An Abstract of the Thesis of

Will Austin for the degree of Master of Science

in Soil Science presented on May 10, 1993.

Title: Duration of Saturation and Redox Potentials in Selected Willamette Valley Soils.

Redacted for privacy

Abstract Approved:

J.H. Huddleston

Water tables, redox potential, soil temperature, and precipitation were recorded using permanently installed field equipment in two toposequences in the Willamette Valley during the 1991-1992 wet season. The study utilized piezometers, tensiometers, platinum electrodes, and thermocouples constructed and installed by the Wet Soil Project personnel. Each toposequence included well drained to poorly drained soils that were morphologically described from excavated pits at each soil type plot.

Relationships between redox potential, duration of saturation, and morphology were studied for each individual soil plot in each toposequence. Trends of these relationships within each toposequence were examined and comparisons were made between the two toposequences.

Longer durations of saturation did not necessarily result in lower redox potentials. Saturation at 100 cm depths for more than 50% of the wet

season did not result in potentials low enough for iron reduction to occur. Low organic matter contents at 100 cm restricted declining redox potentials even when soils were saturated for long periods. Iron reduction is most likely to occur at depths less than 38 cm. Intensity of reduction was greatest during the spring when the soils were saturated and the temperatures were rising.

Depth to mottling was an indication of water table duration. Mottles were deeper in soil plots that had water tables within 25 cm of the surface for 10% or less of the wet season than in soils that had water tables near the surface for 50% or more of the wet season. Surface redoximorphic features occurred in soils that had water tables within 25 cm of the surface for durations greater than 10% of the wet season.

Within each toposequence landscape position and soil texture influenced soil drainage characteristics. Soils on broad, level terraces underlain by clayey sediments and soils in drainageways filled with clayey alluvium were wetter than soils on more dissected landforms underlain by silty sediments.

The 1991-1992 wet season in the Willamette Valley of Oregon was warmer and drier than normal. The data collected during 1991-1992 will provide excellent baseline data for future years that may be more 'normal'.

Duration of Saturation and Redox Potentials in Selected Willamette Valley Soils

by

Will Austin

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed May 10, 1993

Commencement June 1994

APPROVED:

Redacted for privacy

Professor of Soil Science in charge of major

Redacted for privacy

Head of department of Crop and Soil Science

Redacted for privacy

Dean of Graduate School

Date thesis is presented May 10,1993

Typed by Will Austin for Will Austin

ACKNOWLEDGEMENT

I wish to thank Dr. Herb Huddleston for allowing me to be his student. His knowledge, guidance, and encouragement were invaluable to me.

A special thanks to the Soil Conservation Service for their vision and funding of the Wet Soil project in Oregon, of which I was fortunate to be involved with.

A thank you to my committee members: Dr. Jerry Kling, Dr. Bob Frenkel, and Dr. Russ Ingham for all their efforts.

Thanks to Dr. Ladd for his understanding on my trips to the principals office and to Dr. Boersma for convincing me that the pursuit of knowledge is truly a voyage of discovery.

I would like express my appreciation to Rich Guerber, Clarence Venel, Bob Kennel, and Roger Olsen for allowing me the use of their land.

I would like to recognize friends and fellow students who have taken interest in my thesis project:

Dave D'Amore and Lisa Setter who have graciously volunteered to carry on the field research.

Scott Stewart and Helene Murray for their words of encouragement.

Aaron Lieberman, a friend and good field man, who put a lot of effort into the project.

A loving thank you to my wife Mary and my daughter Brigid for allowing their husband and dad the chance to go to graduate school.

Table of Contents

List of Figures

Figure | Page

List of Tables

DURATION OF SATURATION AND REDOX POTENTIALS IN SELECTED WILLAMETTE VALLEY SOILS.

INTRODUCTION

The degree of soil wetness may be inferred from profile morphology. The profile description includes distinct physical characteristics attributed to soil water table depth fluctuations and duration of saturation. These characteristics are used to classify soil moisture regimes (Soil Survey Staff, 1975).

Permanently installed field equipment can be utilized to measure depth to and duration of water tables and soil moisture states. The equipment is easily manufactured and will provide the long term data required to accurately describe soil wetness.

A toposequence of well drained to poorly drained soils allows comparisons of soil temperature, redox potential, water table depth, and matric potential between each soil. The relationship between depth and duration of saturation and redox potential is of particular value because the reduction and oxidation of iron is manifest morphologically as patterns of high and low chroma colors.

Objectives:

1.) To develop field equipment suitable for long term monitoring of soil wetness.

2.) To determine relationships between redox potential, duration of saturation, and morphology.

LITERATURE REVIEW

Geographic Setting

The Willamette Valley lies between the Cascade Mountains and the Coast Range. The valley is a structural depression filled with alluvium. The sediments in the study area are Plio-Pleistocene and recent alluvial deposits (Baldwin, 1982). The landscapes of the Willamette Valley tend to have low relief and are slightly incised. Balster and Parsons (1968) have identified a series of geomorphic surfaces on these landscapes that generally fit a time sequence. A toposequence (Birkeland, 1984) of soils on two of these surfaces, the Calapooyia and the Ingram, (Balster and Parsons, 1968) has been selected as a study area. Soils along this toposequence represent a drainage catena (Ruhe, 1975) that includes the well drained Willamette, moderately well drained Woodburn, somewhat poorly drained Amity, and poorly drained Dayton and Waldo soil series. Detailed descriptions of and taxonomic classification for these soils are given in Appendix A.

Depth and Duration of Saturation

Depth and duration of saturation influence soil redox processes, which in turn create distinctive morphological signatures. If the duration at a given depth is long enough to develop reducing conditions, gray soil colors may develop with or without the formation of mottles or concretions. Long enough is a relative term. As Bonner and Ralston (1968) have shown, under controlled conditions gley colors may develop in 25 days. Using antecedent morphologic characteristics, soil moisture status may be inferred (SCS,1981). The morphologic color changes are due to oxidation-reduction processes within the profile (Veneman, et al 1975; Franzmeier et al, 1983; Evans and Franzmeier, 1985) and according to Vepraskas (1992) may be described as redoximorphic features of redox depletions, redox concentrations, and reduced matrices. For instance, the reduction and mobilization of Fe and Mn may be associated with low chroma colors, whereas subsequent oxidation and precipitation are associated with high chroma colors (Clothier et al, 1978) and these chroma changes are described as soil mottling. The physical occurrence of these mottles can be associated with duration of saturation, as described by Veneman et al (1975), where high chroma colors inside peds, ped mangans and few iron nodules are associated with very short periods of saturation (one day or less); chromas of two inside peds, ped ferans, and few manganese nodules are associated with short periods of saturation (not exceeding a few days); and chromas of one inside peds and lack of manganese nodules are associated with periods of continuous saturation for several months.

Many soil colors are the result of various iron oxide forms and concentrations (Schwertmann, 1985). However soil colors may fail to indicate restricted drainage conditions if the soil lacks an energy source required by the microbial population for redox processes to proceed. Lack of an energy source, such as lack of organic soil materials that are required by the heterotrophic soil organisms, is due to absence of decomposable plant material at the soil surface or roots at depth, animal body tissue or wastes, leaching of organic compounds, and loss of carbon compounds to the atmosphere. In this case even though saturated for long periods, no significant reduction will take place, and no color changes will occur (Couto et al, 1985).

Classifying Soil Moisture Conditions.

Soil wetness is a measure of the total amount of liquid in the profile. As moisture content decreases, water is removed from larger pores, leaving only the smaller ones with water due to surface tension and capillarity (Bouma, et al, 1974). Soil moisture can be measured using both in situ equipment and laboratory techniques. The Soil Conservation Service (SCS, 1981) has established 3 classes, or states, of soil moisture. In the dry state, soil moisture tensions are greater than 15 bars. In the moist state, soil moisture tensions are greater than 0.01 bar but less than 15 bars. In the wet state, soil moisture tensions are less than 0.01 bar. (McRae, 1988) defines saturation as tension less than 0.01 bar.

Piezometers and Tensiometers

Piezometers and tensiometers can be used to record wet and dry conditions in the soil. Piezometers are used to measure depth to a water table and can be used to log changes over time of input and drainage (Hvorslev, 1951). Technically the piezometer indicates the hydraulic head, or pressure potential, (Hillel, 1982) of the water in a soil profile. The use of piezometers in a toposequence provides data points for tracing the depth of the pressure head (Price, 1985).

Tensiometers are used to measure the matric potential of the soil. As defined by Marshall and Holmes (1988), matric potential is the measure of forces on soil water from capillarity and surface adsorption. Capillarity results from the surface tension of the water and its contact angle with soil particles. (Hillel, 1982). Surface tension occurs at the water-air interface and is due to the greater attraction of the water molecules for each other (cohesion) than for the air around them (Brady, 1990). The contact angle is formed by the displacement of air away from the soil particle by water and is measured from the edge of the water particle to the interface with the soil particle. A small contact angle is the result of water being preferentially attracted to the solids compared to its cohesion to other water molecules, as observed when water wets the solid. A large contact angle is the result of a cohesive force stronger than the attractive force to the solid, hence the liquid repels the solid (Jury et al, 1991). Surface adsorption is the adhesion with hydrogen bonds of the water molecules and solid soil particles (Brady, 1990).

The size of pore radii determines how high water will be drawn upward above the water table by capillary forces (Bouma et al, 1974). The maximum height of capillary water is the top of the capillary fringe (Price, 1985). Baumer (1990) has provided estimates of capillary fringe thickness for texture ranges of coarse sand to clay. As described by Bouwer (1978) and Hillel (1982), the pore radii will also determine the air-entry value which is the negative pressure potential at which the largest pore will began to drain.

A tensiometer is a water column connected to the soil through a porous cup (James et al, 1982). If the soil water is at a pressure lower than atmospheric pressure, caused by the adsorptive and capillary forces, a suction will be exerted on the water column (Hillel, 1982). Marshall and Holmes (1988) conclude that soil water held by capillary and adsorptive forces (matric tension) has lower potential energy than water in a standard state and thus has negative values of pressure potential. Tensiometers are limited to a useful range of < .850 bar (Marshall and Holmes, 1988) because as tension approaches 1 bar, gases dissolved in the water begin to form bubbles and the water column will break up (Jury et al, 1991).

When tensiometers are used concurrently with piezometers, an accurate determination of depth to the free water surface may be obtained. First, subtract the water column length (measured from the top of the water column inside the tensiometer to the middle to the ceramic cup) of the tensiometer from the absolute value of the matric potential measurement. If the absolute value of the matric potential is greater than the water column length, then the soil is unsaturated at the cup. If the absolute value is less than the water column length, the numerical difference is the distance above the cup to the free water. In this case the tensiometer-calculated value and piezometer head measurement should provide adequate information as to the depth to the free water surface.

Reduction-Oxidation Measurement by Platinum Electrodes

Redox potentials in soils are measured with platinum electrodes. Platinum has been used for a long time to measure potentials in various media (Gillespie, 1920; and Jones, 1966) including soil (Faulkner, et al 1989; Szogi and Hudnall, 1990). The actual potential is a measure of the electromotive forces of a redox couple (Gillespie, 1920). A redox couple, as defined by Sposito (1989), involves two half-reactions which, when combined, represent a coupled chemical reaction in which reduction of one species and the oxidation of the other species has occurred.

At equilibrium conditions the Nernst equation can be used to calculate the potential.

$$E = \frac{E^\circ - RT \ln Q}{nF} \text{, where}$$

E is electrode potential of the redox couple
E° is standard electrode potential of the redox couple
R is gas constant
T is degrees Kelvin
Q is concentration of oxidized and reduced substances

$$Q = \frac{\text{reduced species}}{\text{oxidized species}}$$

n is number of transferred electrons
F is Faraday constant

This equation represents a voltage (E) created from the ratio of oxidized to reduced molar concentrations of the ions or molecules (Faust and Aly Osman, 1981). The potential will drop as the concentration of reduced species become greater.

Soil conditions, however, are non-equilibrium. Therefore redox in soil is a mixed potential where the platinum electrode measurement represents the average potential of many couples and not the potential of any single couple (Bohn et al, 1985). Soil redox potentials should be corrected to a standard hydrogen electrode and reported as Eh measurements (Bartlett, 1981).

Electrodes in soil are susceptible to "poisoning" of the platinum, which may cause erroneous redox potentials. Jones (1966) attributes "poisoning" to sulfates and organic matter. Other researchers (Lemon and Erickson, 1954;

Rickman et al, 1968; and Van Doren and Erickson, 1966) also report "poisoning" due to formation of oxide coatings or adsorption of foreign matter on the platinum wire. "Poisoning" may occur under extreme reducing conditions (< -200 mv), but it may not occur in moderate reducing conditions (Meek and Grass, 1975). Whisler et al (1974) found that Eh values more positive than or equal to -200 mv for six month periods did not effect electrode functions. These authors indicate that longevity of platinum electrodes may be inferred by the amplitude of oscillations during intermittent flooding and drying in soil columns. Improperly constructed platinum electrodes also will result in incorrect measurements. Van Doren and Erickson (1966) recommend platinum wire sizes between 10 gage (0.259 cm) and 22 gage (0.064 cm) with at least a 4 mm exposed tip for proper construction. These authors conclude that wire which is longer and/or smaller in diameter will create larger effective areas. The larger effective area may not, at negative matric potentials, support the required moisture film needed for electrical continuity. McIntyre (1966) agrees with this conclusion and describes situations of decreasing effective areas on platinum wire when the moisture films rupture.

Organic Matter and Microorganisms

Reduction processes in soils are facilitated by soil organic matter and microorganisms. In their study on substrate, temperature, and nutrient status

Bonner and Ralston (1968) found that organic matter alone will not cause a change in redox potential. They concluded that actively metabolizing microorganisms are a requirement. Alexander (1977) agrees with this conclusion. He found no increases in reduced iron in a soil that had been sterilized of microbes but had all other required components for a reducing environment. Microbial activity causes a change in Eh through consumption of O_2 from respiration and liberation of reduced products during decomposition of organic matter.

An energy source, i.e. organic matter, must be present and available in order for organisms to facilitate electron transfers (Couto et al, 1985). During decomposition, energy is obtained from the carbon compounds of organic matter by removing electrons (oxidation of carbon compounds) from donors. The electrons are subsequently transferred to (reduction) acceptors. The primary electron acceptor is O_2. If O_2 is not available, then in descending order of utilization are NO_3^-, Mn^{4+}, Fe^{3+}, and SO_4^{2-} (Ponnamperuma, 1972).

Meek et al (1968) also studied the effect of organic matter. They found that the Eh values were lower if organic matter amendments were made to a soil than if no organic amendments were made. Further study indicated that when organic amendments are made to a soil which is then subjected to higher temperatures, the result was lower Eh values in the amended soil than in a similar soil with no organic amendments. Microorganisms use free oxygen in the soil as an electron acceptor (reduction of oxygen) for electrons liberated during the decomposition of organic matter (oxidation of carbon compounds) and when the oxygen is depleted they can utilize alternate acceptors such as manganic manganese or ferric iron (Gambrell and Patrick, 1978). The reduced products are soluble forms of Fe^{2+} and Mn^{2+} (Meek et al, 1968).

Saturation of the soil usually leads to O_2 depletion as the soil pores fill with water. Oxygen availability decreases because the diffusion of oxygen in water is much slower than in air. Microbial decomposition continues, however, but as the O_2 supply diminishes organisms rely more and more on secondary acceptors, and the result is a lower redox potential. When the microorganisms deplete the oxygen supply, the result is a reducing environment.

The rate of O_2 depletion is somewhat dependent on soil temperatures Meek and Stolzy (1978). They state that as temperature increases and respiration rate of microbes also increases, O_2 is used up more rapidly, replenishment is slower than utilization.

Redox potentials, however, should not be regarded solely as a measure of soil aeration. Negative potentials representing reduced conditions are indicative not only of O_2 depletion but of increased solubility of metals and accumulation of hydrogen (Bonner and Ralston, 1968).

Soil structure and moisture content also affect the diffusion rate of O_2 (Grable and Siemer, 1968). Bohn et al (1985) state that thin water films (wet but not saturated) in pore spaces will slow gaseous diffusion when organisms are actively consuming O_2. According to Meek and Stolzy (1978) pores in a soil represent a heterogeneous system with smaller pores inside peds and larger ones between peds. When soil aeration is restricted, the smaller entrapped pores may contain little or no O_2 while larger pores may be well aerated. These researchers have documented large changes in O_2 over short distances within a single ped.

The temperature at which biologic activity is considered nil is 5° C (SCS,1981). As temperature increases, biologic activity increases (Meek et al, 1968) resulting in a higher demand for O_2. Should this higher demand for O_2 exceed the rate of replenishment reducing conditions may develop. In contrast a decrease in soil temperature will result in lower biologic activity and therefore lower Eh values should not develop (Pickering and Veneman, 1984). Bonner and Ralston (1968) found that under saturated conditions and at lower temperatures, reducing conditions developed slowly and show smaller (absolute numerical) change than at a higher temperature. As soils begin to warm up in the spring, even under saturated conditions that are common at this time, the soil microbial activity gradually increases, and reducing conditions are likely to occur (Cogger and Kennedy, 1992). The result may be Fe reduction and mottling. However the poorer drained soils are buffered against temperature changes because water insulates the larger pores from outside temperature influences (Pickering and Veneman, 1984).

Duration of Saturation

Short term flooding decreases Eh values steadily (Meek and Stolzy, 1978) and leads to a reducing environment. This happens when the time intervals between flooding periods are so short that O_2 does not reenter the soil. In contrast, during long term flooding the Eh values are in phase with saturated (decreasing Eh) and unsaturated (increasing Eh) values. Whisler et al (1974) found similar changes in Eh with slow declining values during wetting and rapid increases after drainage. These authors attributed the sequence to slow utilization of entrapped O_2 during infiltration while drainage created a suction that pulled O_2 into the soil.

Previous Studies

A number of recent studies detailing in situ monitoring of soil wetness have been done. These studies utilize various field equipment for data acquisition. The equipment array includes devices to measure water table depth and redox potentials. The emphasis is on depth and duration of saturation. Hudnall et al (1990) concentrated their research on saturation, reduction, and redoximorphic features. Field equipment used for this study involved piezometers, unlined boreholes, tensiometers, platinum electrodes, and raingauges. Data collection and field techniques from this study were used by the International Committee on Soils With Aquic Moisture Regimes (ICOMAQ) to aid in the study of aquic conditions in soils of Louisiana and

Texas. Hudnall and Wilding (1990) provide more detail on equipment manufacturing and field data evaluation.

Saturation, reduction, and color patterns in the Puget Lowlands have been evaluated by Cogger and Kennedy (1992). They concluded that soil colors can be used to predict seasonally high water tables. Further they have found landscape position and parent material to influence moisture regimes. Finally they state that low temperature and low organic matter will lower reduction rates in saturated soils.

Faulkner and Patrick (1992) have used quantitative data on soil Eh, O_2, and water table depth to support qualitative hydric soil indicators (low chroma colors, gleying, iron concretions, and mottling). These authors concluded that most but not all quantitative data is correlated with morphological data with the exception that some colors may be relict from previous moisture regimes or inherited from parent materials. They also have shown how soil moisture regime, observed soil mottling and low chroma colors are related through soil forming processes. Soil redox dominates these processes and is controlled by variability in organic matter, temperature, Fe-Mn concentration, and saturation duration. Several researchers (Franzmeier et al 1983, Evans and Franzmeier, 1985, and Vespraskas and Wilding, 1983) agree with these interpretations but add that the criteria for determining an aquic moisture regime (Soil Survey Staff, 1990) and hydric soil characteristics (Wetlands Research Program, 1987) should be amended to include morphologic features of 3 and possibly 4 chromas.

LABORATORY METHODS

Introduction

The equipment for in situ measurements of soil wetness is readily manufactured. For this project platinum electrodes, tensiometers, and piezometers were assembled by the project personnel. Prefabricated thermocouples were reconfigured to meet project needs. The recording raingauges were standard, commercially manufactured styles and not designed or assembled by project personnel.

Manufacture and Testing of Platinum Electrodes

Platinum electrodes were constructed similar to those described by Szogi and Hudnall (1990). The electrode is made by permanently attaching 18 gage platinum wire to 8 mm o.d. by 5 mm i.d. pyrex tube. The platinum tip is part of an electrical circuit that is connected to a surface copper wire lead by a mercury junction. Contamination of the circuit by soil water is avoided by sealing the inside of the platinum tip and pyrex joint with jewelers wax, and by a silicon, latex, and heat shrink tubing seal around the copper lead wire at the top of the pyrex (Figure 37, Appendix B).

After the electrode is constructed a quality check is advisable. A solution of 0.1 gram quinhydrone per 50 ml of distilled water buffered to pH 7 is required. After the platinum electrodes and a calomel reference electrode are placed in the solution, millivolt meter connections are made with the positive lead to the platinum electrode and negative lead to the reference electrode. All millivolt readings should be within plus or minus 10 mv of the value in Table 9, Appendix B. If the electrode is not within the calculated range it must be removed from the test solution, rinsed in distilled water, then scrubbed with household cleanser, and soaked in distilled water for two hours minimum before retesting in fresh quinhydrone solution. If the electrode still does not pass testing it can be soaked in a mixture of 1:1 concentrated hydrochloric and nitric acids for thirty minutes, then soaked in distilled water over night and retested in fresh solution. Destroy any electrode that does not pass testing, recover the platinum, and dispose of the mercury properly. All electrodes that have passed testing are ready for field use and should be stored in a clean environment until needed.

Manufacture and Testing of Tensiometers

The tensiometers are constructed from schedule 80 grey PVC pipe, with clear acrylic sight tubes, and porous ceramic cups (Figure 39, Appendix B). The cups are joined to the schedule 80 with epoxy, and the acrylic tube joined with PVC cement. Improper joining will result in leakage. A rubber septum is placed over the end of the sight tube, through which the needle of a pressure transducer can be inserted to read the soil moisture tension.

Testing of a properly constructed tensiometer is not required but is highly advisable. The object of the test is to find any leaks. A simple test involves soaking the tensiometer with cup submerged in distilled water for 24 hours to saturate the porous cup and expose the epoxy joint to moisture. After 24 hours remove the tensiometer, drain any liquid from inside the tube, and install the proper sized septum. Immediately fill the tensiometer with air using a large syringe and a 21 gage needle to pressure of approximately 1.25 bar. Immerse the joined ends of the tensiometer in water and look for air bubbles as a sign of leakage. Any areas of leakage must be thoroughly dried, reglued, and retested.

Manufacture and Testing of Thermocouples

The thermocouples used for the project are type K, ungrounded, and inconel sheathed. They were premanufactured to 4 foot lengths and calibrated to plus or minus 3 degrees fahrenheit (Oremet specification, 1990). For use in the field, they were cut to the length desired, fitted with male connectors, and provided with a water tight seal (Figure 41, Appendix B). The finished thermocouples were tested in the lab by immersing in cooled liquid of a known temperature and/or placed in a laboratory controlled temperature room.

Manufacture and Testing of Piezometers

Piezometer wells were constructed from 3/4 inch PVC pipe. The bottom 8 cm of the cut length was slotted with seven equally spaced horizontal slits. The slits were covered with geo-fabric in order to keep soil particles out the of tube while buried in the field. A water table measuring device was made from an acrylic tube fitted with a styrofoam float and a nylon covered bottom end[1]. The theory of the float is as the water rises in the piezometer well the styrofoam will float up indicating the water level and as the water recedes the float adheres to the acrylic tube indicating a maximum level (Figure 42, Appendix B). Testing involved immersing the acrylic tube with styrofoam float in 25 cm of water. The styrofoam had to properly adhere to the acrylic three consecutive times to pass testing and if it did not it was removed and replaced.

---

[1](G.F. Kling, personal conversation, 1990)

FIELD METHODS

Platinum Electrode Installation

To install platinum electrodes, a pilot hole is made, using a steel rod, that is 2 cm shallower than the desired depth. Using a hollow copper tube, the electrode is inserted, into the hole and pushed 2 cm into undisturbed soil to ensure good contact between the soil and the platinum tip. Care must be taken while inserting so that neither the electrode is broken nor the platinum wire bent. Broken pyrex or a broken seal will allow contamination by soil water to give erroneous readings, and a bent wire will not have proper contact with the soil. After the electrode is properly installed, the pilot hole must be backfilled and packed with bentonite to within 5 cm of the surface and covered by a tamped soil plug.

Tensiometer Installation

For a tensiometer to work properly the cup must contact undisturbed soil. To ensure proper contact a hollow probe the same diameter as the tensiometer is inserted to 5 cm shallower than the desired depth. When withdrawn the probe will contain a soil core that can be discarded. The tensiometer is inserted into the hole and pushed 5 cm into undisturbed soil. If the tensiometer can not be pushed into the soil, two options are available. The first option is to push the tensiometer as far (if at all) as possible into the undisturbed soil. A consequence of this option is that the cup may not be in contact with undisturbed soil, and may in fact be in contact with smeared sides of the probe hole. A second option is to enlarge the pilot hole, remove country soil at depth desired for placement of the cup, make a slurry of the country soil, pour this slurry into the hole, push the tensiometer in, and then backfill with bentonite to the surface. After the tensiometer is properly installed it should be filled with clean potable water and fitted with a septum stopper. Allow 24 hours for stabilization before taking tension measurements.

Thermocouple Installation

Installation of thermocouples requires a pilot hole, made with a steel rod, the same diameter as the inconel sheath that is 2 cm shallower than the depth desired. After the hole is made the thermocouple is inserted into the hole and pushed 2 cm into undisturbed soil. Coarse fragments can break the weld at the end of the thermocouple, so caution must be exercised if resistance is encountered during insertion. To ensure proper installation, a continuity check with a voltmeter can be done. The continuity check is accomplished by setting the voltmeter to any DC voltage, connecting the voltmeter leads to the exposed male connector leads, and observing the voltage. If zero voltage is obtained, then a complete electrical circuit (continuity) is present and the thermocouple will function properly; if not, then there is a break in the circuit, possibly a loose wire, broken tip weld, or broken wire, and the thermocouple will not function.

Piezometer Installation

To install the piezometers a hole is made, using a worm auger, approximately 3.2 cm in diameter and 2.5 cm deeper than the desired depth is required. Clean sand is poured into the hole to fill the bottom 2.5 cm. The piezometer is inserted into the hole and gently pressed onto the sand. Enough sand is poured around the piezometer to cover the fabric cover plus about 2.5 cm above it. Alternating dry bentonite and local soil plugs are packed around the piezometer to the surface.

Platinum Electrode Data Collection and Interpretation

Instrumentation for reading the platinum electrodes involved a Micronta volt meter and a Cole Palmer calomel reference electrode. The data were recorded as thousandths of a volt. A schematic of the collection system is shown in Figure 38, Appendix B. In the schematic the positive lead from the volt meter is connected to the platinum electrode and the negative lead to the calomel reference electrode. A complete electrical circuit is made by placing the reference electrode in 4 molar KCl solution and using a salt bridge (Veneman and Pickering, 1983) as a connection between the reference electrode and the soil. The salt bridge must be pressed into a saturated paste of surface soil.

Redox reactions are constantly occurring in soil environments (Bohn, 1971). This environment does not provide an equilibrium condition and therefore voltage readings fluctuate. A data recording was made when a fluctuation no greater than 3 mv per minute was obtained.

Electrode potentials of soil redox measurements are not absolute values. They are semi-quantitative results of reduction-oxidation states over the wet and dry cycles of the soil (Szogi and Hudnall, 1990). Redox potentials for sequential soil reactions are known (Ponnamperuma, 1972; Bohn et al, 1985; Patrick and Wyatt, 1964; Conell and Patrick 1967; Turner and Patrick, 1968). (Bohn, 1971) emphasizes that within the soil many reactions occur simultaneously and the result is a mixed potential. The platinum electrode is non-specific to any monoelemental redox reaction and therefore is a qualitative measurement of the average of all redox reactions occurring at a particular moment. Table 1 summarizes some critical empirically determined soil Eh values.

Table 1. Potentials at which reduction of soil components occur. Values in volts.

Component	Keeney (1983)	Bohn (1985)	Gambrell and Patrick (1978)
O_2 disappears	> 0.350	> 0.400	> 0.325
NO_{3-} disappears	0.3 to 0.1	> 0.200	> 0.225
Mn^{+2} formation	0.1 to 0.2	< 0.400	> 0.2
Fe^{+2} formation	0.1 to 0.2	< 0.300	> 0.110
HS^- formation	0.0 to -0.2	0.00 to -0.15	>-.150
CH_4 formation	<-0.2	-0.15 to -0.22	>-.250

The field measurement for each platinum electrode should be adjusted to a standard hydrogen electrode (Eh). When utilizing a calomel reference electrode, + 244 mv is added to the field measurements to adjust to a standard hydrogen electrode (Jones, 1966). This adjustment is a convenience for relating data from other sources. The use of a salt bridge requires no additional adjustment (Szogi and Hudnall, 1990).

When the soil organisms deplete the O_2 supply, reducing conditions are assumed to start. The data in Table 2 are used to semi-quantify the reducing conditions. Of particular importance in this table is the redox potential at which iron is reduced. This value, 200 mv, is important in that reduced and mobile iron may be associated with low chroma colors, whereas oxidation and precipitation of iron, may be associated with high chroma colors.

Table 2. Potentials at which reduction occurs.

Component	mv
O_2 disappears	< 350
NO^{3-} disappears	300 to 200
Mn^{2+} formation	300 to 100
Fe^{2+} formation	200 to 100
HS^- formation	000 to -150
CH_4 formation	-150 to -200

The potentials in Table 2 were used for interpretation of the redox potential measurements associated with field measurements of this project and represent an estimate of the occurrence of soil components brought on by measured redox potentials. The values in Table 2 are taken from Table 1 and from works of other previously cited authors who have measured redox potentials in the soil or have calculated thermodynamically the Eh of these redox couples.

Tensiometer Data Collection and Interpretation

Measurements were made with a Soil Measurements Systems 'TENSIMETER' pressure transducer. The 'TENSIMETER' transducer has an attached syringe needle that is inserted through the septum stopper. Through the needle the pressure in the air space below the septum causes a deflection of the transducer membrane causing a change in resistance of a silicon semiconductor. The change in resistance is corrected by the 'TENSIMETER' into pressure readings of millibars (Marthaler et al, 1983). The 'TENSIMETER' works accurately when a 2 cm^3 air space is below the septum. Because the transducer membrane is deflected by the change in pressure, too large of a volume of air below the septum will result in a small change in pressure and results in under deflection of the resistor.

The equation that describes these relationships is as follows:

$$P_{delta} = (P_{atm} - P_1) \left(\frac{V_0}{(V_0 - V_1)} \right)$$ (Marthaler et al, 1983), where

P_{delta} is the change in pressure of the system at the resistor.
P_{atm} is pressure inside the transducer (atmospheric).
P_1 is pressure in the air space below the septum.
V_0 is volume of air space in the transducer, (constant).
V_1 is volume of air space below the septum.

Therefore as V_1 gets larger the P_{delta} gets smaller and there is less deflection of the silicon resistor.

When the air space volume below the septum becomes too large, refilling of the tensiometer is required either by removing the septum and filling with water or by using a large syringe with an 18 gage needle inserted through the septum and adding water to the column.

The tensiometer is a water column of known length with a known hydrostatic pressure. The water inside the tensiometer makes contact with the soil water through the ceramic cup and will equilibrate with the soil water. When the soil water is at subatmospheric pressure a suction is created on the tensiometer water and some is drawn out causing a drop in the hydrostatic pressure of the tensiometer water column (Hillel, 1982).

The equilibrium state of a tensiometer can be described as a potential function with two components; a gravitational (elevation) component and a pressure component. The gravitational component is determined by the elevation (z) from the ceramic cup to some arbitrary reference level. The pressure component is related to the water content of the soil (Cassel and Klute, 1986).

The elevation component for data interpretation is the height of top of the water column (A) above the center of the cup (B) (Figure 40, Appendix B). The pressure component is the height of the free water surface (X). Millibar values reported by the 'TENSIMETER' represent the total potential of the tensiometer and soil system[2]. If the reference level is the height of the water column (A), then to find the depth to a free water surface, the length of the water column is subtracted from the absolute value of the total potential (measured value from 'TENSIMETER' readout). This will provide the height of the saturated soil above the cup.

If, however the total potential (absolute value) is greater than the water column length, the soil is unsaturated, the free water surface is below the cup of the tensiometer, and it's position cannot be calculated using data provided by this methodology.

Data reported by the 'TENSIMETER' are in millibars. A water column of 1020 cm in height is equivalent to soil water potential of 1.0 bars (Brady, 1990). Therefore 1 cm of water is approximately equal to 1 millibar. In the computation of the depth to saturation this equivalency allows easy calculation between units of water column length (cm) and total potential (mb).

Piezometer Data Collection and Interpretation

Data were collected weekly during the period November 1, 1991 to June 9, 1992. Acrylic tubes, fitted with styrofoam floats, were scribed with a line corresponding to the level of the soil surface at the piezometer in which

---

[2] P. Wieranga, 1991. personal communication.

they were inserted. This line was used to measure the depth below the surface to the water table as indicated by the height to which the styrofoam floated.

Weekly maximum depths to water table were recorded by measuring the distance from the scribed line to the styrofoam float. After the weekly maximum depth was recorded the styrofoam was blown to the bottom end of the acrylic tube and then the tube reinserted into the piezometer. The current table depth was measured by immediately removing the reinserted acrylic tube and measuring the distance to the styrofoam float. After the measurements were made the piezometers were evacuated of water and left to equilibrate.

The interpretation of soil profile water table measurements, utilizing piezometers, requires the consideration of pressure and saturation characteristics. The pressure potential of the water in the soil may be expressed as pressure head. The pressure head is the height to which water will rise in a piezometer that is closed along it's length and open at the top and bottom, from a given point in the profile. This measurement can be expressed as the height (cm) of a column of water.

The water table measurements indicate the boundary between saturated (positive pressure head, excluding artesian effects) and unsaturated conditions (negative pressure head) in the profile. The top of the water table is at atmospheric pressure, has a pressure head equal zero, and represents that part of the profile below which the soil is wholly saturated. The capillary fringe (saturated, but at negative pressure head) is above the water table.

As measured by the piezometers, the expected response of soil water tables, to precipitation inputs is that after the soil initially wets up, any further increase in soil moisture content would raise the water table, a decrease would lower it. Therefore increased precipitation should raise the water table, and a decrease or cessation should lower it.

Piezometer / Tensiometer Data Interpretation

The tensiometers serve as an alternative indicator of depth to water table and validate the data from the piezometers. The tensiometers and piezometers have differing responses and different levels of sensitivity to changes in soil moisture. This difference is caused by the air-entry value of the pores, defined as the suction at which the largest pore will start to drain. On draining, if the air-entry value has not been reached, the pores will be filled with water and will be under a slight negative pressure. The tensiometer will indicate a small positive potential, because the water column in the tensiometer has not reached equilibrium with the pore water and will not do so until a greater suction (greater negative pressure head) occurs after the air-entry value is reached.

The piezometers will not indicate positive head under the situation of slight negative pressure prior to the air-entry value being reached. This is because the piezometers are in essence a large non-soil pore and will drain, due to it's air-entry value being different than the smaller soil pores. Thus, the tensiometers may indicate positive potential under a slight negative pressure head, whereas the piezometers will not. This difference in sensitivity will help to explain lag times between tensiometers and piezometers.

Thermocouple Data Collection and Interpretation

The system utilizes type K thermocouples that have a temperature range of minus 270 degrees to plus 1372 degrees centigrade (ASTM, 1991). A thermometer that is capable of reading type K wire or a voltmeter with a calibrated cold junction is required in order to obtain data from the thermocouples.

A hand held digital thermometer was used to record the thermocouple output from the field instruments. Ambient air temperature readings should be taken at 100 to 110 cm above soil surface to be consistent with Oregon Agricultural Experiment Station procedures[3]. The temperature should be reported as a maximum or minimum daily recording, and if it is not a maxi-

[3] G. Taylor, 1992. Personal communication.

mum or minimum recording it should be reported as a specific time of day recording.

Precipitation Data Collection and Interpretation

Depth and duration of saturation are controlled by the input and outflow of water. All inputs to the toposequences were the result of precipitation mostly in the form of rain and from runon from higher topographic areas. Outputs were in the form of runoff and leaching. The weather summary dated June , 1992 published by the Oregon Climate Service, OSU, indicates precipitation of 69% of seasonal normal as of June 30, 1992, during the water year. This period, which includes the data period for the first year of the wet soils project , was warmer and drier than normal.

The project field precipitation data, collected daily by tipping bucket raingages, have been tabulated as weekly amounts. Precipitation occurred each week from November to the first week of May. Each month had at least one weekly accumulation of > 1 cm except March. Precipitation data for Polk and Benton Counties are not identical in amount, but their distributions are similar, with regular precipitation from November to May and the obvious decrease of rainfall in March.

Site Description

A toposequence of well or moderately well to poorly drained soils was located using Benton, Polk, and Linn county Soil Surveys. Access to the sites involved identifying landowners through local tax records and gaining permission to use untiled portions of their land. Access was approved for 4 plots in Polk County, latitude 44° 44' 30"N and longitude 123° 12' 31"W (Albany 15 minute Quadrangle) just west of Suver, Oregon. Access was approved for 5 plots in Benton County, latitude 44° 26' 00"N and longitude 123° 16' 18"W (Monroe 15 minute Quadrangle) just north of Finley Wildlife Refuge.

Identification of soil series was accomplished by field sampling with an Oakfield probe. The Polk County site contained Woodburn (Wo-P), Dayton (Da-P), Amity (Am-P), and Waldo (Wa-P) soils; the Benton County site contained Willamette (Wi-B), Woodburn (Wo-B), Dayton (Da-B), Amity (Am-B), and Waldo (Wa-B) soils. The Willamette, Woodburn, Dayton, and Amity soils are on the Calapooyia geomorphic surface and are considered to be terraces of the Willamette valley. The Waldo soil is on the Ingram surface which represents bottom lands of the Willamette River and it's major tributaries (Balster and Parsons, 1968).

Soil profile descriptions (SCS, 1981) were made by excavating soil pits at each plot. Textural class was determined in the field by the hand method. Profile descriptions were used to determine the depth of instrument installation, which was adjusted to account for the depth to any restrictive layers. In general the depths are 25 cm, 50 cm, and 100 cm, with adjustment shallower or deeper as required to place instruments just above, in the middle of, or just below restrictive horizons.

Minimum plot dimensions for installation are 6 feet wide by 16 feet long to accommodate triplicate platinum electrodes, piezometers, tensiometers, and single thermocouples at each depth, plus one 200 cm piezometer.

After the instruments were installed, local relief was determined with a surveyors transit and stadia rod. Distances between elevation points were determined by pacing. Absolute elevations have been determined from topographic map benchmarks nearest the sites.

Samples taken from each instrumented horizon have been tested for organic C and pH. The Walkley-Black procedure (Page et al, 1982) was used to determine percent organic matter.

RESULTS AND DISCUSSION

The objectives of this project were to accomplish two goals. The first goal was to install equipment suitable for long term monitoring of soil wetness and the second to interpret data collected from the monitoring. The first goal is rather practical and requires mechanical ingenuity. There is no way to predict how the product will function in the field and what the regular maintenance schedule will be. Therefore the first objective is assumed to have been accomplished, is left for anyone to use as an example, and can be improved upon as appropriate.

The second goal requires evaluation of numerical data, but because of the high degree of spatial variability, the best approach is to evaluate changes over time in a qualitative manner.

Discussion of Data

Data will be evaluated on three levels. The first level will be a discussion of each individual soil plot, nine total, and will provide a narrative description of the unique wetness characteristics of each plot. The second level will involve a descriptive evaluation of each site, a total of two sites, and will provide a characterization of each toposequence. The third level will be a combined evaluation of the two sites and provide a comparison of the toposequences. The data will be evaluated to discover trends within each plot, differences between plots, trends within each toposequence, and differences between the toposequences.

Data summaries are presented in Figures 1-36 and are incorporated in the text. Complete files of raw data are given in Appendix C. Soil profile descriptions are recorded in Appendix A.

Wo-P

Saturation:

The rainfall and piezometer data are presented in Figure 1. After the initial saturation in November, the water table tracked well (no lag time between the precipitation event and the water table response) with the precipitation events , indicated by the rise of the water table after inputs of precipitation. The water table rose from the bottom, indicated by head occurring first at 200 and 100 cm depths, after an initial 18.94 cm of precipitation. The soil was saturated at 100 cm continuously from 12/5/91 to 3/10/92. Piezometer readings from the 200, 100, and 50 cm indicated the same depth to water table on 12/24/91 and 1/28/91 which indicates no restrictive layers from 200 to 50 cm depths. Free water was never recorded in the 25 cm piezometers and only once did the 25 cm tensiometers indicate saturation at this depth. There was a decrease in amount of precipitation in March, compared to the previous months, and the water table dropped below 100 cm and then rose in April in response to increased precipitation, but it did not rise to within 50 cm of the surface during April.

The 50 and 100 cm tensiometer indications of unsaturation did not lag appreciably with corresponding piezometers indications of no water table on wetting or drying and the 100 cm tensiometers exhibited a good correlation (R^2 = .84, Table 3, page 109) with the 100 cm piezometers when comparing their measurements of depth to water table. There was a rapid tensiometer response to the drying trend in March and wetting in April.

Reduction:

The Eh data are presented in Figure 3. The high positive values recorded at 25 and 50 cm depths reflect the oxidizing conditions associated with the low water table and the aerated conditions in the soil above 50 cm. The 25 and 50 cm Eh values changed little over the study period, and the two very short periods of saturation at the 50 cm depth did not cause any noticeable change in the redox potential.

The 100 cm Eh was lower than the 25 and 50 cm values and exhibited little change over time. A trend of decreasing Eh at 100 cm occurred in April, following renewed saturation at 100 cm, which may be in response to the precipitation blocking O_2 diffusion to this depth.

If 350 mv is used as the Eh value for the onset of reducing conditions, as presented in Table 2, the 100 cm Eh data indicate a reduced state only once during the study period, on 4/28/92. At no time were either the 25 or 50 cm potentials indicative of reducing conditions.

Little effect of temperature (Figure 4) on Eh values was seen for this plot. The 25 and 50 cm Eh values exhibited a slight decrease in values during December and January when the temperatures were the lowest and then a slight increase in February when the temperatures began to rise.

Morphology:

The water table did not rise above 25 cm in this profile and this is consistent with the depth at which redoximorphic indicators such as concretions were found (26 cm). Concretions are the result of either redoximorphic concentrations of manganese and/or iron or are relict features possibly transported to a present location. The Wo-P plot concretions are assumed to have formed in place and therefore do not represent the redox environment of the past year (an exceptionally dry year) because the redox potential did not drop below 350 mv which is considered the potential for reducing conditions to occur. In order to have formed iron-manganese concretions the potentials would have had to drop below 350 mv, and this did not occur in this profile in 1991-1992.

The matrix colors, excluding the A horizon, did exhibit some low chroma below 45 cm. The redox potentials did not reach 350 mv at 50 cm but did reach 350-200 mv at 100 cm. This indicates that the low chroma matrix colors are either the result of organic matter accumulations or previous lower redox environments that would have resulted in redox depletions of iron manifest as low chroma colors. It is possible that in previous years the redox potential may have declined into an iron reducing range, and the low chroma matrix colors may be the result of redox depletions.

Figure 1. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 50 cm and 25 cm at the Woodburn plot in Polk County.

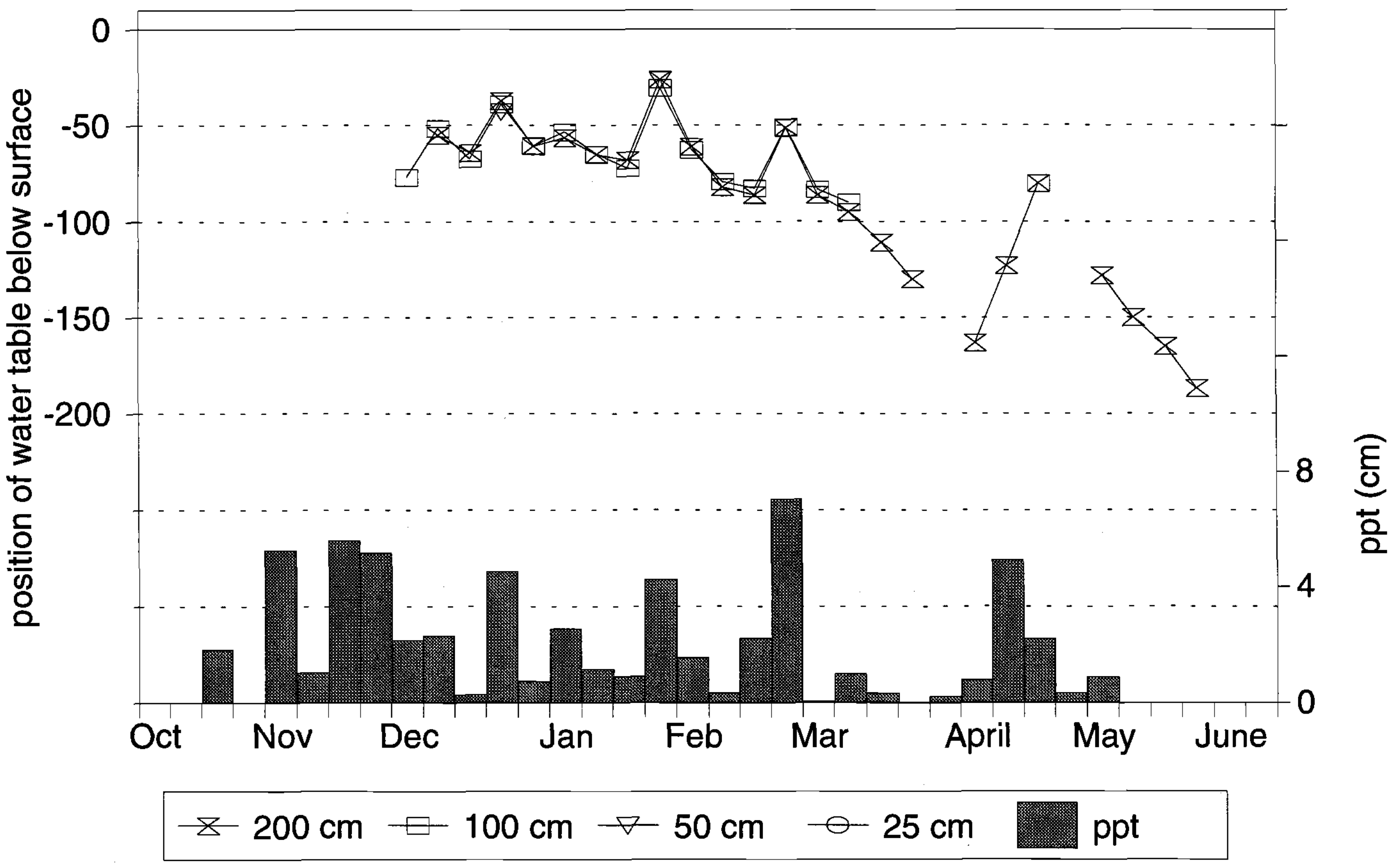


Figure 2. Matric potential data from tensiometers at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Polk County.

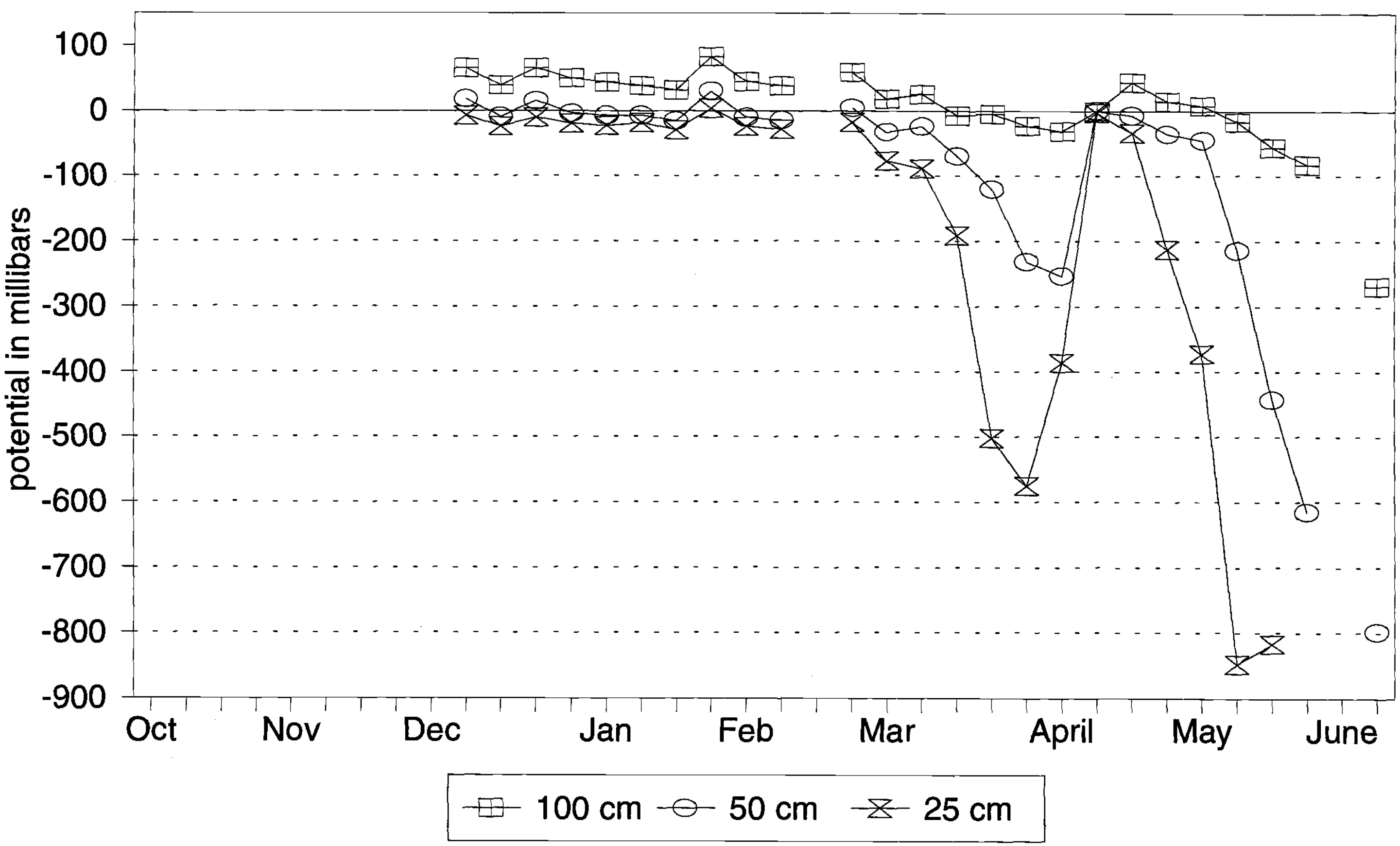


Figure 3. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Polk County.

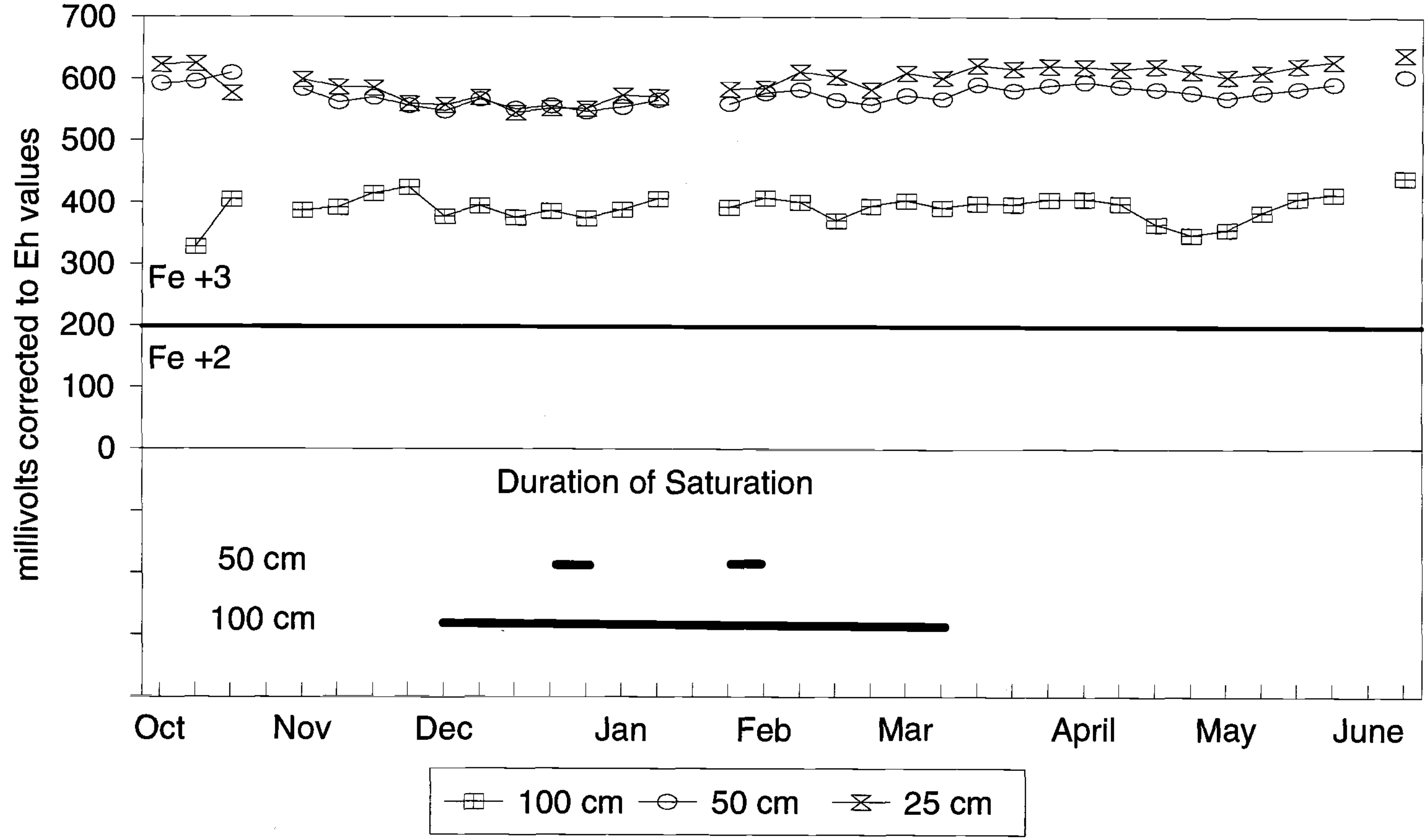
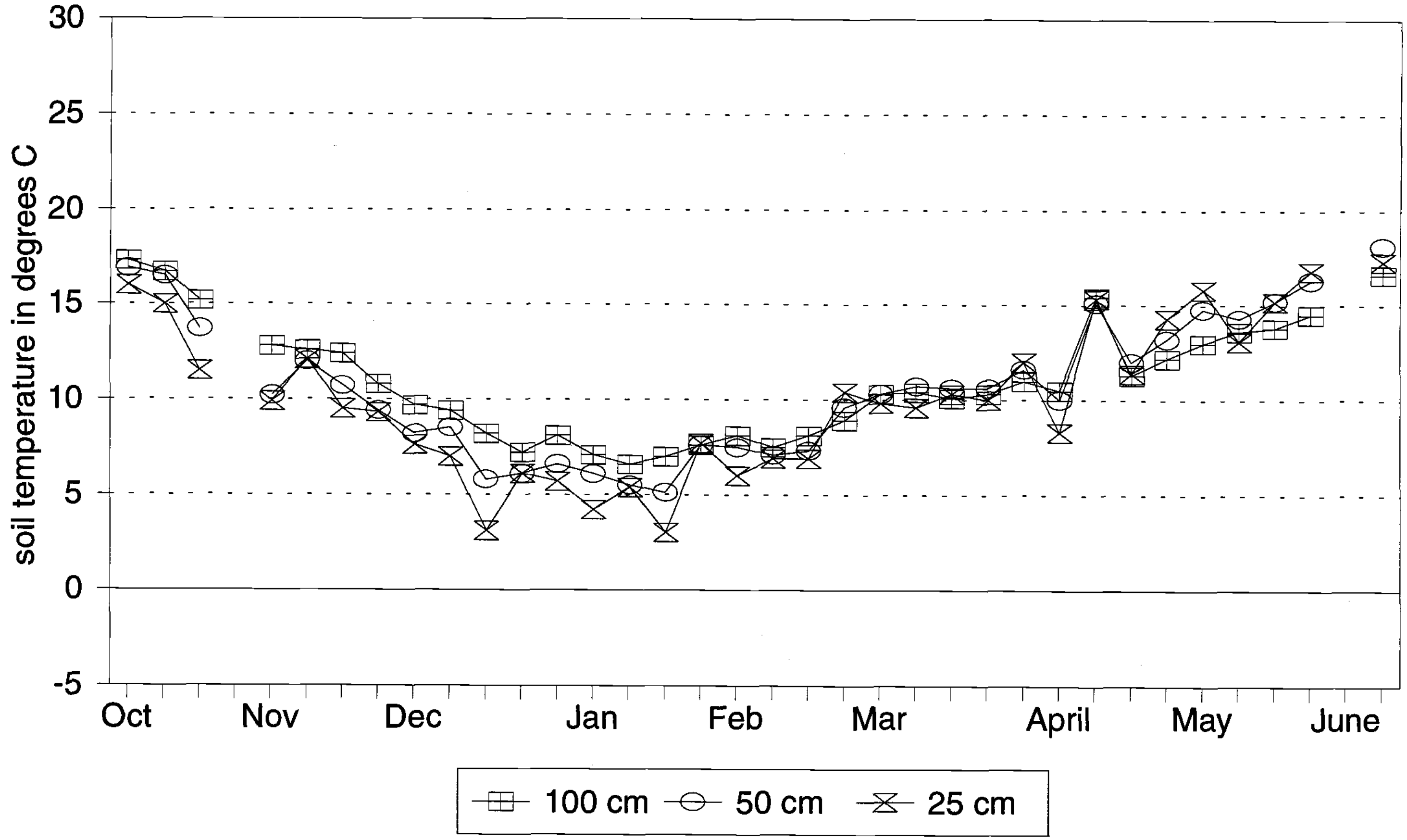


Figure 4. Soil temperature data at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Polk County.



