 | | 2.9 | 17.2 | 8.5 |
| R2N | 2 | 7/26/05 | 1.8 | | 0.24 | 1.53 | 5.9 |
| R2N | 3 | 7/26/05 | 1.8 | | 0.24 | 1.87 | 4.8 |
| R2N | 5 | 7/26/05 | 1.2 | | 4.2 | 1.03 | 4.2 |
| R2N | 6 | 7/26/05 | 2 | | 1.4 | 8.42 | 2.7 |
| R2N | 8 | 7/26/05 | 0.02 | | 3 | 5.58 | 2.9 |
| R2N | 9 | 7/26/05 | 0.01 | | 2 | 15.9 | 2.1 |
| R2N | 11 | 7/26/05 | 0.09 | | 4.2 | 10.1 | 3.6 |
| R2N | 12 | 7/26/05 | 0.05 | | 5.4 | 19.7 | 2.6 |
| R2N | 14 | 7/26/05 | 0.05 | | 2.2 | 7.24 | 2.4 |
| R2N | 15 | 7/26/05 | 0.03 | | 3 | 18.6 | 2.4 |
| R2N | 17 | 7/26/05 | 0.12 | | 0.01 | 2.73 | 17 |
| R2N | 18 | 7/26/05 | 0.03 | | 0 | 7.43 | 2.9 |
| R2N | 20 | 7/26/05 | 0.01 | | 1.2 | 8.75 | 5.3 |
| R2N | 21 | 7/26/05 | 0.07 | | 0 | 15.1 | 1.7 |
| R2N | 23 | 7/26/05 | 0.19 | | 0 | 2.84 | 25 |
| R2N | 24 | 7/26/05 | 0.06 | | 0 | 14.8 | 2.3 |
| R2N | 26 | 7/26/05 | 0.07 | | 0.03 | 4.26 | 14 |
| R2N | 27 | 7/26/05 | 0.04 | | 0 | 16.1 | 1.7 |
| R2N | 29 | 7/26/05 | 0.39 | | 0 | 2 | 15.4 |
| R2N | 30 | 7/26/05 | 0.03 | | 0 | 11.7 | 2.9 |
| R2N | 32 | 7/26/05 | 0.05 | | 3.1 | 4.3 | 2.3 |
| R2N | 33 | 7/26/05 | 0.02 | | 0.87 | 12.9 | 2.3 |
| R2N | 35 | 7/26/05 | 0.07 | | 3.6 | 1.29 | 3.4 |
| R2N | 36 | 7/26/05 | 0.01 | | 1.4 | 10.7 | 2.3 |
| R2N | 38 | 7/26/05 | 0.01 | | 2.6 | 3.54 | 3 |
| R2N | 39 | 7/26/05 | 0.04 | | 2.5 | 19.1 | 2.3 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 41 | 7/26/05 | 0.02 | | 3.5 | 2.88 | 2.8 |
| R2N | 42 | 7/26/05 | 0 | | 4.9 | 13.3 | 2.8 |
| R2N | 44 | 7/26/05 | 0.03 | | 2.9 | 3.42 | 2.6 |
| R2N | 45 | 7/26/05 | 0.01 | | 3.5 | 15.3 | 2.2 |
| R2N | 47 | 7/26/05 | 0 | | 14.1 | 30.7 | 2.4 |
| R2N | 48 | 7/26/05 | 0 | | 6.5 | 24.7 | 2.5 |
| R2N | 50 | 7/26/05 | 0.02 | | 16.8 | 38.9 | 4.1 |
| R2N | 51 | 7/26/05 | 0 | | 5.7 | 24 | 3.3 |
| R2N | 53 | 7/26/05 | 0.04 | | 13.3 | 36 | 3.5 |
| R2N | 54 | 7/26/05 | 0.03 | | 6.2 | 23.2 | 2.7 |
| R2N | 56 | 7/26/05 | 0.08 | | 14.1 | 40.6 | 3.6 |
| R2N | 57 | 7/26/05 | 0.02 | | 9.4 | 26.3 | 3 |
| R2N | 59 | 7/26/05 | 0.36 | | 2.8 | 20.2 | 4.2 |
| R2N | 60 | 7/26/05 | 0.01 | | 3.1 | 15.5 | 2.4 |
| R2N | 62 | 7/26/05 | 0.05 | | 3.7 | 0.86 | 3.4 |
| R2N | 63 | 7/26/05 | 0 | | 1.6 | 10.6 | 2.1 |
| R2N | 65 | 7/26/05 | 0.2 | | 1.8 | 2.48 | 2.7 |
| R2N | 66 | 7/26/05 | 0.02 | | 4.8 | 22.6 | 2.5 |
| R2N | 69 | 7/26/05 | 0 | | 8.4 | 21.9 | 1.9 |
| R2N | 72 | 7/26/05 | 0 | | 9 | 26.5 | 2.3 |
| R2N | Stream | 7/26/05 | 1.5 | | 0 | 2.68 | 16.6 |
| R4W | 2 | 7/26/05 | 0.02 | | 18.2 | 16.8 | 2.9 |
| R4W | 3 | 7/26/05 | 0.06 | | 0.01 | 22.2 | 2.4 |
| R4W | 5 | 7/26/05 | 0.01 | | 18.7 | 15.6 | 2.9 |
| R4W | 6 | 7/26/05 | 0.03 | | 0 | 23.9 | 1.9 |
| R4W | 8 | 7/26/05 | 0.01 | | 17.8 | 17.8 | 2.3 |
| R4W | 9 | 7/26/05 | 0.01 | | 0.16 | 8.38 | 2.2 |
| R4W | 11 | 7/26/05 | 0 | | 17.5 | 16.1 | 2.7 |
| R4W | 12 | 7/26/05 | 0.03 | | 0.28 | 16.1 | 2.8 |
| R4W | 14 | 7/26/05 | 0 | | 16.1 | 23.5 | 3 |
| R4W | 15 | 7/26/05 | 0 | | 12.3 | 17.4 | 2.2 |
| R4W | 17 | 7/26/05 | 0 | | 3.1 | 20.5 | 3.2 |
| R4W | 18 | 7/26/05 | 0.02 | | 0.24 | 14.7 | 2.3 |
| R4W | 20 | 7/26/05 | 0 | | 1.2 | 26.7 | 3.5 |
| R4W | 21 | 7/26/05 | 0.03 | | 0.01 | 6.97 | 2.5 |
| R4W | 23 | 7/26/05 | 0 | | 0.14 | 22.5 | 4.7 |
| R4W | 24 | 7/26/05 | 0 | | 0.03 | 23.7 | 4.1 |
| R4W | 26 | 7/26/05 | 0 | | 1.1 | 19.6 | 5.8 |
| R4W | 27 | 7/26/05 | 0 | | 0.67 | 20.5 | 5.4 |
| R4W | 29 | 7/26/05 | 0.03 | | 1.9 | 17.5 | 4.8 |
| R4W | 30 | 7/26/05 | 0.03 | | 0 | 21.7 | 4 |
| R4W | 32 | 7/26/05 | 0 | | 20.3 | 16.9 | 1.8 |
| R4W | 33 | 7/26/05 | 0.01 | | 0.44 | 16.2 | 1.5 |
| R4W | 35 | 7/26/05 | 0 | | 21.6 | 15.8 | 2.4 |
| R4W | 36 | 7/26/05 | 0.06 | | 0.13 | 8.9 | 1.9 |
| R4W | 38 | 7/26/05 | 0 | | 20.9 | 15.7 | 2.4 |
| R4W | 39 | 7/26/05 | 0.01 | | 9.5 | 17 | 2 |
| R4W | 41 | 7/26/05 | 0 | | 19.2 | 15 | 2.5 |
| R4W | 42 | 7/26/05 | 0.01 | | 16.8 | 15 | 2.1 |
| R4W | 44 | 7/26/05 | 0 | | 20.1 | 15.7 | 2.2 |
| R4W | 45 | 7/26/05 | 0 | | 18.9 | 15.4 | 2.1 |
| R4W | 47 | 7/26/05 | 0 | | 14.4 | 14.5 | 2.4 |
| R4W | 48 | 7/26/05 | 0 | | 10.9 | 18.7 | 2.5 |
| R4W | 50 | 7/26/05 | 0.01 | | 4.1 | 19.2 | 2.9 |
| R4W | 51 | 7/26/05 | 0 | | 2.3 | 19.2 | 3.4 |
| R4W | 53 | 7/26/05 | 0 | | 1.4 | 20.5 | 3.2 |
| R4W | 54 | 7/26/05 | 0.04 | | 0.35 | 24.8 | 3.5 |
| R4W | 56 | 7/26/05 | 0.03 | | 1.2 | 26.2 | 3.6 |
| R4W | 57 | 7/26/05 | 0.01 | | 0.28 | 26.7 | 2.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 59 | 7/26/05 | 0 | | 1.2 | 22.9 | 3.1 |
| R4W | 60 | 7/26/05 | 0 | | 1.1 | 21.8 | 3.1 |
| R4W | 62 | 7/26/05 | 0 | | 20.5 | 16.7 | 2.5 |
| R4W | 63 | 7/26/05 | 0 | | 6.2 | 20.1 | 1.5 |
| R4W | 65 | 7/26/05 | 0 | | 20.8 | 14.9 | 2.9 |
| R4W | 66 | 7/26/05 | 0.01 | | 20 | 17.6 | 3.1 |
| R4W | 68 | 7/26/05 | 0.05 | | 9.1 | 19.2 | 3.6 |
| R4W | 69 | 7/26/05 | 0 | | 8.8 | 20 | 2.6 |
| R4W | 71 | 7/26/05 | 0 | | 1.7 | 19.9 | 3.1 |
| R4W | 72 | 7/26/05 | 0.01 | | 0.5 | 24.9 | 3.7 |
| R4W | Stream | 7/26/05 | 9.3 | | 0 | 17 | 83.5 |
| R5N | 2 | 7/26/05 | 0.01 | | 2.9 | 9.58 | 5.1 |
| R5N | 3 | 7/26/05 | 0 | | 0 | 16.7 | 3.2 |
| R5N | 5 | 7/26/05 | 0 | | 4.7 | 4.56 | 4.2 |
| R5N | 6 | 7/26/05 | 0 | | 0.34 | 10.7 | 4.1 |
| R5N | 8 | 7/26/05 | 0.02 | | 1.2 | 3.22 | 8.8 |
| R5N | 9 | 7/26/05 | 0.01 | | 0.56 | 11.8 | 4.9 |
| R5N | 11 | 7/26/05 | 0 | | 0.79 | 5.34 | 4.4 |
| R5N | 12 | 7/26/05 | 0 | | 0.24 | 14 | 3.5 |
| R5N | 14 | 7/26/05 | 0.01 | | 2.6 | 15.4 | 5.5 |
| R5N | 15 | 7/26/05 | 0.01 | | 0.63 | 6.63 | 4.5 |
| R5N | 17 | 7/26/05 | 0.01 | | 0.26 | 4.93 | 5.2 |
| R5N | 18 | 7/26/05 | 0.01 | | 1.3 | 13.1 | 3.1 |
| R5N | 20 | 7/26/05 | 0.02 | | 1.3 | 10.1 | 3.9 |
| R5N | 21 | 7/26/05 | 0.03 | | 0 | 6.76 | 3.7 |
| R5N | 23 | 7/26/05 | 0 | | 0.19 | 2.65 | 3.4 |
| R5N | 24 | 7/26/05 | 0 | | 0.33 | 8.51 | 2.9 |
| R5N | 26 | 7/26/05 | 0 | | 0.01 | 6.54 | 3.9 |
| R5N | 27 | 7/26/05 | 0.01 | | 0.01 | 6.78 | 2 |
| R5N | 29 | 7/26/05 | 0.01 | | 0 | 13 | 7.6 |
| R5N | 30 | 7/26/05 | 0.02 | | 0 | 20.3 | 5 |
| R5N | 32 | 7/26/05 | 0.01 | | 0.39 | 11.9 | 4.8 |
| R5N | 33 | 7/26/05 | 0 | | 0.11 | 12.5 | 4.4 |
| R5N | 35 | 7/26/05 | 0.02 | | 7 | 4.93 | 3.2 |
| R5N | 36 | 7/26/05 | 0 | | 0.22 | 10.8 | 4.9 |
| R5N | 38 | 7/26/05 | 0.01 | | 1.9 | 5.86 | 4.7 |
| R5N | 39 | 7/26/05 | 0.01 | | 0.22 | 21.5 | 3.6 |
| R5N | 41 | 7/26/05 | 0.03 | | 0.74 | 9.73 | 7 |
| R5N | 42 | 7/26/05 | 0.01 | | 1.7 | 26.5 | 3.5 |
| R5N | 44 | 7/26/05 | 0.04 | | 2.8 | 5.4 | 4.4 |
| R5N | 45 | 7/26/05 | 0.21 | | 2.6 | 10.8 | 5.2 |
| R5N | 47 | 7/26/05 | 0.01 | | 0 | 5.19 | 4.9 |
| R5N | 48 | 7/26/05 | 0 | | 0.98 | 12.8 | 3.7 |
| R5N | 50 | 7/26/05 | 0 | | 0.55 | 3.86 | 5.1 |
| R5N | 51 | 7/26/05 | 0 | | 0.58 | 7.64 | 3.5 |
| R5N | 53 | 7/26/05 | 0 | | 0 | 9.66 | 4 |
| R5N | 54 | 7/26/05 | 0 | | 3.6 | 8.98 | 3.2 |
| R5N | 56 | 7/26/05 | 0.03 | | 0 | 7.14 | 4.7 |
| R5N | 57 | 7/26/05 | 0.01 | | 0 | 8.88 | 2.8 |
| R5N | 59 | 7/26/05 | 0.01 | | 4.1 | 3.86 | 3.5 |
| R5N | 60 | 7/26/05 | 0.01 | | 0 | 9.27 | 5 |
| R5N | 62 | 7/26/05 | 0.01 | | 2.5 | 4.43 | 6.6 |
| R5N | 63 | 7/26/05 | 0.01 | | 0 | 11.2 | 4.8 |
| R5N | 65 | 7/26/05 | 0.01 | | 0.41 | 14 | 5.9 |
| R5N | 66 | 7/26/05 | 0.01 | | 0 | 25.5 | 3.1 |
| R5N | 68 | 7/26/05 | 0.01 | | 0.72 | 4.48 | 4.4 |
| R5N | 69 | 7/26/05 | 0 | | 4.2 | 8.99 | 3.8 |
| R5N | 71 | 7/26/05 | 0.01 | | 0 | 5.35 | 4 |
| R5N | 72 | 7/26/05 | 0 | | 0 | 11.2 | 3.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | Stream | 7/26/05 | 0.06 | | 1.5 | 35.1 | 10.7 |
| R1N | 2 | 8/24/05 | 0.02 | | 6.2 | 12.7 | 3.6 |
| R1N | 3 | 8/24/05 | 0.01 | | 0 | 9.65 | 3 |
| R1N | 5 | 8/24/05 | 0.01 | | 2.5 | 9.7 | 1.9 |
| R1N | 6 | 8/24/05 | 0.01 | | 0.01 | 7.81 | 2.7 |
| R1N | 8 | 8/24/05 | 0.02 | | 5.2 | 13 | 4.4 |
| R1N | 9 | 8/24/05 | 0.02 | | 0.13 | 15.5 | 2.5 |
| R1N | 11 | 8/24/05 | 0.01 | | 5.7 | 16.8 | 2.2 |
| R1N | 12 | 8/24/05 | 0.01 | | 4.6 | 16.3 | 1.9 |
| R1N | 17 | 8/24/05 | 0.01 | | 3.8 | 11.7 | 3.2 |
| R1N | 18 | 8/24/05 | 0.01 | | 2.8 | 13.8 | 2.3 |
| R1N | 20 | 8/24/05 | 0.01 | | 2 | 10 | 2.5 |
| R1N | 21 | 8/24/05 | 0.01 | | 0.03 | 3.69 | 2.1 |
| R1N | 23 | 8/24/05 | 0.03 | | 1.6 | 3.39 | 5 |
| R1N | 24 | 8/24/05 | 0.01 | | 0.01 | 7.96 | 2.1 |
| R1N | 26 | 8/24/05 | 0.02 | | 11 | 12.2 | 1.8 |
| R1N | 27 | 8/24/05 | 0.01 | | 6.5 | 12.3 | 4 |
| R1N | 29 | 8/24/05 | 0.01 | | 8.2 | 12.3 | 3.6 |
| R1N | 30 | 8/24/05 | 0.03 | | 0 | 9.02 | 2.7 |
| R1N | 32 | 8/24/05 | 0.01 | | 6.3 | 20.3 | 2.6 |
| R1N | 33 | 8/24/05 | 0.05 | | 0 | 3.69 | 2.7 |
| R1N | 35 | 8/24/05 | 0.02 | | 3.9 | 10.7 | 2.3 |
| R1N | 36 | 8/24/05 | 0.01 | | 1.7 | 10.2 | 2.2 |
| R1N | 38 | 8/24/05 | 0.02 | | 6.3 | 13.7 | 1.8 |
| R1N | 39 | 8/24/05 | 0.01 | | 5.2 | 14.7 | 1.8 |
| R1N | 41 | 8/24/05 | 0.03 | | 6.4 | 15.3 | 2.3 |
| R1N | 42 | 8/24/05 | 0.02 | | 5.1 | 21.6 | 3.1 |
| R1N | 47 | 8/24/05 | 0.01 | | 6.4 | 13.1 | 2.4 |
| R1N | 48 | 8/24/05 | 0.01 | | 2.7 | 14.8 | 2.5 |
| R1N | 50 | 8/24/05 | 0.01 | | 8 | 9.57 | 2.2 |
| R1N | 51 | 8/24/05 | 0.01 | | 4 | 11.8 | 1.7 |
| R1N | 54 | 8/24/05 | 0.01 | | 10.2 | 9.48 | 1.5 |
| R1N | 57 | 8/24/05 | 0.01 | | 8.3 | 10.7 | 3.2 |
| R1N | 59 | 8/24/05 | 0.04 | | 13 | 14 | 3.2 |
| R1N | 60 | 8/24/05 | 0.02 | | 8.9 | 15.1 | 2.4 |
| R1N | 62 | 8/24/05 | 0.01 | | 2.7 | 10.6 | 3.2 |
| R1N | 63 | 8/24/05 | 0.01 | | 1.9 | 9.81 | 2.9 |
| R1N | 65 | 8/24/05 | 0.06 | | 6.6 | 13.4 | 2.3 |
| R1N | 66 | 8/24/05 | 0.01 | | 3.4 | 16.9 | 2.1 |
| R1N | 71 | 8/24/05 | 0.01 | | 13 | 16.2 | 2.5 |
| R1N | 72 | 8/24/05 | 0.01 | | 11.8 | 17.5 | 2.6 |
| R1N | Stream | 8/24/05 | 0.35 | | 0.46 | 3.74 | 9 |
| R2N | 2 | 8/24/05 | 0.04 | | 3 | 4.57 | 4.6 |
| R2N | 3 | 8/24/05 | 0.02 | | 3.7 | 10.9 | 3.4 |
| R2N | 5 | 8/24/05 | 0.01 | | 2.9 | 3.45 | 3.5 |
| R2N | 6 | 8/24/05 | 0.01 | | 1.1 | 10.2 | 2.6 |
| R2N | 8 | 8/24/05 | 0.01 | | 3.4 | 3.37 | 10 |
| R2N | 9 | 8/24/05 | 0.01 | | 1.7 | 14.3 | 2.4 |
| R2N | 11 | 8/24/05 | 0.01 | | 4.3 | 6.72 | 2.6 |
| R2N | 12 | 8/24/05 | 0.03 | | 5.6 | 19.7 | 2 |
| R2N | 14 | 8/24/05 | 0.01 | | 2.8 | 10 | 2.6 |
| R2N | 15 | 8/24/05 | 0.01 | | 3.1 | 18.7 | 3.5 |
| R2N | 17 | 8/24/05 | 0.06 | | 0.01 | 2.55 | 8.8 |
| R2N | 18 | 8/24/05 | 0.02 | | 0 | 7.36 | 2.9 |
| R2N | 20 | 8/24/05 | 0.01 | | 0.13 | 7.36 | 7.4 |
| R2N | 21 | 8/24/05 | 0.01 | | 0.01 | 14.5 | 1.5 |
| R2N | 23 | 8/24/05 | 0.09 | | 0 | 2.3 | 11.8 |
| R2N | 24 | 8/24/05 | 0.02 | | 0 | 14.1 | 4.6 |
| R2N | 26 | 8/24/05 | 0.1 | | 0.01 | 2.51 | 18 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R2N | 27 | 8/24/05 | 0.04 | | 0 | 15.9 | 2.8 |
| R2N | 29 | 8/24/05 | 0.1 | | 6.9 | 12.4 | 3.9 |
| R2N | 30 | 8/24/05 | 0.01 | | 0 | 13.3 | 2.1 |
| R2N | 32 | 8/24/05 | 0.03 | | 3.7 | 6.33 | 2.6 |
| R2N | 33 | 8/24/05 | 0.01 | | 1 | 13.1 | 2 |
| R2N | 35 | 8/24/05 | 0.03 | | 3.2 | 1.32 | 3 |
| R2N | 36 | 8/24/05 | 0.01 | | 1.2 | 10.4 | 2.6 |
| R2N | 38 | 8/24/05 | 0.01 | | 2.6 | 2.18 | 2.7 |
| R2N | 39 | 8/24/05 | 0.01 | | 2 | 13.6 | 2.1 |
| R2N | 41 | 8/24/05 | 0.01 | | 3.3 | 2.67 | 2.4 |
| R2N | 42 | 8/24/05 | 0.01 | | 4.3 | 9.38 | 2.2 |
| R2N | 44 | 8/24/05 | 0.01 | | 3.3 | 8.85 | 2.2 |
| R2N | 45 | 8/24/05 | 0.01 | | 3.5 | 14.7 | 1.6 |
| R2N | 47 | 8/24/05 | 0.01 | | 10.1 | 26.1 | 2.4 |
| R2N | 48 | 8/24/05 | 0.01 | | 9.3 | 28.2 | 1.9 |
| R2N | 50 | 8/24/05 | 0.01 | | 12.3 | 40.5 | 3 |
| R2N | 51 | 8/24/05 | 0.01 | | 7.4 | 26.2 | 2.2 |
| R2N | 53 | 8/24/05 | 0.01 | | 9.7 | 36.6 | 2.7 |
| R2N | 54 | 8/24/05 | 0.01 | | 8.4 | 28.2 | 2.5 |
| R2N | 56 | 8/24/05 | 0.18 | | 3.6 | 7.78 | 4.9 |
| R2N | 57 | 8/24/05 | 0.01 | | 8.6 | 23.4 | 2.7 |
| R2N | 59 | 8/24/05 | 0.98 | | 1.2 | 3 | 5.2 |
| R2N | 60 | 8/24/05 | 0.01 | | 3.5 | 15.3 | 3.6 |
| R2N | 62 | 8/24/05 | 0.01 | | 3.5 | 0.57 | 3.5 |
| R2N | 63 | 8/24/05 | 0.01 | | 1.8 | 8.49 | 4.2 |
| R2N | 65 | 8/24/05 | 0.01 | | 2 | 2.7 | 3 |
| R2N | 66 | 8/24/05 | 0.01 | | 3.3 | 23.4 | 2.1 |
| R2N | 69 | 8/24/05 | 0.01 | | 11 | 27.2 | 2.1 |
| R2N | 72 | 8/24/05 | 0.01 | | 8.4 | 28.4 | 2.3 |
| R2N | Stream | 8/24/05 | 1.1 | | 1.3 | 5.34 | 17.5 |
| R4W | 2 | 8/24/05 | 0.02 | | 18.5 | 16.9 | 3.6 |
| R4W | 3 | 8/24/05 | 0.01 | | 0 | 21.8 | 2 |
| R4W | 5 | 8/24/05 | 0.01 | | 18.5 | 15.4 | 2.7 |
| R4W | 6 | 8/24/05 | 0.01 | | 0 | 24.7 | 1.6 |
| R4W | 8 | 8/24/05 | 0.01 | | 17.2 | 19.9 | 2.7 |
| R4W | 9 | 8/24/05 | 0.01 | | 0.44 | 8.99 | 2.1 |
| R4W | 11 | 8/24/05 | 0.01 | | 18.6 | 16.6 | 4.3 |
| R4W | 12 | 8/24/05 | 0.01 | | 14 | 16.6 | 3 |
| R4W | 14 | 8/24/05 | 0.01 | | 13.1 | 18.2 | 6.1 |
| R4W | 15 | 8/24/05 | 0.01 | | 9.4 | 20.4 | 3.3 |
| R4W | 17 | 8/24/05 | 0.01 | | 1.8 | 21.3 | 5.4 |
| R4W | 18 | 8/24/05 | 0.01 | | 0.25 | 15.3 | 2.2 |
| R4W | 20 | 8/24/05 | 0.01 | | 0.65 | 25.6 | 4.7 |
| R4W | 21 | 8/24/05 | 0.03 | | 0.01 | 7.45 | 2.3 |
| R4W | 23 | 8/24/05 | 0.01 | | 0.99 | 21.2 | 5.4 |
| R4W | 24 | 8/24/05 | 0.01 | | 0.39 | 22.6 | 6 |
| R4W | 26 | 8/24/05 | 0.01 | | 1.5 | 19.3 | 6.6 |
| R4W | 27 | 8/24/05 | 0.01 | | 0.89 | 19.9 | 5.7 |
| R4W | 29 | 8/24/05 | 0.01 | | 1.5 | 17.2 | 5.3 |
| R4W | 30 | 8/24/05 | 0.01 | | 0.02 | 21.9 | 3.1 |
| R4W | 32 | 8/24/05 | 0.01 | | 19.7 | 18.3 | 2.5 |
| R4W | 33 | 8/24/05 | 0.01 | | 0.2 | 16.5 | 1.6 |
| R4W | 35 | 8/24/05 | 0.01 | | 19.6 | 16.7 | 2.6 |
| R4W | 36 | 8/24/05 | 0.02 | | 0.03 | 9.28 | 1.8 |
| R4W | 38 | 8/24/05 | 0.01 | | 20.1 | 17.2 | 2.9 |
| R4W | 39 | 8/24/05 | 0.01 | | 8.5 | 23.1 | 2.5 |
| R4W | 41 | 8/24/05 | 0.01 | | 17.2 | 17.1 | 4 |
| R4W | 42 | 8/24/05 | 0.01 | | 16.3 | 17.8 | 3 |
| R4W | 44 | 8/24/05 | 0.01 | | 17.7 | 15 | 2.8 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R4W | 45 | 8/24/05 | 0.01 | | 15.9 | 15.7 | 2.4 |
| R4W | 47 | 8/24/05 | 0.01 | | 11.8 | 19 | 3 |
| R4W | 48 | 8/24/05 | 0.01 | | 9.7 | 21.8 | 2.4 |
| R4W | 50 | 8/24/05 | 0.01 | | 2.8 | 18.3 | 2.8 |
| R4W | 51 | 8/24/05 | 0.01 | | 1.6 | 21.3 | 2.9 |
| R4W | 53 | 8/24/05 | 0.01 | | 1.2 | 22.5 | 3 |
| R4W | 54 | 8/24/05 | 0.01 | | 0.22 | 27.1 | 2.1 |
| R4W | 56 | 8/24/05 | 0.02 | | 1.3 | 25.8 | 3.8 |
| R4W | 57 | 8/24/05 | 0.01 | | 0.15 | 28.7 | 3.5 |
| R4W | 59 | 8/24/05 | 0.01 | | 0.28 | 25.8 | 4.9 |
| R4W | 60 | 8/24/05 | 0.01 | | 0.36 | 24.3 | 3.8 |
| R4W | 62 | 8/24/05 | 0.01 | | 19.4 | 18 | 2.5 |
| R4W | 63 | 8/24/05 | 0.01 | | 4.6 | 21.5 | 1.6 |
| R4W | 65 | 8/24/05 | 0.01 | | 20 | 16.7 | 2.9 |
| R4W | 66 | 8/24/05 | 0.01 | | 19.3 | 19.5 | 2.2 |
| R4W | 68 | 8/24/05 | 0.01 | | 8.4 | 19.6 | 5.6 |
| R4W | 69 | 8/24/05 | 0.01 | | 8 | 21.5 | 3.6 |
| R4W | 71 | 8/24/05 | 0.01 | | 1.6 | 19.9 | 3 |
| R4W | 72 | 8/24/05 | 0.01 | | 0.42 | 24.3 | 2.5 |
| R4W | Stream | 8/24/05 | 0.76 | | 0 | 7.54 | 23.4 |
| R5N | 2 | 8/24/05 | 0.02 | | 4.9 | 12.2 | 4.5 |
| R5N | 3 | 8/24/05 | 0.02 | | 0.02 | 14.9 | 3.9 |
| R5N | 5 | 8/24/05 | 0.01 | | 3 | 1.84 | 5.1 |
| R5N | 6 | 8/24/05 | 0.01 | | 0.35 | 9.35 | 4.7 |
| R5N | 8 | 8/24/05 | 0.01 | | 0.42 | 4.44 | 8.3 |
| R5N | 9 | 8/24/05 | 0.02 | | 0.47 | 13.5 | 5 |
| R5N | 11 | 8/24/05 | 0.01 | | 0.26 | 4.93 | 4.8 |
| R5N | 12 | 8/24/05 | 0.01 | | 0.14 | 12.2 | 4 |
| R5N | 14 | 8/24/05 | 0.01 | | 0.2 | 13.2 | 7.3 |
| R5N | 15 | 8/24/05 | 0.01 | | 0.84 | 7.62 | 4.7 |
| R5N | 17 | 8/24/05 | 0.01 | | 0.01 | 8.09 | 5.6 |
| R5N | 18 | 8/24/05 | 0.01 | | 0.37 | 11.1 | 3.4 |
| R5N | 20 | 8/24/05 | 0.01 | | 0 | 11.3 | 4 |
| R5N | 21 | 8/24/05 | 0.01 | | 0.01 | 5.83 | 3.3 |
| R5N | 23 | 8/24/05 | 0.01 | | 0.47 | 1.49 | 3.1 |
| R5N | 24 | 8/24/05 | 0.01 | | 0.22 | 6.17 | 3.5 |
| R5N | 26 | 8/24/05 | 0.01 | | 0 | 5.93 | 4 |
| R5N | 27 | 8/24/05 | 0.01 | | 0 | 5.15 | 4.4 |
| R5N | 29 | 8/24/05 | 0.01 | | 0 | 22.1 | 6.9 |
| R5N | 30 | 8/24/05 | 0.01 | | 0 | 15.3 | 4.1 |
| R5N | 32 | 8/24/05 | 0.01 | | 0.37 | 8.41 | 4.6 |
| R5N | 33 | 8/24/05 | 0.01 | | 0 | 12.9 | 4.2 |
| R5N | 35 | 8/24/05 | 0.01 | | 6.8 | 2.85 | 3.9 |
| R5N | 36 | 8/24/05 | 0.01 | | 0.27 | 12 | 4.9 |
| R5N | 38 | 8/24/05 | 0.01 | | 1.9 | 5.29 | 5.5 |
| R5N | 39 | 8/24/05 | 0.01 | | 0.32 | 24.1 | 4.2 |
| R5N | 41 | 8/24/05 | 0.01 | | 0.39 | 8.06 | 8.5 |
| R5N | 42 | 8/24/05 | 0.01 | | 1.9 | 28.2 | 4.5 |
| R5N | 44 | 8/24/05 | 0.01 | | 2.5 | 4.69 | 5.1 |
| R5N | 45 | 8/24/05 | 0.01 | | 3.4 | 8.22 | 4.8 |
| R5N | 47 | 8/24/05 | 0.01 | | 0.02 | 5.7 | 5.2 |
| R5N | 48 | 8/24/05 | 0.01 | | 1 | 12 | 3 |
| R5N | 50 | 8/24/05 | 0.01 | | 0.43 | 5.86 | 5.7 |
| R5N | 51 | 8/24/05 | 0.01 | | 0.89 | 8.72 | 3 |
| R5N | 53 | 8/24/05 | 0.01 | | 0.02 | 10.5 | 3.5 |
| R5N | 54 | 8/24/05 | 0.01 | | 4.2 | 13.1 | 3.5 |
| R5N | 56 | 8/24/05 | 0.01 | | 0.01 | 8.34 | 3.7 |
| R5N | 57 | 8/24/05 | 0.01 | | 0 | 10.8 | 3.3 |
| R5N | 59 | 8/24/05 | 0.01 | | 3.5 | 0 | 3.6 |

