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Spatial and temporal variabilities on soils in St. Landry Parish, Louisiana

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SPATIAL AND TEMPORAL VARIABILITIES
ON SOILS IN ST. LANDRY PARISH, LOUISIANA

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ABSTRACT

The spatial and temporal variation of soil properties was evaluated on three sites in close proximity to Bayou Wikoff, St. Landry Parish, Louisiana. A total of 1,068 surface (0-5 cm) samples were collected, geo-located, and transported to Louisiana State University for physical and chemical analyses. Physical and chemical properties were spatially and temporally displayed using ArcGIS. Interpolation techniques such as spline, kriging, and inverse distance weighting were evaluated to determine the best fit model for the project. Spline and inverse distance weighting were found to be the least accurate interpolation models. Kriging provided the most accurate model of spatial and temporal data distribution. Clay content (for total suspended solid control), P levels, and organic C % were a primary focus for this study, as potential non-point source pollution threats to water quality in Bayou Wikoff. All three sites were evaluated individually, as each had unique management practices. Pasture Site 1 exhibited larger concentrations of nutrient deposition proportional to increasing organic C % and clay content in areas of lower elevation. These areas were nearest to the bayou and potentially allowed for runoff, reducing water quality. Pasture Site 2 has artificial swale formations that affected the distribution of the evaluated properties. Extensive research at this site exhibited patterns of nutrient distribution that correlated with the swale formations. In the low portion of the swale, clay content, organic C %, and corresponding nutrient concentrations increased. The Pristine Site, used as a control site, showed evidence that the surface soil (0-5cm) was heavily altered from natural deposition as a result of being turned, moved, or replaced. Overall, spatial and temporal assessments revealed that while the three sites have unique distribution patterns of clay and organic C %, the soils are not hazardous for water quality. However, best management

programs should focus on swales and low lying areas to determine the affect of spatial variability.

CHAPTER 1
INTRODUCTION

Water quality has been an escalating environmental concern, state-wide and nationally. Nationally, the Environmental Protection Agency (EPA) is continually enforcing new regulations to improve water quality. The nation's largest water quality threat is non-point source pollution (NPS); water pollution generated during a rainfall event that has an unknown source (Louisiana Department of Environmental Quality, 2009a). Non-point source pollution contributors include forestry, urban runoff, mining/construction, and agriculture. Nationally, the largest contributor to NPS is agriculture. As much as sixty percent of river impairment is a result of agriculture pollution (Environmental Protection Agency, 2008). On a local level, the Louisiana Department of Environmental Quality (LDEQ) has established several research projects to study the effect of best management practices (BMPs), on improvements in water quality. The LDEQ and local farmers together, determined specific BMPs that would serve as an alternative to traditional production techniques, including yield increases, cost reductions, and practices to increase environmental quality. Many agricultural settings have implemented BMPs such as reducing fertilizer and pesticide application to control toxic pollutants. Suspended solids and nutrient runoff inhibit surface waters, decreasing water quality for its designated uses. To determine the effect of suspended solids and nutrient runoff, it is necessary to analyze the properties of the sediment source.

St. Landry Parish, in south-central Louisiana, includes the Bayou Plaquemine Brule (BPB) watershed. This watershed is part of the Mermentau River Basin. A tributary of BPB is Bayou Wikoff, which runs east of BPB until they join south of Church Point, LA. The BPB is classified as "impaired" by the Environmental Protection Agency (2009) due to: agriculture, urban runoff, and unknown NPS pollution. The pollutant causes include: organic enrichment, phosphorus, nitrogen, and turbidity. The BPB flows through the Mermentau River Basin until it reaches the Gulf of Mexico. Bayou Wikoff is one of several water bodies that was selected by the LDEQ to establish management applications designed to improve water quality.

Three local farms were selected along Bayou Wikoff to investigate water quality. These sites were selected because they were available for implementing pre-determined BMPs and potentially have a direct effect on Bayou Wikoff. While there is ongoing research concerning collected surface water samples at these sites, this study will determine the effect of the soil on the bayou surface waters. For soil analysis studies, it is necessary to determine the physical and chemical properties that may have a direct effect on water quality. The main focus of this study is to assess spatial and temporal variability of soil physical and chemical properties, using interpolation techniques in ArcGIS. These maps display possible areas of concern, as well as the overall layout of each studied attribute.

The objectives of this research are to: 1) determine a sampling scheme and appropriate sites for collection, 2) collect soil samples and quantify their physical and chemical properties, 3) determine the spatial and temporal variability of soil properties, especially those of environmental concern, and 4) determine the potential effect on water quality of the soil on Bayou Wikoff.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Water Quality

2.1.1 National Water Quality

Water quality is an increasing topic of concern as society moves towards a more "environmentally friendly" lifestyle. In the recent decades, the United States government has taken several actions to improve the nation's water quality. Aside from establishing policies like the Clean Water Act (CWA; established 1972), which restricts the amount of toxic substances released into the water system, the Environmental Protection Agency (EPA) is continually updating water quality standards and assessments (Environmental Protection Agency, 2009). As water quality management became increasingly more detailed, the EPA developed a method for limiting the amount of toxins in waterbodies, known as total maximum daily loads (TMDL). These TMDL lists address water quality problems (i.e. nutrients, sediments, toxic contaminants, and habitat alteration) in an inclusive approach (Environmental Protection Agency, 2010a). The TMDL list is "based on the relationship between pollution sources and in-stream water quality conditions," and allows for states to establish water-quality regulations with quantifiable standards for a waterbody (Environmental Protection Agency, 2010a). Each state regulates the daily maximum amount of pollutants entering individual waterbodies allowed, while meeting broader EPA water quality standards. A water body that meets all water quality standards must fully support all of its uses, resulting in the EPA identifying the water body as in "good" condition (Environmental Protection Agency, 2009). If the water way does not meet all EPA requirements, it is considered "impaired." Waters that are identified as impaired must specify whether the cause is point or nonpoint source pollution, and may include "good," but threatened waters. Point and nonpoint source pollution will be discussed in further detail throughout the thesis, as they play a critical role for impaired water ways. In 2008, 61 % of nationally assessed waters were impaired, up six percent from 2006 (Environmental Protection Agency, 2009). This percentage does not necessarily mean that water quality is still declining overall, but implies that regulations are becoming more stringent.

Key factors affecting water quality include limiting nutrients (P and N), low dissolved oxygen (DO) levels, total suspended solids (TSS), increased organic matter content, and turbidity in surface waters (Brady and Weil, 1999; Environmental Protection Agency, 2000). Dissolved oxygen is the quantifiable amount of oxygen gas that has dissolved in water (United States Geological Survey, 2010a). As DO levels decrease, it becomes harder for aquatic life to obtain oxygen necessary live. Total suspended solids measure the gravimetrical weight of particles that are suspended in a waterbody. The suspended particles promote water quality reductions, including reduced light penetration, deposition of sediment, and a possible reduction of aquatic ecosystem quality (United States Geological Survey, 2010b). An increase in organic matter content has the same effect as TSS on surface waters. The suspended organic materials contribute to high turbidity levels (United States Geological Survey, 2010c). Turbidity is “a measure of clarity or the light scattering ability of water” (United States Geological Survey, 2010a). The light is reflected by suspended or dissolved particles in water bodies. High quantities of suspended solids, often silts and clays, scatter light in different directions, causing the turbidity level to increase. High turbidity levels may indicate a high sediment pollution concern, also harmful to aquatic ecosystems.

2.1.2 Louisiana Water Quality

Louisiana is also following the nation’s path of moving towards an environmentally conscious lifestyle. In this decade, there has been an increased interest in water quality and groundwater management in Louisiana. Assessment of Louisiana's rivers and streams showed a significant majority of its waterbodies to be impaired (Environmental Protection Agency, 2006). Louisiana's water usage includes: agriculture, drinking water supply, fish and wildlife propagation, and recreation (primarily boating). Of the 1.6 billion gallons of groundwater used per day in Louisiana, agriculture accounts for more than 50 % of its use (United States Geological Survey, 2005). Recent evaluations by the Louisiana Department of Environmental Quality (LDEQ), responsible for assessing the state's water quality, determined that the most common causes of river impairment were dissolved oxygen, turbidity, total suspended solids, P levels, and sedimentation (Table 2.1; Louisiana Department of Environmental Quality, 2008).

Louisiana is well known for its abundant supply of water (Table 2.2), with more than 4,665,556 ha and 106,690 km of surface water (Louisiana Department of Environmental Quality, 2008). The LDEQ has divided surface water uses into seven categories: primary contact recreation (swimming), secondary contact recreation (fishing, wading), fish and wildlife propagation, drinking water supply, shell fish propagation, agriculture, and outstanding natural resources (Louisiana Department of Environmental Quality, 1996).

2.1.3 Nonpoint Source Pollution

Two forms of pollutants are a problem in Louisiana, point and nonpoint source pollution. Point source pollution is a discernible, restricted, and isolated substance that enters waters by means of pipes, ditches, channels, tunnels, or any other specific dischargeable method that can be traced to a particular source, and does not include irrigated agricultural runoff (Louisiana Department of Environmental Quality, 2009b).

Nonpoint source pollution (NPS) has no identifiable origination; it flows freely across an exposed surface into waterbodies; sources consist of natural and human activities, including

Table 2.1. Water quality report for Louisiana rivers, including *good*, *threatened*, and *impaired* rivers and causes of impairment (Environmental Protection Agency, 2006).

WATER QUALITY	TOTAL LENGTH OF RIVERS AFFECTED
	--- km ---
Good rivers	3,438
Threatened rivers	0
Impaired rivers	11,853
CAUSE OF IMPAIRMENT[a]	
Dissolved oxygen	5,251
Turbidity	3,653
Total suspended solids	3,138
Total phosphorous	2,454
Sedimentation/siltation	2,050
Municipal point source discharges	1,255

[a] Not all causes of impairment listed

Table 2.2. Louisiana water resources (Louisiana Department of Environmental Quality, 2008).

WATER RESOURCE	QUANTITY
	----km----
Rivers and streams	106,690
	----ha----
Lakes and reservoirs	436,264
Fresh and tidal wetlands	2,246,394
Estuaries	1,982,898

construction, mining, and agriculture (runoff). Much of this pollution makes its way into salt marshes, bays, and other coastal waters. Nonpoint source pollution is a threat to Louisiana biological, ecological, and wildlife resources, including fish, birds, and humans. Furthermore, NPS has been identified as a leading contributor to poor water quality, with agriculture and forestry heavily contributing to water impairment (Louisiana Department of Environmental Quality, 2009a). National water quality assessments indicate that 60 – 70 % of the nation's waterbodies are impaired by NPS (Randolf, 2004). In Louisiana, NPS is managed by the LDEQ to educate people on pollution, runoff, and best management practices to reduce and control impaired waters (Louisiana Department of Environmental Quality, 2009a). Studies by Ritter (1986) concluded that further research is necessary regarding non-point source pollution, the effects of agriculture and agriculture management practices, and how these contribute to water quality.

2.1.4 Agricultural Runoff and Best Management Practices

Agriculture plays an important role in the central part of Louisiana, as it is the prairie region of the state, with fertile soils. However, agriculture also poses hazards for the Louisiana environment, specifically the water systems. In Louisiana, frequent and/or heavy rainfall events cause a variety of pollutants to flow into canals, bayous, rivers, lakes, and estuaries from agricultural activities. The pollutants cause widespread impairment on these waterbodies and eventually, the Gulf of Mexico. Numerous studies have concluded that pollutants from surface waters (bayous, rivers, lakes, etc.) are deteriorating water quality in the Gulf of Mexico (Bianchi et al., 2010; Kennicutt II et al., 1988; Robinson and Napier, 2001). There are several farming practices that increase the amount of nutrient runoff and sediment load into surface waters. The use of conventional crop production removes the protection of the natural ground cover.

Furthermore, the use of nutrients and pesticides is a common practice for maintaining high production levels, causing an excess of toxins discharging in watersheds. Removing crop cover or natural vegetation leaves the soil exposed and prone to erosion. Tillage is used for aerating soil, mixing nutrients and organic matter, and destroying weeds. However, it also increases runoff and weed problems; the latter is caused by seed germination provoked by an aerator. The major pollutants that are carried by surface runoff include: organic wastes, plant/inorganic nutrients, suspended solids, dissolved solids, acidity/alkalinity, synthetic volatile organic chemicals, inorganic chemicals, and disease causing microorganisms (Randolf, 2004). Table 2.3 describes pollutants that are a concern in agricultural lands.

Organic wastes in water reduce the DO needed to support aquatic life. Runoff contains organic materials that are decomposed by microorganisms, using the available oxygen in the water. Plant and inorganic nutrients, including N and P, cause excessive algae growth along with other undesirable aquatic vegetation in water bodies. Phosphorus, as part of NPS, accounts for a large share of the nation's water quality problems. Numerous research studies have shown the negative impact of P on surface waters (Correll, 1998; Ritter, 1986; Sharpley et al., 1994). Sharpley (1995) determined that soil P influences crop productivity and eutrophication, and must be taken into consideration when developing best management practices. Eutrophication is a quantifiable reduction of oxygen dissolved in water (Environmental Protection Agency, 2010). Implications of eutrophication include algal blooms, fish health declines, degradation of aquatic life and ecosystems, and allows for ecological changes in food webs. High levels of algae and other aquatic vegetation can quickly accumulate if nutrient levels are high in waters (Environmental Protection Agency, 2000). Algae quickly grow when copious levels of N and P

Table 2.3. Water pollutants, sources, and effects (Randolf, 2004).

WATER POLLUTANT	SOURCES	EFFECTS	MEASUREMENT	CONTROLS
Organic oxygen demanding wastes	Sewage, industry, runoff	Depletes DO[a], alters life forms, fish kills	BOD_5[b]	Biological treatment
Plant nutrients	Sewage, agricultural and urban runoff, industry	Algae growth, waterweeds	Nitrogen, phosphorus	Advanced treatment, biological treatment
Sediment, suspended particles	Runoff	Reduces clarity, smothers bottom life	Turbidity	Settling
Minerals, salts	Agricultural runoff	Taste, inhibits freshwater plants	Total dissolved solids	Desalination; chemical treatment
Synthetic, volatile organic chemicals (oil, pesticides)	Industry, spills, agricultural runoff, air pollution	May be toxic to aquatic life, humans; subject to biomagnifications	Chemical analysis	Activated carbon filtration

[a] Dissolved Oxygen
[b] Biochemical oxygen demand; measures the rate of oxygen uptake by microorganisms over five days

are present. When P is added to a P-limited body of water, algal blooms will drastically increase. These algal blooms inhibit water quality by deteriorating taste and smell, and can also produce toxins that negatively affect animal and human health. When the algal blooms and other undesirable aquatic plants die, they accumulate at the bottom of water and begin to consume oxygen. High levels of nutrients in waters also decrease DO levels, which release toxic substances (ammonia and hydrogen sulfide) into the water system, cause an unsatisfactory environment for aquatic organisms (Environmental Protection Agency, 2000). Furthermore, DO has become a major concern in the Gulf of Mexico. High levels of nutrients entering the Gulf from the Mississippi River have resulted in a large area (~17,000 km^2) of hypoxia, water containing < 2 ppm of DO. Hypoxia is exceptionally detrimental to waters as it causes death in many bottom dwelling organisms, due to lack of oxygen.

As water quality problems remain, attention is being focused on controlling runoff from agriculture and various nonpoint pollutant sources (Sharpley et al., 1994). The LDEQ has devised a NPS program to establish projects for improving the state's water quality. Agriculture related projects have been categorized by land use, including cotton, crawfish, dairy, poultry, rice, sugarcane, soybean, and pasture; the latter being the focus of this study. Pastureland is typically fallow or actively grazed, and is used by farmers/ranchers for livestock (Louisiana Department of Environmental Quality, 2009a). Fertilizers are often applied to pastures to maintain vegetative cover used for grazing and erosion control. Concurrently, the application of fertilizers can negatively impact water quality via runoff.

As water quality standards are becoming more stringent, management practices must be developed for improving surface soil stability, reducing soil loss, erosion, and agriculture runoff.

National and state programs have suggested using methods of improving farming practices, known as best management practices (BMP). Best management practices are defined as

> "schedules of activities, prohibitions of practices, maintenance procedures, and other management practices designed to prevent or reduce the pollution of the waters of the state, including treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge, or waste disposal, or drainage from raw material storage" (Louisiana Department of Environmental Quality, 2009b).

Examples of BMPs that apply to this research include: no-till, limited/no fertilization, buffer strips, and artificial swales; as shown in Figures 2.1a-c.

Buffer strips include natural vegetation (trees) and not harvesting/plowing to the edge of the bayou. A no-till practice is a method of planting where the soil and crop residue are left undisturbed, except for the rows where the seed is planted in the soil (Soil Survey Staff, 2006). Jiao et al. (2006) determined that no-till practices increased soil aggregation, when compared to conventional tillage methods in a sandy soil near Quebec, Canada. Non-tilled soils also increase soil organic carbon (Godsey et al., 2007; Ismail et al., 1994). Godsey et al. (2007) studied no-till effects of soil organic matter on a silt loam in Kansas. They determined that no-till plots had greater organic carbon concentrations on surface soils when compared to conventional tillage. Limiting fertilizer application can also be considered as a BMP. The biggest limitation of fertilizer application is the potential for nutrient runoff into watersheds, inhibiting water quality. However, fertilizer allows for a potential increase in crop production, increased soil aggregation, and thus, reducing nutrient loss through a decrease of soil erosion/surface runoff (Jiao et al., 2006).

a.)

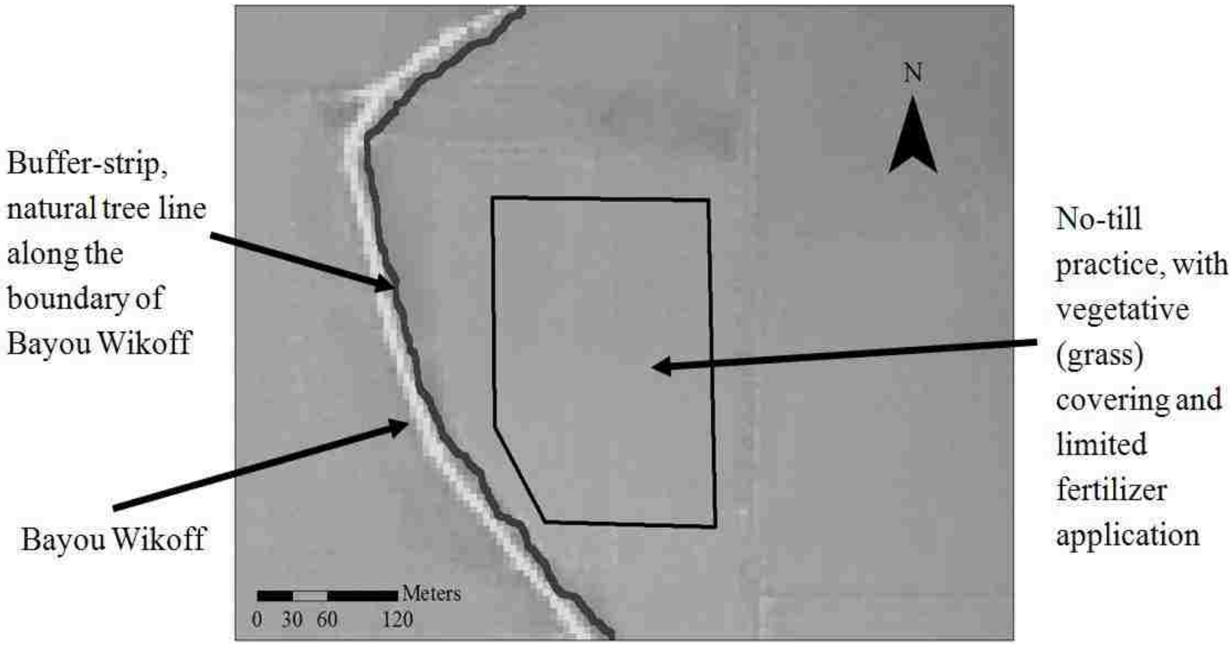

Figure 2.1a. Best management practices for Pasture Site 1 in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

b.)

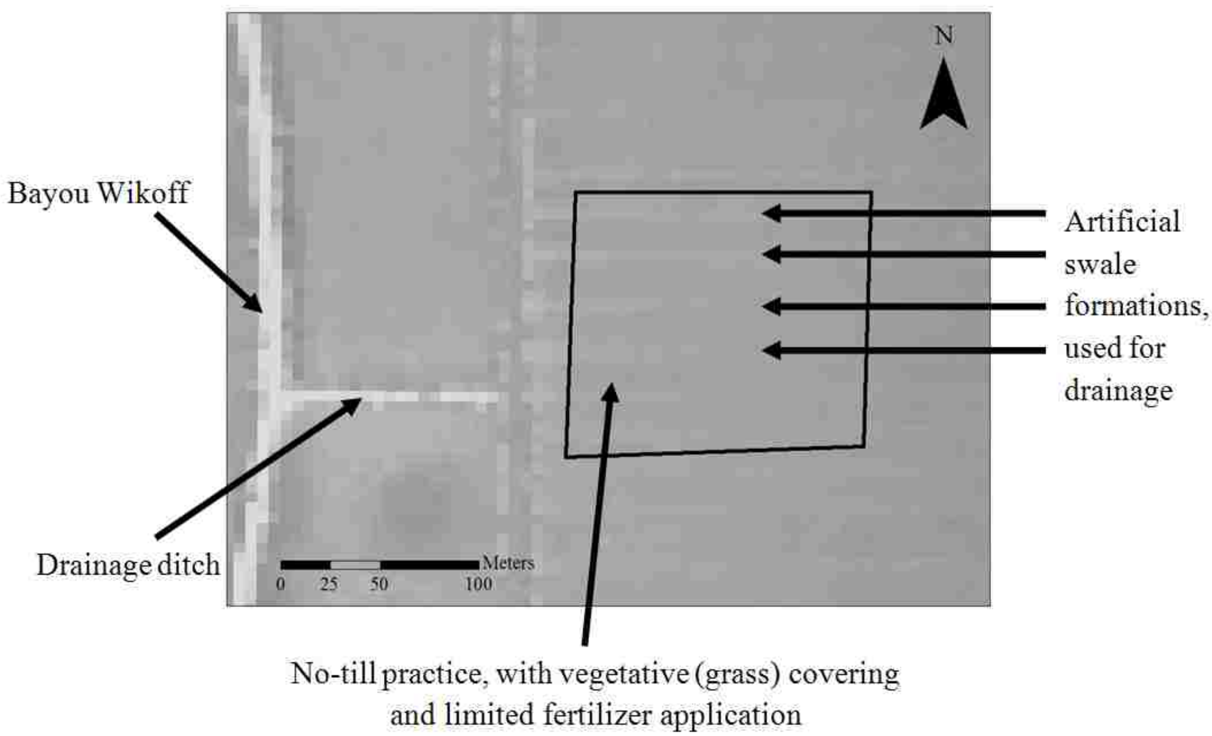

Figure 2.1b. Best management practices for Pasture Site 2 in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

c.)

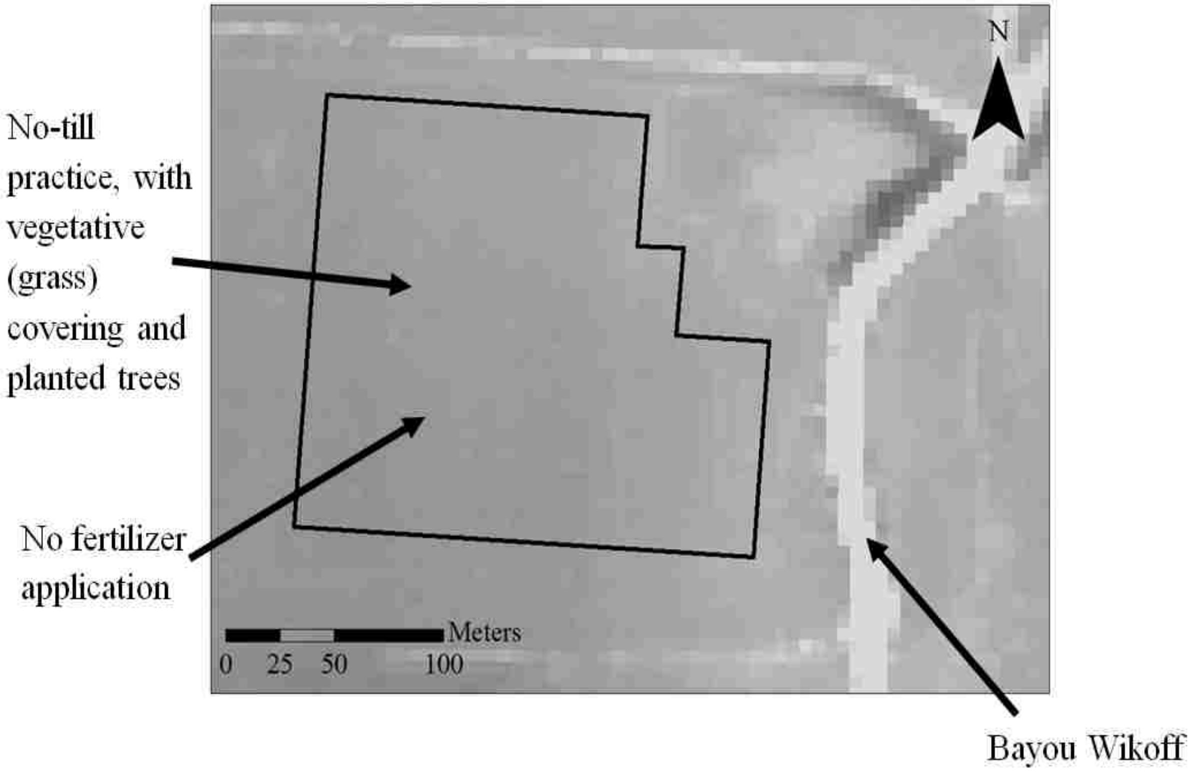

Figure 2.1c. Best management practices for Pristine Site in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

2.2 St. Landry Parish

2.2.1 General Occurrences and Features

St. Landry Parish is located in south central Louisiana and is bordered to the east by the Atchafalaya River. The city of Opelousas is the parish seat and is located ~88 km northwest of Baton Rouge, LA. The parish is mainly rural, with an area of 241,736.5 ha (Soil Survey Staff, 1986). Elevation ranges from 2.4 – 22.9 m above sea level. Land is primarily used for agriculture with sections of bottomland forest and swamp. St. Landry Parish is divided into two physiographic areas. The terrace uplands occupy one third of the parish and encompass the western and central portions. Most of the soils in this region are silty. The alluvial plains constitute the remaining two thirds and extend toward the east of the parish. Soils here have been formed by sediment deposits from the Atchafalaya and Mississippi Rivers. Typical soils of this parish are mostly silt loam. Loamy soils are found on high areas of natural terraces, while clayey soils are found in lower areas where levees and swamps are prevalent. This region is characterized by a subtropical climate with average temperatures of 11.7 °C and 27.2 °C in the winter and summer, respectively. Total annual precipitation is ~ 135 cm to 142 cm (Soil Survey Staff, 1986).

2.2.2 Bayou Plaquemine Brule

Bayou Plaquemine Brule is located in the headwaters of the Mermentau River Basin, which contains the prairie region of Louisiana and a small portion of the coastal region (Figure 2.2). From start to finish, the Bayou Plaquemine Brule flows 80.5 km until it merges with the Mermentau River, and eventually into Grand Lake in southwestern Louisiana (Environmental Protection Agency, 2009). Although this watershed is currently impaired, there is ongoing improvement. In 1993, Bayou Plaquemine Brule was one of six water bodies in the Mermentau River Basin listed as impaired. In 1996, only four of the previous six were listed as impaired, still including Bayou Plaquemine Brule. In 2002, 2004, and 2006, the majority of attainment statuses for the Bayou Plaquemine Brule watershed were not supporting and did not meet government standards. The only standard that met government regulations was the *agriculture usage*. However, the most recent water quality assessment (305b list) from 2008 (Environmental Protection Agency, 2009) has only one attainment area as impaired. Causes, sources, and dates of river impairment in Louisiana for the last decade are available in Table 2.4. The most recent data show DO, total P, sedimentation, and total suspended solids are still a concern in Louisiana. The designated uses for Bayou Plaquemine Brule are primary contact recreation (swimming),

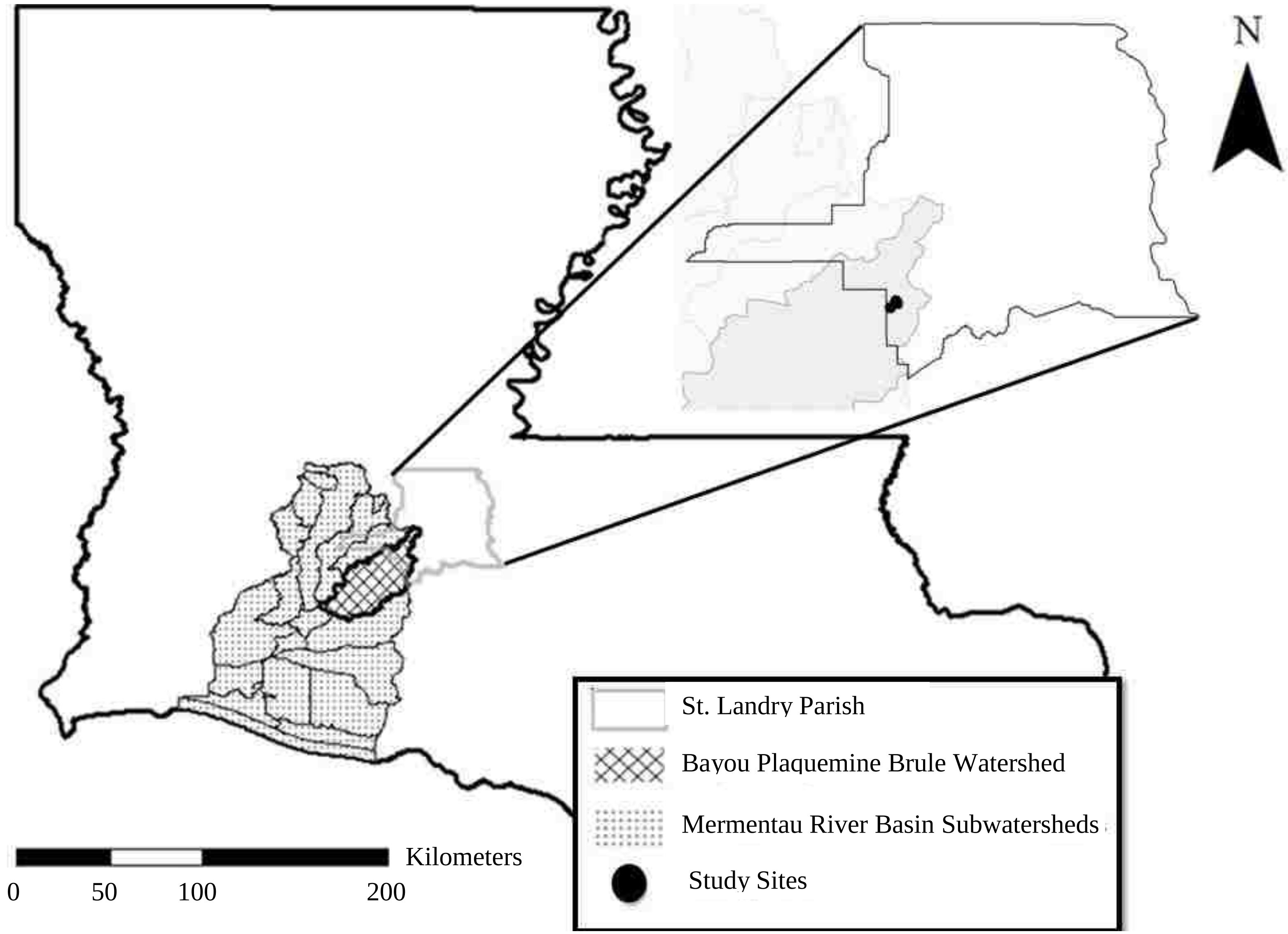

Figure 2.2. Mermentau River Basin with sub-watersheds, including Bayou Plaquemine Brule in Louisiana (LSU ATLAS, 2009).

secondary contact recreation (fishing and wading), fish and wildlife propagation, and agriculture. Table 2.5 includes water quality standards for the Bayou Plaquemine Brule watershed.

2.2.3 Geographic and Climatic Features

The major land resource area associated with this study is the Prairie Terrace Loess formation (Soil Survey Staff, 2010). The major land resource areas are geographic units that contain patterns of soils, climate, water resources, and land uses for a specified location (Soil Survey Staff, 1981). The temperature and moisture regimes are hyperthermic and aquic, respectively. The hyperthermic/thermic boundary line is ~12 km from the study sites. The aquic moisture regime generally follows the floodplains in Louisiana; however the aquic/udic moisture line is ~3 km from the sites. A nearby (~8-10 km) climate monitoring station reported annual mean temperature and precipitation as ~21 °C and ~152 cm, respectively (Louisiana Office of State Climatology, 2009).

2.3 Spatial and Temporal Variability

Soil properties extend continuously, but ultimately there are still uncertainties for non-sampled locations. Regardless of how many samples are taken or how much analysis is performed, prediction is an inevitable procedure in soil science (Heuvelink and Webster, 2001). Computerized simulation models are used to predict the correlation of water and solute movement in the soil. Temporal studies have been used for determining surface soil changes over time (Anderson et al., 2005). Fennessy and Mitsch (2001) evaluated how soil properties were spatially distributed over a 2 yr observation period. They found that the spatial variability of organic C and evaluated nutrient concentrations had declined over the studied time period. Several spatial and temporal studies have determined that OC % is highly variable across the landscape (Anderson et. al., 2005, Fennessy and Mitsch, 2001). Gaston et al. (2001) used

Table 2.4. Cause, source, and years of water impairment in Louisiana (Environmental Protection Agency, 2009).

CAUSE OF IMPAIRMENT	IMPAIRMENT GROUP	SOURCE	YEAR(S)
Dissolved oxygen	Organic enrichment / oxygen depletion	Municipal discharge / sewage	2002, 2004, 2006, 2008
Total phosphorus	Nutrients	Municipal discharge / sewage	2004, 2006, 2008
Sedimentation / siltation	Sediment	Agriculture	2002, 2004, 2006, 2008
Total suspended solids	Turbidity	Agriculture	2002, 2004, 2006, 2008
Turbidity	Turbidity	Agriculture	2002, 2004, 2006, 2008

Table 2.5. Water quality standards for the Bayou Plaquemine Brule watershed, Louisiana (Environmental Protection Agency, 2007).

MAXIMUM CHLORIDES	MAXIMUM SULFATES	MAXIMUM DISSOLVED OXYGEN	PH RANGE	MAXIMUM TEMPERATURE	MAXIMUM TOTAL DISSOLVED SOLIDS
--mg L^{-1}--	-- mg L^{-1}--	-- mg L^{-1}--		--° C--	-- mg L^{-1}--
90	30	Dec-Feb: 5 Mar-Nov: 3	6.0-8.5	32	260

spatial distributions to model soil properties for precision farming practices of different soil map units. This is beneficial for determining chemical fate and nutrient transport patterns.

Analyzing data spatially and temporally is essential for understanding soil variability. A geographic information system (GIS) collects, stores, analyzes, transforms, and displays temporal and spatial data. Winnaar et al. (2007) found that GIS is useful for identifying runoff intervention sites in South Africa, where reducing runoff is critical because of limited high quality water.

2.4 Interpolation Techniques

In GIS, interpolation techniques are used to determine unknown values, by means of incorporating known values. All interpolations use nearby data to predict the unknown pattern of variability. Each technique predicts differently, thus it is necessary to determine a best-fit method for each study. Often, soil maps include soil types and corresponding variable properties within each soil type. These parameters must be taken into consideration when interpolating. Kriging, spline, and inverse distance weighting (IDW) are often used to obtain spatial and temporal distributions of soil properties from soils sampled in grid-like patterns (Gotway et al., 1996; Tabor et al., 1985; Mulla, 1991; Wollenhaupt et al., 1994). These three techniques use inferential statistics that predict unknown data using known data (Coyne and Thompson, 2006).

2.4.1 Spline and Inverse Distance Weighting

Two methods that are frequently used for soil spatial variability are spline and IDW. The spline method offers polynomial smoothing that is used for maximizing continuous data predictions (ESRI, 2009). The IDW interpolation predicts the values at unknown locations that are inversely related to the proximity of nearby established data (Isaaks and Srivastava, 1989). Weber and Englund (1992) determined that IDW was the best model for a 19,800 sample dataset testing the accuracy of elevation data. However, they also acknowledge that the IDW selection in this case is an isolated event, and that if the conditions for this project were optimal, kriging may have proven to be a better fit model. Several studies have shown that IDW is a less optimal choice of study because it infers accurate results with low sample counts.

2.4.2 Kriging

Kriging is a geostatistical interpolation method that uses spatial autocorrelation to determine unknown data points. Direction and distance from known points determine the prediction of values and unknown points (Karydas et al., 2009). Kriging is often preferred over spline and IDW because it minimizes variation. However, it has been suggested that kriging is limited by the number of observed samples. When compared to spline and IDW, kriging interpolations provide a more accurate interpolation of soil properties with larger sample sets (Jung et al., 2006; Mueller et al., 2001). Webster and Oliver (1992) concluded that 50 to 100 data points are necessary to construct an accurate variogram for kriging. Weber and Englund (2002) suggest that overall, when conditions are ideal, kriging is the optimal interpolator. Using kriging is often an advantage for spatially representing data because it minimizes an unbiased estimation variance (if the variogram is known) (Kalivas et al., 2002). Johnson et al. (2009) found a significant correlation between measured soil properties and artificial swale formations. Kriging was the most appropriate interpolation method because it incorporated the effect of elevation and provided a more accurate estimation of soil property variability, in comparison to spline or IDW. For this reason, the majority of the analysis discusses in the remainder of this thesis will be focused on kriging interpolation. Specialized terms will be used during analysis related to kriging interpolation, as they are key elements of the technique. The benefit of using kriging is because of the association and autocorrelation dependency on the semivariogram. Semivariogram models are calculated by plotting a general semivariance (Equation 2.1) (Nkedi-Kizza et al., 1994).

Geostatistics bases the unknown spatially dependent variables on this semivariogram in combination with the kriging interpolation (Wilding and Drees, 1983). An established

$$\gamma(h) = 1/N(h) \sum_{i=1}^{N} (Z_i - Z_{i+h})^2$$ [Eq 2.1]

where,

= semivariance

= number of pairs of observations separated by

= value of a property at point *i*

= value of the property at lag distance *h* away

semivariogram will provide further information necessary for analyzing data, including: range, sill, and nugget (Figure 2.3). The nugget, or nugget variance, is used to limit variance between sampling points and represents random sampling error. A large sampling error results in less accurate data estimations. The range is a component of a semivariogram model that establishes the distance past the autocorrelation threshold (ESRI, 2010). On a semivariogram, this is the distance value where the model begins to flatten out. Another component of a semivariogram is the sill value. The sill represents the scale of error, or variation, at spatial scales. The value detects the discontinuity at the origin of the semivariogram model and is usually smaller than the grid sampling interval. The semivariogram will also determine a best-fit model, outputting four types of variograms: *linear*, *spherical, exponential, and gaussian* shown in Equations 2.2 – 2.5, respectively. The linear variogram model describes a straight line variogram with no sill, the spherical model is a modified quadratic function, the exponential model approaches the sill gradually, but they never actually meet and, the gaussian, a hyperbolic model, assumes a gradual rise in the y-intercept (GS+,).

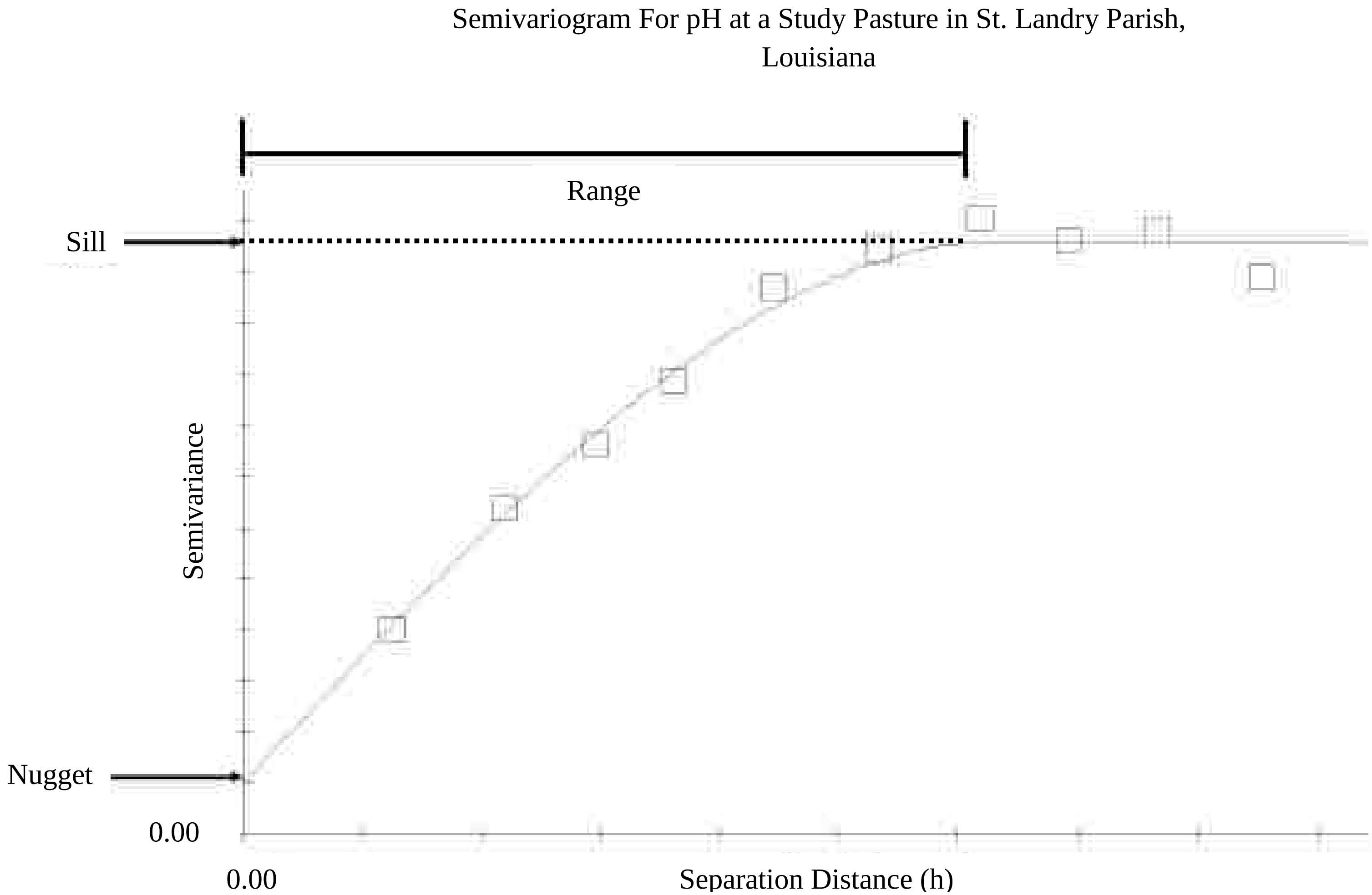

Figure 2.3. Semivariogram showing the range, sill, and nugget for a study site in St. Landry Parish, Louisiana.

$$\gamma(h) = C_0 + [h(C / A_0)] \qquad \text{[Eq 2.2]}$$

$$\gamma(h) = C_0 + C\,[1.5\,(h / A_0) - 0.5(h / A_0)^3] \qquad \text{for } h \leq A_0 \qquad \text{[Eq 2.3]}$$

$$\gamma(h) = C_0 + C \qquad \text{for } h > A_0$$

$$\gamma(h) = C_0 + C\,[1 - \exp(-h / A_0)] \qquad \text{[Eq. 2.4]}$$

$$\gamma(h) = C_0 + C\,[1 - \exp(-h^2 / A_0^2)] \qquad \text{[Eq 2.5]}$$

where,

$\gamma(h)$ = semivariance for interval distance class h

h = lag interval distance (m)

C_0 = nugget variance ≥ 0

C = structural variance $\geq C_0$

A_0 = range parameter

CHAPTER 3
MATERIALS AND METHODS

3.1 Field Location

Three study fields were selected in St. Landry Parish, LA, and are referred to as Pasture Site 1 (PS1), Pasture Site 2 (PS2), and Pristine Site (PR) (Figures 3.1a-c). The three sites have total areas of 5.40, 2.22, and 3.92 ha, respectively. The soil series found in these three fields are presented in Table 3.1. The official series descriptions of soils at these sites are available in Appendix A. Pasture Sites 1 and 2 are fertilized annually with ~113 kg (250 lbs) of 24-6-20 NPK. The vegetation at PS1 and PS2 is native grasses, primarily bermudagrass (*Cynodon dactylon*). The PR is a tree farm with St. Augustine (*Stenotaphrum secundatum*) grass, which receives no inorganic fertilizer; however mulch is applied at the bases of trees.

