THE PENNSYLVANIA STATE UNIVERSITY
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DEPARTMENT OF GEOGRAPHY

SOIL PROPERTIES OF WETLANDS BY HYDROGEOMORPHIC (HGM) TYPE IN THE RIDGE AND VALLEY PROVINCE OF PENNSYLVANIA

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ABSTRACT

The hydrogeomorphic (HGM) approach to wetland functional assessment has been derived as a tool to classify wetlands based on their landscape position, water source, and hydrologic activity. This classification provide a useful framework in which to study wetland functions and characteristics, thus allowing for a greater understanding of one of our valuable natural resources.Many important chemical transformations that distinguish wetlands from non-wetlands take place in wetland soils. A study of these soils in the context of HGM classification provides information on which to base future resource management decisions. Analyses were conducted to identify variation in soil characteristics across a gradient of seven HGM subclasses. Five soil characteristics were analyzed: 1) texture, 2) organic matter, 3) matrix chroma, 4) moisture/hydrologic condition, and 5) redoxymorphic features. A second analysis was performed to determine if soil properties varied significantly between relatively pristine/reference wetlands and degraded/non-reference wetlands. These hypotheses were tested on soils data collected mainly within the Ridge and Valley region of Pennsylvania; data were obtained from 141 reference standard wetlands sampled by the Penn State Cooperative Wetlands Center. Significant variation was identified in HGM subclasses along a hydrologic gradient. Low-energy, depression wetlands possessed distinctly different characteristics than high-energy, riverine wetlands. Slope wetlands typically displayed intermediate conditions between depression and riverine sites. The clearest trends identified were for organic matter content, chroma, and soil moisture. While variability existed between reference and non-reference sites, the differences were not significant enough to support the hypothesis. The results did, however, indicate a tendency for reference wetlands to possess a wider range of variation than more

degraded wetlands for a given soil property. Loss of natural wetland variation may be related to increases in degradation; further work must be done to explore this finding.

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INTRODUCTION

In recent years, wetlands have become a subject of much attention in the environmental management community. These areas are valuable to both ecological communities and human affairs. They provide wildlife habitat, improve water quality, and reduce flooding and erosion. Since 1970, the United States has lost over 50% of its wetland resources. It is estimated that between the mid-1970s and the mid-1980s, over 53,000 ha of wetlands were lost on an annual basis; this is believed to be only half of the amount lost annually in the previous few decades (Dahl 1990).

As awareness of the value of these areas has increased in recent years, so have efforts to preserve existing wetlands and recreate those that have been lost. In an effort to do so, laws have been passed at both the federal and state level to identify and regulate activities surrounding wetlands. Section 404 of the Clean Water Act and the 1890 Rivers and Harbors Act require wetland mitigation projects to replace lost acreage where encroachment is the only available option (Brooks and Vetter, in prep.). As mitigation sites are increasingly developed to compensate for wetland disturbances, it becomes important to take a closer look at how well these re-creations resemble the originals.

The U.S. Army Corps of Engineers provides a definition of wetlands that is used in the delineation process. The three characteristics used in wetland identification are: (i) predominance of hydrophytes, (ii) undrained hydric soils, and (iii) hydrology (Tiner and Veneman 1989). While this approach works well to identify the existence of a wetland, it does not address the many variations that exist in wetlands functions across the landscape.

The hydrogeomorphic (HGM) approach developed by Brinson for assessing wetland functions provides a method of characterizing wetlands by weighing the relative importance the dominant sources of water (ground water, overland flow, and precipitation), the behavior of the water within the wetland, and the wetland's position in the landscape (Brinson 1995, Brinson 1996). This approach draws on the essential role played by hydrology in determining how a wetland functions. A set of reference standard sites is developed by collecting data from relatively pristine (reference) and degraded (non-reference) wetland sites. These sites are classified into HGM categories, providing a range of ecological conditions in each subclass that is useful for functional assessment of all sites (Brooks et al. 2004).

By examining soil properties of sites in different HGM subclasses, a better understanding of the variation between these can ideally be obtained. A profile of soil characteristics for each wetland type will allow for identification of the condition of existing wetlands. It will also provide for greater value in future mitigation sites; if compensating for the loss of a riparian depression type of wetland, similar characteristics should be recreated in the new site. Bishel-Machung et al. (1996) found that soil properties such as organic matter, particle size, and matrix chroma differed significantly between wetland creation sites and reference sites of the same HGM type. Therefore, a general outline of the soil properties that exist within each HGM subclass, or at least a profile of variation between subclasses, is a first step toward establishing mitigated sites that more accurately recreate the functions of the replaced wetlands.

Wetland soils are important to investigate because that is where many chemical transformations take place that differentiate wetlands from non-wetlands. These soils are commonly called hydric soils, which are defined by the U.S. Department of Agriculture Natural Resources Conservation Service as "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS 1998).

Hydric soils are commonly divided into two types: organic soils and mineral soils. This distinction is based upon the amount of organic matter in the upper layer. Organic soils are identified by significant accumulations of plant and animal debris at the surface; organic matter will typically account for 20-30% of these soils (Plaster 2003). Mineral soils are mainly composed of sand, silt, and clay particles, with small quantities of organic matter mixed with the surface layer (Tiner 1998).

Selected Soil Properties

This study focuses on five key soil properties that are indicators of wetland functioning. These are: a) soil texture, b) organic matter, c) matrix chroma, d) hydrologic condition, and e) redoxymorphic features.

Soil texture provides a description of the relative proportion of sand, silt, and clay particles within a soil. At a given site, texture is determined by the origin of the material, its landscape position, and how energy moves through the wetland system. It can serve as an indicator of potential disturbance, because degraded sites tend to receive more intense runoff, depositing sandier material into the wetland.

Particle size distribution affects the moisture storage and drainage characteristics of wetlands. The easiest movement of air and water occurs through sandy soils, leading to rapid drainage. The small particle size of clay soils results in a higher surface area allowing these soils to retain more moisture. Finer particles, and thus finer pore spaces, also have increased capillary action. Clayey soils may attain saturated conditions 0.5 m above the water table, whereas sandy soils will only be saturated up to 5 cm above the water table (Tiner and Veneman 1989). Organic matter, the nutrient-rich top layer of soil, is formed as coarse and fine plant and animal debris are decomposed into tiny particles. The organic matter provides the necessary nutrient levels to sustain wetland vegetation. It also assists in the removal of excess nitrogen from a wetland (Brooks et al. 2004).

The presence of organic matter is studied because it relates to several chemical processes unique to wetlands. Organic matter provides carbon, forming the microbial substrate for chemical reactions. It also indicates the relative abundance of nitrogen in the soil; higher levels of organic matter allow for the removal of excess nitrogen from the ecosystem (Davidsson and Stahl 2000). Organic matter is also correlated with contaminant removal; it has a high capacity to adsorb pesticides and metal ions (Scott et al. 1990, Gambrell 1994). Organic matter is also related to levels of wetland saturation. In sites that have low energy and high saturation, organic matter will accumulate and not decompose.

Soil matrix chroma is the relative purity of the dominant soil color, with a low chroma value representing muddy colors (Plaster 2003). The chroma is determined by field comparisons with the Munsell soil color chart. The matrix chroma is an indicator of the hydrologic condition and reduction potential of a soil.

Chroma decreases as a result of the abundance of oxygen present in a soil. Oxygen presence is regulated by the amount of moisture in a soil. As a soil remains saturated with water, oxidation does not occur and the system enters an anoxic state. Therefore, the longer a soil is saturated, the lower the chroma value. Chroma values are negatively correlated with the amount and duration of moisture presence. Hydric soils are typically characterized by a chroma of 2 or less on the Munsell chart.

The hydrologic condition of a wetland soil is one of the three primary conditions of wetland delineation. Undrained hydric soils must be present at a site for a significant period of time during the growing season for the site to be considered a wetland. The presence of semi-permanent moisture in a soil creates the unique conditions necessary to sustain wetland ecological functions.

Redoxymorphic features are formed by the reduction, translocation, and/or oxidation of iron and manganese oxides within a soil (Mitsch and Gosselink 2000). These features (redox) develop when mineral soils are flooded for extended periods of time. When water fills in the pore spaces, oxygen moves very slowly throughout the soil. This leads to oxygen depletion and thus anaerobic conditions within days of saturation. These conditions create the ideal habitat for wetland-specific vegetation and must be present for their sustenance.

Because microbiological process are involved in the oxidation and reduction process, organic matter is also an agent of the formation of redoxymorphic features because it serves as a substrate for microbial activity (Mitsch and Gosselink 2000). Redoxymorphic features is the collective name for several types of characteristics, such as redox depletions, oxidized pore linings, and mottles/redox concentrations, which result from different oxidation and reduction processes. In this study, redox is being used as a general indicator of prolonged soil moisture.

Hydrogeomorphic (HGM) Classification

The HGM approach is designed to utilize existing knowledge of wetland functions to the greatest possible extent, thus resulting in the most scientifically and ecologically sound analyses and management decisions. The approach addresses both natural variation and that resulting from human activities. This allows for greater understanding of natural systems, and the application of that understanding in exploring anthropogenic effects on wetlands.

Brinson (1995, 1996) acknowledges that every wetland has unique properties, but proposes this approach as a method of utilizing the shared properties of similar wetlands to improve functional assessments. The assignment of wetlands to HGM subclasses is the work of professional wetland scientists, and is not a clear-cut process. The subclasses are used as general frameworks in which to address wetland variation. These are not categories with unique properties; most wetlands possess characteristics that are indicative of more than one subclass. A best fit is determined for each and analysis proceeds with the knowledge that the subclass designations are somewhat subject to interpretation.

Because wetland conditions vary over geographic space, localized sets of reference standard sites must be established for all regional assessments. The Penn State Cooperative Wetlands Center (CWC) has gathered data since 1993 to establish a set of reference standard wetlands for the state of Pennsylvania. This set includes the common types of wetlands found in PA, and spans conditions ranging from relatively pristine to severely disturbed (Brooks et al. 2004). This report will analyze those sites located in the Ridge and Valley physiographic region of PA.

The HGM subclasses being used for this study are isolated depression, riparian depression, slope, headwater floodplain, mainstem floodplain, human impoundment (or fringing), and beaver impoundment. The CWC has provided the following to describe these wetlands (Brooks 2004):

A. *depression* - water contained in a basin, shallow or deep.
   - occur in areas of low relief or at the base of slopes
   - no outlet or a restricted outlet
   - drainage channels are poorly developed
   - directional flow is absent or slow
   - significant storage is possible
   - water sources can be ground, surface, or precipitation

1. *isolated* – wetland has no direct surface connection with other aquatic habitats
2. *riparian* – occurring within the transition areas of low relief between uplands and the edges of shores of streams, rivers, wetlands, or other water bodies; may or may not be subjected to frequent flooding

B. *slope* – wetland is supported by unidirectional flow of water
(e.g. springs, seeps, wet meadows on slopes)
-flow can be slow or fast
-wetland occurs on a measurable slope
-drainage channels often prominent
-water storage is minimal due to slope or flatness of terrain
-water source is primarily groundwater; can include surface flows

C. *floodplain* – areas of low relief adjacent to streams or rivers and subjected to variable rates of flooding

1. *headwater* – wetland is contributing to or is adjacent to a first or second order stream
2. *mainstem* – wetland is adjacent to or strongly influenced by a stream of third order or greater

D**.** *impounded* – water flow in a stream is obstructed by a dam built by beaver or human activities
fringing – water levels maintained or controlled by immediately adjacent body of water (e.g. lake, reservoir, beaver dam)
-provides unimpeded hydrologic connection to body of water
-can result in fringing, vegetated, mud flat, or open water types
-water source can be surface, ground water, or precipitation

1. *beaver* – body of water created from beaver dam
2. *human* – body of water created by constructed dam

Definitions have been provided for both impounded and fringing wetlands, although only the term ‘impoundment’ has been used in this study. Most fringing wetlands in Pennsylvania are found on impounded lakes and reservoirs, so for this study they are generally equivalent. Sites identified as ‘fringing’ have been included in the human impoundment subclass. A diagram depicting the landscape position of each wetland type can be found in Appendix A.

Goals/Hypotheses

The goal of this research was to examine each of five soil properties (texture, organic matter, chroma, hydrologic condition, and redoxymorphic features) to identify variation and significant differences between seven HGM subclasses. Another goal was to compare reference sites to non-reference sites to identify the variations in soil properties that occur in each HGM subclass as sites become degraded. My first hypothesis is that soil characteristics, such as texture, organic matter, chroma, hydrologic condition, and redoxymorphic features, differ between HGM wetland types. Each of these characteristics is influenced by moisture, drainage, and energy variations, which are all factors included in HGM subclass divisions, so differences between them are expected. The null hypothesis to be tested is that no differences in soil characteristics occur among HGM subclasses.

My second hypothesis is that for each soil property, reference sites will differ from non-reference sites. In theory, the reference sites are in the most ecological intact condition and should function in ways based on their hydrogeomorphic characteristics. The non-reference sites typically have been disturbed in some way and should possess less distinctive soil characteristics because they have been subjected to influences from outside the system. The null hypothesis to be tested is that there will be no differences between reference and non-reference wetlands within each HGM subclass.

METHODS

Study Area

The data used in this analysis were collected over the years 1993 to 2003 by the Penn State Cooperative Wetlands Center (Brooks 2004). Of the total dataset, the population of 141 wetlands located in the Ridge and Valley Province of Pennsylvania was selected as the focus area (Figure 1). All sites in this physiographic region were used, of which 33 were classified as pristine/reference standard and 108 were non-reference. Three of the sites used, however, were outside of the Ridge and Valley region. Two were added at the border with the Piedmont ecoregion, and one was added from the Glaciated Pocono region, all to fill in gaps in the set of HGM subclasses. At each site, data were collected from individual plots, which ranged in quantity from 2-30 per site (Appendix B).

Figure 1. Location of sample sites used in analysis of HGM soil properties.

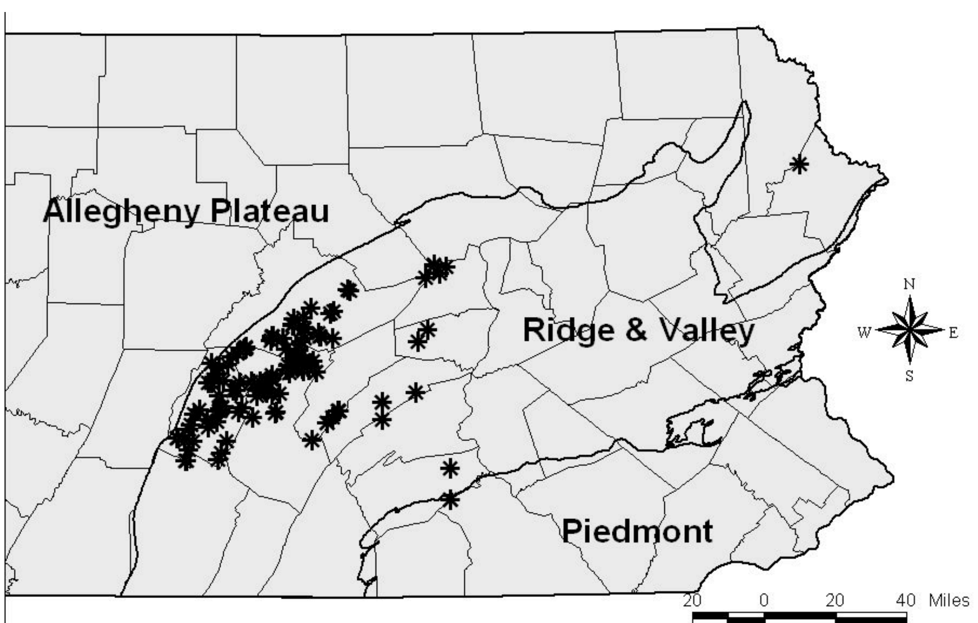


Figure xx. Locations of reference wetlands established by the Penn State Cooperative Wetlands Center 1997 - 2003.

Field Sampling

All soil data was collected following the rapid assessment protocol developed by the Penn State Cooperative Wetlands Center (CWC). The relevant protocol follows; slight variation may have occurred because of site characteristics (Wardrop et al. 2004).

For every wetland, a baseline was established running parallel to the long axis of the wetland. Transects were then established at equal intervals (typically 20 m) perpendicular to the baseline. The length of transects was determined by the distance to the opposite upland area, or if streamside, at least one transect should have crossed the stream. Along each transect, plots were established at the same interval as transects. Every other plot was used for locating soil pits, with a minimum goal of 3 plots per wetland.

Soil pits were dug to a depth of 0.5 m. Data for all soil properties were recorded from 5cm and 20cm below the O horizon. Dominant matrix and mottle colors were recorded in the field using the Munsell color chart; chroma values were later extracted from matrix color. Visual examination for presence of redoxymorphic features was conducted. Standard field methods were used to observe the soil texture. The relative wetness of the soil was determined to be dry, moist, saturated, or inundated. Samples of at least 250ml of soil were collected from both 5cm and 20cm below the O horizon. These were collected for texture analysis and organic content in the laboratory.

Laboratory Analysis

As samples were taken over the years, some data was analyzed in the Agricultural Analytical Laboratory at the Pennsylvania State University to get texture data for proportions of sand, silt, and clay, and the carbon content of organic matter by burning.

DATA ANALYSIS

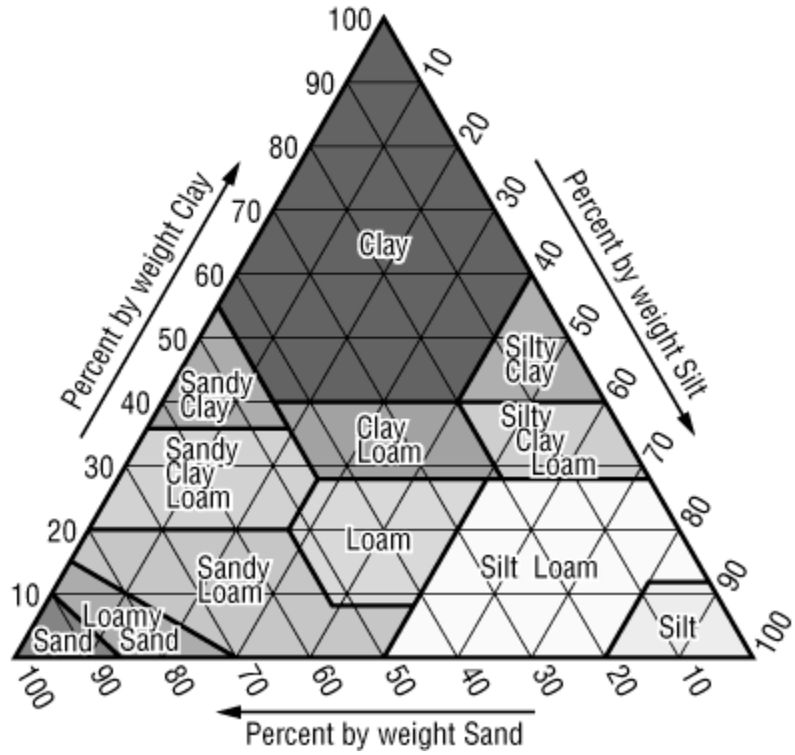
Analyses were performed using Microsoft Excel (Microsoft Corporation, Redmond, WA), Minitab (Minitab Inc., State College, PA), and SAS JMP (SAS Institute Inc., Cary, NC). In some cases, descriptive statistics or graphs were used to display the results. Where sample sizes were sufficiently large, Analysis of Variance (ANOVA) was used to discriminate if variable means were significantly different (Steel and Torrie 1960).

Texture

Soil texture was compared using a mean value for each sample site. A small subset of the sites and plots had texture data from a laboratory analysis, so texture was reported as percentages of sand, silt, and clay. The remaining texture data was collected in the field, with only a textural class reported (i.e., sandy loam, silty clay). To compile these two types of data for comparison purposes, a value was assigned to each of the field measurements. For each of the 12 textural classes, a central value of %sand, %silt, and %clay was calculated using the USDA soil textural triangle (Figure 2). This three-part value was then used for each sample plot that originally had just a texture class (see Appendix C for values).

Texture values were only analyzed at a depth of 5cm because a large number of sites were missing data at 20cm. The site texture percentages were compiled into ternary plots that reflect the structure of the soil textural triangle as a reference standard. A plot was created for each of the seven HGM subclasses to show how reference and non-reference sites compared within subclasses. Another ternary plot was created to present the variation across subclasses; the reference sites only for all seven subclasses are plotted together.

Figure 2. USDA soil textural triangle.



Organic Matter

Organic matter values were compiled from plot data to determine a mean percentage for each site, based on plot measurements. Only data at the 20cm depth were used because of inconsistencies in sampling methods that created excessive variation at 5cm (Brooks pers. comm.).

A one-way analysis of variance (ANOVA) was used to analyze the data to look for statistically significant differences between reference and non-reference sites and between the seven subclasses for both reference and non-reference sites. Tests of normality and equal variance were conducted to ensure that ANOVA results could be reported appropriately and accurately.

Following initial analyses that determined no significant difference in organic matter between reference and non-reference sites, the across subclass ANOVA was used on a merged dataset containing reference and non-reference sites together.

Chroma

Chroma data were analyzed in a similar manner to organic matter. Site means were created from all of the 20 cm plot data. One-way ANOVA was used to determine significant variability between subclasses for both the reference sites and non-reference sites. ANOVA was also used to compare reference sites versus non-reference sites within each HGM subclass.

Following initial analyses that determined no significant difference in matrix chroma between reference and non-reference sites, the across subclass ANOVA was used on a merged dataset containing reference and non-reference sites together.

Hydrologic Condition

Data describing soil moisture were not statistically analyzed. They are presented in graphical form for visual comparison. These data were used at the plot level, because of the difficulty of combining ordinal data into a site mean. A '100% stacked column' chart was created showing the percentage of sample plots identified as dry, moist, saturated or wet. This chart was replicated for 5cm reference sites, 20cm reference sites, 5cm non-reference sites, and 20cm non-reference sites.

Redoxymorphic features

The data for redoxymorphic features (redox) consists of categorical values of ‘Yes’ or ‘No’, indicating their presence or absence at each sample plot. These data also are presented solely in graphical form as a ‘100% stacked column’ chart, showing the percentage of sample plots that had these features. Redox charts were created for 5cm reference sites, 20cm reference sites, 5cm non-reference sites, and 20cm non-reference sites.

RESULTS

A total of 33 reference sites and 108 non-reference sites, all located in the Ridge and Valley physiographic region of Pennsylvania, were used for this study. Three sites were located outside the Ridge and Valley region (Figure 1). Two isolated depressions were located in the border of the Piedmont region where conditions are similar to the Ridge and Valley. The other site found in the glaciated Pocono region was added as a reference standard site to the fringing or human impoundment HGM subclass. The HGM functional model for fringing sites uses sites statewide because they are relatively similar across ecoregions.

REFERENCE VS. NONREFERENCE SITES

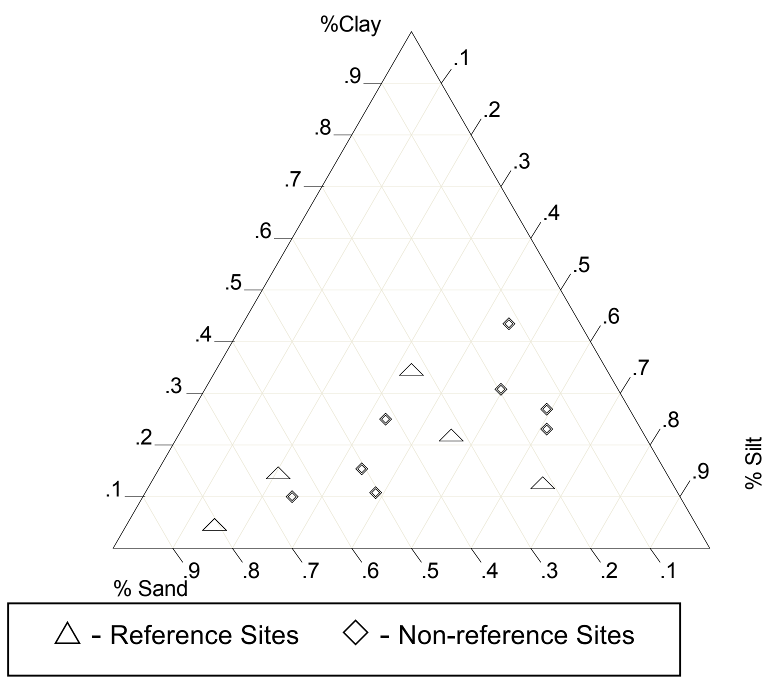
The following are the results of analyses to test the hypothesis that soil properties will vary between reference sites and non-reference sites. The variability of each soil property is addressed for each of the six HGM subclasses that had both reference sites and non-reference sites. These include isolated depression, riparian depression, slope, headwater floodplain, mainstem floodplain, and human impoundment. No beaver impoundment sites are classified as non-reference, so they have been omitted from this section of the analysis.

Isolated Depression

Texture

Isolated depression reference sites contained slightly more sand and less clay than did non-reference sites (Figure 3). No clearly distinguishable trends are discernable from the data, as the two site categories are mixed.

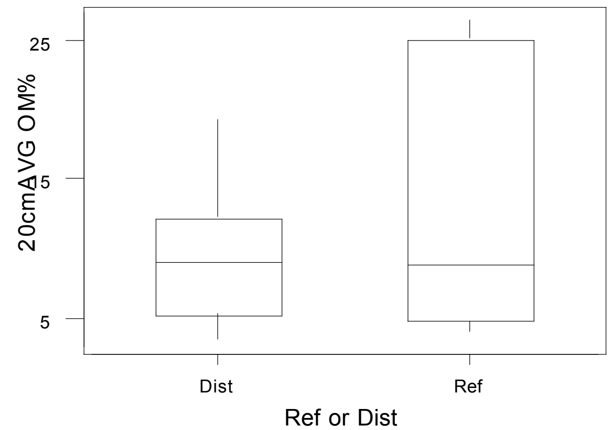
Figure 3. Site averages of 5cm soil texture for reference and non-reference sites in the Isolated Depression subclass.



Organic Matter

A comparison of mean percentage of site organic matter at 20cm showed a tendency toward more organic matter in reference sites than in non-reference (disturbed) sites (Figure 4). However, organic matter was not significantly different between the two ($F=1.24$, $p = 0.29$).

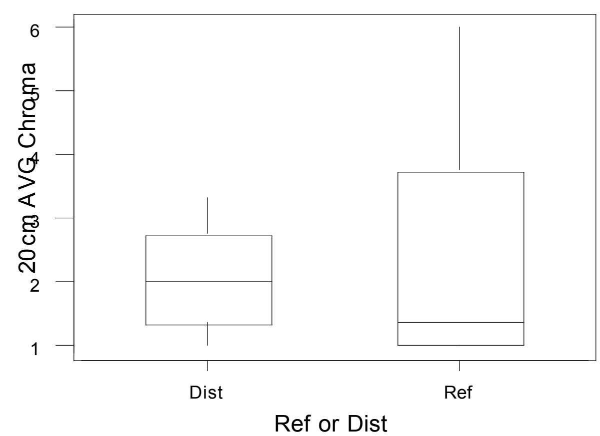
Figure 4. Variation in average % organic matter at 20cm between isolated depression reference and non-reference/disturbed sites.



Chroma

Matrix chroma was not significantly different between reference and non-reference/disturbed sites for the isolated depression HGM subclass ($F=0.13$, $p=0.73$) (Figure 5).

Figure 5. Variation in average matrix chroma at 20cm between isolated depression reference and non-reference/disturbed sites.



Hydrologic Condition

Soil moisture in isolated depressions showed that non-reference sites were wetter than reference sites at depths of both 5cm and 20cm (Figure 6 and Figure 7, respectively).

Figure 6. Percentage of isolated depression sample plots identified for each moisture class at 5cm; non-reference and reference sites are compared.