Table F.1 (continued)

| Sample ID | | Sampling | $PO_4$ | $NH_4$ | $NO_3$ | Cl | DOC |
|---|---|---|---|---|---|---|---|
| Buffer | Well | Date | mg P/L | mg N/L | mg N/L | mg Cl/L | mg C/L |
| R5N | 60 | 8/24/05 | 0.02 | | 0.02 | 8.66 | 4.3 |
| R5N | 62 | 8/24/05 | 0.01 | | 2.1 | 4.62 | 4.3 |
| R5N | 63 | 8/24/05 | 0.01 | | 0.02 | 12.7 | 4.4 |
| R5N | 65 | 8/24/05 | 0.01 | | 0.35 | 12.9 | 5.5 |
| R5N | 66 | 8/24/05 | 0.01 | | 0 | 23.5 | 3.1 |
| R5N | 68 | 8/24/05 | 0.01 | | 1 | 4.35 | 5.1 |
| R5N | 69 | 8/24/05 | 0.01 | | 5.1 | 12 | 2.9 |
| R5N | 71 | 8/24/05 | 0.01 | | 0.03 | 4.4 | 3.8 |
| R5N | 72 | 8/24/05 | 0.01 | | 0 | 11 | 3.5 |
| R5N | Stream | 8/24/05 | 0.09 | | 1.4 | 26.9 | 16 |

Table F.2. Depth to water table for each well (in cm from ground surface).

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **12/15/03** | **1/8/04** | **2/8/04** | **3/8/04** | **4/18/04** | **5/25/04** | **6/29/04** | **7/29/04** |
| R1N | 2 | | 181 | 180 | 178 | 182 | 115 | 176 | 177 |
| R1N | 3 | 129 | 129 | 136 | 114 | 106 | 155 | 88 | 100 |
| R1N | 5 | | 174 | 176 | 174 | 176 | 178 | 167 | 171 |
| R1N | 6 | 147 | 175 | 177 | 174 | 179 | 180 | 173 | 175 |
| R1N | 8 | | 178 | 180 | 177 | 181 | 183 | 170 | 175 |
| R1N | 9 | 151 | 182 | 184 | 180 | 184 | 186 | 174 | 180 |
| R1N | 11 | | 153 | 157 | 153 | 158 | 158 | 148 | 153 |
| R1N | 12 | 135 | 155 | 158 | 155 | 158 | 159 | 148 | 153 |
| R1N | 17 | | 185 | 161 | 155 | 162 | 162 | 149 | 157 |
| R1N | 18 | 146 | 155 | 161 | 157 | 162 | 164 | 149 | 155 |
| R1N | 20 | | 163 | 169 | 165 | 169 | 169 | 159 | 165 |
| R1N | 21 | 154 | 161 | 164 | 161 | 166 | 166 | 155 | 160 |
| R1N | 23 | | 161 | 166 | 163 | 167 | 168 | 155 | 161 |
| R1N | 24 | 256 | 272 | 272 | 272 | 243 | 228 | 218 | 231 |
| R1N | 26 | | 122 | 173 | 169 | 171 | 172 | 156 | 160 |
| R1N | 27 | 158 | 165 | | | 174 | 174 | 158 | 163 |
| R1N | 29 | 170 | 171 | 191 | 188 | 187 | 183 | 171 | 174 |
| R1N | 30 | | 344 | 256 | 254 | 220 | 206 | 194 | 199 |
| R1N | 32 | | 142 | 148 | 144 | 151 | 153 | 141 | 148 |
| R1N | 33 | 130 | 132 | 140 | 131 | 139 | 140 | 126 | 136 |
| R1N | 35 | | 161 | 167 | 154 | 170 | 135 | 160 | 167 |
| R1N | 36 | 156 | 163 | 169 | 173 | 171 | 153 | 161 | 168 |
| R1N | 38 | | 200 | 204 | 201 | 206 | 207 | 195 | 200 |
| R1N | 39 | 183 | 200 | 205 | 201 | 206 | 207 | 196 | 200 |
| R1N | 41 | | 188 | 195 | 190 | 199 | 197 | 185 | 191 |
| R1N | 42 | 182 | 189 | 196 | 192 | 198 | 200 | 187 | 192 |
| R1N | 44 | | 177 | 184 | 177 | 184 | 188 | | |
| R1N | 45 | 152 | 166 | 170 | 165 | 140 | 125 | | |
| R1N | 47 | | 193 | 198 | 191 | 203 | 202 | 189 | 194 |
| R1N | 48 | 190 | 192 | 201 | 194 | 200 | 203 | 187 | 195 |
| R1N | 50 | | 189 | 198 | 191 | 199 | 201 | 186 | 193 |
| R1N | 51 | 190 | 191 | 200 | 192 | 200 | 203 | 187 | 194 |
| R1N | 53 | | 211 | | | 213 | | | 211 |
| R1N | 54 | 209 | 213 | 220 | 214 | 220 | 220 | 207 | 211 |
| R1N | 56 | | | | | | | | |
| R1N | 57 | 220 | 230 | 236 | 230 | 234 | 234 | 220 | 225 |
| R1N | 59 | | 227 | 234 | 228 | 232 | 232 | 217 | 221 |
| R1N | 60 | 217 | 228 | 235 | 228 | 233 | 232 | 218 | 222 |
| R1N | 62 | | 185 | 193 | 187 | 196 | 199 | 185 | 194 |
| R1N | 63 | 186 | 189 | 196 | 191 | 199 | 201 | 189 | 195 |
| R1N | 65 | | 225 | 233 | 227 | 235 | | 224 | 232 |
| R1N | 66 | 224 | 225 | 232 | 225 | 236 | 237 | 224 | 231 |
| R1N | 68 | | 211 | 221 | 212 | 218 | | 208 | 216 |
| R1N | 69 | 210 | 211 | 220 | 213 | 220 | 222 | 207 | 215 |
| R1N | 71 | | 252 | | 253 | 256 | | | 251 |
| R1N | 72 | 247 | 249 | 263 | 255 | 262 | 261 | 247 | 252 |
| R2N | 2 | | 192 | 206 | 193 | 208 | 214 | 184 | 207 |
| R2N | 3 | 121 | 129 | 144 | 129 | 147 | 150 | 121 | 144 |
| R2N | 5 | | 132 | 146 | 130 | 150 | 155 | 124 | 146 |
| R2N | 6 | 125 | 132 | 148 | 132 | 151 | 155 | 124 | 148 |
| R2N | 8 | | 135 | 151 | 135 | 154 | 159 | 131 | 151 |
| R2N | 9 | 132 | 138 | 154 | 139 | 157 | 163 | 131 | 155 |
| R2N | 11 | | 129 | 144 | 128 | 148 | 152 | 120 | 142 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **12/15/03** | **1/8/04** | **2/8/04** | **3/8/04** | **4/18/04** | **5/25/04** | **6/29/04** | **7/29/04** |
| R2N | 12 | 125 | 132 | 148 | 132 | 145 | 155 | 124 | 147 |
| R2N | 14 | | 117 | 132 | 116 | 135 | 139 | 109 | 133 |
| R2N | 15 | 108 | 115 | 130 | 114 | 135 | 138 | 108 | 133 |
| R2N | 17 | | 122 | 135 | 124 | 141 | 154 | 102 | 129 |
| R2N | 18 | 75 | 122 | 135 | 124 | 141 | 154 | 233 | 128 |
| R2N | 20 | | 112 | 123 | 129 | 127 | 130 | 102 | 119 |
| R2N | 21 | 99 | 108 | 122 | 108 | 122 | 124 | 95 | 113 |
| R2N | 23 | | 125 | 135 | 124 | 139 | 144 | 110 | 134 |
| R2N | 24 | 113 | 122 | 138 | 123 | 137 | 139 | 111 | 130 |
| R2N | 26 | | 115 | 128 | 115 | 134 | 148 | 109 | 127 |
| R2N | 27 | 124 | 130 | 144 | 129 | 145 | 147 | 122 | 139 |
| R2N | 29 | | 118 | 133 | 119 | 137 | 143 | 111 | 131 |
| R2N | 30 | 122 | 127 | 143 | 128 | 145 | 148 | 121 | 142 |
| R2N | 32 | | 177 | 191 | 175 | 194 | 197 | 165 | 189 |
| R2N | 33 | 167 | 176 | 190 | 175 | 193 | 196 | 166 | 190 |
| R2N | 35 | | 169 | 187 | 171 | 187 | 191 | 159 | 186 |
| R2N | 36 | 160 | 169 | 184 | 168 | 187 | 190 | 158 | 184 |
| R2N | 38 | | 163 | 178 | 164 | 182 | 185 | 152 | 178 |
| R2N | 39 | 158 | 167 | 182 | 167 | 185 | 189 | 157 | 183 |
| R2N | 41 | | 161 | 175 | 163 | 179 | 183 | 149 | 177 |
| R2N | 42 | 153 | 163 | 177 | 162 | 182 | 181 | 151 | 179 |
| R2N | 44 | | 150 | 166 | 149 | 170 | 173 | 138 | 167 |
| R2N | 45 | 142 | 152 | 167 | 150 | 171 | 173 | 140 | 169 |
| R2N | 47 | | 194 | 205 | 194 | 207 | 209 | 179 | 197 |
| R2N | 48 | 182 | 194 | 206 | 193 | 207 | 203 | 179 | 197 |
| R2N | 50 | | 204 | 216 | 204 | 219 | 221 | 191 | 210 |
| R2N | 51 | 196 | 206 | 218 | 206 | 221 | 221 | 193 | 213 |
| R2N | 53 | | 200 | 214 | 200 | 216 | 217 | 189 | 209 |
| R2N | 54 | 195 | 202 | 217 | 202 | 218 | 219 | 190 | 210 |
| R2N | 56 | | 201 | 215 | 200 | 217 | 220 | 190 | 212 |
| R2N | 57 | 204 | 212 | 224 | 210 | 225 | 228 | 200 | 220 |
| R2N | 59 | | 207 | 222 | 208 | 225 | 227 | 196 | 219 |
| R2N | 60 | 202 | 211 | 224 | 208 | 227 | 231 | 199 | 223 |
| R2N | 62 | | 238 | | 240 | 260 | 262 | 230 | 252 |
| R2N | 63 | 236 | 244 | 259 | 244 | 259 | 268 | 235 | 258 |
| R2N | 65 | | 235 | 252 | 236 | 254 | 259 | 225 | 251 |
| R2N | 66 | 228 | 238 | 252 | 238 | 257 | 260 | 228 | 253 |
| R2N | 68 | | 231 | | 231 | | | 218 | 238 |
| R2N | 69 | 225 | 233 | 246 | 233 | 248 | 255 | 221 | 239 |
| R2N | 71 | | | | | | | | 263 |
| R2N | 72 | 258 | 263 | 278 | 263 | 280 | 286 | 253 | 274 |
| R4W | 2 | | 77 | 84 | 81 | 85 | 88 | 75 | 81 |
| R4W | 3 | 96 | 92 | 106 | 87 | 83 | 75 | 64 | 76 |
| R4W | 5 | | 84 | 89 | 87 | 93 | 95 | 81 | 88 |
| R4W | 6 | 72 | 83 | 89 | 88 | 93 | 95 | 82 | 86 |
| R4W | 8 | | 77 | 81 | 78 | 83 | 86 | 68 | 78 |
| R4W | 9 | 136 | 239 | 253 | 278 | 232 | 197 | 159 | 142 |
| R4W | 11 | | 73 | 79 | 75 | 81 | 82 | 67 | 71 |
| R4W | 12 | 73 | 117 | 111 | 112 | 88 | 84 | 65 | 69 |
| R4W | 14 | | 82 | 89 | 84 | 92 | 91 | 75 | 83 |
| R4W | 15 | 74 | 85 | 92 | 87 | 93 | 94 | 78 | 88 |
| R4W | 17 | | 75 | 80 | 76 | 80 | 82 | 66 | 74 |
| R4W | 18 | 220 | 310 | 310 | 309 | 260 | 246 | 240 | 241 |
| R4W | 20 | | 70 | 77 | 73 | 78 | 79 | 62 | 73 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| Buffer | Well | 12/15/03 | 1/8/04 | 2/8/04 | 3/8/04 | 4/18/04 | 5/25/04 | 6/29/04 | 7/29/04 |
| R4W | 21 | 64 | 315 | 348 | 348 | 342 | 338 | 336 | 337 |
| R4W | 23 | | 69 | 77 | 74 | 78 | 78 | 62 | 71 |
| R4W | 24 | 61 | 69 | 76 | 73 | 77 | 78 | 61 | 71 |
| R4W | 26 | | 73 | 75 | 72 | 76 | 77 | 60 | 70 |
| R4W | 27 | 61 | 72 | 77 | 71 | 76 | 78 | 60 | 70 |
| R4W | 29 | | 84 | 84 | 84 | 87 | 88 | 71 | 81 |
| R4W | 30 | 76 | 86 | 89 | 85 | 89 | 91 | 73 | 84 |
| R4W | 32 | | 97 | 101 | 97 | 103 | 106 | 91 | 98 |
| R4W | 33 | 85 | 97 | 101 | 96 | 102 | 106 | 92 | 98 |
| R4W | 35 | 82 | 94 | 97 | 94 | 100 | 104 | 91 | 95 |
| R4W | 36 | 194 | | 302 | 307 | 298 | 268 | 219 | 206 |
| R4W | 38 | 73 | 86 | 90 | 87 | 92 | 96 | 80 | 86 |
| R4W | 39 | 78 | 86 | 91 | 85 | 91 | 94 | 80 | 89 |
| R4W | 41 | 85 | 98 | 103 | 101 | 104 | 106 | 89 | 97 |
| R4W | 42 | 86 | 99 | 104 | 100 | 105 | 107 | 90 | 99 |
| R4W | 44 | | 104 | 107 | 105 | 109 | 104 | 95 | 104 |
| R4W | 45 | 86 | 99 | 104 | 99 | 105 | 106 | 90 | 99 |
| R4W | 47 | | 105 | 109 | 103 | 112 | 110 | 93 | 102 |
| R4W | 48 | 93 | 104 | 108 | 104 | 109 | 110 | 93 | 104 |
| R4W | 50 | | 108 | 113 | 109 | 114 | 113 | 97 | 108 |
| R4W | 51 | 97 | 109 | 113 | 109 | 115 | 115 | 98 | 108 |
| R4W | 53 | | 109 | 113 | 109 | 113 | 113 | 97 | 108 |
| R4W | 54 | 95 | 107 | 111 | 107 | 106 | 112 | 95 | 105 |
| R4W | 56 | | 119 | 122 | 119 | 122 | 124 | 107 | 116 |
| R4W | 57 | 112 | 115 | 120 | 115 | 90 | 121 | 102 | 118 |
| R4W | 59 | 95 | 106 | 109 | 104 | 109 | 110 | 93 | 103 |
| R4W | 60 | 93 | 101 | 107 | 103 | 107 | 110 | 90 | 99 |
| R4W | 62 | | 114 | 117 | 113 | 119 | 123 | 108 | 116 |
| R4W | 63 | 101 | 115 | 117 | 113 | 118 | 122 | 101 | 121 |
| R4W | 65 | | 99 | 107 | 101 | 110 | 112 | 94 | 102 |
| R4W | 66 | 91 | 101 | 109 | 103 | 112 | 113 | 96 | 105 |
| R4W | 68 | | 100 | 108 | 103 | 110 | 110 | 93 | 105 |
| R4W | 69 | 93 | 102 | 108 | 104 | 109 | 111 | 93 | 105 |
| R4W | 71 | 106 | 116 | 122 | 117 | 123 | 123 | 105 | 117 |
| R4W | 72 | | 116 | 122 | 118 | 122 | 123 | 105 | 119 |
| R5N | 2 | | 131 | 135 | 128 | 137 | 143 | 115 | 136 |
| R5N | 3 | 99 | 131 | 135 | 128 | 137 | 145 | 117 | 137 |
| R5N | 5 | | 120 | 128 | 87 | 127 | 137 | 103 | 128 |
| R5N | 6 | 85 | 118 | 124 | 88 | 126 | 135 | 103 | 127 |
| R5N | 8 | | 127 | 130 | 124 | 131 | 141 | 112 | 134 |
| R5N | 9 | 91 | 126 | 129 | 122 | 130 | 140 | 108 | 133 |
| R5N | 11 | | 134 | 137 | 129 | 139 | 148 | 121 | 142 |
| R5N | 12 | 91 | 126 | 129 | 123 | 132 | 139 | 112 | 135 |
| R5N | 14 | | 128 | 133 | 124 | 132 | 144 | 111 | 137 |
| R5N | 15 | 90 | 128 | 130 | 122 | 132 | 143 | 114 | 137 |
| R5N | 17 | | 126 | 127 | 120 | 128 | 141 | 109 | 136 |
| R5N | 18 | 84 | 124 | 127 | 118 | 127 | 135 | 109 | 135 |
| R5N | 20 | | 122 | 124 | 117 | 126 | 139 | 107 | 134 |
| R5N | 21 | 85 | 120 | 122 | 114 | 126 | 138 | 107 | 131 |
| R5N | 23 | | 109 | 112 | 102 | 115 | 128 | 91 | 122 |
| R5N | 24 | 75 | 111 | 113 | 107 | 116 | 127 | 93 | 123 |
| R5N | 26 | | 118 | 119 | 112 | 123 | 133 | 100 | 130 |
| R5N | 27 | 84 | 119 | 122 | 115 | 122 | 137 | 101 | 133 |
| R5N | 29 | | 119 | 121 | 113 | 124 | 135 | 101 | 132 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **12/15/03** | **1/8/04** | **2/8/04** | **3/8/04** | **4/18/04** | **5/25/04** | **6/29/04** | **7/29/04** |
| R5N | 30 | 78 | 124 | 125 | 115 | 127 | 141 | 102 | 137 |
| R5N | 32 | | 134 | 138 | 131 | 141 | 147 | 115 | 140 |
| R5N | 33 | 98 | 134 | 140 | 130 | 146 | 149 | 116 | 140 |
| R5N | 35 | | 131 | 134 | 131 | 138 | 146 | 112 | 137 |
| R5N | 36 | 93 | 131 | 134 | 123 | 137 | 145 | 111 | 137 |
| R5N | 38 | | 133 | 136 | 129 | 138 | 147 | 114 | 134 |
| R5N | 39 | 95 | 132 | 134 | 127 | 138 | 145 | 113 | 145 |
| R5N | 41 | | 144 | 147 | 138 | 146 | 157 | 124 | 151 |
| R5N | 42 | 103 | 141 | 143 | 135 | 149 | 155 | 122 | 149 |
| R5N | 44 | | 136 | 137 | 130 | 141 | 150 | 116 | 144 |
| R5N | 45 | 94 | 135 | 137 | 130 | 140 | 149 | 116 | 143 |
| R5N | 47 | | 131 | 133 | 125 | 136 | 148 | 111 | 142 |
| R5N | 48 | 87 | 131 | 134 | 125 | 136 | 148 | 111 | 141 |
| R5N | 50 | | 130 | 132 | 123 | 134 | 147 | 109 | 141 |
| R5N | 51 | 86 | 129 | 130 | 122 | 133 | 146 | 109 | 139 |
| R5N | 53 | | 125 | 127 | 119 | 128 | 142 | 105 | 137 |
| R5N | 54 | 84 | 125 | 127 | 119 | 128 | 142 | 106 | 138 |
| R5N | 56 | | 121 | 123 | 115 | 125 | 138 | 101 | 134 |
| R5N | 57 | 79 | 122 | 123 | 114 | 124 | 138 | 100 | 134 |
| R5N | 59 | | 107 | 114 | 104 | 111 | 130 | 88 | 125 |
| R5N | 60 | 62 | 107 | 114 | 103 | 112 | 130 | 90 | 114 |
| R5N | 62 | | 142 | 146 | 137 | 148 | 157 | 121 | 151 |
| R5N | 63 | 96 | 139 | 142 | 133 | 145 | 152 | 118 | 147 |
| R5N | 65 | | 135 | 138 | 128 | 140 | 148 | 115 | 144 |
| R5N | 66 | 89 | 135 | 138 | 127 | 139 | 150 | 114 | 144 |
| R5N | 68 | | 115 | 126 | 117 | 131 | 141 | 104 | 137 |
| R5N | 69 | 77 | 121 | 125 | 115 | 128 | 141 | 100 | 134 |
| R5N | 71 | | 120 | 121 | 112 | 124 | 139 | 99 | 136 |
| R5N | 72 | 74 | 121 | 122 | 113 | 125 | 137 | 99 | 135 |