Wa-P

Saturation:

Rainfall and piezometer data are presented in Figure 5. The water table tracked well with the precipitation events. The water table rose from the bottom, as indicated by the 200 and 100 cm piezometer data, but there was also a perched water table, as indicated by the appearance of water in the 35 cm piezometer one week prior to the appearance of water in the 65 cm piezometer. Further evidence of perched water is given by greater depths to the water table in the 65 cm piezometer than in the 35 cm piezometer from mid December to early January. This indicates the presence of a restrictive layer at or above 65 cm. This layer is probably the Btg2 horizon described in the Waldo profile.

The pore water at 100 cm was under an artesian head from 12/24/91 to 2/21/92. This was indicated by the depth to water in the 100 cm piezometers being nearer the surface than in the 65 cm piezometers. The positive head may be related to the location of Wa-P in a swale. During the study period water was observed flowing from mid slope in the swale area. It was assumed to come from the surrounding upslope topography and was breaking out above the clay layers in the surrounding soils. A further assumption was made that water was also flowing not only over the clay layers but under these layers into the swale position, and this flow would be under the restrictive clay layer in Wa-P. Hence the water flowing under the clay is confined by this overlying restrictive layer, causing the positive pressure head. The tensiometers were not fully functional until 12/24/91. Once functional, they indicated continuous saturated conditions at all instrumented depths from 12/24/91 to 2/11/92 (Figure 6). The 35 cm tensiometers responded immediately to decreases in precipitation in March and track well with the 35 cm piezometers. The 65 and 100 cm tensiometers indicated increasing tension as the water table lowered. All tensiometers responded to the increase and then the decrease of precipitation in April.

At 65 cm there was a time lag of three weeks between the onset of unsaturated conditions as indicated by the piezometers and the onset of unsaturated conditions as indicated by the tensiometers during the drying trend in March. The texture at 65 cm is clay, and this causes a special situation with respect to measurements by the tensiometers. The pores of the clay horizon are so small that they remained saturated even at a small negative pressure head for as long as the air-entry value was not exceeded. The lag time observed represents the time it took to reach the air-entry value, which is three weeks after the piezometers were empty.

Reduction:

The Eh data are presented in Figure 7. Reducing conditions, as indicated by potentials below 350 mv, occur from 12/1/91 to 3/31/92 for the 65 cm depth and from 12/5/91 to 3/17/92 for the 35 cm depth. The 35 cm Eh data indicated a rapid response to the onset of saturated conditions in late November and appear to correlate well with the tensiometer data. Likewise the 65 cm Eh values are correlated with the tensiometers.

Three interesting events are the drop in Eh of the 35 and 65 cm instruments in February, the rise in Eh at 35 and 65 cm depths during the drying trend in March, and the large decrease in Eh at all depths with the subsequent precipitation in early April. The February drop corresponds to an increase in temperature (Figure 8) that may have resulted in increased biologic activity, depletion of available electron acceptors, then a resulting drop in Eh as alternate acceptors were utilized. The March rise and April drop of the 35 and 65 cm Eh values seem reasonable as one would expect a rapid rise going from saturated to unsaturated conditions (anaerobic to aerobic respiration) then a drop when saturated conditions reoccur. However the drop in 100 cm Eh values seems not to fit this pattern as the Eh values had remained nearly constant since October. All Eh values recorded on 4/7/92 and 4/14/92 are near the default values for an improper setup of the recording equipment. The data from these two dates are suspect as being improperly recorded and are not considered valid and an explanation for the corresponding drop in potentials seems ill advised.

All depths had soil temperatures above 5° C except the 35 cm depth which had two occasions, once in mid December and again in mid January, when the temperature dropped below 5° C. The Eh values at 35 cm on these dates does not exhibit any departures, from the previous week recordings, that would appear to have been caused by these lower temperatures.

Morphology:

The presence of an E horizon and the gleyed horizons below the E were the result of redox depletions (and clay depletions in the E) in which the iron has been reduced and leached out leaving the primary grain colors as the dominant matrix colors. The E horizon depth (23-42 cm) correlates with the perched water table at 35 cm, and the Eh values indicate that iron reduction had occurred.

Figure 5. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 65 cm, and 35 cm at the Waldo plot in Polk County.

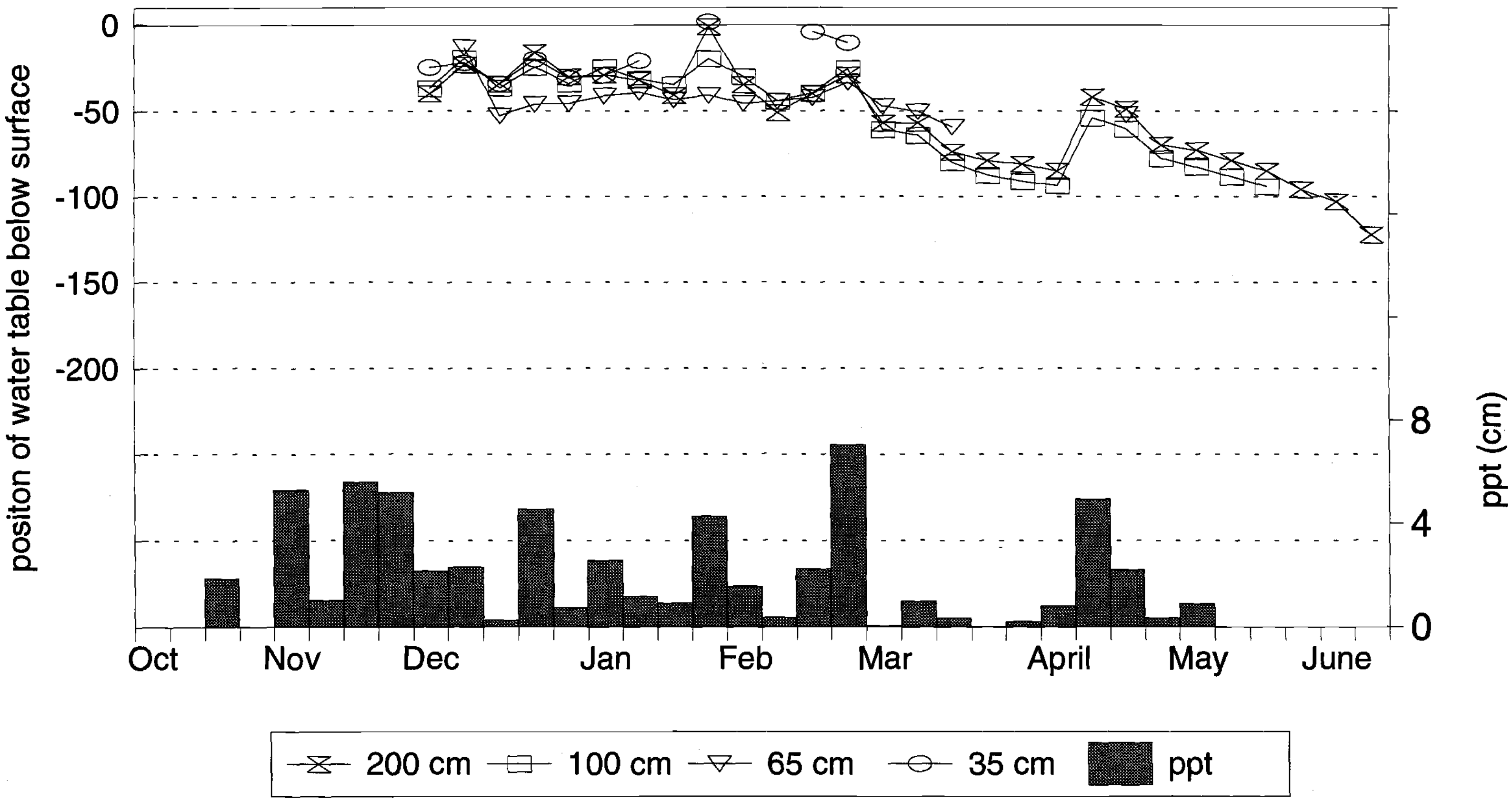


Figure 6. Matric potential data from tensiometers at depths of 100 cm, 65 cm, and 35 cm at the Waldo plot in Polk County.

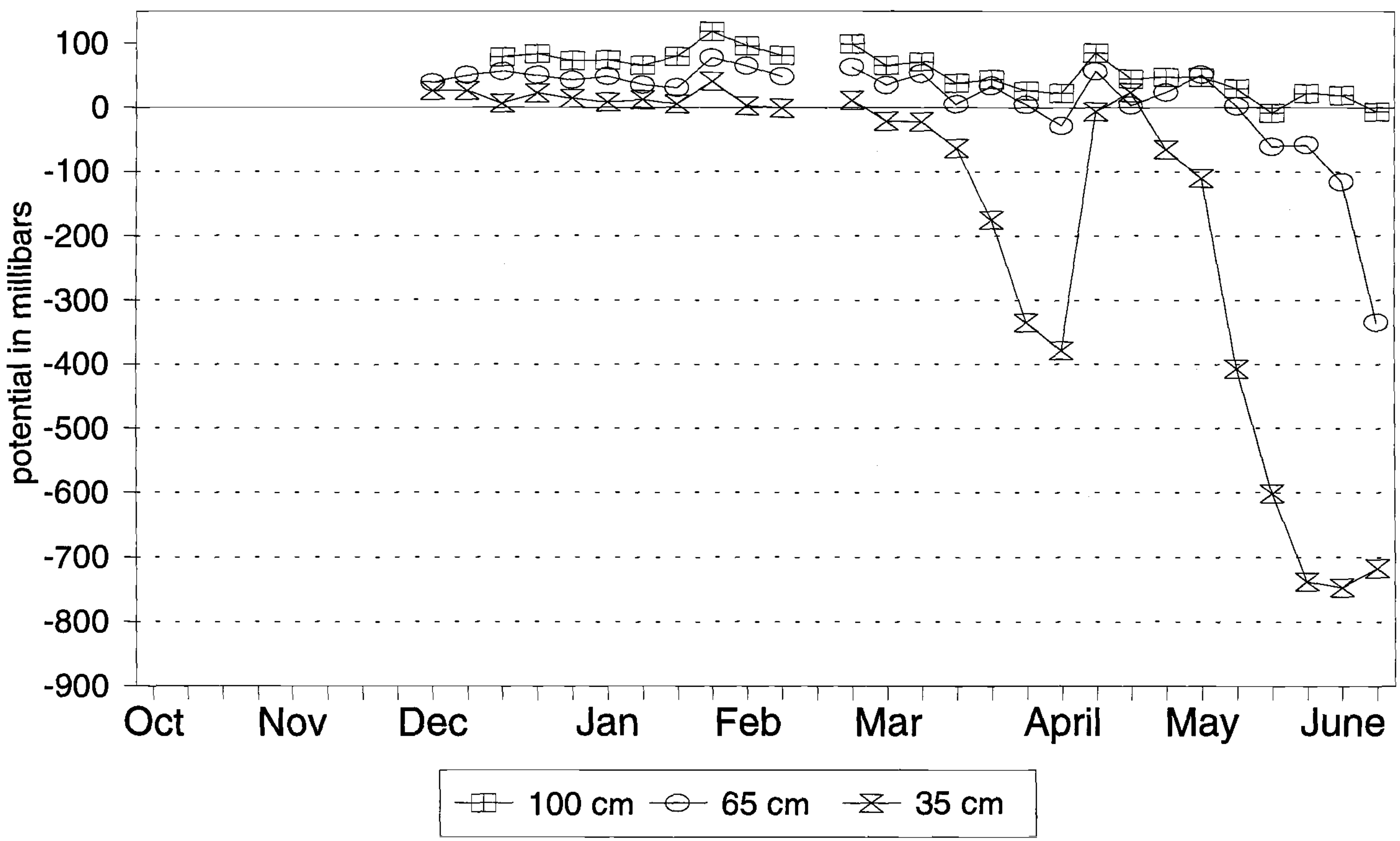


Figure 7. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 65 cm, and 35 cm at the Waldo plot in Polk County.

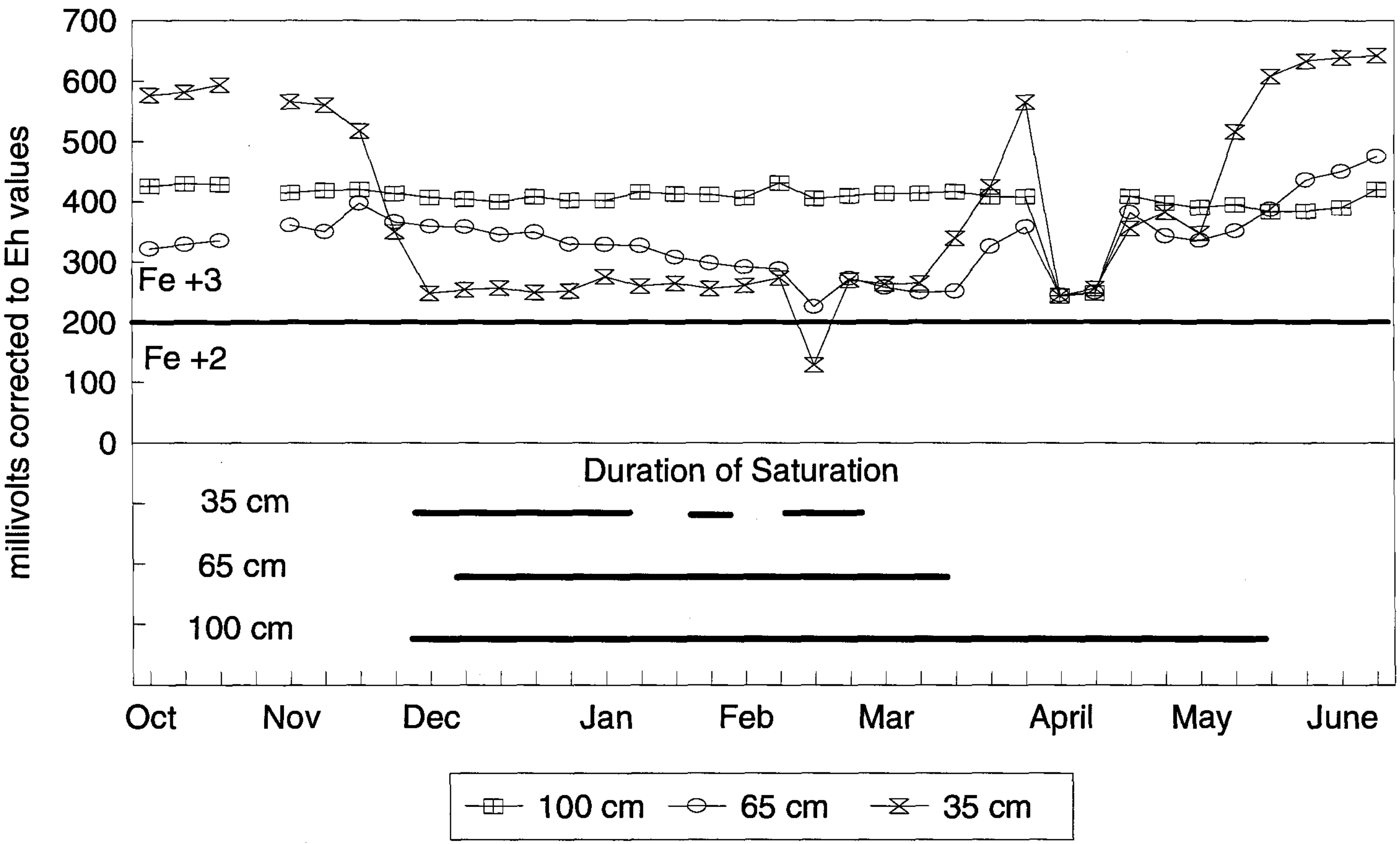
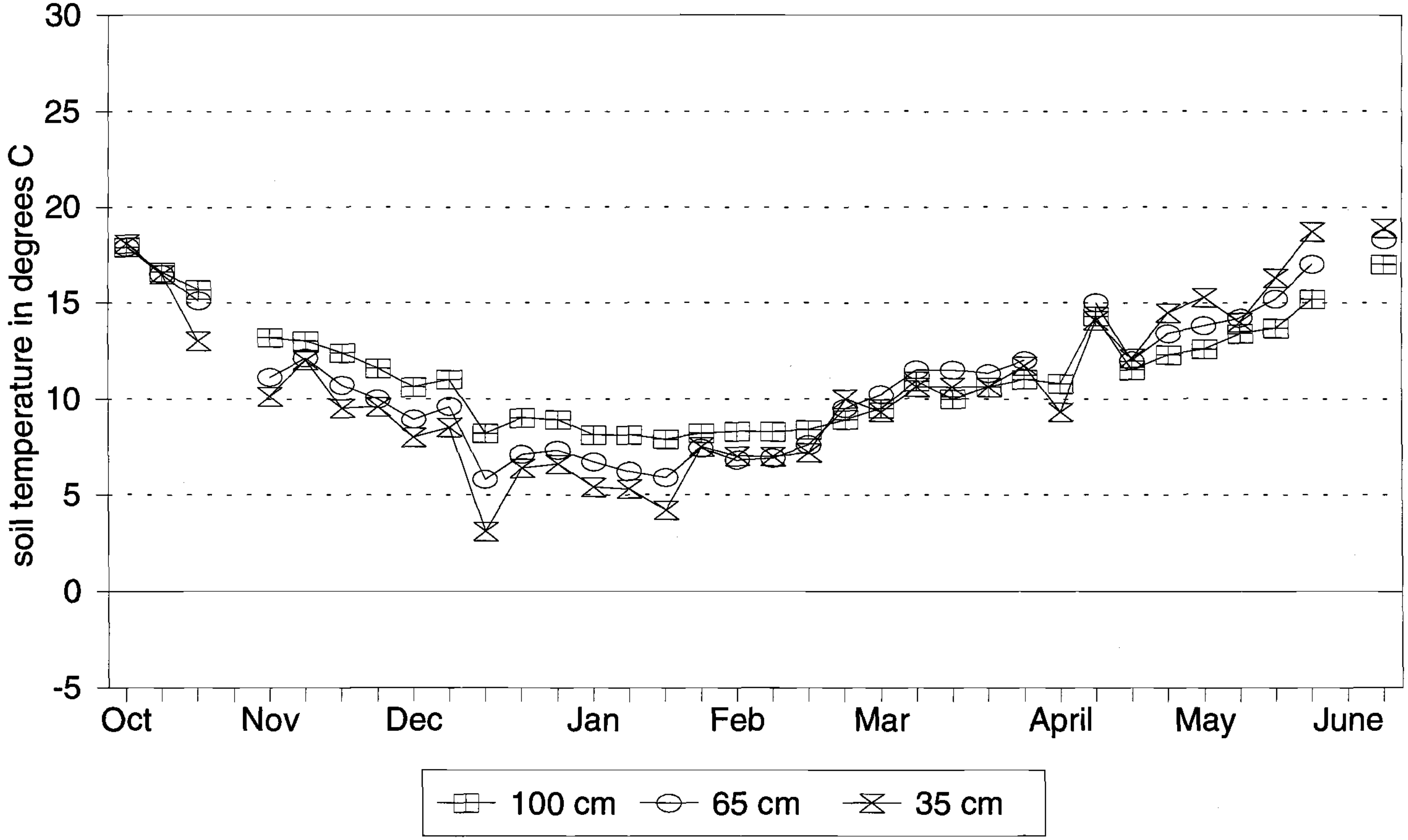


Figure 8. Soil temperature data at depths of 100 cm, 65 cm, and 35 cm at the Waldo plot in Polk County.



Am-P

Saturation:

Rainfall and piezometer data are presented in Figure 9. The water table rose from the bottom, as indicated by head at 200, 100, and 64 cm one week prior to head at 38 cm. Piezometers at all depths track well with the precipitation events.

Several piezometer features lead to the conclusion of unrestricted water movement in this profile. First, all piezometers indicated similar depth to water table, at each depth, under continuous saturation from 12/10/91 to 2/25/92. Second, during the drying trend in March the water table uniformly fell to 92 cm, followed by the precipitation event in April which raised the water table to 29, 28, 34, and 43 cm in the 38, 64, 100, and 200 cm piezometers respectively.

The times at which the tensiometers at 38 and 64 cm indicated onset of unsaturated conditions lagged behind the times at which piezometers indicated desaturation by as much as two weeks in March and one week in April (Figure 10). The lag times are most likely from air-entry effects with the possibility of capillary water rising 19 cm thereby keeping the soil pores filled with water on 3/17/92, water may have risen from a 57 cm deep water table (recorded by the 64 cm piezometers) to effect the 38 cm tensiometers. Then the following week a 4 cm rise from the 68 cm deep water table recorded by the 100 cm piezometers, would be required to affect the 64 cm tensiometers. These capillary fringe effects are reasonable for these soil textures.

Reduction:

The Eh data are presented in Figure 11. The data at 38 and 64 cm exemplify a gradual decrease in Eh under saturated conditions, with a rapid increase during unsaturated periods. However the 38 cm Eh values did continue to decrease (lag) two weeks after the piezometer data indicated unsaturated conditions, in March. Concurrently, the Eh values, when compared with the tensiometers data indicated no lag time. This may be attributed to saturated conditions brought on by the capillary water, as previously mentioned. From these documented events, evidence can be submitted as to the effect of capillary water on redox potentials with the conclusion that saturation by capillary water is sufficient to slow diffusion of O_2 and thus facilitate decreasing redox potentials. A similar trend was seen for the 64 cm Eh values during the same period, but with only a one week lag time.

The soil temperatures (Figure 12) remained above 5° C with the exception of the 38 cm depth which had two recordings of temperatures below 5° C. The duration of temperatures below 5 C did not appear to be long enough for any observable effects to manifest in the Eh values. It appears likely that either much lower temperatures than those recorded or temperatures below 5° C that have longer duration than those recorded will be required before any correlation feature are seen in the Eh data at this plot.

Morphology:

Redox depletions are manifest as the E horizon and low chroma matrix color of the Bt1. The Eh values in the E and Bt1 horizons indicated reducing conditions, but the iron reduction potential was not reached and it is likely that much of the reducible iron has previously been leached from the E horizon leaving it with a low chroma matrix color. Redox concentrations of iron and manganese in the form of many distinct mottles and common/medium concretions in the Bt1 the result of redox concentrations, possibly microsite redox of iron, within the depleted matrix.

Figure 9. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 64 cm, and 38 cm at the Amity plot in Polk County.

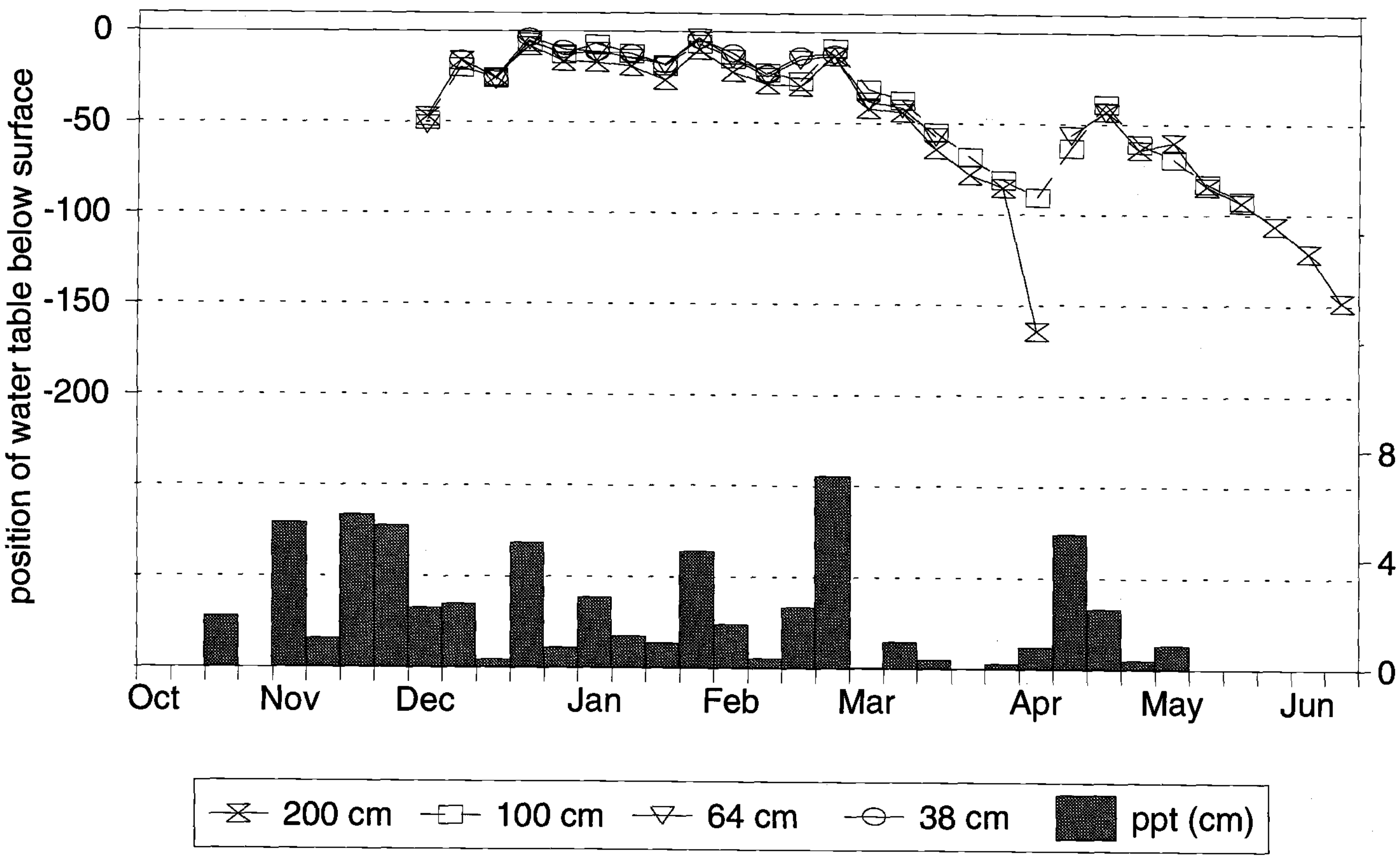


Figure 10. Matric potential data from tensiometers at depths 100 cm, 64 cm, and 38 cm at the Amity plot in Polk County.

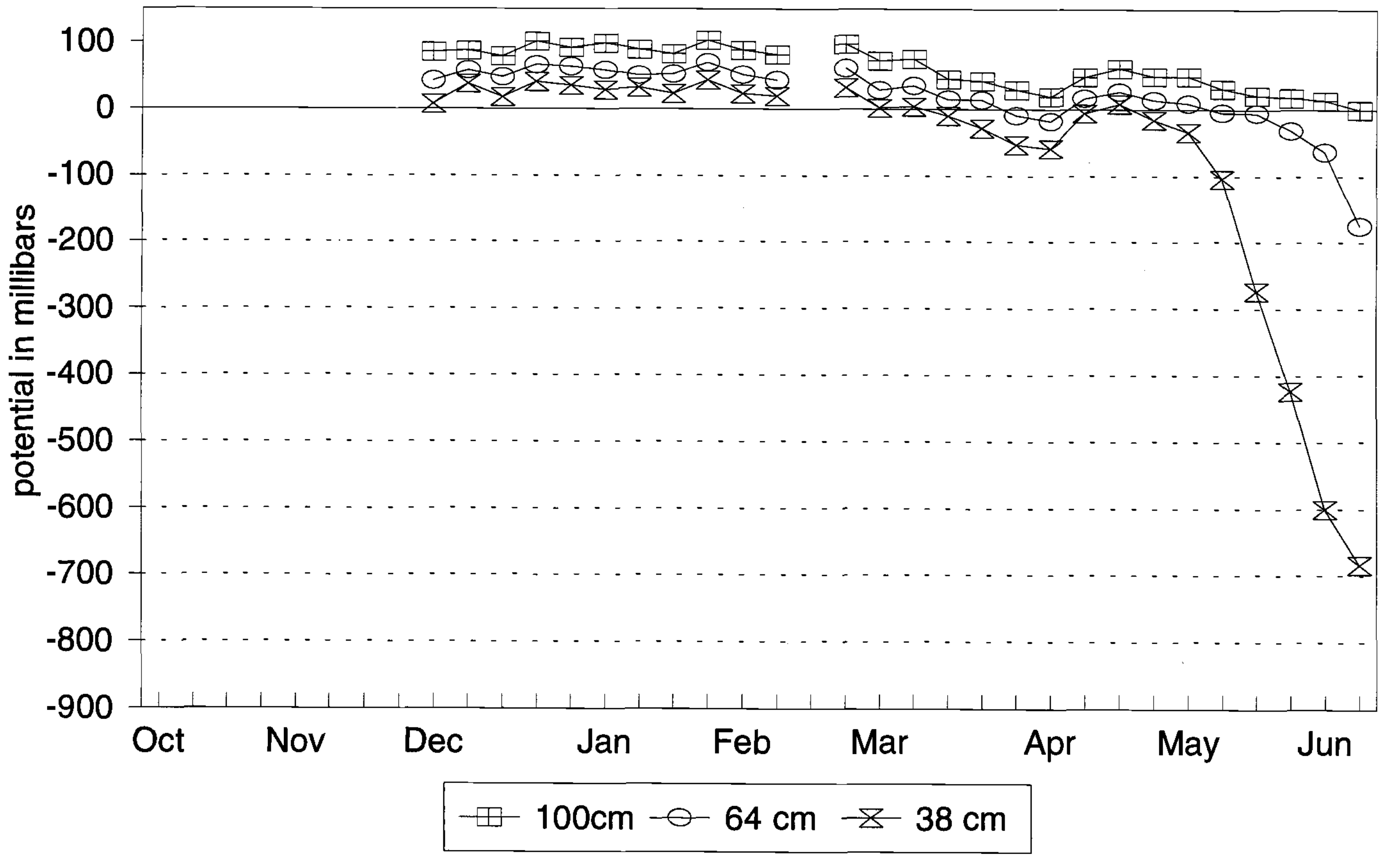


Figure 11. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 64 cm, and 38 cm at the Amity plot in Polk County.

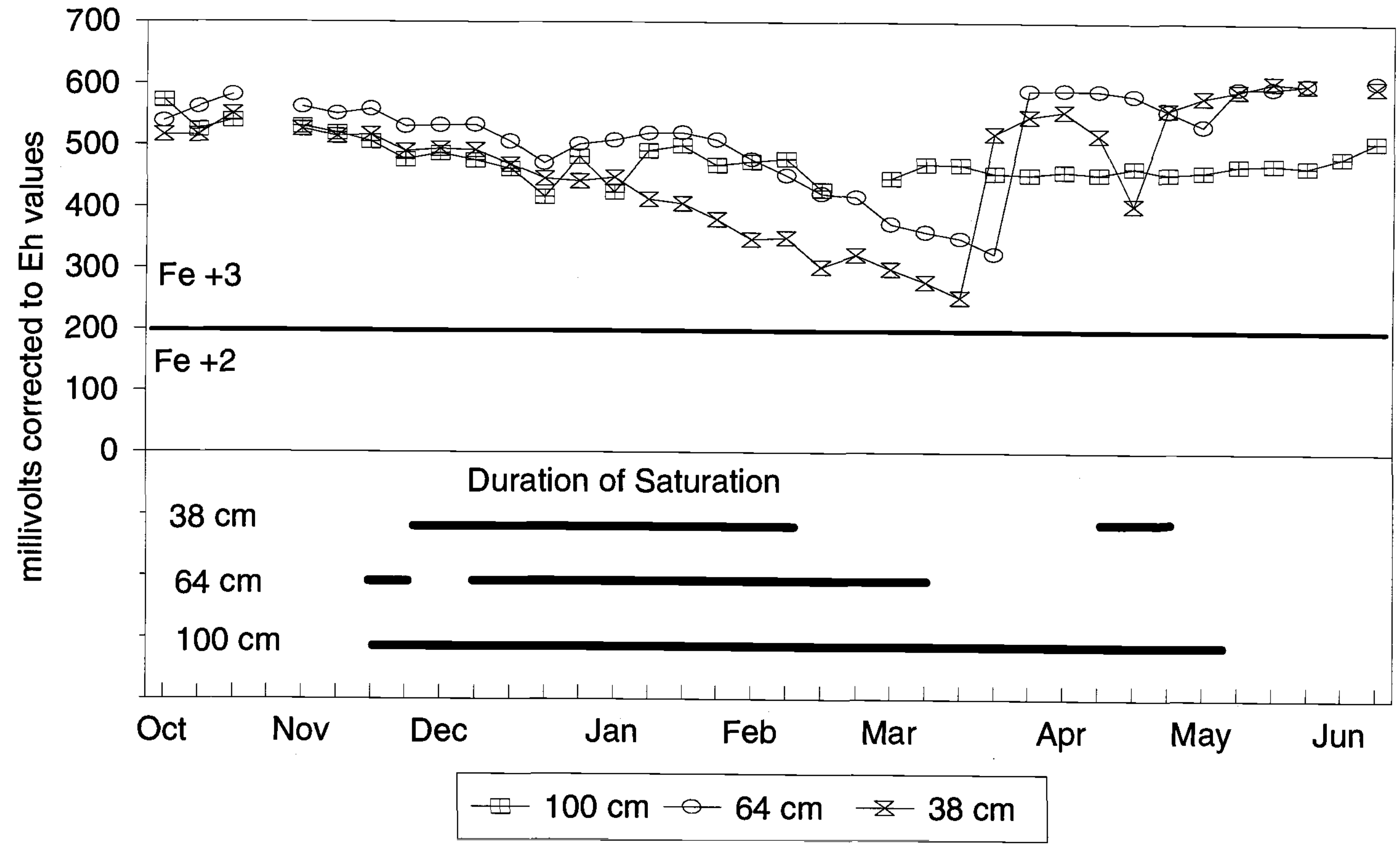
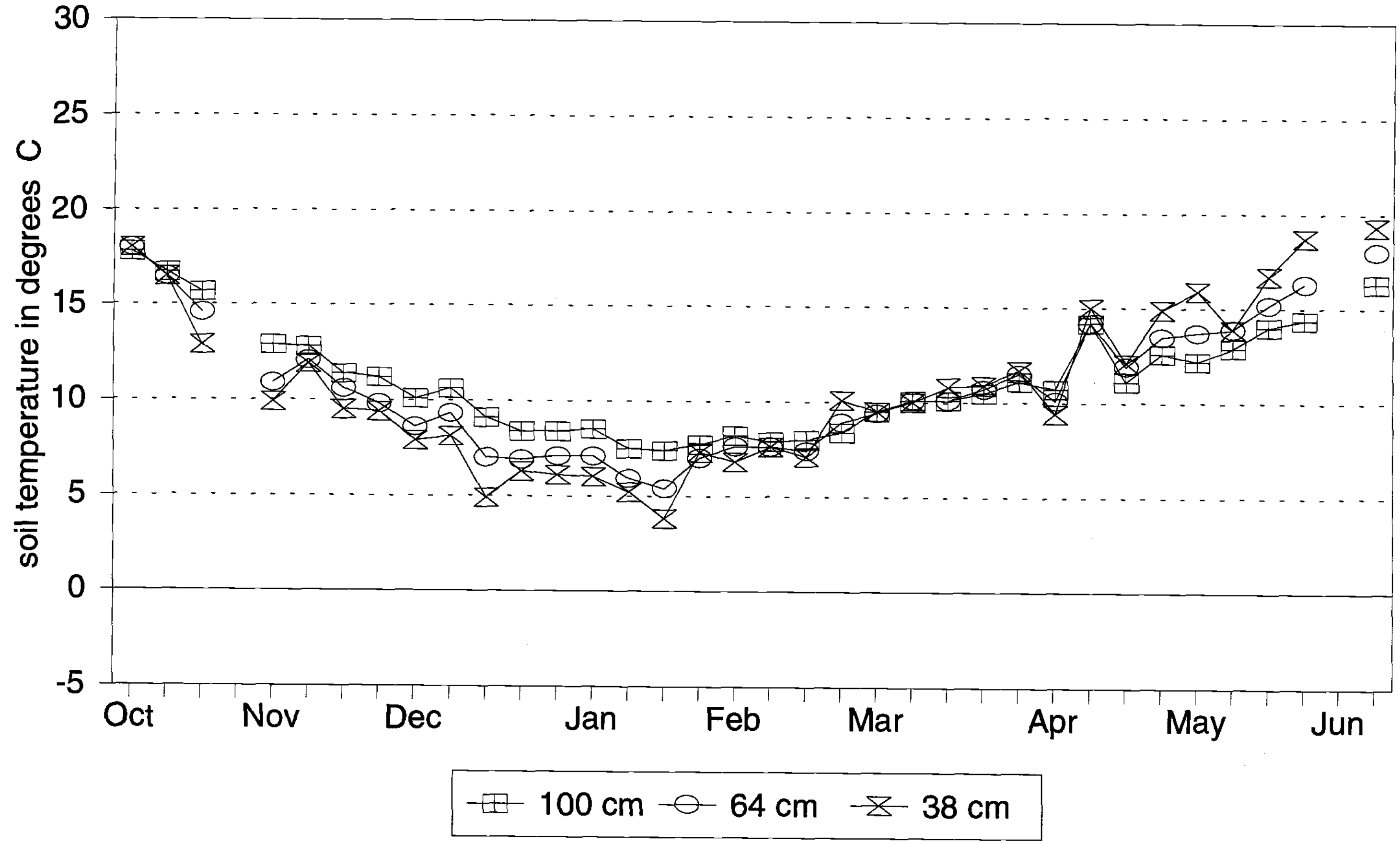


Figure12. Soil temperature data at depths of 100 cm, 64 cm, and 38 cm at the Amity plot in Polk County.



Da-P

Saturation:

Rainfall and piezometer data are presented in Figure 13. Head was recorded at each depth on 11/26/91. The water table initially occurs shallower nearer the surface, possibly indicating a wetting front moving downward from the surface. Some surface cracks at least 30 cm deep were noted in this profile and could facilitate a downward movement of water. It was also noted that the surface cracks did not close during the study period. The water tables are similar to those in Am-P except that Da-P had water tables closer to the surface. The soil was continuously saturated at all depths from 12/5/91 to 3/10/92, 2 weeks longer than Am-P.

After a two week perched water table recorded by the 35 cm piezometers the 100, 60, and 35 cm piezometers indicated similar water table depths. These similar depths are an indication of no restriction of water movement, above 100 cm, after the initial saturation of the profile, whereas continued dissimilar depths would have been evidence for perched water and restrictive horizons. The 200 cm water table (Figure 13) was separated from the water table at 100 cm until March when the upper and low water tables merge and this water table separation indicated restrictive movement below 100 cm.

Tensiometer indications of unsaturated conditions (Figure 14) lag one week behind those of piezometers on drying, but on wetting there was no lag time. This interesting feature may be facilitated by hysteresis effects in which the water content is greater on drying, at a given matric potential, than it is on wetting.

Reduction:

Eh data are presented in Figure 15. The Eh values at 35 and 60 cm exhibited decreasing values during continuous saturation and immediate increases during drying. The slow decrease of Eh values may be due to either low biologic activity which may result from low organic matter for an energy source or to adequate O_2 for respiration, either because of oxygen in the soil solution that was adequate to supply most of the required electron acceptors or because of entrapped air in pore spaces. But any air that would be entrapped would have to be sufficient to last eleven weeks under the continuous saturation environment and this seems unlikely. Organic matter content of the 35 cm depth is 2.48% (Table 5, page 111) and was probably sufficient so as not to limit biologic activity. The possibility exists that the surface cracks at this plot were conduits for dissolved oxygen that could reached a depth of 35 cm and facilitated continued aerobic respiration under saturated conditions. A combination of low temperatures (slowing biologic activity) and dissolved oxygen (providing O_2 as an electron acceptor) may be a plausible explanation for the slow decline in Eh values at the 35 cm depth in this plot.

When the decline of the 35 cm Eh values became more pronounced, starting on 2/18/92, soil temperatures were generally increasing and the soil was still saturated. The increase in temperature and continued saturation coincide with most of the lowest Eh values recorded at the 35 cm depth. This would indicate that the warmer temperatures facilitated an increase in biologic activity that consumed the available O_2 (probably dissolved oxygen) faster than replenishment and the result was Eh values less than 350 mv (Figure 13) as the organisms began utilizing alternate receptors.

In May, when the tensiometers and piezometers at 35 cm indicated unsaturated conditions, the Eh values decreased for two weeks, then rose rapidly in the third week. This continued two week decrease may be an effect of warmer temperatures in May than in March, causing accelerated biologic activity that consumes O_2 faster than replenishment, resulting in utilization of alternate acceptors, and subsequently lower redox potentials.

At 60 cm the Eh values in May rise, from reducing to oxidizing conditions, one week after the piezometers indicated no water table but one week prior to tensiometer data indicating unsaturated conditions. This is a curious event in which the lag with the piezometers could be explained as biologic flush but the lack of correlation with the tensiometers should lead to the possibility of continued saturation and lower potentials. This may be the result of some microsite variability where surface cracks may be open at the electrode positions but not at the tensiometer positions. The air entry, via the cracks, would provide O_2 as an electron acceptor resulting in higher redox potentials, if consumption of O_2 is less than diffusion.

Morphology:

The profile exhibits an eluvial E horizon and low chroma matrices indicative of redox depletions along with abundant concretions and common/many mottles indicative of redox concentrations. These features are characteristic of a reducing environment in which manganese and iron would be mobile. The Eh values in Table 6 (page 112) indicate a reducing environment but as in plot Am-P the redox potentials did not reach the iron reducing range. A plausible explanation for the Eh values not reaching the iron reduction range is that there is dissolved oxygen in sufficient quantity that O_2 is the electron acceptor of choice. In light of the evidence of redoximorphic depletions another explanation may be that the quantity of alternate acceptors may be small, which results in the Eh values that did not reach the iron reducing range because acceptors such as reducible iron are not available.

Figure13. Precipitation (bottom) and water table data (top) below the soil surface as obsevered in piezometers at depths of 200 cm, 100 cm, 60 cm, and 35 cm at the Dayton plot in Polk County.

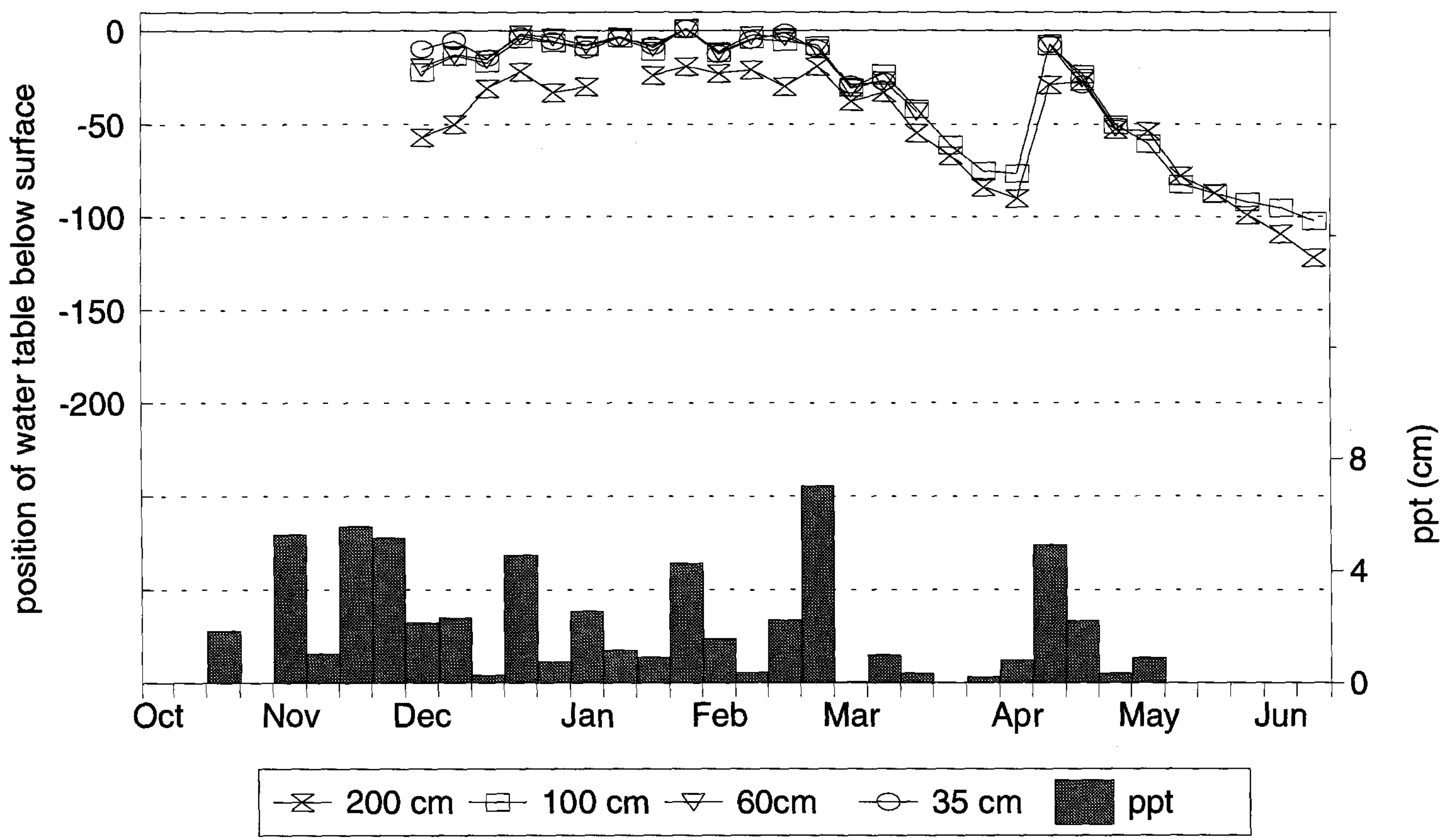


Figure 14. Matric potential data from tensiometers at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Polk County.

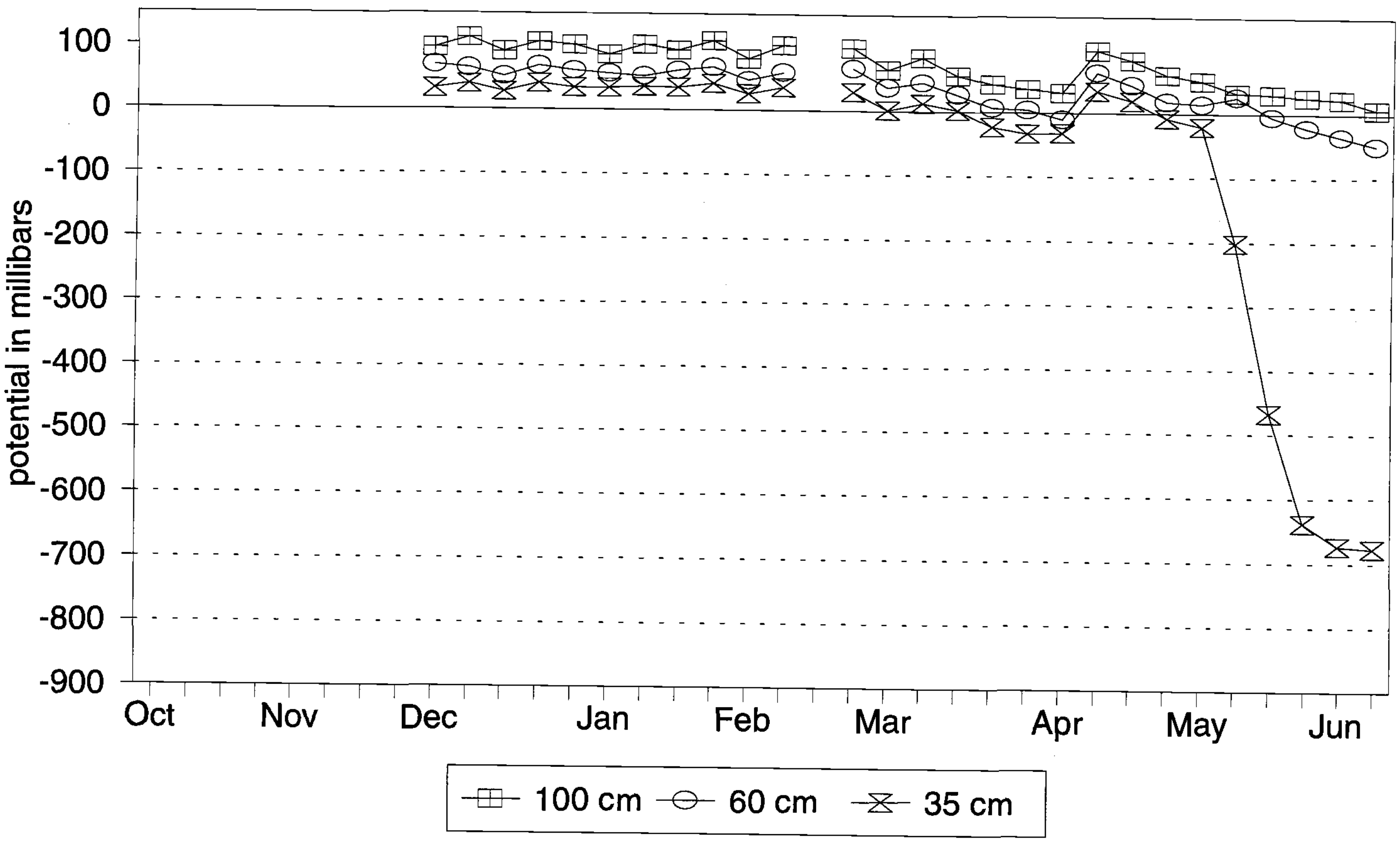


Figure 15. Duration of saruration as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Polk County.

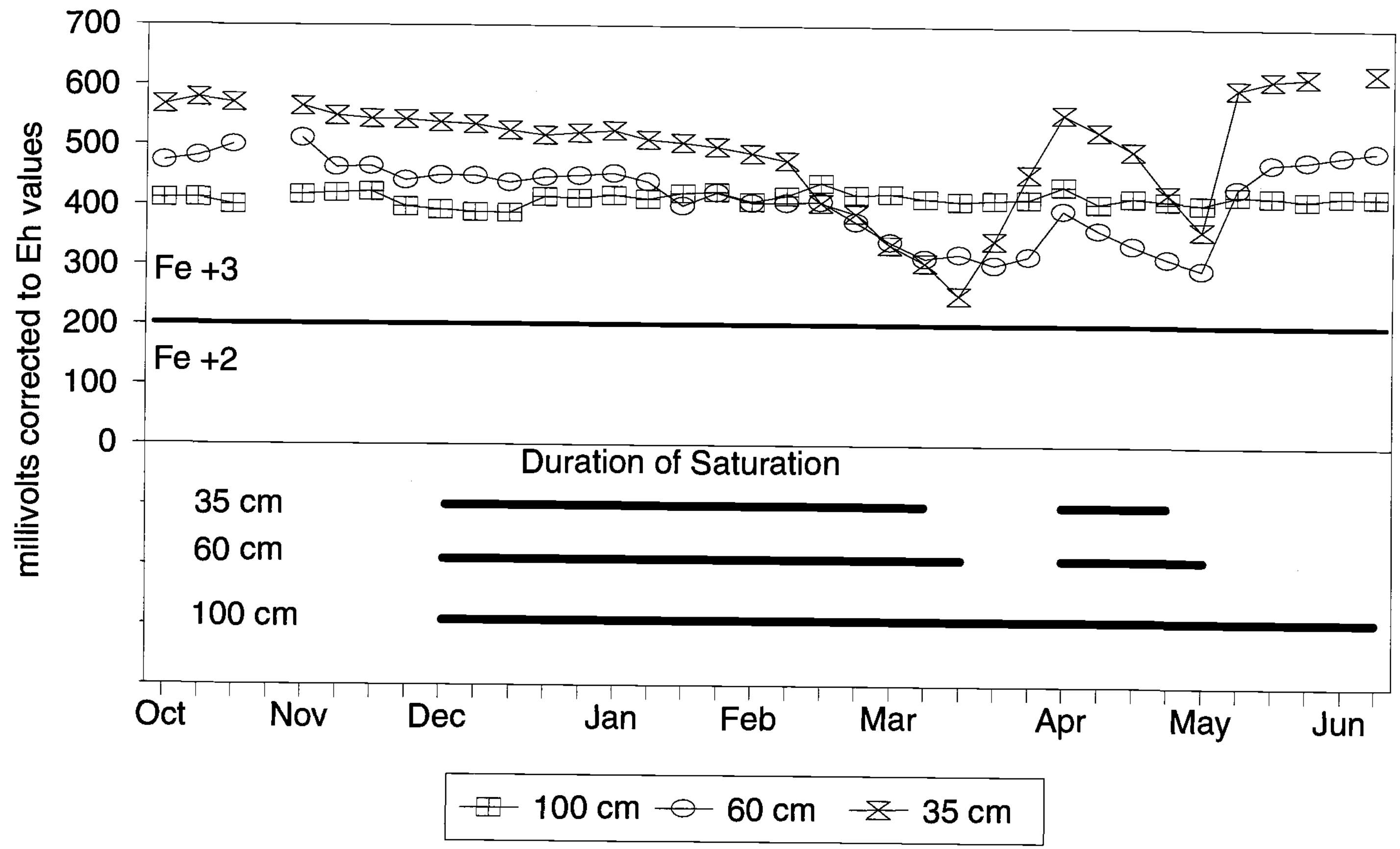
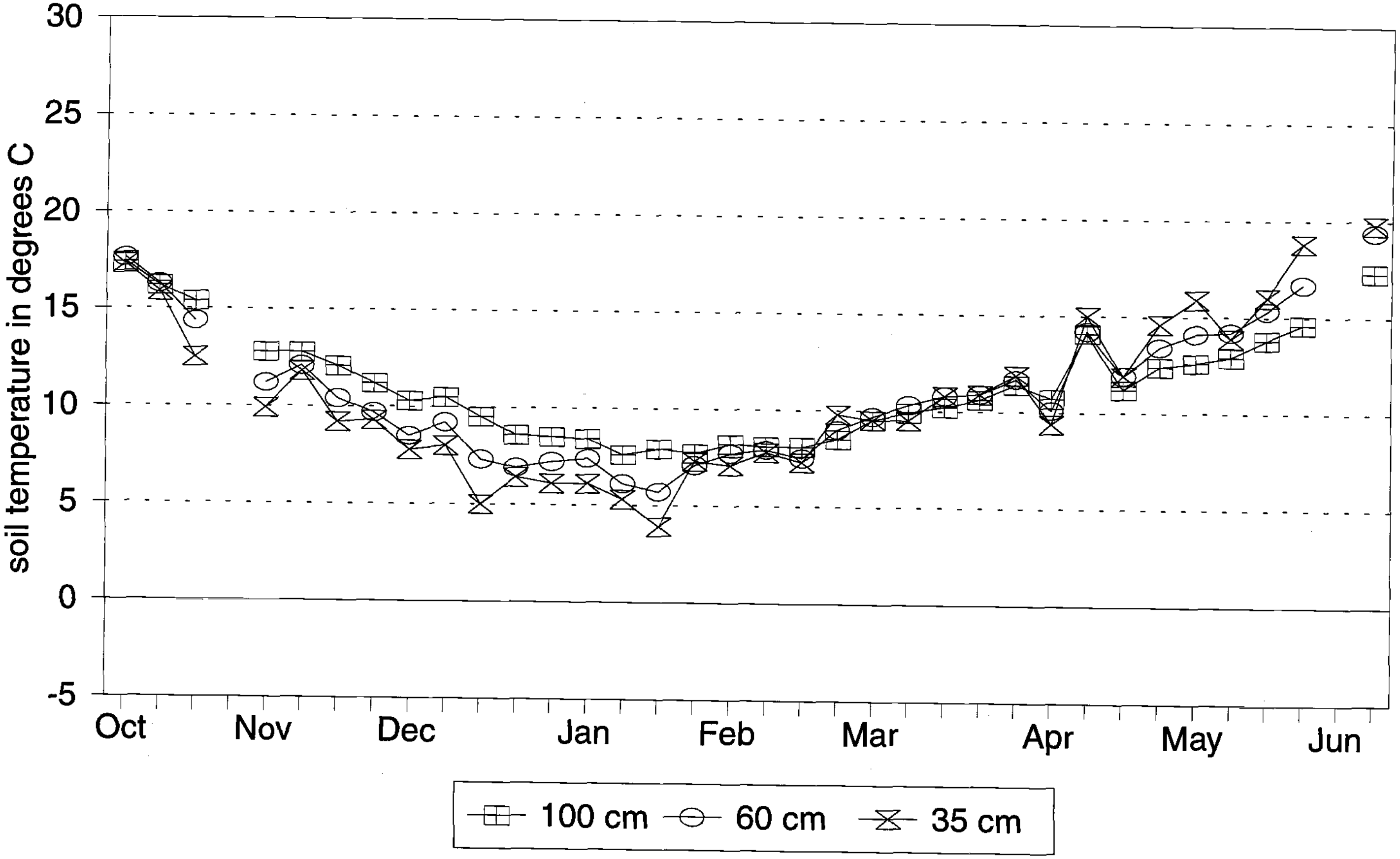


Figure 16. Soil temperature data at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Polk County.