3.2 Soil Sampling

Soils characteristically are spatially dependent, thus many studies have concluded that a systematic sampling scheme is more appropriate than random sampling (McBratney and Webster, 1983). All three fields were divided into a grid-like pattern, individually appropriate for each site (Figures 3.1a-c). Sampling distances were ~18 m apart at all three sites. Grid-like schemes are often more appropriate for spatial sampling as random sampling can generate points that are very close together, preventing accurate assessments of variability (Weindorf and Zhu, 2010). Wang and Qi (1998) determined that a regular grid sample pattern provided more accurate results than a random pattern, and accuracy increased proportionally with sample size. Another benefit of using a grid sampling scheme is that grid spacing provides a good choice of "lag" distance when determining the semivariogram (ESRI, 2009). Surface samples (0-50 mm) were collected from pre-georeferenced locations in September 2008 (Sept08), January 2009 (Jan09), and May 2009 (May09). Other samples were collected for additional analysis within

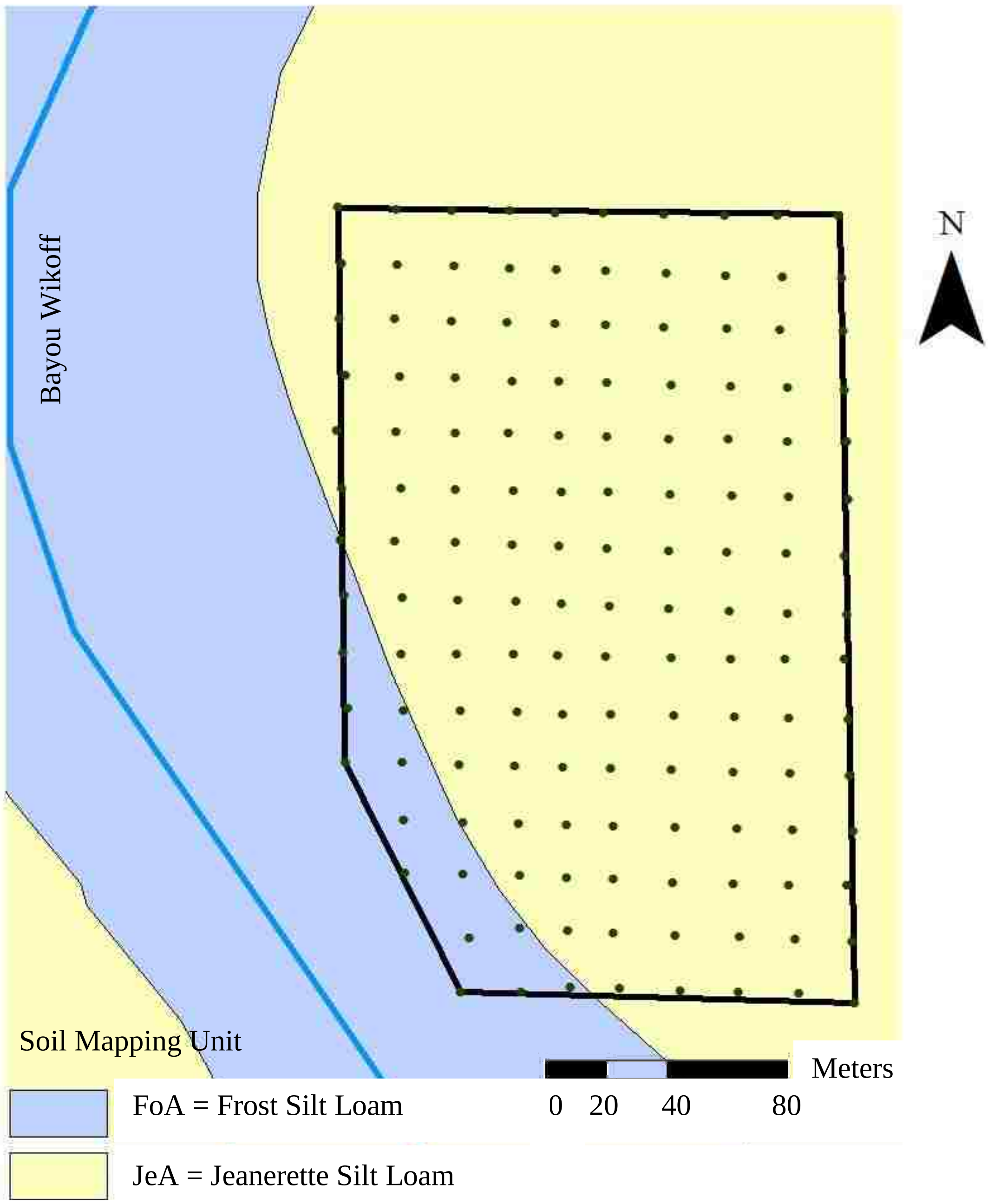

Figure 3.1a. Soil mapping units along with the site boundary line for Pasture Site 1 in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

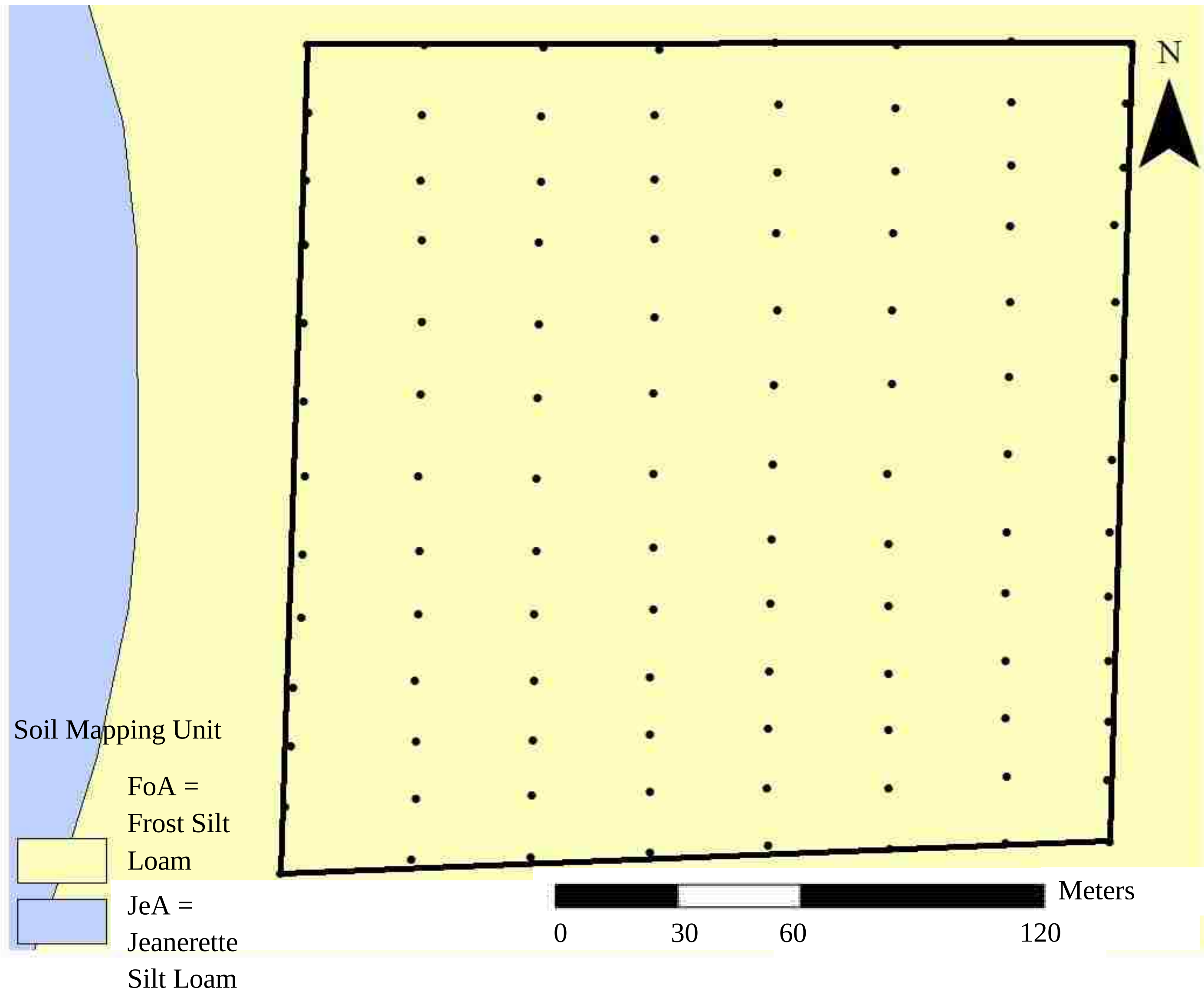

Figure 3.1b. Soil mapping units along with the site boundary line for Pasture Site 2 in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

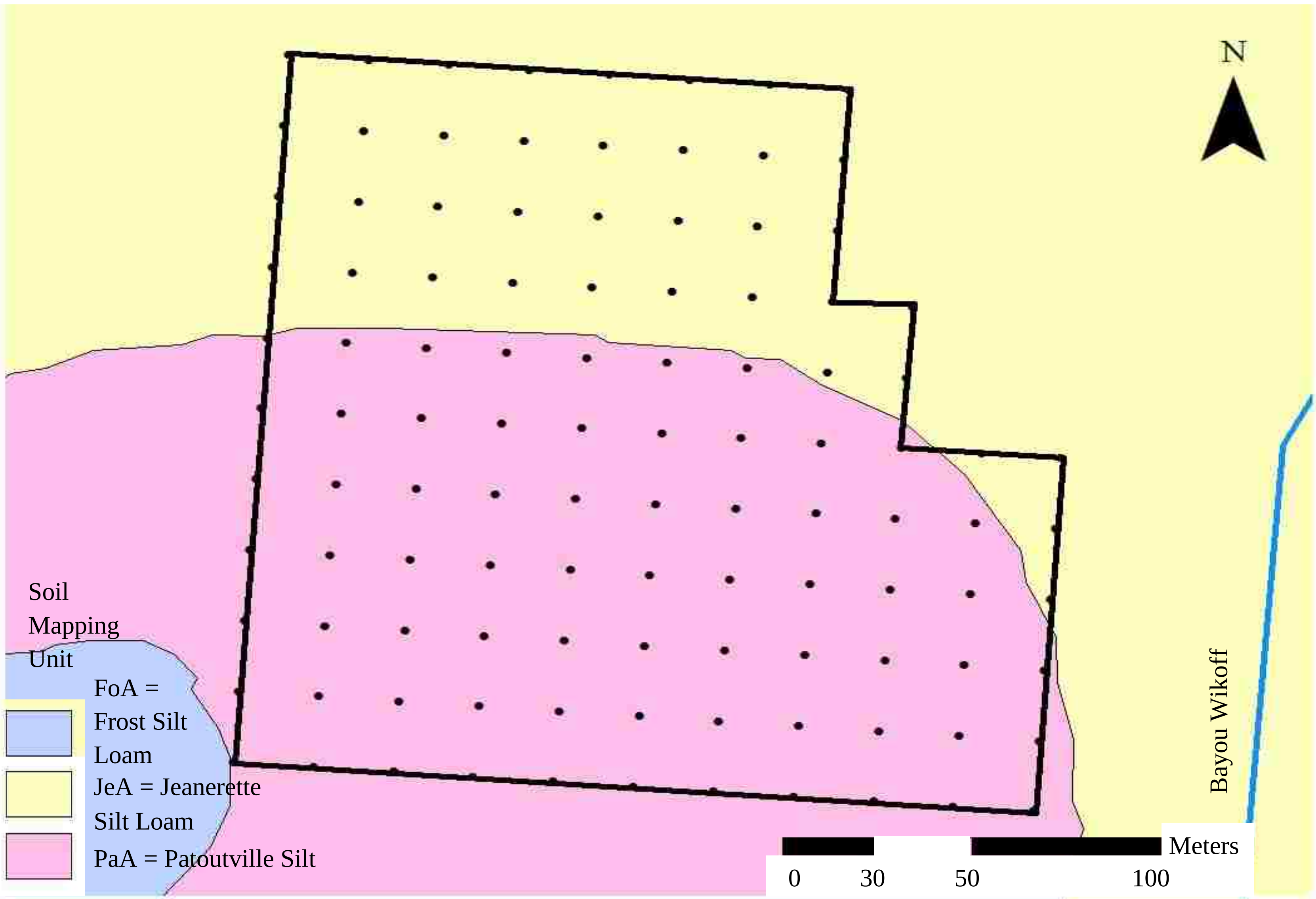

Figure 3.1c. Soil mapping units along with the site boundary line for Pristine Site in St. Landry Parish, Louisiana (LSU ATLAS, 2009).

Table 3.1. Soil series and extent at study sites in St. Landry Parish, Louisiana (Soil Survey Staff, 2009b).

Site	Soil †	Extent	Extent within field
		--ha--	--%--
Pasture Site 1 (PS1)			
	FoA	1.38	21.1
	JeA	5.06	78.9
Pasture Site 2 (PS2)			
	FoA	1.54	22.0
	JeA	3.88	56.4
	PaA	1.50	21.6
Pristine Site (PR)			
	FoA	0.04	1.5
	JeA	1.34	35.9
	PaA	2.35	62.6

† FoA = Frost silt loam; JeA = Jeanerette silt loam; PaA = Patoutville silt

this eight month time span. More than 100 samples were collected at each site to ensure accuracy (Lark, 2000; Webster and Oliver, 1992). A global positioning system (GPS) unit (eTrex-Vista, Garmin Inc., Olathe, KS, USA) with < 3 m accuracy was used for locating the pre-georeferenced data points in the field. Collected soil samples were sealed in labeled plastic bags and transported to Louisiana State University for soil characterization. The samples were oven-dried at 30 °C, ground to pass a 2 mm sieve, and then stored for analysis.

3.3 Particle Size Analysis

Sand, silt, and clay percentages were determined using a modified hydrometer method (Gee and Bauder, 1986). Soil samples were over-dried at 105 °C for 24 h. Each sample was then weighed to 50.0 g and mixed with 50 ml of sodium hexametaphosphate [$(NaPO_3)_6$] and approximately 400 ml of deionized water (DI-H_2O) prior to shaking for 2 h to facilitate dispersion. The suspension was then transferred to a 1000 ml cylinder and brought to volume with distilled water. The suspension was mixed for ~ 1 min to ensure that all particles were in suspension. Hydrometer readings were taken at 40 s and 24 h, using a ASTM 152H soil hydrometer. Temperature was also recorded at 40 s and 24 h. Hydrometer readings were adjusted by +/- 0.36 per degree +/- 20 °C to obtain a corrected hydrometer value. The sand, silt, and clay percentages were calculated using equations 3.1-3.3, respectively.

$$\text{Sand \%} = 100 - [(\text{Corrected 40 s} / \text{Original dry sample wt}) * 100] \qquad [3.1]$$

$$\text{Clay \%} = [(\text{Corrected 24 h} / \text{Original dry sample wt}) * 100] \qquad [3.2]$$

$$\text{Silt \%} = 100 - [\text{Sand \%} + \text{Clay \%}] \qquad [3.3]$$

3.4 Organic Carbon %

Organic C percentages were determined following Nelson and Sommers (1996). Soil samples were oven dried at 105 °C for 24 h, then weighed to ~ 3.0 g. Samples were placed in pre-weighed crucibles and oven dried again at 105 °C for 24 h. Samples were weighed again and then placed in a muffle furnace at 550 °C for 4 h. Samples were cooled to room temperature in a desiccator and weighed to determine organic loss. The organic matter % was determined using Equation 3.4 and converted into OC % using Equation 3.5 (Ranney, 1969).

$$\text{Organic Matter \%} = [(OM_{105} - OM_{550}) / OM_{105}] * 100 \qquad [3.4]$$

OM_{105} = Sample weight, oven-dried at 105 °C

OM_{550} = Sample weight, furnace-combusted at 550 °C

$$\text{Organic Carbon \%} = (OM / 1.80) - 0.35 \qquad [3.5]$$

3.5 Soil Reaction and Salinity

The soil reaction (pH) and electrical conductivity (EC) were determined for samples using a saturated paste method according to the Soil Survey Staff (2004). Soil was mixed with deionized water, using a glass stirring rod, until a saturated paste was formed and then allowed to equilibrate for 12 h. Soil pH measurements were made with an Orion 2 Star pH meter (Thermo Scientific, Waltham, MA) that was calibrated with certified buffer solutions of pH = 4, 7, and 10. Electrical conductivity values were measured for samples using a 4063 Traceable® Portable Conductivity Meter (Control Company, Friendswood, TX).

3.6 Available Nutrient Analysis

To identify the quantities of available elements within the soil, an extraction was prepared using Mehlich III reagent (Soil Survey Staff, 2004) known to extract Al, B, Ca, Cu, Fe, K, Mg, Mn, Na, P, S, and Zn.. Soil samples were oven-dried at 105 °C for 24 h. Weighed samples were extracted using the aforementioned solution (Mehlich, 1984). The mixture was shaken for 5 min at 200 RPM and then centrifuged at 2000 RPM for 10 min. The supernatant solution was decanted and filtered into glass tubes. The extracted samples were quantified via inductively coupled plasma atomic emission spectrometry (ICP-AES) (Spectro Citros CCD, model CCD; Spectro Analytical Instruments, Kleve, Germany). The ICP was standardized using a prepared multi-element standard for 12 elements (listed above). Following quantification, the elemental concentrations were obtained using equation 3.6 (Soil Survey Staff, 2004).

3.7 Statistical Analysis

3.7.1 Classical and Geostatistics

Geostatistical analyses, including isotropic variograms and regression coefficients, were conducted using GS^+ 9.0 software (GammaDesign Software LLC., 2008, Plainwell, MI),

$$\text{Element concentration [mg kg}^{-1}] = [A * B * R * 1000] / E, \text{ where} \quad [3.6]$$

A = Sample extract reading (mg L^{-1})

B = Extract volume (L)

R = Air-dry/oven-dry ratio

1000 = Conversion factor to kg-basis

E = Sample weight (g)

software that is used for analyzing spatial variability patterns. The benefit of using geostatistical analyses for spatial and temporal assessment is the increased dependability of the estimation, thus enhancing map quality, by incorporating spatial and temporal information (Zhang et al., 2007). The spatial variation of soil properties within the studied areas were determined by a developed semivariogram. The semivariogram provides the geostatistics necessary for determining the spatial dependence of these soil properties. The spatial dependency (SpD) can be assessed based on the nugget to sill ratios (NS %) in these semivariogram models (Buytaert et al., 2007; Emadi et al., 2008; Kalivas et al., 2002; Wang et al., 2008; Weindorf and Zhu, 2010). A low ratio (< 25 %) suggests a strong SpD of the variable. Furthermore, a high ratio (> 75) represents weak SpD. Semivariogram models provide an r^2 value comparing the semivariance of a specified value with the lag distance, or the literal distance from one point to another. The larger the lag distance, or the farther away the points are from the initial examined point, the higher the semivariance should be. The r^2 value indicates how well the model fits the variogram. An r^2 value of < 0.5 signifies that if you resampled, there is a < 50 % chance the sampled data would correctly fit the determined variogram, implying lower dependability.

A factor analysis was performed using SAS 9.1 software (SAS Institute Inc., 2003a, Cary, NC), software used for basic and sophisticated statistical analyses. The factor analysis evaluates relationships among a number of measureable units by determining correlations among established variables. The factor analysis provides a *common factor* or a *unique factor* (SAS Institute Inc., 2003b). The common factor, or a hypothetical unknown variable, contributes to the variance of two or more observed variables. The unique factor contributes to only one observed value; thus, this data is not included into the study, as it is unrealistic to attempt to determine the cause of an individual value for an unknown factor. Interpretation of unknown factors is a subjective process and can be difficult to accurately determine the correct values.

3.8 Mapping and Interpolation

Arc GIS 9.2 (ESRI, 2006, Redlands, CA, USA) was used for analyzing and manipulating data to produce accurate maps. Semivariogram models were used for geostatistically interpolated prediction maps (kriging). Interpolation techniques including kriging, spline, and inverse distance weighting were utilized in producing spatial and temporal variability maps.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Pasture Site 1(PS1)

4.1.1 Environmental Properties

Pasture Site 1 is managed with a no-till practice, as a way of reducing runoff. Previous studies have shown an inverse relationship for tillage and erosion reduction with increasing vegetation cover and crop residue (Idowu et al., 2002; Kirsch et al., 2002; Moebius-Clune, et al., 2008). A decrease in erosion will limit the amount of nutrient runoff entering water bodies, like Bayou Wikoff. While TSS have been closely monitored at all studied sites as part of other research (Jeong, C.Y., and H.M. Selim, unpublished data, 2009), associated soil physicochemical properties from non-point source fields have been evaluated in this study.

Pasture Site 1 has limited elevation change (< 2 m) across the site, increasing the likelihood of homogenous soil. Clay content was measured as a component of soil texture. Clay percentages at PS1 ranged from 16.72 – 33.44 %, with observed textures of silt loam and silty clay loam (Figure 4.1). A semivariogram model for clay % showed that SpD was weak (r^2 = 0.016), indicating a limited texture change across the landscape (Figure 4.1) (Table 4.1). However, the statistical evidence notwithstanding, a kriged map of clay % shows an overall texture change of increasing clay near the lower elevations of the field, varying < 4 % across the landscape (Figure 4.2). Similarly, Iqbal et al. (2005) determined that areas with natural drainage had soils with higher clay percentages. Increasing clay content has been associated with high soil loss, specifically medium-textured soils (Udeigwe and Wang, 2007). Lado et al. (2004) found that medium-textured soil (loam) resulted in higher amounts of runoff compared to a very high clay content soil.

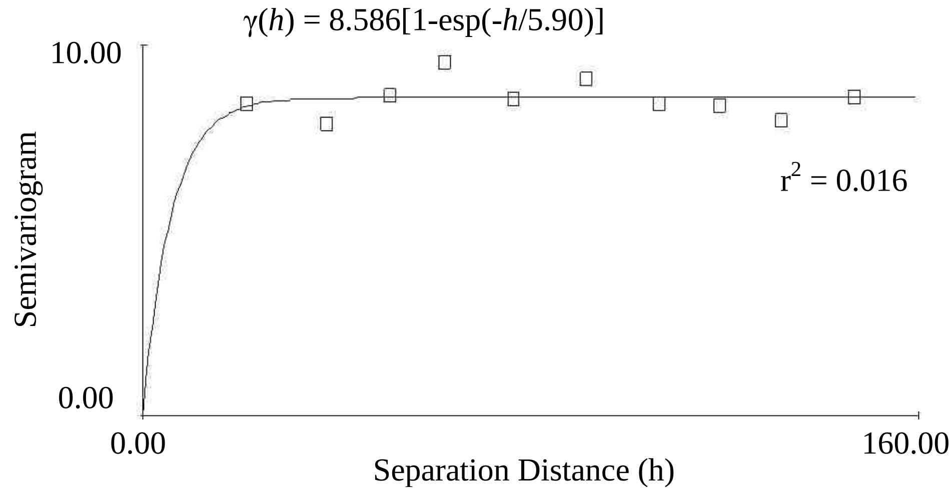

Figure 4.1. Semivariogram for clay % at Pasture Site 1 in St. Landry Parish, Louisiana.

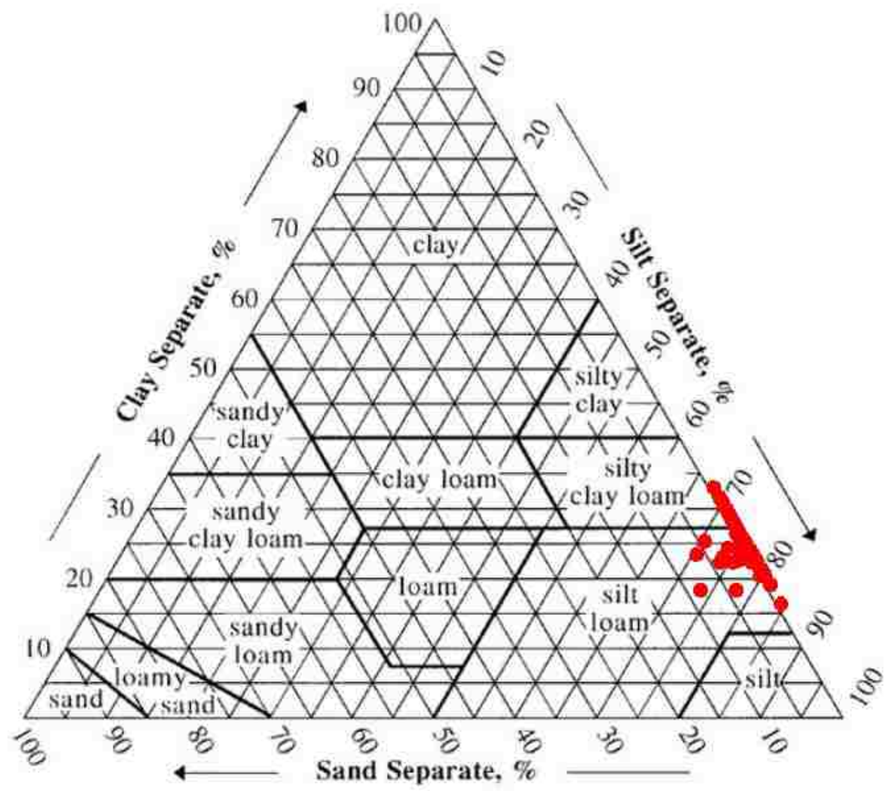

Figure 4.2: Texture distribution at Pasture Site 1 in St. Landry Parish, Louisiana.

Kriging interpolations, used as prediction models, show similar patterns of inverse relationships between decreasing elevation, EC, and pH levels with increasing clay %, P levels, and OC % (Figures 4.3 - 4.5). Soil pH ranged from very acidic to slightly alkaline, with a mean pH of 5.41, or strongly acidic. Spatial dependence for pH was strong for the first sample set (NS % = 8.9). The SpD proceeded to decrease to moderate and then weak for the Jan09 and May09 sampling sets, respectively. The strong SpD for pH is likely directly related to Al concentrations, which will be discussed in a later section. The pH values decreased proportionally with elevation (r^2 = 0.38) (Figure 4.4a). Rodenburg et al. (2003) found that lower pH values occurred where soil runoff was high on soils in Indonesia. Furthermore, they determined that more acidic soils were found in areas of higher P concentrations. Similarly, this present study found nearly significant inverse correlations between pH and P (r^2 = -0.43) (Table 4.2). Weak SpD of P was found for all sampling dates, with r^2 values all below 0.5 (Table 4.1). Fertilizer application prior to sampling dates may have prevented a moderate or strong SpD for P, as application patterns can cause heterogeneity of soil properties (West et al., 1989). Nkedi-Kizza et al. (1994) determined that fertilization increased the spatial variability of P. However, the soils for their study were plowed, which would profoundly increase the SpD (Vieuble-Gonod et al., 2009). Similar to clay models, P prediction models showed an increase of P in areas of lower elevation, with correlation values of r^2 = -0.40. In comparable studies, high P levels were detected in drainage water or areas with waterlogged soils (Djodjic et al., 2000; Sharpley and Rekolainen, 1997; Skaggs et al., 1994). Phosphorus levels ranged from 7.46 to 179.58 mg kg^{-1} with a variance as high as 978.56 (Appendix F). Levels of 0 - 20, 20 - 30, 30 - 40, 40 - 50, and > 50 mg kg^{-1} were categorized as very low, low, optimum, high, and very high, respectively (Figure 4.5) (Sawyer et al., 2008). Phosphorus was also significantly correlated with Fe (r^2 = 0.41) when SpD was higher for Fe. The P is often associated with Fe because both are

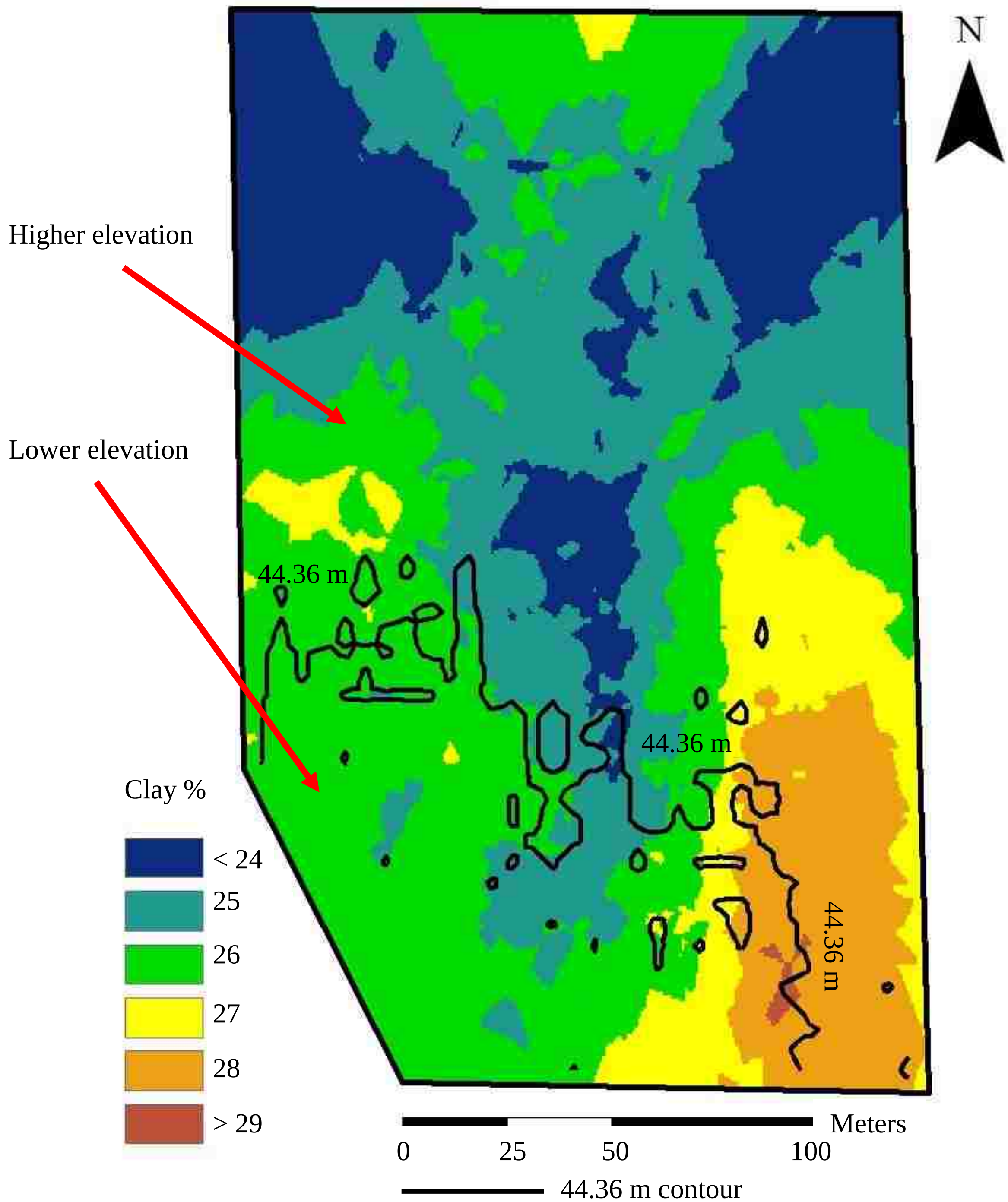

Figure 4.3. Relationships between clay % and elevation at Pasture Site 1 in St. Landry Parish, Louisiana.

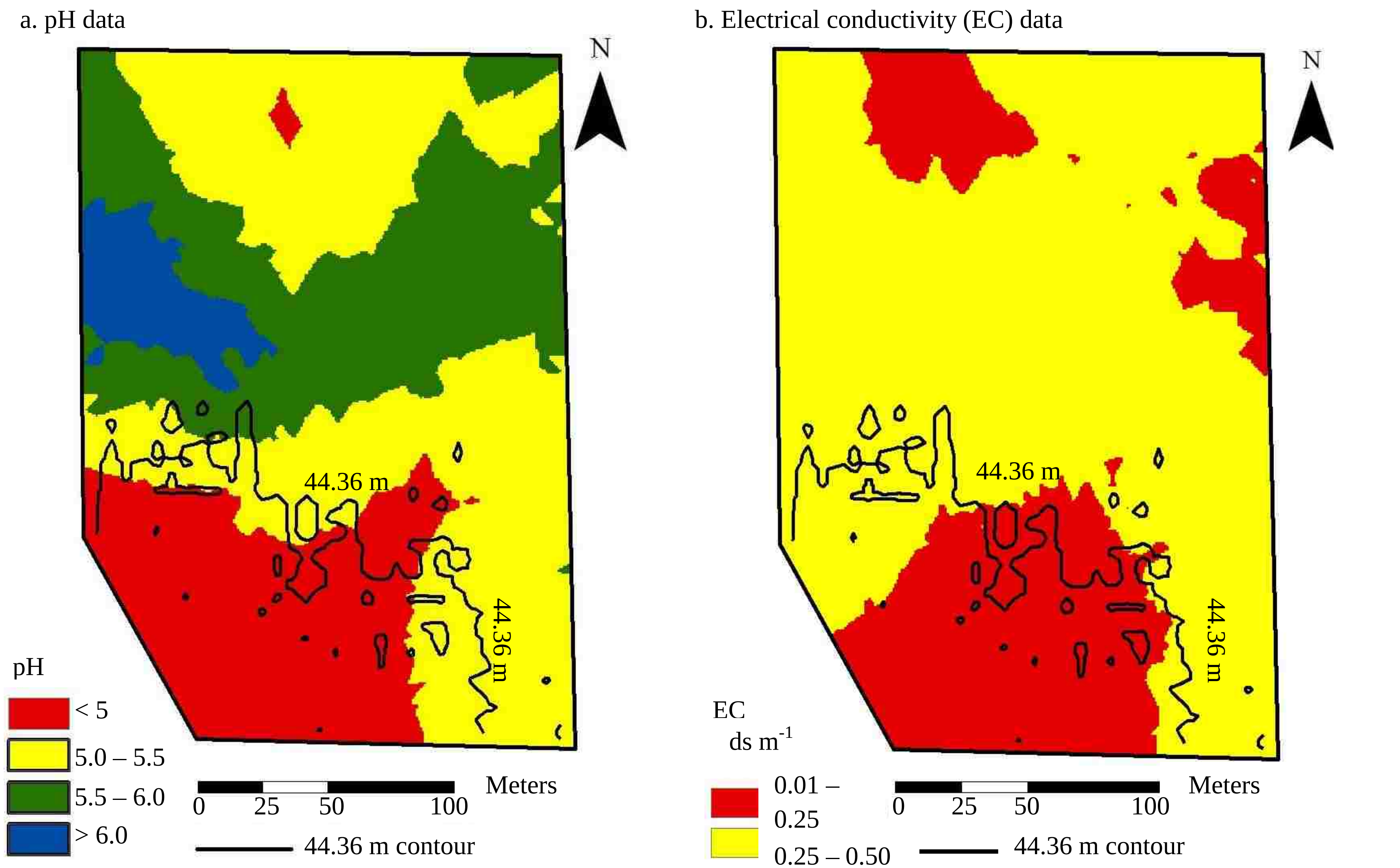

Figure 4.4. Evaluated properties: pH and salinity with relative elevation data for Pasture Site 1 in St. Landry Parish, Louisiana.

Table 4.1. Semivariogram model data for environmental properties at Pasture Site 1in St. Landry Parish, Louisiana.

Date	Variable	Model	Model r^2	Nugget	Sill	Nugget/Sill[a]	Spatial dependency[b]	Effective range[c]
						--%--		--m--
Sept08	Clay %	Exponential	0.016	0.05	8.586	0.6	Weak	53.10
	pH	Spherical	0.985	0.031	0.349	8.9	Strong	109.60
	EC	Spherical	0.958	0.00742	0.01724	43.0	Moderate	143.50
	OC %[d]	Gaussian	0.979	0.165	0.598	27.6	Moderate	329.01
	P	Spherical	0.281	1.2	114.1	1.1	Weak	26.60
Jan09	pH	Gaussian	0.987	0.0835	0.315	26.5	Moderate	178.29
	EC	Exponential	0.467	0.00234	0.01888	12.4	Weak	123.30
	OC %	Exponential	0.088	0.0103	0.1526	6.7	Weak	56.70
	P	Spherical	0.358	0.1	211.1	0.0	Weak	34.40
May09	pH	Exponential	0.169	0.0363	0.3136	11.6	Weak	73.80
	EC	Exponential	0.163	0.00238	0.03046	7.8	Weak	71.10
	OC %	Spherical	0.111	0.0068	0.2916	2.3	Weak	26.60
	P	Exponential	0.257	115	1028	11.2	Weak	85.50

[a]Nugget/sill % = (nugget/sill) *100; [b]Spatial dependency based on strong, moderate, or weak defined by nugget to sill ratios < 25, 25 to 75, or < 75, respectively, and weak if the fitting r^2 < .50 (Duffera et al., 2007; Emadi et al., 2008, and Weindorf and Zhu, 2010); [c]Effective range = model range multiplied by 1.0, 3.0, or 1.73 for spherical, exponential, and Gaussian models, respectively (Duffera et al., 2007; Weindorf and Zhu, 2010); [d]Organic C %.

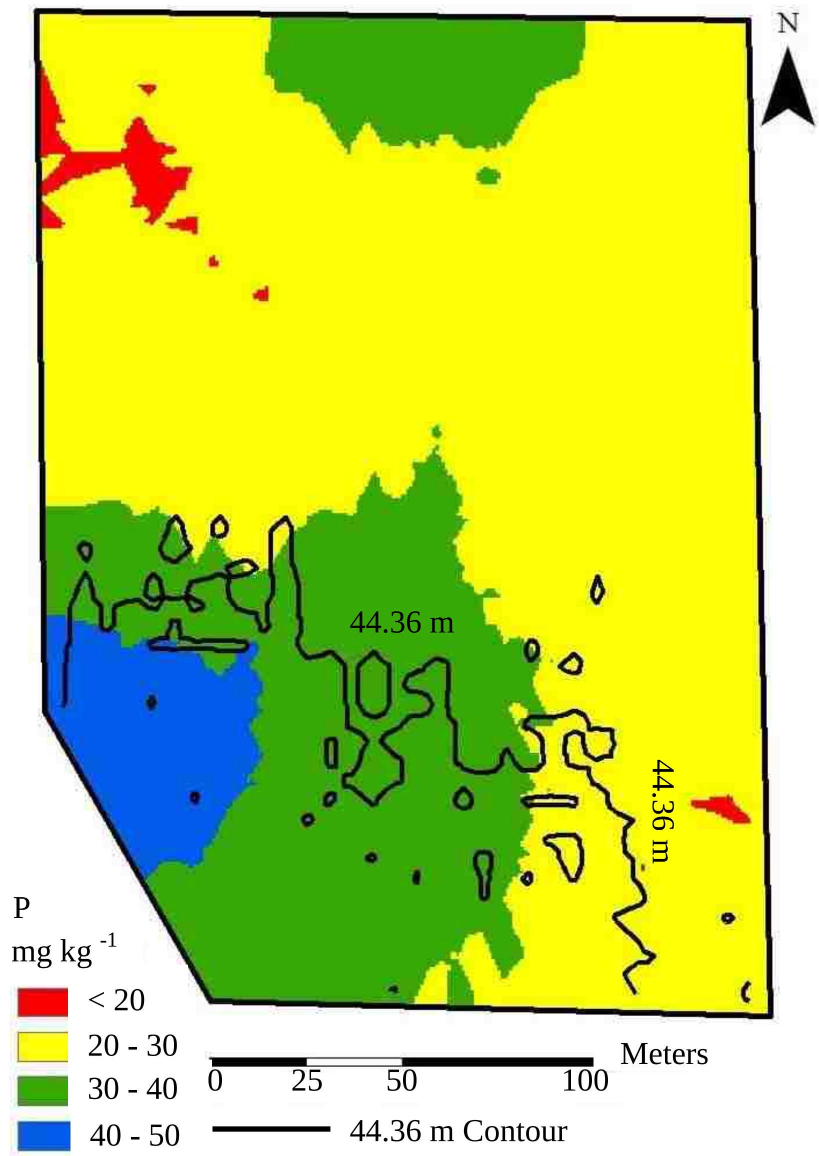

Figure 4.5. Phosphorus levels for Pasture Site 1 in St. Landry Parish, Louisiana.

more available in acidic soils (Tiessen, 2005). Shuman (1988) stated that P increases will cause Fe to become more available. Conversely, Liptzin and Silver (2009) found that P limitations are present with increasing Fe concentrations. Liptzin and Silver theorized that oxidized secondary minerals (Fe) bind with P; thus temporarily inhibiting P uptake for plants and microbes (Sanchez, 1976; Cross and Schlesigner, 1995). Aluminum also reduces the availability of P in the soil (Tiessen, 2005). Conversely, this research determined a general positive, but not statistically significant correlation of Al with P. Prediction maps show proportional trends of Al and P in the lower elevation areas (Figure 4.6). In acidic soils plant uptake of P is primarily in the $H_2PO_4^-$ form, a more available form of P. With increasing available P in acidic soils, the positive correlation of P with Al can be appreciated. Both P and Al had a statistically significant inverse relationship with the pH (r^2 = 0.49 and 0.68, respectively). Soils at PS1 were non-saline. Measured EC values indicated weak to moderate spatial variability across the landscape. However, EC values were too low to quantifiably represent any change (0.15 - 0.92 dS m^{-1}), regardless of spatial variability; they were markedly below the 4 dS m^{-1} EC threshold for saline soils due to high leaching and precipitation. Spatial dependency of OC % was moderate for Sept08, and then weak for Jan09 and May09. Weak spatial SpD is plausible because vegetation and management practices do not vary markedly throughout the site. The moderate SpD found in Sept08 is likely from the grass being cut, baled, and removed from the site. There was a very slight increase (< .05 %) of OC %, possibly from organic residue left from crop harvesting. The area of the field with the lowest OC % (Figure 4.7) generally has less grass, and more weed invasion.