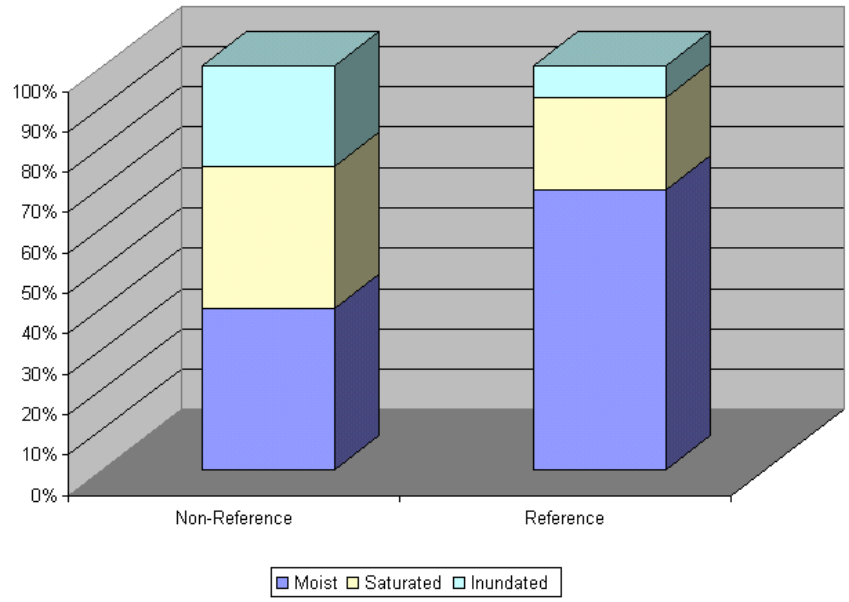
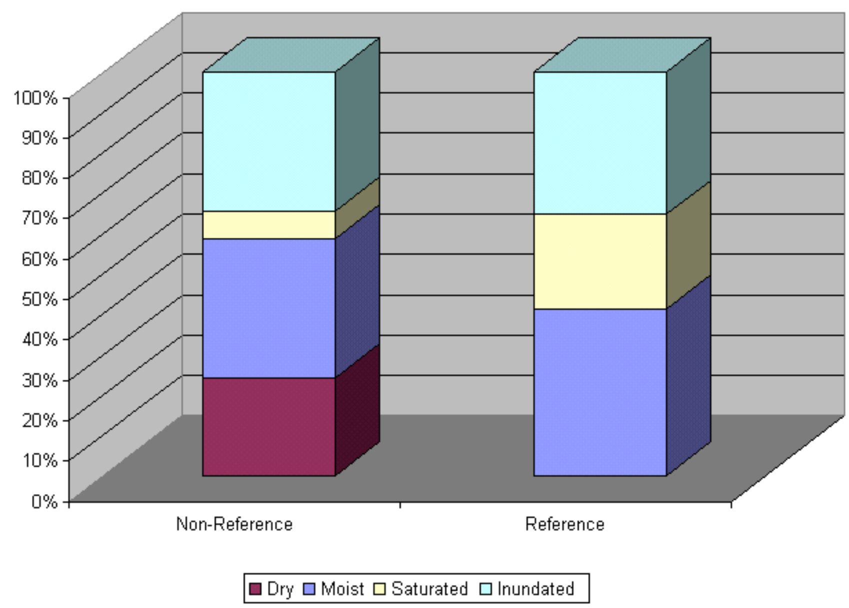


Figure 7. Percentage of isolated depression sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

A comparison of redoxymorphic features at reference and non-reference (disturbed) sites shows the presence of redox to be greater for non-reference isolated depression sites. At 5cm, no evidence of redox was present in reference sites (Figure 8). At 20cm, redox was identified in reference sites, but was more prevalent in non-reference sites (Figure 9).

Figure 8. Percentage of isolated depression sample plots in which redoxymorphic features were identified at 5cm; non-reference and reference sites are compared.

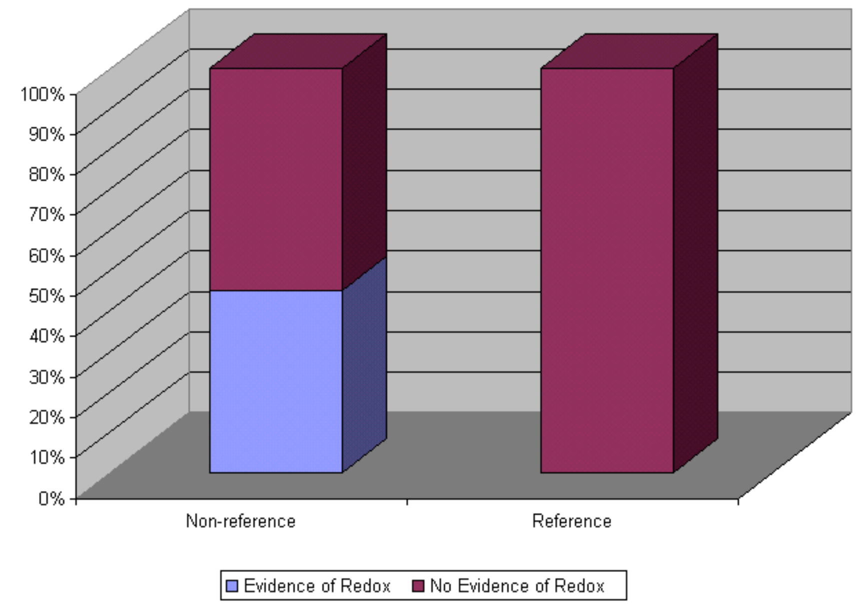
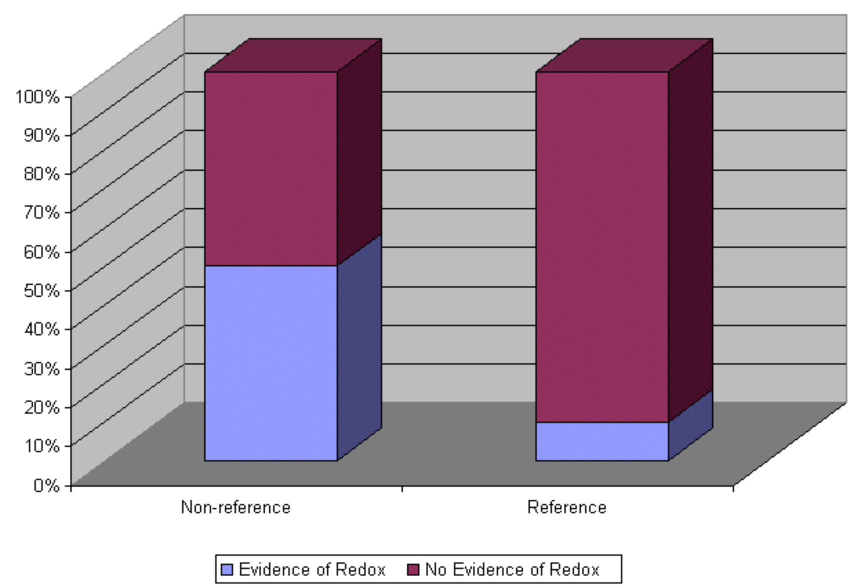


Figure 9. Percentage of isolated depression sample plots in which redoxymorphic features were identified at 20cm; non-reference and reference sites are compared.

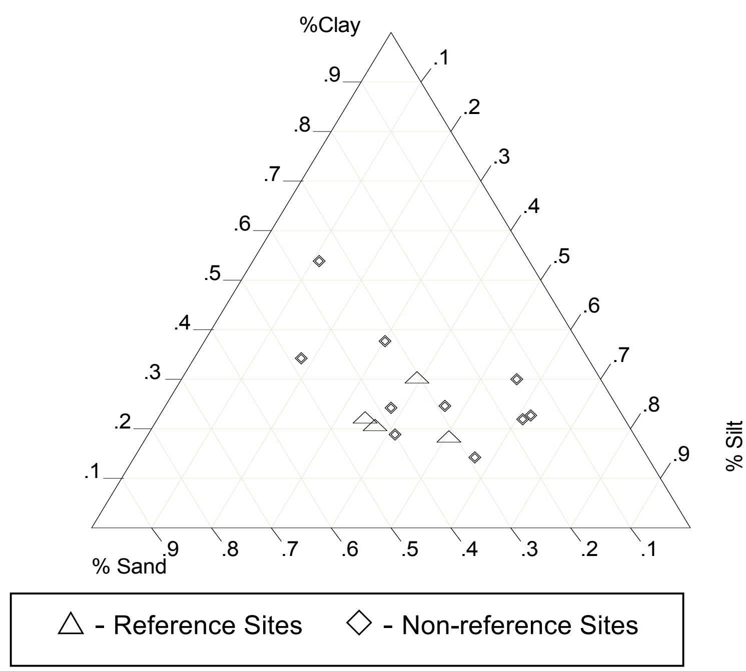


Riparian Depression

Texture

Riparian depression reference sites seemed to possess a much more distinctive particle size distribution than did non-reference sites (Figure 10). Reference sites all had 15-30% clay, 35-50% silt, and 30-45% sand; this results in a clustering of these sites into a small textural 'window', which lies within the loam textural class. Non-reference sites however had a much broader spectrum of values. Clay values ranged between 10-55%, silt between 10-65%, and sand between 10-50%.

Figure 10. Site averages of 5cm soil texture for reference and non-reference sites in the Riparian Depression subclass.

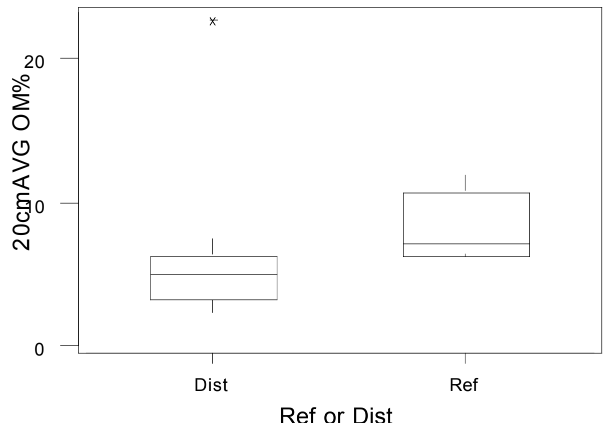


Organic Matter

Organic matter within riparian depression wetlands was not significantly different between reference and non-reference/disturbed sites (F=0.40, p=0.54). A boxplot of the data

(Figure 11) indicates that of the sampled sites, percent organic matter tended to be greater for reference sites than for non-reference sites.

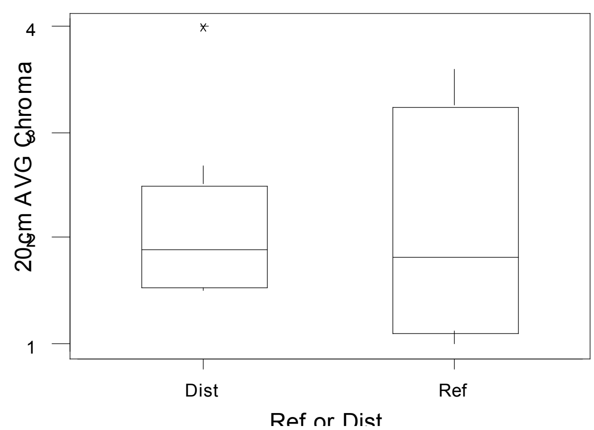
Figure 11. Variation in average % organic matter at 20cm between riparian depression reference and non-reference/disturbed sites.



Chroma

Reference and non-reference/disturbed sites were not significantly different in their matrix chroma values for riparian depression wetlands (F=0.01, p=0.91) (Figure 12).

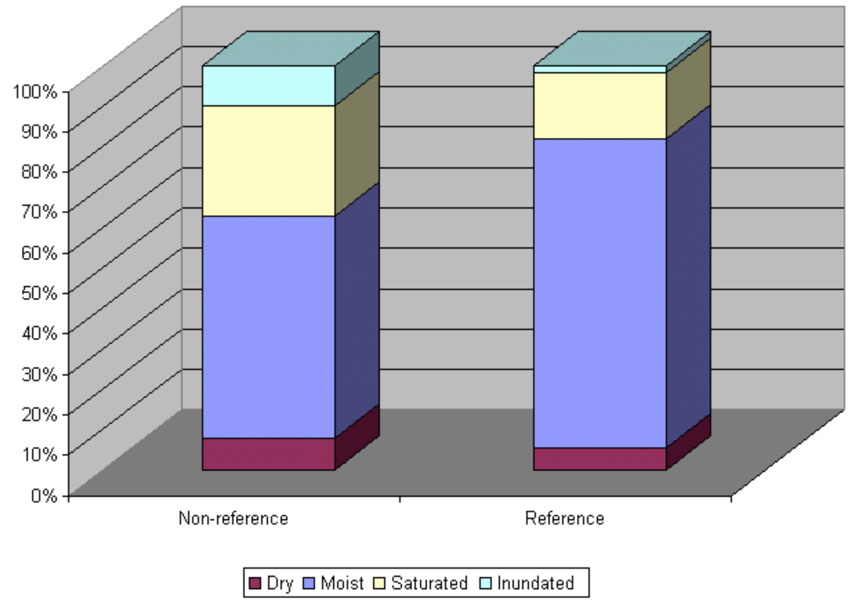
Figure 12. Variation in average matrix chroma at 20cm between riparian depression reference and non-reference/disturbed sites.



Hydrologic Condition

Soil moisture for riparian depressions is approximately the same for non-reference sites and for reference sites (Figure 13). Non-reference sites have a greater percentage of inundated and saturated conditions than reference sites, but also have more dry conditions. Reference sites exhibit mostly moist conditions. These results are based on the 20cm depth; no 5cm moisture reference site data were available for riparian depressions.

Figure 13. Percentage of riparian depression sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

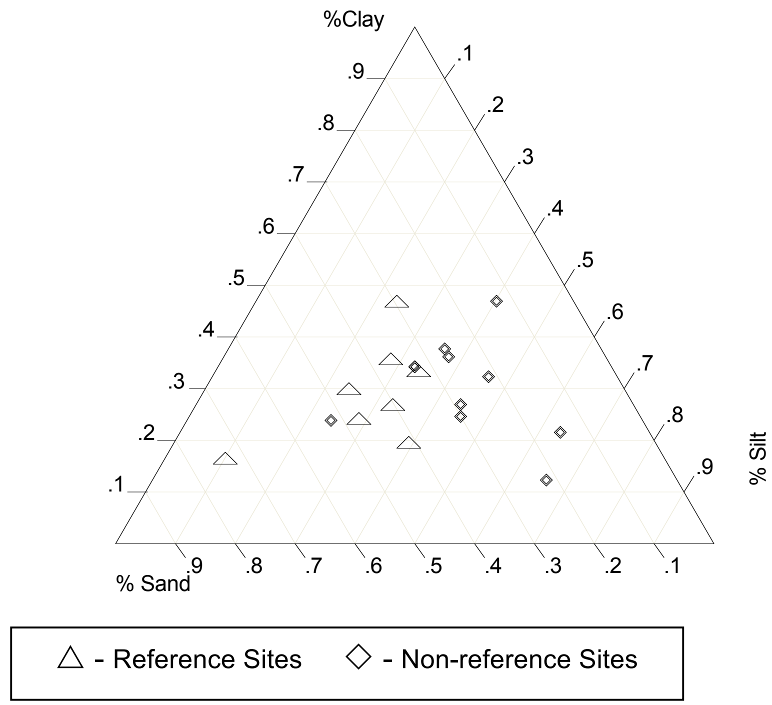
No reference site data were available for redox at riparian depressions, thus making a comparison of reference and non-reference sites impossible.

Slope

Texture

Soil texture appears to vary between reference and non-reference/disturbed sites for slope wetlands (Figure 14). The clay values all lie in a similar range for reference and non-reference sites. Most silt values are greater for non-reference sites, while sand values are generally greater for reference sites.

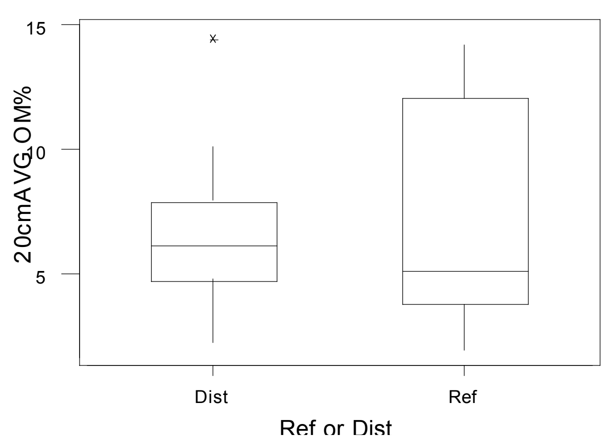
Figure 14. Site averages of 5cm soil texture for reference and non-reference sites in the Slope subclass.



Organic Matter

No significant difference between reference and non-reference site organic matter was found for slope wetlands (F≤ 0.001, p=0.99) (Figure 15). The range of data values, with the exception of one outlier, was much greater for reference sites than for non-reference sites.

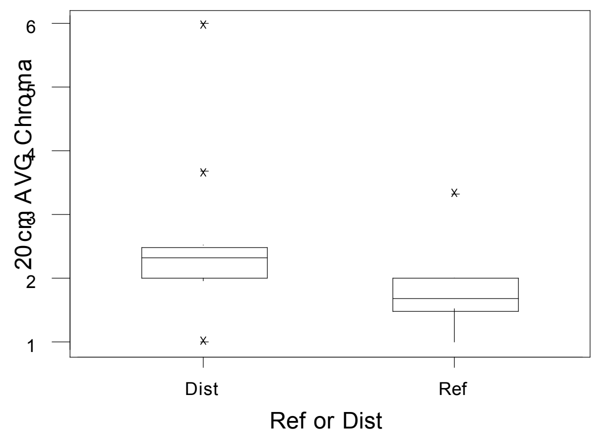
Figure 15. Variation in average % organic matter at 20cm between reference and non-reference/disturbed sites for slope wetlands.



Chroma

Matrix chroma differences between reference and non-reference sites for slope wetlands were not found to be statistically significant (F=2.07, p=0.17). Chroma values for reference sites were mostly 2 or less. Chroma values for non-reference sites were mostly greater than 2 suggesting soil conditions were drier (Figure 16).

Figure 16. Variation in average matrix chroma at 20cm between slope wetlands at reference and non-reference/disturbed sites.



Hydrologic Condition

Soil moisture for slope wetlands tends to be very similar for non-reference and reference sites at both 5cm and 20cm (Figures 17 and 18, respectively). Non-reference sites have a slightly greater percentage of inundated and saturated sites, causing them to have an overall trend toward wetter conditions than reference sites.

Figure 17. Percentage of slope sample plots identified for each moisture class at 5cm; non-reference and reference sites are compared.

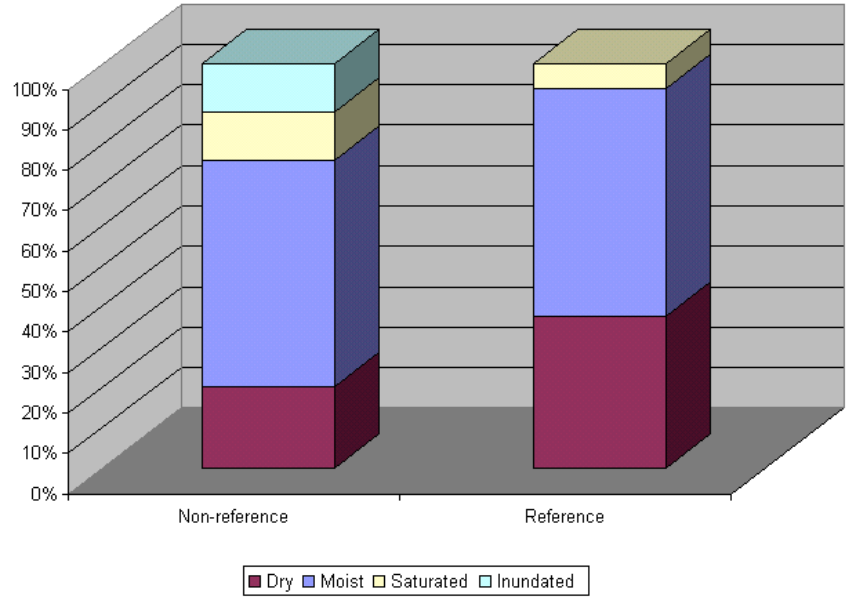
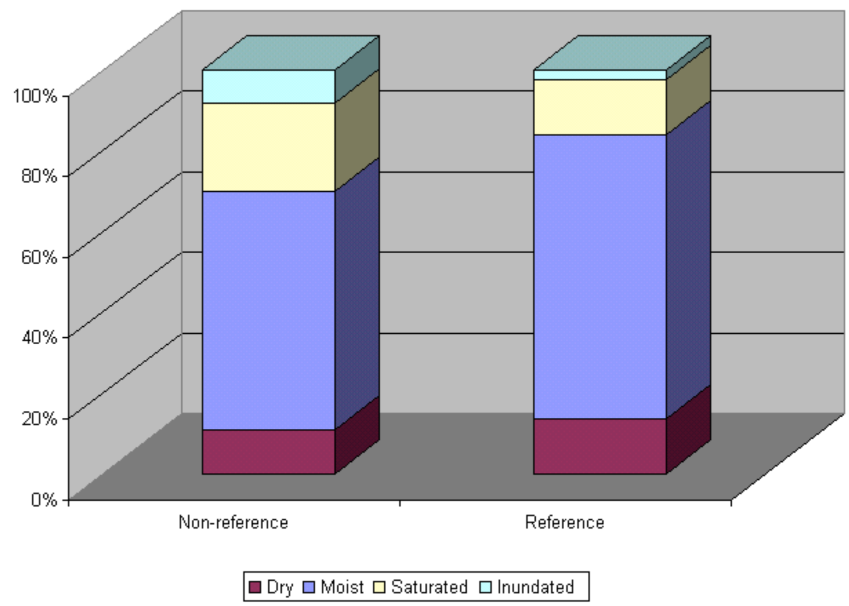


Figure 18. Percentage of slope sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

The presence of redoxymorphic features at slope sites is quite similar between reference and non-reference wetlands. A slightly greater percentage of non-reference sites had redox at

5cm than did reference sites (Figure 19). The opposite was true at 20cm; redox occurred at a slightly greater percentage in reference sites (Figure 20).

Figure 19. Percentage of slope sample plots in which redoxymorphic features were identified at 5cm; non-reference and reference sites are compared.

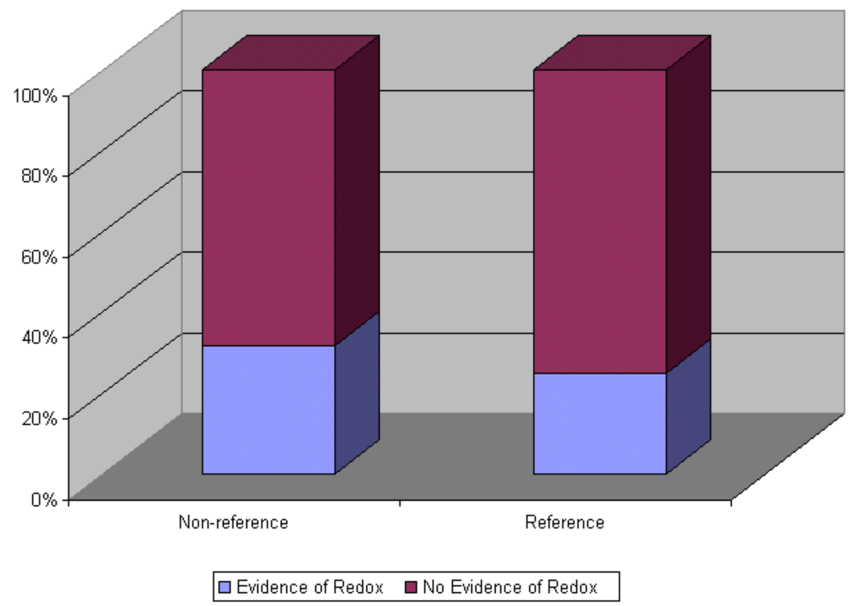
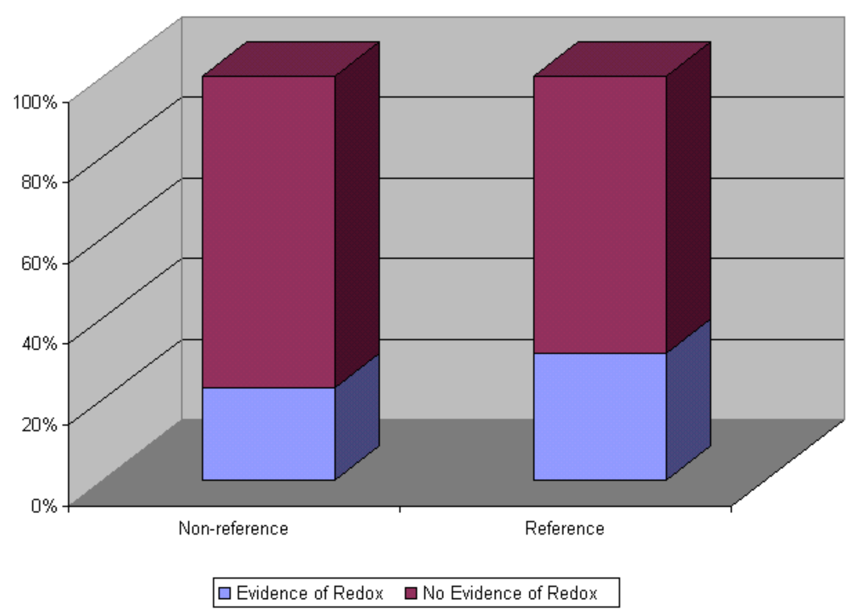


Figure 20. Percentage of slope sample plots in which redoxymorphic features were identified at 20cm; non-reference and reference sites are compared.

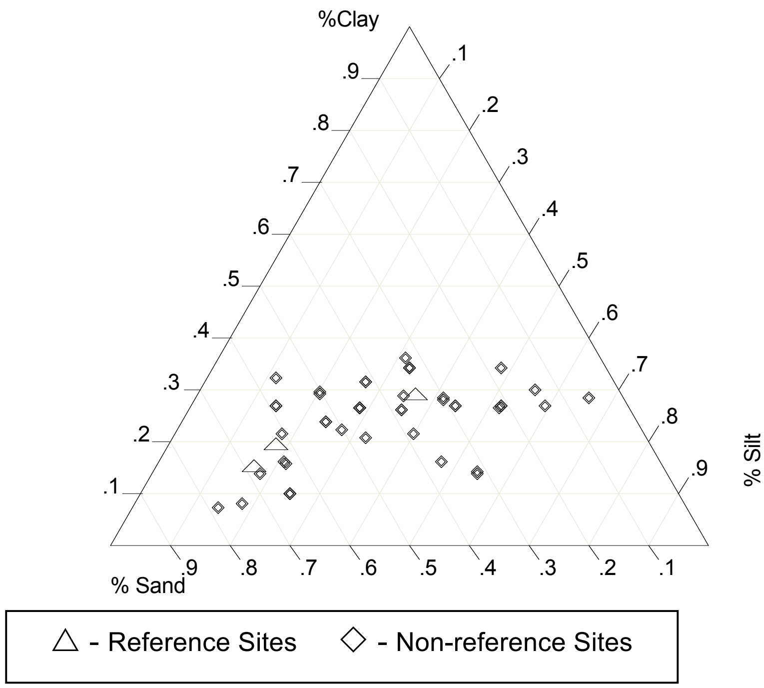


Headwater Floodplain

Texture

Soil textures throughout headwater floodplain wetlands showed no differences between reference and non-reference sites (Figure 21). The large numbers of non-reference sites (n=49) have a wide range of textures that encompass the textures of all reference sites (n=3).

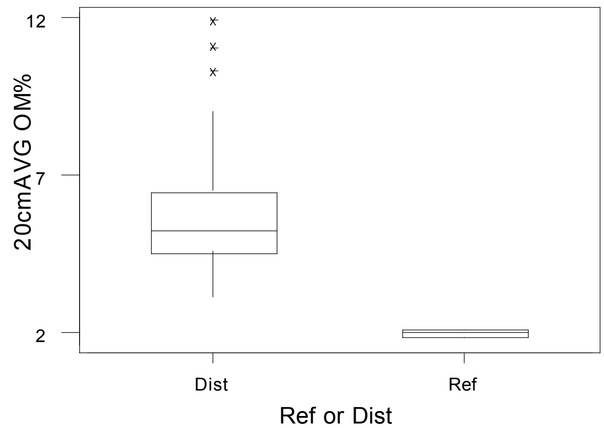
Figure 21. Site averages of 5cm soil texture for reference and non-reference sites in the Headwater Floodplain subclass.



