Archaeological Survey of Steele County, Minnesota

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Abstract

In November 2011, the Minnesota Historical Society contracted with 10,000 Lakes Archaeology, Inc. (10,000 Lakes) and AMEC Environment and Infrastructure (AMEC) to conduct an archaeological survey of Steele County in southeastern Minnesota. Project funding was provided through a Legacy grant from the Minnesota Art and Cultural Heritage Fund. The purpose of this project was to learn about the early inhabitants of Steele County and involved summarizing what was already known about the pre-history of the area, updating the Office of the State Archaeologist (OSA) records regarding specific previously recorded archaeological sites, developing a predictive model, and using the predictive model to locate new archaeological sites.

The Minnesota Historical Society (MHS), Minnesota Indian Affairs Council (MIAC) and OSA chose Steele County as the focus of the study because very little is known about the pre-history of the county. Specific study tasks included conducting background research, creating a GIS predictive model for archaeological sites, conducting an archaeological survey of select parcels within the county, and reconstructing the area’s paleo-environment. Work was conducted between the fall of 2011 and summer of 2012, with the field survey taking place between February and April 2012.

Background research for this project included examining archaeological site files at the OSA and State Historic Preservation Office (SHPO), county notes in the OSA files, field and lab notes from previous University of Minnesota (UM) and MHS archaeological investigations, historic maps, and county histories. Artifacts from seven previously excavated sites dating back to the early 1970s were also re-examined.

Steele County is located within Anfinson’s Prairie Lake east (2e) Archaeological Region (1990). Archaeological fieldwork consisted of pedestrian surface survey of cultivated fields throughout Steele County. More than 25% of the ground surface was visible in all survey areas, and survey transects were spaced 15 meters apart. During the survey 31 parcels totaling 1,115 acres were examined, and 13 previously unrecorded sites were located. All parcels surveyed were privately owned.

Amanda Gronhovd (10,000 Lakes) served as Principal Investigator, and Duane Simpson (AMEC), Amanda Gronhovd and Kari Krause (formerly AMEC) managed the project. Duane Simpson, Nathan Scholl (AMEC) and Kate Ratkovich (10,000 Lakes) conducted the geophysical testing and analyzed the geophysical information to reconstruct the paleo-environment, and Dan Conn (formerly AMEC) built and generated the GIS predictive model. Dr. Kent Bakken and Kate Ratkovich (10,000 Lakes) conducted background research and fieldwork, and Dr. Bakken analyzed artifacts from both previously recorded and newly recorded archaeological sites.
Acknowledgements

The archaeological survey of Steele County was only possible because of the gracious support of numerous people. First and foremost, we would like to thank the landowners for allowing us to survey their property. We also thank Laura Resler and Daniel Moeckly and the Steele County Historical for their support during this project. The information they gave us and conversations they facilitated were invaluable. We especially appreciate the opportunity to hold a “Show and Tell” at the Steele County Historical Society. This event gave local collectors and residents the opportunity to ask questions about the project, see what types of sites were being located, and discuss their collections with us. We thank all the folks that worked on this project. Thanks to Kent Bakken and Kate Ratkovich who kept a positive attitude despite several days of a cold, biting wind. Kari Krause contacted landowners and secured access to our survey parcels, Daniel Conn helped construct our GIS predictive model, Susan Andrews supervised artifact processing and Savannah Darr cataloged the artifacts. We thank Julianna Olsen at the Minnesota Historical Society for her assistance in announcing this project to the public and Eric Weber for continuing to inform the public about the project’s progress. We thank Scott Anfinson and Bruce Koenen of the Office of the State Archaeologist, Patricia Emerson of the Minnesota Historical Society’s Archaeology Department, and Jim Jones of the Minnesota Indian Affairs Council for their assistance and advice pertaining to the project. Finally, we thank the people of Minnesota for funding this research through the tax dollars generated by the Clean Water, Land and Legacy Amendment, and the Minnesota Historical Society for managing the contract.
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1: Introduction

In November 2011, the *Minnesota Historical Society* contracted with *10,000 Lakes Archaeology, Inc. (10,000 Lakes)* and *AMEC Environment and Infrastructure (AMEC)* to conduct an archaeological survey of Steele County in southeastern Minnesota. The project was funded through a Legacy grant from the Minnesota Art and Cultural Heritage Fund. The purpose of this project was to learn about the early inhabitants of Steele County and involved summarizing what was already known about the pre-history of the area, updating the Office of the State Archaeologist (OSA) records regarding specific previously recorded archaeological sites, developing a predictive model, and using the predictive model to locate new archaeological sites.

The Minnesota Historical Society (MHS), Minnesota Indian Affairs Council (MIAC) and OSA chose Steele County as the focus of the study because very little is known about the pre-history of the county, located in southeastern Minnesota (UTM: 15T E0467600 N4893500; E0496300N 4893200; E0496400N 4854900; E0467400 N4855000) (see Figure 1). The specific tasks comprising the study included conducting background research, creating a GIS model defining areas with high, medium, and low potential for containing archaeological sites, conducting an archaeological survey of parcels selected based on the GIS predictive model, reconstructing the area’s paleo-environment and reporting. Work was conducted between the fall of 2011 and summer of 2012.

Amanda Gronhovd (*10,000 Lakes*) served as Principal Investigator, and Duane Simpson (*AMEC*), Amanda Gronhovd and Kari Krause (formerly *AMEC*) managed the project. Duane Simpson, Nathan Scholl (*AMEC*) and Kate Ratkovich (*10,000 Lakes*) conducted the geophysical testing and analyzed the geophysical information to reconstruct the paleo-environment, and Dan Conn (formerly *AMEC*) built and generated the GIS predictive model. Dr. Kent Bakken and Kate Ratkovich (*10,000 Lakes*) conducted background research and fieldwork, and Dr. Bakken analyzed artifacts from both previously recorded and newly recorded archaeological sites. Laura Resler and Daniel Moeckly from the Steele County Historical Society were consulted regarding known archaeological sites and collections, local collectors and area historians. All artifacts recovered during the survey will be curated at the Minnesota Historical Society.
2: The Place: Natural Landscape and Environment

Steele County is located within Anfinson’s (1990) Prairie Lake east (2e) Archaeological Region of Minnesota and lies within the Minnesota Department of Natural Resources’ (MnDNR) Oak Savanna subsection of Minnesota and Northeast Iowa, which is located within the Eastern Broadleaf Forest Province (Figure 1) (MnDNR 2012). Bison were the dominant large mammals in southeastern Minnesota through the mid-1800s. White-tailed deer, elk, black and grizzly bears and gray wolves were also present on the prairies, while muskrats, beaver, mink, otters and raccoons occupied the region’s wetlands (Anfinson 1990).

Steele County generally consists of gently rolling hills and the vast majority of the land is under cultivation. This heavy reliance on agriculture led to extensive draining of the regions wetlands.
Figure 1. Steele County within the MnDNR’s Oak Savanna Ecological Subsection (DNR 2012).
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**Steele County Environmental Background**

**Bedrock**
Minnesota is primarily made up of Late and Middle Ordovician rocks at its bedrock surface, consisting of limestone and dolomite from the Maquoketa and Dubuque Formations and the Galena Group. The Middle Ordovician Decorah Shale Formation makes up a portion of the bedrock. Late Ordovician dolomite, limestone, and sandstone of the Shakopee and Oneota Formations comprise a smaller percentage of the bedrock, along with limestone and dolomites of the Cedar Valley and Wapsipinicon Groups from the Devonian (USGS 2012).

**Physiography/Geomorphology**
The present day geomorphic setting of Steele County has been dictated primarily by the recent geological history of the state and region, the most significant events of which are the most recent periods of glacial activity. The county is defined as part of the Owatonna Moraines physiographic area of the state. This area is characterized by a series of ground moraines that formed on the eastern edge of the Des Moines glacial lobe (Wright 1972b).

**Glacial History/Surface Geology**
The Des Moines lobe was one of the last glacial lobes to move across the entire length of Minnesota. It began to form during the Late Wisconsinan glacial period, sometime before 20,000 radiocarbon years ago, originating from ice flows that had worked their way down from Manitoba (Canada). The geologic make-up of the till (glacially deposited, poorly sorted, and non-stratified sediment) deposited by the Des Moines lobe reflects this origin.

After entering the Minnesota River Valley, the Des Moines lobe crossed the drainage divide near Mankato, MN, moving overland and eventually flowing down the Des Moines River Valley in Iowa. This lobe reached its southern terminus in the Des Moines River Valley around 16,425 calendar years before present day (13,700 radiocarbon years ago). At that time, the Des Moines lobe was approximately 300 miles long (north to south) by 130 miles wide (east to west). After reaching this maximum, it retreated rather quickly, reaching the Mankato area again by 12,700 years ago (Jennings et. al. 2011; Matsch 1972; Patterson and Johnson 2004; Wright 1972a). The sediment this glacial lobe left behind is referred to as New Ulm glacial till, which consists of an olive brown to dark gray calcareous, shale rich, till that can be found throughout the entire county.

The Quaternary geological map of the state of Minnesota (Hobbs and Goebel 1982), which shows the geological deposits at the modern surface, indicates that the surface of Steele County is comprised almost entirely of deposits originating from the Des Moines lobe, including: ground and end moraines in the north and east; stagnation moraines in the southwest; and outwash deposits in the major stream valleys and around the Oak Glen Lake region of Steele County. The margins of this ice lobe are not marked by a single morainal ridge, as seen in other glacial maximum limits, but rather consist of a broad topographic complex of hummocks and depressions (Patterson and Johnson 2002).
As stated above, this landscape is predominantly composed of till, but includes sediments that were sorted by flowing and still water. This is interpreted to show that the glacial ice of this lobe stagnated, allowing kettle lakes to form. While the glacier was immobilized, the surface of the ice would have become at least partially covered by eolian (windblown) sediments, preventing or slowing the melting process.

Sub-glacial meltwater channels and sinkholes formed that were able to transport sediments contained within the ice through the glacier to its base, or out of the ice margins altogether. Finer sediments were eventually completely transported away, leaving deposits of sand and gravel in the routes of former subglacial channels that were linked to the depressions created by melting blocks of ice. These links allowed meltwater to continuously flow into these forming lakes (Bettis and Quade 1997). As such, the webbed pattern of small lakes and ponds, which this region of the state is known for, were created after the retreat of the glaciers.

Loess is the surface deposit in much of the uplands and on high terraces. After the final glacial retreat, loess deposition, occurring between about 25,000 and 12,000 years ago, would represent the last of the glacial related deposit within the area (Forman 1990). The source of this windborn sediment was likely along the margin of the retreating Des Moines lobe (Muhs and Bettis 2003), where fine sediments that could be picked up by winds were being deposited. The thickness of this deposit varies greatly depending on factors such as topography, vegetation, and position on the landscape relative to wind direction (Mason et al. 1994, 1999). Loess deposits are relatively thin in this part of the region (1.0-0.5 m), becoming thicker and finer grained to the east (Mason et al. 1994). It is plausible that this loess could have buried early Holocene cultural deposits; therefore its thickness and distribution are important factors to consider in assessing buried site potential on the landscape. Post-depositional hillslope erosion has differentially removed and redistributed the loess and could also be a source of site burial. Eroded loess can also be a main source of sediment for the fluvial system.

A final note in relation to Steel County’s glacial development concerns the formation of the modern channel of the Straight River. This stream valley is the most prominent in the county and the physiographic region in general. It may have formed as a subglacial erosional valley, perhaps taking advantage of a previously existing bedrock valley (Wright 1972b). Conversely, it may have formed as an outlet for glacial Lake Minnesota, formed from meltwaters fed by the retreat of the Des Moines lobe when it drained around 13,400 years ago (Jennings et. al. 2011). Its valley is comprised of glacial outwash sediments, which could have been derived from either glacial meltwater or the draining of the lake. Oak Glen Lake in the southeastern part of the county likely formed as a pro-glacial lake similar (except in size) to Lake Minnesota.

**Hydrology**

Steele County today is located in two major drainage basins; the majority of the county falls within the Lower Mississippi River Basin, while a small area in the southwest section of the county falls within the Minnesota River Basin. In more specific terms the county is located within four watersheds. The Cannon, Zumbro, and Upper Cedar
watersheds fall within the Mississippi basin, while the Le Sueur watershed is part of the Minnesota basin. The Straight River is the largest stream within the county, followed by Maple Creek and Turtle Creek. These rivers appear to have formed relatively recently, probably since the end of the last glacial period, as their valleys are not deeply incised, their floodplains are small, and little evidence of terrace formation is present.

**Soils**

The soils of Steele County formed mainly after the retreat of the glaciers and consist of a mosaic of Mollisols and Alfisols. Alfisols are mainly associated with forest and savanna vegetation, while Mollisols correlate with either upland or wetland prairies. Common soils include Aquolls (wet soils developed under prairie vegetation), Udolls (well-drained soils developed under prairie vegetation), Udalfs (well-drained soils formed under forest vegetation), and Aqualfs (wet soils developed under forest vegetation) (Cummins and Grigal 1981). These soils formed as a direct result of the parent material, topography, climate, vegetation, and time since the last major geological event.

**Flora- Holocene/pre-settlement (GLO)**

The tundra environment that followed the retreat of the glacial ice was replaced by a spruce pine forest by 11,500 years ago. These were in turn rapidly replaced by pine forests as the climate continued to warm by 10,000 years ago. This warming trend continued, and roughly 9,000-8,000 years ago, the first prairie environment spread into the central part of the state, eventually reaching Steele County. By 6,000 years ago the climate had started to cool and entered a pattern similar to today's. This cooling allowed oak forests to invade, creating the prairie-forest vegetational environment present when the first Euro-Americans settled the area (Baker et. al. 2002; Matsch 1972; Nelson and Hu 2008).

**Paleo-Environment of Steele County**

Dramatic climatic changes set in soon after the glaciers retreated from the region. Although the glaciers had retreated, the climate was still quite cold, permafrost penetrated the ground, and intense freezing cycles characterized the region. The late-glacial environment extending from 11,450 to 10,000 years ago in southeastern Minnesota also appeared to have been dominated by a spruce and larch forests growing in a boreal wetland. Previous environmental work along Money Creek in Houston County, approximately 75 miles southeast of Steele County, found numerous needles of these taxa within sediment samples, along with eones of black spruce and macrofossils of dwarf birch and spike moss (Baker, et. al. 2002). These taxa were interpreted to indicate cold boreal to subarctic conditions during this period. That interpretation is also evidenced at many other Midwestern sites.

Pollen of spruce and larch declined and were replaced by a succession of mainly deciduous trees (primarily oak and elm) by about 10,000 years before present (B.P.) based on data from Kirchner Marsh, Clear Lake, and Roberts Creek (Baker et al.2002; Mather 1998). The paleo-record also indicates that by 9,000 B.P., elm-oak dominated forests covered millions of acres of Minnesota, Wisconsin, Iowa and Illinois.
As the climate warmed, the water table dropped dramatically and the frequency of prairie fires increased, causing small lakes to dry up, inhibiting forest growth, and maintaining prairie vegetation. Investigations at Spring Valley Cave in northeastern Iowa show an increase in prairie vegetation as early as 8,000 B.P. (Baker et al. 2002). This chronology is comparable to the changes from forest to prairie at Kirchner Marsh (Watts and Winters 1966). Investigations completed farther east indicated that the expansion of prairies into the more heavily dominated deciduous forests occurred approximately 6,000 B.P. (Dorale et al. 1992).

In general, cool and moist conditions existed from approximately 7,800 to 5,900 B.P., but after that, temperatures increased steadily (Dorale et al. 1992). These shifts reflect rising middle Holocene temperatures and the continuing replacement of deciduous forests by prairie conditions. Prairie expansion was extending from north to south during this period, meaning that prairie expansion occurred in Steele County earlier than it did further south. While no specific environmental data has been obtained from Steele County, it would seem plausible that prairie conditions would dominate earlier than 6,000 B.P. Data acquired from Money Creek suggests that prairie species common to this period would have included some of the weedier, more aggressive prairie taxa such as wild bergamot, sun flower, ox-eye, common vervain, white vervain, nettle, false buckwheat, and three-seeded mercury (Baker et al. 2002). These prairie taxa and weeds can grow in open woods, along woodland margins, or in floodplain openings.

A general transition began to occur across the region between 6,000 and 5,500 B.P., marked by the regional decline of forest areas. The Money Creek study indicated a drop in elm pollen percentages about 6,000 B.P., (just when Quercus pollen was at its peak) even though elm bud scales remained abundant until 5,500 B.P. (Baker, et. al. 2002). This pattern may indicate that as the climate became drier around 6,000 B.P., and that although elm was no longer present in the upland forest, it was able to survive along lower floodplain positions. Conversely, at this time the numbers of oak began to increase, possibly due to the expansion of burr oak, the most drought-tolerant oak species, in upland forests following the decrease in elm. After 5,500 B.P., the deciduous forest died back over much of the area.

Some prairie plant macrofossils also became prominent around 6,000 years B.P., including two of the dominant prairie grasses; Little bluestem and Indian grass. By 5,500 B.P. an abundance of diverse prairie species was seen across the region, including many species similar to modern prairie remnants, such as Little bluestem, Indian grass, Big bluestem, sunflower, rag weed, and general grasses. During this period, investigations completed across Minnesota, Iowa, and Wisconsin indicate that prairie replaced forest at a regional scale although increases in arboreal pollen have been noted between 3,500 and 3,000 B.P.

Further north, in central Minnesota, Grimm (1983) demonstrated that fire played an important role in the changing positions of the prairie-forest border during the late Holocene. Fire was probably also important in southeastern Minnesota, and is one of the
reasons the prairie-forest border existed for so long. Frequent prairie fires burned off the small trees that would begin to infiltrate the prairie. Additional data argues that this early to mid-Holocene ecotone was maintained by differences in moisture along the boundary (Denniston et al. 1999). Stalagmite growth rates recovered from the area suggest that there was a pronounced change from summer-dominated to winter-dominated precipitation, rather than a decrease in annual precipitation. These changes in seasonal precipitation and fire regime helped to maintain the oak savanna nature of Steele County throughout the remainder of the Holocene period.

The establishment of a prairie-dominated environment also would have led to increased erosion. As the cool-season precipitation peak fell in the spring, most plants would have been dormant and runoff greater (Denniston et al. 1999). Runoff is greater in prairie than in forested environments. Baker et al’s work along Money Creek indicted a greater diversity in weeds that suggested more disturbed, open ground, as would be expected with larger floods, more active channel migration, and channel widening (2002:120-121). This general trend would have also been occurring regionally throughout this period, leading to increased erosion as prairies expanded into alluvial settings. Trends in wetland plants also reflect the changes that were occurring. It is unclear exactly why they changed or what the causes of the changes in wetland habitats were, but presumably they reflect such things as frequency and magnitude of flooding and changes in the local water table (Baker et al. 2002:121).

Geomorphological investigations along the Straight River completed during these investigations indicated significant channel migration, potentially avulsion (when the river jumps from one channel to another rapidly), and aggradations of the river within the late Holocene period. These sorts of channel movements and periods of rapid sediment accumulation could indicate an increased proclivity for erosion and larger scale floods in the last 2,000 to 3,000 years. Once Euroamerican settlers moved to the area, they cleared, drained and plowed the land. This shift in the landscape is also evident in the French Lake pollen study starting about 1855 A.D (Grimm 1985:9-15).
3: Who Lived There? The Cultural History of Steele County

The Minnesota State Historic Preservation Office (SHPO) has developed several historic contexts for the state of Minnesota and the Upper Midwest. These contexts examine Minnesota’s recent (historic) and distant (precontact) past, and are based on decades of archaeological and historic research. They are designed to help generally describe and interpret the history of the state and give basic insight into the prevailing theories pertaining to the precontact and historic communities existing in specific locations and at discrete points in time.

The cultural histories focusing solely on American Indian communities in the vicinity of Steele County are divided into four major traditions: Paleoindian, Archaic, Woodland, and Late Prehistoric Period. These traditions are defined on the basis of significant changes in how American Indian communities lived. The cultural histories that integrate American Indian and Euroamerican history are generally divided into the Contact and Post-Contact Periods. These contexts range from the first contact between Europeans and American Indians during European exploration in the region, through Euroamerican settlement of traditionally American Indian lands.

Paleoindian Tradition (12,000 to 8,000 Before Present [B.P.])

The Paleoindian Tradition refers to the period of time at the close of the Pleistocene and into the Holocene when American Indian communities were small, mobile and focused on hunting (Figure 2). Archaeological evidence from Paleoindian sites throughout the central United States and Canada indicates that these communities hunted a limited number of large animals in a variety of environmental settings. As the Pleistocene ended and the Holocene began, the megafauna (e.g., mammoth) gradually died out. This caused the Paleoindian people to shift their focus to primarily hunting the largest remaining species, bison. In addition to bison, it is likely that gathering wild plant foods and hunting smaller animals also contributed significantly to the diet of the Paleoindian people.

Figure 2. Painting of Paleoindian life (artist unknown see Broekemeier).
The distinctive stone tools made by the Paleoindians included large lanceolate projectile points, which changed through time (Figure 3). The projectile points that were made by the early Paleoindians are often fluted, meaning a channel was created from the base running up the middle of the point (see Clovis and Folsom below), as opposed to those made later which were not (see Plainview below). Because Paleoindian communities were very small and nomadic, archaeologists have found only sparse, scattered evidence of the Paleoindian people.

According to Hannus (2012), no sites from the Paleoindian Tradition had been identified in Steele County prior to this survey; however, the Archaeological Site Files indicate that sites 21ST21 and 21ST25 are “probable” Paleoindian sites. The site form for 21ST21 states that a “broken distal portion of a large spear point with well-executed parallel flaking” was recovered the site, and that artifact is probably a fragment of Plano Paleoindian point. At 21ST25, the base of an Agate Basin projectile point was recovered. One Paleoindian site was identified during the 2012 survey of Steele County (21ST043).

**Archaic Tradition (8,000 to 2,500 B.P.)**

Shifts in diet and settlement patterns define the transition from the Paleoindian to the Archaic Tradition. During this period, evidence suggests that native people were adapting to environmental changes by using more diverse plant and animal resources, and creating and using a broader range of tools including new projectile point forms, atlatls (spear throwers that allowed spears to be thrown farther and with more force), copper tools and ground and pecked stone tools (Figure 4). Although some research suggests that community size increased during the Archaic period, some archaeological evidence counters that assumption, suggesting that community sizes remained small and that day-to-day activities took place at a series of seasonal camps (Anfinson 1987; 1997).
During this period, Archaic people began developing regional differences within their material culture. In Minnesota, this variation appears to have been tied to the natural environment, specifically the plant communities. These variations focused on the "Plains Archaic" in the western prairies, "Eastern Archaic" in the deciduous forest, "Lake-Forest Archaic" in the transitional zone between the deciduous and boreal forest areas, and the "Shield Archaic" in the boreal forest areas of the northeast. As with Paleoindian sites, Archaic sites are relatively small and ephemeral.

Two Archaic sites were recorded in Steele County prior to the 2012 survey. According to the Archaeological Site Files, 21DO007/21ST007 contained a small side-notched point possibly dating to the Late Archaic, and 21ST023 contained a large side-notched point that had been re-sharpened into a drill which dated to the Early to Middle Archaic. Possibly one site dating from the Middle Archaic was identified during the 2012 survey (21ST040); however it is more likely that this site dates to the Early Woodland Tradition.

**Woodland Tradition (2,500 B.P. to 800 B.P.)**

Throughout the Midwest, the Woodland Tradition is generally divided into three periods: Early, Middle and Late. However, Anfinson (1987) has suggested that a division into Initial and Terminal periods might be more appropriate in Minnesota. Archaeological research indicates that in many ways, life for communities during the Woodland Tradition remained similar to those of the Archaic period, with a dependence upon a diverse, seasonal resource base of plants and animals (Anfinson 1987:222; Johnson 1988). The transition from the Archaic to the Initial Woodland Tradition occurred when American Indians began manufacturing ceramic vessels, using bows and arrows, constructing earthen burial mounds, and cultivating and harvesting select plant species. The adoption of ceramics by the Woodland American Indians might have caused
significant changes in many aspects of this culture, the foremost being subsistence strategies (Boszhardt et al. 1986:258) (Figure 5).

![Woodland ceramic pots](https://example.com/woodland_pots.png)

**Figure 5. Woodland ceramic pots (MVAC n.d.).**

Populations began to grow, marking the transition from the Initial Woodland into the Late or Terminal Woodland period. Settlement patterns shift to larger, more permanent villages typically located near rivers. One possible explanation for this is that toward the end of Woodland Period, American Indians became increasingly efficient in how they acquired food. The subsistence strategies of these people incorporated hunting and gathering with limited agriculture focusing on specific plants. Concurrently, ceramic vessels differed from previous types both in form and in decoration. Woodland period communities were situated in locations that ranged from focusing on a specific resource to general environments capable of sustaining a large community for a long time. Sites types assigned to the Woodland Tradition throughout Minnesota range from cemeteries and small, limited use sites to extensive village and habitation sites.

Six sites had been determined as Woodland or possible Woodland sites prior to the 2012 survey. These include 21ST004, 21ST007/21DO007, 21ST019, 21ST021, 21ST024, 21ST025. Of these sites, 21ST017/21DO007 is recorded in the Archaeological Site Files as possibly being an Archaic site. The OSA site files also indicate that sites 21ST021 and 21ST024 also have a Paleoindian component. Three sites (21ST031, 21ST032, 21ST002) located during the 2012 surveys were identified as being associated with the Woodland Tradition.

**Middle Mississippian Period (1,200 B.P. to 500 B.P.)**

Significant changes in subsistence and settlement patterns characterize the Late Prehistoric cultures in Minnesota. Ceramic vessels differ from previous types in form as well as decoration, and settlement patterns shift to larger, more permanent villages often located in riverine settings. The subsistence strategies of these populations appear to incorporate hunting and gathering with agriculture focusing on specific plants. Archaeologists usually attribute sites that exhibit these cultural markers in southeastern Minnesota to the Mississippian or Oneota Periods.

During the Middle Mississippian Period, the site of Cahokia near St. Louis, Illinois was a major center of trade, technological innovation, and religious activity. Characteristics of Middle Mississippian sites include flat-topped mounds, plazas surrounded by rectangular houses, shell-tempered pottery with rolled rims, and storage pits (Kluth 2002:11). The
influence Cahokia had over a vast area was significant and extends into southeastern Minnesota, including the Silvernale and Bryan sites.

**Oneota Period (900 B.P. to 300 B.P.)**

Evidence indicates that the Oneota depended heavily on hunting and gathering combined with intensive maize horticulture. Although archaeologists are uncertain about the origin of the Oneota people, one possibility is that the complex arose through human migration to the Upper Midwest, bringing with them new ceramics, traditions, and life-ways. Another possibility is that people already living in the area began to adopt distinct cultural ideas, different from the other groups around them (Anfinson 1987a:215; Henning and Henning 1978).