4.1.2 Elemental Nutrients

Macronutrient and micronutrient lab data are available in Appendices D – E. The majority of all macro and micronutrients showed weak to moderate SpD, inferring that there is limited elemental change across the landscape. With soil textures, pH, salinity, and OC % having limited variability, elemental concentrations for macro and micronutrients were expected to be mostly homogenous throughout the field. However, Al showed strong spatial variability (NS % = 22.2). Aluminum oxide clays are prevalent in the southeastern United States, present in

Table 4.2. Correlation values for soil properties at Pasture Site 1 in St. Landry Parish, Louisiana.

	pH	EC	OC	Clay	Al	Ca	Cu	Fe	P	K	Mg	Mn	Na	S	Zn	Elev[a]
pH	1.00															
EC	*0.65	1.00														
OC	-0.04	0.21	1.00													
Clay	-0.10	0.02	-0.08	1.00												
Al	*-0.70	*-0.46	0.01	0.18	1.00											
Ca	*0.76	*0.58	0.11	0.14	*-0.48	1.00										
Cu	0.19	0.11	0.06	-0.03	0.02	*0.47	1.00									
Fe	*-0.71	-0.44	0.13	0.10	*0.80	*-0.56	0.07	1.00								
P	-0.43	-0.16	0.32	-0.02	*0.46	-0.23	0.06	*0.49	1.00							
K	-0.25	0.06	*0.45	0.13	0.35	-0.01	0.19	0.43	0.44	1.00						
Mg	0.31	0.39	0.18	0.29	-0.11	*0.74	*0.45	-0.17	0.03	0.28	1.00					
Mn	*0.67	0.42	-0.11	-0.33	*-0.59	*0.45	0.14	*-0.62	-0.38	-0.30	0.08	1.00				
Na	0.15	0.16	0.19	-0.08	-0.20	0.17	0.29	-0.03	-0.06	0.21	0.08	0.11	1.00			
S	0.16	0.24	0.29	-0.09	-0.12	0.23	0.40	0.04	0.07	0.32	0.18	0.13	*0.93	1.00		
Zn	-0.17	-0.01	0.38	0.07	0.06	0.12	0.35	0.29	*0.62	0.43	0.31	-0.16	0.12	0.22	1.00	
Elev	0.38	0.17	-0.20	-0.30	*-0.56	0.22	0.16	-0.37	-0.40	-0.19	-0.02	0.52	0.27	0.18	-0.02	1.00

[a] Elevation

* Significant at $p > .05$ probability level

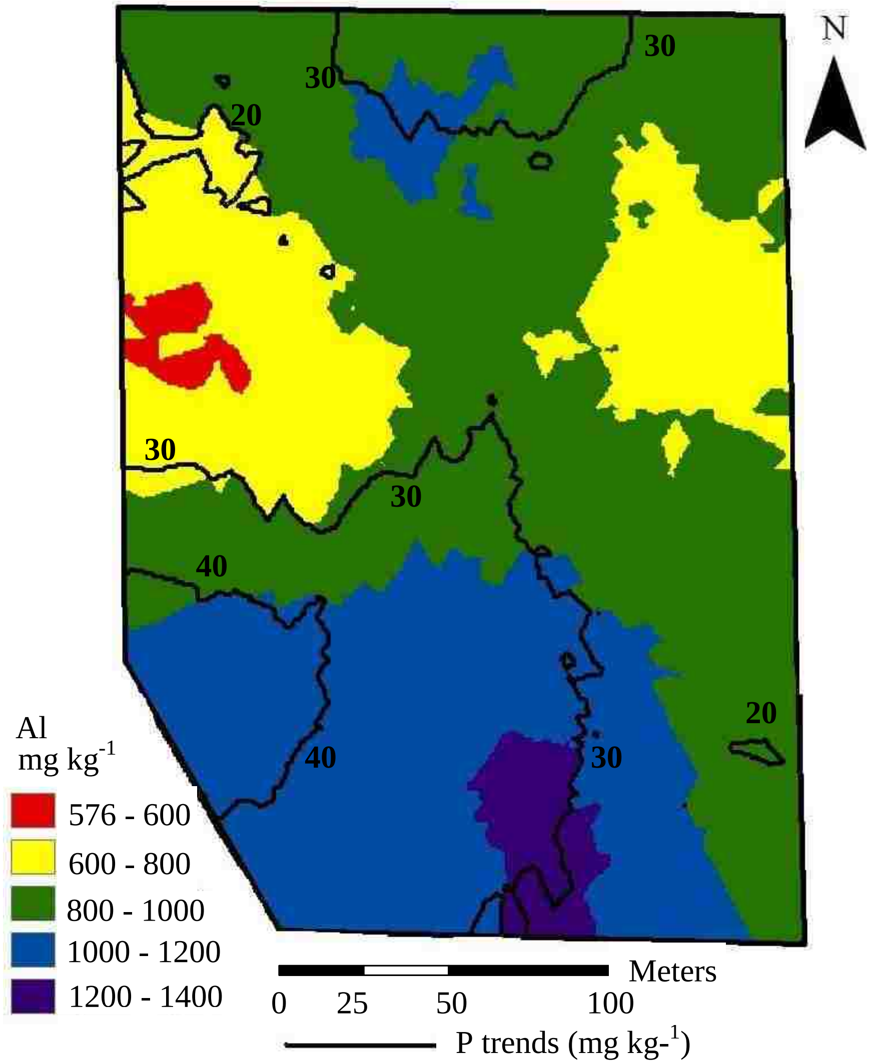

Figure 4.6. Predicted Al distribution with P trendlines for Pasture Site 1 in St. Landry Parish, Louisiana.

Alfisols, and heavily influence the soils in these areas (Brady and Weil, 1999). Predicted models portray Al increasing inversely with elevation (r^2 = -0.56), similar to clay % and pH (Figures 4.3 and 4.4). Soils with low pH (< 4.8) frequently have high amounts of extractable Al (Gerke, 1994; Sparks, 2003). Available Al (Al^{3+}) is bound to negatively charged clay mineral surfaces and soil organic matter; corresponding patterns have been found for this study site (Table 4.2). Wilcke et al. (1998) found significant positive correlations of Al with clay content in slightly acidic Bangkok surface soils.

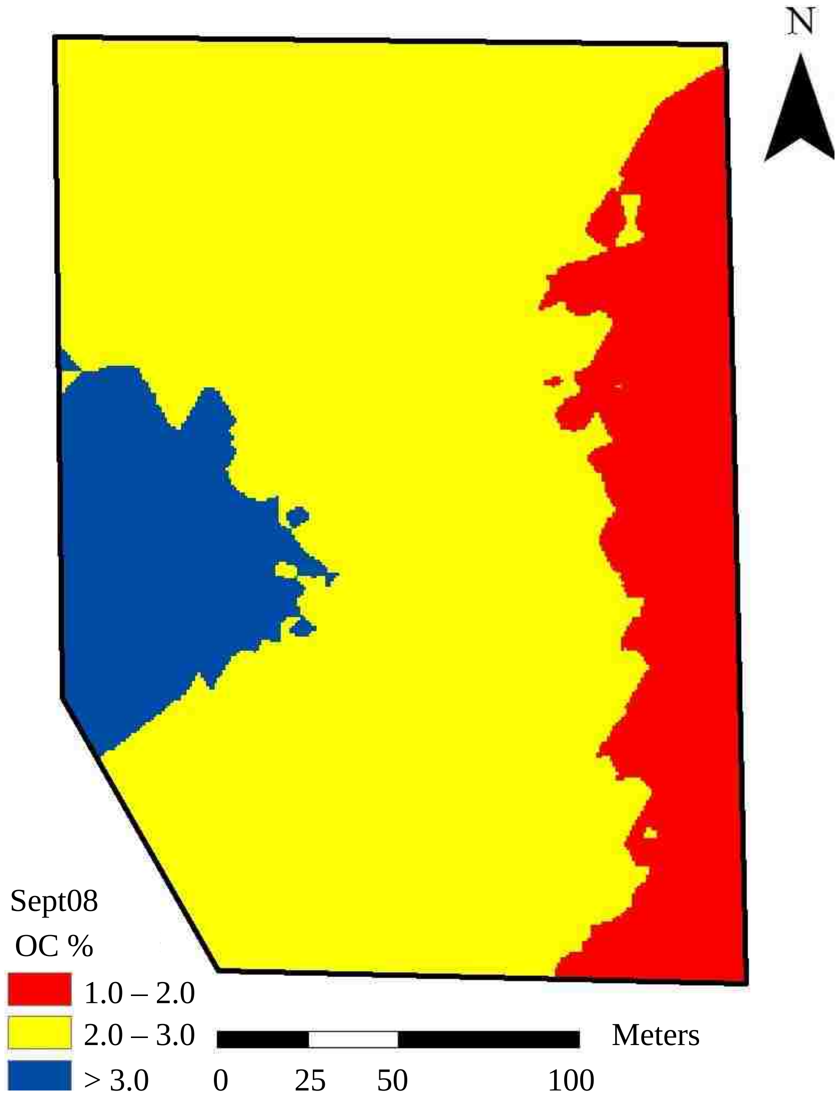

Figure 4.7. Organic C % predictive map for Sept 2008 for Pasture Site 1 in St. Landry Parish, Louisiana.

The vast majority of macro and micronutrients that showed strong SpD appear to be isolated events. Only three elements had more than one sampling date of moderate or high SpD (Appendix G). Furthermore, S and Na were the only elements that had repeating stronger SpD for multiple months. Sulfur and Na were also significantly correlated (r^2 = 0.93). Conflicting research studies show positive and negative correlations between S and Na (Bakr, Weindorf, Bahnassy, and El-Badawi, unpublished data, 2009; Weindorf and Zhu, 2010). The positive correlation in this study cannot be thoroughly explained, although it is possible the increase of S with Na is a result of the latter being almost negligible. Reported values for Na that were below the detectible limit were labeled as *zero*. The large number of "zeros" clearly affects correlation and spatial distribution patterns. Correlation values between S and Na decreased when the non-detectable Na data was not included.

Calcium and Mn showed strong and moderate SpD, respectively, for Sept08. Typically Ca and Mn are inversely related to Al concentrations (Brady and Weil, 1999; Foy, 1984). Noble et al. (1988) found an increase of Ca with decreasing Al on acidic greenhouse soils. Concurrently at this study site, Al concentrations have strong spatial variability and are significantly correlated with Ca and Mn (r^2 = -0.48, -0.59, respectively). The stronger spatial variability of Ca and Mn is dependent on the Al concentrations. As can be expected, Ca and Mn also are significantly correlated with pH (r^2 = 0.76 and 0.67, respectively) and Fe (r^2 = -0.56 and -0.62, respectively), which are all influenced by soil acidity.

The SpD for Fe ranged from weak to strong. The moderate SpD for Fe, in Sept08, can be explained by the highly significant correlation of Fe with Al and pH (r^2 = 0.80 and -0.71, respectively), for aforementioned reasons. Extensive research has found comparative relationships of Fe with Al and inversely with pH and Ca (Li et al., 2007; Poulton and Raiswell, 2005; Wen et al., 2008). Molot and Dillon (2003) found highly significant inverse correlations between Fe and pH, with r^2 = -0.77. They also show correlation coefficients of Fe with Al as r^2 = 0.91, indicating a positive relationship between Al and Fe, and inverse of Fe and Al with pH.

Several macro and micronutrients (Cu, K, Mn, and Zn), which do not typically show troubling symptoms at this site, showed weak SpD. The lack of SpD for K is likely due to uniform fertilizer application. Copper, Mn, and Zn all have non-toxic elemental concentrations, so homogeneity or heterogeneity is irrelevant for this study.

A factor analysis using SAS concluded that two prevailing factors were influencing significant correlations for all sampling three dates. Factor one, determined to be elevation, had positive correlations with pH, Ca, and Mg, and inverse correlations with Al and Fe (Table 4.3). This is further indication of the influence of elevation on the spatial variability of soil properties. Factor two, an undetermined factor, shows significant correlations of EC, P, and S. Factors one and two account for ~ 44 % of the total variance of measured soil properties. All variables except EC, P, and S (all from factor two) were located in a small area on the plot, showing a common source of variation (Figure 4.8).

A temporal study was also conducted as a part of this research. Generally most soil variables changed between sampling dates (Table 4.4), indicating that the respective variables (denoted by a "*" in Table 4.4) are not consistent over time. Changes between September and January are most likely due to high rainfall, as these fall and winter months received among the highest precipitation during the entire study, with a monthly average of ~160 cm (Louisiana Office of State Climatology, 2009). Temporal changes between January and May are likely a result of additional rainfall, but also a fertilizer factor, as fertilizer was applied in late April, within weeks of the final sampling date.

General conclusions for this site include an overview of spatial and temporal variability of micronutrients, macronutrients, and environmental soil properties. Classical statistics provided a temporal view of the data, and this research determined that most variables were statistically different across the landscape between sampling dates. This indicates that individual parameters are changing temporally, and can be monitored using the spatial analysis. High SpD was limited to related, yet not necessarily environmentally important factors. Spatial dependency for P was weak for all sampling dates, indicating that P is consistently homogenous

Table 4.3. Factor analysis for Sept 2008 soil samples at Pasture Site 1 in St. Landry Parish, Louisiana.

Property	Factor 1	Factor 2	Factor 3	Factor 4
pH	*0.87	-0.21	-0.13	0.04
EC	0.44	*0.79	-0.08	0.06
OC	0.09	0.43	*0.58	-0.17
Clay	-0.10	0.03	0.45	*0.68
Al	*-0.81	0.06	0.07	0.13
Ca	*0.87	-0.03	0.28	0.17
Cu	0.11	0.07	-0.04	0.29
Fe	*-0.82	0.28	0.13	-0.09
pH	-0.19	*0.80	0.14	0.01
K	-0.07	-0.28	*0.79	-0.29
Mg	*0.58	-0.11	*0.62	0.25
Mn	*0.69	0.16	-0.45	-0.16
Na	0.27	-0.08	0.38	*-0.63
S	0.21	*0.90	-0.02	-0.07
Zn	0.05	0.14	0.28	0.03

* Significant at p > .05 probability level

across the field. Clay content was also weakly spatially dependent, as the texture was consistently silt loam or silty clay loam. Organic C had an isolated moderate SpD for Sept08, occurring because of crop residue accumulation after harvest. The pH values had higher SpD, and this is most likely due to Al content, a variable which also had strong SpD. Strong SpD for most micronutrients (except of Al) appears to be an isolated event, not generally related to any cause. The primary environmental concern at PS1 was the P levels, clay content, and organic C. All three of these factors were weakly spatially dependent, but predictive maps and significant correlations showed an influence of elevation on each of them. The lower elevation allowed for the accumulation of clays, thus promoting an increase in P and OC % in these areas. Furthermore, a factor analysis provided a statistical conclusion that if indeed factor one correlations are caused by elevation, topographical relief plays a role in the spatial variability

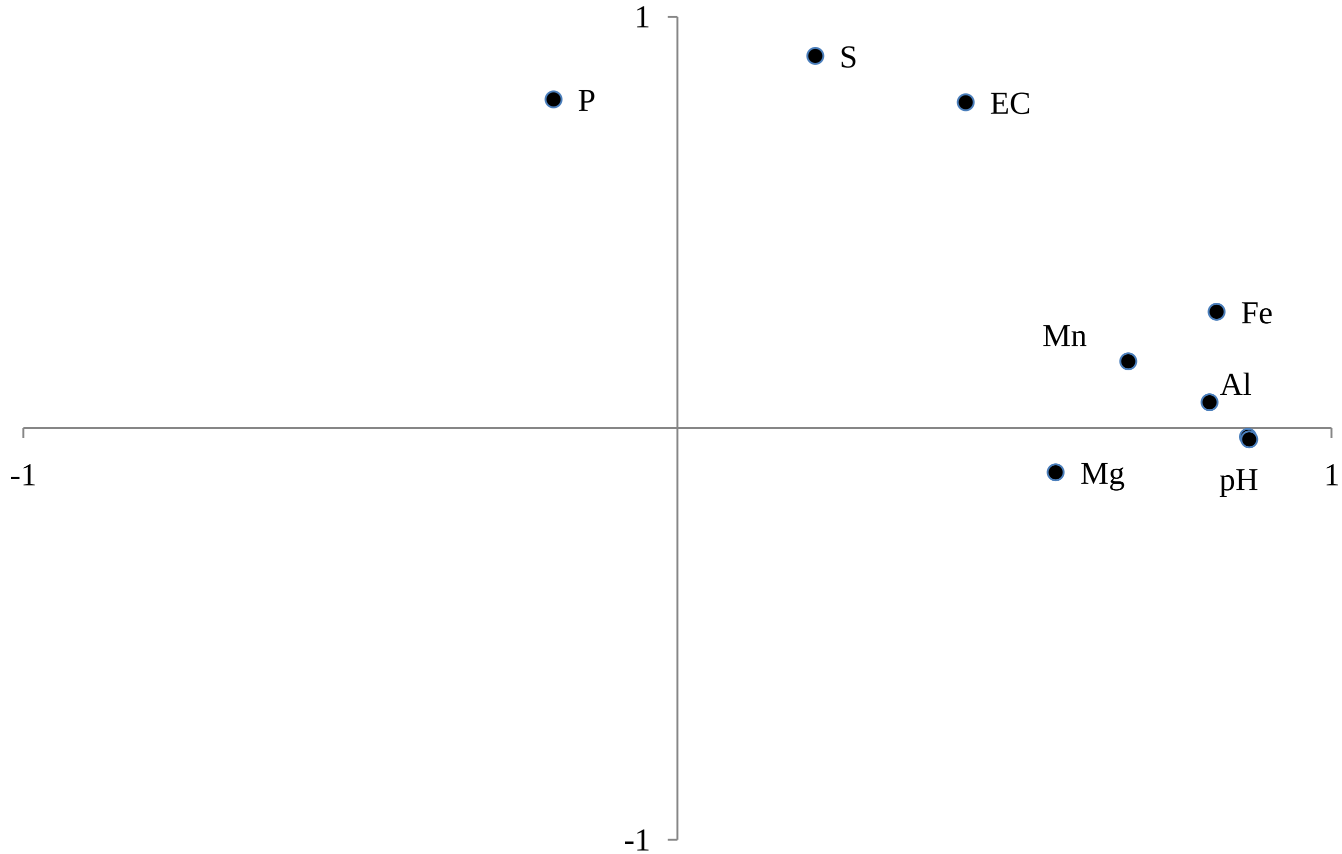

Figure 4.8. Statistical plot of factors one (x axis) and two (y axis) for Sept 2008 soil samples, illustrating a correlation pattern of significant factors at Pasture Site 1 in St. Landry Parish, Louisiana.

Table 4.4. Temporal significance data for Pasture Site 1 in St. Landry Parish, Louisiana.

Variable	Date 1	Date 2	P > .05 Value
pH	Sept08	Jan09	*0.00
	Jan09	May09	0.15
EC	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
OC	Sept08	Jan09	0.30
	Jan09	May09	*0.00
Al	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
Ca	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
Cu	Sept08	Jan09	0.27
	Jan09	May09	0.45
Fe	Sept08	Jan09	*0.00
	Jan09	May09	0.17
P	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
K	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
Mg	Sept08	Jan09	*0.00
	Jan09	May09	0.31
Mn	Sept08	Jan09	*0.00
	Jan09	May09	0.33
Na	Sept08	Jan09	*0.00
	Jan09	May09	*0.04
S	Sept08	Jan09	*0.00
	Jan09	May09	*0.00
Zn	Sept08	Jan09	0.14
	Jan09	May09	0.47

* Significant at p > .05 probability level

on several soil properties. Due to the close proximity of the lowest spot of the landscape to Bayou Wikoff, the aforementioned soil properties could easily be transferred into the water system, degrading water quality.

4.2 Pasture Site 2 (PS2)

Pasture Site 2 has similar features as PS1, including identical management practices and comparable soils. Soil property correlations are provided in Table 4.5 and classical statistics are

Table 4.5. Correlation values for soil properties at Pasture Site 2 in St. Landry Parish, Louisiana.

	pH	EC	OC	Clay	Al	Ca	Cu	Fe	P	K	Mg	Mn	Na	S	Zn
pH	1.00														
EC	0.35	1.00													
OC	0.19	0.39	1.00												
Clay	*0.46	0.37	0.42	1.00											
Al	-0.30	-0.02	0.13	0.26	1.00										
Ca	*0.79	*0.48	0.43	*0.71	-0.10	1.00									
Cu	0.27	0.32	0.26	0.41	0.13	0.44	1.00								
Fe	*-0.60	-0.13	0.04	-0.31	0.19	*-0.55	-0.15	1.00							
P	-0.17	0.18	0.21	-0.16	-0.18	-0.07	-0.01	0.14	1.00						
K	0.10	0.18	0.43	0.24	0.16	0.14	0.14	0.16	0.06	1.00					
Mg	0.39	0.39	*0.56	*0.62	0.22	*0.57	*0.47	-0.17	-0.01	*0.53	1.00				
Mn	0.44	0.22	-0.10	0.12	-0.27	0.26	0.03	*-0.54	-0.02	-0.19	0.05	1.00			
Na	0.03	0.02	0.11	0.06	-0.02	0.04	0.15	-0.23	0.05	0.22	0.36	-0.02	1.00		
S	0.29	*0.54	0.38	0.32	-0.22	*0.49	0.24	-0.19	0.42	0.17	0.35	0.29	0.13	1.00	
Zn	0.05	0.31	0.40	0.06	0.08	0.13	0.20	0.27	*0.45	0.15	0.17	-0.04	-0.15	0.17	1.00

* Significant at p > .05 probability level

provided in Appendix F. Conversely, the spatial distribution of the soil properties at PS2 is greatly affected by artificial swales, approximately 18 m apart. These swales are used for facilitating water distribution across the field. However, an accumulation of water in the lower elevations (swales) is causing high amounts of clays and organic matter to accrue and be transported into nearby waterbodies (Johnson et al., 2009). Swales and agricultural ditches are linked to local streams, bayous, and eventually larger rivers and into the Gulf of Mexico, establishing a direct pathway for sediment and toxic nutrients into these waterbodies (Blanco-Canqui et al., 2004; Vadas and Sims, 1998; Vaughan et al., 2007). Vaughan et al. (2007) determined that high concentrations of P were accumulating in agricultural surfaces in drainage ditches on silt loam soils in Maryland. Three properties (clay %, OC %, and pH) were extensively evaluated to determine the effect of swales for each, respectively (Table 4.6). All three properties were inversely proportional to elevation; as elevation decreases (swales), pH, clay content, and OC % increase. Moreover, the lowest portions of the field (north and western areas) have an overall increase of clay content (Figure 4.9) and OC % and an inverse relationship with pH values, when compared to the southern and eastern sections of the field. Increasing clay % in the swales was further assessed to determine the source. Possibly, clay could be increasing as it moves across the soil surface into the swales as colloidal clay traveling in suspension with water, depositing with elevation relief. However, the Soil Survey Staff (1986) describes all soil series at this site as having an argillic horizon. Theoretically, it is possible that the increase of clay in the swales was a result of exposed argillic horizons. Typical pedons in this area have increasing clay content and decreasing OC % with depth. Thus, subsurface soil cores were sampled to establish the role of the argillic horizon with respect to clay %. Clay content increased proportionally with OC %, indicating that the clays were indeed moving across

Table 4.6. Correlation table for selected properties at Pasture Site 2 in St. Landry Parish, Louisiana

	Clay %	OC %	pH	Elevation
Clay %	1			
OC %	*0.663	1		
pH	0.42	0.399	1	
Elevation	-0.61	*-0.635	-0.32	1

* Significant at p > .05 probability level

the landscape in suspension with water.

Spatial variation at PS2 showed similar SpD trends as PS1. However, one important difference was clay content distribution across the landscape. At PS1, clay was weakly SpD. However, at PS2, clay content was strongly SpD, likely a result of the swale formations. Similar to PS1, other properties were strongly correlated with clay content, and also were found to have moderate to high SpD (Appendix G).

An extensive comparison of interpolation methods was also included in this research for PS2. Spline and kriging methods were compared for accuracy (Figure 4.9) for three soil properties: clay %, OC %, and pH. Kriging interpolation provided more applicable estimates of clay % versus spline, which overestimated clay % in some areas across the field (Figure 4.10). Similar patterns were found for OC % and pH values (Figure 4.9). Both interpolation techniques required the incorporation of topography data prior to estimating each soil property. This was not necessary at PS1 because the influence of elevation was indistinct at that site. However, with the distinct swale patterns affecting the entire landscape, it is necessary to integrate elevation data by merging a digital elevation model (DEM) with the respective soil property. Elevation

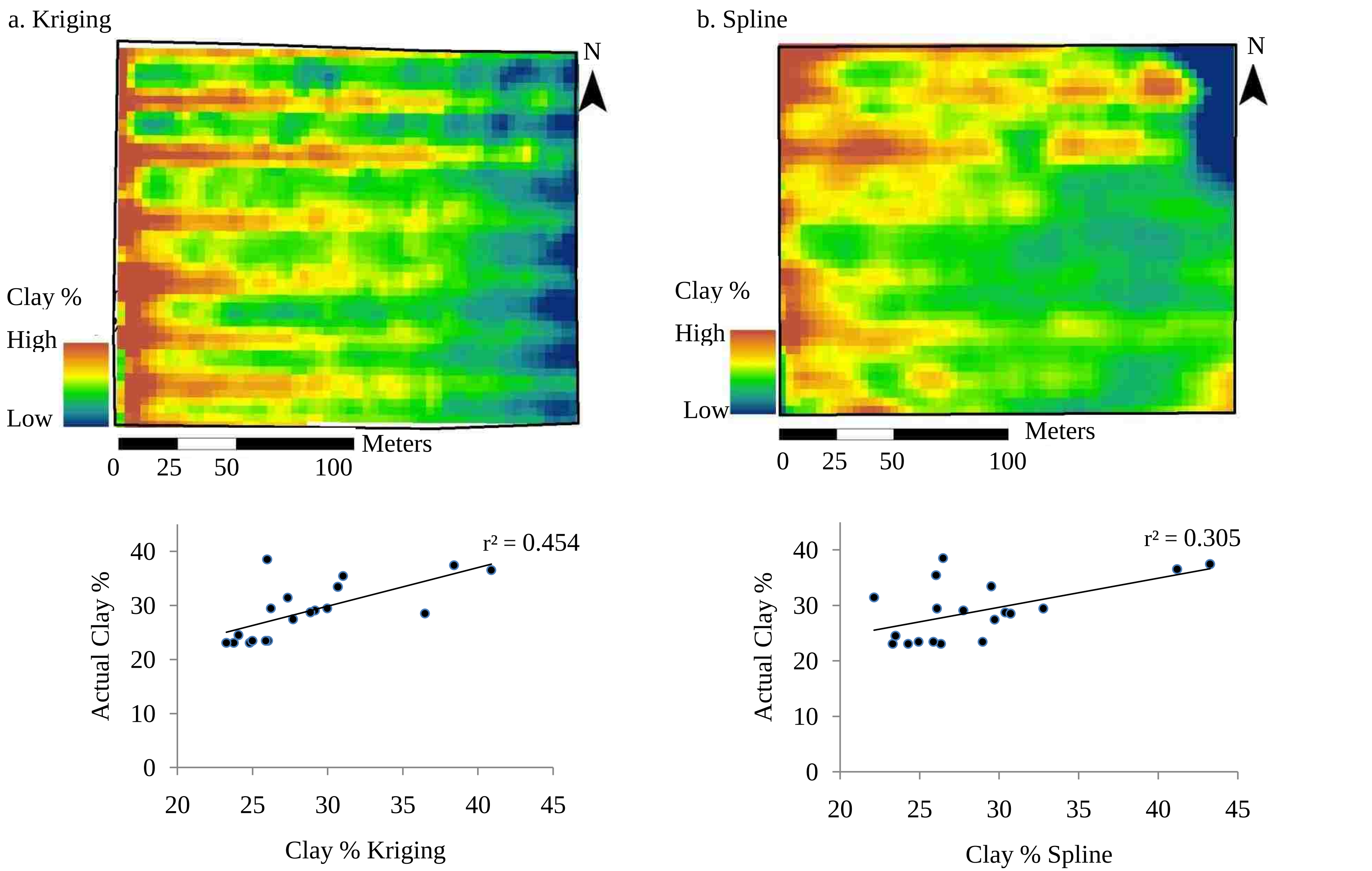

Figure 4.9. Kriging and spline interpolation and correlation graph of clay content, respectively, at Pasture Site 2 in St. Landry Parish, Louisiana.

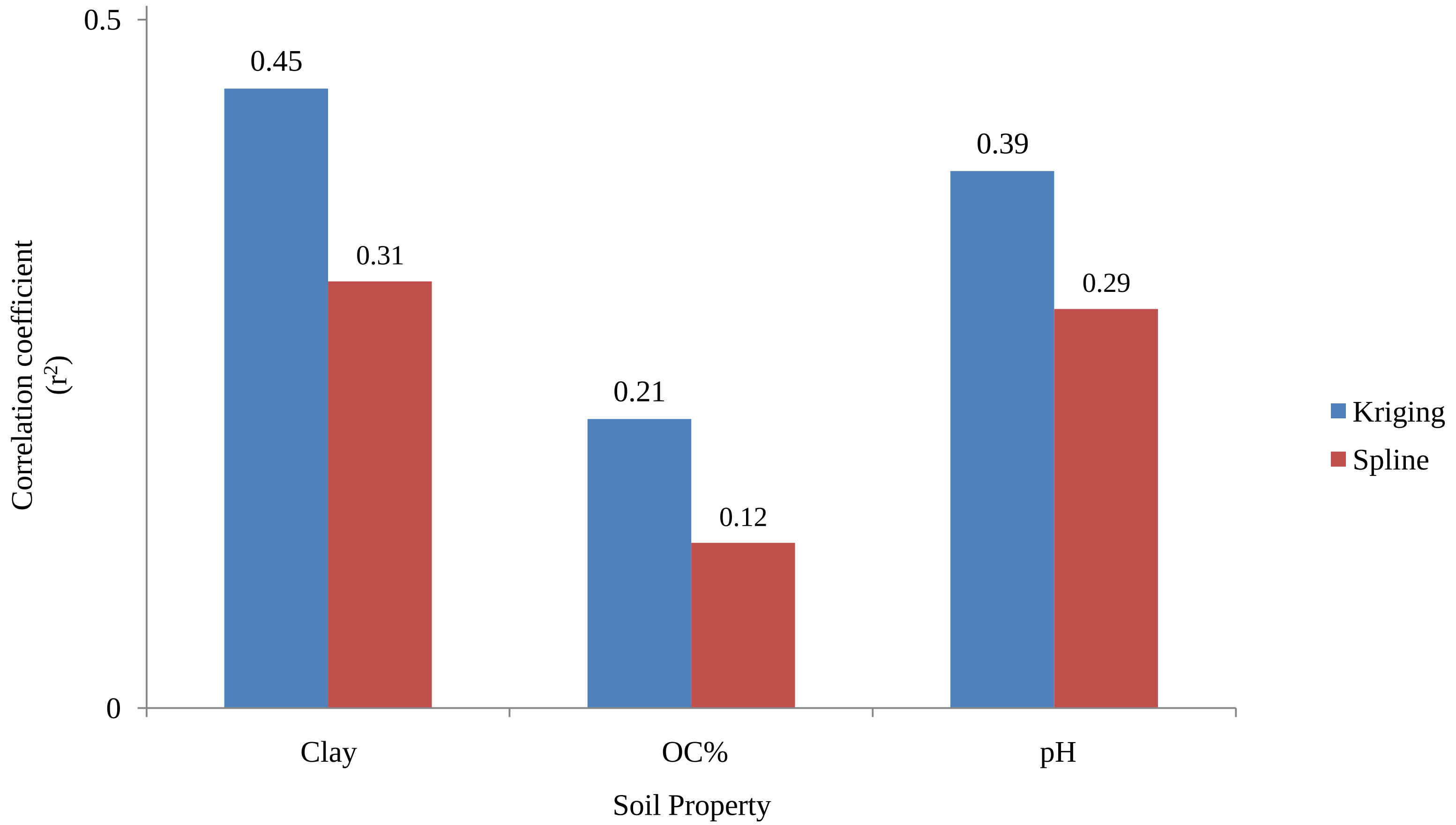

Figure 4.10. Correlation coefficients for evaluated soil properties at Pasture Site 2 in St. Landry Parish, Louisiana.

data was incorporated for the prediction maps in Figure 4.9. A comparative study was evaluated including and excluding the extracted elevations (Figure 4.11).

Similar to PS1, elevation plays an important role on the spatial distribution of soil properties at PS2. However, aforementioned research from this study concluded that it is necessary to include topographical data for interpretation. Similarly, the elevation data must be included as a variable to produce an accurate factor analysis. However, because the elevation data is only extracted from a DEM and therefore not exact, the elevation data cannot be included as a primary factor. Consequently, it is impractical to use a factor analysis at this site.

4.3. Pristine Site

Pristine Site, a tree farm, is used as a control site for water quality monitoring. This site receives no commercial fertilizer; therefore, it is beneficial for monitoring how soil runoff is affecting the adjacent bayou. However, from a spatial aspect, this site is less useful. Numerous varieties of tree species are found randomly placed and spaced throughout the farm; ie: a Magnolia tree could be planted next to a Pine tree. The large variety of species increases factors for spatial variance. Generally, the same selective properties (clay %, OC %, Ca, and Mg) were found to be moderately to highly SpD for the first two dates (Appendix G). However, for May09, SpD was strong for the majority of examined variables (Figure 4.12). Speculation can conclude that the increase of SpD is a result of a change across the landscape, most likely physical, as again, no commercial fertilizers are applied. Because this is a tree farm, additional foreign soil is added to the surface when a tree is removed or planted, or as needed. This additional soil could be a major cause for spatial heterogeneity, as foreign soil likely has different physical and chemical properties than the native soil. Forage type is also different at this site; PS1 and PS2 have a bermudagrass cover, and PR has St. Augustine grass. A difference

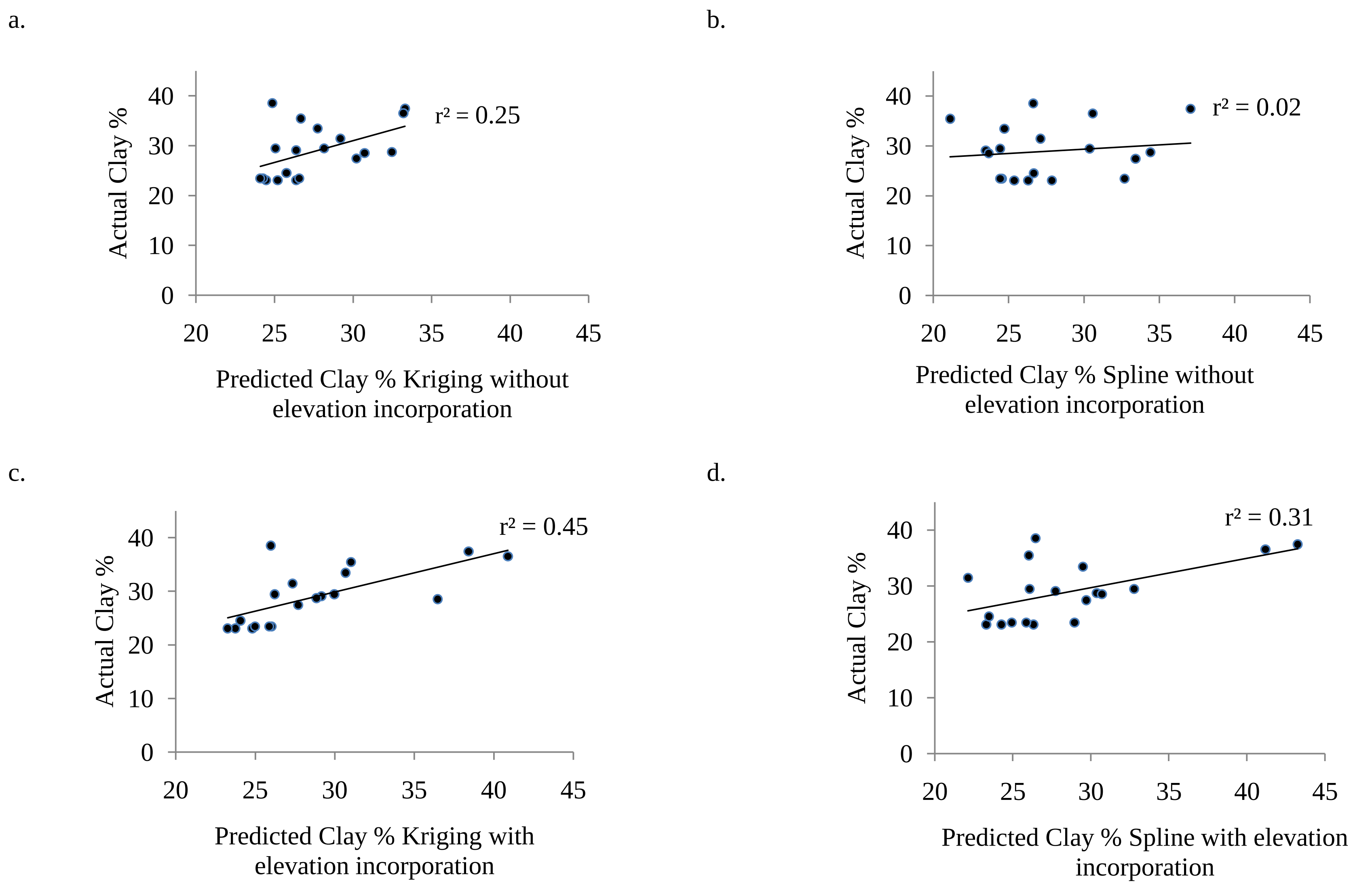

Figure 4.11. Correlation coefficients illustrating the effect of elevation on two different interpolation techniques at Pasture Site 2 in St. Landry Parish, Louisiana.

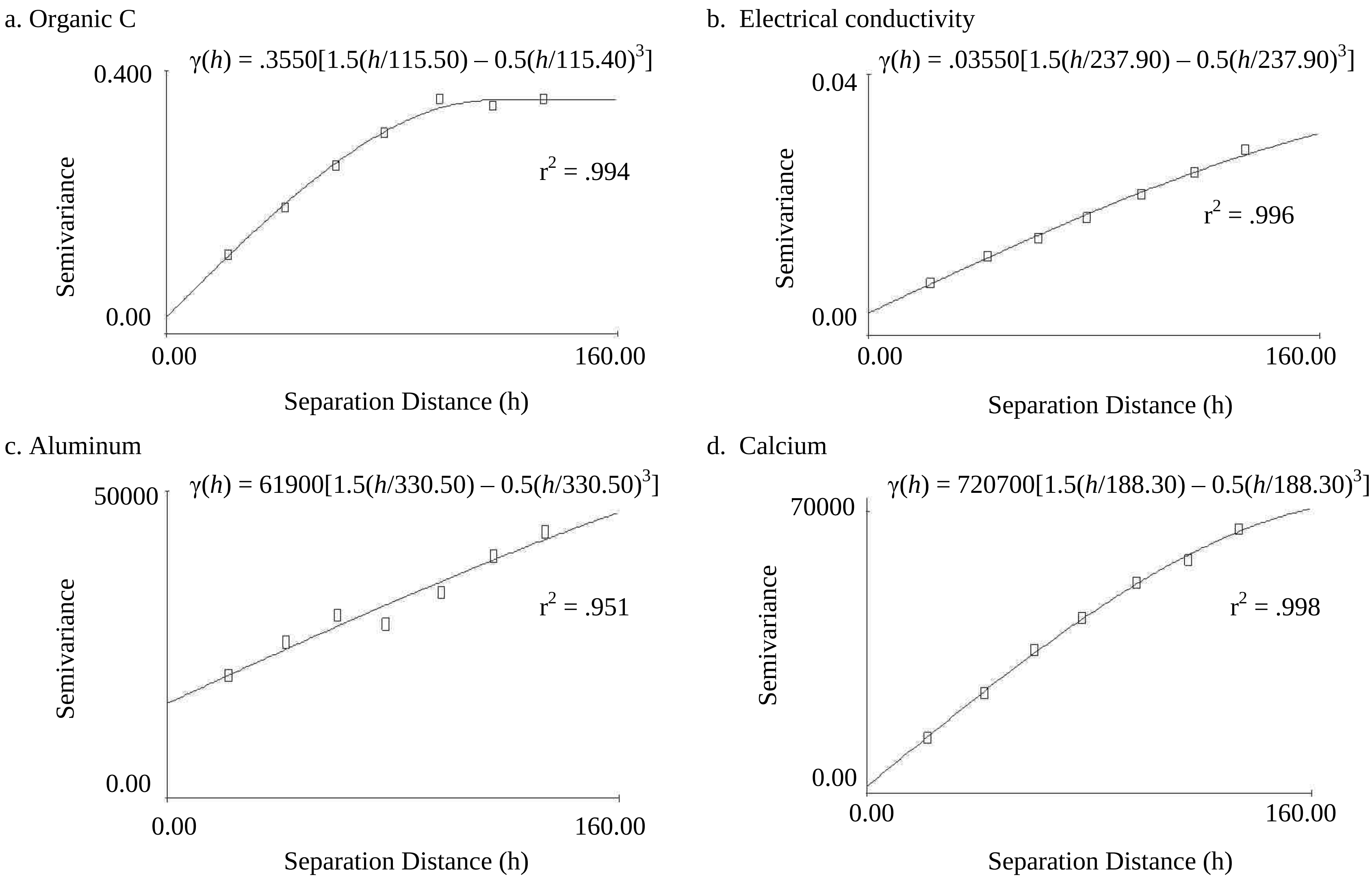

Figure 4.12. Variogram models for examined soil properties at Pristine Site in St. Landry Parish, Louisiana.

in grass type could change the organic C content. Similar to PS1, P levels at PR were also weakly SpD. However, this is a result of no additional P to the site.

Classical statistics showed that the soil had typical properties, with soil textures as silt loam and silty clay loam (Appendix F). Organic C % was compared among all three sites using a paired t-test. Results produced a p value of 0.29 (greater than 0.05), indicating that there is no difference between OC % of all three sites. The pH values were significantly different ($p = .00$) at PR than the other sites, while there was no difference between EC levels ($p = .50$). Nutritient data was also evaluated using the same method. Results indicated a majority of all nutrients were statistically different from the other sites, including P ($p > .05$). At PR, mean P levels were ~14 mg kg^{-1} below the other two sites on average, an indication of the value of a control site.

A factor analysis was also impractical for PR. Due to an unknown amount of variables affecting the spatial variability of the soil, it is difficult to pinpoint an exact cause of SpD, and elevation is not a likely source of variance.

CHAPTER 5
CONCLUSIONS

Water quality is major concern in surface waters of Louisiana. Locating and quantifying a general source is beneficial for limiting pollution. High density soil analysis provides an in-depth look at small scale landscapes. Soil surface samples were collected at three sites to determine spatial and temporal variability as a component of ongoing water quality research at Bayou Wikoff in St. Landry Parish, Louisiana.

A grid scheme was developed for collection and samples were geolocated and analyzed for physiochemical properties to create and manage predictive maps used for spatial and temporal analysis. Physical and chemical analysis determined that all properties were typical for the soil type, landscape, and location.

A spatial evaluation of soil physicochemical properties indicated that the soil properties had little variation. Most soil properties showed weak SpD, indicating homogeneity, with the exception of Pristine Site (PR). Soil texture, specifically clay content, was evaluated and showed little to no change across the landscape at Pasture Site 1 (PS1) and PR sites. However, Pasture Site 2 (PS2) showed strong SpD due to artificial swales installed for facilitating water distribution across the pasture. These swales accumulate water, as well as high amounts of clay, organic matter, and nutrients detrimental to water quality. The PR has high SpD for many evaluated soil properties, but because of numerous unknown factors affecting the spatial variability, it is not possible to predict the source of high SpD.

Temporal studies revealed that most of the sites had significant changes for individual soil properties across the landscape. However, classical statistics revealed that these changes were still not above destructive limits for water quality standards. Pristine Site, considered the “control” site for the study, was compared with PS1 and PS2, and found significant differences in soil properties between sites.

Spatial and temporal analysis shows that while there are many variables with high SpD, several of these soil properties were still well below EPA standards for water quality. Pasture Site 1 and PS2 are indicative of the topographic influence on soil spatial variability. Areas of low elevation should be monitored closely to prevent further pollution into surface waters, like Bayou Wikoff.

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APPENDIX A
OFFICIAL SOIL SERIES DESCRIPTIONS

Official Soil Series Descriptions are provided by the NRCS-USDA (Soil Survey Staff, 2009a).

FROST SERIES

The Frost series consists of very deep, poorly drained, slowly permeable soils that formed in silty alluvium or loess. These soils are in broad depressional areas and in drainage ways on late Pleistocene age terraces. Slope is dominantly less than 0.5 %, but it ranges to 1 % along narrow drainage ways.

Taxonomic Class: Fine-silty, mixed, active, thermic Typic Glossaqualfs

Typical Pedon: Frost silt loam on a 0.5 % slope, in cropland. (Colors are for moist soil unless otherwise stated.)

Ap1--0 to 15 cm; grayish brown (10YR 5/2) silt loam; weak medium granular structure; very friable; many fine and medium roots; very strongly acid; clear smooth boundary.