Organic Matter

A significant difference was found between reference and non-reference sites for percent organic matter in headwater floodplain wetlands (F=7.27, p=0.01). Reference sites had substantially lower percentages of organic matter than non-reference sites (Figure 22), although this was not expected.

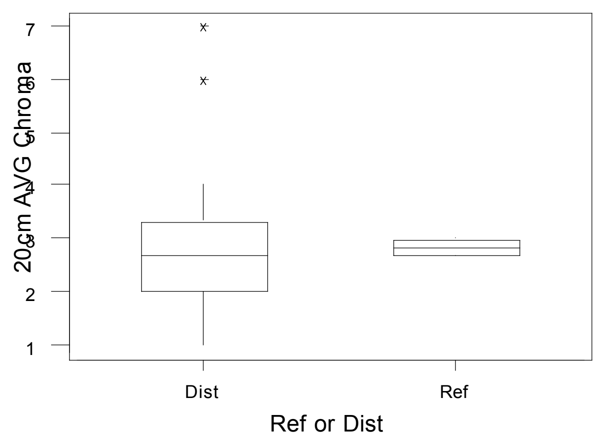
Figure 22. Variation in average % organic matter at 20cm between reference and non-reference/disturbed sites for headwater floodplain wetlands.



Chroma

No significant difference was found between reference and disturbed sites for soil chroma (F=0.01, p=0.93) (Figure 23).

Figure 23. Variation in average matrix chroma at 20cm between headwater floodplain wetlands at reference and non-reference/disturbed sites.



Hydrologic Condition

Non-reference sites exhibited much wetter conditions than reference sites within the headwater floodplain subclass. For both 5cm and 20cm (Figures 24 and 25), reference sites had a large percentage of plots identified as dry, and no saturated or inundated plots. Non-reference sites had mostly moist conditions.

Figure 24. Percentage of headwater floodplain sample plots identified for each moisture class at 5cm; non-reference and reference sites are compared.

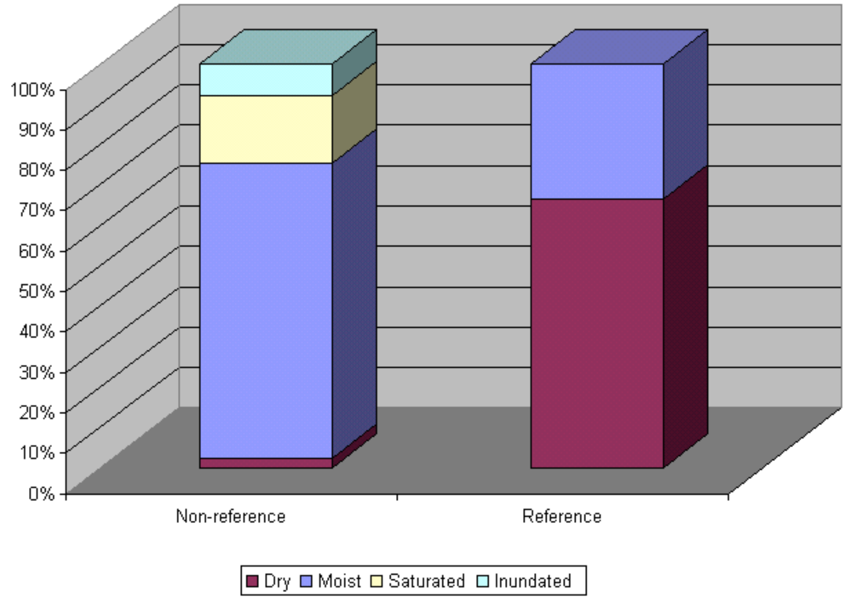
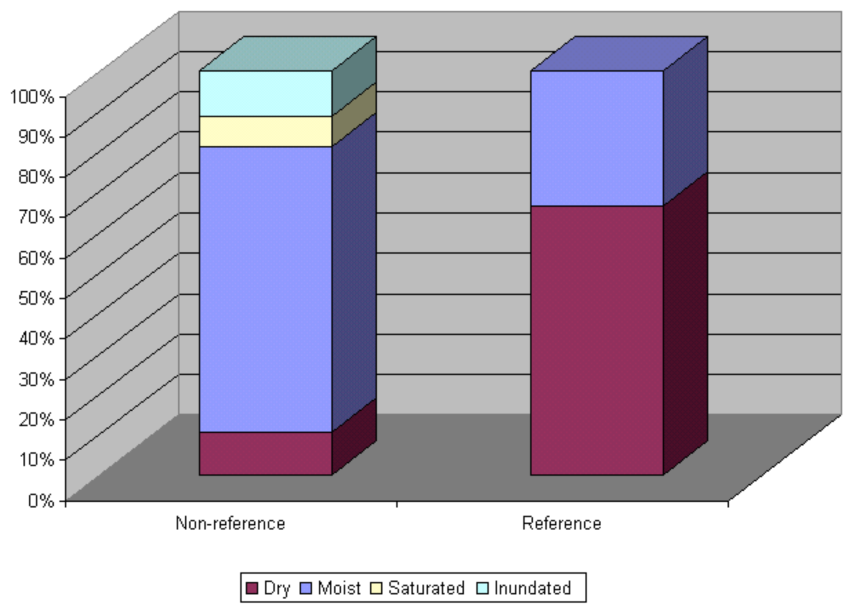


Figure 25. Percentage of headwater floodplain sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

Redox presence was very similar for both reference and non-reference headwater floodplains at a depth of 5cm (Figure 26). At 20cm, reference wetlands had more frequent redox findings than did non-reference wetlands (Figure 27).

Figure 26. Percentage of headwater floodplain sample plots in which redoxymorphic features were identified at 5cm; non-reference and reference sites are compared.

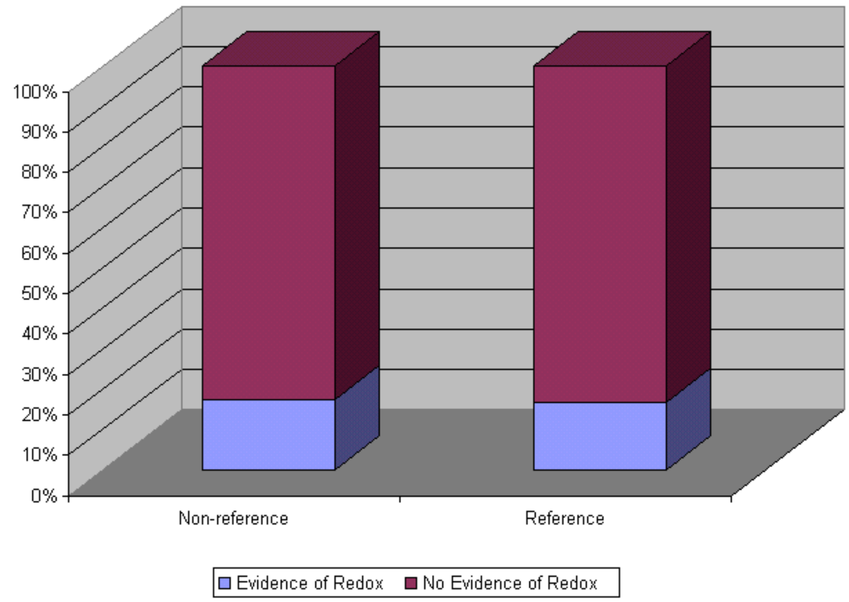
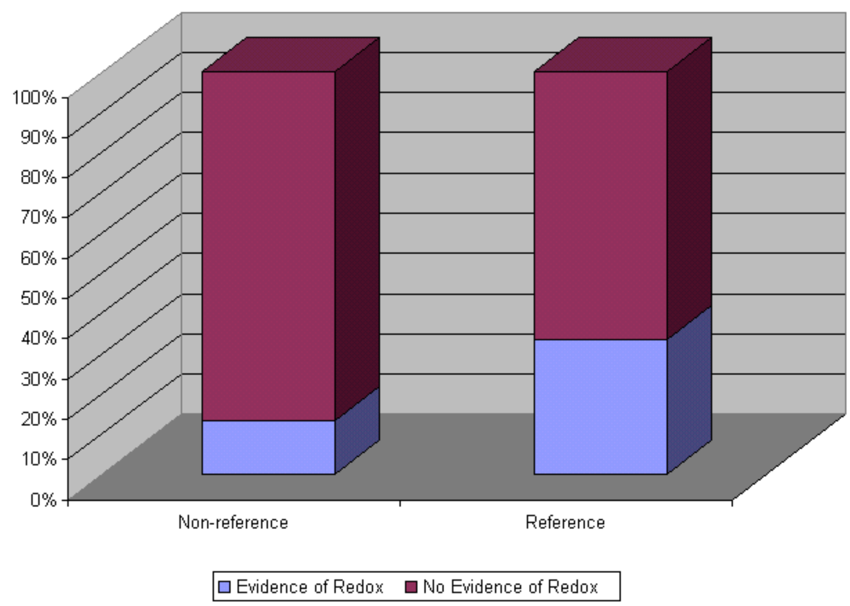


Figure 27. Percentage of headwater floodplain sample plots in which redoxymorphic features were identified at 20cm; non-reference and reference sites are compared.

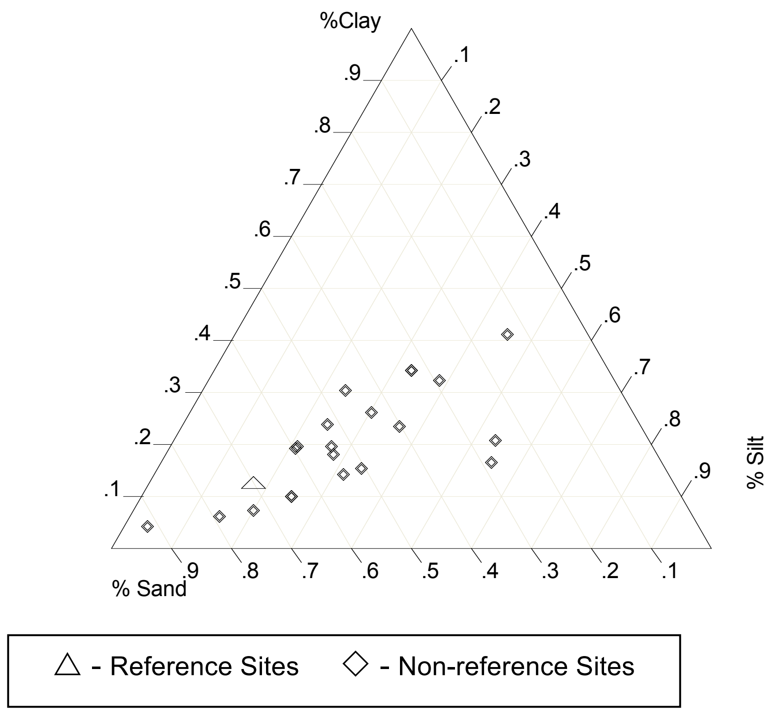


Mainstem Floodplain

Texture

Soil texture variation between reference and non-reference sites is difficult to assess because data only exists for one reference site. This reference site has lower percentages of clay and silt than most of the non-reference sites; its sand percentage is relatively high (Figure 28).

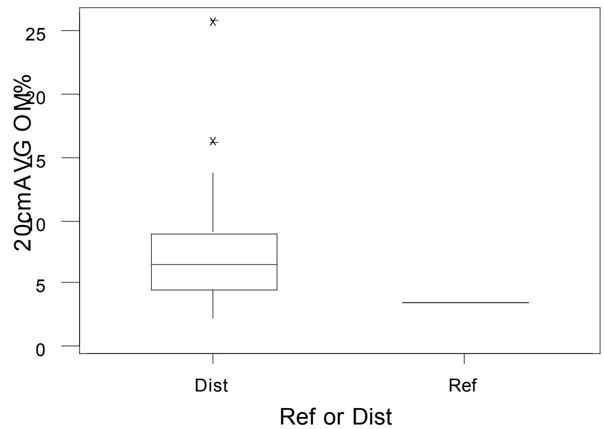
Figure 28. Site averages of 5cm soil texture for reference and non-reference sites in the Mainstem Floodplain subclass.



Organic Matter

No statistical tests were performed for mainstem floodplain organic matter because of the existence of only one reference site. A plot showing the reference value in comparison to the non-reference data shows that organic matter was greater in most non-reference sites than in the reference site (Figure 29).

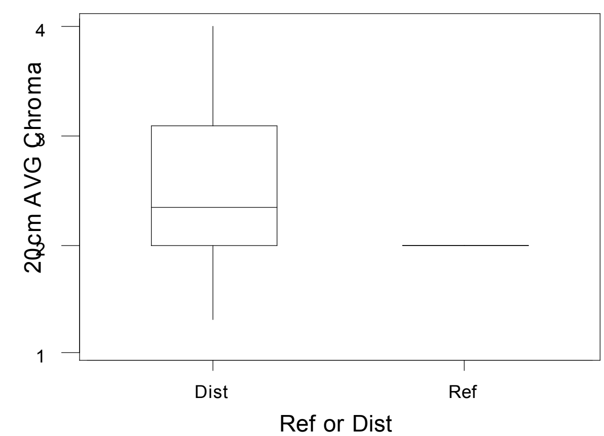
Figure 29. Variation in average % organic matter at 20cm between one reference site and all non-reference/disturbed sites for headwater floodplain wetlands.



<u>Chroma</u>

Statistics also were not performed for mainstem floodplain matrix chroma data because of the presence of only one reference site. The chroma value identified at that reference site is lower than that of the median chroma for non-reference sites (Figure 30).

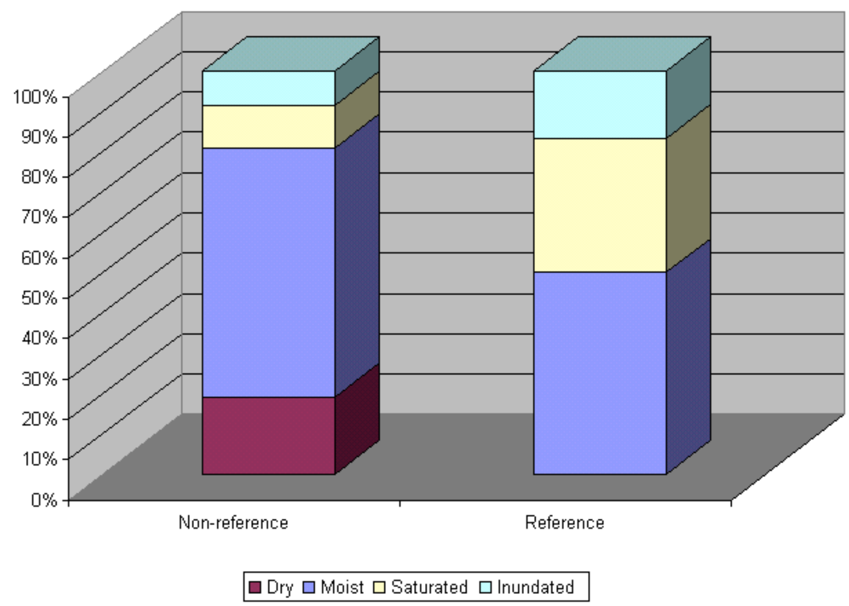
Figure 30. Variation in average matrix chroma at 20cm between mainstem floodplain wetlands at one reference site and all non-reference/disturbed sites.



Hydrologic Condition

Reference sites exhibited moister conditions that non-reference sites for mainstem floodplains (Figure 31). This data is only for a depth of 20cm; no 5cm data were available for reference wetlands in this HGM subclass.

Figure 31. Percentage of mainstem floodplain sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

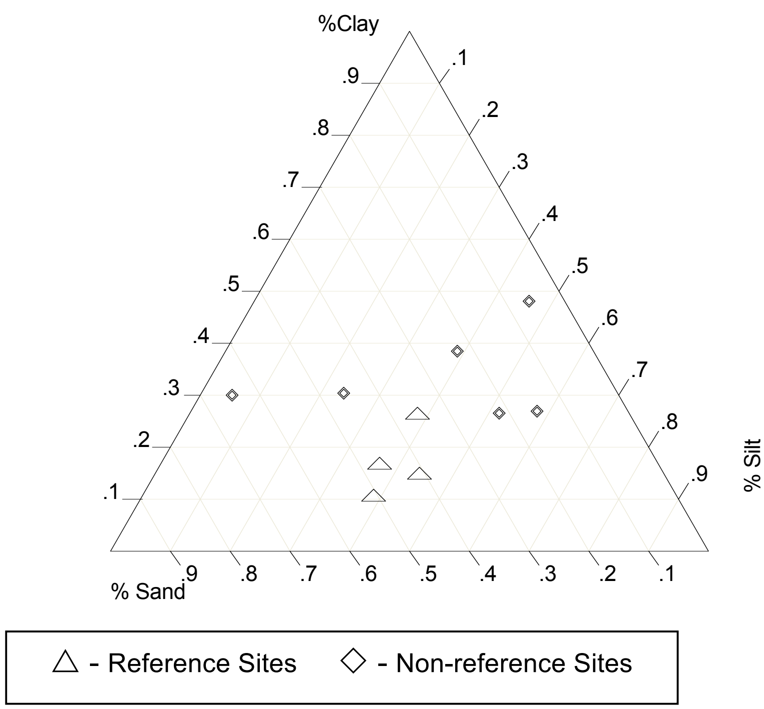
No data for redoxymorphic features at reference sites was available for mainstem floodplain wetlands. No comparison of reference and non-reference wetlands can, therefore, be made.

Human Impoundment (Fringing)

Texture

Soil texture in human impoundment wetlands appears to have significant variation between reference and non-reference sites (Figure 32). Reference sites form a small cluster with each site falling into the loam texture class. Non-reference sites have a much less distinctive trend to their particle size distributions. However, all non-reference sites have higher clay percentages than all of the reference sites.

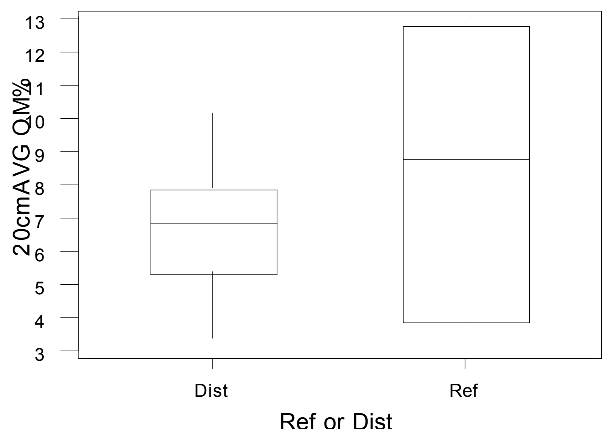
Figure 32. Site averages of 5cm soil texture for reference and non-reference sites in the Human Impoundment subclass.



Organic Matter

Organic matter is not significantly different between reference and non-reference sites (F=0.68, p=0.44). The median value across all human impoundment sites is greater for reference (8.5%) than for non-reference (6.7%) sites (Figure 33).

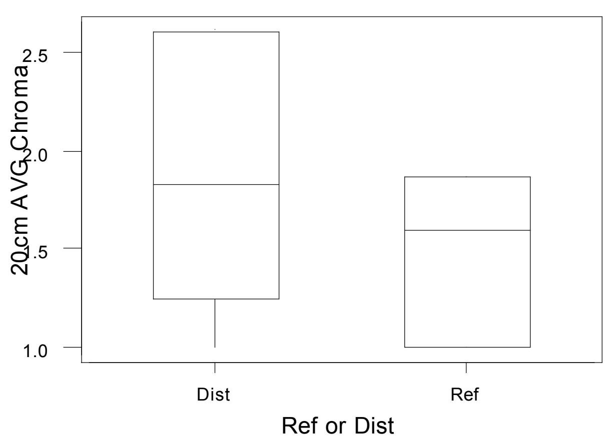
Figure 33. Variation in average % organic matter at 20cm between reference and non-reference/disturbed sites for human impoundment wetlands.



Chroma

Variation in chroma values between reference and non-reference/disturbed sites was not significant at 20cm (F=0.78, p=0.41). However, a visual representation indicates that the values collected for non-reference site chroma are greater than those for reference site chroma (Figure 34), suggesting drier soils are present.

Figure 34. Variation in average matrix chroma at 20cm between human impoundment wetlands at reference and non-reference/disturbed sites.



Hydrologic Condition

Reference sites are much wetter than non-reference sites for human impoundments at both 5cm and 20cm. At 5cm, all reference data was reported as inundated; non-reference sites had a majority of moist classifications, with some saturated and inundated (Figure 35). At 20cm, drier conditions exist in both data sets, but non-reference sites are still much drier than reference sites (Figure 36).

Figure 35. Percentage of human impoundment sample plots identified for each moisture class at 5cm; non-reference and reference sites are compared.

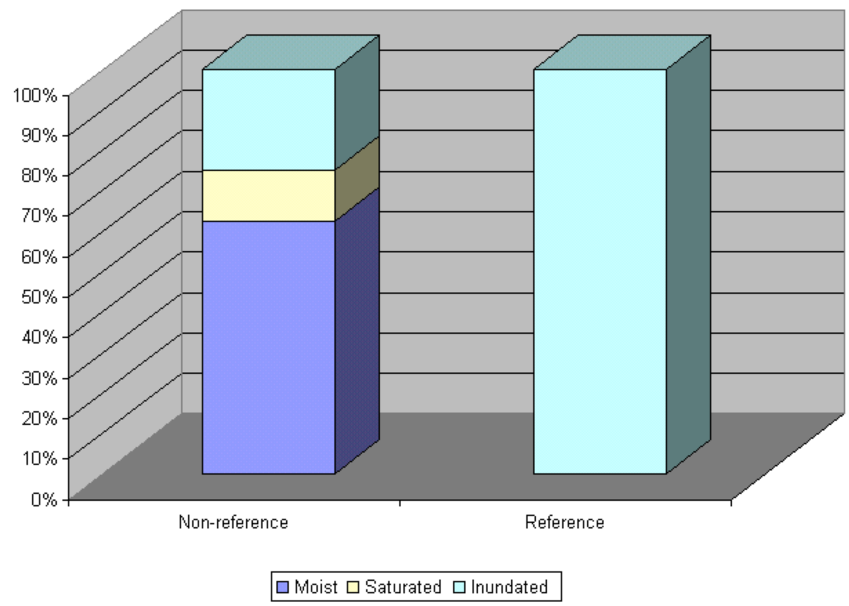
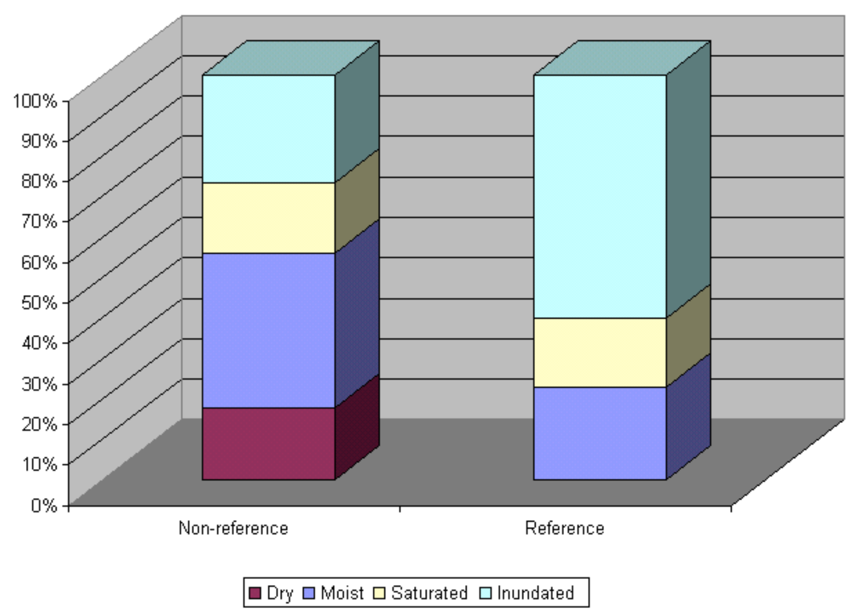


Figure 36. Percentage of human impoundment sample plots identified for each moisture class at 20cm; non-reference and reference sites are compared.



Redoxymorphic Features

No redoxymorphic features were identified at any of the human impoundment reference sites. They were identified at non-reference sites, at both 5cm (Figure 37) and 20cm (Figure 38) depths.

Figure 37. Percentage of human impoundment sample plots in which redoxymorphic features were identified at 5cm; non-reference and reference sites are compared.

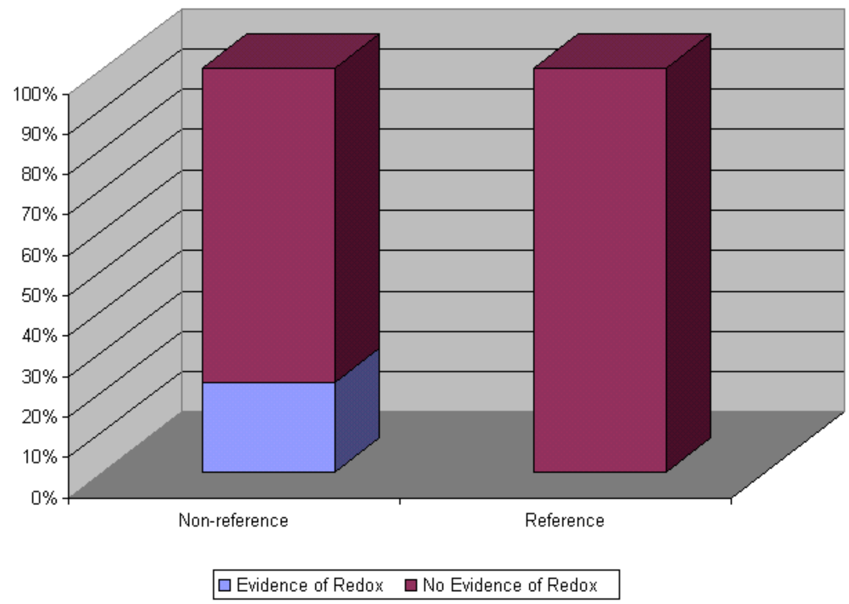
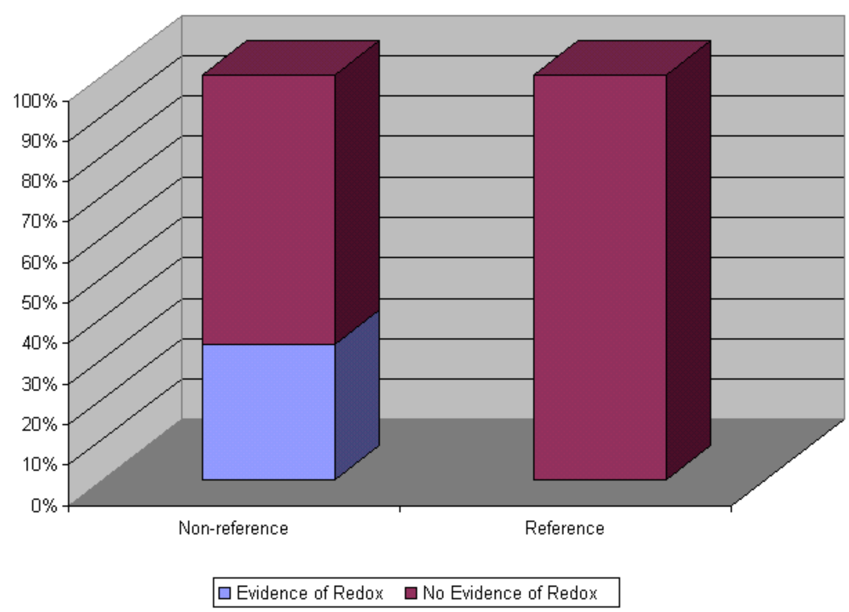


Figure 38. Percentage of human impoundment sample plots in which redoxymorphic features were identified at 20cm; non-reference and reference sites are compared.