Two separate Oneota Phases have been identified in southern Minnesota: the Orr and the Blue Earth. Orr sites are located in the southeastern corner of Minnesota and contain artifacts such as bison scapula hoes, sandstone abraders, catlinite pipes, and small triangular projectile points. The Blue Earth Phase also has scapula hoes as well as antler picks, bone awls, and shell-tempered ceramics.

The archaeological remains of the Oneota Period range from cemeteries to small, limited use sites to extensive habitation sites. Site location depends on numerous factors including the location of specific resources such as food gathering locations, water, or a particularly desirable environment.

**Proto-Historic and Contact Periods (A.D. 1650 to A.D. 1837)**

The Proto-Historic Period refers to the span of time when Euroamerican exploration and settlement in North American began to have an indirect impact on the Native American populations. These interactions did not necessarily involve face-to-face contact but more subtle influences, such as the introduction of European goods into native trade networks.

The Contact Period follows the Proto-Historic and refers to the span of time extending from the first European explorations in Minnesota to the beginning of intensive Euroamerican settlement in the region. The Contact Period involves limited face-to-face contact between Europeans and Native Americans, and generally began in 1673 when French explorers Marquette and Joliet discovered the upper portion of the Mississippi River. In 1680 Catholic Missionary Father Louis Hennepin spent part of a year living with the Dakota Mdewakanton near Mille Lacs. He later returned to France to write the first book about Minnesota and its native population, *Description de la Louisiane*, which tells his story of exploring Minnesota and being held captive by the Dakota Indians (Figure 6).
The Orr Phase of the Proto-Historic refers to the Oneota-related period in southeastern Minnesota. This Phase is centered along the Root and Upper Iowa Rivers, slightly east and south of Steele County, and is probably associated with the proto-historic/early historic Ioway Indians. According to historic documents and oral tradition, the Ioway were in the vicinity of the Root and Upper Iowa Rivers in the 1670s (Gibbon 2009). Although the Ioway’s larger settlements were likely south and west of Steele County, they frequently hunted bison in southeastern Minnesota (BRW 1996: 5-6). During the proto-historic period it seems that the Ioway also developed strong ties to the French. This relationship resulted in violence toward the Ioway by the Algonquian, thus forcing the Ioway to move into northwestern Iowa near their close relatives, the Oto, in the late 1600s (Gibbon 2009; BRW 1996:5-6). The Ioway apparently returned to the Blue Earth area at the request of Le Sueur, but left again by 1702 after attacks by the Fox and Mascouten (BRW 1996:5-6).

In addition to Ioway, Dakota Indians also lived in Minnesota along the Mississippi, Minnesota, and Blue Earth Rivers. The Dakota were semi-sedentary and had large villages in the Mille Lacs area. They also, however, hunted bison in southeastern Minnesota and coexisted peacefully with the Ioway. As the Ojibwe moved west and pressure from white settlement increased, the Dakota also migrated west (BRW 1997).

**Historic Period (post-1837)**

**Treaties and Opening to Settlement**

It was not until the 1850s when treaties with the Dakota opened present-day Steele County to white settlement; specifically, the Treaty of Traverse de Sioux and the
subsequent Treaty of Mendota. On July 23, 1851 the Treaty of Traverse des Sioux was signed. In this treaty the Dakota Indians ceded all their lands in Minnesota to the United States (Figure 7). For this land, according to the 1851 version of the treaty, the United States agreed to make payments to the Dakota and give them two 150-mile wide strips of land; one on the north side and one of the south side of the Minnesota River as reservations (Figure 8). Congress, however, did not ratify the treaty as it was signed by the American Indians in 1851. Instead, Congress ratified the treaty in June of 1852 only after reducing the compensation paid to the tribes.

Figure 7. Signing of the Treaty of Traverse des Sioux (Millet 1905).

Figure 8. Area Dakota ceded (gold) to the United States in the Treaty of Traverse des Sioux (Moen 1896).
When Chief Wabasha of the Mdewakanton Dakota heard about the changes made to the treaty, he told missionary Stephen Riggs, “There is one thing more which our great fathers can do, that is, gather us all together on the prairie and surround us with soldiers and shoot us down” (as quoted in Gilman 2004: 131) Henry H. Sibley, who had played a significant role in negotiating the original agreement was very uncomfortable with the treaty.

“Thus southern Minnesota was taken from the Dakota under duress and in a cloud of deceit and broken promises . . . as [Sibley’s friend and business associate, Hercules] Dousman observed with more precision than he knew: “The Sioux treaty will hang like a curse over our heads the balance of our lives.” Sibley maintained a conspicuous silence about [the treaty] in later years, crucial as the event had been for both him and Minnesota” (Gilman 2004; 134).

To make matters worse, in 1858 the two 150-mile wide strips of land north and south of the Minnesota River were legally removed from the Dakota. The northern strip was ceded in a series of treaties in 1858, and the southern strip was to be allotted, which to the Dakota essentially meant they would forfeit this land (Giese 1997). This left the Dakota with very small tracts of depleted land. The treaties stated that the United States government would supply the Dakota with food, clothing and household goods. These necessities, thanks to exceedingly corrupt Indian agents, were not getting beyond the reservation store house. Little Crow pleaded with the Lower Sioux Reservation Indian agent, Andrew Myrick, for food for his starving people, but to no avail. Even though the warehouse was well-stocked and held abundant supplies, the agent would release none of it to the Indians. Anger, resentment, and desperation roiled within certain factions of the Dakota and resulted in the killing of a local farm family. Thus began the “Sioux Uprising” or what is now referred to as the U.S. - Dakota War.

Henry H. Sibley, no longer serving as governor, was commissioned as the commanding officer to lead the military expedition to stop the conflict, and he led an all-out assault on the Dakota in an attempt to stop the war. After many months, Sibley quelled the violence and sentenced 307 Dakota men to death, and 16 to prison. President Lincoln stayed the execution of the majority and ultimately 38 Dakota men were hanged in Mankato, Minnesota on December 26, 1862. This remains the largest official mass execution in United States history (Gilman 2004).

Although the Treaty of Traverse de Sioux and subsequent Treaty of Mendota opened land including present-day Steele County to white settlement, the U.S. – Dakota War did not directly impact settlers in Steele County.

**Settlers and Development**

The land encompassed by modern Steele County was part of Wabasha County from 1849 until 1851, Dakota County from 1851 to 1853, and Rice County from 1853 to 1855. Steele County was created on February 20, 1855, but did not have the boundaries of modern Steele County until February 27, 1857 (Curtiss-Wedge 1910).
Some of the earliest settlers in Steele County were A.L. Wright, Chauncey Lull, Smith Johnson, Orlandof Johnson and L.M. Howard. These settlers made claims to property in Medford Township in the summer of 1853, at which time they began to “make improvements” to the land. In the fall of 1853, Chauncey Lull and A.L. Wright erected a cabin where they spent the winter of 1853-1854 (Curtiss-Wedge 1910:636).

By the end of 1854, numerous settlers had moved into the Steele County area. By 1880 over 12,200 settlers had moved into Steele County, and by 1930 the county had over 18,400 residents. The primary occupation of the residents of Steele County was farming-related and the county as a whole is most accurately represented by SHPO’s Railroads and Agricultural Development (1870-1940) historic context.

Wheat farming was the main crop produced until 1900. The huge wheat farms in central, western, and southern Minnesota caused mills to spring up along waterways across the state. The most notable milling center was Minneapolis, which ultimately dominated the world in wheat and flour processing until the 1930s.

After 1900, corn production increased. The crop, often used as feed for livestock, was typically grown in a three-year rotation with hay and barley or oats and later oil-seed crops such as soybeans (Granger and Kelly 2005:3.46). Beginning in the 1910s and later into the twentieth century, farmers also began raising increasing numbers of livestock (Granger and Kelly 2005). By 1940 nearly half the farms in the Steele County area focused on dairy. This was partially due to the presence of many low, wet areas that could not be profitably tilled, thus much of the area was used as pasture. In addition to dairy cattle, hogs and chickens were also important. The predominant crops raised in the mid-1900s were small grains and corn, with some vegetables (Granger and Kelly 2005:4.5-4.6).
4: Previous Archaeological Investigations in Steele County and Collections Review

A portion of this project entailed documenting and analyzing the artifacts recovered from previously recorded sites located in Steele County as well as those recovered during this survey. During this part of the project, collections from previously recorded sites were cataloged, analyzed and photographed, and field notes and reports (if available) were examined. For several sites the fieldwork had to be reconstructed by comparing numerous sets of students’ field notes with brief project descriptions from other sources. This work took place at the Fort Snelling History Center.

As part of the Steele County survey, we reviewed institutional collections for materials representing previous investigations in (and near) Steele County. We identified and examined materials in the MHS collections and in the collections of UM which are now curated at MHS (Table 1). The following section summarizes these previous investigations in chronological order, and presents the results of our re-examination of the artifact assemblages. Associated file research also identified negative surveys, which are also briefly summarized below.

Table 1. Overview of relevant sites represented in the Minnesota Historical Society collections.

<table>
<thead>
<tr>
<th>Site</th>
<th>Year</th>
<th>Accession Information</th>
<th>Collection Information</th>
<th>Components</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>21DO002</td>
<td>1972</td>
<td>728-1 to 103, 108 to 163, 170 to 186</td>
<td>Lithics, ceramics, faunal, soil and flotation samples</td>
<td>Woodland, Mississippian, possibly other</td>
<td>No analysis or report; assemblage only partly inventoried.</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21ST002</td>
<td>1972</td>
<td>UM 727-1 to 727-30</td>
<td>Lithics, faunal (n=440)</td>
<td>Woodland, possibly other</td>
<td>No analysis or report; 3 excavation units.</td>
</tr>
<tr>
<td>21ST003</td>
<td>1985</td>
<td>MHS</td>
<td>Lithics (n=17)</td>
<td>Precontact</td>
<td>Artifacts not reviewed.</td>
</tr>
<tr>
<td>21ST004, Beaver Lake</td>
<td>1975</td>
<td>MHS 288-1</td>
<td>Bison bone with embedded projectile point from lake bottom</td>
<td>Middle Woodland?</td>
<td>Oothoudt 1979; bone not inventoried.</td>
</tr>
<tr>
<td></td>
<td>1976</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21ST007-21DO007, &quot;Island&quot;</td>
<td>1972</td>
<td>UM 728-104 to 107, 728-164 to 169</td>
<td>Lithics, ceramics</td>
<td>Woodland, possibly other</td>
<td>No analysis or report; assemblage only partly inventoried.</td>
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</tbody>
</table>
In addition to the collections held by MHS, we examined artifacts from a few private collections. The quality of the available provenience information varies from one collection to another. The available information and the results of our examination of these artifacts are summarized below, following the review of previous investigations.

1971 University of Minnesota Investigations at Rice Lake State Park

In August and again in November 1971 UM conducted limited investigations at Rice Lake State Park. As best can be determined, the work in August consisted of talking to landowners and collectors, limited surface collection, and testing of reported mounds. The work in November apparently consisted of excavation but the extent of those excavations is unknown.

There is limited information about the 1971 UM investigations at Rice Lake Park. The bit that is available consists of five pages of field notes (Roney and Carr 1971) with an introductory page by Johnson (1972), general provenience information in the UM catalog and on an artifact box, and a few words by Harrison in field notes from 1972. The field notes by students Roney and Carr are undated, although from Johnson's (1972) cover page we know that they probably date to the "late summer" of 1971, and the artifact box provides the date of August 11, 1971. Although we can speculate as to what occurred during the University’s 1971 archaeological investigations, we cannot confidently reconstruct their activities.

Despite the lack of solid field documentation, Roney and Carr’s field notes indicate that they talked to local collectors and landowners. These conversations led to Roney and Carr creating a sketch map showing the general locations of sites reported by local collector W.T. Splittstoesser. During the 1971 field investigations, Roney and Carr apparently verified two sites reported by Splittstoesser on the north side of Rice Lake. One of these sites is labeled 21ST01, however this this site number is incorrect. Site 21ST001 is actually located several miles west of Rice Lake and Owatonna. Unfortunately no other information was available pertaining to this reported site, but it seems that the site the collector was referring to is 21ST018 which was examined during the present survey (2012).

The second site Roney and Carr labeled on their sketch map appears to be site 21ST002. This is based on the landowner’s name: Mrs. Duschek. Mrs. Duschek is both mentioned by Harrison in field notes pertaining to site 21ST002 (1972) and named as landowner on
the 21ST002 site survey form in the OSA site files. Although this locational information
is rather general and somewhat speculative, it seems logical to conclude that the site
Roney and Carr were referring to was 21ST002.

In their notes for 21ST002, Roney and Carr state that they conducted a surface survey of
21ST002 and collected 1 core and 15 pieces of flaking debris\(^1\). Because this site had
merely been accessioned and not cataloged, flakes from 21ST002 were cataloged as part
of this study.

Roney and Carr (1971:3) also include information in their notes that “possible mounds”:
“…reported by Mr. Ralph Butler as located T107N, R19W, Sec. 11, NE 1/4 of
SE 1/4 were tested and proved not to be mounds. They were 1 to 4 meters
across with a depression next to each in an area that was once cleared for
pasture land.”

Based on this legal description, these mounds do not appear to be the same mounds
reportedly associated with 21ST002.

In field documents from the University’s 1972 investigations, Harrison mentions an
"Area tested through excavation November 1971 -- nothing found." The map indicates
an area on the south shore of Rice Lake. Since no other documentation was found, the
extent and exact nature of this work remains unknown. However, it was apparently a
different episode of investigation than that recorded by Roney and Carr, which took place
earlier in August of 1971 and seemed to concentrate on the north side of the lake.

1971 Artifact Collection: 21ST002

The surface collection from 21ST002 consisted of 15 flakes. The "core" did not appear to
be cultural. The flakes included one Cedar Valley Chert, one Galena Chert, two Grand
Meadow Chert, two Hixton Quartzite, five Prairie du Chien Chert, one basaltic rock, and
three unidentified chert. One interesting feature of this composition is that Hollandale
Resource Region raw materials are well represented, but South Agassiz materials are
absent.

1972 University of Minnesota Investigations at Rice Lake State
Park at 21ST002, 21DO002, 21ST007-21DO007, and 21ST044-
21DO016

21ST002

In 1972 UM, under the direction of Christina Harrison, again conducted work in and near
Rice Lake State Park, including sites 21ST002, 21DO002, 21ST007-21DO007, and
21ST044/21DO016. Although 21DO2 is in Dodge County, it is located on the border of
Steele County, thus it was included in our review.

\(^1\) These artifacts were accessioned under the numbers 717-24 and 717-25, however the other artifacts
accessioned under 717 come from investigations in Rock County by the same team of students.
Unfortunately most of the field documentation relating to this 1972 work is missing from the University of Minnesota files. Notes in the relevant folders suggest the documentation was borrowed sometime after 1995 when MHS archaeologists Doug George, Dave Radford and LeRoy Gonsior reviewed the files. The only documentation that could be located for the present study includes photocopies of a map and four pages of handwritten notes by Harrison (1972) that are keyed to the map, accession sheets, photo log forms, a series of photos and slides, and information on field bags. Fortunately Radford, George and Gonsior were able to provide copies of some of the missing documentation, and some information was gleaned from their report (Radford et al. 1996, 2002).

Based on what can be reconstructed from these sources, the 1972 work began with limited survey in the spring possibly only at site 21ST002. According to Harrison’s notes, the only artifact found was a ceramic sherd recovered by Johnson, and identified by him as Marion Thick. Unfortunately, the sherd was not located in the current review of the collections, nor was there any indication that it had been accessioned into the collections.

Work continued in June 1972, with a surface collection and excavation presumably at 21ST002. Accession records refer to this work by landowner only, and no site number is mentioned. At the time, the parcel containing 21ST002 was owned by a “Mrs. Duschek”. According to lab records the surface collection took place on Mrs. Duschek's "upper field," "upper terrace of Mrs. Duschek's plowed field," and "Mrs. Duschek's plowed field." There is also a record of an artifact found "below Mrs. Duschek's field, in a gopher hole." Whether these reference one or more locations is not clear. The surface collection produced 60 lithic artifacts.

In addition to the surface collection, 1972 accession records refer to the excavation of three "trenches" or "test pits," terms that seem to have been used interchangeably. The location and size of these excavations is not known, although references to an "east pit" and "west pit" for Trench 1 suggest that it was larger than 1 x 1 m, and possibly measured 1 x 2 m. The excavation levels were generally 20 cm, although some were 10 cm. Total depth of excavation appears to have ranged from 40 to 90 cm in the different units. These excavations yielded 377 lithic artifacts, and a small number of historic artifacts. Only the prehistoric artifacts were re-cataloged and analyzed as part of this project since the historic archaeology of Steele County is beyond the scope of this project.

Materials from 21ST002
The collection from 21ST002 totals 437 lithic artifacts. Of these, 60 come from surface collection and 377 come from excavated contexts. The assemblage includes four projectile points that help shed some light on site chronology and cultural associations. The size of the assemblage also allows limited analysis of raw material use patterns, which can provide a second -- albeit more general -- line of evidence on site chronology.

Artifacts recovered during the surface collection contain a variety of forms, including 42 flakes, seven pieces of shatter, three bipolar cores, three other bipolar fragments, two bifaces, one flake tool, one drill and one projectile point. The drill (catalog #: UM 727-3)
is roughly made, generally asymmetrical, and shows little regularity in flaking pattern. One of the bifaces (catalog #: UM 727-14) is a small, elongated form. It is fairly symmetrical, and the edge is quite regular. It is heavily worn over the entire surface. The second (catalog #: UM 727-17) is a fragment from the end of an early stage biface. It exhibits only rough symmetry, and the edge is not level.

The projectile point recovered during the surface survey is half of the lower part of a large notched form made of Burlington Chert (catalog #: UM 727-16; Figure 8). The notch is wide and shallow, and could be either a corner notch or more likely a side notch. Flaking appears to be well controlled, primarily percussion with little apparent pressure flaking. It looks like the notches may have been produced by indirect percussion. Given the fragmentary nature of this piece, it is impossible to definitively evaluate the typology, but the large size, ovate form and possible indirect percussion in the notches suggests Snyders as a possibility (Justice 1988:201-204).

![Figure 8. Photograph of projectile point from 21ST002 (727-16).](image)

Artifacts recovered during the excavations at 21ST002 include 318 artifacts from Unit 1, 30 artifacts from Unit 2 and 29 artifacts from Unit 3. The large number of artifacts recovered from Unit 1 indicates a high artifact density in some parts of the site.

The artifacts from Unit 1 were distributed through five excavation levels. Artifact density is moderate to high in level 1 (58 artifacts) and level 2 (53 artifacts), peaks at a very high density in level 3 (149 artifacts), then drops off again in level 4 (50 artifacts) and level 5 (8 artifacts). Types of artifacts include 285 flakes, 21 pieces of shatter, three end scrapers, two bifaces, two projectile points, one core, one bipolar core, one other bipolar piece, one flake tool and one spokeshave.

One biface (catalog #: UM 727-21), from level 3, is small with a short production trajectory. The form of the underlying flake is still largely apparent, especially in the plano-convex cross section, even though both faces are entirely retouched. The edge is uneven, and there is a strong ridge on one face as well as a knot produced by a raw material defect. There is no obvious wear. The spokeshave (catalog #: UM 727-27), also from level 3, is roughly made from a large flake. The concave working element is retouched but irregular.
The second biface (catalog #: UM 727-25) is from level 4, and is medium-sized with a thin asymmetrical cross section. One edge is wavy, while the other is more regular and the tool was apparently made from a relatively small clast. There is some pressure flaking along the edge, and although the biface was probably useable as-is, it shows no clear signs of wear.

One complete projectile point was recovered from Unit 1, level 3 (catalog #: UM 727-22; Figure 9). It is a small side-notched form made of an unidentified fossiliferous chert. Overall the piece exhibits very good workmanship. It is relatively thin and fairly symmetrical in outline and in biconvex cross section. The edges are regular but slightly wavy. In outline the edges are convex, the tip is slightly rounded and shows some light damage, and the notches are broad and flaring with a sharp corner between the blade and notches. The base is eared and slightly concave, and the notches and base are ground. There is basal thinning on one face. It exhibits broad, shallow flake scars, generally to mid-blade. There is pressure flaking along edges, some of which relates to resharpening. The edges are also beveled, due to resharpening.

This point seems more likely related to Plains point types than to eastern point types. It is comparable in many respects to Besant, although it does not seem to quite fit into that type. Besant is a Plains point style associated with the Middle Woodland and, according to Kehoe (1974), dates from about 1,950 to 1,550 BP. The point also shares some characteristics with the Archaic type Oxbow, which on the Plains dates from about 4,700 to 3,800 BP. Complicating this, however, is the observation that the same or very similar points have been reported in this region for much later contexts, including with Early to Middle Woodland Brainerd and LaSalle Creek ceramics (Hohman-Caine and Goltz 1995; Hohman-Caine et al. 2012). These wares date to the period of about 2,750 to 1,700 BP. Unfortunately, this provides a window of a bit more than 3,000 years for the estimated age of the point.

The second point recovered from Unit 1 consists of a fragment from level 5 (catalog #: UM 727-30; Figure 10). It is made of heat-treated Prairie du Chien Chert. Although the fragment is quite small, we can still make a few helpful observations. First, the fragment...
appears to come from a relatively large side-notched point. Second, the corners of the base are squared, and the notch is shallow. Finally, the notch is lightly ground. The fragment is too small to allow any good observations of flaking patterns. These characteristics do not allow identification of a particular type, but they do suggest a direction to look. Justice (1988:60-71), for example, discusses a "Large Side Notched Cluster" that includes several point types with similar bases. Many of these are Early Archaic in age, although others may be Middle Archaic or even Late Archaic to initial Woodland in age. Although we cannot be certain, it seems at least possible that this point evidences earlier, pre-Woodland use of this landscape.

![Figure 10. Photograph of projectile point from 21ST002 (727-30) (measurement in cm).](image)

The collection from Unit 2 consisted of 30 artifacts distributed through four levels, although level 3 produced no artifacts. Artifact density is highest in level 1 (16 artifacts) and level 2 (13 artifacts), and drops in level 4 (1 artifact). Both the overall artifact density and the depth of deposits contrast strongly with Unit 1. The types of artifacts recovered include 26 flakes, 3 pieces of shatter, and one core.

The collection from Unit 3 consists of 29 artifacts distributed through two levels. Artifact density was essentially equal in level 1 (15 artifacts) and level 2 (14 artifacts). This parallels Unit 2, and again strongly contrasts with unit 1. Types of artifacts include 23 flakes, 5 shatter, and one projectile point.

The projectile point from Unit 3 was recovered from level 1. It is a Madison Triangular point made by retouching a flake of unidentified chert (catalog #: UM 727-4; Figure 11). This was apparently a flake with an opportune form that needed little modification as parts of both sides of the flake surface remain un-retouched. One side is mostly cortex. The point is very symmetrical in outline, and the edge is nicely leveled. The cross section is less symmetrical, but this is not unexpected given the relatively short production trajectory. The fracture surface seems strangely fresh on this artifact, an observation that is hard to explain without further information on context. Madison Triangular points are
associated with the Late Woodland and other late prehistoric archaeological contexts (Justice 1988).

![Figure 11. Photograph of projectile point from 21ST002 (727-4) (measurement in cm).](image)

It is also worth noting the stratigraphic sequence of these points. The Late Woodland Madison point was recovered from level 1. The potentially Late Archaic to initial Woodland side-notched, indented-base point came from level 3. The fragment of the potentially early large side-notched point came from level 5. This at least suggests the possibility of stratigraphic trends in the deposits at the site, a suggestion that might be investigated by a more intensive analysis of the materials in-hand -- supported by information from the missing documentation (but see also the raw material analysis below).

The sample of lithic artifacts from 21ST002 is large enough to support a raw material analysis. It is especially helpful to have a large sample from Unit 1, and to have that sample spread through 5 excavation levels and 90 cm. The data from Unit 1 indeed do appear to show a clear change from one raw material use pattern to another. In particular we may note the following changes from top to bottom, with the upper two strata best representing one pattern, stratum 3 presenting mixed characteristics, and the bottom two strata best representing the other pattern.

For bedrock-derived materials, Prairie du Chien Chert (PdC) and Grand Meadow Chert (GMC) are important throughout the strata but they are most important in the upper levels. In contrast, Cedar Valley Chert (CVC) and Galena Chert are found almost exclusively in the lower levels. Materials derived from glacial till are found in modest amounts in the lower levels, but are essentially absent from the upper levels. These include Swan River Chert (SRC), Red River Chert (RRC), Tongue River Silica (TRS), materials from the Western River Gravels group, quartz and quartzite and probably the Animikie Group. For exotics, it appears that Hixton Quartzite occurs throughout the strata, while Burlington Chert and Knife River Flint (KRF) are most associated with the
upper strata. For other nonlocal materials, three artifacts comprised of Iowa cherts are not clearly associated with either the upper or lower strata.

If we take this as evidence of two different provisioning and use strategies, we might summarize them this way. In both strategies, GMC and PdC are the most important materials. The earlier strategy is broader, however, and makes use of a wider range of local sources. This includes a variety of materials gathered from glacial till. A range of bedrock sources were also used, including CVC, Galena Chert, and GMC, materials coming from sources a bit beyond the immediate vicinity. PdC may also have been procured from such sources, perhaps as a supplement to PdC gathered from till. Exotic imports appear to have consisted of small amounts of Hixton Quartzite. In terms of technological markers, evidence for bipolar reduction seems to be lacking from this pattern.

The second and later strategy focuses on a narrower range of raw materials and raw material sources. The relative importance of GMC and PdC increases, and the number of different raw materials decreases. CVC and Galena are apparently all but absent, and till-derived materials are much fewer in number and minor by percentage of the assemblage. The percentage of unidentified chert seems to increase, an observation of unclear significance. Exotic imports expand in terms of both sources and materials. Burlington Chert in particular increases in importance, small amount of KRF occur, and Hixton continues to be found. Evidence for bipolar reduction is present in this pattern.

This is the picture gleaned from the distribution of raw materials in Unit 1. Raw material distribution in Unit 2 appears to follow the same trends, although less clearly. Keep in mind that the distinction is seen between levels 1 and 2, and through only 30 cm. The raw material composition of the surface collection arguably resembles the lower pattern, but with a minor admixture from the upper pattern. Initially this might seem strange. Many sites, however, show evidence for the differential distribution of components across the site. This, coupled with a factor like local deposition and burial of an earlier component also evidenced at other sites, could easily account for this kind of distribution. This is especially the case if the earlier components were more intensive.

Unit 3 (two levels, presumably 30 cm), in contrast, is something of a mystery. In terms of raw material composition, it does not resemble any other samples from the site. This is difficult to explain without more specific information on the context excavated, and might be difficult to explain even given such information.

Indeed it should be said that the lack of such information for the site in general handicaps interpretation of the lithic data. If, for example, Unit 1 encountered some sort of feature, the interpretation could change significantly. Or if it turned out that the upper strata were redeposited (a possibility hinted at in the few available field notes), interpretation likewise must accommodate that context. With such caveats in mind, the remaining

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2 Note that this could include Prairie du Chien Chert; our pedestrian survey established that cobbles and pebbles of PdC were common and widespread in regional till. This does not, of course, preclude the use of PdC bedrock sources.
discussion of the raw material data is long on observation and short on interpretation. Should better contextual information become available, the interpretation could perhaps be refined.