Ap2--15 to 25 cm; grayish brown (10YR 5/2) silt loam; weak medium granular structure; friable; many fine and medium roots; common coarse rounded Fe-Mn concretions throughout; few fine and medium prominent yellowish brown (10YR 5/6) masses of Fe accumulation throughout; slightly acid; clear wavy boundary. (5 to 31 cm thick)

Eg—25 to 56 cm; light brownish gray (10YR 6/2) and gray (10YR 6/1) silt loam; weak medium subangular blocky structure; friable; many fine and medium roots; common medium rounded Fe-Mn concretions throughout; neutral; gradual irregular boundary. (15 to 64 cm thick)

Btg/E--56 to 91 cm; 80 % grayish brown (10YR 5/2) silty clay loam (Bt part); weak coarse prismatic structure parting to moderate medium subangular blocky; very firm; common fine and medium roots; thin discontinuous faint clay films on faces of peds; common medium rounded

Fe-Mn concretions throughout; few fine distinct dark yellowish brown (10YR 4/4) masses of Fe accumulation throughout; many fine and medium faint light brownish gray (10YR 6/2) Fe depletions throughout; about 20 % vertical intrusions of light gray (10YR 7/2) silt loam albic material (E part); strongly acid; gradual wavy boundary. (5 to 38 cm thick)

Btg1--91 to 127 cm; light brownish gray (10YR 6/2) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; many fine and medium discontinuous tubular pores; common discontinuous prominent dark gray (10YR 4/1) clay films on faces of peds; common medium rounded Fe-Mn concretions throughout; few medium distinct yellowish brown (10YR 5/6) and few coarse faint brown (10YR 4/3) masses of Fe accumulation throughout; common discontinuous distinct white (10YR 8/1) clay depletions on faces of peds; moderately acid; gradual wavy boundary.

Btg2--127 to 160 cm; light brownish gray (10YR 6/2) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; many fine and medium discontinuous tubular pores; common discontinuous distinct dark gray (10YR 4/1) clay films on faces of peds; common medium rounded Fe-Mn concretions throughout; many medium distinct light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/6) masses of Fe accumulation throughout; strongly acid; clear smooth boundary.

Btg3--160 to 201 cm; light brownish gray (10YR 6/2) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; friable; many fine and very fine pores; thin discontinuous distinct clay films on faces of peds and along pores; common medium dark colored rounded Fe-Mn concretions throughout; many medium distinct light yellowish brown (10YR 6/4) and prominent yellowish brown (10YR 5/6) masses of Fe accumulation throughout; slightly acid (combined thickness of the Btg horizon is 51 to more than 102 cm).

2Btg--201 to 272 cm; light brownish gray (2.5Y 6/2) clay loam; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; many distinct patchy pressure faces on faces of peds; common coarse rounded Fe-Mn concretions throughout; many coarse prominent yellowish brown (10YR 5/6) masses of Fe accumulation throughout; few fine and medium prominent red (2.5YR 4/8) Fe accumulations throughout; neutral; gradual wavy boundary.

2C--272 to 297 cm; yellowish red (5YR 5/6) loam; massive; friable; neutral.

Type Location: Acadia Parish, Louisiana, about ~6.5 km northwest of Church Point, La., ~30 m west of LA Hwy. 751; ~550 m north and ~107 m west of the southeast corner of sec. 3, T. 7 S., R. 2 E.; United States Geological Survey (USGS) Church Point, LA, 7.5 minute topographic quadrangle; 30 degrees 28 minutes 14 seconds N. Latitude, 92 degrees 14 minutes 42 seconds W. Longitude, NAD 83.

Range in Characteristics: Solum thickness ranges from 102 to 203+ cm. Depth to the discontinuity ranges from 102 to 203+ cm. Reaction ranges from very strongly acid to neutral in the A and Eg horizons; from very strongly acid to slightly acid in the Btg/E and the Btg horizon; and from strongly acid to neutral in the 2Btg and 2BCg horizons.

The A or Ap horizon has value of 3 to 5 and chroma of 1 or 2. Where value is 3, the thickness of the A or Ap horizon is less than 15 cm.

The Eg horizon has value of 4 to 6 and chroma of 1 or 2.

The Btg part of the Btg/E horizon has hue of 10YR through 5Y, value of 4 through 6, and chroma of 1 or 2. Texture is silty clay loam or silt loam. Iron depletions and masses of Fe accumulation are in shades of gray and brown. The E part of the Btg/E horizon consists of vertical intrusions of albic material 2 to 15 cm wide that have hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 or 2. The E parts make up 15 – 50 % of the Btg/E horizon.

The Btg horizon has hue of 10YR through 5Y, value of 5 or 6, and chroma of 1 or 2. Texture is silty clay loam or silt loam. Masses of Fe accumulation in shades of brown, and iron depletions in shades of gray are present in most pedons. Peds are partially coated with dark gray (10YR 4/1), very dark gray (10YR 3/1), or black (10YR 2/1) clay films. Thin patches and streaks of uncoated silt between peds range from none to common.

The 2Btg horizon, where present, has hue of 10YR through 5Y, value of 5 or 6, and chroma of 1 or 2. Texture is silty clay loam, clay loam, silt loam, or silty clay. Masses of fe accumulation in shades of brown or red, and Fe depletions in shades of gray are present in most pedons. Thin patches and streaks of uncoated silt between peds range from none to common.

The 2BCg or 2C horizon, where present, is variegated in shades of gray, brown, and red. Texture is loam, silt loam, silty clay loam, or silty clay.

Competing Series: These are the Calhoun, Ethel, and Gilbert series in the same family, and the Basile and Fountain series in closely related families. Calhoun soils do not have dark colored clay films in the Bt horizon. Ethel soils formed in alluvium. Gilbert soils have exchangeable Na that ranges from 15 – 35 % within 43 to 102 cm of the upper boundary of the B horizon. Basile and Fountain soils do not have dark colored clay films in the Bt horizon, have $CaCO_3$ concretions in the subsoil, and have a superactive activity class.

Geographic Setting: Frost soils are in slightly depressional areas and in broad drainage ways. They formed in late Pleistocene age deposits high in silt content over mid to late Pleistocene alluvial sediments. The upper materials have the characteristics of loess mixed with silty alluvium. The average annual temperature ranges from 18 to 21 °C, and the average annual rainfall is 127 to 165 cm. Elevation ranges from 0 to 15 m above mean sea level.

Geographically Associated Soils: These include the Coteau, Deerford, Duson, Jeanerette, Olivier, and Patoutville series. All of these soils are on slightly higher positions than the Frost soil. Coteau and Duson soils are somewhat poorly drained and do not have aquic conditions within a depth of 51 cm. Deerford soils are somewhat poorly drained and have a natric horizon. Jeanerette soils are somewhat poorly drained and have a mollic epipedon. Olivier soils are somewhat poorly drained and have a fragipan. Patoutville soils have red masses of Fe accumulation in the upper part of the subsoil and do not have a glossic horizon.

Drainage and Permeability: Frost soils are poorly drained. Runoff is very slow and permeability is slow. Most areas receive drainage water from higher elevations. The soil is wet in the layers below 0 to 46 cm during the months of December through April in most years.

Use and Vegetation: Most are in crops or improved pasture, however many areas remain in hardwood forest; some areas are cleared and used for pasture.

Distribution and Extent: Louisiana, Mississippi, and possibly Arkansas. Southern Mississippi Valley Silty Uplands (MLRA 134). The series is of large extent.

MLRA Office Responsible: Little Rock, Arkansas

Series Established: Livingston Parish, Louisiana; 1931. The type location was moved to Acadia Parish in 1997.

Remarks: Diagnostic horizons and other significant features are:

Ochric epipedon..........0 to 56 cm (Ap and Eg horizons)

Albic horizon...........25 to 56 cm (Eg horizon)

Glossic horizon..........56 to 91 cm (Btg/E horizon)

Argillic horizon.........56 to 272 cm (Btg/E, Btg, and 2Btg horizons)

JEANERETTE SERIES

The Jeanerette series consists of very deep, somewhat poorly drained, moderately slowly permeable soils that formed in loess or silty alluvium. They are on broad, nearly level areas or slight depressions on late Pleistocene age terraces. Mean annual temperature is ~20 °C near the type location, and mean annual rainfall is about 152 cm. Slope is dominantly less than 0.5 % but ranges up to 1 %.

Taxonomic Class: Fine-silty, mixed, superactive, thermic Typic Argiaquolls

Typical Pedon: Jeanerette silt loam, on a broad flat, in a cultivated field at an elevation of 15 m (colors are for moist soil unless otherwise stated).

Ap--0 to 18 cm; very dark grayish brown (10YR 3/2) silt loam; grayish brown (10YR 5/2), dry; weak fine granular structure; very friable; many very fine and fine roots; slightly acid; clear smooth boundary. (10 to 25 cm thick)

Btg1—18 to 64 cm; very dark gray (10YR 3/1) silt loam; gray (10YR 5/1), dry; moderate medium subangular blocky structure; friable; many fine and very fine roots; 10 % krotovinas; many distinct clay films on faces of peds; few medium, moderately cemented Fe-Mn concretions throughout; slightly alkaline; clear wavy boundary.

Btg2—38 to 61 cm; very dark gray (10YR 3/1) silty clay loam; gray (10YR 5/1), dry; moderate medium subangular blocky structure; firm; few fine and very fine roots; 10 % krotovinas; many distinct clay films on faces of peds; few medium, moderately cemented Fe-Mn concretions throughout; slightly alkaline; clear wavy boundary (combined thickness of the Btg horizon ranges from 15 to 51 cm).

Btkg1—61 to 89 cm; gray (10YR 5/1) paragravelly silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and very fine roots; 10

% krotovinas; many distinct dark gray (10YR 4/1) clay films on faces of peds; common (20 %) weakly to moderately cemented, medium to very coarse $CaCO_3$ concretions throughout; common fine and medium, moderately cemented Fe-Mn concretions throughout; many fine prominent yellowish brown (10YR 5/6) and light olive brown (2.5Y 5/4) masses of Fe accumulation throughout; slightly effervescent; moderately alkaline; gradual wavy boundary.

Btkg2—89 to 132 cm; gray (10YR 5/1) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and very fine roots; 10 % krotovinas; many distinct dark gray (10YR 4/1) clay films on faces of peds; common (3 %) weakly to moderately cemented, coarse and very coarse $CaCO_3$ concretions throughout; common fine and medium, moderately cemented Fe-Mn concretions throughout; common faint light gray (10YR 7/1) $CaCO_3$ coatings throughout; many medium prominent yellowish brown (10YR 5/8) masses of Fe accumulation throughout; moderately alkaline; gradual wavy boundary. (Combined thickness of the Btkg horizon ranges from 13 to 76 cm)

B'tg1—132 to 160 cm; gray (10YR 5/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine and very fine roots; many distinct dark gray (10YR 4/1) clay films on faces of peds; few medium, moderately cemented Fe-Mn concretions throughout; many medium prominent yellowish brown (10YR 5/8) masses of Fe accumulation throughout; slightly alkaline; gradual wavy boundary.

B'tg2—160 to 193 cm; light brownish gray (2.5Y 6/2) silty clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; many distinct very dark gray (10YR 3/1) clay films on faces of peds and in pores; few medium dark colored moderately cemented Fe-Mn concretions throughout; common medium prominent yellowish brown (10YR 5/8) masses of Fe accumulation throughout; slightly alkaline; gradual wavy boundary.

Btg3—193 to 224 cm; light brownish gray (2.5Y 6/2) silty clay loam; weak medium subangular blocky structure; firm; few fine and very fine roots; many distinct very dark gray (10YR 3/1) clay films on faces of peds; few medium dark colored moderately cemented Fe-Mn concretions throughout; common medium prominent yellowish brown (10YR 5/6) masses of Fe accumulation throughout; slightly alkaline.

Type Location: Acadia Parish, Louisiana; ~4.5 km northeast of Richard; ~305 m east of State Highway 95 on Parish Road P3-26; then ~30 m north in cultivated field; ~750 m north and ~305 m east of the southwest corner of sec 8, T.7 S., R.2 E.; USGS Richard, LA., 7.5 minute topographic quadrangle; 30 degrees 27 minutes 32 seconds N. Latitude, 92 degrees 17 minutes 31 seconds W. Longitude, NAD 83.

Range in Characteristics: Solum thickness ranges from 152 to more than 203 cm. The thickness of the mollic epipedon ranges from 25 to 76 cm. The C-Mg ratio is 1 or more. Depth to the Btk horizon ranges from 51 to 102 cm. Total content of very fine sand through very coarse sand is less than 10 % throughout the solum, and strongly cemented or harder concretions are < 5 %. Reaction is moderately acid to slightly alkaline in the A horizon, and neutral to moderately alkaline in the subsoil and underlying layers.

The A or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2; or hue of 2.5Y, value of 3, and chroma of 2; or it is neutral with value of 3. Texture is silt loam or silt.

The Btg horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2, or it is neutral with value of 3. Redoximorphic features are in shades of olive, brown, or gray. Texture is silt loam or silty clay loam.

The Btkg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1; or hue of 2.5Y, value of 4 to 6, and chroma of 1 or 2; or hue of 5Y, value of 4 to 6, and chroma of 1 to 3. Very weakly to moderately cemented $CaCO_3$ concretions, 2 to 75 millimeters in diameter, make up 3 – 25 % of the horizon by volume. Calcium carbonate equivalency ranges 0 – 5 %. Texture is silt loam or silty clay loam in the fine earth fraction. The Btkg horizon is discontinuous in some pedons.

The B'tg horizon and the Btg3 horizon have hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. Peds coatings have chroma of 1 or 2, and redoximorphic features are in shades of olive, brown, or gray. Texture is silt loam or silty clay loam.

Some pedons have a Btk and a Bt horizon that has similar hue, value and texture as the Btkg, B'tg or Btg3 horizon, but with chroma ranging from 3 to 6.

The BC or C horizon, where present, has the same color range as the lower Bt, B'tg or Btg3 horizon. Texture is silt loam, loam, very fine sandy loam, or silty clay loam.

Competing Series: The Andry series is in the same family. The Essen, Loreauville, Meaton, Morey, and Urich series are in closely related families. Andry soils have a histic epipedon and have moderate to high salinity in all mineral horizons. Essen, and Loreauville soils do not have a mollic epipedon. Meaton soils have siliceous mineralogy. Morey soils have a fine-loamy particle size control section. Urich soils are more acid and do not have secondary carbonates in the solum.

Geographical Setting: These soils are on nearly level to depressional areas on uplands or terraces. Slopes are < 1 %. They formed in late Pleistocene age loess deposits or silty alluvium. Average annual temperature ranges from 15 to 21 °C, and average annual rainfall ranges from 140 to 165 cm. Frost free days range from 235 to 350. Elevation ranges from 1.5 to 25 m.

Geographically Associated Soils: These are the Acy, Coteau, Deerford, Essen, Frost, Patoutville, and Duson series. None of these soils have a mollic epipedon. In addition, Acy soils are on nearly level terraces at low elevations that have been influenced by Mississippi River alluvium.

Coteau and Duson soils are on convex ridges and side slopes. Deerford and Patoutville soils are on convex ridges and side slopes at higher elevations. Essen soils are on convex ridges at lower elevations. Frost soils are on broad depressional areas and along drainage ways.

Drainage and Permeability: Jeanerette soils are somewhat poorly drained. Runoff is slow and permeability is moderately slow. The soil is wet in the layers below 30 to 76 cm during the months of December through April in most years. Some areas are subject to rare flooding.

Use and Vegetation: Most of the soil is cleared and is used for pasture or for growing sugarcane, rice, soybeans, cotton, wheat, and grain sorgum, in rotation with crawfish production. Native vegetation is big bluestem, indiangrass, and switchgrass. Some areas are in woodland that is presumed to be recent encroachment on the grassland.

Distribution and Extent: Southern Mississippi Valley Silty Uplands (MLRA 134) in southern Louisiana. The series is of large extent.

MLRA Office Responsible: Little Rock, Arkansas

Series Established: St. Mary Parish, Louisiana; 1952.

Remarks: Diagnostic horizons and properties recognized in the type location pedon include:

Mollic epipedon - from a depth of 0 to 61 cm (Ap, Btg1, and Btg2 horizons).

Argillic horizon - from a depth of 18 to 224 cm (Btg, Btkg, B'tg and Btg3 horizons).

Secondary carbonates - from a depth of 61 to 132 cm (Btkg horizons)

PATOUTVILLE SERIES

The Patoutville series consists of very deep, somewhat poorly drained, slowly permeable soils that formed in loess. These soils are on nearly level to very gently sloping terraces. Mean annual temperature is ~20 °C near the type location, and mean annual rainfall is about 152 cm.

Taxonomic Class: Fine-silty, mixed, superactive, thermic Aeric Epiaqualfs

Typical Pedon: Patoutville silt on a broad, nearly level area in a pasture at an elevation of 12 m (colors are for moist soil unless otherwise stated).

Ap1--0 to 20 cm; grayish brown (10YR 5/2) silt; weak fine granular structure; very friable; many fine and medium roots; many distinct dark yellowish brown (10YR 4/4) Fe oxidation stains along root channels; strongly acid; abrupt smooth boundary.

Ap2—20 to 28 cm; grayish brown (10YR 5/2) silt loam; moderate medium granular structure; friable; many fine and medium roots; many fine and medium Fe-Mn concretions throughout; many distinct dark yellowish brown (10YR 4/4) masses of Fe accumulation throughout; many fine faint light brownish gray (10YR 6/2) Fe depletions throughout; moderately acid; clear smooth boundary (combined thickness of the A and Ap horizons ranges from 8 to 31 cm).

Btg1—28 to 38 cm; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; friable; many fine and medium roots; few faint clay films on faces of peds; few fine prominent yellowish brown (10YR 5/8) and common medium distinct dark yellowish brown (10YR 4/4) masses of Fe accumulation throughout; many medium distinct light brownish gray (10YR 6/2) Fe depletions throughout; strongly acid; clear wavy boundary.

Btg2—38 to 56 cm; dark grayish brown (10YR 4/2) silty clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine and medium roots; many distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and medium Fe-Mn concretions throughout; many medium prominent red (2.5YR 4/6 and 2.5YR 4/8) and brownish yellow (10YR 6/8) masses of Fe accumulation throughout; moderately acid; clear wavy boundary (Combined thickness of the Btg horizon is 13 to 46 cm)

Bt—56 to 71 cm; brown (10YR 5/3) silty clay loam; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and medium roots; many distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and medium moderately cemented Fe-Mn concretions throughout; many medium distinct brownish yellow (10YR 6/6) masses of Fe accumulation throughout; common fine prominent reddish brown (2.5YR 4/4) masses of Fe accumulation throughout; few medium prominent yellowish red (5YR 5/6) masses of Fe accumulation throughout; slightly acid; clear wavy boundary (13 to 51 cm thick).

B'tg1—71 to 97 cm; light brownish gray (2.5Y 6/2) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and medium roots; many distinct dark gray (10YR 4/1) clay films on faces of peds; many fine and medium moderately cemented Fe-Mn concretions throughout; many medium prominent yellowish brown (10YR 5/6 and 10YR 5/8) masses of Fe accumulation throughout; few fine prominent yellowish red (5YR 5/6) masses of Fe accumulation throughout; slightly acid; gradual wavy boundary.

B'tg2—97 to 130 cm; grayish brown (2.5Y 5/2) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; many fine and very fine discontinuous tubular pores; many distinct dark gray (10YR 4/1) clay films on faces of peds; many distinct dark gray (10YR 4/1) silt coatings on faces of peds; many medium prominent yellowish brown (10YR 5/8) and dark yellowish brown (10YR 4/6) masses of Fe accumulation throughout; slightly acid; gradual wavy boundary.

B't—130 to 172 cm; variegated, 35 % yellowish brown (10YR 5/6), 35 % brownish yellow (10YR 6/6), and 30 % light brownish gray (2.5Y 6/2) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; many distinct dark gray (10YR 4/1) clay films on faces of peds; many distinct dark gray (10YR 4/1) silt coatings on faces of peds; the areas with brownish yellow color are Fe accumulations, and the areas with light brownish gray color are Fe depletions; also has many medium prominent yellowish brown (10YR 5/8) and dark yellowish brown (10YR 4/6) masses of Fe accumulation throughout; slightly acid; gradual wavy boundary (combined thickness of the B'tg and B't horizons ranges from 51 to 152 cm).

2Bt—173 to 211 cm; variegated, 35 % gray (10YR 6/1), 35 % brownish yellow (10YR 6/6), and 30 % yellowish brown (10YR 5/6) silt loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common fine and very fine discontinuous tubular pores; thick distinct clay films on faces of peds; common medium dark colored moderately cemented Fe-Mn concretions throughout; the areas with brownish yellow color are Fe accumulations, and the areas with gray color are Fe depletions; neutral (0 to 51 cm thick).

TYPE LOCATION: Acadia Parish, Louisiana; 4 km north-northeast of Mire; ~1.4 km east of State Highway 95; then ~15 m south of Parish Road P2-20; ~9 m south and ~520 m west of the northeast corner of sec. 29, T.8 S., R.3 E.; USGS Mire, Louisiana 7.5 minute topographic quadrangle; 30 degrees 20 minutes 05 seconds N.Latitude, and 92 degrees 10 minutes 52 seconds W.Longitude, NAD 83.

Range in Characteristics: The thickness of the solum ranges from 127 to more than 203 cm. Depth to the 2Bt horizon is 152 to 203+ cm. Typically, these soils have < 10 % sand throughout the solum. The Ca-Mn ratio is 1 or more. Reaction ranges from very strongly acid to slightly alkaline in the A and E horizons. In non-irrigated areas, the A and E horizons are typically very strongly acid to slightly acid. Reaction ranges from strongly acid to neutral in the Btg and Bt horizons; and from slightly acid to moderately alkaline in the underlying horizons.

The A or Ap horizon has hue of 10YR, value of 3 or 4 and chroma of 1 to 3, or value of 5 and chroma of 2 or 3. Where value is 3, the A or Ap horizon is < 15 cm. Texture is silt or silt loam.

The Eg horizon, where present, has hue of 10YR, value of 4 to 6, and chroma of 1 or 2; or hue of 2.5Y, value of 4 or 5, and chroma of 2. Texture is silt loam.

The Btg and B'tg horizons have ped interiors that have hue of 10YR, value of 4 or 6, and chroma of 1 or 2; or hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. Red masses of Fe accumulation are diagnostic for the series and are present in some part of the Btg or B'tg horizon. Iron accumulations in shades of brown, and Fe depletions in shades of gray are present in most pedons. Peds are coated with clay films in shades of brown or gray. Texture is silt loam or silty clay loam.

The Bt and B't horizons have ped interiors that have hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 to 6. Red masses of Fe accumulation are diagnostic for the series and are present in some part of the Bt or B't horizon. Iron accumulations in shades of brown, and Fe depletions in shades of gray are present in most pedons. Peds are coated with clay films in shades of brown or gray. Texture is silt loam or silty clay loam.

The 2Bt horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6; or it is variegated with these colors. Iron accumulations in shades of brown, and Fe depletions in shades of gray are present in most pedons. Texture is silt loam, silty clay loam, or silty clay.

The BC and C horizons, where present, have hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 to 6; or they are variegated with these colors. Iron accumulations in shades of brown, and Fe depletions in shades of gray are present in most pedons. Texture is silt loam, silty clay loam, or silty clay.

Competing Series: These are the Acy, Essen, Frozard, and Solier series in the same family. The Galvez, Kurk, and McGehee series are in closely related families. Acy and Essen soils do not have red Fe accumulations and contain $CaCO_3$ concretions. Frozard, and Galvez soils do not have red Fe accumulations in the subsoil. Solier soils have a discontinuity to a buried albic horizon and an argillic horizon with albic intrusions at 31 to 61 cm deep. Kurk and McGehee soils have an active activity class, formed in alluvium or alluvium over loess, and have a lithologic discontinuity.

Geographic Setting: Patoutville soils are on nearly level to gently sloping terraces. These soils formed in loess. The climate is humid temperate. Average annual precipitation ranges from 140 to 165 cm and mean annual temperature ranges from 15 to 21 °C. Frost free days range from 235 to 350. Elevation ranges from 1.5 to 25 m.

Geographically Associated Soils: These are the Crowley, Duson, Frost, and Jeanerette series. Crowley soils have more than 35 % clay in the upper 51 cm of the argillic horizon, and have an abrupt textural change. In addition, Crowley soils are on slightly lower landscape positions. Frost and Jeanerette soils are in depressions and along drainage ways. In addition, Frost soils are poorly drained, and Jeanerette soils have a mollic epipedon. Duson soils are on side slopes and convex ridges, and do not have aquic conditions in the upper 13 cm of the argillic horizon.

Drainage and Permeability: Somewhat poorly drained. Patoutville soils are wet in the layers below 15 to 91 cm, and moist in the layers below the discontinuity. Runoff is slow. Permeability is slow.

Use and Vegetation: Most areas are now used for pasture, or for growing sugarcane, sweet potatoes, soybeans, grain sorghum, wheat, and rice, in rotation with crawfish. Tall grasses were once the dominant native vegetation.

Distribution and Extent: South Louisiana. The series is of large extent.

MLRA Office Responsible: Little Rock, Arkansas

Series Established: St. Mary Parish, Louisiana; 1953.

Remarks: The CEC:Clay ratio for this pedon is 0.58, which is slightly below the range for the superactive activity class. It was felt that this is within the range of lab error, however, and data from similar soils indicate that soils on these landscapes and parent materials are tending more towards the superactive class.

Diagnostic horizons and properties in this soil include:

Ochric epipedon - from a depth of 0 to 28 cm (Ap1 and Ap2 horizons).

Argillic horizon - from a depth of 28 to 211 cm (Btg, Bt, B'tg, B't, and 2Bt horizons).

Red masses of iron accumulation - from a depth of 38 to 72 cm (Btg2, Bt, and B'tg1 horizons).

Lithologic Discontinuity - at 173 cm (top of 2Bt horizon)

APPENDIX B
LAB ANALYSIS DATA FOR LOCATIONAL PROPERTIES

Sample ID	Latitude	Longitude	Sample ID	Latitude	Longitude
PS1-A1	30.419715	-92.161328	PS1-C12	30.417892	-92.160912
PS1-A2	30.419550	-92.161315	PS1-C13	30.417739	-92.160912
PS1-A3	30.419387	-92.161325	PS1-C14	30.417551	-92.160891
PS1-A4	30.419219	-92.161301	PS1-C15	30.417388	-92.160921
PS1-A5	30.419055	-92.161331	PS1-D1	30.419704	-92.160758
PS1-A6	30.418884	-92.161316	PS1-D2	30.419534	-92.160758
PS1-A7	30.418730	-92.161321	PS1-D3	30.419375	-92.160763
PS1-A8	30.418567	-92.161306	PS1-D4	30.419201	-92.160746
PS1-A9	30.418396	-92.161309	PS1-D5	30.419045	-92.160761
PS1-A10	30.418230	-92.161295	PS1-D6	30.418874	-92.160745
PS1-A11	30.418071	-92.161301	PS1-D7	30.418715	-92.160749
PS1-B1	30.419711	-92.161136	PS1-D8	30.418546	-92.160737
PS1-B2	30.419545	-92.161129	PS1-D9	30.418390	-92.160744
PS1-B3	30.419384	-92.161138	PS1-D10	30.418220	-92.160730
PS1-B4	30.419214	-92.161124	PS1-D11	30.418060	-92.160739
PS1-B5	30.419051	-92.161135	PS1-D12	30.417888	-92.160726
PS1-B6	30.418881	-92.161118	PS1-D13	30.417735	-92.160724
PS1-B7	30.418725	-92.161138	PS1-D14	30.417580	-92.160721
PS1-B8	30.418557	-92.161113	PS1-D15	30.417390	-92.160719
PS1-B9	30.418392	-92.161118	PS1-E1	30.419700	-92.160603
PS1-B10	30.418224	-92.161109	PS1-E2	30.419532	-92.160601
PS1-B11	30.418070	-92.161113	PS1-E3	30.419371	-92.160603
PS1-B12	30.417899	-92.161109	PS1-E4	30.419199	-92.160592
PS1-B13	30.417743	-92.161104	PS1-E5	30.419039	-92.160591
PS1-C1	30.419706	-92.160950	PS1-E6	30.418872	-92.160584
PS1-C2	30.419541	-92.160940	PS1-E7	30.418710	-92.160592
PS1-C3	30.419377	-92.160949	PS1-E8	30.418539	-92.160586
PS1-C4	30.419209	-92.160938	PS1-E9	30.418389	-92.160598
PS1-C5	30.419047	-92.160939	PS1-E10	30.418213	-92.160579
PS1-C6	30.418878	-92.160939	PS1-E11	30.418055	-92.160581
PS1-C7	30.418721	-92.160939	PS1-E12	30.417883	-92.160568
PS1-C8	30.418553	-92.160929	PS1-E13	30.417729	-92.160566
PS1-C9	30.418392	-92.160934	PS1-E14	30.417573	-92.160564
PS1-C10	30.418222	-92.160919	PS1-E15	30.417405	-92.160555
PS1-C11	30.418064	-92.160924	PS1-F1	30.419699	-92.160447

Table cont.

Sample ID	Latitude	Longitude	Sample ID	Latitude	Longitude
PS1-F2	30.419526	-92.160438	PS1-H11	30.418041	-92.160012
PS1-F3	30.419366	-92.160435	PS1-H12	30.417873	-92.160002
PS1-F4	30.419196	-92.160434	PS1-H13	30.417709	-92.160011
PS1-F5	30.419036	-92.160432	PS1-H14	30.417552	-92.159993
PS1-F6	30.418871	-92.160429	PS1-H15	30.417391	-92.159997
PS1-F7	30.418704	-92.160432	PS1-I1	30.419690	-92.159865
PS1-F8	30.418534	-92.160424	PS1-I2	30.419510	-92.159850
PS1-F9	30.418384	-92.160435	PS1-I3	30.419352	-92.159855
PS1-F10	30.418212	-92.160419	PS1-I4	30.419180	-92.159830
PS1-F11	30.418052	-92.160421	PS1-I5	30.419020	-92.159830
PS1-F12	30.417880	-92.160410	PS1-I6	30.418858	-92.159828
PS1-F13	30.417724	-92.160411	PS1-I7	30.418688	-92.159838
PS1-F14	30.417566	-92.160411	PS1-I8	30.418513	-92.159832
PS1-F15	30.417400	-92.160389	PS1-I9	30.418377	-92.159841
PS1-G1	30.419695	-92.160242	PS1-I10	30.418201	-92.159826
PS1-G2	30.419520	-92.160235	PS1-I11	30.418036	-92.159824
PS1-G3	30.419360	-92.160243	PS1-I12	30.417871	-92.159813
PS1-G4	30.419190	-92.160219	PS1-I13	30.417705	-92.159829
PS1-G5	30.419030	-92.160227	PS1-I14	30.417546	-92.159806
PS1-G6	30.418866	-92.160223	PS1-I15	30.417385	-92.159793
PS1-G7	30.418698	-92.160228	PS1-J1	30.419691	-92.159664
PS1-G8	30.418524	-92.160225	PS1-J2	30.419505	-92.159651
PS1-G9	30.418380	-92.160220	PS1-J3	30.419348	-92.159649
PS1-G10	30.418208	-92.160209	PS1-J4	30.419174	-92.159643
PS1-G11	30.418047	-92.160218	PS1-J5	30.419020	-92.159635
PS1-G12	30.417877	-92.160205	PS1-J6	30.418851	-92.159630
PS1-G13	30.417715	-92.160214	PS1-J7	30.418682	-92.159641
PS1-G14	30.417557	-92.160207	PS1-J8	30.418506	-92.159634
PS1-G15	30.417394	-92.160191	PS1-J9	30.418377	-92.159643
PS1-H1	30.419692	-92.160040	PS1-J10	30.418198	-92.159631
PS1-H2	30.419513	-92.160038	PS1-J11	30.418031	-92.159628
PS1-H3	30.419356	-92.160032	PS1-J12	30.417865	-92.159615
PS1-H4	30.419185	-92.160021	PS1-J13	30.417705	-92.159634
PS1-H5	30.419028	-92.160029	PS1-J14	30.417540	-92.159616
PS1-H6	30.418862	-92.160016	PS1-J15	30.417357	-92.159611
PS1-H7	30.418694	-92.160032	PS2-A1	30.414445	-92.159025
PS1-H8	30.418518	-92.160025	PS2-A2	30.414466	-92.158811
PS1-H9	30.418376	-92.160020	PS2-A3	30.414468	-92.158617
PS1-H10	30.418204	-92.160010	PS2-A4	30.414475	-92.158422

Table cont.

Sample ID	Latitude	Longitude	Sample ID	Latitude	Longitude
PS2-A5	30.414485	-92.158230	PS2-F4	30.414907	-92.158417
PS2-A6	30.414481	-92.158032	PS2-F5	30.414918	-92.158225
PS2-A7	30.414489	-92.157844	PS2-F6	30.414912	-92.158034
PS2-A8	30.414491	-92.157673	PS2-F7	30.414928	-92.157841
PS2-B1	30.414539	-92.159017	PS2-F8	30.414928	-92.157673
PS2-B2	30.414552	-92.158805	PS2-G1	30.415007	-92.158986
PS2-B3	30.414556	-92.158616	PS2-G2	30.415007	-92.158800
PS2-B4	30.414562	-92.158422	PS2-G3	30.415005	-92.158607
PS2-B5	30.414567	-92.158233	PS2-G4	30.415011	-92.158417
PS2-B6	30.414566	-92.158033	PS2-G5	30.415024	-92.158223
PS2-B7	30.414582	-92.157842	PS2-G6	30.415010	-92.158035
PS2-B8	30.414578	-92.157677	PS2-G7	30.415039	-92.157839
PS2-C1	30.414626	-92.159008	PS2-G8	30.415030	-92.157669
PS2-C2	30.414633	-92.158805	PS2-H1	30.415114	-92.158987
PS2-C3	30.414634	-92.158614	PS2-H2	30.415123	-92.158796
PS2-C4	30.414643	-92.158422	PS2-H3	30.415119	-92.158606
PS2-C5	30.414650	-92.158230	PS2-H4	30.415125	-92.158417
PS2-C6	30.414649	-92.158033	PS2-H5	30.415137	-92.158221
PS2-C7	30.414665	-92.157844	PS2-H6	30.415138	-92.158028
PS2-C8	30.414660	-92.157676	PS2-H7	30.415148	-92.157837
PS2-D1	30.414709	-92.159004	PS2-H8	30.415146	-92.157666
PS2-D2	30.414719	-92.158806	PS2-I1	30.415224	-92.158987
PS2-D3	30.414719	-92.158612	PS2-I2	30.415226	-92.158794
PS2-D4	30.414723	-92.158422	PS2-I3	30.415223	-92.158604
PS2-D5	30.414731	-92.158228	PS2-I4	30.415232	-92.158415
PS2-D6	30.414728	-92.158033	PS2-I5	30.415243	-92.158215
PS2-D7	30.414746	-92.157843	PS2-I6	30.415243	-92.158028
PS2-D8	30.414746	-92.157675	PS2-I7	30.415253	-92.157835
PS2-E1	30.414807	-92.158992	PS2-I8	30.415253	-92.157663
PS2-E2	30.414813	-92.158801	PS2-J1	30.415335	-92.158985
PS2-E3	30.414812	-92.158611	PS2-J2	30.415341	-92.158795
PS2-E4	30.414819	-92.158418	PS2-J3	30.415338	-92.158604
PS2-E5	30.414827	-92.158226	PS2-J4	30.415343	-92.158416
PS2-E6	30.414824	-92.158034	PS2-J5	30.415351	-92.158216
PS2-E7	30.414842	-92.157843	PS2-J6	30.415352	-92.158027
PS2-E8	30.414838	-92.157675	PS2-J7	30.415362	-92.157835
PS2-F1	30.414897	-92.158990	PS2-J8	30.415363	-92.157666
PS2-F2	30.414902	-92.158798	PS2-K1	30.415425	-92.158984
PS2-F3	30.414902	-92.158608	PS2-K2	30.415425	-92.158796

Table cont.

Sample ID	Latitude	Longitude	Sample ID	Latitude	Longitude
PS2-K3	30.415424	-92.158601	PR-B7	30.408880	-92.170355
PS2-K4	30.415428	-92.158415	PR-B8	30.408716	-92.170369
PS2-K5	30.415438	-92.158215	PR-B9	30.408551	-92.170382
PS2-K6	30.415439	-92.158022	PR-B10	30.408387	-92.170395
PS2-K7	30.415447	-92.157833	PR-B11	30.408222	-92.170408
PS2-K8	30.415443	-92.157650	PR-C1	30.409857	-92.170086
PS2-L1	30.415521	-92.158980	PR-C2	30.409692	-92.170099
PS2-L2	30.415519	-92.158794	PR-C3	30.409527	-92.170113
PS2-L3	30.415517	-92.158600	PR-C4	30.409363	-92.170126
PS2-L4	30.415518	-92.158415	PR-C5	30.409198	-92.170139
PS2-L5	30.415533	-92.158214	PR-C6	30.409034	-92.170152
PS2-L6	30.415528	-92.158023	PR-C7	30.408869	-92.170165
PS2-L7	30.415536	-92.157834	PR-C8	30.408704	-92.170179
PS2-L8	30.415534	-92.157647	PR-C9	30.408540	-92.170192
PS2-M1	30.415617	-92.158982	PR-C10	30.408375	-92.170205
PS2-M2	30.415617	-92.158791	PR-C11	30.408211	-92.170218
PS2-M3	30.415614	-92.158597	PR-D1	30.409845	-92.169896
PS2-M4	30.415610	-92.158407	PR-D2	30.409681	-92.169909
PS2-M5	30.415620	-92.158218	PR-D3	30.409516	-92.169923
PS2-M6	30.415617	-92.158020	PR-D4	30.409351	-92.169936
PS2-M7	30.415622	-92.157833	PR-D5	30.409187	-92.169949
PS2-M8	30.415618	-92.157637	PR-D6	30.409022	-92.169962
PR-A1	30.409880	-92.170466	PR-D7	30.408858	-92.169976
PR-A2	30.409715	-92.170479	PR-D8	30.408693	-92.169989
PR-A3	30.409550	-92.170492	PR-D9	30.408528	-92.170002
PR-A4	30.409386	-92.170506	PR-D10	30.408364	-92.170015
PR-A5	30.409221	-92.170519	PR-D11	30.408199	-92.170029
PR-A6	30.409057	-92.170532	PR-E1	30.409834	-92.169706
PR-A7	30.408892	-92.170545	PR-E2	30.409669	-92.169719
PR-A8	30.408727	-92.170559	PR-E3	30.409505	-92.169733
PR-A9	30.408563	-92.170572	PR-E4	30.409340	-92.169746
PR-A10	30.408398	-92.170585	PR-E5	30.409175	-92.169759
PR-A11	30.408233	-92.170598	PR-E6	30.409011	-92.169772
PR-B1	30.409868	-92.170276	PR-E7	30.408846	-92.169786
PR-B2	30.409704	-92.170289	PR-E8	30.408681	-92.169799
PR-B3	30.409539	-92.170302	PR-E9	30.408517	-92.169812
PR-B4	30.409374	-92.170316	PR-E10	30.408352	-92.169825
PR-B5	30.409210	-92.170329	PR-E11	30.408188	-92.169839
PR-B6	30.409045	-92.170342	PR-F1	30.409822	-92.169516

Table Cont.

Sample ID	Latitude	Longitude	Sample ID	Latitude	Longitude
PR-F2	30.409658	-92.169530	PR-H6	30.408976	-92.169203
PR-F3	30.409493	-92.169543	PR-H7	30.408812	-92.169216
PR-F4	30.409328	-92.169556	PR-H8	30.408647	-92.169229
PR-F5	30.409164	-92.169569	PR-H9	30.408482	-92.169242
PR-F6	30.408999	-92.169582	PR-H10	30.408318	-92.169256
PR-F7	30.408835	-92.169596	PR-H11	30.408153	-92.169269
PR-F8	30.408670	-92.169609	PR-I4	30.409294	-92.168986
PR-F9	30.408505	-92.169622	PR-I5	30.409129	-92.168999
PR-F10	30.408341	-92.169635	PR-I6	30.408965	-92.169013
PR-F11	30.408176	-92.169649	PR-I7	30.408800	-92.169026
PR-G1	30.409811	-92.169326	PR-I8	30.408636	-92.169039
PR-G2	30.409646	-92.169340	PR-I9	30.408471	-92.169052
PR-G3	30.409482	-92.169353	PR-I10	30.408306	-92.169066
PR-G4	30.409317	-92.169366	PR-I11	30.408142	-92.169079
PR-G5	30.409152	-92.169379	PR-J6	30.408953	-92.168823
PR-G6	30.408988	-92.169393	PR-J7	30.408789	-92.168836
PR-G7	30.408823	-92.169406	PR-J8	30.408624	-92.168849
PR-G8	30.408658	-92.169419	PR-J9	30.408459	-92.168862
PR-G9	30.408494	-92.169432	PR-J10	30.408295	-92.168876
PR-G10	30.408329	-92.169446	PR-J11	30.408130	-92.168889
PR-G11	30.408165	-92.169459	PR-K6	30.408942	-92.168633
PR-H1	30.409799	-92.169136	PR-K7	30.408777	-92.168646
PR-H2	30.409635	-92.169150	PR-K8	30.408613	-92.168659
PR-H3	30.409470	-92.169163	PR-K9	30.408448	-92.168673
PR-H4	30.409305	-92.169176	PR-K10	30.408283	-92.168686
PR-H5	30.409141	-92.169189	PR-K11	30.408119	-92.168699

APPENDIX C
LAB ANALYSIS DATA FOR SOIL PHYSICAL (ENVIRONMENTAL) PROPERTIES

Sample ID	pH			EC[a]			OC[b]			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}----------			----------------------------------%------------------------------						
PS1-A1	5.90	5.58	4.95	0.23	0.64	0.79	2.56	1.81	2.90	0.56	76.72	22.72	SiL
PS1-A2	6.61	6.36	6.03	0.42	0.68	0.90	2.63	2.20	2.79	ND[c]	83.28	16.72	SiL
PS1-A3	6.85	6.65	6.43	0.56	0.76	0.87	2.75	1.90	2.46	ND	78.28	21.72	SiL
PS1-A4	7.27	6.72	6.31	0.57	0.76	0.91	2.28	2.05	2.84	ND	75.28	24.72	SiL
PS1-A5	7.13	6.70	6.00	0.36	0.70	0.78	2.70	2.22	2.95	4.56	72.72	22.72	SiL
PS1-A6	6.61	6.24	5.80	0.34	0.55	0.79	2.57	2.40	2.85	ND	71.28	28.72	SiCL
PS1-A7	5.96	5.68	5.14	0.45	0.64	0.83	3.42	2.96	3.18	0.20	75.08	24.72	SiL
PS1-A8	5.39	5.02	4.79	0.31	0.60	0.72	4.45	3.15	3.30	4.92	69.36	25.72	SiL
PS1-A9	5.12	4.73	4.64	0.28	0.58	0.71	3.39	3.23	2.43	ND	71.28	28.72	SiCL
PS1-A10	5.04	4.69	4.82	0.24	0.53	0.33	3.19	2.54	2.27	4.56	76.72	18.72	SiL
PS1-A11	5.17	4.60	4.91	0.24	0.89	0.32	2.71	2.33	1.94	ND	69.28	30.72	SiCL
PS1-B1	5.07	4.59	5.30	0.15	0.32	0.42	2.15	1.87	2.16	ND	75.28	24.72	SiL
PS1-B2	5.12	4.91	5.15	0.20	0.39	0.34	2.11	1.68	1.85	ND	75.28	24.72	SiL
PS1-B3	5.46	4.98	5.54	0.20	0.42	0.37	2.15	1.95	1.97	ND	79.28	20.72	SiL
PS1-B4	5.87	5.47	6.11	0.24	0.65	0.52	2.07	1.91	2.09	8.92	72.36	18.72	SiL
PS1-B5	6.46	6.27	6.72	0.46	0.51	0.64	2.62	2.16	2.39	0.56	78.72	20.72	SiL
PS1-B6	6.69	6.36	6.34	0.60	0.69	0.72	2.79	1.99	2.46	ND	76.28	23.72	SiL
PS1-B7	6.43	5.89	6.35	0.48	0.51	0.67	3.09	2.31	3.11	2.56	72.72	24.72	SiL
PS1-B8	6.23	5.57	5.94	0.33	0.60	0.65	3.86	2.62	2.55	0.56	72.72	26.72	SiL
PS1-B9	5.23	4.95	4.97	0.67	0.58	0.67	4.11	2.57	3.26	ND	71.28	28.72	SiCL
PS1-B10	5.05	4.46	4.66	0.58	0.53	0.53	3.18	2.10	2.71	2.92	74.36	22.72	SiL

[a] Electrical conductivity; [b] Organic C;[c] Not detected

Table cont.