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **8/23/04** | **9/21/04** | **10/12/04** | **12/13/04** | **1/17/05** | **2/15/05** | **3/22/05** | **4/20/05** |
| R1N | 2 | 160 | 171 | 176 | 186 | 159 | 182 | 133 | 179 |
| R1N | 3 | 84 | 92 | 112 | 141 | 138 | 140 | 117 | 99 |
| R1N | 5 | 157 | 163 | 167 | 183 | 166 | 181 | 144 | 176 |
| R1N | 6 | 158 | 166 | 168 | | 181 | 182 | 144 | 178 |
| R1N | 8 | 160 | 167 | 170 | 180 | 166 | 182 | 112 | 176 |
| R1N | 9 | 165 | 171 | 175 | 189 | 168 | 185 | 118 | 182 |
| R1N | 11 | 134 | 141 | 146 | 164 | 154 | 163 | 131 | 158 |
| R1N | 12 | 135 | 146 | 149 | 165 | 159 | 165 | 133 | 158 |
| R1N | 17 | 138 | 143 | 150 | 168 | 166 | 171 | 153 | 162 |
| R1N | 18 | 137 | 143 | 150 | 170 | 166 | 172 | 152 | 163 |
| R1N | 20 | 150 | 155 | 158 | 177 | 177 | 178 | 168 | 168 |
| R1N | 21 | 144 | 149 | 155 | 173 | 173 | 173 | 163 | 164 |
| R1N | 23 | 143 | 149 | 217 | 176 | 175 | 174 | 167 | 167 |
| R1N | 24 | 216 | 250 | 257 | 227 | 266 | 272 | 266 | 272 |
| R1N | 26 | 140 | 150 | 158 | 176 | 176 | 178 | 159 | 169 |
| R1N | 27 | 142 | 150 | 159 | 179 | 178 | 179 | 160 | 170 |
| R1N | 29 | 150 | 163 | 171 | 190 | 189 | 191 | 168 | 185 |
| R1N | 30 | 169 | 217 | 230 | 188 | 240 | 248 | 242 | 245 |
| R1N | 32 | 115 | 116 | 141 | 159 | 155 | 156 | 145 | 150 |
| R1N | 33 | 134 | 122 | 130 | 150 | 151 | 152 | 142 | 137 |
| R1N | 35 | 150 | 127 | 157 | 169 | 175 | 170 | 164 | 170 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| Buffer | Well | 8/23/04 | 9/21/04 | 10/12/04 | 12/13/04 | 1/17/05 | 2/15/05 | 3/22/05 | 4/20/05 |
| R1N | 36 | 151 | 157 | 162 | 189 | 176 | 179 | 165 | 170 |
| R1N | 38 | 183 | 189 | 195 | 210 | 203 | 210 | 182 | 203 |
| R1N | 39 | 184 | 190 | 194 | 211 | 200 | 210 | 181 | 203 |
| R1N | 41 | 174 | 182 | 187 | 203 | 199 | 203 | 184 | 195 |
| R1N | 42 | 177 | 180 | 186 | 207 | 202 | 206 | 185 | 196 |
| R1N | 44 | | | | | | | | |
| R1N | 45 | | | | | | | | |
| R1N | 47 | 178 | 181 | 189 | 209 | 209 | 210 | 200 | 200 |
| R1N | 48 | 179 | 181 | 189 | 211 | 209 | 211 | 200 | 200 |
| R1N | 50 | 175 | 180 | 187 | 192 | 209 | 210 | | 198 |
| R1N | 51 | 177 | 180 | 189 | 209 | 208 | 210 | 200 | 200 |
| R1N | 53 | 192 | 197 | | | | | | |
| R1N | 54 | 195 | 198 | 207 | 229 | 228 | 228 | 216 | 219 |
| R1N | 56 | | | | | | | | |
| R1N | 57 | 204 | 209 | 221 | 240 | 240 | 242 | 225 | 233 |
| R1N | 59 | 202 | 208 | 218 | 240 | 238 | 240 | 222 | 231 |
| R1N | 60 | 202 | 212 | 219 | 240 | 239 | 241 | 223 | 232 |
| R1N | 62 | 177 | 177 | 185 | 205 | 203 | 204 | 195 | 195 |
| R1N | 63 | 178 | 180 | 190 | 206 | 206 | 208 | 200 | 198 |
| R1N | 65 | 213 | 224 | 225 | | | | | |
| R1N | 66 | 212 | 216 | 225 | 245 | 243 | 244 | 235 | 234 |
| R1N | 68 | 198 | 199 | 209 | 231 | 230 | 231 | 221 | 189 |
| R1N | 69 | 197 | 199 | 209 | 231 | 232 | 230 | 222 | 220 |
| R1N | 71 | 232 | 237 | 245 | | 267 | | | 259 |
| R1N | 72 | 232 | 240 | 248 | 270 | 270 | 273 | 255 | 260 |
| R2N | 2 | 192 | 194 | 203 | 226 | 220 | 224 | 210 | 204 |
| R2N | 3 | 129 | 130 | 139 | 161 | 157 | 160 | 147 | 141 |
| R2N | 5 | 132 | 133 | 143 | 166 | 164 | 164 | 151 | 144 |
| R2N | 6 | 133 | 135 | 144 | 166 | 163 | 165 | 152 | 146 |
| R2N | 8 | 137 | 138 | 149 | 170 | 165 | 168 | 155 | 149 |
| R2N | 9 | 140 | 141 | 151 | 173 | 168 | 171 | 159 | 152 |
| R2N | 11 | 131 | 132 | 142 | 164 | 159 | 162 | 150 | 142 |
| R2N | 12 | 135 | 135 | 145 | 167 | 163 | 167 | 153 | 146 |
| R2N | 14 | 119 | 121 | 130 | 151 | 147 | 150 | 137 | 131 |
| R2N | 15 | 117 | 119 | 129 | 150 | 146 | 149 | 137 | 129 |
| R2N | 17 | 110 | 117 | 138 | 149 | 121 | 152 | 123 | 134 |
| R2N | 18 | 110 | 116 | 139 | 150 | 121 | 151 | 123 | 134 |
| R2N | 20 | 102 | 106 | 116 | 134 | 130 | 134 | 124 | 120 |
| R2N | 21 | 99 | 103 | 111 | 133 | 128 | 134 | 122 | 117 |
| R2N | 23 | 110 | 120 | 135 | 148 | 130 | 148 | 130 | 134 |
| R2N | 24 | 115 | 118 | 127 | 148 | 145 | 149 | 139 | 131 |
| R2N | 26 | 112 | 114 | 124 | 145 | 140 | 143 | 132 | 126 |
| R2N | 27 | 123 | 128 | 138 | 159 | 154 | 158 | 148 | 141 |
| R2N | 29 | 117 | 120 | 129 | 150 | 145 | 148 | 136 | 131 |
| R2N | 30 | 126 | 131 | 138 | 161 | 157 | 160 | 147 | 141 |
| R2N | 32 | 175 | 176 | 185 | 207 | 205 | 208 | 199 | 188 |
| R2N | 33 | 176 | 177 | 185 | 208 | 204 | 207 | 193 | 187 |
| R2N | 35 | 171 | 174 | 181 | 203 | 199 | 202 | 191 | 183 |
| R2N | 36 | 170 | 171 | 180 | 202 | 198 | 201 | 189 | 187 |
| R2N | 38 | 164 | 166 | 174 | 196 | 192 | 195 | 183 | 175 |
| R2N | 39 | 168 | 170 | 179 | 201 | 196 | 199 | 186 | 181 |
| R2N | 41 | 162 | 164 | 172 | 194 | 190 | 195 | 181 | 173 |
| R2N | 42 | 164 | 168 | 173 | 197 | 191 | 195 | 182 | 176 |
| R2N | 44 | 153 | 153 | 163 | 185 | 180 | 184 | 172 | 164 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **8/23/04** | **9/21/04** | **10/12/04** | **12/13/04** | **1/17/05** | **2/15/05** | **3/22/05** | **4/20/05** |
| R2N | 45 | 155 | 155 | 164 | 187 | 181 | 185 | 171 | 165 |
| R2N | 47 | 181 | 186 | 195 | 212 | 208 | 212 | 205 | 199 |
| R2N | 48 | 182 | 186 | 195 | 211 | 209 | 214 | 206 | 200 |
| R2N | 50 | 194 | 198 | 207 | 226 | 222 | 224 | 216 | 211 |
| R2N | 51 | 197 | 200 | 209 | 227 | 224 | 228 | 218 | 214 |
| R2N | 53 | 195 | 197 | 206 | 227 | 224 | 226 | 216 | 210 |
| R2N | 54 | 195 | 199 | 207 | 228 | 225 | 230 | 219 | 211 |
| R2N | 56 | 196 | 201 | 211 | 229 | 226 | 228 | 218 | 212 |
| R2N | 57 | 204 | 208 | 215 | 239 | 235 | 238 | 227 | 221 |
| R2N | 59 | 205 | 206 | 215 | 237 | 233 | 236 | 225 | 217 |
| R2N | 60 | 208 | 211 | 219 | 240 | 238 | 240 | 229 | 223 |
| R2N | 62 | 239 | 241 | 249 | | | | | |
| R2N | 63 | 246 | 249 | 256 | 278 | 273 | 276 | 264 | 258 |
| R2N | 65 | 238 | 241 | 248 | | | | | |
| R2N | 66 | 240 | 241 | 250 | 274 | 268 | 271 | 260 | 252 |
| R2N | 68 | 221 | 227 | 231 | | | | | |
| R2N | 69 | 224 | 226 | 237 | 255 | 253 | 256 | 247 | 241 |
| R2N | 71 | | | | | | | | |
| R2N | 72 | 260 | 263 | 271 | 292 | 289 | 292 | 281 | 275 |
| R4W | 2 | 73 | 71 | 83 | 91 | 86 | 85 | 79 | 86 |
| R4W | 3 | 67 | 68 | 89 | 103 | 95 | 102 | 83 | 85 |
| R4W | 5 | 81 | 77 | 88 | 97 | 91 | 91 | 84 | 92 |
| R4W | 6 | 80 | 79 | 88 | 98 | 92 | 91 | 86 | 93 |
| R4W | 8 | 69 | 68 | 77 | 89 | 83 | 84 | 77 | 83 |
| R4W | 9 | 150 | 138 | 171 | 155 | 223 | 278 | 258 | 249 |
| R4W | 11 | 67 | 66 | 74 | 84 | 109 | 82 | 73 | 79 |
| R4W | 12 | 61 | 58 | 73 | 90 | 61 | 99 | 88 | 91 |
| R4W | 14 | 73 | 74 | 83 | 93 | 89 | 90 | 82 | 88 |
| R4W | 15 | 74 | 75 | 86 | 98 | 92 | 93 | 85 | 92 |
| R4W | 17 | 66 | 64 | 74 | 84 | 80 | 80 | 73 | 79 |
| R4W | 18 | 258 | 244 | 271 | 184 | 255 | 313 | 276 | 234 |
| R4W | 20 | 62 | 61 | 72 | 83 | 78 | 80 | 70 | 77 |
| R4W | 21 | 335 | 333 | 341 | 320 | 334 | 347 | 347 | 335 |
| R4W | 23 | 62 | 61 | 72 | 82 | 77 | 77 | 69 | 77 |
| R4W | 24 | 62 | 61 | 72 | 82 | 77 | 77 | 68 | 77 |
| R4W | 26 | 62 | 60 | 70 | 80 | 75 | 76 | 67 | 81 |
| R4W | 27 | 63 | 60 | 72 | 80 | 74 | 75 | 66 | 76 |
| R4W | 29 | 75 | 73 | 87 | 91 | 86 | 86 | 81 | 87 |
| R4W | 30 | 77 | 76 | 85 | 94 | 88 | 89 | 82 | 89 |
| R4W | 32 | 91 | 87 | 99 | 109 | 103 | 103 | 96 | 103 |
| R4W | 33 | 91 | 88 | 99 | 108 | 103 | 103 | 96 | 103 |
| R4W | 35 | 88 | 86 | 96 | 106 | 100 | 99 | 92 | 100 |
| R4W | 36 | 216 | 211 | 242 | 186 | 284 | 299 | 301 | 295 |
| R4W | 38 | 78 | 77 | 88 | 97 | 91 | 94 | 85 | 92 |
| R4W | 39 | 78 | 76 | 86 | 96 | 92 | 93 | 85 | 91 |
| R4W | 41 | 88 | 87 | 97 | 109 | 103 | 105 | 94 | 102 |
| R4W | 42 | 89 | 89 | 98 | 110 | 104 | 104 | 97 | 104 |
| R4W | 44 | 184 | 92 | 103 | 115 | 108 | 108 | 101 | 108 |
| R4W | 45 | 90 | 88 | 98 | 109 | 103 | 104 | 96 | 103 |
| R4W | 47 | 92 | 92 | 71 | 114 | 108 | 108 | 100 | 108 |
| R4W | 48 | 93 | 91 | 103 | 115 | 108 | 110 | 98 | 109 |
| R4W | 50 | 98 | 96 | 107 | 118 | 113 | 113 | 105 | 112 |
| R4W | 51 | 99 | 96 | 107 | 119 | 113 | 113 | 105 | 112 |
| R4W | 53 | 97 | 98 | 108 | 119 | 113 | 113 | 105 | 112 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| **Buffer** | **Well** | **8/23/04** | **9/21/04** | **10/12/04** | **12/13/04** | **1/17/05** | **2/15/05** | **3/22/05** | **4/20/05** |
| R4W | 54 | 97 | 94 | 106 | 116 | 112 | 111 | 103 | 111 |
| R4W | 56 | 109 | 108 | 118 | 127 | 122 | 122 | 116 | 122 |
| R4W | 57 | 106 | 105 | 120 | 214 | 121 | 118 | 112 | 118 |
| R4W | 59 | 98 | 94 | 106 | 115 | 110 | 109 | 100 | 108 |
| R4W | 60 | 94 | 95 | 104 | 113 | 108 | 107 | 101 | 107 |
| R4W | 62 | 110 | 104 | 115 | 126 | 120 | 120 | 98 | 119 |
| R4W | 63 | 111 | 101 | 115 | 125 | 119 | 122 | 97 | |
| R4W | 65 | 94 | 91 | 102 | 117 | 108 | 110 | 99 | 106 |
| R4W | 66 | 95 | 93 | 104 | 116 | 111 | 113 | 100 | 108 |
| R4W | 68 | 94 | 92 | 102 | 118 | 109 | 109 | 111 | 107 |
| R4W | 69 | 93 | 91 | 103 | 118 | 109 | 113 | 114 | 107 |
| R4W | 71 | 107 | 106 | | 129 | 122 | 121 | 114 | 120 |
| R4W | 72 | 118 | 106 | | 129 | 122 | 121 | 114 | 120 |
| R5N | 2 | 118 | 121 | 137 | 146 | 135 | 141 | 131 | -52 |
| R5N | 3 | 119 | 122 | 138 | 147 | 136 | 141 | 131 | 138 |
| R5N | 5 | 111 | 113 | 131 | 141 | 127 | 132 | 121 | 133 |
| R5N | 6 | 109 | 112 | 130 | 138 | 126 | 132 | 121 | 129 |
| R5N | 8 | 118 | 119 | 138 | 145 | 133 | 139 | 125 | 133 |
| R5N | 9 | 116 | 120 | 137 | 143 | 132 | 137 | 125 | 138 |
| R5N | 11 | 126 | 124 | 147 | 154 | 141 | 146 | 133 | 133 |
| R5N | 12 | 118 | 119 | 139 | 146 | 133 | 139 | 126 | 139 |
| R5N | 14 | 120 | 123 | 142 | 150 | 136 | 142 | 128 | 138 |
| R5N | 15 | 120 | 122 | 142 | 150 | 135 | 142 | 125 | 138 |
| R5N | 17 | 119 | 119 | 140 | 149 | 133 | 140 | 124 | 137 |
| R5N | 18 | 117 | 118 | 139 | 147 | 132 | 138 | 122 | 134 |
| R5N | 20 | 115 | 117 | 138 | 147 | 131 | 137 | 121 | 135 |
| R5N | 21 | 113 | 115 | 136 | 145 | 128 | 135 | 118 | 133 |
| R5N | 23 | 104 | 102 | 126 | 137 | 118 | 125 | 108 | 131 |
| R5N | 24 | 105 | 106 | 129 | 137 | 120 | 125 | 109 | 115 |
| R5N | 26 | 111 | 113 | 136 | 144 | 126 | 136 | 116 | 125 |
| R5N | 27 | 113 | 115 | 137 | 145 | 128 | 134 | 119 | 127 |
| R5N | 29 | 112 | 114 | 137 | 145 | 131 | 135 | 117 | 123 |
| R5N | 30 | 116 | 118 | 142 | 152 | 133 | 141 | 124 | 133 |
| R5N | 32 | 121 | 124 | 142 | 149 | 139 | 145 | 134 | 143 |
| R5N | 33 | 123 | 124 | 144 | 153 | 140 | 147 | 136 | 143 |
| R5N | 35 | 120 | 123 | 141 | 149 | 137 | 142 | 130 | 139 |
| R5N | 36 | 120 | 122 | 141 | 145 | 136 | 142 | 130 | 139 |
| R5N | 38 | 123 | 124 | 143 | 151 | 139 | 144 | 132 | 141 |
| R5N | 39 | 121 | 123 | 142 | 150 | 137 | 143 | 131 | 139 |
| R5N | 41 | 134 | 136 | 155 | 162 | 149 | 155 | 141 | 151 |
| R5N | 42 | 131 | 134 | 153 | 160 | 147 | 153 | 138 | 149 |
| R5N | 44 | 124 | 130 | 149 | 156 | 142 | 148 | 136 | 145 |
| R5N | 45 | 121 | 128 | 148 | 155 | 142 | 149 | 131 | 143 |
| R5N | 47 | 124 | 125 | 147 | 155 | 139 | 146 | 130 | 141 |
| R5N | 48 | 124 | 124 | 147 | 155 | 139 | 146 | 130 | 141 |
| R5N | 50 | 122 | 124 | 145 | 153 | 138 | 145 | 128 | 140 |
| R5N | 51 | 121 | 121 | 145 | 152 | 137 | 144 | 127 | 139 |
| R5N | 53 | 117 | 119 | 142 | 150 | 134 | 141 | 124 | 136 |
| R5N | 54 | 118 | 120 | 142 | 152 | 134 | 141 | 124 | 136 |
| R5N | 56 | 117 | 116 | 139 | 149 | 130 | 137 | 121 | 132 |
| R5N | 57 | 113 | 116 | 138 | 146 | 131 | 137 | 120 | 131 |
| R5N | 59 | 105 | 106 | 131 | 138 | 121 | 129 | 107 | 123 |
| R5N | 60 | 104 | 107 | 131 | 139 | 122 | 129 | 108 | 122 |
| R5N | 62 | 131 | 134 | 153 | 161 | 148 | 154 | 139 | 151 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date | Date | Date | Date | Date |
|---|---|---|---|---|---|---|---|---|---|
| Buffer | Well | 8/23/04 | 9/21/04 | 10/12/04 | 12/13/04 | 1/17/05 | 2/15/05 | 3/22/05 | 4/20/05 |
| R5N | 63 | 129 | 129 | 149 | 157 | 146 | 150 | 135 | 146 |
| R5N | 65 | 125 | 128 | 148 | 157 | 142 | 147 | 133 | 142 |
| R5N | 66 | 124 | 127 | 148 | 155 | 140 | 147 | 133 | 142 |
| R5N | 68 | 115 | 113 | 140 | 149 | 132 | 139 | 121 | |
| R5N | 69 | 113 | 113 | 139 | 148 | 131 | 138 | 121 | 132 |
| R5N | 71 | 113 | 114 | 138 | 148 | 128 | 137 | 117 | 133 |
| R5N | 72 | 114 | 115 | 139 | 149 | 129 | 137 | 117 | 135 |