It is difficult to evaluate these observations in terms of the raw material use pattern model proposed by Bakken (2011). That model proposes four basic raw material provisioning and use strategies -- boulder core (B), cobble core (C), pebble core (P), and strategic source (S). The patterns are, for most purposes, listed in order of appearance, although the latter two partly overlap in time and are associated with different populations.

There is no evidence in these data for the B pattern, associated most clearly with Paleoindian populations. The two strategies outlined above might be interpreted as P pattern over C pattern. The C pattern begins with the Archaic in many areas, and probably continues well into the Woodland, while the P pattern may be most strongly identified with the Late Woodland (although these chronologies are tentative). Evidence for P over C includes the arguably more intensive focus on local resources seen in the lower strata, especially evidenced by the presence of a variety of till-derived materials, which is a general characteristic of the C pattern (with caveats). Evidence for bipolar reduction in the upper strata also supports this interpretation; bipolar cores are specifically associated with a bipolar reduction strategy that was absent or uncommon in earlier use patterns.

The two strategies might also be interpreted as S pattern over C pattern. The S pattern is associated with village cultures. This possible interpretation is based mostly on the increase in the importance of GMC, one of the "strategic" raw materials associated with the S pattern. Other evidence for this is slim; one would hope to have more evidence than one Silvernale vessel from a nearby site (discussed in next section with 21DO2). In addition, the place of bipolar reduction in the S pattern remains unevaluated.

Part of this difficulty in interpreting the data comes from the fact that, at this point, we don't know quite what the C, P and S patterns should look like in the southeastern quarter of the state in terms of specific raw material composition. Resolving this will involve the comparative review of the best data from many sites, and will also involve better understanding how the proximity of bedrock raw material sources affects the expression of the raw material use patterns. Unfortunately these matters are beyond the scope of the current research. For now, our conclusion is essentially that there appear to be two lithic raw material use patterns evidenced at the site, and this would likely be a good topic for further research.

21DO002

As the 1972 archaeological investigations continued at 21ST002, surface collection and excavation began at 21DO2. Fortunately, most excavation units at this site were named by grid point, so the relative location can be reconstructed although the absolute position can only be estimated. A few units on the periphery of the site were simply numbered instead of tied to the grid, so their location -- relative or absolute -- is unclear.
It appears that 23 units totaling between 32 and 36 square meters were excavated at 21DO002. The units varied in size. Most measured 1 x 2 m, although a few measured 1 x 1 m and two extensions to other units measured less than a square meter. Out of the 32 to 36 square meters, just over 23 square meters were dug in two adjacent blocks at the southern end of the site. Slides and photos show that these blocks were located close to the lake shore. The remaining nine to 13 square meters seem to have been scattered around the site. Excavation levels were generally 10 cm, although in a few cases 5 cm levels are noted. Total depth of unit excavation ranged from 10 cm to 90 cm with a typical depth around 40 cm.

The set of excavated materials from 21DO002 is rather extensive, and time was not available to review the full assemblage. Instead our review focused on surface collections from various parts of the site, in the expectation that this could tell us something about overall site structure. In addition, we examined all diagnostic lithic and ceramic artifacts, in the hope of learning more about site structure and chronology.

Although both surface collection and excavations were conducted throughout the site, for the purposes of this study they will be discussed in terms of the southern, central, and northern portions of the site. In the southern and central portions of the site both surface collection and excavation took place, while in the northern portion of the site it appears that only surface collection occurred. Our analysis explores differences in parts of the site as represented by the artifacts collected during the surface collection, but there is clearly greater potential for analysis of intrasite patterning.

It should be noted that there was also surface collection in an area described as north and south of the access road, and east of the park boundary. Nine artifacts were recovered from this area. It appears as though this collection area is east of the current 21DO002 site limits. The available information is not clear enough, however, to support any attempt at adjusting site limits or defining a new site.

**Materials from 21DO002**

As previously stated, the collection from 21DO002 is large, thus only a portion of the artifacts were re-examined as part of this project. Specifically the artifacts recovered during the surface collection and all diagnostic lithics and ceramics were re-analyzed.

The surface collections can be grouped by northern, central and southern parts of the site. The surface sample from the northern part of the site consists of one core. The surface sample from the central part of the site is larger, including 58 lithic artifacts and 9 ceramic sherd, while the sample from the southern part of the site includes 164 lithic artifacts and 12 ceramic sherds. (As mentioned above, an additional 9 lithic artifacts appear to come from east of the current site limit; these are not considered further here.) In addition to the surface collections, our examination of diagnostic artifacts added 7 lithic artifacts and 63 ceramic sherds.

The discussion of lithic artifacts looks at raw material composition of each subassemblage, and at diagnostic or potentially diagnostic artifacts (i.e., projectile
The discussions of raw material composition are based only on the surface collections, since inclusion of selected tools from the excavated sample would skew the resulting figures.

The discussion of ceramics focuses on rim and decorated sherds, but also includes selected information on some other sherds. There is also discussion of Vessel A, Vessel B, etc. These are hypothetical vessels rather than actual recovered vessels. We defined a few such hypothetical vessels in cases where a number of sherds seemed to most likely represent a single vessel, and where the sherds allowed some important characteristics of the vessel to be described. Five vessels as well as several diagnostic sherds are discussed here. Vessel C was recovered from the central part of 21DO02, while Vessels A, B, D and E were recovered from the southern part of 21DO002. Vessels were not defined in cases where vessels appeared to be represented by only one or two sherds.

**Northern Part of 21DO002**
Because the assemblage from the northern part of the site consists of a single core, it is therefore minimally informative.

**Central Part of 21DO002**
The 58 lithics recovered from the central part of the site is dominated by PdC (69.0%). The only other Hollandale raw material is GMC which makes up 5.5% of the collection. South Agassiz materials are relatively unimportant with RRC making up only 5.2% of the assemblage. For exotics, Burlington Chert, Hixton Quartzite and KRF are present in small and equal amounts; approximately 1.7% of each. Other raw materials are present, but in relatively small percentages.

There is a fragment of a small PdC point of indeterminate type from the central part of the site which is not diagnostic (catalog #: UM 728-110).

Ceramics from the central part of the site include hypothetical Vessel C and a rim reconstructed from four sherds. Both appear to be Fox Lake Vertical Cordmarked. Fox Lake is a Middle Woodland type. Although the date range is not well established, radiocarbon dates from Fox Lake complex sites typically fall between 1,900 B.P. and 500 B.P. (Anfinson 1979a; Arzigian 2008:204).

The overall form of Vessel C is not clear, although it has a constricted mouth and a cord-marked lip (catalog #: UM 728-113; Figure 12). Typical wall thickness is 6 to 7 mm. The interior surface is dark grey, and smooth with punctates which raise bosses on the exterior approximately 12 mm below the lip and 12 mm apart. The vessel exterior has a vertical cord-rolled treatment and is somewhat reddish. The edge of the sherd is medium grey, while the clay body is massive and contains sand temper.
Vessel C is represented by three rim sherds (two of which conjoin), one near-rim sherd that is missing the lip, and five body sherds. The association of the rims with a single vessel seems quite certain, while the association of the body sherds seems likely. The sherds all come from backfill near a 1 x 1 m test trench about 150 m north of the access road leading to the site, on a wooded ridge and around the 1,250 foot contour. This area is referred to in field documentation as the “Foxhole Ridge”. Although it is not entirely clear from the accession records, it seems that the “backdirt” may actually refer to fill from an animal burrow rather than an archaeological excavation.

Other diagnostic ceramics from the central part of 21DO002 include a rim section (catalog #: UM 728-119) that is comparable to Fox Lake Vertical Cordmarked. This section is comprised of four cataloged sherds mended together. All the sherds were recovered from Foxhole Ridge Unit 1 between 20 and 30 cm below ground surface. The lip of the rim is flat, and displays tool or cord marks. The vessel wall is approximately 5 mm thick and the lip thins slightly. The interior surface is smooth with punctates about 15 mm below the lip which raise exterior bosses. The texture of the exterior surface is indistinct, but based on comparison to other sherds from the site, it is probably vertical cord-rolling. The vessel is sand tempered.

**Southern part of 21DO002**

The lithic assemblage in the southern part of the site consists of 164 artifacts and is dominated by PdC (35.4%) and GMC (28.7%). This contrasts rather clearly with the central part of the site, which had half as much GMC and twice as much PdC. Other Hollandale materials include CVC (0.6%) and Galena Chert (6.1%). The southern part of the site also had more than twice the amount of South Agassiz materials, including SRC (3.0%) and RRC (9.8%). Exotics recovered from this portion of the site include Burlington Chert (3.7%), Hixton Quartzite (0.6%) and Knife River Flint (1.2%). Other raw materials are present in relatively small percentages.

There are a number of points and point fragments from the southern part of the site, some of which provide information on site chronology and cultural associations. Among the more diagnostically useful is the bottom part of a Waubesa Contracting Stem point made...
from heat-treated Galena Chert (catalog #: UM 728-1). Waubesa (also known as Adena) points appear in the Late Archaic and are strongly associated with the Early Woodland (Justice 1988:192-194). Some researchers suggest these points persist into the Middle Woodland. A rough estimate of the time range for this point type is 800 to 200 BC (2,750 to 2,150 BP). This style is most common to the east and southeast of this region, which suggests connections in those directions.

Possibly related to the Waubesa point is a cruder stemmed point that is made of a chert comparable to Galena Chert (catalog #: UM 728-4). This piece resembles the Waubesa point in general form, but the work is cruder almost as if the point had not been finished, thus it is difficult to evaluate this piece typologically. Interestingly, the entire surface of this piece is very well worn, even polished, but since the point was found in or near Rice Lake, this polish could indicate that the point spent significant time in a beach environment.

Five Madison Triangular points, one of unaltered PdC (catalog #: UM 728-150), two of heat-treated PdC (catalog #: UM 728-2, 728-33), one of Hixton Quartzite (catalog #: UM 728-62), and one of unidentified chert (catalog #: UM 728-21) were also recovered from the southern portion of 21DO002. The latter piece has serrated edges. The Madison Triangular point type first appears about 1,150 B.P., and probably persists into the Historic period (Justice 1988:224-227). These and related points are associated with many Late Woodland, Mississippian, and other late-prehistoric cultures.

Two medium-sized points made of Hixton Quartzite (catalog #: UM 728-42, 728-140) may be related. Both look as though they were made from a biface blank with a bluntly pointed tip and an irregularly rounded bottom, from which the corners were removed to create an irregularly shaped stem. Both are also characterized by rather rough flaking. In general, they are relatively thick and not especially symmetrical. No grinding was noted. The typology of these points is less than clear, but they may be comparable to the Fox Valley Stemmed type, which is associated with the Late Archaic (Goldstein and Osborn 1988:40-41; Justice 1988:159-163).

A side-notched point of PdC (catalog #: UM 728-3) is less informative. This is a flake point, made by minimal retouching of a fortuitously shaped flake. Much of the retouching is confined to the edges, and one face is largely cortical. Because of the short production trajectory, and thus minimal reshaping of the underlying flake blank, the typology of this point is not clear.

A section of a point blade made of Hixton Quartzite (catalog #: UM 728-3) is somewhat interesting. The piece is very regular in cross-section, and the edges are very even. The flake scars are hard to read, but the flaking seems to be well controlled. The edges are close to parallel, suggesting that this fragment could be from a larger -- perhaps lanceolate -- point. Given these characteristics, it is tempting to wonder whether it could come from a Paleoindian point. Unfortunately, the fragmentary nature of the piece makes this speculation hard to evaluate.
Finally, there is a badly damaged point made of Red River Chert (UM 728-141). This is a fairly large point that might be either stemmed or notched. It appears that the damage, which includes multiple breaks, might have resulted from an impact. The typology of this point is not clear.

Ceramics from the southern part of the site include four hypothetical vessels (A, B, D, and E), an additional rim, and several decorated body sherds. Identified types include Silvernale Rolled Rim and likely Fox Lake Vertical Cordmarked. Fox Lake is a Middle Woodland type (Anfinson 1979a). The Mississippian Silvernale type dates to 800 B.P. (Anfinson 1979b; R. Schirmer, personal communication 2012).

Vessel A is a distinctive but unidentified type (catalog #: UM 728-186; Figure 13). The vessel is represented by a rim mended from three cataloged sherds, plus fragments from recent breaks; and a body sherd mended from seven cataloged sherds plus fragments from recent breaks. The sherds all come from a single provenience lot. This is the 0-5 cm level of a small extension to an isolated 1 x 2 m test unit about 20 m north of the main excavation blocks, in the southern part of the site. This is the same provenience as Vessel B.

![Figure 13. Photograph of ceramics from 21DO002 (728-186).](image)

The overall form of Vessel A is not clear. The diameter of the vessel contracts towards the mouth. The body of the vessel is around 6 to 7 mm thick, thinner near the lip which is flattened but slightly irregular, while the interior surface is very irregular. The exterior surface exhibits a horizontal cord-rolled treatment, although the surface at the rim is mostly smooth (except for decoration) and the cordmarking is partly smoothed over on the lower part of the vessel. There are vertical to slightly oblique, irregularly spaced cord-wrapped stick impressions on the interior, and oblique (///), closely spaced cord-wrapped stick impressions with a row of rectangular tool marks (long axis up-down) below this, on the exterior. The vessel is sand tempered.

Vessel B may be comparable to Fox Lake Vertical Cordmarked (catalog #: UM 728-186; Figure 14). The vessel is represented by a rim mended from four cataloged sherds, and by another sherd that may be a rim with a damaged lip and with the external surface missing. This sherd may also articulate to the left side of the reconstructed rim. The sherds all
come from the same provenience as Vessel A.

Figure 14. Photograph of ceramics from 21DO002 (728-186).

Like Vessel A, the overall form of Vessel B is unclear. The vessel mouth probably contracts slightly, although the stance of the sherd is not entirely clear. The vessel wall is approximately 8 to 10 mm thick, and thinner near the lip which is flat and smooth. The interior is not well preserved; it displays one oblique ( /// ) cord-wrapped stick impression, although this is difficult to see. A row of interior punctates about 3 cm below the lip raise exterior bosses. The surface is probably plain. There appear to be two rows of horizontal cord-wrapped stick impressions approximately 1 to 1.5 cm below the lip on the exterior, but the poor condition of the exterior (possibly erosion and shovel scrapes) make it hard to be certain. The vessel is sand tempered.

Two other body sherds may also belong to Vessel B. They come from the same excavation unit as the reconstructed rim that defines Vessel B, and bear a good resemblance to it. The first sherd is a decorated body sherd reconstructed from two sherds (catalog #: UM 728-153) (Figure 15). The sherd is sand tempered, and some of the sand grains are quite large (up to ca. 6 mm). The exterior is smooth, and displays three casual, parallel cord-wrapped stick impressions about 5 mm apart; they could be horizontal or oblique (orientation of sherds is not quite clear). It is better preserved than the Vessel B rim, and if it is not part of the same vessel, it is most likely the same ceramic type.

Figure 15. Photograph of ceramics from 21DO002 (728-153).
The second sherd is also reconstructed from two cataloged sherds (catalog #: UM 728-186) plus fragments from recent breaks. It is sand tempered, and the exterior may be cord rolled. The surface treatment does not preclude it belonging to Vessel B, since both plain areas and cord-rolled areas might be found on one vessel. However, this sherd has a distinctly black interior, unlike the interior of the Vessel B rim.

Ceramic Vessel D is Ceramic Vessel D is Ramey Incised (catalog #: UM 728-32, 36, 58, 86, 89; Figure 16). Although the overall vessel form is not clear, it has a constricted mouth with a rolled rim. The walls of the vessel are approximately 4 to 5 mm thick, and the rim is approximately 9 mm thick. The vessel has broad trailed-line decoration on the exterior below the rim, however a decorative motif is not apparent. The exterior surface is smooth, and also quite dark in color compared to other ceramics recovered from the site. The vessel is shell tempered, although the shell has leached out.

![Figure 16. Photograph of ceramics from 21DO002 (728-32, 36, 58, 86, 89).](image)

The type Ramey Incised is associated with Cahokian culture, and it is uncommon in Minnesota. It appears in the Stirling Phase, and can be dated to about 1150 to 1200 BP (cf. Mollerud 2005). This vessel is judged to be a classic example of the type (R. Schirmer, personal communication 2012; G. Holley, personal communication 2012).

Vessel D is represented by 28 rim and body sherds, some of which conjoin. The sherds come from three contiguous test units in the main excavation block in the southern part of the site. Depth of recovery ranges from 0 to 40 cm.

Vessel E may be comparable to Fox Lake Vertical Cordmarked (catalog #: UM 728-53; Figures 17 and 18). This vessel is represented by a rim reconstructed from two cataloged sherds, and probably also by two small undecorated sherds from the same provenience. All come from the 30 to 40 cm level of a peripheral 1 x 2 m unit in the southern part of the site. This unit was located about 80 m north and 40 m east of the main excavation block.
Although the overall vessel form is not clear, the vessel wall is about 10 mm thick, and probably thinner near the lip. The lip is relatively poorly preserved, but the lip appears to be thin and rounded with faint oblique (///) cord-wrapped stick impressions on the interior. Interior punctates approximately 3 cm below the lip do not appear to raise bosses on the exterior surface. The exterior is also poorly preserved, but appears to be cord marked and possibly vertically cord rolled. The vessel is sand tempered.

Other ceramics from the southern part of the site include a second small, worn rim from the same provenience as Vessel E (catalog #: UM 728-53, Figure 19). The rim appears to be from a vessel with a short vertical neck. The lip is thinner than the vessel wall, and is rounded. There are two small punctates about 1 cm below the lip and spaced a little less than 1 cm apart. The sherd is sand tempered. The typology of this rim is unclear.
A sand-tempered body sherd from the main excavation block (catalog #: UM 728-101; Figure 20) has different kinds of decoration than most of the ceramics seen at the site. It is reconstructed from two cataloged sherds. The sherd is eroded, which somewhat handicaps observation of the surface texture and decoration. However, there appear be two parallel narrow trailed lines which are probably at an oblique (\(//\)) angle. There are also one or two tool marks which appear to be, depending on orientation of the sherd, below the trailed lines. There might also be an applied clay "lug," or alternatively an area of clay pushed up between tool marks. The typology of this piece is also unclear.

Finally, there are three grit tempered body sherds that display rows of parallel cord-wrapped stick impressions (catalog #: UM 728-25, 728-27, 728-77). Two are smooth
surfaced, and the third has an indeterminate surface texture. All appear to be from the shoulders of vessels. The typology of these pieces is yet again unclear. If there are differences in the distribution of components over this large site, they are not obvious in our examination. Different types and ages of both ceramics and projectile points seem to be found across the site.

We can however offer a few comments on the lithic raw material composition of the 21DO2 collection in general, as well as a comparison between the surface collections from the central and southern parts of the site. For the collection as a whole, PdC and GMC are the most important materials. Some till-derived materials are present, but generally in small percentages (e.g., SRC, RRC, Fat Rock Quartz, TRS, and other; see also discussion under 21ST002 re. availability of PdC from till). Exotic imports include small amounts of Burlington Chert, Hixton Quartzite, and KRF.

As for the surface assemblages in the central and southern parts of the site, there are a few differences. In the central part of the site, PdC is by far the most important material while GMC is present in a moderate amount. Till-derived materials are present but in very minor amounts, except for a bit higher level of RRC. Burlington, Hixton and KRF appear to be about equal in importance, but are all present in very small amounts. In the southern part of the site, PdC is only half as abundant while GMC is twice as abundant. SRC and RRC are also about twice as important, but there is very little other till-derived material. Burlington, Hixton and KRF are again all present, but Burlington appears to be the most important.

These observations don't correlate especially well with the patterns seen at 21ST2. This might be because each collection comes from a large area; if any horizontal patterning does occur at the site, the pattern may be more fine-grained than the provenience information. One might argue on this basis for piece-plotted surface collection, or some other method of tighter provenience control. It is also possible that components and use patterns are closely intermingled across the surface in ways that are too complex to effectively untangle. The lack of apparent patterning in the case of ceramic and point distribution suggests that this could be the case.

In both cases, examination of the full set of excavated materials from the site could help to sort out questions of intrasite patterning, site structure, and stratigraphy, at least to some degree.

**21ST007/21DO007 (also recorded as part of 21DO002)**

The 1972 Rice Lake work also included surface collection and limited excavation on a landform that was formerly an island in the northeastern arm of Rice Lake. This area is now mapped as wetland. At the time of the 1972 investigation, the island was included as part of 21DO2. When MHS archaeologists conducted investigations in Rice Lake State Park in 1995, however, they recorded the portion of the site located on the island as a separate site. Since it falls on both sides of the Steele-Dodge county line, the site was assigned two trinomials: 21ST007 and 21DO07. (The use of 7 in both trinomials is coincidental, albeit convenient.)
Once again, the total area of excavation at 21ST7-21DO7 is not clear. Radford et al. (2002:272) state that 24 square meters were excavated on the island, but this number is incorrect and results from confusion of the island with another area of the site referred to as the "Foxhole Ridge." In her notes, Harrison (1972) states that a single 1 x 2 m unit was excavated on the island, but surprisingly this also seems to be incorrect. The accession records refer to "Island #1," "Island #3" (1 x 1 m) and "Island #4" (1 x 1 m). This seems to imply the excavation of four test units (presuming that a hypothetical "Island #2" was sterile), for a minimum of 4 square meters of excavation. Accession records also indicate that these units were excavated to final depths of 50 cm to 60 cm. The location of the units is unknown.

The surface collection from the island totaled two artifacts, while the excavated sample consisted of 13 artifacts. Animal bone was also recovered, but a cursory examination suggested that it was modern, and the sample was therefore not re-examined for the current study.

21ST044/21DO016

U of M catalog number 727, most of which pertains to 21ST002, also includes a small assemblage of lithics and ceramics from a previously unrecorded site on the eastern shore of the east arm of Rice Lake. Provenience information on a field bag providing quarter-quarter section locations, indicates that the site straddles the county line, and notes that the site is located on the 1250 foot contour of the USGS topographic map. This information allows the location of the site to be determined with a fair degree of confidence and therefore recorded. Since the site straddles the county line, it has been recorded as 21ST044-21DO016.

Materials from 21ST007-21DO007 (also recorded as part of 21ST002)

The collection from 21ST7-21DO7 consists of 15 artifacts. Additional excavated bone appears to be modern and was not re-examined for this study. Of the 15 artifacts, two come from the surface collection and 13 from the excavations; eight are lithic and seven are ceramic. Happily this small collection can provide some information on the chronology of the site.

The lithic artifacts include one projectile point, one flake tool, and six flakes. Raw materials include two GMC, five PdC, and one unidentified chert artifacts. The projectile point (catalog #: UM 728-106; Figure 21) is made of heat treated PdC. It is a small- to medium-sized notched form, regular in cross-section and outline and with overall good symmetry. The edge is level. Both percussion and pressure flaking are evident. It does not seem to have a strong resemblance to a particular type, but such a side-notched form would not be out of place in perhaps a Late Archaic or any Woodland context.
The ceramic artifacts include one rim sherd, six body sherds, and one crumb. There seem to be two general kinds of ceramics. The first is thicker, sand tempered, often eroded or otherwise worn with a massive clay body. The exterior surface is often plain or has a cord-rolled treatment. Ceramics with such characteristics tend to belong to the earlier end of the Woodland period. At 21ST7/21DO7, such ceramics were recovered throughout the excavated soil column.

The second kind of ceramics recovered from the site is thinner, often grit tempered, usually better preserved, and tends to have a somewhat laminated clay body. The exterior surface often displays cordmarking that can be interpreted as fabric impressions. These ceramics were recovered from the surface collection and upper part of the excavated soil column.

This second group of ceramics included a small rim sherd (catalog #: UM 728-166; Figure 22). The sherd provides little clue to the overall form of the vessel, other than it had a short rim a little more than one cm tall. The mouth of the vessel was probably slightly constricted, although the proper stance of the rim sherd is not entirely clear. The lip was flat and probably smooth. There was a clear juncture (but not a sharp angle) between the neck and the shoulder. The exterior displayed vertical cordmarking that could be interpreted as fabric impressions, as opposed to the rolled-on cord impressions found on other vessels. In other words, it seems that this vessel might have been made inside a fabric bag. No decoration is present on the extant part of the rim. Two other sherds strongly resemble this rim in overall characteristics; one comes from the same excavation context, and the other from the surface. The typology of this rim is not clear, although based on general characteristics it seems more likely to belong to the Late Woodland than to earlier parts of the Woodland period.
It is interesting to note that both of the artifacts from Island test unit #4 (a flake and a possible flake tool) are well worn over their entire surface. This suggests that they were in an abrasive environment such as a beach for some period. The significance of this would, of course, be easier to evaluate if we had more information on context and location of the unit.

**Materials from 21ST044-21DO016**

The collection from this site consists of one ceramic bodysherd and seven lithic artifacts. The sherd is grit tempered and has a massive (rather than laminated) clay body (catalog #: UM 727-33). It is relatively thick at about 8 mm, the interior and exterior surfaces are reddish, and both surfaces are eroded. The interior of the sherd is grey. There are six rows of parallel impressions on the exterior surface, probably cord-wrapped object impressions, but the form of the impressions is obscured by the general surface erosion. The ceramic type is not clear.

The lithics from 21ST044/21DO016 include six flakes and one biface. Raw materials represented include six artifacts of PdC and one of unidentified chert. Only about half of a fairly thick early-stage biface was recovered (catalog #: UM 727-32). The profile of the biface is irregular, the edge uneven, and there is a large knot near the edge of one face. It appears as though the biface was broken during manufacture and thus never completed.

The characteristics of the sherd suggest an Early to Middle Woodland affiliation, although this conclusion is tentative. None of the other artifacts provide any information on chronology or cultural affiliation.

**1975 and 1976 Investigations at 21ST004, Beaver Lake**

In late 1974, MHS archaeologists received a report of the recovery of bison bones from the bottom of Beaver Lake and of a projectile point imbedded in one of the vertebrae. The bones and point had been discovered by high school student Dewayne Farr and a group of friends who were swimming and diving in the lake in 1972. A site report was
published in The Minnesota Archaeologist (Oothoudt 1979), while a set of field notes by Birk (1975) appended to the OSA site form provide some additional detail on the investigations. Additional notes and correspondence are also curated in the OSA files, and the bones and point are curated under MHS accession number 288-1.

MHS archaeologists communicated with Farr to learn the details of the discovery, inspected the bones and point that were recovered, and dove at the site on two occasions. Some of this work was done in their capacity as MHS archaeologists, while some was done independently. The first site visit was in November of 1975, and the second in April of 1976. Visibility was extremely poor, but the divers managed to relocate the site, map its location, and recover additional bison bone.