Sample ID	pH			EC			OM			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PS1-B11	5.12	4.46	4.63	0.21	0.63	0.51	3.12	1.91	1.87	6.92	69.36	23.72	SiL
PS1-B12	5.01	4.49	4.49	0.20	0.56	0.60	3.01	2.21	2.12	ND	73.28	26.72	SiL
PS1-B13	4.98	4.26	4.76	0.22	0.61	0.57	3.22	1.61	2.38	ND	70.92	29.08	SiCL
PS1-C1	5.12	5.15	4.48	0.23	0.36	0.74	2.65	2.56	3.59	ND	72.92	27.08	SiCL
PS1-C2	5.26	5.04	4.48	0.21	0.24	0.72	2.04	2.15	3.17	ND	74.92	25.08	SiL
PS1-C3	5.61	5.73	4.67	0.21	0.34	0.75	2.44	1.94	2.43	ND	77.28	22.72	SiL
PS1-C4	5.68	5.82	5.63	0.24	0.55	0.52	2.81	2.11	2.55	ND	75.28	24.72	SiL
PS1-C5	5.94	6.21	6.39	0.50	0.68	0.79	3.52	2.48	3.22	ND	77.28	22.72	SiL
PS1-C6	6.77	6.50	5.91	0.45	0.74	0.96	2.76	2.55	3.02	ND	73.28	26.72	SiL
PS1-C7	7.00	6.86	6.61	0.67	0.69	0.59	3.33	2.29	3.25	ND	75.28	24.72	SiL
PS1-C8	6.59	6.60	6.59	0.36	0.48	0.74	3.09	2.82	3.21	ND	75.28	24.72	SiL
PS1-C9	5.42	5.29	5.52	0.31	0.54	0.40	3.40	2.35	3.43	ND	75.28	24.72	SiL
PS1-C10	5.03	4.99	5.22	0.22	0.49	0.38	3.25	3.18	3.37	1.12	74.16	24.72	SiL
PS1-C11	5.31	5.15	5.18	0.28	0.35	0.40	2.80	2.85	3.13	ND	75.28	24.72	SiL
PS1-C12	5.21	4.89	5.00	0.25	0.35	0.33	2.86	2.56	2.53	ND	77.28	22.72	SiL
PS1-C13	5.31	5.09	5.31	0.19	0.27	0.39	2.30	2.25	2.94	ND	77.28	22.72	SiL
PS1-C14	5.18	4.99	5.45	0.21	0.32	0.28	2.98	2.71	2.29	ND	73.28	26.72	SiL
PS1-C15	5.27	5.02	5.23	0.21	0.66	0.30	3.23	2.86	2.86	ND	74.92	25.08	SiL
PS1-D1	5.27	5.05	5.36	0.31	0.57	0.44	3.63	3.31	4.68	ND	68.92	31.08	SiCL
PS1-D2	4.76	5.13	5.41	0.28	0.49	0.27	3.43	2.79	2.73	ND	74.92	25.08	SiL
PS1-D3	5.05	4.99	5.33	0.18	0.26	0.27	2.65	1.81	2.21	ND	74.92	25.08	SiL
PS1-D4	5.18	5.16	5.51	0.22	0.30	0.41	2.91	2.62	2.07	ND	72.92	27.08	SiCL
PS1-D5	5.73	5.85	5.43	0.33	0.36	0.34	3.23	2.15	2.48	ND	72.92	27.08	SiCL
PS1-D6	6.47	6.04	6.21	0.32	0.47	0.50	2.08	2.47	2.73	ND	70.92	29.08	SiCL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			---------------------------%------------------------------						
PS1-D7	6.81	6.38	6.19	0.49	0.50	0.48	2.07	2.70	2.15	ND	72.92	27.08	SiCL
PS1-D8	5.75	5.67	5.67	0.38	0.26	0.36	3.66	3.29	2.55	ND	74.56	25.44	SiL
PS1-D9	5.36	5.17	5.56	0.32	0.42	0.35	3.22	3.07	2.77	ND	72.92	27.08	SiCL
PS1-D10	5.20	4.88	5.31	0.21	0.35	0.33	3.04	2.61	2.49	ND	72.92	27.08	SiCL
PS1-D11	5.24	4.85	5.30	0.29	0.39	0.34	2.36	2.19	2.44	ND	72.92	27.08	SiCL
PS1-D12	5.10	5.05	5.19	0.23	0.50	0.36	2.14	2.46	2.62	ND	74.92	25.08	SiL
PS1-D13	5.27	4.95	5.23	0.22	0.29	0.33	2.55	1.99	2.61	ND	78.56	21.44	SiL
PS1-D14	5.17	4.83	5.08	0.19	0.22	0.43	2.38	1.69	2.39	ND	74.92	25.08	SiL
PS1-D15	4.98	4.72	5.14	0.23	0.31	0.32	2.43	2.10	2.74	ND	72.56	27.44	SiCL
PS1-E1	5.07	4.91	5.22	0.27	0.29	0.32	2.84	2.05	3.68	ND	80.56	19.44	SiL
PS1-E2	5.19	5.08	5.17	0.19	0.32	0.40	1.67	2.42	3.09	ND	78.56	21.44	SiL
PS1-E3	5.29	5.13	5.14	0.21	0.32	0.39	2.62	2.39	2.44	ND	78.56	21.44	SiL
PS1-E4	5.31	5.05	5.19	0.20	0.33	0.50	1.85	2.28	2.19	ND	80.56	19.44	SiL
PS1-E5	5.36	5.41	5.51	0.27	0.55	0.35	2.75	2.29	2.76	ND	78.56	21.44	SiL
PS1-E6	6.70	5.11	6.00	0.52	0.53	0.58	2.18	2.65	3.47	ND	78.56	21.44	SiL
PS1-E7	5.86	6.08	6.48	0.50	0.70	0.78	2.69	2.55	2.44	ND	78.56	21.44	SiL
PS1-E8	5.88	5.59	5.77	0.38	0.41	0.43	2.33	2.69	2.47	ND	78.56	21.44	SiL
PS1-E9	4.95	6.31	5.18	0.24	0.35	0.38	3.31	2.96	3.04	ND	78.56	21.44	SiL
PS1-E10	5.32	4.93	5.27	0.22	0.46	0.41	2.69	2.52	2.33	ND	70.92	29.08	SiCL
PS1-E11	5.11	5.04	5.20	0.23	0.58	0.34	3.10	2.77	2.09	ND	72.92	27.08	SiCL
PS1-E12	5.01	4.98	5.17	0.23	0.31	0.35	2.77	2.19	3.00	ND	70.92	29.08	SiCL
PS1-E13	5.21	4.92	5.21	0.21	0.39	0.32	2.07	2.93	1.75	ND	70.92	29.08	SiCL
PS1-E14	4.93	4.99	5.28	0.23	0.46	0.39	2.42	2.91	1.91	ND	72.92	27.08	SiCL
PS1-E15	5.14	5.03	5.00	0.24	0.49	0.37	2.31	2.68	2.43	ND	72.92	27.08	SiCL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			-----------------------------%------------------------------						
PS1-F1	5.15	4.87	5.53	0.31	0.41	0.36	2.10	3.03	1.99	ND	67.84	32.16	SiCL
PS1-F2	5.17	5.24	5.01	0.29	0.30	0.23	1.53	2.74	2.40	ND	69.84	30.16	SiCL
PS1-F3	5.03	4.75	5.24	0.25	0.29	0.23	1.65	2.92	2.00	ND	69.84	30.16	SiCL
PS1-F4	5.16	5.25	5.32	0.20	0.40	0.35	2.91	2.75	1.77	ND	74.56	25.44	SiL
PS1-F5	6.69	5.31	5.64	0.68	0.39	0.43	1.70	2.15	2.30	ND	66.56	33.44	SiCL
PS1-F6	5.23	5.50	5.76	0.25	0.43	0.35	2.23	2.17	2.37	ND	76.56	23.44	SiL
PS1-F7	5.61	5.92	6.00	0.31	0.51	0.48	2.51	2.71	2.74	ND	74.56	25.44	SiL
PS1-F8	5.61	5.81	5.76	0.26	0.41	0.44	2.57	2.48	2.51	ND	74.56	25.44	SiL
PS1-F9	5.08	5.12	5.31	0.31	0.37	0.41	3.47	1.94	3.29	ND	78.56	21.44	SiL
PS1-F10	5.27	5.20	5.30	0.23	0.29	0.35	2.16	1.88	2.98	ND	78.56	21.44	SiL
PS1-F11	4.73	5.17	5.16	0.27	0.26	0.34	2.81	1.90	2.09	ND	76.56	23.44	SiL
PS1-F12	5.04	5.07	5.11	0.22	0.32	0.27	2.96	2.06	2.11	ND	78.56	21.44	SiL
PS1-F13	4.97	5.02	5.14	0.25	0.39	0.28	1.94	2.20	2.09	ND	78.56	21.44	SiL
PS1-F14	5.13	4.87	4.96	0.19	0.31	0.26	1.67	2.20	2.02	ND	76.56	23.44	SiL
PS1-F15	4.96	4.87	5.06	0.19	0.42	0.32	2.14	2.54	2.30	ND	76.56	23.44	SiL
PS1-G1	5.58	5.81	5.60	0.32	0.33	0.36	2.44	1.71	2.61	ND	73.84	26.16	SiL
PS1-G2	5.20	5.54	5.53	0.30	0.33	0.22	2.47	1.63	2.92	ND	75.84	24.16	SiL
PS1-G3	5.36	5.79	4.75	0.21	0.38	0.62	1.88	2.10	2.32	ND	75.84	24.16	SiL
PS1-G4	5.37	5.78	4.85	0.37	0.37	0.62	3.25	2.32	1.87	ND	78.56	21.44	SiL
PS1-G5	5.29	5.60	4.69	0.22	0.34	0.64	1.63	2.07	2.27	ND	77.84	22.16	SiL
PS1-G6	5.30	5.66	4.73	0.21	0.37	0.59	1.91	2.17	2.25	ND	75.84	24.16	SiL
PS1-G7	5.51	5.82	4.67	0.29	0.32	0.66	2.62	2.45	3.05	ND	73.84	26.16	SiL
PS1-G8	5.36	5.43	4.71	0.23	0.37	0.69	2.57	2.22	2.60	ND	73.84	26.16	SiL
PS1-G9	5.25	5.36	4.50	0.29	0.31	0.64	2.41	1.52	3.62	ND	73.84	26.16	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PS1-G10	4.98	5.10	4.33	0.23	0.26	0.60	3.13	2.42	3.06	ND	77.84	22.16	SiL
PS1-G11	4.91	5.11	4.32	0.22	0.26	0.64	2.51	2.53	2.65	ND	75.84	24.16	SiL
PS1-G12	5.07	4.93	4.46	0.21	0.28	0.64	2.47	2.28	2.73	ND	75.84	24.16	SiL
PS1-G13	5.09	4.97	4.43	0.15	0.26	0.56	1.71	2.99	3.38	ND	71.84	28.16	SiCL
PS1-G14	5.00	4.94	4.45	0.22	0.40	0.63	2.43	2.94	3.19	ND	71.84	28.16	SiCL
PS1-G15	5.07	5.17	4.45	0.22	0.32	0.66	2.09	2.43	2.50	ND	71.84	28.16	SiCL
PS1-H1	4.87	5.44	4.82	0.41	0.42	0.69	2.33	2.57	2.63	ND	70.56	29.44	SiCL
PS1-H2	5.43	5.32	4.88	0.21	0.36	0.46	2.85	2.43	2.45	3.84	72.72	23.44	SiL
PS1-H3	5.37	5.49	5.16	0.28	0.38	0.69	2.29	2.47	2.13	ND	76.56	23.44	SiL
PS1-H4	5.15	5.48	5.41	0.25	0.37	0.59	1.88	2.02	2.42	ND	76.56	23.44	SiL
PS1-H5	5.13	5.55	5.15	0.26	0.36	0.66	2.14	2.21	2.42	ND	76.56	23.44	SiL
PS1-H6	5.76	5.61	5.57	0.32	0.45	0.69	1.92	2.75	2.68	ND	74.56	25.44	SiL
PS1-H7	5.57	6.06	6.45	0.41	0.47	0.82	2.47	2.46	2.83	ND	74.56	25.44	SiL
PS1-H8	5.58	5.49	5.55	0.32	0.54	0.80	1.88	3.08	2.80	ND	72.56	27.44	SiCL
PS1-H9	5.59	5.10	4.75	0.24	0.48	0.75	1.87	2.73	4.28	ND	70.56	29.44	SiCL
PS1-H10	4.95	4.71	4.57	0.29	0.58	0.65	2.07	2.82	2.66	ND	69.84	30.16	SiCL
PS1-H11	4.86	5.17	4.61	0.17	0.39	0.63	2.47	2.82	2.73	ND	69.84	30.16	SiCL
PS1-H12	5.04	4.98	4.92	0.31	0.41	0.60	1.96	2.96	2.81	ND	69.84	30.16	SiCL
PS1-H13	5.12	4.99	5.00	0.17	0.37	0.38	1.63	1.93	2.15	ND	69.84	30.16	SiCL
PS1-H14	4.98	5.32	5.07	0.33	0.39	0.40	2.40	2.34	3.14	ND	73.84	26.16	SiCL
PS1-H15	5.14	4.94	4.93	0.24	0.30	0.41	2.08	2.46	2.52	ND	71.84	28.16	SiCL
PS1-I1	5.61	5.38	5.47	0.23	0.31	0.32	1.79	2.27	1.97	3.84	73.08	23.08	SiL
PS1-I2	5.60	5.75	5.38	0.22	0.35	0.31	1.65	2.14	1.83	ND	78.56	21.44	SiL
PS1-I3	5.28	5.79	5.55	0.29	0.40	0.49	1.39	2.02	1.91	ND	78.56	21.44	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PS1-I4	5.79	5.76	5.65	0.24	0.32	0.42	1.58	1.75	1.81	ND	74.56	25.44	SiL
PS1-I5	5.35	5.19	5.24	0.20	0.31	0.40	1.74	2.11	2.55	ND	76.56	23.44	SiL
PS1-I6	5.33	5.25	5.01	0.20	0.32	0.44	1.79	2.25	2.76	ND	72.56	27.44	SiCL
PS1-I7	5.65	5.55	5.86	0.28	0.41	0.36	1.78	2.28	2.13	ND	74.56	25.44	SiL
PS1-I8	5.90	5.71	5.66	0.32	0.40	0.50	1.47	2.45	2.75	ND	72.56	27.44	SiCL
PS1-I9	5.08	5.10	5.43	0.19	0.34	0.47	1.77	2.92	2.12	ND	72.56	27.44	SiCL
PS1-I10	5.29	5.24	5.38	0.35	0.34	0.39	1.77	2.22	2.11	ND	72.56	27.44	SiCL
PS1-I11	5.43	5.20	5.63	0.29	0.36	0.34	2.04	2.42	2.18	ND	74.56	25.44	SiL
PS1-I12	5.65	6.02	5.98	0.31	0.39	0.62	1.73	2.05	2.66	ND	68.56	31.44	SiCL
PS1-I13	6.25	5.65	5.73	0.32	0.39	0.53	1.96	2.44	2.35	ND	72.56	27.44	SiCL
PS1-I14	4.96	5.26	5.41	0.27	0.31	0.32	2.32	2.26	2.29	ND	74.56	25.44	SiL
PS1-I15	5.37	5.31	5.49	0.27	0.40	0.53	2.04	2.52	2.36	ND	68.56	31.44	SiCL
PS1-J1	5.42	5.64	5.44	0.27	0.36	0.53	2.18	2.00	2.14	1.84	75.08	23.08	SiL
PS1-J2	5.53	5.29	5.26	0.20	0.44	0.30	2.30	2.11	2.27	ND	74.92	25.08	SiL
PS1-J3	5.65	5.70	5.39	0.45	0.24	0.30	1.70	2.00	1.89	ND	74.92	25.08	SiL
PS1-J4	5.48	5.80	5.02	0.20	0.32	0.45	1.54	2.11	2.20	ND	76.92	23.08	SiL
PS1-J5	5.33	5.62	5.37	0.19	0.29	0.29	2.14	2.02	1.64	ND	70.92	29.08	SiCL
PS1-J6	5.55	5.25	5.34	0.15	0.33	0.34	1.68	2.49	2.29	ND	76.92	23.08	SiL
PS1-J7	5.37	5.46	5.50	0.24	0.30	0.37	1.95	2.63	2.45	ND	76.92	23.08	SiL
PS1-J8	5.77	5.53	5.70	0.23	0.40	0.39	1.73	2.74	2.88	ND	74.92	25.08	SiL
PS1-J9	5.40	5.54	5.56	0.25	0.29	0.37	1.93	2.29	2.51	ND	74.92	25.08	SiL
PS1-J10	5.37	5.29	5.42	0.26	0.36	0.35	2.15	2.34	2.53	ND	74.92	25.08	SiL
PS1-J11	5.73	5.85	5.99	0.26	0.49	0.40	1.33	2.34	2.59	ND	74.92	25.08	SiL
PS1-J12	6.52	6.25	6.37	0.35	0.52	0.69	1.72	2.45	3.42	ND	72.92	27.08	SiCL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PS1-J13	6.27	5.93	6.23	0.92	0.50	0.64	2.26	2.82	3.74	ND	74.92	25.08	SiL
PS1-J14	6.82	6.40	6.73	0.47	0.69	0.75	1.70	3.29	2.88	ND	72.92	27.08	SiCL
PS1-J15	6.02	5.42	5.98	0.34	0.49	0.45	1.21	3.14	4.69	ND	76.92	23.08	SiL
PS2-A1	4.95	4.88	4.99	0.21	0.37	0.41	2.23	3.02	4.07	ND	70.92	29.08	SiCL
PS2-A2	5.62	4.91	5.01	0.36	0.49	0.52	3.82	2.81	3.52	ND	66.92	33.08	SiCL
PS2-A3	5.95	6.17	5.94	0.39	0.71	0.49	1.08	2.42	4.19	ND	72.92	27.08	SiCL
PS2-A4	5.09	5.05	5.23	0.40	0.29	0.35	0.78	2.65	3.20	ND	72.92	27.08	SiCL
PS2-A5	4.64	4.82	5.28	0.97	0.42	0.41	4.42	2.37	2.97	ND	74.92	25.08	SiL
PS2-A6	4.39	4.64	4.95	0.69	0.23	0.27	3.33	1.97	2.74	ND	76.92	23.08	SiL
PS2-A7	4.61	4.66	4.82	0.65	0.28	0.30	1.43	2.01	3.57	ND	78.92	21.08	SiL
PS2-A8	4.57	4.72	4.68	0.62	0.30	0.31	3.13	2.08	2.24	ND	76.92	23.08	SiL
PS2-B1	5.30	4.79	4.88	0.28	0.35	0.28	1.52	2.72	4.09	ND	64.92	35.08	SiCL
PS2-B2	5.56	5.35	5.23	0.73	0.41	0.53	1.98	2.73	3.68	ND	74.56	25.44	SiL
PS2-B3	5.48	5.34	5.33	0.72	0.43	0.57	2.14	2.80	3.60	ND	66.56	33.44	SiCL
PS2-B4	5.07	4.78	5.23	0.68	0.26	0.38	1.05	2.24	3.34	ND	72.56	27.44	SiCL
PS2-B5	4.85	4.76	5.23	0.62	0.35	0.29	2.67	2.18	2.66	ND	72.56	27.44	SiCL
PS2-B6	4.44	5.08	4.68	0.70	0.35	0.45	1.23	3.14	3.66	ND	72.56	27.44	SiCL
PS2-B7	4.83	4.96	5.19	0.51	0.27	0.32	3.08	2.15	3.26	ND	76.56	23.44	SiL
PS2-B8	5.16	5.83	5.12	0.30	0.48	0.31	1.79	2.84	4.06	ND	76.56	23.44	SiL
PS2-C1	4.87	4.89	4.98	0.23	0.36	0.39	2.98	3.10	3.37	ND	70.56	29.44	SiCL
PS2-C2	5.14	5.06	4.94	0.42	0.37	0.48	1.41	2.34	3.20	ND	68.56	31.44	SiCL
PS2-C3	5.16	5.15	5.18	0.22	0.35	0.43	3.65	2.55	3.01	ND	72.56	27.44	SiCL
PS2-C4	4.85	4.64	4.84	0.74	0.30	0.32	0.97	2.07	3.02	ND	74.56	25.44	SiL
PS2-C5	4.75	4.56	4.91	0.63	0.30	0.32	3.14	2.23	2.83	ND	74.56	25.44	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			-----------------------------%-------------------------------						
PS2-C6	4.83	4.64	4.86	0.13	0.32	0.27	1.19	2.02	2.49	ND	74.56	25.44	SiL
PS2-C7	4.67	4.85	4.79	0.13	0.32	0.25	2.26	1.76	2.41	ND	74.56	25.44	SiL
PS2-C8	4.61	4.72	4.88	0.52	0.36	0.25	1.40	2.02	2.17	ND	74.56	25.44	SiL
PS2-D1	4.82	4.70	5.16	0.82	0.37	0.36	2.37	3.24	3.55	ND	64.56	35.44	SiCL
PS2-D2	4.92	4.89	5.14	0.77	0.36	0.35	2.51	3.00	3.11	ND	68.56	31.44	SiCL
PS2-D3	5.37	4.65	5.68	0.23	0.42	0.37	2.00	2.39	2.80	ND	68.56	31.44	SiCL
PS2-D4	5.09	4.85	5.01	0.91	0.26	0.31	1.55	1.96	2.57	ND	70.56	29.44	SiCL
PS2-D5	4.98	4.81	4.79	0.20	0.28	0.39	2.20	1.93	2.50	ND	74.56	25.44	SiL
PS2-D6	5.07	4.97	5.08	0.28	0.19	0.34	1.79	1.90	2.66	ND	70.56	29.44	SiCL
PS2-D7	5.09	4.98	4.91	0.16	0.28	0.33	1.80	2.49	2.96	ND	74.56	25.44	SiL
PS2-D8	4.87	4.94	4.88	0.69	0.24	0.30	1.86	2.08	2.47	ND	74.56	25.44	SiL
PS2-E1	4.88	4.86	4.99	0.31	0.31	0.37	1.22	3.09	4.99	ND	68.56	31.44	SiCL
PS2-E2	5.05	4.89	5.06	0.27	0.68	0.37	1.18	3.27	2.34	ND	72.92	27.08	SiCL
PS2-E3	5.14	4.89	5.06	0.98	0.38	0.32	1.29	2.46	2.77	ND	74.92	25.08	SiL
PS2-E4	4.99	4.69	4.82	0.14	0.29	0.35	1.41	2.42	2.46	ND	76.92	23.08	SiL
PS2-E5	4.87	4.35	4.61	0.51	0.37	0.37	1.15	2.15	2.37	ND	76.92	23.08	SiL
PS2-E6	4.76	4.35	4.64	0.36	0.38	0.37	0.99	2.30	2.35	ND	76.92	23.08	SiL
PS2-E7	4.69	4.22	4.43	0.89	0.42	0.37	1.15	1.60	2.35	ND	78.92	21.08	SiL
PS2-E8	5.00	4.35	4.71	0.46	0.32	0.35	1.37	2.27	2.18	ND	78.92	21.08	SiL
PS2-F1	4.66	4.83	5.48	0.20	0.41	0.58	1.10	3.46	5.18	ND	68.92	31.08	SiCL
PS2-F2	5.13	5.05	5.26	0.27	0.30	0.52	1.46	3.59	3.68	ND	68.92	31.08	SiCL
PS2-F3	5.22	5.70	5.07	0.36	0.36	0.48	3.19	2.95	2.92	ND	70.92	29.08	SiCL
PS2-F4	4.85	5.06	4.98	0.18	0.19	0.48	0.86	2.59	2.32	ND	74.92	25.08	SiL
PS2-F5	4.89	5.13	5.33	0.58	0.22	0.41	1.04	2.49	2.32	ND	76.92	23.08	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			-----------------------------%------------------------------						
PS2-F6	5.07	4.72	5.28	0.92	0.35	0.43	1.30	2.70	3.43	ND	74.92	25.08	SiL
PS2-F7	4.82	4.70	5.12	0.75	0.32	0.44	1.33	2.26	3.29	ND	76.92	23.08	SiL
PS2-F8	5.03	4.66	5.16	0.20	0.34	0.44	1.00	2.33	3.35	ND	76.92	23.08	SiL
PS2-G1	4.80	5.07	4.93	0.43	0.26	0.45	1.12	2.74	3.63	ND	74.92	25.08	SiL
PS2-G2	5.13	4.77	5.14	0.37	0.36	0.47	1.23	3.06	3.54	ND	72.92	27.08	SiCL
PS2-G3	5.15	5.06	4.92	0.22	0.20	0.40	1.18	2.59	2.65	ND	74.92	25.08	SiL
PS2-G4	4.74	4.98	5.04	0.68	0.22	0.40	1.06	2.10	3.00	ND	74.92	25.08	SiL
PS2-G5	4.78	4.58	5.13	0.67	0.32	0.39	1.30	2.56	2.86	ND	76.92	23.08	SiL
PS2-G6	4.77	4.52	4.98	0.21	0.30	0.38	0.77	2.17	2.47	ND	76.92	23.08	SiL
PS2-G7	4.74	4.35	5.06	0.33	0.29	0.40	0.76	1.97	2.67	ND	78.92	21.08	SiL
PS2-G8	4.88	4.53	4.93	0.45	0.22	0.35	0.71	1.73	2.46	ND	78.92	21.08	SiL
PS2-H1	4.96	5.03	5.20	0.33	0.39	0.40	1.43	4.46	2.82	ND	68.92	31.08	SiCL
PS2-H2	5.27	5.13	5.10	0.57	0.35	0.48	1.52	3.45	3.71	ND	68.92	31.08	SiCL
PS2-H3	5.79	5.16	5.24	0.60	0.38	0.47	0.96	3.16	3.42	ND	68.56	31.44	SiCL
PS2-H4	5.16	5.22	5.27	0.18	0.41	0.49	0.84	2.79	2.68	ND	70.56	29.44	SiCL
PS2-H5	5.06	5.06	5.16	0.27	0.29	0.63	0.87	2.73	2.30	ND	70.56	29.44	SiCL
PS2-H6	5.06	4.99	5.09	0.22	0.26	0.38	1.03	1.87	2.12	ND	76.56	23.44	SiL
PS2-H7	4.96	4.60	5.01	0.41	0.26	0.34	0.90	2.73	2.07	ND	76.56	23.44	SiL
PS2-H8	5.34	4.82	5.08	0.21	0.24	0.36	0.44	2.66	2.84	ND	74.56	25.44	SiL
PS2-I1	5.01	5.12	5.23	0.51	0.35	0.48	0.66	2.92	3.19	ND	66.56	33.44	SiCL
PS2-I2	4.98	5.17	5.49	0.31	0.31	0.43	0.55	2.95	3.14	ND	70.56	29.44	SiCL
PS2-I3	5.17	4.98	5.33	0.41	0.31	0.42	0.60	2.67	2.84	ND	68.56	31.44	SiCL
PS2-I4	5.23	5.28	5.92	0.33	0.31	0.50	0.57	2.50	3.00	ND	72.56	27.44	SiCL
PS2-I5	5.21	4.88	5.41	0.40	0.26	0.43	1.48	2.19	2.67	ND	74.56	25.44	SiL

Table cont.

Sample ID		pH			EC			OC		Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			-----------------------------%------------------------------						
PS2-I6	4.63	4.99	5.21	0.19	0.20	0.34	1.31	1.82	2.05	ND	76.56	23.44	SiL
PS2-I7	4.68	4.74	4.97	0.97	0.23	0.33	1.27	1.77	2.26	ND	76.56	23.44	SiL
PS2-I8	5.01	4.54	4.99	0.72	0.22	0.34	1.30	1.65	2.25	ND	76.56	23.44	SiL
PS2-J1	4.97	5.03	5.37	0.45	0.46	0.50	1.47	2.84	3.96	ND	62.56	37.44	SiCL
PS2-J2	5.66	5.11	5.29	0.59	0.41	0.49	1.54	3.93	3.96	ND	58.56	41.44	SiC
PS2-J3	6.10	6.09	5.97	0.44	0.56	0.63	1.46	3.07	3.29	ND	64.56	35.44	SiCL
PS2-J4	6.49	6.49	5.90	0.25	0.71	0.63	1.70	3.42	4.23	3.12	63.44	33.44	SiCL
PS2-J5	6.06	5.32	5.82	0.42	0.44	0.66	1.00	3.44	3.25	ND	76.56	23.44	SiL
PS2-J6	6.43	5.57	5.34	0.16	0.55	0.40	1.05	3.42	3.07	ND	64.56	35.44	SiCL
PS2-J7	5.28	4.99	5.54	0.26	0.42	0.52	1.24	3.38	2.93	ND	66.56	33.44	SiCL
PS2-J8	5.48	5.92	5.52	0.75	0.55	0.67	1.42	2.86	3.18	ND	72.56	27.44	SiCL
PS2-K1	4.97	4.97	5.70	0.41	0.39	0.54	1.92	2.76	2.84	ND	67.48	32.52	SiCL
PS2-K2	5.22	5.13	5.38	0.85	0.35	0.52	1.31	2.74	3.05	ND	69.48	30.52	SiCL
PS2-K3	5.56	5.41	5.69	0.42	0.43	0.47	1.52	3.11	2.92	ND	69.48	30.52	SiCL
PS2-K4	5.49	5.54	5.91	0.28	0.42	0.52	1.55	2.70	2.91	ND	71.28	28.72	SiCL
PS2-K5	5.60	5.21	5.58	0.31	0.29	0.41	1.36	2.36	2.65	ND	71.48	28.52	SiCL
PS2-K6	5.12	5.09	5.56	0.27	0.24	0.37	1.46	1.94	2.21	0.40	73.08	26.52	SiL
PS2-K7	5.23	4.81	5.27	0.18	0.30	0.35	1.04	2.18	2.31	ND	75.48	24.52	SiL
PS2-K8	4.60	4.75	5.62	0.48	0.25	0.44	1.24	1.99	2.25	ND	75.48	24.52	SiL
PS2-L1	4.95	5.11	5.49	0.24	0.34	0.67	1.44	2.85	3.46	ND	63.48	36.52	SiCL
PS2-L2	5.30	5.23	5.61	0.89	0.53	0.75	2.13	2.81	3.90	ND	71.48	28.52	SiCL
PS2-L3	6.53	6.50	6.37	0.11	0.47	0.70	1.55	2.63	3.39	ND	67.48	32.52	SiCL
PS2-L4	6.51	5.80	5.94	0.19	0.64	0.78	1.27	3.31	3.99	ND	65.48	34.52	SiCL
PS2-L5	5.60	5.23	6.38	0.49	0.47	0.59	1.13	2.65	2.62	ND	69.48	30.52	SiCL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PS2-L6	6.01	4.79	5.81	0.13	0.30	0.55	1.06	2.63	3.36	ND	63.48	36.52	SiCL
PS2-L7	5.37	5.23	5.58	0.47	0.35	0.66	1.63	2.75	4.14	2.40	67.08	30.52	SiCL
PS2-L8	5.25	4.69	5.45	0.54	0.52	0.54	1.36	3.59	3.39	ND	61.48	38.52	SiCL
PS2-M1	5.21	5.14	5.31	0.35	0.33	0.45	1.25	2.82	3.25	ND	67.48	32.52	SiCL
PS2-M2	5.05	5.25	5.71	0.25	0.33	0.48	1.04	2.72	3.23	0.40	73.08	26.52	SiL
PS2-M3	6.01	5.89	5.88	0.73	0.45	0.60	1.39	2.68	3.46	ND	69.48	30.52	SiCL
PS2-M4	6.16	6.14	5.88	0.66	0.51	0.57	1.30	2.78	3.45	ND	69.48	30.52	SiCL
PS2-M5	5.53	5.60	5.71	0.26	0.38	0.44	1.47	2.34	2.91	ND	71.28	28.72	SiCL
PS2-M6	4.86	5.07	5.80	0.52	0.31	0.43	0.81	1.94	3.08	ND	71.48	28.52	SiCL
PS2-M7	5.31	4.91	5.85	0.28	0.22	0.45	1.00	2.04	2.92	ND	75.28	24.72	SiL
PS2-M8	4.98	4.68	5.59	0.68	0.24	0.43	0.83	2.01	2.55	ND	77.28	22.72	SiL
PR-A1	6.14	6.27	6.85	0.68	0.48	0.79	1.76	2.49	3.69	1.12	72.16	26.72	SiL
PR-A2	6.04	6.14	6.31	0.51	0.48	0.66	1.42	4.18	3.49	ND	73.28	26.72	SiL
PR-A3	6.82	6.72	6.63	0.51	0.49	0.68	0.72	2.51	3.30	ND	77.28	22.72	SiL
PR-A4	5.49	6.11	6.45	0.33	0.56	0.68	0.93	2.54	3.42	ND	79.28	20.72	SiL
PR-A5	5.83	5.01	6.25	0.44	0.30	0.48	0.67	2.25	2.87	ND	77.28	22.72	SiL
PR-A6	4.91	5.23	6.34	0.12	0.29	0.57	0.94	2.25	3.03	ND	77.28	22.72	SiL
PR-A7	5.30	5.89	6.14	0.31	0.25	0.50	0.90	2.31	2.80	ND	75.28	24.72	SiL
PR-A8	5.56	5.84	6.18	0.26	0.29	0.45	1.87	1.86	2.62	ND	79.28	20.72	SiL
PR-A9	5.63	5.76	6.09	0.31	0.34	0.47	1.67	1.83	2.75	3.12	78.16	18.72	SiL
PR-A10	5.69	6.02	6.27	0.21	0.40	0.49	1.36	2.57	2.48	ND	81.28	18.72	SiL
PR-A11	5.66	6.13	6.22	0.29	0.58	0.50	1.45	5.19	2.60	1.12	78.16	20.72	SiL
PR-B1	6.47	6.61	6.73	0.58	0.09	0.89	1.77	2.76	3.13	ND	73.28	26.72	SiL
PR-B2	6.69	6.58	6.42	0.12	0.11	0.76	1.93	2.11	3.63	ND	71.28	28.72	SiCL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PR-B3	7.14	7.01	7.14	0.53	0.41	0.55	1.49	2.74	3.65	ND	71.28	28.72	SiCL
PR-B4	6.32	6.89	7.09	0.40	0.44	0.89	1.89	1.87	3.69	ND	73.28	26.72	SiL
PR-B5	7.08	6.81	6.60	0.49	0.29	0.79	1.18	2.09	2.98	ND	75.28	24.72	SiL
PR-B6	6.09	6.11	6.59	0.28	0.28	0.69	1.12	2.11	2.79	ND	79.28	20.72	SiL
PR-B7	6.97	6.54	6.12	0.50	0.25	0.51	0.96	1.81	2.28	ND	77.28	22.72	SiL
PR-B8	5.58	6.18	6.06	0.30	0.26	0.43	1.25	2.28	2.37	ND	81.28	18.72	SiL
PR-B9	5.80	6.16	6.05	0.20	0.22	0.43	1.09	1.91	2.43	ND	79.28	20.72	SiL
PR-B10	5.38	5.47	6.05	0.22	0.16	0.52	0.89	1.63	2.22	ND	81.28	18.72	SiL
PR-B11	5.30	5.88	6.11	0.19	0.19	0.52	0.99	2.23	2.04	ND	79.28	20.72	SiL
PR-C1	6.35	6.21	6.79	0.58	0.80	0.88	1.86	3.12	3.19	ND	70.56	29.44	SiCL
PR-C2	6.19	6.45	6.22	0.15	0.13	0.81	1.27	3.26	3.42	ND	68.56	31.44	SiCL
PR-C3	6.12	6.67	6.95	0.47	0.34	0.82	1.79	2.00	2.51	ND	70.56	29.44	SiCL
PR-C4	4.77	5.89	6.46	0.18	0.25	0.78	1.90	2.23	2.71	ND	72.56	27.44	SiCL
PR-C5	6.57	6.21	6.20	0.69	0.23	0.65	1.59	1.95	2.53	1.48	73.08	25.44	SiL
PR-C6	5.55	5.47	5.91	0.19	0.24	0.45	1.36	1.97	1.84	ND	76.56	23.44	SiL
PR-C7	5.73	5.89	6.31	0.27	0.19	0.46	1.56	2.10	2.19	1.48	75.08	23.44	SiL
PR-C8	5.41	5.58	5.95	0.21	0.21	0.47	1.93	2.36	2.39	ND	76.56	23.44	SiL
PR-C9	5.72	6.17	6.24	0.26	0.35	0.44	1.51	2.07	2.07	1.48	79.08	19.44	SiL
PR-C10	5.33	6.28	6.12	0.21	0.17	0.54	1.13	1.77	2.06	ND	78.56	21.44	SiL
PR-C11	5.81	6.14	6.35	0.21	0.22	0.50	1.12	2.54	2.16	ND	74.56	23.44	SiL
PR-D1	6.21	6.57	6.81	0.51	0.55	0.89	1.92	3.11	2.72	ND	74.56	25.44	SiL
PR-D2	5.97	6.17	6.31	0.31	0.52	0.69	1.05	3.12	2.93	ND	72.56	27.44	SiCL
PR-D3	5.64	6.42	6.58	0.38	0.28	0.64	1.92	3.18	2.29	ND	74.56	25.44	SiL
PR-D4	5.91	6.01	6.14	0.39	0.29	0.51	1.20	2.22	2.44	1.48	77.08	21.44	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PR-D5	5.28	5.92	6.47	0.25	0.23	0.62	0.85	2.13	2.68	ND	74.56	25.44	SiL
PR-D6	5.42	5.68	5.82	0.17	0.31	0.40	1.05	1.88	2.03	ND	74.56	25.44	SiL
PR-D7	5.34	5.57	5.74	0.15	0.12	0.41	1.06	1.82	2.20	ND	75.84	24.16	SiL
PR-D8	4.95	5.88	6.22	0.12	0.41	0.45	1.19	2.58	2.64	ND	78.56	21.44	SiL
PR-D9	5.73	5.64	5.82	0.16	0.16	0.40	0.65	1.78	2.28	ND	78.56	21.44	SiL
PR-D10	5.23	5.98	6.16	0.15	0.22	0.46	0.63	2.02	2.27	ND	74.56	23.44	SiL
PR-D11	5.54	5.91	6.09	0.23	0.23	0.49	0.81	1.77	2.42	ND	74.56	25.44	SiL
PR-E1	6.23	6.37	6.48	0.46	0.24	0.84	1.13	2.56	3.05	ND	68.40	31.60	SiCL
PR-E2	6.33	6.41	6.16	0.57	0.22	0.63	1.16	3.18	2.86	ND	72.56	27.44	SiCL
PR-E3	5.51	6.06	6.00	0.23	0.30	0.54	0.48	2.18	2.49	13.68	71.72	14.60	SiL
PR-E4	5.72	5.84	6.27	1.03	0.35	0.50	0.52	2.74	2.11	9.68	74.72	15.60	SiL
PR-E5	6.05	6.14	6.20	0.27	0.16	0.48	0.37	1.73	1.89	9.68	75.72	14.60	SiL
PR-E6	5.88	5.81	6.23	0.14	0.20	0.44	0.38	1.57	1.89	7.68	76.72	15.60	SiL
PR-E7	5.55	5.91	6.02	0.21	0.23	0.55	0.49	1.88	2.24	5.68	84.16	10.16	Silt
PR-E8	5.91	5.55	5.98	0.22	0.20	0.39	1.24	2.07	2.02	11.68	73.72	14.60	SiL
PR-E9	5.99	5.83	6.23	0.26	0.32	0.57	1.53	2.46	2.49	13.68	69.72	16.60	SiL
PR-E10	5.49	5.97	6.25	0.16	0.28	0.41	1.33	2.58	2.41	11.68	72.72	15.60	SiL
PR-E11	5.16	6.27	6.70	0.14	0.35	0.45	1.39	2.31	2.70	9.68	76.72	13.60	SiL
PR-F1	6.59	6.74	6.60	0.61	0.32	0.84	1.52	2.56	3.32	7.68	75.72	16.60	SiL
PR-F2	6.03	6.21	6.24	0.35	0.31	0.66	1.31	2.06	3.46	7.68	74.72	17.60	SiL
PR-F3	5.49	6.02	6.37	0.16	0.20	0.64	1.43	2.30	2.46	9.68	74.72	15.60	SiL
PR-F4	5.51	6.09	6.00	0.76	0.17	0.54	1.15	1.50	2.61	3.68	80.72	15.60	SiL
PR-F5	5.73	5.87	6.10	0.28	0.21	0.42	1.49	1.97	2.28	13.68	71.72	14.60	SiL
PR-F6	5.62	5.73	6.31	0.20	0.31	0.52	3.26	1.64	2.01	9.68	75.72	14.60	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PR-F7	5.80	5.68	6.15	0.17	0.12	0.45	1.52	2.16	2.16	7.68	76.72	15.60	SiL
PR-F8	5.39	5.81	6.11	0.54	0.26	0.41	3.00	2.25	1.95	11.68	72.72	15.60	SiL
PR-F9	5.44	5.84	5.87	0.16	0.45	0.33	2.15	3.05	2.45	11.68	73.72	14.60	SiL
PR-F10	5.29	5.92	5.91	0.14	0.08	0.45	1.73	3.53	2.43	5.68	77.72	16.60	SiL
PR-F11	5.57	5.71	6.01	0.16	0.31	0.47	3.20	3.17	0.81	11.68	70.72	17.60	SiL
PR-G1	6.00	6.07	6.37	0.54	0.41	0.81	0.13	3.09	3.29	7.68	80.16	12.16	SiL
PR-G2	5.58	5.84	6.64	0.37	0.52	0.91	4.14	2.95	2.97	7.68	82.16	10.16	Silt
PR-G3	6.32	6.27	6.07	0.39	0.12	0.83	2.88	3.12	3.34	11.68	76.16	12.16	Silt
PR-G4	6.86	6.63	6.30	0.17	0.20	0.73	3.97	2.96	2.78	15.68	63.16	21.16	SiL
PR-G5	5.38	5.82	6.20	0.25	0.31	0.54	3.42	1.85	2.45	5.68	82.16	12.16	SiL
PR-G6	4.99	5.09	5.90	0.26	0.28	0.49	2.20	2.41	2.59	ND	89.84	10.16	Silt
PR-G7	5.26	5.66	5.86	0.17	0.16	0.40	2.16	2.04	2.24	9.68	80.16	10.16	Silt
PR-G8	5.46	5.67	6.07	0.19	0.15	0.55	2.13	2.35	2.85	5.68	78.72	15.60	SiL
PR-G9	6.61	6.15	5.75	0.27	0.24	0.39	3.25	2.44	2.42	9.68	72.72	17.60	SiL
PR-G10	5.49	5.41	5.51	0.19	0.26	0.42	2.21	2.53	2.51	11.12	78.80	10.08	SiL
PR-G11	5.32	5.83	5.78	0.17	0.22	0.35	1.43	2.87	2.58	9.68	82.16	8.16	Silt
PR-H1	6.54	6.44	6.34	0.47	0.43	0.82	2.21	3.91	3.78	3.68	70.16	26.16	SiL
PR-H2	6.46	6.45	6.05	0.55	0.54	0.75	3.25	3.19	4.23	5.68	72.16	22.16	SiL
PR-H3	6.10	6.03	6.23	0.63	0.64	0.81	4.73	3.15	3.57	17.76	34.08	48.16	Clay
PR-H4	6.08	5.89	5.90	0.53	0.48	0.64	4.87	4.12	3.30	3.68	70.16	26.16	SiL
PR-H5	5.89	5.91	6.10	0.38	0.38	0.69	0.19	3.88	3.49	9.68	72.16	18.16	SiL
PR-H6	5.62	5.29	5.89	0.31	0.41	0.51	3.06	3.42	2.96	5.68	80.16	14.16	SiL
PR-H7	5.60	6.01	6.10	0.18	0.57	0.57	3.65	3.07	2.65	9.68	74.16	16.16	SiL
PR-H8	5.67	5.76	5.63	0.19	0.14	0.60	2.08	2.72	3.10	15.68	70.16	14.16	SiL

Table cont.