Wo-B

Saturation:

Rainfall and piezometer data are presented in Figure 17. Water first appeared in the 100 cm piezometer in late November. The water table continued to rise until 1/28/92, at which time the depth to the water was similar at the 25, 50, and 100 cm piezometer depths. This indicates no restrictive layers in the 100 cm to surface range. The piezometer data tracked well with the precipitation.

The water table in the 200 cm piezometer was lower than in the other piezometers during most of the study period. This suggests the presence of a restrictive layer somewhere between 100 and 200 cm. This profile exhibits brittleness and very firm consistence near the bottom of the 2Btx horizon (112 cm) and it is likely that this feature restricts water movement, resulting in perching.

Data from the 100 cm tensiometers (Figure 18) correlate well with the corresponding piezometers, indicating continuous saturation from 12/17/91 to 5/19/92. At the 25 and 50 cm depths, saturated conditions as indicated by the tensiometers also were correlated with water table observations in their corresponding piezometers. There is one incident of lag, in which the tensiometer at 50 cm lags two weeks behind the piezometer at 50 cm during drying in April.

Reduction:

Eh data are presented in Figure 19. The 100 cm Eh values exhibited a trend of decline under continuous saturation from 11/26/91 to 5/19/92. The 100 cm Eh values represented oxidizing conditions (> 350 mv) until 2/18/92, and even though the 100 cm depth was saturated there was sufficient dissolved oxygen for biologic activity. The oxidizing conditions were facilitated by the unsaturated condition of the soil profile above the 50 cm depth, allowing air to diffuse into the soil profile. The 100 cm Eh values increased, with a one week lag, after the 100 cm piezometers indicated no water table but did not lag with the tensiometers.

The pattern of decline of Eh values at 50 cm is similar to that at 100 cm until mid January. Then even though the soil at 50 cm was saturated until the end of February, Eh values at 50 cm increased while the 100 and 25 cm Eh values decreased. The 25 cm values declined because actively respiring organisms with adequate available energy (3.51% organic matter, see Table 5, page 111) rapidly depleted the available O_2 under near-saturation conditions, as indicated by the tensiometer data (Figure 18). The 100 cm values declined because of continuous saturated conditions, under which the microbes slowly depleted the dissolved oxygen and ultimately began utilizing alternate electron acceptors. The 50 cm values increased because there was adequate dissolved oxygen, during the period of saturation in January and February, such that reducing conditions (< 350 mv) did not occur.

During the drying trend in March the 25 and 50 cm Eh values increased. The 50 cm values increased two weeks after the tensiometers indicated unsaturated conditions and three weeks after piezometers indicated no water table. The lag times associated with this series of events seems rather long, but this situation has some unique factors. First, the Eh values at 50 cm are all greater than 350 mv, which is the value taken as the onset of reducing conditions, indicating the soil environment here is in an aerobic state. Second, the aerobic state implies the use of O_2, as the acceptor of choice, which has the highest redox potentials of all acceptors in the soil system. Therefore the redox potential was related not to a change in acceptor, and the associated change in redox potentials in going from an acceptor with a low potential to one with a higher potential, but to biologic activity. If the biologic activity is at a level at which near optimum conditions were present, then rapid changes (in this case a rise in redox potential) may not be possible.

In contrast to the Eh values in April at 50 cm, the 25 cm Eh values drop rapidly from aerobic (oxidizing) to reducing conditions as the result of the 6.32 cm precipitation event. The short rainfall event, however, did not result in free water in the 25 cm piezometers, although the 25 cm tensiometers did indicate saturation. The 25 cm Eh values then rose markedly during unsaturated conditions in late April. The same precipitation event indicated a slight decrease in Eh at 50 cm, then a slight increase afterward during unsaturated conditions.

Somewhat related to the preceding scenario was a similar event for the 25 cm Eh values in mid February, apparently related to the 6.5 cm precipitation event. During this event the Eh values at 25 cm dropped from oxidizing to reducing conditions, while the 50 cm values increased slightly. Here, as in the April event, the 25 cm piezometers indicated no head, but this time the tensiometers did indicate unsaturated conditions. From the February and April events, it appears that the largest precipitation events on this soil, which has no slowly permeable layers above 100 cm to restrict a wetting front, have sufficient volumetric water content in the wetting front moving through the 25 cm depth to block the diffusion of O_2 long enough so that the soil organisms depleted the source and turned to alternate acceptors. In summary, the short term near saturation events may result in lower redox potentials when organism are actively respiring.

Soil temperatures (Figure 20) at 25 cm dropped below 5° C for two consecutive weeks in mid January. This coincided with a decrease in Eh values. The drop in temperature would most likely have resulted in a decrease or a cessation of biologic activity and the Eh values should have remained static with no increase or decrease. The decreased Eh values were the result of the near saturation/saturation events occurring in January and not the coincident temperature drop. It is possible that the decrease would have been greater had the temperature remained higher during the saturation events, facilitating increased biologic activity.

Morphology:

The absence of low chroma matrices and low chroma mottles indicates that an oxidizing environment existed in the profile, but there are mottles, a few concretions, and some black stains, indicating that reduction of iron and manganese has taken place and that redox potentials have reached the iron reduction range during previous wet seasons. The absence of widespread redox depletions and the presence of few concretions and faint mottling represent a fluctuating reducing environment where reduction has taken place followed by oxidation of these reduced compounds possibly in microsite environments, but the magnitude of the reduction has not left the Wo-B in a redox depleted state.

Figure 17. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 50 cm, and 25 cm at the Woodburn plot in Benton County.

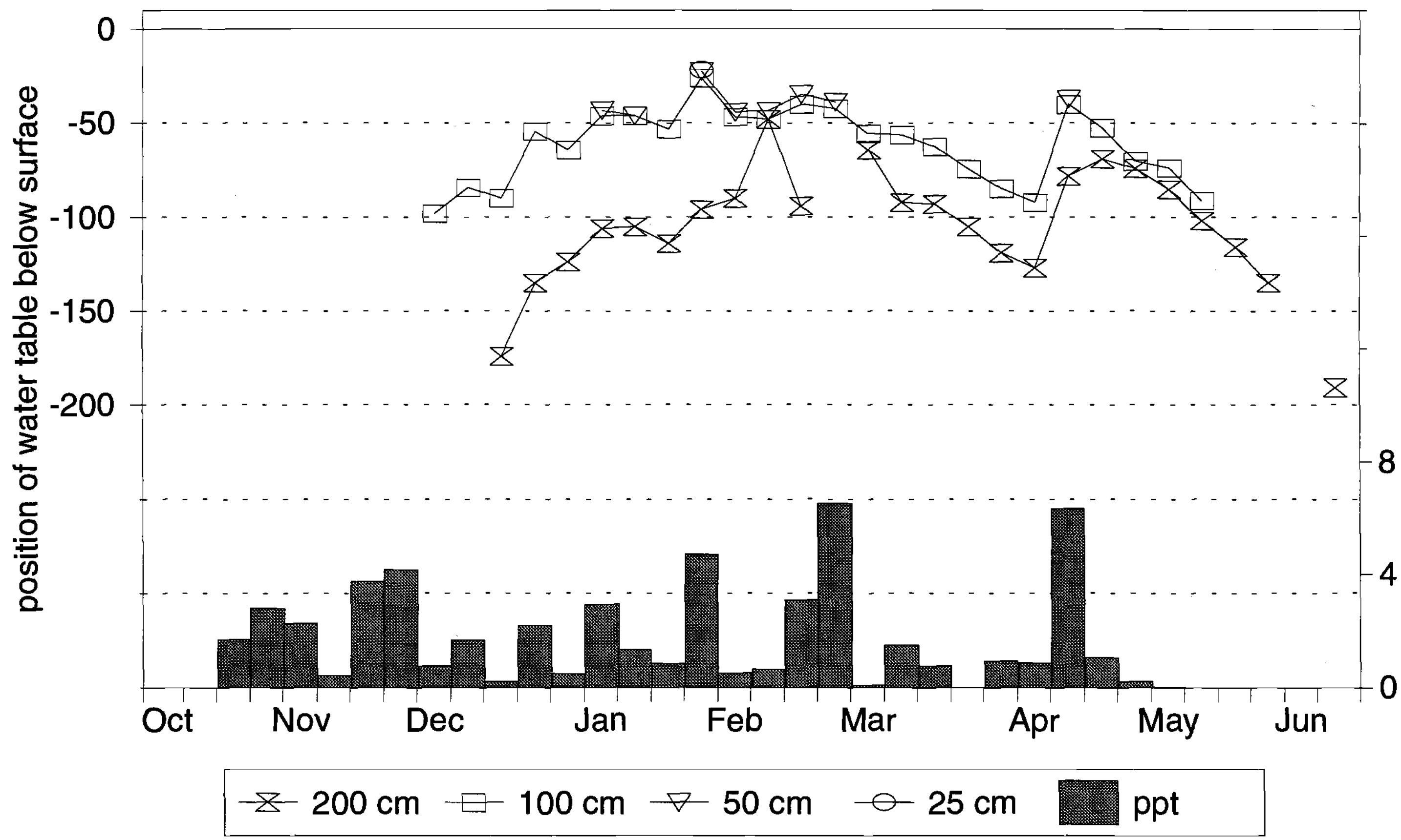


Figure 18. Matric potential data from tensiometers at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Benton County.

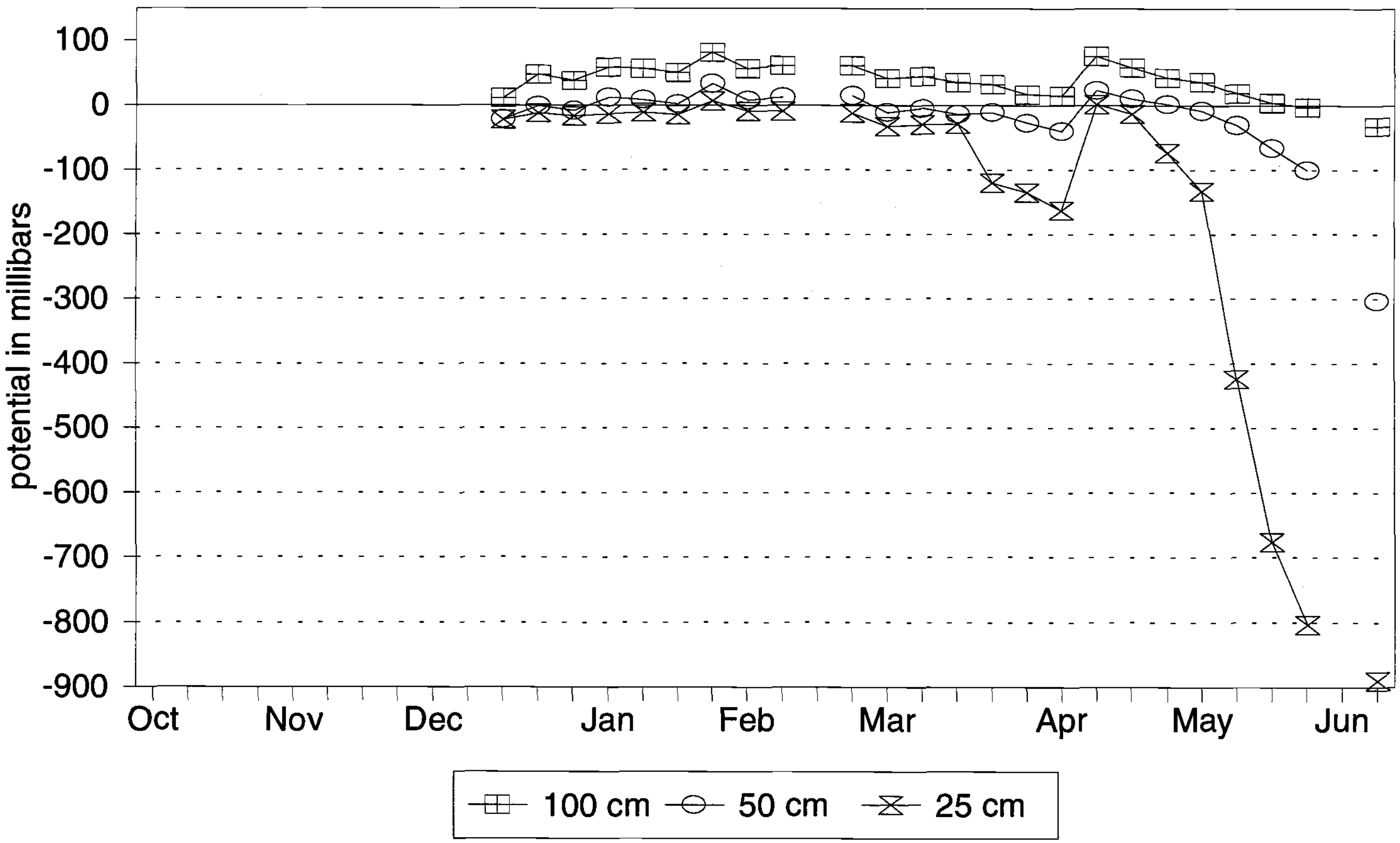


Figure 19. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Benton County.

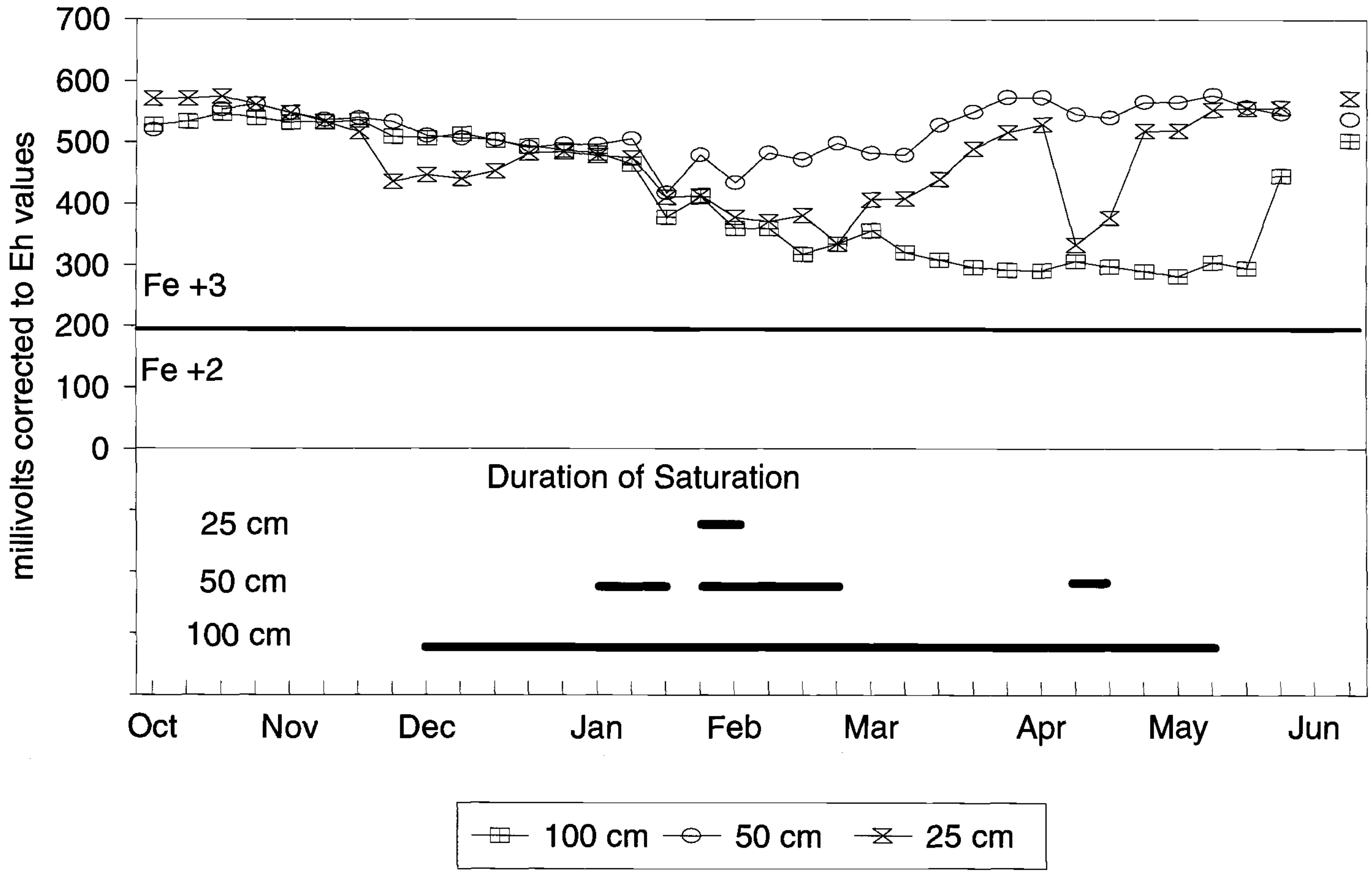
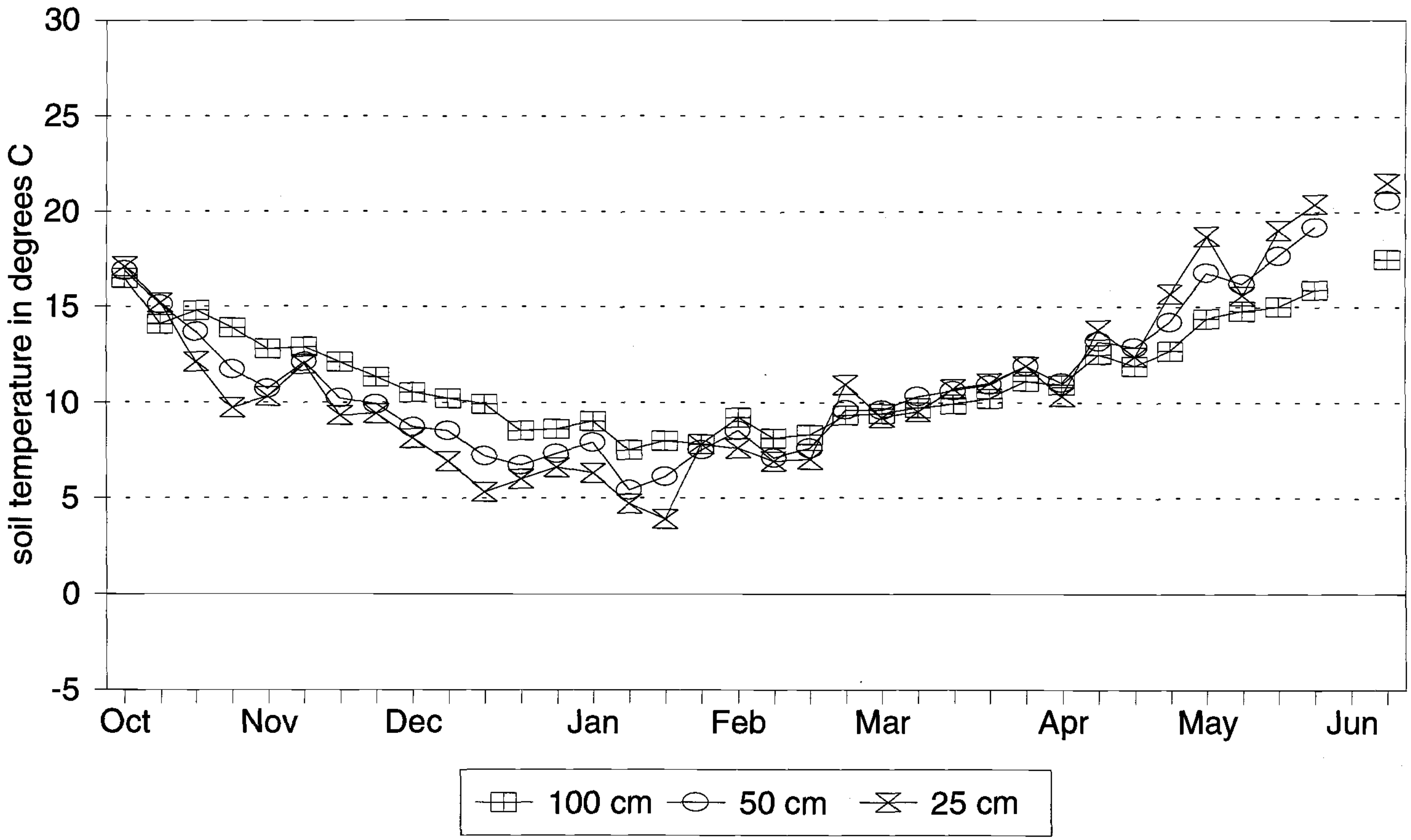


Figure 20. Soil temperature data at depths of 100 cm, 50 cm, and 25 cm at the Woodburn plot in Benton County.



Wi-B

Saturation:

Rainfall and piezometer data are presented in Figure 21. The water table tracks well with the precipitation data. The water table rose from the bottom as indicated by head first at 100 cm then at 50, and finally at 25 cm depths. When all depths had a water table, at the same time, these depths were nearly the same. This indicates no restrictive layers. The 100 cm depth was continuously saturated from 12/24/91 to 5/19/92 as indicated by both the tensiometers (Figure 22) and piezometers. There were no lag times between the tensiometers and piezometers in this profile.

Reduction:

Eh data are presented in Figure 23. The 100 cm values declined steadily under continuous saturation, from 12/24/91 to 5/19/92, then rose immediately when unsaturated conditions developed in May, exhibiting no lag time with the piezometers or tensiometers. The decline of the Eh values at 100 cm at the onset of saturated conditions are the result of adequate energy source (.43% organic matter, Table 5, page 111), with respiration at a rate such that there was a depletion of dissolved oxygen, and alternate electron acceptors were used. Then once unsaturated conditions occurred in May the diffusion of O_2 was faster than depletion by respiration which resulted in oxygen as the electron acceptor and subsequent aerobic conditions.

The 50 and 25 cm values remained nearly unchanged until 1/28/92. At this time the 50 cm values, under continuous saturated conditions until 3/17/92, decreased steadily. In response to the drying in mid March, the 50 cm values increased sharply, followed by a decrease in April from rewetting, and finally rose in May during a drying trend. The rise and fall of the 50 cm Eh values correlated well with the duration of saturation as indicated by the piezometers.

The 50 cm values did exhibit immediate marked changes, as do the 25 and 100 cm values, when going from saturated to unsaturated conditions. This is not a significant problem with data interpretation but it does require some explanation. A factor responsible for increases in Eh values can include available O_2. When going from saturated to unsaturated conditions the soil pores lose water and gain air which brings more O_2 to the soil microbes. It is possible that diffusion of O_2 was slower than demand at the 50 cm due to thin water films in the pores, supported by the capillary effects, slowing down diffusion rate of the air. If the microbes did not have all the O_2 they needed, they would have utilized some O_2 and some alternate acceptors and the potential would have declined.

The 25 cm values remained nearly unchanged but did show immediate decreases in Eh during two large rainfall events in February and April, followed by immediate increases after the events. The event in February correlates with the piezometer indications of saturation but the event in April did not. The tensiometers did, however, indicate saturation in both instances. A possible explanation is that the air-entry value had not been reached, pores have not drained, and until this value is reached the tensiometers would have indicated saturated conditions. Saturated conditions at 25 cm seem likely as the 50 cm piezometers indicated a water table at 27 cm, which is only 2 cm below the depth of the 25 cm tensiometers. The capillary fringe probably saturated the soil at the depth of the tensiometers, even though this water would be under negative pressure head, but the tensiometers would not read a negative potential until the air-entry value was exceeded. An alternative explanation to these decreases in Eh at 25 cm may be a wetting front, facilitated by the largest precipitation events at this plot, of sufficient volume to fill most of the pores with water, exclude air, slow O_2 diffusion and result in lower potentials because of biologic activity consuming O_2 reserves and turning to alternate acceptors.

The 25 and 50 cm Eh values did not indicate reducing conditions, (< 350 mv), during the study period. The 100 cm values did decline into reducing values during the study period. The conditions for this occurrence were the continuous saturation from 12/24/91 to 5/19/92 and available energy sources of .43% organic matter at this depth. The 100 cm Eh values increased markedly when the tensiometers recorded unsaturated conditions, on 5/26/92, which is one week after the piezometers indicated no water table.

The soil temperatures (Figure 24) for Wi-B are lower than the adjacent Wo-B (Figure 20) and Am-B (Figure 28) plots. Overhanging branches of oak trees block sunlight to the soil surface at plot Wi-B. Plots Wo-B and Am-B did not have obstructions that blocked solar radiation and therefore had higher soil temperatures than Wi-B.

The effects of soil temperature on the 25 cm Eh values are seen in the rather static Eh values during December to mid January where temperatures were very near or below 5° C and then the increase in Eh values that started in mid January as temperatures rose. The colder December/ mid January temperatures were a limiting factor in biologic activity during this time period and as a result the redox potentials remained somewhat static. The increase in soil temperature that started in mid January caused an increase in biologic activity that resulted in rising Eh values. The effect of increased biologic activity would have resulted in declining Eh values had the 25 cm depth been saturated and/or biologic activity been of sufficient magnitude to have resulted in limited availability of O_2 and this was the case during the previously mentioned February and April rain events. The soil at 25 cm was apparently well aerated as seen by the Eh values staying above 350 mv for the duration of the study period resulting in optimum oxidizing conditions that were not moderated by the changing soil temperatures.

Morphology:

The lack of mottles within 113 cm of the surface and the lack of any low chroma matrices within the profile represents a well oxidized environment in which the reduction of iron has not taken place with sufficient magnitude to form redox concentrations or depletions. There are at 69 cm few fine concretions which may indicate microsite reduction followed by oxidation into concretion bodies. The Eh values at 100 cm reached below 350 mv, which is a reducing environment and at 50 cm the Eh values were above 350 mv so it is possible that reducing conditions have occurred at previous times at 69 cm or that reduced solutions brought upward by capillary rise could have reached 69 cm at which time oxidation occurred resulting in the formation of concretions.

Figure 21. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 50 cm, and 25 cm at the Willamette plot in Benton County.

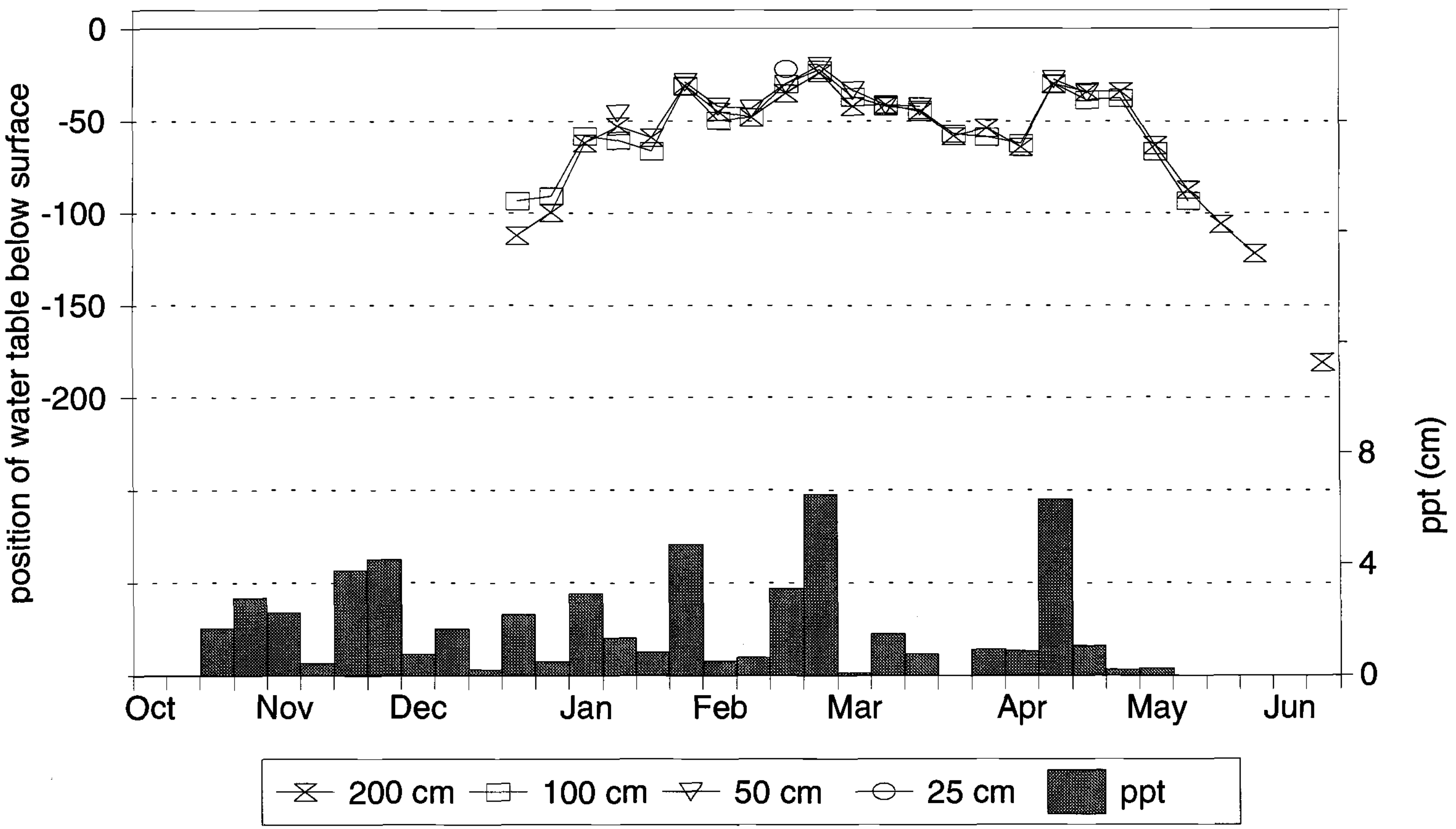


Figure 22. Matric potential data from tensiometers at depths of 100 cm, 50 cm, and 25 cm at the Willamette plot in Benton County.

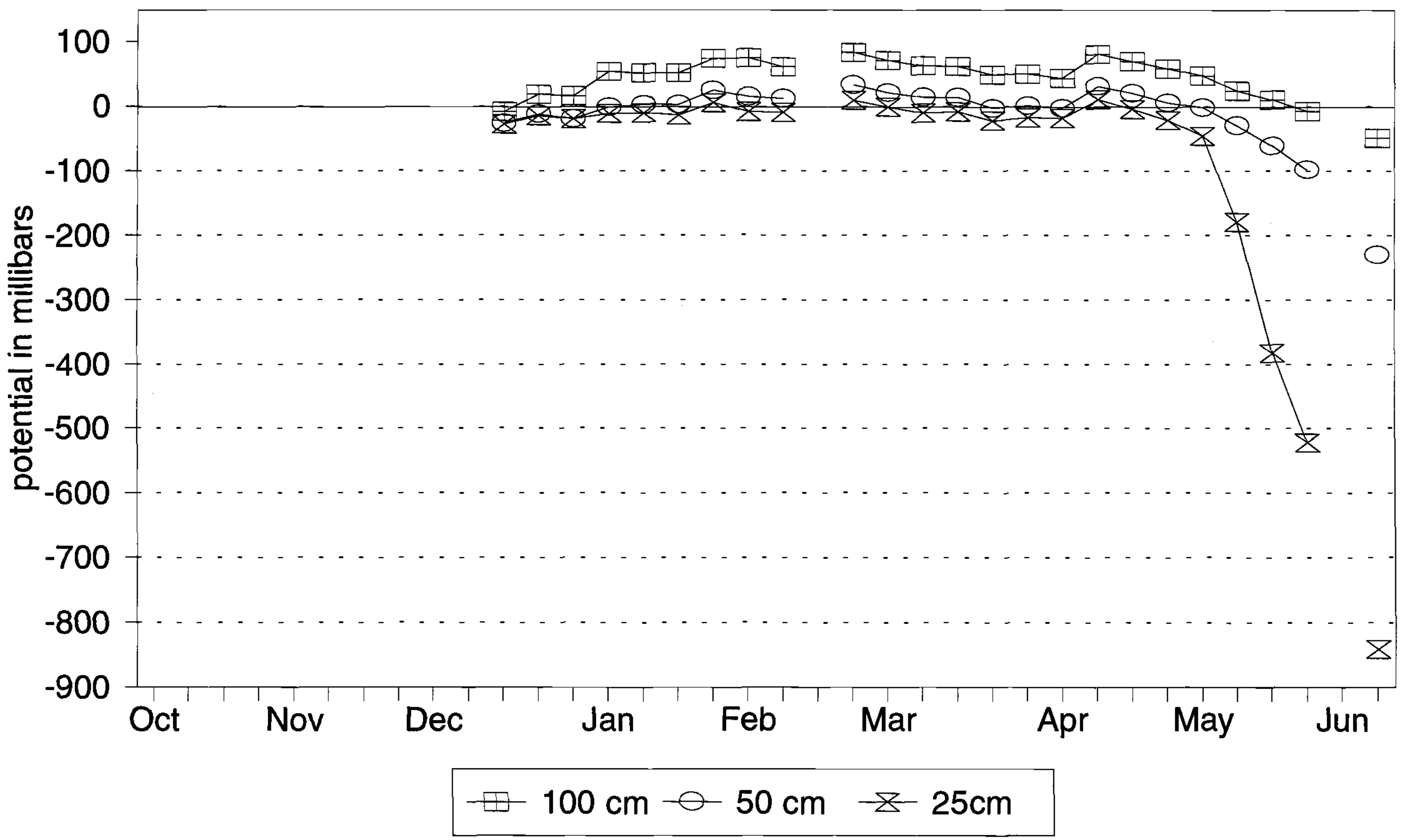


Figure 23. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 50 cm, and 25 cm at the Willamette plot in Benton County.

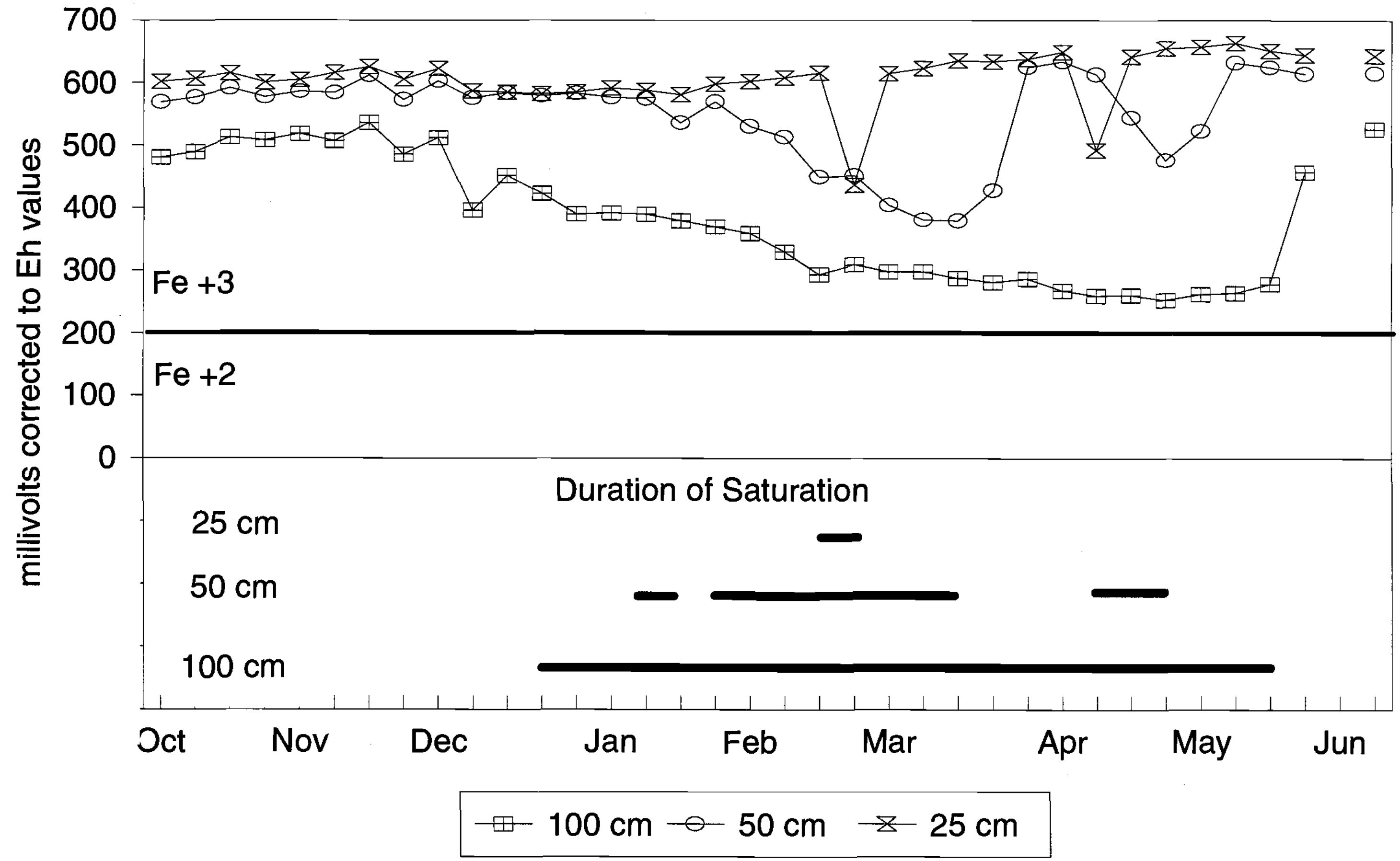
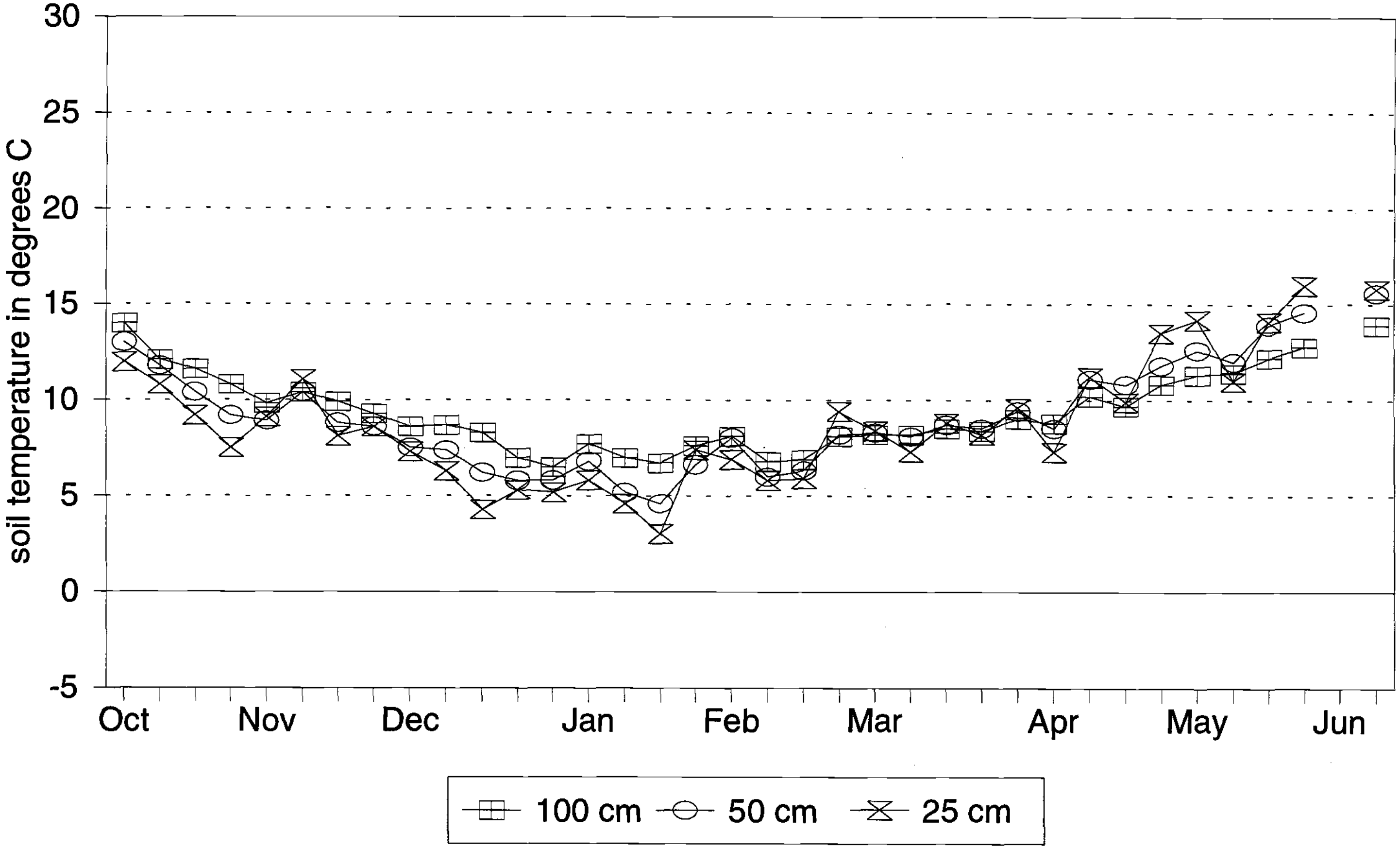


Figure 24. Soil temperature data at depths of 100 cm, 50 cm, and 25 cm at the Willamette plot in Benton County.



Am-B

Saturation:

Rainfall and piezometer data are presented in Figure 25. Head first occurred in the 200 and 100 cm piezometers at 164 and 93 cm respectively, on 11/26/91. The following week water levels in the 200, 100, and 50 cm piezometers were at 96, 40, and 48 cm. During these periods the 25 cm piezometers remained empty. Finally on 12/24/91 the 100, 50, and 25 cm piezometers indicated a water table, at 11, 11, and 10 cm respectively. The 200 cm piezometer indicated a deeper water table (42 cm) on 12/24/91. The soil remained continuously saturated from 12/24/91 to 5/5/92 above the 100 cm depth, was within 25 cm of the surface during this period, and was within 10 cm of the surface for 65% of the period. There were no lag times between the tensiometers (Figure 26) and piezometers on wetting and drying.

The 200 cm water tables were deeper than the 100, 50, and 25 cm water tables but did converge with them twice in March and April, then again once in May. It appearers that the movement of water was slowed down by the silty clay loam horizons above the 200 cm depths (assumed to be silt texture at 200 cm) and it took some time until the soil between 100 and 200 cm became saturated.

The water table did not track well with the precipitation events and the decrease of intensity in March did not drop the water table below 25 cm.

Most of the plots had water tables that fell below the 25 cm depth during the decrease of rainfall in March. Am-B appears to drain slower than most of the others studied and did not exhibit as much of a decline in March as did the others. One reason for this might be that the topographic position of this plot is at the lower toe slope of a hill, where the flow of water from the hillslope, both overland and by subs-surface lateral flow could maintain higher water tables. No attempt was made to measure this possible flow, however.

The water table dropped uniformly below 25 cm on 5/5/91 below 50 cm on 5/19/91 and below 100 cm sometime between 6/9/91 and 7/22/92.

Reduction:

Eh values are presented in Figure 27. Eh declined under saturated conditions at all depths, but the 25 and 50 cm values declined much faster than those at 100 cm. The faster rate of decline of the 25 and 50 cm values than the 100 cm values was because of the higher organic matter content 2.78% and 1.66% (Table 5, page 111) respectively at 25 and 50 cm compared to an organic matter content of .21% at 100 cm. The abundant energy source at 25 and 50 cm facilitated microbial activity that resulted rapid depletion of O_2 leading to utilization of alternate electron acceptors and reducing conditions.

Eh values at all depths reached reducing conditions, but only at the 25 cm depth did they reach values at or below 200 mv, and then on only two occasions. Eh values from 25 and 50 cm converged on 3/17/92 and remained virtually the same and unchanged until 5/19/92. By this time Eh values at 100 cm had declined to the point that Eh readings at all three depths had converged to the same value. The 25 cm Eh values then increased markedly from reducing to oxidized conditions, and this occurred one week after corresponding tensiometers and piezometers indicate unsaturated conditions. The following week the 50 cm Eh also rose to oxidizing conditions, with a lag time of one week after piezometers indicated no water table. There was no lag with the tensiometers, however.

Soil temperatures during the spring months were rising (Figure 28), while the soil was still saturated, creating better conditions for anaerobic biologic activity than under cooler temperatures. One would expect that under these conditions redox potentials might have decreased even further after 3/17/92 but it is obvious that even with favorable conditions the potentials had not decreased. One possible explanation is that the quantity of NO_3^- and manganic Mn (formation of manganous Mn at 300 mv) is so large that the microbes have not utilized all of these acceptors, and until the microbes accomplish this, the next acceptor will not be fully utilized, and therefore the redox potential will not decrease. Another possible explanation is that there was no available next acceptor, in this case iron, which would be required for the next redox couple reaction to occur. In any case the potential had reached an equilibrium with the soil environment and further decreases in potentials did not occur.

Morphology:

Morphological data supports the possibility of mobilization and removal of iron because there is an E horizon (52-73 cm depth) which has low matrix chroma indicative of redox depletion. The extent of mottling from the Ap (surface) horizon through the 3C horizon correlates to the Eh values in Table 6 (page 112) showing that the whole profile was at some time in a reducing environment in which iron and manganese were reduced and then as the oxidizing conditions returned the ferrous iron and manganous manganese were precipitated in the form of mottles. Under the same processes concretions were formed in most of the horizons beginning with the E and below.

Figure 25. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 50 cm, and 25 cm at the Amity plot in Benton County.

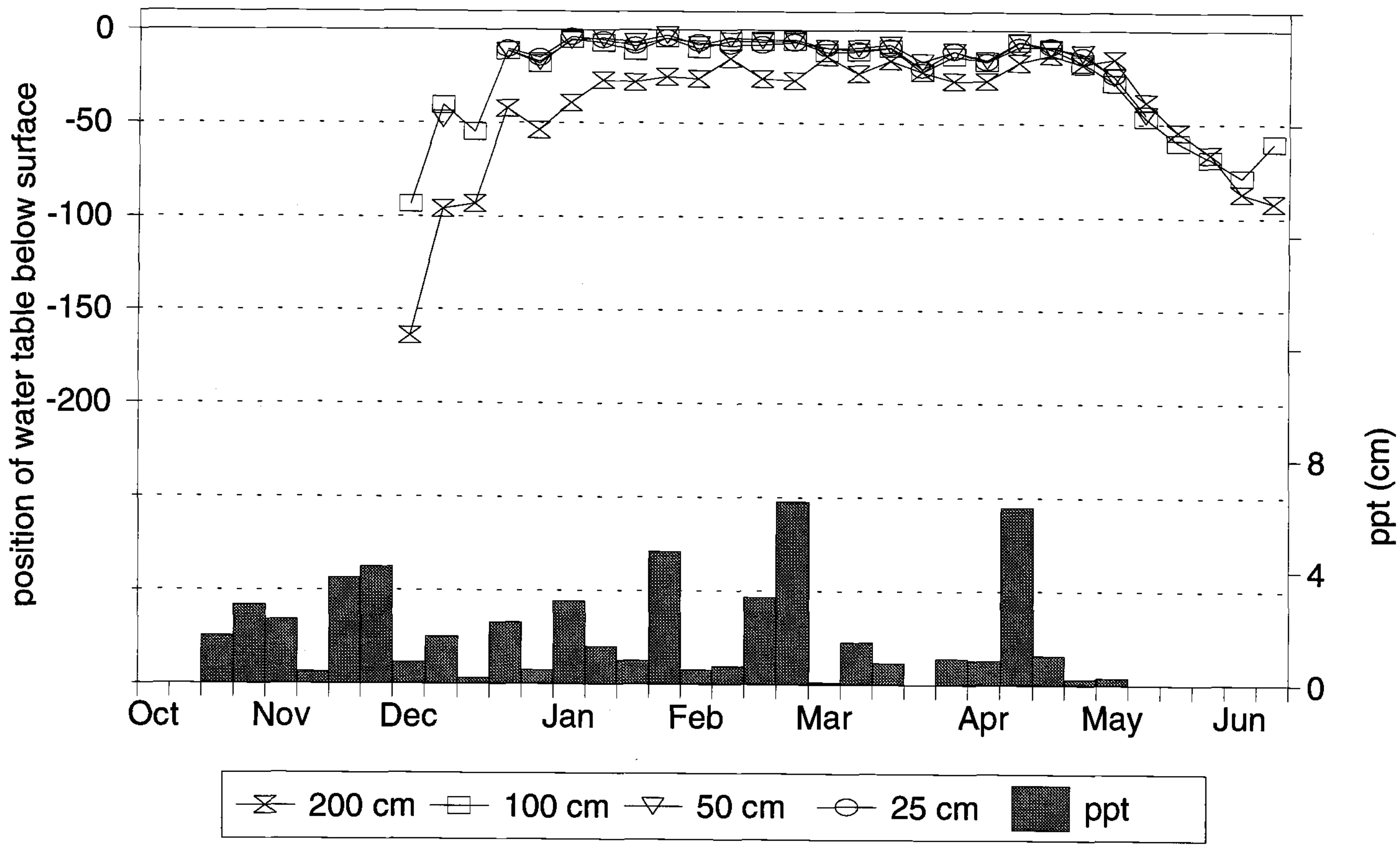


Figure 26. Matric potential data from tensiometers at depths of 100 cm, 50 cm, and 25 cm at the Amity plot in Benton County.

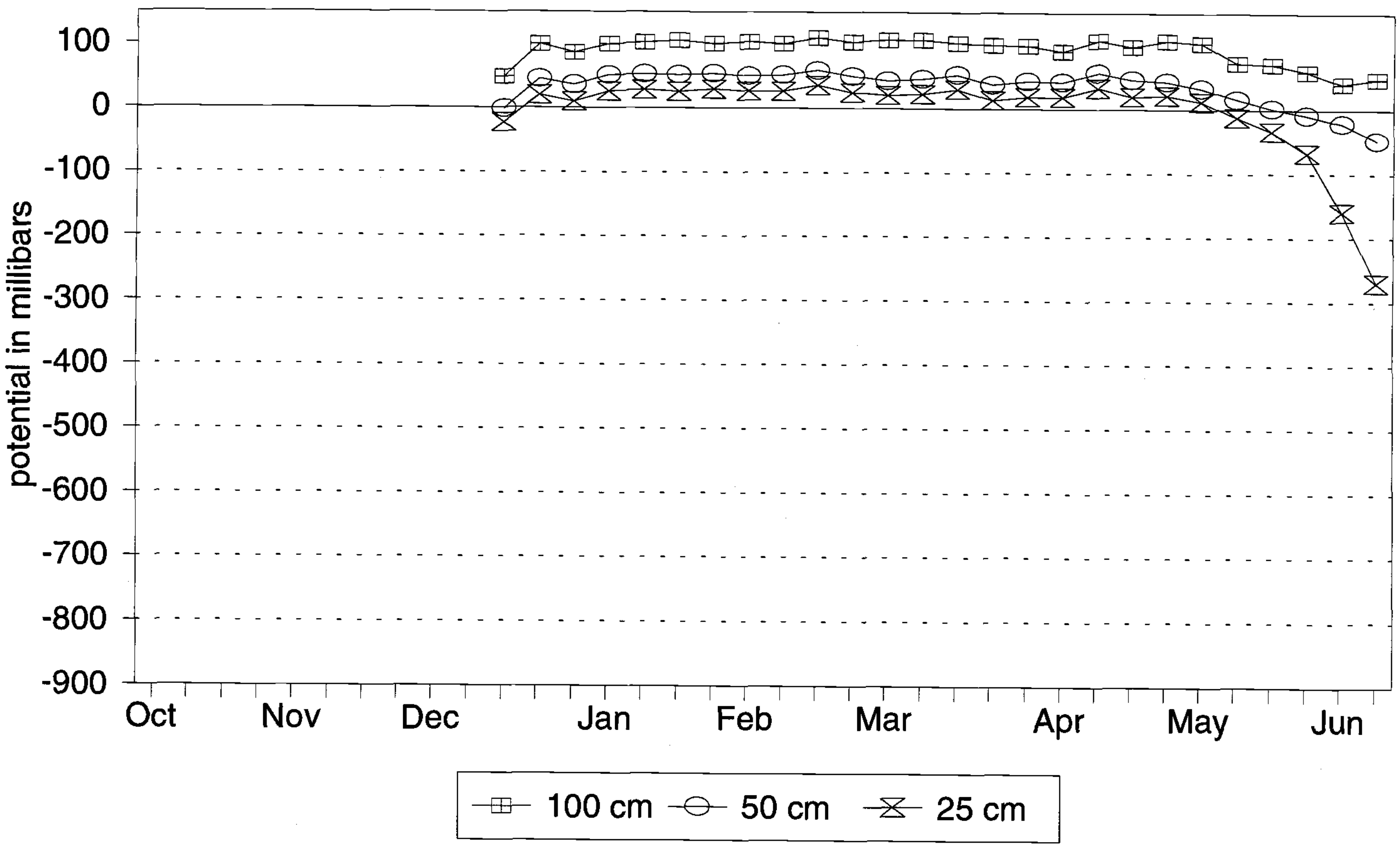


Figure 27. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 50 cm, 25 cm at the Amity plot in Benton County.