The recovered bones represent one mature female and one immature individual. Oothoudt reported that although the bones were recovered from 2.0-plus meter depth, the natural lake level would have been lower and the location could have been a wet shoreline (1979). Based on the skeletal elements recovered he speculates that if the bison were killed in such a near-shore environment, high-value meat cuts might have been removed while the elements later recovered were left to become covered and preserved. The bones were not re-examined for the present study.

The projectile point recovered from a bison vertebrae is made of GMC (catalog #: MHS 288-1-13; Figure 23). It is a symmetrical, corner-notched triangular form that was fairly carefully made. Pressure flaking is evident. There is minor damage to tip, and possible damage and repair to one shoulder. Remarkably there is a hole in the middle of the blade. Closer examination shows that this is a natural vug in the rock which the flintknapper worked around; in fact, the vug appears to display cortex. The style is similar to a number of Middle Woodland forms, including Pelican Lake. Oothoudt suggests a general date of 500 BC to AD 500 based on these affiliations, a conclusion which seems warranted based on our re-examination of the point.

Figure 23. Photograph of projectile point from bison vertebrae at 21ST004 (288-1-13) (measurement in cm).
1985 Minnesota Historical Society Investigations at 21ST003, Rice Lake State Park

In 1985 MHS archaeologists investigated a point of land along the north shore of Rice Lake in Rice Lake State Park prior to construction of a picnic shelter (21ST003 site form). Two flakes were found on the ground surface, and an additional 17 were recovered from two shovel tests. The site form states that the park manager reported that archaeological material had been recovered from the entire point area. None of the recovered artifacts were diagnostic and thus were not re-examined for the current study.

1991 Minnesota Historical Society Investigations at 21ST006, Crane Creek

In 1991, MHS archaeologists conducted a review of a corridor for the planned reconstruction of a portion of Trunk Highway 14. During pedestrian surface survey of a corn field near Crane Creek, they discovered half of a broken biface. The survey was conducted at 2 meter intervals with excellent surface visibility. A second pedestrian survey failed to find any additional artifacts. The biface was found about 500 feet south of Crane Creek (also known as Judicial Ditch No. 1), and 600 feet west of another ditch that was originally a tributary of Crane Creek (Olmanson and Radford 1991).

The biface is made of heat-treated PdC (catalog #: MHS 1991.195.1.1; Figure 24). There is cortex on one face, and a rough surface from an internal crack on the other. This is a basic biface with a short production trajectory, made by retouching the edge of a thin (ca. 5 mm) slab of PdC. There is one unretouched knot along the retouched edge. This piece is not diagnostic of any particular time period or cultural affiliation.

Figure 24. Photograph of biface from 21ST006 (1991.195.1.1) (measurement in cm).
1995 Minnesota Historical Society Investigations at 21ST003 and 21DO2, Rice Lake State Park

In 1995, MHS archaeologists undertook two investigations at Rice Lake State Park. One was in advance of the installation of vault toilets in the canoe camp area south of the lake and the picnic area north of the lake. Surface inspection and shovel testing in both proposed toilet areas proved negative, even though the picnic grounds project area appears to be within the limits of the previously defined 21ST3 (Radford et al. 1996).

That year MHS archaeologists also inspected the project area for a dam rehabilitation on the east shore of Rice Lake and within the limits of 21DO2. That investigation included examination of exposed surfaces and the excavation of four shovel tests. The surface inspection was negative, as were two of the shovel tests. The remaining two shovel tests produced a "steep-sided" scraper and two flakes.

During this investigation MHS archaeologists prepared a separate site form for the former island tested in 1972 by the University of Minnesota. Originally the island was included as part of 21DO2. However, because the island was a distinct landform separated from the main part of 21DO2 by lake-bed (now wetlands) it was rerecorded as a separate site. Because the site lay on both sides of the Steele-Dodge county line, it received two trinomials, used here together as 21ST7/21DO7.

The three artifacts recovered by the second investigation were not located or re-examined as part of the current study.

2000 Minnesota Historical Society Investigations at 21DO2, Rice Lake State Park

In 2000, MHS archaeologists inspected the vicinity of the former Gun Club, within the limits of 21DO2, in preparation for sealing of a well. Because there was no surface visibility, two shovel tests were excavated within the small project area. No artifacts were found (Radford et al. 2002).

2007 Minnesota Historical Society Investigations at 21ST18, Rice Lake State Park Overlook Site

In 2007, MHS archaeologists inspected a project area along the northern shore of the western arm of Rice Lake and within the lettered site 21ST-1 (lower case L). The work was done in preparation for the installation of a bench along a hiking trail. Surface visibility was limited, and two shovel tests were excavated in the project area. The shovel tests produced six flakes and five pieces of fire-cracked rock (catalog #: MHS 2007-127). Information on the lithic assemblage is taken from a report by Gonsior (2008).

Raw materials include three pieces of PdC, one piece of GMC, one piece of SRC, and one piece of TRS. Materials from both bedrock and glacial till sources are present, however, the size of the assemblage does not support further analysis or interpretation.
5: GIS Development and Model

In addition to re-examining existing collections, a GIS predictive model was also developed as part of this project. The development of any model is based in part on previous research completed within a region. Many times this research is obtained from previous archaeological investigations or historical observations of an area. In the case of the current investigation, a broad statewide predictive model has already been created, and provides a level of understanding of prehistoric occupation. While problems exist with this model in its ability to explain broad patterns of prehistoric usage for the county, it does provide an excellent starting place for the development of county-specific model.

Steele County was modeled as part of the large statewide Minnesota Department of Transportation (MnDOT) model known as MnModel. MnModel took a purely statistical approach to modeling the presence or absence of archaeological sites using a logistic regression based analysis (Hudak et al. 2000). This approach was chosen because it is scientific, replicable, and can efficiently handle very large volumes of data. However, it has its shortcomings. Foremost among these is that its performance relies on a sufficiently large database of known site locations. Because the distribution of archaeological sites in Minnesota is quite sparse, there are few known sites in some regions. Since most alternatives to modeling site presence/absence require extracting subsets of the database (i.e. sites of a certain type), such models could not be built using statistical methods because of insufficient data (Hudak et al. 2000).

At the time of MnModel’s development only eight sites were known to exist within Steele County. In order to acquire sufficient data, models were developed on larger physiographic regions. In the case of Steele County, it was modeled within the broader Oak Savanna subsection of the Morainal fields area of Minnesota and Iowa. This broad section contained over 240 sites, making it possible to adequately build a logistic regression based model. While a model could be produced for the County, the low site numbers forced the model to identify only limited areas as having high or moderate site potential (Figure 25). The majority of these were found in relation to Rice Lake or small drainages feeding it or larger lakes to the west. The remainder of the County was found to have low potential, more because of the sparse number of previously recorded sites than anything related to its overall unsuitability.
The probability model developed for the Oak Savanna subsection within MnModel used 11 variables representing topography, vegetation, soils, and hydrology. Distance surface (a map layer that depicts continuous distances from a specific characteristic, such as a stream) were derived from various vegetative communities, such as conifers, paper birch, and sugar maples, as well as overall vegetation diversity which were found to be predictive of site locations. These vegetation layers in some ways act as proxy data for previous environments in which these types of vegetation predominated.

Distance surfaces related to hydrology, such as nearest large lake, nearest lake inlet/outlet, nearest lake permanent inlet/outlet, permanent wetland inlet/outlet, and streams were also found to be predictive to site locations within MnModel. Water related variables are always critical to human adaptation. The reason for the critical nature of water is in some ways obvious, in that, we all must obtain it to live, but water, or associated riparian type areas, also serve a variety of other critical aspects to occupation. Riparian areas, such as wetlands, contain the greatest degree of environmental variability within the landscape, possessing a variety of ecological niches that lead to vastly different plant resources that humans, and other animals, require to survive. Streams also many times represent central arteries of transportation, or contain materials such as stone.
appropriate for creating hunting implements that are again necessary for survival. Thus in some ways, the broad moniker of “distance to water” within a predictive model can relate to a variety of aspects of the adaptation of prehistoric peoples to the Minnesota landscape through time.

The final two variables included within MnModel for the area related to are simply overall elevation of site locations and the height of landforms above surroundings. While seemingly independent of other variables, these two elevation variables are related again to the overwhelming position of known sites to alluvial settings. Sites are placed at lower elevations on the landscape, such as within stream valleys or along lake margins, but at the same time positioned on higher landforms within these riparian surroundings.

Negative information about settlement can also be used in the development of a model. Previous surveys within an area may be used to not only define site locations, but also to inform us where sites tend not to be. As part of the MnModel’s development, an assessment was made of how well or poorly an area had been previously surveyed. The survey probability model for the Oak Savanna subsection indicated that the majority of the landscape had not been adequately surveyed (Hudak et al. 2000). Instead, surveys were concentrated in a band stretching from Waseca, through Steele and Dodge Counties, ending in western Olmsted County. These surveys were conducted along US Highway 14 and Interstate 35 within Steele County, creating a distinct wedge of high and medium survey potential across the subsection’s center. The majority of this survey (BRW 1996; Olmanson and Radford 1991) had been completed west of Owatonna in relationship to the expansion of US 14. While these surveys had identified few sites, it appeared that they might provide significant information about areas of the county that could be considered lower in potential. A review of literature related to these surveys and later surveys that were completed in relation to the US 14 expansion produced some doubt about this assertion.

In 2008 a short survey (less than four miles in length) was completed along US 14 in eastern Steele County (Florin 2009). This survey ran across an upland landform lying above a drained wetland, landforms not dissimilar to areas surveyed in the western portions of the County in previous US 14 surveys. Florin’s (2009) limited survey produced ten sites of varying types and time periods, and represented a significant increase of our collective archaeological knowledge about settlement within the County. The previous surveys looked at over 18 miles of potential right of way and recorded only two sites. This significant disparity of results in comparison between this more recent survey and the older surveys would appear too great to be relatable to chance alone, bringing into question the complete validity of the older surveys results. The right of way expansion was much narrower along many sections of the work west of Owatonna than Florin’s (2009) work, and this disparity may relate to the relative difference between the results obtained. In addition, specific areas along the western section of the US 14 corridor were considered low potential for prehistoric sites and were not subsequently surveyed due to this fact. It is obvious reviewing the survey results that methods have changed over time for a variety of reasons, and as such it is difficult to complete a thorough comparison.
This is one of the core reasons that MnModel did not use previous surveys as non-site background areas, but chose to use random points selected from the environment regardless of it being surveyed or not. It was believed that these disparities could not be overlooked, and the results of the older surveys would be skeptically used when designing the current predictive model. The dearth of archaeological sites and the limited nature of the survey results within the County restricted the types of models that would appear appropriate to design a survey regime, and that would provide an equal assessment of the entire breadth of the county.

For the development of the current Steele County model it was determined that a descriptive or intuitive type model may function better than an inductive based statistical model like MnModel, given that so little was known about archaeological site potential within the county. A descriptive model would use information gleaned from the MnModel process as well as including variables that were believed to be important to prehistoric occupation based on previous research by other modelers and archaeologists within the region. These variables may not correlate entirely to known archaeological sites, but provide a much broader assessment of archaeological potential on which to test than a correlative type deductive model would likely produce.

Archaeological background research for this project identified 30 recorded (numbered) archaeological sites. The majority of these sites were clustered around a number of the lakes within the region, namely Rice, Beaver, and Fosilen. Additional sites have been identified in relation to some of the small feeder drainages into the Straight River and along some of the survey corridors that run through the center of the county. While additional sites have been located within the county since the development of MnModel, many of these sites still lie in close proximity to similar hydrographic features, as was the case during the development of MnModel.

A weighted ranking analysis method was devised to create the Steele County model. This method uses a series of variables that have been weighted accordingly to their correspondence to known site locations. These weights can reflect an *a priori* knowledge of their importance to settlement patterns, or can be equally weighted to remove any biases. In the case of this model, the dearth of previously known sites made it difficult to identify which of the variables created would be more important than another, and as such, equal weights were derived for each variable created within the model.

After consulting the variables developed for MnModel, other regional models (Anderson 1996), and previous archaeological research within the area, a set of seven variables were created. They looked at aspects of hydrography, previous vegetative patterns, landform types, and surface topography to define archaeological potential. The variables created included both buffered surfaces that indicated distances from important environmental characteristics, as well as suitability layers that reclassed aspects of the environment to their importance to define potential unknown site locations. In all cases, the variables were reclassed into a three class system, indicating the areas of highest, moderate, and
The understanding of how to class each variable was obtained, for the most part, from the previous site locations.

The 30 sites recorded within the county possess a wide range in data quality in relation to spatial extent. A few of the sites were recorded as only single points, while others have been recorded arbitrarily by current property extents that bring into question the validity of their defined boundaries. Given the issue that the previous mapped extents of the sites may be highly questionable, centerpoints were developed within the GIS that attempted to represent a base modicum of information for each. These site points were then used to ascertain distances from specific variables, such as nearest stream, confluence, or wetland, or the specific environmental characteristics, such as landform type or soil association, that each site possessed. Average distances and standard deviations were developed for the sites in relation to each variable. Based on these statistics, a series of buffers or classes were defined for each of the seven variables that attempted to define the most basic of correlations to the known sites. The development and proposed purpose of each of these variables is discussed below in more detail.

**Variables**

A small set of environmentally derived variables were created for across the county (Table 2). These variables were then assessed against the known site locations to determine if there was general agreement between the variables and the known sites. In some cases, variables were found that did not relate well to the current site locations, but given that the sites are highly focused within certain physiographic regions within the county, this lack of agreement was not considered a final assessment of each variables potential within the model.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Base Datalayer Created From</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>Derived from the MN DNR’s Digital Elevation Model (3 m resolution).</td>
<td>Sites tend to be on areas of level ground</td>
</tr>
<tr>
<td>Water</td>
<td>Buffered distance from high resolution NHD data set containing both streams and lakes boundaries.</td>
<td>Sites tend to be in close proximity to streams and lake margins</td>
</tr>
<tr>
<td>Wetland</td>
<td>Buffered distance from wetland margins derived from the US Fish and Wildlife Service Restorable Depression Wetland Inventory mapping.</td>
<td>Wetlands represent one of the most biologically rich environments in nature, and an important location for gathering a variety of resources.</td>
</tr>
<tr>
<td>Confluences</td>
<td>Buffered distances from a series of stream confluence points.</td>
<td>Sites tend to be in close proximity to stream confluence points.</td>
</tr>
</tbody>
</table>
### Surface Geology

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream intersection points derived from the high resolution NHD data set.</td>
<td></td>
</tr>
<tr>
<td>Derived from the Sedimentary Association attribute of the Geomorphology of Minnesota data obtained from the MN DNR</td>
<td>Sites in Steele county were noted to be contained within uplands or terrace locations.</td>
</tr>
</tbody>
</table>

### Landform Type

<table>
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<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derived from the Feature Name Attribute of the Geomorphic Description information table of the countywide soil data obtained from the USDA.</td>
<td>Sites tend to be on well-drained landforms in elevated positions across the landscape.</td>
</tr>
</tbody>
</table>

### Prairie Margin

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presettlement vegetation layer was derived from MnDNR from PLSS surveyor notes.</td>
<td>The boundary between prairie areas and forest represents an important ecological niche that was heavily exploited throughout the prehistoric period.</td>
</tr>
</tbody>
</table>

### Slope

The slope of the ground surface plays an important role in defining what areas of the environment are conducive for human settlement. The greater the slope of the ground the increased chance that no permanent settlement was ever attempted, especially during the prehistoric period. A slope layer was derived from a three meter resolution digital elevation model of the county. The slope was calculated in degrees. This slope datalayer was then reclassed using the statistical averages and standard deviations noted between the previously recorded sites and the datalayer (Figure 26). The three classes defined areas of very high slope from approximately 23 to 10 degrees, moderate slope from 10 to 6 degrees, and relatively level ground of <6 degrees. Equal weights were derived for each slope class, giving level ground a weight of 3, moderate sloped areas a weight of 2, and areas of high slope a weight of 1.
Figure 26. Reclassed Slope variable.

**Water**

Distance to water, especially surface streams and lake margins, was shown within MnModel to be highly correlative to site locations. As explained above, this is in some ways to be expected given the overall importance of water to survival. In the case of lakes within the region, they also produce wild rice, a critical adaptive resource used throughout the prehistoric period. The importance of lakes as individual ecotones can be seen in the variables used for MnModel within the overall Oak Savanna region. It was feared that an additional variable specific to lakes as a wild rice resource would over emphasize them in the model, similar to the way they were within MnModel. Given that lakes were contained within this datalayer it was believed that they would be equally represented in the model, and as such a second lake-specific variable was not created.

A distance variable was created from the high resolution National Hydrography dataset (NHD) that included a line file for each stream within the county, as well as the outline of each lake margin. The NHD line files represent a combination of both natural and artificial drainage courses, with a specific column (Feature Type) that codes this information in the database. A review of the data for the county indicated a discontinuous network of natural drainages that were connected by artificial drainage ditches and
canals. It was not possible to truly represent the overall drainage network without including these artificial sections, and as such the artificial sections of drainages were included within the variable. The impact of this inclusion of the artificial drainages was mitigated by the inclusion of lake margins within the water distance variable. The lakes overprinted the artificial lengths that were placed to complete the drainage network, and as such placed the highest probability areas at the lake margin and not in relation to the artificial drainages. In addition to the lakes data, the creation of the wetland variable assisted in mitigating the effect of the artificial drainage lengths. Many of these artificial drainages lay in areas classified as wetland locations. These areas were considered low probability for sites, effectively removing broad sections of the artificial drainages from the final predictive model.

A series of three distance buffers were created using the statistical averages and standard deviations noted between the previously recorded sites and the stream and lake margins (Figure 27). Data was reclassed into 3 buffered distances: Distance of 0 to 247 m was given a weight of 3, distances from 247 to 498 m was given a weight of 2, and distances > 498 m were given a weight of 1.

Figure 27. Reclassed Distance from Water variable.
**Wetland**

Wetlands represent one of the most biologically rich environments in nature, and are thus an important location for gathering a variety of resources. It has been shown within MnModel as well as in many other predictive models that wetlands are highly correlative to site locations. In the case of Steele County, wetlands predominate many areas due to the relatively young nature of the environment, which has not had sufficient time to create a more highly entrenched drainage network. However, the creation of wetland variables for models from modern data sources can be difficult.

Historically farmers have instituted significant drainage programs to drain wetlands and create systems that would reduce if not eradicate wetland locations. Thus, many times wetland locations represented on national datasets, such as the National Wetland Inventory (NWI) mapping, relate modern conditions that represent only those sections of the wetlands that might remain, as well as delineating other modern drainage systems as wetlands, such as cow ponds and drainage ditches. Soils data however can be used to delineate areas that in the past supported wetland type conditions. In the case of the current model’s development, a datalayer devised by the US Fish and Wildlife Service was obtained that identifies restorable depression wetlands using both soils and NWI data. A review of this data appeared sufficient to capture the majority, if not all, of the wetlands that would be expected within the prehistoric period.

The wetland polygons were extracted from the statewide data and converted to line files. A series of three distance buffers were created from these line files using the statistical averages and standard deviations noted between the previously recorded sites and the wetland margins (Figure 28). Data was reclassed into 3 buffered distances: Distance of 0 to 132 m was given a weight of 3, distances from 132 to 313 m was given a weight of 2, and distances > 313 m were given a weight of 1.
Confluences

In discussions with the project team, confluence points along streams were believed to be highly predictive of site locations based upon previous research across southern Minnesota. While MnModel did not identify this as a significant variable within its development, the general lack of sites outside of lake areas made its assessment somewhat speculative in the actual validity of the variable. As such, the variable was included more as an intuitive concept of its value to define sites than for any deductive reasons. Assessment against known sites currently indicated little correspondence, with average distances being over 900 m to confluence points. Given its poor assessment, the variable was constrained to major stream confluence points as a way of mitigating any ill effects that it might impart to the model. Only higher order stream confluence points were used, removing confluence points of smaller first and second order streams.

The confluence points were extracted from the HND derived stream dataset. As indicated above, statistical averages and standard deviations acquired for the variable as compared to known site locations were extremely poor, and as such were not used to create the distance buffers. In this case, simple standardized distances were used to build the buffers that on average were double those obtained for the distance to water variable (Figure 29).
The data was reclassed into 3 buffered distances: Distance of 0 to 500 m was given a weight of 3, distances from 500 to 1000 m were given a weight of 2, and distances > 1000 m were given a weight of 1.

Figure 29. Reclassed Distance from Stream Confluences variable.

**Surface Geology**

The assessment of site locations within the county indicates that sites tended to be located in upland or terrace locations. These positions across the county spoke in some ways to the overwhelming number of poorly drained wetland or wet wood type environments. These poorly drained areas would not be conducive to settlement.

An assessment of MN DNR geomorphology dataset contained a characteristic specific to the sedimentary association of each soil polygon. This characteristic defines what parent material the soil is derived from, such as whether something was derived through glacial or alluvial deposited sediments. Based upon assessments of the known sites to these sediment associations, it was clear that sites tended to be located in either upland locations, denoted as supraglacial Des Moine lobe, or along outwash terraces. These two associations constituted the majority of the county, leaving only smaller, poorly drained areas that included alluvium, lacustrine, till, and organic deposits.
The soils were reclassed into three categories based upon their correlation to previously recorded sites. Supraglacial upland deposits were given a weight of 3, outwash terraces a weight of 2, and all other poorly drained associations a weight of 1 (Figure 30).

Figure 30. Reclassed Suitability of Surface Geology variable.

**Landform Type**

While the surface geology layer defined broad positions within the landscape where sites were more likely located, its breadth included too much of the county to make it strictly predictive. Also, previous archaeological research within the area, as well as MnModel’s assessment, indicated that sites tended to be on landforms that were slightly elevated over their surrounding landscape. In an effort to capture this aspect of settlement strategy, a landform assessment was created. This assessment broke the environment into three classes which ranked the landforms from lower flat areas, against increasingly more well-defined and elevated landforms.

The landforms were divided into three classes (Figure 31). The high probability class represented well-drained landforms, such as knolls, that tended to be more spatially isolated, and was given a weight of 3. The next class represented more broadly spaced upland landforms, such as flats, that were well to somewhat poorly drained. This class was considered to have moderate probability to contain sites, and was given a weight of 2.
2. The final class represented lower elevation areas that were somewhat poorly drained to poorly drained. These areas were considered to have a low probability to contain sites, and were given a weight of 1.

Figure 31. Reclassed Suitability of Landform Types variable.

**Prairie Margin**

In the final assessment of MnModel it was noted that a broader understanding of pre-settlement vegetation could significantly improve the modeling effort. The Public Land surveys (PLS) completed by the General Land Office between 1848-1907 contain surveyors’ notes about vegetation composition and structure that could be extracted and used to attribute, and sometimes add features to, digitized plat maps of the state (Hudak et al. 2000). Surveyors’ notes also include descriptions of vegetation composition and structure along survey lines where significant changes occur ("leave forest, enter prairie"). While the MnModel developers saw the mapping to be too coarse for their use, it appeared sufficient to apply on a single county-wide extent. The PLS survey for Steele County was completed in 1855 (Minnesota Geospatial Information Office 2012). The notes and surveys have been compiled into a single statewide datalayer by the MN Department of Natural Resources, and were used here to define the boundary between the wet prairie areas within Steele County and the forested “savanna like” settings. This
boundary area would allow Native Americans the ability to access a variety of different game and plant resources within a narrow zone.

Assessment of a few new sites lying away from the lake margin areas indicated that the boundary between the wet prairies and forested regions were highly predictive. Known sites lay within a narrow zone of this boundary. The wet prairies category was selected from this dataset as representative of margin areas. The polygon file was converted to a single line, to allow for the buffer to extend in both directions away from the margin. As climatic conditions have changed, so has the boundary between the grassland and forest ecotones. Thus it would make it necessary to buffer in both directions from the margin, attempting to take into account that sites may drift over time in relation to this margin. A series of three distance buffers were created using the statistical averages and standard deviations noted between the previously recorded sites and the prairie margin (Figure 32). These concentric distance buffers were then given equal weights away from the margin: distances of 0-573 m was given a weight of 3, distance from 573 to 1430 m was given a weight of 2, and distance > 1430 m were given a weight of 1.

Figure 32. Reclassed Distance from Prairie Margin variable.

The production of the model from the seven variables utilized addition to create a probability surface. Each of the variables were derived as rasters, or data constructed of
tessellated (grids) of pixels. The various layers can be added together on a pixel to pixel basis using a raster calculator contained with ARCGIS. The final product is a summation of weighted values from each of the seven variables for each final pixel. This summation created values from 7 to 21 for each pixel within the countywide model. This predictive surface was then assessed against the previously recorded sites and breakpoints determined that would capture the majority of the sites within the high and medium classes. Breakpoints were set at 21 to 17 for the high class, 16 to 15 for medium, and 14 to 7 for low potential (Figure 33). An assessment against the previously mapped sites indicated that 15 of the 30 sites (50%) were contained within the high probability class, 10 of the 30 sites (33.4%) were contained within the medium probability, and 5 of the 30 sites (16.6%) were contained within the low probability class. Like MnModel, this would capture around 85% of all of the known sites within the high and medium classes of the model. This model though contains broader areas of the environment within these two classes than what MnModel was constructed upon, with the high class containing approximately 14% of the county, medium class containing 34%, and low class making up the remaining 52% of the county.
MnModel was created with a goal of defining 85% of known sites within 30% of the area or less. This type of division would produce a model that was performing approximately 30-40 percent better than chance. While this level of accuracy was not always maintained.
within the model for each area, it was achieved within the Oak Savanna region. As stated previously though, the problem with this assessment is that while the model may perform well in this fashion it does not provide a realistic understanding of where in fact unknown sites may be located. While the current model designed for this survey does not perform as well, it does appear to provide the necessary breadth on which to contrive an overall testing regime. It is also best considered as an initial exploratory model, in which the results obtained from survey can inform and improve successive versions of the model to isolate more specifically the high and medium probability areas.

Parcel selection
Based on the high-, moderate- and low-potential categories generated by the model, parcels were selected from each probability area. In order to achieve the highest amount of survey possible, sampling subsets focused on cultivated fields in different geographic locations, i.e., uplands, riverine, and dry lake beds. Specifically, parcel locations were chosen based on several factors: proximity to known archaeological sites, information collected from local informants, proximity to the Straight River and confluences of major tributaries, kettle and moraine topography, and spatial distribution of sample locations across the county. Overlaid on these factors were the predictive model and the desire to focus on 40 acre plots in agricultural fields. In order to test the model and attempt to locate as many sites as possible, an initial set of survey parcels was produced that covered approximately 1288 acres.