Sample ID	pH			EC			OC			Sand	Silt	Clay	Texture
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09				
				----------ds m^{-1}---------			----------------------------%------------------------------						
PR-H9	5.61	5.91	5.99	0.28	0.25	0.55	3.07	3.24	2.61	7.68	76.16	16.16	SiL
PR-H10	5.57	5.79	5.98	0.24	0.38	0.68	3.12	3.84	3.58	11.68	74.16	14.16	SiL
PR-H11	5.70	5.72	6.20	0.19	0.23	0.67	2.15	2.83	3.59	13.68	76.16	10.16	SiL
PR-I4	6.30	6.36	6.46	0.62	0.28	0.88	2.56	4.28	3.58	6.12	72.80	21.08	SiL
PR-I5	5.07	5.71	6.01	0.20	0.35	0.45	3.02	4.08	3.02	10.12	71.80	18.08	SiL
PR-I6	5.82	5.83	6.13	0.26	0.32	0.62	2.90	3.50	3.16	9.12	74.80	16.08	SiL
PR-I7	5.51	5.95	5.92	0.16	0.18	0.53	3.45	3.21	2.84	11.68	72.16	16.16	SiL
PR-I8	5.55	5.65	5.64	0.22	0.39	0.46	3.28	3.68	3.19	11.12	69.80	19.08	SiL
PR-I9	5.90	5.93	6.33	0.52	0.37	0.77	5.79	3.94	3.64	6.12	69.80	24.08	SiL
PR-I10	5.68	5.85	6.05	0.22	0.12	0.61	2.69	3.41	3.24	5.68	78.16	16.16	SiL
PR-I11	5.65	5.97	6.17	0.14	0.31	0.56	3.17	3.79	2.60	7.68	80.16	12.16	SiL
PR-J6	5.70	5.85	6.02	0.38	0.41	0.62	2.37	3.82	3.13	11.12	63.80	25.08	SiL
PR-J7	6.10	6.31	6.08	0.50	0.50	0.56	3.43	4.32	3.11	5.12	73.80	21.08	SiL
PR-J8	5.84	6.08	5.92	0.41	0.41	0.61	2.83	4.52	3.26	7.12	74.80	18.08	SiL
PR-J9	5.72	6.28	6.32	0.35	0.38	0.73	2.20	3.89	2.78	7.12	77.80	15.08	SiL
PR-J10	5.93	6.02	5.94	0.31	0.64	0.57	1.36	3.30	2.75	9.12	72.80	18.08	SiL
PR-J11	5.59	6.41	5.75	0.66	0.10	0.57	3.67	3.26	2.57	7.12	68.80	24.08	SiL
PR-K6	5.65	5.84	5.76	0.39	0.46	0.70	2.26	3.86	3.34	5.12	66.80	28.08	SiCL
PR-K7	6.19	6.06	6.24	0.79	0.42	0.66	2.88	4.20	3.09	10.12	64.80	25.08	SiL
PR-K8	5.44	5.59	5.96	0.26	0.23	0.70	2.92	3.33	3.32	8.12	70.80	21.08	SiL
PR-K9	5.41	5.87	5.94	0.24	0.25	0.68	1.64	3.06	3.04	0.12	77.80	22.08	SiL
PR-K10	5.43	5.94	5.79	0.26	0.22	0.69	2.01	2.80	3.28	3.12	81.80	15.08	SiL
PR-K11	5.37	5.84	6.00	0.24	0.35	0.55	1.93	3.08	2.51	2.12	80.80	17.08	SiL

APPENDIX D
LAB ANALYSIS DATA FOR SOIL MACRONUTRIENTS

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS1-A1	1852	1659	1656	20.01	28.68	92.69	49.59	30.69	27.58	338	287	323	11.62	54.78	92.80
PS1-A2	2392	2239	2218	18.32	35.93	71.82	78.85	27.94	26.66	307	293	300	44.42	64.79	100.25
PS1-A3	2789	2604	2515	19.60	28.65	58.83	69.88	17.58	18.75	389	318	325	44.35	66.77	94.27
PS1-A4	2908	2666	2613	15.93	27.58	53.86	49.47	19.44	27.89	377	336	398	54.47	74.10	95.94
PS1-A5	3316	3000	2470	17.12	32.55	67.65	90.79	26.63	24.73	443	357	335	47.93	79.59	91.88
PS1-A6	3128	2825	2356	16.09	35.50	64.07	36.21	26.63	26.57	402	339	309	15.39	72.26	87.57
PS1-A7	3029	2799	2292	29.02	45.49	87.35	124.90	39.90	44.72	460	383	355	39.66	72.76	104.15
PS1-A8	2343	2115	1921	33.65	46.60	100.46	107.73	55.51	33.99	441	357	311	35.57	72.24	97.81
PS1-A9	1882	1582	1666	37.96	51.02	87.25	158.88	106.09	26.57	315	272	256	34.55	69.24	91.89
PS1-A10	1491	1261	1149	53.99	57.07	49.48	126.43	58.18	30.34	293	200	202	44.82	61.41	46.02
PS1-A11	1440	1297	1148	44.24	75.21	48.02	96.04	60.78	22.58	320	267	233	40.20	75.41	41.73
PS1-B1	1145	1118	1013	23.74	29.48	38.74	89.17	33.88	75.50	237	178	186	38.86	52.33	42.29
PS1-B2	1136	1151	1012	17.16	31.02	32.36	88.29	29.66	18.26	219	201	180	31.61	50.82	41.39
PS1-B3	1505	1360	1164	27.13	29.88	33.06	56.22	23.07	16.93	304	244	228	16.95	50.44	41.78
PS1-B4	1750	1650	1724	22.66	32.56	25.50	65.82	28.88	14.30	297	269	280	30.52	57.76	48.46
PS1-B5	2416	2446	2227	17.53	32.37	23.81	62.69	30.00	19.90	333	309	293	33.85	65.31	62.64
PS1-B6	2894	2531	2289	22.45	32.07	29.82	88.69	17.24	18.46	473	382	366	48.47	64.39	62.43
PS1-B7	3487	2928	2792	20.88	37.76	34.44	96.62	31.91	21.79	490	354	394	50.37	78.97	77.47
PS1-B8	2644	2620	2445	26.33	39.64	43.41	52.55	41.81	26.97	383	324	323	32.24	69.85	74.51
PS1-B9	2190	2047	1857	25.77	43.43	79.83	103.37	31.40	33.23	425	331	336	14.02	67.49	80.87
PS1-B10	1779	1508	1447	50.45	47.34	81.14	105.39	36.95	33.78	356	252	256	28.48	65.70	75.43

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS1-B11	1541	1312	1305	58.45	62.45	76.54	91.94	40.82	31.36	317	234	232	38.54	68.67	69.06
PS1-B12	1375	1201	1202	45.33	55.37	77.36	84.52	45.05	26.98	262	217	215	25.44	66.21	68.61
PS1-B13	1640	1228	1427	45.88	47.54	93.26	73.67	37.56	36.57	306	204	237	23.90	65.40	74.19
PS1-C1	1561	1437	1587	21.55	19.21	131.75	61.02	60.54	37.54	306	266	280	32.52	38.29	108.07
PS1-C2	1351	1253	1377	13.68	19.08	117.37	72.96	42.14	39.54	247	224	257	19.80	38.96	99.94
PS1-C3	2026	1754	1237	22.76	20.74	94.60	80.59	26.02	25.03	284	246	221	40.57	41.30	84.65
PS1-C4	1859	1858	1624	21.91	23.08	33.28	62.65	46.24	25.34	353	345	303	16.85	46.51	64.70
PS1-C5	2331	2263	2200	28.35	21.06	48.86	110.34	31.33	22.05	457	394	369	49.02	56.33	105.70
PS1-C6	2944	2658	2407	14.20	23.60	60.23	38.18	40.92	22.48	479	423	396	23.48	60.00	125.59
PS1-C7	3978	3860	3124	24.39	33.80	23.26	87.93	34.45	35.68	485	361	376	42.71	71.86	72.28
PS1-C8	3433	3084	2832	18.78	22.64	17.48	83.52	34.35	18.16	478	389	402	48.44	61.90	66.86
PS1-C9	2211	2046	1824	27.71	23.17	25.43	109.14	41.77	30.61	456	371	390	39.34	46.27	48.03
PS1-C10	1789	1559	1432	34.71	32.21	33.68	95.13	52.14	42.36	332	282	291	35.72	42.72	43.90
PS1-C11	1643	1468	1471	52.55	45.34	28.13	67.65	40.35	28.30	344	303	307	14.53	42.19	42.13
PS1-C12	1441	1299	1217	33.59	23.56	30.01	103.98	45.94	25.13	285	241	255	15.72	39.97	37.71
PS1-C13	1542	1343	1445	38.40	28.99	41.76	64.18	41.84	42.23	281	251	242	13.93	38.95	43.31
PS1-C14	1576	1299	1230	56.39	31.90	35.14	120.01	57.22	26.16	321	249	266	23.05	38.51	36.72
PS1-C15	1740	1508	1401	32.51	25.51	30.22	90.71	54.95	29.54	307	249	253	14.55	39.81	38.13
PS1-D1	2040	1981	1797	43.35	21.88	53.34	142.86	84.18	91.48	465	417	401	40.36	47.60	50.26
PS1-D2	1642	1372	1216	23.98	17.73	18.61	170.87	90.51	31.39	378	309	267	47.16	43.13	35.31
PS1-D3	349	963	1028	7.78	20.76	16.42	42.85	33.81	17.40	90	221	204	5.62	31.95	31.08
PS1-D4	1993	1569	2031	20.76	17.14	10.18	90.78	68.77	26.97	346	282	373	20.92	44.86	40.83
PS1-D5	2374	2318	1696	25.59	23.76	16.44	120.00	50.00	25.75	444	374	330	39.11	52.14	36.95
PS1-D6	2986	2688	2158	17.42	23.53	17.25	74.18	56.59	20.92	411	379	377	39.49	56.08	47.97
PS1-D7	3159	3016	2280	16.14	24.26	15.38	86.02	55.20	20.02	551	522	411	17.95	63.78	48.45

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS1-D8	2948	2911	2133	31.90	26.99	23.63	124.18	65.80	24.31	528	427	374	38.30	60.74	44.93
PS1-D9	2214	1921	2178	36.87	29.07	18.89	96.43	73.89	24.22	423	352	394	13.15	50.05	42.78
PS1-D10	1784	1660	1695	37.51	28.53	29.52	102.04	61.29	41.72	400	342	364	15.96	47.42	47.41
PS1-D11	1776	1590	1494	41.45	26.45	31.74	103.27	51.84	28.71	390	307	305	31.31	40.03	41.95
PS1-D12	1704	1649	1577	38.14	31.58	26.60	105.58	103.75	34.29	428	409	358	37.98	44.05	44.66
PS1-D13	1833	1496	1402	33.36	28.22	36.68	88.88	50.31	32.46	438	322	337	31.11	43.62	43.46
PS1-D14	257	1394	1479	7.46	24.93	31.69	15.12	42.96	43.76	60	285	347	3.40	39.00	43.51
PS1-D15	1548	1243	1276	36.87	27.77	30.99	89.49	59.42	37.44	357	272	255	29.82	38.47	41.25
PS1-E1	1711	1314	1301	68.04	20.44	47.66	118.66	38.11	50.26	366	262	283	39.03	37.36	44.08
PS1-E2	1383	1174	1179	18.91	16.30	37.20	50.82	58.74	50.17	282	214	255	27.83	38.10	40.51
PS1-E3	1226	1072	1110	33.16	17.71	27.74	66.73	58.95	28.19	252	220	215	29.79	36.91	46.58
PS1-E4	1236	1178	1476	18.34	19.90	27.43	66.43	42.75	25.54	202	193	265	30.67	36.06	47.04
PS1-E5	1670	1675	1454	27.73	22.12	20.80	87.93	46.77	37.14	298	286	260	40.50	44.26	43.82
PS1-E6	2674	2412	2190	21.51	25.47	32.33	61.31	47.88	38.16	413	359	364	49.17	55.37	63.46
PS1-E7	1206	2544	2646	33.36	24.95	25.72	103.98	39.94	24.62	321	429	434	51.53	59.25	84.76
PS1-E8	2415	2306	2025	24.34	29.02	27.12	69.75	62.65	34.57	426	402	356	35.69	59.49	56.25
PS1-E9	1912	1635	1515	34.04	29.03	30.15	135.21	71.35	49.35	401	320	305	21.45	46.50	45.22
PS1-E10	1721	1544	1524	33.24	26.36	34.43	94.08	52.14	42.53	361	293	292	35.60	42.17	48.56
PS1-E11	1752	1681	1573	42.37	28.80	28.74	127.70	80.97	36.00	368	326	310	42.39	45.33	48.78
PS1-E12	1623	1506	1338	30.39	22.65	27.09	102.85	48.57	47.40	344	320	285	40.19	41.42	42.83
PS1-E13	1592	1427	1487	43.28	41.08	30.63	66.94	84.25	27.47	300	263	284	29.29	44.83	43.62
PS1-E14	1449	1340	1408	38.36	31.24	27.29	65.13	60.71	20.33	294	275	266	45.08	44.54	45.18
PS1-E15	1559	1418	1283	31.80	27.16	29.66	80.41	73.88	30.34	342	297	263	33.79	47.97	45.57
PS1-F1	1587	1443	1119	52.45	50.10	25.19	152.14	127.45	56.19	359	313	244	39.70	78.25	37.69
PS1-F2	1418	1268	1052	39.84	51.83	27.94	154.80	109.30	51.69	338	282	247	32.27	48.64	41.49

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS1-F3	1722	1550	1306	28.95	36.27	24.96	93.76	95.59	47.39	395	354	290	24.54	51.32	43.61
PS1-F4	1885	1616	1561	21.27	28.32	17.19	108.47	103.67	24.01	402	373	317	31.68	46.77	45.35
PS1-F5	3525	2038	2250	29.48	27.27	15.24	152.76	51.22	35.55	670	377	401	29.74	49.32	58.80
PS1-F6	1856	1682	1772	27.54	27.76	21.30	76.36	42.28	36.06	383	341	338	40.00	45.47	46.49
PS1-F7	3216	2398	2323	32.20	31.30	16.00	98.78	34.08	26.15	653	414	455	33.27	53.27	57.56
PS1-F8	3073	2233	2180	32.05	36.68	20.69	87.76	51.12	25.24	696	464	381	20.49	59.93	54.88
PS1-F9	1923	1538	1573	42.20	28.16	38.75	157.01	47.77	55.49	436	294	329	26.97	40.86	45.75
PS1-F10	1555	1441	1483	28.74	32.01	31.91	107.04	30.37	42.67	340	272	300	14.38	41.27	45.33
PS1-F11	1417	1430	1322	38.45	27.21	27.01	100.83	32.42	22.28	311	281	258	37.57	43.52	40.64
PS1-F12	1564	1349	1352	38.30	32.51	24.30	90.84	34.76	17.64	343	268	271	23.41	42.45	40.40
PS1-F13	1536	1275	1433	41.82	39.27	24.19	115.91	50.42	18.59	347	277	285	17.64	45.90	43.09
PS1-F14	1499	1240	1302	26.88	43.80	23.25	43.67	54.48	28.62	323	285	268	14.13	39.89	40.07
PS1-F15	1418	1333	1299	27.27	60.71	39.16	65.71	47.55	34.09	348	290	325	16.88	48.02	42.05
PS1-G1	1849	1567	1519	24.84	179.58	24.11	77.14	20.27	27.18	448	331	387	18.02	35.71	45.27
PS1-G2	1397	1299	1474	28.20	26.49	25.74	72.89	24.90	33.10	303	244	279	32.49	31.62	44.82
PS1-G3	1441	1481	1186	24.20	34.49	86.56	57.45	21.73	34.19	291	306	256	11.73	34.39	81.56
PS1-G4	1539	1304	1201	28.20	25.68	78.70	86.26	30.29	24.00	285	236	237	38.80	32.19	70.57
PS1-G5	1435	1311	1278	29.21	25.96	82.72	55.72	23.37	35.80	248	225	238	33.45	33.03	81.39
PS1-G6	1467	1431	1293	28.47	30.32	83.75	64.27	23.58	25.34	256	241	212	32.91	28.32	73.56
PS1-G7	1953	1843	1512	30.79	29.96	99.23	71.22	13.41	42.03	457	353	314	16.39	39.00	89.53
PS1-G8	1869	1223	1556	29.88	21.01	88.38	116.22	15.75	37.44	434	297	331	14.24	37.13	80.87
PS1-G9	1790	1620	1450	30.15	29.68	132.88	93.82	32.50	51.70	374	268	292	38.39	33.46	106.63
PS1-G10	1543	1376	1188	33.37	25.29	110.53	107.70	34.01	42.57	318	229	214	26.73	33.38	92.41
PS1-G11	1217	1229	1062	32.40	28.34	112.21	109.30	40.65	44.77	250	210	220	37.78	30.79	84.93
PS1-G12	1303	997	1090	46.72	27.44	137.42	89.80	36.60	35.49	268	197	217	16.28	28.71	84.99

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg $^{-1}$														
PS1-G13	1272	1088	1059	24.24	33.64	128.45	51.22	47.78	36.47	233	235	212	11.77	29.12	90.09
PS1-G14	1322	1200	1208	25.42	27.34	120.73	278.16	68.16	44.93	296	259	240	16.58	39.93	90.35
PS1-G15	1531	1377	1238	32.05	26.71	94.05	62.76	31.48	36.93	307	258	260	17.13	32.71	80.46
PS1-H1	1966	1722	1645	27.11	31.65	81.67	122.59	59.29	42.70	607	461	503	35.02	40.34	88.45
PS1-H2	2047	1633	1390	45.05	33.37	72.44	80.31	40.82	41.99	446	276	303	15.82	42.41	71.83
PS1-H3	2069	1490	1630	32.08	28.14	57.56	57.09	88.98	38.00	355	277	282	18.04	38.87	74.29
PS1-H4	1667	1575	1979	22.37	27.09	77.05	93.93	87.51	31.77	369	346	328	35.13	36.31	82.60
PS1-H5	1934	1884	1770	28.03	28.08	67.14	71.21	23.38	36.63	354	302	320	18.78	42.71	78.39
PS1-H6	2761	2290	2350	18.81	33.47	57.58	48.88	48.60	36.41	479	400	415	32.49	51.83	88.29
PS1-H7	2674	2452	2540	21.51	26.63	45.87	37.00	34.80	28.81	487	423	537	32.65	46.24	93.58
PS1-H8	2525	2211	2286	18.71	44.47	51.81	82.28	68.57	30.14	626	555	489	15.85	51.94	86.09
PS1-H9	2831	2343	1980	20.00	41.92	104.24	70.20	49.59	67.94	602	479	435	11.87	58.47	104.25
PS1-H10	2068	1689	1604	20.65	44.82	67.55	76.25	84.66	33.07	483	356	339	35.78	51.33	78.59
PS1-H11	2074	1585	1512	23.24	37.83	69.77	118.21	87.46	41.38	510	359	354	38.33	42.06	77.98
PS1-H12	1909	1697	1545	23.60	38.30	33.80	60.71	46.28	50.47	479	391	390	37.22	52.53	52.23
PS1-H13	1677	1515	1363	16.53	30.43	39.43	50.51	28.64	26.46	410	311	274	32.12	42.54	40.21
PS1-H14	1804	1492	1609	30.75	33.83	38.72	66.68	47.07	35.41	413	355	311	20.99	35.36	53.66
PS1-H15	1452	1362	1267	18.49	34.56	32.04	58.47	37.96	32.46	325	287	299	13.11	42.00	46.60
PS1-I1	1418	1059	1101	22.77	21.32	13.63	41.84	33.64	17.74	315	209	207	12.59	27.32	34.54
PS1-I2	1381	1284	1237	25.68	24.98	14.27	67.04	38.01	22.90	279	248	237	13.83	30.35	37.44
PS1-I3	1406	1364	1385	18.58	32.23	33.45	50.87	25.41	23.69	245	243	257	38.05	35.56	46.26
PS1-I4	1635	1616	1507	21.98	32.05	27.47	43.78	12.09	20.84	253	246	249	32.00	38.37	45.56
PS1-I5	1588	1407	1309	21.44	41.83	40.86	62.15	20.55	31.42	257	234	242	37.59	37.68	45.80
PS1-I6	1550	1451	1382	29.06	37.32	41.62	39.29	27.64	43.55	277	255	256	12.35	38.98	54.78
PS1-I7	1956	1780	1839	21.35	37.40	19.29	55.51	30.67	13.85	378	337	342	11.65	42.60	47.60

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS1-I8	2635	2225	2189	13.34	29.96	22.17	63.45	33.38	41.78	386	352	342	31.70	49.38	62.28
PS1-I9	1846	1819	1799	32.20	53.05	24.76	74.78	42.92	35.21	345	369	322	34.59	50.21	51.41
PS1-I10	1800	1723	1604	26.06	36.70	24.44	35.11	25.51	5.02	349	304	306	13.04	45.05	42.32
PS1-I11	2005	1813	1826	30.44	28.01	20.28	63.06	38.82	17.10	434	375	368	16.61	44.79	47.70
PS1-I12	2265	2467	2471	15.54	26.96	31.63	88.44	28.75	34.57	372	324	349	34.55	51.32	69.95
PS1-I13	2909	2144	2229	13.73	33.05	28.23	26.24	37.25	51.39	325	279	288	13.62	50.92	65.72
PS1-I14	1902	1675	1598	22.74	28.26	11.76	82.73	26.53	22.67	333	284	276	35.53	40.52	44.23
PS1-I15	1962	1991	1968	43.69	56.77	39.10	77.45	42.15	28.51	379	400	369	15.28	51.73	63.77
PS1-J1	1822	1525	1704	24.34	24.00	26.60	70.76	20.55	33.10	346	278	283	26.16	37.09	53.25
PS1-J2	1813	1644	1213	26.49	33.51	17.75	56.11	21.85	18.36	317	284	211	19.44	45.62	37.00
PS1-J3	3153	1310	1200	16.44	25.01	22.49	20.03	15.92	16.69	381	225	210	14.37	29.60	35.90
PS1-J4	1509	1409	1301	22.91	29.78	38.83	34.91	21.26	30.34	258	243	225	12.77	33.91	51.03
PS1-J5	1456	1286	1238	18.99	22.01	19.10	36.15	21.43	16.93	223	227	207	30.37	28.36	36.56
PS1-J6	1499	1446	1333	25.97	38.51	29.65	38.93	30.15	27.17	230	230	233	10.13	41.31	37.39
PS1-J7	1995	1860	1729	30.26	33.23	26.54	74.06	30.47	20.94	297	288	288	32.55	40.91	48.17
PS1-J8	2231	1915	2062	31.89	42.03	23.19	42.55	39.80	45.26	325	310	331	10.55	43.84	52.13
PS1-J9	1892	1683	1689	26.89	29.51	21.95	55.92	30.37	21.33	326	280	266	30.86	33.40	41.49
PS1-J10	1911	1687	1580	29.22	29.06	22.92	57.66	27.86	18.72	305	260	268	35.08	40.60	41.96
PS1-J11	2404	2445	2242	15.81	32.92	15.40	61.54	32.12	18.95	307	321	337	31.35	53.56	53.24
PS1-J12	2837	2532	2495	13.54	23.85	27.90	36.39	29.15	34.26	374	325	376	13.47	49.44	70.88
PS1-J13	1361	2796	2736	20.09	31.53	29.01	49.80	24.49	36.33	209	354	353	12.60	56.53	68.27
PS1-J14	3357	3448	3225	15.10	39.37	28.97	49.59	50.41	33.51	354	386	363	15.18	72.45	80.45
PS1-J15	2860	1350	2518	54.62	32.80	151.63	90.70	81.21	140.63	467	303	515	16.35	59.15	68.41
PS2-A1	1799	1969	1657	22.19	45.74	35.41	81.50	56.06	117.69	379	369	364	21.22	69.47	48.53
PS2-A2	2234	2014	1750	20.27	32.69	22.85	70.69	82.58	88.42	359	386	352	20.86	98.51	74.48

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS2-A3	2540	2497	2227	45.50	34.12	51.61	77.86	100.21	29.32	353	341	439	42.62	74.60	59.92
PS2-A4	1725	1512	1525	36.73	30.45	22.79	79.26	39.33	31.08	276	254	264	25.78	37.97	42.42
PS2-A5	1173	1150	1609	23.20	24.58	20.91	46.22	127.76	109.42	250	249	330	21.90	52.45	45.07
PS2-A6	861	749	749	44.66	27.58	23.79	73.13	36.39	37.95	166	174	196	57.22	40.85	30.07
PS2-A7	749	861	789	33.69	28.02	39.14	43.26	31.99	59.73	195	201	265	25.19	50.72	33.31
PS2-A8	.	973	780	.	30.68	20.46	.	48.79	22.37	.	243	209	.	45.33	32.25
PS2-B1	2319	1858	1875	12.06	31.33	49.42	108.95	63.42	86.26	482	375	392	13.90	58.54	66.24
PS2-B2	2956	2761	2293	14.32	24.37	26.40	116.65	111.66	61.13	407	394	364	14.63	60.74	65.31
PS2-B3	2403	1949	2272	16.62	26.01	24.46	67.29	174.71	90.01	379	332	377	15.76	54.27	66.90
PS2-B4	1220	1194	1253	23.70	32.20	29.25	69.44	46.97	82.24	320	298	434	17.88	43.90	38.20
PS2-B5	776	801	910	15.64	25.32	19.63	48.36	225.10	57.82	231	210	341	19.12	49.59	29.90
PS2-B6	938	1121	1048	51.98	37.21	49.97	81.43	284.90	88.37	266	267	320	51.06	59.49	53.97
PS2-B7	972	923	970	45.34	33.09	31.21	72.38	56.06	78.96	241	198	297	42.83	45.93	36.71
PS2-B8	1104	1243	994	41.48	33.33	25.51	108.62	558.16	85.58	259	276	285	17.90	51.12	37.24
PS2-C1	1727	1813	1541	36.57	37.65	24.51	1205.57	57.22	301.25	1727	353	322	29.26	65.66	48.25
PS2-C2	1922	1908	1778	39.13	25.85	43.70	1039.86	37.81	52.51	1922	305	338	21.48	63.32	65.51
PS2-C3	1752	1878	1943	21.99	40.06	23.74	1039.32	50.62	32.31	1752	356	341	21.20	72.68	49.21
PS2-C4	1162	1232	1132	34.06	33.47	23.06	1139.79	37.56	30.77	1162	241	275	18.24	57.40	38.42
PS2-C5	.	970	973	.	39.21	22.33	.	55.29	36.47	.	222	220	.	58.44	34.20
PS2-C6	763	868	781	26.20	25.84	19.60	1242.44	39.38	17.03	763	168	190	16.32	51.43	31.42
PS2-C7	580	724	601	20.45	29.13	20.94	1297.97	23.79	27.28	580	143	138	17.92	46.72	28.31
PS2-C8	676	760	662	22.29	22.72	18.50	1168.55	50.10	19.44	676	149	157	25.39	36.70	27.89
PS2-D1	1614	1639	1726	20.76	20.66	27.34	1518.15	88.73	68.83	1614	392	452	19.03	43.90	45.99
PS2-D2	2155	1866	1923	22.40	17.63	18.72	1279.54	88.98	60.17	2155	380	389	17.75	46.16	51.61
PS2-D3	2164	1893	2290	12.56	24.20	10.86	1155.72	105.18	52.82	2164	358	360	10.14	43.51	52.75

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS2-D4	976	997	921	19.83	23.03	14.89	1329.08	44.04	34.80	976	254	267	15.54	33.09	32.57
PS2-D5	942	898	708	26.59	24.64	13.63	1357.40	44.11	57.82	942	242	194	24.23	31.19	32.79
PS2-D6	1013	956	1402	28.99	21.03	23.81	1307.07	38.77	37.96	1013	260	303	17.91	25.82	41.49
PS2-D7	1065	961	1019	13.45	19.00	31.00	1009.72	46.02	47.81	1065	244	283	11.71	29.72	35.93
PS2-D8	928	924	949	28.85	23.66	19.17	1213.13	57.47	24.63	928	250	244	22.30	28.56	32.47
PS2-E1	1578	1599	1421	23.28	36.91	31.66	70.73	50.00	40.56	333	359	363	19.74	52.76	43.98
PS2-E2	1569	1591	1595	36.94	36.57	25.17	46.52	209.59	20.13	286	286	315	29.61	61.84	45.52
PS2-E3	1467	1373	1374	28.68	27.77	26.45	47.92	264.48	26.36	257	263	259	19.37	53.34	41.10
PS2-E4	1064	1027	1043	36.62	29.19	36.39	76.48	45.33	32.62	242	218	256	18.59	39.02	38.41
PS2-E5	911	866	899	39.69	34.49	37.40	61.08	26.22	23.30	209	180	211	19.18	55.15	34.23
PS2-E6	845	818	861	29.78	45.16	40.80	56.71	31.71	41.07	187	193	209	23.47	64.03	36.27
PS2-E7	845	702	738	37.63	48.03	36.28	67.02	28.14	23.50	196	130	159	22.42	62.05	30.71
PS2-E8	575	536	690	98.63	46.23	37.98	56.70	32.24	17.27	203	161	164	19.51	49.12	31.31
PS2-F1	1806	1679	2184	10.09	45.52	44.17	66.10	110.61	142.47	504	451	579	11.26	51.22	60.47
PS2-F2	2099	1996	1783	15.34	32.92	24.88	78.13	88.48	112.28	409	371	327	15.22	51.83	50.48
PS2-F3	1677	2069	1557	26.65	24.56	23.20	84.78	68.06	54.34	335	321	347	17.59	41.98	46.06
PS2-F4	911	998	1166	22.60	16.91	32.40	52.40	56.31	96.44	277	270	336	18.13	23.10	38.64
PS2-F5	1013	953	929	20.15	17.21	32.28	68.90	54.97	43.01	285	244	268	14.35	22.83	33.21
PS2-F6	1184	1083	1358	31.96	23.88	45.67	83.48	51.12	43.29	330	253	296	19.46	41.52	41.33
PS2-F7	953	1003	1177	51.94	24.46	26.73	73.59	32.73	60.24	249	214	328	21.30	34.40	38.39
PS2-F8	972	919	1145	22.38	37.57	51.40	78.86	34.90	66.65	241	208	359	17.71	37.50	40.28
PS2-G1	1666	1614	1494	48.72	25.00	36.88	64.75	48.19	59.87	373	355	345	34.76	32.33	47.18
PS2-G2	1782	1596	1806	23.95	34.00	28.98	62.69	51.63	60.44	338	304	373	22.16	51.02	50.64
PS2-G3	1421	1375	1177	22.84	27.17	21.63	53.76	41.30	56.45	265	259	259	19.24	31.68	39.11
PS2-G4	1198	1190	1303	18.34	20.77	30.55	20.02	19.82	37.14	236	233	288	13.21	26.73	39.73

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS2-G5	936	1045	1137	26.43	36.81	23.97	48.87	37.96	28.61	203	199	260	23.39	37.53	34.87
PS2-G6	980	917	927	30.33	29.57	28.32	43.81	25.00	22.58	195	186	212	26.04	39.32	32.36
PS2-G7	722	645	837	27.12	32.10	36.63	52.85	19.34	28.61	149	126	143	18.58	39.00	32.80
PS2-G8	700	566	777	29.91	21.77	33.42	23.89	8.37	31.06	132	91	177	20.86	30.82	30.85
PS2-H1	1989	1869	1549	25.11	35.12	20.10	127.25	164.14	43.11	526	525	410	23.18	45.49	43.59
PS2-H2	2705	2182	2183	24.55	21.37	21.45	124.45	68.16	70.42	502	411	497	15.97	42.44	56.01
PS2-H3	2130	2164	1821	27.70	23.33	16.15	167.13	102.75	41.68	473	487	366	24.51	44.43	47.89
PS2-H4	1466	1917	1625	27.24	36.73	10.09	91.21	143.91	34.43	397	552	437	15.88	45.44	40.75
PS2-H5	1247	1329	1232	26.56	25.73	17.18	88.11	69.90	43.62	331	345	292	16.65	29.57	39.87
PS2-H6	960	1055	1109	46.98	15.85	19.72	75.46	41.22	27.49	249	257	280	19.69	28.79	36.01
PS2-H7	728	780	897	32.63	25.11	19.77	64.34	52.95	24.51	164	195	209	16.76	34.65	33.98
PS2-H8	971	924	1089	36.09	24.61	28.07	56.03	56.63	44.62	216	196	271	15.05	32.93	35.77
PS2-I1	2042	1888	1899	53.21	37.58	27.97	82.01	59.83	35.72	339	422	410	51.08	62.16	54.47
PS2-I2	2107	2108	1946	22.46	35.78	25.64	71.94	50.82	43.29	352	332	367	23.06	66.91	53.88
PS2-I3	2069	2050	1910	23.60	31.13	24.45	69.32	50.72	31.75	411	339	367	18.04	68.84	51.08
PS2-I4	1933	2008	2125	32.74	32.17	24.78	66.23	39.63	44.13	382	369	363	20.68	62.01	56.13
PS2-I5	1333	1240	1350	44.21	29.49	26.67	56.29	27.75	35.47	375	320	363	20.06	49.82	42.86
PS2-I6	1014	1005	1061	41.97	25.60	23.23	47.80	31.61	20.05	245	222	246	24.67	40.40	37.19
PS2-I7	659	751	653	30.63	33.74	29.96	45.94	24.70	30.16	143	171	161	24.30	46.13	31.22
PS2-I8	566	594	874	28.39	26.62	22.94	67.83	23.16	19.94	136	145	208	23.59	45.33	33.63
PS2-J1	2428	2437	2165	13.14	41.77	33.24	89.38	122.65	132.20	590	606	562	12.70	68.16	56.33
PS2-J2	3691	2467	2247	11.44	39.85	23.80	170.97	136.56	123.15	550	511	534	12.11	69.34	59.25
PS2-J3	3241	3079	2547	14.75	32.37	21.84	120.54	129.58	134.30	440	451	501	16.20	71.04	63.42
PS2-J4	4217	4121	3100	25.99	36.23	33.88	131.07	111.53	102.98	385	391	475	20.58	90.00	72.63
PS2-J5	2576	2409	2434	19.01	42.43	26.63	110.61	131.90	90.51	496	509	478	16.95	68.13	64.13

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PS2-J6	2753	2810	1627	13.49	31.53	21.71	161.70	114.64	58.82	569	531	471	12.53	68.97	45.20
PS2-J7	1693	1551	1926	12.98	44.01	14.02	88.57	87.62	77.44	605	508	672	13.51	62.52	54.18
PS2-J8	2046	2313	2167	11.38	28.61	23.41	93.40	131.09	89.75	796	629	552	15.71	61.75	61.81
PS2-K1	2023	2133	2686	37.06	30.87	22.65	86.72	52.95	58.74	439	416	441	30.40	62.71	66.18
PS2-K2	2308	2324	1987	22.71	34.72	28.25	71.20	38.47	46.99	425	404	420	17.00	64.89	54.79
PS2-K3	2388	2459	2452	20.95	39.30	20.91	96.67	75.20	26.96	461	467	427	15.57	73.16	59.04
PS2-K4	2296	2366	2002	16.15	29.85	19.90	74.70	56.94	39.59	380	417	391	15.73	69.18	56.97
PS2-K5	1613	1560	1603	22.92	20.87	18.01	143.35	34.42	28.29	363	328	388	17.67	49.78	42.95
PS2-K6	1298	1086	1247	26.49	18.72	20.79	63.66	36.60	26.26	360	280	332	22.27	41.36	38.94
PS2-K7	965	1018	926	28.41	26.07	23.11	44.41	33.41	28.28	249	244	240	19.97	54.26	34.88
PS2-K8	652	868	1016	41.93	22.54	27.06	71.79	36.44	29.53	189	208	238	32.53	51.43	43.81
PS2-L1	2018	2212	2149	19.85	25.49	31.41	114.27	85.51	112.24	554	556	612	14.73	52.96	59.18
PS2-L2	3338	2498	2682	31.40	31.24	31.27	163.60	74.39	82.65	490	423	442	27.13	66.12	69.67
PS2-L3	3496	3458	3185	21.21	29.50	29.49	144.51	72.57	72.94	405	367	410	17.06	76.63	70.39
PS2-L4	3739	3305	2698	18.17	30.61	27.40	122.07	80.31	74.29	445	431	419	17.67	78.98	67.09
PS2-L5	2145	2084	2371	26.29	35.22	19.68	97.32	67.28	65.02	435	403	431	19.07	64.13	56.82
PS2-L6	2873	2045	2127	23.99	28.58	20.16	136.02	108.98	56.50	561	471	447	29.21	58.06	58.59
PS2-L7	2266	2141	1714	15.86	25.35	43.93	169.62	100.41	100.84	795	730	491	17.44	61.53	55.19
PS2-L8	2190	1600	1677	15.18	41.84	17.25	134.68	119.45	80.71	733	510	567	15.64	62.76	49.89
PS2-M1	1747	1657	1632	26.47	29.85	24.59	81.87	170.03	61.30	416	344	360	22.24	56.31	51.61
PS2-M2	934	2174	2128	21.32	37.11	21.52	56.47	38.57	42.37	279	347	365	21.73	66.00	54.97
PS2-M3	3086	2874	2595	26.25	30.13	20.43	48.29	32.01	41.99	423	381	404	18.31	73.48	66.90
PS2-M4	2693	2826	2473	19.47	30.83	23.37	45.18	27.44	46.99	434	409	435	18.72	76.02	66.08
PS2-M5	2117	2014	1127	46.68	30.12	24.28	110.30	34.25	36.63	393	359	318	41.71	61.79	41.37
PS2-M6	1719	1248	1919	36.38	24.42	18.53	77.16	28.13	43.83	354	280	350	31.90	52.23	52.95

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg $^{-1}$														
PS2-M7	1208	1199	1525	29.95	22.13	23.87	132.45	40.53	35.35	317	285	341	25.54	46.33	48.67
PS2-M8	906	960	981	23.73	27.20	24.97	42.26	34.22	38.26	253	231	299	22.64	55.88	40.92
PR-A1	3744	3903	4029	21.85	31.18	16.89	51.41	23.99	84.52	485	366	468	19.96	78.36	89.73
PR-A2	3677	3780	3269	18.62	37.76	15.31	106.95	73.30	50.78	360	450	441	22.34	88.33	76.96
PR-A3	3997	3406	2515	11.29	27.23	13.12	61.88	16.40	31.36	307	242	282	34.10	68.43	62.18
PR-A4	2361	2464	2196	14.50	24.42	19.08	51.54	22.89	26.05	332	257	294	15.23	64.43	77.16
PR-A5	1977	2126	1839	11.17	25.64	11.90	46.13	13.52	24.62	185	174	211	26.76	58.34	52.54
PR-A6	1658	1979	2248	18.55	22.52	12.33	56.84	20.25	37.55	345	251	328	13.75	57.20	57.34
PR-A7	1889	2278	1901	20.33	30.22	15.49	54.98	49.70	46.98	382	272	261	16.22	60.78	51.34
PR-A8	1447	1336	1323	16.65	18.61	12.57	59.05	16.03	26.97	315	208	244	13.83	35.19	39.09
PR-A9	1533	1017	1379	14.02	24.43	17.53	35.57	28.84	40.31	227	233	254	15.61	31.48	46.70
PR-A10	1206	1758	1360	21.39	22.10	20.67	36.87	53.15	30.87	227	349	247	14.03	49.71	38.81
PR-A11	1166	4003	1566	17.85	28.44	14.30	49.73	121.05	35.96	255	258	250	11.07	75.72	43.40
PR-B1	3922	4021	3624	8.64	64.33	19.25	64.44	45.17	43.45	366	348	531	11.64	76.53	80.33
PR-B2	3470	3852	2955	12.97	22.44	14.85	52.12	46.73	38.77	427	353	457	15.52	73.88	75.53
PR-B3	3785	3474	3746	5.80	24.70	16.79	80.82	42.99	32.72	389	367	317	33.19	69.82	95.91
PR-B4	2856	2091	3162	11.90	19.94	10.49	70.48	17.76	36.06	376	392	389	16.82	47.00	75.73
PR-B5	2058	2280	2317	4.36	25.91	15.80	41.40	12.55	48.33	416	316	430	13.05	53.05	62.14
PR-B6	1853	1809	2298	10.85	15.50	10.67	34.65	14.84	26.97	252	320	340	32.40	45.38	57.87
PR-B7	2150	1369	1536	8.67	19.79	13.93	28.60	16.43	30.83	351	250	300	31.19	36.58	45.09
PR-B8	1359	1778	1374	13.28	17.82	14.00	37.32	15.43	18.16	224	195	234	14.50	46.47	40.96
PR-B9	1405	1002	1259	14.37	16.58	11.82	30.78	19.34	24.52	166	164	180	13.32	39.67	37.40
PR-B10	971	982	1232	11.89	16.43	14.60	57.42	9.73	25.85	159	161	206	8.97	35.05	38.80
PR-B11	1131	1429	1428	6.68	18.01	13.35	38.58	19.39	24.10	240	189	230	11.29	43.05	43.93
PR-C1	4175	4653	3913	15.08	30.13	13.48	67.67	62.62	43.08	440	352	383	31.36	89.94	85.40

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg $^{-1}$														
PR-C2	3299	3752	3142	12.34	27.71	25.54	20.93	32.47	69.23	405	391	446	16.38	73.71	72.28
PR-C3	2664	2429	2388	10.26	21.67	13.38	82.08	18.73	40.30	627	484	552	17.98	52.13	57.74
PR-C4	1435	2041	1835	82.94	21.14	12.69	87.32	38.72	33.38	275	353	472	44.77	59.29	54.78
PR-C5	2054	1598	2015	9.21	18.89	10.76	30.69	17.58	31.24	552	309	371	14.69	43.58	52.23
PR-C6	1173	1440	1252	9.95	18.05	9.95	37.03	14.07	24.73	427	329	231	10.97	40.03	39.58
PR-C7	2040	1379	1457	10.47	21.45	10.81	58.92	14.94	26.97	359	218	271	34.36	39.54	42.41
PR-C8	1343	1720	1276	16.80	24.29	14.02	54.95	36.33	35.25	322	332	298	28.35	50.79	41.62
PR-C9	1389	1257	1172	14.07	23.30	9.87	52.63	25.21	19.31	214	197	196	12.84	39.99	37.59
PR-C10	1371	921	1133	17.14	15.21	15.02	62.40	4.73	31.26	319	155	251	18.30	36.08	35.07
PR-C11	1307	1273	1576	15.60	23.03	14.36	18.01	57.42	23.19	222	218	243	14.14	44.07	46.73
PR-D1	3579	3890	2924	23.68	28.14	11.24	98.59	46.68	32.21	432	398	368	24.43	77.24	71.81
PR-D2	2247	3595	1927	8.69	36.33	28.05	59.84	64.48	56.90	353	442	390	13.17	77.95	55.61
PR-D3	1962	1807	1544	13.44	24.24	14.17	52.43	55.80	33.78	411	386	452	38.03	52.65	47.74
PR-D4	1330	1450	1260	12.62	12.73	12.53	25.27	42.35	28.31	311	351	357	15.00	40.99	44.82
PR-D5	1360	1857	2188	9.30	22.23	13.73	44.24	34.08	23.91	296	368	350	13.99	53.16	59.99
PR-D6	1078	865	938	13.31	16.38	13.73	56.90	23.99	24.31	321	269	304	30.79	39.71	33.92
PR-D7	843	1389	871	9.17	21.14	16.71	56.03	18.16	28.61	315	265	279	10.15	43.78	33.01
PR-D8	673	2679	2052	7.26	25.39	44.30	86.37	63.11	52.71	228	541	257	11.59	59.46	52.84
PR-D9	1118	616	1135	9.91	12.49	16.10	52.38	26.94	37.23	207	258	278	13.36	33.36	37.73
PR-D10	760	1153	1132	12.12	19.90	11.49	46.22	50.21	21.95	236	311	228	14.74	41.33	42.36
PR-D11	1089	1114	1186	12.25	19.76	14.25	67.93	30.00	26.15	280	268	262	15.95	37.56	44.41
PR-E1	3236	2707	2697	10.90	32.64	10.28	92.81	58.74	39.18	405	380	399	36.80	69.62	69.85
PR-E2	3402	3327	2203	12.93	24.97	12.86	60.53	45.98	33.38	371	420	314	17.87	72.60	60.81
PR-E3	1422	1477	1440	9.78	22.72	12.34	55.32	29.46	42.74	306	273	332	16.74	52.34	46.70
PR-E4	1218	1172	1163	13.22	25.56	10.19	24.13	69.34	21.98	331	234	282	13.55	57.50	40.03