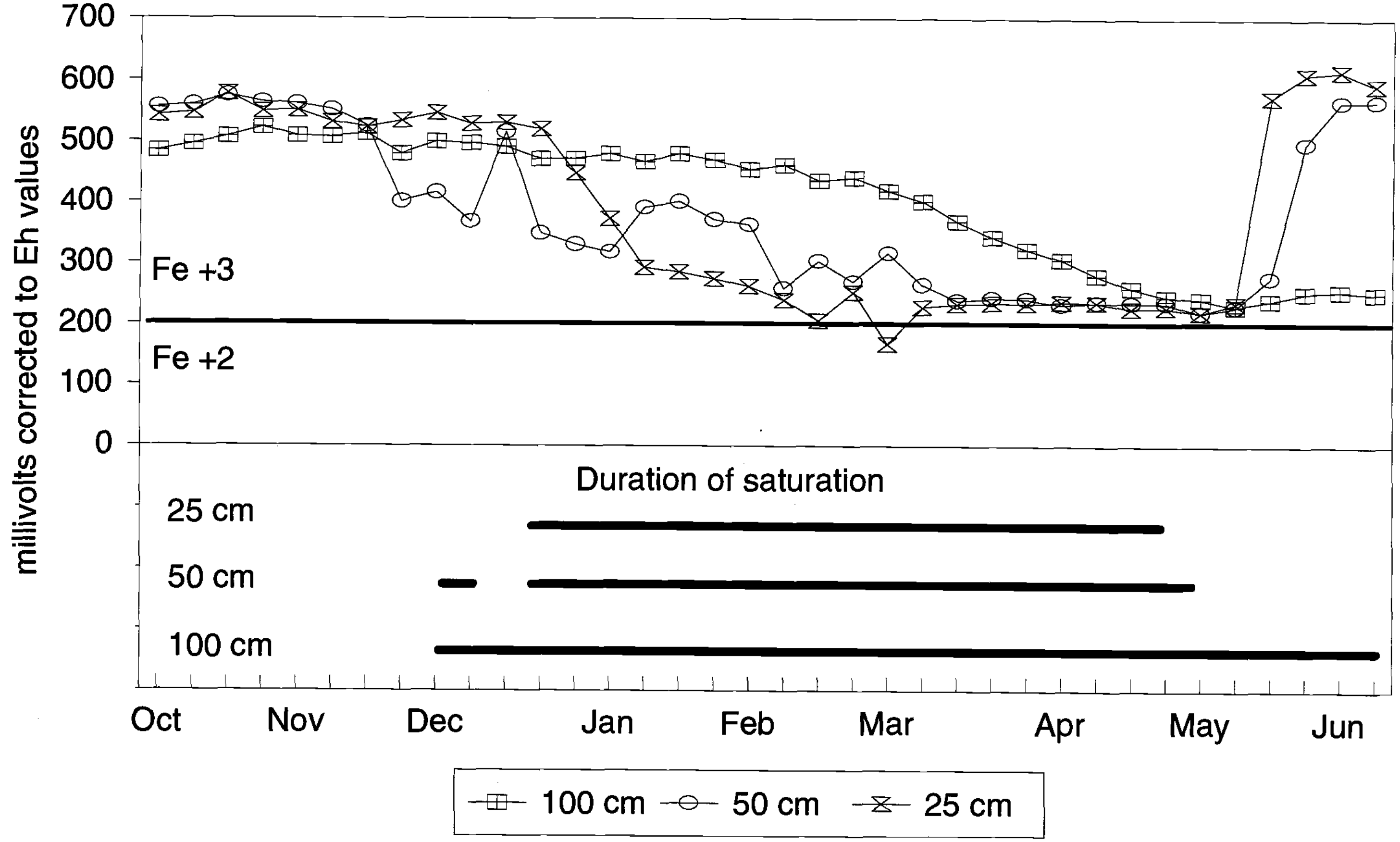
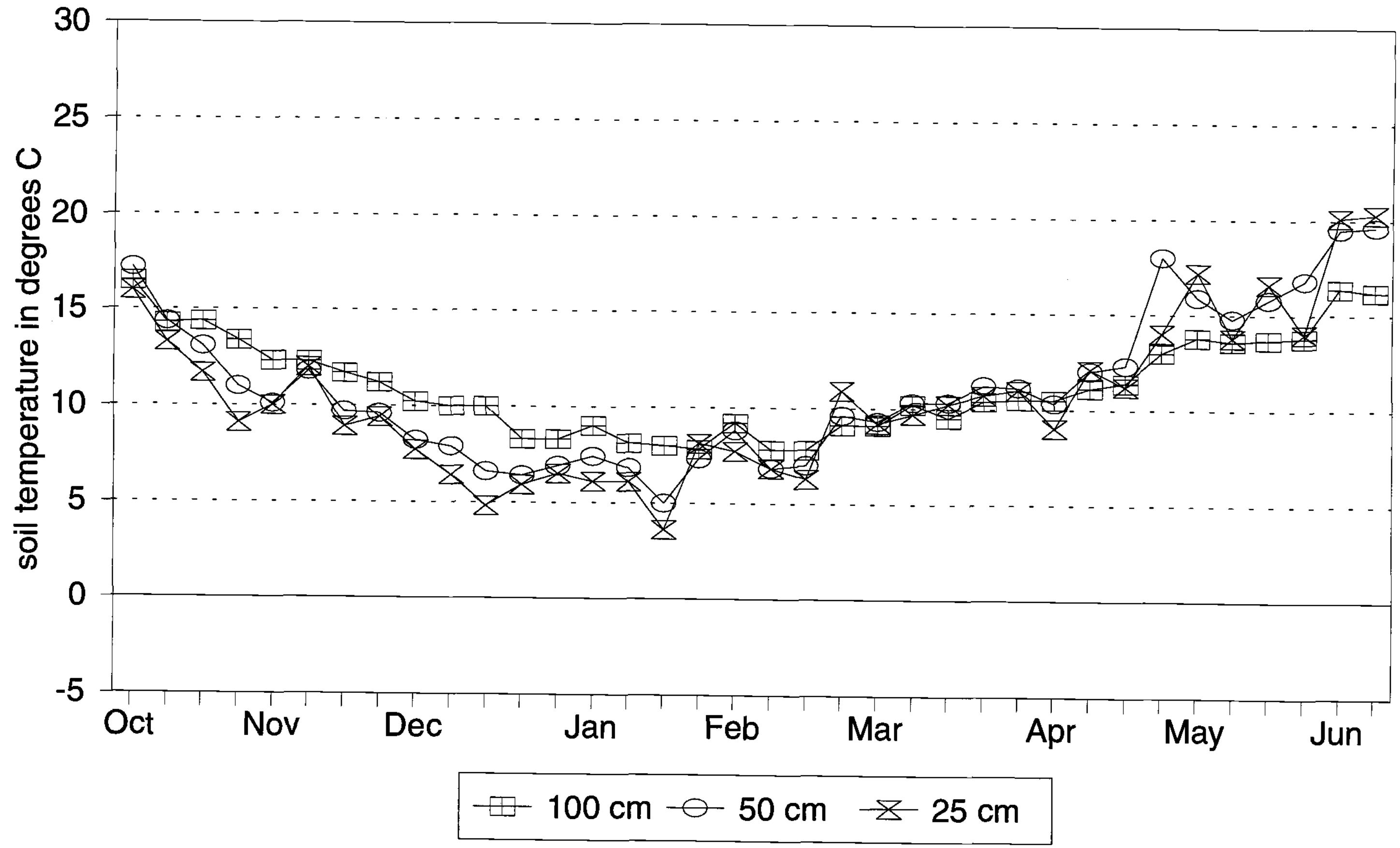


Figure 28. Soil temperature data at depths of 100 cm, 50 cm, and 25 cm at the Amity plot in Benton County.



Da-B

Saturation:

Rainfall and piezometer data are presented in Figure 29. Head was first indicated on 12/10/91 by water levels in the 110, 60, and 35 cm at 99, 9, and 9 cm respectively. The soil at the depths of these piezometers remained continuously saturated from 12/24/91 to 3/17/92. The 35 and 60 cm data are nearly identical, but the 110 cm data indicates a greater depth to water table than the 35 and 60 cm piezometers. This suggests that the upper water table was perched above 60 cm depth. The 60 cm piezometer was placed in the 2Bt2, silty clay horizon and this texture may facilitate the perching. The lower water table did converge with the perched water table once in March and again in April during drying periods. This convergence appears to be related to the greater and more rapid head loss of the 35 and 60 cm piezometers than of the 110 cm ones when precipitation decreased. Both the 35 and 60 cm piezometers track with the precipitation, but the 110 cm did not, probably because of the restriction of water movement through the silty clay horizon. The 35 and 60 cm tensiometers (Figure 30) correlated with the piezometers on wetting and drying, exhibiting no lag times. Correspondence with both rainfall and piezometer data suggests that water movement in the upper 60 cm of the profile was not restricted.

Reduction:

Eh data are presented in Figure 31. Eh values decreased under continuous saturation at all depths. The 35 and 60 cm values dropped most noticeably on 12/17/91, one week after piezometers at these depths first indicated head.

Eh values at 35 cm fell into the range for reduction of iron to take place for four continuous weeks in February and March, then rose markedly at the end of March, one week after tensiometers and piezometers data indicated unsaturated conditions. When rewetting occurred in April, the perched water table rose to within 9 cm of the soil surface and the Eh values decreased again to the iron reducing range, then rose immediately (no lag) when the water table dropped below 35 cm, in late April.

Eh values at 60 cm also reached the iron reduction range for eight continuous weeks from March to May, then increased immediately when tensiometers and piezometers indicated unsaturated conditions.

There was a lag time of four weeks between the onset of saturated conditions and the noticeable decline of Eh value sat 110 cm. The lag time is probably do to low biologic activity because of the low organic matter content (.27%) at this depth.

Eh values at both 60 and 100 cm approached an equilibrium near the iron reduction potential, whereupon Eh values did not decrease further even under conditions of warmer spring temperatures and continued saturation.

Possible explanations for equilibrium are that at 65 and 110 cm there is an abundance of reducible iron that will buffer any further decline in redox potential or that the most of the reducible iron has been removed from these depths resulting in the lack of iron electron acceptors and therefore the potential would not decline. Morphological data suggests that there was a lack of reducible iron. This data feature is similar to that in plot Am-P.

Morphology:

The presence of an E horizon (23-38 cm depth) and low chroma matrices in the profile suggest the reduction and removal of iron and manganese. From Table 6 (page 112) it is shown that Eh values reached the iron reducing at 65 and 35 cm. The magnitude of iron reduction can be inferred as having reached from 65 cm to the surface as evidenced by the presence of mottles in the surface horizon.

The perching of the water table above 65 cm is associated with the clay and silty clay textures of the 2Bt1 and 2Bt2 horizons respectively which have matrix colors of 2.5Y 4/2. It is not evident that the 2.5Y color is caused by the perching of water, duration of saturation, and iron reduction; and it is possible that the matrix color is associated with a discontinuity and change in parent material color.

Figure 29. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezometers at depths of 200 cm, 100 cm, 60 cm, and 35 cm at the Dayton plot in Benton County.

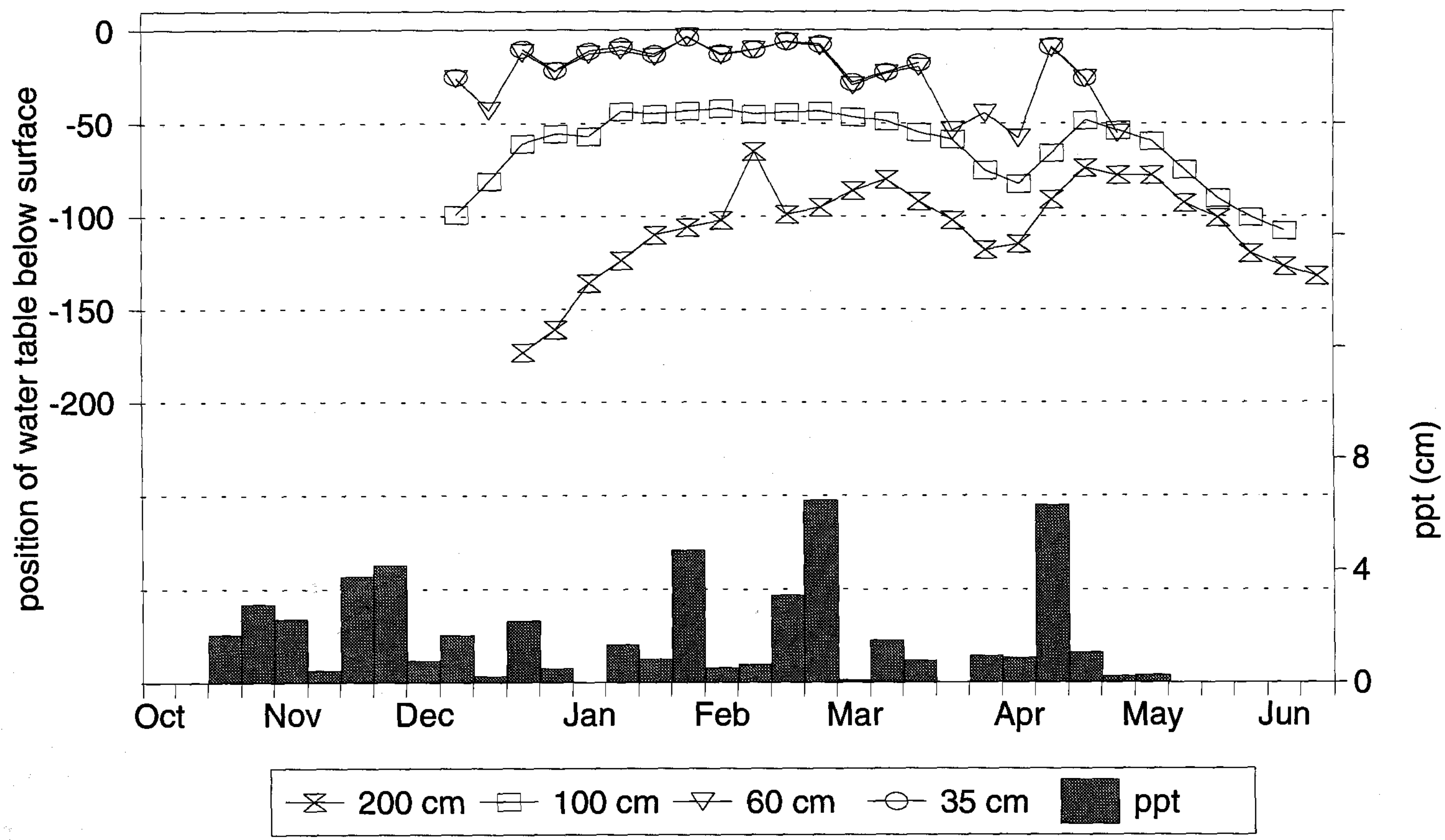


Figure 30. Matric potential data from tensiometers at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Benton County.

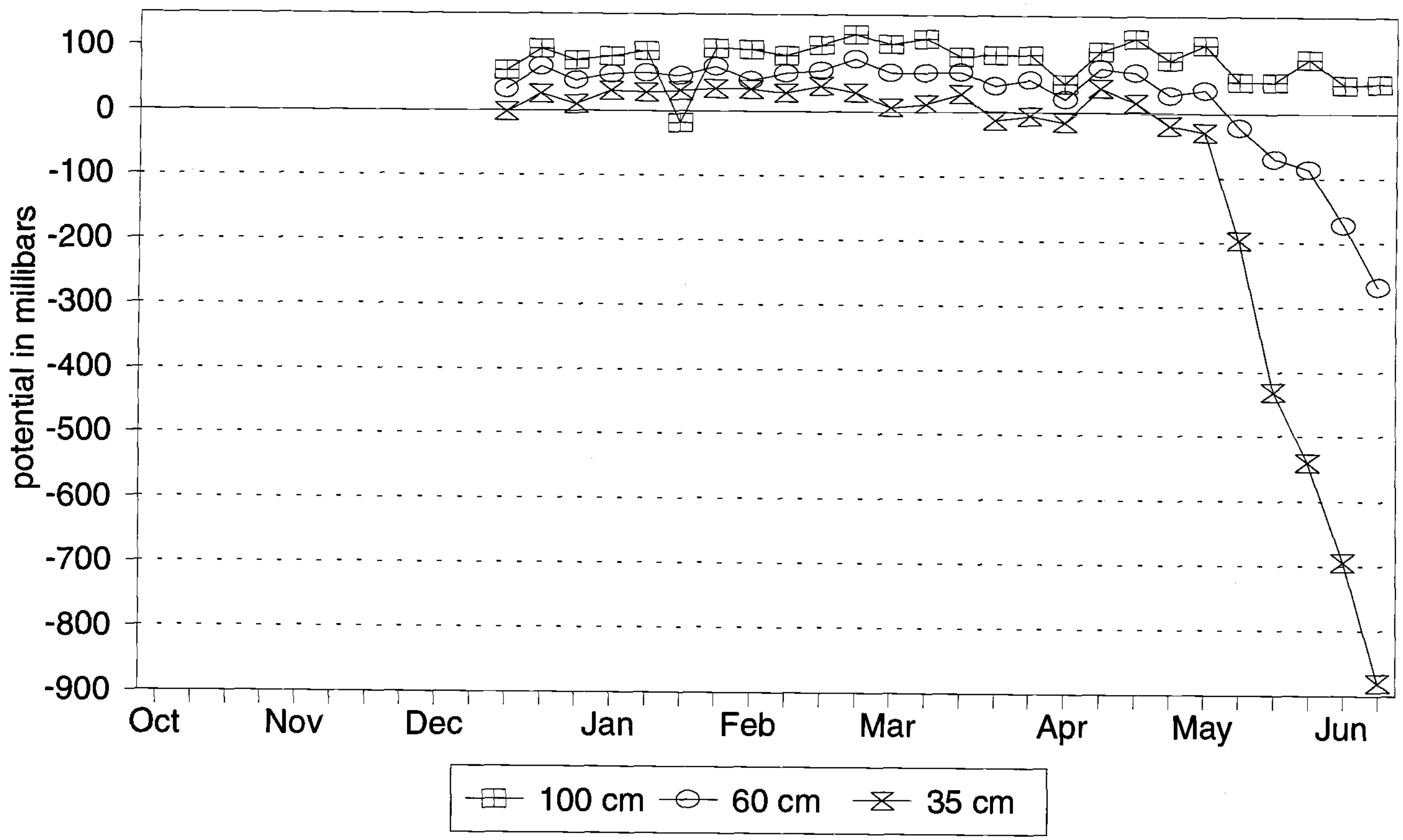


Figure 31. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Benton County.

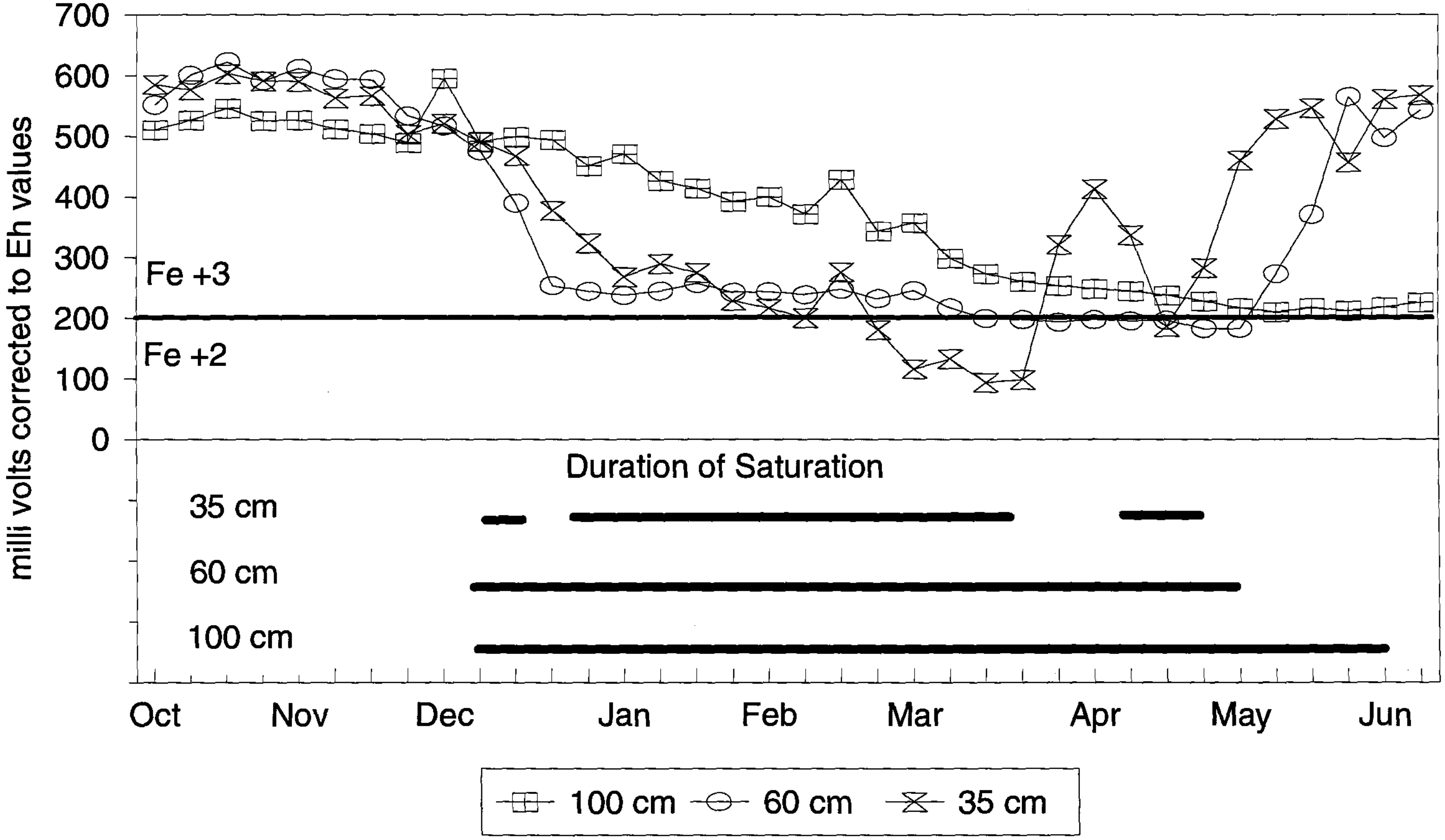
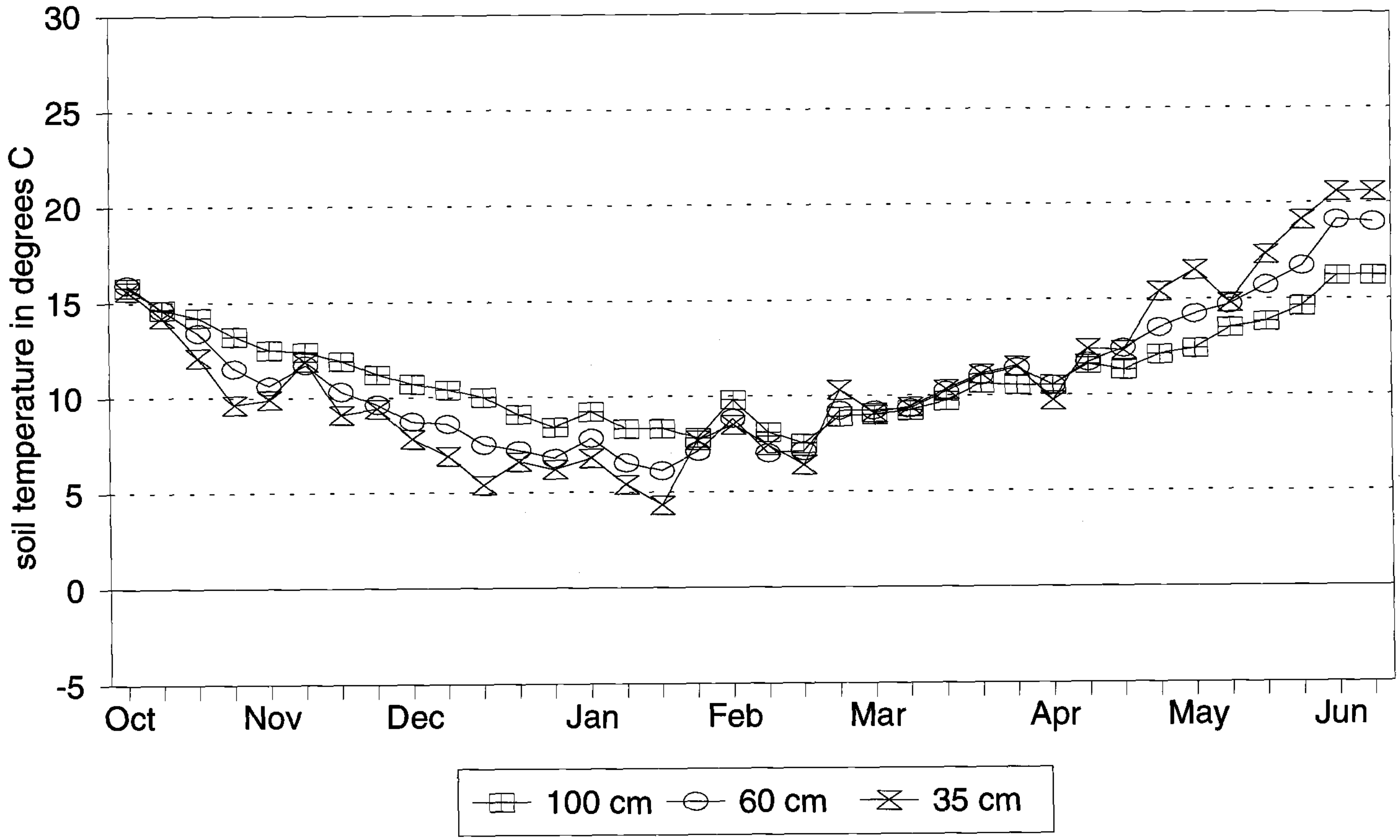


Figure 32. Soil temperature data at depths of 100 cm, 60 cm, and 35 cm at the Dayton plot in Benton County.



Wa-B

Saturation:

Rainfall and piezometer data are presented in Figure 33. Head first was indicated in the 100 and 200 cm piezometers by water levels at 58 and 62 cm, respectively, on 12/5/91. The 20, 50, and 100 cm piezometers, all indicated head on 12/10/91, and the soil at these depths was continuously saturated from this date until 4/28/92, at which time the 20 cm piezometers and tensiometers (Figure 34) indicated unsaturated conditions. When going from saturated to unsaturated conditions there was no lag between the tensiometers and the piezometers.

During the continuous saturation period, all depths to water tables (measured by 20, 50, and 100 cm piezometers), were within 7 cm of each other indicating no discontinuities were perching water. The water table was within 10 cm of the surface for 48% of this period, but the soil surface was never documented as being covered with water. Continuous saturation probably was facilitated by a nearly continuous supply of surface water, as Wa-B is located in a drainageway that collects water from a large surrounding area. The soil surface exhibited cracking when dry and these may be conduits for water when wetting, but they do swell shut when saturated.

On 5/12/92 the 50 cm piezometers were empty but the tensiometers indicated saturated conditions until sometime between 6/9/92 and 7/22/92. There was a very long lag time associated with drying for the 50 cm tensiometers, and here, as in Wa-P, the instruments indicating the long lag times are placed in thick clay horizons. Correlation coefficients in Table 3 (page 109) show that the clay textures in plots Wa-B and Wa-P have very poor correlation when utilizing piezometer and tensiometer measurements to indicate depth to water tables. This is probably because of differing responses to the air-entry value of the piezometers and tensiometers.

Reduction:

Eh data are presented in Figure 35. The trend for the 100 cm values shows a steady decline during continuous saturation and the onset of this decline coincides with the onset of saturation. The values at 100 cm remained relatively unchanged from late February to early June and have been documented to remain at reducing values (< 350 mv) until sometime between 8/7/92 and 9/16/92.

The 20 cm Eh values did not show a marked decrease until three weeks after the onset of saturation, then declined rapidly to the same values that occur at 100 cm. The 20 cm Eh values increased markedly in mid May, two weeks after piezometers and tensiometers indicated unsaturated conditions. This lag of the Eh values may have been the result of increased biologic activity (flush) facilitated by rising soil temperatures (Figure 36). The 50 cm values did not exhibit the trend of steady decline that was shown by the 100 and 20 cm values. After continuous saturation for six weeks, the Eh values at 50 cm were still in the oxidized range (> 350 mv). But in late

January and continuing to early March, the potentials fluctuated weekly from oxidized to reducing conditions. During this time period the piezometers and tensiometers indicated continuous saturation. From these data it can be concluded that the soil profile did not dry out then resaturate, causing fluctuating aerobic and anaerobic conditions. A possible explanation for the fluctuation in potentials may be a fluctuating energy source or type of organisms, but neither of these seem likely. Perhaps the fluctuations were facilitated by changes in concentration of dissolved oxygen within the horizon, caused by subsurface flow from the surrounding higher topography, but there are no data to support this. It is possible that carbonates observed, in the next deeper BC horizon may have been dissolving into solution forming bicarbonate resulting in the decrease in pH. The formula that explains this reversible relationship is as follows:

$$CaCO_3 + CO_2 + H_2O = Ca^{2+} + 2HCO_3^-$$

This reaction can proceed to the right if 1) there is $CaCO_3$ present, described in the profile description, 2) H_2O is present, the profile was saturated as indicated by the piezometers and tensiometers, and 3) if there is CO_2 present, probably available from biologic respiration. When the CO_2 concentration decreases the reaction will proceed to the left resulting in an increase in pH.

According to the Nernst equation when considering the effect of pH on Eh values, the Eh values will increase as the hydrogen ion (pH) decreases. This relationship is explained by the following:

$$Eh = \frac{Eh^\circ - RT \ln Q}{nF}$$

Eh is electrode potential of the redox couple
Eh° is standard electrode potential of the redox couple
R is gas constant
T is degrees Kelvin
Q is concentration of oxidized and reduced substances
n is number of transferred electrons
F is Faraday constant

The effect of pH is explained by the following relationship:

$$Q = \frac{\text{reduced species}}{\text{(oxidized species) (H ion concentration)}}$$ (Bohn et al, 1985)

From this relationship it can be seen that as the pH decreases that the Eh values will increase. It is possible that at this plot the fluctuating Eh values are the result of change in pH caused by the concentration of CO_2.

There may be no clear explanation for the fluctuating potentials at 50 cm with the available data and perhaps the continuing studies at this plot will reveal more details on this anomaly.

Morphology:

The presence of gleying below the A horizon in the Bg1 and Bg2 horizons indicates reduction and removal of iron, manifest as redox depletions, facilitated by the long duration of saturation. From Table 6 (page 112) it is seen that the Eh values reached iron reduction ranges in both the 20 and 50 cm depths and from Table 4 (page 110) it is shown that the frequency of observed water tables was greater than 50% at these depths. There are a few concretions present in the Btg1 horizon but are not found in any other horizons which indicate removal and not concentration of the iron and manganese has occurred in most of the profile, facilitated by the long periods of saturation.

Figure 33. Precipitation (bottom) and water table data (top) below the soil surface as observed in piezomerters at depths of 200 cm, 100 cm, 50 cm, and 20 cm at the Waldo plot in Benton County.

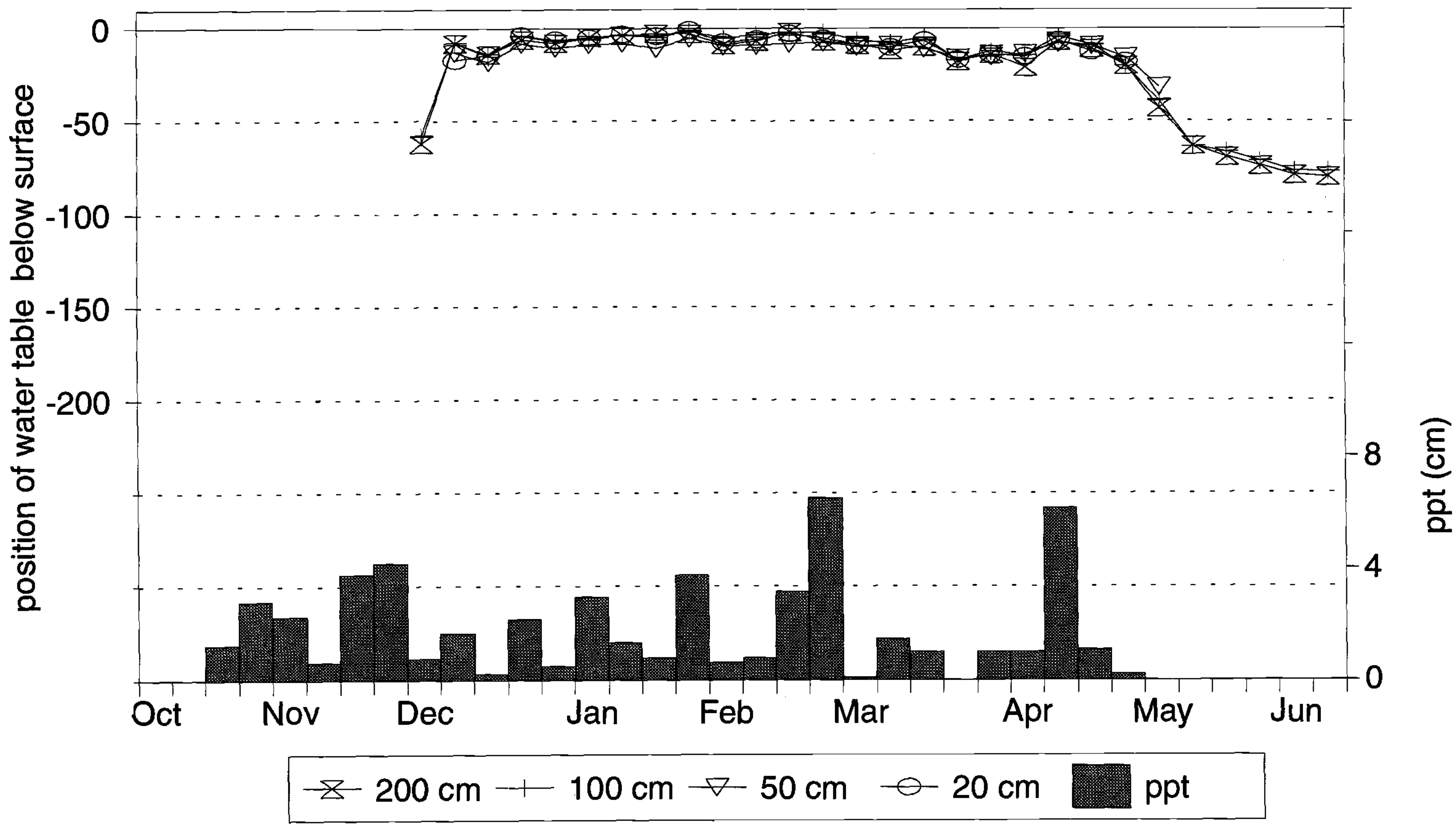


Figure 34. Matric potential data from tensiometers at depths of 100 cm, 50 cm, and 20 cm at the Waldo plot in Benton County.

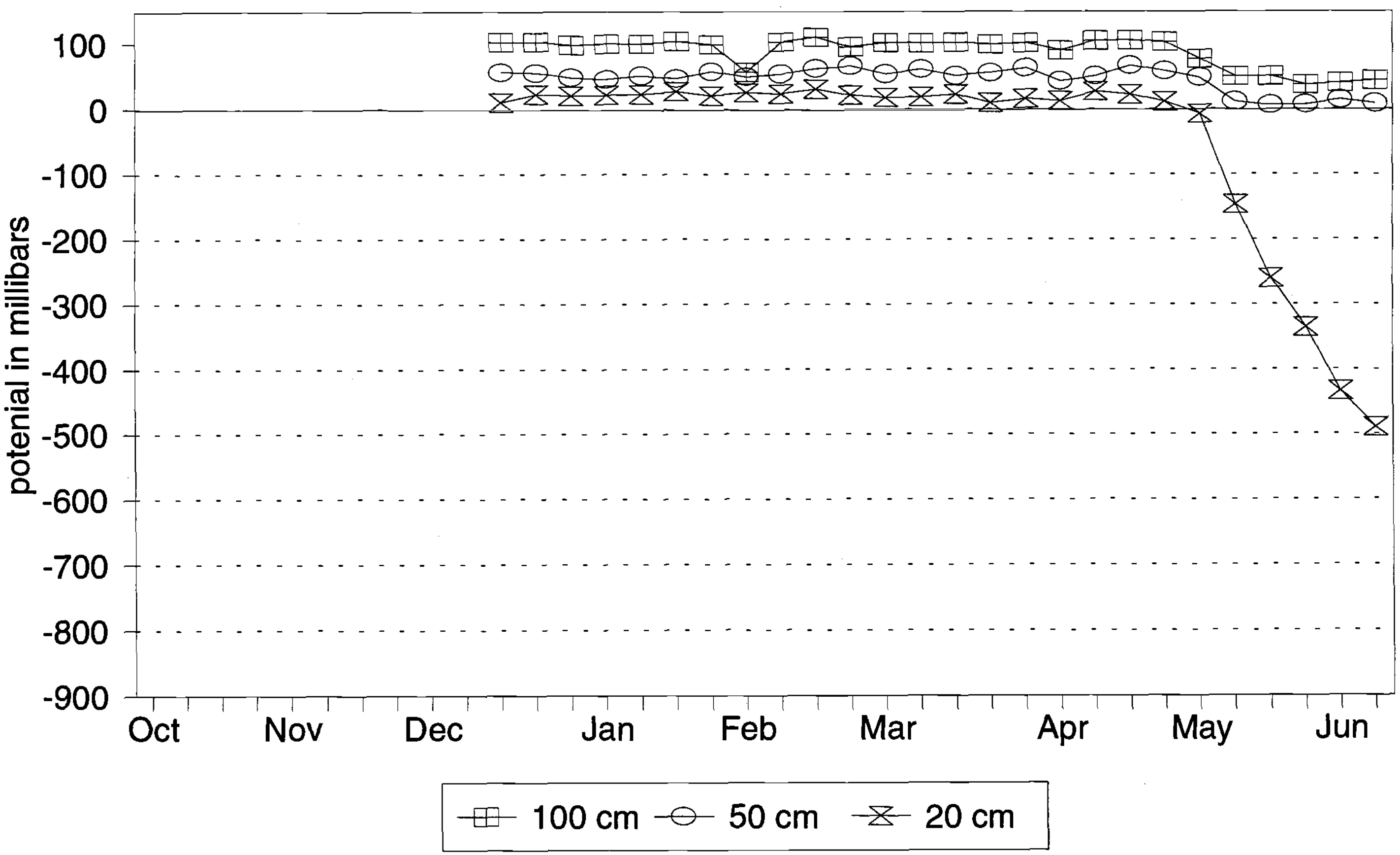


Figure 35. Duration of saturation as measured by piezometers (bottom) and electrode potentials (top) at depths of 100 cm, 50 cm, and 20 cm at the Waldo plot in Benton County.

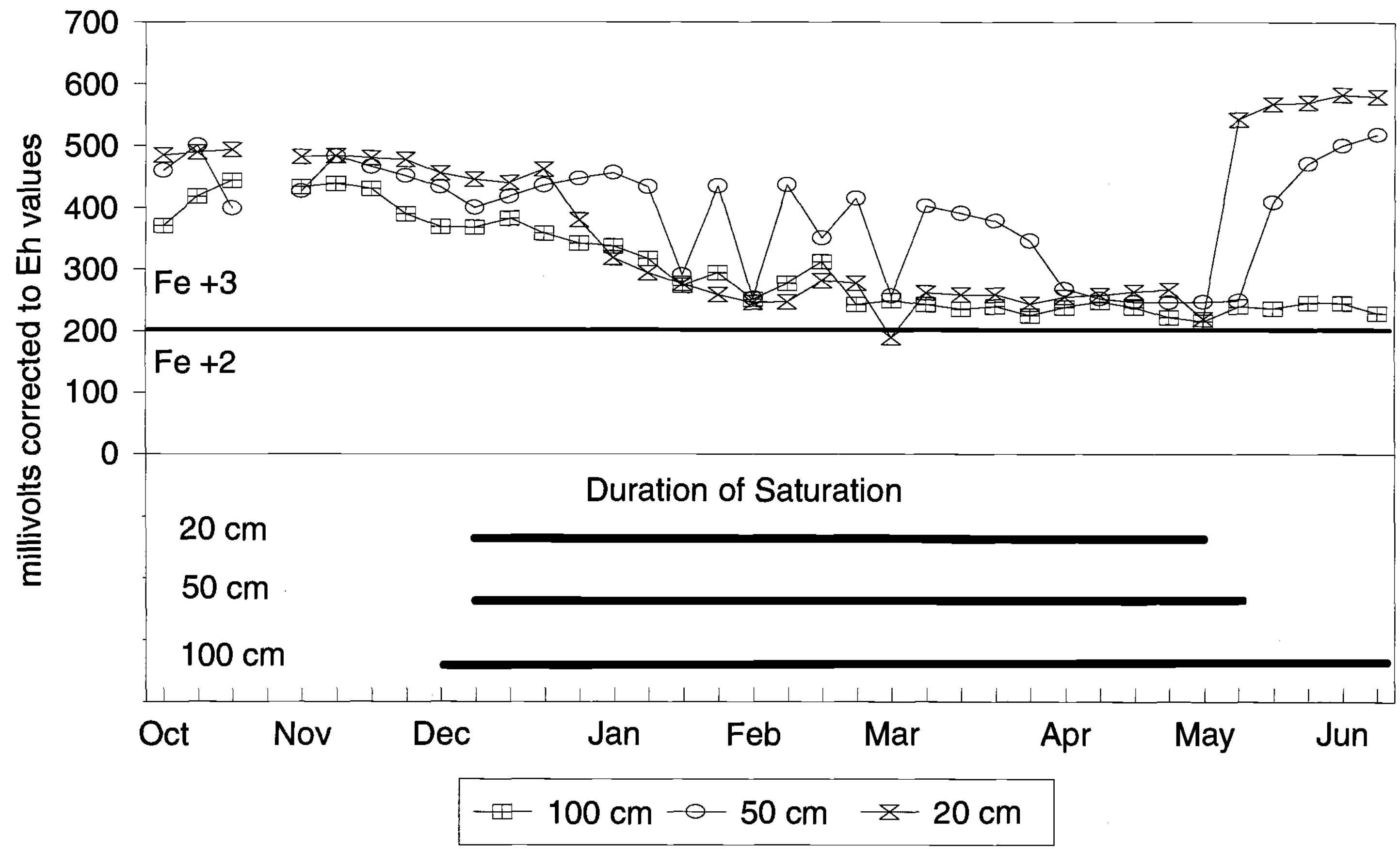


Figure 36. Soil temperature data at depths of 100 cm, 50 cm, and 20 cm at the Waldo plot in Benton County.

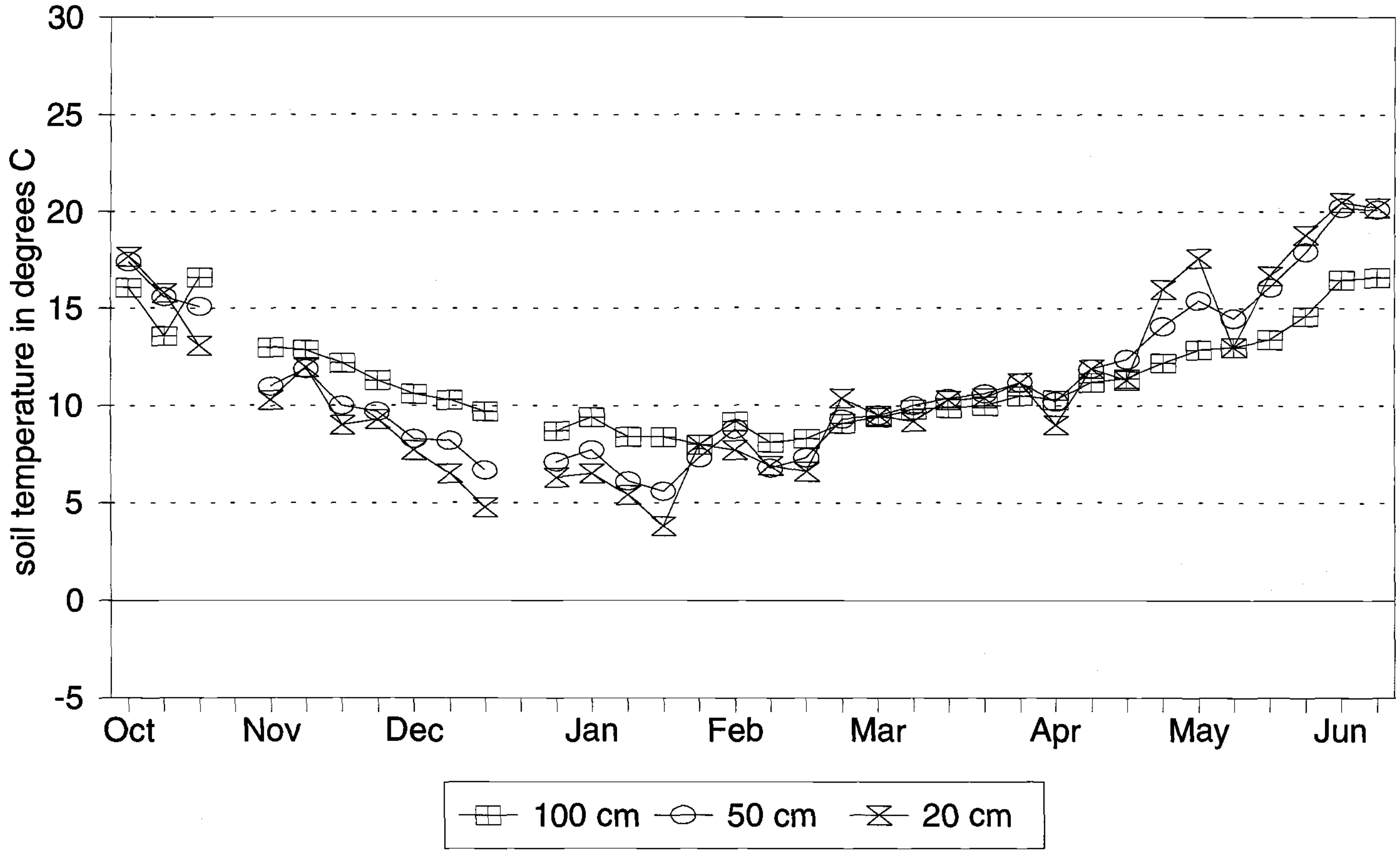


Table 3. Correlation of piezometers to tensiometers and the relationship to soil texture.

Plot[a]	Depth[b]	R^2	Text.[c]
Wo-P	S	n/a	sil
	I	n/a	h, sil
	D	.84	h, sil
Wa-P	S	.46	sil
	I	.16	c
	D	.75	sic
Am-P	S	.69	sil
	I	.88	sicl
	D	.94	h, sil
Da-P	S	.89	sicl
	I	.77	h, sicl
	D	.95	sicl

Plot[a]	Depth[b]	R^2	Text.[c]
Wo-B	S	n/a	sil
	I	.92	sil
	D	.95	sic
Wi-B	S	n/a	sil
	I	.72	sil
	D	.90	sicl
Am-B	S	.49	sil
	I	.87	sil
	D	.87	sil
Da-B	S	.79	sil
	I	.68	sic
	D	.56	sic
Wa-B	S	.66	sicl
	I	.01	c
	D	.81	sicl

[a] Plot soil type: Wo = Woodburn, Wa = Waldo, Am = Amity, Da = Dayton, Wi = Willamette; P = Polk County toposequence, B = Benton County toposequence.

[b] Depth: D = deep instrument, I = intermediate depth instrument, S = shallow instrument

[c] Texture class: sil = silt loam, h,sil = heavy silt loam, c = clay, sic = silty clay loam, sicl = silty clay loam, h,sicl = heavy silty clay loam.

Table 4. Observed frequency[b] of water table depths and depth to redoximorphic indicators.

cm depth	200-100	100-75	75-50	50-25	25-0	Depth to indicator *
Plot[a]						
Wo-P	e	c	c	b	a	26,C
Wa-P	e	d	d	c	b	0,C,M
Am-P	e	d	d	c	c	0,C,M
Da-P	e	e	d	d	c	0,C,M
Wo-B	d	d	d	b	a	17,M
Wi-B	d	d	d	c	a	69,M
Am-B	e	e	d	d	d	0,M
Da-B	d	d	d	d	c	0,M
Wa-B	e	e	d	d	d	0,M

[a] Plot soil type: Wo = Woodburn, Am = Amity, Da = Dayton, Wa = Waldo, Wi = Willamette; P = Polk County toposequence, B = Benton County toposequence

[b] Observed frequency of water table: a = 0-10%, b = 10-25%, c = 25-50%, d = 50-75%, e = 75-100%

* Depth to indicator: C = concretions, M = mottles

Table 5. Organic matter content for Polk and Benton Counties toposequences.

Plot[a]	Depth[b]	Organic Matter %[c]
Wo-P	S	3.29
	I	1.30
	D	.11
Wa-P	S	1.51
	I	.54
	D	.01
Am-P	S	1.35
	I	.59
	D	.05
Da-P	S	2.48
	I	.22
	D	.11

Plot[a]	Depth[b]	Organic Matter %[c]
Wo-B	S	3.51
	I	.97
	D	.22
Wi-B	S	3.24
	I	1.24
	D	.43
Am-B	S	2.78
	I	1.66
	D	.21
Da-B	S	1.02
	I	.80
	D	.27
Wa-B	S	3.27
	I	.70
	D	.27

[a] Plot soil type: Wo = Woodburn, Wa = Waldo, Am = Amity, Da = Dayton, Wi = Willamette; P = Polk County toposequence, B = Benton County toposequence.

[b] Depth: D = deep instrument, I = intermediate depth instrument, S = shallow instrument

[c] Walkley-Black method.

Table 6. Eh values[a] and depths to redoximorphic indicators.

depth[b] (cm)	D	I	S	Depth to indicator *	Depth to low chroma matrix #
Plot[c]					
Wo-P	b	a	a	26,C	45
Wa-P	a	b	c	0,C,M	23
Am-P	a	b	b	0,C,M	19
Da-P	a	b	b	0,C,M	18
Wo-B	b	a	b	17,M	X
Wi-B	b	a	a	69,M	X
Am-B	b	b	c	0,M	29
Da-B	b	c	c	0,M	23
Wa-B	b	c	c	0,M	23

[a] Eh Observed Eh values: a = > 350mv, b = 350-200mv, c = < 200mv.

[b] Depth: D = deep instrument, I = intermediate depth instrument, S = shallow instrument

[c] Plot soil type: Wo = Woodburn, Wa = Waldo, Am = Amity, Da = Dayton, Wi = Willamette; P = Polk County toposequence, B = Benton County toposequence.

Depth to low chroma matrix: (excludes A horizons), low chroma defined as less or equal to 2; X = does not occur in this profile.

* Depth to indicator: C = concretions, M = mottles

Table 7. Correlation of soil colors of the Polk and Benton Counties toposequences to duration of saturation.

Plot[a]	Horizon	Depth (cm)	Moist Matrix Color[b]	Moist Mottle Color[c,d]	Concretions[e]	Duration of Saturation[f]
Wo-P	Ap	0-15	10YR 3/2	- -	- -	a
	A	15-26	10YR 3/2	- -	- -	a
	AB	26-45	10YR 3/3	- -	ff	b
	Bt	45-64	10YR 4/2	fff 10YR 4/3	ff	c
	Btx	64-82	10YR 4/2	mfd 10YR 4/4	cf	c
	BCtx	82-114	10YR 5/3	cff 10YR 4/3	cf	c
	C	114+	2.5Y 4/4	fff 2.5Y 5/2	cf	e
Wa-P	Ap1	0-14	10YR 3/2	fff 10YR 4/3	ff	b
	Ap2	14-25	10YR 3/2	- -	ff	b
	E	25-42	10YR 4/1	mmd 10YR 4/3 mmd 10YR 4/2	mf	c
	Btg1	42-53	10YR 3/1	mfp 10YR 4/3	mm	d
	Btg2	53-71	5Y 3/1	fff 10YR 4/4	mf	d
	BCt1	71-90	5Y 4/2	ffd 10YR 4/4	cf	d
	BCt2	90-112	2.5Y 4/2	cfd 10YR 4/3	cf	e
	C	112	2.5Y 5/2	mfd 10YR 4/3	- -	e
Am-P	Ap1	0-10	10YR 3/2	fff 10YR 4/4	ff	c
	Ap2	10-19	10YR 3/2	cff 10YR 4/4	ff	c
	AE	19-30	10YR 4/2	cff 10YR 5/6	cf	c
	E	30-54	10YR 5/2	mmd 10YR 5/4	cf	c
	Bt1	54-77	10YR 4/1	mfd 10YR 4/4	cf fm	d
	2Bt2	77-87	2.5Y 4/4	cfd 10YR 4/4	cf	d
	3BCt	87-109	2.5Y 5/4	cfd 10YR 4/4	cf	d
	3C	109+	2.5Y 5/4	cmd 10YR 4/4	cf	e

Plot[a]	Horizon	Depth (cm)	Moist Matrix Color[b]	Moist Mottle Color[c,d]	Concretions[e]	Duration of Saturation[f]
Da-P	Ap1	0-10	10YR 3/3	cfd 7.5YR 4/4	ff	c
	Ap2	10-18	10YR 4/2	cfd 7.5YR 4/4	ff	c
	AE	18-24	10YR 4/2	mmp 10YR 4/4 mmp 10YR 4/6	cf cm	c
	E	24-43	2.5Y 5/2	cfd 10YR 4/4	cf cm	d
	2Bt1	43-53	2.5Y 5/2	mfp 10YR 5/6	cf fm	d
	3Bt2	53-75	2.5Y 5/2	mfp 7.5YR 5/4	mf	d
	3Bt3	75-92	2.5Y 4/2	cff 2.5Y 4/3	mf	e
	3C	92+	2.5Y 5/4	cff 2.5Y 4/4	- -	e
Wo-B	Ap1	0-17	10YR 3/2	- -	- -	a
	Ap2	17-31	10YR 3/2	fff 10YR 4/6	- -	a
	A	31-47	10YR 3/3	fff 10YR 4/4	- -	b
	BA	47-69	10YR 5/3	fff 10YR 4/3	- -	d
	Bt	69-90	10YR 4/3	cff 10YR 4/3	ff	d
	2Btx	90-112	10YR 5/4	cff 10YR 5/6	ff	d
	2BC	112-148	10YR 3/4	cff 10YR 5/6	- -	d
	3C	148+	10YR 4/4	cff 10YR 4/3	- -	d
Wi-B	Ap	0-17	10YR 3/2	- -	- -	a
	A	17-31	10YR 3/2	- -	- -	a
	AB	31-49	10YR 3/3	- -	- -	c
	BA	49-69	10YR 3/3	- -	- -	d
	Bt1	69-91	10YR 4/3	- -	ff	d
	Bt2	91-113	10YR 5/3	- -	cf	d
	BC	113-124	10YR 5/3	cff 10YR 4/3	- -	d
	C	124+	10YR 5/4	cff 10YR 4/3	- -	d

Plot[a]	Horizon[b]	Depth (cm)	Moist Matrix Color[b]	Moist Mottle Color[c,d]	Concretions[e]	Duration of Saturation[f]
Am-B	Ap1	0-15	10YR 3/2	fff 10YR 4/3	- -	d
	Ap2	15-29	10YR 3/2	cff 10YR 4/3	- -	d
	AE	29-52	10YR 4/2	cff 10YR 4/2	- -	d
	E	52-73	10YR 5/2	cfd 10YR 4/3	cf	d
	2Bt1	73-94	10YR 5/3	cff 10YR 4/3	ff	e
	2Bt2	94-108	10YR 5/3	cff 10YR 4/3	ff	e
	2BCt	108-119	10YR 5/3	mff 10YR 4/3	ff	
	3C1	119-143	10YR 5/4	fcd 2.5Y 5/2 mff 10YR 4/3	- -	e
	3C2	143+	10YR 5/3	fcd 2.5Y 5/2 mff 10YR 4/3	- -	e
Da-B	Ap1	0-6	10YR 4/2	ffp 7.5YR 5/6	- -	c
	Ap2	6-23	10YR 3/3	cfp 7.5YR 6/8	- -	c
	E	23-38	10YR 5/2	mfp 7.5YR 5/8	ff	d
	2EB	38-43	10YR 5/2	cmd 10YR 4/4	ff	d
	2Bt1	43-56	2.5Y 4/2	ffd 10YR 5/6	ff	d
	2Bt2	56-85	2.5Y 4/2	fff 2.5Y 5/4	cf	d
	3Bt3	85-104	2.5Y 5/2	mfp 10YR 5/4	ff	d
	3BCt	104-143	2.5Y 5/3	mff 10YR 5/6	- -	d
	3C	143-168	2.5Y 4/4	mff 10YR 4/6	- -	d
	4C	168+	10YR 5/3	cff 10YR 4/4	- -	d

Plot[a]	Horizon[b]	Depth (cm)	Moist Matrix Color[b]	Moist Mottle Color[c,d]	Concretions[e]	Duration of Saturation[f]
Wa-B	Ap	0-13	10YR 3/2	cff 7.5YR 5/8	- -	d
	A	13-23	10YR 3/2	mfd 7.5YR 5/8	- -	d
	Btg1	23-65	5Y 4/1	fff 7.5YR 3/4	fvf	d
	Btg2	65-83	5Y 4/1	fff 7.5YR 4/6	- -	e
	BCt	83-110	2.5Y 5/4	cfd 10YR 5/4	- -	e
	C	110+	2.5Y 5/4	cfd 2.5Y 5/4	- -	e

[a] Plot soil type: Wo = Woodburn, Wa = Waldo, Am = Amity, Da = Dayton, Wi = Willamette; P = Polk County toposequence, B = Benton County toposequence.

[b] Munsell notation.

[c,d] SCS field description and Munsell notation.

[e] SCS field description

[f] Duration of saturation during study period: a = 0-10%, b = 10-25%, c = 25-50%, d = 50-75%, e = 75-100%

Table 8. Cumulative data for the Polk and Benton Counties toposequences showing relationship of duration of saturation, at the shallow, intermediate, and deep instrument depths, and corresponding Eh[a] values.

	------------Duration of Saturation----------------				
Instrument Depth	0-10%	10-25%	25-50%	50-75%	75-100%
Shallow	a,a,a		b,c	b,c,c,c	
Intermediate		a,a	a	b,b,b,b,b,c	
Deep			b	a,a,b,b,b	a,b,b

[a] Eh values: a = > 350 mv, b = 350-200 mv, c = < 200 mv.