| Sample ID | | Date | Date | Date | Date |
|---|---|---|---|---|---|
| Buffer | Well | 5/19/05 | 6/28/05 | 7/26/05 | 8/24/05 |
| R1N | 2 | 178 | 180 | 181 | 164 |
| R1N | 3 | 118 | 102 | 106 | 108 |
| R1N | 5 | 175 | 177 | 179 | 161 |
| R1N | 6 | 176 | 178 | 179 | 162 |
| R1N | 8 | 175 | 176 | 176 | 155 |
| R1N | 9 | 179 | 180 | 180 | 157 |
| R1N | 11 | 155 | 158 | 156 | 140 |
| R1N | 12 | 159 | 160 | 154 | 142 |
| R1N | 17 | 161 | 166 | 165 | 153 |
| R1N | 18 | 161 | 166 | 165 | 152 |
| R1N | 20 | 168 | 174 | 172 | 166 |
| R1N | 21 | 164 | 170 | 168 | 162 |
| R1N | 23 | 165 | 172 | 167 | 157 |
| R1N | 24 | 249 | 219 | 237 | 226 |
| R1N | 26 | 165 | 170 | 164 | 147 |
| R1N | 27 | 167 | 172 | 166 | 149 |
| R1N | 29 | 179 | 181 | 172 | 142 |
| R1N | 30 | 231 | 180 | 207 | 194 |
| R1N | 32 | 151 | 157 | 159 | 154 |
| R1N | 33 | 141 | 146 | 147 | 146 |
| R1N | 35 | 170 | 177 | 179 | 173 |
| R1N | 36 | 170 | 177 | 179 | 173 |
| R1N | 38 | 204 | 206 | 207 | 194 |
| R1N | 39 | 203 | 207 | 207 | 193 |
| R1N | 41 | 195 | 200 | 199 | 192 |
| R1N | 42 | 197 | 202 | 202 | 194 |
| R1N | 44 | | | | |
| R1N | 45 | | | | |
| R1N | 47 | 199 | 207 | 207 | 202 |
| R1N | 48 | 200 | 208 | 207 | 203 |
| R1N | 50 | 197 | 204 | 203 | 200 |
| R1N | 51 | 199 | 206 | 205 | 201 |
| R1N | 53 | | | | |
| R1N | 54 | 217 | 224 | 220 | 215 |
| R1N | 56 | | | | |
| R1N | 57 | 230 | 236 | 229 | 219 |
| R1N | 59 | 229 | 233 | 225 | 215 |
| R1N | 60 | 229 | 234 | 227 | 216 |
| R1N | 62 | | 203 | 205 | 202 |
| R1N | 63 | | 207 | 208 | 204 |
| R1N | 65 | | | | |
| R1N | 66 | 234 | 242 | 242 | 239 |
| R1N | 68 | 219 | | 226 | 224 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date |
|---|---|---|---|---|---|
| Buffer | Well | 5/19/05 | 6/28/05 | 7/26/05 | 8/24/05 |
| R1N | 69 | 220 | 227 | 226 | 224 |
| R1N | 71 | 258 | 263 | 257 | 252 |
| R1N | 72 | 259 | 264 | 258 | 252 |
| R2N | 2 | 204 | 224 | 223 | 219 |
| R2N | 3 | 141 | 160 | 160 | 156 |
| R2N | 5 | 144 | 164 | 164 | 159 |
| R2N | 6 | 146 | 165 | 165 | 160 |
| R2N | 8 | 149 | 169 | 169 | 164 |
| R2N | 9 | 153 | 172 | 172 | 167 |
| R2N | 11 | 142 | 162 | 163 | 158 |
| R2N | 12 | 146 | 166 | 166 | 162 |
| R2N | 14 | 132 | 150 | 151 | 146 |
| R2N | 15 | 130 | 150 | 150 | 145 |
| R2N | 17 | 136 | 156 | 118 | 121 |
| R2N | 18 | 136 | 157 | 116 | 125 |
| R2N | 20 | 118 | 134 | 127 | 127 |
| R2N | 21 | 114 | 131 | 125 | 124 |
| R2N | 23 | 134 | 150 | 132 | 129 |
| R2N | 24 | 130 | 146 | 142 | 140 |
| R2N | 26 | 125 | 144 | 139 | 137 |
| R2N | 27 | 140 | 158 | 157 | 149 |
| R2N | 29 | 130 | 149 | 148 | 143 |
| R2N | 30 | 140 | 158 | 159 | 152 |
| R2N | 32 | 188 | 207 | 207 | 203 |
| R2N | 33 | 188 | 207 | 207 | 203 |
| R2N | 35 | 182 | 202 | 202 | 198 |
| R2N | 36 | 181 | 201 | 201 | 197 |
| R2N | 38 | 175 | 196 | 196 | 192 |
| R2N | 39 | 180 | 200 | 201 | 196 |
| R2N | 41 | 174 | 194 | 194 | 190 |
| R2N | 42 | 175 | 196 | 196 | 192 |
| R2N | 44 | 165 | 185 | 184 | 181 |
| R2N | 45 | 167 | 186 | 185 | 181 |
| R2N | 47 | 199 | 213 | 205 | 206 |
| R2N | 48 | 199 | 213 | 205 | 206 |
| R2N | 50 | 209 | 225 | 220 | 219 |
| R2N | 51 | 213 | 228 | 223 | 222 |
| R2N | 53 | 209 | 226 | 223 | 220 |
| R2N | 54 | 210 | 227 | 224 | 221 |
| R2N | 56 | 210 | 229 | 226 | 222 |
| R2N | 57 | 221 | 238 | 237 | 234 |
| R2N | 59 | 217 | 236 | 236 | 231 |
| R2N | 60 | 220 | 240 | 240 | 235 |
| R2N | 62 | | | | |
| R2N | 63 | 257 | 277 | 278 | 273 |
| R2N | 65 | | | | |
| R2N | 66 | 252 | 272 | 272 | 268 |
| R2N | 68 | | | | |
| R2N | 69 | 239 | 255 | 251 | 249 |
| R2N | 71 | | | | |
| R2N | 72 | 273 | 292 | 291 | 286 |
| R4W | 2 | 86 | 87 | 90 | 85 |
| R4W | 3 | 81 | 81 | 74 | 76 |
| R4W | 5 | 92 | 95 | 98 | 92 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date |
|---|---|---|---|---|---|
| Buffer | Well | 5/19/05 | 6/28/05 | 7/26/05 | 8/24/05 |
| R4W | 6 | 92 | 98 | 97 | 92 |
| R4W | 8 | 85 | 89 | 91 | 85 |
| R4W | 9 | 241 | 171 | 171 | 142 |
| R4W | 11 | 82 | 87 | 88 | 82 |
| R4W | 12 | 96 | 88 | 90 | 75 |
| R4W | 14 | 91 | 96 | 98 | 91 |
| R4W | 15 | 94 | 99 | 101 | 94 |
| R4W | 17 | 79 | 88 | 90 | 79 |
| R4W | 18 | 295 | 224 | 250 | 245 |
| R4W | 20 | 79 | 85 | 88 | 80 |
| R4W | 21 | 345 | 337 | 338 | 335 |
| R4W | 23 | 79 | 83 | 87 | 79 |
| R4W | 24 | 78 | 84 | 87 | 80 |
| R4W | 26 | 78 | 82 | 86 | 77 |
| R4W | 27 | 77 | 82 | 86 | 78 |
| R4W | 29 | 88 | 92 | 97 | 89 |
| R4W | 30 | 90 | 95 | 99 | 91 |
| R4W | 32 | 103 | 105 | 108 | 103 |
| R4W | 33 | 103 | 104 | 107 | 103 |
| R4W | 35 | 102 | 104 | 107 | 101 |
| R4W | 36 | 293 | 224 | 207 | 190 |
| R4W | 38 | 93 | 98 | 100 | 94 |
| R4W | 39 | 95 | 100 | 100 | 93 |
| R4W | 41 | 104 | 109 | 111 | 105 |
| R4W | 42 | 106 | 111 | 113 | 106 |
| R4W | 44 | 110 | 116 | 118 | 111 |
| R4W | 45 | 108 | 111 | 113 | 106 |
| R4W | 47 | 109 | 116 | 118 | 111 |
| R4W | 48 | 110 | 116 | 119 | 111 |
| R4W | 50 | 114 | 120 | 123 | 115 |
| R4W | 51 | 115 | 121 | 124 | 116 |
| R4W | 53 | 114 | 120 | 123 | 116 |
| R4W | 54 | 113 | 118 | 123 | 114 |
| R4W | 56 | 124 | 129 | 133 | 125 |
| R4W | 57 | 123 | 130 | 130 | 122 |
| R4W | 59 | 110 | 115 | 119 | 111 |
| R4W | 60 | 109 | 113 | 118 | 110 |
| R4W | 62 | 120 | 153 | 126 | 120 |
| R4W | 63 | 124 | 123 | 124 | 119 |
| R4W | 65 | 110 | 115 | 117 | 110 |
| R4W | 66 | 111 | 116 | 119 | 112 |
| R4W | 68 | 110 | 115 | 118 | 111 |
| R4W | 69 | 111 | 116 | 119 | 112 |
| R4W | 71 | 123 | 128 | 131 | 124 |
| R4W | 72 | 124 | 128 | 131 | 124 |
| R5N | 2 | 141 | 151 | 151 | 139 |
| R5N | 3 | 141 | 152 | 151 | 140 |
| R5N | 5 | 134 | 145 | 145 | 131 |
| R5N | 6 | 132 | 144 | 143 | 130 |
| R5N | 8 | 138 | 152 | 151 | 137 |
| R5N | 9 | 137 | 151 | 149 | 136 |
| R5N | 11 | 147 | 161 | 160 | 147 |
| R5N | 12 | 139 | 153 | 153 | 139 |
| R5N | 14 | 142 | 156 | 156 | 142 |

Table F.2 (continued)

| Sample ID | | Date | Date | Date | Date |
|---|---|---|---|---|---|
| Buffer | Well | 5/19/05 | 6/28/05 | 7/26/05 | 8/24/05 |
| R5N | 15 | 141 | 156 | 156 | 142 |
| R5N | 17 | 139 | 155 | 156 | 141 |
| R5N | 18 | 138 | 154 | 154 | 140 |
| R5N | 20 | 137 | 152 | 154 | 140 |
| R5N | 21 | 135 | 150 | 152 | 138 |
| R5N | 23 | 126 | 141 | 143 | 129 |
| R5N | 24 | 126 | 142 | 145 | 130 |
| R5N | 26 | 133 | 149 | 151 | 136 |
| R5N | 27 | 134 | 151 | 153 | 138 |
| R5N | 29 | 134 | 131 | 152 | 139 |
| R5N | 30 | 139 | 157 | 160 | 146 |
| R5N | 32 | 145 | 153 | 156 | 143 |
| R5N | 33 | 147 | 162 | 157 | 144 |
| R5N | 35 | 143 | 156 | 155 | 142 |
| R5N | 36 | 142 | 155 | 154 | 142 |
| R5N | 38 | 144 | 160 | 158 | 144 |
| R5N | 39 | 144 | 158 | 156 | 143 |
| R5N | 41 | 154 | 170 | 169 | 155 |
| R5N | 42 | 153 | 168 | 167 | 153 |
| R5N | 44 | 149 | 164 | 164 | 150 |
| R5N | 45 | 148 | 163 | 164 | 149 |
| R5N | 47 | 147 | 162 | 163 | 148 |
| R5N | 48 | 147 | 162 | 163 | 148 |
| R5N | 50 | 145 | 160 | 162 | 148 |
| R5N | 51 | 144 | 159 | 161 | 147 |
| R5N | 53 | 141 | 156 | 159 | 144 |
| R5N | 54 | 140 | 157 | 159 | 144 |
| R5N | 56 | 137 | 153 | 156 | 142 |
| R5N | 57 | 137 | 152 | 155 | 139 |
| R5N | 59 | 129 | 147 | 147 | 133 |
| R5N | 60 | 128 | 145 | 148 | 133 |
| R5N | 62 | 157 | 173 | 167 | 154 |
| R5N | 63 | 152 | 164 | 163 | 150 |
| R5N | 65 | 149 | 165 | 164 | 149 |
| R5N | 66 | 149 | 163 | 163 | 149 |
| R5N | 68 | 138 | 156 | 157 | 143 |
| R5N | 69 | 139 | 154 | 156 | 141 |
| R5N | 71 | 135 | 152 | 155 | 140 |
| R5N | 72 | 137 | 153 | 156 | 142 |

Figure F.3. Average redox potential measurements for each probe station (mV).

| Buffer | Probe station | 12/15/03 | | 1/8/04 | | 2/8/04 | | 3/8/04 | | 4/18/04 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | probe depth | | probe depth | | probe depth | | probe depth | | probe depth | |
| | | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm |
| R1 | FED | 386 | 432 | 356 | 432 | 334 | 428 | 329 | 54 | 379 | 48 |
| R1 | FEF | 440 | -365 | 456 | -346 | 455 | -337 | 417 | -346 | 463 | -328 |
| R1 | NAD | 326 | -403 | 336 | -398 | 241 | -414 | 411 | -425 | 401 | -411 |
| R1 | NAF | 488 | 528 | 447 | 377 | 415 | 238 | 437 | 136 | 458 | 157 |
| R1 | O | 690 | 19 | 657 | 25 | 688 | 26 | 636 | 233 | 681 | 224 |
| R1 | P | 677 | 612 | 666 | 567 | 680 | 627 | 642 | 317 | 671 | 315 |
| R1 | Q | 689 | 591 | 681 | 492 | 680 | 451 | 654 | 501 | 661 | 487 |
| R1 | R | 646 | 32 | 647 | 30 | 652 | 25 | 630 | 71 | 652 | 64 |
| R1 | S | 696 | -437 | 686 | -428 | 694 | -423 | 660 | -314 | 640 | -299 |
| R1 | T | 480 | 339 | 483 | 414 | 510 | 446 | 493 | 229 | 536 | 209 |
| R1 | TD | 418 | -273 | 375 | -261 | 369 | -255 | 351 | -123 | 410 | -113 |
| R1 | TF | -160 | 237 | -60 | 243 | -19 | 257 | 1 | 500 | 3 | 443 |
| R1 | U | 667 | -250 | 649 | -262 | 642 | -291 | 598 | -346 | 645 | -348 |
| R1 | V | 542 | -420 | 482 | -428 | 455 | -406 | 460 | -364 | 475 | -399 |
| R1 | XD | 493 | 458 | 499 | 453 | 502 | 459 | 509 | 487 | 569 | 479 |
| R1 | XF | 400 | 525 | 400 | 543 | 388 | 492 | 401 | 324 | 377 | 295 |
| R2N | A | -81 | -71 | -60 | -67 | -275 | -59 | -254 | 236 | -279 | 237 |
| R2N | B | 556 | 442 | 561 | 380 | 564 | 441 | | | 539 | 244 |
| R2N | C | -8 | 488 | 371 | 485 | 375 | 482 | 509 | 349 | 364 | 332 |
| R2N | D | 514 | 463 | 519 | 421 | 508 | 275 | 537 | 252 | 507 | 293 |
| R2N | E | 313 | 49 | 472 | 76 | 495 | 72 | 593 | 199 | 246 | 211 |
| R2N | F | 646 | 216 | 645 | 153 | 645 | 298 | 619 | 184 | 647 | 217 |
| R2N | G | 572 | -230 | 492 | 183 | 564 | 282 | 589 | -61 | 596 | -57 |
| R2N | H | 488 | 8 | 497 | 23 | 490 | -40 | 474 | 317 | 470 | 265 |
| R2N | I | 595 | -217 | 600 | 153 | 594 | 215 | 590 | 224 | 585 | 315 |
| R2N | J | -154 | -363 | -123 | -313 | -141 | -332 | -134 | -335 | -148 | -241 |
| R2N | K | 263 | -446 | 144 | -446 | 275 | -474 | 352 | -367 | 136 | -388 |
| R2N | L | 593 | 289 | 602 | 324 | 597 | 321 | 587 | 307 | 591 | 318 |
| R2N | M | -156 | -371 | -162 | -343 | -193 | -349 | -149 | -295 | -197 | -341 |
| R2N | N | 326 | 87 | 317 | 125 | 319 | 114 | 361 | 261 | 331 | 271 |
| R2N | NA50F | 314 | 53 | 323 | 70 | 310 | 75 | 335 | 198 | 319 | 180 |
| R2N | SG25D | 262 | -206 | 216 | -17 | 206 | -36 | 257 | 88 | 208 | 41 |
| R2N | SG25F | 290 | -162 | 332 | -10 | 322 | 8 | 316 | 364 | 283 | 367 |
| R2N | SG50D | -397 | -393 | -395 | -393 | -391 | -403 | -375 | -305 | -384 | -330 |
| R2N | SG50F | 471 | 370 | 446 | 383 | 444 | 382 | 466 | 498 | 451 | 489 |
| R2N | T50F | -221 | -357 | -221 | 83 | -227 | 105 | -231 | 77 | -235 | 78 |
| R4W | F25DW | 339 | 593 | 353 | 576 | 392 | 583 | 364 | 88 | 356 | 102 |
| R4W | F25FW | 459 | 579 | 424 | 576 | 442 | 576 | 395 | 545 | 413 | 553 |
| R4W | F50DW | 89 | -67 | -25 | 159 | -43 | 205 | 11 | 336 | -20 | 420 |
| R4W | F50FW | 299 | -86 | 279 | 188 | 300 | 240 | 301 | -64 | 305 | -71 |
| R4W | N25DW | 596 | 603 | 596 | 604 | 587 | 598 | 535 | 445 | 572 | 476 |
| R4W | N25FW | 456 | 558 | 385 | 530 | | 560 | 378 | 111 | 366 | 113 |
| R4W | N50DW | -86 | 14 | -64 | 8 | -69 | -18 | -70 | -46 | -80 | -40 |
| R4W | N50FW | 164 | -87 | 152 | 409 | 164 | 395 | 192 | 376 | 155 | 343 |
| R4W | SG25DW | 2 | -315 | 6 | -308 | 40 | -308 | 58 | -338 | 95 | -314 |
| R4W | SG25FW | 556 | -339 | 520 | -334 | 551 | -334 | 473 | -280 | 532 | -302 |
| R4W | SG50DW | 373 | 283 | 15 | -285 | 15 | -286 | 7 | -309 | 236 | -302 |
| R4W | SG50FW | -289 | 589 | -258 | 503 | 5 | 575 | -75 | 432 | -287 | 376 |
| R4W | T25DW | 523 | -423 | 512 | -332 | 496 | -317 | 486 | -353 | 487 | -337 |
| R4W | T25FW | 574 | 552 | 561 | 549 | 552 | 569 | 250 | 544 | 572 | 283 |
| R4W | T50DW | 409 | 499 | 345 | 71 | 377 | 202 | 331 | 143 | 427 | 77 |
| R4W | T50FW | 644 | 609 | 631 | 609 | 509 | 609 | 637 | 359 | 631 | 358 |