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PR-E5	1080	1277	948	15.35	13.74	8.34	38.27	8.83	24.11	243	285	216	14.62	35.33	34.86
PR-E6	959	989	1125	9.06	19.13	15.58	44.69	12.35	26.97	184	188	216	11.88	34.81	38.55
PR-E7	1040	1088	1350	15.08	19.69	14.61	36.82	18.32	33.58	227	227	322	15.32	36.57	44.76
PR-E8	963	842	872	8.37	12.71	11.49	37.24	25.10	21.85	211	144	195	10.80	35.49	33.68
PR-E9	1342	1111	1160	12.71	20.63	16.37	81.78	41.02	32.69	269	211	226	31.00	46.24	45.50
PR-E10	863	1854	1165	5.18	24.12	8.79	41.88	29.17	24.93	244	310	244	13.60	50.82	39.90
PR-E11	856	1110	1113	11.21	22.10	10.39	72.88	42.58	25.23	261	255	261	14.96	43.63	38.98
PR-F1	2957	3341	2887	13.15	37.89	18.73	88.07	37.15	40.66	383	368	462	25.14	86.35	71.62
PR-F2	1801	2800	1996	12.63	24.63	21.63	45.16	20.63	51.49	341	332	381	16.42	59.05	58.26
PR-F3	1459	1514	1482	15.96	18.43	10.08	73.72	41.22	26.16	299	254	266	32.41	42.36	48.82
PR-F4	1127	976	1268	9.75	14.62	15.50	43.46	17.11	39.08	275	182	337	12.18	30.21	44.82
PR-F5	1083	1406	969	14.82	22.95	11.56	68.02	26.42	29.75	263	403	232	35.06	38.44	35.28
PR-F6	1068	1062	973	12.37	33.86	10.05	49.45	22.86	21.39	321	256	224	10.82	45.21	33.26
PR-F7	996	1052	1015	6.45	18.02	13.72	26.95	47.79	27.88	223	322	208	12.51	36.41	39.13
PR-F8	1141	1076	860	10.35	24.35	11.40	58.93	34.18	35.08	249	208	217	16.02	43.43	33.67
PR-F9	921	1267	946	11.95	29.85	12.63	82.32	100.12	29.01	234	285	219	26.64	56.89	36.83
PR-F10	834	1328	922	9.47	25.24	14.80	7.58	47.16	23.82	183	284	212	13.54	48.73	38.61
PR-F11	831	968	887	11.21	28.63	12.97	37.28	41.00	26.97	200	211	203	12.94	48.46	38.17
PR-G1	2508	3224	3096	8.62	28.89	14.81	30.63	37.00	47.61	345	391	444	11.57	67.36	76.85
PR-G2	2328	3029	2162	12.87	30.32	19.87	62.28	34.82	47.80	401	557	474	16.74	69.24	63.56
PR-G3	1900	1949	1795	7.76	25.98	23.77	41.73	28.54	54.64	434	394	420	31.61	53.04	59.28
PR-G4	3572	1371	1516	13.42	27.98	14.19	119.78	43.12	29.12	555	254	329	39.64	46.35	50.29
PR-G5	1319	993	1457	8.36	25.94	13.58	36.98	13.21	26.77	351	150	274	11.40	40.39	48.58
PR-G6	928	1103	1170	13.25	19.95	14.15	69.83	20.57	33.71	245	243	237	16.05	41.52	43.75
PR-G7	1602	761	991	11.38	14.56	13.43	73.07	12.20	18.42	411	201	176	26.55	27.24	39.47

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg $^{-1}$														
PR-G8	539	712	1141	11.04	16.62	21.59	26.44	14.84	54.06	168	167	274	14.41	31.34	45.47
PR-G9	1269	1023	790	13.51	17.84	12.32	93.44	21.56	19.31	271	202	173	21.51	41.86	37.18
PR-G10	804	767	699	24.67	19.90	16.58	68.96	28.56	42.81	199	181	186	38.47	34.35	37.05
PR-G11	727	888	780	10.47	25.29	15.70	49.49	49.41	31.26	173	195	182	18.67	51.52	35.01
PR-H1	3406	3434	2815	7.34	31.16	16.93	87.86	54.55	52.82	512	422	470	13.36	77.34	77.57
PR-H2	3132	2139	2183	9.28	24.22	25.51	70.24	44.69	57.82	600	544	462	18.69	62.14	67.21
PR-H3	2747	2574	2041	10.13	23.58	13.35	160.95	39.64	53.41	752	676	473	18.62	59.05	60.16
PR-H4	1783	2798	1547	6.99	29.50	16.03	135.68	61.95	41.64	523	491	386	17.45	68.63	53.16
PR-H5	1886	1904	1864	13.29	36.45	15.19	87.67	61.91	43.08	421	374	450	14.87	67.66	55.01
PR-H6	1509	1286	1605	15.24	24.89	16.99	67.79	65.31	27.39	274	264	295	16.16	49.28	50.34
PR-H7	1101	1021	1275	13.12	20.48	11.43	49.95	58.58	29.42	226	197	297	15.05	47.03	41.34
PR-H8	1266	962	1198	10.41	10.43	9.95	62.21	58.16	76.93	280	241	421	15.55	34.39	42.51
PR-H9	1263	1019	1139	11.87	18.73	13.86	80.94	40.35	22.78	292	215	284	16.12	39.90	41.94
PR-H10	1374	1178	1554	10.63	26.92	14.94	63.52	89.44	63.09	321	317	411	12.62	49.82	52.94
PR-H11	1072	1013	1317	10.09	20.09	22.21	45.93	41.10	37.70	235	242	264	12.56	43.37	49.25
PR-I4	2355	1934	2751	10.19	27.36	14.46	66.31	68.40	54.67	596	461	578	11.33	60.57	70.88
PR-I5	1780	1628	1500	19.45	22.93	18.10	53.04	75.52	27.79	407	372	297	34.86	45.89	48.38
PR-I6	1810	1261	1901	20.10	31.92	18.28	70.36	60.23	39.23	360	275	337	32.67	41.16	56.03
PR-I7	1179	1337	1457	11.78	36.74	16.34	67.63	27.33	27.17	230	299	368	12.66	52.13	45.36
PR-I8	1525	958	1255	15.17	36.81	18.84	71.88	86.41	49.85	377	262	326	35.04	49.76	48.25
PR-I9	2714	1459	2090	11.32	30.82	15.35	106.09	47.87	44.57	450	404	528	14.50	53.76	59.28
PR-I10	1237	1087	1586	12.88	26.01	16.88	36.50	68.36	39.84	270	297	331	16.08	44.92	53.46
PR-I11	1044	1105	1175	14.00	25.20	11.17	69.53	63.52	23.70	247	289	273	18.21	46.19	40.49
PR-J6	2405	1894	1755	13.10	33.67	16.73	103.81	42.05	34.94	524	408	344	15.87	49.54	55.10
PR-J7	2251	2552	2085	30.85	31.31	18.71	126.64	112.63	48.11	618	712	399	45.80	67.25	58.31

Table Cont.

Sample ID	Ca			P			K			Mg			S		
	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09	Sept08	Jan09	May09
	mg kg^{-1}														
PR-J8	2245	2192	2125	9.82	30.84	16.76	89.58	48.48	50.27	638	632	466	17.69	57.32	59.99
PR-J9	1741	1839	2051	7.99	25.40	13.65	43.65	51.93	34.46	440	520	393	12.72	55.17	58.72
PR-J10	1768	1290	1518	6.50	26.79	19.90	38.50	31.10	32.77	466	254	313	11.37	45.97	49.58
PR-J11	1202	1243	1479	11.90	28.03	24.73	45.60	26.42	42.84	257	284	338	12.83	43.92	48.86
PR-K6	3175	2576	2566	13.33	32.45	19.39	44.59	41.77	52.21	587	554	528	11.93	64.84	71.11
PR-K7	3011	2891	2289	11.12	29.40	13.97	59.21	39.99	40.41	551	564	407	16.51	69.04	63.15
PR-K8	2123	1737	2095	15.28	31.50	17.14	73.83	43.33	39.38	505	403	456	15.70	46.38	60.10
PR-K9	1755	1934	1923	13.83	25.68	21.69	63.59	26.62	41.52	382	325	412	14.43	50.60	54.88
PR-K10	1616	1345	1754	18.50	21.68	28.02	54.64	14.52	41.27	264	224	379	36.06	43.03	55.20
PR-K11	1865	2422	1801	8.92	19.67	16.88	44.00	42.35	34.60	240	405	320	13.09	54.65	53.25

APPENDIX E
LAB ANALYSIS DATA FOR SOIL MICRO/BENEFICIAL NUTRIENTS

Sample ID	Al Sept 08	Al Jan 09	Al May 09	Cu Sept 08	Cu Jan 09	Cu May 09	Fe Sept 08	Fe Jan 09	Fe May 09	Mn Sept 08	Mn Jan 09	Mn May 09	Na Sept 08	Na Jan 09	Na May 09	Zn Sept 08	Zn Jan 09	Zn May 09
	mg kg^{-1}																	
PS1A1	714	856	875	2.4	2.9	2.7	316	401	443	164	214	201	0	76	40	1.8	1.8	4.0
PS1A2	577	682	670	3.3	2.9	2.9	303	424	410	293	304	339	177	89	88	2.3	2.4	2.7
PS1A3	470	661	673	3.3	2.9	2.8	305	333	362	279	312	297	149	85	59	2.1	1.5	1.8
PS1A4	467	630	793	3.2	3.1	2.9	280	369	326	256	293	211	173	95	59	1.4	1.9	2.5
PS1A5	401	568	659	3.9	3.3	3.0	272	349	378	192	192	167	171	88	41	2.4	3.7	2.9
PS1A6	623	746	894	2.9	3.2	2.6	209	271	309	173	198	150	2	74	21	1.7	1.9	1.9
PS1A7	681	888	971	3.2	2.9	2.7	212	261	330	102	123	118	154	63	34	3.0	2.9	2.3
PS1A8	861	1176	1084	3.1	2.7	2.7	367	499	503	72	87	116	124	77	47	3.2	2.3	2.7
PS1A9	1146	1289	1269	2.5	1.5	3.0	477	554	486	64	101	83	119	69	35	2.1	2.8	1.4
PS1A10	1172	1215	1439	3.4	2.4	1.9	473	498	549	103	112	71	132	67	9	4.0	2.7	0.8
PS1A11	982	1183	1333	3.0	3.0	2.5	428	573	500	95	146	75	120	73	17	3.0	3.3	1.4
PS1B1	1176	1231	1139	3.2	2.3	2.4	553	542	562	88	137	174	145	70	17	2.2	1.8	1.4
PS1B2	996	1140	1262	2.6	2.6	2.7	377	490	526	120	168	180	116	68	25	1.2	1.6	1.0
PS1B3	922	911	968	2.6	2.5	2.2	341	327	298	228	266	258	10	61	18	1.5	1.6	1.2
PS1B4	724	839	838	2.4	2.6	2.5	246	350	261	289	385	388	118	72	13	1.2	2.0	1.5
PS1B5	516	813	730	3.0	2.9	2.6	247	261	294	230	243	294	101	70	46	1.9	1.7	1.0
PS1B6	491	743	836	3.4	3.2	2.6	228	260	243	178	191	212	156	63	39	2.4	1.9	1.3
PS1B7	641	840	727	3.8	3.1	3.0	264	256	241	155	150	142	178	72	37	2.9	1.7	2.0
PS1B8	631	911	897	1.9	2.7	2.6	184	287	269	112	149	130	126	27	33	2.0	1.9	1.5
PS1B9	918	1167	1123	2.6	3.1	2.8	400	444	610	80	66	96	0	64	34	2.5	1.4	2.8
PS1B10	1085	1295	1396	2.9	2.8	2.6	431	548	497	120	80	88	2	67	32	3.2	1.5	1.6
PS1B11	1110	1356	1326	3.1	2.9	2.4	403	521	524	121	91	99	132	60	19	4.4	2.0	1.8

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS1-B12	1205	1353	1356	2.8	2.7	2.4	498	552	492	89	99	101	0	72	30	2.6	2.2	1.6
PS1-B13	1271	1405	1299	2.8	3.1	2.3	510	508	543	69	67	99	0	61	18	3.2	1.5	2.9
PS1-C1	1072	1180	1130	3.6	2.1	1.1	600	618	674	64	86	145	112	45	26	2.9	3.5	3.9
PS1-C2	1033	1169	989	3.1	2.9	1.2	544	597	702	69	98	153	38	83	34	1.5	2.2	2.8
PS1-C3	741	914	1168	3.8	3.1	2.6	368	354	542	178	252	225	159	44	59	2.9	1.8	1.7
PS1-C4	904	1017	985	2.7	3.2	2.5	371	356	318	246	355	380	0	61	37	1.4	1.7	1.1
PS1-C5	641	881	795	3.2	3.2	2.8	329	469	354	222	285	369	141	72	80	2.6	1.9	1.6
PS1-C6	643	798	813	3.5	3.8	3.1	335	386	390	192	203	216	18	73	82	1.5	1.9	1.8
PS1-C7	450	700	798	3.5	3.2	3.3	191	217	309	140	138	133	133	55	22	2.5	1.5	2.3
PS1-C8	473	675	666	3.0	2.9	2.9	175	238	256	164	210	203	151	44	43	2.5	2.1	2.3
PS1-C9	793	1043	1059	2.9	3.1	2.4	336	348	351	85	92	106	141	50	33	2.6	1.2	1.6
PS1-C10	983	1329	1407	2.9	2.9	2.5	418	557	537	81	86	86	134	51	24	3.6	2.9	2.2
PS1-C11	1093	1223	1378	2.6	3.0	2.3	429	560	514	73	90	79	0	45	8	3.5	3.7	1.6
PS1-C12	1279	1456	1539	2.3	2.7	2.6	498	593	494	72	86	67	0	61	8	2.7	1.9	1.6
PS1-C13	1216	1390	1374	2.9	2.9	2.5	440	569	519	69	74	82	0	40	20	1.7	1.9	2.6
PS1-C14	1147	1447	1387	3.4	3.0	2.5	449	590	494	75	74	53	0	51	9	3.8	2.9	1.5
PS1-C15	1166	1410	1375	2.4	2.8	2.6	511	582	547	72	89	69	0	33	0	3.7	3.2	2.4
PS1-D1	887	1254	1074	3.3	1.9	1.3	584	620	640	57	82	70	166	68	36	4.9	5.1	4.9
PS1-D2	1116	1235	1235	2.7	1.6	2.3	639	647	634	56	54	50	153	83	34	4.1	2.9	2.0
PS1-D3	360	1560	1267	1.0	3.1	2.6	164	565	578	16	76	95	0	71	12	0.5	1.3	1.3
PS1-D4	1140	1215	1203	3.2	2.0	3.5	559	600	342	73	102	204	20	69	0	2.4	3.0	0.9
PS1-D5	933	1119	1263	3.1	3.4	2.7	428	347	333	94	182	138	147	52	0	3.2	1.4	1.1
PS1-D6	754	1055	1013	3.2	3.3	3.1	292	312	319	154	169	147	140	54	0	2.0	2.2	1.1
PS1-D7	641	797	811	2.9	3.5	3.3	158	253	290	132	180	157	5	79	0	0.8	2.1	1.6
PS1-D8	694	910	1016	2.9	3.1	2.6	256	269	305	126	147	131	114	50	0	4.2	3.0	1.7

Table cont.

Sample ID	Al Sept 08	Al Jan 09	Al May 09	Cu Sept 08	Cu Jan 09	Cu May 09	Fe Sept 08	Fe Jan 09	Fe May 09	Mn Sept 08	Mn Jan 09	Mn May 09	Na Sept 08	Na Jan 09	Na May 09	Zn Sept 08	Zn Jan 09	Zn May 09
	mg kg^{-1}																	
PS1-D9	957	1197	989	2.7	3.1	2.9	498	578	349	57	67	55	0	75	0	2.8	2.2	0.8
PS1-D10	1124	1411	1380	2.4	3.2	2.9	468	549	501	63	58	46	0	77	39	2.6	2.0	1.5
PS1-D11	1145	1451	1330	2.9	3.0	2.6	427	504	447	54	50	66	115	39	18	3.4	1.3	1.4
PS1-D12	969	1383	1576	2.8	3.3	2.6	428	497	517	49	61	63	128	46	25	2.5	2.7	1.5
PS1-D13	1134	1466	1393	2.8	3.4	2.5	394	483	508	58	57	59	81	60	27	2.2	1.8	1.7
PS1-D14	178	1665	1646	0.3	2.9	2.8	73	462	502	6	41	68	0	45	30	0.1	1.0	1.8
PS1-D15	1221	1507	1525	2.8	3.2	2.5	488	555	601	66	62	74	75	46	32	2.7	1.7	2.1
PS1-E1	841	1224	1287	2.9	1.7	1.3	577	670	669	82	49	64	114	42	35	4.8	2.6	4.7
PS1-E2	1036	1255	1244	3.1	1.8	1.5	542	632	658	57	73	65	95	54	40	1.9	2.6	3.0
PS1-E3	1179	1386	1372	2.6	2.3	1.9	471	623	642	70	108	106	129	64	32	2.1	2.2	1.7
PS1-E4	1065	1263	1306	2.9	2.6	2.6	468	592	476	92	123	103	129	44	21	1.2	1.7	1.3
PS1-E5	825	1142	1092	3.2	3.0	2.7	466	558	561	123	156	115	126	62	33	2.1	2.0	2.0
PS1-E6	539	811	887	3.3	3.4	2.9	283	391	397	205	218	204	148	57	49	2.3	2.2	2.8
PS1-E7	1152	720	720	2.6	3.4	3.1	484	297	283	40	151	172	140	80	86	1.4	2.8	2.1
PS1-E8	624	869	863	3.0	3.4	2.9	227	346	331	111	151	138	120	82	54	2.3	2.9	2.4
PS1-E9	963	1177	1198	4.5	3.3	2.5	500	587	557	67	76	49	16	59	44	3.2	2.6	1.8
PS1-E10	1019	1364	1245	2.5	3.0	2.5	428	573	496	63	59	93	125	38	26	2.5	1.7	1.6
PS1-E11	1052	1397	1364	3.0	2.9	2.6	462	572	464	83	69	61	114	48	50	3.1	2.0	1.1
PS1-E12	1197	1495	1357	3.0	2.8	2.0	517	587	621	48	53	56	126	43	34	2.0	1.7	2.1
PS1-E13	1201	1333	1336	2.8	2.9	2.9	445	575	462	55	107	57	102	52	30	1.7	3.4	1.2
PS1-E14	1144	1368	1403	2.8	2.6	2.8	524	586	530	50	87	66	134	52	14	2.2	3.3	1.4
PS1-E15	1205	1375	1437	3.1	2.1	2.4	585	612	622	46	79	66	99	72	30	2.6	2.6	1.8
PS1-F1	972	1328	1041	2.0	1.7	2.1	677	743	644	22	68	71	115	81	22	7.4	5.2	1.9
PS1-F2	1305	1343	1624	3.0	1.6	1.6	586	722	671	42	74	58	105	83	47	2.3	4.4	2.0
PS1-F3	1360	1540	1481	3.3	1.8	2.3	536	603	533	85	108	74	2	67	37	2.7	3.4	1.1

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS1-F4	1259	1241	1137	3.3	2.5	2.5	542	609	379	56	71	83	117	67	30	1.1	2.3	1.1
PS1-F5	754	1130	1076	2.8	3.1	2.7	204	393	288	113	152	206	107	51	44	2.0	2.0	1.3
PS1-F6	988	1064	1047	2.9	3.0	2.7	452	427	388	50	126	110	136	50	32	1.5	2.1	1.6
PS1-F7	913	790	771	3.7	3.3	2.9	338	383	257	150	150	151	93	45	30	3.6	3.4	1.9
PS1-F8	1037	971	865	3.6	3.4	2.7	337	405	285	128	143	125	0	69	27	4.0	3.0	1.9
PS1-F9	1044	1153	1099	3.2	2.8	2.8	522	480	580	55	54	56	10	50	40	4.0	1.7	2.7
PS1-F10	1258	1278	1311	2.7	2.8	2.7	558	531	574	43	51	50	0	45	40	1.6	1.4	1.6
PS1-F11	1236	1425	1514	2.5	2.8	2.5	473	518	537	49	52	47	115	47	23	1.9	1.2	0.8
PS1-F12	1237	1426	1432	2.9	2.7	2.7	488	582	537	59	50	48	4	48	17	2.5	1.6	0.9
PS1-F13	1299	1343	1368	2.8	2.5	2.8	502	551	488	44	55	44	0	40	32	1.5	1.5	0.9
PS1-F14	1378	1490	1558	2.6	2.2	2.6	487	569	542	40	55	40	0	0	23	0.7	1.8	1.1
PS1-F15	1398	1416	1617	2.9	2.3	2.5	563	567	548	33	78	43	0	0	28	1.6	2.7	1.7
PS1-G1	750	852	755	2.3	42.3	2.4	390	456	436	193	174	174	18	0	54	2.7	2.3	2.5
PS1-G2	660	871	816	2.4	2.4	2.3	313	447	454	157	173	157	117	0	48	1.9	2.0	2.5
PS1-G3	888	896	854	2.2	2.5	1.4	365	405	671	147	180	207	0	0	39	1.6	2.6	4.3
PS1-G4	613	781	796	2.6	2.4	2.3	517	487	599	165	150	154	182	0	26	3.1	2.2	1.5
PS1-G5	738	913	867	2.5	2.9	1.3	371	541	669	99	107	155	119	0	32	1.5	2.0	4.1
PS1-G6	835	1008	928	3.2	3.0	2.5	416	558	510	78	109	112	111	0	28	1.7	2.6	3.4
PS1-G7	732	840	807	2.6	3.6	3.1	386	396	480	74	114	129	7	0	38	4.2	3.7	3.8
PS1-G8	770	987	828	3.3	3.5	2.8	417	483	442	113	245	122	0	159	26	5.2	2.5	4.3
PS1-G9	866	1158	1069	3.1	3.0	2.8	482	517	638	80	79	110	126	0	34	3.4	2.9	5.3
PS1-G10	1040	1186	1162	2.9	2.7	1.6	552	554	669	81	57	69	22	0	30	3.4	1.7	2.6
PS1-G11	1025	1232	1065	2.2	2.2	2.2	499	607	632	65	69	55	139	0	20	2.3	2.3	1.8
PS1-G12	1120	1282	1055	1.8	2.0	2.2	514	602	616	69	43	75	0	0	48	3.2	1.8	2.8
PS1-G13	1229	1421	1145	2.5	2.0	2.1	504	596	611	41	46	83	0	0	50	1.1	2.5	3.0

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS1-G14	1387	1527	1215	2.4	2.3	2.3	588	619	615	42	48	93	0	0	27	1.2	1.8	2.8
PS1-G15	1227	1457	1167	2.4	2.4	1.8	517	595	648	45	58	71	0	0	13	2.5	2.1	1.8
PS1-H1	881	1016	940	3.1	2.7	1.2	388	411	662	139	126	169	89	0	46	2.4	3.5	3.5
PS1-H2	1051	1217	1031	2.9	2.7	2.1	482	490	638	116	124	140	0	0	15	3.3	2.4	1.9
PS1-H3	757	906	871	3.0	2.6	2.3	337	533	411	113	102	190	18	0	26	2.5	2.9	2.7
PS1-H4	800	969	811	3.0	2.6	2.1	359	418	569	105	120	125	128	0	28	2.0	1.9	2.5
PS1-H5	779	970	800	2.7	2.6	2.4	346	411	421	94	106	147	15	0	34	2.0	1.6	2.0
PS1-H6	849	939	824	2.9	2.7	2.8	245	361	319	109	127	170	127	0	30	1.8	3.0	1.5
PS1-H7	665	838	576	2.8	2.9	3.0	248	315	299	130	169	154	106	0	70	3.7	3.6	2.4
PS1-H8	740	842	681	2.8	3.3	3.0	239	373	323	123	112	172	5	0	39	2.3	4.8	2.9
PS1-H9	1004	1004	865	3.5	3.1	2.8	398	416	605	48	58	93	0	0	33	1.9	2.3	3.9
PS1-H10	1089	1097	1170	3.2	2.9	2.5	497	558	532	33	41	53	129	0	37	1.2	1.8	1.1
PS1-H11	1003	995	1136	3.4	2.3	12.6	470	503	494	43	45	42	114	0	35	2.6	1.9	1.5
PS1-H12	1238	1295	1318	2.7	2.3	2.5	514	548	608	47	33	35	140	0	25	1.7	1.2	1.5
PS1-H13	1227	1172	1258	2.7	2.5	2.1	522	495	517	34	41	46	114	0	0	1.0	1.0	0.8
PS1-H14	1179	1171	1246	2.8	2.7	2.3	548	547	574	28	44	70	2	0	30	1.6	1.6	1.6
PS1-H15	1120	1191	1251	2.7	2.2	13.1	562	586	632	36	57	44	0	0	10	1.8	2.1	1.1
PS1-I1	931	983	992	2.6	2.3	2.3	425	592	611	143	142	164	0	0	22	2.3	2.3	2.2
PS1-I2	874	847	945	2.4	2.6	2.5	359	451	510	239	287	255	0	0	38	1.6	2.3	1.7
PS1-I3	737	743	775	2.4	2.4	2.4	351	500	475	258	259	275	135	0	38	1.6	2.4	2.0
PS1-I4	681	759	788	2.1	2.7	2.5	301	443	403	151	191	162	123	0	26	1.6	2.3	1.8
PS1-I5	852	898	915	2.9	2.5	2.4	446	607	476	107	128	97	139	0	35	2.2	2.5	2.6
PS1-I6	942	940	1005	2.6	2.6	2.6	435	507	571	68	101	94	0	0	32	1.7	2.4	2.5
PS1-I7	689	891	781	2.9	3.7	3.2	303	407	285	123	162	181	0	0	38	2.6	4.5	2.3
PS1-I8	722	842	761	4.8	4.2	4.4	250	335	336	140	138	175	103	0	46	4.2	5.4	10.2

Table cont.

Sample ID	Al Sept 08	Al Jan 09	Al May 09	Cu Sept 08	Cu Jan 09	Cu May 09	Fe Sept 08	Fe Jan 09	Fe May 09	Mn Sept 08	Mn Jan 09	Mn May 09	Na Sept 08	Na Jan 09	Na May 09	Zn Sept 08	Zn Jan 09	Zn May 09
	mg kg^{-1}																	
PS1-I9	959	1024	859	4.6	3.3	4.5	403	488	263	95	106	119	114	0	19	3.9	5.0	50.4
PS1-I10	809	908	911	2.6	2.8	2.6	370	433	332	74	95	80	4	0	28	1.8	2.6	1.3
PS1-I11	937	1017	917	2.6	2.5	2.6	414	409	288	84	109	112	2	0	32	1.6	1.9	1.2
PS1-I12	921	968	864	2.6	2.9	3.0	239	262	470	206	209	201	88	0	42	0.8	1.6	1.4
PS1-I13	812	1059	1023	2.6	2.5	4.8	183	321	449	259	211	170	0	0	25	0.6	2.0	1.3
PS1-I14	1156	1232	1184	3.0	2.7	2.6	484	494	627	69	97	61	107	0	26	2.0	2.3	0.8
PS1-I15	901	1090	947	2.9	3.2	2.5	562	584	600	29	51	84	0	0	46	3.7	4.4	1.7
PS1-J1	874	1008	925	3.0	2.7	39.4	362	483	338	203	252	242	20	0	24	2.3	2.0	1.9
PS1-J2	912	1042	1092	2.7	2.6	1.8	332	384	584	204	210	147	10	0	17	2.0	2.2	1.6
PS1-J3	674	872	949	2.6	2.3	2.3	194	431	399	220	212	184	0	0	16	1.8	2.8	1.3
PS1-J4	816	975	1024	2.5	2.2	2.5	336	592	505	162	170	122	0	0	37	1.8	3.9	1.7
PS1-J5	777	1015	855	2.7	2.3	2.4	336	614	422	111	126	92	106	0	33	1.0	2.3	1.1
PS1-J6	795	1095	946	2.4	2.7	2.5	367	573	508	66	105	69	0	0	6	1.3	3.5	1.7
PS1-J7	787	993	820	3.4	3.2	3.1	363	442	345	131	147	120	100	0	39	2.8	4.2	3.0
PS1-J8	736	983	803	3.2	3.3	3.0	259	512	376	115	121	86	0	0	24	3.8	6.2	3.8
PS1-J9	831	1148	884	3.4	3.1	3.7	375	542	478	95	97	101	105	0	3	3.2	4.4	2.9
PS1-J10	875	1150	919	2.6	2.5	3.1	401	584	414	60	77	94	119	0	17	2.1	2.4	1.7
PS1-J11	756	1086	851	2.9	2.7	2.6	213	369	272	199	218	193	113	0	19	1.1	2.3	1.3
PS1-J12	677	1054	763	2.4	2.6	7.2	197	403	339	186	241	236	0	0	44	1.3	2.2	2.2
PS1-J13	779	975	766	2.0	2.9	3.1	272	343	398	208	272	250	0	0	16	1.1	3.7	2.8
PS1-J14	658	867	661	2.8	3.2	3.2	173	335	270	202	240	244	0	0	36	1.1	4.1	2.2
PS1-J15	683	1152	772	3.4	3.0	2.1	302	490	647	124	216	67	0	53	36	4.3	4.3	8.1
PS2-A1	1207	1360	1274	3.2	2.9	2.5	482	494	496	72	116	58	0	71	19	2.2	3.4	2.6
PS2-A2	954	1301	1060	3.0	2.5	2.7	311	606	438	79	105	46	0	0	52	1.0	3.8	2.3
PS2-A3	808	1063	862	3.3	3.6	3.1	371	564	404	122	145	80	5	21	41	1.8	3.5	4.8

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS2-A4	959	1354	1128	3.1	3.1	2.7	369	530	405	78	101	66	0	0	12	1.6	3.5	1.9
PS2-A5	1076	1280	899	2.9	2.2	2.0	427	621	244	91	127	68	0	16	21	1.3	3.1	1.5
PS2-A6	1048	1480	1310	2.5	2.6	2.4	532	592	446	133	82	57	0	0	25	1.8	2.4	1.6
PS2-A7	1034	1271	1067	2.1	2.8	1.8	415	544	427	92	96	75	0	0	35	1.2	2.2	3.4
PS2-A8	.	1221	1200	.	2.6	2.2	.	502	340	.	118	67	.	0	55	.	2.6	1.1
PS2-B1	1321	1724	1351	3.6	3.3	2.7	330	553	461	57	75	76	0	1	44	1.2	3.1	2.6
PS2-B2	1040	1560	1084	3.5	3.9	3.3	257	456	401	77	114	126	0	0	34	1.0	2.1	1.8
PS2-B3	1010	1320	1051	3.3	3.6	3.5	269	557	462	116	115	102	0	0	25	1.3	2.8	3.2
PS2-B4	1402	1641	1481	3.0	3.2	3.0	370	505	528	104	94	114	0	0	25	1.2	2.2	2.0
PS2-B5	1420	1561	1446	3.0	2.6	2.7	428	606	620	72	105	106	0	0	6	6.9	1.9	1.5
PS2-B6	1065	1381	1280	2.7	2.7	2.8	518	598	578	142	134	103	0	0	26	1.8	3.8	2.2
PS2-B7	1018	1215	1307	2.5	2.6	2.5	331	582	452	138	123	127	0	0	39	1.4	2.7	2.7
PS2-B8	1050	1142	1411	2.7	2.9	2.6	391	526	604	126	124	63	0	0	38	1.7	2.6	2.6
PS2-C1	1206	1562	1371	3.1	3.4	2.6	451	587	404	3	104	55	451	0	19	2.2	4.1	1.8
PS2-C2	1040	1437	1148	2.6	3.3	3.1	375	579	417	3	91	84	375	9	28	1.8	2.8	2.6
PS2-C3	1039	1286	1125	3.2	3.2	2.7	401	568	361	3	120	68	401	17	23	1.6	3.7	1.8
PS2-C4	1140	1413	1315	2.5	3.0	2.6	343	522	437	3	123	62	343	0	42	1.6	2.6	1.7
PS2-C5	.	1329	1284	.	2.8	2.2	.	549	367	.	109	75	.	0	56	.	3.3	1.3
PS2-C6	1242	1336	1301	2.7	2.3	2.6	485	621	501	3	94	58	485	0	36	1.9	2.1	1.1
PS2-C7	1298	1410	1403	2.8	3.2	2.3	497	571	424	3	92	55	497	0	43	1.5	2.5	1.0
PS2-C8	1169	1355	1310	2.5	2.4	2.2	388	502	387	2	94	66	388	0	24	1.4	2.4	0.7
PS2-D1	1518	1809	1691	3.2	1.9	2.9	481	602	516	3	83	57	481	0	24	1.7	3.2	1.8
PS2-D2	1280	1706	1554	3.5	1.8	2.7	383	600	547	3	84	69	383	0	30	1.7	2.5	1.3
PS2-D3	1156	1477	1225	3.3	2.3	4.0	295	603	315	3	89	110	295	0	27	1.1	3.1	1.0
PS2-D4	1329	1562	1459	2.9	3.5	2.7	396	621	548	3	71	54	396	0	48	0.7	4.0	1.1

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS2-D5	1357	1398	1558	2.8	2.4	2.0	484	605	655	3	76	49	484	0	37	1.4	1.7	1.1
PS2-D6	1307	1493	1364	2.7	2.6	2.7	413	589	410	3	67	52	413	0	50	1.2	1.6	1.5
PS2-D7	1010	1302	1271	4.1	2.2	2.8	528	642	582	4	78	91	528	0	34	2.3	3.0	2.2
PS2-D8	1213	1439	1398	3.2	3.0	3.5	485	581	532	3	94	65	485	0	16	1.5	2.1	2.2
PS2-E1	1242	1421	1267	3.0	3.1	2.8	411	545	407	67	86	68	0	0	26	1.8	3.3	2.3
PS2-E2	1118	1251	1195	2.8	3.0	2.7	405	556	362	85	135	79	0	0	23	1.6	3.7	1.4
PS2-E3	1097	1158	1153	3.0	2.6	2.7	405	521	399	94	108	70	0	0	26	2.0	2.4	1.6
PS2-E4	1191	1387	1322	2.7	2.6	2.7	405	555	367	101	118	83	0	0	48	2.6	2.8	2.0
PS2-E5	1161	1400	1365	2.3	2.5	2.6	388	604	381	108	129	67	0	0	40	2.1	2.9	1.6
PS2-E6	1075	1278	1324	2.3	2.8	2.7	417	601	432	97	166	70	0	0	51	2.1	3.3	2.2
PS2-E7	1085	1342	1413	2.9	2.9	2.4	436	588	457	123	185	73	0	0	23	4.2	4.1	2.7
PS2-E8	1138	1299	1319	2.2	2.1	2.6	537	624	405	86	131	56	0	0	37	3.7	3.4	2.1
PS2-F1	1242	1423	1236	3.1	2.9	2.9	363	569	545	34	90	81	0	0	32	1.2	3.7	7.2
PS2-F2	1301	1544	1093	3.4	2.4	2.8	392	574	527	77	104	72	0	0	12	2.5	4.1	2.8
PS2-F3	1209	1507	1458	3.2	3.2	3.1	352	479	576	90	90	97	0	0	17	2.2	3.1	2.8
PS2-F4	1131	1599	1178	2.6	1.8	2.3	431	608	393	57	72	70	0	0	28	1.5	2.7	2.0
PS2-F5	1170	1326	1174	3.4	1.8	2.8	443	618	533	66	75	75	0	0	19	2.6	3.0	2.4
PS2-F6	1025	1371	1273	3.5	1.6	3.0	465	652	396	87	131	126	0	0	27	3.0	3.6	3.4
PS2-F7	1135	1244	1023	3.2	2.2	2.9	367	615	639	116	117	74	0	0	18	3.7	3.4	4.0
PS2-F8	1017	1212	1169	2.9	2.8	3.0	440	538	611	79	122	97	0	0	27	1.9	3.0	6.2
PS2-G1	1120	1473	1361	2.7	3.1	2.8	368	483	394	77	79	63	0	0	63	1.6	2.4	2.7
PS2-G2	1084	1428	1276	3.1	2.2	2.5	369	600	403	77	92	73	0	0	41	1.3	2.6	2.0
PS2-G3	1160	1439	1390	2.9	2.7	2.8	396	504	468	82	89	58	0	0	31	1.4	2.3	1.3
PS2-G4	1184	1479	1332	2.6	2.8	2.5	408	537	424	70	85	72	0	0	28	0.9	1.9	2.1
PS2-G5	1144	1265	1296	2.6	2.7	2.6	434	526	435	90	107	84	0	0	32	1.6	8.2	1.4

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS2-G6	1138	1339	1338	2.9	2.6	2.7	428	579	484	105	112	73	0	0	24	2.1	2.8	1.9
PS2-G7	1216	1457	1451	2.7	2.5	2.7	468	587	457	89	117	74	0	0	30	2.1	3.0	2.7
PS2-G8	1195	1397	1359	2.3	2.6	2.4	433	560	435	80	98	70	0	0	26	1.1	1.7	1.9
PS2-H1	1208	1588	1635	3.1	3.2	3.4	434	585	442	58	70	80	0	0	29	2.4	5.3	1.9
PS2-H2	1194	1476	1702	3.3	2.8	3.0	230	529	443	132	67	84	0	0	29	2.5	2.4	1.8
PS2-H3	1263	1644	1774	3.0	3.1	3.2	411	561	534	80	123	68	0	0	19	2.5	3.7	1.5
PS2-H4	1111	1543	1426	2.7	3.2	3.3	437	555	513	53	150	70	0	0	21	1.8	3.9	1.6
PS2-H5	1215	1658	1641	2.7	2.8	3.3	417	571	518	65	62	60	0	0	46	1.7	2.8	1.5
PS2-H6	1151	1394	1427	2.5	2.0	3.6	455	647	566	83	97	80	0	0	31	2.8	2.4	1.9
PS2-H7	1229	1491	1495	2.7	1.6	3.5	489	630	554	74	87	95	0	0	44	2.3	3.4	1.7
PS2-H8	945	1413	1609	2.5	1.7	3.0	428	640	515	75	102	79	0	0	27	2.0	3.7	2.1
PS2-I1	1038	1344	1497	2.7	3.3	3.1	312	484	393	103	112	89	0	63	34	1.7	2.7	1.6
PS2-I2	1092	1346	1289	3.1	3.6	2.7	353	468	389	77	97	66	0	87	43	0.9	2.1	2.1
PS2-I3	1073	1339	1387	2.7	3.1	2.7	308	455	378	68	85	68	0	83	31	0.9	1.5	1.1
PS2-I4	909	1087	1064	2.7	3.3	2.6	287	321	284	126	152	119	0	76	54	1.3	2.3	1.7
PS2-I5	937	1149	1203	2.5	2.9	2.8	290	452	349	164	149	151	0	75	64	1.4	1.9	1.9
PS2-I6	1037	1193	1313	2.5	2.9	2.7	366	423	357	165	163	146	0	71	54	1.4	2.0	1.4
PS2-I7	1278	1260	1511	2.4	2.8	2.3	374	434	394	135	169	135	0	68	30	1.6	2.3	1.3
PS2-I8	1203	1179	1492	2.1	2.3	2.2	407	439	376	159	156	129	0	49	25	1.3	1.5	1.0
PS2-J1	1280	1498	1528	3.6	4.0	3.1	264	471	449	100	105	81	0	72	16	1.4	3.0	2.8
PS2-J2	1350	1601	1735	2.1	2.9	2.3	182	454	457	90	108	131	0	62	20	1.0	3.4	2.5
PS2-J3	1179	1361	1455	2.7	3.1	3.0	168	260	386	231	134	193	0	73	23	1.6	3.3	2.9
PS2-J4	999	1337	1572	2.4	3.5	3.1	138	233	506	160	202	135	0	67	29	1.4	3.5	2.9
PS2-J5	1138	1441	1273	2.5	2.9	3.1	182	334	473	182	203	243	0	59	35	1.7	3.9	2.9
PS2-J6	973	1376	1399	2.5	2.9	2.9	175	318	354	166	204	197	0	65	27	1.3	3.4	1.7

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg $^{-1}$																	
PS2-J7	1166	1422	1411	3.1	5.5	3.8	239	463	306	211	261	307	0	95	42	1.2	4.4	3.3
PS2-J8	1256	1491	1499	3.3	2.9	3.2	198	371	436	288	217	277	0	64	37	1.2	2.9	2.2
PS2-K1	1211	1497	1203	2.9	3.4	3.4	336	439	352	107	113	98	0	57	26	1.9	2.1	1.9
PS2-K2	1142	1398	1278	3.0	3.4	3.2	301	372	347	85	105	104	0	64	32	1.6	2.2	2.2
PS2-K3	946	1203	1108	2.9	3.4	3.1	242	393	245	110	148	111	0	74	27	1.6	3.1	1.4
PS2-K4	953	1029	1010	3.3	3.3	2.9	292	314	277	162	170	230	0	85	35	1.2	2.1	1.6
PS2-K5	930	1229	1150	2.1	2.8	2.9	237	361	305	195	242	185	0	78	18	1.0	1.7	1.3
PS2-K6	1006	1305	1176	2.7	2.5	2.5	297	354	340	256	278	206	0	66	30	1.5	1.6	1.4
PS2-K7	1086	1310	1300	2.1	2.6	2.4	265	471	330	243	278	222	0	91	35	1.1	1.9	1.2
PS2-K8	1154	1279	1111	2.0	2.5	2.4	395	474	350	231	264	255	0	77	38	1.5	1.7	1.7
PS2-L1	1363	1656	1485	3.5	3.6	3.6	392	496	548	64	68	132	0	56	28	2.1	2.5	2.9
PS2-L2	1264	1546	1407	2.9	3.1	3.5	274	362	498	112	128	149	0	61	16	3.7	3.5	3.2
PS2-L3	970	1214	1124	2.5	3.2	3.0	221	267	433	187	177	171	0	82	24	3.0	3.5	3.8
PS2-L4	1012	1324	1228	3.2	2.8	3.3	190	224	472	239	256	220	0	86	9	3.0	3.1	4.7
PS2-L5	1157	1527	1173	3.0	3.3	3.0	234	316	295	255	217	266	0	73	17	2.6	3.2	1.8
PS2-L6	1131	1583	1282	2.9	3.5	2.8	197	374	353	271	198	177	0	67	32	1.7	3.1	2.4
PS2-L7	1249	1712	1563	2.8	3.4	3.4	258	431	540	144	127	157	0	102	31	2.0	2.4	5.8
PS2-L8	1253	1550	1547	3.1	3.2	3.2	240	541	466	209	181	372	0	95	21	1.2	4.3	2.4
PS2-M1	1261	1509	1418	3.1	2.9	2.7	354	458	342	106	142	113	0	56	22	2.2	2.5	1.2
PS2-M2	1105	1347	1256	2.2	3.4	3.0	311	423	319	189	133	147	0	78	19	1.0	2.5	1.4
PS2-M3	745	1123	1133	3.1	3.1	2.7	191	319	259	135	155	104	0	94	51	2.0	2.3	1.5
PS2-M4	743	972	1062	2.6	3.3	2.9	180	311	269	170	194	120	0	119	37	0.8	2.6	1.8
PS2-M5	880	1059	1156	2.5	3.0	2.4	268	335	312	177	235	216	0	78	28	1.8	2.0	1.5
PS2-M6	941	1268	1011	2.5	2.6	2.6	257	356	262	213	291	191	0	58	30	1.3	1.2	1.1
PS2-M7	998	1309	1166	1.9	2.5	2.5	275	389	292	214	292	212	0	45	33	1.3	1.6	1.4

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PS2-M8	1059	1360	1258	2.3	2.6	2.4	349	452	322	135	250	221	0	81	29	1.0	1.4	1.5
PR-A1	574	636	676	3.9	4.2	4.6	209	247	243	82	143	147	0	52	43	5.3	2.1	3.0
PR-A2	754	737	776	4.4	4.7	4.3	306	281	284	103	80	125	0	49	24	3.3	6.3	3.5
PR-A3	352	488	635	4.2	4.1	3.7	214	323	483	182	240	195	157	39	32	3.7	2.7	3.4
PR-A4	758	906	661	3.5	3.0	3.4	336	538	401	153	241	199	0	41	73	4.3	3.3	4.1
PR-A5	779	843	763	3.5	3.3	3.0	419	505	341	210	235	202	3	56	34	2.4	2.7	2.5
PR-A6	920	705	769	3.4	2.6	3.2	312	513	307	132	255	161	0	50	36	2.6	2.8	2.6
PR-A7	814	876	811	3.6	4.0	3.2	315	429	378	133	166	151	0	29	23	3.1	3.5	2.6
PR-A8	643	650	679	2.9	2.6	3.3	362	460	359	104	213	159	0	10	32	2.8	2.9	2.6
PR-A9	412	592	689	2.1	2.8	2.9	326	468	367	161	181	167	0	0	48	3.6	3.0	3.0
PR-A10	547	1354	738	2.7	3.0	2.8	318	397	368	132	214	158	0	41	19	2.4	6.0	3.0
PR-A11	766	418	903	2.4	2.1	3.5	300	560	326	163	164	154	1	13	41	2.7	7.4	2.1
PR-B1	546	692	603	3.8	13.0	3.9	167	262	219	116	134	136	0	23	82	1.3	2.1	3.2
PR-B2	709	834	707	3.9	4.0	3.8	221	379	307	126	202	154	0	49	78	2.4	1.7	2.6
PR-B3	597	743	442	4.2	3.2	4.9	276	535	361	183	194	267	142	53	47	1.5	2.4	3.0
PR-B4	821	563	631	4.2	2.8	4.5	294	515	404	128	207	186	0	282	43	1.8	1.5	2.4
PR-B5	507	570	716	3.6	3.9	3.3	349	412	339	170	195	171	220	50	235	0.9	2.9	2.2
PR-B6	550	568	550	3.3	1.8	4.2	318	572	421	177	186	160	144	51	32	2.8	3.6	3.2
PR-B7	471	748	742	3.7	3.2	3.3	361	434	384	187	202	142	186	26	31	1.9	3.0	2.3
PR-B8	610	716	664	3.2	3.2	3.0	406	530	387	180	186	147	0	50	31	2.9	2.8	2.6
PR-B9	605	952	682	2.8	1.9	2.8	351	673	370	163	169	146	0	51	32	2.0	2.4	2.2
PR-B10	576	668	688	2.2	1.6	2.7	288	599	322	144	169	157	0	64	65	1.6	2.2	2.3
PR-B11	820	883	825	2.9	2.7	2.9	348	383	323	151	240	170	0	67	38	1.9	2.6	5.7
PR-C1	569	821	648	3.9	4.4	3.9	232	310	266	122	153	132	119	49	24	1.9	2.4	2.7
PR-C2	799	810	912	3.9	4.1	3.8	254	398	496	179	176	137	0	48	14	1.4	2.2	2.6

Table cont.