Polk County Toposequence Characteristics

Differences in water table frequency and depth for the Polk county toposequence are shown in Table 4 (page 110). The water tables reached maximum heights in the period December to February as shown in Figures 1,5, 9, and 13. From the data in Table 4 water tables were observed more frequently nearer the surface at the Wa-P, Am-P, and Da-P plots than at the Wo-P plot. There appears to be a correlation of depth and frequency of water tables to redoximorphic indicators as shown in Table 4, with depths to indicators being at the surface for the Wa-P, Am-P, and Da-P plots, which exhibited more frequent water tables nearer the surface than the Wo-P plot.

The topographic positions (map insert Polk County) of Da-P and Am-P are higher absolute elevation than the Wo-P plot. From the data in Figures 1,9,13 and Table 4 it was apparent that the water table at Da-P and Am-P was higher in elevation and longer in duration than at Wo-P. This is somewhat of an anomaly in that within this toposequence the positions of higher elevation appear to be poorer drained than the lower elevation position. In accounting for this anomaly it is possible that the finer textured and thicker argillic horizons of the Da-P and Am-P compared to that of Wo-P (profile descriptions Appendix A) slowed water movement through their profiles and this did not occur in the Wo-P profile.

The data in Table 6 (page 112) show that the Da-P, Am-P, and Wa-P plots had near surface Eh values that were lower and indicated reducing conditions whereas Wo-P plot did not have near surface reducing conditions. Also from Table 6 it can be seen that the depth to redoximorphic indicators and depth to low chroma matrix is deeper in Wo-P than for the others. From these data it appears that the nearer surface low Eh values are correlated to the depth at which redoximorphic features and low chroma matrix colors occur.

The redoximorphic indicators are an indication of reduction and mobilization of iron brought about by long periods of saturation, which correlates well with water table data from the Table 4. Only in Wa-P did Eh values indicate potentials low enough for the reduction of iron to occur, which would lead to the mobilization and leaching of iron resulting in low chroma matrix colors. In plots Wo-P, Am-P, and Da-P the Eh values do not support iron reduction and it is likely that the low chroma matrix colors are from previous years where potentials would have developed that would have allowed for iron mobilization.

The depth to yellower hues is shallower in Wa-P, Am-P, and Da-P plots than in the Wo-P plot. The yellow color may be evidence of the reduction and translocation of iron which has resulted in bleached matrix colors. The yellow colors may also be from the parent material and the justification for this is in the profile description of the Da-P and Am-P plots there is a discontinuity at or near the depth at which the 2.5Y hues occur.

Depth to distinct mottling occurs shallower in the poorer drain plots than in the Wo-P plot with a majority of all mottles being not low chroma. This would indicate a fluctuating water table where saturation occurs long enough and redox potentials reach low enough to reduce, mobilize, and translocate iron followed by unsaturated conditions in which the iron is oxidized to form higher chroma mottles. The high chroma mottles are generally associated low chroma matrices which indicates that iron has being translocated within the matrix and reprecipitates in the form of the high chroma mottles.

Benton County Toposequence Characteristics

Water table frequency at depth are given in Table 4 (page 110) and actual depth and duration are given in Figures 17, 21, 25, 29, and 33. From the data in Table 4 it is apparent that the water tables were observed more frequently nearer the surface in the Am-B, Da-B, and Wa-B plots than in the Wi-B and Wo-B plots. The frequency of water tables within 25 cm of the surface is greater than 25% for Am-B, Da-B, and Wa-B and less than or equal to 10% for Wo-B and Wi-B. There appears to be a correlation between the frequency of water tables within 25 cm of the surface and the depth to redoximorphic indicators as shown by data in Table 4 indicating that the depth to indicators was deeper for the plots with a less than or equal to 10% frequency compared to the plots with greater than 25% frequency.

The topographic position of each plot within the transect is shown on the Benton County map insert. From the map it is shown that the Wi-B plot is the highest, Am-B is the next highest, then Wo-B, Da-B, and Wa-B. In comparing the absolute elevations (map insert) of each plot to the depth to water table (Figures 17, 21, 25, 29, and 33) it is seen that Am-B had a higher water table than the lower elevation Wo-B and is probably not attributed to a difference in texture, as in the Polk County toposequence, because the textures of Am-B and Wo-B are very similar with depth (see profile descriptions Appendix A). It is possible that the Am-B plot drainage is confined by the topography of being on a broad terrace in contrast to the Wo-B plot being near the margin of a terrace escarpment that may facilitate in drainage.

Table 6 (page 112) shows that the Am-B, Da-B, and Wa-B plots had Eh values in the iron reducing range within 38 cm of the surface and these three plots also had low chroma matrices within 29 cm of the surface. In comparison the Wo-B and Wi-B plots did not have low chroma matrices. This would suggest that the duration of saturation has been long enough and Eh values have declined low enough at Am-B, Da-B, and Wa-B to result in the reduction, mobilization and translocation of iron from the matrices of these profiles.

The presence of E horizons with low chroma matrices in the Am-B and Da-B indicate eluviation processes where iron may have been leached. The Da-B plot exhibits yellower hues and low chroma colors below the E horizon than does the Am-B. This may be evidence of a greater reducing environment in the Da-B than in the Am-B under which the Da-B has been bleached by translocation of iron from the profile at a greater depth than the Am-B. The data in Table 6 does support this as it is shown that iron reducing conditions occurred at depth in Da-B and did not occur in Am-B.

The morphological signature for Wa-B indicate a strong reducing environment. The reducing conditions are evidenced by the gleyed colors of the Btg1 and Btg2 horizons. Data from Table 6 does support the low Eh values that were required for the reduction and subsequent removal of iron from these horizons.

Comparison of the Polk and Benton Counties Toposequence

All plots except Wo-P had frequencies of observed water tables at 75 to 50 cm for > 50% of the observations. Above 50 cm, Am-B and Wa-B had durations longer than the Am-P and Wa-P. The landscape position of Am-B, being near a hillslope that may have supplied water by lateral flow and runon, and that of Wa-B, being near a drainageway that may have supplied water by lateral flow, may explain the longer durations of water tables at Am-B and Wa-B than at Am-P and Wa-P which did not have these types of water sources. Da-B (Figure 29) had a perched water table above 60 cm and greater separation of water table below 60 cm than did Da-P (Figure 13). The morphology of Da-B includes a clay texture (2Bt1 horizon) at 43-56 cm with silty clay in the horizons above and below. The same approximate depth (2Bt1) of the Da-P plot had a heavy silty clay loam texture with silty clay loam above and heavy silty clay loam below. The texture of Da-B caused perching of water above 60 cm and in contrast, the somewhat coarser Da-P texture with the observed open surface cracks to at least a 30 cm depth, did not restrict the flow of water in the profile to the extent of that in Da-B.

The 200 cm water tables at Wo-B, Am-B, and Da-B were deeper than the 200 cm tables at Wo-P, Am-P, and Da-P (Figures 17, 25, 29 and 1, 9, 13 respectively). The Wo-B, Am-B, and Da-B had a finer texture (silty clay loam) that extended deeper in their profiles than the Wo-P, Am-P, and Da-P.

The thicker, finer texture may have resulted in the slowing of water flow in Wo-B, Am-B, and Da-B causing a lower pressure head at the 200 cm depths that was interpreted as a deeper water table.

The Eh values at 100 cm in Polk did not change much over time in comparison to the 100 cm Eh values in Benton. This was because of the low organic matter contents at the 100 cm depths in Polk compared to those in Benton (Table 5). The overall organic matter content was lower in Polk than Benton. The higher organic matter content in the Benton plots may have resulted in the lower Eh values at depth due to the greater availability of energy sources for microbial activity in Wa-B, Am-B, and Da-B than in Wa-P, Am-P, and Da-P (Table 6).

Duration of saturation > 25% (Table 7) was correlated to matrix low chroma, excluding A horizons, in all plots except Wo-B and Wi-B which had no low chroma matrices within their profiles. Reducing conditions were most likely to occur (Table 8) when duration of saturation is > 50% and is least likely to occur when duration of saturation is < 25%. Intensity of reduction at which iron is reduced is most likely to occur at shallow depths when saturation is > 50% and may not occur at deeper depths even when duration of saturation reaches 75%.

Translocation of iron is evidenced by the higher content of concretions and bleached matrix colors. Concretions were larger and more abundant in Polk than in Benton and occurred closer to the surface in Polk than in

Benton. This should be evidence for greater reduction and translocation of iron in the Polk plots but as shown in Table 6 iron reduction occurred in three Benton plots (Am-B, Da-B, and Wa-B) and in only one Polk plot (Wa-P). The data indicates that the intensity of reduction and translocation of iron may have been more prevalent in the Benton plots than in the Polk plots. Reduction and translocation of iron was also evidenced by the presence of eluvial horizons in Da-P and Da-B. Longer term reductions and translocation of iron may have occurred in Da-P than in Da-B, which was inferred from the greater thickness of the E horizon and yellower hue of the matrix color of Da-P. A possible conclusion in comparing the concretion and eluvial data, and lack of iron reduction occurring at the Polk plots to that of the Benton plots is that the Polk plots have experienced past reduction and translocation of iron which is manifest as a larger number and greater distribution of concretions, thicker eluvial horizons, and currently less available reducible iron for low potential electron acceptors than has occurred in the Benton plots.

Absolute elevation did not equate to better drainage in both the Polk and Benton toposequences. Within each toposequence there was a better drained plot (Wo-P and Wo-B) that was at a lower elevation than a poorer drained plot. It appears possible that absolute elevation within a toposequence does not correspond to water table frequency and depth, and that the relative position within a drainage catena may be more of an influence than elevation on water table occurrences.

SUMMARY

Equipment required for permanent installation in the field for long term monitoring of soil wetness is readily manufactured and easily installed. Weekly measurements were made from piezometers, tensiometers, platinum electrodes, thermocouples, and raingages installed along two toposequence transects, one in Polk County and one in Benton County. These measurements provide a data record of depths to water tables, durations of saturation, redox potentials, soil temperatures, and precipitation.

Measurements of depth and duration of water tables from piezometers were poorly correlated with calculations of depth and duration of water tables from tensiometer data in finer textured soils. This poor correlation was due to the differences of intrinsic sensitivity between tensiometers and piezometers.

Longer durations of saturation were not consistently correlated with reducing conditions in the toposequences. Reducing conditions did occur during the wet season and were most intense in the early spring when both the soil was saturated (or immediately during post saturation) and the soil temperatures were rising. Surface redoximorphic features occur in soils that had water tables within 25 cm of the surface for durations greater than 10% of the wet season. Soils that had water tables within 25 cm of the surface for durations less than 10% of the wet season did not exhibit surface redoximorphic features. Iron reduction was most likely to occur at depths shallower than 38 cm when the duration of saturation was greater than 25% of the wet season. Iron reduction was least likely to occur at 100 cm depths even when saturated conditions persist for durations greater than 50% of the wet season.

Some soils had low organic matter contents at 100 cm depths. Low biologic activity in these soils may explain the fact that redox potentials required for iron reduction to occur were not obtained.

Soils in the Polk County transect contained more concretions, to greater depths, than soils in the Benton County transect. The Dayton soil in Polk County also had a thicker eluvial horizon than the Dayton soil in Benton County. These may be indications that previously, reducing conditions were more intense in the Polk County toposequence than in the Benton County toposequence.

Higher absolute elevation within these toposequences did not equate to better drainage. Relative position within the drainage catena and soil texture corresponding to the presence or absence of the Malpass clay influenced drainage characteristics of the individual soil plots.

The 1991-1992 wet season was a warmer and drier period than normal. Longer term data collected during 'more normal' years will be required to positively correlate current durations of saturation and redox potentials to the morphology in these toposequences.

LITERATURE CITED

Alexander, M. 1977. Introduction to soil microbiology (sec. ed.). John Wiley and Sons. New York.

ASTM. 1991. Annual book of ASTM standards, general methods, and instrumentation. Temperature measurement designation E 230-87, vol. 14.03. ASTM Philadelphia, PA.

Baldwin, E.M. 1981. Geology of Oregon. Kendall/Hunt Publishing Company. Dubuque, Iowa.

Balster, C.A., and R.B. Parsons. 1968. Geomorphology and soils of the Willamette Valley, Oregon. Special Report 265, Agricultural Experiment Station, Oregon State University and Soil Conservation Service, USDA.

Bartlett, R.J. 1981. Oxidation-reduction status of aerobic soils. In Chemistry in the soil environment. ASA Special Publication 40. American Society of Agronomy, Madison, Wisconsin.

Baumer, O. 1990. In, Soil survey interpretations for wet soils. M.J. Mausbach (author). VIII International Soil Correlation Meeting, Classification and Management of Wet Soils. USDA-Soil Conservation Service. Alexandria, Louisiana.

Birkeland, P.W. 1984. Soils and geomorphology. Oxford Press, New York.

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

Bohn, H., B. McNeal, and G. O'Connor. 1985. Soil chemistry. 2nd. ed. Wiley and Sons, New York.

Bonner, F.T. and C.W. Ralston. 1968. Oxidation-reduction potential of saturated forest soils. Soil Sci. Soc. Amer. Proc. 33:111-112.

Bouma, J., F.G. Baker, and P.L.M. Veneman. 1974. Measurement of water movement in soil pedons above the water table. University of Wisconsin-Madison. College of Agriculture and Life Sciences. Information Circular Number 27.

Bouwer, H. 1978. Groundwater hydrology. McGraw-Hill Book Company, New York.

Brady, N.C. 1990. The nature and properties of soils. 10th ed. Macmillan Publishing Company, New York.

Cassel, D.K. and A. White. 1986. Water potential: tensiometry. In Methods of soil analysis part I, physical and mineralogical methods sec. edition. Arnold Klute (ed.). American Society of Agronomy Inc., Soil Science Society of America Inc. Madison, Wisconsin.

Clothier, B.E., J.A. Pollok, and D.R. Scotter. 1978. Mottling in soil profiles containing a coarse-textured horizon. Soil Sci. Am. J. 42:761-763.

Cogger, C.G. and P.E. Kennedy. 1992. Seasonally saturated soils in the Puget Lowland. I. saturation, reduction, and color patterns.

Conell W.E. and W.H. Patrick. 1967. Sulfate reduction in soils: effects of redox potential and pH. Science. 159:86-87.

Couto, W.,C. Sanzonowicz, and A. de O. Barcellos. 1985. Factors affecting oxidation-reduction processes in an oxisol with a seasonal water table. Soil Sci. Soc. Am. J. 49:1245-1248.

Evans, C.V. and D.P. Franzmeier. 1985. Saturation, aeration, and color patterns in a toposequence of soils in North-central Indiana. Soil Sci. Am. J. 50: 975-980.

Faulkner, S.P. and W.H. Patrick. 1992. Redox processes and diagnostic wetland soil indicators in bottomland hardwoods forests. Soil Sci. Am. J. 56:856-865.

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

Faust, S.D. and M. Aly Osman. 1981. Oxidation-reduction conditions of natural waters and environs. In Chemistry of natural waters. Ann Arbor Science Publishers. Ann Arbor, MI.

Franzmeier, D.P., J.E. Yahner, G.C. Steinhardt, and H.R. Sinclair. 1983. Color patterns and water table levels in some Indiana soils. Soil Sci. Am. J. 47:1196-1202.

Gambrell, R.P. and W.H. Patrick. 1978. Chemical and microbiological properties of anaerobic soils and sediments. In Plant Life in Anaerobic Environments. Ann Arbor Sci. Publ. Ann Arbor, MI.

Gillespie, L. 1920. Reduction potential of bacterial cultures and of water logged soils. Soil Science IX;4:199-216.

Grable, A.R. and E.G. Siemer. 1968. Effects of bulk density, aggregate size, and soil water suction on oxygen diffusion, redox potentials, and elongation of corn roots. Soil Sci. Soc. Am. Proc. 23:180-186.

Hillel, D. 1982. Introduction to Soil Physics. Academic Press, Inc. San Diego, California.

Hvorslev, M.J. 1951. Time lag and soil permeability in ground-water observations. Waterways Experiment Station, Corps of Engineers. Vicksburg, Mississippi.

Hudnall, W.H., A. Szogi, B.A. Touchet, J. Diagle, J.P. Edwards, and W.C. Lynn. 1990. VIII International Soil Correlation Meeting, Classification and Management of Wet Soils. USDA-Soil Conservation Service. Alexandria, Louisiana.

Hudnall, W.H. and L.P. Wilding. 1990. Monitoring soil wetness conditions in Louisiana and Texas. In Proceeding of The Eighth International Soil Correlation Meeting (VIII ISCOM): Characterization, Classification, and Utilization of Wet Soil. J.M. Kimble (ed.). Soil Conservation Service. USDA. Washington, D.C.

James, D.W., R.J. Hanks, and J.J. Jurinak. 1982. Modern Irrigated Soils. John Wiley and Sons. New York.

Jones, R.H. 1966. Oxidation-reduction potential measurement. ISA Journal Nov. 1966, 40-44.

Jury, W.A., R. Gardner, and W.H. Gardner. 1991. Soil physics. John Wiley and Sons. New York.

Keeney, D.R. 1983. Principles of microbial processes of chemical degrada toin, assimilation, and accumulation. In Chemical Mobility and Reactivity in Soil Systems. SSSA Special Publication, Number 11. Soil Science Society of America. Madison, Wisconsin.

Lemon, E.R. and A.E. Erickson. 1954. Principle of the platinum microelectrode as a method of characterizing soil aeration.

Marshall, T.J. and J.W. Holmes. 1988. Soil physics. Cambridge University Press. New York.

Marthaler, H.P., W. Vogelsanger, F. Richard, and P.J. Wierenga. 1983. A pressure transducer for field tensiometers. Soli Sci. Soc. Am. J. 47:624-627.

McIntyre, D.S. 1966. Characterizing soil aeration with a platinum microelectrode. Aust. J. Soil Res. 4:95-102.

McRae, Stuart G. 1988. Practical pedology, studying soils in the field. Ellis Horwood Limited. Chicester, England.

Meek, B.D. and L.B. Grass. 1975. Redox potential in irrigated desert soils as an indicator of aeration status. Soil Sci. Soc. Amer. Proc. 39:870-875.

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

Meek, B.D. and L.H. Stolzy. 1978. Short term flooding. In Plant Life in Anaerobic Environments. Ann Arbor Sci. Publ. Ann Arbor, MI.

Nelson, D.W. and L.E. Sommers. 1982. Total carbon, organic carbon, and organic matter. In Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, Second Edition. A.L. Page (ed.). American Society of Agronomy. Madison, Wisconsin.

Oremet Titanium, 1990. Oremet qa/qc specification, millproducts division.

Patrick, W.H. 1964. Extractable iron and phosphorus in a submerged soil at controlled redox potentials. 8^{th} Intern. Congress of Soil Science. IV 66:605-610.

Patrick, W.H. and R. Wyatt. 1964. Soil nitrogen loss as a result of alternate submergence and drying. Soil Sci. Soc. Proc. 28:647-653.

Pickering, E.W. and P.L.M. Veneman. 1984. Moisture regimes and morphological characteristics in a hydrosequence in central Massachusetts. Soil Sci. Soc. Am. J. 48:113-118.

Ponnamperuma, F.N. 1972. The chemistry of submerged soils. In Advances in agronomy. Vol. 24. N.C. Brady (ed.). Academic, New York.

Price, M. 1985. Introducing groundwater. Allen and Unwin. London.

Rickman, R.W., J. Letey, G.M. Aubertin, and L.H. Stolzy. 1968. Platinum microelectrode poisoning factors. Soil Sci. Soc. Amer. Proc. 32:204-208.

Ruhe, 1975. Geomorphology: geomorphic processes and surficial geology. Houghton Mifflin Company. Boston, Mass.

Schwertmann, U. 1985. The effect of pedogenic environments on iron oxide minerals. In Advances in Soil Science. B.A. Stewart (ed.). Springer-Verlag. New York.

SCS. 1981. Soil Survey Manual. Examination and description of soil in the field. USDA, Washington, D.C. 430-V-SSM, May 1981. Chapter 4.

Soil Survey Staff. 1975. Soil taxonomy: a basic system of classification for making and interpreting soil surveys. pp. 754 Washington, D.C. Agricultural handbook No. 346. USDA, U.S. Government Printing Office.

Soil Survey Staff. 1990. Keys to soil taxonomy. SMSS Technical Monograph No. 19. USDA. Washington, D.C.

Sposito, G. 1989. The Chemistry of Soils. Oxford University Press. New York.

Szogi, A.A. and W.H. Hudnall. 1990. Measurement of redox potentials in soils with permanently installed platinum electrodes. Manuscript 91-09-5227. Louisiana Agric. Exp. Stn.

Turner, F.T. and W.H. Patrick. 1968. Chemical changes in waterlogged soils as a result of oxygen depletion. 9th Intern. Congress of Soil Science. The International Society of Soil Science and Angus & Robertson LTD. Sydney, Australia.

Turner, F.T. and W.H. Patrick. 1968. Effect of redox potential on manganese transformation in waterlogged soil. Nature. 200:476-478.

Van Doren D.M. and A.E. Erickson. 1966. Factors affecting the platinum microelectrode method for measuring the rate of oxygen diffusion through the soil solution. Soil Science. 102(1): 23-28.

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

Veneman, P.L.M., M.J. Vepraskas, and J. Bouma. 1975. The physical significance of soil mottling in a Wisconsin toposequence. Geoderma 15:103-118.

Vepraskas, M.J. 1992. Redoximorphic features for identifying aquic conditions. Technical Bulletin 301. North Carolina Agricultural Research Service, North Carolina State University, Raleigh, North Carolina.

Whisler, F.D., J.C. Lance, and R.S. Linebarger. 1974. Redox potentials in soil columns intermittently flooded with sewage water. J. Environ. Quality 3(1): 68-74.

APPENDICES

Appendix A

Profile Descriptions

Plot Wo-P

Pedon classification: Aquultic Argixeroll

Pedon description

Ap 0 - 15cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable, slightly sticky and slightly plastic; many fine roots; many medium and many very fine tubular pores; abrupt smooth boundary.

A 15 - 26cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable, slightly sticky and slightly plastic; many fine roots; many medium and many very fine tubular pores; clear smooth boundary.

AB 26 - 45cm. Dark brown (10YR 3/3) silt loam; grayish brown (10YR 5/2) dry; moderate medium granular structure; friable, sticky and slightly plastic; many fine roots; many medium and many very fine tubular pores; few fine black concretions; clear smooth boundary.

Bt 45 - 64cm. Dark grayish brown (10YR 4/2) heavy silt loam, light grayish brown (10YR 6/2) dry; few fine faint brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable, sticky and plastic; common fine roots; many medium and many fine tubular pores; few faint silica coatings; few fine black concretions; clear smooth boundary.

Btx 64 - 82cm. Dark grayish brown (10YR 4/2) silty clay loam, pale brown (10YR 6/3) dry; many fine distinct dark yellowish brown (10YR 4/4) and common fine faint grayish brown (10YR 5/2) mottles; weak medium prismatic structure; friable, sticky and plastic; few fine roots; many fine tubular pores; few thin silica coatings; common fine black concretions; gradual smooth boundary.

BCtx 82 - 114cm. Brown (10YR 5/3) heavy silt loam, pale brown (10YR 6/3) dry; common fine faint dark brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable, slightly sticky and plastic; few fine roots;many very fine tubular pores; common distinct clay skins in pores; common fine black nodules; gradual smooth boundary.

C 114^{+}cm. Olive brown (2.5Y 4/4) silt loam; many fine distinct dark grayish brown (2.5Y 4/2) and few fine faint grayish brown (2.5Y 5/2) mottles; massive; friable, slightly sticky and plastic; many fine tubular pores; common distinct clay skins in pores; common fine black concretions.

Plot Wa-P

Pedon classification: Xeric Argialboll

Pedon description

Ap1 0 -14cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (2.5Y 5/2) dry; few fine faint brown (10YR 4/3) mottles; weak fine granular structure; friable, slightly sticky and slightly plastic; common very fine roots; many fine tubular pores; few fine black concretions; clear smooth boundary.

Ap2 14 - 25cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (2.5Y 5/2) dry; moderate fine subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine roots; few medium and many very fine tubular pores; thin silt coatings; few fine black concretions; clear smooth boundary.

E 25 - 42cm. Dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; many fine and many medium distinct dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable, sticky and slightly plastic; common very fine roots; many medium and many fine tubular pores; thin silt coatings; coarse black stains; many fine black concretions; abrupt smooth boundary.

Btg1 42 - 53cm. Very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; many fine prominent brown (10YR 4/3) mottles; moderate medium subangular blocky structure; friable, very sticky and slightly plastic; few very fine roots; many fine tubular pores; common faint clay films; many medium black concretions; clear smooth boundary.

Btg2 53 - 71cm. Very dark gray (5Y 3/1) clay, olive gray (5Y 5/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium prismatic parting to moderate medium subangular blocky structure; firm very sticky and plastic; few very fine roots; many fine tubular pores; many moderate distinct clay skins; many fine black concretions; slickensides on ped faces; clear wavy boundary.

BCt1 71 - 90cm. Olive gray (5Y 4/2) clay, light gray (5Y 6/2) dry; few fine distinct dark yellowish brown (10Yr 4/4) mottles; weak medium prismatic parting to moderate medium subangular blocky structure; firm, sticky and very plastic; few very fine roots; common fine tubular pores; continuous moderately distinct clay skins; common fine black concretions; gradual wavy boundary.

BCt2 90 - 112cm. Dark grayish brown (2.5Y 4/2) silty clay, light gray (2.5Y 7/2) dry; common fine distinct dark brown (10YR 4/3) mottles; weak medium prismatic parting to moderate medium subangular blocky structure; firm, sticky and very plastic; many fine tubular pores; common faint clay skins in pores; common fine black concretions; clear wavy boundary.

C 112^{+}cm. Grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; many fine distinct brown (10YR 4/3) mottles; massive; firm, sticky and plastic; many fine tubular pores; common fine black stains.

Plot Am-P

Pedon classification: Argiaquic Xeric Argialboll

Pedon description

Ap1 0 - 10cm. Very dark brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; Few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium granular structure; friable, slightly sticky and slightly plastic; common fine roots; many medium and many very fine tubular pores; few fine concretions; clear smooth boundary.

Ap2 10 - 19cm. Very dark brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; common fine faint yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine roots; many medium and many very fine tubular pores; few fine concretions; abrupt smooth boundary.

AE 19 - 30cm. Dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; many medium and many very fine tubular pores; common fine concretions; clear smooth boundary.

E 30 - 54cm. Grayish brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; many fine and many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure; friable, slightly sticky and slightly plastic; few fine roots along ped faces; many fine tubular pores; common fine concretions; abrupt smooth boundary.

Bt1 54 - 77cm. Dark gray (10YR 4/1) silty clay loam, light gray (10YR 6/1) dry; many fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure; friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; moderately faint clay skins; common fine and few fine medium concretions; clear smooth boundary.

2Bt2 77 - 87cm. Olive brown (2.5Y 4/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; moderately distinct clay skins; common fine concretions; clear wavy boundary.

3BCt 87 - 109cm. Light olive brown (2.5Y 5/4) heavy silt loam, light gray (2.5Y 7/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium and coarse subangular blocky structure; firm slightly sticky and slightly plastic; few very fine roots; common fine tubular pores; few distinct clay skins in pores and on ped surfaces; common fine concretions; gradual wavy boundary.

3C 109^{+}cm. Light olive brown (2.5Y 5/4) silt loam, white (10YR 8/1) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable, slightly sticky and slightly plastic; common fine tubular pores; thick clay accumulation in pores; common fine concretions.

Plot Da-P

Pedon classification: Typic Albaqualf

Pedon description

Ap1 0 - 10cm. Dark brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; weak coarse platy structure; friable, slightly sticky and slightly plastic; common fine roots; few medium and many fine tubular pores; few fine black concretions and black stains; gradual smooth boundary.

Ap2 10 - 18cm. Dark grayish brown (10YR 4/2) silt loam; light brownish gray (10YR 6/2) dry; common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; common fine roots; few medium and many fine tubular pores; few fine black concretions and black stains; abrupt smooth boundary.

AE 18 - 24cm. Dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; many medium prominent dark brown (10YR 4/4) and strong brown (10YR 4/6) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; common fine and common medium black concretions and black stains; clear smooth boundary.

E 24 - 43cm. Grayish brown (2.5Y 5/2) silty clay loam, light gray (10YR 7/1) dry; Common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine prismatic parting to weak moderate subangular blocky structure; friable, sticky and plastic; few very fine roots; many fine tubular pores; thin silt coatings; common fine and common medium black concretions clear smooth boundary.

2Bt1 43 - 53cm. Dark grayish brown (2.5Y 4/2) heavy silty clay loam, 3% rounded gravel and 3% granitic gravel; light brownish gray (2.5Y 6/2) dry; many fine prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure; friable, sticky and plastic; few very fine roots; many fine tubular pores; many distinct clay skins on ped surfaces and in pores; common fine black concretions and few medium black concretions; clear smooth boundary.

3Bt2 53 - 75cm. Grayish brown (2.5Y 5/2) heavy silty clay loam, light brownish gray (2.5Y 6/2) dry; many fine prominent brown (7.5YR 5/4) mottles; weak moderate prismatic parting to moderate medium subangular blocky structure; friable, sticky and slightly plastic; few very fine roots; many fine and few medium tubular pores; many moderately distinct clay skins on ped surfaces and in pores; many fine black concretions; clear smooth boundary.

3Bt3 75 - 92cm. Dark grayish brown (2.5Y 4/2) heavy silty clay loam, light gray (2.5Y 7/2) dry; common fine faint olive brown (2.5Y 4/3) mottles; weak moderate prismatic structure; friable, sticky and slightly plastic; few very fine roots; many fine and few medium tubular pores; common distinct clay skins on ped surfaces and in pores; many fine black concretions and black stains; gradual smooth boundary.

3C 92$^+$cm. Dark grayish brown (2.5Y 5/4) silty clay loam, light olive brown (2.5Y 5/4) dry; common fine faint olive brown (2.5Y 4/4) mottles; massive; friable, sticky and slightly plastic; many medium tubular pores; few distinct clay skins in pores; many fine black stains.

Plot Wo-B

Pedon classification: Ultic Argixeroll

Pedon description

Ap1	0 - 17cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable, sticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores; clear wavy boundary.
Ap2	17 - 31cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine faint dark yellowish brown (10YR 4/6) mottles; weak medium subangular blocky structure; friable, sticky and slightly plastic; many fine roots; many very fine tubular pores; claer wavy boundary.
A	31 - 47cm. Dark brown (10YR 3/3) heavy silt loam; grayish brown (10YR 5/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine prismatic parting to moderate medium subangular blocky structure; friable, sticky and slightly plastic; common fine roots; many fine and very fine tubular pores; clear smooth boundary.
BA	47 - 69cm. Brown (10YR 5/3) silt loam, light brown gray (10Yr 6/2) dry; few fine faint brown (10YR 4/3) mottles; weak medium prismatic parting to moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; few fine black stains; clear smooth boundary.
Bt	69 - 90cm. Brown (10YR 4/3) silty clay loam, brownish gray (10YR 6/2) dry; common faint brown (10YR 4/3) mottles; weak coarse prismatic parting to moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; common faint clay skins in pores; few fine black concretions and black stains; clear smooth boundary.
2Btx	90 - 112cm. Yellowish brown (10YR 5/4) silty clay loam; pale brown (10YR 6/3) dry; common fine faint yellowish brown (10YR 5/6) mottles; weak medium prismatic parting to moderate medium blocky structure; very friable, sticky and plastic; few fine roots; common fine tubular and common fine vesicular pores; common distinct clay skins on ped surfaces; few fine black concretions and black stains; clear smooth boundary.
2BC	112 - 148cm. Dark yellowish brown (10YR 3/4) silt loam, pale brown (10YR 6/3) dry; common fine faint yellowish brown (10YR 5/6) mottles; moderate coarse prismatic parting to weak medium blocky structure; friable, sticky and plastic; few fine roots; many very fine tubular pores; common distinct clay skins in pores; few fine black stains; clear wavy boundary.
3C	148^{+}cm. Dark yellowish brown (10YR 4/4) silt, light yellowish brown (2.5Y 6/4) dry; common fine faint brown (10YR 4/3) and few coarse distinct grayish brown (10YR 5/2) mottles; massive; very friable, sticky and slightly plastic; few fine roots; many very fine tubular pores; few faint clay skins in pores; few black stains.

Plot Wi-B

Pedon classification: Pachic Ultic Argixeroll

Pedon description

Ap	0 - 17cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium granular structure; friable nonsticky and nonplastic; many very fine and common fine roots; many very fine tubular pores; clear smooth boundary.
A	17 - 31cm. Very dark grayish brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable, nonsticky and non plastic; common fine and few medium roots; many very fine interstitial pores; clear wavy boundary.
AB	31 - 49cm. Dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure; friable, nonsticky and non plastic; few common and common fine roots; many fine and common medium tubular pores; clear wavy boundary.
BA	49 - 69cm. Dark brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure; friable, nonsticky and slightly plastic; common fine, common medium, and few coarse roots; many fine and common many tubular pores; clear smooth boundary.
Bt1	69 - 91cm. Brown (10YR 4/3) silty clay loam; dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure; friable, sticky and slightly plastic; few fine, few medium, and few coarse roots; common fine and common medium tubular pores; few faint clay skins; few fine concretions; clear smooth boundary.
Bt2	91 - 113cm. Brown (10YR 5/3) silty clay loam, light brownish gray (10YR 6/2) dry; moderate medium prismatic structure; friable sticky and slightly plastic; few fine roots; many fine and many medium tubular pores; many faint clay skins; common fine concretions; clear smooth boundary.
BC	113 - 124cm. Brown (10YR 5/3) silty clay loam, grayish brown (2.5Y 5/2) dry; coarse fine faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable, sticky and slightly plastic; few coarse roots; many medium and many fine tubular pores; common fine black stains; clear wavy boundary.
C	124^{+}cm. yellowish brown (10YR 5/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; coarse fine faint brown (10YR 4/3) mottles; massive; friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; common fine black stains.

Plot Am-B

Pedon classification: Argiaquic Xeric Argialboll

Pedon description

Ap1 0 - 15 cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine faint brown (10YR 4/3) mottles; moderate medium granular structure; very friable slightly sticky and slightly plastic; many very fine and common fine roots; many very fine interstitial pores; clear smooth boundary.

Ap2 15 - 29cm. Very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common fine faint brown (10YR 4/3) mottles; moderate medium prismatic structure; friable slightly sticky and slightly plastic; common fine roots; many very fine interstitial pores; clear smooth boundary.

AE 29 - 52cm. Dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common fine faint brown (10YR 4/3) mottles; weak medium prismatic structure; friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; clear smooth boundary.

E 52 - 73cm. Grayish brown (10YR 5/2) silt loam, light gray (10YR 7/1) dry; common fine distinct brown (10YR 4/3) mottles; weak medium prismatic structure; friable, slightly sticky and plastic; common fine roots; common fine tubular pores; common fine black concretions; abrupt smooth boundary.

2Bt1 73 - 94cm. Brown (10YR 5/3) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine faint brown (10YR 4/3) mottles; moderate medium prismatic parting to moderate medium subangular blocky structure; firm, sticky and plastic; few very fine roots on ped faces; many distinct clay skins; few fine black concretions; clear smooth boundary.

2Bt2 94 - 108cm. Brown (10YR 5/3) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine faint brown (10YR 4/3) mottles; moderate coarse subangular blocky structure; firm, sticky and plastic; common very fine roots on ped faces; common very fine tubular pores; many distinct clay skins; few fine black concretions; clear smooth boundary.

2BCt 108 - 119cm. Brown (10YR 5/3) silty clay loam, light brownish gray (2.5Y 6/2) dry; many fine faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; very firm, sticky and slightly plastic; few very fine roots; common fine tubular pores; common distinct clay skins in pores; few fine black concretions; abrupt smooth boundary.

3C1 119 - 143cm. Yellowish brown (10YR 5/4) silt loam, light olive brown (2.5Y 5/4) dry; many fine faint brown (10YR 4/3) and few coarse distinct grayish brown (2.5Y 5/2) mottles; massive; firm, sticky and slightly plastic; few very fine roots; common fine tubular pores; common distinct clay skins in pores; gradual smooth boundary.

3C2 143^{+}cm. Brown (10YR 5/3) silt, light yellowish brown (2.5Y 6/4) dry; many fine faint brown (10YR 4/3) and few coarse distinct grayish brown (2.5Y 5/2) mottles;

massive; firm, sticky and nonplastic; few very fine roots; common fine tubular pores; common faint clay skins in pores.

Plot Da-B

Pedon classification: Typic Albaqualf

Pedon description

Ap1 0 - 6cm. Dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; few very fine interstitial pores; clear smooth boundary.

Ap2 26 - 23cm. Dark brown (10YR 3/3) silt loam, light gray (7.5YR 6/8) dry; common fine prominent reddish yellow (7.5YR 6/8) mottles; moderate medium subangular blocky structure; friable, slightly sticky and slightly plastic; many fine roots; few very fine interstitial pores; abrupt smooth boundary.

E 23 - 38cm. Grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; many fine prominent strong brown (7.5YR 5/8) mottles; weak coarse prismatic structure; friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; few fine black concretions and black stains; gradual smooth boundary.

2EB 38 - 43cm. Grayish brown (10YR 5/2) silty clay, light gray (10YR 7/1) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; firm, sticky and plastic; few fine roots; few fine interstitial pores; few fine black concretions and black stains; gradual smooth boundary.

2Bt1 43 - 56cm. Dark grayish brown (2.5Y 4/2) clay, light brownish gray (2.5Y 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm, sticky and plastic; common very fine roots; many fine irregular pores; many distinct clay skins on ped surfaces; few fine black concretions; clear smooth boundary.

2Bt2 56 - 85cm. Dark grayish brown (2.5Y 4/2) silty clay, light brownish gray (2.5Y 6/2) dry; few fine faint light olive brown (2.5Y 5/4) mottles; moderate coarse prismatic structure; firm, sticky and plastic; common fine roots; common fine irregular pores; many distinct clay skins on ped surfaces and in pores; common fine black concretions; clear wavy boundary.

3Bt3 85 - 104cm. Grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; many fine prominent yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm, sticky and plastic; many fine roots between peds; many fine vesicular pores; many distinct clay skins on peds and in pores; few fine black concretions; abrupt wavy boundary.

3BCt 104 - 143cm. Light olive brown (2.5Y 5/3) silty clay, light gray (2.5Y 7/2) dry; many fine faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; friable, very sticky and very plastic; common fine roots; many fine vesicular pores; common prominent clay skins on peds and in pores; clear smooth boundary.

3C 143 - 168cm. Olive brown (2.5Y 4/4) silt loam, light gray (2.5Y 7/2) dry; many fine faint dark yellowish brown (10YR 4/6) mottles; massive; friable, slightly sticky and slightly plastic; common fine roots; common fine vesicular pores; common distinct clay skins in pores; gradual smooth boundary.

4C 168^{+}cm. Brown (10YR 5/3) silt loam, light gray (10YR 7/2) dry; common fine faint dark yellowish brown (10YR 4/4) mottles; massive; friable, slightly sticky and slightly plastic; few very fine roots; common fine vesicular pores.

Plot Wa-B

Pedon classification: Fluvaquentic Haplaquoll

Pedon description

Ap 0 - 13cm. Very dark brown (10YR 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; common fine faint strong brown (7.5YR 5/8) mottles; moderate coarse granular structure; firm, slightly sticky and slightly plastic;many very fine and fine roots; many very fine interstitial pores; clear smooth boundary.

A 13 - 25cm. Very dark brown (10YR 3/2) silty clay loam, grayish brown (2.5Y 5/2)dry; many fine distinct strong brown (7.5YR 5/8) mottles; moderate coarse granular structure; firm, slightly sticky and plastic; common very fine roots; many very fine interstitial pores; abrupt smooth boundary.

Bg1 25 - 65cm. Dark gray (5Y 4/1) clay, gray (5Y 5/1) dry; few fine faint dark brown (7.5YR 3/4) mottles; moderate coarse subangular blocky and moderate medium prismatic structure; very firm, sticky and plastic; common very fine roots; common fine tubular pores; few very fine manganese concretions; pressure faces and striations on ped surfaces; clear smooth boundary.

Bg2 65 - 83cm. Gray (5Y 5/1) clay, olive gray (5Y 5/2) dry; few fine faint strong brown (7.5YR 4/6) mottles; weak medium prismatic and weak medium subangular blocky structure; firm, sticky and plastic; few fine roots; few medium tubular and many very fine vesicular pores; pressure faces on ped surfaces; gradual smooth boundary.

BC 83 - 110cm. Light olive gray (2.5Y 5/4) silty clay loam, light gray (2.5Y 7/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; slightly effervescent in upper horizon; gradual smooth boundary.

C 110^{+}cm. Olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct light olive brown (2.5Y 5/4) mottles; massive parting to thin platy structure; very friable, slightly sticky and nonplastic; few very fine roots; many fine tubular pores.

Appendix B

Construction and Installation Techniques

Construction and Installation of Platinum Electrodes

Material:

1. Pyrex tube (8 mm O.D.).
2. Platinum wire (18 gauge).
3. Jewelers wax.
4. Stranded copper wire (12 gauge).
5. Triple distilled mercury.
6. Latex tubing (5/16" O.D. X 5/32" I.D.)
7. Silicon sealer.
8. Quinhydrone and pH buffer tablets.
9. Heat shrink tubing
10. Calomel reference electrode.
11. Millivolt meter.

Procedure:

1. Cut pyrex tubing into 15 cm lengths, wash with deionized water, and let dry.
2. Cut platinum wire into 1.2 cm lengths, soak wire in 1:1 concentrated HCL and HNO_3 for four hours, rinse in distilled water, and soak in distilled water for eight hours.
   Use chrome plated wire cutters to cut the wire and do not cut anything else with them as contamination of the platinum may result.
3. Heat pyrex tube to collapse one end to just larger diameter than the platinum wire. Fire polish other end of pyrex.
4. Attach wire to pyrex tube: a) remove wire from water using stainless steel forceps, b) heat both tube and wire, c) insert glowing orange wire into tube, d) release wire, e) rotate tube continuously, f) keep wire centered

and straight, g) continue to heat until tube constricts at least 3 mm around wire, and f) let cool.

5. Seal wire and pyrex junction with jewelers wax by dropping small amounts of wax down tube and heating to melt but not to boil.

6. Add .5 cc of mercury to tube. To add mercury use a 3 cc syringe with an 18 ga. needle. For mercury spills use crushed elemental sulfur and dispose of properly.

7. Cut latex into 2 cm lengths and insert over open end of tube.

8. Cut copper wire to length depending on depth desired, strip one end to expose 3 cm bare wire , the other end to expose 5 cm.

9. Insert the 5 cm stripped end through the mercury and onto the bottom of the tube.

10. Seal the latex-wire area with silicon. Force silicon at least 2 cm down into pyrex, then let dry for 24 hours.

TEST PROCEDURE (required)

1. Soak electrodes for 24 hours in distilled water.

2. Make solution of quinhydrone, distilled water, and buffer to pH 7: a) add 0.1 gram quinhydrone per 50 ml of distilled water, b) stir to dissolve, c) add buffer tablet as required, d) stir to dissolve, e) put electrodes in the solution, f) put reference electrode in, g) record temperature of solution in degrees celsius, and h) connect voltmeter to electrodes. The voltmeter reading should be within + or - 10 mv of value in the chart below.

Table 9. Test values for platinum electrodes.

solution temperature	20	21	22	23	24
* millivolt	47	45.8	44.6	43.4	42.2

* Data interpolated from Jones, 1966.

3. If electrode passes test install heat shrink tubing over latex area. The heat shrink should be sufficient to cover part of pyrex, all of latex, and part of 12 ga. wire.

4. Clean electrodes in distilled water and store in clean place.

Installation:

1. Use a steel rod slightly larger than the electrode diameter to make a hole to one half the final depth desired, then using a rod the same diameter as the electrode make a hole 2 cm shorter than desired depth.

2. Select a hollow plastic or copper tube that is smaller than the electrode. Thread copper wire through tube and place end of tube firmly on the heat shrink part of electrode. Insert electrode in hole and push 2 cm into undisturbed soil.

3. Pack to within 5 cm of the surface with bentonite, then tamp to surface with a local soil plug.

Note: Construction similar to A.A. Szogi and W.H. Hudnall, 1990.

REFERENCES

Jones, R.H. 1966. Oxidation-reduction potential measurements. ISA J. 13(11): 41-44.

Szogi, A.A. and W.H. Hudnall. 1990. Measurement of redox potentials in soils with permanently installed platinum electrodes. Louisiana Agric. Exp. Stn. manuscript 91-09-5227.

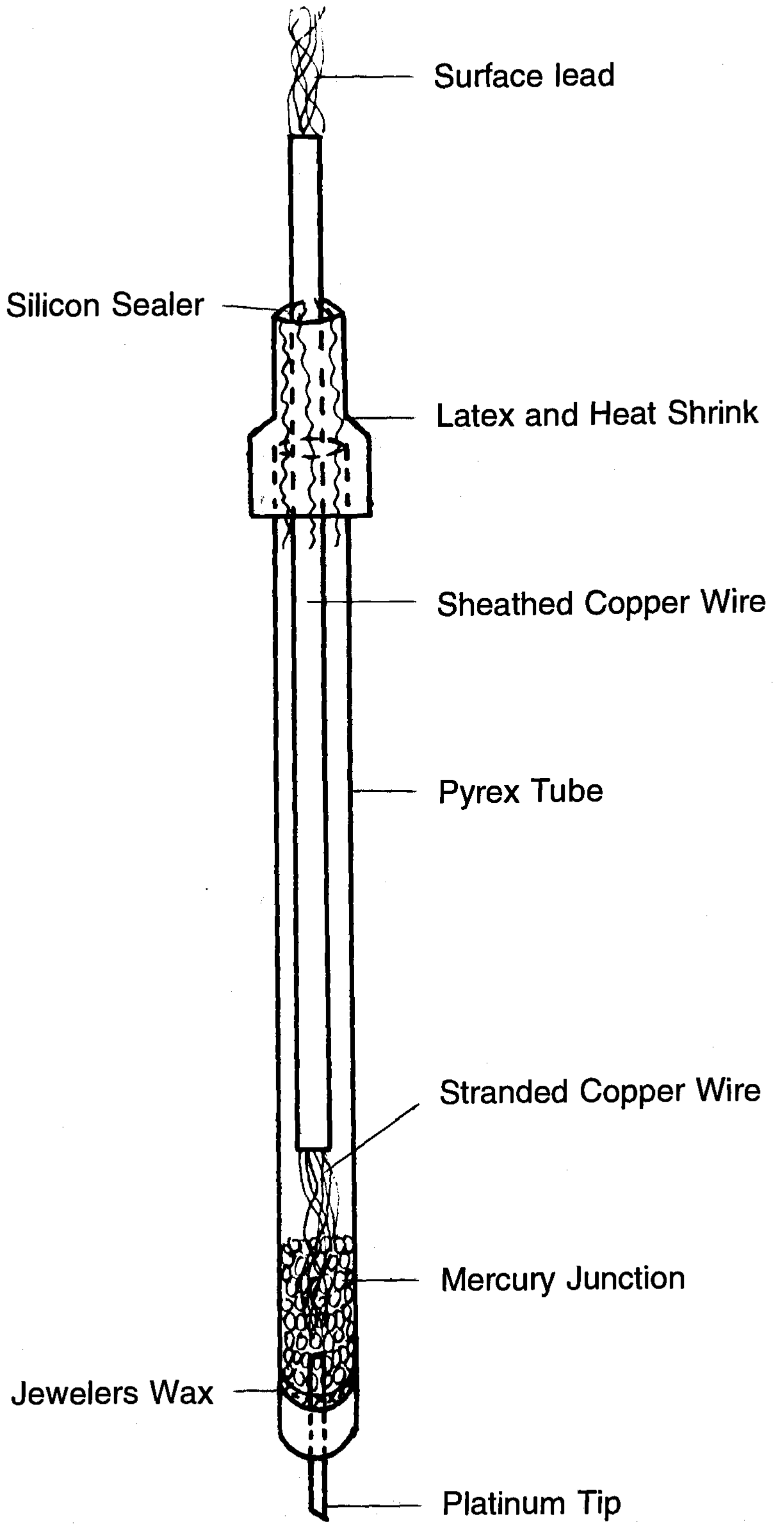
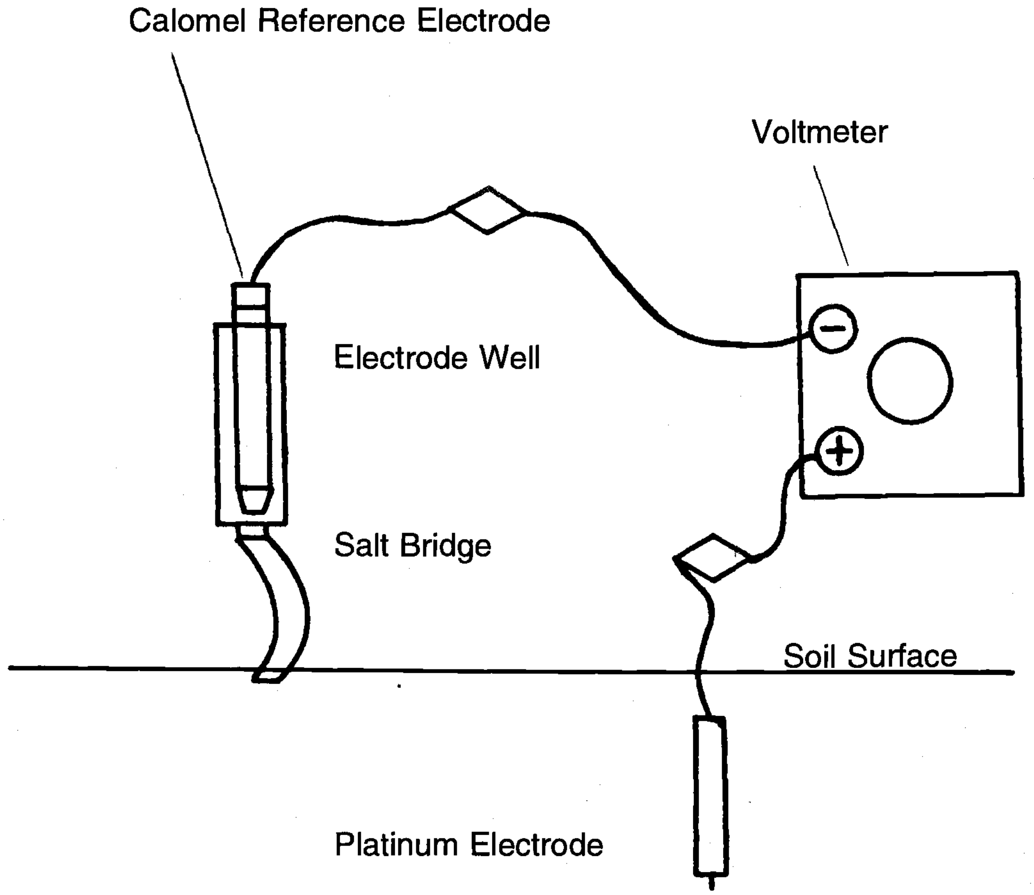


Figure 37. Platinum electrode.

Figure 38. Field setup for electrode measurements.



Construction and Installation of Tensiometers

Material:

1. Schedule 80 grey plastic pipe. (.83" O.D. X .5" I.D.)

2. Clear acrylic tube. (.625" O.D. X .5" I.D.)

3. Porous cup with round bottom and radius on neck. One bar sensitivity.

4. Epoxy glue. Fast or slow setting 'Duro Master Mend'.

5. PVC cement.

6. Septum stoppers.

Procedure:

1. Cut acrylic tube into 2.75" lengths. Ends must be straight cut and debur red.

2. Cut schedule 80 tubing to length. The schedule 80 tube should be at least one inch above soil surface when installed. Adjust length accordingly.

3. Bore lower end of schedule 80 tube (end where cup will be fitted) to 35/64 + 1/16, -.000 inch over a length of 1/2 + 1/4 (no minus) inch, then bevel inside with 3/4 inch countersink.

4. Bore upper end of schedule 80 tube (end where acrylic sight tube will be fitted) to 21/32 + or - 1/32 inch over a length of 3/4 + or - 1/8 inch, then bevel inside with 3/4 inch countersink.

5. Spread **very** thin, **even** layer of epoxy over the neck and radius area of the porous cup, let dry for 24 hours minimum. If using fast setting epoxy do not let epoxy 'skin' before applying to cup. If using slow setting epoxy do not allow to run down neck and form uneven clumps.

6. Apply PVC cement to acrylic tube, then insert into schedule 80 with twisting motion of at least 720 degrees, and apply pressure to insure tube does not back out of schedule 80. Let dry in vertical position for 24 hours.

7. Apply epoxy to cup neck and radius. Some experimenting may be necessary as too much epoxy will block insertion into schedule 80 and too little will leave air bubbles that may lead to leakage at cup-tube connection. When inserting cup twist at least 720 degrees. Remove excess epoxy from cup, do not allow cup to become covered with foreign materials.

8. Set tensiometer in vertical position and let dry for 24 hours.

9. Install septum stoppers.

TESTING (optional)

1. Fill tensiometer with distilled water and submerge cup in water for 24 hours.

2. Remove from water and drain tube.

3. Install septum and fill tube with excess air pressure greater than one bar (1.25 bar is good). To fill tube use large syringe with 21 gauge needle.

4. Submerge cup and check for leaks at cup-tube connection, then sub merge acrylic tube end and check for leaks.

5. Other testing may be required, check literature for details.

Installation:

1. With a probe that is the same diameter as the tensiometer create a hole that is five centimeters shorter depth to which tensiometer will be installed.

2. Insert tensiometer in hole and push five centimeters into undisturbed soil.

3. Fill with water (any potable water is good enough for the tensiometer).

4. Install septum, cover with a 35 mm film canister to protect the septum from sunlight.

Note: The above instructions are for tensiometers that use a portable trans ducer for data acquisition. The above can be used with a pressure gauge permanently installed on the side of the tensiometer by tapping threads and sealing the connection with epoxy.

Construction instructions are modeled after those from Soil Measure ment Systems, Tucson, Arizona. Construction has been modified as required.

Figure 39. Tensiometer.