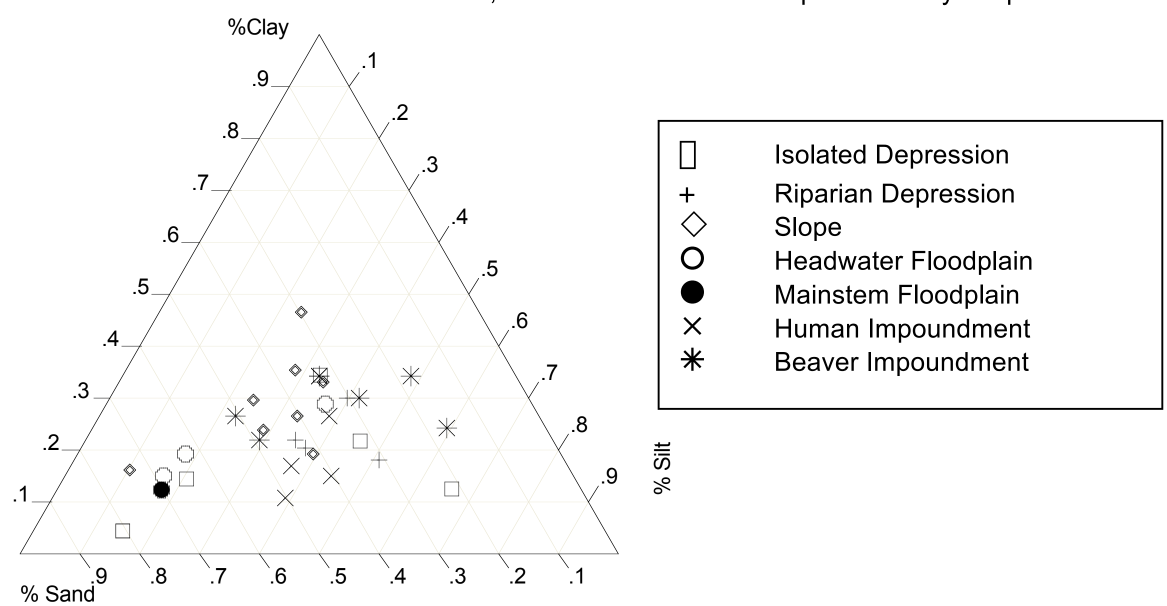
SOIL VARIATIONS ACROSS HGM SUBCLASSES

The following are the results of analyses to test the hypothesis that soil properties will vary across HGM subclasses. Each soil property is reported individually with a comparison of the data for each subclass. Where possible, comparisons were made for reference sites, non-reference sites, and all sites. As data availability allowed, these comparisons were made for depths of both 5cm and 20cm.

Texture

Soil texture of reference sites varies between hydrogeomorphic subclasses, although some data points for each subclass overlap the regions covered by other subclasses (Figure 39). Slope sites tend to have higher clay percentages than other subclass sites. Riparian depression and human impoundment sites exhibit similar textural properties, with human impoundments having slightly more sand and riparian depressions having slightly more clay.

Figure 39. Soil textures of all reference sites; each HGM subclass is represented by unique characters.



Organic Matter

Organic matter sampled at 20cm did not vary significantly across HGM subclasses for reference sites or for non-reference sites (F=1.24, p=0.33 and F=1.83, p=0.11, respectively) (Figure 40, Figure 41). Tukey's pairwise comparison indicated that no significant variation existed between any two individual subclasses for the same data (family error rate = 0.05).

However, when reference sites and non-reference sites of each HGM subclass were analyzed together, significant variation was present. This was true both at 5cm (F=4.32, p=0.001) and at 20cm (F=2.85, p=0.012). At 5cm, Tukey's pairwise comparison found significant difference between two pairs of HGM subclasses (Figure 42). The variation occurred between isolated depression and headwater floodplain sites and between isolated depression and mainstem floodplain sites (family error rate = 0.05). At 20cm, Tukey's pairwise comparison identified significant difference only between isolated depression and headwater floodplain sites (Figure 43) (family error rate = 0.05).

Figure 40. Comparison of 20cm organic matter at reference sites across HGM subclasses.

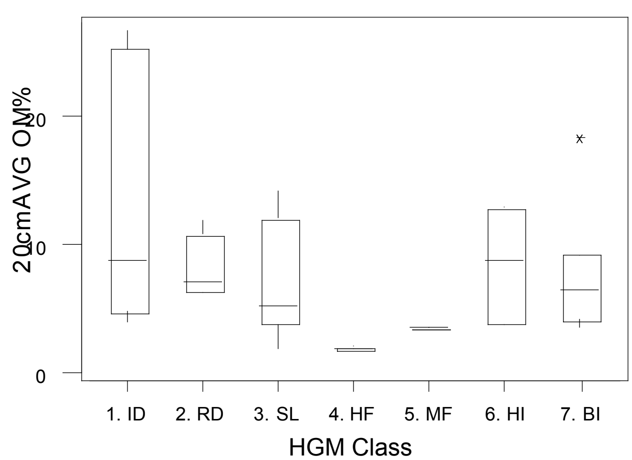


Figure 41. Comparison of 20cm organic matter at non-reference sites across HGM subclasses.

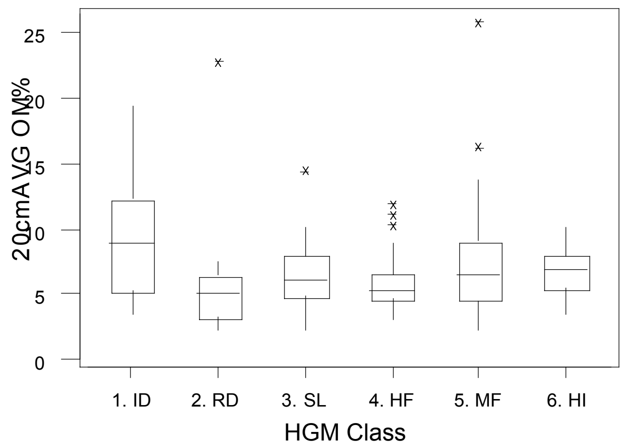


Figure 42. Comparison of 5cm organic matter at all sample sites across HGM subclasses

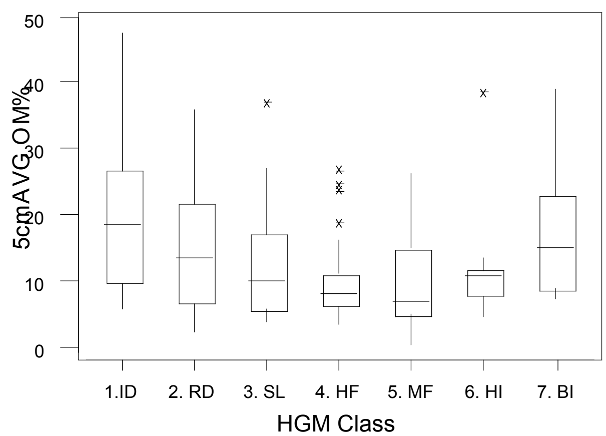
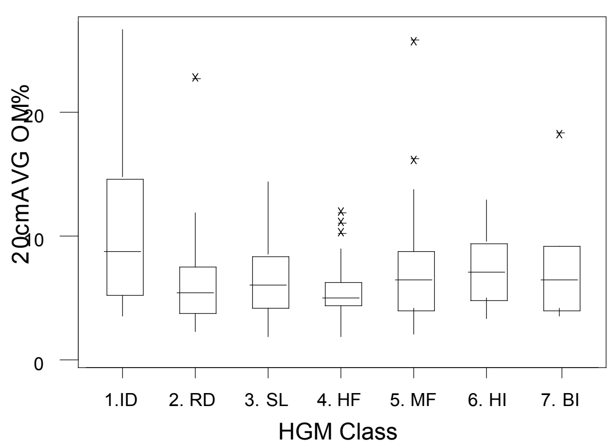


Figure 43. Comparison of 20cm organic matter at all sample sites across HGM subclasses.



Chroma

Soil matrix chroma (20cm sample depth) does not vary significantly across HGM subclasses for reference sites or for non-reference sites (F=0.30, p=0.93 and F=2.02, p=0.08, respectively) (Figure 44, Figure 45).

When all sample sites were combined together and analyzed, significance was found at 20cm (F=2.53, p=0.024) (Figure 46), but not at 5cm (F=1.04, p=0.41) (Figure 47). This corresponds to evidence from wetland delineations where soil differences are expected below the A-horizon, which would correspond with 20 cm (Tiner 1998). Both of these data sets produce a clear tendency toward higher chroma values in floodplain sites and lower chroma values in depression sites.

Figure 44. Soil matrix chroma at 20cm for reference sites, across HGM subclasses.

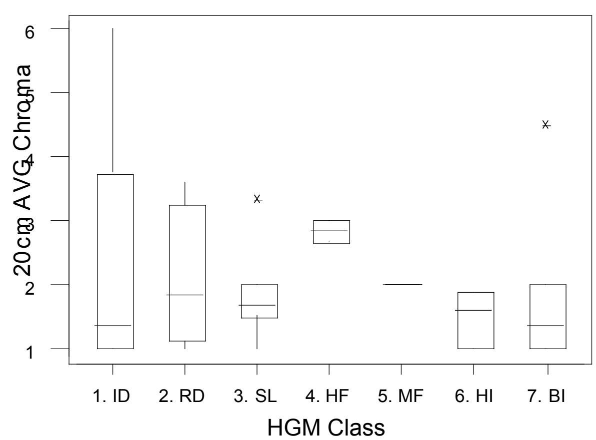


Figure 45. Soil matrix chroma at 20cm for non-reference sites, across HGM subclass.

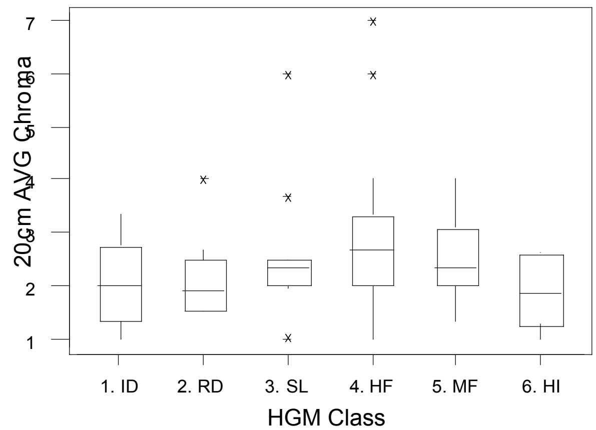


Figure 46. Soil matrix chroma at 20cm for all sample sites across HGM subclasses.

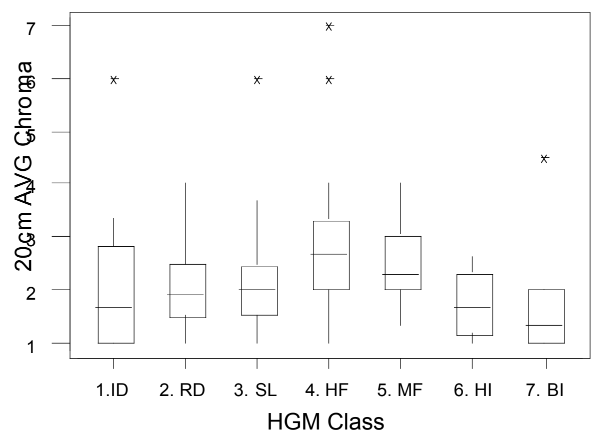
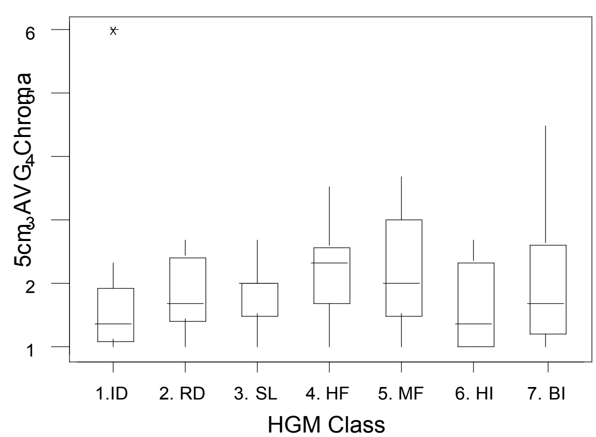


Figure 47. Soil matrix chroma at 5cm for all sample sites across HGM subclasses.



Hydrologic Condition

Soil moisture in both reference and non-reference sites generally decreases from isolated depressions to headwater floodplains. Human impoundments of reference status possess very wet conditions at both 5cm and 20cm (Figures 48 and 49). This anomaly is less obvious in non-reference sites, although HI sites still have a greater moisture content than most other subclasses (Figures 50 and 51). Beaver impoundments also have very high moisture levels. Headwater floodplain sites appear to be the driest throughout all of the data.

Figure 48. Percentage of reference sample plots identified for each moisture class at 5cm; HGM subclasses are compared. No 5cm moisture data available for riparian depression or mainstem floodplain reference sites.

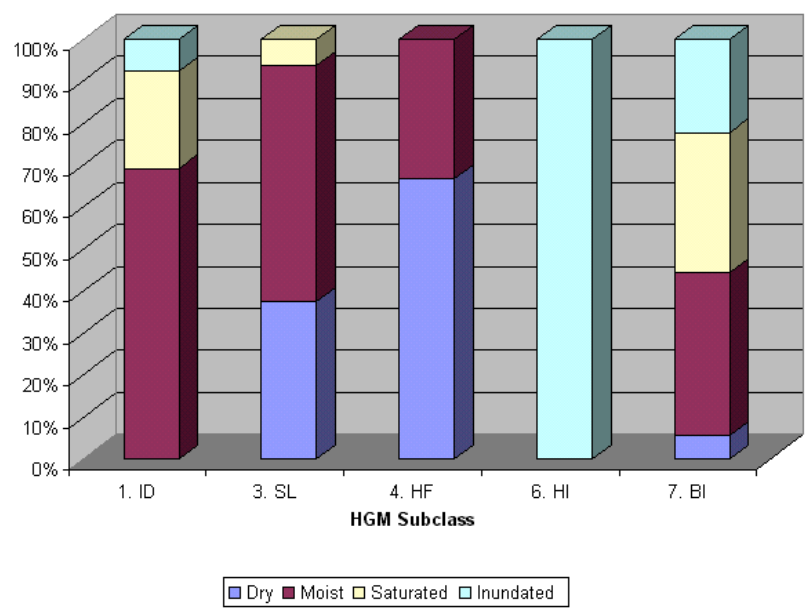


Figure 49. Percentage of reference sample plots identified for each moisture class at 20cm; all HGM subclasses are compared.

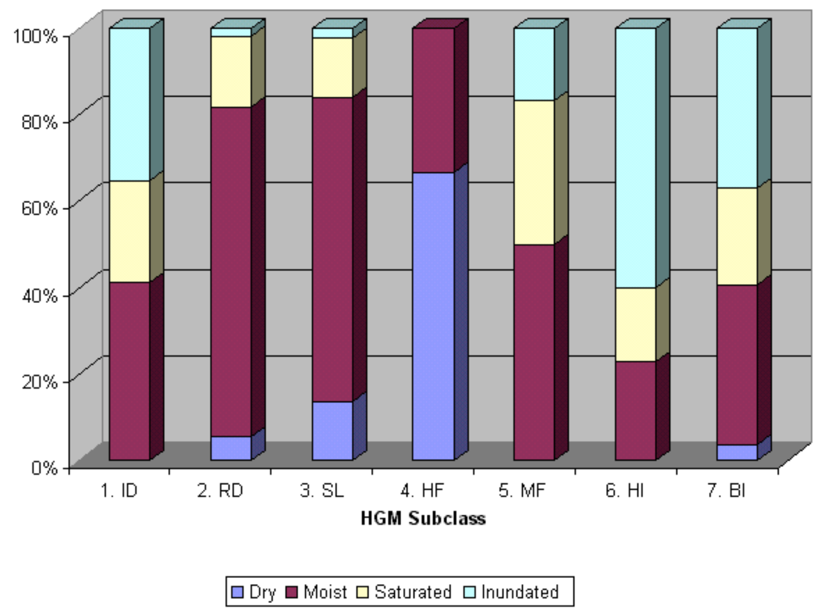


Figure 50. Percentage of non-reference sample plots identified for each moisture class at 5cm; all HGM subclasses are compared. Non-reference sites do not exist for beaver impoundments.

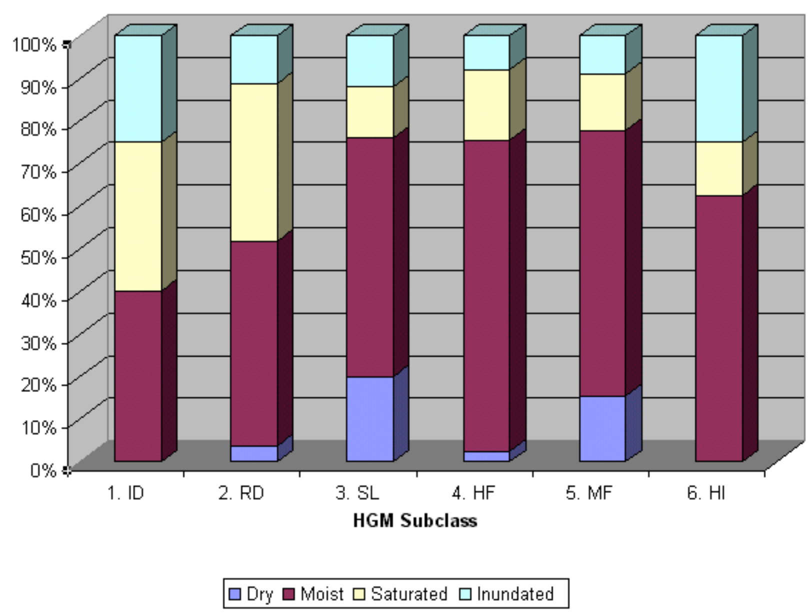
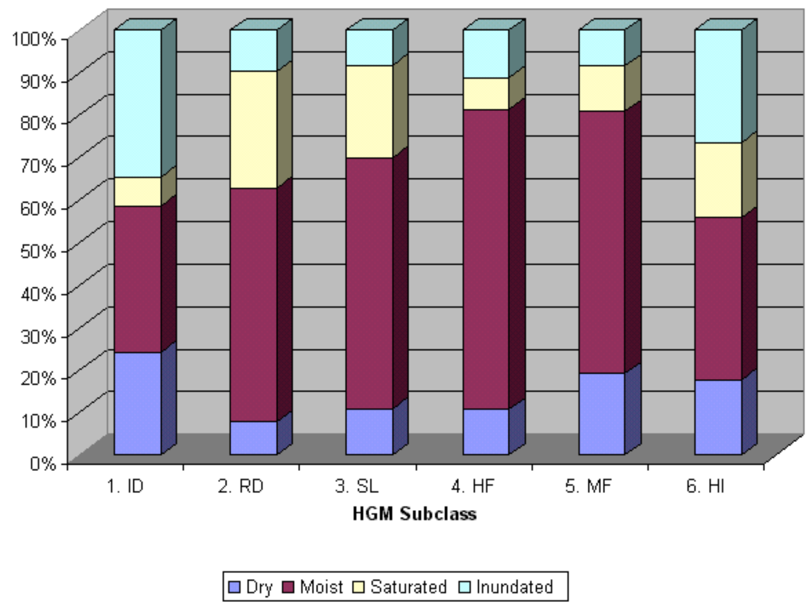


Figure 51. Percentage of non-reference sample plots identified for each moisture class at 20cm; all HGM subclasses are compared. Non-reference sites do not exist for beaver impoundments.



Redoxymorphic Features

The presence of redoxymorphic features was found in reference sites at isolated depression (only at 20cm), slope, headwater floodplain, and beaver impoundment wetlands (Figures 52 and 53). Human impoundment reference sites yielded no evidence of redox. No data for redox was reported at the reference standard riparian depression sites.

For non-reference sites, redox was identified in every HGM subclass. The ratio of subclass sites with redox to those without decreases from isolated depression to mainstem floodplain (Figures 54 and 55).

Figure 52. Percentage of reference sample plots in which redoxymorphic features were identified at 5cm; HGM subclasses are compared. No redox data was available for riparian depression or mainstem floodplain reference sites.

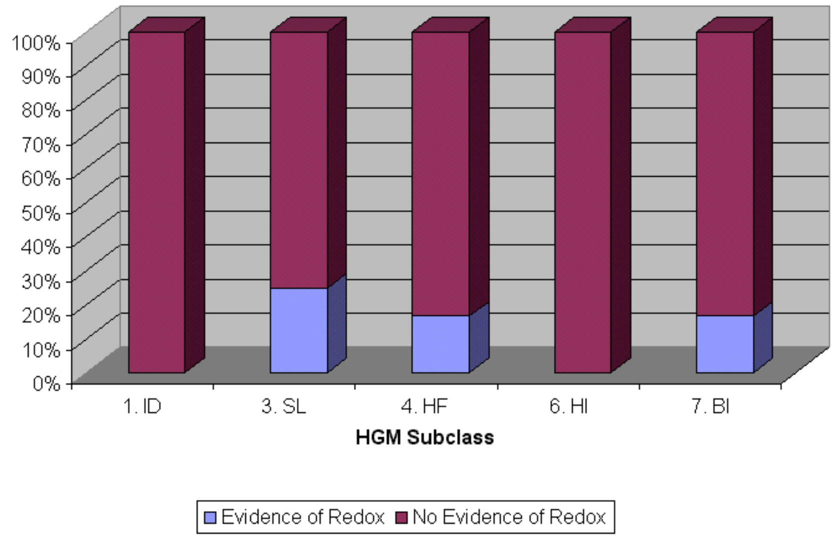


Figure 53. Percentage of reference sample plots in which redoxymorphic features were identified at 20cm; HGM subclasses are compared. No redox data was available for riparian depression or mainstem floodplain reference sites.

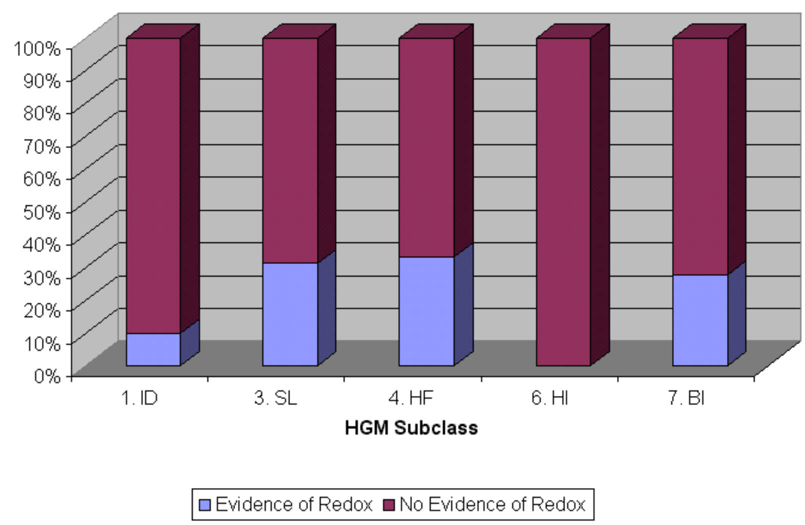


Figure 54. Percentage of non-reference sample plots in which redoxymorphic features were identified at 5cm; HGM subclasses are compared. Non-reference sites do not exist for beaver impoundments.

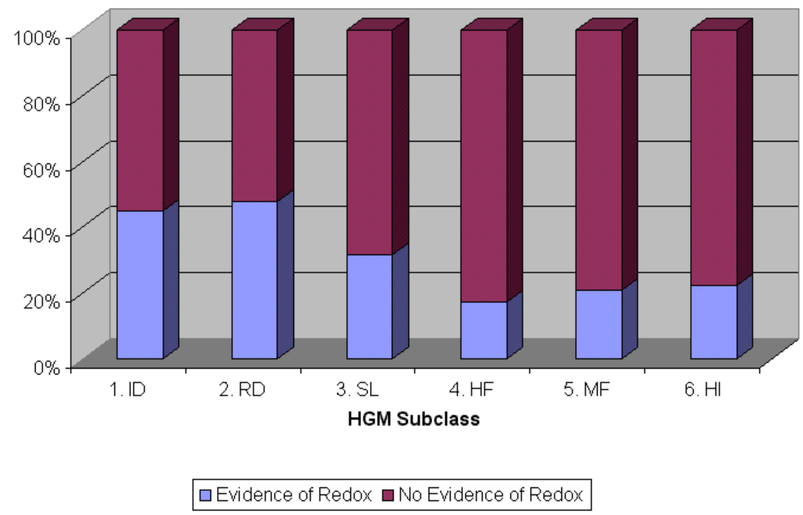
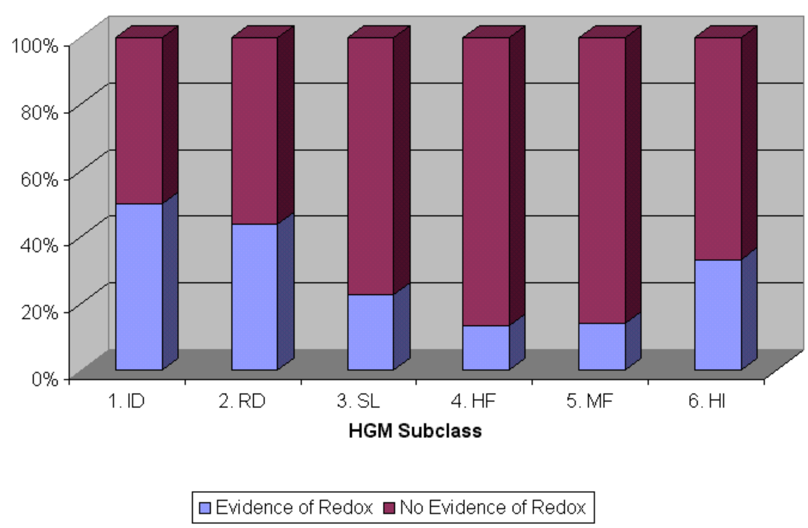


Figure 55. Percentage of non-reference sample plots in which redoxymorphic features were identified at 20cm; HGM subclasses are compared. Non-reference sites do not exist for beaver impoundments.



DISCUSSION

The results obtained from the prescribed analyses did not coincide with the hypotheses. Statistical significance was rarely found, although general trends that matched the hypotheses could frequently be extracted from the data. Low sample sizes for most comparisons among wetland types contributed to the lack of significance.

Reference vs. Non-reference comparisons

Isolated Depression. The data for isolated depressions did not produce many clear, significant results. This could potentially be due to the fact that reference sites in this HGM subclass exhibit a wide range of values for several of the soil properties.

Texture data were highly intermixed between reference and non-reference sites across the textural triangle. For the number of sites analyzed, any slight trends in the data cannot be interpreted as significant variations.

Organic matter was not significantly different between reference and non-reference sites; the medians are approximately equal. Chroma had no significant variation, although the reference median was lower. This lower median value supports the theory that reference standard sites most closely adhere to the criteria for wetland delineation (chroma must be 2 or less). The range of the data for both organic matter and chroma was much greater in reference sites than in the corresponding non-reference sites. A potential explanation of this is that reference sites within a subclass display greater variation of these characteristics. Once sites become degraded, this natural variation is reduced.

The hydrologic condition charts show opposing trends at 5cm (reference wetter) and at 20cm (non-reference wetter); this could be related to the low amount of reference moisture data for isolated depressions. Redoxymorphic features were much more prevalent in non-reference sites than in reference sites, which could be an artifact of increased mottling of soils in non-reference sites where water fluctuations might be greater due to surrounding landscape disturbances.

Riparian Depression. The data for this HGM subclass possess more noticeable differences between reference and non-reference sites. However, limited data make comparisons of moisture at 5cm and of all redox features impossible.

Soil texture for reference sites forms a cluster located around the loam textural class. It is a relatively tight clustering of texture data when compared to all other HGM subclasses. Only four reference sites are present, but the proximity of the data points to one another in the ternary diagram suggests a cluster. The non-reference data are scattered rather evenly throughout a much wider range of values. This seems to point to a more common soil texture for more pristine wetlands, and divergence from this in several directions as degradation increases.