Sample ID	Al Sept 08	Al Jan 09	Al May 09	Cu Sept 08	Cu Jan 09	Cu May 09	Fe Sept 08	Fe Jan 09	Fe May 09	Mn Sept 08	Mn Jan 09	Mn May 09	Na Sept 08	Na Jan 09	Na May 09	Zn Sept 08	Zn Jan 09	Zn May 09
	mg kg^{-1}																	
PR-C3	650	978	703	3.8	4.0	4.1	334	320	475	152	324	225	73	91	148	2.5	1.6	2.0
PR-C4	986	1071	601	2.9	2.6	3.2	428	529	287	84	271	159	0	85	194	3.5	2.2	1.6
PR-C5	440	899	670	3.4	3.4	3.3	311	443	353	175	308	162	121	87	50	2.2	2.0	1.5
PR-C6	648	979	748	3.4	3.3	2.9	424	410	346	111	168	184	26	75	77	2.4	1.7	1.1
PR-C7	675	778	630	4.6	3.4	2.8	304	530	346	175	224	191	151	39	39	3.2	2.0	2.1
PR-C8	582	879	639	3.4	4.0	2.7	382	463	375	129	183	158	142	87	58	2.0	3.4	2.2
PR-C9	568	767	741	2.7	2.9	2.5	309	475	313	202	251	198	4	54	63	2.9	4.2	2.0
PR-C10	1062	690	567	2.5	2.4	2.6	340	471	308	204	171	135	0	83	58	1.4	1.7	2.9
PR-C11	762	1134	828	2.8	3.2	3.0	322	443	290	204	184	162	0	53	84	3.0	3.2	2.4
PR-D1	504	785	523	3.3	4.2	3.5	226	330	245	99	154	151	7	68	246	3.3	2.8	1.6
PR-D2	813	719	1057	3.8	4.0	3.5	297	541	582	144	152	150	0	91	43	1.3	4.9	2.4
PR-D3	744	1148	637	3.6	2.7	3.5	577	578	530	71	157	138	238	75	163	1.7	3.4	1.5
PR-D4	519	935	735	2.6	1.9	2.8	348	718	529	169	133	212	27	104	67	2.7	2.2	2.1
PR-D5	574	879	591	3.5	2.7	2.9	396	583	451	156	121	136	0	114	69	1.9	1.7	3.0
PR-D6	732	806	717	3.5	1.9	2.3	348	741	369	118	97	135	152	64	57	2.6	3.0	1.8
PR-D7	786	849	840	2.5	3.3	2.4	436	441	412	102	199	132	17	117	51	2.8	2.3	2.0
PR-D8	744	1053	1419	2.5	4.2	4.6	534	504	347	158	153	217	0	50	21	2.5	2.5	16.1
PR-D9	743	1035	1022	2.8	1.7	2.5	315	703	367	217	44	142	0	67	44	2.1	2.3	2.9
PR-D10	813	1145	885	2.3	3.0	2.4	288	465	348	238	191	196	0	61	55	1.4	2.4	2.5
PR-D11	1020	1149	1048	3.0	3.2	2.6	283	448	328	182	152	222	0	49	65	2.2	2.6	2.1
PR-E1	661	1003	801	4.6	4.0	4.1	323	401	438	123	114	156	115	58	74	2.7	2.7	2.7
PR-E2	577	749	894	4.6	3.6	3.3	283	532	411	135	144	190	0	104	66	2.1	2.7	2.1
PR-E3	986	1213	1049	3.6	2.7	2.9	468	581	421	131	172	143	0	61	98	1.5	2.0	2.0
PR-E4	799	1271	931	3.2	3.2	2.9	307	426	492	151	312	165	25	39	97	1.7	3.5	1.6
PR-E5	513	982	718	2.1	3.1	2.3	366	516	341	164	233	130	10	112	119	3.4	1.6	1.9

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PR-E6	552	722	929	2.9	3.0	2.9	333	580	432	159	159	151	32	72	80	1.7	1.8	4.9
PR-E7	662	895	803	4.1	2.8	2.9	316	559	311	209	223	162	0	35	79	2.6	3.4	2.8
PR-E8	862	950	929	2.6	2.1	2.5	272	771	329	195	203	205	0	54	57	2.1	2.5	1.6
PR-E9	951	1162	953	3.0	2.3	3.2	287	597	354	215	230	223	98	33	65	2.0	2.6	2.3
PR-E10	1080	992	1047	2.7	3.4	2.8	327	466	313	270	287	239	0	69	53	1.2	3.8	2.0
PR-E11	1124	1271	1028	2.4	2.8	2.9	296	392	307	238	294	304	0	38	46	1.5	3.2	2.4
PR-F1	496	652	520	4.6	4.5	4.3	250	345	404	146	164	163	0	65	93	2.1	3.3	2.7
PR-F2	604	508	801	3.6	4.2	3.6	380	422	561	176	221	154	47	239	89	2.1	2.0	3.3
PR-F3	836	1076	731	3.0	3.5	3.3	337	534	409	146	204	276	126	38	105	1.9	2.2	1.7
PR-F4	775	898	946	3.0	2.9	3.0	298	530	483	192	143	126	0	56	118	1.7	1.5	1.9
PR-F5	554	1079	788	2.9	3.3	2.8	337	402	374	177	195	154	180	127	121	2.9	2.9	1.7
PR-F6	519	723	583	2.7	5.4	2.3	327	481	314	136	236	166	27	114	102	2.7	2.7	1.7
PR-F7	805	1525	988	3.0	3.7	3.2	325	468	454	227	219	165	0	42	57	2.0	2.1	2.0
PR-F8	959	1154	1025	3.3	2.8	2.5	307	358	281	211	199	182	0	37	77	2.3	2.3	1.2
PR-F9	972	1112	1071	2.7	3.1	2.7	268	420	329	207	342	252	66	42	59	1.9	3.8	2.0
PR-F10	1033	1285	990	2.3	3.2	2.4	300	417	283	205	172	290	0	63	57	1.3	2.7	2.0
PR-F11	947	1268	1034	2.4	3.2	2.5	259	390	282	254	279	325	4	53	49	1.4	3.4	1.8
PR-G1	587	702	650	3.6	3.6	3.6	242	259	246	139	130	178	0	43	65	2.6	3.0	2.1
PR-G2	670	433	730	4.0	4.1	4.3	311	299	413	224	228	238	0	140	98	4.2	2.7	3.2
PR-G3	465	701	804	3.6	4.1	3.3	283	393	349	195	221	195	205	140	172	1.4	3.0	3.6
PR-G4	853	778	857	3.0	3.7	3.3	278	388	303	265	228	214	197	60	214	3.2	2.6	2.3
PR-G5	870	616	834	2.2	2.6	2.5	303	391	327	141	146	167	0	32	69	1.9	2.2	2.0
PR-G6	915	920	969	1.9	2.7	2.4	412	392	375	125	149	190	0	77	57	3.0	2.5	2.7
PR-G7	816	1046	893	4.1	2.4	2.5	343	400	372	191	148	226	137	33	50	2.8	1.8	2.2
PR-G8	688	829	830	1.1	2.5	2.2	323	552	341	248	204	222	43	68	62	1.8	2.4	2.6

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PR-G9	945	1043	1095	3.2	2.5	1.5	276	348	364	316	272	333	0	54	34	3.2	1.7	1.7
PR-G10	877	950	1073	2.2	2.7	2.5	351	355	350	320	410	289	0	38	18	1.8	3.0	2.5
PR-G11	921	1170	1056	2.5	2.7	2.5	319	362	351	350	280	313	0	50	38	1.4	3.0	2.0
PR-H1	775	913	802	4.0	3.9	3.9	243	310	323	147	104	222	0	80	83	2.6	2.9	3.4
PR-H2	583	894	1009	4.2	3.7	3.4	293	297	367	222	283	227	5	298	57	2.4	2.1	3.9
PR-H3	832	652	996	4.8	4.0	4.2	290	365	304	223	278	235	0	335	69	2.6	2.2	2.3
PR-H4	1130	826	1106	4.3	3.4	2.9	223	542	308	230	94	228	5	114	88	1.5	2.7	1.6
PR-H5	759	1104	1036	3.8	4.2	3.9	281	394	321	130	186	181	13	73	36	4.8	4.1	2.7
PR-H6	936	1004	1072	3.0	3.0	3.2	343	381	264	190	192	152	0	52	63	4.6	3.6	2.2
PR-H7	840	989	1075	1.6	1.4	2.7	300	426	257	147	186	199	0	47	47	2.6	3.8	1.4
PR-H8	837	1118	1408	2.5	1.2	2.1	307	310	216	164	275	169	0	46	53	1.6	2.1	1.4
PR-H9	867	1052	1133	3.2	2.5	2.6	283	402	235	202	258	166	0	39	75	2.8	4.3	1.8
PR-H10	894	993	1293	2.7	2.7	3.3	217	299	333	156	152	195	0	50	100	2.4	4.2	2.2
PR-H11	1001	1163	986	3.0	2.9	3.3	268	312	320	200	208	254	0	48	45	2.1	2.1	3.6
PR-I4	821	1204	914	3.5	4.2	4.3	250	363	338	144	242	205	25	117	79	2.1	2.6	2.7
PR-I5	1028	1124	1072	5.7	4.0	4.2	308	399	320	78	108	182	138	82	39	8.7	3.5	3.8
PR-I6	885	1017	881	5.4	4.8	4.8	253	414	278	161	167	157	145	30	61	6.2	3.9	3.2
PR-I7	929	1042	1015	3.5	4.9	3.7	276	376	257	253	167	117	0	82	65	5.5	6.7	2.9
PR-I8	941	1126	986	3.9	3.6	2.9	285	418	312	221	166	202	125	45	53	4.7	3.2	3.0
PR-I9	617	968	774	3.5	3.4	3.3	278	404	260	112	295	117	0	135	66	2.3	4.3	3.2
PR-I10	926	1283	959	2.8	3.3	2.8	256	469	292	207	215	229	0	44	59	1.8	2.6	2.7
PR-I11	973	1114	881	3.0	3.0	2.4	244	328	227	369	279	190	0	48	109	2.2	3.6	1.4
PR-J6	814	855	865	5.7	5.6	3.9	291	403	299	153	213	173	0	65	63	4.6	5.0	3.3
PR-J7	776	1098	899	4.8	4.1	3.6	321	316	280	151	163	166	134	68	61	2.9	3.6	5.6
PR-J8	750	973	929	5.0	5.0	3.3	280	352	270	196	246	199	28	71	72	3.1	3.0	2.8

Table cont.

Sample ID	Al			Cu			Fe			Mn			Na			Zn		
	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09	Sept 08	Jan 09	May 09
	mg kg^{-1}																	
PR-J9	668	866	763	3.1	3.5	3.8	270	337	287	230	260	267	0	82	114	2.0	2.7	2.5
PR-J10	692	761	810	3.2	2.8	2.6	234	467	296	191	216	184	0	92	54	1.8	3.7	2.4
PR-J11	757	893	826	2.6	2.8	2.9	273	311	353	249	235	127	0	62	93	1.9	2.2	2.7
PR-K6	794	960	903	3.2	3.5	3.2	246	345	293	77	136	103	26	87	78	4.7	5.1	3.9
PR-K7	596	755	809	4.4	4.3	4.0	231	298	269	94	98	163	67	95	70	4.5	5.8	3.8
PR-K8	781	930	827	3.6	3.6	3.5	337	386	299	139	145	176	7	44	57	4.5	5.3	3.4
PR-K9	900	695	933	3.3	3.2	3.3	244	319	375	151	305	180	0	41	37	1.5	2.8	2.5
PR-K10	722	764	886	2.9	2.7	2.8	344	418	397	152	200	126	120	33	22	2.6	2.3	3.2
PR-K11	633	809	866	3.3	2.9	3.0	244	323	310	177	150	165	0	41	39	2.0	2.3	3.4

APPENDIX F
CLASSICAL STATISTICS FOR THREE STUDIED SITES

Site	Date	Variable	Min	Max	Mean	Skewness	Kurtosis	Variance	SE[a]	SD[b]	CV[c]
PS1	Sept08	pH	4.73	7.27	5.49	1.39	1.24	0.30	0.05	0.55	9.99
		EC (ds m^{-1})	0.15	0.92	0.29	2.14	5.92	0.01	0.01	0.12	41.21
		OC (%)	1.21	4.45	2.43	0.54	0.01	0.38	0.05	0.61	25.32
		Clay (%)	16.72	33.44	25.24	0.10	-0.10	9.18	0.25	3.03	12.00
		P (mg kg^{-1})	7.46	68.05	28.63	0.92	1.07	114.11	0.89	10.68	37.32
		Ca (mg kg^{-1})	256.72	3978.23	1952.56	0.78	0.63	401316.00	52.79	633.50	32.44
		Mg (mg kg^{-1})	60.11	695.92	363.05	0.61	1.70	9911.36	8.30	99.56	27.42
		S (mg kg^{-1})	3.40	54.47	28.08	0.02	-1.06	137.99	0.98	11.75	41.84
		Al (mg kg^{-1})	177.77	1397.96	916.41	-0.22	-0.40	59122.62	20.26	243.15	26.53
		Cu (mg kg^{-1})	0.31	4.78	2.87	-0.34	5.39	0.28	0.04	0.53	18.50
		Fe (mg kg^{-1})	72.64	676.53	398.70	-0.26	-0.65	14845.46	10.15	121.84	30.56
		K (mg kg^{-1})	15.12	278.16	81.85	1.59	6.54	1187.90	2.87	34.47	42.11
		Mn (mg kg^{-1})	5.52	292.74	108.84	0.94	0.17	4159.66	5.37	64.50	59.26
		Na (mg kg^{-1})	0.00	181.94	71.58	-0.03	-1.71	3990.46	5.26	63.17	88.25
		Zn (mg kg^{-1})	0.05	7.45	2.39	1.06	2.73	1.15	0.09	1.07	44.85
	Jan09	P (mg kg^{-1})	16.30	179.58	33.06	6.02	52.89	246.88	1.31	15.71	47.53
		pH	4.26	6.86	5.39	0.67	0.14	0.27	0.04	0.52	9.64
		EC (ds m^{-1})	0.22	0.89	0.43	0.94	0.36	0.02	0.01	0.13	31.26
		OC (%)	1.52	3.31	2.40	0.23	-0.43	0.15	0.03	0.39	16.37
		Ca (mg kg^{-1})	962.71	3860.07	1757.68	1.20	1.11	303997.87	45.95	551.36	31.37
		Mg (mg kg^{-1})	178.37	555.10	307.69	0.73	0.66	4802.76	5.78	69.30	22.52
		S (mg kg^{-1})	27.32	79.59	47.80	0.70	-0.21	154.10	1.03	12.41	25.97
		Al (mg kg^{-1})	568.47	1664.73	1100.85	0.05	-0.85	56851.44	19.87	238.44	21.66
		Cu (mg kg^{-1})	1.54	42.30	3.05	11.65	138.36	11.06	0.28	3.33	109.06
		Fe (mg kg^{-1})	216.68	743.04	480.53	-0.39	-0.68	12963.02	9.49	113.86	23.69
		K (mg kg^{-1})	12.09	127.45	45.24	1.25	1.55	479.51	1.82	21.90	48.40
		Mn (mg kg^{-1})	32.93	385.00	129.00	1.06	0.72	5375.75	6.11	73.32	56.84
		Na (mg kg^{-1})	0.00	159.36	36.18	0.30	-0.57	1133.75	2.81	33.67	93.07

[a]Standard Error; [b]Standard Deviation; [c]Coefficient of Variance

Table cont.

Site	Date	Variable	Min	Max	Mean	Skewness	Kurtosis	Variance	SE	SD	CV
PS1	Jan09	Zn (mg kg $^{-1}$)	0.98	6.23	2.48	1.33	1.82	0.94	0.08	0.97	39.08
	May09	P (mg kg $^{-1}$)	10.18	151.63	45.88	1.37	1.10	978.56	2.61	31.28	68.17
		pH	4.32	6.73	5.35	0.43	-0.13	0.30	0.05	0.55	10.19
		EC (ds m^{-1})	0.22	0.96	0.50	0.57	-0.71	0.03	0.01	0.17	35.12
		OC (%)	1.64	4.69	2.60	1.11	2.30	0.29	0.04	0.54	20.61
		Ca (mg kg $^{-1}$)	1012.43	3224.82	1681.13	0.90	0.12	236779.82	40.55	486.60	28.94
		Mg (mg kg $^{-1}$)	180.48	537.22	306.18	0.72	0.57	4838.75	5.80	69.56	22.72
		S (mg kg $^{-1}$)	31.08	125.59	60.43	0.77	-0.50	450.72	1.77	21.23	35.13
		Al (mg kg $^{-1}$)	575.98	1646.20	1063.86	0.33	-0.90	65136.62	21.27	255.22	23.99
		Cu (mg kg $^{-1}$)	1.14	39.40	3.00	9.46	99.66	11.23	0.28	3.35	111.79
		Fe (mg kg $^{-1}$)	241.29	701.76	473.07	-0.16	-1.15	15951.18	10.52	126.30	26.70
		K (mg kg $^{-1}$)	5.02	140.63	32.97	3.23	19.18	224.96	1.25	15.00	45.49
		Mn (mg kg $^{-1}$)	35.46	387.93	127.73	1.28	1.78	5373.14	6.11	73.30	57.39
		Na (mg kg $^{-1}$)	0.00	87.81	30.76	0.72	1.91	267.80	1.36	16.36	53.20
		Zn (mg kg $^{-1}$)	0.82	50.42	2.46	10.56	120.14	17.71	0.35	4.21	171.11
PS2	Sept08	pH	4.39	6.53	5.15	1.27	1.59	0.20	0.04	0.45	8.76
		EC (ds m^{-1})	0.11	0.98	0.45	0.57	-0.70	0.05	0.02	0.23	51.89
		OC (%)	0.44	4.42	1.51	1.71	3.13	0.54	0.07	0.74	48.99
		Clay	21.08	41.44	27.94	0.59	-0.16	19.47	0.43	4.41	15.79
		Al (mg kg $^{-1}$)	742.88	1518.15	1128.19	-0.16	0.38	19618.39	13.87	140.07	12.42
		Ca (mg kg $^{-1}$)	566.40	4216.79	1653.58	0.85	0.32	655554.67	80.17	809.66	48.96
		Cu (mg kg $^{-1}$)	1.87	4.08	2.82	0.07	0.00	0.17	0.04	0.41	14.61
		Fe (mg kg $^{-1}$)	138.29	537.44	355.60	-0.32	-0.71	9158.88	9.48	95.70	26.91
		P (mg kg $^{-1}$)	10.09	98.63	27.91	2.12	9.36	153.40	1.23	12.39	44.38
		K (mg kg $^{-1}$)	20.02	1518.15	249.85	2.06	2.49	167536.51	40.53	409.31	163.82
		Mg (mg kg $^{-1}$)	132.06	2164.05	492.74	2.55	6.69	169626.97	40.78	411.86	83.59
		Mn (mg kg $^{-1}$)	2.49	288.36	106.26	0.51	-0.08	4779.79	6.85	69.14	65.07
		Na (mg kg $^{-1}$)	0.00	528.32	62.85	2.13	2.76	23692.29	15.24	153.92	244.92
		S (mg kg $^{-1}$)	10.14	57.22	21.44	2.19	5.86	67.92	0.82	8.24	38.44
		Zn (mg kg $^{-1}$)	0.72	6.92	1.79	2.83	13.36	0.71	0.08	0.84	46.90
	Jan09	pH	4.22	6.50	5.03	1.27	2.14	0.19	0.04	0.43	8.65

Table cont.

Site	Date	Variable	Min	Max	Mean	Skewness	Kurtosis	Variance	SE	SD	CV
PS2	Jan09	EC (ds m^{-1})	0.19	0.71	0.35	1.19	1.84	0.01	0.01	0.11	30.66
		OC (%)	1.60	4.46	2.59	0.55	0.48	0.28	0.05	0.53	20.61
		Al (mg kg^{-1})	971.92	1808.87	1386.23	0.02	0.05	25795.68	15.75	160.61	11.59
		Ca (mg kg^{-1})	535.71	4121.43	1588.27	0.80	0.49	520608.71	70.75	721.53	45.43
		Cu (mg kg^{-1})	1.60	5.54	2.86	0.70	4.17	0.32	0.06	0.56	19.68
		Fe (mg kg^{-1})	224.18	652.49	501.24	-0.77	-0.32	11243.52	10.40	106.04	21.15
		P (mg kg^{-1})	15.85	48.03	30.18	0.36	-0.31	51.63	0.70	7.19	23.81
		K (mg kg^{-1})	8.37	558.16	74.98	3.93	22.45	4878.54	6.85	69.85	93.16
		Mg (mg kg^{-1})	91.43	729.59	321.86	0.66	0.35	14976.17	12.00	122.38	38.02
		Mn (mg kg^{-1})	62.04	291.50	132.69	1.27	0.89	3174.98	5.53	56.35	42.46
		Na (mg kg^{-1})	0.00	118.91	39.69	0.63	-1.30	1372.37	3.63	37.05	124.79
		S (mg kg^{-1})	22.83	98.51	52.30	0.22	-0.11	225.55	1.47	15.02	28.72
		Zn (mg kg^{-1})	1.21	8.16	2.86	1.83	8.82	0.88	0.09	0.94	32.75
	May09	pH	4.22	6.38	5.26	0.60	0.09	0.15	0.04	0.38	7.31
		EC (ds m^{-1})	0.19	0.78	0.44	0.81	0.38	0.01	0.01	0.11	25.73
		OC (%)	1.60	5.18	3.05	0.74	0.75	0.39	0.06	0.62	20.44
		Al (mg kg^{-1})	862.44	1773.65	1314.38	0.15	-0.09	32869.10	17.78	181.30	13.79
		Ca (mg kg^{-1})	535.71	3185.10	1546.80	0.46	-0.59	372699.07	59.86	610.49	39.47
		Cu (mg kg^{-1})	1.60	3.98	2.81	0.29	0.21	0.16	0.04	0.40	14.21
		Fe (mg kg^{-1})	224.18	654.64	428.24	22.00	-0.48	8845.71	9.22	94.05	21.96
		P (mg kg^{-1})	10.09	51.61	26.74	1.02	1.02	73.26	0.84	8.56	32.00
		K (mg kg^{-1})	8.37	301.25	56.47	3.01	15.69	1448.44	3.73	38.06	67.40
		Mg (mg kg^{-1})	91.43	671.52	342.29	0.42	0.12	12008.34	10.75	109.58	32.01
		Mn (mg kg^{-1})	46.50	671.99	112.44	1.62	2.48	4152.71	6.32	64.44	57.31
		Na (mg kg^{-1})	0.00	64.03	31.09	0.61	0.32	132.94	1.13	11.53	37.08
		S (mg kg^{-1})	22.83	74.48	46.60	0.42	-0.88	146.07	1.19	12.09	25.93
		Zn (mg kg^{-1})	0.72	7.17	2.14	2.24	6.72	1.14	0.10	1.07	49.77
PR	Sept08	pH	4.77	7.14	5.79	0.73	0.49	0.22	0.05	0.47	8.13
		EC (ds m^{-1})	0.12	1.03	0.33	1.24	1.49	0.03	0.02	0.18	54.16
		OC (%)	0.13	5.79	1.91	0.97	1.02	1.14	0.10	1.07	56.04
		Clay (%)	8.16	48.16	20.10	0.85	2.86	37.02	0.59	6.08	30.27

Table cont.

Site	Date	Variable	Min	Max	Mean	Skewness	Kurtosis	Variance	SE	SD	CV
PR	Sept08	Al (mg kg $^{-1}$)	352.37	1130.01	751.79	0.01	-0.68	29400.37	16.50	171.47	22.81
		Ca (mg kg $^{-1}$)	539.41	4175.27	1808.72	0.99	0.00	800109.58	86.07	894.49	49.45
		Cu (mg kg $^{-1}$)	1.10	5.74	3.33	0.45	0.61	0.69	0.08	0.83	24.89
		Fe (mg kg $^{-1}$)	167.12	577.32	309.27	1.28	3.61	3953.12	6.05	62.87	20.33
		P (mg kg $^{-1}$)	4.36	82.94	13.18	6.48	55.08	63.69	0.77	7.98	60.57
		K (mg kg $^{-1}$)	7.58	160.95	59.70	1.11	2.24	639.26	2.43	25.28	42.35
		Mg (mg kg $^{-1}$)	158.92	751.77	340.36	0.93	0.55	15050.76	11.81	122.68	36.04
		Mn (mg kg $^{-1}$)	70.69	368.96	173.78	0.89	1.60	3031.33	5.30	55.06	31.58
		Na (mg kg $^{-1}$)	0.00	237.86	37.76	1.55	1.08	4012.81	6.10	63.30	167.78
		S (mg kg $^{-1}$)	8.97	45.80	19.24	1.27	0.46	77.86	0.85	8.82	45.86
		Zn (mg kg $^{-1}$)	0.90	8.69	2.59	2.02	6.42	1.40	0.11	1.18	45.69
	Jan09	pH	5.01	7.01	6.01	0.20	0.56	0.13	0.04	0.36	6.07
		EC (ds m $^{-1}$)	0.08	0.80	0.31	0.83	0.76	0.02	0.01	0.14	44.33
		OC (%)	1.50	5.19	2.73	0.66	-0.19	0.62	0.08	0.78	28.69
		Al (mg kg $^{-1}$)	418.45	1525.08	908.10	0.09	-0.20	45626.08	20.55	213.60	23.52
		Ca (mg kg $^{-1}$)	616.33	4653.34	1838.84	1.06	0.20	882716.25	90.41	939.53	51.09
		Cu (mg kg $^{-1}$)	1.18	13.01	3.36	4.30	32.44	1.57	0.12	1.25	37.29
		Fe (mg kg $^{-1}$)	247.48	771.40	435.85	0.79	0.62	11469.19	10.31	107.09	24.57
		P (mg kg $^{-1}$)	10.43	64.33	24.52	1.62	7.67	51.50	0.69	7.18	29.27
		K (mg kg $^{-1}$)	4.73	121.05	39.19	1.11	1.72	494.52	2.14	22.24	56.74
		Mg (mg kg $^{-1}$)	144.12	711.87	316.69	1.06	1.16	13630.18	11.23	116.75	36.87
		Mn (mg kg $^{-1}$)	43.67	709.89	199.68	0.43	0.63	3714.54	5.86	60.95	30.52
		Na (mg kg $^{-1}$)	0.00	335.49	70.24	3.11	11.88	2656.65	4.96	51.54	73.38
		S (mg kg $^{-1}$)	27.24	89.94	51.63	0.72	-0.12	19.62	1.35	14.02	27.16
		Zn (mg kg $^{-1}$)	1.47	7.42	2.97	1.64	3.27	1.24	0.11	1.11	37.43
	May09	pH	5.51	7.14	6.18	0.76	0.97	0.09	0.03	0.30	4.90
		EC (ds m $^{-1}$)	0.33	0.91	0.59	0.49	-0.75	0.02	0.01	0.15	24.78
		OC (%)	0.81	4.23	2.77	-0.09	0.41	0.31	0.05	0.55	19.98
		Al (mg kg $^{-1}$)	4441.51	1418.55	847.92	0.46	0.54	32796.13	17.43	181.10	21.36
		Ca (mg kg $^{-1}$)	698.75	4029.25	1737.05	1.11	0.90	538720.80	70.63	733.98	42.25
		Cu (mg kg $^{-1}$)	1.54	4.92	3.19	0.49	-0.06	0.43	0.06	0.65	20.45

Table cont.

Site	Date	Variable	Min	Max	Mean	Skewness	Kurtosis	Variance	SE	SD	CV
PR	May09	Fe (mg kg $^{-1}$)	215.79	581.90	346.59	0.91	1.01	5305.56	7.01	72.84	21.02
		P (mg kg $^{-1}$)	8.34	44.30	15.45	2.45	10.84	23.84	0.47	4.88	31.60
		K (mg kg $^{-1}$)	18.16	84.52	36.29	1.18	1.89	155.05	1.20	12.45	34.32
		Mg (mg kg $^{-1}$)	172.53	577.75	326.65	0.48	-0.66	9613.71	9.43	98.05	30.02
		Mn (mg kg $^{-1}$)	103.46	33.01	183.97	1.11	1.12	2219.74	4.53	47.11	25.61
		Na (mg kg $^{-1}$)	14.02	246.43	69.01	2.12	5.65	1769.27	4.05	42.06	60.95
		S (mg kg $^{-1}$)	33.01	95.91	51.75	0.91	0.39	190.33	1.33	13.80	26.66
		Zn (mg kg $^{-1}$)	1.12	16.08	2.67	6.44	54.62	2.36	0.15	1.54	57.53

APPENDIX G
SEMIVARIOGRAM DATA FROM GS+

Site	Date	Variable	Model[a]	Model	Nugget	Sill	Nugget/Sill	Spatial Dependency[b]	Effective Range[c]
				---r^2---			--%--		---m---
PS1	Sept08	Clay	Exponential	0.016	0.05	8.586	0.6	Weak	53.10
		pH	Spherical	0.985	0.031	0.349	8.9	Strong	109.60
		EC	Spherical	0.958	0.00742	0.01724	43.0	Moderate	143.50
		OC%	Gaussian	0.979	0.165	0.598	27.6	Moderate	329.01
		Al	Exponential	0.956	15200	68510	22.2	Strong	536.40
		Ca	Spherical	0.896	96000	482900	19.9	Strong	109.20
		Cu	Exponential	0.332	0.0406	0.2982	13.6	Weak	140.40
		Fe	Spherical	0.931	5050	15730	32.1	Moderate	94.60
		P	Spherical	0.281	1.2	114.1	1.1	Weak	26.60
		K	Exponential	0.043	19	1110	1.7	Weak	67.50
		Mg	Spherical	0.583	5160	11510	44.8	Moderate	92.50
		Mn	Exponential	0.983	30	4110	0.7	Strong	333.90
		Na	Exponential	0.034	330	4033	8.2	Weak	45.90
		S	Exponential	0.602	13.6	141.7	9.6	Strong	72.00
		Zn	Exponential	0.245	0.114	1.25	9.1	Weak	91.80
	Jan09	pH	Gaussian	0.987	0.0835	0.315	26.5	Moderate	178.29
		EC	Exponential	0.467	0.00234	0.01888	12.4	Weak	123.30
		OC %	Exponential	0.088	0.0103	0.1526	6.7	Weak	56.70
		Al	Exponential	0.033	4700	57230	8.2	Weak	55.80
		Ca	Spherical	0	6800	307000	2.2	Weak	21.40
		Cu	Spherical	0.151	0.01	8.259	0.1	Weak	35.70

[a]Model type was determined by a best fit analysis in GS+ (Gamma Design Software LLC, 2008); [b]Based on strong, moderate, or weak defined by nugget to sill ratios < 25, 25 to 75, or < 75, respectively, and weak if the fitting $r^2 < .50$ (Duffera et al., 2007; Emadi et al., 2008, and Weindorf and Zhu, 2010); [c] Effective range = model range multiplied by 1.0, 3.0, or 1.73 for spherical, exponential, and Gaussian models, respectively (Duffera et al., 2007; Weindorf and Zhu, 2010); [e] Organic C %.

Table Cont.

Site	Date	Variable	Model	Model ---r^2---	Nugget	Sill	Nugget/Sill --%--	Spatial Dependency	Effective Range ---m---
		Fe	Gaussian	0	1440	13140	11.0	Weak	23.37
		P	Spherical	0.358	0.1	211.1	0.0	Weak	34.40
		K	Spherical	0.111	4	478.1	0.8	Weak	26.80
		Mg	Exponential	0.063	480	4926	9.7	Weak	58.50
		Mn	Exponential	0.287	250	5251	4.8	Weak	79.20
		Na	Spherical	0.962	157	1280	12.3	Strong	103.60
		S	Exponential	0.564	21.1	165.5	12.7	Strong	154.80
		Zn	Exponential	0.045	0.075	0.947	7.9	Weak	56.70
	May09	pH	Exponential	0.169	0.0363	0.3136	11.6	Weak	73.80
		EC	Exponential	0.163	0.00238	0.03046	7.8	Weak	71.10
		OC %	Spherical	0.111	0.0068	0.2916	2.3	Weak	26.60
		Al	Exponential	0.234	6900	66180	10.4	Weak	112.50
		Ca	Spherical	0	4900	238700	2.1	Weak	21.40
		Cu	Gaussian	0.153	0.01	9.7	0.1	Weak	51.24
		Fe	Spherical	0.968	4060	18680	21.7	Strong	109.30
		P	Exponential	0.257	115	1028	11.2	Weak	85.50
		K	Spherical	0.337	0.1	220.7	0.0	Weak	31.40
		Mg	Exponential	0.047	320	4796	6.7	Weak	63.00
		Mn	Gaussian	0.391	370	5270	7.0	Weak	44.95
		Na	Spherical	0.52	5.5	271.5	2.0	Strong	33.40
		S	Exponential	0.079	37	455.9	8.1	Weak	56.70
		Zn	Spherical	0	3.55	21.03	16.9	Weak	23.20
PS2	Sept08	Clay %	Gaussian	0.974	10.5	46.18	22.7	Strong	433.89
		pH	Gaussian	0.652	0.0884	0.2188	40.4	Moderate	122.55
		EC*	Spherical	0	0.0017	0.0526	3.2	Weak	10.50

Table Cont.

Site	Date	Variable	Model	Model	Nugget	Sill	Nugget/Sill	Spatial Dependency	Effective Range
				---r^2---			--%--		---m---
		OC %	Spherical	0.943	0.297	0.914	32.5	Moderate	269.30
		Al	Exponential	0.769	32600	96300	33.9	Moderate	3212.10
		Ca	Gaussian	0.944	231000	922900	25.0	Strong	186.98
		Cu	Gaussian	0.904	0.236	2.149	11.0	Strong	1117.38
		Fe	Gaussian	0.888	5900	12900	45.7	Moderate	150.12
		P	Gaussian	0	30.2	173.2	17.4	Weak	5.09
		K	Spherical	0.388	8300	168500	4.9	Weak	21.20
		Mg	Exponential	0.392	28900	176500	16.4	Weak	96.30
		Mn	Gaussian	0.945	1660	8192	20.3	Strong	261.29
		Na	Exponential	0.625	16420	32850	50.0	Moderate	1185.30
		S	Exponential	0.815	55.3	161.6	34.2	Moderate	2853.00
		Zn*	Spherical	0	0.023	0.731	3.1	Weak	10.50
	Jan09	pH	Spherical	0.715	0.0704	0.2018	34.9	Moderate	82.40
		EC	Exponential	0.131	0.00127	0.01164	10.9	Weak	54.00
		OC %	Gaussian	0.873	0.1834	0.3918	46.8	Moderate	259.79
		Al	Exponential	0.658	20500	56240	36.5	Moderate	3698.10
		Ca	Gaussian	0.933	133000	665100	20.0	Strong	166.90
		Cu	Exponential	0.775	0.2599	0.5208	49.9	Moderate	2782.80
		Fe	Gaussian	0.799	1580	13390	11.8	Strong	139.93
		P*	Spherical	0	3.8	52.27	7.3	Weak	10.50
		K	Exponential	0.504	3500	12100	28.9	Moderate	2925.00
		Mg	Gaussian	0.93	8150	25780	31.6	Moderate	314.33
		Mn	Gaussian	0.981	980	5335	18.4	Strong	257.99
		Na	Gaussian	0.968	176	2241	7.9	Strong	221.74
		S	Spherical	0.78	63.6	236.3	26.9	Moderate	64.20

Table cont.

Site	Date	Variable	Model	Model ---r²---	Nugget	Sill	Nugget/Sill --%--	Spatial Dependency	Effective Range ---m---
		Zn*	Spherical	0	0.051	0.873	5.8	Weak	10.50
		pH	Gaussian	0.935	0.0402	0.1934	20.8	Strong	175.59
		EC	Gaussian	0.931	0.00657	0.01994	32.9	Moderate	277.17
		OC %	Gaussian	0.937	0.261	1.028	25.4	Moderate	562.43
		Al	Exponential	0.164	3690	32750	11.3	Weak	54.00
		Ca	Gaussian	0.984	103000	550000	18.7	Strong	212.45
		Cu	Exponential	0.666	0.1262	0.4	35.2	Moderate	3698.10
		Fe	Spherical	0	440	8840	5.0	Weak	10.50
	May09	P*	Exponential	0.161	12.2	75.91	16.1	Weak	60.30
		K	Gaussian	0.767	981	4072	24.1	Strong	529.47
		Mg	Gaussian	0.911	7110	21580	32.9	Moderate	347.29
		Mn	Gaussian	0.967	1270	10349	12.3	Strong	379.05
		Na	Exponential	0.037	12.2	129.2	9.4	Weak	37.80
		S	Gaussian	0.993	48.1	224.7	21.4	Strong	233.42
		Zn	Spherical	0	0.104	1.193	8.7	Weak	10.50
		pH	Exponential	0.885	0.1552	0.4294	36.1	Moderate	3317.40
		EC	Exponential	0.904	0.0202	0.0659	30.7	Moderate	3050.10
		OC %	Spherical	0.985	0.488	2.039	23.9	Strong	292.10
		Clay %	Spherical	0.996	11.87	41.99	28.3	Moderate	120.70
		Al	Exponential	0.997	9540	34320	27.8	Moderate	461.70
PR	Sept08	Ca	Spherical	0.995	44000	1099000	4.0	Strong	198.70
		Cu	Gaussian	0.999	0.275	0.713	38.6	Moderate	126.75
		Fe	Exponential	0.798	800	4406	18.2	Strong	257.40
		P*	Spherical	0	5.3	67.67	7.8	Weak	21.80
		K	Exponential	0.946	469	1054.3	44.5	Moderate	2094.30

Table Cont.

Site	Date	Variable	Model	Model ---r^2---	Nugget	Sill	Nugget/Sill --%--	Spatial Dependency	Effective Range ---m---
		Mg	Spherical	0.973	4990	23920	20.9	Strong	254.60
		Mn	Spherical	0.943	1211	3251	37.3	Moderate	124.30
		Na	Spherical	0	240	4185	5.7	Weak	21.80
		S*	Spherical	0	1.9	78.4	2.4	Weak	21.80
		Zn	Spherical	0.986	0.556	1.627	34.2	Moderate	116.10
	Jan09	pH	Gaussian	0.956	0.0807	0.1624	49.7	Moderate	252.30
		EC	Exponential	0.138	0.0009	0.0174	5.2	Weak	103.50
		OC %	Spherical	0.998	0.097	1.101	8.8	Strong	247.40
		Al	Exponential	0.983	22670	53510	42.4	Moderate	630.90
		Ca	Spherical	0.994	57000	1524000	3.7	Strong	275.10
		Cu	Exponential	0.954	0.834	2.22	37.6	Moderate	1932.30
		Fe	Exponential	0.975	3950	14480	27.3	Moderate	527.40
		P	Spherical	0.973	28.7	67.37	42.6	Moderate	247.30
		K	Exponential	0.959	331	790	41.9	Moderate	1737.00
		Mg	Exponential	0.935	5770	19780	29.2	Moderate	1060.20
		Mn	Exponential	0.352	290	3684	7.9	Weak	94.50
		Na	Gaussian	0.972	1820	5750	31.7	Moderate	568.13
		S	Spherical	0.999	37.9	254.9	14.9	Strong	189.40
		Zn	Exponential	0.956	0.691	2.575	26.8	Moderate	2692.80
		pH	Gaussian	0.99	0.0463	0.1676	27.6	Moderate	461.75
		EC	Spherical	0.996	0.0034	0.0355	9.6	Strong	237.90
		OC %	Spherical	0.994	0.025	0.355	7.0	Strong	115.40
	May09	Al	Spherical	0.951	15400	61900	24.9	Strong	330.50
		Ca	Spherical	0.998	16000	720700	2.2	Strong	188.30
		Cu	Exponential	0.992	0.07	0.506	13.8	Strong	440.10

Table Cont.

Site	Date	Variable	Model	Model ---r^2---	Nugget	Sill	Nugget/Sill --%--	Spatial Dependency	Effective Range ---m---
		Fe	Exponential	0.945	2560	7822	32.7	Moderate	1049.40
		P	Spherical	0.212	1.3	24.85	5.2	Weak	29.10
		K	Exponential	0.935	96.8	195.6	49.5	Moderate	1037.70
		Mg	Exponential	0.993	1260	17510	7.2	Strong	1177.20
		Mn	Spherical	0.836	463	2374	19.5	Strong	79.50
		Na	Exponential	0.827	1314	2800	46.9	Moderate	2050.20
		S	Spherical	0.998	5.8	266	2.2	Strong	191.60
		Zn	Spherical	0.082	0.478	2.813	17.0	Weak	30.20

VITA

Stephanie Johnson was born in 1984 in Galesburg, Illinois. She moved to Keller, Texas, with her family as a young adult and chose a university close to her home. She earned a Bachelor of Science degree in agronomy in 2008 from Tarleton State University in Stephenville, Texas. Stephanie's introduction to soil science began only as an elective course with Dr. David Weindorf at Tarleton State University, but she continued her studies under his guidance when he accepted a tenured-track position at Louisiana State University. Stephanie specifically chose to come to Louisiana State University to work with Dr. Weindorf and started her Master of Science degree in agronomy in August 2008.

Stephanie married George Whitaker in June 2009. George works as a vestibular audiologist in Norfolk, Virginia, where they will be living after Stephanie receives her Master of Science degree.