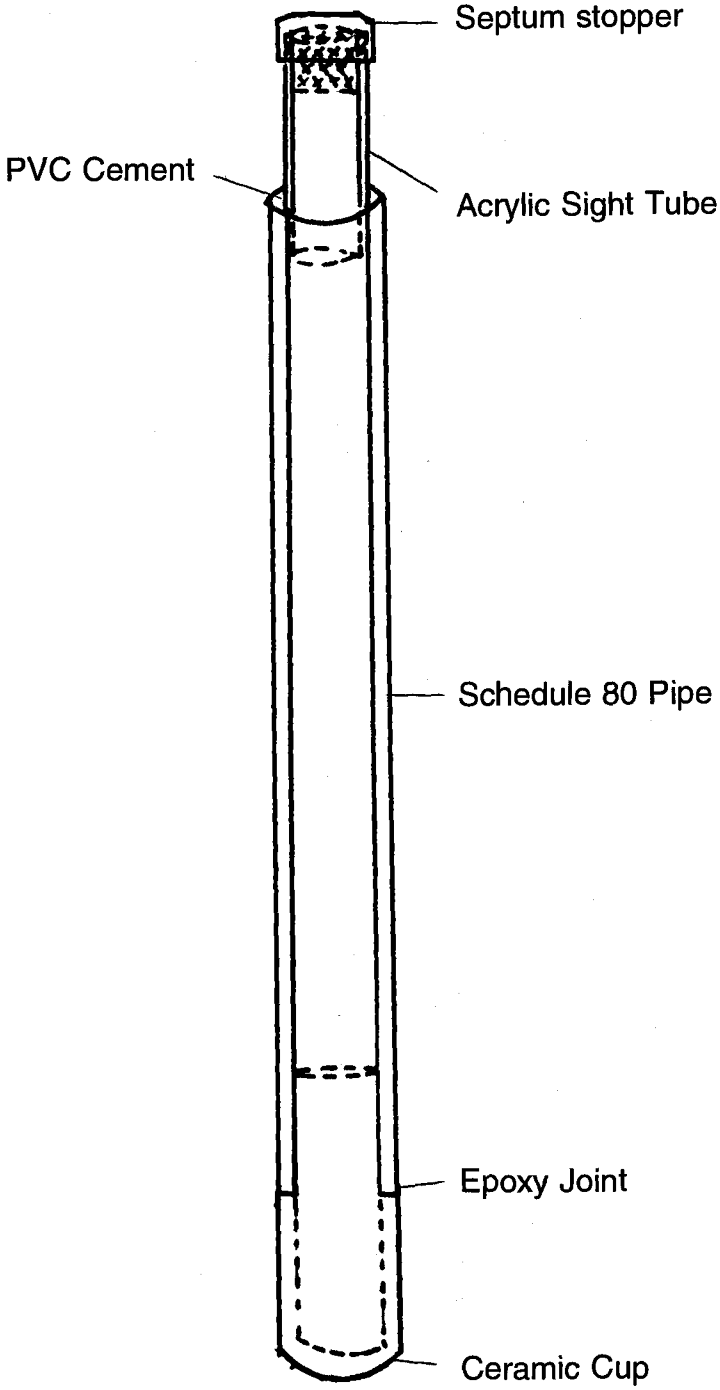
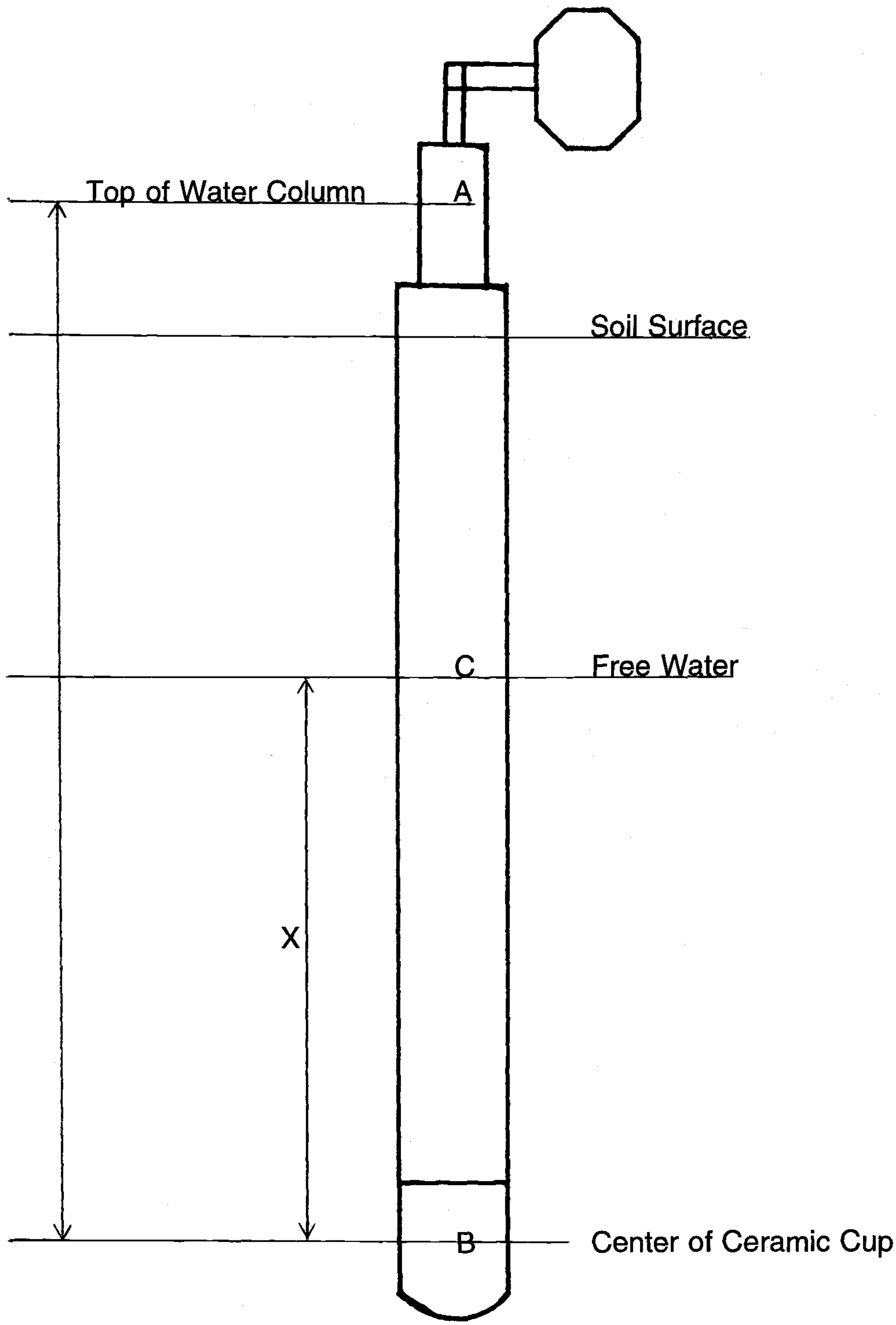


Figure 40. Tensiometer calculations.



Calculation of water table depth using tensiometer data:

1. Subtract length of water column (A) from the absolute value of the total potential (millibar reading from the digital readout of the 'TENSIMETER'). The calculated value will be the height of free water (X) above the ceramic cup (B) at some point (C).

2. If the total potential (absolute value of a negative total potential value) is greater than the water column length, the soil is unsaturated at the cup, the free water surface is below the cup and can not be calculated using this method.

Example:

'TENSIMETER' readout value = - 54 mb
water column length = 120 cm

54 - 120 = - 66 ; the height of free water is 66 cm above the cup.

Construction and Installation of Thermocouples

Material:

1. Inconel sheathed, nongrounded, type K thermocouples (.25" diameter).

2. Type K thermocouple wire (12 gauge).

3. Type K male connectors.

Procedure:

1. Cut thermocouple to length. Leave enough excess to expose at least one inch of bare wire on top end of the thermocouple. The thermocouple should be at least one inch above highest seasonal surface water expected.

2. Strip inconel from top end to expose wires, then remove insulation from wires.

3. Strip at least one inch of insulation from each end of a length of 12 ga. wire. The length required will depend on desired location for data collection.

4. Connect 12 ga. wire to thermocouple wire. The thermocouple wire consists of two different metal types. Be sure to connect like metal to like metal. The like wires must be in **contact.** Do not allow dissimilar wires to contact at any point other than where temperature measurement is desired.

5. Seal connection, must be water tight.

6. Connect male receptacle to other end of wire.

Testing (optional):

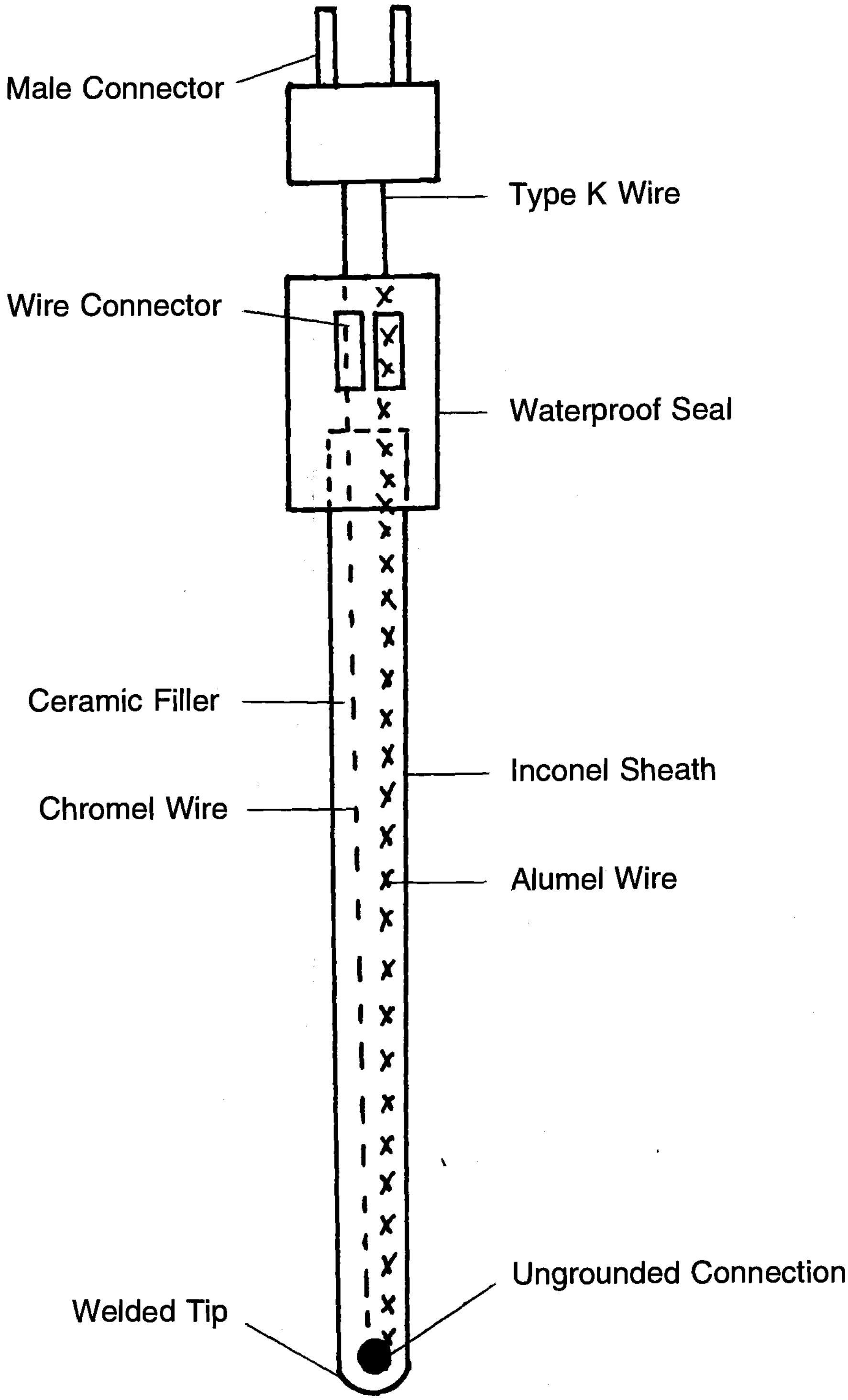
1. Test thermocouple at desired temperature range. Type K thermocouples are accurate in the range of - 50 to + 2300 degrees fahrenheit.

Installation:

1. Use steel rod that is same diameter as thermocouple to make a hole 2 cm shorter than desired length.

2. Insert thermocouple into hole and push 2 cm into undisturbed soil.

Figure 41. Thermocouple.



Construction and Installation of Piezometers

Material:

1. White, 200psi PVC pipe. (.75" diameter)

2. Geofabric or nursery cloth.

3. Clear acrylic tube. (.5" diameter)

4. PVC end caps. (.75" diameter)

5. Hot glue or caulking equipment.

6. Monofilament fishing line (30 pound test).

7. Fiberglass or plastic window screen.

8. Bentonite clay, 200 mesh.

Procedure:

1. Cut PVC pipe to length. The pipe should be at least one inch above highest surface water expected. Adjust accordingly.

2. Cut seven 1/8 inch wide slots in bottom end of pipe. Cut four slots 1/2 inch apart on one side of tube then stagger remaining three slots on other side of tube. The tube should have slots 1/4 inch apart, staggered on opposite half radii of the tube.

3. Cut fabric or cloth to cover open end, slots, and at least 1/2 inch above highest slot.

4. Hot glue fabric to slotted end.

5. Cut acrylic to same length as PVC pipe.

6. Cut screen mesh to cover one end of acrylic tube.

7. Tie screen mesh to acrylic tube with monofilament.

8. Drill 1/16 inch diameter hole through top of PVC cap and through non covered end of acrylic tube.

9. Insert small styrofoam piece into acrylic tube. The piece should float when the tube is immersed in water, then stick to side of tube when water is drained out the bottom. (The height to which the styrofoam floats is the depth below your reference point of free water.)

10. Thread monofilament through acrylic tube and PVC cap then tie ends on top of cap. The objective is to remove cap from PVC tube and pull acrylic tube up and out.

11. Insert acrylic tube into PVC tube and secure cap.

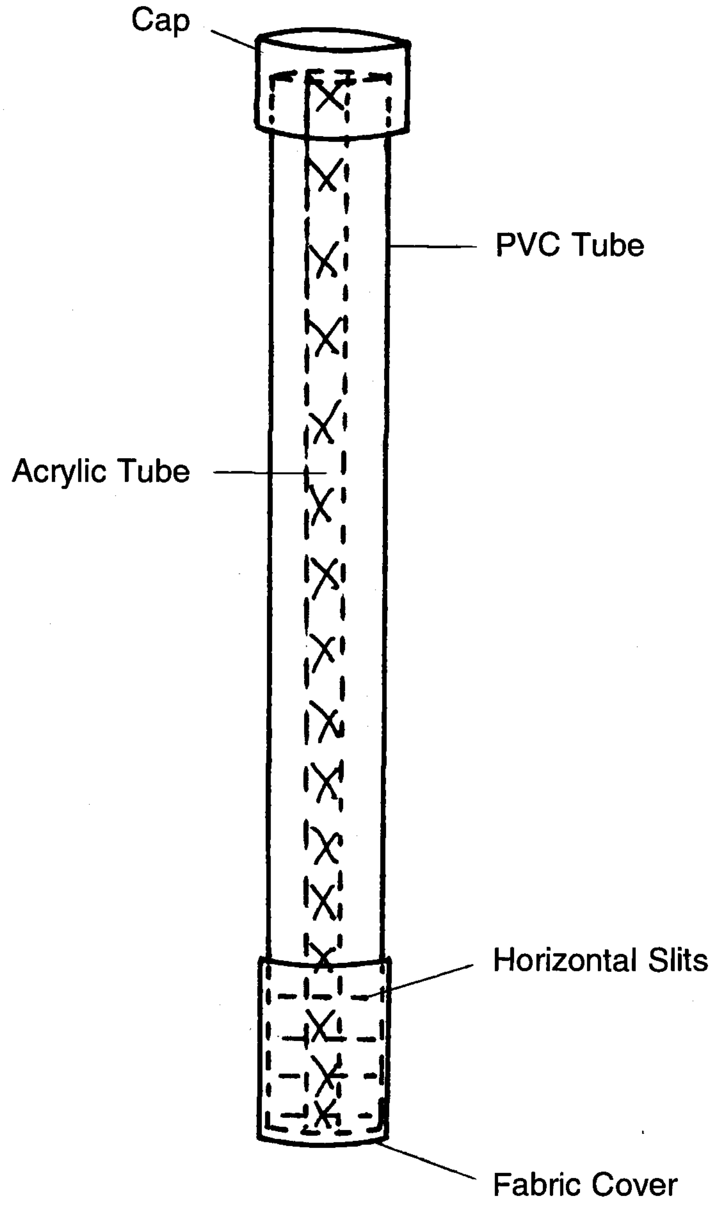
Installation:

1. Bore hole one inch deeper than desired depth for piezometer. Use 1.25" diameter screw auger.

2. Fill bottom one inch of hole with clean sand, insert piezometer, and fill around sides of piezometer with sand so that all of fabric to approximately one inch above the fabric is covered.

3. Pack with alternating Bentonite 200 mesh clay and local soil plugs to surface. Be sure to tamp down each alternate plug all the way to the surface to ensure tight seal.

Figure 42. Piezometer.



Appendix C

Raw Data for Field Measurements

Key for raw field data and mean corrected data.

Instrument identification:
- T = tensiometer
- P = piezometer
- E = platinum electrode
- TC = thermocouple
- Ambient = air temperature
- PPT = weekly precipitation from raingage

Missing data entered as ND.

Instrument depths in centimeters.

Instrument replication given as 1,2, or 3 (if applicable).

Piezometer data indicated as:
- M or MAX = weekly maximum head
- C, current, or CUR = current daily head

Example: T-100-3
This data record is for a tensiometer at 100 cm depth and is the third replicate instrument at this depth for this soil plot.

Raw field data was collected weekly at test plots in Polk and Benton Counties.

Mean, corrected data represents mean values of raw data. The mean, raw electrode data has been corrected to a standard hydrogen electrode value (Eh).

Raw field data for Wo-P, Woodburn plot, Polk County.

Wo-P	Woodburn, Polk County						
	10/08/91	10/17/91	10/24/91	11/05/91	11/12/91	11/19/91	11/26/91
T-100-1							
T-100-2							
T-100-3							
T-50-1							
T-50-2							
T-50-3							
T-25-1							
T-25-2							
T-25-3							
							MAX
P-200 M							99
P-100-1M							90
P-100-2M							90
P-100-3M							90
P-200 C							
P-100-1C							
P-100-2C							
P-100-3C							
P-50-1M							
P-50-2M							
P-50-3M							
P-50-1C							
P-50-2C							
P-50-3C							
P-25-1M							
P-25-2M							
P-25-3M							
P-25-1C							
P-25-2C							
P-25-3C							
E-100-1			252	239	241	207	235
E-100-2		84	71	160	152	149	130
E-100-3				29	52	156	177
E-50-1	344	345	367	328	319	316	336
E-50-2	334	338	362	328	301	318	289
E-50-3	368	372	369	364	333	345	311
E-25-1	379	382	327	356	341	354	322
E-25-2	375	376	319	342	328	322	306
E-25-3	385	386	352	368	359	349	320
TC-100	17.3	16.7	15.2	12.8	12.6	12.4	10.8
TC-50	16.9	16.5	13.7	10.2	12	10.7	9.4
TC-25	16	15	11.5	9.9	12.1	9.5	9.3
ambient	13.8	16.2	11.7	13	13.3	7.6	8.8

Raw field data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	12/05/91	12/10/91	12/17/91	12/24/91	12/31/91	01/07/91	01/14/91	01/ 21/91	01/28/91
T-100-1			-79	-55	-78	-78	-84	-85	-34
T-100-2		-53	-82	-55	-77	-76	nd	-89	-39
T-100-3		-54	-81	-52	-52	-73	-79	-88	-37
T-50-1			-78	-53	-74	-77	-78	-84	-40
T-50-2		-53	-79	-55	-75	-80	-78	-85	-39
T-50-3		-50	-78	-54	-72	-73	-75	-87	-39
T-25-1			-70	-54	-64	-66	-64	-78	-42
T-25-2		-52	-70	-55	-65	-70	-63	-72	-41
T-25-3		-52	-66	-55	-62	-67	-62	-71	-39
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	64	45	59	34	48.5	36	55	63	26
P-100-1M	64	-	67	31	47	37	57	64	32
P-100-2M	64	45	58	34	51	34	nd	68	24
P-100-3M	62	42	57	32	47	36	57	62	24
	current	current	current	current	current	current	current	current	current
P-200 C		55	64	37	60.5	56	65	68	26
P-100-1C	76	49	67	41	58	53	64	72	36
P-100-2C	78	53	70	39	62	55	66	74	27
P-100-3C	76	52	65	37	61	52	64	70	28
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M		35	-	28	42	31	-	-	22
P-50-2M		35	-	28	43	32	-	-	24
P-50-3M		36	-	26	44	33	-	-	nd
		current	current	current	current	current	current	current	current
P-50-1C		-	-	42	-	-	-	-	26
P-50-2C		-	-	43	-	-	-	-	26
P-50-3C		-	-	43	-	-	-	-	27
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M		-	-	23	-	-	-	-	21
P-25-2M		-	-	23	-	-	-	-	21
P-25-3M		-	-	23	-	-	-	-	20
		current	current	current	current	current	current	current	current
P-25-1C		-	-	-	-	-	-	-	-
P-25-2C		-	-	-	-	-	-	-	-
P-25-3C		-	-	-	-	-	-	-	-
E-100-1	186	219	189	207	187	192	248	24	240
E-100-2	122	134	124	116	122	138	140	-9	119
E-100-3	92	99	81	102	82	102	98	7	88
E-50-1	302	310	293	301	297	305	320	-4	312
E-50-2	297	310	295	304	293	288	299	-5	297
E-50-3	314	347	334	331	319	336	347	-18	339
E-25-1	323	331	301	312	310	329	330	-4	348
E-25-2	287	305	285	295	292	303	304	-1	315
E-25-3	333	342	317	318	322	355	349	9	358
TC-100	9.7	9.4	8.2	7.2	8.1	7.1	6.6	7	7.6
TC-50	8.2	8.5	5.8	6.1	6.6	6.1	5.5	5.1	7.6
TC-25	7.6	7	3.1	6.1	5.7	4.2	5.4	3	7.7
ambient	9.3	-0.3	2.1	4.3	4.1	8	9.8	7.6	13.4

Raw field data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	02/04/91	02/11/91	02/18/91	02/25/91	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-65	-78		-52	-100	-84	-119	-120	-140
T-100-2	-80	-83		-63	-104	-97	-134	-125	-142
T-100-3	-80	-84		-65	-100	-100	-128	-128	-144
T-50-1	-81	-85		-66	-101	-90	-134	-195	-324
T-50-2	-81	-82		-63	-104	-98	-144	-195	-295
T-50-3	-76	-85		-66	-101	-92	-139	-180	-285
T-25-1	-69	-75		-62	-125	-154	-255	-567	-651
T-25-2	-72	-76		-63	-128	-152	-248	-575	-642
T-25-3	-65	-67		-61	-112	-94	-205	-500	-567
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	29	62	79	15	52	84	91	114	129
P-100-1M	32	62	79	17	57	83	91	-	-
P-100-2M	27	62	78	13	55	83	91	-	-
P-100-3M	26	58	76	9	53	82	89	-	-
	current	current	current	current	current	current	current	current	current
P-200 C	61	82	86	51	86	95	111	130	-
P-100-1C	58	78	85	50	83	89	-	-	-
P-100-2C	66	83	83	51	84	90	-	-	-
P-100-3C	64	76	80	51	83	91	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	25	-	-	11	-	-	-	-	-
P-50-2M	26	-	-	14	-	-	-	-	-
P-50-3M	28	-	-	12	-	-	-	-	-
	current	current	current	current	current	current	current	current	current
P-50-1C	-	-	-	-	-	-	-	-	-
P-50-2C	-	-	-	-	-	-	-	-	-
P-50-3C	-	-	-	-	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	-	-	-	10	-	-	-	-	-
P-25-2M	-	-	-	10	-	-	-	-	-
P-25-3M	-	-	-	10	-	-	-	-	-
	current	current	current	current	current	current	current	current	current
P-25-1C	-	-	-	-	-	-	-	-	-
P-25-2C	-	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-	-
E-100-1	244	238	209	232	224	223	238	233	238
E-100-2	157	143	122	128	163	149	150	151	159
E-100-3	89	91	49	91	90	72	76	77	88
E-50-1	327	334	313	311	332	331	350	335	346
E-50-2	338	345	333	320	329	320	340	332	335
E-50-3	334	338	320	314	328	321	354	347	355
E-25-1	342	369	372	335	366	360	380	373	377
E-25-2	322	356	355	326	359	354	375	371	377
E-25-3	359	378	353	357	372	360	380	376	378
TC-100	8.1	7.5	8.1	8.9	10.3	10.4	10.1	10.3	11
TC-50	7.5	7.1	7.3	9.6	10.3	10.7	10.6	10.6	11.6
TC-25	6	6.9	6.9	10.4	9.8	9.6	10.3	10	12
ambient	9.4	11.7	9.9	13.1	19.2	18.6	13.3	19.3	22.8

Raw field data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-155	-144	-84	-108	-110	-144	-192	-204
T-100-2	-139	-96	-56	-97	-106	-127	-168	-226
T-100-3	-159	-119	-88	-109	-119	-138	-165	-175
T-50-1	-360	-79	-79	-112	-118	-314	-572	-738
T-50-2	-300	-65	-75	-101	-111	-270	-498	-697
T-50-3	-309	-66	-77	-102	-114	-269	-470	-620
T-25-1	-487	-48	-77	-282	-458	-930	-971	6
T-25-2	-444	-48	-88	-248	-421	-845	-658	1
T-25-3	-362	-47	-70	-242	-375	-903	-957	3
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	145	120	73	79	113	127	149	166
P-100-1M	-	-	73	84	-	98	-	-
P-100-2M	-	-	73	84	-	98	-	-
P-100-3M	-	-	71	81	-	99	-	-
	current	current	current	current	current	current	current	current
P-200 C	163	123	80	-	128	150	165	187
P-100-1C	-	-	80	-	-	-	-	-
P-100-2C	-	-	81	-	-	-	-	-
P-100-3C	-	-	79	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	-	-	-	-	-	-	-	-
P-50-2M	-	-	-	-	-	-	-	-
P-50-3M	-	-	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-50-1C	-	-	-	-	-	-	-	-
P-50-2C	-	-	-	-	-	-	-	-
P-50-3C	-	-	-	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	-	-	-	-	-	-	-	-
P-25-2M	-	-	-	-	-	-	-	-
P-25-3M	-	-	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-25-1C	-	-	-	-	-	-	-	-
P-25-2C	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-
E-100-1	245	238	233	209	210	231	229	233
E-100-2	140	135	60	53	86	128	171	172
E-100-3	102	92	70	49	42	63	90	104
E-50-1	348	345	345	340	331	340	344	344
E-50-2	355	332	332	325	317	325	333	354
E-50-3	352	354	342	338	328	337	346	347
E-25-1	377	376	383	372	364	368	386	389
E-25-2	376	369	370	363	355	364	373	387
E-25-3	377	373	380	372	362	368	376	380
TC-100	10.5	15.4	11.3	12.2	13	13.6	13.8	14.5
TC-50	10	15.1	12	13.2	14.8	14.3	15.2	16.3
TC-25	8.3	15.3	11.4	14.3	15.8	13.1	15.2	16.8
ambient	14.6	19.8	11.6	24.1	29	19.9	18.6	27.1

Raw field data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P			
	6/2/92	6/9/92	
T-100-1		-356	
T-100-2		-524	
T-100-3		-285	
T-50-1		-834	
T-50-2		-975	
T-50-3		-797	
T-25-1		0	
T-25-2		0	
T-25-3		0	
	MAX	MAX	MAX
P-200 M		184	
P-100-1M		-	
P-100-2M		-	
P-100-3M		-	
	current	current	CURREN
P-200 C		-	
P-100-1C		-	
P-100-2C		-	
P-100-3C		-	
	MAX	MAX	MAX
P-50-1M		-	
P-50-2M		-	
P-50-3M		-	
	current	current	CURREN
P-50-1C		-	
P-50-2C		-	
P-50-3C		-	
	MAX	MAX	MAX
P-25-1M		-	
P-25-2M		-	
P-25-3M		-	
	current	current	CURREN
P-25-1C		-	
P-25-2C		-	
P-25-3C		-	
E-100-1		256	
E-100-2		200	
E-100-3		135	
E-50-1		369	
E-50-2		348	
E-50-3		367	
E-25-1		395	
E-25-2		401	
E-25-3		393	
TC-100		16.6	
TC-50		18.1	
TC-25		17.3	
ambient		22.4	

Raw field data for Wa-P, Waldo plot, Polk County.

Wa-P	Waldo, Polk County						
	10/10/91	10/17/91	10/24/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1							
T-100-2							
T-100-3							
T-65-1							
T-65-2							
T-65-3							
T-35-1							
T-35-2							
T-35-3							
						MAX	MAX
P-200 M						65	11
P-100-1M							78
P-100-2M							0
P-100-3M							48
P-200 C							
P-100-1C							
P-100-2C							
P-100-3C							
P-65-1M							
P-65-2M							
P-65-3M							
P-65-1C							
P-65-2C							
P-65-3C							
							MAX
P-35-1M							0
P-35-2M							0
P-35-3M							0
							current
P-35-1C							
P-35-2C							
P-35-3C							
E-100-1	82	90	90	81	116	128	131
E-100-2	234	233	231	217	196	192	185
E-100-3	228	234	233	215	213	208	195
E-65-1	137	140	131	110	131	149	152
E-65-2	66	85	124	127	141	149	107
E-65-3	31	28	18	113	46	163	110
E-35-1	365	369	343	320	329	259	106
E-35-2	347	321	365	337	315	313	48
E-35-3	285	320	341	307	304	246	164
TC-100	17.9	16.6	15.7	13.2	13	12.4	11.6
TC-65	17.9	16.5	15.1	11.1	12.1	10.7	10
TC-35	18.1	16.5	13	10.1	12	9.5	9.6
ambient	17	15	11.6	12.9	13.2	7.6	8.5

Raw field data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			-36	-33	-47	-41	-59	-35	-8
T-100-2			-45	-38	-53	-42	-54	-38	0
T-100-3			-42	-38	-40	-55	-49	-48	3
T-65-1	-30	-17	-10	-17	-29	-19	-27	-22	9
T-65-2	-32	-26	-16	-22	-25	-25	-39	-28	7
T-65-3	-30	-17	-14	-21	-29	-21	-37	-68	7
T-35-1	-16	-14	-33	-18	-19	-30	-29	-33	-1
T-35-2	-30	-19	-39	-20	-31	-33	-31	-37	-3
T-35-3	-11	-23	-42	-30	-42	-47	-39	-48	-9
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	8	0	23	-2	19	29	nd	nd	nd
P-100-1M		-	29	nd	41	28	35	40	36
P-100-2M	0	0	30	-4	18	-4	5	20	-5
P-100-3M	31	20	40	13	31.5	13	28	36	24
	current	current	current	current	current	current	current	current	current
P-200 C	40	23	34	16	30	29	32	41	1
P-100-1C	47	17	40	36	41	28	35	41	36
P-100-2C	29	13	30	20	28	24	28	23	-2
P-100-3C	35	28	40	17	33.5	22	31	40	25
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-65-1M		-	-	58	53.5	48	48	47	48
P-65-2M		-	60	53	51	44	44	46	46
P-65-3M		39	-	27	32	24	26	35	26
		current	current	current	current	current	current	current	current
P-65-1C		-	62	58	53.5	49	48	48	49
P-65-2C		-	58	53	51	52	44	48	46
P-65-3C		39	38	27	32	23	26	35	28
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M	0	0	-		27	-3	4	29	-3
P-35-2M	0	0	22	-4	18.5	-4	3	22	-4
P-35-3M	0	0	23	-3	22	-1	26	34	1
	current	current	current	current	current	current	current	current	current
P-35-1C	25	23	34	19	34	31	-	-	-2
P-35-2C	23	20	34	19	28	27	31	-	-4
P-35-3C	26	23	34	22	30.5	30	32	-	1
E-100-1	111	128	117	123	137	128	149	142	142
E-100-2	187	167	178	188	173	176	184	180	174
E-100-3	192	185	173	181	165	171	183	184	189
E-65-1	112	127	107	118	111	101	107	86	81
E-65-2	138	104	132	123	101	103	97	70	50
E-65-3	95	111	65	75	44	49	43	35	32
E-35-1	-23	55	13	22	20	54	13	34	20
E-35-2	3	-76	9	-24	-2	11	7	6	3
E-35-3	30	49	16	16	4	28	28	23	11
TC-100	10.6	11	8.2	9	8.9	8.1	8.1	7.9	8.2
TC-65	8.9	9.6	5.8	7.1	7.3	6.7	6.2	5.9	7.4
TC-35	8	8.5	3.1	6.4	6.6	5.4	5.3	4.2	7.5
ambient	9.4	1	2.1	4.8	4	6.7	8.9	7.9	11.3

Raw field data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-16	-32		-12	-48	-45	-81	-78	-92
T-100-2	-16	-33		-16	-46	-36	-80	-64	-91
T-100-3	-38	-50		-35	-69	-65	-85	-87	-99
T-65-1	1	-17		-3	-30	-22	-58	-26	-49
T-65-2	-6	-28		-11	-35	-22	-67	-44	-83
T-65-3	-9	-21		-7	-38	-7	-70	-39	-66
T-35-1	-34	-41		-29	-60	-68	-93	-201	-350
T-35-2	-40	-45		-31	-64	-63	-106	-195	-350
T-35-3	-53	-52		-41	-74	-70	-127	-265	-440
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	ND	47	nd	-6	31	40	55	nd	45
P-100-1M	28	29	46	27	54	57	71	89	92
P-100-2M	-5	38	10	-9	25	34	60	74	81
P-100-3M	10	48	52	5	42	56	76	85	89
	current	current	current	current	current	current	current	current	current
P-200 C	35	51	40	29	57	57	74	79	81
P-100-1C	32	40	47	27	54	60	77	89	92
P-100-2C	30	40	14	25	58	60	78	83	87
P-100-3C	28	53	58	24	70	72	85	90	94
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-65-1M	43	46	48	41	47	52	-	58	-
P-65-2M	42	nd	46	40	47	52	58	61	-
P-65-3M	ND	nd	48	ND	39	44	54	-	-
	current	current	current	current	current	current	current	current	current
P-65-1C	43	46	45	41	48	52	-	-	-
P-65-2C	47	46	41	40	48	52	61	-	-
P-65-3C	47	41	41	18	46	47	58	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M	-3	-	4	32	-	35	-	-	-
P-35-2M	-5	35	2	-9	27	31	-	-	-
P-35-3M	-2	-	nd	35	34	36	-	-	-
	current	current	current	current	current	current	current	current	current
P-35-1C	-	-	4	-	-	-	-	-	-
P-35-2C	-	-	2	31	-	-	-	-	-
P-35-3C	-	-	5	-	-	-	-	-	-
E-100-1	135	162	143	138	133	129	130	117	113
E-100-2	168	191	186	178	186	184	189	185	184
E-100-3	182	207	154	183	190	196	200	191	196
E-65-1	77	77	0	56	35	9	18	109	151
E-65-2	40	19	-24	21	3	3	1	132	191
E-65-3	23	35	-33	9	4	2	3	4	1
E-35-1	27	47	-107	36	24	31	81	154	254
E-35-2	7	15	-85	16	9	11	64	101	362
E-35-3	16	25	-152	24	25	21	140	287	346
TC-100	8.3	8.3	8.4	8.9	9.5	10.9	10	10.6	11
TC-65	6.8	6.9	7.6	9.5	10.2	11.5	11.5	11.3	12
TC-35	7	7	7.2	10	9.3	10.6	10.6	10.6	11.7
ambient	12.6	11.2	9.6	13.5	17.4	20	14.4	20	22.2

Raw field data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-95	-29	-73	-73	-70	-96	-131	-106
T-100-2	-94	-29	-74	-64	-67	-84	-126	-85
T-100-3	-105	-46	-79	-82	-81	-90	-128	-103
T-65-1	-69	-6	-64	-36	47	-55	-98	-33
T-65-2	-126	-16	-72	-47	-32	-79	-147	-154
T-65-3	-100	-19	-65	-57	-71	-69	-146	-198
T-35-1	-336	-49	-51	-96	-138	-463	-704	-832
T-35-2	-462	-47	54	-101	-132	-390	-617	-710
T-35-3	-473	-57	-68	-134	-194	-505	-619	-807
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	78	32	21	48	68	72	79	86
P-100-1M	90	26	24	58	82	89	93	95
P-100-2M	83	75	19	53	69	78	86	92
P-100-3M	91	47	31	63	82	87	93	96
	current	current	current	current	current	current	current	current
P-200 C	85	42	49	70	73	79	85	96
P-100-1C	95	35	60	72	82	91	95	-
P-100-2C	90	77	54	76	79	86	90	-
P-100-3C	95	50	67	85	87	88	97	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-65-1M	-	-	52	-	-	-	-	-
P-65-2M	-	-	-	63	-	-	-	-
P-65-3M	-	-	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-65-1C	-	-	52	-	-	-	-	-
P-65-2C	-	-	-	-	-	-	-	-
P-65-3C	-	-	-	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M	-	-	34	-	-	-	-	-
P-35-2M	-	-	19	-	-	-	-	-
P-35-3M	-	-	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-35-1C	-	-	-	-	-	-	-	-
P-35-2C	-	-	-	-	-	-	-	-
P-35-3C	-	-	-	-	-	-	-	-
E-100-1	-8	-10	114	100	87	88	139	73
E-100-2	-4	-1	181	174	168	177	139	163
E-100-3	11	22	199	189	185	190	141	185
E-65-1	19	21	147	141	134	147	142	155
E-65-2	33	38	180	156	119	149	141	148
E-65-3	-50	-46	87	1	22	27	147	274
E-35-1	-3	-15	99	119	89	139	379	407
E-35-2	10	28	91	92	71	361	372	398
E-35-3	-7	21	147	204	148	316	339	362
TC-100	10.8	14.3	11.5	12.3	12.6	13.4	13.7	15.2
TC-65	nd	15	12	13.4	13.8	14.2	15.2	17
TC-35	9.3	14.1	12.1	14.5	15.3	14	16.3	18.7
ambient	14.2	20.3	9.6	24.7	27.7	18.8	18.9	25.8

Raw field data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P			
	6/2/92	6/9/92	
T-100-1	-100	-132	
T-100-2	-91	-120	
T-100-3	-111	-128	
T-65-1	-34	-90	
T-65-2	4	-322	
T-65-3	-526	-804	
T-35-1	-980	-947	
T-35-2	-840	-920	
T-35-3	-558	-423	
	MAX	MAX	MAX
P-200 M	93	100	
P-100-1M	99	-	
P-100-2M	97	-	
P-100-3M	-	-	
	current	current	CURREN
P-200 C	103	122	
P-100-1C	-	-	
P-100-2C	-	-	
P-100-3C	-	-	
	MAX	MAX	MAX
P-65-1M	-	-	
P-65-2M	-	-	
P-65-3M	-	-	
	current	current	CURREN
P-65-1C	-	-	
P-65-2C	-	-	
P-65-3C	-	-	
	MAX	MAX	MAX
P-35-1M	-	-	
P-35-2M	-	-	
P-35-3M	-	-	
	current	current	CURREN
P-35-1C	-	-	
P-35-2C	-	-	
P-35-3C	-	-	
E-100-1	72	121	
E-100-2	172	197	
E-100-3	194	209	
E-65-1	191	243	
E-65-2	148	174	
E-65-3	279	277	
E-35-1	412	405	
E-35-2	402	399	
E-35-3	371	391	
TC-100		17	
TC-65		18.3	
TC-35		18.9	
ambient		25.3	

Raw field data for Am-P, Amity plot, Polk County.

Am-P	Amity, Polk County					
	10/8/91	10/17/91	10/24/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1							
T-100-2							
T-100-3							
T-64-1							
T-64-2							
T-64-3							
T-38-1							
T-38-2							
T-38-3							
							MAX
P-200 M							88
P-100-1M							84
P-100-2M							99
P-100-3M							95
							current
P-200 C							
P-100-1C							
P-100-2C							
P-100-3C							
P-64-1M							
P-64-2M							
P-64-3M							
P-64-1C							
P-64-2C							
P-64-3C							
P-38-1M							
P-38-2M							
P-38-3M							
P-38-1C							
P-38-2C							
P-38-3C							
E-100-1	319	265	303	281	267	280	274
E-100-2	339	302	316	301	283	300	278
E-100-3	330	273	268	277	278	204	146
E-64-1	290	308	327	302	295	303	313
E-64-2	319	319	337	321	305	320	295
E-64-3	274	325	346	330	320	320	250
E-38-1	275	272	296	292	281	284	272
E-38-2	311	312	324	311	290	318	290
E-38-3	232	232	298	240	238	217	175
TC-100	17.8	16.7	15.7	12.9	12.8	11.4	11.2
TC-64	18	16.5	14.6	10.9	12.1	10.6	9.8
TC-38	18	16.5	12.9	9.9	11.9	9.5	9.4
ambient	19	12.9	12.1	12.7	13.4	7.5	8.8

Raw field data for Am-P, Amity plot, Polk County. (cont.)

Am-P									
	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1	-54	-28	-40	-17	-27	-27	-24	-36	-14
T-100-2	-3	-29	-42	-19	-25	-32	-28	-35	-19
T-100-3	-46	-40	-40	-19	-31	-5	-39	-39	-18
T-64-1			-26	-5	2	-15	-19	-21	-1
T-64-2	-32	-12	-19	-5	-5	-22	-16	-26	-3
T-64-3	-24		-21	-2	-16	1	-22	-6	5
T-38-1	-57	-7	-31	-7	-17	-22	-15	-23	-4
T-38-2	-28		-26	-3	-10	-19	-13	-19	-1
T-38-3	-28		-26	-3	-2	-8	-11	-23	0
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M		16	16	6	14	0	15	20	4
P-100-1M		0	17	0	3	0	4	7	1
P-100-2M		20	25	7	10	5	10	15	11
P-100-3M		17	20	2	4	0	7	9	6
	current	current	current	current	current	current	current	current	current
P-200 C	47	16	25	8	16.5	17	19	27	10
P-100-1C	47	16	24	3	11	8	10	19	1
P-100-2C	52	22	28	8	14	9	17	20	12
P-100-3C	48	21	26	7	12	4	9	17	7
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-64-1M	47	10	18	3	4	3	5	6	4
P-64-2M		8	15	0	1	0	3	5	3
P-64-3M		7	15	-1	1	0	2	3	2
	current	current	current	current	current	current	current	current	current
P-64-1C	60		26	8	14	13	16	20	5
P-64-2C	47		31	5	13	12	17	19	3
P-64-3C	47		24	2	12	8	11	15	2
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-38-1M		6	15	2	1	0	3	5	3
P-38-2M		7	16	2	3	2	5	6	4
P-38-3M		7	16	2	3	1	3	6	4
		current	current	current	current	current	current	current	current
P-38-1C		16	25	2	9.5	9	11	17	3
P-38-2C		14	26	4	10	14	13	20	5
P-38-3C		17	27	4	11	11	12	17	5
E-100-1	229	244	220	195	206	218	257	278	258
E-100-2	297	299	273	275	255	276	271	279	248
E-100-3	204	150	160	46	251	45	212	210	166
E-64-1	271	272	251	178	266	276	283	293	280
E-64-2	314	305	264	214	255	267	302	315	301
E-64-3	280	290	271	288	251	248	241	221	215
E-38-1	262	241	210	168	171	181	150	130	92
E-38-2	301	309	291	294	285	297	229	231	228
E-38-3	185	192	172	142	136	133	125	124	85
TC-100	10.1	10.6	9.1	8.4	8.4	8.5	7.5	7.4	7.7
TC-64	8.6	9.3	7	6.9	7.1	7.1	5.9	5.4	7
TC-38	7.9	8.1	4.9	6.3	6.1	6	5.2	3.8	7.3
ambient	9.4	0.2	2.2	4.6	6.2	4.9	7.8	8.3	10.8

Raw field data for Am-P, Amity plot, Polk County. (cont.)

Am-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-31	-32		-24	-36	-38	-79	-80	-93
T-100-2	-36	-39		-28	-55	-57	-76	-85	-95
T-100-3	-28	-43		-14	-50	-38	-70	-68	-84
T-64-1	-24	-27		-8	-44	-38	-57	-67	-86
T-64-2	-28	-29		-14	-50	-43	-60	-42	-77
T-64-3	-2	-25		-4	-30	-24	-48	-58	-73
T-38-1	-25	-28		-17	-46	-44	-58	-79	-108
T-38-2	-20	-23		-12	-42	-41	-52	-71	-90
T-38-3	-20	-25		-8	-41	-39	-54	-71	-96
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	0	29	nd	ND	24	28	44	60	72
P-100-1M	0	18	24	-1	16	25	43	56	70
P-100-2M	5	23	33	6	24	32	48	61	74
P-100-3M	0	18	27	0	20	26	43	56	70
	current	current	current	current	current	current	current	current	current
P-200 C	22	29	30	13	42	44	64	78	85
P-100-1C	20	22	22	9	28	39	56	70	81
P-100-2C	14	24	32	11	34	39	56	70	82
P-100-3C	10	20	27	6	32	34	52	64	79
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-64-1M	2	16	14	2	15	26	44	nd	58
P-64-2M	ND	15	14	0	13	nd	42	56	-
P-64-3M	-2	12	15	-1	12	21	40	54	-
	current	current	current	current	current	current	current	current	current
P-64-1C	16	26	14	16	40	44	58	-	-
P-64-2C	16	24	18	12	38	42	57	-	-
P-64-3C	12	23	13	11	36	39	56	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-38-1M	0	15	11	0	12	23	-	-	-
P-38-2M	2	15	17	ND	14	25	-	-	-
P-38-3M	0	14	14	1	13	21	-	-	-
	current	current	current	current	current	current	current	current	current
P-38-1C	12	23	11	10	-	-	-	-	-
P-38-2C	14	24	15	16	-	-	-	-	-
P-38-3C	9	22	13	10	-	-	-	-	-
E-100-1	273	276	249	265	222	262	256	232	228
E-100-2	268	273	240	268	234	274	284	276	278
E-100-3	148	153	63	158	151	141	134	125	123
E-64-1	256	199	122	134	63	45	47	34	349
E-64-2	292	294	260	263	248	236	190	145	348
E-64-3	152	130	152	120	75	65	77	59	339
E-38-1	38	24	-20	8	10	6	1	308	328
E-38-2	225	205	164	173	69	28	20	284	292
E-38-3	46	88	28	52	85	68	6	236	291
TC-100	8.2	7.9	8	8.4	9.5	10.1	10.1	10.5	11.1
TC-64	7.6	7.6	7.4	8.9	9.4	10.1	10.1	10.7	11.5
TC-38	6.8	7.6	7.1	10.1	9.5	10	10.8	10.9	11.7
ambient	12.5	8.9	9.1	16.1	18.5	17.9	15.6	18.7	21.9

Raw field data for Am-P, Amity plot, Polk County. (cont.)

Am-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-91	-67	-57	-76	-73	-94	-100	-109
T-100-2	-103	-72	-57	-75	-82	-93	-99	-107
T-100-3	-108	-75	-60	-61	-55	-80	-98	-89
T-64-1	-90	-54	-42	-60	-67	-79	-74	-113
T-64-2	-85	-59	-47	-62	-65	-70	-79	-94
T-64-3	-86	-48	-40	-45	-51	-74	-74	-97
T-38-1	-125	-57	-41	-67	-92	-164	-300	-420
T-38-2	-83	-47	-32	-55	-73	-132	-292	-550
T-38-3	-103	-46	-37	-60	-72	-149	-361	-433
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	81	58	33	43	60	68	83	93
P-100-1M	82	nd	30	40	60	72	84	92
P-100-2M	85	65	38	39	64	75	87	93
P-100-3M	81	60	33	38	60	74	84	94
	current	current	current	current	current	current	current	current
P-200 C	164	nd	43	64	60	84	93	106
P-100-1C	90	nd	40	63	70	83	92	-
P-100-2C	90	66	40	61	70	84	93	-
P-100-3C	90	60	37	58	67	80	90	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-64-1M	-	-	30	45	62	-	-	-
P-64-2M	-	56	29	46	60	-	-	-
P-64-3M	-	56	26	41	58	-	-	-
	current	current	current	current	current	current	current	current
P-64-1C	-	-	45	-	-	-	-	-
P-64-2C	-	57	44	-	-	-	-	-
P-64-3C	-	55	41	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-38-1M	-	-	-	-	-	-	-	-
P-38-2M	-	-	29	-	-	-	-	-
P-38-3M	-	-	28	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-38-1C	-	-	-	-	-	-	-	-
P-38-2C	-	-	-	-	-	-	-	-
P-38-3C	-	-	-	-	-	-	-	-
E-100-1	245	224	234	220	217	244	246	248
E-100-2	272	273	279	272	262	277	279	271
E-100-3	125	135	149	140	162	153	154	149
E-64-1	349	348	342	320	307	348	351	360
E-64-2	349	353	348	333	329	353	353	353
E-64-3	342	337	325	286	230	349	349	359
E-38-1	342	276	-3	361	367	363	369	361
E-38-2	294	293	273	295	325	341	364	364
E-38-3	299	252	209	288	313	335	347	343
TC-100	10.7	14.2	11.1	12.6	12.2	12.9	14	14.4
TC-64	10.1	14.2	11.9	13.5	13.7	13.9	15.2	16.3
TC-38	9.4	15	12.1	14.9	15.9	13.9	16.7	18.7
ambient	15.2	27	8.9	23.6	29.6	18.6	23.5	25.6

Raw field data for Am-P, Amity plot, Polk County. (cont.)

Am-P

	6/2/92	6/9/92	
T-100-1	-106	-136	
T-100-2	-108	-131	
T-100-3	-104	-93	
T-64-1	-125	-124	
T-64-2	-115	-133	
T-64-3	-160	-476	
T-38-1	-517	-609	
T-38-2	-873	-941	
T-38-3	-546	-637	
	MAX	MAX	MAX
P-200 M	105	116	
P-100-1M		-	
P-100-2M		-	
P-100-3M		-	
	current	current	CURREN
P-200 C	121	148	
P-100-1C		-	
P-100-2C		-	
P-100-3C		-	
	MAX	MAX	MAX
P-64-1M		-	
P-64-2M		-	
P-64-3M		-	
	current	current	CURREN
P-64-1C		-	
P-64-2C		-	
P-64-3C		-	
	MAX	MAX	MAX
P-38-1M		-	
P-38-2M		-	
P-38-3M		-	
	current	current	CURREN
P-38-1C		-	
P-38-2C		-	
P-38-3C		-	
E-100-1	245	273	
E-100-2	273	297	
E-100-3	195	222	
E-64-1		366	
E-64-2		361	
E-64-3		359	
E-38-1		356	
E-38-2		354	
E-38-3		351	
TC-100		16.3	
TC-64		18	
TC-38		19.3	
ambient		26.3	

Raw field data for Da-P, Dayton plot, Polk County.

Da-P	Dayton, Polk County						
	10/18/91	10/17/91	10/24/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1							
T-100-2							
T-100-3							
T-60-1							
T-60-2							
T-60-3							
T-35-1							
T-35-2							
T-35-3							
							MAX
P-200 M							100
P-100-1M							50
P-100-2M							50
P-100-3M							24
							current
P-200 C							
P-100-1C							
P-100-2C							
P-100-3C							
							MAX
P-60-1M							28
P-60-2M							46
P-60-3M							32
							current
P-60-1C							
P-60-2C							
P-60-3C							
							MAX
P-35-1M							25
P-35-2M							21
P-35-3M							18
							current
P-35-1C							
P-35-2C							
P-35-3C							
E-100-1	230	226	212	198	201	200	173
E-100-2				78	97	90	78
E-100-3	270	275	258	243	230	245	209
E-60-1	211	221	228	259	205	229	176
E-60-2	204	223	269	278	209	215	205
E-60-3	271	266	271	266	243	218	210
E-35-1	312	318	314	302	285	288	297
E-35-2	302	320	314	314	287	285	292
E-35-3	354	364	353	345	342	327	308
TC-100	17.4	16.2	15.4	12.8	12.8	12.1	11.2
TC-60	17.6	16.3	14.4	11.2	12.1	10.4	9.7
TC-35	17.3	15.9	12.5	9.9	11.8	9.2	9.3
ambient	11.2	8.3	12.7	12.5	13.4	8.5	7.9

Raw field data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1	-30	-6	-32	-17	-29	-41	-22	-32	-15
T-100-2	-20		-31	-14	-24	-28	-18	-26	-11
T-100-3	-20	-10	-24	-11	-5	-32	-13	-20	-9
T-60-1			-18	-1	-14	-13	-21	-12	-8
T-60-2			-19	-1	-3	-7	-17	-6	0
T-60-3		-5	-18	-2	-10	-19	-12	-6	1
T-35-1	-13	2	-15	-4	-11	-10	-10	-10	-5
T-35-2	-14	-5	-18	-4	-11	-9	-10	-10	-2
T-35-3	-11	-12	-19	-5	-10	-13	-7	-10	-3
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M		-	-	nd	17	9	nd	16	12
P-100-1M		-	11	2	0	-3	3	0	-1
P-100-2M		-	14	4	3	0	5	5	-1
P-100-3M		0	5	2	-2	-3	-1	0	-2
	current	current	current	current	current	current	current	current	current
P-200 C	57	50	31	22	33	30	nd	24	19
P-100-1C	24	16	15	5	8	8	4	12	-1
P-100-2C	27	12	23	4	6	7	5	14	-1
P-100-3C	15	12	13	3	5	10	2	6	-2
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M		1	6	2	0	0	0	0	0
P-60-2M		7	10	0	0	-4	-2	0	-3
P-60-3M		6	10	-2	0	0	3	10	0
	current	current	current	current	current	current	current	current	current
P-60-1C	17	17	16	3	6.5	13	4	10	0
P-60-2C	20	7	13	2	0	2	0	5	-3
P-60-3C	21	14	17	0	3.5	8	5	12	0
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M		0	4	5	1	0	0	2	0
P-35-2M		-	-	3	4	nd	nd	7	0
P-35-3M		-	-	-2	-3	-4	-4	-2	-3
	current	current	current	current	current	current	current	current	current
P-35-1C	13	3	18	5	7	13	6	10	0
P-35-2C	10	8	13	3	5.5	9	5	10	0
P-35-3C	6	5	13	0	4	8	0	4	-3
E-100-1	174	171	180	177	177	201	203	207	230
E-100-2	72	59	63	129	130	124	103	115	111
E-100-3	200	205	188	206	197	196	196	209	197
E-60-1	208	212	194	205	213	207	190	173	166
E-60-2	194	192	176	204	212	207	193	106	177
E-60-3	215	210	211	199	194	215	206	192	191
E-35-1	284	289	281	261	273	278	266	254	247
E-35-2	271	264	270	263	256	256	246	251	244
E-35-3	326	320	291	295	303	309	287	278	273
TC-100	10.3	10.5	9.5	8.6	8.5	8.4	7.6	7.9	7.7
TC-60	8.5	9.2	7.3	6.9	7.2	7.4	6.1	5.7	7.1
TC-35	7.8	8	5	6.4	6.1	6.1	5.3	3.9	7.3
ambient	9.6	1	1.8	5.9	5.1	4.8	7.5	8.5	9.4

Raw field data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-41	-20		-25	-60	-40	-68	-80	-90
T-100-2	-43	-21		-20	-55	-32	-64	-77	-80
T-100-3	-34	-13		-20	-49	-34	-57	-71	-79
T-60-1	-21	-13		-5	-29	-15	-43	-58	-63
T-60-2	-20	-13		-1	-32	-31	-42	-70	-70
T-60-3	-28	-7		-3	-38	-26	-44	-63	-63
T-35-1	-20	-10		-15	-37	-32	-41	-70	-76
T-35-2	-18	-8		-16	-46	-32	-37	-67	-77
T-35-3	-19	-9		-14	-47	-32	-48	-67	-77
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	4	19	21	156	18	33	33	47	65
P-100-1M	-4	4	4	0	18	4	30	43	64
P-100-2M	-2	6	8	2	23	6	34	46	68
P-100-3M	-2	-1	0	-2	13	0	27	39	63
	current	current	current	current	current	current	current	current	current
P-200 C	23	21	30	19	38	33	55	67	84
P-100-1C	10	5	6	6	30	23	42	59	74
P-100-2C	12	6	11	8	30	21	42	61	77
P-100-3C	13	2	0	10	31	25	41	64	75
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M	0	1	2	-1	14	2	30	40	-
P-60-2M	-7	-2	-2	-5	13	-3	35	35	60
P-60-3M	0	3	4	0	12	3	31	42	-
	current	current	current	current	current	current	current	current	current
P-60-1C	12	4	4	11	28	28	41	-	-
P-60-2C	9	0	0	8	33	25	47	-	-
P-60-3C	12	3	6	9	32	27	42	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M	3	2	3	0	13	2	29	-	-
P-35-2M	-3	-1	0	-2	21	0	27	-	-
P-35-3M	5	-2	-1	-2	9	-1	25	-	-
	current	current	current	current	current	current	current	current	current
P-35-1C	15	6	3	12	-	30	-	-	-
P-35-2C	12	8	2	10	-	27	-	-	-
P-35-3C	10	1	-1	7	29	25	-	-	-
E-100-1	196	204	224	194	204	192	191	192	197
E-100-2	103	115	95	132	121	115	113	116	114
E-100-3	191	202	267	201	208	200	193	195	198
E-60-1	146	147	181	115	67	33	64	55	51
E-60-2	151	151	109	116	86	64	58	40	56
E-60-3	188	186	201	158	136	111	108	81	114
E-35-1	235	225	175	159	97	57	8	160	246
E-35-2	242	234	168	140	74	50	7	49	165
E-35-3	255	237	141	131	103	79	8	90	222
TC-100	8.2	8.1	8.1	8.5	9.5	9.9	10.2	10.6	11.4
TC-60	7.7	7.9	7.5	9	9.7	10.3	10.8	10.9	11.7
TC-35	7.1	7.8	7.3	9.8	9.5	9.5	10.8	10.9	11.9
ambient	12.2	9.2	10.7	14.8	16.1	21.2	16.9	18.9	21.9

Raw field data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-91	-24	-43	-63	-74	-94	-95	-89
T-100-2	-93	-23	-38	-64	-66	-84	-86	-94
T-100-3	-80	-21	-32	-53	-67	-85	-87	-98
T-60-1	-85	-8	-34	-55	-54	-75	-70	-82
T-60-2	-80	-6	-29	-54	-57	-78	-82	-104
T-60-3	-75	-6	-15	-46	-55	22	-72	-86
T-35-1	-73	-11	-27	-54	-66	-228	-480	-642
T-35-2	-77	-11	-27	-53	-64	-221	-439	-598
T-35-3	-78	-9	-23	-49	-65	-293	-617	-809
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	76	26	5	27	45	65	76	87
P-100-1M	76	4	1	21	32	65	82	87
P-100-2M	78	7	4	23	35	68	84	90
P-100-3M	75	0	-3	25	20	63	83	90
	current	current	current	current	current	current	current	current
P-200 C	90	29	27	53	54	78	87	99
P-100-1C	75	8	22	48	57	80	85	90
P-100-2C	80	10	23	50	60	83	89	93
P-100-3C	75	6	25	53	65	84	88	93
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M	-	-2	-1	28	25	-	-	-
P-60-2M	-	-4	-5	22	17	60	-	-
P-60-3M	-	9	3	26	30	-	-	-
	current	current	current	current	current	current	current	current
P-60-1C	-	7	28	55	-	-	-	-
P-60-2C	-	4	23	50	-	-	-	-
P-60-3C	-	10	25	51	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-35-1M	-	0	0	31	25	-	-	-
P-35-2M	-	-2	-2	-	33	-	-	-
P-35-3M	-	-3	-3	27	22	-	-	-
	current	current	current	current	current	current	current	current
P-35-1C	-	9	31	-	-	-	-	-
P-35-2C	-	8	28	-	-	-	-	-
P-35-3C	-	5	28	-	-	-	-	-
E-100-1	224	187	196	197	193	209	208	204
E-100-2	122	104	116	110	105	114	109	103
E-100-3	226	196	206	194	189	210	210	205
E-60-1	124	90	57	65	27	157	225	235
E-60-2	165	139	114	79	62	203	242	242
E-60-3	162	125	107	69	70	206	225	229
E-35-1	302	272	254	207	168	343	353	361
E-35-2	300	284	264	151	81	353	372	376
E-35-3	329	290	232	177	104	371	384	387
TC-100	10.7	14.1	11.2	12.4	12.6	12.9	13.8	14.6
TC-60	10.1	14.2	11.9	13.4	14.1	14.2	15.3	16.7
TC-35	9.4	15	11.9	14.6	15.9	13.9	16	18.8
ambient	15.2	21.5	9.8	23.7	30.2	16.1	22.3	24.8

Raw field data for Da-P, Dayton plot, Polk County. (cont.)