Table F.3 (continued)

| Buffer | Probe station | 12/15/03 | | 1/8/04 | | 2/8/04 | | 3/8/04 | | 4/18/04 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | probe depth | | probe depth | | probe depth | | probe depth | | probe depth | |
| | | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm |
| R1 | FED | 386 | 432 | 356 | 432 | 334 | 428 | 329 | 54 | 379 | 48 |
| R1 | FEF | 440 | -365 | 456 | -346 | 455 | -337 | 417 | -346 | 463 | -328 |
| R1 | NAD | 326 | -403 | 336 | -398 | 241 | -414 | 411 | -425 | 401 | -411 |
| R1 | NAF | 488 | 528 | 447 | 377 | 415 | 238 | 437 | 136 | 458 | 157 |
| R1 | O | 690 | 19 | 657 | 25 | 688 | 26 | 636 | 233 | 681 | 224 |
| R1 | P | 677 | 612 | 666 | 567 | 680 | 627 | 642 | 317 | 671 | 315 |
| R1 | Q | 689 | 591 | 681 | 492 | 680 | 451 | 654 | 501 | 661 | 487 |
| R1 | R | 646 | 32 | 647 | 30 | 652 | 25 | 630 | 71 | 652 | 64 |
| R1 | S | 696 | -437 | 686 | -428 | 694 | -423 | 660 | -314 | 640 | -299 |
| R1 | T | 480 | 339 | 483 | 414 | 510 | 446 | 493 | 229 | 536 | 209 |
| R1 | TD | 418 | -273 | 375 | -261 | 369 | -255 | 351 | -123 | 410 | -113 |
| R1 | TF | -160 | 237 | -60 | 243 | -19 | 257 | 1 | 500 | 3 | 443 |
| R1 | U | 667 | -250 | 649 | -262 | 642 | -291 | 598 | -346 | 645 | -348 |
| R1 | V | 542 | -420 | 482 | -428 | 455 | -406 | 460 | -364 | 475 | -399 |
| R1 | XD | 493 | 458 | 499 | 453 | 502 | 459 | 509 | 487 | 569 | 479 |
| R1 | XF | 400 | 525 | 400 | 543 | 388 | 492 | 401 | 324 | 377 | 295 |
| R2N | A | -81 | -71 | -60 | -67 | -275 | -59 | -254 | 236 | -279 | 237 |
| R2N | B | 556 | 442 | 561 | 380 | 564 | 441 | | | 539 | 244 |
| R2N | C | -8 | 488 | 371 | 485 | 375 | 482 | 509 | 349 | 364 | 332 |
| R2N | D | 514 | 463 | 519 | 421 | 508 | 275 | 537 | 252 | 507 | 293 |
| R2N | E | 313 | 49 | 472 | 76 | 495 | 72 | 593 | 199 | 246 | 211 |
| R2N | F | 646 | 216 | 645 | 153 | 645 | 298 | 619 | 184 | 647 | 217 |
| R2N | G | 572 | -230 | 492 | 183 | 564 | 282 | 589 | -61 | 596 | -57 |
| R2N | H | 488 | 8 | 497 | 23 | 490 | -40 | 474 | 317 | 470 | 265 |
| R2N | I | 595 | -217 | 600 | 153 | 594 | 215 | 590 | 224 | 585 | 315 |
| R2N | J | -154 | -363 | -123 | -313 | -141 | -332 | -134 | -335 | -148 | -241 |
| R2N | K | 263 | -446 | 144 | -446 | 275 | -474 | 352 | -367 | 136 | -388 |
| R2N | L | 593 | 289 | 602 | 324 | 597 | 321 | 587 | 307 | 591 | 318 |
| R2N | M | -156 | -371 | -162 | -343 | -193 | -349 | -149 | -295 | -197 | -341 |
| R2N | N | 326 | 87 | 317 | 125 | 319 | 114 | 361 | 261 | 331 | 271 |
| R2N | NA50F | 314 | 53 | 323 | 70 | 310 | 75 | 335 | 198 | 319 | 180 |
| R2N | SG25D | 262 | -206 | 216 | -17 | 206 | -36 | 257 | 88 | 208 | 41 |
| R2N | SG25F | 290 | -162 | 332 | -10 | 322 | 8 | 316 | 364 | 283 | 367 |
| R2N | SG50D | -397 | -393 | -395 | -393 | -391 | -403 | -375 | -305 | -384 | -330 |
| R2N | SG50F | 471 | 370 | 446 | 383 | 444 | 382 | 466 | 498 | 451 | 489 |
| R2N | T50F | -221 | -357 | -221 | 83 | -227 | 105 | -231 | 77 | -235 | 78 |
| R4W | F25DW | 339 | 593 | 353 | 576 | 392 | 583 | 364 | 88 | 356 | 102 |
| R4W | F25FW | 459 | 579 | 424 | 576 | 442 | 576 | 395 | 545 | 413 | 553 |
| R4W | F50DW | 89 | -67 | -25 | 159 | -43 | 205 | 11 | 336 | -20 | 420 |
| R4W | F50FW | 299 | -86 | 279 | 188 | 300 | 240 | 301 | -64 | 305 | -71 |
| R4W | N25DW | 596 | 603 | 596 | 604 | 587 | 598 | 535 | 445 | 572 | 476 |
| R4W | N25FW | 456 | 558 | 385 | 530 | | 560 | 378 | 111 | 366 | 113 |
| R4W | N50DW | -86 | 14 | -64 | 8 | -69 | -18 | -70 | -46 | -80 | -40 |
| R4W | N50FW | 164 | -87 | 152 | 409 | 164 | 395 | 192 | 376 | 155 | 343 |
| R4W | SG25DW | 2 | -315 | 6 | -308 | 40 | -308 | 58 | -338 | 95 | -314 |
| R4W | SG25FW | 556 | -339 | 520 | -334 | 551 | -334 | 473 | -280 | 532 | -302 |
| R4W | SG50DW | 373 | 283 | 15 | -285 | 15 | -286 | 7 | -309 | 236 | -302 |
| R4W | SG50FW | -289 | 589 | -258 | 503 | 5 | 575 | -75 | 432 | -287 | 376 |
| R4W | T25DW | 523 | -423 | 512 | -332 | 496 | -317 | 486 | -353 | 487 | -337 |
| R4W | T25FW | 574 | 552 | 561 | 549 | 552 | 569 | 250 | 544 | 572 | 283 |
| R4W | T50DW | 409 | 499 | 345 | 71 | 377 | 202 | 331 | 143 | 427 | 77 |
| R4W | T50FW | 644 | 609 | 631 | 609 | 509 | 609 | 637 | 359 | 631 | 358 |

Table F.3 (continued)

| Buffer | Probe station | 5/25/04 | | 6/29/04 | | 7/29/04 | | 8/31/04 | | 10/22/04 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | probe depth | | probe depth | | probe depth | | probe depth | | probe depth | |
| | | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm |
| R1 | FED | 336 | -17 | 375 | -65 | 305 | -7 | 226 | 0 | 389 | -75 |
| R1 | FEF | 469 | -284 | 456 | -359 | 440 | -263 | 419 | -216 | 463 | -371 |
| R1 | NAD | 273 | -345 | 197 | -422 | 164 | -340 | 138 | -342 | 340 | -412 |
| R1 | NAF | 433 | 114 | 422 | 148 | 388 | 120 | 434 | 73 | 474 | 203 |
| R1 | O | 655 | 228 | 673 | 217 | 592 | 211 | 530 | 214 | 624 | 49 |
| R1 | P | 649 | 321 | 662 | 292 | 551 | 281 | 522 | 292 | 650 | 358 |
| R1 | Q | 613 | 357 | 640 | 640 | 480 | 452 | 370 | 500 | 500 | 546 |
| R1 | R | 626 | 74 | 650 | 76 | 611 | 71 | 612 | 73 | 645 | 91 |
| R1 | S | 480 | -268 | 668 | -291 | 615 | -258 | 595 | -277 | 676 | -348 |
| R1 | T | 567 | 183 | 608 | 185 | 397 | 221 | 429 | 202 | 381 | 172 |
| R1 | TD | 371 | -144 | 415 | -150 | 285 | -138 | 288 | -150 | 184 | -141 |
| R1 | TF | 39 | 425 | -35 | 317 | 9 | 428 | 76 | 376 | 243 | 430 |
| R1 | U | 625 | -309 | 657 | -306 | 599 | -292 | 408 | -243 | 582 | -333 |
| R1 | V | 487 | -253 | 501 | -374 | 431 | -255 | 320 | -248 | 438 | -392 |
| R1 | XD | 440 | 463 | 508 | 458 | 410 | 468 | 399 | 454 | 487 | 494 |
| R1 | XF | 361 | 299 | 355 | 318 | 346 | 287 | 344 | 272 | 333 | 359 |
| R2N | A | -286 | 179 | -161 | 208 | -31 | 156 | -287 | 157 | -316 | 245 |
| R2N | B | 482 | 199 | 461 | 250 | 464 | 176 | 453 | 100 | 535 | 224 |
| R2N | C | 368 | 290 | 273 | 292 | 210 | 280 | 58 | 312 | -40 | 820 |
| R2N | D | 494 | 202 | 509 | 289 | 482 | 161 | 385 | 102 | 420 | 333 |
| R2N | E | 609 | 184 | 606 | 261 | 559 | 139 | 602 | 264 | 598 | 85 |
| R2N | F | 615 | 197 | 627 | 261 | 628 | 69 | 602 | 264 | 535 | - |
| R2N | G | 562 | -35 | 588 | -212 | 579 | 26 | 555 | -5 | 598 | -250 |
| R2N | H | 451 | 202 | 440 | 221 | 436 | 201 | 416 | 217 | 525 | 201 |
| R2N | I | 589 | 78 | 545 | 153 | 527 | 136 | 555 | 99 | 581 | -2 |
| R2N | J | -128 | -272 | -164 | -352 | -26 | -160 | -133 | -195 | -184 | -327 |
| R2N | K | 295 | -386 | 357 | -398 | 205 | -312 | 115 | -330 | 1010 | 1010 |
| R2N | L | 581 | 283 | 581 | 277 | 549 | 282 | 519 | 298 | 521 | 236 |
| R2N | M | -157 | 12 | -214 | -351 | -214 | 46 | -197 | 61 | -81 | -328 |
| R2N | N | 324 | 249 | 281 | 269 | 331 | 259 | 311 | 276 | 335 | 250 |
| R2N | NA50F | 334 | 186 | 190 | 190 | 383 | 269 | 381 | 207 | 95 | 347 |
| R2N | SG25D | 266 | 27 | 237 | -21 | 234 | 63 | 93 | 83 | 186 | 100 |
| R2N | SG25F | 198 | 363 | 175 | 359 | 226 | 268 | 123 | 176 | -282 | 245 |
| R2N | SG50D | -397 | -210 | -403 | -353 | -354 | -185 | -397 | -209 | -397 | -368 |
| R2N | SG50F | 444 | 492 | 418 | 469 | 484 | 511 | 435 | 473 | 445 | 500 |
| R2N | T50F | -259 | 71 | -261 | 56 | -192 | 72 | -225 | -72 | -247 | 59 |
| R4W | F25DW | 252 | 114 | 477 | 68 | 211 | 74 | 238 | 103 | 595 | 294 |
| R4W | F25FW | 288 | 555 | 420 | 547 | 266 | 430 | 269 | 397 | 637 | 703 |
| R4W | F50DW | -132 | 131 | -112 | 212 | 1 | 313 | -2 | 303 | 550 | 248 |
| R4W | F50FW | 246 | -55 | 330 | -78 | 116 | -83 | 112 | -132 | 353 | -107 |
| R4W | N25DW | 457 | 464 | 558 | 407 | 322 | 529 | 363 | 511 | 622 | 763 |
| R4W | N25FW | 362 | 110 | 347 | 103 | 339 | 39 | 295 | 0 | 525 | 284 |
| R4W | N50DW | 6 | -31 | -85 | -65 | 39 | -21 | 91 | -15 | 158 | 31 |
| R4W | N50FW | 287 | 417 | 305 | 328 | 101 | 296 | 187 | 295 | 428 | 348 |
| R4W | SG25DW | 40 | -323 | 121 | -348 | 35 | -333 | 54 | -328 | 112 | 59 |
| R4W | SG25FW | 588 | -159 | 507 | -309 | 486 | -134 | 477 | -118 | 713 | -92 |
| R4W | SG50DW | 130 | -281 | 22 | -296 | 141 | -176 | 114 | -124 | 215 | -105 |
| R4W | SG50FW | 93 | 344 | -266 | 368 | 306 | 293 | 286 | 274 | 149 | -80 |
| R4W | T25DW | 447 | -258 | 477 | -364 | 298 | -118 | 337 | -76 | 742 | 47 |
| R4W | T25FW | 425 | 258 | 556 | 236 | 245 | 456 | 509 | 239 | 723 | 762 |
| R4W | T50DW | 281 | 111 | 371 | 17 | 122 | -62 | 188 | 113 | 224 | 149 |
| R4W | T50FW | 575 | 354 | 591 | 328 | 415 | 319 | 396 | 329 | 662 | 694 |

Table F.3 (continued)

| Buffer | Probe station | 12/13/04 | | 1/17/05 | | 2/15/05 | | 3/22/05 | | 4/20/05 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | probe depth | | probe depth | | probe depth | | probe depth | | probe depth | |
| | | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm |
| R1 | FED | 267 | -66 | 318 | -123 | 360 | -120 | 358 | -195 | 405 | -129 |
| R1 | FEF | 465 | -355 | 467 | -362 | 467 | -325 | 465 | -292 | 473 | -359 |
| R1 | NAD | 275 | -396 | 321 | -406 | 351 | -405 | 352 | -376 | 317 | -394 |
| R1 | NAF | 458 | 161 | 320 | 154 | 422 | 88 | 415 | 96 | 337 | 180 |
| R1 | O | 684 | 154 | 686 | 141 | 676 | 138 | 677 | 110 | 681 | 127 |
| R1 | P | 310 | 664 | 683 | 545 | 646 | 489 | 658 | 492 | 663 | 464 |
| R1 | Q | 676 | 552 | 678 | 564 | 642 | 565 | 671 | 550 | 700 | 559 |
| R1 | R | 658 | 65 | 641 | 54 | 657 | 66 | 653 | 58 | 661 | 88 |
| R1 | S | 689 | -357 | 698 | -333 | 696 | -319 | 692 | -279 | 696 | -300 |
| R1 | T | 628 | 173 | 629 | 145 | 631 | 117 | 613 | 105 | 539 | 125 |
| R1 | TD | 381 | -132 | 354 | -132 | 354 | 488 | 417 | -122 | 444 | -121 |
| R1 | TF | 21 | 501 | -3 | 505 | 43 | 508 | 21 | 511 | -16 | 518 |
| R1 | U | 626 | -338 | 641 | -343 | 611 | -335 | 650 | -326 | 665 | -333 |
| R1 | V | 531 | -387 | 458 | -375 | 532 | -382 | 540 | -355 | 457 | -378 |
| R1 | XD | 594 | 500 | 448 | 490 | 458 | 488 | 446 | 492 | 560 | 490 |
| R1 | XF | 343 | 339 | 159 | 147 | 281 | 392 | 283 | 354 | 275 | 334 |
| R2N | A | 203 | -298 | -297 | 207 | 282 | -203 | -258 | 214 | -277 | 177 |
| R2N | B | 574 | 163 | 591 | 152 | 584 | 140 | 561 | 176 | 535 | 270 |
| R2N | C | 323 | 297 | 113 | 314 | 320 | 224 | 120 | 276 | -110 | 259 |
| R2N | D | 529 | 321 | 549 | 327 | 542 | 276 | 556 | 347 | 555 | 355 |
| R2N | E | 611 | 140 | 615 | 121 | 610 | 133 | 596 | 181 | 410 | 123 |
| R2N | F | 644 | - | 645 | - | 640 | - | 642 | - | 643 | - |
| R2N | G | 610 | -256 | 619 | -179 | 617 | -135 | 595 | -156 | 618 | -239 |
| R2N | H | 450 | 202 | 451 | 206 | 451 | 208 | 425 | 220 | 441 | 211 |
| R2N | I | 579 | 130 | 587 | 143 | 593 | 146 | 588 | 166 | 575 | 146 |
| R2N | J | -209 | -362 | -210 | -346 | -215 | -339 | -261 | -332 | -215 | -356 |
| R2N | K | 30 | -352 | 153 | -341 | 195 | -345 | 290 | -334 | 271 | -369 |
| R2N | L | 517 | 241 | 532 | 266 | 533 | 253 | 536 | 255 | 540 | 269 |
| R2N | M | -250 | -345 | -241 | -315 | -242 | -308 | -240 | 100 | -254 | -320 |
| R2N | N | 376 | 183 | 328 | 265 | 327 | 226 | 339 | 277 | 328 | 208 |
| R2N | NA50F | 267 | 56 | 307 | 182 | 264 | 104 | 276 | 134 | 273 | 93 |
| R2N | SG25D | 151 | 108 | 142 | 44 | 142 | 13 | 159 | -20 | 199 | -34 |
| R2N | SG25F | 338 | 226 | 247 | 331 | 251 | 276 | 243 | 100 | 187 | 258 |
| R2N | SG50D | -392 | -357 | -391 | -273 | -393 | -264 | -388 | -311 | -389 | -351 |
| R2N | SG50F | 463 | 463 | 456 | 489 | 467 | 486 | 466 | 504 | 454 | 501 |
| R2N | T50F | -214 | -214 | -246 | 80 | -223 | 77 | -229 | 100 | -244 | 98 |
| R4W | F25DW | 385 | 95 | 310 | 105 | 326 | 107 | 305 | 104 | 389 | 31 |
| R4W | F25FW | 462 | 436 | 403 | 465 | 385 | 249 | 392 | 454 | 420 | 492 |
| R4W | F50DW | 325 | 80 | -118 | 320 | -124 | 324 | -124 | 324 | -118 | 327 |
| R4W | F50FW | 203 | -273 | 197 | -250 | 225 | -249 | 184 | -237 | 300 | -241 |
| R4W | N25DW | 397 | 536 | 585 | 262 | 580 | 323 | 585 | 335 | 575 | 343 |
| R4W | N25FW | 375 | 97 | 384 | 99 | 342 | 121 | 353 | 186 | 394 | 136 |
| R4W | N50DW | -67 | -155 | -39 | -164 | 19 | -186 | 107 | -177 | 198 | -157 |
| R4W | N50FW | 278 | 136 | 162 | 68 | 161 | 268 | 92 | 266 | 156 | 293 |
| R4W | SG25DW | -113 | -227 | 29 | -346 | 26 | -342 | 60 | -327 | 131 | -333 |
| R4W | SG25FW | 553 | -222 | 448 | -182 | -254 | -183 | -166 | 542 | 556 | -277 |
| R4W | SG50DW | -10 | -308 | -6 | -304 | -5 | -297 | 20 | -273 | -5 | -288 |
| R4W | SG50FW | -1 | -265 | -238 | -103 | -254 | 114 | -58 | 337 | 323 | 359 |
| R4W | T25DW | 517 | -109 | 519 | -354 | 478 | -339 | 535 | -304 | 519 | -315 |
| R4W | T25FW | 573 | 573 | 586 | 248 | 578 | 249 | 581 | 454 | 601 | 251 |
| R4W | T50DW | -1 | -46 | 422 | -124 | 418 | 225 | 428 | -208 | 563 | -247 |
| R4W | T50FW | 512 | 512 | 617 | 352 | 619 | 354 | 629 | 373 | 630 | 364 |

Table F.3 (continued)

| Buffer | Probe station | 5/19/05 | | 6/28/05 | | 7/26/05 | | 8/24/05 | |
|---|---|---|---|---|---|---|---|---|---|
| | | probe depth | | probe depth | | probe depth | | probe depth | |
| | | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm | 152 cm | 300 cm |
| R1 | FED | 361 | -193 | 285 | -209 | 194 | -235 | 125 | -41 |
| R1 | FEF | 474 | -300 | 449 | -254 | 472 | -273 | 429 | -33 |
| R1 | NAD | 361 | -396 | 241 | -404 | 290 | -394 | 222 | -292 |
| R1 | NAF | 399 | 168 | 398 | 165 | 398 | 152 | 403 | 112 |
| R1 | O | 656 | 114 | 641 | 38 | 634 | 7 | 516 | -39 |
| R1 | P | 643 | 389 | 642 | 374 | 634 | 350 | 523 | 292 |
| R1 | Q | 661 | 557 | 517 | 546 | 636 | 523 | 593 | 549 |
| R1 | R | 648 | 81 | 641 | 93 | 636 | 89 | 618 | 79 |
| R1 | S | 690 | -286 | 573 | -286 | 647 | -269 | 644 | -276 |
| R1 | T | 598 | 83 | 600 | 71 | 592 | 81 | 564 | 71 |
| R1 | TD | 423 | -122 | 402 | -129 | 60 | -160 | 90 | -136 |
| R1 | TF | -14 | 511 | 110 | 217 | -44 | 403 | 8 | 485 |
| R1 | U | 631 | -335 | 612 | -332 | 647 | -331 | 607 | -321 |
| R1 | V | 442 | -375 | 456 | -362 | 411 | -365 | 365 | -303 |
| R1 | XD | 558 | 499 | 467 | 500 | 471 | 512 | 427 | 503 |
| R1 | XF | 272 | 332 | 250 | 337 | 257 | 353 | 230 | 326 |
| R2N | A | -287 | 229 | -55 | 210 | -288 | 234 | -235 | 150 |
| R2N | B | 273 | 238 | 460 | 145 | 435 | 103 | 440 | 144 |
| R2N | C | -130 | 286 | 275 | 301 | 530 | 391 | 91 | 410 |
| R2N | D | 550 | 352 | 470 | 252 | 481 | 246 | 479 | 225 |
| R2N | E | 407 | 76 | 623 | 40 | 582 | -21 | 561 | 77 |
| R2N | F | 639 | - | 625 | - | 622 | - | 584 | - |
| R2N | G | 624 | -264 | 609 | -180 | 607 | -226 | 573 | 56 |
| R2N | H | 448 | 216 | 438 | 218 | 459 | 196 | 281 | 91 |
| R2N | I | 587 | 154 | 584 | 143 | 553 | 38 | 581 | 124 |
| R2N | J | -210 | -344 | -176 | -310 | -126 | -302 | -103 | -124 |
| R2N | K | 123 | -336 | 406 | -289 | 203 | -302 | 36 | -305 |
| R2N | L | 510 | 236 | 520 | 249 | 550 | 266 | 507 | 238 |
| R2N | M | -252 | -298 | -305 | -284 | -182 | -209 | -119 | 85 |
| R2N | N | 344 | 270 | 350 | 236 | 348 | 6 | 347 | 245 |
| R2N | NA50F | 255 | 100 | 251 | 115 | 321 | 98 | 325 | 135 |
| R2N | SG25D | 201 | 2 | 195 | -3 | 170 | -50 | 198 | 40 |
| R2N | SG25F | -226 | 234 | -86 | 316 | 344 | 365 | 293 | 275 |
| R2N | SG50D | -416 | -345 | -376 | -317 | -365 | -300 | -266 | -173 |
| R2N | SG50F | 463 | 498 | 434 | 471 | 340 | 345 | 477 | 275 |
| R2N | T50F | -247 | 98 | -258 | 81 | -261 | 37 | -206 | 86 |
| R4W | F25DW | 401 | 72 | 241 | 99 | 381 | 105 | 398 | 100 |
| R4W | F25FW | 484 | 503 | 215 | 365 | 390 | 445 | 405 | 467 |
| R4W | F50DW | 84 | 182 | -73 | 316 | 70 | 309 | 78 | 304 |
| R4W | F50FW | 325 | -242 | 270 | -241 | 242 | -276 | 269 | -274 |
| R4W | N25DW | 578 | 425 | 322 | 378 | 504 | 324 | 380 | 82 |
| R4W | N25FW | 428 | 143 | 482 | 4 | 492 | -43 | 505 | 76 |
| R4W | N50DW | 191 | -162 | 236 | -47 | -11 | -126 | 226 | 98 |
| R4W | N50FW | 282 | 292 | 105 | 198 | 60 | 277 | 94 | 219 |
| R4W | SG25DW | 127 | -308 | 54 | -253 | 99 | -317 | 42 | -340 |
| R4W | SG25FW | 564 | -280 | 402 | -75 | 529 | -292 | 529 | -177 |
| R4W | SG50DW | -76 | -284 | 107 | -175 | -62 | -284 | -22 | -292 |
| R4W | SG50FW | 218 | 415 | 253 | 426 | 81 | 303 | -2 | -131 |
| R4W | T25DW | 511 | -310 | 323 | -81 | 514 | -315 | 522 | -319 |
| R4W | T25FW | 598 | 255 | 473 | 296 | 570 | 240 | 561 | 251 |
| R4W | T50DW | 458 | -227 | 176 | -133 | 347 | -192 | 295 | -221 |
| R4W | T50FW | 636 | 353 | 572 | 275 | 607 | 345 | 594 | 352 |