Divided into 40 acre sections, the project team initially anticipated surveying 597 (46%) acres identified as high-potential, 459 (36%) acres identified as moderate-potential, and 232 (18%) acres identified as low-potential for containing unrecorded archaeological resources (Figure 34). In northern Steele County, eight general locations were proposed for survey. These focused more on high-potential areas encompassing or in the vicinity of waterways, namely Straight River, Medford Creek, Mud Creek, Crane Creek, Judicial Ditch No. 1, and Rice Lake. Approximately nine sample areas were identified in the southern half of the county. While focusing more in high- and moderate-potential areas, low-potential areas examined correlated to kettle and moraine topography. Waterways included the Straight River and its tributaries, Turtle Creek, tributaries of the Le Sueur River, Lonergan and Beaver Lakes, and Oak Glen Lake.
Survey conditions and lack of landowner permission to access some of these originally selected parcels forced the project team to adjust some of the sample areas (Figure 35). These adjustments meant shifting defined 40 acre survey limits within the same agricultural field and property owner to compensate for: difficulty accessing fields on the opposite side of a waterway, avoiding sections of field already planted, or to fully delineate an archeological site. These modifications to the original survey design resulted in the overall reduction of the acreage surveyed from the original 1288 acre estimate to 1115 acres. These modifications also resulted in a general shift in the acreage surveyed within each of the probability classes, with approximately 440 (39%) acres identified as
high-potential, 444 (40%) acres identified as moderate-potential, and 231 (21%) acres identified as low-potential for containing unrecorded archaeological resources.

Figure 35. Final Survey Areas completed, overlaid on the Steele County Model.
6: 2012 Archaeological Investigations of Steele County

The archaeological investigation of Steele County began with background research, public outreach, and examination of previous collections. The fieldwork portion of the project involved both and archaeological survey as well as a geomorphological assessment of Steele County. The archaeological survey consisted entirely of pedestrian surface survey of the previously mentioned selected parcels. The geomorphological assessment was conducted using a 3-inch bucket auger excavated to varying depths between 120 and 300 cm in an attempt to determine the potential for deeply buried soils that could contain archaeological sites.

**Background Research and Public Outreach**

Background research took place in the fall and early winter of 2011-2012 and involved examination of the archaeological site files at the OSA and SHPO. In addition to the site files, reports from previous surveys and county notes in the OSA files were examined, as were field and lab notes from previous University of Minnesota and MHS archaeological investigations.

Archaeologists also consulted numerous maps during the background research, including the Trygg land survey, Public Land Survey, soils, wetlands, vegetation, and hydrology maps. *Aborigines of Minnesota* (Winchell 1911) and *Minnesota’s Indian Mounds and Burial Sites* (Arzigian and Stevenson 2003) were also consulted.

Archaeologists met with the Steele County Historical Society twice during the project. During the first meeting the conversation focused on the general history of Steele County, types of collections held by the Steele County Historical Society, local collectors that might be willing to talk to archaeologists, and ways the Historical Society might want to participate in the research.

The second visit involved 10,000 Lakes employees holding a “Show and Tell” for area residents. This took place during the Grand Opening of the Steele County Historical Society’s new facility, and drew large number of participants. During the Show and Tell archaeologists answered questions and examined numerous collections and artifacts. Unfortunately, most of the collections brought to the Show and Tell were from areas outside of Steele County, but the event raised the public’s awareness about Minnesota archaeology in general and the project in specific.

**Previously Recorded Sites**

During the background research, archaeologists found that 30 numbered sites (verified by archaeologists) and 12 lettered sites (not yet verified by archaeologists) had been previously recorded in Steele County (Figure 36). Of these, 22 were numbered and three were lettered precontact sites. Since this study focuses on the precontact period, historic sites were not included in the background research or re-surveyed.
Figure 36. Map showing the locations of numbered previously recorded sites in Steele County.
Archaeologists had visited sites 21ST018 – 026 and 21ST028-029 in the last ten years, and sites 21ST006, 21ST017, 21ST027, 21ST030, 21STa and 21STb were isolated finds. These 17 sites were not re-visited as part of this study.

Nine sites (21ST001 – 005, 21ST007 – 008 and 21STl [lower case L]) had not been visited by an archaeologist in more than 10 years. Of these eight sites, 21ST002, 21ST005, and 21STl were re-surveyed as part of this project. Sites 21ST003, 21ST004 and 21ST007 were visited to determine if the site had been disturbed or was likely still present and intact, but the sites were not re-surveyed. Access to sites 21ST001 and 21ST008 was denied by the current landowners, although the sites were driven by and photographed from the road.

Sites 21ST003 and 21ST007 are both on property owned by the MnDNR and located within the boundaries of Rice Lake State Park. Site 21ST003 appeared to be relatively intact although a picnic area, road, parking area (unimproved), trails and a small footbridge were located on top of the site (see Figure 36; Figures 37, 38 and 39). Site 21ST007 on the other hand, is located in a fairly remote part of the park and appears to be undisturbed and intact (see Figure 36; Figures 40 and 41). Site 21ST004 was also revisited and appears to be intact and undisturbed, but since the site is located underwater it is hard to say for certain (see Figure 36; Figures 42 and 43).

Figure 37. Map showing location of 21ST003.
Figure 38. Site 21ST003 showing road.

Figure 39. Site 21ST003 showing trail.

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Figure 40. Map showing location of 21ST007.

Figure 41. Site 21ST007.
Figure 42. Map showing location of 21ST004.

Figure 43. Site 21ST004.

Sites 21ST001 and 21ST008 are located on private property and the landowners would not grant access to archaeologists to resurvey these sites. Thus, the sites were photographed from the road. It appears as though site 21ST001 is currently in a woodland/grassland area that is not being cultivated or otherwise disturbed at this time (see Figure 36; Figures 44 and 45). Thus it appears that the site might not be disturbed.
and may remain intact. Site 21ST008 however may have been significantly disturbed. Although it was difficult to see the site area from the road, it was obvious that some sort of excavation was on-going in the vicinity of the site. Thus, it is possible if not probable that the site has been at least disturbed if not destroyed (see Figure 36; Figures 46 and 47).

Figure 44. Map showing location of 21ST001.

Figure 45. Site 21ST001.
Because sites 21ST002, 21ST005, and 21ST1 were re-surveyed, they will be discussed in the following “Fieldwork” section. The surveyed areas are discussed in alphabetical order according to the landowner’s name, so site 21ST002 will be discussed under Rower, 21ST005 will be discussed under Buendorf, and 21ST1 will be discussed under Spinler.
Fieldwork
The archaeological fieldwork focused on cultivated fields throughout Steele County. More than 25% of the ground surface was visible in all survey areas, so archaeologists adhered to the MnModel standards of walking over the area in 15-meter intervals while examining the ground surface for archaeological materials and features. Field surveys were consistent with the research design used for the 1995 MnModel field surveys, as well as methods set forth in the SHPO Manual for Archaeological Projects in Minnesota (Anfinson 2005).

The survey examined 31 parcels owned by 22 separate landowners (Figure 48). These parcels were selected using the GIS predictive model developed as part of this study. Archaeologists photographed each parcel and mapped their corners using a hand-held GPS unit. All the artifacts located during the survey were collected and their bags were labeled according to the provenience of the artifacts. Artifacts were returned to the lab where they were cleaned, cataloged, photographed (as appropriate) and analyzed. All artifacts that were donated to MHS were accessioned according to MHS standards. Artifacts that were not donated to MHS will be returned to the landowners at the end of this project.

All parcels surveyed are discussed below in alphabetical order according to the landowner’s name.

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3 Due to adjustments made in the field after the original parcel selection occurred, some of the following maps showing archaeological potential do not precisely match the shape of the maps showing the actual areas surveyed. Acreage counts and high, medium and low percentages given in the “5: GIS Development and Model” chapter, “Parcel Selection” section (pages 65-67) are based on actual land surveyed.
Figure 48. Parcels surveyed showing landowners.
Ahlborn (21ST031)
The Ahlborn parcel is located south of Owatonna (see Figure 48). The 44.73-acre parcel consisted of an agricultural field situated on the south and west side of Turtle Creek (Figure 49). According to the GIS model, the majority of the parcel had moderate potential for archaeological sites, although a few areas had high and low potential (Figure 50). The day of the survey, surface visibility was good with light to moderate corn stubble and a well-weathered ground surface. One site was located during the survey of the Ahlborn parcel (Figure 51).

Figure 49. Topographic map showing Ahlborn parcel.
Two lithic artifacts were recovered from the Ahlborn parcel (21ST031). These include one projectile point and one flake tool. Both are Prairie du Chien Chert.

The projectile point (Figure 52) is a small, possibly side-notched form of Prairie du Chien Chert.
Chert. The tip and part of the base are missing. The edges of the blade are excurvate and the base is concave. There is no basal grinding. The base might be called eared. There is a weak, broad notch on one side, while the other side of the base is broken off so any corresponding notch is not preserved. The extant notch is flaked mostly from one face. It is possible that it may represent unsuccessful re-sharpening rather than a deliberate notch. The blade is thickest at the notches, the cross-section is fairly regular, and the edge generally level. The flake scars are irregular, and many are broad.

Figure 52. Photograph of Ahlborn projectile point (measurement in cm) (Ahlborn 1.1).

This point is hard to evaluate typologically, in part because it is fragmentary. Doubt over whether or not the point is notched, for example, introduces a fundamental problem that is difficult to overcome. The small size suggests that it could be an arrow point rather than a dart point, which in turn would suggest a Woodland affiliation. This suggestion is, however, a bit tenuous.

**Anderson**

The Anderson parcel consists of 42.68 acres of cultivated land located in the northwest corner of Steele County (see Figure 48). The entire parcel was considered high potential due to its location adjacent to the drained Pelican Lake and a (now channelized) stream is located west and north of the parcel (Figures 53 and 54). The day of the survey, surface visibility was good with moderate corn stubble and a well-weathered ground surface. No artifacts were recovered from the Anderson parcel.
Figure 53. Topographic map showing Anderson parcel and drained lake bed.

Figure 54. Aerial photograph of Anderson parcel showing high potential.
Antl (21ST032)
The Antl parcel is located in northeast quadrant of Steele County (see Figure 48). The 41.32-acre parcel has a mixture of high and moderate potential for archaeological sites due to its location adjacent to Maple Creek (Figures 55 and 56). The day of the survey, surface visibility was good to very good with low to moderate corn stubble. One site was located during the survey of the Antl parcel (Figure 57).

Figure 55. Topographic map showing Antl parcel and Maple Creek.

Figure 56. Aerial photograph of Antl parcel showing potential.
The collection from the Antl Site (21ST32) consists of four lithics: one projectile point, one flake tool, and two flakes. Raw materials represented include one piece each of Fat Rock Quartz, Prairie du Chien Chert, Red River Chert, and unidentified chert. The projectile point is a small triangular form of Prairie du Chien Chert (Figure 58). It is a flake point; all of one face (flake dorsal) is retouched, but retouching on the other face (flake ventral) is confined to the lateral margins. The base is not retouched. The point is quite symmetrical in outline, but the cross section is less regular. The edges are level.

Figure 57. Map showing site boundaries of 21ST32.

Figure 58. Photograph of Antl projectile point (measurement in cm) (Antl 1.1).
Flake points are generally hard to evaluate typologically, since the production trajectory is quite short. In this case, however, it seems fairly clear that the intention was to produce a small triangular arrow point of the sort generally associated with Late Woodland or village cultures.

The biface is early stage, and is broken through the middle of the blade. The outline is fairly regular, the cross section is irregular, and the edges are not level.

**Brase (21ST033)**

The Brase parcel consists of 43.61 acres of cultivated land located in the northwest corner of Steele County (see Figure 48; Figure 59). The parcel is fairly evenly split between low, medium and high potential (Figure 60). The day of the survey, surface visibility was generally good with only moderate amounts of corn stubble and a well-weathered ground surface. One lithic flake of Prairie du Chien Chert was recovered from the Brase parcel (21ST33) (Figure 61).

Figure 59. Topographic map showing Brase parcel.
Figure 60. Aerial photograph of Brase parcel showing high, medium and low potential.

Figure 61. Map showing site boundaries of 21ST33.
Buendorf (21ST005)

The Buendorf parcel consists of 45.27 acres of cultivated land that is located in the southwest corner of Steele County (see Figure 48; Figure 62). The majority of the parcel is considered high potential due to its location next to the remains of a drained lake (Figure 63). Site 21ST005 is also located on the Buendorf property and a portion of the site was re-surveyed as part of this parcel (see Figure 36; Figure 64). The day of the survey, surface visibility was generally good but somewhat diminished due to recent plowing.

Figure 62. Topographic map showing Buendorf parcel.

Figure 63. Aerial photograph of Buendorf parcel showing potential.
Figure 64. Map showing previous site boundaries for 21ST005.

The 2012 collection from 21ST005 consists of two lithic artifacts. One is a flake tool and the other a flake. Raw materials represented include Grand Meadow Chert and Prairie du Chien Chert. These artifacts resulted in extending the Buendorf site boundaries further south (Figure 65).
The survey on Gloria Eaker’s land consisted of three separate parcels located in proximity to one another (see Figure 48; Figure 66). The three parcels, totaling 117.96 acres, were located in the southeast quadrant of Steele County. The parcels primarily had moderate potential with some low and high potential despite being situated north of Oak Glen Lake which has been partially drained (Figures 67). The day of the survey, surface visibility was good to very good with some soybean stubble and a well-weathered ground surface. Three sites were located during the survey of the Eaker property (Figure 68).
Figure 66. Topographic map showing Eaker parcels and partially drained lake bed.

Figure 67. Aerial photograph of Eaker parcels showing potential.
The collection from 21ST034 (Eaker 1) consists of four lithic artifacts. These include a core tool, two cores and one piece of shatter. Raw materials represented include two pieces of Prairie du Chien Chert, one piece of Fat Rock Quartz, and one piece of Red River Chert. The core tool (2012.151.1.1) is a naturally fractured piece of Red River Chert that has been retouched along a section of the edge.

The collection from 21ST035 (Eaker 2) consists of 13 lithic artifacts including one biface and 12 flakes. Raw materials represented include 11 pieces of Prairie du Chien Chert, one piece of Shell Rock Chert, and one piece of quartzite.

The biface (2012.152.1.1) is mid-sized and made of Prairie du Chien Chert. It is plano-convex in cross section, a form that probably reflects the morphology of the underlying flake. Both faces are completely retouched, although there is a flat facet at the base that may be the flake's striking platform. The tip is broken off. The outline is irregular, and the edge is not level. The faces display variable percussion flakes, but no apparent pressure flakes.

The collection from 21ST036 (Eaker 3) consists of one flake tool and six flakes. Raw materials represented include four pieces of Prairie du Chien chert, one piece of Burlington Chert, one piece of Galena Chert, and one piece of Swan River Chert.
Gehring
The Gehring parcel consists of 39.78 acres of cultivated land located in the southwest corner of Steele County (see Figure 48). The parcel varied from low to high potential (Figures 69 and 70). The day of the survey, surface visibility was very good. No artifacts were recovered from the Gehring parcel.

Figure 69. Topographic map showing Gehring parcel.

Figure 70. Aerial photograph of Gehring parcel showing varying potential.
Jensen/Thompson (Jensen) (21ST037)
The Jensen/Thompson parcel consists of 40.45 acres of cultivated land in the southwest corner of Steele County (see Figure 48). The parcel is located on the south side of Beaver Lake and varied from low potential away from the lake to high potential near the lake (Figures 71 and 72). The day of the survey, surface visibility was generally good with moderate to dense corn stubble and a well-weathered ground surface. One site was identified during the survey of the Jensen/Thompson parcel (21ST37) consisting of one flake of Burlington Chert (Figure 73).

![Figure 71](image1.png)

Figure 71. Topographic map showing Jensen-Thompson parcel.

![Figure 72](image2.png)

Figure 72. Aerial photograph of Jensen-Thompson parcel showing potential.
The Johnson parcel consists of 37.91 acres of cultivated land in the southeast corner of Steele County (see Figure 48). Almost the entire parcel had low potential despite being located near a (now channelized) stream (Figures 74 and 75). The day of the survey, surface visibility was excellent. One site was located during this survey (Figure 76).

Figure 73. Map showing site boundaries of 21ST37.

**Johnson (21ST038)**

The Johnson parcel consists of 37.91 acres of cultivated land in the southeast corner of Steele County (see Figure 48). Almost the entire parcel had low potential despite being located near a (now channelized) stream (Figures 74 and 75). The day of the survey, surface visibility was excellent. One site was located during this survey (Figure 76).

Figure 74. Topographic map showing Johnson parcel.
Figure 75. Aerial photograph of Johnson parcel showing potential.

Figure 76. Map showing site boundaries of 21ST38.

The collection from the Johnson parcel (site 21ST038) consists of two lithic artifacts and one faunal element. One of the lithic artifacts is a Prairie du Chien Chert spokeshave (Figure 77), and the other is a Fat Rock Quartz flake. The spokeshave (2012.154.1.1) is classified as such because it has a retouched concave edge, although the edge is quite
irregular and probably would not have worked well as a spokeshave, making the actual function unclear. The tool is made from a relatively large flake, and modification is confined to the concave edge.

![Figure 77. Photograph of the spokeshave from 21ST038 (2012.154.1.1).](image)

The faunal element (2012.154.1.3) is a plate of tooth enamel, most likely from a bovid. Surface staining and overall condition suggest considerable age. It was not more specifically identified.
Kasper

The Kasper parcel, located in the southeast quadrant of Steele County consists of 35.61 acres of cultivated land, and varied from low to high potential (see Figure 48; Figures 78 and 79). The day of the survey, surface visibility was moderate to good. No artifacts were recovered from the Kasper parcel.

Figure 78. Topographic map showing Kasper parcel.

Figure 79. Aerial photograph of Kasper parcel showing potential.
Klocek

The Klocek parcel consists of 38.8 acres of cultivated land in the center of the southern half of Steele County (see Figure 48). The majority of the parcel was considered high potential due to its location adjacent to the Straight River which is located north of the parcel (Figures 80 and 81). The day of the survey, surface visibility was moderate to good with moderate corn stubble and a well-weathered ground surface. No artifacts were recovered from the Klocek parcel.

Figure 80. Topographic map showing Klocek parcel.

Figure 81. Aerial photograph of Klocek parcel showing potential.
Larson (21ST039)

The Larson parcel is located in the southwestern quadrant of Steele County and consists of 80.06 acres of cultivated land (see Figure 48). Nearly the entire parcel was considered high potential due to its location adjacent to a now channelized river (Figures 82 and 83). The day of the survey, surface visibility was good with moderate corn stubble and a generally well-weathered ground surface. The collection from the Larson parcel (site 21ST39) consists of one lithic artifact; a flake of unidentified chert (Figure 84).

Figure 82. Topographic map showing Larson parcel and adjacent river.

Figure 83. Aerial photograph of Larson parcel showing potential.
During the survey, the landowner also shared a stone ax that had been recovered from his grandfather’s farm two to three miles northeast of the survey parcel (Figures 85 and 86). The ax which had been collected many years ago is fairly well-made from a relatively thin and flat cobble. The ax is grooved and the groove wraps nearly the entire way around the tool. The ax is dulled and rounded from use and the base exhibits pecking.

Figure 85. Photograph of the ax recovered from Mr. Larson’s grandfather’s farm a few miles northeast of the survey parcel.
Figure 86. Photograph of the other side of the ax recovered from Mr. Larson’s grandfather’s farm.
Nash
The Nash parcel consists of 49.96 acres of cultivated land located in the northwest quadrant of Steele County (see Figure 48). Most of the parcel was considered high potential due to its location adjacent to the now channelized Crane Creek (Figures 87 and 88). The day of the survey, surface visibility was excellent with small amounts of corn stubble and a well-weathered ground surface. No artifacts were recovered.

Figure 87. Topographic map showing Nash parcel and Crane Creek.

Figure 88. Aerial photograph of Nash parcel showing potential.
Nelson

The Nelson parcel is located in the southeast quadrant of Steele County and consists of 47.52 acres of cultivated land. The Nelson parcel varied from low to high potential (see Figure 48; Figures 89 and 90). The day of the survey, surface visibility was moderate to good. No artifacts were recovered from the Nelson parcel.

![Figure 89. Topographic map showing both the Kasper and Nelson parcels.](image1)

![Figure 90. Aerial photograph of the Kasper and Nelson parcels showing potential.](image2)
Pichner

The Pichner parcel consists of 40.75 acres of cultivated land located in the center of the western half of Steele County (see Figure 48). The entire parcel was considered low to moderate potential (Figures 91 and 92). The day of the survey, surface visibility was moderate with some corn stubble. No artifacts were recovered from the Pichner parcel.

Figure 91. Topographic map showing Pichner parcel.

Figure 92. Aerial photograph of Pichner parcel showing potential.
Polacek (21ST040)
The Polacek parcel is located in the center of the eastern half of Steele County and consisted of 43.94 acres of cultivated land (see Figure 48). Almost the entire Polacek parcel was considered high potential due to its location adjacent to Turtle Creek (Figures 93 and 94). Surface visibility was poor to moderate with heavy crop stubble, but exposed surfaces were flat and well-weathered. One site was located (Figure 95).

Figure 93. Topographic map showing Polacek parcel.

Figure 94. Aerial photograph of Polacek parcel showing high potential.
The collection recovered from the Polacek parcel (21ST040) consists of five lithic artifacts. These include a projectile point and four flakes. Raw materials represented include Prairie du Chien Chert (n=3) and Grand Meadow Chert (n=2).

The projectile point (2012.156.1.1) is a side-notched form of Prairie du Chien Chert (Figure 96). It is broken across the blade just above the notches, so only the base is present. The notches are broad and flaring. The base is eared, and one ear is damaged. The base is concave and may be lightly ground. The flaking pattern is indistinct. The blade may be beveled, which would suggest resharpening.
There is some ambiguity in the typology of this piece. It resembles the eared Oxbow type which, on the Plains, is regarded as a Middle Archaic type. In Minnesota, however, similar points are also found in association with the Early Woodland ceramic types Brainerd and LaSalle Creek (Hohman-Caine and Goltz 1995; Hohman-Caine et al. 2012). One might argue that the apparent absence of ceramics at the site argues for the earlier affiliation. It is important to note, however, that Woodland point types are found on other apparently aceramic sites recorded during this survey. The affiliations and chronology of this point remain ambiguous.
Rowher (21ST002, 21ST041, 21ST042)
The survey on the Rowher land consisted of four parcels along the north side of Rice Lake in the northeast quadrant of Steele County (see Figure 48). A total of 22.42 acres of Rowher’s land was surveyed, all of which was cultivated. The parcels were considered low to moderate potential despite their location adjacent to Rice Lake (Figures 97 and 98). The parcels were surveyed over two days and exhibited good to very good surface visibility with moderate soybean stubble and a well-weathered ground surface. One previously recorded site’s boundaries were expanded (21ST002) and two new sites (21ST041 and 21ST042) were recorded as a result of this survey (see Figure 36; Figures 99 and 100).

Figure 97. Topographic map showing Rowher’s parcels north of Rice Lake.
Figure 98. Aerial photograph of Rowher’s parcels showing potential.

Figure 99. Map showing previous and revised site boundaries of 21ST002.
Additionally, Mr. Rowher informed the archaeologists conducting the surveys that his property had been collected for several years by a local collector. Among other pieces, Mr. Rowher indicated that the collector had found an “ax head.” The 2012 collection from previously recorded site 21ST002 consists of 10 lithic artifacts. These include two projectile points, one end scraper, two bipolar cores, three flakes, and two pieces of shatter. Raw materials represented include six pieces of Prairie du Chien Chert, one piece from the Western River Gravels Group, one piece of quartz, and two pieces of unidentified chert.

The first of the two projectile points recovered from 21ST002 is a small side-notched form of Prairie du Chien Chert (Figure 101). The tip is fairly sharp, and possibly slightly damaged. The sides of the blade are convex. The notches are u-shaped, and slightly deeper than wide. The base is ground, straight to slightly convex, and narrower than the bottom of the blade. The point is somewhat plano-convex in cross section, although both faces are fully retouched. The point is thickest mid-blade. The blade is beveled, which indicates that it has likely been resharpened. The faces display variable percussion flakes, some extending past mid-blade. There is some pressure flaking along the edge.
Small side-notched points like this one are difficult to classify typologically. We can, however, make a number of general observations regarding affiliation and chronology. First, it seems likely that the affiliations of this point are to the west rather than to the east. Many kinds of small notched points occur on the Plains, and their typology has only partly been worked out. Points resembling this one clearly occur to the west, however, and could probably even be called common. Second, it seems more likely that this point is chronologically late rather than early. A Woodland and perhaps even Late Woodland age seems more likely than an Archaic age.

The second point (Rowher 1-1.2) is a mid-sized flake point of Prairie du Chien Chert (Figure 102). One surface (dorsal surface of the underlying flake) is fully retouched, while the other surface (flake ventral) is retouched along the edges only. The point is broken mid-blade with the upper part missing, and the base is possibly also broken near the edge. The outline is symmetrical, and the edge fairly level. Because this is a flake point with a short production trajectory, typological classification is difficult and probably not reliable. In general, however, this point resembles the small triangular points of the Late Woodland and may date from that period.
Additionally, the site card in the site files at the OSA state that mounds were originally reported at 21ST002. These mounds were not apparent during the survey of the Rowher property or 21ST002.

The second site located on Rowher’s land (21ST041) consists of five lithic artifacts. These include a pebble core (not bipolar), a bipolar core, and three flakes. Raw materials represented include three pieces of Prairie du Chien Chert, one piece of Fat Rock Quartz and one piece of Red River Chert.

The third site on Rowher’s property (21ST042) consists of one lithic artifact, a flake of Maynes Creek Chert.
Spinler (21STI, 21ST018, 21ST043)
The survey on Spinler’s property consisted of two parcels north and west of Rice Lake along the eastern edge of Steele County. The parcel north of Rice Lake included 49.92 acres of cultivated land while the parcel west of Rice Lake consisted of 35.95 acres (see Figure 48). The parcels varied between high, medium and low potential (Figures 103 and 104). During the survey, surface visibility was good to excellent with moderate corn stubble and a well-weathered ground surface. Two sites were located during the survey of the Spinler’s property.

Figure 103. Topographic map showing Spinler parcels and Rice Lake.

Figure 104. Aerial photograph of Spinler parcels showing potential.
The Spinler parcel located north of Rice Lake was also immediately north of a verified archaeological site along the shore of Rice Lake (21ST018). A second unverified site (21ST1 [lower case L]) was located on the portion of the Spinler property south of the road and north of 21ST0018 (Figure 105). During the survey, numerous artifacts were recovered from this portion of Spinler’s property. One artifact was recovered from the portion of the parcel located north of the road. The artifacts recovered from 21ST1 were located in two distinct concentrations; one to the east and one to the west with a light scatter between the two concentrations. Locating the artifacts north of 21ST018 within 21ST1 verified this reported (lettered) site and resulted in combining the site with 21ST018 and redefining 21ST0018’s boundaries (Figure 106).

Figure 105. Location of 21ST0018 and 21ST1 prior to the 2012 survey.
Figure 106. Revised boundaries of site 21ST0018 after the 2012 survey.

The 2012 collection from 21ST18/21STl consists of 92 artifacts. These include 87 lithic artifacts, 1 faunal element, and 4 pieces of FCR. The flaked stone lithic artifacts include 1 biface, 1 end scraper, 4 flake tools, 1 tested cobble, 70 flakes, and 10 pieces of shatter. Raw materials represented include 53 pieces of Prairie du Chien Chert, 12 pieces of unidentified chert, six pieces of Swan River Chert, three pieces of Burlington Chert, two pieces each of Fat Rock Quartz, Grand Meadow Chert and quartzite, and one piece each of Galena Chert, Red River Chert, Western River Gravels Group, basaltic rock, burned chert, jasper, and siltstone (not KLS).