Organic matter did not vary significantly between reference and non-reference sites. However, the boxplot shows the interquartile ranges barely overlapping, with reference percentages being the higher of the two. This conforms to the standard theory that more pristine sites will accumulate more organic matter while more degraded sites will accumulate less.

Soil chroma variation for riparian depressions was scarce between reference and non-reference sites. With ANOVA returning $p=0.91$, it is clear that there is no significant variation.

The moisture levels between reference and non-reference sites were similar. There are a greater number of saturated and inundated samples for non-reference riparian depressions, but also more dry samples. When compared with reference sites that had a large majority of samples identified as moist, the variation does not seem clear enough to warrant an assumption of significant difference.

Slope. The slope HGM subclass does not do well to support the hypothesis of reference and non-reference sites having noticeably differing soil properties. Data for almost all of the 5 properties are quite similar between the two.

Soil texture is the most varied of the soil properties at slope sites. The reference sites and non-reference sites make up reasonably distinct clusters in the ternary plot. They both have similar values for clay, but reference sites have more sand and non-reference sites have more silt. An explanation for this observation is possibly that non-reference slope sites receive a higher sediment load due to disturbance, which would consist primarily of silt. More work would need to be done to examine the cause of this finding.

Organic matter shows no significant variation across disturbance classes. The range and median of the data are quite similar for reference and non-reference sites.

Although matrix chroma did not differ significantly in the ANOVA test, the boxplot indicates that reference samples had lower chroma values than non-reference samples. The interquartile ranges for the two do not overlap, but separate at a value of 2, which is the indicator value used to define the hydric soil criterion.

Hydrologic conditions are relatively similar for slope sites. At both 5cm and 20cm reference sites appear a bit drier, but not enough to be significant given the limitations of the data. Less moisture variation between reference and non-reference in this subclass makes sense. Moisture presence on an elevation gradient is determined more by natural water-generating processes and gravity than by a disturbance that would cause more or less standing water as in some other wetland types.

Redox features were similar for both reference and non-reference sites. No significant trends can be extracted from the chart.

Headwater Floodplain. Soil data between reference and non-reference wetlands within this subclass were clearly varied for some properties and less so for others. No clear trends were evident for texture, chroma, and redox. Variation is significant for organic matter and moisture. These comparisons must be considered cautiously, acknowledging that only 3 reference sites were used.

Soil texture does not appear to have any identifiable unique properties for reference or non-reference sites. The presence of only 3 reference sites makes the comparison difficult because this sample size would have to be extremely clustered to warrant assumption of a significant trend.

Variation in organic matter was identified as significant at 20cm, with reference having much less than non-reference. The significant result that was produced is contrary to the hypothesis that reference sites should have more organic matter than non-reference sites. Although ANOVA reported statistical significance, there is potential error in the fact that only 3 reference sites were used.

Soil chroma was not found to be significantly different between reference and non-reference sites. The reference sites fit into a small data range, but the medians for the two categories are very similar.

Reference sites are much drier than non-reference sites at both 5cm and 20cm. This difference could potentially be due to wetlands of reference status exhibiting wetland properties at greater distances from the stream, whereas at non-reference sites the delineated area is only immediately next to the stream. The actual 'wetland' area would be much more saturated on a site basis because drier areas at non-reference sites are not included in the wetland. At reference sites, these somewhat drier areas may still possess wetland conditions because of their relatively pristine nature.

Headwater floodplain data for redoxymorphic features identified variation, although insignificant, between reference classes. The percentage of sample plots where redox was observed was nearly the same for 5cm; at 20cm, plots with redox were twice as common for reference than for non-reference sites.

Mainstem Floodplain. Comparisons of reference and non-reference data for mainstem floodplains are reported, but display no significance because only one reference site was used. In comparison to the non-reference data, values for the reference site generally were: a) higher in sand and lower in silt particles, b) lower for organic matter, c) lower for chroma, and d) wetter. No redox data was available for the site.

Human Impoundment. The analyses of soil data for this subclass presented a much clearer distinction between reference and non-reference sites than those for other subclasses.

The soil texture of all reference sites is distinctly classified as loam. These sites form a small cluster, while the non-reference sites are spread throughout the textural distribution. The textures of the reference sites had lower clay percentages than the non-reference sites. A clear difference exists here between reference and non-reference sites.

The median value of percent organic matter is greater in reference sites than in non-reference sites. This variation can be seen in the boxplot (Figure 33), but was not found to be significant in the ANOVA test. The range of values was very wide for reference sites, but a tendency towards higher organic matter in reference sites indicates consistency with ecological principles.

Soil chroma variation was also insignificant between reference and non-reference sites. The median value was less for reference sites, with the data skewed toward lower values. A trend can be identified, but not a significant difference.

The tendency toward more organic matter and lower chroma in reference sites is consistent with the moisture analysis. These are both indicators of saturated conditions, and reference sites are much wetter than non-reference sites. All of the reference plots were inundated at 5cm, and a majority of them also were at 20cm. At non-reference plots, 'moist' was the most dominant moisture class at both 5cm and 20cm.

Redox data are not as consistent as the previous three variables. None of the reference sites had any redoxymorphic features identified. With conditions being as moist as they were, at least at the time of sampling, these would be expected. Approximately one-fourth of the non-reference sites exhibited redox features.

HGM Subclass Comparisons

Texture. While no clear separations can be made between the soil textures of any of the HGM subclasses, relations and trends can be extracted. Some of the subclasses had concise clusters of data, while others had a wide range of values. The most plausible explanation of this is simply that the number of reference samples for each subclass is limited, so differentiation between general trends and rare exceptions is difficult.

Two HGM subclasses, human impoundment and riparian depression, fit neatly into a small, specific area of the ternary diagram. Their conditions mostly indicate a loam texture class. A specific landscape-based cause for the distinct similarity in these two is difficult to find, however these two subclasses have similar results for most of the soil properties.

Although data are limited for headwater and mainstem floodplains, the two riverine subclasses, they seem to possess different characteristics from the two depression subclasses, isolated and riparian. Using the order in which these subclasses are being analyzed (ID, RD, SL, HF, MF, HI, BI), an energy gradient exists from isolated depressions having the lowest energy to mainstem floodplains having the highest energy. Human and beaver impoundments do not fit into this gradient, and should not be considered here. The fact that the depressions tend to have less sand and more silt than the floodplain sites is likely related to these energy variations. As lower-energy systems, the depressions do not have fast-moving water traveling to them and carrying large sediments. The floodplains are located immediately along streams, where water moves faster and supports greater particle sizes; these drop out, creating sandier soils, as water slows upon entering the wetland. Slope sites fit into the middle of this energy gradient; they possess slower-moving water and thus less sandy conditions than the floodplains.

Beaver impoundments had finer textures than human impoundments did for the reference texture data, which might relate to excavation to subsoil in some of the reservoir sites.

Organic Matter. To identify differences between HGM subclasses' organic matter content, comparisons were made for reference sites alone, non-reference sites alone, and all sample sites combined. The original goal was to only analyze the reference and non-reference categories, but the combined results provided a useful perspective. The reference or non-reference sites alone did not have statistically significant variation across subclasses, although a vague trend seemed to emerge. However, the combined results confirmed these trends, possibly because the data pool was greater, thus allowing for statistical significance. The limitations of insufficient 5cm data were overcome by incorporating both reference and non-reference results together; these results are also presented. Merging the two categories was assumed to be acceptable because there was little significant difference between reference and non-reference sites in the first set of analyses.

The results at 20cm for both reference and non-reference sites show the highest levels of organic matter at isolated depressions. Values are lower for floodplain sites.

The results for all sample sites, at 5cm and 20cm, indicated significant differences between subclasses. The boxplots show a clear decrease in percent organic matter from low-energy to high-energy systems. Tukey's pairwise comparisons indicated significant variation at 5cm between isolated depressions and headwater floodplains and between isolated depressions and mainstem floodplains. At 20cm, significant pairwise variation only was identified for isolated depressions and headwater floodplains.

This significance seems to indicate that the visual trend is indeed real. Significant difference between all subclasses is not expected; the HGM approach to wetland classification does not identify subclasses as separate, bounded entities. Brinson (1995, 1996) describes the classification process as a tool to "reduce the range of variation that must be dealt with for any given assessment", acknowledging that wetlands exist on a continuum, with shared characteristics between similar subclasses. His HGM classification uses the aspects of water source, hydrodynamics, and landscape position to define subclasses, all of which influence the results of my analyses.

This similarity can be seen with beaver and human impoundments. They have very similar organic matter content at reference sites, with values closer to those of the depressions than those of the floodplains.

Chroma. As with organic matter, and for similar reasons, analyses were conducted at the reference, non-reference, and all sites levels. Significant cross-subclass trends were only identified for the merged dataset, although these can be extracted from the boxplots of reference and non-reference data.

A significant difference (F=2.53, p=0.024) between subclasses was found for the 20cm data across all sites. Chroma values were lowest in isolated depressions, increasing along the energy gradient to the floodplain sites. Median values for mainstem floodplains were slightly lower than those for headwater floodplains, but they still fit into the overall trend. This trend makes sense, considering that the depression sites are generally wetter than the floodplain sites (see below). Low chroma values are typically associated with wet conditions.

Hydrologic Condition. Soil moisture data is graphically presented for depths of both 5cm and 20cm, at reference sites and at non-reference sites. An identifiable trend is present in each of these four graphs. Along the energy gradient, soil moisture is greatest for isolated depressions and least for headwater floodplains. Mainstem floodplains are wetter than headwater floodplains at reference sites. At non-reference sites they are essentially the same.

Human impoundment soil moisture is generally comparable to that of the depression sites, except at 5cm reference sites where all sample plots were classified as ‘inundated’. Beaver impoundments were also very moist, with conditions slightly drier than at human impoundments.

The moisture gradient exhibited between the low-energy depressions and the high-energy floodplains is consistent with the other data presented. Wetter conditions prevent the decomposition of organic matter, leading to accumulation and thus higher site percentages; the depression sites had the highest values for organic matter. Chroma values are lowest for wetter conditions; isolated depressions had the highest moisture content and the lowest median chroma.

Redoxymorphic Features. The graphical analysis of redox data produced contrary results for reference sites and non-reference sites. The reference data is difficult to interpret because no redox data was available for riparian depressions or mainstem floodplains. The other subclasses had data, but not as much as existed for non-reference sites.

The existing data for reference sites indicate less redoxymorphic features at isolated depressions, and more at slope and headwater floodplain wetlands. Human impoundments had no redox, while beaver impoundments had proportions comparable to those of the slopes and headwater floodplains. Wetter sites (i.e. isolated depressions) typically are more conducive to the development of reduced conditions. When the reducing conditions are dominant, the resultant hydric soil can appear dark and somewhat featureless. When water tables fluctuate, as they do in the drier types of wetlands, then features such as mottling and concretions may be more apparent to the observer. Thus, analyzing these observational data may not be the best way to define the degree of wetness found in a range of wetland soils (Brooks, pers. comm..).

Redoxymorphic features were much more prevalent in every subclass at the non-reference sites. This is potentially due to greater fluctuations in the water table. Relatively degraded sites tend to have flashier runoff events, often as a result of surrounding disturbances. These variations in hydrology allow for alternating patterns of reduction and oxidation, and are the precise conditions necessary for the formation of redoxymorphic features.

CONCLUSIONS

This analysis of hydric soil characteristics, primarily for wetlands in the Ridge and Valley province of Pennsylvania, demonstrated that soils display fundamentally different characteristics across the array of HGM subclasses when arranged along a hydrologic gradient. Low energy, and often wetter, depressions are distinctly different from the riverine types, which have higher energy, uni-directional flow, and a more fluctuating hydroperiod. Slope wetlands display typically intermediate conditions between depressions and riverine types. With few exceptions, the five soil parameters investigated (i.e., soil texture, organic matter, matrix chroma, hydrologic condition, and redoxymorphic features) showed consistent trends across this hydrologic gradient and among each other. Based on my analyses, I believe I can reject the null hypothesis of no differences among wetlands types. Although not all relationships were significant, based in part on low sample sizes, the trends were consistent, and in some cases fairly strong in support of variations in soil characteristics along the HGM gradient. Thus, I believe my first hypothesis is supported.

The analysis did not, however, demonstrate that substantial differences exist between soil characteristics of reference and non-reference wetlands. Relatively pristine reference wetlands exhibited traits that, in most cases, were quite similar to those of more degraded non-reference wetlands. These findings may have been influenced by the low sample size, however, the results are not sufficient to reject the null hypothesis of no differences between reference and non-reference wetlands. Therefore, my second hypothesis is not supported. Although significant variation did not exist, a noteworthy finding did emerge from the analyses. Results from statistical tests showed that although median values were often similar for reference and non-reference sites, the range of the variation was wider for reference sites. This may indicate that relatively pristine wetlands possess a natural variability that may become curtailed under the influence of disturbance. Further investigations would need to be made to explore this hypothesis.

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APPENDIX A

HGM CLASSIFICATION DIAGRAM

APPENDIX B

1993-2003 SITE DATA

Table 1. Data collected from each sample site, at plot level, for hydrologic conditions and redoxymorphic features.

Site Nu	Reference Site Name	HGM C	Plot	5cm Moi	20cm Mo	5cm R	20cm F	Ref/Nonre
8	Duncansville	1. ID	T11		Dry			Nonref
8	Duncansville	1. ID	T12		Dry			Nonref
8	Duncansville	1. ID	T13		Dry			Nonref
8	Duncansville	1. ID	T14		Dry			Nonref
8	Duncansville	1. ID	T15		Dry			Nonref
8	Duncansville	1. ID	T16		Dry			Nonref
9	PSU Airport	1. ID	T11		Dry			Nonref
9	PSU Airport	1. ID	T22		Moist			Nonref
9	PSU Airport	1. ID	Wells		Moist			Nonref
38	Twin Ponds - PGC	1. ID	Plot 1		Wet			Ref
38	Twin Ponds - PGC	1. ID	Plot 2		Wet			Ref
38	Twin Ponds - PGC	1. ID	Plot 3		Wet			Ref
38	Twin Ponds - PGC	1. ID	Plot 4		Wet			Ref
73	Barrens Bear Pond	1. ID	T1-2	Saturated	Saturated			Ref
73	Barrens Bear Pond	1. ID	T2-1					Ref
73	Barrens Bear Pond	1. ID	T2-2					Ref
73	Barrens Bear Pond	1. ID	T3-1	Moist	Moist			Ref
73	Barrens Bear Pond	1. ID	T3-2	Saturated	Saturated			Ref
74	Barrens Long Pond	1. ID	T1-1					Ref
74	Barrens Long Pond	1. ID	T1-2	Wet	Wet	No	No	Ref
74	Barrens Long Pond	1. ID	T2-1					Ref
74	Barrens Long Pond	1. ID	T2-2	Moist	Wet	No	Yes	Ref
74	Barrens Long Pond	1. ID	T3-1					Ref
74	Barrens Long Pond	1. ID	T3-2	Moist	Moist	No	No	Ref
75	Green Heron Pond	1. ID	T1-1					Nonref
75	Green Heron Pond	1. ID	T1-3					Nonref
75	Green Heron Pond	1. ID	T2-1	Saturated	Wet	No	Yes	Nonref
75	Green Heron Pond	1. ID	T2-2					Nonref
75	Green Heron Pond	1. ID	T2-3	Wet	Wet	Yes	Yes	Nonref
75	Green Heron Pond	1. ID	T3-2	Moist	Moist	No	No	Nonref
76	Spray Pond	1. ID	T1-2	Wet	Wet	No	No	Nonref
76	Spray Pond	1. ID	T2-1	Saturated	Saturated	Yes	Yes	Nonref
76	Spray Pond	1. ID	T2-2					Nonref
76	Spray Pond	1. ID	T2-3					Nonref
76	Spray Pond	1. ID	T3-1	Saturated	Wet	Yes	Yes	Nonref
76	Spray Pond	1. ID	T3-2					Nonref
77	Mohn Mills 1	1. ID	T1-1	Saturated	Saturated	No	No	Ref
77	Mohn Mills 1	1. ID	T1-2	Moist	Saturated	No	No	Ref
77	Mohn Mills 1	1. ID	T1-3	Moist	Moist	No	No	Ref
78	Mohn Mills Moss	1. ID	T1-1	Moist	Moist	No	No	Ref
78	Mohn Mills Moss	1. ID	T1-2	Moist	Moist	No	No	Ref

78	Mohn Mills Moss	1. ID	T1-3	Moist	Moist	No	No	Ref
80	Kimmel 1	1. ID	T1-1	Moist	Moist	Yes	Yes	Nonref
80	Kimmel 1	1. ID	T2-1	Moist	Moist	Yes	Yes	Nonref
80	Kimmel 1	1. ID	T2-2	Moist	Moist	Yes	Yes	Nonref
80	Kimmel 1	1. ID	T2-3					Nonref
80	Kimmel 1	1. ID	T3-1					Nonref
81	Kimmel 2	1. ID	T1-1	Moist	Moist	No	No	Ref
81	Kimmel 2	1. ID	T2-1					Ref
117	Twin Ponds	1. ID	1-0	Moist	Moist	No	No	Nonref
117	Twin Ponds	1. ID	1-1	Wet	Wet	Yes	Yes	Nonref
117	Twin Ponds	1. ID	1-2					Nonref
117	Twin Ponds	1. ID	1-3	Saturated	Wet	Yes	Yes	Nonref
137	Scotia Road	1. ID	1-1	Saturated	Wet	No	No	Nonref
137	Scotia Road	1. ID	2-1					Nonref
137	Scotia Road	1. ID	3-1	Moist	Moist	No	No	Nonref
137	Scotia Road	1. ID	4-1					Nonref
141	SGL-166	1. ID	1-1	Moist	Moist	No	No	Nonref
141	SGL-166	1. ID	1-2					Nonref
141	SGL-166	1. ID	2-1	Moist	Moist	No	No	Nonref
141	SGL-166	1. ID	2-3					Nonref
141	SGL-166	1. ID	3-1					Nonref
141	SGL-166	1. ID	3-2					Nonref
141	SGL-166	1. ID	4-1	Saturated	Saturated	Yes	Yes	Nonref
141	SGL-166	1. ID	4-2					Nonref
148	Pilgrim	1. ID	1-1	Saturated	Wet	No	No	Nonref
148	Pilgrim	1. ID	1-2					Nonref
148	Pilgrim	1. ID	1-3					Nonref
148	Pilgrim	1. ID	2-1					Nonref
148	Pilgrim	1. ID	2-2	Wet	Wet	No	No	Nonref
148	Pilgrim	1. ID	2-3	Wet	Wet	No	No	Nonref
148	Pilgrim	1. ID	3-1					Nonref
5	McCall Dam	2. RD	T11		Moist			Ref
5	McCall Dam	2. RD	T12		Moist			Ref
5	McCall Dam	2. RD	T21		Saturated			Ref
5	McCall Dam	2. RD	T22		Moist			Ref
5	McCall Dam	2. RD	T31		Moist			Ref
5	McCall Dam	2. RD	T32		Moist			Ref
5	McCall Dam	2. RD	T33		Moist			Ref
5	McCall Dam	2. RD	Wells 1		Moist			Ref
5	McCall Dam	2. RD	Wells 2		Moist			Ref
6	Sand Spring	2. RD	T11		Moist			Ref
6	Sand Spring	2. RD	T12		Moist			Ref
6	Sand Spring	2. RD	T21		Moist			Ref
6	Sand Spring	2. RD	T22		Moist			Ref
6	Sand Spring	2. RD	T23		Moist			Ref
6	Sand Spring	2. RD	T31		Moist			Ref
6	Sand Spring	2. RD	T32		Moist			Ref
6	Sand Spring	2. RD	T41		Moist			Ref
6	Sand Spring	2. RD	T42		Moist			Ref
6	Sand Spring	2. RD	T43		Saturated			Ref
6	Sand Spring	2. RD	T51		Moist			Ref
6	Sand Spring	2. RD	T52		Moist			Ref
6	Sand Spring	2. RD	T53					Ref

6	Sand Spring	2. RD	Wells 2		Moist	Ref
6	Sand Spring	2. RD	Wells 5		Moist	Ref
7	Canoe Creek	2. RD	T11		Moist	Nonref
7	Canoe Creek	2. RD	T12		Moist	Nonref
7	Canoe Creek	2. RD	T13		Saturated	Nonref
7	Canoe Creek	2. RD	T21		Moist	Nonref
7	Canoe Creek	2. RD	T22		Moist	Nonref
7	Canoe Creek	2. RD	T23		Moist	Nonref
7	Canoe Creek	2. RD	T24		Moist	Nonref
7	Canoe Creek	2. RD	T25		Moist	Nonref
7	Canoe Creek	2. RD	Wells 1		Moist	Nonref
7	Canoe Creek	2. RD	Wells 4		Saturated	Nonref
7	Canoe Creek	2. RD	Wells 5		Moist	Nonref
10	Whipple Dam SP	2. RD	T11		Moist	Ref
10	Whipple Dam SP	2. RD	T12		Moist	Ref
10	Whipple Dam SP	2. RD	T13		Moist	Ref
10	Whipple Dam SP	2. RD	T21		Moist	Ref
10	Whipple Dam SP	2. RD	T22		Moist	Ref
10	Whipple Dam SP	2. RD	T23		Moist	Ref
10	Whipple Dam SP	2. RD	T31		Moist	Ref
10	Whipple Dam SP	2. RD	T32		Moist	Ref
10	Whipple Dam SP	2. RD	T41		Moist	Ref
10	Whipple Dam SP	2. RD	T42		Moist	Ref
10	Whipple Dam SP	2. RD	T51		Moist	Ref
10	Whipple Dam SP	2. RD	T52		Moist	Ref
13	Clark’s Trail	2. RD	T11		Moist	Ref
13	Clark’s Trail	2. RD	T12		Moist	Ref
13	Clark’s Trail	2. RD	T13		Saturated	Ref
13	Clark’s Trail	2. RD	T21		Moist	Ref
13	Clark’s Trail	2. RD	T22		Saturated	Ref
13	Clark’s Trail	2. RD	T23		Saturated	Ref
13	Clark’s Trail	2. RD	T31		Moist	Ref
13	Clark’s Trail	2. RD	T32		Saturated	Ref
13	Clark’s Trail	2. RD	T41		Moist	Ref
13	Clark’s Trail	2. RD	T42		Moist	Ref
13	Clark’s Trail	2. RD	T43		Saturated	Ref
13	Clark’s Trail	2. RD	T51		Dry	Ref
13	Clark’s Trail	2. RD	T52		Moist	Ref
13	Clark’s Trail	2. RD	T53		Moist	Ref
13	Clark’s Trail	2. RD	T61		Dry	Ref
13	Clark’s Trail	2. RD	T62		Dry	Ref
13	Clark’s Trail	2. RD	T63		Wet	Ref
13	Clark’s Trail	2. RD	Wells 3		Saturated	Ref
13	Clark’s Trail	2. RD	Wells 4		Saturated	Ref
13	Clark’s Trail	2. RD	Wells 8		Moist	Ref
52	Tadpole	2. RD	T11			Nonref
52	Tadpole	2. RD	T12			Nonref
52	Tadpole	2. RD	T13	Moist	Moist	Nonref
52	Tadpole	2. RD	T14			Nonref
52	Tadpole	2. RD	T15			Nonref
52	Tadpole	2. RD	T21			Nonref
52	Tadpole	2. RD	T22			Nonref
52	Tadpole	2. RD	T23			Nonref

52	Tadpole	2. RD	T24					Nonref
52	Tadpole	2. RD	T31					Nonref
52	Tadpole	2. RD	T32					Nonref
52	Tadpole	2. RD	T33	Wet	Wet			Nonref
52	Tadpole	2. RD	T34					Nonref
52	Tadpole	2. RD	T35					Nonref
52	Tadpole	2. RD	T36					Nonref
52	Tadpole	2. RD	T41					Nonref
52	Tadpole	2. RD	T42					Nonref
52	Tadpole	2. RD	T43					Nonref
52	Tadpole	2. RD	T44					Nonref
52	Tadpole	2. RD	T45					Nonref
52	Tadpole	2. RD	T51					Nonref
52	Tadpole	2. RD	T52					Nonref
52	Tadpole	2. RD	T53					Nonref
52	Tadpole	2. RD	T54					Nonref
52	Tadpole	2. RD	T55					Nonref
52	Tadpole	2. RD	T61					Nonref
52	Tadpole	2. RD	T62					Nonref
52	Tadpole	2. RD	T63					Nonref
52	Tadpole	2. RD	T64					Nonref
52	Tadpole	2. RD	T65					Nonref
56	Farm 12	2. RD	T101		Moist			Nonref
56	Farm 12	2. RD	T21		Dry			Nonref
56	Farm 12	2. RD	T22		Dry			Nonref
56	Farm 12	2. RD	T41		Dry			Nonref
56	Farm 12	2. RD	T42		Moist			Nonref
56	Farm 12	2. RD	T61		Saturated			Nonref
56	Farm 12	2. RD	T62		Saturated			Nonref
56	Farm 12	2. RD	T81		Saturated			Nonref
56	Farm 12	2. RD	T82		Saturated			Nonref
59	NBB - RD	2. RD	T11		Moist			Nonref
59	NBB - RD	2. RD	T12		Moist			Nonref
59	NBB - RD	2. RD	T13		Moist			Nonref
59	NBB - RD	2. RD	T14		Moist			Nonref
122	Corndog	2. RD	1-0	Moist	Moist	No	No	Nonref
122	Corndog	2. RD	1-1					Nonref
122	Corndog	2. RD	1-2	Moist	Moist	No	No	Nonref
122	Corndog	2. RD	1-3					Nonref
122	Corndog	2. RD	1-4	Saturated	Saturated	Yes	Yes	Nonref
122	Corndog	2. RD	3-0					Nonref
122	Corndog	2. RD	3-1	Saturated	Saturated	Yes	Yes	Nonref
122	Corndog	2. RD	3-2					Nonref
122	Corndog	2. RD	3-3	Saturated	Saturated	Yes	Yes	Nonref
122	Corndog	2. RD	3-4	Wet	Wet	Yes	Yes	Nonref
157	Symphony	2. RD	1-1					Nonref
157	Symphony	2. RD	1-2					Nonref
157	Symphony	2. RD	2-2	Saturated	Saturated	No	No	Nonref
157	Symphony	2. RD	3-1					Nonref
157	Symphony	2. RD	3-3					Nonref
157	Symphony	2. RD	4-0	Moist	Moist	Yes	No	Nonref
157	Symphony	2. RD	4-2					Nonref
157	Symphony	2. RD	5-1	Saturated	Saturated	No	No	Nonref