Table F.4. Probe station buffer locations.

| Buffer | Probe station | Width | Position | Vegetation |
|---|---|---|---|---|
| R1 | FED | 15 m | ditch-edge | fescue |
| R1 | FEF | 15 m | field-edge | fescue |
| R1 | NAD | 15 m | ditch-edge | native |
| R1 | NAF | 15 m | field-edge | native |
| R1 | O | 8 m | ditch-edge | native |
| R1 | P | 8 m | field-edge | native |
| R1 | Q | 8 m | ditch-edge | fescue |
| R1 | R | 8 m | field-edge | fescue |
| R1 | S | 8 m | ditch-edge | trees |
| R1 | T | 8 m | field-edge | trees |
| R1 | TD | 15 m | ditch-edge | trees |
| R1 | TF | 15 m | field-edge | trees |
| R1 | U | 8 m | ditch-edge | control |
| R1 | V | 8 m | field-edge | control |
| R1 | XD | 15 m | ditch-edge | control |
| R1 | XF | 15 m | field-edge | control |
| R2N | A | 8 m | ditch-edge | native |
| R2N | B | 8 m | field-edge | native |
| R2N | C | 8 m | ditch-edge | trees |
| R2N | D | 8 m | field-edge | trees |
| R2N | E | 8 m | ditch-edge | control |
| R2N | F | 8 m | field-edge | control |
| R2N | G | 8 m | ditch-edge | fescue |
| R2N | H | 8 m | field-edge | fescue |
| R2N | I | 15 m | ditch-edge | native |
| R2N | J | 15 m | ditch-edge | trees |
| R2N | K | 15 m | ditch-edge | control |
| R2N | L | 15 m | field-edge | control |
| R2N | M | 15 m | ditch-edge | fescue |
| R2N | N | 15 m | field-edge | fescue |
| R2N | NA50F | 15 m | field-edge | native |
| R2N | SG25D | 8 m | ditch-edge | switchgrass |
| R2N | SG25F | 8 m | field-edge | switchgrass |
| R2N | SG50D | 15 m | ditch-edge | switchgrass |
| R2N | SG50F | 15 m | field-edge | switchgrass |
| R2N | T50F | 15 m | field-edge | trees |
| R4W | F25DW | 8 m | ditch-edge | fescue |
| R4W | F25FW | 8 m | field-edge | fescue |
| R4W | F50DW | 15 m | ditch-edge | fescue |
| R4W | F50FW | 15 m | field-edge | fescue |
| R4W | N25DW | 8 m | ditch-edge | native |
| R4W | N25FW | 8 m | field-edge | native |
| R4W | N50DW | 15 m | ditch-edge | native |
| R4W | N50FW | 15 m | field-edge | native |
| R4W | SG25DW | 8 m | ditch-edge | switchgrass |
| R4W | SG25FW | 8 m | field-edge | switchgrass |
| R4W | SG50DW | 15 m | ditch-edge | switchgrass |
| R4W | SG50FW | 15 m | field-edge | switchgrass |
| R4W | T25DW | 8 m | ditch-edge | trees |
| R4W | T25FW | 8 m | field-edge | trees |
| R4W | T50DW | 15 m | ditch-edge | trees |
| R4W | T50FW | 15 m | field-edge | trees |

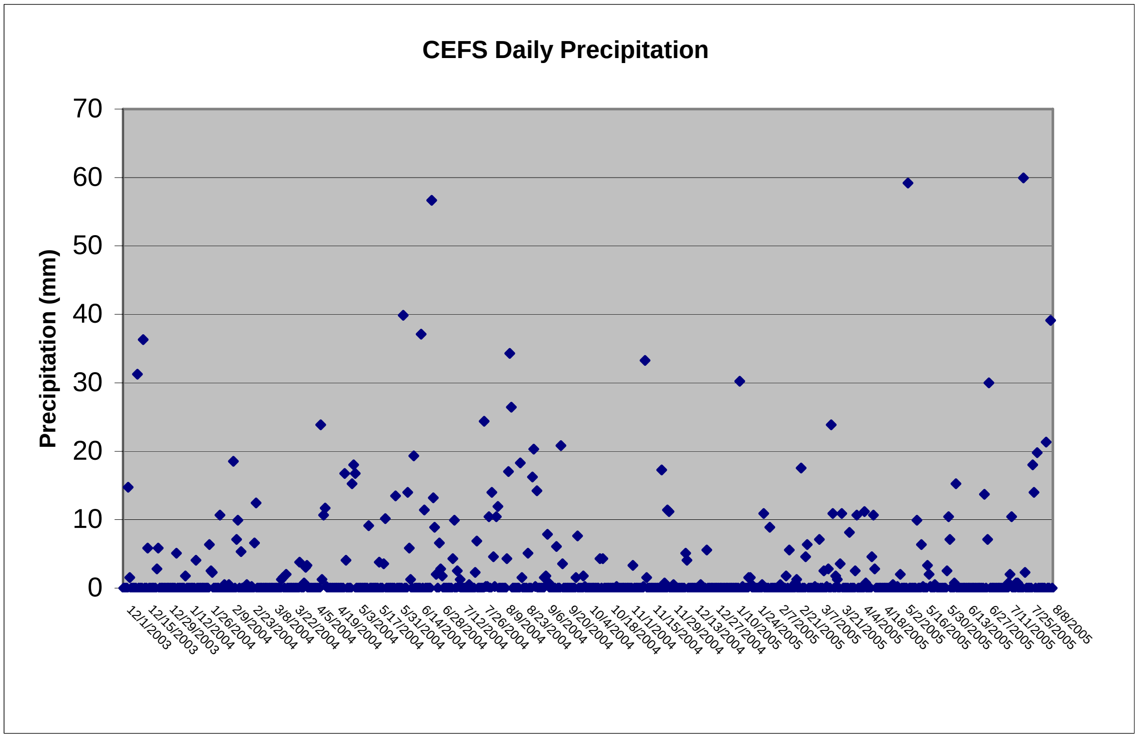


Figure F.1.  Average daily precipitation for the CEFS site.

Note:  Daily precipitation data given by the State Climate Office of North Carolina.

## Chapter 3: Vegetative Effect on $NO_3$-N Removal in Riparian Buffers in the North Carolina Mountains.

### INTRODUCTION

Riparian buffers are considered a major best management practice (BMP) to reduce nutrient pollutant loading, especially in agricultural regions. However, most information developed on buffer effectiveness has occurred within the Coastal Plain of the eastern United States. This study is important to further the current understanding of riparian buffer zone effectiveness in mountainous regions, since so little information exists. Agricultural and urban areas in mountain regions may have detrimental effects on stream water quality, though the quality of streams in this region is generally considered high when compared to watersheds in coastal regions. Yet, these sensitive watersheds still need protection from agricultural sources of nutrient contamination. Results from this study will be directly applicable to other areas of the Appalachian Mountain region in particular and for mountain regions in general elsewhere.

Additionally, results are just beginning to be accumulated on the benefits of buffer mitigation projects. Mitigation is fast becoming a popular practice, with millions of public funds involved, yet little information is available in assessing the effectiveness of buffers installed for mitigation purposes. This project offers the ability to track the effectiveness of an installed buffer over time, allowing the site to provide for the long-term gathering of buffer information.

Finally, there are no definitive studies on different vegetative types on buffer effectiveness. Since shrub or grass buffers are more acceptable to the agricultural producers than other more costly and time consuming types, it is critical that this information be developed as many dollars are being directed to buffer practices that may not be the most effective. Currently, expensive planting of trees may be required with little or no additional water quality benefit. Buffers in the mountains may prove to have differing results for the commonly planted buffer vegetative types as compared to the coastal plain or piedmont regions.

The objectives of this project are to: i) restore buffers on a stream segment in the French Broad River Basin, and ii) test and demonstrate the effectiveness of vegetative type on riparian buffer ability to reduce shallow groundwater $NO_3$-N concentrations in the Mountain region of North Carolina.

## MATERIALS AND METHODS

### Site Description

This study was conducted at the Mountain Horticultural Crops Research Station (MHCRS) located outside Fletcher (Henderson County), North Carolina. The station is a 265 acre experimental farm used for testing vegetable, fruit, small grain, and specialty crop production, and is operated by the NC Department of Agriculture and Consumer Service's Research Stations Division. Within the farm, a riparian buffer was established along McDowell Creek, a deeply-incised, channelized stream located adjacent to experimental crop fields (Figure 1). The creek empties into the French Broad River located to the East of the farm. The buffer strip was divided into twelve plots, each one being 7.5-m wide and 12-m long (Figure 2). The plots were vegetated in April of 2004 with one of four treatment types, with three replications planted for each type. The treatments were as follows: planted shrubs (a mix of *Viburnum dentatum*, *Cornus* *amomum*, *Physocarpus opulifolius*, *Clethra alnifolia*, *Itea virginica*, and *Cephalanthus occidentalis*), planted tall fescue (*Festuca arundinacea*), native vegetation, and a no-buffer control. The native vegetation plots were left alone and allowed to revegetate naturally in whatever species arose, mostly grass, vines, and weeds. The no-buffer control strips consisted of the adjacent crop species (corn with a winter wheat cover crop). The treatment types were randomly assigned to each of the twelve plots as shown below in Table 1.

Table 1. Buffer plot treatment type assignments

| Treatment type | Buffer plots |
|---|---|
| Shrubs | Plots 3, 8, and 11 |
| Fescue | Plots 4, 7, and 12 |
| Native vegetation | Plots 2, 5, and 10 |
| No-buffer control | Plots 1, 6, and 9 |

Prior to the buffer establishment, this strip of land consisted of a high, narrow berm running alongside the stream with an unfarmed, but mowed, grassy area behind it. In preparation for the buffer, the area was graded and the berm was removed. During the pre-buffer sampling period, the plots were maintained as grassy buffers.

The soil series' as mapped by the *Soil Survey of Henderson County, North Carolina* (1980) for the buffers are as follows: Codorus loam (fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts, nearly level) located in the buffer, with Elsinboro loam (fine-loamy, mixed, semiactive, mesic Typic Hapludults, with 0-3% slopes) and Bradson gravelly loam (clayey, oxidic, mesic Typic Hapludults, with 2-7% slopes) located upland into the adjacent farm field. Field sampling to confirm these descriptions was conducted for the buffer and adjacent field in August 2004. Results generally confirm the soil survey's findings. See Appendix A for field profile descriptions.

The subsurface groundwater flow paths for the buffer was determined using the relative water table elevations calculated from monthly depth to water measurements along with the survey data collected for all of the wells. Standard 3-point survey contours were created and the results indicate that subsurface flow was generally perpendicular towards the stream in each of the buffers. There were no seasonal variations noted for any of the flow paths in any of the buffers.

In September 2004, Hurricane Ivan contributed to intensive rainfall causing significant flooding to the project area. The monitoring wells were underwater for several days but were not damaged. When flooding subsided, the wells were pumped dry to help remove the surface floodwater that entered the well. Figure 3 shows the daily precipitation measurements for the project site.

In April 2004, due to disappointing progress in the maturation of the recently planted vegetation in the shrub buffer plots, a soil fertility test was conducted on several soil samples gathered throughout the buffer. They revealed a lack of fertility in the buffer (especially regarding phosphorus), and particularly in the portion closest to the stream that had previously been covered by a natural berm. To rectify the problem, and particularly to encourage faster shrub establishment, a one-time fertilizer application was applied to the plots in May 2005. Figure 4 shows what soil amendments were added to each individual buffer plot.

## Groundwater Monitoring

Prior to the buffer vegetation being established in April 2004, each of the twelve buffer plots had two wells installed in May 2003, one located along the field-edge of the buffer plots (labeled 1B-12B), and one located along the ditch-edge of the buffer plot (labeled 1A-12A). The wells were each placed approximately 2.5 m deep as measured from ground surface to the bottom of the well. All wells were made of 5-cm diameter polyvinyl chloride (PVC) and had a screened section for the bottom 30 cm of the well. Dedicated tubing was installed in each of the wells to expedite sampling. The wells were sampled monthly starting in May 2003, a full year before the vegetative treatment types were fully installed, and continue to be sampled monthly to the present day. Samples were collected prior to the full installation of the buffer vegetation to gather background "pre-buffer" data for comparative purposes.

Samples were collected in 40 ml acid-washed glass bottles using an Isco150 Well Pump brand peristaltic pump after having purged the well of three well volumes. Adjacent surface water samples were also taken each month at the upstream and downstream sections of the creek, with results shown in Appendix B. All samples were kept on ice until they reached the laboratory. Once there, the samples were filtered using 0.45 µm Durapore brand filters then acidified to pH 2 with a 5% $H_2SO_4$, solution and stored at 4° C in a cold room until analyzed.

The samples were analyzed for nitrate ($NO_3$-N), ammonium ($NH_4$-N), phosphate ($PO_4$-P), chloride (Cl), and dissolved organic carbon (DOC) by the Analytical Services Laboratory in the Soil Science Department at NC State University. The lab used a Lachat Instruments QuikChem brand 8000 Automated Ion Analyzer to measure $NO_3$-N, $NH_4$-N, and $PO_4$-P.  A Haack-Buchler Digital Chloridometer was used to measure chloride.  A Shimadzu Total Organic Carbon Analyzer 5050 was used to measure DOC.  Prior to sampling, the depth to water table was also measured for each well using a Solinst brand water level meter.

**Dilution**

A comparison of $NO_3$-N to Cl concentration ratios were made between the field-edge and ditch-edge wells to determine if a dilution effect was causing any observed decreases in $NO_3$-N concentration.  Chloride is considered a conservative element with respect to groundwater, so if the $NO_3$-N/Cl ratio was to remain constant across the buffer, it implies that water has been added to the groundwater, not having had $NO_3$-N removed from it.  Thus, if we were to observe a 50% $NO_3$-N concentration decrease across a given buffer plot, then we would expect the $NO_3$-N/Cl ratio to also decrease by about 50% if there was true $NO_3$-N removal.  However, if the ratio remained the same we might suspect that dilution was responsible for the observed $NO_3$-N concentration decrease, while if the ratio only decreased by about 20%, we might consider the possibility that some true removal was taking place along with some dilution.  Dilution may also be caused by a groundwater source containing a substantial amount of Cl and/or $NO_3$-N, in which case the results would vary and could even imply $NO_3$-N removal where none actually occurred.  The analysis conducted for this study assumes that any dilution occurring on the site is from uncontaminated groundwater.  The primary source of Cl in groundwater for this study site, as in many agricultural areas, is potassium fertilizer, added as potassium chloride (KCl).

## PRELIMINARY RESULTS AND DISCUSSION

### Groundwater Monitoring Results

***Influence of Vegetative Type***

Figure 5 shows the pre-buffer installation sampling results, which reveal the following $NO_3$-N concentrations; the future shrub plots had an average decrease of 22% (from 5.94 to 4.65 mg $NO_3$-N $L^{-1}$), the future fescue plots had an increase of 10% (from 6.96 to 7.65 mg $NO_3$-N $L^{-1}$), the future native vegetation plots had a decrease of 41% (from 5.82 to 3.45 mg $NO_3$-N $L^{-1}$), and the no-buffer control plots had a decrease of 48% (from 8.44 to 4.36 mg $NO_3$-N $L^{-1}$).

In the sixteen months of sampling since the installation of the vegetation for the buffer, the influence of vegetative type on buffer $NO_3$-N concentrations (Figure 6) were as follows; the shrub plots had an average increase of 43% (from 2.98 to 4.25 mg $NO_3$-N $L^{-1}$), fescue plots had an increase of 40% (from 3.31 to 4.63 mg $NO_3$-N $L^{-1}$), native vegetation plots had a decrease of 5% (from 1.91 to 1.80 mg $NO_3$-N $L^{-1}$), and the no-buffer control had a decrease of 40% (from 6.39 to 3.82 mg $NO_3$-N $L^{-1}$). These calculations are averages of all three treatment replications for each of the vegetation type plots.

Thus, in the sampling period prior to buffer installation, the future native vegetation and control plots appeared about equally effective in removing substantial $NO_3$-N, while the future shrub plots were less so, and the future fescue plots actually revealed $NO_3$-N increases across the buffer. However, in the sampling period after buffer installation, the control plots continue to show substantial removal, the native vegetation plots show only slight reductions, and the shrub and fescue plots both reveal substantial overall increases in $NO_3$-N concentrations.

The results are somewhat surprising as we might have reasonably expected to find an overall increase in buffer effectiveness for the time period after the buffer vegetation was installed. In particular, the fact that the no-buffer control was the superior treatment type for both sampling periods is perplexing. However, the vegetation has not yet had time enough to establish itself. As it continues to mature, trends showing increased benefits from the buffers in general, and from specific vegetation types in particular, may yet emerge.

The very rocky nature of the soil at the buffer, with gravel found throughout the upper profile, and cobbles found deeper, might lead to significant preferential flow pathways in which the groundwater might circumvent the buffer, flowing under it or perhaps just very quickly through it. An abbreviated residence time through such flow in the buffer might explain the very erratic, low removal rates observed. Also, the water tables measured on the site were fairly deep (Figure 7), likely still below the root zone of the maturing vegetation, and right at the depth at which the soil gets very rocky with gravel and cobbles commonly found.

The overall $NO_3$-N concentrations measured in the buffer went down in the post-buffer time period, to less than half that of the pre-buffer levels. This difference appears to largely be due to the comparatively very high concentrations measured during the first few sampling months early in the Spring and Summer of 2003. There is no apparent, obvious explanation for this trend.

For the full set of data for vegetation type please see Appendix C.

***Dilution***

The results for the $NO_3$-N/Cl ratio determinations for both the pre- and post-buffer installation sampling periods are found in Tables 2 and 3. The average Cl concentrations for those same buffers are provided in Tables 4 and 5.

The results for the pre-buffer installation sampling period indicate that dilution does not appear to be a substantial influencing factor for the $NO_3$-N concentration changes observed in either the future shrub or fescue buffers, as their $NO_3$-N/Cl ratio changes (28% and -11%, respectively) match closely with observed $NO_3$-N concentration changes (22% and -10%, respectively). However, dilution may be an influencing factor for both the native vegetation and control plots, as their $NO_3$-N/Cl ratio decreases (1% and 25%, respectively) are much less than their observed $NO_3$-N concentration changes (41% and 48%, respectively).

The results for the post-buffer installation sampling period are much more confusing. The shrub plots reveal a $NO_3$-N/Cl ratio decrease of 11% and a $NO_3$-N concentration increase of 43%, the fescue plots reveal a $NO_3$-N/Cl ratio increase of 5% and a $NO_3$-N concentration increase of 40%, the native vegetation plots reveal a $NO_3$-N/Cl ratio decrease of 24% and a $NO_3$-N concentration decrease of 5%, and the no-buffer control plots reveal a $NO_3$-N/Cl ratio decrease of 61% and a $NO_3$-N concentration decrease of 40%.

It is difficult to say whether or not dilution is occurring in these wells during this sampling period. The notable decrease in both overall $NO_3$-N and Cl concentrations across the entire buffer may play some part in the puzzling results, or perhaps the unequal rainfall distribution due to the hurricane between the two sampling periods affected the outcome as well. In any event, the results found here cast at least some doubt on the validity of the assumption that any observed $NO_3$-N concentration decreases or increases represent true removal or addition of $NO_3$-N to the buffer.

## Dissolved Organic Carbon

The results for the average DOC values for both the pre- and post-buffer installation can be found in Tables 6 and 7, respectively. For the post-buffer installation sampling, DOC averages were 2.3 mg C $L^{-1}$ for the shrub plots, 2.6 mg C $L^{-1}$ for the fescue plots, 2.8 mg C $L^{-1}$ for the native vegetation plots, and 3.2 mg C $L^{-1}$ for the no-buffer control plots. For the pre-buffer installation sampling, DOC averages in those same plots were 2.3 mg C $L^{-1}$ for the future shrub plots, 2.8 mg C $L^{-1}$ for the future fescue plots, 3.3 mg C $L^{-1}$ for the future native vegetation plots, and 2.7 mg C $L^{-1}$ for the no-buffer control plots. These averages were calculated from the results of the ditch-edge wells only.

In comparing the differences between the pre- and post- buffer installation, there was no change between DOC values for the shrub plots, the fescue plots decreased by 0.2 mg C $L^{-1}$, the native vegetation plots decreased by 0.5 mg C $L^{-1}$, while the no-buffer control plots increased by 0.5 mg C $L^{-1}$. These negligible differences might be somewhat surprising as we might expect to find more organic carbon accumulating in the buffer over time. Thus far though, it appears that none of these vegetation types is superior in providing an addition of organic carbon to the buffers. However, the vegetation has only begun to get established in the buffer and might yet contribute more carbon once fully mature.

Nevertheless, these current values represent relatively low levels of organic carbon and present an inhibiting, but not an outright prohibiting, influence on denitrification for the buffer.

**REFERENCES**

King, J.M., J.W. Turpin, and C.H. Young. 1980. *Soil Survey of Henderson County, North Carolina.* Soil Conservation Service and Forest Service, Washington, DC.