The biface (2012.157.1.16) is an early stage piece of Prairie du Chien Chert. It is broken through the middle of the blade. The outline is fairly regular, but the cross section is irregular and the edge not leveled.

The faunal element is a tooth from a medium sized mammal. It is possible that the piece may be modern, although this is not certain. Taxonomic identification was not attempted.

This site provides a large enough lithic assemblage to support some raw material analysis. Note that the total assemblage comes from two distinct artifact concentrations, plus a light scatter of artifacts between the concentrations. It is not entirely clear that these can meaningfully be lumped together for a raw material analysis. For the purposes of this analysis, the two concentrations were analyzed together. In addition, six artifacts from a previous MHS investigation at the south end of the site are also included.
The total assemblage from 21ST018 bears some resemblance to the assemblage from the central portion of 21DO002, discussed previously in this report. In both cases, PdC occurs in similar proportions (21ST18=60.2%, 21DO2=69.05) and most other raw materials occur in small amounts. The assemblages differ, however, in that there is substantially less Grand Meadow Chert at 21ST018 (%=3.2) than in the central part of 21DO002 (%=15.5). In addition, exotics at 21ST018 are limited to Burlington Chert (%=3.2), while the central part of 21DO002 has Burlington (%=1.7), Hixton Quartzite (%=1.7) and Knife River Flint (%=1.7). Finally, the raw material diversity at 21ST018 is higher (n=15, sample size 93) than in the central part of 21DO002 (n=8, sample size 58).

Beyond this approximate resemblance, the assemblage from 21ST018 bears little resemblance to the other assemblages subjected to raw material analysis in this report. As was discussed in connection with those analyses, it is difficult to evaluate these observations in terms of raw material use patterns since, at this point, we don't know exactly what raw material use patterns should look like in the southeastern quarter of the state. With more data and additional comparative study, however, it should be possible to resolve this situation.

The second site (21ST043) identified on the Spinler's parcels is west of Rice Lake (Figure 107). The collection from 21ST043 consists of six lithic artifacts. These include a projectile point, a flake tool, three flakes, and a piece of shatter. Raw materials represented include one piece each of Galena Chert, Grand Meadow Chert, Hixton Quartzite, and Prairie du Chien Chert, and two pieces of unidentified chert.

![Figure 107. Map showing the location of site 21ST043.](image)

The projectile point (2012.158.1.1) is a lanceolate form made of Hixton Quartzite (Figure 108). This is the basal end of the point, broken mid-blade. The nature of the break is not clear. The point is 45 mm in length, 9 mm in greatest width (at base and break), and about 5 mm thick. This is a finely made piece. It is very regular in outline and cross...
section, and the edge is well leveled. The flaking is parallel oblique and well controlled, although the flake scars are hard to read precisely because of the texture of the raw material and because of a light mineral accretion on parts of each face. One ear is also broken off the base.

Figure 108. Photograph of the projectile point recovered from 21ST043.

The point has straight, near-parallel sides that expand slightly at the base to create slight "ears." The width also expands very slightly towards the break. The widest parts (by ca. 1 mm) are at the base and the mid-blade break. The variation in blade width may be due to resharpening. Beveling is apparent, beginning a short distance above the base (Figures 109 and 110). The base is concave; the concavity takes the form of two straight edges angled up from the ears and meeting at a point. The basal concavity and the blade edges on the lower part of the blade are ground.

Figure 109. Lateral view of the projectile point recovered from 21ST043.
Figure 110. Photograph from the top of the projectile point recovered from 21ST043.

Mineral accretion darkens most of one face and the distal end of the other face, but similar mineral accretion was seen on other, typologically younger points found during this survey. Thus the accretion is probably partly a function of calcareous soil and partly a function of age.

Typologically, this is a Paleoindian lanceolate point. More specifically, it strongly resembles the Plainview type (Justice 1988:30-31). Plainview seems to be technologically related to Clovis, and dates to around 10,000 B.P.
Stoos

The Stoos parcel consists of 31.11 acres of cultivated land where an unnamed tributary joins Medford Creek in the center of the northern portion of Steele County (see Figure 48). The majority of the parcel was considered high potential due to its location south of Medford Creek (Figures 111 and 112). The day of the survey, surface visibility was good with light corn stubble and a well-weathered ground surface. No artifacts were recovered from the Stoos parcel.

Figure 111. Topographic map showing Stoos parcel and Medford Creek.

Figure 112. Aerial photograph of Stoos parcel showing potential.
Toft

The Toft parcel consists of 42.55 acres of cultivated land in the southwest corner of Steele County (see Figure 48). The parcel varied from low to high potential (Figures 113 and 114). The day of the survey, surface visibility was good with moderate corn and soybean stubble. No artifacts were recovered from the Toft parcel.

Figure 113. Topographic map showing Toft parcel.

Figure 114. Aerial photograph of Toft parcel showing potential.
Trotman

The Trotman parcel consists of 89.33 acres of cultivated land located in the southeastern corner of Steele County (see Figure 48). The parcel was generally considered medium potential despite its location adjacent to Oak Glen Lake (Figures 115 and 116). The day of the survey, surface visibility varied between poor and excellent depending on amounts of corn and soybean stubble. The ground surface was generally well-weathered. No artifacts were recovered from the Trotman parcel.

Figure 115. Topographic map showing Trotman parcel.

Figure 116. Aerial photograph of Trotman parcel showing potential.
Wegner
The Wegner parcel consists of 50.73 acres of cultivated land is located along the far northern edge of Steele County (see Figure 48). Much of the parcel was considered low potential with about half being moderate to high potential (Figures 117 and 118). The day of the survey, surface visibility was excellent with a well-weathered ground surface. No artifacts were recovered from the Wegner parcel.

Figure 117. Topographic map showing Wegner parcel.

Figure 118. Aerial photograph of Wegner parcel showing potential.
Results
The field survey of Steele County took place in March and April of 2012 and resulted in locating 13 previously unrecorded sites (Figure 119). These sites were assigned numbers 21ST031 through 043. Three previously recorded sites were also re-surveyed (21ST002, 21ST005, 21ST1), while three other previously recorded sites were revisited in order to assess the current condition of the sites (21ST003, 21ST004, 21ST007). Archaeologists were denied access to two sites (21ST001, 21ST008). Site boundaries for all three of the previously recorded and re-surveyed sites were modified as a result of these surveys.
Figure 119. New sites recorded during the 2012 survey.
7: Geomorphology of Steele County

As part of this project, a geomorphological field survey of Steele County took place to determine the potential for deeply buried archaeological deposits. As little data exist for what types of landforms have potential for buried archaeological deposits for this county, areas of presumed high potential for buried archaeological deposits were the focus of this study.

The primary goal of the geomorphological/geoarchaeological survey was to identify locations where buried archaeological deposits might be present. The geomorphological survey of Steele County focused on the stratification of the regional landscape. This method helps identify the potential for buried sites by selecting landforms and Landform Sediment Assemblages (LSAs) that would likely contain buried archaeological deposits\(^4\) (Stafford 1995). Regional landscapes were examined by excavating hand-augured cores along various landscapes to test the landforms. Four landforms with the potential to contain buried archaeological deposits appear to exist in Steele County; alluvial, lacustrine, colluvial, and eolian depositional environments. The auguring survey attempted to log profiles from each of these landforms.

Geoarchaeological Background and Methods

Recent geoarchaeological methods and models for the Midwest focus on the question: can specific landscape units be used as good archaeological chrono-markers, and if so, where and what type of prehistoric settlement can be expected to be found within the sediments contained within them? The unit of landscape resolution most often used is the fine scale landform (e.g. terraces, floodplains, and fans) (Bettis and Hajic 1995). Gray’s (1984) predictive model, based on the sub-parallel alluvial ridges found along certain stretches of the Ohio River, is a good example of a model based on such fine scale landforms. Gray found that the position of these ridges in relation to the river can be an indication of their relative ages: the closer to the river, the younger the landform. Additionally, the downstream portion of the ridge is younger than the upstream portion (Gray 1984). This type of information can be used as a predictive model (the Sub-Parallel Ridge model): a ridge’s relative position in a river valley can be used to predict the relative ages of prehistoric sites found on such ridges.

A brief discussion of the factors that influence soil formation and soil weathering is useful for understanding the use of soil properties as a proxy for the age of landforms. Hans Jenny outlined the main factors that influence soil formation to be parent material, climate, living organisms, topography, and time (Birkeland 1999; Brady and Weil 1999). These factors can work independently of, or dependently with, each other to form a soil. Every soil is a product of its environment and different environments will produce different soils. Variations of the above factors within an environment can produce different soils as well. For example, the top of a slope may have a less developed A

\(^4\) For a full discussion of Steele County’s landscape history please see Chapter 2: The Place: Natural Landscape and Environment.
horizon than the bottom of a slope, due to erosion moving soils from the top to the bottom of the slope. Climatic variation within an environment can produce different soils; an area that experiences periods of high temperature and precipitation will produce more clay from weathering than areas that experience lower precipitation and temperature.

Differing parent material can also weather in different ways and produce different soils, as can the variety of organisms that can live on or in soil. Perhaps the most important formation factor is time. The longer a soil has been forming on a landscape the longer it has been affected by other factors. Soil weathering is also subject to the same five factors, and the by-products of soil weathering (such as soil color, motting, and structure) can also vary based on these factors. Time is the most important factor in the methods and models discussed below. Many characteristics are directly related to the length of time a soil has been developing, such as the size of albic material mottles, which grow larger and more numerous with time.

A geoarchaeological soil-based prediction method was created after extensive archaeological and geomorphological studies of the alluvial landforms of the Des Moines River Valley and their associated soil orders. By identifying informal lithological units called Landform Sediment Assemblages (LSAs) (defined as genetically and temporally related landforms and their associated soil deposits) it was concluded that certain alluvial landforms can be directly correlated with the soil order identified from these deposits (Bettis 1992). The weathering characteristics of the soils that make up these landforms, together with the radiocarbon dates obtained from samples derived from the LSA, showed that landforms of certain ages have similarly weathered soils. There is also a correlation between these deposits’ ages and the soil orders of the alluvial landforms, which shows that they can be useful as proxy indicators to the relative age of the deposits.

These alluvial deposit ages could in turn be categorized as three general divisions of the Holocene period: Early/Middle, Late, and Historic. Early/Middle Holocene (EMH) deposits were deposited between ca. 10,500 to 4,000 B.P. and generally are silt loams to loams that exhibit oxidized colorations with red, brown, or grey mottles. Surface soils of landform dating to the EMH are usually Mollisols or Alfisols located on low terraces. These soils exhibit brown to dark brown subsurface B horizons with Argillic horizons (Bt), a moderate soil structure, and well developed horizons.

Late Holocene (LH) deposits were deposited after 3,500 radio-carbon years before present (rcybp). These soils are loam, silt loams, or clay loams that are darker than older deposits due to a higher level of organic material, and have occasional mottles. LH surface soils are usually Mollisols or Inceptisols, with weakly expressed B (Bw) horizons, or Entisols with no B horizon. They have a weak to moderate structure and are generally found in the floodplains.

Historic deposits are very young (ca. 500-100 rcybp), and often contain no natural prehistoric deposits. They are lighter in color than LH deposits, and are Entisols with a
poor horizonation A-C soil make-up, weak to moderate structure, and located anywhere on the landscape covering older deposits.

Overall, this soil-based investigation method can predict the age of an alluvial deposit for Holocene alluvial landforms based on soil orders and soil descriptions. This information thus allows archaeologists to predict what type of archaeological deposits might be found within the landform. For instance, a floodplain composed of a Mollisol soil order would have a high potential to contain Late Holocene archaeological deposits. This landform soil method not only can be used to predict the age of sites that can be expected in such landforms but also, gives significant predictive power to the location of deeply buried sites.

Further research showed that this model could be applied to other regions of the Midwest with similar results, and has been successfully tested and proved applicable in the Mississippi and lower Ohio River Valleys (Bettis and Hajic 1995; Bettis et al. 1996; Hajic et. al. 1996; Hajic et. al. 2006; Stafford and Creasman 2002; Stafford 2004).

**MnModel**

Most applicable to the current study is the Minnesota Department of Transportation’s MnModel. Contained within this study of the predictability of the location of archaeological sites across the state was a model for geologically buried prehistoric cultural recourses (Hudak and Hajic 1999; 2002). The stated goal for the geomorphology aspect of MnModel was to develop a working LSA model for the selected project testing areas. Specifically, this study was aimed at establishing the potential for "suitable habitats" to be geologically buried beneath recognizable landforms, which may in turn hold prehistoric cultural materials.

The interpretation of the burial potential was assessed using geologic age, depositional environment, and post-depositional alterations to strata. As used in this context, “potential” is a qualitative measure of the likelihood that a particular geologic environment will contain archaeological deposits in primary context. Major geologic criteria used when assigning a level of potential are: age of the deposits, depositional environment, and post-depositional modifications (Hudak and Hajic 2002).

This study used a multitude of methods to map, describe, and evaluate LSA within multiple depositional environmental landscapes throughout the state. Field methods included taking soils cores and describing them using standard pedagogical and sedimentological terms as put forth by the Natural Resource Conservation Service (NRCS) (see Soil Survey Staff 1993).

While the majority of these testing locations focused on Minnesota’s major river basins, some were located in upland settings similar to Steele County. However, the results of the study considered such upland areas to remain poorly understood. Specifically cited issues included, the relationship of archaeological site locations to lake margin fluctuations, the distribution and thickness of loess deposits, the erosion of upland hills and hill-slopes, and the buried site potential within lower order streams.
The two closest study areas to the current investigation were the Mountain Lake Uplands and the Nicollet Uplands, both located to the west. In these areas, seven separate landscapes with distinct LSA were identified (Table 3). At least two of these landscapes are glacially derived; four are related to valley and stream development, and one is a lake (lacustrine) environment.

Table 3. MnModel LSA Identified in the Nicollet and Mountain Lake Uplands.

<table>
<thead>
<tr>
<th>Landscape</th>
<th>LSA- Description</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stagnant Ice landscape</strong></td>
<td>SLD- linked depressions</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SLDB- small linked depressions</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SHU- hummocks</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SHUE- eroded hummocks</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>SP- stagnant ice plain</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>SPE- eroded stagnant ice plain</td>
<td>No</td>
</tr>
<tr>
<td><strong>Glaciofluvial landscape</strong></td>
<td>OPC- paleochannel</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>OT- outwash terrace</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Paleovalley landscape</strong></td>
<td>YDI- modern reservoirs</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>YHU- rounded hummocks</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>YHUT- low rounded hummocks</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>YPC- paleochannel</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>YST- strath terrace</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Valley Terrace landscape</strong></td>
<td>VST- strath terrace</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>VT- terrace</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Floodplain landscape</strong></td>
<td>FDE- delta</td>
<td>Low to medium</td>
</tr>
<tr>
<td></td>
<td>FDA- thin discontinuous alluvium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>FDACO- coarse alluvial sediment</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>FFY- “y” type floodplains</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>FFZ- “z” type floodplains</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>FF- undifferentiated fine alluvium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>FFCO- undifferentiated coarse alluvium</td>
<td>Low</td>
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<tr>
<td></td>
<td>FV- “z” type floodplains</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Valley Margin landscape</strong></td>
<td>MC- colluvial slopes</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>MAF- aluvial fans</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>MH- hillslopes</td>
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</tr>
<tr>
<td></td>
<td>MHE- eroded hillslopes</td>
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</tr>
<tr>
<td><strong>Lacustrine landscape</strong></td>
<td>LLN- linked depression basins</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>LLB- exposed lake beds</td>
<td>Low</td>
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<tr>
<td></td>
<td>LLBF- exposed lake bed, no peat</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>LLR- modern reservoir</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>LSH- shoreline features</td>
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</tr>
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</table>
Steele County Archaeological Survey

**Steele County Investigations**

Prehistoric human occupation within the region began during the Late Pleistocene and lasted through the Holocene and into historic Euro-American settlement (approximately 14,000 B.P. to 400 B.P.) Given this, sediments deposited during that span of time have the potential to contain buried archaeological materials. The depositional environments most conducive to burying and preserving archaeological sites in this county are vertical accreted alluvium on floodplains and terraces, colluvial/alluvial hillslope erosion, eolian loess dunes/sand sheets, and lake/wetland margin lacustrine deposits.

Throughout much of the Midwest, settings where Holocene alluvium has accrued have high potential for deeply buried cultural deposits. While many locations of alluvial deposition existed in Steele County, the Straight River is the largest stream and, as such, has the largest and most extensive floodplains.

Most of the rest of the county is defined by the ridge tops and slopes from glacially deposited moraines and depressions. These landforms were generally deposited prior to the prehistoric occupation of the region and they often exhibit archaeological sites on their surfaces, with little to no potential for buried sites. Slope erosion is the most common form of sediment transport in upland settings in which the majority of the glacial landscape of this county is located. Episodic erosion of ridge tops and, more commonly, their slopes can deposit sediment in layers on foot-slopes and toe-slopes. Soil may form at the surface portion of each of these layers if erosion-derived deposition episodes are separated by enough time (decades to millennia).

When a new cycle of erosion and deposition buries the surface soil, the now-buried soil may be preserved, thereby representing the former land surface and a period of past landscape stability (Mandel and Bettis 2001). As such, these colluvial deposits represent a possible location for buried archaeological deposits. If colluvial deposition was active in the Holocene, it is possible that cultural deposits may be buried within these soils.

Colluvium in Steele County will likely be most prevalent in the county’s numerous glacially deposited landscapes. Some potential for direct burial by original loess deposition may also exist within the county in similar glacial landscapes. While broad mapping of the surface geology of the county does not reflect the deposition of widespread loess, county soils mapping does list loess as parent material for some landforms. The relative depth of this loess is unknown and needs better definition.

According to the historic documentation seen in the GLO maps, lake environments were once prevalent within the county. As with all environments, lakes change in size and appearance depending on internal and external factors. Thus, the potential exists for buried prehistoric sites in lacustrine depositional environments. Lacustrine deposition and the potential for buried prehistoric sites depend on previous transgression and regression (rise and fall of the water) of the body of water (Waters 1992). Identifying previous shorelines can aid in the understanding of the evolution of a lake and its potential for buried archaeological materials.
Since the primary goal of the geomorphological study was to identify the potential for buried archaeological deposits, the geomorphological/geoarchaeological survey of Steele County was aimed at exploring soils and landforms that might hold such deposits. Targeted testing areas for potential buried site locations included:

- **Straight River Alluvial Deposits**
  - Testing a section of the floodplain and any feature the floodplain may exhibit

- **Colluvial Slopes and Loess Blankets**
  - Testing areas generally at the base of a glacial ridge or hill slope that may contain Holocene-age colluvium. Also investigate the ridge tops, slopes, and bases of landforms where loess deposits are present for evidence of buried surfaces

- **Lake Margins**
  - Testing near current lake margins to determine whether transgression and/or regression has occurred along the lake margin

Areas and soils identified for investigation were chosen based on online county soil maps, soils datalayers, USGS quadrangles, and countywide DEMs. Additionally, this survey served not only as an exploratory device for the geoarchaeological potential of Steele County, but also as a means of ground-truthing the information gathered from the above sources. Of particular note is the level of accuracy of county soil surveys, which are not always sufficient for use in geoarchaeological studies, because a certain level of generalization is used to create these maps (Holiday 2004: 53-71). Recognizing these limitations, soil maps can be and were useful as general guides to the soils present in a project area.

In the field, methods focused primarily on the use of a 3-in (8-cm) bucket auger to test areas of potential interest (Figure 120). Tests were excavated to a depth of refusal where bedrock or other rocky surface was encountered, or to a depth that revealed a landform profile non-conducive for prehistoric occupations. These 3-in diameter auger tests were excavated from 120 cm (47.2 in) below surface to approximately 300 cm (118.1 in) below surface (the practical reach of the hand auger unit). The depth of sediment or soil changes, soil descriptions (including color, texture, structure, and inclusions), and any other important details were recorded during the testing. Due to the nature of this type of testing, soils were somewhat disturbed and some characteristics (e.g. structure) may have been obscured. The location of each test was photographed, and mapped with a Trimble GeoXT GPS handheld unit with submeter accuracy running ESRI’s ArcPad 7.0.1 software.
Field Testing Locations

Two test areas were chosen based on their presumed depositional history and geomorphological setting (Figure 121). The first was within the Straight River floodplain, and the second in and around Oak Glen Lake where glacial, eolian, and lacustrine deposits exist. In all, 18 cores were excavated during the field investigations. Summary descriptions of the cores, landforms, and the geoarchaeological potential for each area follows. For detailed descriptions, see Appendix 1.
Figure 121. Map of Steele County showing the locations of the two geomorphological testing locations.

**Straight River**

This testing locality is inside a large meander of the Straight River, less than half a mile south of the city of Owatonna (see Figure 121; Figure 122). The floodplain contained within this loop is relatively broad compared to the rest of this stream’s reach. This floodplain contains several landscape features. Most notable are the many paleochannels/oxbow lakes across its length. Cores were taken from a single generalized north to south transect on the west side of a set of railroad tracks that cross the river at this location. The transect covered a segment of the floodplain just under 200 m in length.
Soils maps indicated that at least four different alluvial deposits existed here, providing an opportunity to potentially investigate different landforms and/or age deposits. Eleven cores (Cores 1-11) were collected from this location (Figure 123).

Figure 122. View west of the Straight River, testing location in on the northern bank. Small grass area represents the extent of the small modern floodplain.
Figure 123. Straight River testing location showing the location of the auger cores, the cross-section, and the different soils/sediments present on the floodplain (as mapped in SURRGO).
Mapped soils on this floodplain segment include Calco, Spillville, and frequently flooded “Alluvial lands.” All are Mollisols that are considered to be moderately to poorly drained. As encountered in the field, Calco soil was moderately to poorly drained, while Spillville and the Alluvial lands were moderately to well drained.

The fine scale topography and cores revealed that four landforms make up the overall floodplain and, thus, four Stratigraphic Units (SU) were encountered (Figure 124).

Figure 124. Stratigraphic cross-section of the entire Straight River floodplain testing location, detailing the four different landscapes.

**Straight River Stratigraphic Units**

Coring began on the north side of the floodplain at the base of a scarp that leads to the upland surface to the north. Cores 1, 2, and 5 were placed in topographically low areas, currently containing standing water, interpreted to be paleochannel meanders. Cores 1 and 2 were both located within two northern channels; while Core 5 was placed in the southern channel.

Cores 3, 4, and 6 were placed on topographically higher areas directly associated with these paleochannels. Cores 3 and 4 were located on a small rise between the two paleochannels. Core 6 was placed on a rise just south of the southern paleochannel. Cores 1, 2, and 5 comprise SU 2, while Cores 3, 4, and 6 comprise SU 3.
Cores 7-10 were taken from the topographically highest surface of the floodplain, located south of the paleochannel complex. This landform was a low terrace, and was higher and drier than the landforms to the north or south of it. It is labeled SU 4. Core 11 was taken from the low modern floodplain surface between SU 4 to the north and the modern active channel of the Straight River to the south. This modern floodplain surface was labeled SU 1.

**Stratigraphic Unit 1**
SU 1 has a distinct landform surface that is nearly a meter lower than the surface of SU 4 to its north. A short steep scarp separates the two landform surfaces. This lower landform consists of a vertical overbank unit underlain by lateral bar and stream lag deposits. The overbank deposit (Unit 1a) is composed mainly of sandy loam that coarsens with depth until it reaches the coarse sands and gravels of the underlying bar and channel deposits. A distinct layer of fragmentary mollusk shells was found directly above the basal gravels. Channel gravels seemed to be comprised mainly of limestone, with large woody organic inclusions. An A-C-C2-C3-C4-2C-2C2-2Cr horizon sequence was recorded for this landform. Due primarily to its landscape position, topographically low and in direct association with the active stream channel, this SU is considered to be the youngest deposit to comprise this landscape.

**Stratigraphic Units 2 and 3**
SU 2 is comprised of the paleochannels on the northern end of the floodplain. SU 3 appears to be channel or bankside deposits directly associated with these paleochannels. Both SUs have a vertical overbank unit, underlain by a lateral bar and channel deposits. There are two main characteristics that differentiate these SUs from one another. First is their profiles sequences; SU 2 is an A/0-A-ACg-ACg2-Cg-2Cg-2Crg, while SU 3 is an Ag-ACg-Cg-Cg2-2Cg-2Crg. Second are the soils textures; SU 2 has a slightly finer texture, containing loam transitioning to sandy clay loam while SU 3 transitions from loam to sandy loam.

Looking at these differences the finer, more organic, soils within SU 2 appear consistent with a gradually infilling paleochannel scenario. The coarser and less organic SU 3 soils appear to indicate a rapidly forming side channel deposit, not unlike that seen with SU 1. The segment of SU 3 from which Cores 3 and 4 were taken (the small rise between the northern and southern branches of the paleochannel), appears to have formed over a small mid-channel sand bar. The SU is underlain by a sandy bar, which is underlain by a gravelly channel lag deposit. The gravels of SU 3 consist mainly of limestone, and woody organic fragments are common.

**Stratigraphic Unit 4**
SU 4 is the largest and most extensive of the units, and the highest surface on the floodplain. This low terrace surface rises gently away from SU 3 on its northern end, but has a more pronounced scarp separating it from SU 1 to its south. The top of this scarp also appears to represent a low natural levee (at less than 50 cm higher than the same surface directly to the north) (see Figure 123). This LSA appears to grade from older to newer deposits from north to south.
Cores 7 and 8 exhibit the best developed soil profiles seen in this floodplain, with a sequence of A-ABg-Cg-Cg2-2Cg-2Crg. However, by Core 9 the ABg horizon has transitioned to an ACg horizon and subsumed the first Cg horizon, for an A-ACg-Cg-2Cg-2Crg sequence. All three core profiles present loams coarsening to sandy loams with depth. Core 10 is the most diverse, exhibiting a much sandier AC-C-C2 profile sequence, but is still part of the overall SU 4. Core 10 likely represents a natural levee front to this terrace landform. This progression of less developed soils with coarser textures belies a southward building landform, likely following the meandering of the river. The same type of sandy bar and channel lag gravels as noted underlying the overbank deposits of the other SU are seen here as well.

**Straight River Location Discussion**

Based on the soil development found in Cores 1-11, all SUs appear to have formed within the Holocene period. In relative dating terms, the northern part of SU 4 exhibits the most well developed soil profile and is thus, probably the oldest of these landforms. However, its southern extent, being less well developed, may indicate that this landform did not stabilize until later than its initial formation. Conversely, the southern extent of SU 4 may be an entirely separate SU welded against SU 4.