Da-P		
	6/2/92	6/9/92
T-100-1	-89	-99
T-100-2	-104	-133
T-100-3	-98	-104
T-60-1	-89	-93
T-60-2	-132	-161
T-60-3	-93	-102
T-35-1	-679	-818
T-35-2	-572	-404
T-35-3	-905	-945
	MAX	MAX
P-200 M	100	105
P-100-1M	93	94
P-100-2M	93	97
P-100-3M	93	95
	current	current
P-200 C	109	122
P-100-1C	93	102
P-100-2C	-	-
P-100-3C	97	-
	MAX	MAX
P-60-1M	na	-
P-60-2M	na	-
P-60-3M	na	-
	current	current
P-60-1C	na	-
P-60-2C	na	-
P-60-3C	na	-
	MAX	MAX
P-35-1M	na	-
P-35-2M	na	-
P-35-3M	na	-
	current	current
P-35-1C	na	-
P-35-2C	na	-
P-35-3C	na	-
E-100-1	207	206
E-100-2	106	99
E-100-3	216	220
E-60-1	244	247
E-60-2	255	274
E-60-3	234	232
E-35-1	na	373
E-35-2	na	378
E-35-3	na	394
TC-100	na	17.3
TC-60	na	19.4
TC-35	na	19.8
ambient	na	25.6

Raw field data for Wo-B, Woodburn plot, Benton County.

Wo-B	Woodburn, Benton County							
	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1								
T-100-2								
T-100-3								
T-50-1								
T-50-2								
T-50-3								
T-25-1								
T-25-2								
T-25-3								
								MAX
P-200 M								
P-100-1M								
P-100-2M								
P-100-3M								93
								current
P-200 C								
P-100-1C								
P-100-2C								
P-100-3C								
P-50-1M								
P-50-2M								
P-50-3M								
P-50-1C								
P-50-2C								
P-50-3C								
P-25-1M								
P-25-2M								
P-25-3M								
P-25-1C								
P-25-2C								
P-25-3C								
E-100-1	274	282	294	290	258	298	298	273
E-100-2	323	325	337	335	351	299	327	306
E-100-3	259	261	279	262	257	268	251	219
E-50-1	269	n/a	317	328	272	289	321	357
E-50-2	281	n/a	293	304	313	280	266	266
E-50-3	279	n/a	318	324	327	310	298	246
E-25-1	346	353	352	348	304	310	290	276
E-25-2	327	311	318	301	293	278	257	134
E-25-3	308	316	323	304	314	282	271	168
TC-100	16.5	14.1	14.8	13.9	12.8	12.9	12.1	11.3
TC-50	16.9	15.1	13.7	11.7	10.7	12.1	10.2	9.9
TC-25	17.1	15.2	12.1	9.7	10.3	12	9.3	9.4
ambient	30.4	13.2	8.5	10.2	15.1	15.4	11.8	8.8

Raw field data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			-105	-70	-79	-60	-61	-66	-34
T-100-2			-112	-75	-83	-59	-65	-71	-39
T-100-3			-108	-71	-83	-65	-64	-72	-41
T-50-1			-91	-71	-78	-57	-62	-68	-37
T-50-2			-92	-71	-78	-55	-62	-69	-36
T-50-3			-92	-70	-79	-60	-60	-67	-37
T-25-1			-68	-58	-63	-62	-57	-60	-40
T-25-2			-68	-57	-61	-62	-55	-60	-40
T-25-3			-67	-56	-61	-53	-56	-58	-35
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M		-	171	135	122	103	103	104	95
P-100-1M	91	62	82	50	56.5	34	39	45	24
P-100-2M		72	85	50	56	32	35	52	16
P-100-3M	86	60	84	50	56	35	38	44	20
	current	current	current	current	current	current	current	current	current
P-200 C		-	174	135	124	106	105	114	96
P-100-1C		82	90	54	65	46	46	54	29
P-100-2C	98	89	89	53	62.5	45	46	52	21
P-100-3C		81	91	56	64.5	47	46	53	28
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M		-	-	48	-	27	32	39	9
P-50-2M		-	-	48	-	35	32	40	12
P-50-3M		-	-	-	-	30	32	40	11
	current	current	current	current	current	current	current	current	current
P-50-1C		-	-	-	-	39	46	-	17
P-50-2C		-	-	-	-	45	46	-	23
P-50-3C		-	-	-	-	45	46	-	27
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M		-	-	-	-	-	-	-	12
P-25-2M		-	-	-	-	-	-	-	15
P-25-3M		-	-	-	-	-	-	-	11
		current	current	current	current	current	current	current	current
P-25-1C		-	-	-	-	-	-	-	20
P-25-2C		-	-	-	-	-	-	-	-
P-25-3C		-	-	-	-	-	-	-	23
E-100-1	269	283	263	260	258	257	248	170	226
E-100-2	289	291	289	278	272	258	235	129	152
E-100-3	230	236	225	210	201	198	181	102	123
E-50-1	269	268	288	256	259	270	261	208	276
E-50-2	228	226	234	234	246	235	274	162	223
E-50-3	303	294	259	250	255	252	251	150	207
E-25-1	245	295	309	355	371	325	294	157	125
E-25-2	178	179	207	203	223	219	261	194	258
E-25-3	184	118	111	155	129	158	138	147	126
TC-100	10.5	10.2	9.9	8.5	8.6	9	7.5	8	7.8
TC-50	8.7	8.5	7.2	6.7	7.3	7.9	5.4	6.1	7.5
TC-25	8.1	6.9	5.3	6	6.6	6.3	4.7	3.9	7.8
ambient	9	4.1	2	6.9	5.6	2.1	7	6.5	12.2

Raw field data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/17/92	3/31/92
T-100-1	-59	-56		-54	-75	-73	-81	-84	-99
T-100-2	-66	-57		-60	-76	-77	-82	-92	-108
T-100-3	-65	-61		-61	-82	-75	-90	-85	-102
T-50-1	-62	-62		-54	-80	-76	-82	-82	-96
T-50-2	-64	-48		-56	-80	-75	-85	-82	-97
T-50-3	-61	-62		-54	-82	-73	-84	-80	-97
T-25-1	-51	-54		-57	-82	-77	-72	-212	-214
T-25-2	-53	-52		-59	-73	-73	-80	-175	-224
T-25-3	-59	-56		-56	-76	-73	-68	-109	-101
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	87	39	87	ND	59	91	87	103	104
P-100-1M	31	41	40	8	44	45	58	63	75
P-100-2M	25	nd	37	8	41	42	62	62	74
P-100-3M	31	38	41	10	43	42	56	63	74
	current	current	current	current	current	current	current	current	current
P-200 C	90	48	94	ND	64	92	93	105	119
P-100-1C	48	51	40	44	56	57	63	75	85
P-100-2C	43	47	39	39	55	56	62	73	84
P-100-3C	49	46	41	43	56	55	63	75	85
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	19	44	34	-1	37	39	-	-	-
P-50-2M	23	35	35	6	40	40	-	-	-
P-50-3M	23	36	35	8	40	40	-	-	-
	current	current	current	current	current	current	current	current	current
P-50-1C	43	-	34	37	-	-	-	-	-
P-50-2C	46	42	35	40	-	-	-	-	-
P-50-3C	43	45	35	39	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	21	-	-	2	-	-	-	-	-
P-25-2M	23	-	-	6	-	-	-	-	-
P-25-3M	24	-	-	8	-	-	-	-	-
	current	current	current	current	current	current	current	current	current
P-25-1C	-	-	-	-	-	-	-	-	-
P-25-2C	-	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-	-
E-100-1	169	179	134	129	149	99	75	54	43
E-100-2	91	82	34	45	78	41	33	28	26
E-100-3	88	83	53	95	110	89	85	77	74
E-50-1	205	280	288	282	299	308	345	283	326
E-50-2	174	240	205	292	224	214	262	383	405
E-50-3	192	193	190	190	192	183	245	253	259
E-25-1	103	142	150	94	135	129	151	195	242
E-25-2	215	102	173	144	226	236	228	287	291
E-25-3	83	136	88	33	128	128	209	256	284
TC-100	9.2	8.1	8.3	9.3	9.4	9.7	9.9	10.2	11.1
TC-50	8.5	7.1	7.6	9.6	9.6	10.3	10.6	10.9	11.9
TC-25	7.6	6.9	7	10.9	9.2	9.5	10.7	11	11.9
ambient	1.4	6.6	9.2	19.8	15.4	10.9	11.3	13.5	19.1

Raw field data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-103	-40	-58	-76	-78	-99	-112	-114
T-100-2	-109	-46	-68	-85	-88	-106	-117	-129
T-100-3	-103	-45	-59	-69	-84	-99	-120	-124
T-50-1	-110	-52	-63	-72	-76	-101	-135	-155
T-50-2	-112	-44	-59	-69	-82	-101	-136	-181
T-50-3	-108	-45	-57	-63	-76	-100	-138	-174
T-25-1	-193	-41	-62	-143	-236	-600	-882	-920
T-25-2	-221	-44	-53	-119	-182	-486	-754	-938
T-25-3	-210	-45	-59	-93	-117	-321	-530	-690
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	113	73	69	64	74	83	97	112
P-100-1M	85	23	42	56	63	75	92	-
P-100-2M	85	23	39	54	63	73	90	-
P-100-3M	85	31	42	54	63	74	91	-
	current	current	current	current	current	current	current	current
P-200 C	127	78	69	74	85	102	116	135
P-100-1C	91	41	53	70	75	92	-	-
P-100-2C	92	38	50	70	73	90	-	-
P-100-3C	93	41	54	70	73	91	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	-	24	34	-	-	-	-	-
P-50-2M	-	25	39	-	-	-	-	-
P-50-3M	-	26	38	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-50-1C	-	35	-	-	-	-	-	-
P-50-2C	-	38	-	-	-	-	-	-
P-50-3C	-	38	-	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	-	24	-	-	-	-	-	-
P-25-2M	-	-	-	-	-	-	-	-
P-25-3M	-	-	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-25-1C	-	-	-	-	-	-	-	-
P-25-2C	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-
E-100-1	37	54	41	30	25	34	23	122
E-100-2	27	45	34	27	19	30	20	341
E-100-3	77	88	85	80	69	118	109	143
E-50-1	342	264	251	323	323	329	299	285
E-50-2	362	386	392	383	309	385	352	331
E-50-3	286	256	246	261	333	286	291	292
E-25-1	210	152	189	261	241	248	287	285
E-25-2	342	175	274	332	276	356	323	327
E-25-3	306	-59	-64	232	308	325	325	326
TC-100	10.9	12.5	11.9	12.7	14.4	14.8	15	15.9
TC-50	11	13.2	12.9	14.2	16.8	16.2	17.7	19.2
TC-25	10.3	13.8	12.4	15.7	18.7	15.6	19	20.4
ambient	12.9	15.6	11.7	24.7	25.5	16.7	23.6	19.2

Raw field data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B		
		6/9/92
T-100-1		-140
T-100-2		-154
T-100-3		-163
T-50-1		-292
T-50-2		-453
T-50-3		-376
T-25-1		
T-25-2		
T-25-3		-936
	MAX	MAX
P-200 M		138
P-100-1M		-
P-100-2M		-
P-100-3M		-
	current	current
P-200 C		191
P-100-1C		-
P-100-2C		-
P-100-3C		-
	MAX	MAX
P-50-1M		-
P-50-2M		-
P-50-3M		-
	current	current
P-50-1C		-
P-50-2C		-
P-50-3C		-
	MAX	MAX
P-25-1M		-
P-25-2M		-
P-25-3M		-
	current	current
P-25-1C		-
P-25-2C		-
P-25-3C		-
E-100-1		291
E-100-2		341
E-100-3		144
E-50-1		280
E-50-2		302
E-50-3		299
E-25-1		304
E-25-2		342
E-25-3		339
TC-100		17.5
TC-50		20.6
TC-25		21.5
ambient		17.9

Raw field data for Wi-B, Willamette plot, Benton County.

Wi-B	Willamette, Benton County							
	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1								
T-100-2								
T-100-3								
T-50-1								
T-50-2								
T-50-3								
T-25-1								
T-25-2								
T-25-3								
P-200 M								
P-100-1M								
P-100-2M								
P-100-3M								
P-200 C								
P-100-1C								
P-100-2C								
P-100-3C								
P-50-1M								
P-50-2M								
P-50-3M								
P-50-1C								
P-50-2C								
P-50-3C								
P-25-1M								
P-25-2M								
P-25-3M								
P-25-1C								
P-24-2C								
P-25-3C								
E-100-1	275	280	300	283	290	278	309	250
E-100-2	222	232	257	237	252	245	278	213
E-100-3	212	223	248	272	282	266	290	262
E-50-1	341	352	354	344	364	363	369	352
E-50-2	309	315	340	321	324	332	346	286
E-50-3	325	329	348	336	337	324	388	348
E-25-1	353	345	352	340	353	362	369	350
E-25-2	343	353	366	346	339	351	360	338
E-25-3	378	389	394	385	388	402	413	396
TC-100	14	12.1	11.6	10.8	9.8	10.4	9.9	9.3
TC-50	13	11.8	10.4	9.2	8.9	10.4	8.8	8.6
TC-25	12	10.8	9.2	7.5	9.1	11.1	8.1	8.6
ambient	21	8.8	8.7	6.2	15	14.8	10	10

Raw field data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			-126	-95	-100	-61	-65	-66	-43
T-100-2			-127	-100	-103	-60	-66	-67	-43
T-100-3			-130	-106	-107	-76	-70	-68	-49
T-50-1			-92	-81	-87	-74	-70	-71	-49
T-50-2			-98	-82	-89	-61	-71	-56	-49
T-50-3			-96	-82	-91	-76	-59	-73	-36
T-25-1			-69	-57	-61	-50	-53	-58	-39
T-25-2			-74	-60	-65	-55	-55	-57	-40
T-25-3			-74	-60	-66	-61	-55	-59	-38
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M		-	-	nd	95	49	47	48	27
P-100-1M		-	-	94	89.5	47	47	49	27
P-100-2M		-	-	90	86.5	47	nd	46	nd
P-100-3M		-	-	92	86.5	42	42	46	23
	current	current	current	current	current	current	current	current	current
P-200 C		-	-	112	99.5	62	53	59	31
P-100-1C		-	-	96	92	60	67	60	33
P-100-2C		-	-	90	90	58	nd	83	30
P-100-3C		-	-	94	90	56	54	56	31
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M		-	-	-	-	-	-	-	30
P-50-2M		-	-	-	-	36	40	40	20
P-50-3M		-	-	-	-	39	40	44	22
		current	current	current	current	current	current	current	current
P-50-1C		-	-	-	-	-	-	-	34
P-50-2C		-	-	-	-	-	46	-	25
P-50-3C		-	-	-	-	-	-	-	28
		MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M		-	-	-	-	-	-	-	23
P-25-2M		-	-	-	-	-	-	-	-
P-25-3M		-	-	-	-	-	-	-	-
		current	current	current	current	current	current	current	current
P-25-1C		-	-	-	-	-	-	-	-
P-24-2C		-	-	-	-	-	-	-	-
P-25-3C		-	-	-	-	-	-	-	-
E-100-1	254	31	nd	nd	nd	183	182	177	159
E-100-2	245	164	157	119	64	31	46	28	42
E-100-3	304	262	258	238	228	229	209	202	177
E-50-1	377	351	358	342	354	352	354	360	346
E-50-2	325	306	312	296	307	294	298	278	289
E-50-3	375	338	349	368	357	350	340	237	342
E-25-1	368	338	336	334	330	344	340	338	359
E-25-2	365	327	327	326	322	330	332	321	344
E-25-3	402	362	358	354	369	368	358	353	360
TC-100	8.6	8.7	8.3	7	6.5	7.7	7	6.7	7.6
TC-50	7.5	7.4	6.2	5.8	5.8	6.8	5.2	4.6	6.6
TC-25	7.3	6.3	4.3	5.3	5.2	5.8	4.6	3	7.4
ambient	8.9	4.2	2.1	6.2	5.8	1.4	6.1	4.4	11.2

Raw field data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-51	-56		-32	-46	-55	-58	-65	-64
T-100-2	-37	-57		-36	-47	-52	-53	-73	-64
T-100-3	nd	-61		-39	-51	-62	-61	-72	-80
T-50-1	-60	-62		-41	-51	-58	-63	-76	-66
T-50-2	-43	-48		-31	-41	-48	-46	-67	-63
T-50-3	-61	-62		-36	-53	-61	-57	-72	-76
T-25-1	-54	-54		-37	-46	-58	-58	-70	-61
T-25-2	-51	-52		-35	-45	-55	-50	-64	-61
T-25-3	-52	-56		-32	-46	-52	-50	-65	-64
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	36	39	33	8	24	26	39	41	54
P-100-1M	33	41	33	4	24	27	41	43	56
P-100-2M	36	nd	nd	ND	22	24	41	nd	54
P-100-3M	30	38	26	5	22	23	39	47	53
	current	current	current	current	current	current	current	current	current
P-200 C	45	48	35	24	42	41	45	58	54
P-100-1C	55	51	33	23	38	43	48	60	63
P-100-2C	48	47	nd	23	nd	42	nd	60	55
P-100-3C	46	46	27	21	36	41	40	50	58
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	28	44	32	4	22	27	42	43	-
P-50-2M	27	35	22	2	19	21	40	nd	-
P-50-3M	28	36	36	5	20	22	37	47	-
	current	current	current	current	current	current	current	current	current
P-50-1C	-	-	32	23	-	45	45	-	-
P-50-2C	41	42	22	18	32	38	42	-	-
P-50-3C	43	45	36	19	35	41	39	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	-	-	22	4	21	-	-	24	-
P-25-2M	-	-	-	3	-	-	-	-	-
P-25-3M	-	-	-	3	-	-	-	-	-
	current	current	current	current	current	current	current	current	current
P-25-1C	-	-	22	-	-	-	-	-	-
P-24-2C	-	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-	-
E-100-1	153	144	115	121	117	102	84	60	52
E-100-2	26	15	13	31	30	38	30	33	43
E-100-3	169	99	21	45	16	21	18	18	32
E-50-1	328	328	297	273	230	195	187	351	385
E-50-2	210	188	51	280	69	36	64	75	382
E-50-3	322	294	270	70	184	182	156	127	375
E-25-1	348	364	364	179	356	368	372	373	400
E-25-2	342	353	374	218	373	379	383	388	386
E-25-3	387	375	376	181	383	391	419	409	396
TC-100	8.1	6.8	6.9	8.1	8.2	8.2	8.5	8.4	9
TC-50	8	6	6.3	8.2	8.3	8.1	8.7	8.5	9.4
TC-25	6.9	5.8	5.9	9.4	8.4	7.3	8.8	8.2	9.6
ambient	0.3	6.7	9.3	19.5	13.1	9.8	9.5	13	23

Raw field data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B								
	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-76	-41	-48	-58	-72	-96	-108	-128
T-100-2	-71	-35	-46	-57	-69	-93	-108	-124
T-100-3	-79	-41	-55	-68	-74	-98	-111	-129
T-50-1	-80	-44	-53	-67	-71	-103	-142	-183
T-50-2	-73	-32	-45	-56	-68	-92	-111	-128
T-50-3	-63	-39	-48	-68	-74	-102	-140	-193
T-25-1	-64	-38	-48	-66	-116	-288	-501	-630
T-25-2	-62	-31	-52	-62	-72	-187	-377	-501
T-25-3	-62	-34	-48	-68	-84	-197	-404	-570
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	56	13	24	34	40	61	90	107
P-100-1M	56	7	25	42	69	65	92	-
P-100-2M	61	7	24	38	59	63	90	-
P-100-3M	56	10	23	33	39	63	90	-
	current	current	current	current	current	current	current	current
P-200 C	64	30	34	34	63	87	106	122
P-100-1C	61	31	43	42	69	96	-	-
P-100-2C	65	30	35	38	66	92	-	-
P-100-3C	61	28	38	33	64	92	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	-	13	26	37	43	-	-	-
P-50-2M	-	6	19	38	35	-	-	-
P-50-3M	-	10	21	34	37	-	-	-
	current	current	current	current	current	current	current	current
P-50-1C	-	30	40	-	-	-	-	-
P-50-2C	-	25	32	-	-	-	-	-
P-50-3C	-	27	32	-	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	-	8	-	-	-	-	-	-
P-25-2M	-	10	-	-	-	-	-	-
P-25-3M	-	13	-	-	-	-	-	-
	current	current	current	current	current	current	current	current
P-25-1C	-	-	-	-	-	-	-	-
P-24-2C	-	-	-	-	-	-	-	-
P-25-3C	-	-	-	-	-	-	-	-
E-100-1	29	15	16	8	15	16	56	196
E-100-2	29	21	23	13	24	27	22	159
E-100-3	15	10	10	6	15	19	25	289
E-50-1	400	391	353	309	369	377	375	370
E-50-2	378	347	209	129	258	402	393	381
E-50-3	393	372	338	259	209	386	374	361
E-25-1	406	230	394	401	419	420	413	410
E-25-2	402	222	373	407	410	409	397	390
E-25-3	407	295	428	424	412	429	413	403
TC-100	8.8	10.2	9.7	10.8	11.3	11.4	12.2	12.8
TC-50	8.5	11.1	10.8	11.8	12.6	12	13.9	14.6
TC-25	7.3	11.2	9.9	13.5	14.2	11	14.1	16
ambient	9.5	12.7	11.8	22.1	21.6	12.8	17.7	19

Raw field data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B			
		6/9/92	
T-100-1		-163	
T-100-2		-158	
T-100-3		-185	
T-50-1		-310	
T-50-2		-218	
T-50-3		-373	
T-25-1		-931	
T-25-2		-816	
T-25-3		-913	
	MAX	MAX	MAX
P-200 M		128	
P-100-1M		-	
P-100-2M		-	
P-100-3M		-	
	current	current	current
P-200 C		181	
P-100-1C		-	
P-100-2C		-	
P-100-3C		-	
	MAX	MAX	MAX
P-50-1M		-	
P-50-2M		-	
P-50-3M		-	
	current	current	current
P-50-1C		-	
P-50-2C		-	
P-50-3C		-	
	MAX	MAX	MAX
P-25-1M		-	
P-25-2M		-	
P-25-3M		-	
	current	current	current
P-25-1C		-	
P-24-2C		-	
P-25-3C		-	
E-100-1		214	
E-100-2		293	
E-100-3		341	
E-50-1		376	
E-50-2		381	
E-50-3		358	
E-25-1		410	
E-25-2		390	
E-25-3		399	
TC-100		13.9	
TC-50		15.6	
TC-25		15.8	
ambient		15.8	

Raw field data for Am-B, Amity plot, Benton County.

Am-B	Amity, Benton County							
	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1								
T-100-2								
T-100-3								
T-50-1								
T-50-2								
T-50-3								
T-25-1								
T-25-2								
T-25-3								
								MAX
P-200 M								
P-100-1M								94
P-100-2M								
P-100-3M								
P-200 C								
P-100-1C								
P-100-2C								
P-100-3C								
								MAX
P-50-1M								46
P-50-2M								-
P-50-3M								46
								current
P-50-1C								
P-50-2C								
P-50-3C								
P-25-1M								
P-25-2M								
P-25-3M								
P-25-1C								
P-25-2C								
P-25-3C								
E-100-1	276	286	292	304	284	282	296	251
E-100-2	202	216	232	251	250	246	251	259
E-100-3					257	259	253	194
E-50-1	296	302	319	308	283	295	260	-91
E-50-2	303	308	321	312	319	305	285	277
E-50-3	331	333	349	337	343	321	294	282
E-25-1	310	304	333	280	258	261	262	276
E-25-2	290	300	333	313	324	306	291	300
E-25-3	291	301	332	317	333	293	281	289
TC-100	16.5	14.3	14.4	13.4	12.3	12.3	11.7	11.2
TC-50	17.2	14.4	13.1	11	10.1	11.8	9.7	9.6
TC-25	16	13.3	11.7	9.1	10	12	8.9	9.4
AMBIENT	26.2	7.9	7	6	14.9	14.3	9.8	10.2

Raw field data for Am-B, Amity plot, Benton County. (cont.)

Am-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			-71	-17	-29	-17	-15	-16	-22
T-100-2			-73	-23	-38	-22	-20	-16	-20
T-100-3			-71	-21	-34	-22	-18	-13	-16
T-50-1			-75	-26	-34	-19	-17	-17	-17
T-50-2			-72	-25	-35	-20	-17	-19	-15
T-50-3			-68	-23	-32	-18	-19	-19	-16
T-25-1			-67	-25	nd	-19	-14	-18	-14
T-25-2			-71	-25	-36	-18	-20	-20	-20
T-25-3			-67	-24	-35	-22	-15	-20	-14
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	135	77	91	42	35.5	26	24	25	16
P-100-1M	80	25	58	15	16.5	nd	5	7	nd
P-100-2M	-	22	47	7	10	0	2	8	1
P-100-3M	79	21	45	6	10	0	2	10	1
	current	current	current	current	current	current	current	current	current
P-200 C	164	96	93	42	53.5	39	27	28	25
P-100-1C	95	42	58	15	17	3	9	11	10
P-100-2C	98	34	54	8	16	3	7	11	2
P-100-3C	87	45	52	11	21	9	5	12	1
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	46	16	49	4	15.5	4	2	4	0
P-50-2M	-	-	-	6	11	2	0	6	2
P-50-3M	47	16	44	9	10	0	-1	7	3
	current	current	current	current	current	current	current	current	current
P-50-1C		49	-	10	16.5	5	3	6	0
P-50-2C		-	-	12	19	8	3	6	3
P-50-3C		47	-	12	15.5	4	7	8	5
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M		16	-	5	9.5	0	-2	4	2
P-25-2M		14	-	6	7.5	-2	-3	8	1
P-25-3M		16	-	10	12	2	1	10	5
	current	current	current	current	current	current	current	current	current
P-25-1C		-	-	10	14.5	4	4	5	3
P-25-2C		-	-	8	12	2	3	-	2
P-25-3C		-	-	13	17.5	5	9	12	8
E-100-1	277	282	278	257	256	282	253	279	266
E-100-2	247	239	233	213	211	202	203	204	194
E-100-3	239	235	227	207	214	219	210	219	214
E-50-1	-33	-148	236	-196	-224	-213	223	226	211
E-50-2	248	243	290	236	230	233	218	223	198
E-50-3	299	274	285	272	252	199	0	19	-26
E-25-1	282	282	282	267	179	111	3	11	-9
E-25-2	315	288	291	276	174	87	6	31	-8
E-25-3	306	281	284	281	253	186	136	79	107
TC-100	10.2	10	10	8.3	8.3	9	8.1	8	7.8
TC-50	8.2	7.9	6.6	6.4	6.9	7.4	6.8	5	7.3
TC-25	7.7	6.4	4.8	5.9	6.5	6.1	6.1	3.6	8.1
AMBIENT	8.8	4.2	2.1	6.8	7.6	1.4	1.6	3.4	13.4

Raw field data for Am-B, Amity plot, Benton County. (cont.)

Am-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-17	-17	-9	-12	0	-3	-18	-12	-13
T-100-2	-19	-21	-16	-20	-33	-25	-18	-29	-32
T-100-3	-14	-22	-7	-17	-7	-10	-17	-20	-18
T-50-1	-20	-17	-9	-19	-25	-22	-18	-30	-26
T-50-2	-19	-21	-12	-19	-27	-24	-14	-30	-24
T-50-3	-20	-16	-10	-21	-29	-24	-21	-38	-29
T-25-1	-17	-18	-10	-21	-22	-22	-14	-29	-27
T-25-2	-15	-19	-8	-20	-21	-20	-12	-30	-22
T-25-3	-23	-19	-8	-20	-29	-25	-18	-36	-29
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	11	8	13	18	5	11	12	10	20
P-100-1M	6	9	8	5	10	10	6	16	11
P-100-2M	4	4	2	0	8	7	10	18	10
P-100-3M	4	nd	0	0	8	1	4	nd	6
	current	current	current	current	current	current	current	current	current
P-200 C	26	15	26	27	14	23	16	22	27
P-100-1C	11	9	9	6	11	12	10	21	14
P-100-2C	10	5	4	6	12	9	12	22	17
P-100-3C	9	4	6	6	12	13	6	23	10
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	0	2	2	0	4	2	3	4	3
P-50-2M	3	5	3	2	7	3	4	7	7
P-50-3M	5	3	5	4	7	6	7	8	5
	current	current	current	current	current	current	current	current	current
P-50-1C	5	2	3	4	8	8	5	15	11
P-50-2C	10	7	6	5	10	10	9	18	12
P-50-3C	8	4	7	6	10	10	8	17	10
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	3	5	2	5	4	8	4	16	4
P-25-2M	3	3	3	ND	5	3	4	5	4
P-25-3M	8	8	9	6	10	9	13	10	7
	current	current	current	current	current	current	current	current	current
P-25-1C	6	5	3	6	7	8	7	16	10
P-25-2C	4	6	10	4	7	10	8	21	11
P-25-3C	11	14	10	10	14	14	12	25	12
E-100-1	254	252	221	228	215	208	184	158	127
E-100-2	181	194	155	178	170	162	143	127	101
E-100-3	194	204	198	181	139	101	47	9	6
E-50-1	191	176	131	92	21	30	9	24	19
E-50-2	152	-112	28	15	168	6	-9	3	1
E-50-3	14	-20	18	-31	27	26	-18	-33	-29
E-25-1	-3	-11	-20	-16	-18	-17	-23	-18	-14
E-25-2	-13	-40	-91	-15	-234	-17	-22	-19	-22
E-25-3	68	37	-4	53	22	-16	10	8	5
TC-100	9.2	7.8	7.8	9.1	9.1	10.2	9.5	10.4	10.5
TC-50	8.8	6.8	7	9.6	9.3	10.3	10.3	11.2	11.1
TC-25	7.7	6.8	6.3	10.9	9.2	9.7	10.2	10.7	11
AMBIENT	-1.2	6.1	7.7	20.3	14.7	13	8.5	16	18.2

Raw field data for Am-B, Amity plot, Benton County. (cont.)

Am-B

	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-26	-9	-18	-13	-2	-43	-42	-51
T-100-2	-33	-21	-29	-30	-33	-57	-60	-74
T-100-3	-31	-10	-21	5	-15	-44	-46	-58
T-50-1	-28	-13	-22	-24	-35	-52	-67	-77
T-50-2	-27	-16	-25	-28	-36	-52	-69	-78
T-50-3	-27	-12	-25	-28	-39	-58	-68	-78
T-25-1	-23	-13	-23	-17	-29	-53	-77	-108
T-25-2	-24	-10	-25	-21	-30	-54	-80	-120
T-25-3	-30	-14	-26	-30	-39	-62	-79	-109
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	17	10	9	11	10	15	35	51
P-100-1M	13	6	7	13	21	38	54	63
P-100-2M	6	5	6	18	20	43	57	67
P-100-3M	7	0	7	14	6	46	64	65
	current	current	current	current	current	current	current	current
P-200 C	27	17	13	18	15	38	54	66
P-100-1C	14	9	7	13	23	39	56	63
P-100-2C	18	8	10	18	26	48	59	69
P-100-3C	18	2	12	20	35	53	64	74
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	3	0	5	11	2	23	43	-
P-50-2M	5	3	3	10	3	28	47	-
P-50-3M	7	5	4	10	6	25	43	-
	current	current	current	current	current	current	current	current
P-50-1C	14	4	8	11	24	44	-	-
P-50-2C	17	6	11	12	26	48	-	-
P-50-3C	16	8	8	13	23	42	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-25-1M	5	4	5	7	3	23	-	-
P-25-2M	5	3	2	10	3	22	-	-
P-25-3M	11	8	8	11	11	-	-	-
	current	current	current	current	current	current	current	current
P-25-1C	13	5	7	11	24	-	-	-
P-25-2C	17	7	5	10	-	-	-	-
P-25-3C	20	13	13	20	-	-	-	-
E-100-1	111	73	32	12	5	19	1	2
E-100-2	67	37	16	-1	-7	-42	-9	1
E-100-3	7	-4	-3	-7	-6	-19	-7	19
E-50-1	-14	8	7	6	9	12	12	266
E-50-2	-3	-1	-4	-5	-46	-15	-8	333
E-50-3	-22	-33	-32	-31	-39	-44	91	158
E-25-1	-2	-2	-28	-20	-14	14	339	340
E-25-2	-22	-28	-27	-23	-45	3	338	382
E-25-3	2	3	0	-6	-17	-47	307	375
TC-100	10.5	11.1	11.4	13	13.8	13.6	13.7	13.8
TC-50	10.3	12	12.3	18	15.9	14.8	15.8	16.8
TC-25	9	12.1	11.2	14	17.2	13.8	16.6	14
AMBIENT	9.4	10.6	13	21.5	26.6	16.1	19	23.1

Raw field data for Am-B, Amity plot, Benton County. (cont.)

Am-B		
	6/2/92	6/9/92
T-100-1	-75	-72
T-100-2	-89	-73
T-100-3	-75	-72
T-50-1	-86	-112
T-50-2	-97	-109
T-50-3	-90	-131
T-25-1	-174	-240
T-25-2	-250	-399
T-25-3	-190	-306
	MAX	MAX
P-200 M	65	78
P-100-1M	72	82
P-100-2M	69	78
P-100-3M	76	85
	current	current
P-200 C	87	92
P-100-1C	76	85
P-100-2C	72	95
P-100-3C	87	-
	MAX	MAX
P-50-1M	-	-
P-50-2M	-	-
P-50-3M	-	-
	current	current
P-50-1C	-	-
P-50-2C	-	-
P-50-3C	-	-
	MAX	MAX
P-25-1M	-	-
P-25-2M	-	-
P-25-3M	-	-
	current	current
P-25-1C	-	-
P-25-2C	-	-
P-25-3C	-	-
E-100-1	-2	-2
E-100-2	2	4
E-100-3	31	17
E-50-1	272	272
E-50-2	335	333
E-50-3	357	361
E-25-1	356	329
E-25-2	382	356
E-25-3	375	359
TC-100	16.4	16.2
TC-50	19.5	19.6
TC-25	20.1	20.3
AMBIENT	22	21.5

Raw field data for Da-B, Dayton plot, Benton County.

Da-B	Dayton, Benton County							
	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1								
T-100-2								
T-100-3								
T-60-1								
T-60-2								
T-60-3								
T-30-1								
T-30-2								
T-30-3								
P-200 M								
P-100-1M								
P-100-2M								
P-100-3M								
P-200 C								
P-100-1C								
P-100-2C								
P-100-3C								
							MAX	MAX
P-60-1M								46
P-60-2M								46
P-60-3M							52	
P-60-1C								
P-60-2C								
P-60-3C								
								MAX
P-30-1M								21.5
P-30-2M								19
P-30-3M								
P-30-1C								
P-30-2C								
P-30-3C								
E-100-1	281	290	302	278	286	272	270	264
E-100-2	253	275	302	284	298	296	280	243
E-100-3					263	234	231	230
E-60-1	322	383	400	366	379	363	362	324
E-60-2	274	355	387	342	370	343	338	300
E-60-3	328	332	350	333	354	345	346	245
E-30-1	363	325	359	345	342	330	312	288
E-30-2	351	338	360	353	352	310	336	250
E-30-3	309	333	358	344	346	315	321	239
TC-100	15.8	14.6	14.2	13.2	12.5	12.4	11.9	11.2
TC-60	15.9	14.6	13.4	11.5	10.6	11.7	10.3	9.6
TC-30	15.6	14.2	12.1	9.6	9.9	11.87	9.1	9.4
ambient	22.3	7	7	5.7	14.8	14.3	9.2	10.2

Raw field data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			-55	-21	-40	-34	-22	-97	-22
T-100-2			-60	-31	-48	-44	-37	-218	-27
T-100-3			-56	-22	-38	-29	-22	-100	-17
T-60-1			-18	14	-10	-12	0	-9	12
T-60-2			-51	-17	-36	-15	-17	-14	-13
T-60-3			-42	-4	-24	-12	-15	-24	-3
T-30-1			-42	-15	-34	-15	-15	-13	-8
T-30-2			-49	-22	-37	-11	-20	-14	-14
T-30-3			-50	-21	-35	-15	-15	-14	-9
	max	max	max	max	max	max	MAX	MAX	MAX
P-200 M		-	-	172	151	124	nd	109	96
P-100-1M		99	73	50	49.5	37	37	36	36
P-100-2M		-	-	79	67.5	56	56	56	56
P-100-3M		99	73	50	49	49	nd	38	36
	current	current	current	current	current	current	current	current	current
P-200 C		-	-	173	161	136	124	110	106
P-100-1C		99	73	50	50	51	37	39	38
P-100-2C		-	97	79	67.5	70	56	57	56
P-100-3C		99	73	54	49	50	38	39	36
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M	36	9	23	5	11.5	12	2	8	nd
P-60-2M		-	44	6	11	3	4	6	3
P-60-3M		-	44	5	11	nd	3	2	0
		current	current	current	current	current	current	current	current
P-60-1C		25	41	14	22	13	11	13	3
P-60-2C		26	44	11	21.5	13	9	16	4
P-60-3C		26	44	11	22	nd	12	14	3
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-30-1M	18	-	20	2	7.5	0	0	2	2
P-30-2M	16	8	26	9	11	8	7	9	8
P-30-3M		10	24	5	11	nd	1	5	0
		current	current	current	current	current	current	current	current
P-30-1C		22	-	5	20	10	6	12	2
P-30-2C		29	-	14	24	12	12	14	8
P-30-3C		24	-	11	21	12	9	ND	2
E-100-1	357	251	264	255	219	234	242	230	221
E-100-2	345	244	246	245	194	220	206	198	184
E-100-3							98	82	39
E-60-1	296	247	98	-35	-11	-11	-15	19	-17
E-60-2	290	254	210	-1	-2	-13	3	7	5
E-60-3	231	194	127	62	12	4	11	14	6
E-30-1	299	262	239	158	106	42	57	41	6
E-30-2	233	208	182	51	14	-3	30	18	-53
E-30-3	298	270	249	190	119	31	49	32	1
TC-100	10.7	10.4	10	9.1	8.4	9.2	8.3	8.3	7.8
TC-60	8.7	8.6	7.5	7.2	6.8	7.8	6.5	6.1	7.1
TC-30	7.8	6.9	5.4	6.6	6.2	6.8	5.4	4.3	7.7
ambient	9	3.8	2.8	6.7	9	1	4.1	4	13

Raw field data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-17	-26	-17	-4	-22	-9	-40	-35	-41
T-100-2	ND	-41	-22	5	-14	-9	-38	-26	-21
T-100-3	-31	-33	-11	-1	-8	-2	-23	-32	-31
T-60-1	-33	-10	-10	54	14	13	1	10	18
T-60-2	-17	-15	-8	2	-37	-37	-15	-64	-52
T-60-3	-16	-8	-1	-21	-5	-4	-8	-33	-24
T-30-1	-11	-15	-4	-14	-36	-29	-14	-61	-48
T-30-2	-13	-18	-8	-17	-37	-33	-14	-61	-52
T-30-3	-10	-16	-3	-16	-40	-33	-19	-48	-52
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	89	nd	66	92	73	nd	81	82	98
P-100-1M	34	40	38	38	39	43	49	53	67
P-100-2M	54	55	55	53	52	59	62	66	76
P-100-3M	34	40	ND	39	40	43	49	54	69
	current	current	current	current	current	current	current	current	current
P-200 C	102	65	99	95	86	80	92	102	118
P-100-1C	36	40	38	38	42	44	52	55	73
P-100-2C	55	55	56	53	57	59	63	66	79
P-100-3C	35	40	38	39	41	43	50	55	74
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M	2	3	2	0	31	3	16	-	44
P-60-2M	3	5	4	3	14	5	17	20	45
P-60-3M	0	4	4	3	14	8	18	17	40
	current	current	current	current	current	current	current	current	current
P-60-1C	14	9	4	10	29	23	17	-	44
P-60-2C	12	11	6	8	30	24	19	-	46
P-60-3C	14	11	9	8	30	23	23	54	44
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-30-1M	0	2	0	1	9	2	12	14	-
P-30-2M	8	9	8	8	12	8	14	14	-
P-30-3M	0	5	ND	3	13	3	18	25	-
	current	current	current	current	current	current	current	current	current
P-30-1C	12	8	2	5	28	22	14	-	-
P-30-2C	14	13	10	10	-	25	18	-	-
P-30-3C	12	10	ND	8	-	21	20	-	-
E-100-1	230	218	279	185	170	120	70	43	36
E-100-2	144	150	125	103	159	34	9	3	-19
E-100-3	94	16	148	8	11	9	7	2	9
E-60-1	-17	-16	25	-15	-24	-26	-35	-34	-35
E-60-2	10	6	-54	-1	70	4	4	6	8
E-60-3	4	-6	38	-21	-42	-61	-105	-114	-127
E-30-1	-62	-105	62	-75	-85	-136	-141	-103	105
E-30-2	-53	-69	-43	-124	-300	-189	-202	-220	-35
E-30-3	29	42	75	7	0	-10	-109	-116	159
TC-100	9.8	8.1	7.5	8.9	9	9.2	9.7	10.6	10.5
TC-60	8.8	7	7.1	9.2	9.2	9.3	10.2	11	11.4
TC-30	8.5	7.4	6.4	10.3	9.1	9.4	10.3	11.1	11.5
ambient	-1	5.4	7.5	20.4	11.7	13.6	9.2	16.8	19.3

Raw field data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-67	-27	-15	-36	-11	-68	-71	-47
T-100-2	-78	-28	13	-36	-11	-72	-73	-31
T-100-3	-79	-19	-12	-42	-21	-75	-70	-27
T-60-1	-32	3	10	-16	9	-56	-75	-39
T-60-2	-64	-10	-30	-69	-73	-116	-191	-247
T-60-3	-50	3	-3	-41	-37	-103	-153	-182
T-30-1	-57	-5	-23	-62	-72	-244	-463	-603
T-30-2	-65	-8	-35	-67	-78	-249	-486	-556
T-30-3	-57	-5	-30	-63	-74	-233	-481	-597
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	106	84	69	70	71	72	92	100
P-100-1M	77	61	41	50	57	66	84	92
P-100-2M	83	74	60	62	66	76	87	95
P-100-3M	79	62	44	50	56	74	82	95
	current	current	current	current	current	current	current	current
P-200 C	115	91	74	78	78	93	101	120
P-100-1C	80	62	41	50	57	74	91	101
P-100-2C	84	74	60	62	66	77	90	98
P-100-3C	84	62	44	50	56	74	90	103
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-60-1M	52	3	3	27	23	-	-	-
P-60-2M	47	5	5	27	18	-	-	-
P-60-3M	48	3	2	27	32	-	-	-
	current	current	current	current	current	current	current	current
P-60-1C	58	10	27	56	-	-	-	-
P-60-2C	-	11	26	56	-	-	-	-
P-60-3C	-	7	25	54	-	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-30-1M	-	2	1	23	15	-	-	-
P-30-2M	-	9	8	28	15	-	-	-
P-30-3M	-	nd	6	26	25	-	-	-
	current	current	current	current	current	current	current	current
P-30-1C	-	9	23	-	-	-	-	-
P-30-2C	-	9	29	-	-	-	-	-
P-30-3C	-	nd	25	-	-	-	-	-
E-100-1	40	29	17	9	1	9	4	7
E-100-2	-37	-35	-41	-63	-87	-82	-89	-107
E-100-3	10	6	4	5	4	-29	3	4
E-60-1	-26	-30	-28	-26	-33	64	163	321
E-60-2	6	8	5	-11	4	174	285	300
E-60-3	-120	-125	-122	-147	-155	-152	-68	342
E-30-1	194	126	-54	121	219	286	302	188
E-30-2	86	-10	-44	-183	130	236	260	317
E-30-3	225	162	-78	177	297	332	344	133
TC-100	10.5	11.6	11.3	12.1	12.4	13.5	13.8	14.6
TC-60	10.5	11.7	12.4	13.5	14.2	14.7	15.7	16.7
TC-30	9.7	12.4	12.3	15.4	16.5	14.8	17.3	19.1
ambient	9.6	10.6	16.1	21.3	26.6	16	19.7	24.4

Raw field data for Da-B, Dayton plot, Benton County. (cont.)

Da-B		
	6/2/92	6/9/92
T-100-1	-73	-75
T-100-2	-74	-73
T-100-3	-77	-70
T-60-1	-104	-149
T-60-2	-338	-419
T-60-3	-285	-444
T-30-1	-799	-946
T-30-2	-579	-869
T-30-3	-842	-961
	MAX	MAX
P-200 M	118	123
P-100-1M	102	109
P-100-2M	100	105
P-100-3M	102	108
	current	current
P-200 C	127	132
P-100-1C	109	-
P-100-2C	106	-
P-100-3C	109	-
	MAX	MAX
P-60-1M	-	-
P-60-2M	-	-
P-60-3M	-	-
	current	current
P-60-1C	-	-
P-60-2C	-	-
P-60-3C	-	-
	MAX	MAX
P-30-1M	-	-
P-30-2M	-	-
P-30-3M	-	-
	current	current
P-30-1C	-	-
P-30-2C	-	-
P-30-3C	-	-
E-100-1	5	-5
E-100-2	-139	-160
E-100-3	55	109
E-60-1	253	256
E-60-2	311	337
E-60-3	195	303
E-30-1	330	323
E-30-2	266	298
E-30-3	355	349
TC-100	16.2	16.2
TC-60	19.1	19
TC-30	20.6	20.6
ambient	22.1	22

Raw field data for Wa-B, Waldo plot, Benton County.

Wa-B	Waldo, Benton county							
	10/10/91	10/17/91	10/24/91	n/a	11/5/91	11/12/91	11/19/91	11/26/91
T-100-1								
T-100-2								
T-100-3								
T-50-1								
T-50-2								
T-50-3								
T-20-1								
T-20-2								
T-20-3								
								MAX
P-200 M								47
P-100-1M								58.5
P-100-2M								82.5
P-100-3M								83.5
P-200 C								
P-100-1C								
P-100-2C								
P-100-3C								
								MAX
P-50-1M								43.5
P-50-2M								
P-50-3M								48
P-50-1C								
P-50-2C								
P-50-3C								
								MAX
P-20-1M								18
P-20-2M								19
P-20-3M								18
P-20-1C								
P-20-2C								
P-20-3C								
E-100-1	211	218	225		179	219	209	172
E-100-2	65	148	202		215	212	209	172
E-100-3	105	155	172		173	155	140	95
E-50-1	233	239	159		198	234	229	232
E-50-2								
E-50-3	199	274	150		166	245	214	183
E-20-1	331	330	332		314	316	304	309
E-20-2	80	83	85		81	88	105	84
E-20-3	312	323	332		320	316	301	307
TC-100	16.1	13.6	16.6		13	12.9	12.2	11.3
TC-50	17.4	15.6	15.1		11	11.9	10	9.7
TC-20	17.7	15.8	13.1		10.3	12	9	9.3
AMBIENT	29.7	13.6	10.3		14.7	15	10.8	10.2

Raw field data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100-1			7	-19	-22	-21	-20	-15	-23
T-100-2			-27	-15	-19	-16	-17	-12	-19
T-100-3			-28	-15	-22	-21	-21	-18	-18
T-50-1			12	-11	-24	-26	-21	-40	-7
T-50-2			-27	-16	-16	-25	-13	-8	-10
T-50-3			-24	-14	-22	-21	-20	-21	-19
T-20-1			-33	-18	-20	-20	-19	-13	-22
T-20-2			-35	-25	-26	-25	-23	-18	-22
T-20-3			-35	-24	-26	-23	-23	-20	-27
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	36		9	4	5.5	3	2	3	2
P-100-1M	27		11	0	1	-2	-1	0	-2
P-100-2M	38		6	1	1.5	-2	-1	0	-1
P-100-3M	42		7	3	4	1	1	3	0
	current	current	current	current	current	current	current	current	current
P-200 C	62	8	14	6	8	5	4	3	3
P-100-1C	54	4	18	2	5.5	4	1	4	0
P-100-2C	60	6	13	5	6	6	3	4	2
P-100-3C	60	13	14	6	9	8	7	7	3
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M			28	18	nd	13	nd	17	nd
P-50-2M	21		4	1	4.5	0	0	0	-1
P-50-3M	26		8	3	5.5	3	3	5	2
	current	current	current	current	current	current	current	current	current
P-50-1C		31	31	18	19	14	16	18	15
P-50-2C		3	10	2	5.5	5	3	5	-1
P-50-3C		5	14	5	7.5	7	5	10	3
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-20-1M	13		5	0	4.5	0	0	2	nd
P-20-2M	17		7	0	5	2	1	0	1
P-20-3M	18		7	2	4.5	0	2	3	0
	current	current	current	current	current	current	current	current	current
P-20-1C		2	14	2	4.5	3	2	4	2
P-20-2C		5	14	6	7.5	8	6	5	1
P-20-3C		45	15	4	7	5	2	4	0
E-100-1	202	204	216	196	189	185	168	103	143
E-100-2	172	162	187	146	106	89	49	-5	10
E-100-3	0	6	11	1	0	5	1	-11	-2
				r2					
E-50-1	232	187	186	211	209	210	189	47	188
E-50-2				188	208	221	197	49	202
E-50-3	147	125	162	176	194	206	183	43	184
				r2					
E-20-1	273	267	261	225	135	81	62	56	37
E-20-2	102	72	100	225	184	90	34	16	0
E-20-3	258	267	228	203	90	50	55	24	5
TC-100	10.6	10.3	9.7		8.7	9.4	8.4	8.4	8
TC-50	8.3	8.2	6.7		7.1	7.7	6.1	5.6	7.3
TC-20	7.7	6.5	4.8		6.3	6.5	5.4	3.8	8
AMBIENT	9.1	2.8	2.9		4.7	1	4	2.4	14.4

Raw field data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B									
	2/4/92	2/11-92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100-1	-60	-18	-13	-24	-17	-22	-20	-24	-23
T-100-2	-60	-17	-2		-21	-20	-13	-21	-17
T-100-3	-69	-13	-11		-15	-14	-20	-16	-16
T-50-1	ND	-16	-7	28	-10	8	-24	5	20
T-50-2	-22	-12	-7	-18	-19	-18	-14	-27	-23
T-50-3	-19	-18	-7	-20	-17	-14	-18	-18	-16
T-20-1	-16	-17	-15	-21	-25	-21	-19	-29	-25
T-20-2	-22	-22	-13	-23	-28	-30	-22	-42	-32
T-20-3	-21	-24	-13	-25	-27	-25	-24	-34	-30
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	3	3	4	0	6	4	6	6	9
P-100-1M	0	0	0	-4	0	0	0	3	5
P-100-2M	0	0	0	-3	3	0	2	4	5
P-100-3M	0	2	2	-1	5	2	5	-	8
	current	current	current	current	current	current	current	current	current
P-200 C	9	7	2	7	9	12	10	18	14
P-100-1C	5	2	2	2	4	6	4	16	10
P-100-2C	5	4	2	2	6	8	5	18	14
P-100-3C	7	5	3	3	10	10	7	18	13
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	17	nd	ND	ND	17	nd	19	2	7
P-50-2M	0	0	0	-4	3	0	3	3	5
P-50-3M	4	5	5	2	6	4	7	8	12
	current	current	current	current	current	current	current	current	current
P-50-1C	17	16	15	17	15	15	19	21	25
P-50-2C	4	5	4	2	6	5	6	13	9
P-50-3C	8	7	6	4	9	7	8	14	12
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-20-1M	5	5	2	-2	4	7	4	9	6
P-20-2M	3	5	2	-2	6	2	5	7	8
P-20-3M	6	2	2	2	5	2	4	7	9
	current	current	current	current	current	current	current	current	current
P-20-1C	5	5	2	5	7	10	6	17	12
P-20-2C	10	7	4	6	10	10	8	-	15
P-20-3C	8	6	3	6	10	11	6	-	15
E-100-1	48	111	144	1	1	0	-5	-1	-1
E-100-2	-11	-11	16	-1	13	0	-5	-1	-6
E-100-3	-17	-3	46	-6	2	-6	-15	-12	-50
E-50-1	10	198	106	181	11	186	169	163	136
E-50-2	8	203	122	190	23	189	168	146	87
E-50-3	7	179	92	143	5	99	104	93	82
E-20-1	7	36	59	45	6	25	20	19	-29
E-20-2	-7	-30	19	25	-175	12	10	10	11
E-20-3	6	3	34	29	5	16	14	15	15
TC-100	9.2	8.1	8.3	9.1	9.4	9.8	9.9	10	10.5
TC-50	8.8	6.8	7.3	9.3	9.5	10	10.4	10.6	11.2
TC-20	7.7	6.9	6.6	10.4	9.5	9.2	10.3	10.4	11.2
AMBIENT	-1.2	6.8	7.4	21.1	8.2	15.4	8	10	17.8

Raw field data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100-1	-33	-14	-19	-21	-48	-71	-73	-84
T-100-2	-29	-15	-12	-16	-48	-71	-64	-80
T-100-3	-27	-14	-9	-13	-30	-66	-71	-83
T-50-1	-15	-28	13	6	15	-54	-58	-54
T-50-2	-33	-15	-11	-27	-39	-61	-66	-69
T-50-3	-31	-16	-11	-13	-38	-59	-67	-66
T-20-1	-34	-16	-17	-27	-25	-159	-215	-246
T-20-2	-29	-15	-28	-42	-59	-161	-340	-466
T-20-3	-35	-20	-22	-32	-72	-252	-359	-429
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-200 M	8	3	3	10	11	39	65	68
P-100-1M	5	0	-1	6	7	38	60	64
P-100-2M	7	0	0	7	7	49	61	64
P-100-3M	6	0	3	9	9	42	63	64
	current	current	current	current	current	current	current	current
P-200 C	21	7	11	20	43	63	69	74
P-100-1C	12	4	11	17	37	62	64	69
P-100-2C	16	5	8	22	38	64	67	71
P-100-3C	16	5	8	22	42	64	68	74
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-50-1M	21	12	5	18	5	-	-	-
P-50-2M	5	0	0	7	6	39	-	-
P-50-3M	11	4	7	12	13	-	-	-
	current	current	current	current	current	current	current	current
P-50-1C	22	13	11	18	24	-	-	-
P-50-2C	5	5	6	14	38	-	-	-
P-50-3C	14	6	11	15	32	-	-	-
	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
P-20-1M	4	0	2	9	8	-	-	-
P-20-2M	8	3	3	11	11	-	-	-
P-20-3M	8	0	1	12	11	-	-	-
	current	current	current	current	current	current	current	current
P-20-1C	13	8	11	18	-	-	-	-
P-20-2C	17	6	13	-	-	-	-	-
P-20-3C	16	6	13	-	-	-	-	-
E-100-1	-2	4	-3	-21	-19	-3	-5	-6
E-100-2	-4	3	-3	-21	-16	-3	-4	-5
E-100-3	-11	2	-10	-25	-52	-7	-14	16
E-50-1	7	7	2	1	1	4	157	251
E-50-2	28	1	3	2	4	9	234	276
E-50-3	37	16	4	3	4	3	101	156
E-20-1	13	20	25	29	-9	342	353	357
E-20-2	6	8	12	15	-35	263	274	287
E-20-3	13	13	20	22	-32	290	345	335
TC-100	10.3	11.2	11.4	12.2	12.9	13	13.4	14.6
TC-50	10.2	11.9	12.4	14.1	15.4	14.5	16.1	17.9
TC-20	9	11.9	11.3	16	17.6	13	16.7	18.8
AMBIENT	8.6	9.2	12.8	20.8	21	13.5	15.3	19.2

Raw field data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B			
	6/2/92	6/9/92	
T-100-1	-83	-81	
T-100-2	-77	-78	
T-100-3	-77	-68	
T-50-1	-44	-61	
T-50-2	-66	-66	
T-50-3	-57	-55	
T-20-1	-288	-299	
T-20-2	-626	-675	
T-20-3	-520	-629	
	MAX	MAX	MAX
P-200 M	73	74	
P-100-1M	68	71	
P-100-2M	68	72	
P-100-3M	72	73	
	current	current	CURREN
P-200 C	79	80	
P-100-1C	76	74	
P-100-2C	77	78	
P-100-3C	77	79	
	MAX	MAX	MAX
P-50-1M	-	-	
P-50-2M	-	-	
P-50-3M	-	-	
	current	current	CURREN
P-50-1C	-	-	
P-50-2C	-	-	
P-50-3C	-	-	
	MAX	MAX	MAX
P-20-1M	-	-	
P-20-2M	-	-	
P-20-3M	-	-	
	current	current	CURREN
P-20-1C	-	-	
P-20-2C	-	-	
P-20-3C	-	-	
E-100-1	-6	-11	
E-100-2	-6	-11	
E-100-3	16	-25	
E-50-1	260	271	
E-50-2	286	290	
E-50-3	222	262	
E-20-1	355	353	
E-20-2	293	281	
E-20-3	370	374	
TC-100	16.5	16.6	
TC-50	20.2	20.1	
TC-20	20.5	20.2	
AMBIENT	20	15.8	

Mean, corrected values from raw data for Wo-P, Woodburn plot, Polk County.