157	Symphony	2. RD	5-2					Nonref
162	Scat	2. RD	1-2	Moist	Moist	No	No	Nonref
162	Scat	2. RD	2-1					Nonref
162	Scat	2. RD	2-3	Saturated	Wet	Yes	Yes	Nonref
162	Scat	2. RD	3-1	Moist	Moist	Yes	No	Nonref
162	Scat	2. RD	3-2					Nonref
162	Scat	2. RD	4-2					Nonref
172	Damm!	2. RD	1-0	Wet	Wet	Yes	Yes	Nonref
172	Damm!	2. RD	2-0					Nonref
172	Damm!	2. RD	2-1	Moist	Saturated	No	No	Nonref
172	Damm!	2. RD	2-2	Moist	Dry	No	No	Nonref
172	Damm!	2. RD	2-3					Nonref
172	Damm!	2. RD	3-0					Nonref
172	Damm!	2. RD	3-1					Nonref
172	Damm!	2. RD	3-3					Nonref
178	Nada	2. RD	1-1	Moist	Moist	Yes	Yes	Nonref
178	Nada	2. RD	2-0					Nonref
178	Nada	2. RD	2-1	Dry	Moist	No	No	Nonref
178	Nada	2. RD	3-1					Nonref
185	Fugitive	2. RD	1-1					Nonref
185	Fugitive	2. RD	1-2	Moist	Moist	No	No	Nonref
185	Fugitive	2. RD	2-2					Nonref
185	Fugitive	2. RD	3-1	Moist	Saturated	Yes	Yes	Nonref
185	Fugitive	2. RD	6-1	Moist	Moist	No	No	Nonref
185	Fugitive	2. RD	6-2					Nonref
186	Muy Bueno	2. RD	1-1	Moist	Moist	No	No	Nonref
186	Muy Bueno	2. RD	1-2	Saturated	Wet	No	No	Nonref
186	Muy Bueno	2. RD	2-1					Nonref
186	Muy Bueno	2. RD	2-2					Nonref
187	Skullz	2. RD	1-1	Saturated	Moist	Yes	Yes	Nonref
187	Skullz	2. RD	1-2	Saturated	Moist	Yes	Yes	Nonref
187	Skullz	2. RD	2-2					Nonref
187	Skullz	2. RD	3-1	Saturated	Saturated	No	Yes	Nonref
187	Skullz	2. RD	3-2					Nonref
187	Skullz	2. RD	4-2					Nonref
14	LFC - PFO	3. SL	T11					Ref
14	LFC - PFO	3. SL	T12					Ref
14	LFC - PFO	3. SL	T21					Ref
14	LFC - PFO	3. SL	T22					Ref
14	LFC - PFO	3. SL	T31					Ref
14	LFC - PFO	3. SL	T32					Ref
14	LFC - PFO	3. SL	T41		Wet			Ref
14	LFC - PFO	3. SL	T42		Moist			Ref
14	LFC - PFO	3. SL	T51		Moist			Ref
14	LFC - PFO	3. SL	T61		Saturated			Ref
14	LFC - PFO	3. SL	T71		Moist			Ref
14	LFC - PFO	3. SL	T72		Moist			Ref
14	LFC - PFO	3. SL	Wells 3					Ref
19	Rothrock State Forest	3. SL	T10		Moist			Ref
19	Rothrock State Forest	3. SL	T11		Moist			Ref
19	Rothrock State Forest	3. SL	T12		Moist			Ref
19	Rothrock State Forest	3. SL	T20		Saturated			Ref
19	Rothrock State Forest	3. SL	T21		Moist			Ref

19	Rothrock State Forest	3. SL	T22	Moist	Ref
19	Rothrock State Forest	3. SL	T23	Moist	Ref
19	Rothrock State Forest	3. SL	T30	Moist	Ref
19	Rothrock State Forest	3. SL	T31	Moist	Ref
19	Rothrock State Forest	3. SL	T32	Moist	Ref
19	Rothrock State Forest	3. SL	T33	Moist	Ref
19	Rothrock State Forest	3. SL	T40	Saturated	Ref
19	Rothrock State Forest	3. SL	T41	Moist	Ref
19	Rothrock State Forest	3. SL	T42	Moist	Ref
19	Rothrock State Forest	3. SL	T43		Ref
19	Rothrock State Forest	3. SL	T44	Moist	Ref
19	Rothrock State Forest	3. SL	T50	Moist	Ref
19	Rothrock State Forest	3. SL	T51	Moist	Ref
19	Rothrock State Forest	3. SL	T52	Moist	Ref
19	Rothrock State Forest	3. SL	T53	Moist	Ref
19	Rothrock State Forest	3. SL	T61	Moist	Ref
19	Rothrock State Forest	3. SL	T62	Moist	Ref
19	Rothrock State Forest	3. SL	T63	Moist	Ref
23	Shaver's Creek	3. SL	T11	Saturated	Nonref
23	Shaver's Creek	3. SL	T12	Moist	Nonref
23	Shaver's Creek	3. SL	T13	Moist	Nonref
23	Shaver's Creek	3. SL	T21	Moist	Nonref
23	Shaver's Creek	3. SL	T22	Moist	Nonref
23	Shaver's Creek	3. SL	T31	Moist	Nonref
23	Shaver's Creek	3. SL	T32	Moist	Nonref
23	Shaver's Creek	3. SL	T41	Moist	Nonref
23	Shaver's Creek	3. SL	T42	Moist	Nonref
23	Shaver's Creek	3. SL	T43		Nonref
23	Shaver's Creek	3. SL	T51		Nonref
23	Shaver's Creek	3. SL	T52	Moist	Nonref
23	Shaver's Creek	3. SL	T53	Moist	Nonref
24	McGuire Rd	3. SL	T11	Moist	Nonref
24	McGuire Rd	3. SL	T12	Moist	Nonref
24	McGuire Rd	3. SL	T13		Nonref
24	McGuire Rd	3. SL	T14	Moist	Nonref
24	McGuire Rd	3. SL	T21	Saturated	Nonref
24	McGuire Rd	3. SL	T22	Saturated	Nonref
24	McGuire Rd	3. SL	T23	Saturated	Nonref
24	McGuire Rd	3. SL	T24	Moist	Nonref
24	McGuire Rd	3. SL	T31	Moist	Nonref
24	McGuire Rd	3. SL	T32	Moist	Nonref
24	McGuire Rd	3. SL	T33	Moist	Nonref
24	McGuire Rd	3. SL	T34	Moist	Nonref
25	Windy Hill Farms	3. SL	T102	Saturated	Nonref
25	Windy Hill Farms	3. SL	T103	Wet	Nonref
25	Windy Hill Farms	3. SL	T105	Moist	Nonref
25	Windy Hill Farms	3. SL	T12	Moist	Nonref
25	Windy Hill Farms	3. SL	T14	Dry	Nonref
25	Windy Hill Farms	3. SL	T21	Moist	Nonref
25	Windy Hill Farms	3. SL	T23	Moist	Nonref
25	Windy Hill Farms	3. SL	T31	Moist	Nonref
25	Windy Hill Farms	3. SL	T34	Moist	Nonref
25	Windy Hill Farms	3. SL	T35	Saturated	Nonref

25	Windy Hill Farms	3. SL	T36					Nonref
25	Windy Hill Farms	3. SL	T41					Nonref
25	Windy Hill Farms	3. SL	T42					Nonref
25	Windy Hill Farms	3. SL	T44					Nonref
25	Windy Hill Farms	3. SL	T51		Saturated			Nonref
25	Windy Hill Farms	3. SL	T52		Saturated			Nonref
25	Windy Hill Farms	3. SL	T53		Dry			Nonref
25	Windy Hill Farms	3. SL	T63		Dry			Nonref
25	Windy Hill Farms	3. SL	T64		Saturated			Nonref
25	Windy Hill Farms	3. SL	T65		Moist			Nonref
25	Windy Hill Farms	3. SL	T71		Dry			Nonref
25	Windy Hill Farms	3. SL	T72		Moist			Nonref
25	Windy Hill Farms	3. SL	T73		Moist			Nonref
25	Windy Hill Farms	3. SL	T74		Dry			Nonref
25	Windy Hill Farms	3. SL	T81		Moist			Nonref
25	Windy Hill Farms	3. SL	T83		Moist			Nonref
25	Windy Hill Farms	3. SL	T86		Saturated			Nonref
25	Windy Hill Farms	3. SL	T91		Moist			Nonref
25	Windy Hill Farms	3. SL	T92		Wet			Nonref
25	Windy Hill Farms	3. SL	T94		Saturated			Nonref
67	Cumberland Valley H.S.	3. SL	T11	Moist	Saturated			Nonref
67	Cumberland Valley H.S.	3. SL	T21	Wet	Wet	Yes	Yes	Nonref
67	Cumberland Valley H.S.	3. SL	T31 sample					Nonref
67	Cumberland Valley H.S.	3. SL	T41	Moist	Moist			Nonref
67	Cumberland Valley H.S.	3. SL	T42					Nonref
67	Cumberland Valley H.S.	3. SL	T43	Moist	Saturated			Nonref
84	West Licking Creek	3. SL	T1-1					Ref
84	West Licking Creek	3. SL	T1-2	Moist	Moist	No	No	Ref
84	West Licking Creek	3. SL	T1-3	Dry	Dry	No	No	Ref
84	West Licking Creek	3. SL	T3-1	Dry	Dry	No	No	Ref
84	West Licking Creek	3. SL	T3-2					Ref
84	West Licking Creek	3. SL	T3-3					Ref
85	East Licking Creek	3. SL	T1-0	Moist	Moist	No	No	Ref
85	East Licking Creek	3. SL	T1-1					Ref
85	East Licking Creek	3. SL	T1-2	Dry	Dry	No	No	Ref
85	East Licking Creek	3. SL	T2-0	Moist	Moist	No	No	Ref
85	East Licking Creek	3. SL	T3-1					Ref
85	East Licking Creek	3. SL	T3-2					Ref
87	TSF Slope	3. SL	T1-1					Ref
87	TSF Slope	3. SL	T1-3					Ref
87	TSF Slope	3. SL	T2-1					Ref
87	TSF Slope	3. SL	T2-4	Dry	Dry	Yes	Yes	Ref
87	TSF Slope	3. SL	T3-1	Dry	Dry	No	No	Ref
87	TSF Slope	3. SL	T3-3	Dry	Dry	Yes	Yes	Ref
88	Licking Creek NW Slope	3. SL	T1-1	Moist	Saturated	No	No	Ref
88	Licking Creek NW Slope	3. SL	T1-2	Moist	Saturated	No	No	Ref
88	Licking Creek NW Slope	3. SL	T1-4					Ref
88	Licking Creek NW Slope	3. SL	T1-6					Ref
88	Licking Creek NW Slope	3. SL	T2-2	Moist	Moist	Yes	Yes	Ref
89	Licking Creek SW Slope	3. SL	T1-2					Ref
89	Licking Creek SW Slope	3. SL	T2-0					Ref
89	Licking Creek SW Slope	3. SL	T2-1	Saturated	Moist	No	Yes	Ref
89	Licking Creek SW Slope	3. SL	T2-2					Ref

91	Licking Creek - Mad Dog Slope	3. SL	T1-1					Ref
91	Licking Creek - Mad Dog Slope	3. SL	T1-2					Ref
91	Licking Creek - Mad Dog Slope	3. SL	T1-3	Moist	Saturated	Yes	Yes	Ref
91	Licking Creek - Mad Dog Slope	3. SL	T2-2	Moist	Moist	No	No	Ref
91	Licking Creek - Mad Dog Slope	3. SL	T3-1	Moist	Moist	No	No	Ref
91	Licking Creek - Mad Dog Slope	3. SL	T3-2					Ref
92	Corn Field	3. SL	T1-1					Nonref
92	Corn Field	3. SL	T1-2	Dry	Moist	Yes	Yes	Nonref
92	Corn Field	3. SL	T2-1	Dry	Moist	No	No	Nonref
92	Corn Field	3. SL	T3-1	Dry	Moist	Yes	Yes	Nonref
121	Mustang Sally	3. SL	1-1					Nonref
121	Mustang Sally	3. SL	1-2	Wet	Wet	No	No	Nonref
121	Mustang Sally	3. SL	1-3					Nonref
121	Mustang Sally	3. SL	3-1					Nonref
121	Mustang Sally	3. SL	3-2	Wet	Wet	Yes	No	Nonref
121	Mustang Sally	3. SL	3-4					Nonref
121	Mustang Sally	3. SL	5-1					Nonref
121	Mustang Sally	3. SL	5-2					Nonref
121	Mustang Sally	3. SL	5-3	Saturated	Wet	Yes	Yes	Nonref
142	Whipper	3. SL	1-2	Moist	Moist	No	No	Nonref
142	Whipper	3. SL	1-4	Moist	Moist	Yes	No	Nonref
142	Whipper	3. SL	2-2	Moist	Moist	No	No	Nonref
142	Whipper	3. SL	2-4					Nonref
142	Whipper	3. SL	3-2					Nonref
142	Whipper	3. SL	3-4					Nonref
152	Death Valley	3. SL	1-1	Moist	Moist	No	No	Nonref
152	Death Valley	3. SL	1-3	Moist	Moist	No	No	Nonref
152	Death Valley	3. SL	2-1	Saturated	Saturated	Yes	Yes	Nonref
152	Death Valley	3. SL	2-3					Nonref
152	Death Valley	3. SL	3-1					Nonref
152	Death Valley	3. SL	3-2					Nonref
152	Death Valley	3. SL	4-1					Nonref
152	Death Valley	3. SL	4-2					Nonref
155	Yogi	3. SL	1-0	Dry	Dry	No	No	Nonref
155	Yogi	3. SL	1-1					Nonref
155	Yogi	3. SL	2-0	Moist	Dry	No	No	Nonref
155	Yogi	3. SL	3-0					Nonref
155	Yogi	3. SL	3-1	Moist	Moist	No	No	Nonref
160	Mizzle	3. SL	1-0	Moist	Moist	No	No	Nonref
160	Mizzle	3. SL	1-1					Nonref
160	Mizzle	3. SL	1-2					Nonref
160	Mizzle	3. SL	2-0	Moist	Moist	No	No	Nonref
160	Mizzle	3. SL	3-1	Moist	Moist	No	No	Nonref
160	Mizzle	3. SL	4-2					Nonref
160	Mizzle	3. SL	5-0					Nonref
160	Mizzle	3. SL	5-1					Nonref
166	Cloverleaf	3. SL	1-1	Moist	Saturated	No	No	Nonref
166	Cloverleaf	3. SL	1-2					Nonref
166	Cloverleaf	3. SL	1-3					Nonref
166	Cloverleaf	3. SL	2-1					Nonref
166	Cloverleaf	3. SL	2-2	Saturated	Saturated	No	No	Nonref
166	Cloverleaf	3. SL	2-3					Nonref
166	Cloverleaf	3. SL	3-1					Nonref

166	Cloverleaf	3. SL	4-2	Dry	Dry	No	No	Nonref
18	Buffalo Run	4. HF	T10		Moist			Nonref
18	Buffalo Run	4. HF	T11		Moist			Nonref
18	Buffalo Run	4. HF	T12		Moist			Nonref
18	Buffalo Run	4. HF	T20		Moist			Nonref
18	Buffalo Run	4. HF	T21		Moist			Nonref
18	Buffalo Run	4. HF	T22		Moist			Nonref
18	Buffalo Run	4. HF	T30		Moist			Nonref
18	Buffalo Run	4. HF	T31		Moist			Nonref
18	Buffalo Run	4. HF	T32		Dry			Nonref
18	Buffalo Run	4. HF	T33		Moist			Nonref
18	Buffalo Run	4. HF	T40		Moist			Nonref
18	Buffalo Run	4. HF	T41		Moist			Nonref
18	Buffalo Run	4. HF	T42		Moist			Nonref
18	Buffalo Run	4. HF	T43		Dry			Nonref
18	Buffalo Run	4. HF	T50		Saturated			Nonref
18	Buffalo Run	4. HF	T51		Moist			Nonref
18	Buffalo Run	4. HF	T52		Moist			Nonref
18	Buffalo Run	4. HF	T60					Nonref
18	Buffalo Run	4. HF	T61		Wet			Nonref
18	Buffalo Run	4. HF	T62		Moist			Nonref
18	Buffalo Run	4. HF	Wells 1		Dry			Nonref
18	Buffalo Run	4. HF	Wells 17		Wet			Nonref
26	Water Authority	4. HF	T12		Moist			Nonref
26	Water Authority	4. HF	T13		Moist			Nonref
26	Water Authority	4. HF	T14		Moist			Nonref
26	Water Authority	4. HF	T22		Moist			Nonref
26	Water Authority	4. HF	T23		Moist			Nonref
26	Water Authority	4. HF	T31		Moist			Nonref
26	Water Authority	4. HF	T42		Moist			Nonref
26	Water Authority	4. HF	T51		Moist			Nonref
26	Water Authority	4. HF	T52		Moist			Nonref
26	Water Authority	4. HF	T61					Nonref
26	Water Authority	4. HF	T62		Moist			Nonref
26	Water Authority	4. HF	T72					Nonref
31	Cedar Run	4. HF	T11		Moist			Nonref
31	Cedar Run	4. HF	T12		Dry			Nonref
31	Cedar Run	4. HF	T21		Dry			Nonref
31	Cedar Run	4. HF	T22		Dry			Nonref
31	Cedar Run	4. HF	T31		Moist			Nonref
31	Cedar Run	4. HF	T32		Moist			Nonref
31	Cedar Run	4. HF	T33		Moist			Nonref
31	Cedar Run	4. HF	T41		Dry			Nonref
31	Cedar Run	4. HF	T42		Dry			Nonref
31	Cedar Run	4. HF	T43		Moist			Nonref
31	Cedar Run	4. HF	T51					Nonref
31	Cedar Run	4. HF	T52					Nonref
31	Cedar Run	4. HF	T53					Nonref
31	Cedar Run	4. HF	T61					Nonref
31	Cedar Run	4. HF	T62					Nonref
31	Cedar Run	4. HF	T63					Nonref
33	Lee’s Gap	4. HF	T01		Dry			Nonref
33	Lee’s Gap	4. HF	T02		Dry			Nonref

33	Lee’s Gap	4. HF	T11		Moist	Nonref
33	Lee’s Gap	4. HF	T12		Moist	Nonref
33	Lee’s Gap	4. HF	T21		Moist	Nonref
33	Lee’s Gap	4. HF	T22		Moist	Nonref
33	Lee’s Gap	4. HF	T31		Moist	Nonref
33	Lee’s Gap	4. HF	T32		Moist	Nonref
33	Lee’s Gap	4. HF	T41		Dry	Nonref
33	Lee’s Gap	4. HF	T42		Moist	Nonref
53	NBB - HWF	4. HF	T30			Nonref
53	NBB - HWF	4. HF	T31			Nonref
53	NBB - HWF	4. HF	T32			Nonref
53	NBB - HWF	4. HF	T33			Nonref
53	NBB - HWF	4. HF	T34			Nonref
53	NBB - HWF	4. HF	T35			Nonref
53	NBB - HWF	4. HF	T36			Nonref
53	NBB - HWF	4. HF	T37			Nonref
53	NBB - HWF	4. HF	T38			Nonref
53	NBB - HWF	4. HF	T40			Nonref
53	NBB - HWF	4. HF	T41			Nonref
53	NBB - HWF	4. HF	T42			Nonref
53	NBB - HWF	4. HF	T43			Nonref
53	NBB - HWF	4. HF	T44			Nonref
53	NBB - HWF	4. HF	T45			Nonref
53	NBB - HWF	4. HF	T46			Nonref
53	NBB - HWF	4. HF	T47			Nonref
53	NBB - HWF	4. HF	T48			Nonref
57	Thompson Run	4. HF	T00		Dry	Nonref
57	Thompson Run	4. HF	T03		Moist	Nonref
57	Thompson Run	4. HF	T10		Moist	Nonref
57	Thompson Run	4. HF	T13		Moist	Nonref
57	Thompson Run	4. HF	T20		Moist	Nonref
57	Thompson Run	4. HF	T23		Moist	Nonref
57	Thompson Run	4. HF	T30		Moist	Nonref
57	Thompson Run	4. HF	T33		Moist	Nonref
57	Thompson Run	4. HF	T40		Moist	Nonref
57	Thompson Run	4. HF	T43		Moist	Nonref
57	Thompson Run	4. HF	T50			Nonref
57	Thompson Run	4. HF	T53		Moist	Nonref
60	Laurel Run	4. HF	T12			Ref
60	Laurel Run	4. HF	T14			Ref
60	Laurel Run	4. HF	T16			Ref
60	Laurel Run	4. HF	T34			Ref
60	Laurel Run	4. HF	T36			Ref
60	Laurel Run	4. HF	T42			Ref
60	Laurel Run	4. HF	T72			Ref
60	Laurel Run	4. HF	T74			Ref
60	Laurel Run	4. HF	T76			Ref
60	Laurel Run	4. HF	T92			Ref
60	Laurel Run	4. HF	T94			Ref
60	Laurel Run	4. HF	T96			Ref
64	State College H.S.	4. HF	T21	Wet	Wet	Nonref
64	State College H.S.	4. HF	T22	Wet	Wet	Nonref
64	State College H.S.	4. HF	T23	Wet	Wet	Nonref

64	State College H.S.	4. HF	T24	Wet	Wet			Nonref
64	State College H.S.	4. HF	T41	Saturated	Saturated			Nonref
64	State College H.S.	4. HF	T42	Saturated	Saturated			Nonref
83	Tuscarora HWF	4. HF	T3-1					Ref
83	Tuscarora HWF	4. HF	T3-3					Ref
83	Tuscarora HWF	4. HF	T4-1	Dry	Dry	No	No	Ref
83	Tuscarora HWF	4. HF	T4-3	Moist	Moist	No	No	Ref
83	Tuscarora HWF	4. HF	T5-1	Dry	Dry	No	No	Ref
83	Tuscarora HWF	4. HF	T5-3					Ref
90	TSF Floodplain	4. HF	T2-1					Ref
90	TSF Floodplain	4. HF	T3-2	Moist	Moist	Yes	Yes	Ref
90	TSF Floodplain	4. HF	T6-2	Dry	Dry	No	No	Ref
90	TSF Floodplain	4. HF	T6-3	Dry	Dry	No	Yes	Ref
110	Top Gun	4. HF	1-2					Nonref
110	Top Gun	4. HF	1-3					Nonref
110	Top Gun	4. HF	2-1	Moist	Moist	Yes	No	Nonref
110	Top Gun	4. HF	2-2	Moist	Dry	No	No	Nonref
110	Top Gun	4. HF	2-3					Nonref
110	Top Gun	4. HF	3-1					Nonref
110	Top Gun	4. HF	3-2					Nonref
110	Top Gun	4. HF	3-3	Moist	Moist	No	No	Nonref
112	Deer Trail	4. HF	1-0					Nonref
112	Deer Trail	4. HF	2-2					Nonref
112	Deer Trail	4. HF	3-0					Nonref
112	Deer Trail	4. HF	3-1	Saturated	Wet	Yes	Yes	Nonref
112	Deer Trail	4. HF	4-0	Moist	Dry	No	No	Nonref
112	Deer Trail	4. HF	4-1	Moist	Moist	No	No	Nonref
113	Willow	4. HF	1-0	Moist	Moist	No	No	Nonref
113	Willow	4. HF	1-1	Moist	Moist	No	No	Nonref
113	Willow	4. HF	2-1					Nonref
113	Willow	4. HF	3-0					Nonref
113	Willow	4. HF	4-1					Nonref
113	Willow	4. HF	5-0	Moist	Dry	No	No	Nonref
113	Willow	4. HF	5-3	Saturated	Saturated	Yes	Yes	Nonref
113	Willow	4. HF	5-4					Nonref
114	Bush	4. HF	1-1					Nonref
114	Bush	4. HF	2-2	Moist	Moist	No	No	Nonref
114	Bush	4. HF	2-3					Nonref
114	Bush	4. HF	3-2	Wet	Wet	No	No	Nonref
114	Bush	4. HF	3-3					Nonref
114	Bush	4. HF	4-1	Saturated	Wet	No	No	Nonref
115	Mucho Rosa	4. HF	1-1					Nonref
115	Mucho Rosa	4. HF	1-3					Nonref
115	Mucho Rosa	4. HF	2-2	Moist	Moist	No	No	Nonref
115	Mucho Rosa	4. HF	3-1					Nonref
115	Mucho Rosa	4. HF	3-3	Moist	Moist	No	No	Nonref
115	Mucho Rosa	4. HF	4-3	Moist	Moist	No	No	Nonref
116	Cows	4. HF	1-1	Moist		No	Yes	Nonref
116	Cows	4. HF	1-2	Wet	Wet	No	No	Nonref
116	Cows	4. HF	1-5					Nonref
116	Cows	4. HF	3-2					Nonref
116	Cows	4. HF	3-3					Nonref
116	Cows	4. HF	3-4	Moist	Moist	No	No	Nonref

116	Cows	4. HF	4-3					Nonref
120	Snag in my Pants	4. HF	1-1					Nonref
120	Snag in my Pants	4. HF	1-2	Saturated	Wet	No	No	Nonref
120	Snag in my Pants	4. HF	2-2	Wet	Wet	Yes	Yes	Nonref
120	Snag in my Pants	4. HF	2-3					Nonref
120	Snag in my Pants	4. HF	2-4					Nonref
120	Snag in my Pants	4. HF	3-3	Wet	Wet	Yes	Yes	Nonref
120	Snag in my Pants	4. HF	4-1					Nonref
120	Snag in my Pants	4. HF	4-2					Nonref
123	Thistle	4. HF	1-0	Moist	Moist	No	No	Nonref
123	Thistle	4. HF	2-1	Moist	Moist	No	No	Nonref
123	Thistle	4. HF	2-2					Nonref
123	Thistle	4. HF	3-1					Nonref
123	Thistle	4. HF	3-2					Nonref
123	Thistle	4. HF	4-0					Nonref
123	Thistle	4. HF	4-3	Moist	Moist	No	No	Nonref
124	Got Milk?	4. HF	1-1					Nonref
124	Got Milk?	4. HF	1-2					Nonref
124	Got Milk?	4. HF	1-3	Moist	Moist	No	No	Nonref
124	Got Milk?	4. HF	1-4					Nonref
124	Got Milk?	4. HF	2-1	Saturated		No		Nonref
124	Got Milk?	4. HF	3-2					Nonref
124	Got Milk?	4. HF	3-3					Nonref
128	Wingstem	4. HF	1-1	Moist	Moist	No	No	Nonref
128	Wingstem	4. HF	1-2					Nonref
128	Wingstem	4. HF	1-3		Moist	No	No	Nonref
128	Wingstem	4. HF	2-2					Nonref
128	Wingstem	4. HF	2-3					Nonref
128	Wingstem	4. HF	3-3	Moist	Moist	No	No	Nonref
128	Wingstem	4. HF	5-1					Nonref
129	Cattle Drive	4. HF	1-1					Nonref
129	Cattle Drive	4. HF	2-3					Nonref
129	Cattle Drive	4. HF	3-1					Nonref
129	Cattle Drive	4. HF	3-2	Dry	Dry	No	No	Nonref
129	Cattle Drive	4. HF	4-1	Wet	Wet	Yes	No	Nonref
129	Cattle Drive	4. HF	5-1	Moist	Moist	No	No	Nonref
130	Joke	4. HF	1-1	Moist	Moist	No	No	Nonref
130	Joke	4. HF	1-2					Nonref
130	Joke	4. HF	2-0	Moist	Moist	No	No	Nonref
130	Joke	4. HF	3-(-1)					Nonref
130	Joke	4. HF	3-1	Moist	Moist	No	No	Nonref
130	Joke	4. HF	4-0					Nonref
131	Crackhouse	4. HF	1-1	Saturated	Saturated	Yes	Yes	Nonref
131	Crackhouse	4. HF	1-2					Nonref
131	Crackhouse	4. HF	2-1					Nonref
131	Crackhouse	4. HF	2-2	Saturated	Saturated	Yes	Yes	Nonref
131	Crackhouse	4. HF	2-3					Nonref
131	Crackhouse	4. HF	4-1	Saturated	Wet	Yes	Yes	Nonref
132	Scenic	4. HF	1-1	Moist	Saturated	Yes	Yes	Nonref
132	Scenic	4. HF	1-4	Moist	Moist	No	No	Nonref
132	Scenic	4. HF	2-2					Nonref
132	Scenic	4. HF	2-3					Nonref
132	Scenic	4. HF	3-1	Saturated	Wet	Yes	Yes	Nonref