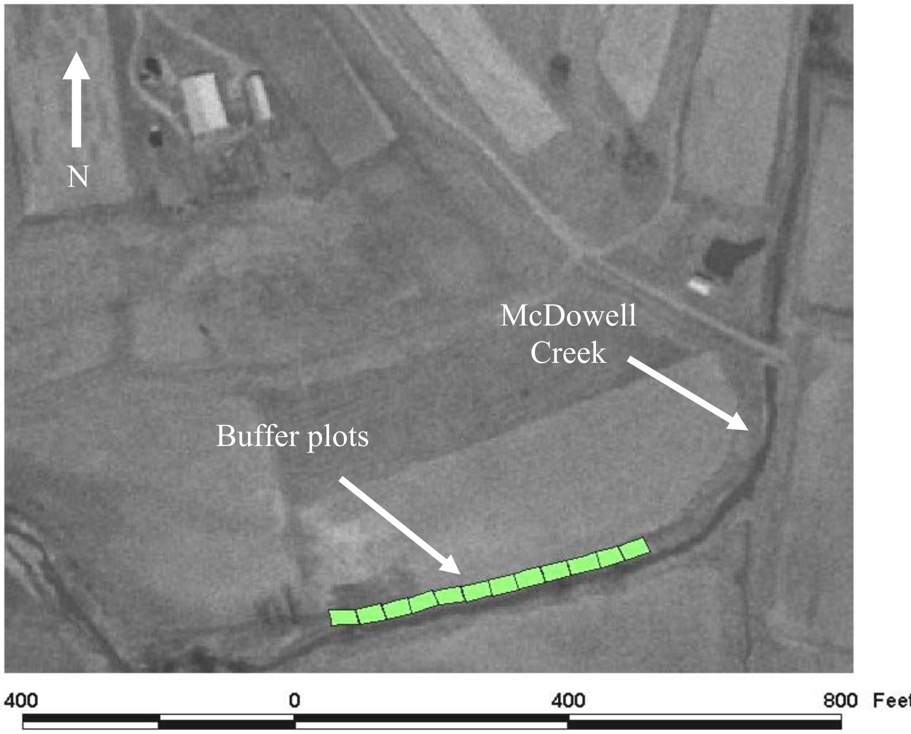


Figure 1. Aerial photograph of the study site and twelve buffer plots located at the Mountain Horticultural Crops Research Station in Fletcher, North Carolina.

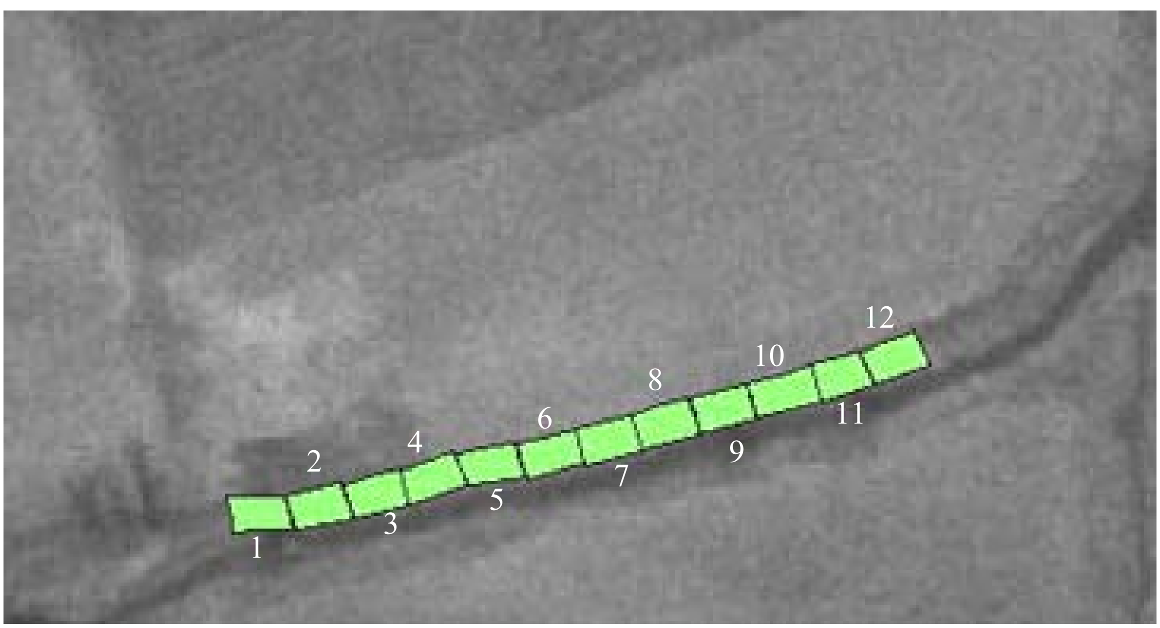


Figure 2. The buffer plots numbering assignments.

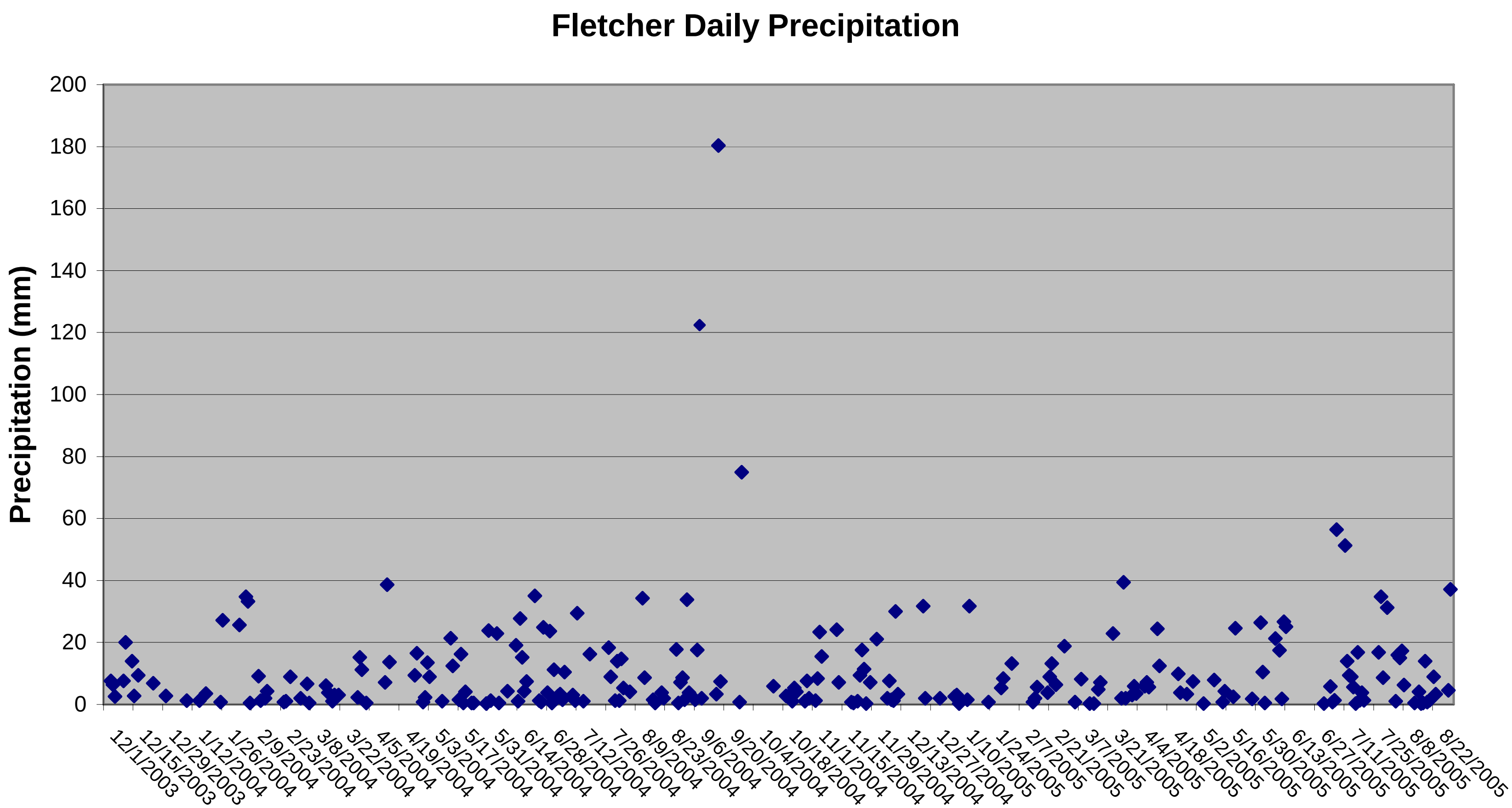


Figure 3. Fletcher daily precipitation data.

**Fletcher Buffer plots** A=plot half adjacent creek, B=plot half adjacent creek

| Plot | Vegetation | # lime/plot half to amend to 6.0 | # 0-46-0/plot half to amend to 70 PI | # 0-0-60/plot half to amend to 80 KI | | Current pH | Current PI | Current KI |
|---|---|---|---|---|---|---|---|---|
| 1A | Corn | 16 | 2.2 | 0.4 | | 5.4 | 24 | 65 |
| 1B | Corn | 20 | 1.4 | 0 | | 5.2 | 36 | 88 |
| 2A | Nat. Veg. | 17 | 3.8 | 1.2 | | 5.5 | 1 | 37 |
| 2B | Nat. Veg. | 20 | 3.8 | 0.8 | | 5.4 | 4 | 51 |
| 3A | Pl. Shrubs | 18 | 3.8 | 1.7 | | 5.2 | 0 | 25 |
| 3B | Pl. Shrubs | 18 | 3 | 0.2 | | 5.4 | 11 | 70 |
| 4A | Fescue | 25 | 3.8 | 1.5 | | 5.1 | 0 | 28 |
| 4B | Fescue | 14 | 2.2 | 0 | | 5.6 | 16 | 102 |
| 5A | Nat. Veg. | 24 | 3.8 | 1.5 | | 5.2 | 0 | 30 |
| 5B | Nat. Veg. | 13 | 3 | 0.2 | | 5.6 | 12 | 73 |
| 6A | Corn | 13 | 3.8 | 1.9 | | 5.6 | 1 | 24 |
| 6B | Corn | 16 | 3 | 0.6 | | 5.5 | 12 | 63 |
| 7A | Fescue | 23 | 3.8 | 1.9 | | 5.3 | 0 | 24 |
| 7B | Fescue | 12 | 2.8 | 0 | | 5.6 | 15 | 78 |
| 8A | Pl. Shrubs | 23 | 3.8 | 1.7 | | 5.2 | 0 | 26 |
| 8B | Pl. Shrubs | 12 | 2.3 | 0.6 | | 5.7 | 19 | 59 |
| 9A | Corn | 27 | 2.8 | 0.8 | | 4.9 | 14 | 47 |
| 9B | Corn | 27 | 2.8 | 0.8 | | 5.1 | 17 | 55 |
| 10A | Nat. Veg. | 9 | 2.8 | 1 | | 5.7 | 13 | 45 |
| 10B | Nat. Veg. | 12 | 1 | 0 | | 5.6 | 39 | 94 |
| 11A | Pl. Shrubs | 10 | 2.3 | 0 | | 5.7 | 20 | 88 |
| 11B | Pl. Shrubs | 16 | 2.5 | 1.2 | | 5.5 | 14 | 44 |
| 12A | Fescue | 8 | 2 | 0 | | 5.7 | 26 | 122 |
| 12B | Fescue | 9 | 2 | 0 | | 5.7 | 26 | 78 |

Figure 4. Fertilization and soil amendment additions to buffer.

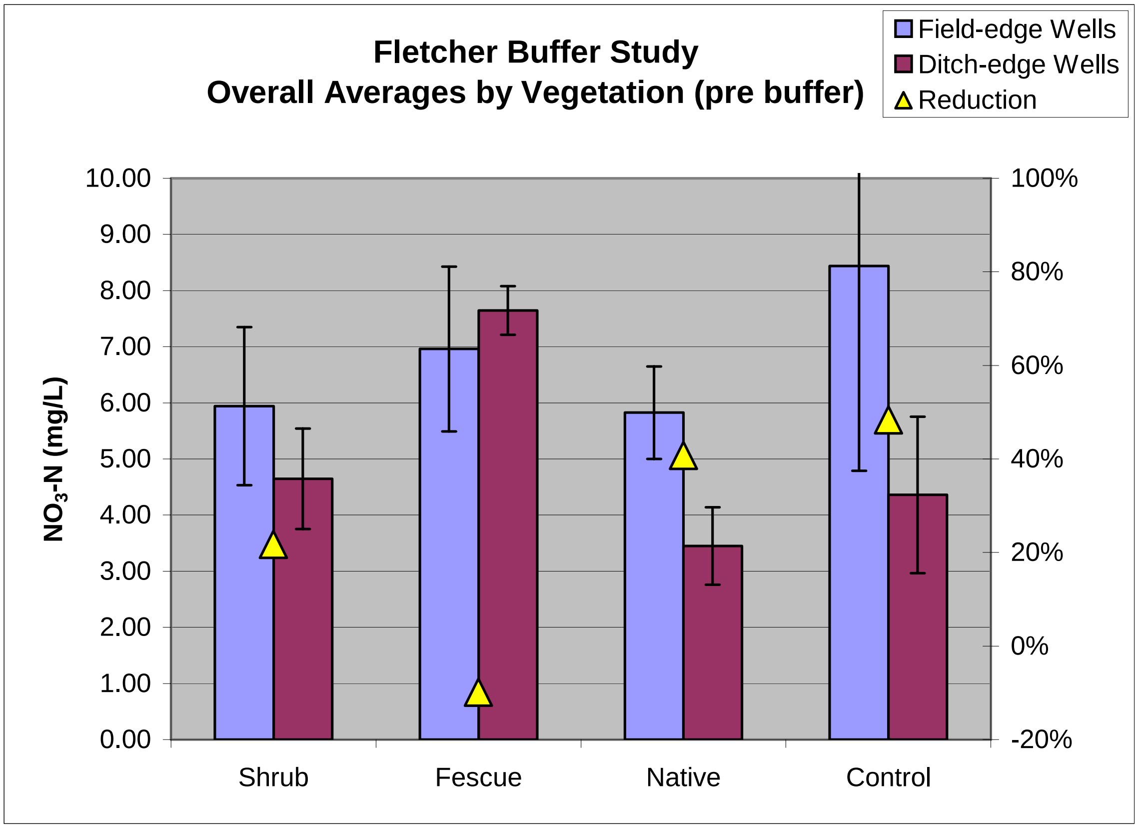


Figure 5. Pre-buffer installation $NO_3$-N concentration averages.

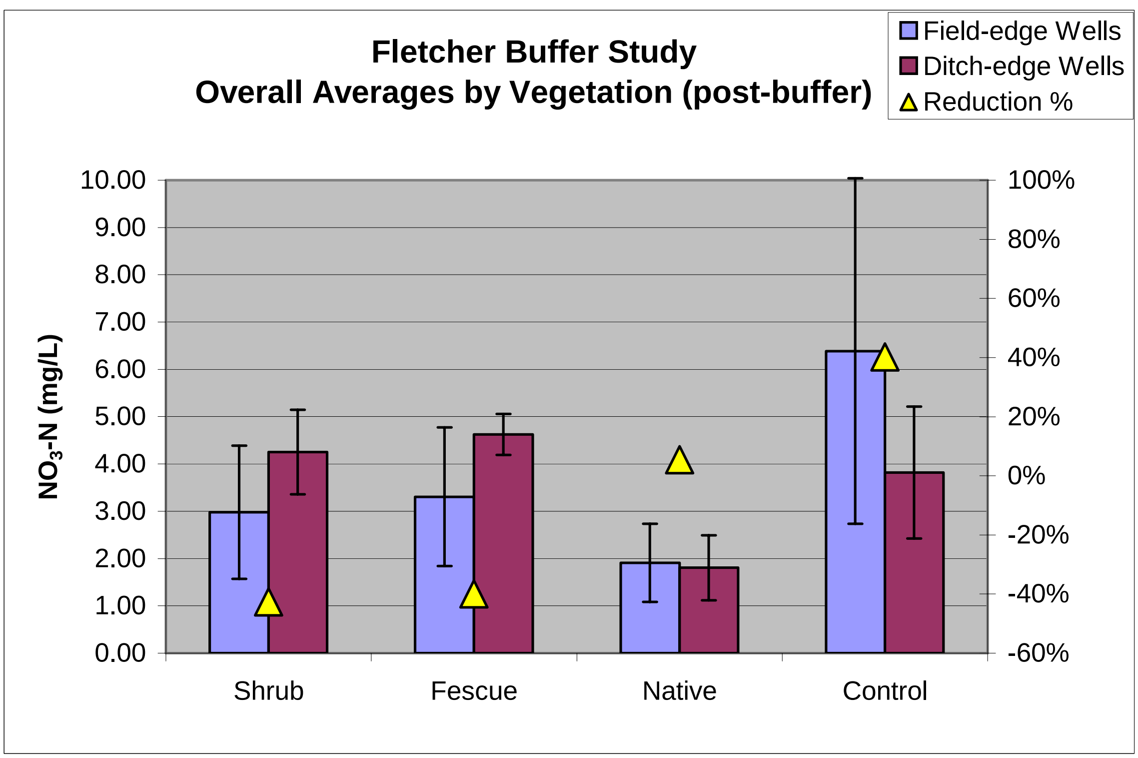


Figure 6. Post-buffer installation $NO_3$-N concentration averages.

| Table 2. Dilution determination: Pre-buffer $NO_3$-N/Cl ratios. | | | | |
|---|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N/Cl ratios | | Ratio reduction | $NO_3$-N reduction |
| | Field-edge wells | Ditch-edge wells | | |
| Shrub | 1.25 | 0.90 | 28% | 22% |
| Fescue | 1.02 | 1.13 | -11% | -10% |
| Native vegetation | 0.68 | 0.67 | 1% | 41% |
| No-buffer control | 1.12 | 0.84 | 25% | 48% |

| Table 3. Dilution determination: Post-buffer $NO_3$-N/Cl ratios. | | | | |
|---|---|---|---|---|
| Vegetation Type | Mean $NO_3$-N/Cl ratios | | Ratio reduction | $NO_3$-N reduction |
| | Field-edge wells | Ditch-edge wells | | |
| Shrub | 1.07 | 0.95 | 11% | -43% |
| Fescue | 1.02 | 1.07 | -5% | -40% |
| Native vegetation | 0.64 | 0.49 | 24% | 5% |
| No-buffer control | 1.77 | 0.70 | 61% | 40% |

| Table 4. Pre-buffer Cl concentrations. | | | |
|---|---|---|---|
| Vegetation Type | Mean Cl concentrations (mg Cl/L) | | |
| | Field-edge wells | Ditch-edge wells | Reduction |
| Shrub | 5.9 | 5.5 | 6% |
| Fescue | 7.7 | 7.0 | 9% |
| Native vegetation | 9.1 | 7.4 | 19% |
| No-buffer control | 9.7 | 4.9 | 50% |

| Table 5. Post-buffer Cl concentrations. | | | |
|---|---|---|---|
| Vegetation Type | Mean Cl concentrations (mg Cl/L) | | |
| | Field-edge wells | Ditch-edge wells | Reduction |
| Shrub | 3.5 | 4.9 | -39% |
| Fescue | 4.2 | 5.3 | -25% |
| Native vegetation | 4.6 | 3.9 | 16% |
| No-buffer control | 4.9 | 4.8 | 3% |

| Table 6. Pre-buffer dissolved organic carbon (DOC) concentrations. | | |
|---|---|---|
| Vegetation Type | Mean DOC concentrations (mg C/L) | |
| | Field-edge wells | Ditch-edge wells |
| Shrub | 4.79 | 2.34 |
| Fescue | 3.23 | 2.84 |
| Native vegetation | 3.18 | 3.27 |
| No-buffer control | 3.97 | 2.69 |

| Table 7. Post-buffer dissolved organic carbon (DOC) concentrations. | | |
|---|---|---|
| Vegetation Type | Mean DOC concentrations (mg C/L) | |
| | Field-edge wells | Ditch-edge wells |
| Shrub | 3.58 | 2.31 |
| Fescue | 3.40 | 2.62 |
| Native vegetation | 3.13 | 2.79 |
| No-buffer control | 4.32 | 3.19 |

# APPENDICES – CHAPTER 3

Appendix A: Soil Profile Descriptions

Profile descriptions as listed in the *Soil Survey for Henderson County, North Carolina* (1980):

Codorus loam (fine-loamy, mixed, active, mesic Fluvaquentic Dystrudepts) located in the buffer itself, with Elsinboro loam (fine-loamy, mixed, semiactive, mesic Typic Hapludults, with 0-3% slopes) and Bradson gravelly loam (clayey, oxidic, mesic Typic Hapludults, with 2-7% slopes) located upland into the adjacent farm field.

The survey also describes the typical organic matter content for each series being as low to medium in the surface layers, though it does not discuss organic matter deeper in the profiles.

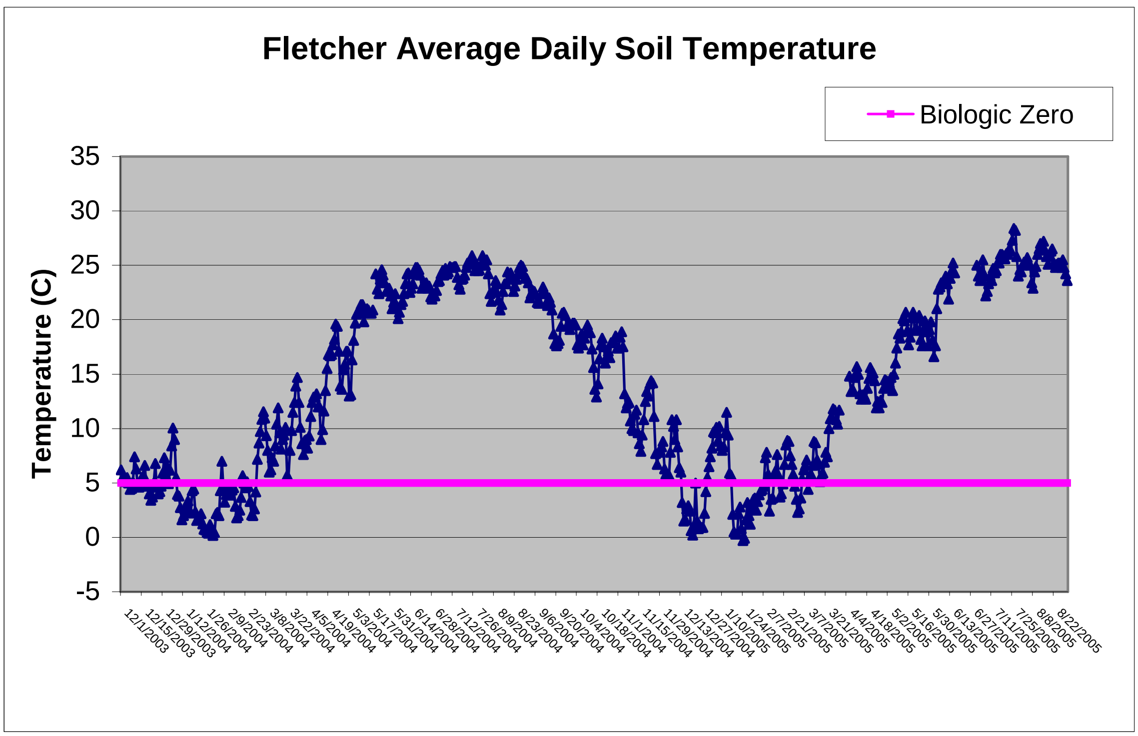


Figure A.1. Average daily soil temperature at 10 cm for the Fletcher site.

Note: Soil temperature data given by the State Climate Office of North Carolina.