Wo-P	Woodburn, Polk County							
	10/08/91	10/17/91	10/24/91		11/05/91	11/12/91	11/19/91	11/26/91
T-100								
T-50								
T-25								
P-200 MAX								-99
P-200 CUR								
P-100 MAX								-90
P-100 CUR								
P-50 MAX								
P-50 CUR								
P-25 MAX								
P-25 CUR								
E-100		328	406		387	392	415	425
E-50	593	596	610		584	562	570	556
E-25	624	625	577		599	587	586	560
TC-100	17.3	16.7	15.2		12.8	12.6	12.4	10.8
TC-50	16.9	16.5	13.7		10.2	12	10.7	9.4
TC-25	16	15	11.5		9.9	12.1	9.5	9.3
ambient	13.8	16.2	11.7		13	13.3	7.6	8.8
PPT in.	0	0	0.73		2.08	0.41	2.2	2.04
	Oct				Nov			
PPT cm	0.00	0.00	1.85	0.00	5.28	1.04	5.59	5.18

Mean, corrected values from raw data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	12/05/91	12/10/91	12/17/91	12/24/91	12/31/91	01/07/91	01/14/91	01/21/91	01/28/91
T-100		67	39	66	51	44	39	33	83
T-50		19	-8	16	-4	-7	-7	-15	31
T-25		-7	-24	-10	-19	-23	-18	-29	4
P-200 MAX	-64	-45	-59	-34	-49	-36	-55	-63	-26
P-200 CUR		-55	-64	-37	-61	-56	-65	-68	-26
P-100 MAX	-63	-29	-61	-32	-48	-36	-38	-65	-27
P-100 CUR	-77	-51	-67	-39	-60	-53	-65	-72	-30
P-50 MAX		-35		-27	-43	-32			-15
P-50 CUR				-43					-26
P-25 MAX				-23					-21
P-25 CUR									
E-100	377	395	375	386	374	388	406		393
E-50	548	566	551	556	547	554	566		560
E-25	558	570	545	552	552	573	572		584
TC-100	9.7	9.4	8.2	7.2	8.1	7.1	6.6	7	7.6
TC-50	8.2	8.5	5.8	6.1	6.6	6.1	5.5	5.1	7.6
TC-25	7.6	7	3.1	6.1	5.7	4.2	5.4	3	7.7
ambient	9.3	-0.3	2.1	4.3	4.1	8	9.8	7.6	13.4
PPT in.	0.85	0.91	0.11	1.79	0.29	1.01	0.46	0.36	1.68
	Dec					Jan			
PPT cm	2.16	2.31	0.28	4.55	0.74	2.57	1.17	0.91	4.27

Mean, corrected values from raw data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	02/04/91	02/11/91	02/18/91	02/25/91	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	45	38		60	19	26	-7	-4	-22
T-50	-9	-14		5	-32	-23	-69	-120	-231
T-25	-24	-28		-17	-77	-88	-191	-502	-575
P-200 MAX	-29	-62	-79	-15	-52	-84	-91	-114	-129
P-200 CUR	-61	-82	-86	-51	-86	-95	-111	-130	
P-100 MAX	-28	-61	-78	-13	-55	-83	-90		
P-100 CUR	-63	-79	-83	-51	-83	-90			
P-50 MAX	-26			-12					
P-50 CUR									
P-25 MAX				-10					
P-25 CUR									
E-100	407	401	371	394	403	392	399	398	406
E-50	577	583	566	559	574	568	592	582	589
E-25	585	612	604	583	610	602	622	617	621
TC-100	8.1	7.5	8.1	8.9	10.3	10.4	10.1	10.3	11
TC-50	7.5	7.1	7.3	9.6	10.3	10.7	10.6	10.6	11.6
TC-25	6	6.9	6.9	10.4	9.8	9.6	10.3	10	12
ambient	9.4	11.7	9.9	13.1	19.2	18.6	13.3	19.3	22.8
PPT in.	0.62	0.14	0.88	2.77	0.02	0.39	0.13	0.01	0.08
	Feb				Mar				
PPT cm	1.57	0.36	2.24	7.04	0.05	0.99	0.33	0.03	0.20

Mean, corrected values from raw data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	-31	0	44	15	8	-16	-55	-82
T-50	-253	0	-7	-35	-44	-214	-443	-615
T-25	-386	-3	-33	-212	-373	-848	-817	
P-200 MAX	-145	-120	-73	-79	-113	-127	-149	-166
P-200 CUR	-163	-123	-80		-128	-150	-165	-187
P-100 MAX			-72	-83		-98		
P-100 CUR			-80					
P-50 MAX								
P-50 CUR								
P-25 MAX								
P-25 CUR								
E-100	406	399	365	348	357	385	407	414
E-50	596	588	584	578	569	578	585	592
E-25	621	617	622	613	604	611	622	629
TC-100	10.5	15.4	11.3	12.2	13	13.6	13.8	14.5
TC-50	10	15.1	12	13.2	14.8	14.3	15.2	16.3
TC-25	8.3	15.3	11.4	14.3	15.8	13.1	15.2	16.8
ambient	14.6	19.8	11.6	24.1	29	19.9	18.6	27.1
PPT in.	0.32	1.94	0.87	0.13	0.35	0	0	0
	April				May			
PPT cm	0.81	4.93	2.21	0.33	0.89	0.00	0.00	0.00

Mean, corrected values from raw data for Wo-P, Woodburn plot, Polk County. (cont.)

Wo-P		
	6/2/92	6/9/92
T-100		-268
T-50		-799
T-25		
P-200 MAX		-184
P-200 CUR		
P-100 MAX		
P-100 CUR		
P-50 MAX		
P-50 CUR		
P-25 MAX		
P-25 CUR		
E-100		441
E-50		605
E-25		640
TC-100		16.6
TC-50		18.1
TC-25		17.3
ambient		22.4
PPT in.	0	0
	June	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Wa-P, Waldo plot, Polk County.

Wa-P	10/10/91	10/17/91	10/24/91		11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-65								
T-35								
P-200 MAX							-65	-11
P-200 CUR								
P-100 MAX								-42
P-100 CUR								
P-65 MAX								
P-65 CUR								
P-35 MAX								
P-35 CUR								
E-100	425	430	429		415	419	420	414
E-65	322	328	335		361	350	398	367
E-35	576	581	594		565	560	517	350
TC-100	17.9	16.6	15.7		13.2	13	12.4	11.6
TC-65	17.9	16.5	15.1		11.1	12.1	10.7	10
TC-35	18.1	16.5	13		10.1	12	9.5	9.6
ambient	17	15	11.6		12.9	13.2	7.6	8.5
PPT in.	0	0	0.73		2.08	0.41	2.2	2.04
	Oct				Nov			
PPT cm	0.00	0.00	1.85	0.00	5.28	1.04	5.59	5.18

Mean, corrected values from raw data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100	nd	nd	79	84	73	74	66	80	118
T-65	39	50	57	50	42	48	36	31	78
T-35	26	26	7	22	14	8	12	6	41
P-200 MAX	-8	0	-23	2	-19	-29			
P-200 CUR	-40	-23	-34	-16	-30	-29	-32	-41	-1
P-100 MAX	-10	-7	-33	-3	-30	-12	-23	-32	-18
P-100 CUR	-37	-19	-37	-24	-34	-25	-31	-35	-20
P-65 MAX		-13	-20	-46	-46	-39	-39	-43	-40
P-65 CUR		-13	-53	-46	-46	-41	-39	-44	-41
P-35 MAX			-15	2	-23	3	-11	-28	2
P-35 CUR	-25	-22	-34	-20	-31	-29	-21		2
E-100	407	404	400	408	402	402	416	413	412
E-65	359	358	345	349	329	328	326	308	298
E-35	247	253	257	249	251	275	260	265	255
TC-100	10.6	11	8.2	9	8.9	8.1	8.1	7.9	8.2
TC-65	8.9	9.6	5.8	7.1	7.3	6.7	6.2	5.9	7.4
TC-35	8	8.5	3.1	6.4	6.6	5.4	5.3	4.2	7.5
ambient	9.4	1	2.1	4.8	4	6.7	8.9	7.9	11.3
PPT in.	0.85	0.91	0.11	1.79	0.29	1.01	0.46	0.36	1.68
	Dec					Jan			
PPT cm	2.16	2.31	0.28	4.55	0.74	2.57	1.17	0.91	4.27

Mean, corrected values from raw data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	97	82		99	66	71	38	44	26
T-65	65	48		63	36	53	5	34	4
T-35	3	-1		11	-21	-22	-64	-175	-335
P-200 MAX		-47		6	-31	-40	-55	nd	-45
P-200 CUR	-35	-51	-40	-29	-57	-57	-74	-79	-81
P-100 MAX	-11	-38	-36	-8	-40	-49	-69	-83	-87
P-100 CUR	-30	-44	-40	-25	-61	-64	-80	-87	-91
P-65 MAX	-28	-15	-47	-27	-44	-49	-56	-60	
P-65 CUR	-46	-44	-42	-33	-47	-50	-60		
P-35 MAX	3	-12	-2	-19	-20	-34			
P-35 CUR			-4	-10					
E-100	406	431	405	410	414	414	417	408	408
E-65	291	288	225	273	258	249	251	326	358
E-35	261	273	129	269	263	265	339	425	565
TC-100	8.3	8.3	8.4	8.9	9.5	10.9	10	10.6	11
TC-65	6.8	6.9	7.6	9.5	10.2	11.5	11.5	11.3	12
TC-35	7	7	7.2	10	9.3	10.6	10.6	10.6	11.7
ambient	12.6	11.2	9.6	13.5	17.4	20	14.4	20	22.2
PPT in.	0.62	0.14	0.88	2.77	0.02	0.39	0.13	0.01	0.08
	Feb				Mar				
PPT cm	1.57	0.36	2.24	7.04	0.05	0.99	0.33	0.03	0.20

Mean, corrected values from raw data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	22	85	45	47	47	30	-8	22
T-65	-28	56	3	23	51	2	-60	-58
T-35	-379	-6	23	-65	-110	-408	-602	-738
P-200 MAX	-78	-32	-21	-48	-68	-72	-79	-86
P-200 CUR	-85	-42	-49	-70	-73	-79	-85	-96
P-100 MAX	-88	-49	-25	-58	-78	-85	-91	-94
P-100 CUR	-93	-54	-60	-78	-83	-88	-94	
P-65 MAX			-52	-63				
P-65 CUR			-52					
P-35 MAX			-27					
P-35 CUR								
E-100	244	248	409	398	391	396	384	384
E-65	245	248	382	343	336	352	387	436
E-35	244	255	356	382	347	516	607	633
TC-100	10.8	14.3	11.5	12.3	12.6	13.4	13.7	15.2
TC-65	nd	15	12	13.4	13.8	14.2	15.2	17
TC-35	9.3	14.1	12.1	14.5	15.3	14	16.3	18.7
ambient	14.2	20.3	9.6	24.7	27.7	18.8	18.9	25.8
PPT in.	0.32	1.94	0.87	0.13	0.35	0	0	0
	April				May			
PPT cm	0.81	4.93	2.21	0.33	0.89	0.00	0.00	0.00

Mean, corrected values from raw data for Wa-P, Waldo plot, Polk County. (cont.)

Wa-P		
	6/2/92	6/9/92
T-100	19	-7
T-65	-115	-335
T-35	-748	-718
P-200 MAX	-93	-100
P-200 CUR	-103	-122
P-100 MAX	-98	
P-100 CUR		
P-65 MAX		
P-65 CUR		
P-35 MAX		
P-35 CUR		
E-100	390	420
E-65	450	475
E-35	639	642
TC-100		17
TC-65		18.3
TC-35		18.9
ambient		25.3
PPT in.	0	0
	June	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Am-P, Amity plot, Polk County.

Am-P	10/8/91	10/17/91	10/24/91		11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-64								
T-38								
P-200 MAX								-88
P-200 CUR								
P-100 MAX								-93
P-100 CUR								
P-64 MAX								
P-64 CUR								
P-38 MAX								
P-38 CUR								
E-100	573	524	540		530	520	505	477
E-64	538	561	581		562	551	558	530
E-38	517	516	550		525	514	517	490
TC-100	17.8	16.7	15.7		12.9	12.8	11.4	11.2
TC-64	18	16.5	14.6		10.9	12.1	10.6	9.8
TC-38	18	16.5	12.9		9.9	11.9	9.5	9.4
ambient	19	12.9	12.1		12.7	13.4	7.5	8.8
PPT in.	0	0	0.73		2.08	0.41	2.2	2.04
	Oct				Nov			
PPT cm	0.00	0.00	1.85	0.00	5.28	1.04	5.59	5.18

Mean, corrected values from raw data for Am-P, Amity plot, Polk County. (cont.)

Am-P	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100	86	88	79	102	92	99	90	83	103
T-64	42	58	48	66	64	58	51	52	70
T-38	7	38	17	41	35	29	32	23	43
P-200 MAX		-16	-16	-6	-14		-15	-20	-4
P-200 CUR	-47	-16	-25	-8	-17	-17	-19	-27	-10
P-100 MAX		-12	-21	-3	-6	-2	-7	-10	-6
P-100 CUR	-49	-20	-26	-6	-12	-7	-12	-19	-7
P-64 MAX	-16	-8	-16	-1	-2	-1	-3	-5	-3
P-64 CUR	-51		-27	-5	-13	-11	-15	-18	-3
P-38 MAX		-7	-16	-2	-2	-1	-4	-6	-4
P-38 CUR		-16	-26	-3	-10	-11	-12	-18	-4
E-100	487	475	462	416	481	424	491	500	468
E-64	532	533	506	471	501	508	519	520	509
E-38	493	491	468	445	441	448	412	406	379
TC-100	10.1	10.6	9.1	8.4	8.4	8.5	7.5	7.4	7.7
TC-64	8.6	9.3	7	6.9	7.1	7.1	5.9	5.4	7
TC-38	7.9	8.1	4.9	6.3	6.1	6	5.2	3.8	7.3
ambient	9.4	0.2	2.2	4.6	6.2	4.9	7.8	8.3	10.8
PPT in.	0.85	0.91	0.11	1.79	0.29	1.01	0.46	0.36	1.68
	Dec					Jan			
PPT cm	2.16	2.31	0.28	4.55	0.74	2.57	1.17	0.91	4.27

Mean, corrected values from raw data for Am-P, Amity plot, Polk County. (cont.)

Am-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	88	82		98	73	76	45	42	29
T-64	52	43		61	29	35	15	14	-9
T-38	23	20		33	2	4	-10	-29	-53
P-200 MAX	0	-29	nd	ND	-24	-28	-44	-60	-72
P-200 CUR	-22	-29	-30	-13	-42	-44	-64	-78	-85
P-100 MAX	-2	-20	-28	-2	-20	-28	-45	-58	-71
P-100 CUR	-15	-22	-27	-9	-31	-37	-55	-68	-81
P-64 MAX	0	-14	-14	-0	-13	-24	-42	-55	-58
P-64 CUR	-15	-24	-15	-13	-38	-42	-57		
P-38 MAX	-1	-15	-14	-1	-13	-23			
P-38 CUR	-12	-23	-13	-12					
E-100	474	478	428		446	470	469	455	454
E-64	477	452	422	416	373	359	349	323	589
E-38	347	350	301	322	299	278	253	520	548
TC-100	8.2	7.9	8	8.4	9.5	10.1	10.1	10.5	11.1
TC-64	7.6	7.6	7.4	8.9	9.4	10.1	10.1	10.7	11.5
TC-38	6.8	7.6	7.1	10.1	9.5	10	10.8	10.9	11.7
ambient	12.5	8.9	9.1	16.1	18.5	17.9	15.6	18.7	21.9
PPT in.	0.62	0.14	0.88	2.77	0.02	0.39	0.13	0.01	0.08
	Feb				Mar				
PPT cm	1.57	0.36	2.24	7.04	0.05	0.99	0.33	0.03	0.20

Mean, corrected values from raw data for Am-P, Amity plot, Polk County. (cont.)

Am-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	19	49	62	49	50	31	21	18
T-64	-17	16	27	14	9	-4	-6	-31
T-38	-59	-5	8	-16	-34	-103	-273	-423
P-200 MAX	-81	-58	-33	-43	-60	-68	-83	-93
P-200 CUR	-164	nd	-43	-64	-60	-84	-93	-106
P-100 MAX	-83	-63	-34	-39	-61	-74	-85	-93
P-100 CUR	-90	-63	-39	-61	-69	-82	-92	
P-64 MAX		-56	-28	-44	-60			
P-64 CUR		-56	-43					
P-38 MAX			-29					
P-38 CUR								
E-100	458	455	465	455	458	469	470	467
E-64	591	590	582	557	533	594	595	601
E-38	556	518	404	559	579	590	604	600
TC-100	10.7	14.2	11.1	12.6	12.2	12.9	14	14.4
TC-64	10.1	14.2	11.9	13.5	13.7	13.9	15.2	16.3
TC-38	9.4	15	12.1	14.9	15.9	13.9	16.7	18.7
ambient	15.2	27	8.9	23.6	29.6	18.6	23.5	25.6
PPT in.	0.32	1.94	0.87	0.13	0.35	0	0	0
	Apr				May			
PPT cm	0.81	4.93	2.21	0.33	0.89	0.00	0.00	0.00

Mean, corrected values from raw data for Am-P, Amity plot, Polk County. (cont.)

Am-P		
	6/2/92	6/9/92
T-100	14	0
T-64	-63	-174
T-38	-600	-684
P-200 MAX	-105	-116
P-200 CUR	-121	-148
P-100 MAX		
P-100 CUR		
P-64 MAX		
P-64 CUR		
P-38 MAX		
P-38 CUR		
E-100	482	508
E-64		606
E-38		598
TC-100		16.3
TC-64		18
TC-38		19.3
ambient		26.3
PPT in.	0	0
	Jun	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Da-P, Dayton plot, Polk County.

Da-P	10/18/91	10/17/91	10/24/91		11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-60								
T-35								
P-200 MAX								-100
P-200 CUR								
P-100 MAX								-41
P-100 CUR								
P-60 MAX								-35
P-60 CUR								
P-35 MAX								-21
P-35 CUR								
E-100	411	411	401		417	420	422	397
E-60	473	481	500		512	463	465	441
E-35	567	578	571		564	549	544	543
TC-100	17.4	16.2	15.4		12.8	12.8	12.1	11.2
TC-60	17.6	16.3	14.4		11.2	12.1	10.4	9.7
TC-35	17.3	15.9	12.5		9.9	11.8	9.2	9.3
ambient	11.2	8.3	12.7		12.5	13.4	8.5	7.9
PPT in.	0	0	0.73		2.08	0.41	2.2	2.04
	Oct				Nov			
PPT cm	0.00	0.00	1.85	0.00	5.28	1.04	5.59	5.18

Mean, corrected values from raw data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100	97	112	91	106	101	86	102	94	108
T-60	70	65	52	69	61	57	53	62	68
T-35	32	40	28	41	34	34	36	35	42
P-200 MAX					-17	-9		-16	-12
P-200 CUR	-57	-50	-31	-22	-33	-30		-24	-19
P-100 MAX			-10	-3	-0	2	-2	-2	1
P-100 CUR	-22	-13	-17	-4	-6	-8	-4	-11	1
P-60 MAX		-5	-9	0	0	1	-0	-3	1
P-60 CUR	-19	-13	-15	-2	-3	-8	-3	-9	1
P-35 MAX		0	-1	-2	-1	2	2	-2	1
P-35 CUR	-10	-5	-15	-3	-6	-10	-4	-8	1
E-100	393	389	388	415	412	418	411	421	423
E-60	450	449	438	447	450	454	440	401	422
E-35	538	535	525	517	521	525	510	505	499
TC-100	10.3	10.5	9.5	8.6	8.5	8.4	7.6	7.9	7.7
TC-60	8.5	9.2	7.3	6.9	7.2	7.4	6.1	5.7	7.1
TC-35	7.8	8	5	6.4	6.1	6.1	5.3	3.9	7.3
ambient	9.6	1	1.8	5.9	5.1	4.8	7.5	8.5	9.4
PPT in.	0.85	0.91	0.11	1.79	0.29	1.01	0.46	0.36	1.68
	Dec					Jan			
PPT cm	2.16	2.31	0.28	4.55	0.74	2.57	1.17	0.91	4.27

Mean, corrected values from raw data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	81	102		98	65	85	57	44	37
T-60	47	59		67	37	46	27	6	5
T-35	26	36		30	2	13	3	-23	-32
P-200 MAX	-4	-19	-21	-156	-18	-33	-33	-47	-65
P-200 CUR	-23	-21	-30	-19	-38	-33	-55	-67	-84
P-100 MAX	3	-3	-4	0	-18	-3	-30	-43	-65
P-100 CUR	-12	-4	-6	-8	-30	-23	-42	-61	-75
P-60 MAX	2	-1	-1	2	-13	-1	-32	-39	-60
P-60 CUR	-11	-2	-3	-9	-31	-27	-43		
P-35 MAX	-2	0	-1	1	-14	-0	-27		
P-35 CUR	-12	-5	-1	-10	-29	-27			
E-100	407	418	439	420	422	413	410	412	414
E-60	406	405	408	374	340	313	321	303	318
E-35	488	476	405	387	335	306	252	344	455
TC-100	8.2	8.1	8.1	8.5	9.5	9.9	10.2	10.6	11.4
TC-60	7.7	7.9	7.5	9	9.7	10.3	10.8	10.9	11.7
TC-35	7.1	7.8	7.3	9.8	9.5	9.5	10.8	10.9	11.9
ambient	12.2	9.2	10.7	14.8	16.1	21.2	16.9	18.9	21.9
PPT in.	0.62	0.14	0.88	2.77	0.02	0.39	0.13	0.01	0.08
	Feb				Mar				
PPT cm	1.57	0.36	2.24	7.04	0.05	0.99	0.33	0.03	0.20

Mean, corrected values from raw data for Da-P, Dayton plot, Polk County. (cont.)

Da-P	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	32	97	82	60	51	32	31	26
T-60	-10	63	44	18	15	26	-5	-21
T-35	-31	35	19	-7	-20	-202	-467	-638
P-200 MAX	-76	-26	-5	-27	-45	-65	-76	-87
P-200 CUR	-90	-29	-27	-53	-54	-78	-87	-99
P-100 MAX	-76	-4	-1	-23	-29	-65	-83	-89
P-100 CUR	-77	-8	-23	-50	-61	-82	-87	-92
P-60 MAX		-1	1	-25	-24	-60		
P-60 CUR		-7	-25	-52				
P-35 MAX		2	2	-29	-27			
P-35 CUR		-7	-29					
E-100	435	406	417	411	406	422	420	415
E-60	394	362	337	315	297	433	475	479
E-35	554	526	494	422	362	600	614	619
TC-100	10.7	14.1	11.2	12.4	12.6	12.9	13.8	14.6
TC-60	10.1	14.2	11.9	13.4	14.1	14.2	15.3	16.7
TC-35	9.4	15	11.9	14.6	15.9	13.9	16	18.8
ambient	15.2	21.5	9.8	23.7	30.2	16.1	22.3	24.8
PPT in.	0.32	1.94	0.87	0.13	0.35	0	0	0
	Apr				May			
PPT cm	0.81	4.93	2.21	0.33	0.89	0.00	0.00	0.00

Mean, corrected values from raw data for Da-P, Dayton plot, Polk County. (cont.)

Da-P		
	6/2/92	6/9/92
T-100	23	8
T-60	-35	-49
T-35	-674	-677
P-200 MAX	-100	-105
P-200 CUR	-109	-122
P-100 MAX	-93	-95
P-100 CUR	-95	-102
P-60 MAX		
P-60 CUR		
P-35 MAX		
P-35 CUR		
E-100	420	419
E-60	488	495
E-35		626
TC-100		17.3
TC-60		19.4
TC-35		19.8
ambient		25.6
PPT in.	0	0
	Jun	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Wo-B, Woodburn plot, Benton County.

Wo-B								
	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-50								
T-25								
P-200 MAX								
P-200 CUR								
P-100 MAX								-93
P-100 CUR								
P-50 MAX								
P-50 CUR								
P-35 MAX								
P-35 CUR								
E-100	529	533	547	540	533	532	536	510
E-50	520		553	563	548	537	539	534
E-35	571	571	575	562	548	534	517	437
TC-100	16.5	14.1	14.8	13.9	12.8	12.9	12.1	11.3
TC-50	16.9	15.1	13.7	11.7	10.7	12.1	10.2	9.9
TC-25	17.1	15.2	12.1	9.7	10.3	12	9.3	9.4
ambient	30.4	13.2	8.5	10.2	15.1	15.4	11.8	8.8
PPT in.	0	0	0.67	1.1	0.89	0.17	1.48	1.64
	Oct				Nov			
PPT cm	0.00	0.00	1.70	2.79	2.26	0.43	3.76	4.17

Mean, corrected values from raw data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100			12	48	38	59	57	50	82
T-50			-22	-1	-8	13	9	2	33
T-25			-23	-12	-17	-14	-11	-14	7
P-200 MAX			-171	-135	-122	-103	-103	-104	-95
P-200 CUR			-174	-135	-124	-106	-105	-114	-96
P-100 MAX	-89	-65	-84	-50	-56	-34	-37	-47	-20
P-100 CUR	-98	-84	-90	-54	-64	-46	-46	-53	-26
P-50 MAX				-48		-31	-32	-40	-11
P-50 CUR						-43	-46		-22
P-35 MAX									-13
P-35 CUR									-22
E-100	507	514	503	493	488	482	465	378	411
E-50	511	507	504	491	497	496	506	417	479
E-35	446	441	453	482	485	478	475	410	414
TC-100	10.5	10.2	9.9	8.5	8.6	9	7.5	8	7.8
TC-50	8.7	8.5	7.2	6.7	7.3	7.9	5.4	6.1	7.5
TC-25	8.1	6.9	5.3	6	6.6	6.3	4.7	3.9	7.8
ambient	9	4.1	2	6.9	5.6	2.1	7	6.5	12.2
PPT in.	0.3	0.66	0.08	0.86	0.19	1.16	0.53	0.33	1.85
	Dec					Jan			
PPT cm	0.76	1.68	0.20	2.18	0.48	2.95	1.35	0.84	4.70

Mean, corrected values from raw data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/17/92	3/31/92
T-100	57	62		62	42	45	36	33	17
T-50	8	13		15	-11	-5	-14	-11	-27
T-25	-9	-9		-12	-32	-29	-28	-120	-135
P-200 MAX	-87	-39	-87	nd	-59	-91	-87	-103	-104
P-200 CUR	-90	-48	-94	nd	-64	-92	-93	-105	-119
P-100 MAX	-29	-40	-39	-9	-43	-43	-59	-63	-74
P-100 CUR	-47	-48	-40	-42	-56	-56	-63	-74	-85
P-50 MAX	-22	-38	-35	-4	-39	-40			
P-50 CUR	-44	-44	-35	-39					
P-35 MAX	-23			-5					
P-35 CUR									
E-100	360	359	318	334	356	320	308	297	292
E-50	434	482	472	499	482	479	528	550	574
E-35	378	371	381	334	407	408	440	490	516
TC-100	9.2	8.1	8.3	9.3	9.4	9.7	9.9	10.2	11.1
TC-50	8.5	7.1	7.6	9.6	9.6	10.3	10.6	10.9	11.9
TC-25	7.6	6.9	7	10.9	9.2	9.5	10.7	11	11.9
ambient	1.4	6.6	9.2	19.8	15.4	10.9	11.3	13.5	19.1
PPT in.	0.2	0.25	1.22	2.56	0.03	0.59	0.3	0	0.37
	Feb				Mar				
PPT cm	0.51	0.64	3.10	6.50	0.08	1.50	0.76	0.00	0.94

Mean, corrected values from raw data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	15	76	58	43	37	19	4	-2
T-50	-40	23	10	2	-8	-31	-66	-100
T-25	-163	2	-13	-73	-133	-424	-677	-804
P-200 MAX	-113	-73	-69	-64	-74	-83	-97	-112
P-200 CUR	-127	-78	-69	-74	-85	-102	-116	-135
P-100 MAX	-85	-26	-41	-55	-63	-74	-91	
P-100 CUR	-92	-40	-52	-70	-74	-91		
P-50 MAX		-25	-37					
P-50 CUR		-37						
P-35 MAX		-24						
P-35 CUR								
E-100	291	306	297	290	282	305	295	446
E-50	574	546	540	566	566	577	558	547
E-35	530	333	377	519	519	554	556	557
TC-100	10.9	12.5	11.9	12.7	14.4	14.8	15	15.9
TC-50	11	13.2	12.9	14.2	16.8	16.2	17.7	19.2
TC-25	10.3	13.8	12.4	15.7	18.7	15.6	19	20.4
ambient	12.9	15.6	11.7	24.7	25.5	16.7	23.6	19.2
PPT in.	0.34	2.49	0.42	0.08	0.01	0	0	0
	Apr				May			
PPT cm	0.86	6.32	1.07	0.20	0.03	0.00	0.00	0.00

Mean, corrected values from raw data for Wo-B, Woodburn plot, Benton County. (cont.)

Wo-B		
		6/9/92
T-100		-32
T-50		-304
T-25		-891
P-200 MAX		-138
P-200 CUR		-191
P-100 MAX		
P-100 CUR		
P-50 MAX		
P-50 CUR		
P-35 MAX		
P-35 CUR		
E-100		503
E-50		538
E-35		572
TC-100		17.5
TC-50		20.6
TC-25		21.5
ambient		17.9
PPT in.	0	0
Jun		
PPT cm	0.00	0.00

Mean, corrected values from raw data for Wi-B, Willamette plot, Benton County.

Wi-B	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-50								
T-25								
P-200 MAX								
P-200 CUR								
P-100 MAX								
P-100 CUR								
P-50 MAX								
P-50 CUR								
P-25 MAX								
P-25 CUR								
E-100	480	489	512	508	519	507	536	486
E-50	569	576	591	578	586	584	612	573
E-25	602	606	615	601	604	616	625	605
TC-100	14	12.1	11.6	10.8	9.8	10.4	9.9	9.3
TC-50	13	11.8	10.4	9.2	8.9	10.4	8.8	8.6
TC-25	12	10.8	9.2	7.5	9.1	11.1	8.1	8.6
ambient	21	8.8	8.7	6.2	15	14.8	10	10
PPT in.	0	0	0.67	1.1	0.89	0.17	1.48	1.64
	Oct				Nov			
PPT cm	0.00	0.00	1.70	2.79	2.26	0.43	3.76	4.17

Mean, corrected values from raw data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100			-8	20	17	54	53	53	75
T-50			-25	-12	-19	-0	3	3	25
T-25			-27	-14	-19	-10	-9	-13	6
P-200 MAX				nd	-95	-49	-47	-48	-27
P-200 CUR				-112	-100	-62	-53	-59	-31
P-100 MAX				-92	-88	-45	-45	-47	-25
P-100 CUR				-93	-91	-58	-61	-66	-31
P-50 MAX						-38	-40	-42	-24
P-50 CUR							-46		-29
P-25 MAX									-23
P-25 CUR									
E-100	512	396	452	423	390	392	390	380	370
E-50	603	576	584	579	583	576	575	536	570
E-25	622	586	584	582	584	591	587	581	598
TC-100	8.6	8.7	8.3	7	6.5	7.7	7	6.7	7.6
TC-50	7.5	7.4	6.2	5.8	5.8	6.8	5.2	4.6	6.6
TC-25	7.3	6.3	4.3	5.3	5.2	5.8	4.6	3	7.4
ambient	8.9	4.2	2.1	6.2	5.8	1.4	6.1	4.4	11.2
PPT in.	0.3	0.66	0.08	0.86	0.19	1.16	0.53	0.33	1.85
	Dec					Jan			
PPT cm	0.76	1.68	0.20	2.18	0.48	2.95	1.35	0.84	4.70

Mean, corrected values from raw data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	76	62		84	72	64	63	50	51
T-50	15	13		34	22	14	15	-2	2
T-25	-7	-9		10	-1	-10	-8	-21	-17
P-200 MAX	-36	-39	-33	-8	-24	-26	-39	-41	-54
P-200 CUR	-45	-48	-35	-24	-42	-41	-45	-58	-54
P-100 MAX	-33	-40	-30	-5	-23	-25	-40	-45	-54
P-100 CUR	-50	-48	-30	-22	-37	-42	-44	-57	-59
P-50 MAX	-28	-38	-30	-4	-20	-23	-40	-45	
P-50 CUR	-42	-44	-30	-20	-34	-41	-42		
P-25 MAX			-22	-3	-21			-24	
P-25 CUR			-22						
E-100	360	330	294	310	298	298	288	281	286
E-50	531	514	450	452	405	382	380	428	625
E-25	603	608	615	437	615	623	635	634	638
TC-100	8.1	6.8	6.9	8.1	8.2	8.2	8.5	8.4	9
TC-50	8	6	6.3	8.2	8.3	8.1	8.7	8.5	9.4
TC-25	6.9	5.8	5.9	9.4	8.4	7.3	8.8	8.2	9.6
ambient	0.3	6.7	9.3	19.5	13.1	9.8	9.5	13	23
PPT in.	0.2	0.25	1.22	2.56	0.03	0.59	0.3	0	0.37
	Feb				Mar				
PPT cm	0.51	0.64	3.10	6.50	0.08	1.50	0.76	0.00	0.94

Mean, corrected values from raw data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	45	81	70	59	48	24	11	-7
T-50	-2	32	21	6	-1	-29	-61	-98
T-25	-18	11	-4	-20	-46	-179	-382	-522
P-200 MAX	-56	-13	-24	-34	-40	-61	-90	-107
P-200 CUR	-64	-30	-34	-34	-63	-87	-106	-122
P-100 MAX	-58	-8	-24	-38	-56	-64	-91	
P-100 CUR	-62	-30	-39	-38	-66	-93		
P-50 MAX		-10	-22	-36	-38			
P-50 CUR		-27	-35					
P-25 MAX		-10						
P-25 CUR								
E-100	268	259	260	253	262	265	278	459
E-50	634	614	544	476	523	632	625	615
E-25	649	493	642	655	658	663	652	645
TC-100	8.8	10.2	9.7	10.8	11.3	11.4	12.2	12.8
TC-50	8.5	11.1	10.8	11.8	12.6	12	13.9	14.6
TC-25	7.3	11.2	9.9	13.5	14.2	11	14.1	16
ambient	9.5	12.7	11.8	22.1	21.6	12.8	17.7	19
PPT in.	0.34	2.49	0.42	0.08	0.1	0	0	0
	Apr				May			
PPT cm	0.86	6.32	1.07	0.20	0.25	0.00	0.00	0.00

Mean, corrected values from raw data for Wi-B, Willamette plot, Benton County. (cont.)

Wi-B		
		6/9/92
T-100	na	-49
T-50	na	-230
T-25	na	-842
P-200 MAX	na	-128
P-200 CUR	na	-181
P-100 MAX	na	
P-100 CUR	na	
P-50 MAX	na	
P-50 CUR	na	
P-25 MAX	na	
P-25 CUR	na	
E-100	na	527
E-50	na	616
E-25	na	644
TC-100	na	13.9
TC-50	na	15.6
TC-25	na	15.8
ambient	na	15.8
PPT in.	0	0
	Jun	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Am-B, Amity plot, Benton County.

Am-B	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-50								
T-25								
P-200 MAX								
P-200 CUR								
P-100 MAX								-94
P-100 CUR								
P-50 MAX								-46
P-50 CUR								
P-25 MAX								
P-25 CUR								
E-100	483	495	506	522	508	506	511	479
E-50	554	558	574	563	559	551	524	400
E-25	541	546	577	547	549	531	522	532
TC-100	16.5	14.3	14.4	13.4	12.3	12.3	11.7	11.2
TC-50	17.2	14.4	13.1	11	10.1	11.8	9.7	9.6
TC-25	16	13.3	11.7	9.1	10	12	8.9	9.4
AMBIENT	26.2	7.9	7	6	14.9	14.3	9.8	10.2
PPt in.	0	0	0.67	1.1	0.89	0.17	1.48	1.64
	Oct				Nov			
PPT cm	0.00	0.00	1.70	2.79	2.26	0.43	3.76	4.17

Mean, corrected values from raw data for Am-B, Amity plot, Benton County. (cont.)

Am-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100			48	100	86	100	102	105	101
T-50			-2	45	36	51	52	52	54
T-25			-23	20	10	25	29	26	29
P-200 MAX	-135	-77	-91	-42	-36	-26	-24	-25	-16
P-200 CUR	-164	-96	-93	-42	-54	-39	-27	-28	-25
P-100 MAX	-80	-23	-50	-9	-12	0	-3	-8	-1
P-100 CUR	-93	-40	-55	-11	-18	-5	-7	-11	-4
P-50 MAX	-47	-16	-47	-6	-12	-2	-0	-6	-2
P-50 CUR		-48		-11	-17	-6	-4	-7	-3
P-25 MAX		-15		-7	-10	0	1	-7	-3
P-25 CUR				-10	-15	-4	-5	-9	-4
E-100	498	496	490	470	471	478	466	478	469
E-50	415	367	514	348	330	317	391	400	372
E-25	545	528	530	519	446	372	292	284	274
TC-100	10.2	10	10	8.3	8.3	9	8.1	8	7.8
TC-50	8.2	7.9	6.6	6.4	6.9	7.4	6.8	5	7.3
TC-25	7.7	6.4	4.8	5.9	6.5	6.1	6.1	3.6	8.1
AMBIENT	8.8	4.2	2.1	6.8	7.6	1.4	1.6	3.4	13.4
PPt in.	0.3	0.66	0.08	0.86	0.19	1.16	0.53	0.33	1.85
	Dec					Jan			
PPT cm	0.76	1.68	0.20	2.18	0.48	2.95	1.35	0.84	4.70

Mean, corrected values from raw data for Am-B, Amity plot, Benton County. (cont.)

Am-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	103	100	109	104	107	107	102	100	99
T-50	50	52	60	50	43	47	52	37	44
T-25	27	26	36	25	21	23	30	13	19
P-200 MAX	-11	-8	-13	-18	-5	-11	-12	-10	-20
P-200 CUR	-26	-15	-26	-27	-14	-23	-16	-22	-27
P-100 MAX	-5	-7	-3	-2	-9	-6	-7	-11	-9
P-100 CUR	-10	-6	-6	-6	-12	-11	-9	-22	-14
P-50 MAX	-3	-3	-3	-2	-6	-4	-5	-6	-5
P-50 CUR	-8	-4	-5	-5	-9	-9	-7	-17	-11
P-25 MAX	-5	-5	-5	-6	-6	-7	-7	-10	-5
P-25 CUR	-7	-8	-8	-7	-9	-11	-9	-21	-11
E-100	454	461	435	440	419	401	369	342	322
E-50	363	259	303	269	316	265	238	242	241
E-25	261	239	206	251	167	227	232	234	234
TC-100	9.2	7.8	7.8	9.1	9.1	10.2	9.5	10.4	10.5
TC-50	8.8	6.8	7	9.6	9.3	10.3	10.3	11.2	11.1
TC-25	7.7	6.8	6.3	10.9	9.2	9.7	10.2	10.7	11
AMBIENT	-1.2	6.1	7.7	20.3	14.7	13	8.5	16	18.2
PPt in.	0.2	0.25	1.22	2.56	0.03	0.59	0.3	0	0.37
	Feb				Mar				
PPT cm	0.51	0.64	3.10	6.50	0.08	1.50	0.76	0.00	0.94

Mean, corrected values from raw data for Am-B, Amity plot, Benton County. (cont.)

Am-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	90	107	97	107	103	72	71	59
T-50	43	56	46	43	33	16	2	-8
T-25	19	33	20	22	12	-11	-34	-67
P-200 MAX	-17	-10	-9	-11	-10	-15	-35	-51
P-200 CUR	-27	-17	-13	-18	-15	-38	-54	-66
P-100 MAX	-9	-4	-7	-15	-16	-42	-58	-65
P-100 CUR	-17	-6	-10	-17	-28	-47	-60	-69
P-50 MAX	-5	-3	-4	-10	-4	-25	-44	
P-50 CUR	-16	-6	-9	-12	-24	-45		
P-25 MAX	-7	-5	-5	-9	-6	-23		
P-25 CUR	-17	-8	-8	-14	-24			
E-100	306	279	259	245	241	230	239	251
E-50	231	235	234	234	219	228	276	496
E-25	237	235	226	228	219	234	572	610
TC-100	10.5	11.1	11.4	13	13.8	13.6	13.7	13.8
TC-50	10.3	12	12.3	18	15.9	14.8	15.8	16.8
TC-25	9	12.1	11.2	14	17.2	13.8	16.6	14
AMBIENT	9.4	10.6	13	21.5	26.6	16.1	19	23.1
PPt in.	0.34	2.49	0.42	0.08	0.1	0	0	0
	Apr				May			
PPT cm	0.86	6.32	1.07	0.20	0.25	0.00	0.00	0.00

Mean, corrected values from raw data for Am-B, Amity plot, Benton County. (cont.)

Am-B		
	6/2/92	6/9/92
T-100	40	48
T-50	-21	-47
T-25	-160	-270
P-200 MAX	-65	-78
P-200 CUR	-87	-92
P-100 MAX	-72	-82
P-100 CUR	-78	-60
P-50 MAX		
P-50 CUR		
P-25 MAX		
P-25 CUR		
E-100	254	250
E-50	565	566
E-25	615	592
TC-100	16.4	16.2
TC-50	19.5	19.6
TC-25	20.1	20.3
AMBIENT	22	21.5
PPt in.	0	0
	Jun	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Da-B, Dayton plot, Benton County.

Da-B	10/10/91	10/17/91	10/24/91	10/29/91	11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-60								
T-30								
P-200 MAX								
P-200 CUR								
P-100 MAX								
P-100 CUR								
P-60 MAX							-26	-46
P-60 CUR								
P-30 MAX								-20
P-30 CUR								
E-100	511	527	546	525	526	511	504	490
E-60	552	601	623	591	612	594	593	534
E-30	585	576	603	591	591	562	567	503
TC-1OO	15.8	14.6	14.2	13.2	12.5	12.4	11.9	11.2
TC-60	15.9	14.6	13.4	11.5	10.6	11.7	10.3	9.6
TC-30	15.6	14.2	12.1	9.6	9.9	11.87	9.1	9.4
ambient	22.3	7	7	5.7	14.8	14.3	9.2	10.2
PPT in.	0	0	0.67	1.1	0.89	0.17	1.48	1.64
	Oct				Nov			
PPT cm	0.00	0.00	1.70	2.79	2.26	0.43	3.76	4.17

Mean, corrected values from raw data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100			63	95	78	84	93	-18	98
T-60			33	68	47	57	59	54	69
T-30			-2	26	10	31	28	31	35
P-200 MAX				-172	-151	-124	nd	-109	-96
P-200 CUR				-173	-161	-136	-124	-110	-106
P-100 MAX		-99	-73	-60	-55	-47	-47	-43	-43
P-100 CUR		-99	-81	-61	-56	-57	-44	-45	-43
P-60 MAX	-36	-9	-37	-5	-11	-8	-3	-5	-2
P-60 CUR		-26	-43	-12	-22	-13	-11	-14	-3
P-30 MAX	-17	-9	-23	-5	-10	-4	-3	-5	-3
P-30 CUR		-25		-10	-22	-11	-9	-13	-4
E-100	595	492	499	494	451	471	426	414	392
E-60	516	476	389	253	244	237	244	257	242
E-30	521	491	467	377	324	267	289	274	229
TC-100	10.7	10.4	10	9.1	8.4	9.2	8.3	8.3	7.8
TC-60	8.7	8.6	7.5	7.2	6.8	7.8	6.5	6.1	7.1
TC-30	7.8	6.9	5.4	6.6	6.2	6.8	5.4	4.3	7.7
ambient	9	3.8	2.8	6.7	9	1	4.1	4	13
PPT in.	0.3	0.66	0.08	0.86	0.19	1.16	0.53	0.33	1.85
	Dec					Jan			
PPT cm	0.76	1.68	0.20	2.18	0.48	current	1.35	0.84	4.70

Mean, corrected values from raw data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	2/4/92	2/11/92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	96	87	103	120	105	113	86	89	89
T-60	48	59	64	82	61	61	63	41	51
T-30	34	29	40	29	7	13	29	-12	-6
P-200 MAX	-89	nd	-66	-92	-73	nd	-81	-82	-98
P-200 CUR	-102	-65	-99	-95	-86	-80	-92	-102	-118
P-100 MAX	-41	-45	-47	-43	-44	-48	-53	-58	-71
P-100 CUR	-42	-45	-44	-43	-47	-49	-55	-59	-75
P-60 MAX	-2	-4	-3	-2	-20	-5	-17	-19	-43
P-60 CUR	-13	-10	-6	-9	-30	-23	-20	-54	-45
P-30 MAX	-3	-5	-4	-4	-11	-4	-15	-18	
P-30 CUR	-13	-10	-6	-8	-28	-23	-17		
E-100	400	372	428	343	357	298	273	260	253
E-60	243	239	247	232	245	216	199	197	193
E-30	215	200	275	180	116	132	93	98	320
TC-100	9.8	8.1	7.5	8.9	9	9.2	9.7	10.6	10.5
TC-60	8.8	7	7.1	9.2	9.2	9.3	10.2	11	11.4
TC-30	8.5	7.4	6.4	10.3	9.1	9.4	10.3	11.1	11.5
ambient	-1	5.4	7.5	20.4	11.7	13.6	9.2	16.8	19.3
PPT in.	0.2	0.25	1.22	2.56	0.03	0.59	0.3	0	0.37
	Feb				Mar				
PPT cm	0.51	0.64	3.10	6.50	0.08	1.50	0.76	0.00	0.94

Mean, corrected values from raw data for Da-B, Dayton plot, Benton County. (cont.)

Da-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	45	95	115	82	106	48	49	85
T-60	21	69	62	28	36	-22	-70	-86
T-30	-15	39	16	-19	-30	-197	-432	-540
P-200 MAX	-106	-84	-69	-70	-71	-72	-92	-100
P-200 CUR	-115	-91	-74	-78	-78	-93	-101	-120
P-100 MAX	-80	-66	-48	-54	-60	-72	-84	-94
P-100 CUR	-83	-66	-48	-54	-60	-75	-90	-101
P-60 MAX	-49	-4	-3	-27	-24			
P-60 CUR	-58	-9	-26	-55				
P-30 MAX		-6	-5	-26	-18			
P-30 CUR		-9	-26					
E-100	248	244	237	228	217	210	217	212
E-60	197	195	196	183	183	273	371	565
E-30	412	337	185	282	459	529	546	457
TC-1OO	10.5	11.6	11.3	12.1	12.4	13.5	13.8	14.6
TC-60	10.5	11.7	12.4	13.5	14.2	14.7	15.7	16.7
TC-30	9.7	12.4	12.3	15.4	16.5	14.8	17.3	19.1
ambient	9.6	10.6	16.1	21.3	26.6	16	19.7	24.4
PPT in.	0.34	2.49	0.42	0.08	0.1	0	0	0
	Apr				May			
PPT cm	0.86	6.32	1.07	0.20	0.25	0.00	0.00	0.00

Mean, corrected values from raw data for Da-B, Dayton plot, Benton County. (cont.)

Da-B		
	6/2/92	6/9/92
T-100	45	47
T-60	-172	-267
T-30	-695	-880
P-200 MAX	-118	-123
P-200 CUR	-127	-132
P-100 MAX	-101	-107
P-100 CUR	-108	
P-60 MAX		
P-60 CUR		
P-30 MAX		
P-30 CUR		
E-100	218	225
E-60	497	543
E-30	561	567
TC-1OO	16.2	16.2
TC-60	19.1	19
TC-30	20.6	20.6
ambient	22.1	22
PPT in.	0	0
	Jun	
PPT cm	0.00	0.00

Mean, corrected values from raw data for Wa-B, Waldo plot, Benton County.

Wa-B								
	10/10/91	10/17/91	10/24/91	n/a	11/5/91	11/12/91	11/19/91	11/26/91
T-100								
T-50								
T-20								
P-200 MAX								-47
P-200 CUR								
P-100 MAX								-75
P-100 CUR								
P-50 MAX								-31
P-50 CUR								
P-20 MAX								-18
P-20 CUR								
E-100	371	418	444		433	439	430	390
E-50	460	501	399		426	484	466	452
E-20	485	489	494		482	484	481	477
TC-100	16.1	13.6	16.6		13	12.9	12.2	11.3
TC-50	17.4	15.6	15.1		11	11.9	10	9.7
TC-20	17.7	15.8	13.1		10.3	12	9	9.3
AMBIENT	29.7	13.6	10.3		14.7	15	10.8	10.2
PPT in.	0	0	0.49	1.1	0.89	0.24	1.48	1.64
	Oct				Nov			
PPT cm	0.00	0.00	1.24	2.79	2.26	0.61	3.76	4.17

Mean, corrected values from raw data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B	12/5/91	12/10/91	12/17/91	12/24/91	12/31/91	1/7/92	1/14/92	1/21/92	1/28/92
T-100			104	104	99	101	101	105	100
T-50			57	56	49	46	52	47	58
T-20			11	23	21	22	23	28	21
P-200 MAX	-36	nd	-9	-4	-6	-3	-2	-3	-2
P-200 CUR	-62	-8	-14	-6	-8	-5	-4	-3	-3
P-100 MAX	-36	nd	-8	-1	-2	1	0	-1	1
P-100 CUR	-58	-8	-15	-4	-7	-6	-4	-5	-2
P-50 MAX	-24	nd	-13	-7	-5	-5	-2	-7	-1
P-50 CUR		-13	-18	-8	-11	-9	-8	-11	-6
P-20 MAX	-16	nd	-6	-1	-5	-1	-1	-2	-1
P-20 CUR		-17	-14	-4	-6	-5	-3	-4	-1
E-100	369	368	382	358	342	337	317	273	294
E-50	434	400	418	436	448	456	434	290	435
E-20	455	446	440	462	380	318	294	276	258
TC-100	10.6	10.3	9.7		8.7	9.4	8.4	8.4	8
TC-50	8.3	8.2	6.7		7.1	7.7	6.1	5.6	7.3
TC-20	7.7	6.5	4.8		6.3	6.5	5.4	3.8	8
AMBIENT	9.1	2.8	2.9		4.7	1	4	2.4	14.4
PPT in.	0.3	0.66	0.08	0.86	0.19	1.16	0.52	0.31	1.47
	Dec					Jan			
PPT cm	0.76	1.68	0.20	2.18	0.48	2.95	1.32	0.79	3.73

Mean, corrected values from raw data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B	2/4/92	2/11-92	2/18/92	2/25/92	3/3/92	3/10/92	3/17/92	3/24/92	3/31/92
T-100	57	104	111	96	102	101	102	100	101
T-50	50	55	63	67	55	62	51	57	64
T-20	25	24	31	22	18	20	23	10	16
P-200 MAX	-3	-3	-4	0	-6	-4	-6	-6	-9
P-200 CUR	-9	-7	-2	-7	-9	-12	-10	-18	-14
P-100 MAX	0	-1	-1	3	-3	-1	-2	-4	-6
P-100 CUR	-6	-4	-2	-2	-7	-8	-5	-17	-12
P-50 MAX	-7	-3	-3	1	-9	-2	-10	-4	-8
P-50 CUR	-10	-9	-8	-8	-10	-9	-11	-16	-15
P-20 MAX	-5	-4	-2	1	-5	-4	-4	-8	-8
P-20 CUR	-8	-6	-3	-6	-9	-10	-7	-17	-14
E-100	251	276	313	242	249	242	236	239	225
E-50	252	437	351	415	257	402	391	378	346
E-20	246	247	281	277	189	262	259	259	243
TC-100	9.2	8.1	8.3	9.1	9.4	9.8	9.9	10	10.5
TC-50	8.8	6.8	7.3	9.3	9.5	10	10.4	10.6	11.2
TC-20	7.7	6.9	6.6	10.4	9.5	9.2	10.3	10.4	11.2
AMBIENT	-1.2	6.8	7.4	21.1	8.2	15.4	8	10	17.8
PPT in.	0.24	0.31	1.24	2.55	0.03	0.57	0.39	0	0.39
	Feb				Mar				
PPT cm	0.61	0.79	3.15	6.48	0.08	1.45	0.99	0.00	0.99

Mean, corrected values from raw data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B	4/7/92	4/14/92	4/21/92	4/28/92	5/5/92	5/12/92	5/19/92	5/26/92
T-100	90	106	107	103	78	51	51	38
T-50	44	50	67	59	49	12	6	7
T-20	12	28	23	11	-7	-146	-260	-335
P-200 MAX	-8	-3	-3	-10	-11	-39	-65	-68
P-200 CUR	-21	-7	-11	-20	-43	-63	-69	-74
P-100 MAX	-6	0	-1	-7	-8	-43	-61	-64
P-100 CUR	-15	-5	-9	-20	-39	-63	-66	-71
P-50 MAX	-12	-5	-4	-12	-8	-39		
P-50 CUR	-14	-8	-9	-16	-31			
P-20 MAX	-7	-1	-2	-11	-10			
P-20 CUR	-15	-7	-12	-18				
E-100	238	247	239	222	215	240	236	246
E-50	268	252	247	246	247	249	408	472
E-20	255	258	263	266	219	542	568	570
TC-100	10.3	11.2	11.4	12.2	12.9	13	13.4	14.6
TC-50	10.2	11.9	12.4	14.1	15.4	14.5	16.1	17.9
TC-20	9	11.9	11.3	16	17.6	13	16.7	18.8
AMBIENT	8.6	9.2	12.8	20.8	21	13.5	15.3	19.2
PPT in.	0.39	2.41	0.42	0.08	0	0	0	0
	Apr				May			
PPT cm	0.99	6.12	1.07	0.20	0.00	0.00	0.00	0.00

Mean, corrected values from raw data for Wa-B, Waldo plot, Benton County. (cont.)

Wa-B		
	6/2/92	6/9/92
T-100	41	44
T-50	14	9
T-20	-433	-489
P-200 MAX	-73	-74
P-200 CUR	-79	-80
P-100 MAX	-69	-72
P-100 CUR	-77	-77
P-50 MAX		
P-50 CUR		
P-20 MAX		
P-20 CUR		
E-100	245	228
E-50	500	518
E-20	583	580
TC-100	16.5	16.6
TC-50	20.2	20.1
TC-20	20.5	20.2
AMBIENT	20	15.8
PPT in.	0	0
	Jun	
PPT cm	0.00	0.00