132	Scenic	4. HF	3-3					Nonref
132	Scenic	4. HF	4-1					Nonref
132	Scenic	4. HF	4-2	Moist	Moist	No	No	Nonref
134	Spirit Fawn	4. HF	1-1	Moist	Moist	No	No	Nonref
134	Spirit Fawn	4. HF	1-2	Moist	Moist	No	No	Nonref
134	Spirit Fawn	4. HF	2-1					Nonref
134	Spirit Fawn	4. HF	2-2	Wet	Wet	No	No	Nonref
134	Spirit Fawn	4. HF	3-0					Nonref
134	Spirit Fawn	4. HF	3-1					Nonref
139	Rhoda	4. HF	1-1	Moist	Moist	No	No	Nonref
139	Rhoda	4. HF	1-2					Nonref
139	Rhoda	4. HF	2-1	Moist	Moist	No	No	Nonref
139	Rhoda	4. HF	2-2	Moist	Moist	No	No	Nonref
139	Rhoda	4. HF	2-3					Nonref
139	Rhoda	4. HF	3-1					Nonref
140	Cambaris	4. HF	1-0					Nonref
140	Cambaris	4. HF	1-1					Nonref
140	Cambaris	4. HF	2-0	Moist	Moist	No	No	Nonref
140	Cambaris	4. HF	2-1	Moist	Moist	No	No	Nonref
140	Cambaris	4. HF	2-2					Nonref
140	Cambaris	4. HF	3-1	Moist	Moist	No	No	Nonref
145	Lost World	4. HF	1-0					Nonref
145	Lost World	4. HF	1-1					Nonref
145	Lost World	4. HF	2-1					Nonref
145	Lost World	4. HF	3-1	Moist	Moist	No	No	Nonref
145	Lost World	4. HF	4-1	Saturated	Wet	No	No	Nonref
145	Lost World	4. HF	5-1					Nonref
146	Spice Valley	4. HF	1-1	Saturated	Saturated	Yes	Yes	Nonref
146	Spice Valley	4. HF	1-2	Moist	Moist	No	No	Nonref
146	Spice Valley	4. HF	2-0					Nonref
146	Spice Valley	4. HF	2-1	Moist	Moist	No	No	Nonref
146	Spice Valley	4. HF	3-0					Nonref
146	Spice Valley	4. HF	3-1					Nonref
147	Model T	4. HF	1-1	Moist	Moist	No	No	Nonref
147	Model T	4. HF	2-1					Nonref
147	Model T	4. HF	2-2	Moist	Moist	No	No	Nonref
147	Model T	4. HF	3-0					Nonref
147	Model T	4. HF	3-1					Nonref
147	Model T	4. HF	3-2	Moist	Moist	No	No	Nonref
149	Sheep	4. HF	1-0					Nonref
149	Sheep	4. HF	1-2	Moist	Moist	No	No	Nonref
149	Sheep	4. HF	2-1	Moist	Moist	No	No	Nonref
149	Sheep	4. HF	2-2					Nonref
149	Sheep	4. HF	3-2	Moist	Moist	No	No	Nonref
149	Sheep	4. HF	3-3					Nonref
150	Berry Good	4. HF	3-1					Nonref
150	Berry Good	4. HF	3-2	Moist	Moist	No	No	Nonref
150	Berry Good	4. HF	3-3					Nonref
150	Berry Good	4. HF	4-1	Moist	Moist	No	No	Nonref
150	Berry Good	4. HF	4-2	Moist	Moist	No	No	Nonref
150	Berry Good	4. HF	5-1					Nonref
151	Mosquito	4. HF	1-1	Moist	Saturated	Yes	Yes	Nonref
151	Mosquito	4. HF	1-2					Nonref

151	Mosquito	4. HF	2-1	Moist	Moist	No	No	Nonref
151	Mosquito	4. HF	2-2	Saturated	Wet	No	No	Nonref
151	Mosquito	4. HF	3-1					Nonref
151	Mosquito	4. HF	3-2					Nonref
153	Drippy	4. HF	1-1					Nonref
153	Drippy	4. HF	1-3					Nonref
153	Drippy	4. HF	2-2	Saturated	Moist	No	No	Nonref
153	Drippy	4. HF	3-0					Nonref
153	Drippy	4. HF	3-2	Saturated	Saturated	Yes	Yes	Nonref
153	Drippy	4. HF	3-3					Nonref
153	Drippy	4. HF	4-4					Nonref
153	Drippy	4. HF	5-2	Moist	Moist	No	No	Nonref
154	Canary Roe	4. HF	1-1					Nonref
154	Canary Roe	4. HF	2-1	Saturated	Saturated	No	No	Nonref
154	Canary Roe	4. HF	2-2	Moist	Moist	No	No	Nonref
154	Canary Roe	4. HF	2-3	Moist	Moist	No	No	Nonref
154	Canary Roe	4. HF	3-1					Nonref
154	Canary Roe	4. HF	3-2					Nonref
154	Canary Roe	4. HF	3-3					Nonref
158	Cauldron	4. HF	1-1	Moist	Moist	No	No	Nonref
158	Cauldron	4. HF	1-2					Nonref
158	Cauldron	4. HF	2-1	Moist	Moist	No	No	Nonref
158	Cauldron	4. HF	2-2	Moist	Moist	No	No	Nonref
158	Cauldron	4. HF	2-3					Nonref
158	Cauldron	4. HF	3-2					Nonref
158	Cauldron	4. HF	4-1					Nonref
159	R&R	4. HF	1-2	Moist	Moist	Yes	No	Nonref
159	R&R	4. HF	1-3	Moist	Moist	Yes	No	Nonref
159	R&R	4. HF	2-1					Nonref
159	R&R	4. HF	2-3					Nonref
159	R&R	4. HF	3-2	Moist	Moist	No	No	Nonref
159	R&R	4. HF	3-3					Nonref
163	Blue Bomber	4. HF	2-1	Moist	Moist	No	No	Nonref
163	Blue Bomber	4. HF	4-1	Moist	Moist	No	No	Nonref
165	Franky	4. HF	1-1					Nonref
165	Franky	4. HF	1-2	Moist	Moist	No	No	Nonref
165	Franky	4. HF	2-3	Moist	Dry	No	No	Nonref
165	Franky	4. HF	3-1	Saturated	Saturated	Yes	Yes	Nonref
165	Franky	4. HF	3-2					Nonref
165	Franky	4. HF	4-1					Nonref
165	Franky	4. HF	4-2					Nonref
167	Monday Monday	4. HF	1-1	Moist	Saturated	No	No	Nonref
167	Monday Monday	4. HF	2-0					Nonref
167	Monday Monday	4. HF	2-1	Moist	Moist	No	No	Nonref
167	Monday Monday	4. HF	3-0					Nonref
167	Monday Monday	4. HF	3-1	Moist	Moist	No	No	Nonref
169	Comedy of Errors	4. HF	1-2					Nonref
169	Comedy of Errors	4. HF	2-1					Nonref
169	Comedy of Errors	4. HF	2-3					Nonref
169	Comedy of Errors	4. HF	3-1					Nonref
169	Comedy of Errors	4. HF	3-4					Nonref
169	Comedy of Errors	4. HF	4-1	Moist	Moist	No	No	Nonref
169	Comedy of Errors	4. HF	5-2					Nonref

170	Rooster	4. HF	1-2	Moist	Moist	No	No	Nonref
170	Rooster	4. HF	1-3					Nonref
170	Rooster	4. HF	2-2	Moist	Dry	No	No	Nonref
170	Rooster	4. HF	2-3					Nonref
170	Rooster	4. HF	3-1					Nonref
170	Rooster	4. HF	3-2	Moist	Dry	No	No	Nonref
171	Joy Ride	4. HF	1-1	Moist	Moist	Yes	No	Nonref
171	Joy Ride	4. HF	2-1	Saturated	Saturated	Yes	Yes	Nonref
171	Joy Ride	4. HF	2-2					Nonref
171	Joy Ride	4. HF	3-1					Nonref
171	Joy Ride	4. HF	3-2	Moist	Moist	No	No	Nonref
171	Joy Ride	4. HF	4-1					Nonref
173	Amd	4. HF	1-0	Moist	Moist	No	No	Nonref
173	Amd	4. HF	1-1	Moist	Moist	No	No	Nonref
173	Amd	4. HF	2-1					Nonref
173	Amd	4. HF	2-3	Dry	Dry	No	No	Nonref
173	Amd	4. HF	3-1					Nonref
173	Amd	4. HF	3-2					Nonref
174	Far Side	4. HF	1-1	Moist	Moist	No	No	Nonref
174	Far Side	4. HF	1-2	Moist	Moist	No	No	Nonref
174	Far Side	4. HF	2-1					Nonref
174	Far Side	4. HF	2-2					Nonref
174	Far Side	4. HF	3-1	Saturated	Wet	Yes	Yes	Nonref
174	Far Side	4. HF	3-2					Nonref
174	Far Side	4. HF	4-1					Nonref
174	Far Side	4. HF	5-1					Nonref
175	Dinky Dale	4. HF	1-0	Moist	Moist	No	No	Nonref
175	Dinky Dale	4. HF	1-1					Nonref
175	Dinky Dale	4. HF	2-1	Moist	Moist	No	No	Nonref
175	Dinky Dale	4. HF	2-2					Nonref
175	Dinky Dale	4. HF	3-0	Moist	Moist	No	No	Nonref
175	Dinky Dale	4. HF	3-1					Nonref
176	Makin' Hay	4. HF	1-0					Nonref
176	Makin' Hay	4. HF	1-1	Saturated	Wet	No	No	Nonref
176	Makin' Hay	4. HF	2-1					Nonref
176	Makin' Hay	4. HF	3-2					Nonref
176	Makin' Hay	4. HF	4-1	Moist	Moist	No	No	Nonref
176	Makin' Hay	4. HF	4-3	Moist	Moist	No	No	Nonref
177	Magnum PI	4. HF	1-1	Moist	Moist	No	No	Nonref
177	Magnum PI	4. HF	2-1					Nonref
177	Magnum PI	4. HF	2-2	Moist	Moist	No	No	Nonref
177	Magnum PI	4. HF	3-1	Moist	Moist	No	No	Nonref
177	Magnum PI	4. HF	4-1					Nonref
179	Buggy Bumpin'	4. HF	1-1	Moist	Moist	No	No	Nonref
179	Buggy Bumpin'	4. HF	1-2					Nonref
179	Buggy Bumpin'	4. HF	2-2					Nonref
179	Buggy Bumpin'	4. HF	3-1	Moist	Moist	No	No	Nonref
182	Goofy	4. HF	1-2	Moist	Moist	No	No	Nonref
182	Goofy	4. HF	2-0	Moist	Moist	Yes	No	Nonref
182	Goofy	4. HF	2-1					Nonref
182	Goofy	4. HF	3-2	Moist	Moist	No	No	Nonref
182	Goofy	4. HF	3-3					Nonref
182	Goofy	4. HF	3-4					Nonref

184	Fungus Amongus	4. HF	1-2	Moist	Moist	No	No	Nonref
184	Fungus Amongus	4. HF	2-1					Nonref
184	Fungus Amongus	4. HF	3-1					Nonref
184	Fungus Amongus	4. HF	3-3	Moist	Moist	No	No	Nonref
184	Fungus Amongus	4. HF	4-1	Moist	Moist	No	No	Nonref
184	Fungus Amongus	4. HF	4-2					Nonref
184	Fungus Amongus	4. HF	4-3					Nonref
184	Fungus Amongus	4. HF	5-1					Nonref
188	Fork	4. HF	1-1					Nonref
188	Fork	4. HF	1-2					Nonref
188	Fork	4. HF	2-1	Dry	Moist	No	No	Nonref
188	Fork	4. HF	3-1	Moist	Moist	No	No	Nonref
188	Fork	4. HF	3-2					Nonref
27	WDC - Gaging Station	5. MF	T1		Saturated			Ref
27	WDC - Gaging Station	5. MF	T2		Saturated			Ref
27	WDC - Gaging Station	5. MF	T3		Wet			Ref
27	WDC - Gaging Station	5. MF	T4		Moist			Ref
27	WDC - Gaging Station	5. MF	T5		Moist			Ref
27	WDC - Gaging Station	5. MF	T6		Moist			Ref
28	Millbrook Marsh	5. MF	T11		Moist			Nonref
28	Millbrook Marsh	5. MF	T12		Saturated			Nonref
28	Millbrook Marsh	5. MF	T13		Moist			Nonref
28	Millbrook Marsh	5. MF	T14		Moist			Nonref
28	Millbrook Marsh	5. MF	T21		Moist			Nonref
28	Millbrook Marsh	5. MF	T22		Moist			Nonref
28	Millbrook Marsh	5. MF	T23		Moist			Nonref
28	Millbrook Marsh	5. MF	T24		Dry			Nonref
28	Millbrook Marsh	5. MF	T25		Dry			Nonref
28	Millbrook Marsh	5. MF	T31					Nonref
28	Millbrook Marsh	5. MF	T32		Moist			Nonref
28	Millbrook Marsh	5. MF	T33		Moist			Nonref
28	Millbrook Marsh	5. MF	T34		Moist			Nonref
28	Millbrook Marsh	5. MF	T35		Dry			Nonref
28	Millbrook Marsh	5. MF	T41		Moist			Nonref
28	Millbrook Marsh	5. MF	T42		Moist			Nonref
28	Millbrook Marsh	5. MF	T43					Nonref
28	Millbrook Marsh	5. MF	T44					Nonref
28	Millbrook Marsh	5. MF	T45					Nonref
28	Millbrook Marsh	5. MF	T51					Nonref
28	Millbrook Marsh	5. MF	T52					Nonref
28	Millbrook Marsh	5. MF	T53					Nonref
28	Millbrook Marsh	5. MF	T54					Nonref
28	Millbrook Marsh	5. MF	T55					Nonref
30	PFBC - Spring Creek	5. MF	T12		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T13		Dry			Nonref
30	PFBC - Spring Creek	5. MF	T21		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T22		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T23					Nonref
30	PFBC - Spring Creek	5. MF	T31		Dry			Nonref
30	PFBC - Spring Creek	5. MF	T32		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T33		Saturated			Nonref
30	PFBC - Spring Creek	5. MF	T34		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T41		Moist			Nonref

30	PFBC - Spring Creek	5. MF	T42		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T43		Moist			Nonref
30	PFBC - Spring Creek	5. MF	T44		Saturated			Nonref
32	Fravel	5. MF	T11		Moist			Nonref
32	Fravel	5. MF	T12		Moist			Nonref
32	Fravel	5. MF	T13		Moist			Nonref
32	Fravel	5. MF	T14		Moist			Nonref
32	Fravel	5. MF	T21		Moist			Nonref
32	Fravel	5. MF	T22		Moist			Nonref
32	Fravel	5. MF	T23		Moist			Nonref
32	Fravel	5. MF	T24		Saturated			Nonref
32	Fravel	5. MF	T31		Moist			Nonref
32	Fravel	5. MF	T32		Moist			Nonref
32	Fravel	5. MF	T33		Moist			Nonref
32	Fravel	5. MF	T34		Moist			Nonref
35	Davis	5. MF	T11		Moist			Nonref
35	Davis	5. MF	T21		Dry			Nonref
35	Davis	5. MF	T31		Moist			Nonref
35	Davis	5. MF	T32		Dry			Nonref
35	Davis	5. MF	T3-streamside		Moist			Nonref
35	Davis	5. MF	T41		Dry			Nonref
35	Davis	5. MF	T42		Dry			Nonref
35	Davis	5. MF	T51		Dry			Nonref
35	Davis	5. MF	T52		Dry			Nonref
35	Davis	5. MF	T5-streamside					Nonref
35	Davis	5. MF	T61		Dry			Nonref
65	Juniata Valley H.S.	5. MF	T11	Moist	Saturated			Nonref
65	Juniata Valley H.S.	5. MF	T13	Moist	Saturated			Nonref
65	Juniata Valley H.S.	5. MF	T15	Wet	Wet	Yes		Nonref
82	Juniata Railroad Depression	5. MF	T1-1	Dry	Dry	No	No	Nonref
82	Juniata Railroad Depression	5. MF	T2-1	Dry	Dry	No	No	Nonref
82	Juniata Railroad Depression	5. MF	T3-1					Nonref
82	Juniata Railroad Depression	5. MF	T5-3					Nonref
82	Juniata Railroad Depression	5. MF	T6-3					Nonref
93	Crawbow	5. MF	T1-1	Dry	Dry	No	No	Nonref
93	Crawbow	5. MF	T2-3	Moist	Moist	No	Yes	Nonref
93	Crawbow	5. MF	T3-1					Nonref
93	Crawbow	5. MF	T3-2					Nonref
93	Crawbow	5. MF	T4-1	Moist	Moist	No	No	Nonref
93	Crawbow	5. MF	T5-1					Nonref
111	Juniata Island Point	5. MF	1-1	Saturated	Saturated	Yes	Yes	Nonref
111	Juniata Island Point	5. MF	1-2					Nonref
111	Juniata Island Point	5. MF	1-3	Saturated	Saturated	Yes	No	Nonref
111	Juniata Island Point	5. MF	2-2	Moist	Moist	Yes	No	Nonref
111	Juniata Island Point	5. MF	2-3					Nonref
111	Juniata Island Point	5. MF	3-2					Nonref
111	Juniata Island Point	5. MF	3-3					Nonref
118	Willis	5. MF	1-1					Nonref
118	Willis	5. MF	1-2	Moist	Moist	No	Yes	Nonref
118	Willis	5. MF	3-1					Nonref
118	Willis	5. MF	3-3					Nonref
118	Willis	5. MF	4-1	Moist	Moist	No	No	Nonref
118	Willis	5. MF	4-3	Saturated	Wet	Yes	Yes	Nonref

125	Juniata Emergent	5. MF	1-1	Moist	Moist	No	No	Nonref
125	Juniata Emergent	5. MF	1-2					Nonref
125	Juniata Emergent	5. MF	1-3	Wet	Wet	No	No	Nonref
125	Juniata Emergent	5. MF	1-4					Nonref
125	Juniata Emergent	5. MF	1-5	Saturated	Wet	Yes	No	Nonref
125	Juniata Emergent	5. MF	2-1					Nonref
125	Juniata Emergent	5. MF	2-2					Nonref
125	Juniata Emergent	5. MF	2-3					Nonref
125	Juniata Emergent	5. MF	2-4					Nonref
125	Juniata Emergent	5. MF	2-5					Nonref
135	Dagobah	5. MF	2-1A	Saturated	Wet	No	No	Nonref
135	Dagobah	5. MF	2-1B	Wet	Wet	Yes	Yes	Nonref
135	Dagobah	5. MF	2-2	Wet	Wet	No	No	Nonref
135	Dagobah	5. MF	3-1					Nonref
135	Dagobah	5. MF	4-1					Nonref
135	Dagobah	5. MF	5-1					Nonref
144	Gravens	5. MF	1-1					Nonref
144	Gravens	5. MF	1-2	Moist	Moist	No	No	Nonref
144	Gravens	5. MF	2-1	Moist	Moist	No	No	Nonref
144	Gravens	5. MF	2-2					Nonref
144	Gravens	5. MF	3-1	Moist	Wet	No	No	Nonref
144	Gravens	5. MF	3-2					Nonref
161	Jungle Fever	5. MF	1-1					Nonref
161	Jungle Fever	5. MF	2-1	Dry	Moist	No	No	Nonref
161	Jungle Fever	5. MF	3-1					Nonref
161	Jungle Fever	5. MF	4-1	Dry	Dry	No	No	Nonref
161	Jungle Fever	5. MF	5-1					Nonref
164	Rock-a-Billy	5. MF	1-1					Nonref
164	Rock-a-Billy	5. MF	1-2					Nonref
164	Rock-a-Billy	5. MF	2-1					Nonref
164	Rock-a-Billy	5. MF	2-2	Moist	Saturated	No	No	Nonref
164	Rock-a-Billy	5. MF	3-1					Nonref
164	Rock-a-Billy	5. MF	3-2	Moist	Moist	No	No	Nonref
168	Website	5. MF	1-1					Nonref
168	Website	5. MF	2-2					Nonref
168	Website	5. MF	3-1	Dry	Dry	No	No	Nonref
168	Website	5. MF	4-1					Nonref
168	Website	5. MF	4-2	Dry	Dry	No	No	Nonref
168	Website	5. MF	5-1	Saturated	Saturated	No	No	Nonref
180	Chicken Dance	5. MF	1-2					Nonref
180	Chicken Dance	5. MF	2-1					Nonref
180	Chicken Dance	5. MF	3-3	Moist	Moist	No	No	Nonref
180	Chicken Dance	5. MF	4-3					Nonref
181	Militia	5. MF	1-1	Moist	Moist	No	No	Nonref
181	Militia	5. MF	1-2					Nonref
181	Militia	5. MF	2-1	Moist	Moist	No	No	Nonref
181	Militia	5. MF	2-2					Nonref
181	Militia	5. MF	3-1					Nonref
181	Militia	5. MF	3-2					Nonref
183	Lily’s Land	5. MF	1-1	Moist	Moist	No	No	Nonref
183	Lily’s Land	5. MF	1-2					Nonref
183	Lily’s Land	5. MF	2-1	Moist	Moist	No	No	Nonref
183	Lily’s Land	5. MF	2-2					Nonref

189	Mill	5. MF	1-2	Moist	Moist	Yes	No	Nonref
189	Mill	5. MF	2-2					Nonref
189	Mill	5. MF	2-3					Nonref
189	Mill	5. MF	3-1					Nonref
189	Mill	5. MF	3-2	Moist	Moist	Yes	Yes	Nonref
189	Mill	5. MF	3-3	Moist	Moist	No	No	Nonref
189	Mill	5. MF	5-1					Nonref
189	Mill	5. MF	5-2	Moist	Moist	No	No	Nonref
189	Mill	5. MF	5-3					Nonref
190	Blue Juniata	5. MF	1-1	Moist	Moist	No	No	Nonref
190	Blue Juniata	5. MF	2-1	Moist	Moist	No	No	Nonref
190	Blue Juniata	5. MF	3-1					Nonref
190	Blue Juniata	5. MF	4-1	Moist	Moist	No	No	Nonref
190	Blue Juniata	5. MF	5-1					Nonref
191	7	5. MF	1-1	Moist	Moist	No	No	Nonref
191	7	5. MF	1-2	Moist	Moist	No	No	Nonref
191	7	5. MF	2-0					Nonref
191	7	5. MF	2-2					Nonref
191	7	5. MF	3-1	Moist	Moist	No	No	Nonref
4	LFC Dam	6. HI	T11		Saturated			Ref
4	LFC Dam	6. HI	T12		Saturated			Ref
4	LFC Dam	6. HI	T13		Moist			Ref
4	LFC Dam	6. HI	T15		Moist			Ref
4	LFC Dam	6. HI	T16		Moist			Ref
11	Toftrees	6. HI	T11		Saturated			Nonref
11	Toftrees	6. HI	T21		Saturated			Nonref
11	Toftrees	6. HI	T22		Moist			Nonref
11	Toftrees	6. HI	T31		Wet			Nonref
11	Toftrees	6. HI	T32		Moist			Nonref
11	Toftrees	6. HI	T33		Wet			Nonref
11	Toftrees	6. HI	T34		Moist			Nonref
11	Toftrees	6. HI	T41		Saturated			Nonref
11	Toftrees	6. HI	T42		Wet			Nonref
11	Toftrees	6. HI	T43		Moist			Nonref
11	Toftrees	6. HI	T51		Wet			Nonref
11	Toftrees	6. HI	T52		Wet			Nonref
11	Toftrees	6. HI	Wells 3		Saturated			Nonref
29	Colyer Lake	6. HI	T11		Wet			Ref
29	Colyer Lake	6. HI	T12		Wet			Ref
29	Colyer Lake	6. HI	T13		Wet			Ref
29	Colyer Lake	6. HI	T21		Moist			Ref
29	Colyer Lake	6. HI	T22		Wet			Ref
29	Colyer Lake	6. HI	T23		Wet			Ref
29	Colyer Lake	6. HI	T31		Moist			Ref
29	Colyer Lake	6. HI	T32		Saturated			Ref
29	Colyer Lake	6. HI	T33		Wet			Ref
29	Colyer Lake	6. HI	T41		Moist			Ref
29	Colyer Lake	6. HI	T42		Saturated			Ref
29	Colyer Lake	6. HI	T43		Saturated			Ref
29	Colyer Lake	6. HI	T51		Moist			Ref
29	Colyer Lake	6. HI	T52		Moist			Ref
29	Colyer Lake	6. HI	T53		Saturated			Ref
34	Stone Valley	6. HI	T11		Dry			Nonref

34	Stone Valley	6. HI	T12		Dry			Nonref
34	Stone Valley	6. HI	T13		Dry			Nonref
34	Stone Valley	6. HI	T14		Moist			Nonref
34	Stone Valley	6. HI	T21		Moist			Nonref
34	Stone Valley	6. HI	T22		Moist			Nonref
34	Stone Valley	6. HI	T23		Saturated			Nonref
34	Stone Valley	6. HI	T24		Wet			Nonref
34	Stone Valley	6. HI	T31		Dry			Nonref
34	Stone Valley	6. HI	T32		Dry			Nonref
34	Stone Valley	6. HI	T33		Moist			Nonref
34	Stone Valley	6. HI	T41		Dry			Nonref
34	Stone Valley	6. HI	T42		Saturated			Nonref
36	Decker Pond	6. HI	T00		Wet			Ref
36	Decker Pond	6. HI	T01		Wet			Ref
36	Decker Pond	6. HI	T10		Wet			Ref
36	Decker Pond	6. HI	T11		Wet			Ref
36	Decker Pond	6. HI	T20		Wet			Ref
36	Decker Pond	6. HI	T21		Wet			Ref
36	Decker Pond	6. HI	T30		Wet			Ref
36	Decker Pond	6. HI	T31		Wet			Ref
36	Decker Pond	6. HI	T32		Wet			Ref
36	Decker Pond	6. HI	T40		Wet			Ref
36	Decker Pond	6. HI	T41		Wet			Ref
36	Decker Pond	6. HI	T42		Wet			Ref
94	Whipple Lake	6. HI	T1-1	Wet	Wet	No	No	Ref
94	Whipple Lake	6. HI	T1-2	Wet	Wet	No	No	Ref
94	Whipple Lake	6. HI	T1-3					Ref
94	Whipple Lake	6. HI	T1-4					Ref
94	Whipple Lake	6. HI	T2-3	Wet	Wet	No	No	Ref
94	Whipple Lake	6. HI	T2-4					Ref
95	Faylor Lake	6. HI	T1-1					Nonref
95	Faylor Lake	6. HI	T1-2					Nonref
95	Faylor Lake	6. HI	T2-1	Moist	Moist	No	No	Nonref
95	Faylor Lake	6. HI	T2-2					Nonref
95	Faylor Lake	6. HI	T3-1	Moist	Moist	No	No	Nonref
95	Faylor Lake	6. HI	T4-1	Saturated	Wet	No	No	Nonref
95	Faylor Lake	6. HI	T4-2					Nonref
96	Walker Lake	6. HI	T1-1	Moist	Moist	No	No	Nonref
96	Walker Lake	6. HI	T1-2					Nonref
96	Walker Lake	6. HI	T1-3					Nonref
96	Walker Lake	6. HI	T2-1					Nonref
96	Walker Lake	6. HI	T2-2					Nonref
96	Walker Lake	6. HI	T3-1					Nonref
96	Walker Lake	6. HI	T3-2					Nonref
133	Marsh Trail	6. HI	1-1					Nonref
133	Marsh Trail	6. HI	2A-1	Wet	Wet	No	No	Nonref
133	Marsh Trail	6. HI	2B-1	Moist	Moist	Yes	Yes	Nonref
133	Marsh Trail	6. HI	3A-1					Nonref
133	Marsh Trail	6. HI	3B-1					Nonref
133	Marsh Trail	6. HI	4-1					Nonref
143	Wet n' Wild	6. HI	1-2					Nonref
143	Wet n' Wild	6. HI	2-1	Moist	Moist	No	No	Nonref
143	Wet n' Wild	6. HI	2-2	Wet	Wet	Yes	Yes	Nonref

143	Wet n' Wild	6. HI	2-5					Nonref
143	Wet n' Wild	6. HI	3-2					Nonref
143	Wet n' Wild	6. HI	4-0			No	Yes	Nonref
143	Wet n' Wild	6. HI	4-2					Nonref
12	Mothersbaugh	7. BI	T12		Moist			Ref
12	Mothersbaugh	7. BI	T13		Moist			Ref
12	Mothersbaugh	7. BI	T14					Ref
12	Mothersbaugh	7. BI	T15		Moist			Ref
12	Mothersbaugh	7. BI	T21		Moist			Ref
12	Mothersbaugh	7. BI	T22		Saturated			Ref
12	Mothersbaugh	7. BI	T23		Moist			Ref
12	Mothersbaugh	7. BI	T24					Ref
12	Mothersbaugh	7. BI	T25					Ref
12	Mothersbaugh	7. BI	T31		Wet			Ref
12	Mothersbaugh	7. BI	T32		Wet			Ref
12	Mothersbaugh	7. BI	T33		Saturated			Ref
12	Mothersbaugh	7. BI	T34					Ref
12	Mothersbaugh	7. BI	T35					Ref
12	Mothersbaugh	7. BI	T36					Ref
12	Mothersbaugh	7. BI	T43		Wet			Ref
12	Mothersbaugh	7. BI	T44					Ref
12	Mothersbaugh	7. BI	T45					Ref
12	Mothersbaugh	7. BI	T46					Ref
12	Mothersbaugh	7. BI	Wells 13					Ref
12	Mothersbaugh	7. BI	Wells 20					Ref
12	Mothersbaugh	7. BI	Wells 3					Ref
86	TSF Beaver Impoundment	7. BI	T1-1					Ref
86	TSF Beaver Impoundment	7. BI	T1-2	Moist	Saturated	No	Yes	Ref
86	TSF Beaver Impoundment	7. BI	T1-3					Ref
86	TSF Beaver Impoundment	7. BI	T2-1					Ref
86	TSF Beaver Impoundment	7. BI	T2-2					Ref
86	TSF Beaver Impoundment	7. BI	T3-0	Moist	Moist	No	Yes	Ref
86	TSF Beaver Impoundment	7. BI	T4-4	Wet	Wet	Yes	Yes	Ref
126	Beaver Thicket	7. BI	1-1	Moist		No	No	Ref
126	Beaver Thicket	7. BI	1-2					Ref
126	Beaver Thicket	7. BI	1-3	Saturated	Wet	No	No	Ref
126	Beaver Thicket	7. BI	2-1	Moist	Saturated	No	No	Ref
126	Beaver Thicket	7. BI	2-2					Ref
126	Beaver Thicket	7. BI	2-3					Ref
126	Beaver Thicket	7. BI	3-1					Ref
126	Beaver Thicket	7. BI	3-3					Ref
127	Old Beaver	7. BI	1-2	Wet	Wet	No	No	Ref
127	Old Beaver	7. BI	1-3					Ref
127	Old Beaver	7. BI	1-4	Wet	Wet	No	No	Ref
127	Old Beaver	7. BI	2-1					Ref
127	Old Beaver	7. BI	2-2					Ref
127	Old Beaver	7. BI	2-3					Ref
127	Old Beaver	7. BI	3-1	Saturated	Moist	No	No	Ref
127	Old Beaver	7. BI	3-2					Ref
127	Old Beaver	7. BI	3-3					Ref
127	Old Beaver	7. BI	4-2					Ref
136	New Beginnings	7. BI	1-1	Moist	Saturated	No	No	Ref
136	New Beginnings	7. BI	1-2					Ref

136	New Beginnings	7. Bl	2-1					Ref
136	New Beginnings	7. Bl	2-2					Ref
136	New Beginnings	7. Bl	3-1	Dry	Dry	No	No	Ref
136	New Beginnings	7. Bl	3-2					Ref
138	Misty Mornin'	7. Bl	1-1					Ref
138	Misty Mornin'	7. Bl	1-2	Saturated	Wet	No	No	Ref
138	Misty Mornin'	7. Bl	2-2	Wet	Wet	Yes	Yes	Ref
138	Misty Mornin'	7. Bl	2-3					Ref
138	Misty Mornin'	7. Bl	2-4					Ref
138	Misty Mornin'	7. Bl	3-2					Ref
138	Misty Mornin'	7. Bl	4-1	Moist	Moist	No	No	Ref
138	Misty Mornin'	7. Bl	4-3					Ref
138	Misty Mornin'	7. Bl	5-2					Ref
156	Songbird Serenade	7. Bl	1-4					Ref
156	Songbird Serenade	7. Bl	1-5	Saturated	Moist	No	No	Ref
156	Songbird Serenade	7. Bl	2-1					Ref
156	Songbird Serenade	7. Bl	2-10					Ref
156	Songbird Serenade	7. Bl	2-2	Moist	Moist	No	No	Ref
156	Songbird Serenade	7. Bl	2-3					Ref
156	Songbird Serenade	7. Bl	2-4	Saturated	Wet	Yes	Yes	Ref
156	Songbird Serenade	7. Bl	2-5					Ref
156	Songbird Serenade	7. Bl	2-6					Ref
156	Songbird Serenade	7. Bl	2-7	Saturated	Saturated	No	No	Ref
156	Songbird Serenade	7. Bl	2-8					Ref
156	Songbird Serenade	7. Bl	2-9					Ref

Table 2. Texture data compiled for all sites.