SU 3 appears to be the next oldest, followed closely by SU 2. These two SUs appear to be part of the same complex of landforms, representing an abandoned meander belt. The paleochannels themselves still hold water and are still actively infilling, and newer, more distinct abandoned meanders from this same belt are readily discernible directly to the east. All together, these abandoned meanders show that the Straight River used to run across the bottom of the scarp leading to the upland surface to the north, following a somewhat tighter bend of the same general broad meander seen today. It also appears, based on these abandoned channels, that the Straight River was much more sinuous in the past than is seen today. Their lower topographic position and general lack of soil development would seem to indicate that these deposits are younger than SU 4, located to the south. SU 1’s landscape position suggests it is the youngest of these landforms.

As far as evolutionary development, the following scenario is suggested. Earlier in the Holocene, the Straight River flowed on the northern side of the floodplain, in the channel belt that SU 2 and 3 represent. The northern portion of SU 4 had developed before the formation of this belt, when the Straight River was on the southern side of the landform. Then, the Straight River avulsed to the north, moving to the base of the scarp on the northern side of the valley and abandoning the southern channel. After a relatively brief period of time the channel avulsed back to the south, reoccupying the general position of the original channel and abandoning the northern meander belt, forming the less sinuous modern channel. This pattern of sudden channel abandonment, from south to north and back to south again, left the northern channel belt and side channel deposits (SU 2 and 3) intact, as well as leaving the original terrace/floodplain (SU 4) intact.

Geologically, it appears this floodplain is young enough to have the potential to bury Holocene age cultural deposits, however, almost every profile encountered was
predominantly gleyed, indicating that the soils had formed in generally very wet conditions. This suggests that the floodplain is often very wet reducing the potential for archaeological sites. Further, no profiles exhibited strong indications of past periods of landscape stability that might have allowed a buried surface to form. Instead most profiles appear to have aggraded over a brief period of time, as represented by the extensive C horizons, and then had long periods of slower but steady growth as represented by the A-AC horizons. Both these factors may indicate that this landscape was not the most attractive place for long term occupation, but proximity to water may have outweighed those factors. No cultural material was encountered in any of the cores taken in this location.

SU 1 likely has little to no probability of holding deeply buried archaeological sites. The landform itself is not extensive in width and does not exhibit the more extensive A horizons seen in the other SUs that would indicate a slow accumulation of sediments. The surface of SU 4 would have offered a much more suitable surface for occupation. SU 2, being a paleochannel that is still actively holding water, can be ascribed no potential for buried materials. SU 3 appears very similar to SU 1 in that it is not extensive in width, and while its A-AC horizons are better developed, it likely has little to no potential. SU 4 being the highest and most well developed SU may have a better potential, and as such is ascribed a low (as opposed to no) potential. None of the SU, except SU 3, have extensive A or B horizons that extend below a meter, limiting the chances of significant buried sites to the upper meter of the profile.

**Oak Glen Lake**

This testing area is on the north side of Oak Glen Lake, located approximately four miles north of Blooming Prairie (see Figure 121; Figure 125). This area contains several glacial landscape features and possibly some lacustrine and eolian features as well. Cores were taken from a single generalized north to south transect north of the lake. Coring was planned to take place on a sandy island that exists in the marshy area between the two largest bodies of water that constitute the Oak Glen Lake, however, due to the high lake level at the time of investigation, the island was not accessible. Soils maps indicated that at least four different types of deposits exist here, providing an opportunity to investigate potentially different landforms and/or aged deposits. The transect was approximately 450 m in length and covered a landforms mapped as glacial and eolian in origin. Seven cores were collected from this testing location (Cores 1-7) (Figure 126).
Figure 125. General view west of the Oak Glen Lake testing location. Photo looking west toward the lake from the second summit of the prominent moraine of this location.
Figure 126. Oak Glen Lake testing location showing auger cores, profile location, and soils/sediments (as mapped in SURRGO).
Mapped soils at this testing location include Kato, Maxcreek, and Blooming types. Kato and Blooming soils are well drained Alfisols, while the Maxcreek soils are poorly drained Mollisols. As encountered in the field, all soils were moderately to well drained.

The topography and the core descriptions revealed four landforms in this testing location, two at the surface and two buried below it. As such, four Stratigraphic Units were encountered (Figure 127). Note that Core 1 is not included in the profile for reasons detailed below.

Figure 127. Stratigraphic cross-section of the Oak Glen Lake testing location.

**Oak Glen Lake Stratigraphic Units**

Coring began on the northern end of the transect, in an open field that grades gently up to the north, and exhibits a few low lying ridges. Cores 1, 2, and 3 were placed across the southern-most of these ridges. Core 1 encountered a high density of impenetrable rock relatively close to the surface (0.85 m below surface), so the transect was shifted to the west in the hope of reaching deeper deposits. The placement of Cores 2 and 3 allowed for much deeper depths to be reached.

Core 4 was placed in the lowest part of this landscape, between two agricultural fields. Cores 5-7 were placed in the next field to the south, tracing the length of a large morainal hill which overlooks Oak Glen Lake to the south. Core 5 was placed near the base of the
northern slope of this hill, while Core 6 was placed at the top of the slope. Core 7 was placed on a small secondary panicle at the summit of this hill.

Cores 1-3 are seen to comprise one unit, SU 1, a small loess dune and accompanying sheet. Underlying this was a sandy lacustrine deposit SU 2, which was subsequently underlain by a second silt to silt loam lacustrine deposit, SU 3. Core 4 is seen to be comprised of SUs 1 and 3, perhaps from a different depositional period than the same SUs to the north. Cores 5-7 comprise SU 4, a (relatively) large moraine on the northern bank of Oak Glen Lake.

**Stratigraphic Unit 1**

SU 1 is an indistinct landform surface that consists of an eolian sheet mantle of loess, with occasional low lying dunes. The small dune ridges may be a later deposit, as a buried A horizon was observed in Core 3 which was excavated on the small ridge summit. Texturally this unit appears to consist of loam to sandy loam or sandy clay loam, generally coarsening with depth. An Ap-Bw-C-C2 horizon sequence was recorded for this landform in Cores 1 and 2. Core 3, with an Ap-BC-2A-2BwC-2BC sequence, provides both a buried horizon and a somewhat better weathered profile. Due primarily to its landscape position, overlying the majority of the rest of the units, this SU is considered to be the youngest deposit within this landscape. This eolian, presumably loess, deposit is relatively thick in this location, perhaps due to erosional additions from the moraine to the south. It thins greatly to the south, though, possibly negating the idea of erosional augmentation.

**Stratigraphic Unit 2**

SU 2 and 3 are both lacustrine deposits. These deposits are presumed to be glacial in origin and perhaps represent a paleo-extension of Oak Glen Lake. SU 2 is a loose sandy deposit of crude beds (multiple C horizons) that contain many fine water rolled pebbles. This may be a near-shore beach-like deposit, sand spit, or island. Such relic landforms are seen in and around the present Oak Glen Lake margins.

**Stratigraphic Unit 3**

SU 3 is a silty lacustrine deposit that underlies SU 2 in Core 2 (and most likely Core 3 as well), but directly underlies SU 1 in Core 4. In Core 2 this unit was predominantly a silty gleyed deposit (C horizon) with medium gravels, in which the auger refused, preventing further investigation of this unit. Core 4 revealed a varied pattern of alternating black and light olive grey (gleyed C horizons) deposits at least a meter in depth. SU 3 is located much closer to the surface than SU 2 indicating that SU 2 and 3 are two different lacustrine deposits, dating to different periods of the lake’s development.

**Stratigraphic Unit 4**

SU 4 is the largest and most extensive of the SUs, as well as being the highest surface on the landscape. This moraine surface rises sharply away from the landform surface to the north and then slopes down again just as sharply to the Oak Glen Lake basin to the south. The top of the moraine has a secondary rise/pinnacle that is characterized by a relatively
dense expression of coarse surface gravels not seen on the lower summit surface or the slopes of the same hill.

Cores 5, 6, and 7 exhibit the best developed soil profiles seen in this landscape, with a sequence of Ap-BE-Bw-C-2C, however, the BE horizon is not as well expressed in Cores 6 and 7 and may have been incorporated into the plowzone (Ap horizon). All three are loams that coarsen to sandy loams with depth. Two apparent subunits exist in this profile relating to its depositional history; the surface of this moraine appears covered by thin to moderate loess deposits (SU 4a), which overly glacial till (SU 4 b). Core 7, taken from the secondary summit area, differs in that it includes coarse gravels in all its upper soils horizons. The reason for this is unclear as the similar soil development belies a relative age similarity between the deposits of this higher surface and the deposits of the surface of the moraine below. Perhaps some amount of erosion of the surficial loess or some freeze/thaw activity on this secondary summit has allowed for the mixing of glacial till into the upper loess deposit.

**Oak Glen Lake Location Discussion**

The Oak Glen Lake landforms appear to have formed within the late Pleistocene to early Holocene periods. In relative dating terms, the SU 4 moraine, consisting of till overlain by loess, exhibits the best developed soil profile and is thus, assumed to be the oldest of these landforms. SU 3 appears to be the next oldest, followed by SU 2. These both appear to belong to the same general lacustrine depositional regime, however, SU 3 appears to be a lake bed deposit, while SU 2 is a near-shore beach or other sandy near-lake surface/margin landform (sand spit). It seems that SU 3 is the older of the two, as SU 2 overlies it in the northern extent of the transect, but the two may be contemporaneous as they could exist side-by-side in their southern extents. Additionally, it is assumed that SU 3 abuts SU 4 to the south, but it may be possible that SU 4 actually overlies SU 3, which would instead make SU 3 the oldest deposit. Finally, the SU 1 eolian loess that overlies SUs 2 and 3 is the youngest deposit on this landscape.

Generally, the evolutionary development of this landscape suggested by the stratigraphic units involves the deposition of the SU 4 moraine with the retreat of the last glacial ice around 12,000 B.P., followed by, or contemporaneous with, the development of a lake. This lake may have been part of, or even a predecessor to, the modern Oak Glen Lake, which likely began as a pro-glacial or even a sub-glacial lake. The till that makes up the base of SU 4 was quickly covered by a loess deposit less than 1 meter thick, as no soil development was noted on the till surface.

Over time the lake began to fill in with sediment from either further glacial sediment input, eolian deposits, or transported hill-slope erosion, ultimately creating the SU 2 and 3 deposits. The concluding infilling of this lake occurred with the final eolian deposit that served to cap the lake sediments, creating SU 1. None of the landforms observed here appeared to be composed of or contain any significant quantities of colluvial erosion packages.
No cultural material was encountered in any of the auger cores performed in this testing location. Most if not all of these profiles appear as though the sediments they are comprised of were deposited over a relatively short period of time, limiting the likelihood of potential archaeological site burial. Thus, buried site potential is low to non-existent. Only the eolian deposits have any real potential to contain buried cultural deposits.

Of these landscapes, SU 1 is the most likely to potentially contain buried cultural deposits, because it is the youngest deposit on the landscape and it exhibits a buried surface. If SU 2 is a shoreline deposit, depending on when it was exposed, it may have been attractive due to its proximity to water. It may, therefore, have a low potential to contain cultural deposits on its surface, which SU 1 may have buried. There is no potential for intact cultural deposit to be contained within SU 3. Depending on the age of the loess that blankets SU 4, there may be low potential for buried cultural deposits within the top meter of this landform. If these landforms did contain cultural deposits they would likely be from late Pleistocene/early Holocene period (Paleoindian or Early Archaic). These groups were definitely present within the region around the time that the glaciers were retreating from this part of the state and they may have had the opportunity to use this landscape before the eolian deposits capped the till and lake deposits.
8: Conclusions
During the 2012 survey of Steele County, archaeologists conducted background research, developed a GIS predictive model, re-examined existing archaeological collections, conducted archaeological surveys, and tested geological landforms.

GIS Predictive Model in Steele County
The GIS predictive model was developed using cultural and environmental variables, including location of known archaeological sites, elevation, slope, aspect (direction the slope faces), soil type, distance to water, and landforms. The purpose of the model was to develop an updatable, dynamic GIS layer that would capture the highest percentage of archaeological sites within a given physiographic region, while covering the smallest percentage of area within that region. The model delineated high-, medium- and low-potential areas for archaeological sites, and helped archaeologists identify which locations should undergo further investigation for prehistoric sites. This GIS layer can be overlaid onto topographic maps, providing a tool for determining areas with higher archaeological potential.

The rationale for testing a predictive model was to validate any assumptions that had been made during the modeling process, refine these assumptions, and sample zones where archaeological potential had not been evaluated (Kvamme 1988). In northern Steele County, eight locations were proposed for survey. These focused primarily on high-potential areas in the vicinity of waterways, namely Straight River, Medford Creek, Mud Creek, Crane Creek, Judicial Ditch No. 1, and Rice Lake. In the southern Steele County, eight sample areas were also identified. These areas focused on high- and moderate-potential areas, while low-potential areas were examined in kettle and moraine topography. Waterways included the Straight and Le Sueur Rivers and their tributaries, Turtle Creek, and Lonergan, Beaver and Oak Glen Lakes.

In all, the archaeological survey examined 1,115 acres within all three classes of the model (low, medium and high potential) and resulted in the identification of 13 new sites (Table 4). Of the 13 new sites, four are isolates that encompass very small areas, and as such were not totaled into the overall assessment of the model. Of the four isolate sites, site 21ST39 was located in high potential area, sites 21ST37 and 21ST42 were located in moderate potential areas, and 21ST38 was located in a low potential area. The nine larger sites covered a total area of approximately 128 acres, of which 48 acres were contained within areas deemed as having high-potential, 64 acres within areas of moderate potential, and 16 acres within areas of low potential. It should be noted that none of these nine sites were found within an area deemed to be wholly low-potential for prehistoric sites, and all sites identified would be primarily defined within the high/medium classes of the model. In fact, all of the areas identified as having low potential comprised a significant minority at each site location, usually averaging less than 10 percent of the total site area defined. Of the nine larger sites, three were predominately located within the high potential class and six within the moderate potential class.
The model’s goal was to define the majority of sites to the highest potential class, fewer within the medium potential class, and few or preferably none within the lowest class. The assessment of how well the model performs is different for each class. For the high class it is a straightforward assessment of how many sites were recorded, or in this case, what percentage of the area surveyed was classified correctly. The assessment of the medium class is the same as that of the high class, but this section of the model is where the majority of improvement can be made. The assessment of the low class is almost the opposite of the higher two classes, in that its assessment is based on how few sites area contained within it, or how well the model defines areas that are not likely to contain sites.

The survey results indicate that the model generally performed well, but alterations to classifications between the high and moderate classes are needed to shift more potential to the high potential class. Variables used to define the medium potential class need to be modified in order to reduce the area of the model for this class. Variables also need to be modified so as to focus the high/medium classes into a goal of only 30-35 percent of the environment instead of the current 48 percent. In addition, outliers identified within the low probability class in the vicinity of the larger lakes also need to be addressed so that these areas are more properly associated with the high and moderate classes.

### Survey of Low Potential Areas

The survey of the low potential sections within the model included 231 acres between 28 survey parcels. Of these 28 parcels, eight contained less than one acre of low potential

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5 Many sites were located in more than one “probability” area, thus sites are categorized according to where the majority of their site area is located; High, Medium, or Low Probability areas.
area, and were thus dropped from consideration. This left 20 parcels totaling approximately 228 acres that were large enough to infer the quality of the model. On average each area contained about 11.5 acres of low probability area. The sites that were found during the survey contained an average of 1.3 acres of low potential area. This number is highly elevated due to large outliers at three sites located in the around Oak Glen Lake and Rice Lake. These sites constitute approximately 90 percent of the low potential area contained within the sites. Removing these outliers lowers the average low potential area per site to 0.2 acres, or a total area of approximately 2 acres.

Overall the testing indicated that the low potential class within the GIS model is highly accurate with the exception of the areas around Oak Glen and Rice Lakes. One means to improve the model would be to add a variable that defines vertical elevation above stream and lake margins as a high potential area. An additional variable in the model that defines these upland settings would appear to correctly identify this as an area of high potential for site location. An assessment of other sites previously recorded in proximity to Rice and Beaver Lakes also benefit from the inclusion of a vertical elevation variable to better define landform edges above these environments.

**Survey of Medium Potential Areas**

The survey of the medium potential class sections of the model included 444 acres between 29 survey parcels. Of these 29 parcels, only one contained less than an acre of medium potential area, and was dropped from consideration. The 28 parcels left averaged around 15.9 acres of medium potential area per parcel surveyed. The sites that were found during the 2012 survey contained an average of 4.6 acres of medium potential area per site. While the overall percentage of area classified as moderate within each site location is very good, the overall size of the medium class within the total model is too large.

The medium class encompasses approximately 34 percent of the entire county. The sampling strategy mimicked this large percentage, with the largest area tested by the survey being the medium class at 444 acres. When looking at the total area contained within sites from the survey, only 14 percent of the area was correctly identified as site locations. This is lower than expected if the medium class was functioning excellently in defining potential site locations. A review of the model indicated that a few individual variables needed to be altered so as to maximize the medium class. Of the new sites identified in the survey, the majority lie in proximity to the outwash class (Class 2) within the surface geology layer. Thus, it would appear to improve the model if we buffered this area of the environment as having higher potential than assigned within the initial model. By limiting this variable, the medium class would be reduced with no significant loss in number of sites. It also appears probable that distance to prairie margins and landform type could be altered to better differentiate the high and moderate classes.

Of the twelve larger sites identified during the survey, five lie within the moderate potential class, while the remaining seven lie in the high potential class. The criteria that define this layer can be reviewed and revised to weight these areas as higher potential,
reducing the overall size of the medium class and more accurately capturing these aspects of the environment as highly probable for prehistoric site locations.

Additionally, the distance to prairie margins found five of the sites within the high, five in medium, and two within the low probability class. In a review of these areas the model would be improved by increasing the distance from 573 to 750 m for high class and reducing the medium class distance from 1430 m to 1250 m. This would also more accurately define the high probability zone and reduce the overall area included within the medium class of the model.

**Survey of High Potential Areas**

The survey of the high potential sections of the model included 440 acres between 24 survey parcels. Of these 24 parcels, four contained less than one acre of high potential area, and thus were dropped from consideration. The 20 parcels left averaged around 22.0 acres of high probability area per parcel surveyed. Given the desire to test the higher potential sections of the model, this increase was expected. A review of the 2012 survey sites contained an average of 4.0 acres of high potential area per site. At some survey parcels high potential areas were under-sampled in comparison with moderate probability areas.

In general, the model averaged around 10 percent accuracy in identifying site locations. A review of the relationship between the newly identified sites and model, indicates that reclassifying the slope variable can improve the overall model. In reviewing the location of the twelve larger sites, all but one lies on a landform in which the slope averages less than 4 degrees. The high probability model was defined for landforms of less than 6 degrees. The reduction of the model from 6 to 4 degrees would significantly reduce the area classified as high potential.

Distance to water is also an area where the model could better define the high potential class. The distance was set as 247 to 498 m to water for high and medium classes. A review of the newly recorded sites indicated that eleven of the twelve larger sites lay within 300 m or less of water. The remaining site was over 630 m from water. These buffers could be reduced to between 200 and 350 m from water with no significant loss of sites, and a significant reduction in overall model area.

In general all of the variables used in the model performed well, identifying new site locations within the high and medium potential classes, with the exception of one. The confluence layer was highly correlated to only one site, with three others being moderately correlated. On average, site locations were generally over 1,000 to 1,500 m away from confluence points. This lack of correspondence may relate to the rather broad and wet nature of the floodplains within the county. This sort of environment may lead to sites being located on elevated landforms in close proximity to the stream but not within the valley itself. As mentioned above, a vertical distance variable above streams and lake margins should be added to the model. While confluence locations are generally seen in other areas of the state as highly predictive, it would appear that in Steele County other environmental aspects drive settlement patterns in relation to stream environments. This
lack of correspondence between site locations and stream confluences would concur with findings gleaned from MnModel for the region.

**Geoarchaeology in Steele County**

No cultural materials were encountered during the geoarchaeological study in Steele County. Of the landscapes and landforms evaluated, a general assessment of low to no potential for buried sites was determined (Table 5). Reasons for this evaluation center on the relative ages on the landforms and, in the case of the Straight River floodplain, the poorly drained nature of the landscape. However, additional surveys of the county that focus on testing multiple examples of the same types of landforms, and afford the opportunity to absolutely date the formation and stabilization of landforms, is necessary to strengthen the statements of archaeological potential.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
<th>Approximate age</th>
<th>Potential for Buried Deposits (meters below unit surface)</th>
<th>Possible Cultural Periods represented</th>
<th>Possible MnModel LSA correlates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0-1</td>
<td>1+</td>
<td></td>
</tr>
<tr>
<td>Straight River</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Modern Floodplain</td>
<td>Holocene</td>
<td>Low</td>
<td>No</td>
<td>Archaic/Woodland</td>
</tr>
<tr>
<td>2</td>
<td>Paleochannel</td>
<td>Holocene</td>
<td>No</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Floodplain/Levee</td>
<td>Holocene</td>
<td>Low</td>
<td>No</td>
<td>Archaic/Woodland</td>
</tr>
<tr>
<td>4</td>
<td>Terrace</td>
<td>Holocene</td>
<td>Low</td>
<td>Low</td>
<td>Archaic/Woodland</td>
</tr>
<tr>
<td>Oak Glen Lake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Eolian dune/sheet</td>
<td>Late Pleistocene/Early Holocene</td>
<td>Low</td>
<td>No</td>
<td>Paleoindian/Early Archaic</td>
</tr>
<tr>
<td>2</td>
<td>Lacustrine Shoreline-Sand</td>
<td>Late Pleistocene/Early Holocene</td>
<td>Low</td>
<td>No</td>
<td>Paleoindian/Early Archaic</td>
</tr>
<tr>
<td>3</td>
<td>Lacustrine Basin-Silt</td>
<td>Late Pleistocene/Early Holocene</td>
<td>No</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Glacial Moraine</td>
<td>Late Pleistocene/Early Holocene</td>
<td>Low</td>
<td>No</td>
<td>Paleoindian/Early Archaic</td>
</tr>
</tbody>
</table>

Further study of the Straight River and large and small streams within the county could help determine if all these drainages were as poorly drained as the one studied here. The county also contains several other examples of glacial moraine and lacustrine depressions similar to the ones at Oak Glen Lake, as well as other patchy deposits of eolian loess, any of which could help expand our knowledge of the potential for these landscapes to contain buried cultural deposits.
Archeology of Steele County

The archaeological investigations of Steele County began with conducting background research and re-examining collections from eight sites (21ST002, 21ST003, 21ST004, 21ST006, 21ST018, 21DO002, 21ST007-21DO007, 21ST016-21DO044). After completing these tasks, a GIS predictive model was developed and survey parcels were selected. The survey resulted in the identification of 13 previously unrecorded sites (21ST031-21ST043). Three previously recorded sites were also resurveyed (21ST002, 21ST005, 21STl) which resulted in redefining these sites’ boundaries.

Artifacts recovered during previous archaeological investigations and the 2012 survey date from the Paleoindian through the Late Prehistoric Periods. Although no ceramics were located during the 2012 surveys, ceramics had been recovered during previous archaeological investigations. Based on analysis of the artifacts from the 2012 and previous investigations it appears that 21DO002 possibly has Paleoindian and Archaic components, site 21ST040 possibly has an Archaic component, and 21ST043 has a confirmed Paleoindian component. Sites 21ST002, 21DO002, 21ST004, 21ST007/21DO007, 21ST031, 21ST032, and 21ST040 have probable or confirmed Woodland components. The Woodland component can be further refined for 21DO002 from which both Fox Lake and Ramey Incised ceramics were recovered (Figure 128).

---

6 Site 21DO002 was included in this study because, although it is located in Dodge County, it is immediately adjacent to Steele County, on the north shore of Rice Lake.
The Fox Lake ceramics recovered from 21DO002 originate from the complex of the same name, while Ramey Incised ceramics are Cahokian in origin. The Fox Lake Complex dates from the Middle Prehistoric period (2,200 B.P. – 1,300 B.P.), and is found generally in the prairie-lakes region in southern Minnesota (Harrison 1992; Arzigian 2008). Sites from this complex date to the first appearance of ceramics within the prairie-lakes region and are typically located on the shores, peninsulas, and islands of shallow prairie lakes, although they can also be found along rivers and streams (Harrison 1992; Arzigian 2008).

Fox Lake settlements appear to have been quite small and it seems that many of the subsistence tactics typical of the Fox Lake Complex are a continuation of those employed during the Archaic. Fox Lake lithics are also generally the same as during the Archaic with some stylistic differences, however, the emergence of ceramics represents a dramatic technological shift (Harrison 1992). Fox Lake ceramics are grit-tempered with conoidal bases, wide mouths and thick walls. The exteriors are cord-marked and
decorated with “trailed or incised lines, bosses or punctates and cord-marked stick-impressions” (Harrison 1992:11).

Ramey Incised ceramics were also recovered from 21DO002. This type of ceramic dates to 1,150 to 1,200 B.P. and originated at the Middle Mississippian site of Cahokia at the beginning of the Stirling Phase (Mollerud 2005). Ramey Incised ceramics are a distinctive pottery type. The ceramics have a glossy sheen on the exterior and the vessel’s shoulder is incised with motifs thought to be associated with the underworld or water. The pottery type also seems to have a strong socio-religious connection and has been found in association “with high-status items fashioned from exotic materials and associated with specialized structures such as mortuaries and temples, and were almost certainly vessels used exclusively by the elites and for ritual purposes” (Illinois State Museum 2012). The Middle Mississippian Period in Minnesota has been documented in southeastern Minnesota, including the Silvernale and Bryan sites.

**Avenues for Future Research in Steele County**

Steele County represents a region where significant research could be conducted relating to the early inhabitants and archaeological sites of the region. Studies examining the potentially extensive trade networks both to the east and west, research pertaining to raw materials and their use by early humans, and the potential for specific landforms to hold previously unrecorded archaeological sites all represent directions for future research.

**GIS and Predictive Modeling**

The predictive model created for Steele County indicated that sites tended to be located on very level surfaces: less than 4 percent slope. While located on extremely level sections of the landscape, sites also tend to be in proximity to points of relief and water. Sites were identified around lake margins and along valley margins, usually within 300 m or less.

The wide and inundated nature of the valleys and alluvial settings focused prehistoric occupations not within the valley bottoms but on uplands or high terraces along the valley margins. An assessment of the model variables indicated that the addition of a vertical distance above water would greatly enhance the model’s accuracy. This is because it appears that the higher the landform, the lower the potential for sites. This sort of site placement reiterates the importance of water and water-related resources. It also appears to indicate from a climatic point of view the relative stability over time for the broad pattern of wetland domination of the valley bottoms. A few isolated landforms were noted within the broader valley bottoms that appear to hold potential for limited prehistoric use, but additional fine resolution sampling of these landforms would be necessary to truly understand their potential.

Not all sites were wholly focused on riverine or lacustrine portions of the landscapes. A few sites were situated above these locations or broader uplands, many of which were within a 1,000 m or less of prairie margins. While this distance on the surface appears fairly great and therefore somewhat tenuous in its association to site locations, we must remember that the expansion and contraction of the prairie is a continual process. This
process represents a great swath of time that results in a wide band of area representing the “margin”, and as such the broad distances are, in fact, quite narrow. The focus on a narrow, resource-rich strip of land indicates the importance of biodiversity to Native Americans. The prairie margins represent a resource-diverse landscape, providing easy access to both forest as well as prairie resources. These resource diverse areas were most likely used heavily throughout the Prehistoric Period.