Field profile descriptions:

Profile 1:
Sample taken near well 1B

Ap  0 to 8 cm; 2.5Y 4/3 loam; granular structure; with many fine roots and common flakes of mica.
AB  8 to 36 cm; 2.5Y 4/4 loam; with 5% 2.5Y 6/6 pieces of subsoil mixed from lower horizon; medium subangular blocky structure; with common flakes of mica.
Bt  36 to 64 cm; 10YR 6/8 heavy loam; with 25% 2.5Y 6/1 depletions around root channels and 1% 2.5YR 5/8 mottles; medium subangular blocky structure.
BCg  64 to 86 cm; 2.5Y 6/1 micaceous loam; with 10% 10YR 4/1 mottles; common flakes of mica.
Note:  Auger refusal at 86 cm due to large cobbles.

Profile 2:
Sample taken near well 1A

Ap  0 to 18 cm; 2.5Y 4/3 fine sandy loam.
Bt  18 to 43 cm; 2.5Y 6/4 loam; subangular blocky structure.
BC  43 to 71 cm; 2.5Y 5/4 sandy loam; 20% rounded 1" diameter gravel; with common flakes of mica.
C 71 to 86 cm; 10YR 6/8 sandy loam; with 20% 10YR 7/8 mottles; with 0.5" diameter gravel and few mica flakes.
Note:  Auger refusal at 86 cm due to large cobbles.

Profile 3:
Sample taken near well 5B

Ap  0 to 5 cm; 2.5Y 4/2 loam; granular; with many mica flakes
BA  5 to 30 cm; 2/5Y 5/3 loam; medium subangular blocky structure; with 10% 1" diameter rounded gravel.
Bt  30 to 58 cm; 2.5Y 6/4 loam with 30% 5Y 6/1 depletions and 10% 2.5Y 7/8 masses; medium subangular blocky structure.
Btg  58 to 94 cm; N/6 clay loam with 25% 10YR 5/8 and 5% 7.5YR 6/8 mottles.
BCg  94 to 109 cm; N/6 sandy loam with 25% 10YR 5/8 and 10% 7.5YR 6/8 concretions; with common mica flakes.
Cg  109 to 117 cm; 5Y 6/1 micaceous loam with 10% 5Y 4/1 mottles.
Ab  117 to 137 cm; 2.5Y 4/2 sandy loam; with common decayed fibers.

Profile 4:
Sample taken near well 5A

Ap 0 to 8 cm; 2.5Y 4/3 loam.
BA 8 to 36 cm; 2.5Y 5/4 loam.
Bw 36 to 61 cm; 2.5Y 6/4 loam.
Bg 61 to 89 cm; 2.5Y 6/2 loam with 10% 2.5Y 6/6 concretions; with common mica flakes and 5% pea gravel.
C 89 to 122 cm; 10YR 5/4 loamy sand; granular; with 15% 10YR 6/2 depletions, and 10% 7.5YR 5/8 concretions; with 30% pea gravel.
Note: Auger refusal at 122 cm due to large cobbles.

Profile 5:
Sample taken near well 8B

Ap 0 to 18 cm; 2.5Y 4/3 loam; granular; with common mica flakes.
A 18 to 43 cm; 2.5Y 4/3 loam; medium subangular blocky structure; common mica flakes.
Bt 43 to 79 cm; 2.5Y 6/4 heavy loam; with 20% 10YR 6/8 concretions and 35% 2.5Y 6/2 depletions; medium subangular blocky; with common mica flakes.
C 79 to 94 cm; 2.5Y 5/3 sandy loam; with 5% 10YR 7/8 concretions and 35% 10YR 7/3 depletions; granular; with common mica flakes.
Note: Auger refusal at 94 cm due to cobbles.

Profile 6:
Sample taken near well 8A

Ap 0 to 10 cm; 10YR 4/3 sandy loam; granular.
Bw1 10 to 41 cm; 10YR 5/4 sandy loam; medium subangular blocky structure.
Bw2 41 to 81 cm; 10YR 6/4 light sandy loam; medium subangular blocky structure.
BC 81 to 97 cm; 10YR 5/4 loamy sand; with 5% 2.5YR 5/6 mottles, and 10% 10YR 7/8 concretions, and 10% 2.5Y 7/2 depletions.
C 97 to 112 cm; 2.5Y 7/4 sand; with 5% 2.5YR 5/6 concretions and 10% 2.5Y 7/1 depletions.
2C 112 to 127 cm; 10YR 4/4 loamy sand; granular; with 5% 10YR 7/8 mottles; with 50% gravel.
Note: Auger refusal at 127 cm due to cobbles.

Profile 7:
Sample taken near well 12B

Ap 0 to 28 cm; 2.5Y 4/3 loam; granular.
Bw 28 to 53 cm; 2.5Y 5/4 sandy loam; granular; with 40% gravel.

C  53 to 66 cm; 2.5Y 5/4 loamy sand; granular; with 65% gravel.
Note:  Auger refusal multiple times at 66 cm due to cobbles.

Profile 8:
Sample taken near well 12A

Ap  0 to 15 cm; 10YR 3/3 loam; granular; with gradual boundary.
Bw1  15 to 71 cm; 10YR 5/4 sandy loam; granular; gradual boundary.
Bw2  71 to 99 cm; 10YR 4/4 sandy loam; granular; distinct boundary.
BC  99 to 114 cm; 10YR 5/4 sandy loam; granular; distinct boundary.
Ab  114 to 137 cm; 10YR 4/1 sandy loam; with 5% 10YR 6/8 and 10% 10YR 6/3 mottles; granular; distinct boundary.
Note:  Increased mica seen towards the bottom of the profile.

Appendix B:
Fletcher Adjacent Stream Data

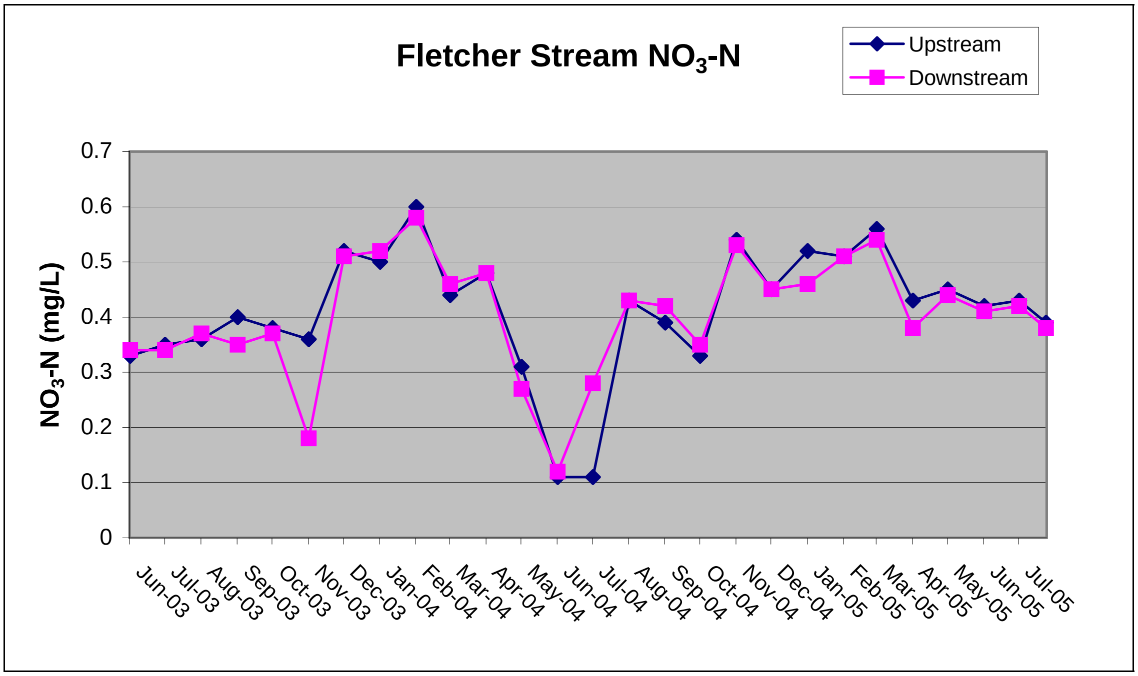

Figure B.1. Fletcher adjacent stream $NO_3$-N data.

Appendix C:
$NO_3$-N Concentration Data for Vegetative Type

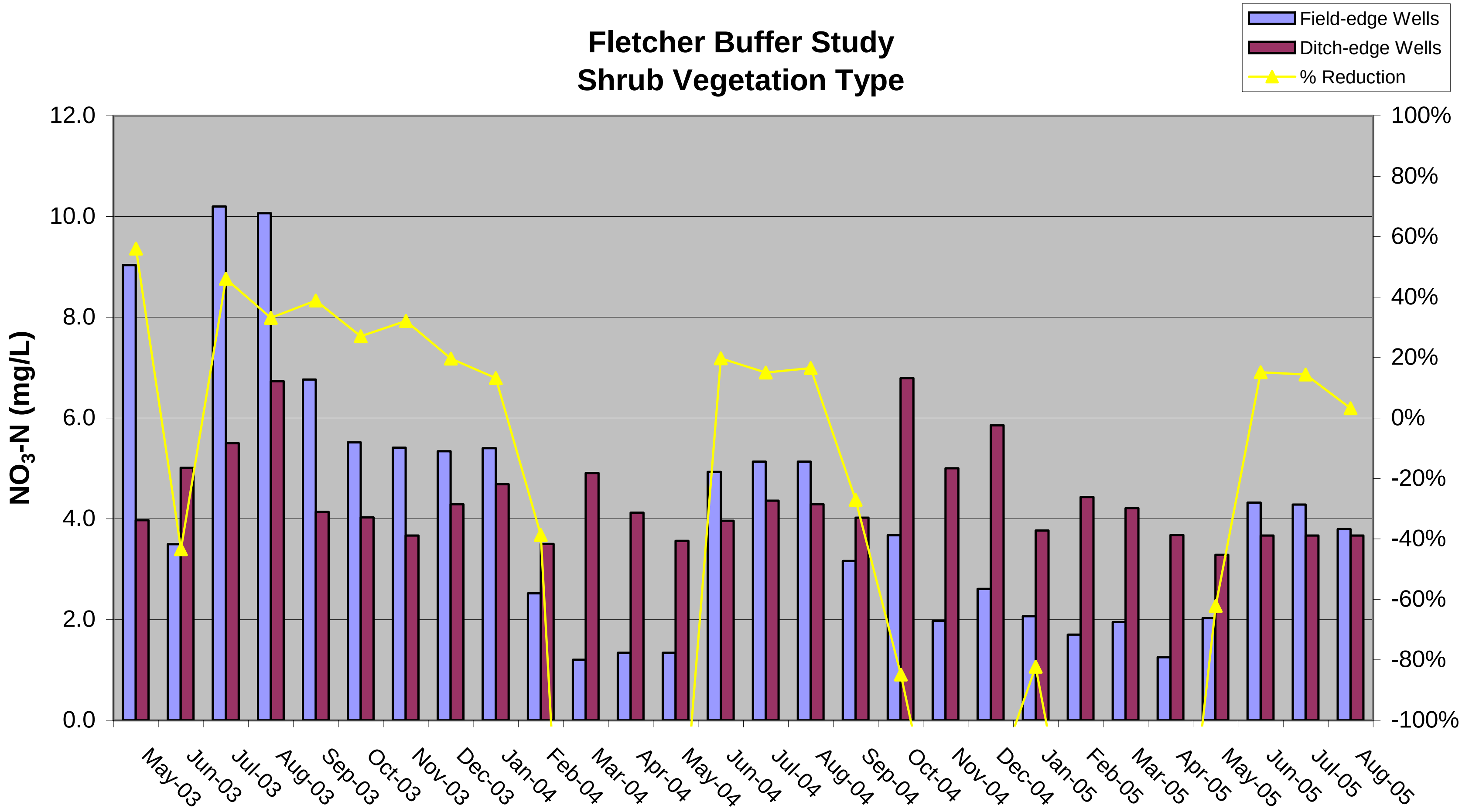


Figure C.1. $NO_3$-N concentration data for the shrub vegetation type.

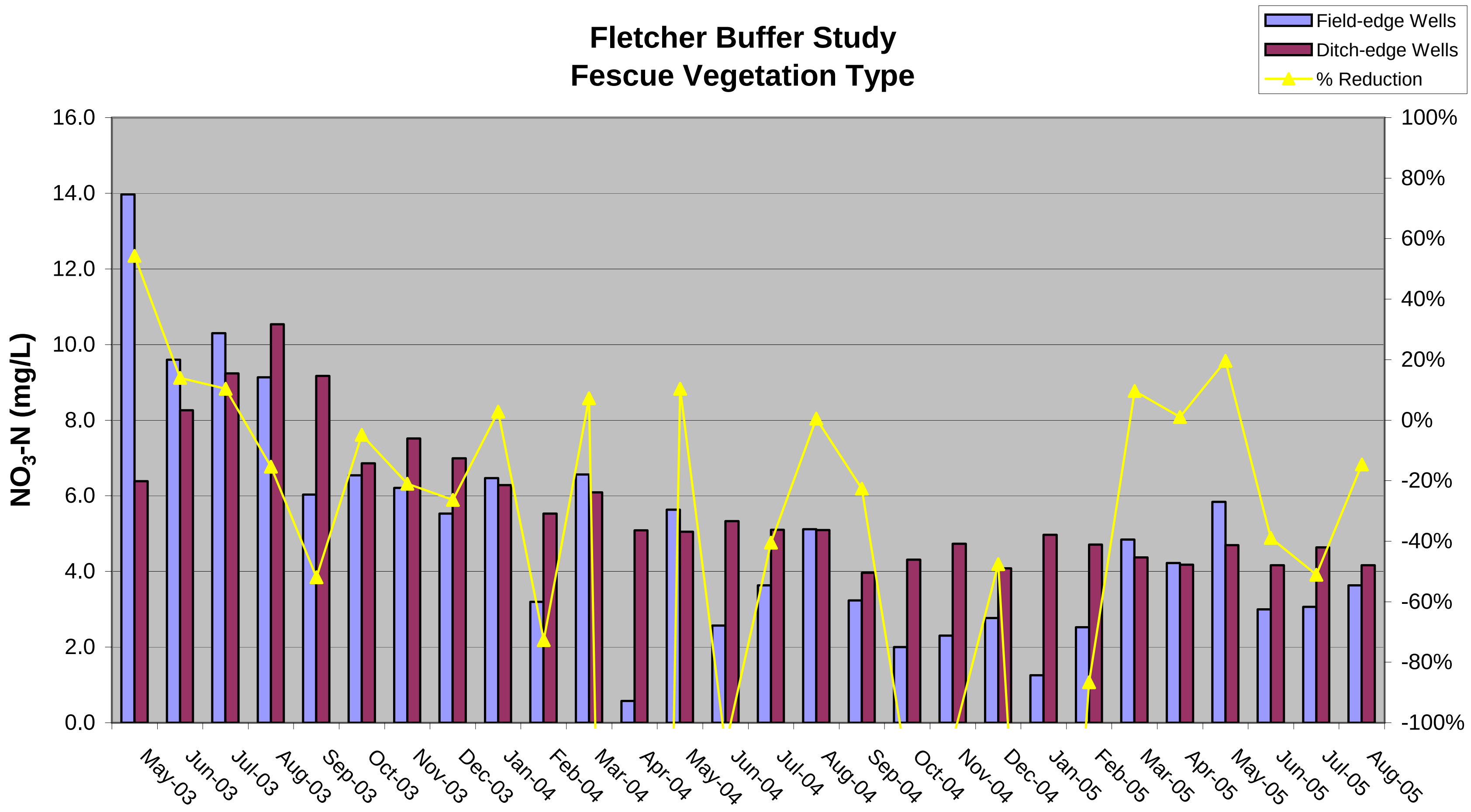


Figure C.2. $NO_3$-N concentration data for the fescue vegetation type.

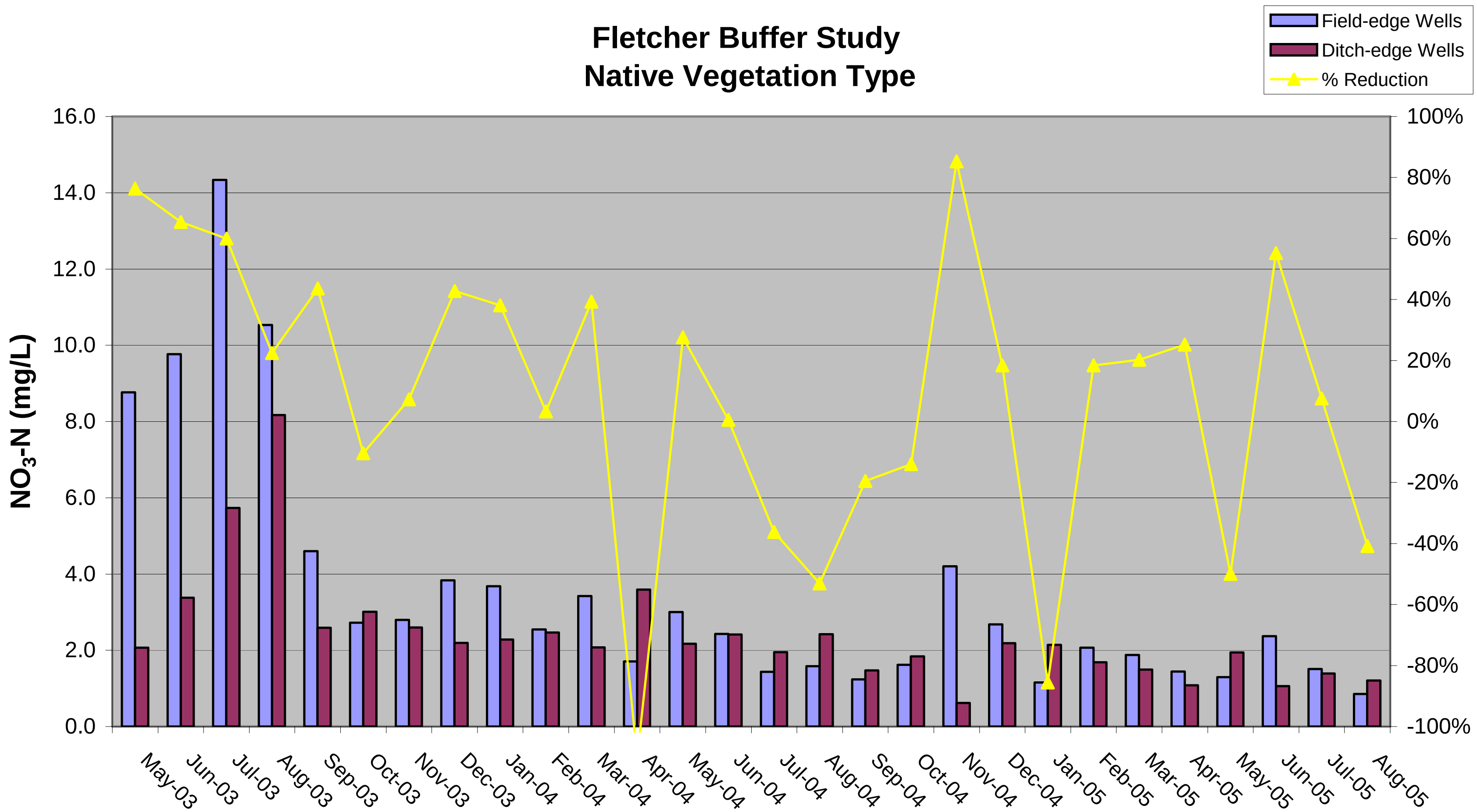


Figure C.3. $NO_3$-N concentration data for the native vegetation type.

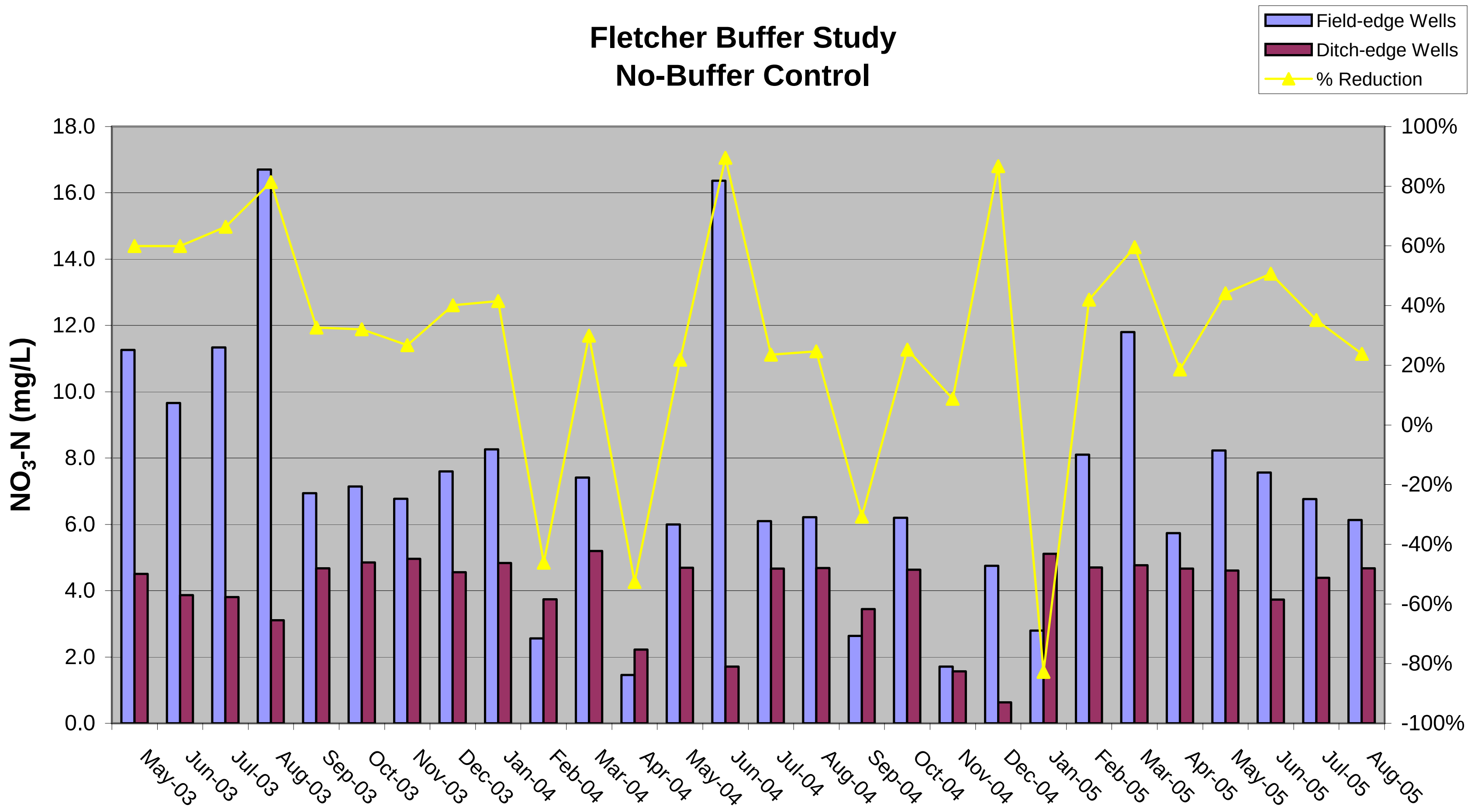


Figure C.4. $NO_3$-N concentration data for the no-buffer control.