Site Num	Reference Site Name	HGM Class	% Sand	% Silt	%Clay	Ref/Dist
8	Duncansville	1. Isolated Depression	12	44.4	43.6	dist
9	PSU Airport	1. Isolated Depression	19.7	49.4	30.9	dist
38	Twin Ponds - PGC	1. Isolated Depression	65.6	20.4	14	ref
73	Barrens Bear Pond	1. Isolated Depression	81	15	4	ref
74	Barrens Long Pond	1. Isolated Depression	81	15	4	ref
75	Green Heron Pond	1. Isolated Depression	16	61	23	dist
76	Spray Pond	1. Isolated Depression				dist
77	Mohn Mills 1	1. Isolated Depression	33	45.7	21.3	ref
78	Mohn Mills Moss	1. Isolated Depression	22	66	12	ref
80	Kimmel 1	1. Isolated Depression	42.1	32.8	25.1	dist
81	Kimmel 2	1. Isolated Depression	33	33	34	ref
117	Twin Ponds	1. Isolated Depression	51	33.7	15.3	dist
137	Scotia Road	1. Isolated Depression	65	25	10	dist
141	SGL-166	1. Isolated Depression	14	59.3	26.7	dist
148	Pilgrim	1. Isolated Depression	50.7	38.6	10.7	dist
5	McCall Dam	2. Riparian Depression	42.5	37.1	20.4	ref
6	Sand Spring	2. Riparian Depression	43.6	34.7	21.7	ref
7	Canoe Creek	2. Riparian Depression	15.5	61.9	22.6	dist
10	Whipple Dam SP	2. Riparian Depression	30.8	39.4	29.8	ref
13	Clark’s Trail	2. Riparian Depression	31.7	50.4	17.9	ref
52	Tadpole	2. Riparian Depression	14	56	30	dist
56	Farm 12	2. Riparian Depression				dist
59	NBB - RD	2. Riparian Depression				dist
122	Corndog	2. Riparian Depression	17.3	61	21.7	dist
157	Symphony	2. Riparian Depression	32.5	30	37.5	dist
162	Scat	2. Riparian Depression	40	41.3	18.7	dist
172	Damm!	2. Riparian Depression	38	37.7	24.3	dist
178	Nada	2. Riparian Depression	35	11	54	dist
185	Fugitive	2. Riparian Depression	48	17.7	34.3	dist
186	Muy Bueno	2. Riparian Depression	29	46.5	24.5	dist
187	Skullz	2. Riparian Depression	29.3	56.7	14	dist
14	LFC - PFO	3. Slope	41.7	39.1	19.2	ref
19	Rothrock State Forest	3. Slope	40.8	32.9	26.3	ref
23	Shaver’s Creek	3. Slope	21.7	46.2	32.1	dist
24	McGuire Rd	3. Slope	26.5	37.2	36.3	dist
25	Windy Hill Farms	3. Slope	15.1	63.3	21.6	dist
67	Cumberland Valley H.S.	3. Slope	26.3	36.2	37.5	dist
84	West Licking Creek	3. Slope	29.9	23.6	46.5	ref
85	East Licking Creek	3. Slope	47.5	28.8	23.7	ref
87	TSF Slope	3. Slope	36.6	28	35.4	ref
88	Licking Creek NW Slope	3. Slope	46.5	24	29.5	ref
89	Licking Creek SW Slope	3. Slope	33.1	34	32.9	ref
91	Licking Creek - Mad Dog Slope	3. Slope	73.7	10.2	16.1	ref
92	Corn Field	3. Slope	13	40	47	dist
121	Mustang Sally	3. Slope	52.3	24	23.7	dist
142	Whipper	3. Slope	33	33	34	dist
152	Death Valley	3. Slope	29.3	44	26.7	dist

155	Yogi	3. Slope	33	33	34	dist
160	Mizzle	3. Slope	22	66	12	dist
166	Cloverleaf	3. Slope	30.3	45.3	24.4	dist
18	Buffalo Run	4. Headwater Floodplain	30.4	41.5	28.1	dist
26	Water Authority	4. Headwater Floodplain	38.7	39.8	21.5	dist
31	Cedar Run	4. Headwater Floodplain	6	65.7	28.3	dist
33	Lee's Gap	4. Headwater Floodplain	31.9	54.4	13.7	dist
53	NBB - HWF	4. Headwater Floodplain				dist
57	Thompson Run	4. Headwater Floodplain				dist
60	Laurel Run	4. Headwater Floodplain	63.1	17.9	19	ref
64	State College H.S.	4. Headwater Floodplain	14	59.3	26.7	dist
83	Tuscarora HWF	4. Headwater Floodplain	34.7	36.7	28.6	ref
90	TSF Floodplain	4. Headwater Floodplain	68.7	16.3	15	ref
110	Top Gun	4. Headwater Floodplain	33	33	34	dist
112	Deer Trail	4. Headwater Floodplain	45.3	28.3	26.4	dist
113	Willow	4. Headwater Floodplain	30.2	41.3	28.5	dist
114	Bush	4. Headwater Floodplain	41.7	26.7	31.6	dist
115	Mucho Rosa	4. Headwater Floodplain	59	14	27	dist
116	Cows	4. Headwater Floodplain	21.6	51.7	26.7	dist
120	Snag in my Pants	4. Headwater Floodplain	31.7	54.3	14	dist
123	Thistle	4. Headwater Floodplain	21.7	51.7	26.6	dist
124	Got Milk?	4. Headwater Floodplain	38.5	35.5	26	dist
128	Wingstem	4. Headwater Floodplain	36.7	34.6	28.7	dist
129	Cattle Drive	4. Headwater Floodplain	63	21.3	15.7	dist
130	Joke	4. Headwater Floodplain	41.7	26.7	31.6	dist
131	Crackhouse	4. Headwater Floodplain	21.6	51.7	26.7	dist
132	Scenic	4. Headwater Floodplain	50.3	27.5	22.2	dist
134	Spirit Fawn	4. Headwater Floodplain	32.7	31	36.3	dist
139	Rhoda	4. Headwater Floodplain	17.7	48.3	34	dist
140	Cambaris	4. Headwater Floodplain	59	14	27	dist
145	Lost World	4. Headwater Floodplain	33	33	34	dist
146	Spice Valley	4. Headwater Floodplain	68.3	18	13.7	dist
147	Model T	4. Headwater Floodplain	56.3	11.3	32.4	dist
149	Sheep	4. Headwater Floodplain	63.3	20.7	16	dist
150	Berry Good	4. Headwater Floodplain	50.4	20.3	29.3	dist
151	Mosquito	4. Headwater Floodplain	29.3	44	26.7	dist
153	Drippy	4. Headwater Floodplain	36.7	47.3	16	dist
154	Canary Roe	4. Headwater Floodplain	14	56	30	dist
158	Cauldron	4. Headwater Floodplain	33	33	34	dist
159	R&R	4. Headwater Floodplain	74	18	8	dist
163	Blue Bomber	4. Headwater Floodplain	78.5	14.5	7	dist
165	Franky	4. Headwater Floodplain	45.4	28.3	26.3	dist
167	Monday Monday	4. Headwater Floodplain	45.4	28.3	26.3	dist
169	Comedy of Errors	4. Headwater Floodplain	65	25	10	dist
170	Rooster	4. Headwater Floodplain	33	33	34	dist
171	Joy Ride	4. Headwater Floodplain	47.3	32	20.7	dist
173	Amd	4. Headwater Floodplain	65	25	10	dist
174	Far Side	4. Headwater Floodplain	29.3	44	26.7	dist
175	Dinky Dale	4. Headwater Floodplain	50.3	20.3	29.4	dist
176	Makin' Hay	4. Headwater Floodplain	52.3	24	23.7	dist

177	Magnum PI	4. Headwater Floodplain	61	17.7	21.3	dist
179	Buggy Bumpin’	4. Headwater Floodplain	38.5	35.5	26	dist
182	Goofy	4. Headwater Floodplain	45.3	28.3	26.4	dist
184	Fungus Amongus	4. Headwater Floodplain	52.3	24	23.7	dist
188	Fork	4. Headwater Floodplain	65	25	10	dist
27	WDC - Gaging Station	5. Mainstem Floodplain	70.5	17.2	12.3	ref
28	Millbrook Marsh	5. Mainstem Floodplain	29.3	38.5	32.2	dist
30	PFBC - Spring Creek	5. Mainstem Floodplain	26	53.4	20.6	dist
32	Fravel	5. Mainstem Floodplain	28.7	54.9	16.4	dist
35	Davis	5. Mainstem Floodplain	59.4	21	19.6	dist
65	Juniata Valley H.S.	5. Mainstem Floodplain	40.4	36.3	23.3	dist
82	Juniata Railroad Depression	5. Mainstem Floodplain	60	21	19	dist
93	Crawbow	5. Mainstem Floodplain	53.9	26.6	19.5	dist
111	Juniata Island Point	5. Mainstem Floodplain	33	33	34	dist
118	Willis	5. Mainstem Floodplain	51	33.7	15.3	dist
125	Juniata Emergent	5. Mainstem Floodplain	54.5	31.5	14	dist
135	Dagobah	5. Mainstem Floodplain	54.3	27.7	18	dist
144	Gravens	5. Mainstem Floodplain	79.3	14.7	6	dist
161	Jungle Fever	5. Mainstem Floodplain	65	25	10	dist
164	Rock-a-Billy	5. Mainstem Floodplain	92	4	4	dist
168	Website	5. Mainstem Floodplain	52.3	24	23.7	dist
180	Chicken Dance	5. Mainstem Floodplain	65	25	10	dist
181	Militia	5. Mainstem Floodplain	46	23.5	30.5	dist
183	Lily’s Land	5. Mainstem Floodplain	73	20	7	dist
189	Mill	5. Mainstem Floodplain	13.7	45.3	41	dist
190	Blue Juniata	5. Mainstem Floodplain	33	33	34	dist
191	7	5. Mainstem Floodplain	43.7	30.3	26	dist
4	LFC Dam	6. Human Impoundment	46.9	36.7	16.4	ref
11	Toftrees	6. Human Impoundment	22.7	38.7	38.6	dist
29	Colyer Lake	6. Human Impoundment	41.4	44.2	14.4	ref
34	Stone Valley	6. Human Impoundment	15.3	57.9	26.8	dist
36	Decker Pond	6. Human Impoundment	50.8	38.8	10.4	ref
94	Whipple Lake	6. Human Impoundment	35.9	38.2	25.9	ref
95	Faylor Lake	6. Human Impoundment	21.7	51.7	26.6	dist
96	Walker Lake	6. Human Impoundment	6	46	48	dist
133	Marsh Trail	6. Human Impoundment	46	23.5	30.5	dist
143	Wet n' Wild	6. Human Impoundment	64.7	5.3	30	dist
12	Mothersbaugh	7. Beaver Impoundment	28.4	41.5	30.1	ref
86	TSF Beaver Impoundment	7. Beaver Impoundment	50.9	22.7	26.4	ref
126	Beaver Thicket	7. Beaver Impoundment	17.7	48.3	34	ref
127	Old Beaver	7. Beaver Impoundment	16.7	59.3	24	ref
136	New Beginnings	7. Beaver Impoundment	49	29	22	ref
138	Misty Mornin’	7. Beaver Impoundment	33	33	34	ref
156	Songbird Serenade	7. Beaver Impoundment	33	33	34	ref

Table 3. Data for organic matter and matrix chroma, as site means.

Site N	Reference Site Name	5cm O	20cm	5cm Cl	20cm (	Ref/Di	HGM Class
8	Duncansville	7.21	5.77		2.83	Dist	1. Isolated Depre
9	PSU Airport	8.66	5.37		1.67	Dist	1. Isolated Depre
38	Twin Ponds - PGC	35.3	5.6		3	Ref	1. Isolated Depre
73	Barrens Bear Pond	15.2	8.7	1.33	1.67	Ref	1. Isolated Depre
74	Barrens Long Pond	17.45	3.95	1.33	1	Ref	1. Isolated Depre
75	Green Heron Pond	12.57	19.4	2.33	2.67	Dist	1. Isolated Depre
76	Spray Pond	19.85	5.15	2	1.33	Dist	1. Isolated Depre
77	Mohn Mills 1	47.7	26.5	1.67	1	Ref	1. Isolated Depre
78	Mohn Mills Moss	37.75	23.9	1.33	1	Ref	1. Isolated Depre
80	Kimmel 1	5.8	3.5	1.33	1.33	Dist	1. Isolated Depre
81	Kimmel 2			6	6	Ref	1. Isolated Depre
117	Twin Ponds	10.18	11.48	1	3.33	Dist	1. Isolated Depre
137	Scotia Road	23.46	8.97	1	2	Dist	1. Isolated Depre
141	SGL-166	22.29	13.11	1	1	Dist	1. Isolated Depre
148	Pilgrim	23.85	9.52	1.33	2	Dist	1. Isolated Depre
5	McCall Dam	16.21	6.18		1	Ref	2. Riparian Depr
6	Sand Spring	36.02	7.61		3.6	Ref	2. Riparian Depr
7	Canoe Creek	13.85	6.38		1.6	Dist	2. Riparian Depr
10	Whipple Dam SP	22.1	6.76		1.42	Ref	2. Riparian Depr
13	Clark's Trail	20.37	11.85		2.2	Ref	2. Riparian Depr
52	Tadpole	2.4	2.8	1.5	1.5	Dist	2. Riparian Depr
56	Farm 12	6.7			1.78	Dist	2. Riparian Depr
59	NBB - RD	5.2	3.8		2	Dist	2. Riparian Depr
122	Corndog	14.45	7.52	1.33	1.75	Dist	2. Riparian Depr
157	Symphony	10.45	4.99	2.67	2.67	Dist	2. Riparian Depr
162	Scat	13.09	3.25	1.67	2.5	Dist	2. Riparian Depr
172	Damm!	29.67	22.65	2	2.5	Dist	2. Riparian Depr
178	Nada	5.9	5.46	2.5	1.5	Dist	2. Riparian Depr
185	Fugitive	9.58	5.19	2.33	2	Dist	2. Riparian Depr
186	Muy Bueno	6.96	2.35	1.5	4	Dist	2. Riparian Depr
187	Skullz	27.27	3.88	1	1.5	Dist	2. Riparian Depr
14	LFC - PFO	37.06	14.19		1.83	Ref	3. Slope
19	Rothrock State Forest	27.17	5.14		1.52	Ref	3. Slope
23	Shaver's Creek	6.15	6.81		2.46	Dist	3. Slope
24	McGuire Rd	7.5	6.07		2.33	Dist	3. Slope
25	Windy Hill Farms	9.96	6.13		1.93	Dist	3. Slope
67	Cumberland Valley H.S.	13.2	14.4	2.5	2	Dist	3. Slope
84	West Licking Creek	8.23	3.83	1.67	2	Ref	3. Slope
85	East Licking Creek	17.07	12.03	1.67	1	Ref	3. Slope
87	TSF Slope	4.23	2	2	3.33	Ref	3. Slope
88	Licking Creek NW Slope	4.92	3.82	2	1.5	Ref	3. Slope
89	Licking Creek SW Slope	5.8	6.85	2	2	Ref	3. Slope

91	Licking Creek - Mad Dog Slope	3.85		2	1.5	Ref	3. Slope
92	Corn Field	4.2	2.3	2	2.5	Dist	3. Slope
121	Mustang Sally	18.56	7.94	1	6	Dist	3. Slope
142	Cloverleaf	11.91	10.08	1	2	Dist	3. Slope
152	Whipper	10.43	5.65	1.67	2	Dist	3. Slope
155	Death Valley	7.92	4.78	2.67	3.67	Dist	3. Slope
160	Yogi	22.21	6.73	1	1	Dist	3. Slope
166	Mizzle	11.34	4.36	2	2.33	Dist	3. Slope
18	Buffalo Run	8.2	5.68		1.86	Dist	4. Headwater Flo
26	Water Authority	6.12	4.57		2	Dist	4. Headwater Flo
31	Cedar Run	6.11	3.84		3	Dist	4. Headwater Flo
33	Lee's Gap	11.76	11.06		2.3	Dist	4. Headwater Flo
53	NBB - HWF	23.73				Dist	4. Headwater Flo
57	Thompson Run		4.6		1.83	Dist	4. Headwater Flo
60	Laurel Run	16.35				Ref	4. Headwater Flo
64	State College H.S.			2	3	Dist	4. Headwater Flo
83	Tuscarora HWF	3.63	2.1	2	3	Ref	4. Headwater Flo
90	TSF Floodplain	6.43	1.87	2.33	2.67	Ref	4. Headwater Flo
110	Top Gun	8.41	5.84	2.33	4	Dist	4. Headwater Flo
112	Deer Trail	9.17	5.57	2	2.67	Dist	4. Headwater Flo
113	Willow	6.69	4.75	2.5	2.75	Dist	4. Headwater Flo
114	Bush	24.69	4.84	1.33	3	Dist	4. Headwater Flo
115	Mucho Rosa	10.12	6.5	2	2	Dist	4. Headwater Flo
116	Cows	8.39	5.51	2	3	Dist	4. Headwater Flo
120	Snag in my Pants	14.72	7.59	1.33	1.33	Dist	4. Headwater Flo
123	Thistle	11.88	8.87	2.33	2	Dist	4. Headwater Flo
124	Got Milk?	15.61	8.04	1.5	4	Dist	4. Headwater Flo
128	Wingstem	5.93	4.36	2.33	3.33	Dist	4. Headwater Flo
129	Cattle Drive	5.62	5.99	2.33	2	Dist	4. Headwater Flo
130	Joke	5.8	4.95	2.67	2.33	Dist	4. Headwater Flo
131	Crackhouse	11.91	10.28	1.33	1.33	Dist	4. Headwater Flo
132	Scenic	6.58	5.21	2.5	2.25	Dist	4. Headwater Flo
134	Spirit Fawn	6.73	4.94	3	3.67	Dist	4. Headwater Flo
139	Rhoda	9.67	4.69	2	3.33	Dist	4. Headwater Flo
140	Cambaris	8.35	4.63	2.67	3.33	Dist	4. Headwater Flo
145	Lost World	9.68	4.5	1.5	3	Dist	4. Headwater Flo
146	Spice Valley	9.14	4.97	1	3.67	Dist	4. Headwater Flo
147	Model T	6.27	4.77	2.33	2.33	Dist	4. Headwater Flo
149	Sheep	4.28	3.34	3	3	Dist	4. Headwater Flo
150	Berry Good	8.14	5.44	2.33	2.33	Dist	4. Headwater Flo
151	Mosquito	7.1	6.19	2.33	2.33	Dist	4. Headwater Flo
153	Drippy	13.23	4.7	1.33	1	Dist	4. Headwater Flo
154	Canary Roe	9.05	5.96	3	2.67	Dist	4. Headwater Flo
158	Cauldron	8.76	5.07	2.33	2.67	Dist	4. Headwater Flo
159	R&R	26.84	3.86	1.33	3.67	Dist	4. Headwater Flo
163	Blue Bomber	3.5	3.94	3	2.5	Dist	4. Headwater Flo
165	Franky	6.54	4.38	2.33	2	Dist	4. Headwater Flo
167	Monday Monday	5.93	3.94	3.33	3.67	Dist	4. Headwater Flo

169	Comedy of Errors	6.78	6.63	3	6	Dist	4. Headwater Flo
170	Rooster	5.83	5.6	2.67	3	Dist	4. Headwater Flo
171	Joy Ride	18.91	11.88	1.33	1.33	Dist	4. Headwater Flo
173	Amd	9.74	7.31	1.67	2.33	Dist	4. Headwater Flo
174	Far Side	10.94	3.09	2	3	Dist	4. Headwater Flo
175	Dinky Dale	16.19	8.16	1.33	1.67	Dist	4. Headwater Flo
176	Makin' Hay	6.05	5.83	2.67	2.33	Dist	4. Headwater Flo
177	Magnum PI	5.41	8.98	1.67	1.67	Dist	4. Headwater Flo
179	Buggy Bumpin'	8.07	5.43	3.5	3.5	Dist	4. Headwater Flo
182	Goofy	10.08	7.22	2.33	2.33	Dist	4. Headwater Flo
184	Fungun Amongus	7.07	3.94	2	3.67	Dist	4. Headwater Flo
188	Fork	7.96	3.87	2.5	7	Dist	4. Headwater Flo
27	WDC - Gaging Station	3.95	3.54		2	Ref	5. Mainstem Floo
28	Millbrook Marsh	5.2	3.94		2.1	Dist	5. Mainstem Floo
30	PFBC - Spring Creek	6.98	7.29		2.15	Dist	5. Mainstem Floo
32	Fravel	12.26	7.98		1.3	Dist	5. Mainstem Floo
35	Davis	3.9	4.69		3.2	Dist	5. Mainstem Floo
65	Juniata Valley H.S.	21.37	25.7	1.33	2	Dist	5. Mainstem Floo
82	Juniata Railroad Depression	26.5	13.7	1	4	Dist	5. Mainstem Floo
93	Crawbow	2.2	2.2	3.33	2.33	Dist	5. Mainstem Floo
111	Juniata Island Point	14.55	9.5	1.67	1.33	Dist	5. Mainstem Floo
118	Willis	10.21	8.55	1.67	2	Dist	5. Mainstem Floo
125	Juniata Emergent	18.04	7.41	1	2.5	Dist	5. Mainstem Floo
135	Dagobah	17.58	11.31	1.33	1.33	Dist	5. Mainstem Floo
144	Gravens	5.09	6.51	3	3	Dist	5. Mainstem Floo
161	Jungle Fever	16.37	16.14	3.5	4	Dist	5. Mainstem Floo
164	Rock-a-Billy	0.55	3.33	3	2.5	Dist	5. Mainstem Floo
168	Website	4.71	3.77	3.67	3.67	Dist	5. Mainstem Floo
180	Chicken Dance	6.63	6.27	2	2	Dist	5. Mainstem Floo
181	Militia	8.11	5.5	2	3.5	Dist	5. Mainstem Floo
183	Lily's Land	7.18	6.63	2	2	Dist	5. Mainstem Floo
189	Mill	6.97	4.26	2	2.25	Dist	5. Mainstem Floo
190	Blue Juniata	7.03	5.64	2	2.33	Dist	5. Mainstem Floo
191	7	7.57	6.05	2.33	2.33	Dist	5. Mainstem Floo
4	LFC Dam	11.01	8.81		1.6	Ref	6. Human Impou
11	Toftrees	11	6.62		2.62	Dist	6. Human Impou
29	Colyer Lake	8.02	3.87		1.87	Ref	6. Human Impou
34	Stone Valley	13.53	7.17		2.62	Dist	6. Human Impou
36	Decker Pond	38.61				Ref	6. Human Impou
94	Whipple Lake	8.35	12.83	1	1	Ref	6. Human Impou
95	Faylor Lake	10.95	6.05	2.67	1.67	Dist	6. Human Impou
96	Walker Lake	4.64	3.43	1	1	Dist	6. Human Impou
133	Marsh Trail	10.64	7.04	2	2	Dist	6. Human Impou
143	Wet n' Wild	7.36	10.16	1.33	1.33	Dist	6. Human Impou
12	Mothersbaugh	38.94	18.26		1	Dist	7. Beaver Impou
86	TSF Beaver Impoundment	9	3.6	2	2	Dist	7. Beaver Impou
126	Beaver Thicket	8.72	7.23	2	2	Dist	7. Beaver Impou
127	Old Beaver	15.01	5.09	1	1	Dist	7. Beaver Impou

136	New Beginnings	7.29	6.38	4.5	4.5	Dist	7. Beaver Impou
138	Misty Mornin'	23.01	4.14	1.33	1.33	Dist	7. Beaver Impou
156	Songbird Serenade	17.12	9.22	1.25	1	Dist	7. Beaver Impou

APPENDIX C

DERIVED SOIL TEXTURE VALUES

Table 5. Values interpreted from USDA soil textural triangle for use in texture analyses.

Textural Class	**%Clay**	**%Silt**	**%Sand**
Clay	65	16	19
Silty Clay	48	46	6
Silty Clay Loam	34	56	10
Clay Loam	34	33	33
Sandy Clay	43	6	51
Sandy Clay Loam	27	14	59
Loam	18	38	44
Sandy Loam	10	25	65
Loamy Sand	4	15	81
Sand	4	4	92
Silt Loam	12	66	22
Silt	6	87	7