Geoarchaeology

The geoarchaeological assessment of Steele County indicated that low to no potential for buried sites exists within the landforms tested. Reasons for this evaluation center on the relatively young ages of the landforms and, in the case on the Straight River floodplain, the poorly drained nature of the landscape. These two characteristics are believed to be common themes within all alluvial settings within the county. However, the limited aerial scope and ability of this survey to absolutely date these landforms limits this evaluation, leaving the potential that buried Holocene landforms may exist. Additionally, previous investigations completed in and around the lake margins within the county indicate limited potential for the shallow burial of sites through the expansion and contraction of the lakes. These sorts of lacustrine deposits can yield not only archaeological sites, but also pollen and archaeobotanical materials that could be used to understand shifts within the climatic record on a localized level.

The county also contains several examples of glacial moraine and lacustrine depressions similar to the ones at Oak Glen Lake, and patchy eolian loess deposits. These soils could yield information about the potential for these landscapes to contain buried cultural deposits. While the investigations completed during this study did not indicate that buried deposits might be present, it appears reasonable to believe that the deposits still retain some limited potential. Like the assessment of the alluvial settings within the county, these areas would more than likely not be extensive, and would rather represent smaller isolated locations. Additional surveys of the county that focus on testing multiple examples of the same types of landforms, such as lacustrine depressions or alluvial settings, may provide the ability to more definitively understand the specific potential for buried Holocene deposits. Absolutely dating the formations and periods of stabilization would also allow these statements of archaeological potential to carry more weight.

Archaeology

Based on the results of the archaeological research and investigations, several avenues for future research in Steele County became apparent. First, the potential connection between the inhabitants of Cahokia and the Steele County area should be examined further. Is there more evidence of interactions and trade between the two regions or is site 21DO002 simply a fluke?

Second, in addition to exploring the connection between the early inhabitants of Steele County and the prehistoric people to the south and east (Cahokia), exploring the connections to the west (Plains cultures) might shed light on the overall trade networks and subsistence strategies employed by these people. Point types that could be related to Plains cultures were recovered from two sites (21ST002 and 21ST0040). Although these
point types have also been recovered from sites containing Brainerd and LaSalle ceramics in central Minnesota, it certainly seems possible that trade networks extended west onto the Plains, just as the networks seem to extend south and east to Cahokia.

Third, Fox Lake ceramics, which date to the emergence of ceramics within the prairie-lakes region, have been recovered from archaeological sites in the vicinity of Steele County. During the 2012 surveys, numerous sites dating to the Woodland period were located, yet all the collections were aceramic. Could this indicate that although these people possessed the knowledge and technology to produce ceramics, they often chose not to? The Fox Lake Complex is similar to the Archaic in many ways. Could the absence of ceramics have been a choice these people made? If so, are there other, more subtle indicators for the Fox Lake Complex that we might define with additional research.

Finally, by comparing the best data from many sites in Steele County and southeastern Minnesota in general, archaeologists might begin to better understand how the proximity of bedrock raw material sources affects the region’s expression of the raw material use patterns. This would in turn allow for more detailed examinations of lithic assemblages and potential trade networks.

In conclusion, people have been living in the vicinity of Steele County for a very long time, as evidenced by the presence of Paleoindian archaeological material. The prehistoric people that lived in this region also appear to have adopted cultural and subsistence practices from a variety of sources. The previously and recently recorded archaeological sites show influences from a variety of sources including Mississippian and possibly Plains cultures. This leaves scholars numerous opportunities for potential research into the prehistory of Steele County. This research could entail additional artifact analysis, traditional archaeological survey and excavation, geoarchaeology, or GIS modeling; ideally incorporating all of these aspects. Although several new sites were located as part of this project and artifacts from many known sites were re-analyzed, much remains to be learned.
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Appendix 1: Documentation of Auger Cores Sampled in Steele County
### Straight River Testing Locality

Core 1 profile. Top of core is on the left side of the photo.

#### Core 1 - Holocene Straight River Paleochannel (345.3 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.10</td>
<td>2a</td>
<td>A/O</td>
<td>Dark grey (2.5Y4/1); silt loam; weak medium granular structure; very friable; many medium gray (2.5Y6/1) depletions, many fine yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>0.10-0.30</td>
<td></td>
<td>A</td>
<td>Black (2.5Y2/1); loam; weak medium granular structure; very friable; many few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.30-0.70</td>
<td></td>
<td>ACg</td>
<td>Greenish black (10Y2.5/1); loam; massive structure; very friable; diffuse lower boundary</td>
</tr>
<tr>
<td>0.70-1.20</td>
<td></td>
<td>ACg2</td>
<td>Greenish black (10Y2.5/1); sandy clay loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>1.20-1.50</td>
<td></td>
<td>Cg</td>
<td>Very dark grey (N3/0); sandy clay loam; massive structure; very friable; few faint yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>1.50-1.90</td>
<td>2b</td>
<td>2Cg</td>
<td>Light grey (N7/0); sand, medium; single grained/loose; gradual lower boundary; many woody organics</td>
</tr>
<tr>
<td>1.90-2.00</td>
<td></td>
<td>2Cgr</td>
<td>Light grey (N7/0); gravels; single grained/loose; unknown lower boundary, refusal on rock at 2.00 m BS</td>
</tr>
</tbody>
</table>
Core 2 profile. Top of core is on the left side of the photo.

### Core 2- Holocene Straight River Paleochannel (345.0 ft AMSL)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>A/O</td>
<td>Dark grey (2.5Y4/1); silt loam; weak medium granular structure; very friable; many medium gray (2.5Y6/1) depletions, many fine yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>2a</td>
<td>A</td>
<td>Black (2.5Y2/1); loam; weak medium granular structure; very friable; many few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>2a</td>
<td>ACg</td>
<td>Greenish black (10Y2.5/1); loam; massive structure; very friable; diffuse lower boundary</td>
</tr>
<tr>
<td>2a</td>
<td>ACg2</td>
<td>Greenish black (10Y2.5/1); sandy clay loam, massive structure; very friable; many fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>2a</td>
<td>Cg</td>
<td>Very dark grey (N3/0); sandy clay loam; massive structure; very friable; few faint fine yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>2b</td>
<td>2Cg</td>
<td>Black (2.5Y2/1); sandy loam; massive structure; very friable; gradual lower boundary; many woody organics</td>
</tr>
<tr>
<td>2b</td>
<td>2Crg</td>
<td>Light grey (N7/0); sand, medium; single grained/loose; unknown lower boundary due to hole collapse at 1.80 m</td>
</tr>
</tbody>
</table>
Core 3 profile. Top of core is on the left side of the photo.

### Core 3- Holocene Straight River Floodplain/Levee (345.4 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.40</td>
<td>3a</td>
<td>Ag</td>
<td>Black (2.5Y2/1); silt loam; weak medium granular structure; very friable; many fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.40-0.60</td>
<td></td>
<td>ACg</td>
<td>Bluish grey (10B2.5/1); loam; weak medium granular to massive structure; very friable; few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.60-0.90</td>
<td></td>
<td>Cg</td>
<td>Bluish grey (10B2.5/1); sandy loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.90-1.40</td>
<td></td>
<td>Cg2</td>
<td>Dark grey (N4/0); sandy loam; massive; structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>1.40-1.60</td>
<td>3b</td>
<td>2Cg</td>
<td>Grey (2.5Y5/1), grayish brown (2.5Y5/3) mottles; fine to medium sand; single grained/loose structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>1.60-1.70</td>
<td></td>
<td>2Crg</td>
<td>Grey (2.5Y5/1); fine to medium gravels, sand matrix; single grained/loose structure; very friable; unknown lower boundary; limestone gravels, refusal on rock at 1.70 m BS</td>
</tr>
</tbody>
</table>
Core 4 profile. Top of core is on the left side of the photo.

**Core 4- Holocene Straight River Floodplain/Levee (345.4 ft AMSL)**

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td>3a</td>
<td>Ag</td>
<td>Black (2.5Y2/1); silt loam; moderate fine granular structure; very friable; many fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.30-0.60</td>
<td>ACg</td>
<td></td>
<td>Bluish grey (10B2.5/1); sandy loam; massive structure; very friable; abrupt; lower boundary</td>
</tr>
<tr>
<td>0.60-0.62</td>
<td>Cg</td>
<td></td>
<td>Grayish brown (2.5Y5/3); fine sand; single grained/loose structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>0.62-0.80</td>
<td>Cg2</td>
<td></td>
<td>Dark grey (N4/0); sandy loam; massive structure: very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>0.80-1.50</td>
<td>3b</td>
<td>2Cg</td>
<td>Grayish brown (2.5Y5/3); fine sand; single grained/loose structure; clear lower boundary</td>
</tr>
<tr>
<td>1.50-1.60</td>
<td>2Crg</td>
<td></td>
<td>Grayish brown (2.5Y5/3); fine to medium gravels; single grained/loose structure; unknown lower boundary; predominantly limestone gravels, refusal on rock at 1.60 m BS</td>
</tr>
</tbody>
</table>
Core 5 profile. Top of core is on the right side of the photo.

### Core 5 - Holocene Straight River Floodplain/Levee (344.9 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.10</td>
<td>2a</td>
<td>A/O</td>
<td>Dark grey (2.5Y4/1); silt loam; weak medium granular structure; very friable; many medium gray (2.5Y6/1) depletions, many fine yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>0.10-0.30</td>
<td></td>
<td>A</td>
<td>Black (2.5Y2/1); loam; weak medium granular structure; very friable; many few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.30-0.60</td>
<td></td>
<td>ACg</td>
<td>Greenish black (10Y2.5/1); loam; massive structure; very friable; diffuse lower boundary</td>
</tr>
<tr>
<td>0.60-0.90</td>
<td></td>
<td>ACg2</td>
<td>Greenish black (10Y2.5/1); sandy clay loam; massive structure; very friable; many fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.90-1.10</td>
<td></td>
<td>Cg</td>
<td>Very dark grey (N3/0); sandy clay loam; massive structure; very friable; few faint fine yellowish brown (10YR5/8) Fe masses; clear lower boundary</td>
</tr>
<tr>
<td>1.10-1.30</td>
<td>2b</td>
<td>2Cg</td>
<td>Light grey (N7/0); sand, coarse; single grained/loose; abrupt lower boundary</td>
</tr>
<tr>
<td>1.30-1.40</td>
<td></td>
<td>2Crg</td>
<td>Light grey (N7/0); gravels; single grained/loose; unknown lower boundary, refusal on rock at 1.40 m BS</td>
</tr>
</tbody>
</table>
Core 6 profile. Top of core is on the right side of the photo.

### Core 6- Holocene Straight River Floodplain/Levee (345.2 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.10</td>
<td>3a</td>
<td>A/O</td>
<td>Black (10YR2/1); silt loam; moderate fine granular structure; very friable; many very fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.10-0.30</td>
<td>3a</td>
<td>Ag</td>
<td>Black (2.5Y2/1); silt loam; weak medium granular structure; very friable; many fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.30-0.50</td>
<td>3a</td>
<td>ACg</td>
<td>Bluish grey (10B2.5/1); loam; weak medium granular to massive structure; very friable; few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.50-0.70</td>
<td>3a</td>
<td>Cg</td>
<td>Bluish grey (10B2.5/1); sandy loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.70-1.10</td>
<td>3a</td>
<td>Cg2</td>
<td>Dark grey (N4/0); sandy loam; massive; structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>1.10-1.40</td>
<td>3b</td>
<td>2Cg</td>
<td>Grey (2.5Y5/1), grayish brown (2.5Y5/3) mottles; fine to medium sand; single grained/loose structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>1.40-1.55</td>
<td>3b</td>
<td>2Crg</td>
<td>Grey (2.5Y5/1); fine to medium gravels, sand matrix; single grained/loose structure; very friable; unknown lower boundary; limestone gravels, refusal on rock at 1.55 m BS</td>
</tr>
</tbody>
</table>
Core 7 profile. Top of core is on the right side of the photo.

**Core 7- Holocene Straight River Terrace (345.4 ft AMSL)**

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.10</td>
<td>4a</td>
<td>A</td>
<td>Black (2.5Y2/1); silt loam; moderate fine granular structure; very friable; many very fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.10-0.50</td>
<td>ABg</td>
<td>Black (N2.5/0); loam; weak fine; subangular blocky structure; very friable; gradual lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.50-0.90</td>
<td>Cg</td>
<td>Greenish grey (10Y2.5/1); loam; massive structure; very friable; gradual lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.90-1.40</td>
<td>Cg2</td>
<td>Greenish black (10GY2.5/1); sandy loam; massive structure; very friable; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.40-1.70</td>
<td>2Cg</td>
<td>Grayish brown (2.5YR5/3); coarse sand; single grained/loose structure; gradual lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.70-1.80</td>
<td>2Crg</td>
<td>Grayish brown (2.5YR5/3); fine to medium gravels in coarse sand matrix; single grained/loose structure; unknown lower boundary, refusal on rock at 1.80 m BS</td>
<td></td>
</tr>
</tbody>
</table>
Core 8 profile. Top of core is on the left side of the photo.

### Core 8 - Holocene Straight River Terrace (345.8 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.10</td>
<td>4a</td>
<td>A</td>
<td>Black (2.5Y2/1); silt loam; moderate fine granular structure; very friable; many very fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.10-0.60</td>
<td></td>
<td>ABg</td>
<td>Black (N2.5/0); loam; weak fine; subangular blocky structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.60-1.00</td>
<td></td>
<td>Cg</td>
<td>Greenish grey (10Y2.5/1); loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>1.00-1.40</td>
<td></td>
<td>Cg2</td>
<td>Greenish black (10GY2.5/1); sandy loam; massive structure; very friable; abrupt lower boundary</td>
</tr>
<tr>
<td>1.40-1.60</td>
<td>4b</td>
<td>2Cg</td>
<td>Grayish brown (2.5YR5/3); coarse sand; single grained/loose structure; gradual lower boundary</td>
</tr>
<tr>
<td>1.60-1.65</td>
<td></td>
<td>2Crg</td>
<td>Grayish brown (2.5YR5/3); fine to medium gravels in coarse sand matrix; single grained/loose structure; unknown lower boundary, refusal on rock at 1.65 m BS</td>
</tr>
</tbody>
</table>

### Core 9 - Holocene Straight River Terrace (345.9 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.20</td>
<td>4a</td>
<td>Ag</td>
<td>Black (2.5Y2/1); loam; weak fine granular structure; very friable; few medium roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.20-0.80</td>
<td></td>
<td>ACg</td>
<td>Black (2.5Y2/1); loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.80-1.60</td>
<td></td>
<td>Cg</td>
<td>Grey (5Y4/1); sandy loam; massive structure; very friable; clear lower boundary</td>
</tr>
<tr>
<td>1.60-1.80</td>
<td>4b</td>
<td>2Cg</td>
<td>Grayish brown (2.5YR5/3); coarse sand; single grained/loose structure; gradual lower boundary</td>
</tr>
<tr>
<td>1.80-2.00</td>
<td></td>
<td>2Cr</td>
<td>Grayish brown (2.5YR5/3); fine to medium gravels, in coarse sand matrix; single grained/loose structure; unknown lower boundary, refusal on rock at 2.00 m BS</td>
</tr>
</tbody>
</table>
Core 10 profile. Top of core is on the left side of the photo.

### Core 10- Holocene Straight River Terrace/Levee (345.9 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.60</td>
<td>4</td>
<td>AC</td>
<td>Black (2.5Y2/1); sandy loam; massive structure; very friable; very few very fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.60-1.40</td>
<td></td>
<td>C</td>
<td>Dark grey (2.5Y4/1); fine loamy sand; massive structure; very friable; very few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>1.40-2.00</td>
<td></td>
<td>C2</td>
<td>Grayish brown (2.5Y5/2); fine to medium loamy sand; massive structure; very friable; very few very fine yellowish brown (10YR5/8) Fe and black (2.5Y2/1) Mn masses, increasing with depth; unknown lower boundary, hole collapse at 2.00 m</td>
</tr>
</tbody>
</table>
Core 11 profile. Top of core is on the left side of the photo.

### Core 11- Holocene Straight River Floodplain (345.3 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.40</td>
<td>1a</td>
<td>A</td>
<td>Black (2.5Y2/1); sandy clay loam; moderate fine granular structure; very friable; few fine roots; gradual lower boundary</td>
</tr>
<tr>
<td>0.40-0.90</td>
<td>C</td>
<td></td>
<td>Dark grey (2.5Y4/1); sandy loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.90-1.20</td>
<td>C2</td>
<td></td>
<td>Grayish brown (2.5Y5/3); sandy loam; massive structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>1.20-1.60</td>
<td>C3</td>
<td></td>
<td>Greenish black (5GY2.5/1); medium loamy sand; massive structure; very friable; clear lower boundary</td>
</tr>
<tr>
<td>1.60-1.80</td>
<td>2C</td>
<td></td>
<td>Greenish black (5GY2.5/1); fine to medium sand; single grained/loose structure; gradual lower boundary</td>
</tr>
<tr>
<td>1.80-1.90</td>
<td>2C2</td>
<td></td>
<td>Greenish black (5GY2.5/1); coarse sand; single grained/loose structure; clear lower boundary; many mollusk shell fragments</td>
</tr>
<tr>
<td>1.90-2.20</td>
<td>2Cr</td>
<td></td>
<td>Greenish black (5GY2.5/1); fine gravels, primarily limestone, in coarse sand matrix; single grained/loose structure; unknown lower boundary; large fragments of woody organics, refusal on rock at 2.20 m BS</td>
</tr>
</tbody>
</table>
Oak Glen Lake Testing Locality

Core 1 profile. Top of core is on the right side of the photo.

Core 1- Late Pleistocene/Early Holocene Eolian (392.8 ft AMSL)

<table>
<thead>
<tr>
<th>cm BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.15</td>
<td>1</td>
<td>Ap</td>
<td>Very dark grey (2.5Y3/1); loam; strong fine granular structure; friable; very few very fine roots and pores; abrupt lower boundary</td>
</tr>
<tr>
<td>0.15-0.60</td>
<td></td>
<td>Bw</td>
<td>Greyish brown (10YR5/2); sandy clay loam, medium sand; weak coarse subangular blocky structure; friable; few fine yellowish brown (10YR5/8) Fe masses; gradual lower boundary</td>
</tr>
<tr>
<td>0.60-0.85</td>
<td></td>
<td>C</td>
<td>Greyish brown (10YR5/2); sandy clay loam, medium to coarse sand; massive structure; firm masses; unknown lower boundary; refusal on rock at 0.85 m BS</td>
</tr>
</tbody>
</table>
Core 2- Late Pleistocene/Early Holocene Eolian and Lake Bed (393.0 ft AMSL)

<table>
<thead>
<tr>
<th>cm BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.25</td>
<td>Ap</td>
<td>Very dark grey (2.5Y3/1); loam; strong fine granular structure; friable; very few very fine roots and pores; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.25-0.40</td>
<td>Bw</td>
<td>Greyish brown (10YR5/2); sandy clay loam, medium sand; weak coarse subangular blocky structure; friable; few fine yellowish brown (10YR5/8) Fe masses; gradual lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.40-0.90</td>
<td>C</td>
<td>Greyish brown (10YR5/2); sandy clay loam, medium; massive structure; firm; few fine yellowish brown (10YR5/8) Fe masses, few coarse light gray (10YR7/2) depletions increase with depth, possible silt coats/films on horizontal pores?; clear lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.90-1.15</td>
<td>C2</td>
<td>Greyish brown (2.5Y5/2); sandy loam; massive structure; very friable; few fine dark yellowish brown (10YR4/6) Fe masses; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.15-1.69</td>
<td>2C</td>
<td>Very pale brown (10YR8/3); sand; single grained/loose structure; very coarse yellowish brown (10YR5/8) Fe coats/films; clear lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.69-1.80</td>
<td>2C2</td>
<td>Brown (10YR5/3); coarse sand, few fine gravels; single grained/loose structure; clear lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.80-2.10</td>
<td>2C3</td>
<td>Pale brown (10YR6/3); coarse sand, many fine gravels; single grained/loose structure; clear lower boundary</td>
<td></td>
</tr>
<tr>
<td>2.10-2.30</td>
<td>2C4</td>
<td>Brown (10YR5/3); coarse sand; single grained/loose structure; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>2.30-2.50</td>
<td>4</td>
<td>Dark greyish brown (2.5Y4/2); silt, coarse, with very few fine gravels; massive structure; firm; few prominent medium dark yellowish brown (10YR4/6) Fe masses; unknown lower boundary; refusal on rock at 2.50 m BS</td>
<td></td>
</tr>
</tbody>
</table>
Core 3 profile. Top of core is on the right side of the photo.

### Core 3- Late Pleistocene/Early Holocene Eolian and Lake Bed (393.2 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td>Ap</td>
<td>Very dark grey (2.5Y3/1); loam; strong fine granular structure; friable; very few very fine roots and pores; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.30-0.70</td>
<td>BC</td>
<td>Dark yellowish brown (10YR4/4); sandy loam; weak subangular blocky to massive structure; very friable; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.70-0.80</td>
<td>1</td>
<td>Very dark grey (10YR3/1); sandy loam; weak granular to massive structure; very friable; very few very fine roots; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.80-1.00</td>
<td>2A</td>
<td>Greyish brown (10YR5/2); sandy loam; weak subangular blocky to massive structure; very friable; common prominent yellowish brown (10YR5/8) Fe masses; gradual lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.00-1.50</td>
<td>2BwC</td>
<td>Very pale brown (10YR7/3); loamy sand; massive structure; very friable; yellowish brown (10YR5/8) coats/films on grains increasing with depth; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.50-1.80</td>
<td>2</td>
<td>Light brownish grey (10YR6/2); sandy loam, many very fine gravels; massive structure; very friable; few medium yellowish brown (10YR4/6) Fe and many fine black (10YR2/1) Mn nodules; abrupt lower boundary</td>
<td></td>
</tr>
<tr>
<td>1.80-2.40</td>
<td>3C</td>
<td>Light brownish grey (10YR6/2); loamy sand, many fine gravels; single grained/loose structure; many medium yellowish brown (10YR4/6) Fe and many fine black (10YR2/1) Mn nodules; unknown lower boundary, refusal on rock at 2.40 m BS</td>
<td></td>
</tr>
</tbody>
</table>
Core 4 profile. Top of core is on the left side of the photo.

### Core 4 - Late Pleistocene/Early Holocene Eolian and Lake Bed (392.4 ft AML)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td>1</td>
<td>Ap/A</td>
<td>Very dark grey (10YR3/1); loam; moderate medium granular structure; friable; very few very fine roots; abrupt lower boundary</td>
</tr>
<tr>
<td>0.30-1.20</td>
<td>3</td>
<td>2Cg (alternating beds of 5-10 cm)</td>
<td>Black (N2.5/0); silt loam; platy structure; firm; abrupt lower boundary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light olive grey (5Y6/2); silt loam; platy to massive structure; firm; abrupt lower boundary</td>
<td></td>
</tr>
</tbody>
</table>
Core 5- Late Pleistocene/Early Holocene Moraine (393.3 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.30</td>
<td>4a</td>
<td>Ap</td>
<td>Very dark grey (10YR3/1); loam; moderate medium granular structure; friable; very few very fine roots; abrupt lower boundary</td>
</tr>
<tr>
<td>0.30-0.40</td>
<td></td>
<td>BE</td>
<td>Greyish brown (10YR5/2); sandy loam; subangular blocky structure; very friable; gradual lower boundary</td>
</tr>
<tr>
<td>0.40-0.65</td>
<td></td>
<td>Bw</td>
<td>Yellowish brown (10YR5/6); sandy loam; weak fine subangular to massive structure; very friable; diffuse lower boundary</td>
</tr>
<tr>
<td>0.65-0.90</td>
<td></td>
<td>C</td>
<td>Strong brown (7.5YR5/6); sand, few very fine gravels; single grained/loose; clear lower boundary</td>
</tr>
<tr>
<td>0.90-1.20</td>
<td>4b</td>
<td>2C</td>
<td>Light yellowish brown (10YR6/4); sandy loam, many fine to coarse gravels; massive structure; friable; many coarse light grey (10YR7/2) depletions; many fine strong brown (7.5YR5/8) Fe nodules; refusal on rock at 1.20 m BS</td>
</tr>
</tbody>
</table>
Core 6 profile. Top of core is on the left side of the photo.

### Core 6- Late Pleistocene/Early Holocene Moraine (398.2 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.22</td>
<td>4a</td>
<td>Ap</td>
<td>Very dark grey (10YR3/1); loam; moderate medium granular structure; friable; very few very fine roots; abrupt lower boundary</td>
</tr>
<tr>
<td>0.22-0.50</td>
<td>Bw</td>
<td></td>
<td>Yellowish brown (10YR5/6); sandy loam; weak fine subangular to massive structure; very friable; diffuse lower boundary</td>
</tr>
<tr>
<td>0.50-0.70</td>
<td>C</td>
<td></td>
<td>Strong brown (7.5YR5/6); sand, few very fine gravels; single grained/loose; clear lower boundary</td>
</tr>
<tr>
<td>0.70-1.10</td>
<td>4b</td>
<td>2C</td>
<td>Light yellowish brown (10YR6/4); sandy loam, many fine to coarse gravels; massive structure; friable; many coarse light grey (10YR7/2) depletions; many fine strong brown (7.5YR5/8) Fe nodules; refusal on rock at 1.10 m BS</td>
</tr>
</tbody>
</table>
Core 7 profile. Top of core is on the left side of the photo.

### Core 7 - Late Pleistocene/Early Holocene Moraine (400.2 ft AMSL)

<table>
<thead>
<tr>
<th>m BS</th>
<th>Unit</th>
<th>Soil Horizon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00-0.25</td>
<td>4a?</td>
<td>Ap</td>
<td>Very dark grey (10YR3/1); loam, common coarse gravels; moderate medium granular structure; friable; very few very fine roots; abrupt lower boundary, some possible mottles of BE (as seen in Core 5) at base of horizon</td>
</tr>
<tr>
<td>0.25-0.40</td>
<td>Bw</td>
<td>Yellowish brown (10YR5/6); sandy loam common coarse gravels; weak fine subangular to massive structure: very friable; diffuse lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.40-0.80</td>
<td>C</td>
<td>Strong brown (7.5YR5/6); sand, common coarse gravels, few very fine gravels; single grained/loose; clear lower boundary</td>
<td></td>
</tr>
<tr>
<td>0.80-0.90</td>
<td>4b</td>
<td>2C</td>
<td>Light yellowish brown (10YR6/4); sandy loam, common coarse gravels; massive structure; friable; many coarse light grey (10YR7/2) depletions; many fine strong brown (7.5YR5/8) Fe nodules; refusal on rock at 0.90 m BS</td>
</tr>
</tbody>
</table>